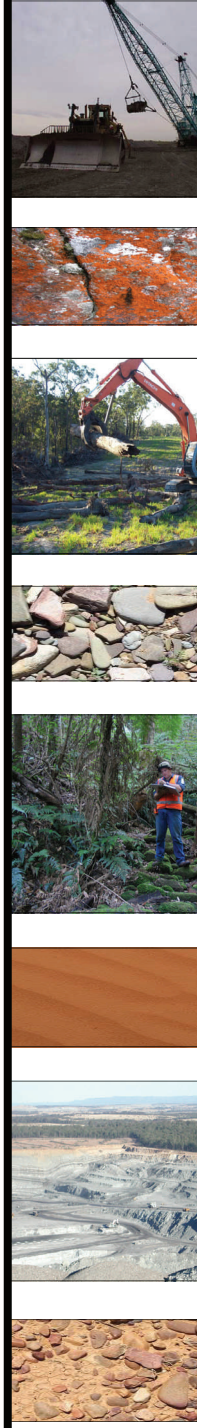
# AIR QUALITY IMPACT ASSESSMENT



APPENDIX 10

HEGGIES

REPORT 30-2497-R1

Revision 0

# Awaba Colliery Mining Project
# Part 3A Application
# Air Quality Impact Assessment

PREPARED FOR

Centennial Coal Company
PO Box 1000
TORONTO NSW 2283

9 SEPTEMBER 2010

**HEGGIES PTY LTD**
ABN 29 001 584 612

# Awaba Colliery Mining Project
# Part 3A Application
# Air Quality Impact Assessment

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DOCUMENT CONTROL

| Reference | Status | Date | Prepared | Checked | Authorised |
|---|---|---|---|---|---|
| 30-2497-R1 | Revision 0 | 9 September 2010 | Florence Mananyu | Gary Graham and Jason Watson | Gary Graham |
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## EXECUTIVE SUMMARY

Heggies Pty Ltd (Heggies) has been commissioned by GSS Environmental (GSSE) on behalf of Centennial Coal Pty Limited (Centennial) to undertake an Air Quality Impact Assessments (AQIA) for the Awaba underground coal mine (hereafter referred to as "Awaba Colliery") located approximately one kilometre south of the Awaba village and 5.5 kilometres (km) south west of Toronto on the western side of Lake Macquarie, near Newcastle NSW.

Broadly, the objective of the air quality assessment was to identify the potential impacts of air pollutants from the operation of the facility and to provide advice with regard to effective mitigation strategies where necessary.

Awaba Colliery is seeking a project approval from the NSW Department of Planning under the provisions of Part 3A of the EP&A Act to:

- Continue bord and pillar development and pillar extraction by continuous miners within the "Main South Area" (being the remaining sections of Stage 2 and Revised Stage 3, refer Study Area 2);
- Extend bord and pillar development and pillar extraction by continuous miners into the "East B" Area (refer Study Area 3);
- Produce, handle and distribute up to 880,000 tonnes of Run of Mine coal per annum (financial year) using existing surface facilities;
- Continue the use of existing ancillary surface facilities (all Study Areas);
- Expand the existing final Pollution Control Dam (refer Study Area 1);
- Continue the delivery of coal to the Newstan Colliery and/or the Eraring Power Station using the existing private haul road/transport facilities (refer Study Area 4).

Ambient background particulate matter monitoring data was obtained from the NSW Department of Environment, Climate Change and Water (DECCW), who maintains an air quality monitoring site in Wallsend, approximately 18 km northeast of the Project Site.

Based on the available data**,** site-specific ambient air quality levels adopted for assessment purposes are as follows.

- Dust: An annual average ambient dust deposition level of the order of 2 g/m$^2$/month
- $PM_{10}$: A daily varying 24-hour average concentration based on local ambient monitoring data
- An annual average $PM_{10}$ concentration of 21.5 µg/m$^3$
- TSP: An annual average of 47.0 µg/m$^3$

The following project-specific air quality goals have been established for assessment of the Project Site operations.

- A 24-hour maximum $PM_{10}$ concentration of 50 µg/m$^3$.
- An annual average $PM_{10}$ concentration of 30 µg/m$^3$.
- An annual average TSP concentration of 90 µg/m$^3$.
- A total monthly average dust deposition rate (background plus increment) of 4 g/m$^2$/month.
- A 1-hour average $NO_2$ concentration of 246 µg/m$^3$.
- A 1-hour average CO concentration of 30 µg/m$^3$.

## EXECUTIVE SUMMARY

Atmospheric dispersion modelling predictions of fugitive emissions from the Project Site were undertaken using the Ausplume Gaussian Plume Dispersion Model software (Version 6.0) developed by the EPA (Victoria).

All modelling predictions indicate that the concentrations of particulate matter and dust deposition attributable to the Project would be within the current NSW DECCW air quality goals at all surrounding residences.

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# 1 INTRODUCTION

Heggies Pty Ltd (Heggies) has been commissioned by GSS Environmental (GSSE) on behalf of Centennial Coal Pty Limited (Centennial) to undertake an Air Quality Impact Assessments (AQIA) for the Awaba underground coal mine (hereafter referred to as "Awaba Colliery") located on Wilton Road, approximately 1 km south of the township of Awaba and approximately 5.5 km southwest of Toronto, NSW.

This AQIA has been prepared in accordance with the NSW Department of Environment and Climate Change and Water's (DECCW) "*Approved Methods for the Modelling and Assessment of Air Pollutants in NSW*" (NSW Department of Environment and Conservation [DEC], 2005) (hereafter the Approved Methods). The Approved Methods outline the requirements for conducting an AQIA, as follows:

- Description of local topographic features and sensitive receptor locations.
- Establishment of air quality assessment criteria.
- Analysis of climate and dispersion meteorology for the region.
- Description of the existing air quality environment.
- Compilation of a comprehensive emissions inventory for existing operations.
- Completion of atmospheric dispersion modelling and analysis of results.

The scope of the AQIA was also designed to address the DECCW's and Director-General's requirements for the project with regard to air quality. A synopsis of these requirements is given in **Table 1**.

**Table 1 Requirement Pertaining to Air Quality Issues**

| Requirements | Relevant Section |
|---|---|
| A description of the existing air quality including the following parameters:<br>• Dust deposition;<br>• Total suspended particulates; and<br>• $PM_{10}$ particulate matter. | **Section 6** |
| Identification and location of all fixed and mobile sources of air emissions from the development including:<br>• Location of all emission sources;<br>• Identification of all pollutants of concern; and<br>• Estimation of emissions quantity. | Appendix C (Emissions Inventory) |
| Details of the project essential for predicting and assessing impacts on air quality. | **Section 2.5** |
| A description of the topography and surrounding land uses. | **Section 3.1** |
| Details of exact locations of dwellings. | **Section 3.2** |
| Estimation of resulting ground level concentrations of all pollutants. | **Section 8** |
| Detailed description of the methodology used to assess air quality impacts including:<br>• Justification and discussion of choice of dispersion model and model parameters; and<br>• Dispersion model input/output files. | **Section 7** and **Appendix D** |
| Air quality impact predictions including plans showing projected incremental levels of;<br>• 24-hour average $PM_{10}$ concentrations;<br>• annual average dust deposition rates; and<br>• annual average total suspended particulate concentrations. | **Section 8** |
| Assessment of cumulative air quality impacts and a description of the methodology used. | **Section 7** |
| Assessment of the potential impacts on air quality other than by dust, e.g. nitrogen oxide emissions from diesel equipment and/or odour emissions arising from mine ventilation. | **Section 2** and **Section 7** |
| Description of the effects and significance of pollutant concentration on the environment, human health, amenity and regional ambient air quality goals. | **Section 8** |
| Description of contribution ( if any) that the development will make to regional pollution particularly in sensitive locations. | **Section 8** |
| Description of control measures to be implemented to minimise pollutants including dust generation during any construction activities and coal handling and stockpiles. | **Section 2** |
| Specifications of pollution control equipment and management protocols for both point and fugitive emissions. | **Section 2** |
| Details of an air quality monitoring program to determine effectiveness of mitigation and to verify predictions, including:<br>• provision for investigations in response to complaints. | **Section 2** |

This report also includes a quantitative Greenhouse Gas Assessment which examines the potential Scope 1, 2 and 3 greenhouse gas emissions of the Project.

Additional policies, guidelines and plans referenced within this assessment are the *Protection of the Environment Operations (Clean Air) Regulation, 2002*, the "*Approved Methods for the Sampling and Analysis of Air Pollutants in NSW*" (DEC, 2007), and the "*National Greenhouse Accounts (NGA) Factors*" (hereafter the NGA Factors) (Commonwealth Department of Climate Change [DCC], 2009).

## 1.1 Report Structure

This AQIA is structured as follows:

| | |
|---|---|
| **Section 1** | Introduction and report structure |
| **Section 2** | A description of the existing operations at Awaba Colliery including:<br>• overview of current Awaba Colliery operations;<br>• particulate sources and emissions;<br>• existing mitigation and management measures; and<br>• complaints history |
| **Section 3** | Description of the study area including:<br>• local topography;<br>• receptor details;<br>• neighbouring emission sources; and<br>• regional emission sources |
| **Section 4** | Ambient Air Quality criteria including:<br>• goals applicable to particulate matter less than 10 microns in size ($PM_{10}$);<br>• goals applicable to Total Suspended Particulate (TSP);<br>• nuisance impacts of fugitive emissions; and<br>• Project air quality goals. |
| **Section 5** | A description of the prevailing dispersion meteorology including:<br>• meteorological conditions; and<br>• meteorological modelling. |
| **Section 6** | A description of the baseline air quality in the region |
| **Section 7** | A description of the Air Quality modelling methodology including:<br>• emissions parameters and calculations. |
| **Section 8** | Dispersion modelling results. |
| **Section 9** | Greenhouse gas assessment. |
| **Section 10** | Conclusions. |
| **Section 11** | Lists the reports and other material cited in this document. |

# 2 PROJECT OVERVIEW

## 2.1 Background and Existing Awaba Colliery Mine Operations

Awaba Colliery is a small underground coal mine operated by Centennial Newstan Pty Ltd (Newstan), a wholly owned subsidiary of Centennial Coal Company Ltd (Centennial). The mine entry and primary surface facilities are located approximately one kilometre south of the Awaba village and 5.5 kilometres (km) south west of Toronto on the western side of Lake Macquarie, near Newcastle NSW.

Awaba Colliery has been producing coal by bord and pillar method since 1947. The site is situated on crown land under lease to Centennial for the purpose of mining under Consolidated Coal Lease CCL746, and is adjacent to the Newstan-Eraring haul road owned by Eraring Energy. The locality of the mine is illustrated on **Figure 1**.

Awaba Colliery is a small operation with approximately 100 employees and contractors, historically producing around 800,000 tonnes of thermal coal annually. Since commencing mining operations in 1947, over 30 million tonnes of coal has been won from the Great Northern Seam using a combination of first workings development, pillar extraction, pillar quartering, and pillar stripping.

A form of pillar extraction of narrow panels is used to recover coal in pillars developed previously by bord and pillar methods. Development of bords (roadways) and pillars is ongoing but in some areas were developed many years ago. This mining method currently utilises continuous miners. Mine planning ensures panels are not extracted where depth of cover or surface constraints preclude total extraction. This mining method has been developed in consultation with the Department of Primary Industries – Mineral Resources (now known as Industry and Investment, NSW (I&I)) and has been used successfully to date, and is proposed to be continued for the Project.

Awaba Colliery presently operates pursuant to section 109(1) of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) and clause 6B(1) of the *State Environmental Planning Policy (Major Development) 2005*. An application for a Part 3A Project Approval has been lodged by Centennial for the ***Awaba Colliery Mining Project (the "Project")***, which seeks approval from the Minister of Planning to allow an extension of underground mining and the ongoing use of associated surface operations.

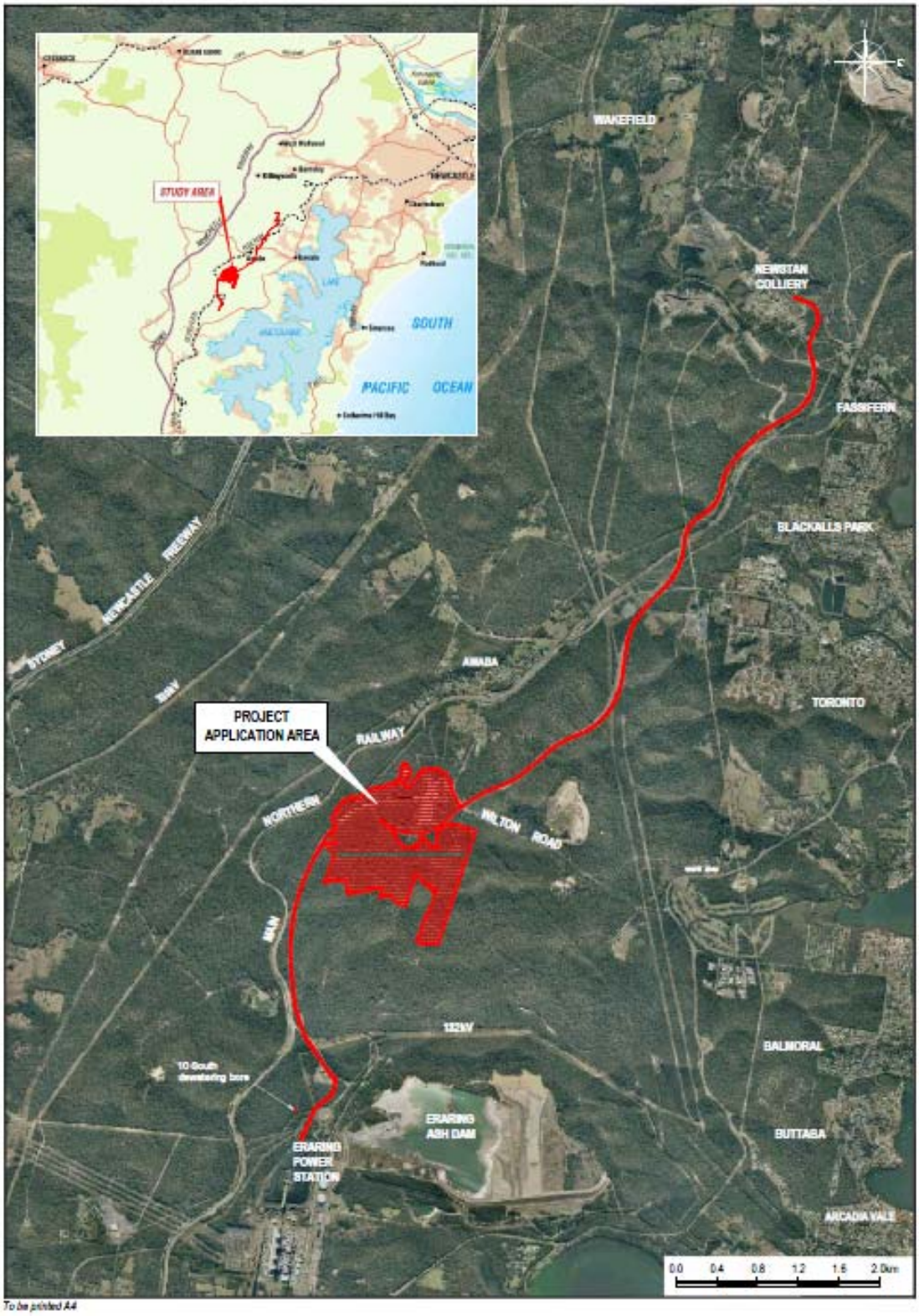
Minimal changes are proposed to existing surface operations, with one proposed additional surface disturbance relating to increased pollution control dam capacity located in a previously disturbed area. No significant changes to coal handling are proposed At present, it is anticipated that the Project will recover approximately 2.0 million tonnes of coal which will be extracted from those areas depicted in Study Area 2 and Study Area 3 over a period of approximately five years or more, depending on actual mining conditions and relevant market drivers.

Adjacent to the Awaba colliery is a quarry, which is owned and operated by Centennial ("Awaba Quarry"). Material stockpiled within the Awaba Quarry will be used occasionally to supply material for rehabilitation of sinkholes and subsidence cracks at Awaba and Newstan Collieries. The material will also be used for road base at both sites. It is Heggies understanding that the material stockpiled within the quarry will be utilised possibly once every two (2) months on average for a period of one day.

## 2.2 Project Application Area

The Project Application Area is illustrated on **Figure 1**. The Application Area has been identified as the footprint of the proposed Project including proposed mining areas and related surface operations that are considered relevant to the continuation of Awaba Collieries operations, as well as, the existing workings areas that will continue to be relied upon for ventilation and other mining related purposes, access to proposed mining areas or for any required emergency evacuation.

**Figure 1 Awaba Colliery Project Location Area**



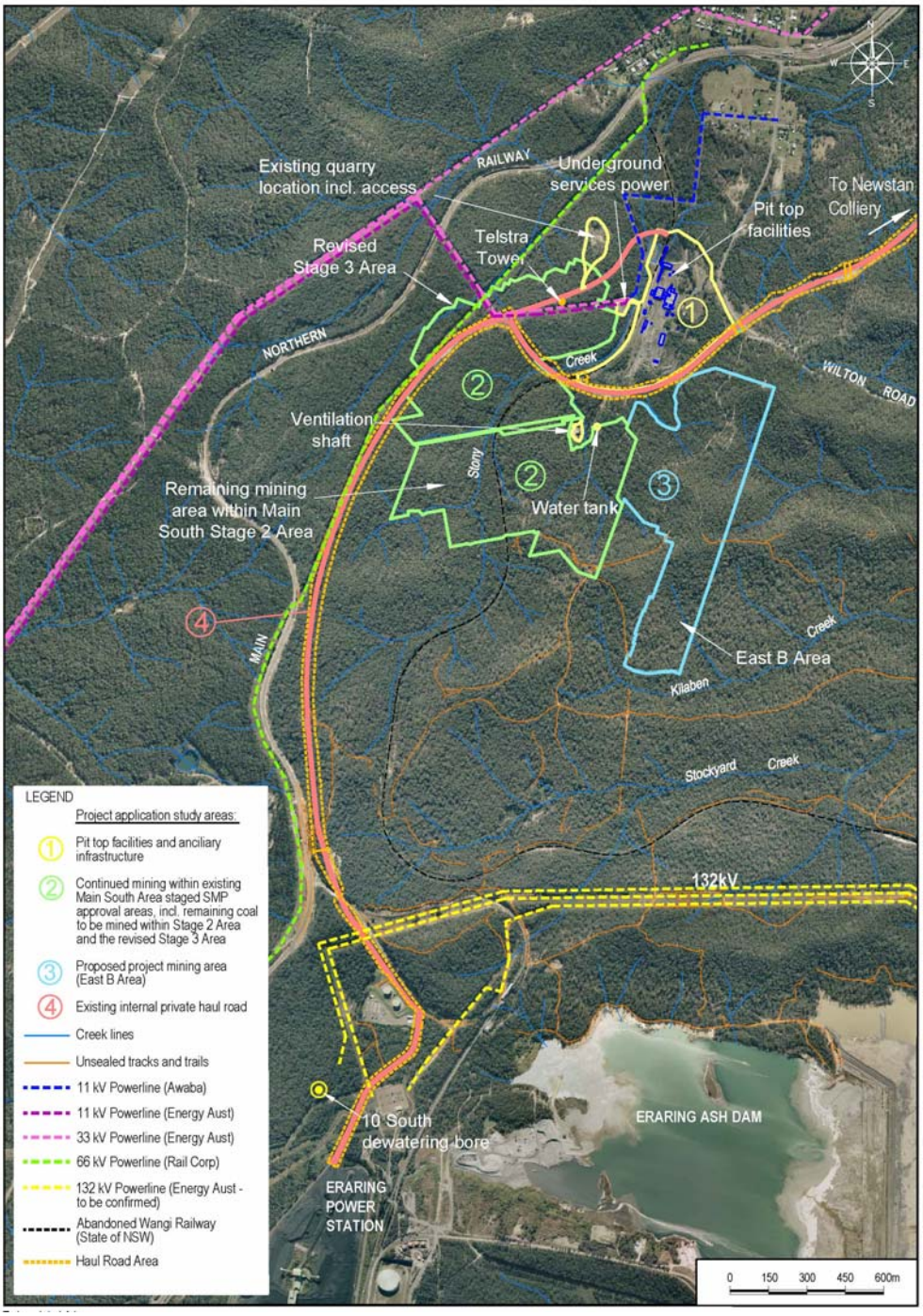

Source: GSSE, February 2010

The Application Area has been broken into a number of Study Areas based on the types of activities to be undertaken for the Project. These Study Areas are outlined below in **Section 2.2.1**. The extent of the existing workings has not been included as a Study Area as it is considered inappropriate to obtain retrospective approval for historical operations. Additionally, there are no activities proposed in these areas for the Project and ongoing management of these areas is covered by the existing Awaba Colliery Mining Lease conditions.

### 2.2.1 Study Areas

The Project Application Study Areas for the Environmental Assessment are illustrated in **Figure 2**.

**Figure 2 Project Application Area**




Source: GSSE

The study areas are described as follows:

- **Study Area 1 – Surface Facilities and Ancillary Infrastructure** – This area includes the colliery pit top facilities (including office and amenities buildings, existing coal crushing plant, workshop and storage areas) ventilation shafts, an existing quarry and mine dewatering bore (10 South Bore).

- **Study Area 2 – Continued Mining within Existing Main South Area staged SMP Approval Areas (including the Remaining Coal to be Mined within Stage 2 and the Revised Stage 3)** – The impacts associated with mining in these areas have previously been assessed in Subsidence Management Plan (SMP) Applications. The Stage 2 Area application was approved by Industry and Investment in September 2008, with the SMP Application for the Revised Stage 3 Area submitted to I&I in December 2009 awaiting approval. These areas are defined by a 26.5 degree angle of draw (as per DPI-MR SMP Guidelines, 2003). The outcomes from the SMP assessment will be summarised along with any impacts that are not considered to have been adequately addressed for this EA. It is important to note that, in relation to Stage 2 Area, only the coal remaining from the 1st of August will require approval for this Project;
- **Study Area 3 – Proposed Project Mining Areas** - Consideration of the proposed Mining Area (East B Area) defined as the proposed workings plus 26.5 degree angle of draw (i.e. as per DPI-MR SMP Guidelines, 2003); and
- **Study Area 4 – Existing Internal Private Haul Road** – This haul road will be utilised for transporting coal from the Awaba Colliery operations to Newstan Collieries existing Run of Mine Stockpile or Rail Loop and subsequently transported to the Port of Newcastle or Port Kembla for shipping to export markets (to be undertaken in accordance with the Newstan Colliery development consent) and also to the Eraring Power Station. It is noted that a modification to the Newstan Colliery development consent (DA 73-11-98) will be applied for under Section 96(1A) of the EP&A Act to allow for the preparation of coal sourced from the Awaba Colliery using the existing Newstan Colliery infrastructure.

In general, potential environmental impacts associated with mine access, ventilation and other services provided through the existing workings areas to the active and proposed mining areas will also be addressed in the EA.

It should be noted that for the purposes of assessing potential impacts of air pollutants from the Project Site only Study Area 1 has been considered. The impacts from Study Areas 2, 3 and 4 are minimal and have not been included as part of this assessment.

The Greenhouse Gas Assessment relates to the entire Application Area, and includes Scope 1, 2 and 3 emissions for the Project.

## 2.3 Project Description

Awaba Colliery is seeking an approval from the Minister of Planning under the provisions of Part 3A of the EP&A Act to:

- Continue bord and pillar development and pillar extraction by continuous miners within the "Main South Area" (being the remaining sections of Stage 2 and Revised Stage 3, refer Study Area 2);
- Extend bord and pillar development and pillar extraction by continuous miners into the "East B" Area (refer Study Area 3);
- Produce, handle and distribute up to 880,000 tonnes of Run of Mine coal per annum (financial year) using existing surface facilities;
- Continue the use of existing ancillary surface facilities (all Study Areas);
- Expand the existing final Pollution Control Dam (refer Study Area 1);
- Continue the delivery of coal to the Newstan Colliery and/or the Eraring Power Station using the existing private haul road/transport facilities (refer Study Area 4).

The proposed East B Area contains a proportion of coal that extends beyond the existing footprint of mining at Awaba Colliery and includes areas of both existing workings and areas requiring new workings to be developed. Subsequently, areas of new workings are lateral extensions to the mine footprint which will require new development approval (being sought under the current Part 3A application). The East B area is located to the east of the Main South Stage 2 Area. The overlying surface in the East B Area is predominantly bush land on crown land leased to Centennial Newstan and contains no significant surface infrastructure. This area is part of ***Study Area 3*** for the Project as discussed in **Section 2.2.1** above.

Mining will also be continued at Awaba Colliery in two (2) separate areas, these have been outlined below:

- Remaining sections of Stage 2 of the Main South Area (currently being mined) – this area was approved by I&I in September 2008 following an SMP application (as modified) under the NSW Mining Act, 1992. This area is part of ***Study Area 2*** for the Project as discussed in **Section 2.2.1**.
- Revised Stage 3 Area (of Main South Area) – this area has recently undergone a number of specialist surveys relating to a SMP application submitted in December 2009 (approval currently awaited from I&I prior to December 2010). Along with Stage 2 of the Main South Area, this area is part of Study Area 2 for the Project as discussed in **Section 2.2.1**.

At present, it is anticipated that the Project will recover approximately 2.0 million tonnes of coal which will be extracted from those areas depicted in Study Area 2 and Study Area 3 over a period of approximately five years or more, depending on actual mining conditions and relevant market drivers.

All existing ancillary surface facilities, supporting infrastructure, workings and their associated uses will continue to be relied upon by the Awaba Colliery (no significant change) as outlined further below. These aspects of the Project will continue to be used until such time as the Awaba Colliery is placed on care and maintenance, and thereafter throughout that phase also. When the Awaba Colliery is placed on care and maintenance, this will be done in accordance with the Life of Mine Plan approved by I&I NSW in 2009, until such time that a final Detailed Life of Mine Strategy has been developed.

Annual production, handling and distribution of approximately 880,000 tonnes per financial year is required.

Awaba Colliery requires approval to deliver coal via the private haul road to the Newstan Colliery ROM coal stockpile (in addition to the Rail Loop stockpile). This is assessed within **Study Area 4**. Newstan Colliery has submitted an application to modify its development consent in order to process coal received from the Awaba Colliery.

Existing mining areas, will continue to be utilised for ongoing mining operations including (but not limited to) mine access, emergency management and underground services and infrastructure.

## 2.4 Continuing Mine Operations:

For the purposes of environmental assessment, further to the information above regarding continued mining areas, it is noted that the following aspects of mine operations are proposed to continue and remain unchanged. Existing mining operations are presented in detail in Section 3 of the *Environmental Assessment (EA)* and, where relevant, components are discussed further in this specialist report.

- **Coal Handling, preparation and stockpiles** – No changes are proposed to the current coal handling, preparation or stockpile procedures to the existing operations;

- **Mine support facilities and site access** – No changes are proposed to the current infrastructure and facilities, with the only exclusion being the expansion of the Pollution Control Dam (PCD) mentioned earlier above, with related water management considerations. Mine access from Wilton Road will continue to be utilised and no significant change is anticipated from current use;
- **Plant and equipment** – No changes are proposed to the typical plant and equipment used at the Awaba Colliery;
- **Transportation procedures** – No changes are proposed to the current transport procedures. The Project will continue to use the Newstan-Eraring private haul road to transport coal from the operations to Newstan and Eraring;
- **Mining methodology** – There will be no significant changes to current mining methods for the Project. This includes predicted subsidence levels and operational structure. Production rates may be slightly increased from approximately 800,000 to 880,000 tonnes per annum (financial year), depending on mining efficiency and market demands;
- **Operational water management** – the domestic wastewater generation rate from the Pit Top facilities will be similar to that which currently exists as there is no plan for an increase or significant change in staff numbers. Disposal of the domestic wastewater will remain as currently exists at site; and
- **Mine dewatering procedures** – the10 South Bore will continue to be used for groundwater management and dewatering during both continued operation and care and maintenance conditions.

**Table 2** provides a summary of the existing operations and the proposed changes as part of this project.

**Table 2 Summary Comparison of Existing Awaba Colliery Operations and Proposed Changes**

| Project Component | Summary of the Existing Awaba Colliery | Summary of the Project (Proposed changes) |
|---|---|---|
| Active Mine Period | - | 5 years or more |
| Mining Method | Bord and Pillar development and Pillar Extraction within narrow panels by continuous miners | No change |
| Annual Coal Production Rate | Approximately 850,000 tonnes per annum | Allowing for potential productivity improvements up to 800,000 tonnes per annum |
| Operating Hours | 24 hours per day ,7 days a week | No change |
| Mine Access | Access to surface facilities is off Wilton Road | No change |
| Run-of-Mine (ROM) Coal Stockpile | Approximately 30,000 tonnes (t) | No change |
| On-site Coal Crushing and Screening | Loaded onto conveyor and through the ROM bin then send to Coal Preparation Plant where it is crushed to less than 100mm before truck loading or movement to stockpiles | No change |
| On-site Coal Crushing and Screening Operating Hours | 24 hours per day, 7 days a week | No change |
| Product Coal Stockpile | Product coal stockpile area with a capacity of 35,000 to 50,000 t | No change |
| Road Transport Requirements | Use of internal haul roads and main Mine Access road.<br>Use of private haul road to either Newstan ROM stockpile or Rail Loop (export) or Eraring Power Station. | No change |
| Mine infrastructure and service facilities | Mine access and ventilation, coal handling, coal preparation and transport, workshop, administration, water management and pollution control | No change |
| Workforce | Approximately 100 staff and contractors | No change |

## 2.5 Particulate Sources and Emissions from Awaba Colliery

This subsection provides a review of the likely sources of particulate associated with the existing Awaba Colliery and Awaba Quarry.

Atmospheric pollutants generated by activities occurring at the Project Site primarily comprise fugitive emissions of particulates ($PM_{10}$[1] and TSP[2]), those generated through the combustion of fuel in vehicles (nitrogen oxides [$NO_X$], sulphur dioxide [$SO_2$], volatile organic compounds [VOCs], carbon monoxide [CO], $PM_{10}$) and fugitive emissions from the coal seam. Emissions of combustion related pollutants from Awaba Colliery sources are small and resulting concentrations at the nearest receptors negligible, taking into account the plant and equipment used at Awaba Colliery and the fact that it is an underground coal mine.

[1] $PM_{10}$ is used to describe particulate matter with an aerodynamic diameter of 10 microns (μm) or less.
[2] TSP (Total Suspended Particulate) describes particulate matter which is less than 50 microns in diameter.

Therefore, the focus of this assessment will be fugitive emissions of dust and particulates.

Major sources of particulate pollution from current mining activities at Awaba Colliery are expected to occur as a result of the activities presented in **Table 3**.

**Table 3 Likely Particulate Generating Activities Occurring at Awaba Colliery**

| Activity | Particulate Emission Source |
|---|---|
| Stockpiles / Open Areas | Wind erosion of stockpiles and open areas |
| Overflow | Overflow of coal from the Bin via chute to the stockpile |
| Truck loading | Loading trucks from coal chute and loader |
| Awaba Quarry | Extraction of stockpiled materials |

## 2.6 Existing Air Quality Mitigation and Management Measures

Air quality management at Awaba Colliery is described in the Dust Management Plan (Centennial Coal Awaba Colliery, February 2009). Current air quality mitigation and management measures employed at Awaba Colliery include:

- Designated haulage routes where vehicles are restricted to the most direct route with minimal manoeuvring;
- Speed limits;
- Water spraying of unsealed roads, manoeuvring areas and stockpiles;
- Sealing of haul roads; All haul roads (excluding the road into the quarry) are sealed.
- Vacuum sweeping adjacent to coal stockpiles, haul roads and hard stand areas; and,
- Covering of truck loads entering and leaving the premises.

It is Heggies understanding that a sprinkler dust suppression system has been installed adjacent to the stockpile in September 2009.

## 2.7 Air Quality Complaints

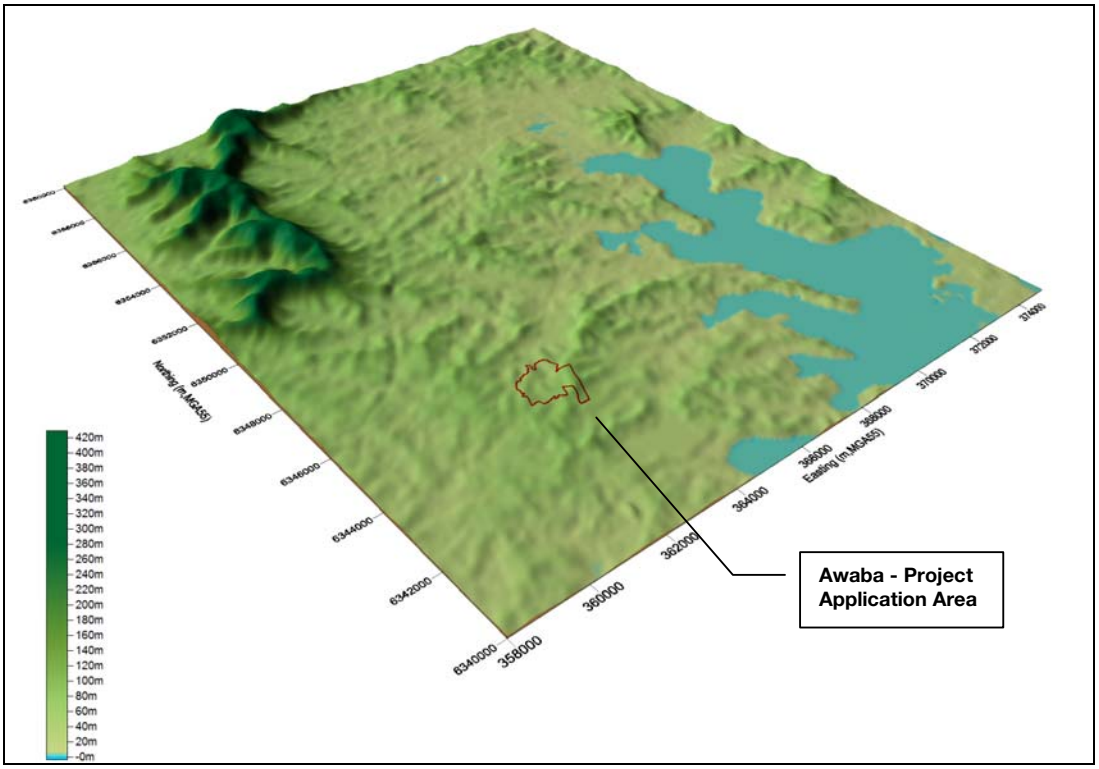
There have been no community complaints received regarding air quality from the Project Site.

# 3 PROJECT SETTING

## 3.1 Local Topography

A three (3) dimensional representation of the regional scale topography surrounding Awaba Colliery is illustrated in **Figure 3**. The Project Site is located in forested undulating terrain, bordered by dense vegetation, on the sloping side of a narrow valley, which trends in an approximate north-south orientation. The pit top topography falls between 55 m AHD (eastern pit top) and 31 m AHD (western pit top). Further south of the Project Site the topography undulates, decreasing to 0 m AHD at the western edge of Lake Macquarie.

**Figure 3 Three Dimensional Representation of the Regional Scale Topography Surrounding Awaba Colliery**




Note: Vertical exaggeration factor of 2 is applied

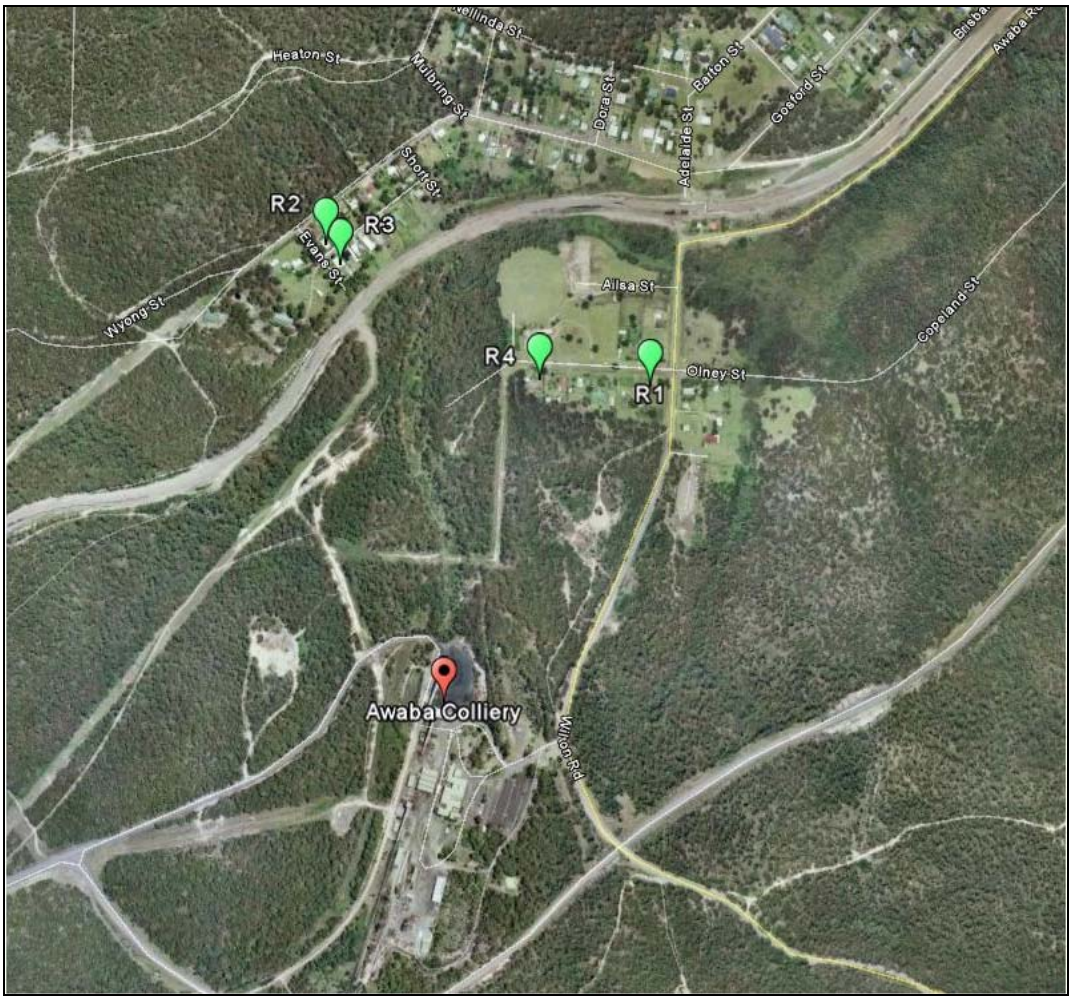
## 3.2 Sensitive Receptors

A number of residences or land uses are located in the area surrounding the Project Site. The nearest residences have been identified as sensitive receptor locations to be taken into account during the assessment. A list of the nearest sensitive receptors, as described within the Newstan EIS (R1 to R4) identified in the immediate vicinity of the Project Site, and their respective distances from the Project Site boundary are presented in **Table 4** and **Figure 4**.

**Table 4 Nearest Sensitive Receptors**

| Receptor ID | Location | Location (m, MGA56) | | Distance (km) / Direction From Site Boundary | Elevation (m, AHD) |
|---|---|---|---|---|---|
| | | Easting | Northing | | |
| R1 | 9 Olney Street, Awaba | 363733 | 6346064 | 0.6 / NNE | 30 |
| R2 | 15 Evans Street, Awaba | 363203 | 6346323 | 0.8 / N | 32 |
| R3 | 51 Puddy Lane, Awaba | 363220 | 6346274 | 0.7 / N | 29 |
| R4 | 1A Olney Street, Awaba | 363547 | 6346080 | 0.5 / NNE | 32 |

**Figure 4 Surrounding Sensitive Receptor Locations**




Source: Google, 2010

## 3.3 Neighbouring Pollutant Sources

### 3.3.1 Local Sources

Sources of atmospheric pollution surrounding the Project Site are mainly from mining activities from the mines in the vicinity of the Project Site. Awaba Colliery is situated approximately 5.5 km southwest of Newstan Colliery, approximately 5.4 km southwest of Myuna Colliery and approximately 3.3 km north-northeast of the Eraring Power station. The ash dam at Eraring Power station is also a potential source of atmospheric pollution.

Given the above, it is considered that the surrounding coal mining operations have the potential to cause cumulative impacts upon receptors surrounding the Project Site due to the relatively small distances between the Project Site and these identified sources.

### 3.3.2 Regional Sources

Concentrations of pollutants can be elevated under certain conditions, such as bushfires or dust storms. Although these events are relatively infrequent, they do occur and can result in elevated concentrations of particulates over several days in some instances. These events can be identified through the use of a network of air quality monitors as simultaneous elevations of particulate will be noted across an area.

# 4 AMBIENT AIR QUALITY CRITERIA

## 4.1 Particulate Matter

### 4.1.1 Goals Applicable to $PM_{10}$

$PM_{10}$ is considered to be an important pollutant in terms of potential impact due to its ability to penetrate into the respiratory system.

The DECCW $PM_{10}$ assessment goals as expressed in the Approved Methods are:

- a 24-hour maximum of 50 micrograms per cubic metre (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 "*Ambient Air Quality National Environment Protection Measure"* (NEPM) (National Environmental Protection Council, 1998) reporting standard except that the NEPM reporting standard allows for five exceedances per year.

### 4.1.2 Goals Applicable to TSP

The annual goal for TSP is given as 90 µg/m$^3$ as recommended by the National Health and Medical Research Council (NHMRC) at their 92nd session in October 1981. This goal has also been adopted in the Approved Methods.

### 4.1.3 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 dust deposition. 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. To avoid dust nuisance the DECCW has developed assessment criteria for dust deposition, or fallout. **Table 5** presents the allowable increase in dust deposition relative to the ambient levels.

**Table 5 DECCW Goals for Allowable Dust Deposition**

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

Source: Approved Methods, DECCW 2005.

### 4.1.4 Nitrogen Dioxide

The impact assessment criterion for nitrogen dioxide ($NO_2$) as described within the Approved Methods, DECCW 2005 are:

- a 1-hour average of 246 µg/m$^3$.
- an annual average of 62 µg/m$^3$.

### 4.1.5 Carbon Monoxide

The impact assessment criterion for carbon monoxide (CO), as described within the Approved Methods, DECCW 2005 are:

- a 1-hour average of 30 µg/m$^3$.
- an 8-hour average of 10 µg/m$^3$.

## 4.2 Project Air Quality Goals

The air quality goals adopted for the assessment of the Project are those specified in the Approved Methods or the NEPM. In summary, the specific goals being applied to this study are as follows:

- $PM_{10}$: A 24-hour maximum of 50 µg/m$^3$; and
  An Annual average of 30 µg/m$^3$.
- TSP: An annual average of 90 µg/m$^3$.
- Deposited Dust: An incremental (Project only) annual average dust deposition level of 2 g/m$^2$/month; and
  A total annual average dust deposition level of 4 g/m$^2$/month (Project and other sources).
- Nitrogen Dioxide a 1-hour average of 246 µg/m$^3$; and
  an annual average of 62 µg/m$^3$.
- Carbon Monoxide a 1-hour average of 30 µg/m$^3$; and
  An annual average of 10 µg/m$^3$.

# 5 PREVAILING DISPERSION METEOROLOGY

## 5.1 Meteorological Data Availability

There is no weather station located at the Project Site. There are two (2) weather stations located in the area surrounding the Project Site. These include:

- Newstan Colliery; and
- Cooranbong- Lake Macquarie - Bureau of Meteorology (BOM).

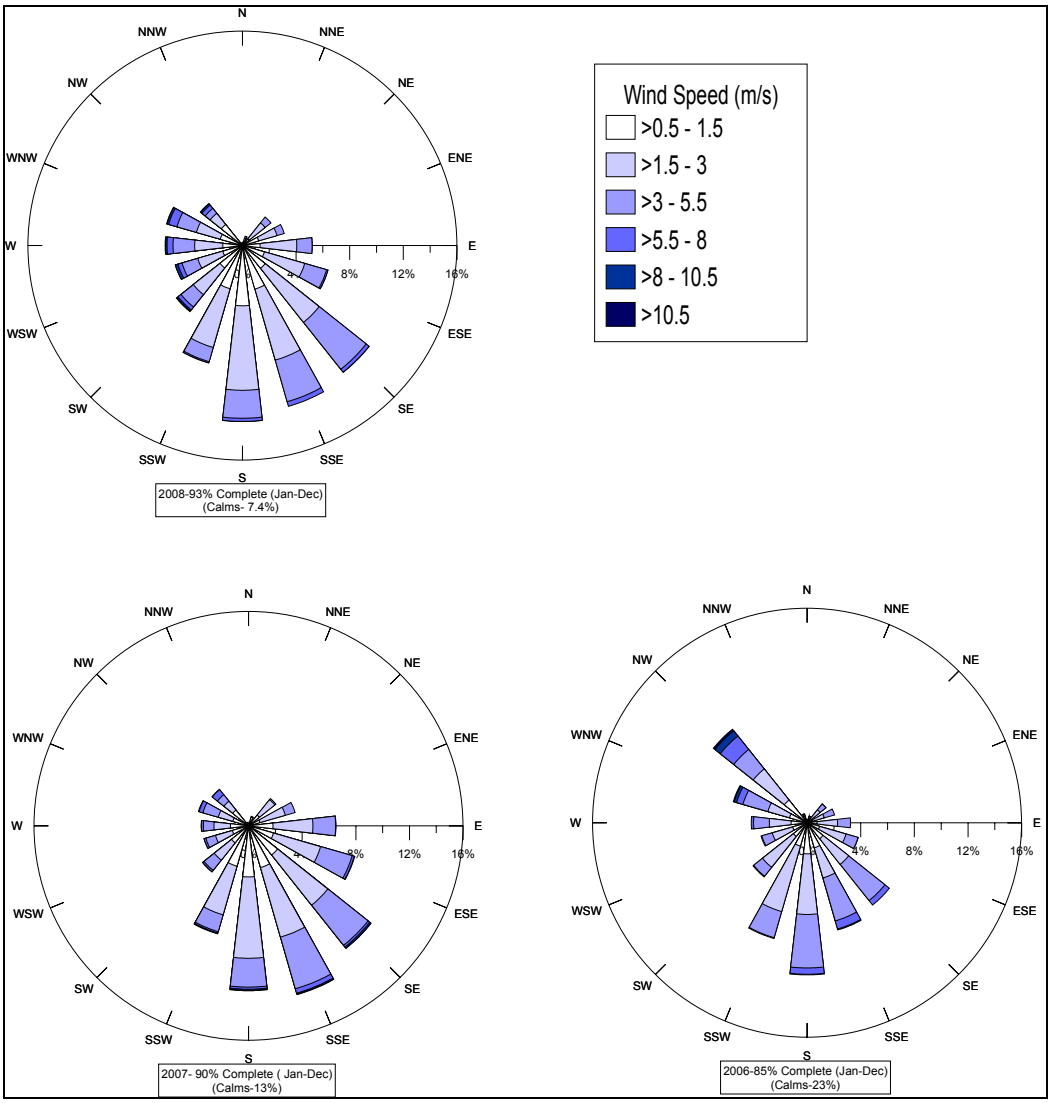
### 5.1.1 Newstan Colliery Weather Station

Newstan Colliery is located approximately 5.5 km northeast of the Project Site. The following parameters, recorded at hourly intervals, were available from this station.

- Wind Speed.
- Wind Direction.
- Temperature.
- Relative Humidity.
- Solar Radiation.

Hourly data recorded between October 2005 and April 2009 was provided by Newstan Colliery. The wind speed and direction profile of the calendar years 2006, 2007 and 2008 is presented within **Figure 5**.

**Figure 5 Hourly Annual Wind Rose Comparison - Newstan Colliery Weather Station January 2006 to December 2008**




As illustrated in **Figure 5**, the trends for both wind speed and wind direction are similar for each year presented. The 2006 windrose does indicate a higher proportion of north-west winds, which was not measured in the 2007 and 2008 data. The 2008 calendar year represents the most complete dataset recorded by the Newstan weather station, with a total percentage complete of approximately 93% and has been selected as an appropriate year for consideration within this assessment.

The wind roses illustrated in **Figure 3** indicate that northerly winds from the north north-west to north north-east are absent. Following a review of the weather station calibration records, it would seem that winds within this range during calibration were determined to be faulty. Winds detected in all other directions were determined to be appropriately calibrated and functional.

As described in **Figure 4**, the sensitive receivers are all located to the north of the project site. With winds dominating from the south, this meteorological data set is considered to be worse case, when assessing to these sensitive receiver locations.

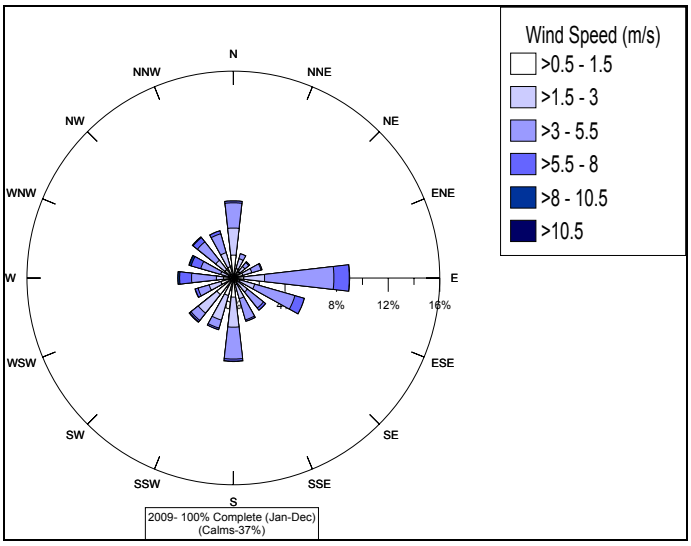
### 5.1.2 Cooranbong - Lake Macquarie Bureau of Meteorology Weather Station

Cooranbong - Lake Macquarie weather station (061412) is located approximately 10.5 km south-west of the Project Site. The following parameters, recorded at hourly intervals, were available from this station.

- Wind Speed
- Wind Direction
- Temperature
- Relative Humidity
- Rainfall

Hourly data recorded between August 2008 and December 2009 was provided by the Cooranbong- Lake Macquarie station. The wind speed and direction profile of the calendar year 2009 is presented within **Figure 6**.

**Figure 6 Hourly Annual Wind Rose - Cooranbong - Lake Macquarie 2009**




The Cooranbong meteorological station was installed in mid 2008. Therefore, no historic data before this date is available at the site. Data for a full calendar year was limited to 2009.

The wind rose illustrated in **Figure 6** indicates that the prevailing wind direction at the Cooranbong monitoring site is from the East. A point of interest is that 37% of the data is impacted by calm conditions. The majority of these occur between 6pm and 8am.

It is noted that Heggies consider that the percent calms in unusually high, and is not typical for a location with relatively uncomplicated terrain. The Bureau of Meteorology (BOM) was contacted to investigate the quality of the data. They indicated that the data was quality checked and the data is considered to be within their acceptable ranges.

### 5.1.3 Meteorology Applicable for this Assessment

The Approved Methods state in Section 4.1 that for a Level 2 air quality assessment, a site-specific meteorological dataset with at least 90% complete hourly observational data for a one year period must be used (i.e. for 8760 hours, maximum of 876 missing).

The Newstan monitoring locality is 5.5 km from the project site, and is considered to be representative of site conditions of the Awaba Colliery. As discussed above, the 2008 dataset is 93% complete and is the preferred data set.

Cooranbong is considered to be too far from the project site to represent local conditions (10.5 km), has only been operational since the middle of 2008 and the high percent calms within the data set are potentially erroneous.

It is recognised that within the Newstan meteorological data, northerly winds from the north north-west to north north-east are absent. However, the prevailing winds are from the south. This is considered to be worst case meteorological conditions for dust dispersion towards the receivers and is considered highly conservative and an applicable data set to use in this instance. As described in **Section 5.3** TAPM has been used to also generate a synthetic meteorological file for the calendar year 2008. **Figure 17** illustrates a windrose comparison between the Newstan and TAPM 2008 annual wind roses. To provide a robust approach, a sensitivity modelling run was undertaken to determine the impacts upon the nearest receivers from the Awaba Colliery under these meteorological conditions.

## 5.2 Meteorological Conditions

### 5.2.1 Wind Regime

A summary of the 2008 annual wind speed and direction experienced at Newstan and adopted at the Project Site is presented as a windrose in **Figure 7**.

**Figure 7 Annual Wind Rose for Project Site - 2008**

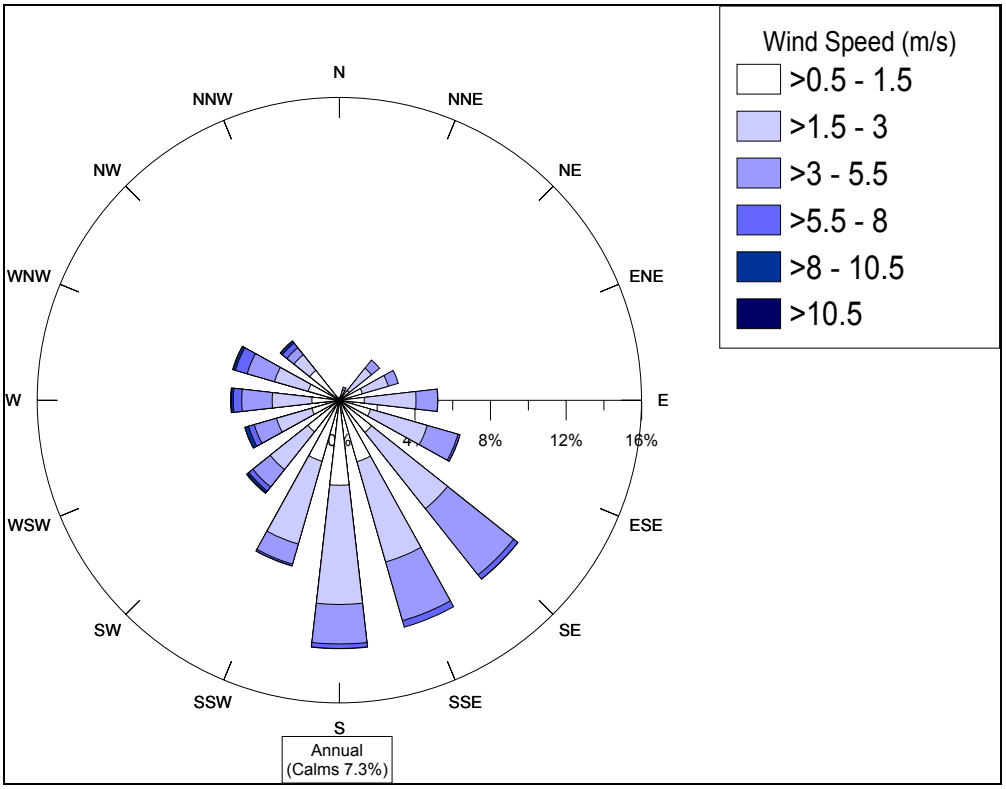


**Figure 7** indicates that winds experienced are predominately light to moderate winds (between 1.5 m/s and 5.5 m/s and primarily from the southeast to the south. Calm wind conditions (wind speed less than 0.5m/s were observed to occur 7.3% of the time throughout 2008.

The seasonal variation in predicted wind speed and direction is presented in **Appendix A**. The seasonal wind roses indicate that:

- In spring light to fresh winds (between 1.5 m/s and 3 m/s) from east southeast to the south and relatively moderate winds (between 3 m/s and 5.5 m/s) from south southwest to northwest predominate.
- In summer fresh to light winds are experienced predominately from the southeast to the south.
- In autumn fresh to light winds are experienced predominately from the south to south southwest.
- In winter fresh to light winds are experienced predominately from the south southeast to the west northwest.

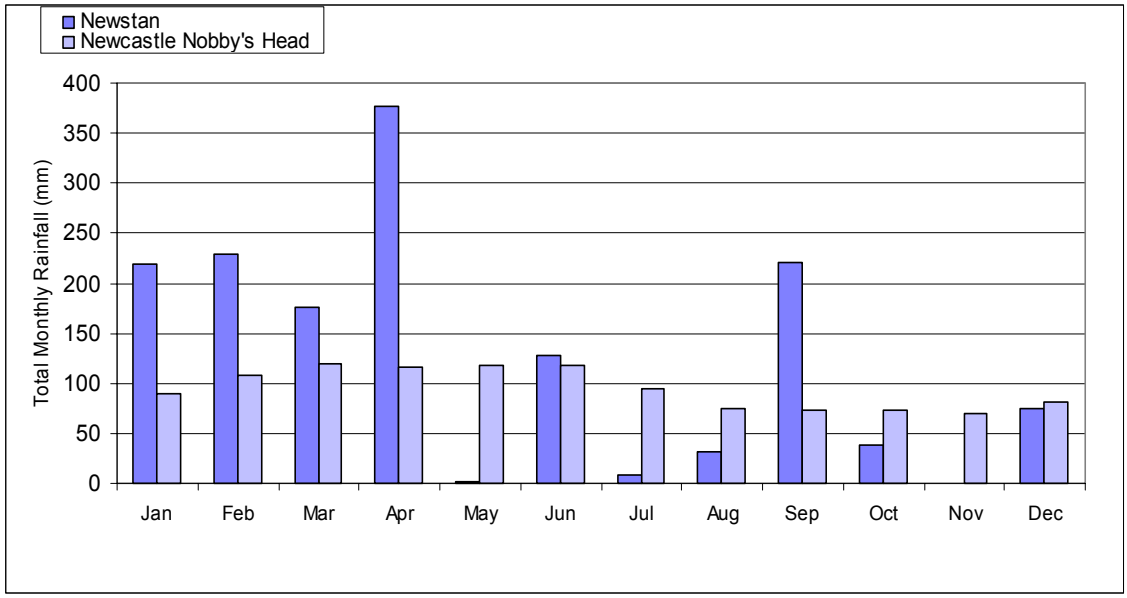
### 5.2.2 Rainfall

Precipitation is important to air pollution studies since it reduces the potential for fugitive dust emissions and represents an effective removal mechanism of atmospheric pollutants. A graph displaying the recorded total monthly rainfall measured at Newstan during 2008 is shown in **Figure 8**. Also shown is the monthly mean rainfall measured at Newcastle Nobby's Head between 1862 and 2010 (BoM, 2010).

Rainfall experienced in the greater region surrounding the Project Site can be described as low to moderate, with the historic annual average rainfall recorded at Newcastle Nobby's Head totalling approximately 1136.5 mm. Review of data recorded at Newstan during 2008 shows that, while some months (notably May, July and November) were lower than the corresponding regional monthly average, total rainfall recorded during 2008 was approximately 1505 mm and therefore higher than the regional average.

Rainfall in the region surrounding the Project Site is typically lower during the winter months with a maximum generally experienced during the summer months.

**Figure 8 Monthly Rainfall for Newstan Colliery - 2008 and Historic Annual Rainfall, Newcastle Nobby's Head**




### 5.2.3 Relative Humidity

The relative humidity in the region surrounding the Project Site can be described as moderate. The mean 9 am relative humidity at Newcastle Nobby's Head was between 68% to 80%, while the 3 pm relative humidity varies between 56% and 74% throughout the year (BoM, 2010). This is in agreement with relative humidity data collected at Newstan, with a 9am and 3pm annual average relative humidity of 79% and 80% respectively recorded throughout 2008.

## 5.3 Meteorological Modelling

In order to calculate all required meteorological parameters required by the dispersion modelling process, meteorological modelling using The Air Pollution Model (TAPM) meteorological model (Version 3) has been undertaken.

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 with no local data inputs required.

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. This function of accounting for actual meteorological observations within the region of interest is referred to as "data assimilation".

Thus, direct measurements for 2008 of hourly average wind speed and wind direction at the Newstan onsite weather station were input into the TAPM simulations to provide realignment to local conditions.

**Table 6** details the parameters used in the TAPM meteorological modelling for this assessment.

**Table 6 Meteorological Parameters Used for the Assessment**

| **TAPM (v 3.0)** | |
|---|---|
| Number of grids (spacing) | 4 (30 km, 10 km, 3 km, 1 km) |
| Number of grid points | 25 x 25 x 30 |
| Year of analysis | 2008 |
| Centre of analysis | 336292 m E, 6350733 m S (Awaba Colliery) |
| Data assimilation | Meteorological data assimilation using wind data from the Newstan onsite weather station into lower 4 levels of model |

### 5.3.1 Atmospheric Stability and Mixing Depth

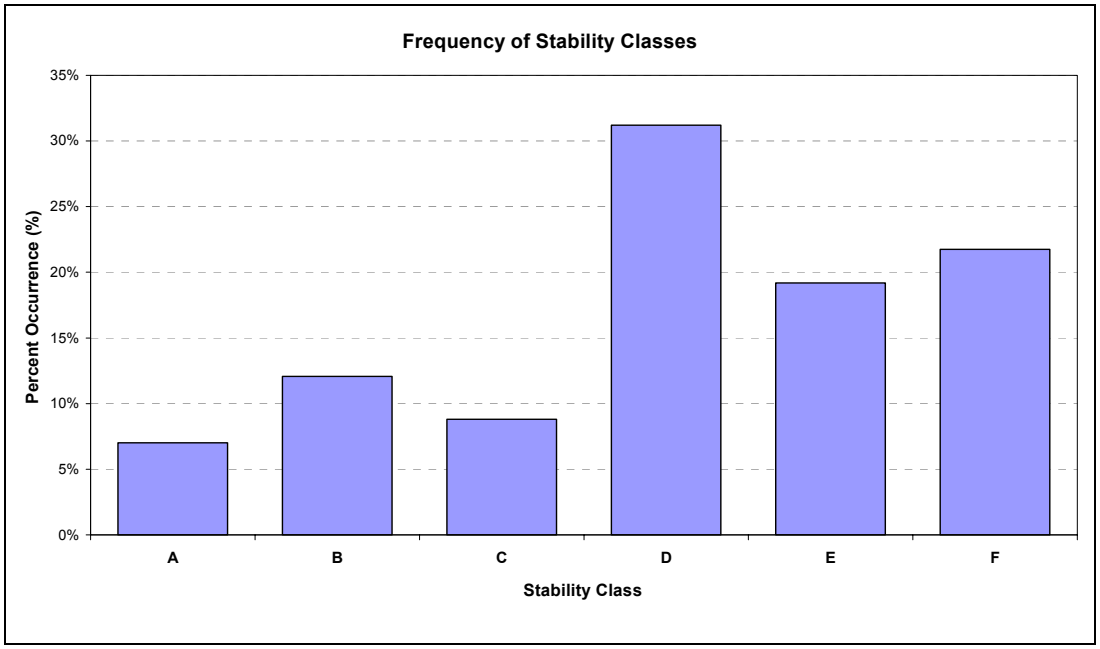
Atmospheric stability refers to the tendency of the atmosphere to resist or enhance vertical motion. The Pasquill-Turner assignment scheme identifies six Stability Classes, "A" to "F", to categorise the degree of atmospheric stability. These classes indicate the characteristics of the prevailing meteorological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

**Table 7 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 TAPM predicted frequency of each stability class at the Project Site during 2008 is presented in **Figure 9**. The TAPM predicted seasonal stability class distributions for the Project Site are included in **Appendix B.**

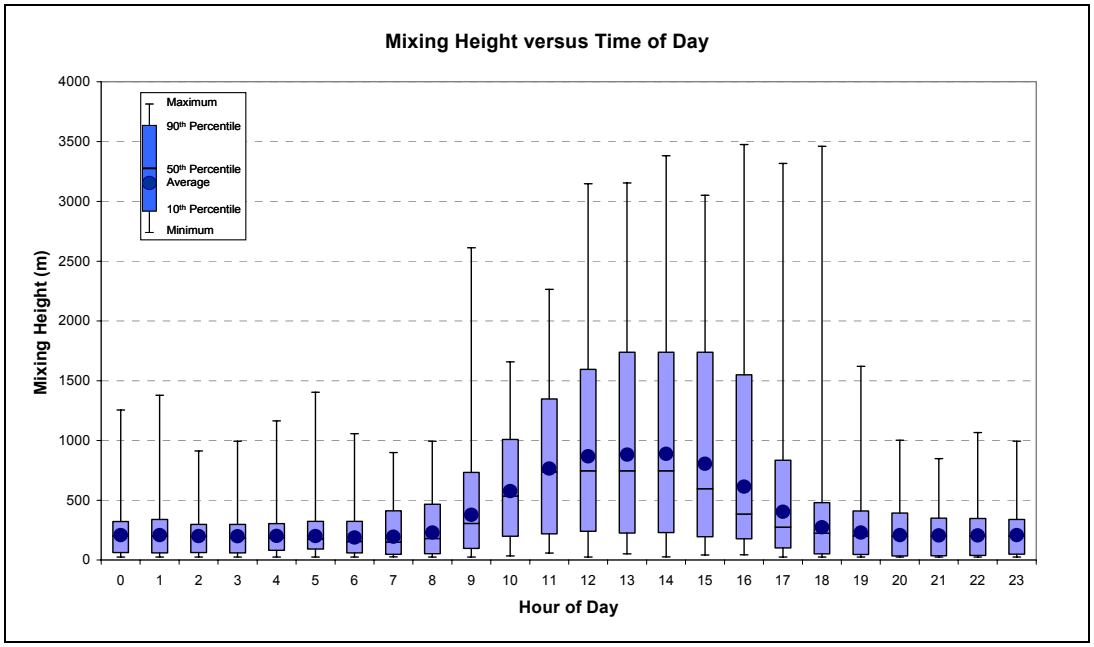
**Figure 9 TAPM Predicted Annual Stability Class Distributions for Project Site 2008**




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.

Diurnal variations in maximum and average mixing depths predicted by TAPM at the Project Site during 2008 are illustrated in **Figure 10**. It can be seen that an increase in the mixing depth during the morning, arising due to the onset of vertical mixing following sunrise, is apparent with maximum mixing heights occurring in the mid to late afternoon, due to the dissipation of ground-based temperature inversions and the growth of the convective mixing layer.

Figure 10 TAPM-Predicted Diurnal Variation in Mixing Depth for Project Site-2008

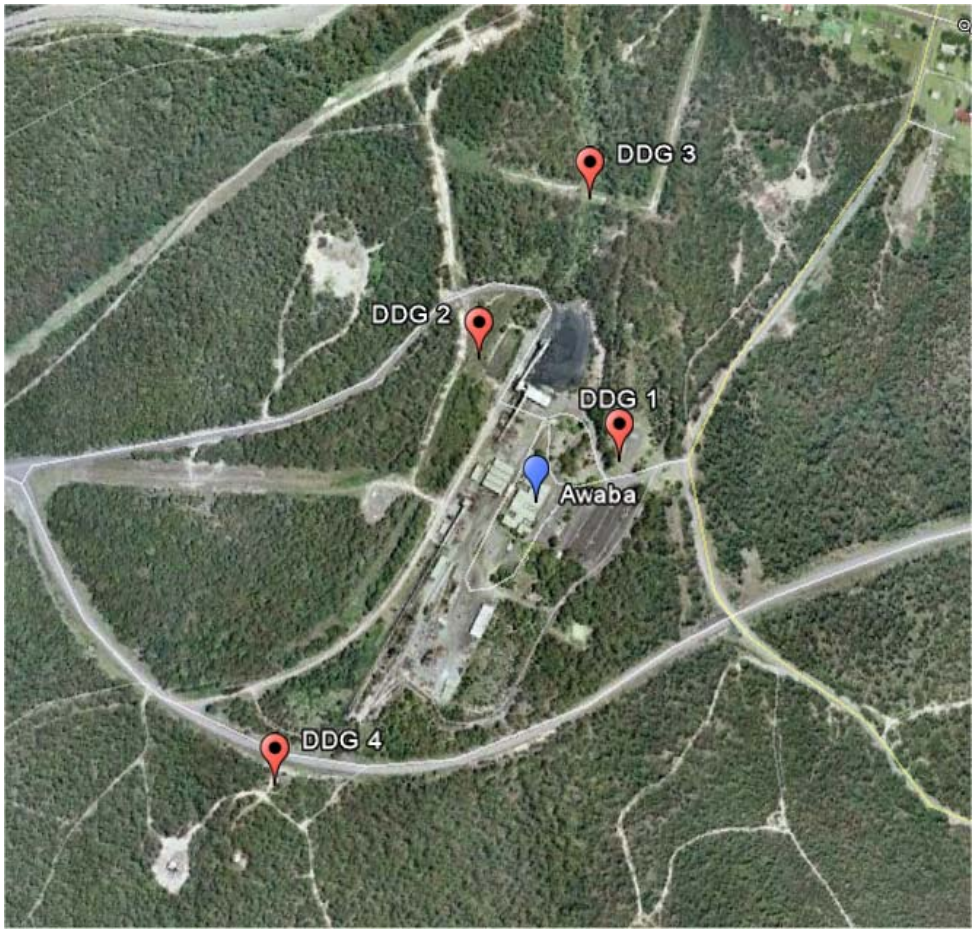



# 6 BASELINE AIR QUALITY

## 6.1 Awaba Colliery Air Quality Monitoring Network

In order to determine the effectiveness of the colliery's dust control measures, a monitoring network has been established. The pollutant monitored by the Awaba Colliery air quality monitoring network is dust deposition. **Figure 11** illustrates the distribution of the Awaba Colliery air quality monitoring network.

**Figure 11 Environmental Monitoring Locations**

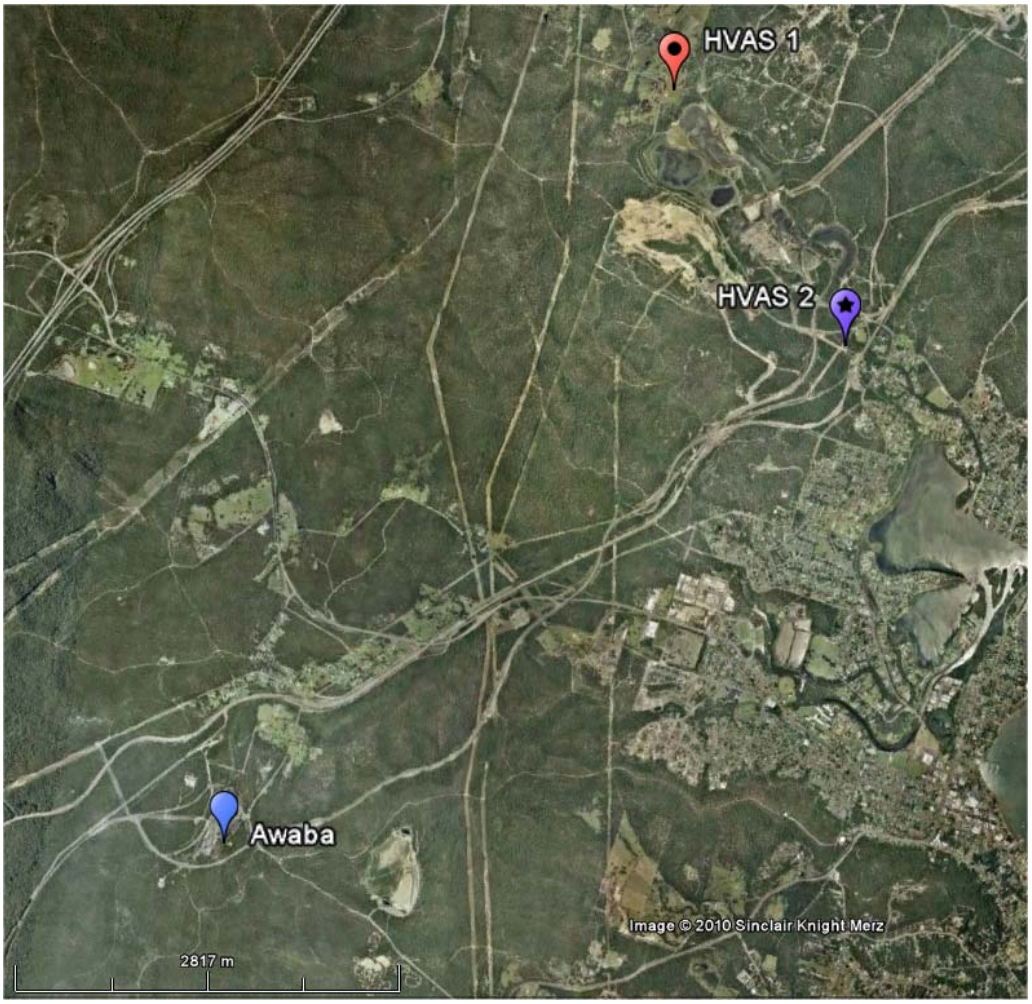



Source: Google Earth 2010

## 6.2 Particulate Matter

$PM_{10}$ concentrations (24-hour average, 1-in-6 day cycle) are measured by High Volume Air Sampler (HVAS) at two locations in the vicinity of the Awaba Colliery. The HVAS locations are situated at "Culgan" property on a hilltop north of the Northern Reject Emplacement Area at Newstan Colliery and at "Fassifern" south of Newstan Colliery near Fassifern Railway Station. It is noted that both HVAS are maintained by Newstan Colliery. The locations of the HVAS are illustrated in **Figure 12** below.

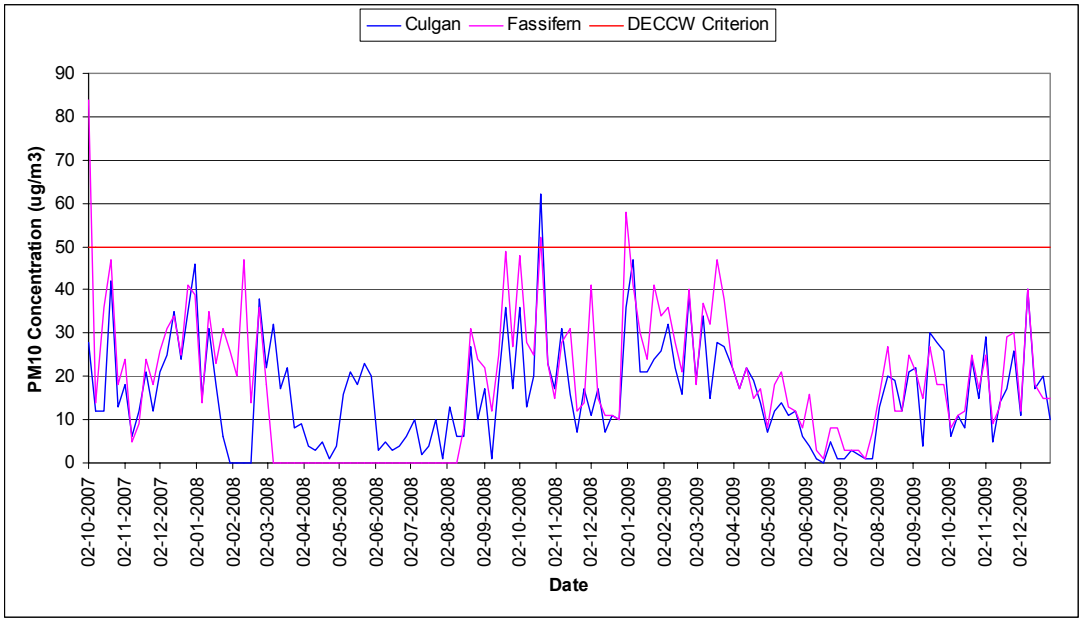
**Figure 12 HVAS Monitoring Locations, Newstan Colliery**




Source: Google Earth 2010

In order to assess 24-hour average $PM_{10}$ concentrations for the region surrounding Awaba Colliery, data recorded at the "Culgan" and "Fassifern" HVAS locations between January 2007 and December 2009 has been sourced from Newstan Colliery and presented in **Figure 13**

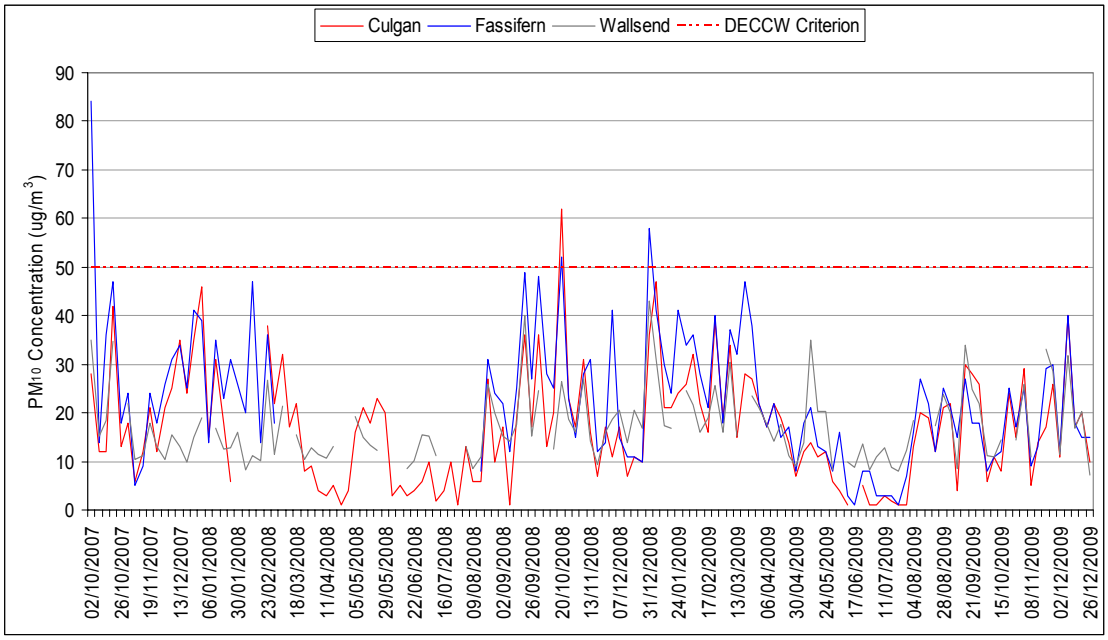
**Figure 13 24-hour Average $PM_{10}$ Concentrations - January 2007 to December 2009 - Newstan Air Quality Monitoring Network**




With the exception of four 24-hour periods - three in the "Fassifern" dataset (20 October 2008 and 31 December 2008) and one in the "Culgan" dataset (20 October 2008), all measured concentrations at both HVAS locations between January 2007 and December 2009 were below the DECCW 24-hour average criterion of 50 µg/m$^3$. The exact cause of these exceedances is not readily known, and may have been due to a localised event. The annual average $PM_{10}$ concentrations of the "Fassifern" and "Culgan" HVAS datasets are 21.2 µg/m$^3$ and 15.8 µg/m$^3$ respectively, which may be compared against the Project assessment goal of 30 µg/m$^3$ (reference **Section 4.2**).

The NSW DECCW maintains a network of continuous air quality monitoring stations across NSW. The closest of these stations is located at Wallsend, approximately 18 km northeast of the Project Site. This air quality monitoring site is located in the grounds of the Newcastle City Swimming Pool, off Frances Street, Wallsend and was commissioned in November 1992. The 24-hour average $PM_{10}$ concentrations recorded at the DECCW Wallsend monitoring station between January 2007 and December 2009, along with the HVAS data recorded by Newstan Colliery in that period are presented in **Figure 14.**

**Figure 14 DECCW Wallsend data compared to Newstan HVAS data**




As illustrated in **Figure 14**, concentrations of $PM_{10}$ are generally lower at Wallsend than at the Newstan HVAS locations. It is therefore considered that in the absence of a continuous site-specific monitoring 24-hour varying $PM_{10}$ dataset, data from the DECCW Wallsend monitoring station can be used as it is not impacted by the influence of mining operations and hence can be considered site representative.

In order to illustrate that the data recorded at the DECCW Wallsend can be considered site-representative, an analysis of the maxima and averages in each dataset has been tabulated.

**Table 8 DECCW Wallsend 2008 dataset in comparison with Newstan dataset**

| $PM_{10}$ Concentrations ($\mu g/m^3$) | DECCW Wallsend | Newstan-Culgan | Newstan-Fassifern |
|---|---|---|---|
| **Maximum** | 56.5 | 62.0 | 58.0 |
| **Average** | 15.7 | 15.2 | 26.0 |

**Table 8** shows that the Wallsend dataset has the lowest maximum concentration in comparison with the Newstan dataset. Overall the Wallsend dataset shows lower concentrations as seen in **Figure 14**.

Therefore, in order to meet the requirements of Section 5.1.1 of the Approved Methods regarding continuous monitoring data, the 24-hour average $PM_{10}$ concentrations recorded at the DECCW Wallsend monitoring station for the period 1 January 2008 to 31 December 2008, presented in **Figure 15** will be drawn upon in conjunction with the Newstan $PM_{10}$ HVAS data to estimate existing levels of $PM_{10}$. The Wallsend data will be used as measured background data while the Newstan data used to obtain corresponding dispersion model predictions in the atmospheric dispersion modelling This 2008 dataset is concurrent with the meteorological data set to be used in the atmospheric dispersion modelling process (as discussed in **Section 7.2** ).

**Figure 15 DECCW $PM_{10}$ (24-Hour Average) Monitoring Results for Wallsend 2008**

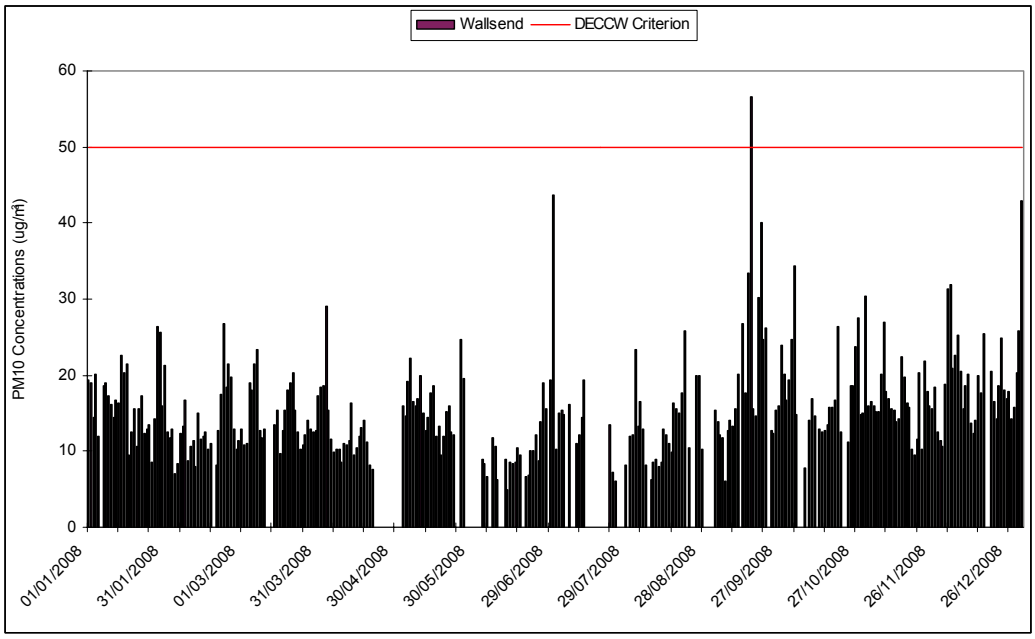



**Figure 15** indicates that the highest 24-hour average $PM_{10}$ recorded in DECCW's Wallsend monitoring station was 56.5 µg/m$^3$ recorded on 16 September 2008. This is above the DECCW goal of 50 µg/m$^3$. However, in accordance with the Approved Methods, these values have been included in the assessment as it is appropriate to demonstrate that no additional exceedances of the impact assessment criteria will occur as a result of the proposed continued operations at the Project Site.

The highest $PM_{10}$ concentration not in exceedance of the 24-hour criterion at Wallsend was 43.6 µg/m$^3$, recorded on 1 July 2008. It is noted that this concentration is also amongst the identified dust storm period and may be considered as elevated for the region. The annual average $PM_{10}$ concentration for 2008, recorded at the DECCW's Wallsend monitoring site was 21.5 µg/m$^3$.

## 6.3 Total Suspended Particulates (TSP)

TSP concentrations (24-hour average, 1-in-6 day cycle) are also measured by High Volume Air Sampler (HVAS) at two (2) locations in the vicinity of the Awaba Colliery. The HVAS locations are situated at "Culgan" property on a hilltop north of the Northern Reject Emplacement Area at Newstan Colliery and at "Fassifern" south of Newstan Colliery near Fassifern Railway Station. It is noted that both HVAS are maintained by Newstan Colliery. The locations of the HVAS are illustrated in **Figure 12**.

The TSP monitoring results for 2008 (including site specific TSP/$PM_{10}$ ratios) are presented in **Table 9**.

**Table 9 2008 TSP Newstan Monitoring Results (including TSP/$PM_{10}$ ratio)**

| | Newstan-Culgan | Newstan-Fassifern |
|---|---|---|
| Annual Average TSP | 33.0 | 53.0 |
| Annual Average $PM_{10}$ | 15.2 | 26.0 |
| TSP/$PM_{10}$ Ratio | 2.1:1 | 2:1 |

Due to the one-in-six day cycle, there is insufficient data available for use in the assessment of existing background TSP concentrations in accordance with the DECCW Approved Methods.

It is considered appropriate that the above TSP/$PM_{10}$ ratio be applied to the annual $PM_{10}$ data measured at Wallsend to enable the calculation of an annual background TSP concentration.

Based on the TSP/$PM_{10}$ ratio for Newstan - Fassifern provided in **Table 9**, and the annual average $PM_{10}$ concentration for $PM_{10}$ at Wallsend (21.5 µg/$m^3$), the proposed background TSP concentration for the project site is 47.0 µg/$m^3$.

## 6.4 Dust Deposition

Dust deposition levels have been monitored surrounding the Project Site since 2003 at the locations indicated in **Figure 11**. Available dust deposition data for the period January 2004 to December 2009 is presented in **Table 10** and **Figure 16**.

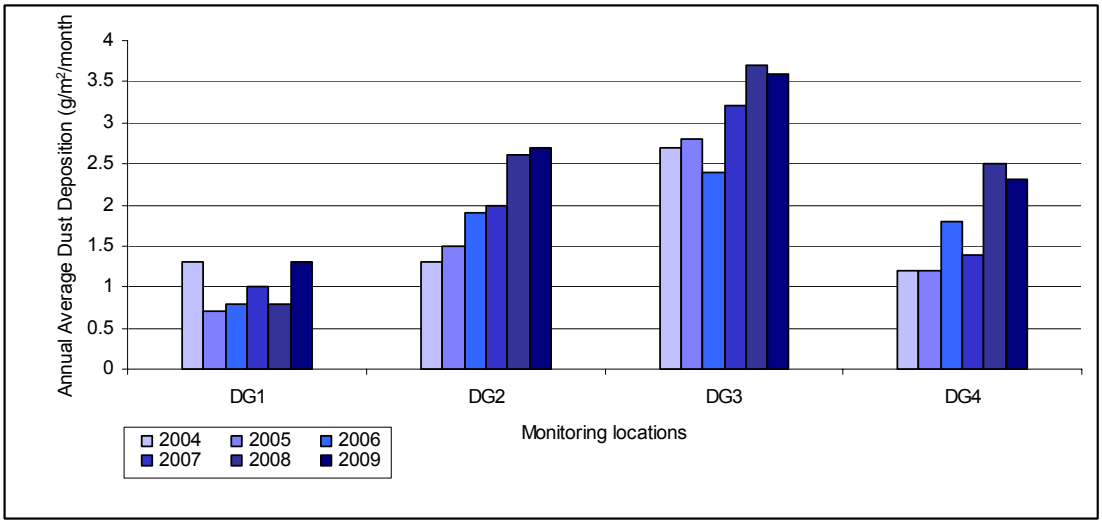
A review of the dust deposition levels presented within **Table 10** indicate that the highest annual average for any site was 3.0 g/$m^2$/month occurring at DG3 located on the northern boundary adjacent to the coal stockpile. The highest monthly average at any site was 3.7 g/$m^2$/month, occurring at DG3 during 2008.

Taking into account the large number and geographical spread of dust deposition monitoring undertaken around the Project Site; given the distance of the DG2 monitoring location Awaba Colliery operations, it is likely that this location best provides a measure of ambient dust deposition levels without the influence of local mining operations.

**Table 10 Annual Average Dust Deposition Levels - Awaba Colliery 2004-2009**

| Monitoring Location | Annual Average Dust Deposition Levels (g/$m^2$/month) | | | | | | Site Average |
|---|---|---|---|---|---|---|---|
| | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | |
| DG1 | 1.3 | 0.7 | 0.8 | 1.0 | 0.8 | 1.3 | **1.0** |
| DG2 | 1.3 | 1.5 | 1.9 | 2.0 | 2.6 | 2.7 | **2.0** |
| DG3 | 2.7 | 2.8 | 2.4 | 3.2 | 3.7 | 3.6 | **3.0** |
| DG4 | 1.2 | 1.2 | 1.8 | 1.4 | 2.5 | 2.3 | **1.7** |
| **Annual Average** | **1.6** | **1.6** | **1.7** | **1.9** | **2.4** | **2.5** | **2.0** |

**Figure 16 Annual Dust Deposition Levels - Awaba Colliery Network, 2004-2009**




## 6.5 Background Air Quality for Assessment Purposes

For the purposes of this assessment background air quality concentrations/levels as presented **Table 11** have been adopted. The maximum monitored values from site data have been adopted. Daily varying background 24-hour $PM_{10}$ concentrations from the DECCW Wallsend monitoring site have been adopted.

**Table 11 Background Air Quality Used for Assessment Purposes**

| Air Quality Parameter | Concentration / Level |
|---|---|
| $PM_{10}$ | Daily varying ( 24- hour) |
| | 21.5 µg/m$^3$ (annual average) |
| TSP | 47.0 µg/m$^3$ (annual average) |
| Dust Deposition | 2.0 g/m$^2$/month (annual average) |

# 7 AIR QUALITY MODELLING METHODOLOGY

Activities associated with the existing Awaba Colliery operations with the potential to generate particulates that have been identified in **Section 2.5** of this report. As the Project is proposed to be a continuation of existing operations, potential sources of dust are considered to be the same.

The dust generating activities identified in **Section 2.5** have been quantified for the Project as outlined in **Section 7.1**.

## 7.1 Emissions Inventory

The quantities of particulate emissions from the Project have been estimated using various factors developed by the Commonwealth Department of the Environment, Water, Heritage and the Arts (DEWHA) National Pollutant Inventory (NPI) Emission Estimation Technique Manuals (EETM). Where appropriate EETM factors are not available, factors developed by the US EPA have been used. **Table 12** below presents the emissions inventory for the Project.

**Table 12 Emissions Inventory Summary**

| Activity | TSP Emission Factor | $PM_{10}$ Emission Factor | Emission Factor Units |
|---|---|---|---|
| **Quarry** | | | |
| Excavator on overburden | 0.025 | 0.012 | kg/t |
| Truck loading | 0.005 | 0.002 | kg/t |
| **Coal processing and handling** | | | |
| Front end loader on coal | 0.025 | 0.012 | kg/t |
| Loading stockpiles (via conveyor) | 0.004 | 0.0017 | kg/t |
| Truck loading (from loading chute) | 0.0004 | 0.00017 | kg/t |
| **Stockpiles and exposed areas** | | | |
| Main stockpile wind erosion | 0.04 | 0.02 | kg/ha/hr |
| Exposed area | 0.04 | 0.02 | kg/ha/hr |
| Quarry stockpile and exposed area | 0.04 | 0.02 | kg/ha/hr |
| **Product transportation** | | | |
| Quarry haul road | 1.997 | 0.532 | kg/VKT |

### 7.1.1 Model Assumptions

The following sections detail the assumptions made in creating the emissions inventory for the operational scenario. **Appendix C** details the emissions inventory compiled for this assessment.

- Underground coal mining and product distribution (excluding mobile plant) operations occur 24 hours a day, seven days a week.
- It is assumed that maximum annual production is 880,000 tonnes.
- It is assumed that coal to the ROM stockpile is loaded directly from underground conveying. ROM Coal is then transported to the surface via underground reclaiming. Product coal is loaded straight onto trucks via the overhead bin from the coal preparation plant (CPP) via conveying.
- It is assumed that one front end loader is in operation at the product stockpiles.
- It is assumed that the front end loader is in operation 9 hours per day, 5 days a week.
- The emission factors for the excavator and front end loader were derived from Table 1 of the EETM for Mining (EETMM). The equations corresponding to excavators (on overburden) and front end loaders (on coal) were used.
- The emission factor for truck loading was derived from Table 1 of the EETMM. The emission factor corresponding to train loading were used.
- The following moisture content (mc) and silt content (sc) have been assumed for the modelling.
    - Coal: mc - 6.1%, sc - 25.2% (based on information provided by the Proponent).
    - Quarry: sc- 6% ( based on USEPA)

### 7.1.2 Wind Erosion Estimation

Annual Wind Erosion at the Project Site was estimated using the following equation, as per Section A1.1.15 of the EETMM:

$$EF = 1.9 \times \left(\frac{s}{1.5}\right) \times 365 \times \left(\frac{365 - p}{235}\right) \times \left(\frac{f}{15}\right) \text{ kg/ha/year}$$

where $s$= silt content, $p$ = number of days when rainfall is greater than 0.25mm, $f$= percentage of time that wind speed at the mean height of the stockpile is greater than 5.4 m/s. $PM_{10}$ is 50% of TSP, as derived by this equation.

The suspension of particulate matter typically commences when wind speed approaches 5 m/s (SKM, 2005). To reflect this within the modelling process, the annual wind erosion amount has been divided proportionally amongst the hours throughout the year that are greater than 5m/s.

Ausplume provides the following default wind speed bands by which the emission rate for a source can be varied: 0-1.54, 1.54-3.09, 3.09-5.14, 5.14-8.23, 8.23-10.8 and 10.8+.

To derive a wind erosion proportion for each wind speed band, the US EPA's erosion potential equation within Chapter 13, Section 13.2.5 Industrial Wind Erosion (US EPA, 2006), was used to estimate the erosion potential for each band. Within this equation, a Particle Threshold Friction Velocity of 0.5 m/s (considered highly conservative as fine coal dust is quoted as 0.54 m/s) was assumed. Hourly friction velocity was derived from hourly wind speed and the US EPA's conversion equation (US EPA, 2006).

### 7.1.3 Underground Ventilation Emissions

There is one ventilation fan situated within the Project Site, designed to stimulate the movement of fresh air to underground mining areas and remove emissions associated with the mining activities (diesel combustion, coal seam gas extractive operations). Heggies have conducted a number of dispersion modelling assessments for the ventilation shaft associated with underground coal mining operations.

Based on the level of annual underground extraction at the Project Site (proposed 880,000tpa) and the knowledge of potential emissions associated with significantly larger underground coal mines, it is considered that minimal impacts will be associated with the emissions from the mine ventilation system at the Project Site. With this conclusion in mind, and in the absence of site specific monitoring data, potential particulate and odorous emissions from the ventilation shaft at the Project Site have not been considered further in this modelling assessment.

Diesel is used in the underground mining areas by a range of plant and equipment. A total of 126,000 litres of diesel is anticipated to be consumed per annum as part of the Project. In accordance with the DECCW requirements, the nitrogen dioxide ($NO_2$) and carbon monoxide (CO) emissions associated with the combustion of the diesel, which is emitted via the ventilation system are quantitatively assessed below.

There was no data available to determine site specific emissions of $NO_2$ and CO. The following has been assumed to approximate $NO_2$ and CO emissions from the ventilation system:

- 100% of the 126,000 litres of diesel is assumed to be consumed underground;
- 14.4 litres per hour is assumed as a constant underground consumption;
- Emissions data for a Rigid Truck, contained within Table 4.4 of the Environment Australia Document *Technical Report 1: Toxic Emissions from Diesel Vehicles in Australia*, 2003 has been adopted to represent the plant and equipment $NO_2$ and CO emissions underground;

- The ventilation system is operated at 130 $m^3$ per second;
- 100% of $NO_X$ emitted is assumed to be $NO_2$.;
- an in-stack $NO_2$ of 1.02 $mg/m^3$;
- an in-stack CO of 0.33 $mg/m^3$;
- an exit velocity of the order of 10.6 m/s;
- an exit temperature of 293 K (20°C);
- a stack release height of the order of 6 m; and
- a stack diameter of the order of 3.9 m.

It is considered that the above assumptions provide a conservative assessment of the emission of $NO_2$ and CO from the mine ventilation system.

Considering the above, **Table 13** describes the emission rates for the Project Site.

**Table 13 Qualitative ventilation system emission rate estimates**

| Contaminant | Emission Factor (g/L)* | Emission Rate (g/hr) | Underground ventilation emission rate at source ($\mu g/m^3$) |
|---|---|---|---|
| $NO_2$ | 33.2 | 478 | 1020 |
| CO | 10.78 | 155 | 331 |

Note: * Emission factors were developed considering Table 4.4 of the Environment Australia Document *Technical Report 1: Toxic Emissions from Diesel Vehicles in Australia*, 2003.

Based on the above inputs, atmospheric modelling was undertaken using Ausplume (as described in **Section 7.2**). Concentrations of $NO_2$ and CO were predicted to the nearest sensitive receivers described in **Section 3.2**. The results of the dispersion modelling for both $NO_2$ and CO were negligible (<0.1 $\mu g/m^3$) at all receivers. Therefore the relevant assessment criteria (refer **Section 4**) was achieved at each of the identified sensitive receivers.

## 7.2 Atmospheric Dispersion Modelling

The particulate dispersion modelling carried out for the Project utilises the Ausplume Gaussian Plume Dispersion Model software (Version 6.0) developed by the EPA (Victoria).

Ausplume is the dispersion model that DECCW has approved for use in the majority of applications in New South Wales, and is commonly regarded as the "workhorse" model for assessments of extractive industries in particular. According to Section 6.4 of the EETMM Ausplume is a steady state model and assumes the atmosphere is in a state of uniform flow, and wind velocity is a function of height and does not vary with direction.

From the regional topography surrounding the project site in **Figure 3**, it is clear that the terrain within both the immediate and regional vicinity of the Project Site is not steep or complex. NSW DECCW guidance for dispersion model selection within the Approved Methods states that a dispersion model, such as Ausplume, should be used where the subject site is located within uncomplex terrain.

Default options specified in the Technical Users Manual (EPA Victoria, 2000) have been used, as per the Approved Methods. A number of validation studies for the Ausplume model have been conducted, comparing predicted concentrations of pollutants with actual recorded observations, in particular by Hamilton (1999) and Hurley & Luhar (2005). Findings from these studies indicated that Ausplume performs well in predicting upper percentile concentrations of pollutants at specific locations.

# 8 AIR QUALITY MODELLING RESULTS

Results of the dispersion model predictions for the Project Site are presented in the following sections.

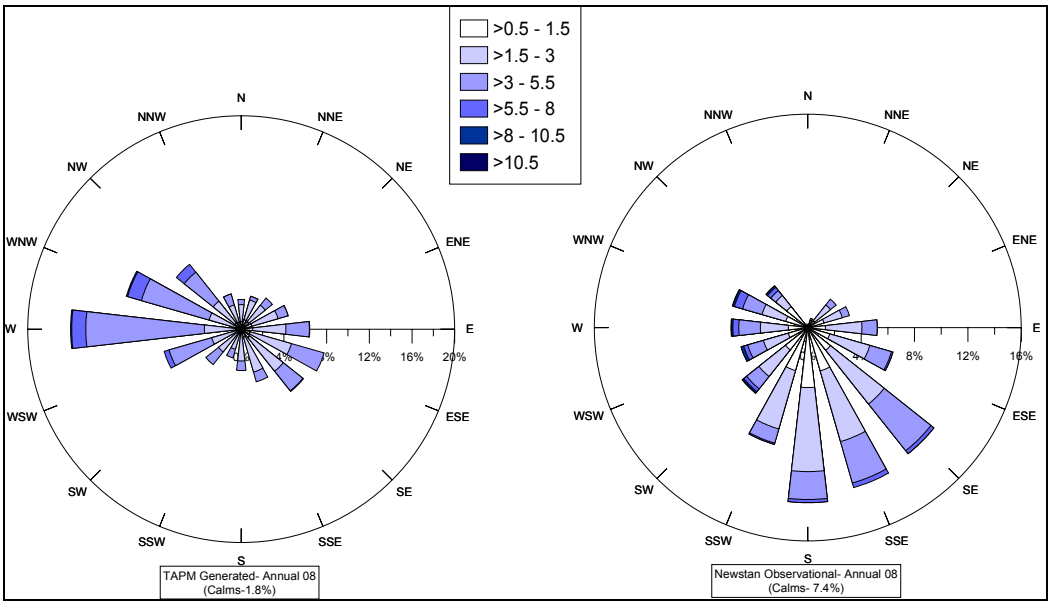
As discussed in Section **5.1.3**, a sensitivity analysis was carried out within the dispersion modelling using a synthetic TAPM generated file to account for the identified limitation in the meteorology data for Newstan.

## 8.1 Sensitivity Analysis

This sensitivity analysis was conducted to account for the missing northly data from within the Newstan Colliery meteorological data

A summary of the annual wind behaviour experienced from both datasets is presented as a windroses in **Figure 17** .

**Figure 17 Hourly Annual Wind Rose Comparison - TAPM Generated vs Newstan Colliery Weather Station**




As illustrated in **Figure 17** there is no similarity in wind speed or wind direction pattern from both datasets.

The TAPM generated data indicates that winds experienced at Awaba Colliery are predominately light to moderate winds (between 1.5m/s and 8m/s). They are primarily westerly, with calm wind conditions observed to occur 1.8% of the time.

The Newstan observational data indicates that winds experienced are predominately light to fresh winds (between 1.5m/s and 5.5m/s). They are primarily southerlys, with calm wind conditions observed to occur approximately 7.4 % of the time.

Both datasets were run through the dispersion model to identify any differences in impacts to the sensitive receptors. It was identified that the Newstan observational data had higher impacts, with the sensitive receptors being to the north of Awaba Colliery and the high incidences of southerlys from that dataset.

Therefore for the purpose of this assessment the Newstan observational dataset was used in the dispersion modelling for the assessment as it was deemed to be a conservative worst case scenario.

## 8.2 Ausplume Modelling Results

Dispersion modelling predictions of dust deposition and $PM_{10}$ concentrations for the receptors nominated in **Section 3.2** attributable to the Project operations are presented in **Section 8.2.1** to **Section 8.2.4**.

### 8.2.1 Dust Deposition

**Table 14** shows the results of the dispersion modelling for dust deposition (annual average) resulting from the Project operations at each of the identified receptors using the emission rates calculated in **Appendix C**.

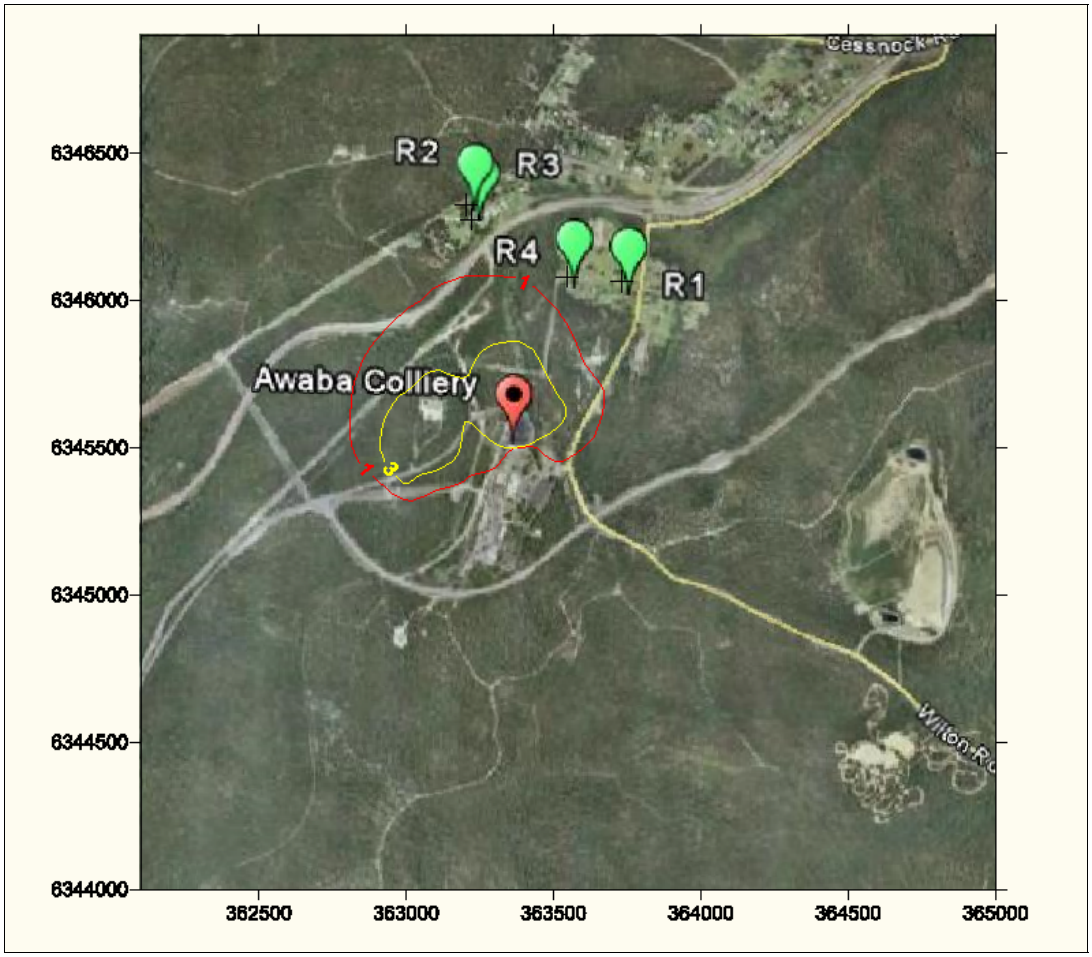
**Table 14 Background and Incremental Dust Deposition - Annual Average**

| Residence ID | Dust Deposition Annual Average (g/m²/month) | | | |
|---|---|---|---|---|
| | Background | Increment | Background + Increment | Assessment criterion |
| R1 | 2 | 0.4 | 2.4 | 4 |
| R2 | 2 | 0.5 | 2.5 | 4 |
| R3 | 2 | 0.6 | 2.6 | 4 |
| R4 | 2 | 0.6 | 2.6 | 4 |

The results indicate that total annual average dust deposition levels at all receptors surrounding the Project are predicted to be below the Project criterion of 4 g/m²/month (cumulative dust deposition) when using a background deposition level of 2.0 g/m²/month.

A contour plot of the predicted total annual dust deposition experienced around the site is presented in **Figure 18**.

Figure 18 Predicted Total Annual Dust Deposition Contours




### 8.2.2 Total Suspended Particulates (TSP)

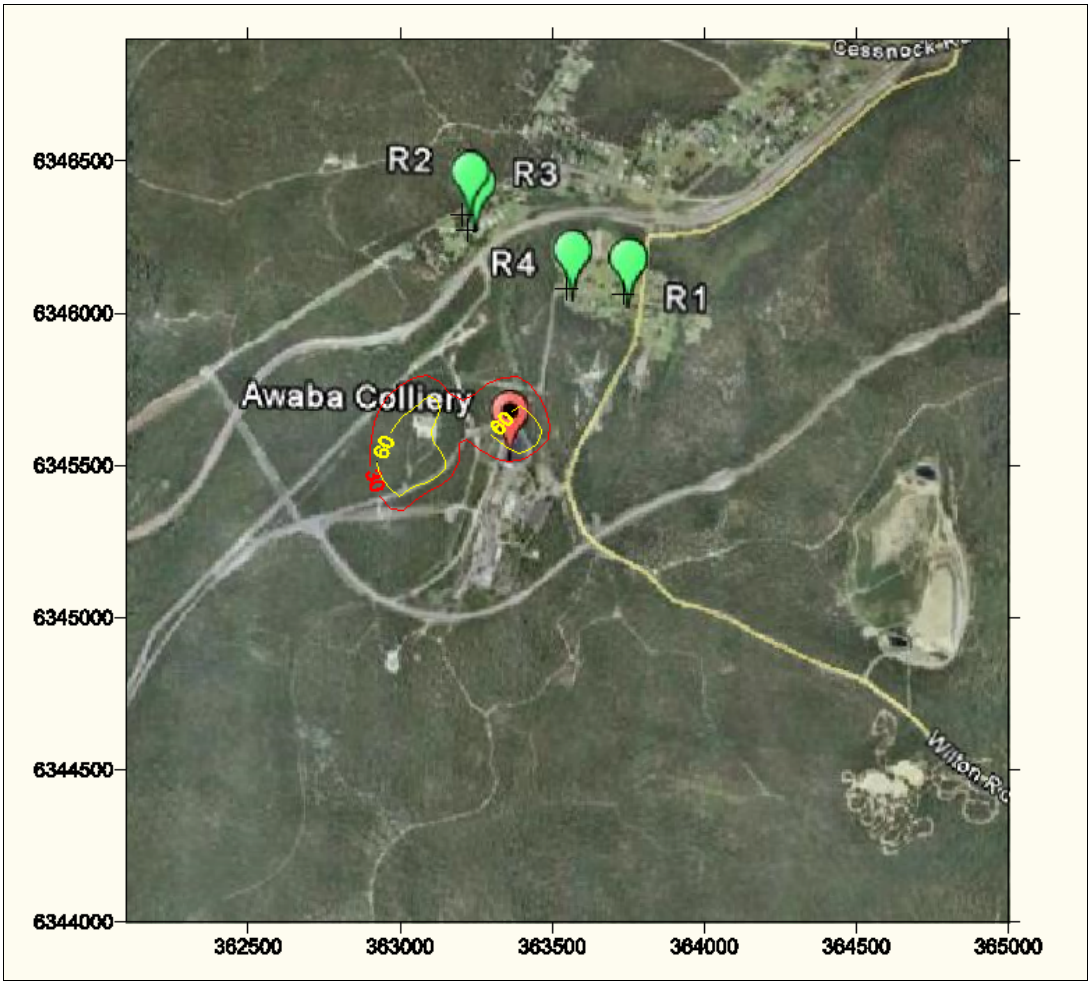
**Table 15** shows the results of the dispersion modelling for TSP from the Project at each of the identified receptors using the emission rates calculated in **Appendix C**.

Table 15 Background and Incremental TSP - Annual Average

| Residence ID | TSP Annual Average (µg/m³) | | | |
|---|---|---|---|---|
| | Background | Increment | Background + Increment | Assessment criterion |
| R1 | 47.0 | 3.0 | 50.0 | 90 |
| R2 | 47.0 | 5.0 | 52.0 | 90 |
| R3 | 47.0 | 5.4 | 52.4 | 90 |
| R4 | 47.0 | 5.1 | 52.1 | 90 |

A contour plot of the incremental increase in TSP concentrations attributable to the Project is presented in **Table 16**. The contour plot is indicative of the concentrations of TSP that could potentially be reached under the meteorological conditions modelled.

Table 16 Predicted TSP Annual Average Concentration Contours




### 8.2.3 Particulate Matter ($PM_{10}$)-24 Hour Average

**Table 17** to **Table 20** shows the results of the dispersion modelling for 24-hour maximum $PM_{10}$ concentrations resulting from the Project operations at each of the identified receptors using the emission rates calculated in **Appendix C**. The tables show the five highest maximum 24-hour average $PM_{10}$ concentrations as well as the five highest predicted increment concentrations predicted at receptors R1 to R4. This has been simulated by using daily monitoring data provided by the NSW DECCW, coupled with contemporaneous meteorological observations.

A contour plot of the predicted $PM_{10}$ concentrations experienced around the site is presented in **Figure 19**.

**Table 17 24-Hour Average $PM_{10}$ Concentrations - R1**

| Date | $PM_{10}$ 24-hour average ($\mu g/m^3$) | | | Date | $PM_{10}$ 24-hour average ($\mu g/m^3$) | | |
|---|---|---|---|---|---|---|---|
| | Background | Predicted increment | Total | | Background | Highest predicted increment | Total |
| 16/09/2008 | 56.5 | 1.3 | 57.8 | 04/07/2008 | 15.3 | 7.9 | 23.2 |
| 01/07/2008 | 43.6 | 0.6 | 44.2 | 18/02/2008 | 11.1 | 7.8 | 18.9 |
| 31/12/2008 | 43.0 | 2.1 | 45.1 | 14/07/2008 | 21.5 | 7.6 | 29.1 |
| 20/09/2008 | 40.0 | 1.2 | 41.2 | 07/06/2008 | 11.8 | 7.0 | 18.8 |
| 01/10/2008 | 35.2 | 0.0 | 35.2 | 12/03/2008 | 21.5 | 6.5 | 28.0 |

**Table 18 24-Hour Average $PM_{10}$ Concentrations - R2**

| Date | $PM_{10}$ 24-hour average ($\mu g/m^3$) | | | Date | $PM_{10}$ 24-hour average ($\mu g/m^3$) | | |
|---|---|---|---|---|---|---|---|
| | Background | Predicted increment | Total | | Background | Highest predicted increment | Total |
| 16/09/2008 | 56.5 | 1.3 | 57.8 | 29/07/2008 | 8.2 | 14.3 | 22.5 |
| 01/07/2008 | 43.6 | 0.0 | 43.6 | 31/05/2008 | 21.5 | 11.1 | 32.6 |
| 31/12/2008 | 43.0 | 0.4 | 43.4 | 27/05/2008 | 19.6 | 10.4 | 30.0 |
| 20/09/2008 | 40.0 | 0.2 | 40.0 | 06/04/2008 | 9.9 | 10.1 | 20.0 |
| 01/10/2008 | 35.2 | 0.0 | 35.2 | 22/04/2008 | 21.5 | 8.8 | 30.3 |

**Table 19 24-Hour Average $PM_{10}$ Concentrations - R3**

| Date | $PM_{10}$ 24-hour average ($\mu g/m^3$) | | | Date | $PM_{10}$ 24-hour average ($\mu g/m^3$) | | |
|---|---|---|---|---|---|---|---|
| | Background | Predicted increment | Total | | Background | Highest predicted increment | Total |
| 16/09/2008 | 56.5 | 1.3 | 57.8 | 27/05/2008 | 19.6 | 14.1 | 33.7 |
| 01/07/2008 | 43.6 | 0.0 | 43.6 | 29/07/2008 | 8.2 | 13.4 | 21.6 |
| 31/12/2008 | 43.0 | 0.4 | 43.4 | 31/05/2008 | 21.5 | 12.0 | 33.5 |
| 20/09/2008 | 40.0 | 0.3 | 40.3 | 21/04/2008 | 7.6 | 10.9 | 18.5 |
| 01/10/2008 | 35.2 | 0.0 | 35.2 | 06/04/2008 | 9.9 | 10.5 | 20.4 |

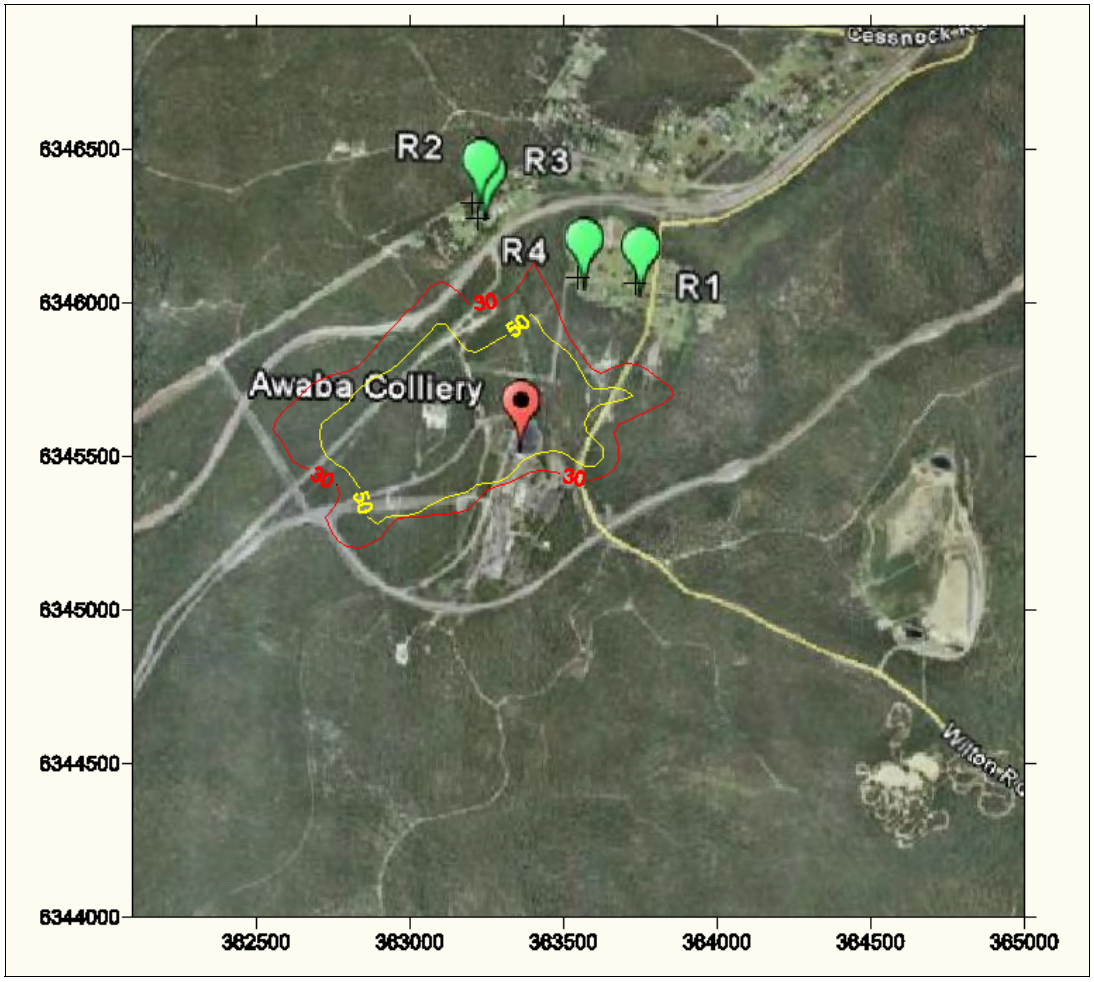
**Table 20 24-Hour Average $PM_{10}$ Concentrations - R4**

| Date | $PM_{10}$ 24-hour average ($\mu g/m^3$) | | | Date | $PM_{10}$ 24-hour average ($\mu g/m^3$) | | |
|---|---|---|---|---|---|---|---|
| | Background | Predicted increment | Total | | Background | Highest predicted increment | Total |
| 16/09/2008 | 56.5 | 1.3 | 57.8 | 27/05/2008 | 19.6 | 17.1 | 36.7 |
| 01/07/2008 | 43.6 | 0.1 | 43.7 | 21/02/2008 | 12.7 | 14.8 | 27.5 |
| 31/12/2008 | 43.0 | 1.4 | 44.4 | 23/05/2008 | 12.2 | 13.0 | 25.2 |
| 20/09/2008 | 40.0 | 0.8 | 40.8 | 07/03/2008 | 23.3 | 12.3 | 35.6 |
| 01/10/2008 | 35.2 | 0.0 | 35.2 | 20/02/2008 | 8.2 | 11.5 | 19.7 |

**Table 17** to **Table 20** differentiate between the five highest predicted maximum 24-hour average $PM_{10}$ concentrations (background plus predicted increment) and the five highest predicted $PM_{10}$ increment concentrations associated with the Project Site experienced by receptors surrounding the site. It can be seen from **Table 17** to **Table 20** that total 24-hour average $PM_{10}$ (background plus predicted increment) are all in exceedance of 50 µg/m$^3$ at all the nearest sensitive receptors. As indicated in **Section 0** this exceedance is attributed to the background $PM_{10}$ used within this assessment.

However, the total 24-hour average $PM_{10}$ (background plus highest predicted increment) are predicted to be below the Project criterion of 50 µg/m$^3$, hence showing that no additional exceedances have occurred as a result of the proposed expanded operations at the Project Site.

**Figure 19 Predicted 24-Hour Average $PM_{10}$ Concentrations Contours**



### 8.2.4 Particulate Matter ($PM_{10}$) - Annual Average

**Table 21 Annual Average $PM_{10}$ Concentrations**

| Residence ID | PM 10 - Annual Average (µg/m³) | | | |
|---|---|---|---|---|
| | Background | Increment | Background + Increment | Assessment criterion |
| R1 | 21.5 | 1.2 | 22.7 | 30 |
| R2 | 21.5 | 1.9 | 23.4 | 30 |
| R3 | 21.5 | 2.1 | 23.6 | 30 |
| R4 | 21.5 | 2.1 | 23.6 | 30 |

An annual average background concentration of 21.5 µg/m³ has been applied to obtain an indication of the potential cumulative impacts associated with the Project and to allow comparison with the annual average $PM_{10}$ criterion of 30 µg/m³.

The results indicate that annual average $PM_{10}$ levels at all receptors surrounding the Project are predicted to below the Project criterion of 30 µg/m³.

A contour plot of the predicted annual average $PM_{10}$ concentrations experienced around the site is not presented for this assessment due to the low concentrations across the modelling domain.

## 8.3 Air Quality Mitigation, Management and Monitoring Measures

As discussed in **Section 2.4**, Awaba Colliery currently employs air quality mitigation and management measures at the Colliery which is considered to be generally best practice.

Specific air quality mitigation measures that were included in the dispersion modelling include:

- Permanent road sealing (bitumen seals);
- Enclosures on all main conveyors; and
- Enclosed coal chute at stacking conveyor discharge point.

# 9 GREENHOUSE GAS ASSESSMENT

A quantitative greenhouse gas assessment has been undertaken to estimate potential greenhouse gas (GHG) emissions associated with the Project.

Activity data for the following have been obtained from the Proponent:

- 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 use of sulphur hexafluoride ($SF_6$);
- Emissions from the use of Liquid Petroleum Gas (LPG);
- Emissions from the use of oils and greases (consumed without combustion); and,

- Weekly Total Employee Vehicle Movements.

Data have been sourced primarily from the Proponent provided spreadsheet 'AWA Greenhouse Report 2008-2009' with data on employee transport provided separately.

Data was made available for the period July 2008 to June 2009, 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. The product extracted during this reporting period was 805,825 tonnes. Data presented in this report for Scope 1 and 2 emissions is directly extracted from the Awaba NGERS report for the July 2008 to June 2009 period and utilises NGERS emission factors, or other acceptable NGERS emission calculation methodologies. Scope 3 emissions have been calculated using proponent provided data, or activity data reported under NGERS in the case of diesel and electricity consumption.

To assess the GHG impact of the proposed Awaba operations (to 880,000 tonnes per annum (tpa) extraction rate), activity data has been scaled to reflect the proposed modified ROM extraction operations of 880,000 tpa as outlined in **Table 22**. Also presented are the calculated annual activity data reflecting this modification.

**Table 22 Summary of Project Related Activity Data Relevant to GHG Emissions (Current and Proposed Operations)**

| Activity | Quantity (Current Project Operations – July 2008 to June 2009 [805,825 tpa]) | Quantity (Modified Project Operations [880,000 tpa]) | Scaling Factor Applied |
|---|---|---|---|
| Annual ROM production (Mt) | 805,825 | 880,000 | 1.09 (880,000t/805,825t) |
| Annual Electricity Consumption (kWh) | 12,965,019 | 14,158,430 | 1.09 |
| Annual Diesel Consumption | | | |
| mine operation (L) | 115,275 | 125,886 | 1.09 |
| coal haulage contractor (L) | 279,995 | 305,768 | 1.09 |
| Solid Waste to Landfill (t) | 43 | 43 | Assumed no change in waste generation |
| Sulphur hexafluoride ($SF_6$) (kg) | 8.028 | 8.028 | Assumed no change |
| Liquid Petroleum Gas (LPG) (kg) | 200 | 200 | Assumed no change |
| Petroleum Based Oil/ greases used (L) | 204,000 | 223,000 | 1.09 |
| Employee Vehicle Movements | 4,680 | 4,680 | Assumed no change in employee numbers |

## 9.1 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*

(2) ***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***).

*Meaning of production*

(3) ***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.

Note 1: Emissions from the use of petroleum based oils/ greases not reported in 2008/2009 however may be required in future

Meaning of consumption

(4) ***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 Centennial Coal has a restricted capacity to reduce their GHG emissions under Scope 3. 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 Centennial coal but are reported here for completeness, as required by the Department of Planning.

## 9.2 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.

The greenhouse gas emissions associated with the modified 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 23**.

**Table 23 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 (Includes ROM coal transport by coal haulage contractor) | N/A | 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 |
| Consumption of sulphur hexafluoride | Consumption of $SF_6$ for gas insulated switchgear and circuit breaker applications | N/A | N/A |
| Electricity | NA | Emissions associated with the consumption of generated and purchased electricity at the Project Site. | Estimated emissions from the extraction, production and transport of fuel burned for the generation of electricity consumed at the Project Site and the electricity lost in delivery in the transmission and distribution network. |
| Coal Combustion | N/A | N/A | Emissions from the combustion of coal from the Project. |

N/A = Not applicable

***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 08-09 financial year using Method 4, subdivision 3.2.2.2 of the NGERS Measurement Determination 2008.

It is assumed that based on the mine being non gassy and additionally that in association with the planned production there will be no increase in ventilation required and therefore no increase in fugitive emissions will result from the project modifications

***Diesel Usage***

The primary fuel source for the vehicles operating at the Project Site is diesel. Diesel consumption for all mobile and fixed equipment is calculated as 115,275 (L) used in the underground operation and 279,995 L by coal haulage contractors in the assessment year (July 2008 to June 2009). Based on the adopted scaling factor of 1.09 (880,000/805,825) the estimated diesel consumption resulting from modified Project operations for all mobile and fixed equipment is assumed to be 125,886 L per annum, and 305,768 L by coal haulage contractors.

Scope 1 emissions from use of diesel fuel as defined by NGERS were estimated for the 08-09 financial year using Method 1, Division 2.4.2 section 2.41 of the NGERS Measurement Determination 2008.

***Liquid Petroleum Gas***

LPG used on site is related to periodic use for staff amenities

LPG consumption is estimated as 200 kg per annum, which is not expected to change due to the modified Plant operations.

Scope 1 emissions from use of LPG as defined by NGERS were estimated for the 08-09 financial year using Method 1, Division 2.4.2 section 2.41 of the NGERS Measurement Determination 2008.

***Emissions of Sulphur Hexafluoride***

Sulphur hexafluoride ($SF_6$) is used in gas insulated switchgear and circuit breaker applications on site.

The stock of $SF_6$ for the financial year 08-09 is estimated as 8.028 kg per annum, which is not expected to change due to the modified Plant operations.

Scope 1 emissions from use of $SF_6$ as defined by NGERS were estimated for the 08-09 financial year using Method 1, Division 2.48A of the NGERS Measurement Determination.

It has been assumed that the leakage rate from switchgear is 0.5% per annum as per Table 25 of the NGA Factors Workbook (2009).

### 9.2.1 Scope 2: Indirect Emissions through the Consumption of Purchased Electricity

Scope 2 GHG emissions as defined by NGERS were estimated for the 08-09 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 the Project Site has been calculated as (approximately) 13 Megawatt-hours (MWh) in the current year of mining (July 2008 to June 2009). Based on the adopted scaling factor of 1.09 the estimated electricity consumption resulting from modified Project operations is assumed to be (approximately) 14 MWh per annum.

The emission factor for Scope 2 (0.89 tonnes of $CO_2$-equivalents per kilowatt hour [t $CO_2$-e/kWh]) represents the consumption of purchased electricity in NSW.

### 9.2.2 Scope 3: Other Indirect Emissions

As discussed previously, Scope 3 emissions of GHG attributable to the Project are reported for completeness. Centennial Coal has a restricted capacity to reduce their GHG emissions under Scope 3. 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 Centennial coal. Also beyond the control of Centennial 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 880,000 tpa of ROM coal is expected to be produced by the Project, with the majority destined for domestic markets.

This calculation assumes that 100% of ROM coal produced by the Project is combusted as coking coal this is because a Scope 3 emission factor associated with coal combustion for use in electricity generation (thermal coal) is not available. In lieu of this availability, the most appropriate Scope 3 emission factor has been utilised. The Scope 3 emission factor for coking coal (20.7 kg $CO_2$-e/GJ) has been used which is considered to be conservative, given that 100% of coal produced by the Project will not be used as coking coal, and that coking coal use results in significantly higher emissions of GHG than coal used in electricity production. However, in the absence of appropriate Scope 3 emission factors or details on coal consumer operations, the most relevant have been used to present a worst case scenario.

The GHG emissions from combustion of product coal by other (non-Centennial) entities have been based on a coal energy content of 30 gigajoules per tonne (GJ/t) for coking coal (Table 1 of the NGA Factors). Standard emission factors for Scope 3 emissions from coal combustion have been taken from Table 36 of the NGA Factors.

***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 (0.18 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.

***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.

***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 the Proponent on the assumed number of vehicle trips undertaken by mine employees per week. It has been assumed that employee numbers will not change as part of the Project modification and therefore the number of trips per week will remain at 90 vehicle movements per week or 4,680 movements per year (one way).

No data on the origin of the employee trips has been provided by the Proponent although it has been assumed that all employee vehicle trips originate within a 20 km radius of the Project Site. 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 1,460L per annum.

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.

***Waste Generation***

Solid waste generated at the Project Site and disposed of in landfill between July 2008 and June 2009 totalled 43 tonnes. It has been assumed that generation of waste is independent of ROM production and, assuming that employee numbers remain constant during the proposed modification, waste generation is assumed to remain at 43 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 commercial and industrial waste (1.1 t $CO_2$-e / tonne waste) has been used within this assessment.

***Sources not Included***

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

- Employee business travel;
- Outsourced activities; and,
- Combustion of product coal.

***Extraction, Production and Transport of Diesel Consumed at the Modified Project***

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

The annual emissions of $CO_2$ and other greenhouse gases from this source have been estimated using Table 38 of the NGA Factors (DCC, 2009).

## 9.3 Greenhouse Gas Calculation Results

Calculated Scope 1, Scope 2 and Scope 3 emissions of greenhouse gas resulting from the emissions sources outlined above for the existing (July 2008 to June 2009, 805,825 tpa ROM extraction rate) and modified Project (880,000 tpa ROM extraction rate) are presented in **Table 24.**

### 9.3.1 Scope 1 Emissions Estimations

Direct (Scope 1) GHG emissions ($CO_2$-e) resulting from modified Project operations are estimated to be 14,565 t per annum, an increase of approximately 116 tonnes per annum.

### 9.3.2 Scope 2 Emissions Estimations

Indirect (Scope 2) GHG emissions ($CO_2$-e) resulting from modified Project operations are estimated to be 12,601 tonnes per annum, an increase of approximately 1,062 tonnes per annum on current operations. This increase is directly related to the increased extraction scenario of 880,000 tpa increased from 805,825 tpa.

### 9.3.3 Scope 3 Emissions Estimations

Indirect (Scope 3) GHG emissions ($CO_2$-e) resulting from modified Project operations are estimated to be 715,484 tonnes per annum, an increase of approximately 61,000 tonnes per annum on current operations. The increased emissions are due to increases in diesel and electricity consumption and combustion of coal by third parties. No increases result from employee vehicle use or waste generation as these activities are assumed to remain constant between the current and modified scenarios.

**Table 24 Summary of GHG Emissions Attributable to the Project (Current and Modified)**

| Emissions Scope | Emissions Source | Activity Data | | Activity Rate | Emission Factor ($CO_2$-e) | | | Total Emissions (t $CO_2$-e/annum) | |
|---|---|---|---|---|---|---|---|---|---|
| | | Current | Modification | | Emission Factor | Units | Source | Current | Modification |
| Scope 1 | Fugitive Emissions [1] | 805,825 | 880,000 | tpa ROM | - | - | NGERS method 4 | 13,160 | 13,160 |
| | Diesel Combustion | 395 | 431 | kL/annum | 69.9[2] | kg $CO_2$-e /GJ | Table 4 NGA Factors | 1,066 | 1,162 |
| | LPG consumption | 0.39 | 0.39 | kL/annum | 60.8 | kg $CO_2$-e/GJ | Table 4 NGA Factors | 1 | 1 |
| | Use of sulphur hexafluoride | 8.028 | 8.028 | kg/annum | 23.9 | t CO2 /kg | App 1 NGA Factors | 1 | 1 |
| | Use of oils / grease | 204 | 223 | kL/annum | 1.08 | t CO2 /kL | NGERS method 1 | 221 | 241 |
| **Sub-Total Scope 1** | | | | | | | | **14,449** | **14,565** |
| Scope 2 | Electricity Consumption | 13 | 14 | MWh/annum | 0.89 | kg $CO_2$-e /kWh | Table 5 NGA Factors | 11,539 | 12,601 |
| **Sub-Total Scope 2** | | | | | | | | **11,539** | **12,601** |
| Scope 3 | Diesel Combustion | 395 | 431 | kL/annum | 5.3[2] | kg $CO_2$-e /GJ | Appendix 4 Table 39 NGA Factors | 81 | 88 |
| | Electricity Consumption | 13 | 14 | MWh/annum | 0.18 | kg $CO_2$-e /kWh | Appendix 4 Table 39 NGA Factors | 2,334 | 2,549 |
| | Waste Generation | 43 | 43 | t/annum | 1.1 | t $CO_2$-e / t waste | Appendix 4 Table 42 NGA Factors | 47 | 47 |
| | Employee Transport | 1,460 | 1,460 | L/annum | 5.3 | kg $CO_2$-e /GJ | Appendix 4 Table 38 NGA Factors | 0.3 | 0.3 |

| Emissions Scope | Emissions Source | Activity Data | | Activity Rate | Emission Factor ($CO_2$-e) | | | Total Emissions (t $CO_2$-e/annum) | |
|---|---|---|---|---|---|---|---|---|---|
| | | Current | Modification | | Emission Factor | Units | Source | Current | Modification |
| | Coal Combustion | 805,825 | 880,000 | tpa ROM | 20.7 | kg $CO_2$-e /GJ | Appendix 4 Table 36 NGA Factors | 652,000 | 712,800 |
| **Sub-Total Scope 3** | | | | | | | | **654,462** | **715,484** |
| **TOTAL** | | | | | | | | **680,450** | **742,650** |

Note 1: Fugitive emissions are related to the ventilation data viz, Flow, Pressure, Temperature and gas % and it is considered that these parameters and therefore the fugitive emissions will not change materially with the proposed additional production. Emissions are as reported for Awaba during the 08/09 year under NGERS using NGERS Method 4

Note 2: For transport energy purposes

## 9.4 Comparison with National and State GHG Emissions

The estimated annual emissions associated with the modified Project are presented in **Table 25**.

**Table 25 Scope 1, 2 and 3 GHG Emissions Estimated to Result from Modified Project Operation (t $CO_2$-e / annum)**

| Emission Scope | Estimated Emissions (t $CO_2$-e/annum) |
|---|---|
| 1 | 14,565 |
| 2 | 12,601 |
| 3 | 715,484 |
| **TOTAL** | **742,650** |

Emissions of GHG in NSW were reported to be 163 Mt in 2007, 27% of the Australian total GHG emissions of 597 Mt. Comparison of the emissions attributable to the modified Project with NSW and Australia emission totals is presented in **Table 26**.

**Table 26 Comparison of Modified Project GHG Emissions with State and National Totals 2007**

| Emission Scope | Estimated Emissions ($tCO_2$-e/annum) | Percentage of NSW 2007 GHG Emission Total | Percentage of Australian 2007 GHG Emission Total |
|---|---|---|---|
| 1 | 14,565 | 0.0089 | 0.0024 |
| TOTAL (1,2 and 3) | 742,650 | 0.45 | 0.12 |

## 9.5 Greenhouse Gas Mitigation Measures

Awaba is currently implementing a number of measures to minimise to the greatest extent practicable GHG emissions from the Colliery. 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 which minimise transportation distances for ROM coal and therefore fuel use.

Additional measures that the Project Site 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;
- Consideration of energy efficiency in plant and equipment selection/phase; and,

# 10 CONCLUSIONS

Modelling of potential mining fugitive dust, TSP and $PM_{10}$ emissions was undertaken using the Ausplume Gaussian Plume Dispersion Model software (Version 6.0) developed by the EPA (Victoria) and approved by the DECCW.

One (1) scenario was modelled to represent the potential particulate emissions from the Project Site.

The findings of the modelling exercise indicate that the Project would comply with the relevant criteria. In summary:

- Dust deposition levels are predicted to be below the Project air quality criteria at all surrounding dwellings.
- Cumulative annual average TSP concentrations are predicted to be below the Project air quality goal at all surrounding dwellings.
- Cumulative annual average $PM_{10}$ concentrations are predicted to be below the Project air quality goal at all surrounding dwellings.
- Cumulative maximum 24-hour $PM_{10}$ concentrations attributable to the Project are predicted to be below the Project air quality goals at all surrounding dwellings, excluding periods of regional pollution events.

The modelling methodology contains a number of assumptions which mean that conservative 'worst case' scenarios were modelled. Therefore, all particulate predictions should be viewed as conservative, with levels expected to be lower than those modelled during standard operations.

The total direct (Scope 1) emissions from the Project are estimated to be approximately 14,565 t $CO_2$-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 indirect emissions (Scope 2 and 3) from mining coal are estimated to be 728085 t $CO_2$-e, per annum.

The total GHG emissions (direct and indirect) will contribute 0.45% of the NSW 2007 GHG emission total and 0.12% of the Australian 2007 GHG emission total.

# 11 REFERENCES

The following material has been referenced within this report:

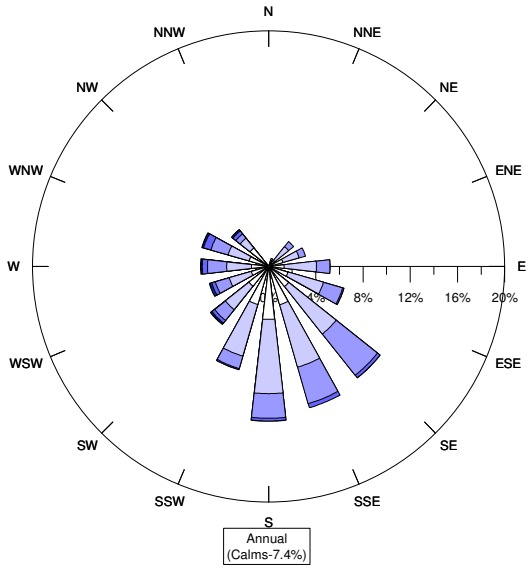

- Awaba Dust Management Plan (Centennial Coal, February 2009).
- Commonwealth of Australia (2001) "*National Pollutant Inventory, Emission Estimation Technique Manual for Mining*", Version 2.3, December 2001.
- Environmental Australia (2003) Technical Report 1: Toxic Emissions from Diesel Vehicles in Australia.
- Hamilton, S.D. (1999), A Comparison of the Air Dispersion Models AUSPLUME and AUSPUFF. Clean Air and Environmental Quality, v.33-2.
- Hurley, P.J and Luhar, A.K. (2005), "*An evaluation and inter-comparison of AUSPLUME, CALPUFF and TAPM - Part 1: The Kincaid and Indianapolis Field Datasets*". Clean Air and Environmental Quality, v.39-1.
- National Environmental Protection Council (1998) "*Ambient Air Quality National Environment Protection Measure*".
- NSW Department of Environment and Conservation (DEC) (2005), "*Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales*".
- NSW Department of Environment and Conservation (2007) "*Approved Methods for the Sampling and Analysis of Air Pollutants in NSW*".
- NSW Department of Environment, Climate Change and Water (2009).
- Sinclair Knight Merz (2005) "I*mprovement of NPI Fugitive Particulate Matter Emission Estimation Techniques*".

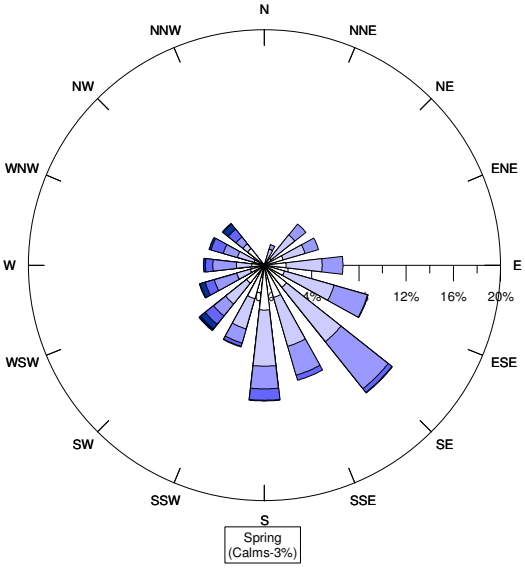
- US EPA (2006) "*Compilation of Air Pollutant Emission Factors AP-42*" (Chapter 13, Section 13.2.5 Industrial Wind Erosion).

# 12 GLOSSARY AND TERMS

| | |
|---|---|
| AHD | Australian Height Datum |
| AEMR | Annual Environmental Management Report |
| Approved Methods NSW | Approved Methods for the Modelling and Assessment of Air Pollutants in NSW |
| CHPP | Coal Handling and Preparation Plant |
| CSIRO | Commonwealth Scientific and Industrial Research Organisation |
| DECCW | NSW Department of the Environment, Climate Change and Water |
| g/m$^2$/month | Grams per square metre per month |
| Heggies | Heggies Pty Ltd |
| HVAS | High Volume Air Sampler |
| µg | Microgram (g x $10^{-6}$) |
| m$^3$ | Cubic metre |
| MGA | Map Grid of Australia |
| NEPC | National Environment Protection Council |
| NEPM | National Environment Protection Measure |
| NHMRC | National Health and Medical Research Council |
| $PM_{10}$ | Particulate matter less than 10 microns in aerodynamic diameter |
| ROM | Run of Mine |
| TAPM | "The Air Pollution Model" |
| tpa | Tonnes per Annum |
| TSP | Total Suspended Particulate |
| USEPA | United States Environmental Protection Agency |

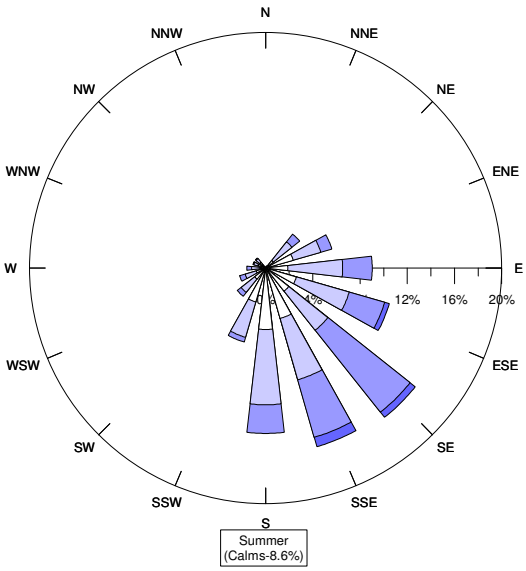
ANNUAL AND SEASONAL WIND ROSE - 2008

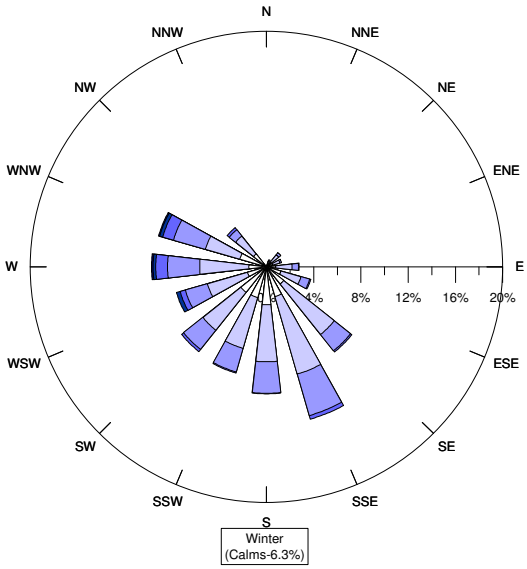


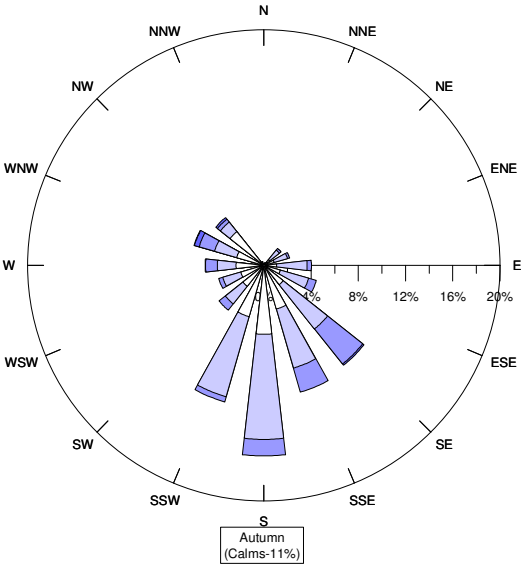







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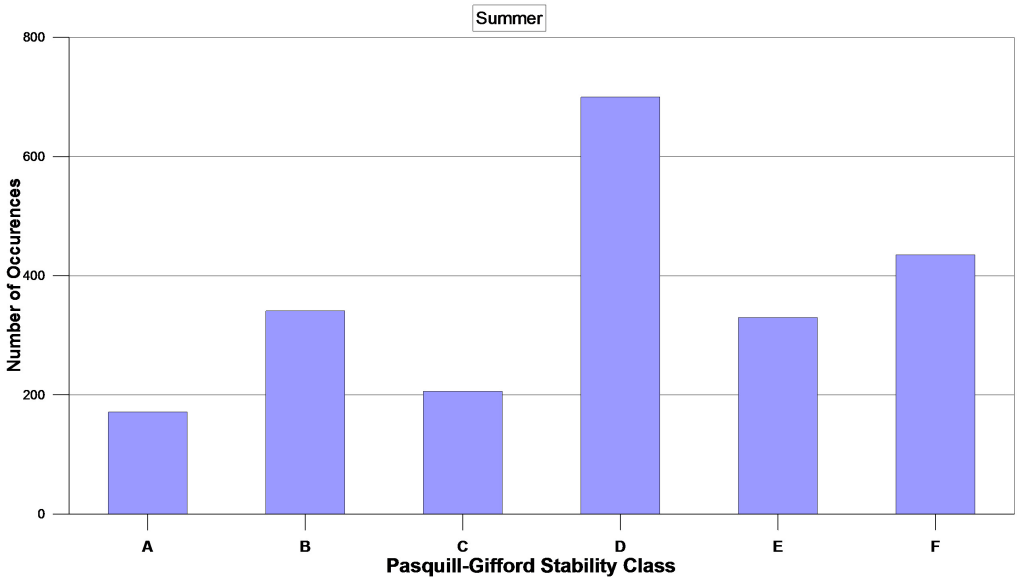
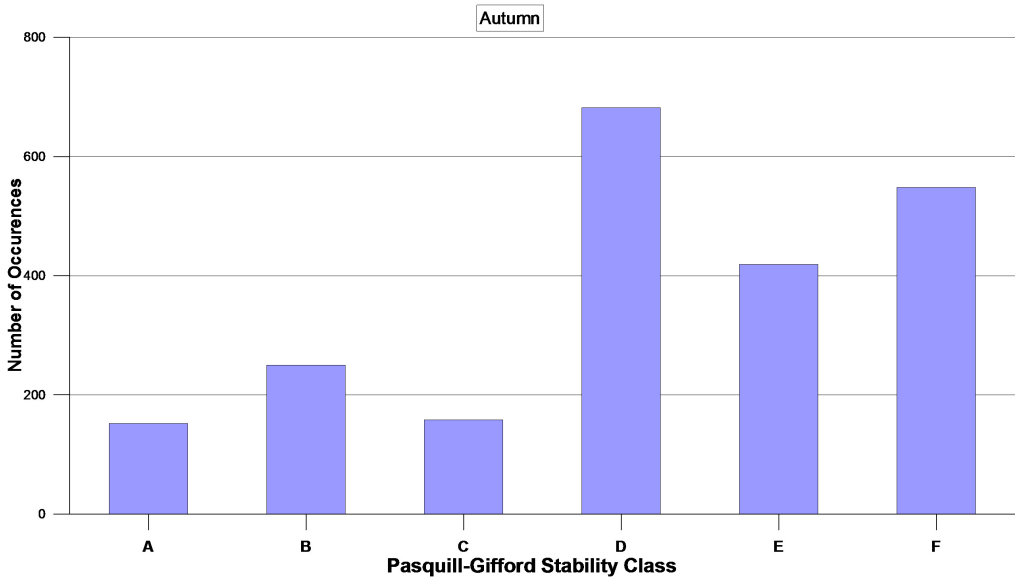
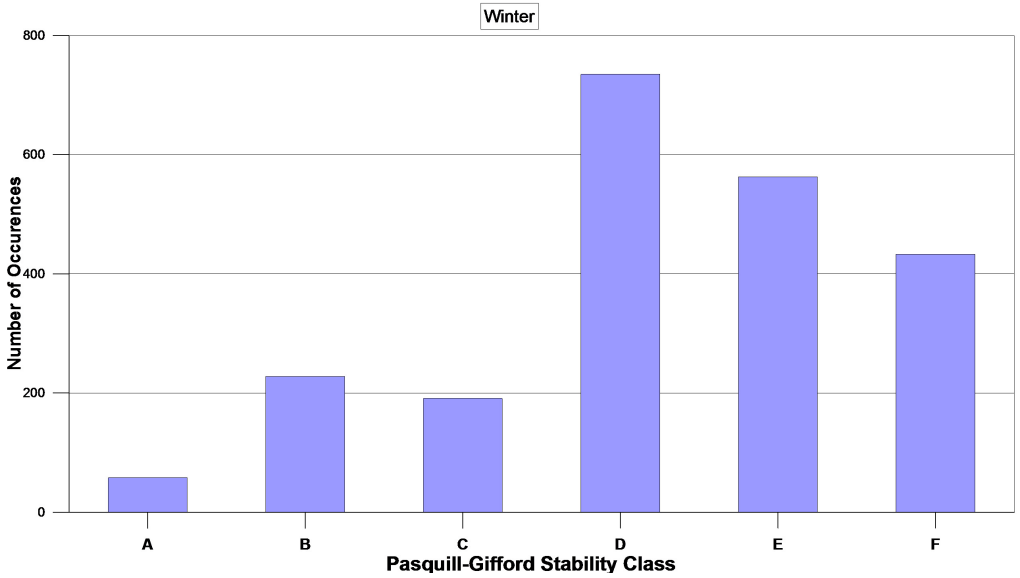
| Designed by | Checked by | Approved by - date | Filename | Dated |
|---|---|---|---|---|
| Florence Mananyu | Jason Watson | Jason Watson | 30-2497 | 30/04/2010 |

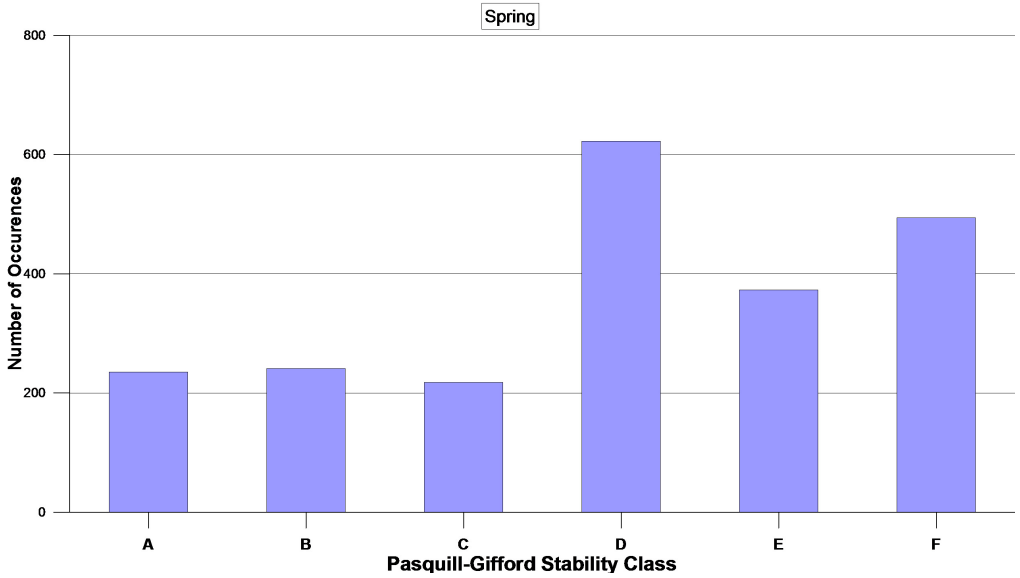
**Appendix A: Annual and Seasonal Wind Roses for the Project Site (2008)**

SEASONAL STABILITY CLASS DISTRIBUTION


Summer
800
600
400
200
0
Number of Occurences
A
B
C
D
E
F
Pasquill-Gifford Stability Class


Autumn
800
600
400
200
0
Number of Occurences
A
B
C
D
E
F
Pasquill-Gifford Stability Class


Winter
800
600
400
200
0
Number of Occurences
A
B
C
D
E
F
Pasquill-Gifford Stability Class


Spring
800
600
400
200
0
Number of Occurences
A
B
C
D
E
F
Pasquill-Gifford Stability Class

# EMISSIONS INVENTORY

| ***Awaba Part 3A Application Project*** | Source ID | Moisture content (%) | Silt Content (%) | TSP Emission Factor | $PM_{10}$ Emission Factor | Emission Factor Units | Notes/Controls | Emission Reduction from controls | Throughput (tonnes per hour) | Number of Hectares of stockpile | Average number of kilometres per hour | Working days available | Working hours per day | Annual Average Dust Emission Rate (g/s) | Total Dust Emission Rate (mg/s) | $PM_{10}$ Emission Rate (mg/s) | TSP Emission Flux ($mg/s/m^2$) | $PM_{10}$ Emission Flux ($mg/s/m^2$) | Easting | Northing | width | length | height |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Particulate Generating Activities*** | | | | | | | | | | | | | | | | | | | | | | | |
| **Quarry** | | | | | | | | | | | | | | | | | | | | | | | |
| Excavator | Exca | N/A | N/A | 0.025 | 0.012 | kg/t | | | 42 | N/A | N/A | 54 | 9 | 0.01 | 291.7 | 140.0 | N/A | N/A | 363088 | 6345644 | 3 | 4 | 4 |
| Loading truck | TruLoa | N/A | N/A | 0.005 | 0.002 | kg/t | | | 42 | N/A | N/A | 54 | 9 | 0.00 | 58.3 | 23.3 | N/A | N/A | 363079 | 6345619 | 2 | 1 | 4 |
| **Coal Processing and Handling** | | | | | | | | | | | | | | | | | | | | | | | |
| Front End Loader | FEL | 6.1 | N/A | 0.025 | 0.012 | kg/t | | | 100.5 | N/A | N/A | 260 | 8 | 165.6 | 697.6 | 334.9 | N/A | N/A | 363383 | 6345601 | 3.4 | 4 | 4 |
| Loading Stockpiles(via conveyor) | LoaSto | N/A | N/A | 0.004 | 0.0017 | kg/t | | | 100.5 | N/A | N/A | 365 | 24 | N/A | 111.62 | 47.4 | N/A | N/A | 363362 | 6345566 | 2 | 2 | 4 |
| Truck loading (from loading chute) | TruLoa | N/A | N/A | 0.0004 | 0.00017 | kg/t | | | 100.5 | N/A | N/A | 365 | 24 | N/A | 11.16 | 4.74 | N/A | N/A | 363352 | 6345571 | 1 | 1 | 1 |
| ***Stockpiles and Exposed areas*** | | | | | | | | | | | | | | | | | | | | | | | |
| Main Stockpile Wind Erosion | Mstoc | N/A | 25.2 | 0.04 | 0.02 | kg/ha/hr | | | N/A | 1 | N/A | N/A | N/A | N/A | N/A | N/A | 0.0007 | 0.0003 | 363390 | 6345561 | 10 | 30 | 4 |
| Stockpiles and Exposed areas | StoExp | N/A | 25.2 | 0.04 | 0.02 | kg/ha/hr | | | N/A | 0.30 | N/A | N/A | N/A | N/A | N/A | N/A | 0.0003 | 0.0002 | 363392 | 6345548 | 5 | 7 | 2 |
| Quarry Stockpiles and Exposed areas | QStoExp | N/A | N/A | 0.04 | 0.02 | kg/ha/hr | | | N/A | 0.40 | N/A | N/A | N/A | N/A | N/A | N/A | 0.0005 | 0.0002 | 363080 | 6345637 | 6 | 8 | 2 |
| ***Product Transportation*** | | | | | | | | | | | | | | | | | | | | | | | |
| Quarry Haul Road (3 sources) | QHauRd | N/A | N/A | 1.997 | 0.532 | kg/VKT | | | N/A | N/A | 2.04 | 54 | 9 | 21 | 377 | 101 | N/A | N/A | varies | varies | 3 | 8 | 2 |

**Assumed 6% for Surface Silt Content for Quarry Haul Road**

# AUSPLUME INPUT AND OUTPUT FILE

1

30-2497 Awaba PM10

| | |
|---|---|
| Concentration or deposition | Concentration |
| Emission rate units | grams/second |
| Concentration units | microgram/m3 |
| Units conversion factor | 1.00E+03 |
| Constant background concentration | 0.00E+00 |
| Terrain effects | None |
| Smooth stability class changes? | No |
| Other stability class adjustments ("urban modes") | None |
| Ignore building wake effects? | Yes |
| Decay coefficient (unless overridden by met. file) | 0.000 |
| Anemometer height | 10 m |
| Roughness height at the wind vane site | 0.300 m |
| Use the convective PDF algorithm? | No |
| Averaging time for sigma-theta values | 60 min. |

DISPERSION CURVES

| | |
|---|---|
| Horizontal dispersion curves for sources <100m high | Sigma-theta |
| Vertical dispersion curves for sources <100m high | Pasquill-Gifford |
| Horizontal dispersion curves for sources >100m high | Briggs Rural |
| Vertical dispersion curves for sources >100m high | Briggs Rural |
| Enhance horizontal plume spreads for buoyancy? | Yes |
| Enhance vertical plume spreads for buoyancy? | Yes |
| Adjust horizontal P-G formulae for roughness height? | Yes |
| Adjust vertical P-G formulae for roughness height? | Yes |
| Roughness height | 0.100m |
| Adjustment for wind directional shear | None |

PLUME RISE OPTIONS

| | |
|---|---|
| Gradual plume rise? | Yes |
| Stack-tip downwash included? | Yes |
| Building downwash algorithm: | PRIME method. |
| Entrainment coeff. for neutral & stable lapse rates | 0.60,0.60 |
| Partial penetration of elevated inversions? | No |
| Disregard temp. gradients in the hourly met. file? | No |

and in the absence of boundary-layer potential temperature gradients given by the hourly met. file, a value from the following table (in K/m) is used:

| Wind Speed Category | Stability Class A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| 1 | 0.000 | 0.000 | 0.000 | 0.000 | 0.020 | 0.035 |
| 2 | 0.000 | 0.000 | 0.000 | 0.000 | 0.020 | 0.035 |
| 3 | 0.000 | 0.000 | 0.000 | 0.000 | 0.020 | 0.035 |
| 4 | 0.000 | 0.000 | 0.000 | 0.000 | 0.020 | 0.035 |
| 5 | 0.000 | 0.000 | 0.000 | 0.000 | 0.020 | 0.035 |
| 6 | 0.000 | 0.000 | 0.000 | 0.000 | 0.020 | 0.035 |

WIND SPEED CATEGORIES
Boundaries between categories (in m/s) are: 1.54, 3.09, 5.14, 8.23, 10.80

WIND PROFILE EXPONENTS: "Irwin Urban" values (unless overridden by met. file)

AVERAGING TIMES
24 hours

SOURCE CHARACTERISTICS

---

INTEGRATED POLYGON AREA SOURCE: MSTOC

| X0(m) | Y0(m) | Ground El | No. Vertices | Ver. spread | Height |
|---|---|---|---|---|---|
| 363352 | 6345549 | 0m | 4 | 4m | 4m |

Integrated Polygon Area Source Vertice Locations (in metres)

| No. | X | Y | No. | X | Y |
|---|---|---|---|---|---|
| 1 | 363352 | 6345549 | 2 | 363385 | 6345557 |
| 3 | 363370 | 6345606 | 4 | 363370 | 6345606 |

Emission rates by stability and wind speed, in grams/second per square metre:

| Wind speeds (m/s): | < 1.5 | 1.5_ 3.1 | 3.1_ 5.1 | 5.1_ 8.2 | 8.2_10.8 | >10.8 |
|---|---|---|---|---|---|---|
| Stability A: | 0.00E+00 | 0.00E+00 | 0.00E+00 | 1.16E-03 | 8.09E-03 | 3.82E-02 |
| Stability B: | 0.00E+00 | 0.00E+00 | 0.00E+00 | 1.16E-03 | 8.09E-03 | 3.82E-02 |
| Stability C: | 0.00E+00 | 0.00E+00 | 0.00E+00 | 1.16E-03 | 8.09E-03 | 3.82E-02 |
| Stability D: | 0.00E+00 | 0.00E+00 | 0.00E+00 | 1.16E-03 | 8.09E-03 | 3.82E-02 |
| Stability E: | 0.00E+00 | 0.00E+00 | 0.00E+00 | 1.16E-03 | 8.09E-03 | 3.82E-02 |
| Stability F: | 0.00E+00 | 0.00E+00 | 0.00E+00 | 1.16E-03 | 8.09E-03 | 3.82E-02 |

No gravitational settling or scavenging.

INTEGRATED POLYGON AREA SOURCE: STOEXP

| X0(m) | Y0(m) | Ground El | No. Vertices | Ver. spread | Height |
|---|---|---|---|---|---|
| 363359 | 6345521 | 0m | 7 | 1m | 2m |

Integrated Polygon Area Source Vertice Locations (in metres)

| No. | X | Y | No. | X | Y |
|---|---|---|---|---|---|
| 1 | 363359 | 6345521 | 2 | 363402 | 6345526 |
| 3 | 363408 | 6345579 | 4 | 363396 | 6345609 |
| 5 | 363385 | 6345616 | 6 | 363391 | 6345566 |
| 7 | 363354 | 6345537 | | | |

Emission rates by stability and wind speed, in grams/second per square metre:

| Wind speeds (m/s): | < 1.5 | 1.5_ 3.1 | 3.1_ 5.1 | 5.1_ 8.2 | 8.2_10.8 | >10.8 |
|---|---|---|---|---|---|---|
| Stability A: | 0.00E+00 | 0.00E+00 | 0.00E+00 | 1.16E-03 | 8.09E-03 | 3.82E-02 |
| Stability B: | 0.00E+00 | 0.00E+00 | 0.00E+00 | 1.16E-03 | 8.09E-03 | 3.82E-02 |
| Stability C: | 0.00E+00 | 0.00E+00 | 0.00E+00 | 1.16E-03 | 8.09E-03 | 3.82E-02 |
| Stability D: | 0.00E+00 | 0.00E+00 | 0.00E+00 | 1.16E-03 | 8.09E-03 | 3.82E-02 |
| Stability E: | 0.00E+00 | 0.00E+00 | 0.00E+00 | 1.16E-03 | 8.09E-03 | 3.82E-02 |
| Stability F: | 0.00E+00 | 0.00E+00 | 0.00E+00 | 1.16E-03 | 8.09E-03 | 3.82E-02 |

No gravitational settling or scavenging.

INTEGRATED POLYGON AREA SOURCE: QSTOEX

| X0(m) | Y0(m) | Ground El | No. Vertices | Ver. spread | Height |
|---|---|---|---|---|---|
| 363115 | 6345601 | 0m | 5 | 1m | 2m |

Integrated Polygon Area Source Vertice Locations (in metres)

| No. | X | Y | No. | X | Y |
|---|---|---|---|---|---|
| 1 | 363115 | 6345601 | 2 | 363098 | 6345665 |
| 3 | 363058 | 6345685 | 4 | 363038 | 6345651 |
| 5 | 363049 | 6345606 | | | |

Emission rates by stability and wind speed, in grams/second per square

metre:

| Wind speeds (m/s): | < 1.5 | 1.5_ 3.1 | 3.1_ 5.1 | 5.1_ 8.2 | 8.2_10.8 | >10.8 |
|---|---|---|---|---|---|---|
| Stability A: | 0.00E+00 | 0.00E+00 | 0.00E+00 | 1.16E-03 | 8.09E-03 | 3.82E-02 |
| Stability B: | 0.00E+00 | 0.00E+00 | 0.00E+00 | 1.16E-03 | 8.09E-03 | 3.82E-02 |
| Stability C: | 0.00E+00 | 0.00E+00 | 0.00E+00 | 1.16E-03 | 8.09E-03 | 3.82E-02 |
| Stability D: | 0.00E+00 | 0.00E+00 | 0.00E+00 | 1.16E-03 | 8.09E-03 | 3.82E-02 |
| Stability E: | 0.00E+00 | 0.00E+00 | 0.00E+00 | 1.16E-03 | 8.09E-03 | 3.82E-02 |
| Stability F: | 0.00E+00 | 0.00E+00 | 0.00E+00 | 1.16E-03 | 8.09E-03 | 3.82E-02 |

No gravitational settling or scavenging.

VOLUME SOURCE: EXCA

| X(m) | Y(m) | Ground Elevation | Height | Hor. spread | Vert. spread |
|---|---|---|---|---|---|
| 363088 | 6345644 | 0m | 4m | 1m | 1m |

Emission rates by hour of day in grams/second:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | 0.00E+00 | 2 | 0.00E+00 | 3 | 0.00E+00 | 4 | 0.00E+00 |
| 5 | 0.00E+00 | 6 | 0.00E+00 | 7 | 1.40E+02 | 8 | 1.40E+02 |
| 9 | 1.40E+02 | 10 | 1.40E+02 | 11 | 1.40E+02 | 12 | 1.40E+02 |
| 13 | 1.40E+02 | 14 | 1.40E+02 | 15 | 1.40E+02 | 16 | 1.40E+02 |
| 17 | 0.00E+00 | 18 | 0.00E+00 | 19 | 0.00E+00 | 20 | 0.00E+00 |
| 21 | 0.00E+00 | 22 | 0.00E+00 | 23 | 0.00E+00 | 24 | 0.00E+00 |

No gravitational settling or scavenging.

VOLUME SOURCE: TRULOA

| X(m) | Y(m) | Ground Elevation | Height | Hor. spread | Vert. spread |
|---|---|---|---|---|---|
| 363079 | 6345619 | 0m | 4m | 1m | 1m |

Emission rates by hour of day in grams/second:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | 0.00E+00 | 2 | 0.00E+00 | 3 | 0.00E+00 | 4 | 0.00E+00 |
| 5 | 0.00E+00 | 6 | 0.00E+00 | 7 | 2.33E+01 | 8 | 2.33E+01 |
| 9 | 2.33E+01 | 10 | 2.33E+01 | 11 | 2.33E+01 | 12 | 2.33E+01 |
| 13 | 2.33E+01 | 14 | 2.33E+01 | 15 | 2.33E+01 | 16 | 2.33E+01 |
| 17 | 0.00E+00 | 18 | 0.00E+00 | 19 | 0.00E+00 | 20 | 0.00E+00 |
| 21 | 0.00E+00 | 22 | 0.00E+00 | 23 | 0.00E+00 | 24 | 0.00E+00 |

No gravitational settling or scavenging.

VOLUME SOURCE: FEL

| X(m) | Y(m) | Ground Elevation | Height | Hor. spread | Vert. spread |
|---|---|---|---|---|---|
| 363383 | 6345601 | 0m | 4m | 1m | 1m |

Emission rates by hour of day in grams/second:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | 0.00E+00 | 2 | 0.00E+00 | 3 | 0.00E+00 | 4 | 0.00E+00 |
| 5 | 0.00E+00 | 6 | 0.00E+00 | 7 | 3.35E+02 | 8 | 3.35E+02 |
| 9 | 3.35E+02 | 10 | 3.35E+02 | 11 | 3.35E+02 | 12 | 3.35E+02 |
| 13 | 3.35E+02 | 14 | 3.35E+02 | 15 | 3.35E+02 | 16 | 0.00E+00 |
| 17 | 0.00E+00 | 18 | 0.00E+00 | 19 | 0.00E+00 | 20 | 0.00E+00 |
| 21 | 0.00E+00 | 22 | 0.00E+00 | 23 | 0.00E+00 | 24 | 0.00E+00 |

No gravitational settling or scavenging.

VOLUME SOURCE: LOASOC

| X(m) | Y(m) | Ground Elevation | Height | Hor. spread | Vert. spread |
|---|---|---|---|---|---|
| 363362 | 6345566 | 0m | 4m | 1m | 1m |

Emission rates by hour of day in grams/second:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | 4.74E+01 | 2 | 4.74E+01 | 3 | 4.74E+01 | 4 | 4.74E+01 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 5 | 4.74E+01 | 6 | 4.74E+01 | 7 | 4.74E+01 | 8 | 4.74E+01 |
| 9 | 4.74E+01 | 10 | 4.74E+01 | 11 | 4.74E+01 | 12 | 4.74E+01 |
| 13 | 4.74E+01 | 14 | 4.74E+01 | 15 | 4.74E+01 | 16 | 4.74E+01 |
| 17 | 4.74E+01 | 18 | 4.74E+01 | 19 | 4.74E+01 | 20 | 4.74E+01 |
| 21 | 4.74E+01 | 22 | 4.74E+01 | 23 | 4.74E+01 | 24 | 4.74E+01 |

No gravitational settling or scavenging.

VOLUME SOURCE: CTRULO

| X(m) | Y(m) | Ground Elevation | Height | Hor. spread | Vert. spread |
|---|---|---|---|---|---|
| 363352 | 6345571 | 0m | 1m | 0m | 0m |

Emission rates by hour of day in grams/second:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | 4.74E+00 | 2 | 4.74E+00 | 3 | 4.74E+00 | 4 | 4.74E+00 |
| 5 | 4.74E+00 | 6 | 4.74E+00 | 7 | 4.74E+00 | 8 | 4.74E+00 |
| 9 | 4.74E+00 | 10 | 4.74E+00 | 11 | 4.74E+00 | 12 | 4.74E+00 |
| 13 | 4.74E+00 | 14 | 4.74E+00 | 15 | 4.74E+00 | 16 | 4.74E+00 |
| 17 | 4.74E+00 | 18 | 4.74E+00 | 19 | 4.74E+00 | 20 | 4.74E+00 |
| 21 | 4.74E+00 | 22 | 4.74E+00 | 23 | 4.74E+00 | 24 | 4.74E+00 |

No gravitational settling or scavenging.

VOLUME SOURCE: QHARD1

| X(m) | Y(m) | Ground Elevation | Height | Hor. spread | Vert. spread |
|---|---|---|---|---|---|
| 363028 | 6345512 | 0m | 1m | 0m | 0m |

Emission rates by hour of day in grams/second:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | 0.00E+00 | 2 | 0.00E+00 | 3 | 0.00E+00 | 4 | 0.00E+00 |
| 5 | 0.00E+00 | 6 | 0.00E+00 | 7 | 1.01E+02 | 8 | 1.01E+02 |
| 9 | 1.01E+02 | 10 | 1.01E+02 | 11 | 1.01E+02 | 12 | 1.01E+02 |
| 13 | 1.01E+02 | 14 | 1.01E+02 | 15 | 1.01E+02 | 16 | 1.01E+02 |
| 17 | 0.00E+00 | 18 | 0.00E+00 | 19 | 0.00E+00 | 20 | 0.00E+00 |
| 21 | 0.00E+00 | 22 | 0.00E+00 | 23 | 0.00E+00 | 24 | 0.00E+00 |

No gravitational settling or scavenging.

VOLUME SOURCE: QHARD2

| X(m) | Y(m) | Ground Elevation | Height | Hor. spread | Vert. spread |
|---|---|---|---|---|---|
| 363069 | 6345508 | 0m | 1m | 0m | 0m |

Emission rates by hour of day in grams/second:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | 0.00E+00 | 2 | 0.00E+00 | 3 | 0.00E+00 | 4 | 0.00E+00 |
| 5 | 0.00E+00 | 6 | 0.00E+00 | 7 | 1.01E+02 | 8 | 1.01E+02 |
| 9 | 1.01E+02 | 10 | 1.01E+02 | 11 | 1.01E+02 | 12 | 1.01E+02 |
| 13 | 1.01E+02 | 14 | 1.01E+02 | 15 | 1.01E+02 | 16 | 1.01E+02 |
| 17 | 0.00E+00 | 18 | 0.00E+00 | 19 | 0.00E+00 | 20 | 0.00E+00 |
| 21 | 0.00E+00 | 22 | 0.00E+00 | 23 | 0.00E+00 | 24 | 0.00E+00 |

No gravitational settling or scavenging.

VOLUME SOURCE: QHARD3

| X(m) | Y(m) | Ground Elevation | Height | Hor. spread | Vert. spread |
|---|---|---|---|---|---|
| 363024 | 6345422 | 0m | 1m | 0m | 0m |

Emission rates by hour of day in grams/second:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | 0.00E+00 | 2 | 0.00E+00 | 3 | 0.00E+00 | 4 | 0.00E+00 |
| 5 | 0.00E+00 | 6 | 0.00E+00 | 7 | 1.01E+02 | 8 | 1.01E+02 |
| 9 | 1.01E+02 | 10 | 1.01E+02 | 11 | 1.01E+02 | 12 | 1.01E+02 |
| 13 | 1.01E+02 | 14 | 1.01E+02 | 15 | 1.01E+02 | 16 | 1.01E+02 |
| 17 | 0.00E+00 | 18 | 0.00E+00 | 19 | 0.00E+00 | 20 | 0.00E+00 |

21 0.00E+00  22 0.00E+00  23 0.00E+00  24 0.00E+00

No gravitational settling or scavenging.

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1

30-2497 Awaba PM10

RECEPTOR LOCATIONS

The Cartesian receptor grid has the following x-values (or eastings):
362100.m 362200.m 362300.m 362400.m 362500.m 362600.m 362700.m
362800.m 362900.m 363000.m 363100.m 363200.m 363300.m 363400.m
363500.m 363600.m 363700.m 363800.m 363900.m 364000.m 364100.m
364200.m 364300.m 364400.m 364500.m 364600.m 364700.m 364800.m
364900.m 365000.m

and these y-values (or northings):
6344000.m 6344100.m 6344200.m 6344300.m 6344400.m 6344500.m 6344600.m
6344700.m 6344800.m 6344900.m 6345000.m 6345100.m 6345200.m 6345300.m
6345400.m 6345500.m 6345600.m 6345700.m 6345800.m 6345900.m 6346000.m
6346100.m 6346200.m 6346300.m 6346400.m 6346500.m 6346600.m 6346700.m
6346800.m 6346900.m

DISCRETE RECEPTOR LOCATIONS (in metres)

| No. | X | Y | ELEVN | HEIGHT | No. | X | Y | ELEVN | HEIGHT |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 363733 | 6346064 | 0.0 | 0.0 | 3 | 363220 | 6346274 | 0.0 | 0.0 |
| 2 | 363203 | 6346323 | 0.0 | 0.0 | 4 | 363547 | 6346080 | 0.0 | 0.0 |

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METEOROLOGICAL DATA : "AUSPLUM " E M " ETFI" " L E"

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1 HIGHEST RECORDINGS FOR EACH RECEPTOR (in microgram/m3)

AVERAGING TIME = 24 HOURS

| X (km): | 362.100 | 362.200 |
|---|---|---|
| Y (km) | | |
| 6346.900 | 4.15E+00 24,16/06/08 | 4.55E+00 24,16/06/08 |
| 6346.800 | 4.02E+00 24,16/06/08 | 4.83E+00 24,16/06/08 |
| 6346.700 | 3.59E+00 24,16/06/08 | 4.73E+00 24,16/06/08 |
| 6346.600 | 3.43E+00 24,24/12/08 | 4.19E+00 24,16/06/08 |
| 6346.500 | 3.74E+00 24,17/06/08 | 3.82E+00 24,24/12/08 |
| 6346.400 | 4.61E+00 24,17/06/08 | 4.35E+00 24,17/06/08 |
| 6346.300 | 5.16E+00 24,17/06/08 | 5.46E+00 24,17/06/08 |
| 6346.200 | 5.48E+00 24,17/06/08 | 6.23E+00 24,17/06/08 |
| 6346.100 | 6.14E+00 24,17/06/08 | 6.82E+00 24,17/06/08 |
| 6346.000 | 9.33E+00 24,04/02/08 | 9.06E+00 24,04/02/08 |
| 6345.900 | 1.22E+01 24,04/02/08 | 1.32E+01 24,04/02/08 |
| 6345.800 | 1.22E+01 24,04/02/08 | 1.41E+01 24,04/02/08 |
| 6345.700 | 1.03E+01 24,04/02/08 | 1.24E+01 24,04/02/08 |
| 6345.600 | 9.02E+00 24,04/02/08 | 1.13E+01 24,04/02/08 |
| 6345.500 | 1.03E+01 24,18/06/08 | 1.16E+01 24,18/06/08 |
| 6345.400 | 9.44E+00 24,04/02/08 | 1.05E+01 24,04/02/08 |
| 6345.300 | 6.15E+00 24,04/02/08 | 6.92E+00 24,29/10/08 |
| 6345.200 | 5.50E+00 24,16/03/08 | 7.03E+00 24,16/03/08 |

1

30-2497 Awaba TSP

| | |
|---|---|
| Concentration or deposition | Concentration |
| Emission rate units | grams/second |
| Concentration units | microgram/m3 |
| Units conversion factor | 1.00E+03 |
| Constant background concentration | 0.00E+00 |
| Terrain effects | None |
| Smooth stability class changes? | No |
| Other stability class adjustments ("urban modes") | None |
| Ignore building wake effects? | Yes |
| Decay coefficient (unless overridden by met. file) | 0.000 |
| Anemometer height | 10 m |
| Roughness height at the wind vane site | 0.300 m |
| Use the convective PDF algorithm? | No |
| Averaging time for sigma-theta values | 60 min. |

DISPERSION CURVES

| | |
|---|---|
| Horizontal dispersion curves for sources <100m high | Sigma-theta |
| Vertical dispersion curves for sources <100m high | Pasquill-Gifford |
| Horizontal dispersion curves for sources >100m high | Briggs Rural |
| Vertical dispersion curves for sources >100m high | Briggs Rural |
| Enhance horizontal plume spreads for buoyancy? | Yes |
| Enhance vertical plume spreads for buoyancy? | Yes |
| Adjust horizontal P-G formulae for roughness height? | Yes |
| Adjust vertical P-G formulae for roughness height? | Yes |
| Roughness height | 0.100m |
| Adjustment for wind directional shear | None |

PLUME RISE OPTIONS

| | |
|---|---|
| Gradual plume rise? | Yes |
| Stack-tip downwash included? | Yes |
| Building downwash algorithm: | PRIME method. |
| Entrainment coeff. for neutral & stable lapse rates | 0.60,0.60 |
| Partial penetration of elevated inversions? | No |
| Disregard temp. gradients in the hourly met. file? | No |

and in the absence of boundary-layer potential temperature gradients given by the hourly met. file, a value from the following table (in K/m) is used:

| Wind Speed Category | Stability Class A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| 1 | 0.000 | 0.000 | 0.000 | 0.000 | 0.020 | 0.035 |
| 2 | 0.000 | 0.000 | 0.000 | 0.000 | 0.020 | 0.035 |
| 3 | 0.000 | 0.000 | 0.000 | 0.000 | 0.020 | 0.035 |
| 4 | 0.000 | 0.000 | 0.000 | 0.000 | 0.020 | 0.035 |
| 5 | 0.000 | 0.000 | 0.000 | 0.000 | 0.020 | 0.035 |
| 6 | 0.000 | 0.000 | 0.000 | 0.000 | 0.020 | 0.035 |

WIND SPEED CATEGORIES
Boundaries between categories (in m/s) are: 1.54, 3.09, 5.14, 8.23, 10.80

WIND PROFILE EXPONENTS: "Irwin Urban" values (unless overridden by met. file)

AVERAGING TIMES
average over all hours

SOURCE CHARACTERISTICS

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INTEGRATED POLYGON AREA SOURCE: MSTOC

| X0(m) | Y0(m) | Ground El | No. Vertices | Ver. spread | Height |
|---|---|---|---|---|---|
| 363352 | 6345549 | 0m | 4 | 4m | 4m |

Integrated Polygon Area Source Vertice Locations (in metres)

| No. | X | Y | No. | X | Y |
|---|---|---|---|---|---|
| 1 | 363352 | 6345549 | 2 | 363385 | 6345557 |
| 3 | 363370 | 6345606 | 4 | 363370 | 6345606 |

Emission rates by stability and wind speed, in grams/second per square metre:

| Wind speeds (m/s): | < 1.5 | 1.5_ 3.1 | 3.1_ 5.1 | 5.1_ 8.2 | 8.2_10.8 | >10.8 |
|---|---|---|---|---|---|---|
| Stability A: | 0.00E+00 | 0.00E+00 | 0.00E+00 | 1.16E-03 | 8.09E-03 | 3.82E-02 |
| Stability B: | 0.00E+00 | 0.00E+00 | 0.00E+00 | 1.16E-03 | 8.09E-03 | 3.82E-02 |
| Stability C: | 0.00E+00 | 0.00E+00 | 0.00E+00 | 1.16E-03 | 8.09E-03 | 3.82E-02 |
| Stability D: | 0.00E+00 | 0.00E+00 | 0.00E+00 | 1.16E-03 | 8.09E-03 | 3.82E-02 |
| Stability E: | 0.00E+00 | 0.00E+00 | 0.00E+00 | 1.16E-03 | 8.09E-03 | 3.82E-02 |
| Stability F: | 0.00E+00 | 0.00E+00 | 0.00E+00 | 1.16E-03 | 8.09E-03 | 3.82E-02 |

No gravitational settling or scavenging.

INTEGRATED POLYGON AREA SOURCE: STOEXP

| X0(m) | Y0(m) | Ground El | No. Vertices | Ver. spread | Height |
|---|---|---|---|---|---|
| 363359 | 6345521 | 0m | 7 | 1m | 2m |

Integrated Polygon Area Source Vertice Locations (in metres)

| No. | X | Y | No. | X | Y |
|---|---|---|---|---|---|
| 1 | 363359 | 6345521 | 2 | 363402 | 6345526 |
| 3 | 363408 | 6345579 | 4 | 363396 | 6345609 |
| 5 | 363385 | 6345616 | 6 | 363391 | 6345566 |
| 7 | 363354 | 6345537 | | | |

Emission rates by stability and wind speed, in grams/second per square metre:

| Wind speeds (m/s): | < 1.5 | 1.5_ 3.1 | 3.1_ 5.1 | 5.1_ 8.2 | 8.2_10.8 | >10.8 |
|---|---|---|---|---|---|---|
| Stability A: | 0.00E+00 | 0.00E+00 | 0.00E+00 | 1.16E-03 | 8.09E-03 | 3.82E-02 |
| Stability B: | 0.00E+00 | 0.00E+00 | 0.00E+00 | 1.16E-03 | 8.09E-03 | 3.82E-02 |
| Stability C: | 0.00E+00 | 0.00E+00 | 0.00E+00 | 1.16E-03 | 8.09E-03 | 3.82E-02 |
| Stability D: | 0.00E+00 | 0.00E+00 | 0.00E+00 | 1.16E-03 | 8.09E-03 | 3.82E-02 |
| Stability E: | 0.00E+00 | 0.00E+00 | 0.00E+00 | 1.16E-03 | 8.09E-03 | 3.82E-02 |
| Stability F: | 0.00E+00 | 0.00E+00 | 0.00E+00 | 1.16E-03 | 8.09E-03 | 3.82E-02 |

No gravitational settling or scavenging.

INTEGRATED POLYGON AREA SOURCE: QSTOEX

| X0(m) | Y0(m) | Ground El | No. Vertices | Ver. spread | Height |
|---|---|---|---|---|---|
| 363115 | 6345601 | 0m | 5 | 1m | 2m |

Integrated Polygon Area Source Vertice Locations (in metres)

| No. | X | Y | No. | X | Y |
|---|---|---|---|---|---|
| 1 | 363115 | 6345601 | 2 | 363098 | 6345665 |
| 3 | 363058 | 6345685 | 4 | 363038 | 6345651 |
| 5 | 363049 | 6345606 | | | |

Emission rates by stability and wind speed, in grams/second per square

metre:

| Wind speeds (m/s): | < 1.5 | 1.5_ 3.1 | 3.1_ 5.1 | 5.1_ 8.2 | 8.2_10.8 | >10.8 |
|---|---|---|---|---|---|---|
| Stability A: | 0.00E+00 | 0.00E+00 | 0.00E+00 | 1.16E-03 | 8.09E-03 | 3.82E-02 |
| Stability B: | 0.00E+00 | 0.00E+00 | 0.00E+00 | 1.16E-03 | 8.09E-03 | 3.82E-02 |
| Stability C: | 0.00E+00 | 0.00E+00 | 0.00E+00 | 1.16E-03 | 8.09E-03 | 3.82E-02 |
| Stability D: | 0.00E+00 | 0.00E+00 | 0.00E+00 | 1.16E-03 | 8.09E-03 | 3.82E-02 |
| Stability E: | 0.00E+00 | 0.00E+00 | 0.00E+00 | 1.16E-03 | 8.09E-03 | 3.82E-02 |
| Stability F: | 0.00E+00 | 0.00E+00 | 0.00E+00 | 1.16E-03 | 8.09E-03 | 3.82E-02 |

No gravitational settling or scavenging.

VOLUME SOURCE: EXCA

| X(m) | Y(m) | Ground Elevation | Height | Hor. spread | Vert. spread |
|---|---|---|---|---|---|
| 363088 | 6345644 | 0m | 4m | 1m | 1m |

Emission rates by hour of day in grams/second:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | 0.00E+00 | 2 | 0.00E+00 | 3 | 0.00E+00 | 4 | 0.00E+00 |
| 5 | 0.00E+00 | 6 | 0.00E+00 | 7 | 2.92E+02 | 8 | 2.92E+02 |
| 9 | 2.92E+02 | 10 | 2.92E+02 | 11 | 2.92E+02 | 12 | 2.92E+02 |
| 13 | 2.92E+02 | 14 | 2.92E+02 | 15 | 2.92E+02 | 16 | 2.92E+02 |
| 17 | 0.00E+00 | 18 | 0.00E+00 | 19 | 0.00E+00 | 20 | 0.00E+00 |
| 21 | 0.00E+00 | 22 | 0.00E+00 | 23 | 0.00E+00 | 24 | 0.00E+00 |

No gravitational settling or scavenging.

VOLUME SOURCE: TRULOA

| X(m) | Y(m) | Ground Elevation | Height | Hor. spread | Vert. spread |
|---|---|---|---|---|---|
| 363079 | 6345619 | 0m | 4m | 1m | 1m |

Emission rates by hour of day in grams/second:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | 0.00E+00 | 2 | 0.00E+00 | 3 | 0.00E+00 | 4 | 0.00E+00 |
| 5 | 0.00E+00 | 6 | 0.00E+00 | 7 | 5.83E+01 | 8 | 5.83E+01 |
| 9 | 5.83E+01 | 10 | 5.83E+01 | 11 | 5.83E+01 | 12 | 5.83E+01 |
| 13 | 5.83E+01 | 14 | 5.83E+01 | 15 | 5.83E+01 | 16 | 5.83E+01 |
| 17 | 0.00E+00 | 18 | 0.00E+00 | 19 | 0.00E+00 | 20 | 0.00E+00 |
| 21 | 0.00E+00 | 22 | 0.00E+00 | 23 | 0.00E+00 | 24 | 0.00E+00 |

No gravitational settling or scavenging.

VOLUME SOURCE: FEL

| X(m) | Y(m) | Ground Elevation | Height | Hor. spread | Vert. spread |
|---|---|---|---|---|---|
| 363383 | 6345601 | 0m | 4m | 1m | 1m |

Emission rates by hour of day in grams/second:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | 0.00E+00 | 2 | 0.00E+00 | 3 | 0.00E+00 | 4 | 0.00E+00 |
| 5 | 0.00E+00 | 6 | 0.00E+00 | 7 | 6.98E+02 | 8 | 6.98E+02 |
| 9 | 6.98E+02 | 10 | 6.98E+02 | 11 | 6.98E+02 | 12 | 6.98E+02 |
| 13 | 6.98E+02 | 14 | 6.98E+02 | 15 | 6.98E+02 | 16 | 0.00E+00 |
| 17 | 0.00E+00 | 18 | 0.00E+00 | 19 | 0.00E+00 | 20 | 0.00E+00 |
| 21 | 0.00E+00 | 22 | 0.00E+00 | 23 | 0.00E+00 | 24 | 0.00E+00 |

No gravitational settling or scavenging.

VOLUME SOURCE: LOASOC

| X(m) | Y(m) | Ground Elevation | Height | Hor. spread | Vert. spread |
|---|---|---|---|---|---|
| 363362 | 6345566 | 0m | 4m | 1m | 1m |

Emission rates by hour of day in grams/second:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | 1.12E+02 | 2 | 1.12E+02 | 3 | 1.12E+02 | 4 | 1.12E+02 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 5 | 1.12E+02 | 6 | 1.12E+02 | 7 | 1.12E+02 | 8 | 1.12E+02 |
| 9 | 1.12E+02 | 10 | 1.12E+02 | 11 | 1.12E+02 | 12 | 1.12E+02 |
| 13 | 1.12E+02 | 14 | 1.12E+02 | 15 | 1.12E+02 | 16 | 1.12E+02 |
| 17 | 1.12E+02 | 18 | 1.12E+02 | 19 | 1.12E+02 | 20 | 1.12E+02 |
| 21 | 1.12E+02 | 22 | 1.12E+02 | 23 | 1.12E+02 | 24 | 1.12E+02 |

No gravitational settling or scavenging.

VOLUME SOURCE: CTRULO

| X(m) | Y(m) | Ground Elevation | Height | Hor. spread | Vert. spread |
|---|---|---|---|---|---|
| 363352 | 6345571 | 0m | 1m | 0m | 0m |

Emission rates by hour of day in grams/second:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | 1.12E+01 | 2 | 1.12E+01 | 3 | 1.12E+01 | 4 | 1.12E+01 |
| 5 | 1.12E+01 | 6 | 1.12E+01 | 7 | 1.12E+01 | 8 | 1.12E+01 |
| 9 | 1.12E+01 | 10 | 1.12E+01 | 11 | 1.12E+01 | 12 | 1.12E+01 |
| 13 | 1.12E+01 | 14 | 1.12E+01 | 15 | 1.12E+01 | 16 | 1.12E+01 |
| 17 | 1.12E+01 | 18 | 1.12E+01 | 19 | 1.12E+01 | 20 | 1.12E+01 |
| 21 | 1.12E+01 | 22 | 1.12E+01 | 23 | 1.12E+01 | 24 | 1.12E+01 |

No gravitational settling or scavenging.

VOLUME SOURCE: QHARD1

| X(m) | Y(m) | Ground Elevation | Height | Hor. spread | Vert. spread |
|---|---|---|---|---|---|
| 363028 | 6345512 | 0m | 1m | 0m | 0m |

Emission rates by hour of day in grams/second:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | 0.00E+00 | 2 | 0.00E+00 | 3 | 0.00E+00 | 4 | 0.00E+00 |
| 5 | 0.00E+00 | 6 | 0.00E+00 | 7 | 3.77E+02 | 8 | 3.77E+02 |
| 9 | 3.77E+02 | 10 | 3.77E+02 | 11 | 3.77E+02 | 12 | 3.77E+02 |
| 13 | 3.77E+02 | 14 | 3.77E+02 | 15 | 3.77E+02 | 16 | 3.77E+02 |
| 17 | 0.00E+00 | 18 | 0.00E+00 | 19 | 0.00E+00 | 20 | 0.00E+00 |
| 21 | 0.00E+00 | 22 | 0.00E+00 | 23 | 0.00E+00 | 24 | 0.00E+00 |

No gravitational settling or scavenging.

VOLUME SOURCE: QHARD2

| X(m) | Y(m) | Ground Elevation | Height | Hor. spread | Vert. spread |
|---|---|---|---|---|---|
| 363069 | 6345508 | 0m | 1m | 0m | 0m |

Emission rates by hour of day in grams/second:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | 0.00E+00 | 2 | 0.00E+00 | 3 | 0.00E+00 | 4 | 0.00E+00 |
| 5 | 0.00E+00 | 6 | 0.00E+00 | 7 | 3.77E+02 | 8 | 3.77E+02 |
| 9 | 3.77E+02 | 10 | 3.77E+02 | 11 | 3.77E+02 | 12 | 3.77E+02 |
| 13 | 3.77E+02 | 14 | 3.77E+02 | 15 | 3.77E+02 | 16 | 3.77E+02 |
| 17 | 0.00E+00 | 18 | 0.00E+00 | 19 | 0.00E+00 | 20 | 0.00E+00 |
| 21 | 0.00E+00 | 22 | 0.00E+00 | 23 | 0.00E+00 | 24 | 0.00E+00 |

No gravitational settling or scavenging.

VOLUME SOURCE: QHARD3

| X(m) | Y(m) | Ground Elevation | Height | Hor. spread | Vert. spread |
|---|---|---|---|---|---|
| 363024 | 6345422 | 0m | 1m | 0m | 0m |

Emission rates by hour of day in grams/second:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | 0.00E+00 | 2 | 0.00E+00 | 3 | 0.00E+00 | 4 | 0.00E+00 |
| 5 | 0.00E+00 | 6 | 0.00E+00 | 7 | 3.77E+02 | 8 | 3.77E+02 |
| 9 | 3.77E+02 | 10 | 3.77E+02 | 11 | 3.77E+02 | 12 | 3.77E+02 |
| 13 | 3.77E+02 | 14 | 3.77E+02 | 15 | 3.77E+02 | 16 | 3.77E+02 |
| 17 | 0.00E+00 | 18 | 0.00E+00 | 19 | 0.00E+00 | 20 | 0.00E+00 |

21 0.00E+00  22 0.00E+00  23 0.00E+00  24 0.00E+00

No gravitational settling or scavenging.

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30-2497 Awaba TSP

RECEPTOR LOCATIONS

The Cartesian receptor grid has the following x-values (or eastings):
362100.m 362200.m 362300.m 362400.m 362500.m 362600.m 362700.m
362800.m 362900.m 363000.m 363100.m 363200.m 363300.m 363400.m
363500.m 363600.m 363700.m 363800.m 363900.m 364000.m 364100.m
364200.m 364300.m 364400.m 364500.m 364600.m 364700.m 364800.m
364900.m 365000.m

and these y-values (or northings):
6344000.m 6344100.m 6344200.m 6344300.m 6344400.m 6344500.m 6344600.m
6344700.m 6344800.m 6344900.m 6345000.m 6345100.m 6345200.m 6345300.m
6345400.m 6345500.m 6345600.m 6345700.m 6345800.m 6345900.m 6346000.m
6346100.m 6346200.m 6346300.m 6346400.m 6346500.m 6346600.m 6346700.m
6346800.m 6346900.m

DISCRETE RECEPTOR LOCATIONS (in metres)

| No. | X | Y | ELEVN | HEIGHT | No. | X | Y | ELEVN | HEIGHT |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 363733 | 6346064 | 0.0 | 0.0 | 3 | 363220 | 6346274 | 0.0 | 0.0 |
| 2 | 363203 | 6346323 | 0.0 | 0.0 | 4 | 363547 | 6346080 | 0.0 | 0.0 |

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METEOROLOGICAL DATA : "AUSPLUM " E M " ETFI" " L E"

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AVERAGE OVER ALL HOURS AND FOR ALL SOURCES
in microgram/m3

| Y (km) \ X (km): | 362.100 | 362.200 | 362.300 | 362.400 | 362.500 | 362.600 |
|---|---|---|---|---|---|---|
| 6346.900 | 1.17E+00 | 1.29E+00 | 1.40E+00 | 1.53E+00 | 1.67E+00 | 1.74E+00 |
| 6346.800 | 1.22E+00 | 1.35E+00 | 1.49E+00 | 1.63E+00 | 1.80E+00 | 1.92E+00 |
| 6346.700 | 1.26E+00 | 1.40E+00 | 1.56E+00 | 1.74E+00 | 1.93E+00 | 2.12E+00 |
| 6346.600 | 1.30E+00 | 1.46E+00 | 1.64E+00 | 1.85E+00 | 2.09E+00 | 2.32E+00 |
| 6346.500 | 1.34E+00 | 1.52E+00 | 1.73E+00 | 1.96E+00 | 2.24E+00 | 2.55E+00 |
| 6346.400 | 1.35E+00 | 1.56E+00 | 1.81E+00 | 2.09E+00 | 2.40E+00 | 2.79E+00 |
| 6346.300 | 1.36E+00 | 1.58E+00 | 1.86E+00 | 2.21E+00 | 2.61E+00 | 3.06E+00 |
| 6346.200 | 1.37E+00 | 1.59E+00 | 1.89E+00 | 2.27E+00 | 2.80E+00 | 3.40E+00 |
| 6346.100 | 1.40E+00 | 1.62E+00 | 1.92E+00 | 2.34E+00 | 2.91E+00 | 3.72E+00 |
| 6346.000 | 1.44E+00 | 1.67E+00 | 1.98E+00 | 2.42E+00 | 3.03E+00 | 3.95E+00 |
| 6345.900 | 1.48E+00 | 1.74E+00 | 2.08E+00 | 2.53E+00 | 3.20E+00 | 4.20E+00 |
| 6345.800 | 1.44E+00 | 1.72E+00 | 2.10E+00 | 2.64E+00 | 3.41E+00 | 4.56E+00 |
| 6345.700 | 1.36E+00 | 1.63E+00 | 2.00E+00 | 2.54E+00 | 3.35E+00 | 4.67E+00 |
| 6345.600 | 1.28E+00 | 1.54E+00 | 1.89E+00 | 2.40E+00 | 3.19E+00 | 4.51E+00 |
| 6345.500 | 1.22E+00 | 1.44E+00 | 1.76E+00 | 2.20E+00 | 2.90E+00 | 4.04E+00 |
| 6345.400 | 1.17E+00 | 1.37E+00 | 1.64E+00 | 2.01E+00 | 2.55E+00 | 3.41E+00 |
| 6345.300 | 1.04E+00 | 1.20E+00 | 1.41E+00 | 1.70E+00 | 2.09E+00 | 2.65E+00 |
| 6345.200 | 9.25E-01 | 1.06E+00 | 1.22E+00 | 1.41E+00 | 1.66E+00 | 1.98E+00 |
| 6345.100 | 8.21E-01 | 9.12E-01 | 1.02E+00 | 1.15E+00 | 1.30E+00 | 1.49E+00 |