ABN: 69 107 169 102

Werris Creek Coal Pty Limited

AIR QUALITY ASSESSMENT

For

Werris Creek Coal Mine Life of Mine Project

Prepared by

Heggies Pty Ltd

Specialist Consultant Studies Compendium
Volume 1, Part 4

December 2010

This page has intentionally been left blank

WHITEHAVEN COAL

ABN: 69 107 169 102

Werris Creek Coal Pty Limited

AIR QUALITY ASSESSMENT

for

Werris Creek Coal Mine
Life of Mine Project

Prepared for: R.W. Corkery & Co. Pty Limited
1st Floor, 12 Dangar Road
PO Box 239
BROOKLYN NSW 2083

Tel: (02) 9985 8511
Fax: (02) 9985 8208
Email: brooklyn@rwcorkery.com

On behalf of: Werris Creek Coal Pty Limited
ABN: 69 107 169 103
PO Box 600
GUNNEDAH NSW 2380

Tel: (02) 6768 7071
Fax: (02) 6768 7072
Email: bcullen@whitehavencoal.com.au

Prepared by: Heggies Pty Ltd
PO Box 176
LANE COVE NSW 1595

Tel: (02) 9427 8100
Fax: (02) 9427 9200
Email: sydney@heggies.com

December 2010

APPENDICES

FIGURES

TABLES

EXECUTIVE SUMMARY

Heggies Pty Ltd has been commissioned by R.W. Corkery and Co. Pty Limited on behalf of Werris Creek Coal Pty Limited to conduct an air quality impact assessment of a proposed extension of mining operations and associated activities of the Werris Creek Coal Mine. The proposal is referred to as the Life of Mine Project (LOM Project).

Atmospheric dispersion modelling predictions of fugitive emissions of particulate matter (PM_{10}, $PM_{2.5}$ and TSP) from the Project Site were undertaken using the CALPUFF dispersion model in screening mode. Emissions associated with overburden removal, coal mining, processing, storage and rail loading and transport activities for the LOM Project have been modelled.

Local meteorological conditions obtained from a weather station operated at the existing mine site since 2005 and air quality monitoring data from local and regional sources were integrated into the dispersion model.

The three selected modelling scenarios comprised of typical coal extraction, overburden emplacement and coal processing locations over the life of the Project, and sought to represent worst case air quality impacts at all eighteen discrete surrounding properties/residences.

The results of the dispersion modelling conducted for the LOM Project indicate the potential for exceedance of the DECCW 24-hour PM_{10} assessment criteria at the nearest non-Project related residence to the east of the Project Site, the yet to be constructed Residence 14. However, the modelled scenario presents a conservative prediction of emissions likely to be generated by the proposed LOM Project. The predicted emissions are therefore likely to be higher than those that would actually occur.

Continuation of air quality monitoring at the surrounding PM_{10} and dust deposition monitoring network for the life of the LOM Project would validate this conclusion. Additionally, the commencement of $PM_{2.5}$ monitoring would assist in the validation of the findings of the $PM_{2.5}$ assessment, which is necessarily highly uncertain.

Greenhouse gas emissions for the proposed LOM Project were also calculated. Direct (Scope 1) emissions were calculated to total approximately 165,000t of CO_2 equivalent (CO_2-e) annually. This represents an increase of less than 0.03% on Australia's national net 2007 emissions. Scope 1, 2 and 3 emissions were calculated to total approximately 3.2 Mt per annum.

This page has intentionally been left blank

1. INTRODUCTION

Heggies Pty Ltd (Heggies) has been commissioned by R.W Corkery & Co. Pty. Ltd. (RWC) to undertake an *Air Quality Assessment* (AQA) for the proposed Werris Creek Coal Mine Life of Mine Project (LOM Project). The current Werris Creek Coal Mine is located within Mining Lease (ML) 1563, approximately 4 km south of the town of Werris Creek and 11 km north of Quirindi, NSW.

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

- Description of local topographic features and sensitive receptor locations (Section 3).
- Establishment of air quality assessment criteria (Section 4).
- Analysis of climate and dispersion meteorology for the region (Section 5).
- Description of existing air quality environment (Section 6).
- Compilation of a comprehensive emissions inventory for proposed operations (Section 8).
- Completion of atmospheric dispersion modelling and analysis of results (Section 10**)**.
- Preparation of an air quality impact assessment report comprising of the above.

This assessment aims to describe the existing environment of the area surrounding the Project Site and contains detailed information relating to items 1 to 6 above in the sections noted. This report also presents a greenhouse gas assessment for the LOM Project, in Section 10.2.

Table 1 paraphrases the requirements associated with this assessment by the Director General of the Department of Planning and other government agencies. **Table 1** also summaries where each of the requirements are addressed within this report.

2. PROJECT DESCRIPTION

2.1 CURRENT OPERATIONS

The Werris Creek Coal Mine is located approximately 4 km south of the township of Werris Creek, 11 km north northwest of Quirindi and 40 km southwest of Tamworth in the North West Slopes and Plains district of New South Wales. **Figure 1** illustrates the local setting of the Project Site.

Approval to extract and process up to a maximum of 2 million tonnes per annum (Mtpa) of Run-of-Mine (ROM) coal was granted for the Werris Creek Coal Mine in February 2005 (DA 172-7-2004). Five modifications to the approval have since been granted, with the last approval granted in 2009 allowing for a small northerly extension of the existing open cut operations (Northern Extension).

Table 1
Paraphrased Requirements for the Air Quality Assessment

Page 1 of 2

Government Agency	Paraphrased Requirement	Relevant Section(s) in this Assessment
Department of Planning	Include a quantitative assessment of potential air quality impacts, including dust emissions from rail wagons.	Section 8.3 Section 10
Liverpool Plains Shire Council	Dust generated from loaded coal carriages especially as they move through urbanised areas. …………Council would like to see an undertaking from the proponent that only rail coal carriers will be utilised that have covers fitted to the carriages similar to the road carriers described at the bottom of page 11 of the PEA.	Section 8.3 Section 10
	Council proposes that the final PEA should address the monitoring of finer dust particles than proposed in view of the public health implications for the residents of Werris Creek, Quirindi and Willow Tree. Council's information on this matter suggests that particle sizes from PM1 to PM2.5 (as a minimum) should be monitored with monitoring to commence as soon as possible.	Section 10.1.4 Section 10.2
	………Council's expectation would be that the final PEA will address these impacts as generated by this proposal and any mitigation activities proposed.	Section 10.1.4
Environment Climate Change & Water	In summary the Department's key information requirements for the project are:	
	the impact on ***air quality***, noise amenity, water quality and quantity for all operations proposed for the mine and associated infrastructure;	
	Impacts on air quality	Section 10
	The goal is to maintain existing rural air quality and protect sensitive receptors, both on and off site, from adverse impacts of dust and odour.	Section 10
	Dust (PM2.5, PM10 and TSP) is the primary concern with potential emissions from construction activity, clearing and open cut mining operations, heavy equipment movement, crushing equipment and conveyors, transfer points, loading facilities and from coal, topsoils and overburden stockpiles.	Section 7 Section 10
	The air quality impacts from the proposed development will need to be assessed using the methodology detailed in the DEC document "Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in New South Wales"……	Section 7 Section 10
	all assumptions used in modelling impacts will need to be clearly identified and justified……….	Section 7 Section 10
	If the modelling and proposed management incorporates dust suppression using water then the volume requirements and source of the water must be identified, particularly for drier periods where water availability for dust suppression may be problematic.	Section 7.2.1
	Contingencies to modify operations during high wind periods and as a result of water availability may need to be considered to minimise dust impacts.	Section 8.2 Section 10.2

Table 1 (Cont)
Paraphrased Requirements for the Air Quality Assessment

Page 2 of 2

Government Agency	Paraphrased Requirement	Relevant Section(s) in this Assessment
	Any assumptions made in relation to wind borne dust sources from disturbed/ undisturbed land, particularly the progressive/ maximum area of disturbance against realistic rehabilitation objectives must be clearly established.	Section 7.1.3
	…….Any assumptions in the air quality modelling made in relation to rate of progressive rehabilitation to minimise dust sources from wind borne erosion be a clear commitment by the proponent.	Section 7.1.3
	Air quality impacts from movement of coal in uncovered wagons by rail should also be assessed……….	Section 8.3 Section 10
	The proponent should liaise with ARTC regarding any outcomes from Pollution Reduction Program on the ARTC rail network licence (EPL 3142) to evaluate coal dust issues from rail transport and implement a work program to reduce dust emissions	Section 10.1.6
Environment Climate Change & Water	**Greenhouse gas emissions**	
	The EA should include a comprehensive assessment of, and report on, the project's predicted greenhouse gas emissions (tCO2e).	Section 11
	Emissions should be reported broken down by:	
	a. direct emissions (scope 1 as defined by the Greenhouse Gas Protocol- see reference below), b. indirect emissions from electricity (scope 2), and c. upstream and downstream emissions (scope 3).	Section 11.2.1
	Before and after implementation of the project, including annual emissions for each year of the project (construction, operation and decommissioning).	Section 11.3
	The emissions should be estimated using an appropriate methodology, in accordance with NSW, Australian and international guidelines……..	Section 11.2
	……… evaluate and report on the feasibility of measures to reduce greenhouse gas emissions associated with the project. This could include a consideration of energy efficiency opportunities or undertaking an energy use audit for the site.	Section 11.4
	The proponent should also identify if there are any cost-effective opportunities to reduce scope 3 emissions (eg by using different methods of supply or distribution)	Section 11.4

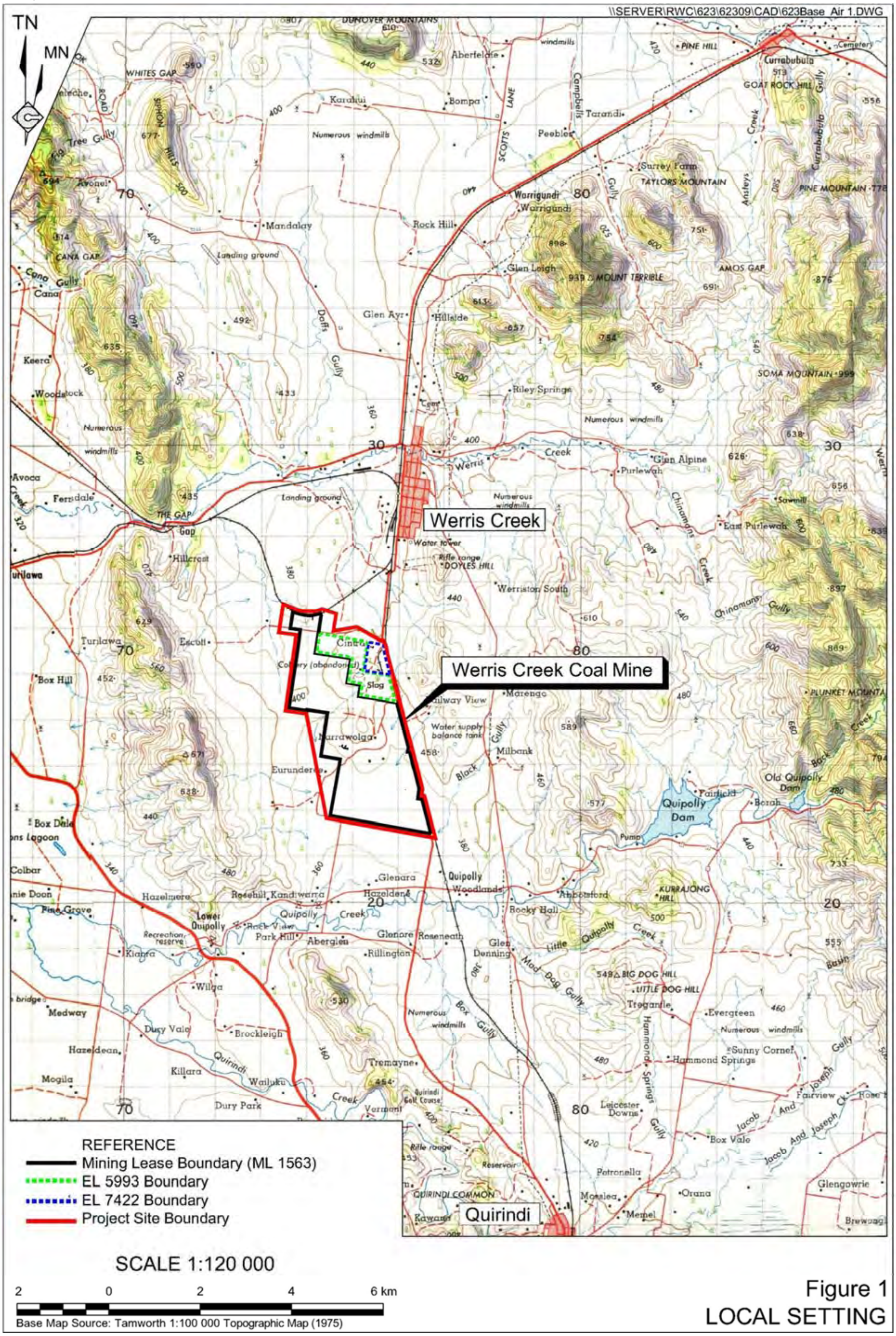


Figure 1
LOCAL SETTING

Current operations at the Werris Creek Coal Mine involve the following activities.

- Vegetation removal in advance of the active pit.
- Stripping of topsoil and subsoil.
- Programmed placement of overburden and interburden materials from the open cut, using both out-of-pit overburden emplacement and emplacement within the open cut void.
- Construction of near horizontal benches through blasting and coal removal.
- On-site coal processing (size reduction and screening only).
- Operation of a Rail Load-out Facility adjacent to a rail siding originating from near Werris Creek.
- Transportation of product coal from the on-site size reduction and screening facility to the Rail Load-out Facility along a purpose-built rail load-out road or to domestic markets by road.
- Progressive shaping and rehabilitation of the open cut mining area.

Hours of operations at the Werris Creek Coal Mine currently vary depending on the type of activity undertake. Overburden removal and management, maintenance and coal loading to trains is current licensed for 24 hours 7 days per week, whereas other operations such as drilling, internal transport of coal products to ROM stockpiles, on-site processing and coal transport to the Rail Load-out Facility are currently not licensed between the hours of 4:00am and 7:00am Monday to Friday and between 2:00pm Saturday and 7:00am Monday. Further restrictions are placed on activities such as rehabilitation and blasting.

2.2 SUMMARY OF PREVIOUS AIR QUALITY IMPACT ASSESSMENTS

2.2.1 Proposed Werris Creek Coal Mine AQA

As part of the *Environmental Impact Statement* compiled for the original Werris Creek Coal Mine development application, an AQA was conducted by Heggies in July 2004.

The 2004 AQA for the original Werris Creek Coal Mine focused on the potential impact on the surrounding environment from operational emissions at the Werris Creek Coal Mine during two stages, namely:

- Year 1 - (extraction closest to the southern residence (“Gedhurst”) – simulation of initial overburden emplacement activities); and
- Year 7 - (extraction closest to the remaining northern and eastern residences).

Emissions from the following operational activities for each stage of the initial project were calculated and input into the EPA Victoria dispersion model Ausplume.

- Mining activities (excavators, dozers, scrapers and graders).
- Blasting activities.
- Placement of materials within the site (i.e. topsoil, subsoil, overburden / interburden, mined coal).
- Coal Processing Area activities (front-end loader, primary crusher, secondary crusher, handling / transfer / conveying, product bin loading to trucks).

- Wind erosion of open cut area, soil stockpiles (topsoil and subsoil), out-of-pit overburden emplacement areas, in-pit overburden emplacement and coal stockpiles.
- General movement of heavy vehicles on unsealed roads within the site (haul truck wheel dust).

Pollutants that were assessed through the dispersion modelling process included emissions of particulate matter (PM_{10}[1] and deposited dust) nitrogen dioxide (NO_2) and sulphur dioxide (SO_2). Existing air quality conditions were assessed through the analysis and application of air quality monitoring data acquired from the then operational Canyon (formerly Whitehaven) Open Cut Coal Mine (for dust deposition) and DECCW recorded data from Tamworth (for PM_{10}).

Initial modelling of Year 7 operations for the original Werris Creek Coal Mine revealed that the use of water sprays during hauling on unpaved roads may be a defining factor in achieving acceptable air quality goals for particulate matter. It was assumed that watering of haul roads in excess of 2 litres/m^2/h would be applied during adverse weather condition days.

Total mean monthly dust deposition (background plus increment) rates were predicted to be less than 3.4 g/m^2/month, assuming that the above dust mitigation measure was implemented. The development was therefore predicted to satisfy the project criterion of 3.6 g/m^2/month.

All modelling predictions indicated that particulate matter, dust deposition, NO_2 and SO_2 attributable to original Werris Creek Coal Mine were within the current NSW DECCW air quality goals at the time.

However, in order to demonstrate compliance, it was recommended that monitoring of dust deposition rates was undertaken at a minimum of three locations throughout the mine life.

Annual greenhouse gas emissions from the original Werris Creek Coal Mine were also calculated during the original AQA. Total annual emissions were calculated to be approximately 77 000 t of Carbon Dioxide Equivalent (CO_2-e), which equated to a potential increase of 0.015% on Australia's 1990 greenhouse gas emissions.

2.2.2 Proposed Modification to the Werris Creek Coal Mine AQA (MOD 5 – Northern Extension)

An AQA for the Northern Extension at the Werris Creek Coal Mine was conducted by Heggies in March 2009.

The 2009 AQA for the Northern Extension focused on the potential impact on the surrounding environment from operational emissions at the Werris Creek Coal Mine during two worst case scenarios.

- Year 1 (2009) - (maximum annual overburden removal amount).
- Year 3 (2011) – (northern-most point of open cut development, closest to non-project related receptors to the north of mine).

[1] PM_{10} is used to describe particulate matter with an aerodynamic diameter of 10 microns (μm) or less.

Emissions from the following operational activities for each stage of the Northern Extension were calculated and inputted into the CALPUFF dispersion model.

- Coal extraction operations, including drilling and blasting, bulldozer and excavator.
- Overburden removal, including use of scraper on topsoil and excavator.
- Construction and maintenance of the overburden emplacement area, including wind-generated erosion.
- Coal Processing Area operations.
- Movement of haul trucks about the mine site.
- Operation of the Rail Load-out Facility in the north of the mine site.

Pollutants that were assessed through the dispersion modelling process included emissions of particulate matter (PM_{10} and deposited dust). Existing air quality conditions were assessed through the analysis and application of air quality monitoring data acquired at the existing Werris Creek Coal Mine (for dust deposition) and DECCW recorded data from Tamworth (for PM_{10}).

The results of the dispersion modelling conducted for the Northern Extension of the Werris Creek Coal Mine, indicated the potential for exceedance of the incremental dust deposition and DECCW 24-hour PM_{10} assessment criteria at the nearest then non-Project related residence to the north of the site. However, the modelled scenario presented a conservative prediction of emissions likely to be generated by the Northern Extension. The predicted emissions were therefore likely to be higher than those that would actually occur.

Greenhouse gas emissions for the Northern Extension to the Werris Creek Coal Mine were also calculated. Full fuel cycle (Scope 1 to Scope 3) emissions were calculated to total approximately 400kt CO_2 equivalent (CO_2-e) annually. This represented an increase of less than 0.1% on Australia's national net 2006 emissions.

Furthermore, when compared with the greenhouse gas emissions calculated for the existing operations, the Northern Extension was predicted to result in an increase in annual Scope 1 emissions of approximately 30%. This equated to an additional increase of less than 0.0001% on Australia's national net 2006 emissions annually.

2.3 PROPOSED WERRIS CREEK COAL MINE LOM PROJECT

The main activities associated with the proposed LOM Project are illustrated in **Figure 2** and include the following.

- Increased total coal production to up to 2.5 Mtpa.
- An extension to the out-of-pit and in-pit overburden emplacements. In order to attenuate noise impacts and screen the operation visually from Werris Creek, the overburden emplacement would extend around the eastern and northeastern perimeter of the open cut and a bund wall would be constructed of overburden around the northeastern perimeter of the open cut. This extension of the overburden emplacement is referred to as the Acoustic and Visual Amenity Bund.
- Relocation of the Coal Processing Area and increasing the size of the ROM stockpile to 200 000 t.

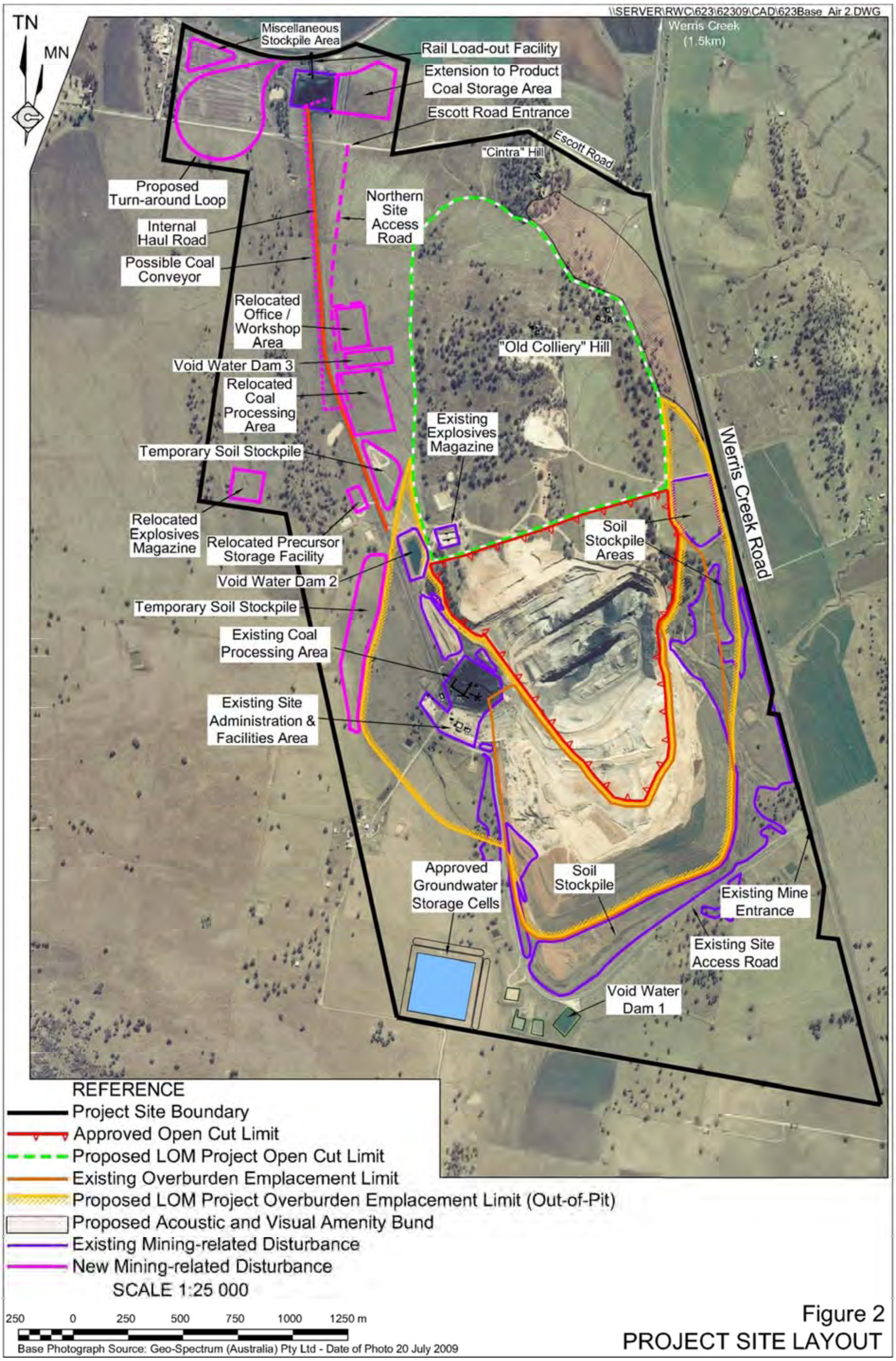


Figure 2
PROJECT SITE LAYOUT

- Relocation of the Site Facilities and Administration Area.
- Increasing the size of the Product Coal Storage Area to 250 000 t by extending the pad to the east.
- Installation of a second feed point at the Rail Load-out Facility.
- Construction of a 'turn-around' rail loop off the Werris Creek Rail Siding to the immediate west of the Rail Load-out Facility.
- Construction of a new mine entrance off Escott Road (and closing the existing mine entrance off the Werris Creek Road).
- Continued dewatering of the old underground workings.
- Construction of a new Void Water Dam at the northern end of the Project Site.
- An increase in the road transportation of domestic coal to 100 000 tpa.
- Increased hours of operation to 24 hours a day, 7 days a week.

2.5 PARTICULATE EMISSIONS FROM THE LOM PROJECT

Atmospheric pollutants generated by activities that would occur at the Werris Creek Coal Mine for the LOM Project include fugitive emissions of particulates (PM_{10}, $PM_{2.5}$, TSP and deposited dust) in addition to those generated through the combustion of fuel in vehicles (NOx, SO_2, VOCs, CO, PM_{10}, $PM_{2.5}$).

It is considered that background concentrations of combustion related pollutants (including PM_1) in the local area are low, due to the absence of significant combustion sources within the immediate region. Additionally, the emissions of these pollutants from sources related to the LOM Project would be relatively minor, with resulting concentrations at the nearest receptors negligible. Consequently, the focus of this assessment is on fugitive emissions of dust and particulate (PM_{10}, $PM_{2.5}$ and TSP).

2.6 EXISTING AIR QUALITY MITIGATION AND MANAGEMENT MEASURES

To ensure that relevant air quality criteria are satisfied in accordance with the operational conditions of consent for the Project, the following measures were implemented by the Proponent during 2008-2009 operations (WCC, 2009a).

- Use of trunks, branches and leaf litter from clearing for mine site rehabilitation. No materials are burnt.
- Limiting groundcover removal in advance of mining consistent with operational requirements.
- Groundcover removal as part of the topsoil removal activities, rather than prior to topsoil removal.
- Where practicable, limiting soil stripping activities to periods when there is sufficient soil moisture to prevent significant dust lift-off and avoiding periods of high winds.
- Application of water to exposed surfaces, with emphasis on those areas subject to frequent vehicle / equipment movements which may cause dust generation and dispersal.

- Conveyor cleaning and collection devices to minimise amount of material falling from the return conveyor belt.
- The use of water injection on the drilling rigs.
- Regular watering of internal haul roads.
- Water application at the feed hopper, crusher and at all conveyor transfer and discharge points.
- The cessation of coal processing activities during periods of concurrent high winds and temperatures which cause coal dust dispersal, independent of water applications.
- Coal is moist when stockpiled and residence times limited where possible.
- Progressive shaping and rehabilitation of areas once they are no longer required for mining purposes.
- Mobile vehicles and equipment on the Project Site travel at appropriate speeds.
- Equipment exhaust positioning to avoid exhausts impinging on the ground and causing dust lift-off.
- Use of covers on all product coal trucks leaving the Project Site.
- Regular locomotive maintenance to ensure compliance with exhaust emission standards.

2.7 AIR QUALITY COMPLAINTS

Examination of the Werris Creek Coal Mine's *Annual Environmental Management Report* (AEMR) for 2008/2009 and 2009/2010 (WCC 2009a, WCC 2010a) indicates that complaints pertaining to air quality are rarely received. Six complaints pertaining to air quality issues have been received and were recorded in the complaints register during the April 2008 to March 2010 period. Details of the six complaints are provided in **Table 2**.

Table 2
Air Quality Complaints Received at the Werris Creek Coal Mine (April 2008 to March 2010)

Date	Location of Complainant	Complaint	Response
1 April 2008	Unknown	Plume of dust moving east off project site across Werris Creek/Quirindi Rd	Extra water cart cycles implemented in the pre-strip area. Operator instructed to stop work if pad/haul road becomes dry and wait for water cart.
22 May 2008	Neighbouring property, north of the rail spur. Patterson Residence	Coal dust blowing off train carriages onto Patterson property. Tank water may contain coal dust	First flush system and in line filter installed on the Patterson residence rain water supply.
13 August 2008	"Marengo" Residence	Excessive dust plume coming from mine onto property between 5pm and 6pm.	Meeting held with complainant. WCC staff were not working between those hours. Neighbouring property did not note excessive dust during the indicated time.
8 September 2008	"Marengo" Residence	Excessive dust coming from mine onto property	Continued discussions with the complainant to work toward a resolution. Adjacent dust monitoring results confirmed that levels were within criteria.
4 August 2009	"Marengo" Residence	Blasting complaint due to fume and dust crossing property and potentially contaminating rain water tank.	Weather data indicated a westerly wind blowing towards the residence at the time of blast. Orica blasting consultants reviewed explosive types used and recommended changing product types to minimise fume generation.
8 October 2009	"Marengo" Residence	Blasting complaint from the previous day with dust and fumes over property	Weather data indicated light winds at time of blast. A dust gauge was installed on the property.

It is noted that of the six complaints received between April 2008 and March 2010, four were received from the "Marengo" residence. "Marengo" was purchased by the Proponent on 17 May 2010 and it is now a project-related residence.

3. PROJECT SETTING

3.1 LOCAL TOPOGRAPHY

Locally, the Project Site and surrounding residences are located on undulating terrain, within the centre of a valley flanked to the east and west by elevated terrain. The Project Site is located at an approximate elevation of between approximately 360m and 440m AHD, on land that rises from the southern and northern boundaries to the centre of the Project Site.

The topography of the local region surrounding the WCCM is presented in **Figure 1**.

3.2 NON PROJECT-RELATED PROPERTIES AND RESIDENCES

A number of project and non project-related residential dwellings are situated in the area surrounding the Project Site (**Figure 3).** Properties and residences that were used as assessment locations within the dispersion modelling study for the LOM Project to determine compliance with air quality regulations surrounding the Project Site are shown in **Figure 3** and **4**. Details relating to each of the assessed property's locations in relation to the Project Site, altitude and project-related status are provided in **Table 3**.

Residences shown in **Figure 3** as black symbols and in **Figure 4** as blue diamonds are owned by the Proponent. As these are Project related locations, air pollutant concentrations have not been assessed at these locations. Residences shown on **Figure 3** as white symbols, and **Figure 4** as red crosses, are those which were modelled as part of this assessment.

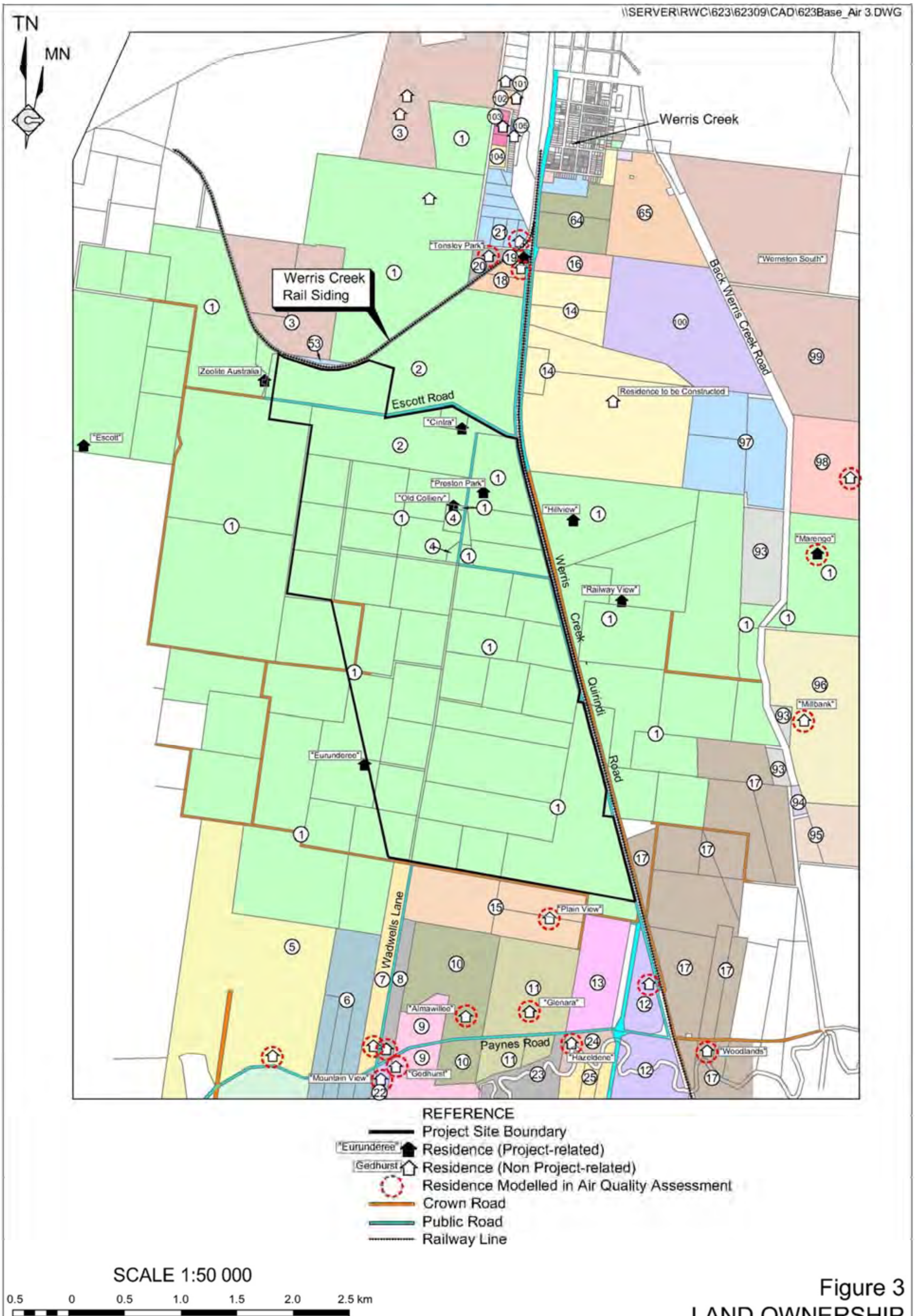
Residences are also identified on **Figure 4** as red triangles (to the north of the WCCM and west of Werris Creek). These residences have been identified following community consultation as locations of concern. Predictions of air quality at these locations have not been explicitly modelled, however, likely air quality concentrations expected to be experienced within the vicinity of these residences can be derived using the gridded model output.

3.3 NEIGHBOURING POLLUTANT SOURCES

3.3.1 Local Sources

Within the wider region of the Gunnedah Basin, there are a number of coal mining-related operations including a number of Whitehaven Coal Limited affiliated operations. It is not considered likely that these other coal mining operations in the area would have the potential to cause cumulative impacts upon receptors surrounding the LOM Project due to the large distances (greater than 50 km) between those mines and sources associated with the LOM Project.

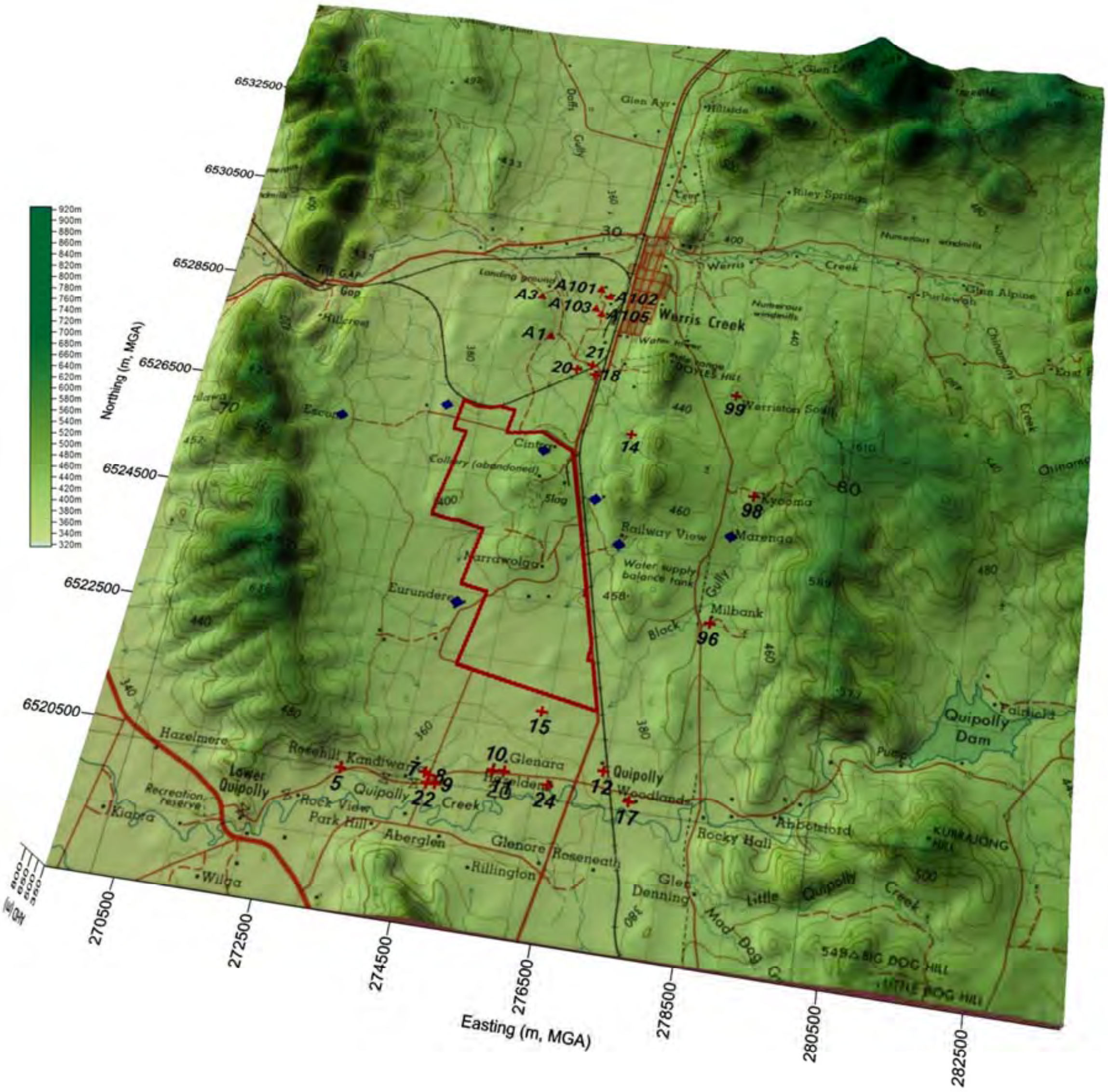
The Zeolite Australia plant and quarry located to the north and west of the Werris Creek Coal Mine will have the potential to contribute to local emissions of particulate matter. The plant and quarry do not report under the NPI and can therefore be assumed to be under the reporting threshold for PM_{10} and are therefore not considered further within this assessment.



Cadastral Information Source: LPI (Bathurst) - Digitised from DCDB
Land Ownership Source: LPI Title Search (2010)

Figure 3
LAND OWNERSHIP
AND RESIDENCES

Figure 4 Location of Surrounding Sensitive Receptors with Overlain Topographical Features



Note: Topography shown with vertical exaggeration of x2 to emphasise terrain features

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 unusual, they do occur and can result in elevated concentrations of particulates over several days in some instances. These events are easily identified through the use of a network of air quality monitors as simultaneous elevations of particulate will be noted across an area (refer Section 6.1).

Table 3
Surrounding Sensitive Receptor Locations

Receptor ID	Receptor Name	Receptor ID Ownership	Receptor Status	Location (m, MGA)	
				Easting	Northing
5	"Rosehill"	R. & A. George	Non-Project	273298	6520261
7		P.R. & J.S. Andrews	Non-Project	274532	6520388
8	"Almawillee"	P.A. & T.M. Hird	Non-Project	274599	6520347
9	"Gedhurst"	B.R. & A.J. Smith	Non-Project	274716	6520233
10	"Glenore"	A. Blackwell	Non-Project	275494	6520552
11	"Glenara"	W.H. & S.I. Ryan	Non-Project	275671	6520581
12		B.A. Fletcher	Non-Project	277094	6520799
14		A.D. & C. Teskera	Non-Project	276639	6526298
15	"Plain View"	R.G. & A.R. Maxwell	Non-Project	276049	6521557
17	"Woodlands"	M.M. Doolan & A.E. Hogan	Non-Project	277529	6520396
18		R.F. & H.T. Withers	Non-Project	275862	6527348
20	"Tonsley Park"	L. Patterson	Non-Project	275559	6527403
21		G.J. Currey	Non-Project	275799	6527523
22	"Mountain View"	L.F. & R.M. Parkes	Non-Project	274588	6520227
24	"Hazeldene"	P. George	Non-Project	276327	6520460
96	"Millbank"	B. Davison	Non-Project	278317	6523290
98	"Kyooma"	J. Colville	Non-Project	278706	6525448
99	"Werriston South"	C. Colville	Non-Project	278193	6527212
A1		T. Windsor	Non-Project	275019	6527976
A103		M.W. & T.M. Parsons	Non-Project	275671	6528620
A3		M.J. Lomax	Non-Project	274742	6528709
A101		J.L. & G.D. O'Brien	Non-Project	275691	6529019
A102		J.W. De Haart	Non-Project	275859	6528896
A105		W.R. Lewis	Non-Project	275776	6528536

4. AMBIENT AIR QUALITY CRITERIA

4.1 PARTICULATE MATTER

Airborne contaminants that can be inhaled directly into the lungs can be classified on the basis of their physical properties as gases, vapours or particulate matter. In common usage, the terms "dust" and "particulates" are often used interchangeably. The term "particulate matter" refers to a category of airborne particles, typically less than 30 microns (µm) in diameter and ranging down to 0.1 µm and is termed total suspended particulate (TSP).

The annual goal for TSP is 90µg/m^3, as recommended by the National Health and Medical Research Council (NHMRC) at their 92nd session in October 1981. This goal was developed before the more recent results of epidemiological studies suggested a relationship between health impacts and exposure to concentrations of finer particulate matter.

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

The current NSW PM_{10} assessment goals as expressed in the Approved Methods are:

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

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

In December 2000, the NEPC initiated a review to determine whether a new ambient air quality criterion for $PM_{2.5}$ was required in Australia and the feasibility of developing such a criterion. The review found that:

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

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

As such, in July 2003, a variation to the *Ambient Air Quality* NEPM was made to extend its coverage to $PM_{2.5}$. This document references the following reporting goals for $PM_{2.5}$:

- A 24-hour average concentration of 25 µg/m^3.
- An annual average concentration of 8 µg/m^3.

It is noted that the goals relating to $PM_{2.5}$ particles are currently guidelines only.

4.2 NUISANCE IMPACTS OF FUGITIVE EMISSIONS

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

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

Table 4
DECCW Goals for Allowable Dust Deposition

Averaging Period	Maximum Increase in Deposited Dust Level	Maximum Total Deposited Dust Level
Annual	2 g/m^2/month	4 g/m^2/month
Source: Approved Methods, DECCW 2005.		

4.3 PROJECT AIR QUALITY GOALS

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

Table 5
Project Air Quality Goals

Pollutant	Averaging Time	Goal
TSP	Annual	90 µg/m^3
PM_{10}	24 hours Annual	50 µg/m^3 30 µg/m^3
$PM_{2.5}$	24 hours Annual	[1]25 µg/m^3 [1]8 µg/m^3
Dust Deposition	Annual	Maximum incremental (Project only) increase of 2 g/m^2/month Maximum Total of 4 g/m^2/month (Project and other sources)
Note 1 – Guideline only.		
Source: Approved Methods, DECCW 2005.		

5. PREVAILING DISPERSION METEOROLOGY

5.1 METEOROLOGICAL DATA AVAILABILITY

To adequately characterise the dispersion meteorology of the Project Site, monitoring data from the existing on-site meteorological station was sourced. The data from this monitoring station was used to characterise the local meteorology and provide the input datasets for the meteorological modelling undertaken. The following parameters, recorded at 10 to 15 minute intervals, were available from this station.

- Wind Speed.
- Wind Direction.
- Temperature.
- Relative Humidity.
- Dew Point Temperature.
- Solar Radiation.
- Precipitation.
- Atmospheric Pressure.

Data at 10 minute intervals recorded between April 2005 and March 2008 and 15 minute data recorded between January 2009 and April 2010 was provided by Proponent. The wind speed and direction profiles for each year, in addition to the 2007/2008 dataset used in the AQA (2009) for the Northern Extension, are presented within **Figure 5**.

The *Approved Methods* state that for Level 2 air quality impact assessments such as this 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, a maximum of 876 hours missing).

As shown in **Figure 5**, only the 2006/2007 and 2009/2010 datasets had a total completeness above 90%. The 2009/2010 dataset also displayed a lower frequency of south-southeast winds and a higher frequency of southeast winds than other years and was deemed not to be representative of the local wind environment. The April 2006 to March 2007 dataset does, however, correspond well to the September 2007 to August 2008 dataset used in the 2009 AQA for the Northern Extension and therefore both datasets are considered a good estimate of the local wind.

The September 2007 to August 2008 dataset from the 2009 AQA for the Northern Extension has therefore been used in the dispersion modelling process for the LOM Project, in accordance with the requirements of the *Approved Methods*. This dataset is 95% complete, and where insufficient data was available for certain parameters, meteorological modelling was conducted as described below.

5.2 METEOROLOGICAL MODELLING

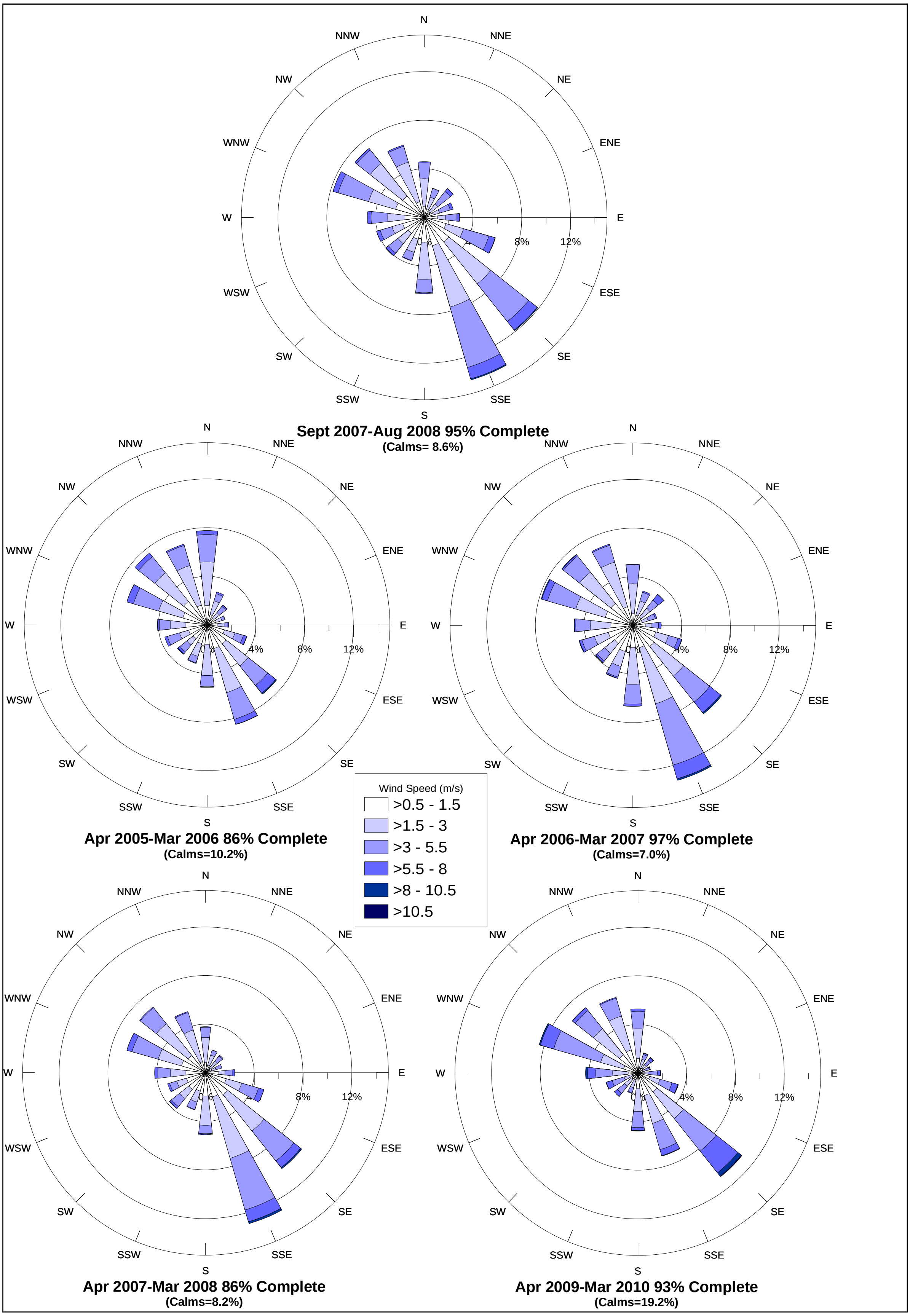
Data obtained by the on-site meteorological monitoring station was used as an input into the atmospheric dispersion modelling. For indirect parameters not recorded on-site, as well as missing hourly data points, *The Air Pollution Model* (TAPM) meteorological model (Version 3) was used to supplement the mine site meteorological dataset. Since this meteorological dataset was prepared, Version 4 of TAPM has been released. Version 4 contains new algorithms designed to overcome the tendency of TAPM Version 3 to underestimate the frequency of light wind speed conditions. Use of TAPM Version 3 rather than Version 4 is expected to result in a conservative assessment of impacts from the LOM Project, because higher wind speeds will give rise to increased wind erosion emissions and will disperse the particulate emissions further from the Project Site.

Use of the September 2007 to August 2008 meteorological dataset provides consistency between the current assessment and the AQA undertaken in 2009. Any changes in predicted impacts from the LOM Project can be confidently attributed to changes in emissions (intensity and/or location) rather than changes in meteorological conditions.

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.

Figure 5 Annual Wind Rose Comparison – Werris Creek Coal Mine Weather Station



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 hourly average wind speed and wind direction at the Proponent’s on-site meteorological station were inputted into the TAPM simulations to provide realignment to local and regional conditions.

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

Table 6
Meteorological parameters used for this study

TAPM (v 3.0)	
Number of grids (spacing)	5 (30 km, 10 km, 3 km, 1 km, 300 m)
Number of grid points	25 x 25 x 30
Year of analysis	September 2007 – August 2008
Centre of analysis	31^{o}24’ S, 150^{o}38’ E
Data assimilation	Meteorological data assimilation using wind data from on-site station.

5.3 METEOROLOGICAL CONDITIONS

5.3.1 Wind Regime

A summary of the September 2007 to August 2008 annual wind behaviour experienced at the Project Site is presented as a wind rose in **Figure 6**. This wind rose displays occurrences of winds from all quadrants.

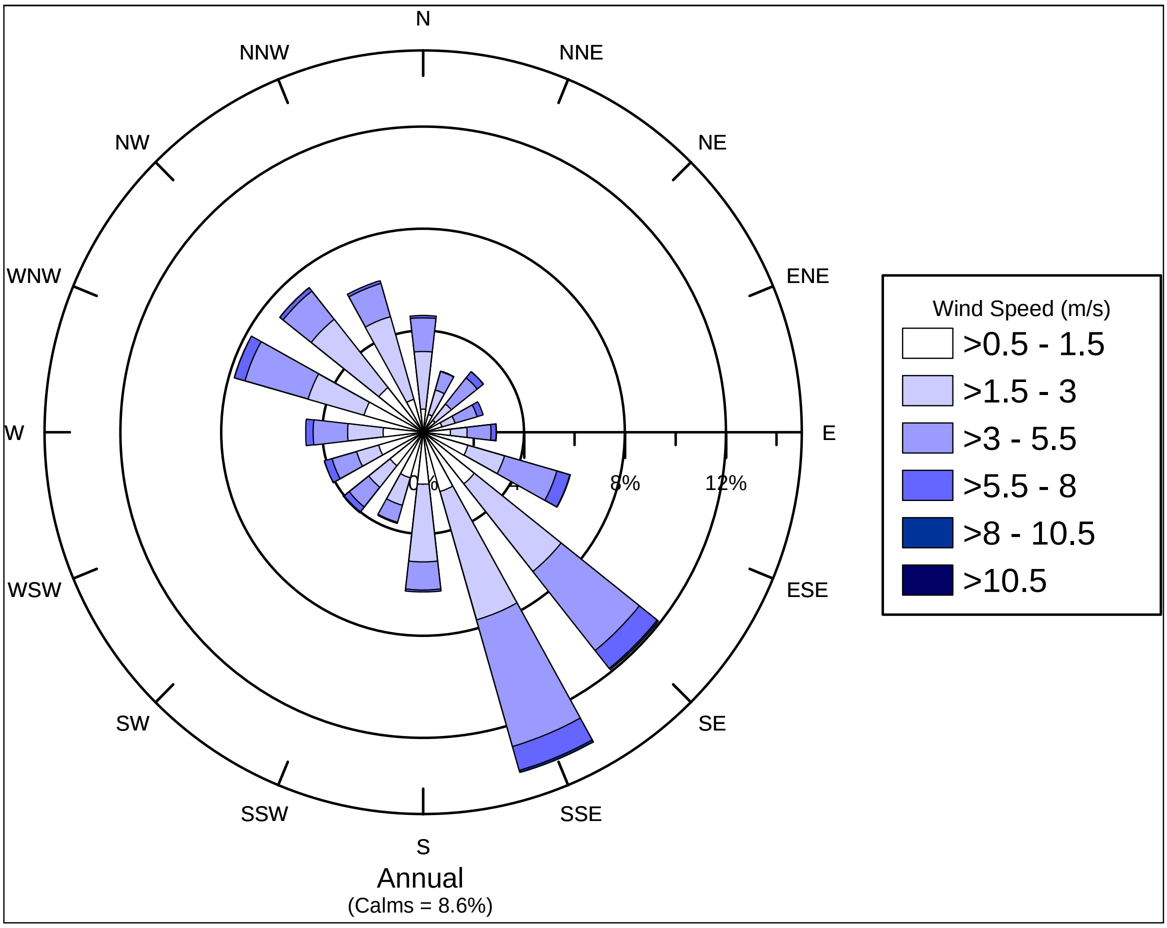
Hourly-average wind speed and direction were derived from the provided 15-minute average dataset using the US EPA (2000) approach for calculating scalar wind speed and direction.

Figure 6 indicates that winds experienced at the Project Site are predominately light to moderate (between 1.5 m/s and 8 m/s) from the southeast to south-southeast (approximately 25% combined) and from the west-northwest to north-northwest (approximately 33% combined). Calm wind conditions (wind speeds less than 0.5m/s) were recorded approximately 8.6% of the time throughout the dataset.

The seasonal variation in predicted wind behaviour at the mine site is presented in **Appendix A**. The seasonal wind roses indicate that:

- in spring, light to moderate winds are experienced predominantly from the southeast to south-southeast (approximately 22% combined) and west to northwest (approximately 27% combined);
- in summer, light to moderate winds are experienced predominantly from the east-southeast to south-southeast (approximately 44% combined);
- in autumn, light to moderate winds are experienced predominantly from the east-southeast to south (approximately 41% combined); and
- in winter, light to moderate winds are experienced from the west to north (approximately 47% combined) and from the southeast to south (approximately 23% combined).

Figure 6 Annual Wind Rose for Project Site – September 2007 to August 2008



5.3.2 Atmospheric Stability and Mixing Depth

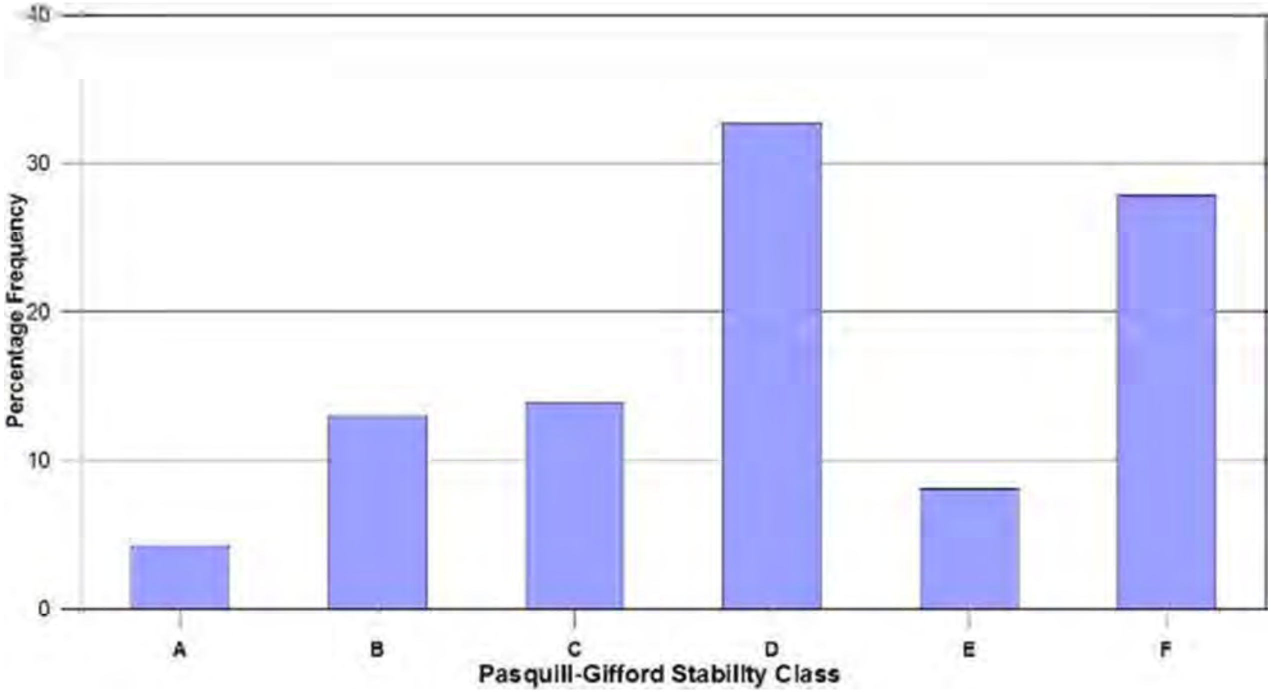
Atmospheric stability refers to the tendency of the atmosphere to resist or enhance vertical motion. The Pasquill-Turner assignment scheme identifies six Stability Classes, "A" to "F", to categorise the degree of atmospheric stability. These classes indicate the characteristics of the prevailing meteorological conditions and are used as input into various air dispersion models **Table 7**).

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 US EPA solar radiation/delta-T method (USEPA, 2000) was used to calculate hourly varying atmospheric stability. This approach uses the recorded 10m wind speed in combination with measured solar radiation during daylight hours, and the measured vertical temperature difference between 2m and 10m during the night hours to derive atmospheric stability. The calculated frequency of each stability class at the Project Site is presented in **Figure 7**. The seasonal stability class distributions for each station are included in **Appendix B**.

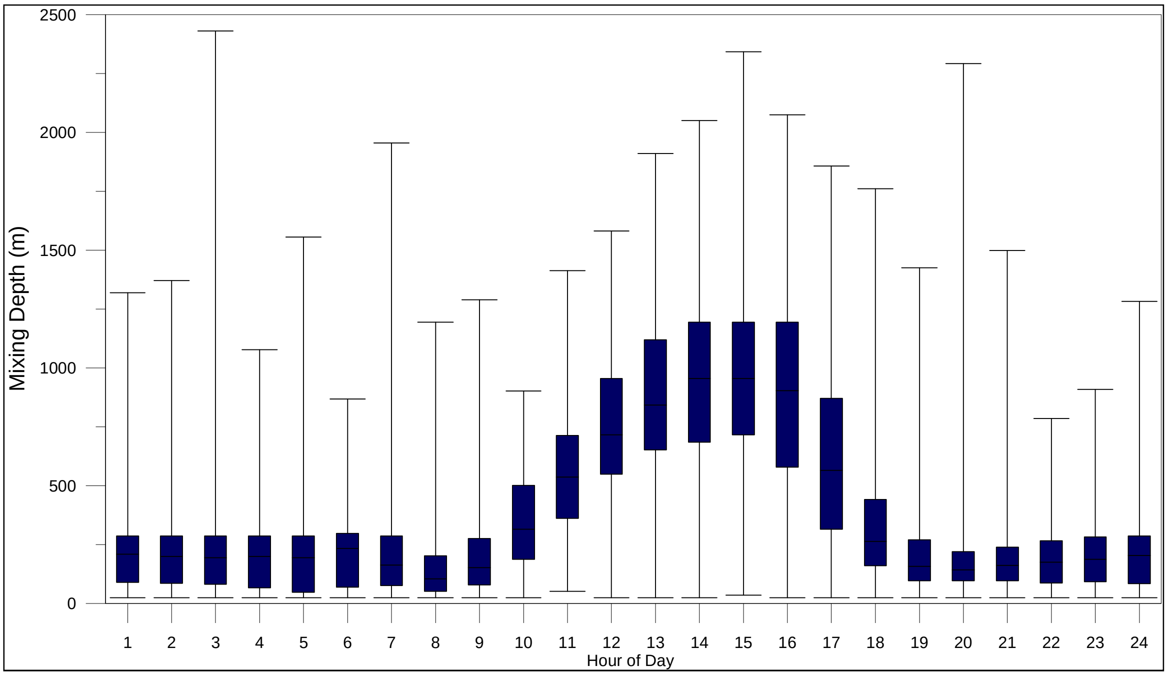
Figure 7 Annual Stability Class Distributions for the Project Site, September 2007 to August 2008



The results indicate a high frequency of conditions typical to Stability Class "D" and "F". Stability Class "D" is indicative of neutral conditions, conducive to a moderate level of pollutant dispersion due to mechanical mixing. Stability Class "F" is indicative of highly stable conditions, representing a low potential for pollutant dispersion.

Diurnal variations in maximum and average mixing depths predicted by TAPM at the Project Site within the dataset are illustrated in **Figure 8**. 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 convective mixing layer.

Figure 8 TAPM-Predicted Diurnal Variation in Mixing Depth for the Project Site, September 2007 to August 2008



6. EXISTING AIR QUALITY ENVIRONMENT

6.1 AIR QUALITY MONITORING AT THE PROJECT SITE

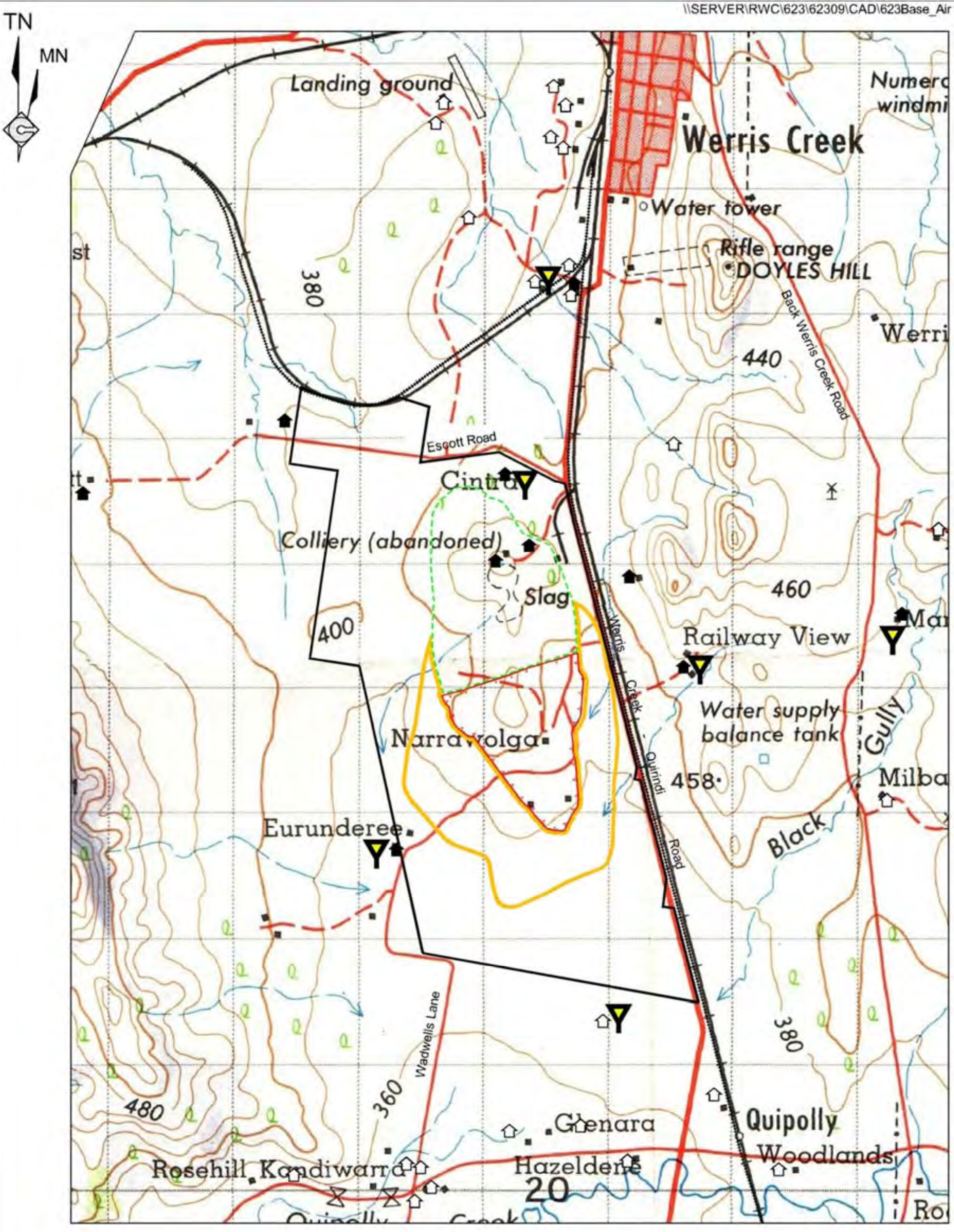
An air quality monitoring network of high volume air samplers (HVAS), for TSP and PM_{10} monitoring and dust deposition gauges (DDG) have been established surrounding the Project Site. PM_{10}, TSP and dust deposition data has been provided by the Proponent for use in this assessment to provide an indication of the existing air quality environment. The current monitoring locations are presented in **Figure 9**. High volume air sampling is currently undertaken for PM_{10} at "Cintra", "Tonsley Park", "Railway View", "Eurunderee" and for TSP at "Railway View". Dust deposition monitoring is currently undertaken at "Cintra", "Tonsley Park", "Railway View" and "Plain View". The air quality monitoring network has been rationalised in recent years although data from historic monitoring locations is also presented within this report. Historic air monitoring locations are presented in **Figure 10**. No monitoring data is currently available for $PM_{2.5}$.

The monitoring data obtained for the assessment is analysed in the following sections. Of particular focus is the period selected for the dispersion modelling, September 2007 to August 2008, although all available data is presented.

6.2 PARTICULATE MATTER

6.2.1 TSP and PM_{10}

PM_{10} monitoring has been conducted at four locations in the vicinity of the Project Site, the locations of which are indicated on **Figure 10** as WCHV-1 to WCHV-4. In addition, TSP monitoring has historically been conducted at WCHV-5. Each monitoring location comprised of a HVAS unit, with 24-hour sampling conducted on a one-in-six day sampling routine. The results of the 24-hour PM_{10} monitoring, conducted between September 2007 and March 2010, are presented in **Table 8**.



REFERENCE
- Project Site Boundary
- Approved Open Cut Limit
- Proposed LOM Project Open Cut Limit
- Proposed LOM Project Overburden Emplacement Limit (Out-of-Pit)
- Air Quality Monitoring Location

SCALE 1:50 000

0.5 0 0.5 1.0 1.5 2.0 2.5 km

Base Map Source: Tamworth (1972) 1:100 000 Topographic Map (1975)

Figure 9
AIR QUALITY MONITORING
LOCATIONS 2010

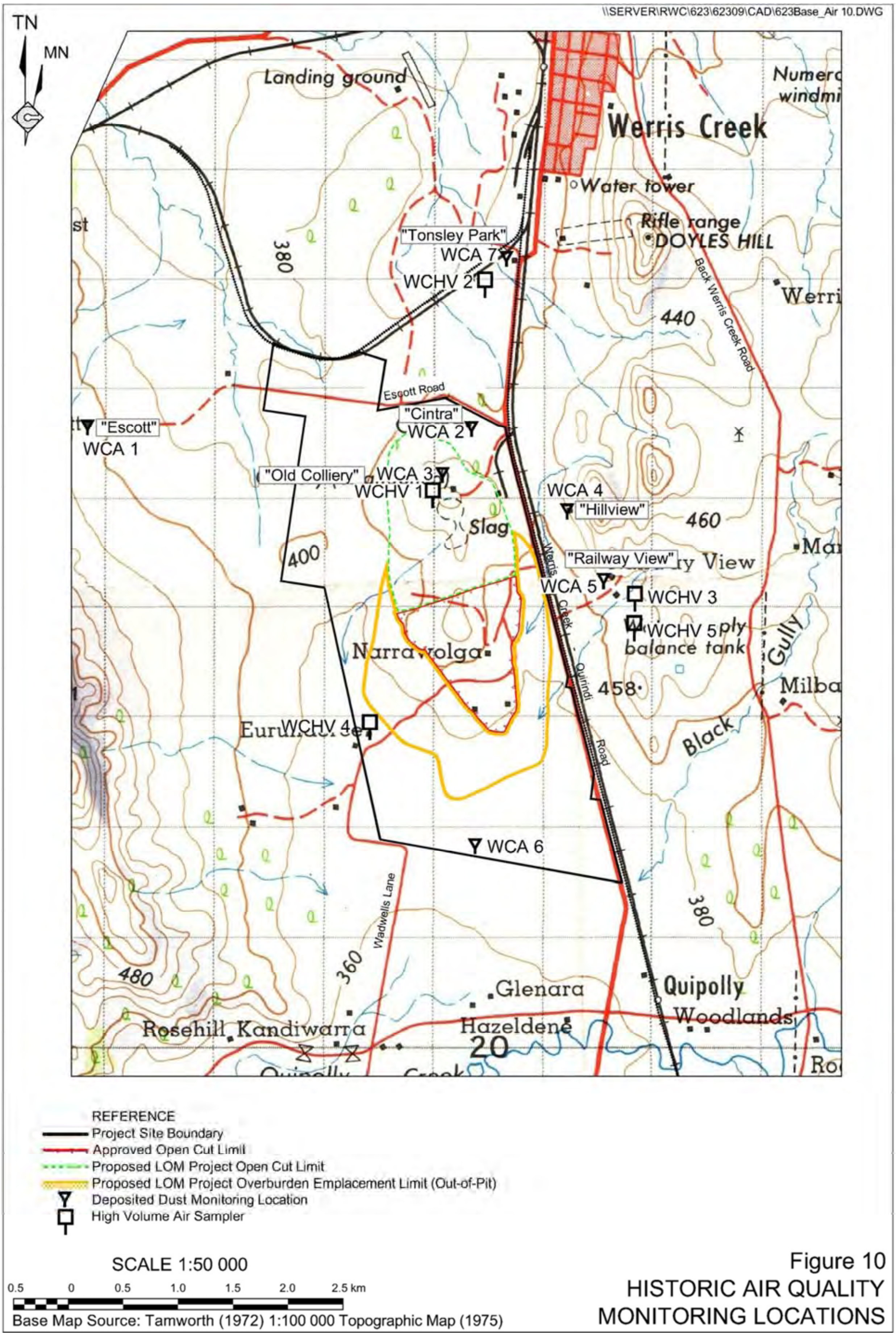


Figure 10
HISTORIC AIR QUALITY MONITORING LOCATIONS

Table 8
24-hour Average PM_{10} and TSP Concentrations – September 2007 to March 2010

HVAS ID	Parameter	Number of Samples	Total Average (µg/m^3)	Modelling Period (Sept 07-Aug 08) Average (µg/m^3)	Modelling Period (Sept 07-Aug 08) Maximum 24 hour (µg/m^3)
WCHV-1	PM_{10}	153	16.4	14.4	52
WCHV-2	PM_{10}	156	14.2	11.5	41
WCHV-3	PM_{10}	155	14.0	12.5	38
WCHV-4	PM_{10}	131	17.9	17.9	47
WCHV-5	TSP	121	30.9	25.0	78

Table 8 indicates that the HVAS locations WCHV-1 and WCHV-4 are subject to a greater level of impact from emissions of PM_{10} generated by the existing operations than WCHV-2 and WCHV-3. WCHV-2 may be viewed as a reasonable reflection of ambient concentrations of PM_{10} in the local air shed, excluding emissions from the mine site, given the distance of the HVAS location from operations.

However, Section 5.1.1 of the *Approved Methods* states that for air quality assessments of this nature, ambient monitoring data for at least one year of *continuous* measurements should be used in dispersion modelling, concurrent with the meteorological dataset. The “one day in six” sampling regime used for the site monitoring program, while compliant with the relevant Australian Standards for ambient sampling of TSP and PM_{10}, does not meet this requirement.

The dispersion modelling conducted for this assessment utilised meteorological data from the September 2007 and August 2008 period (refer Section 5). Data is also available for this period from the DECCW’s Tamworth air quality monitoring station. This air quality monitoring site is located in Hyman Park, off Robert Street and Hillvue Road, Tamworth, approximately 42 km northeast of the Project Site.

The 24-hour average PM_{10} concentrations recorded at the Tamworth air quality monitoring station for the period 1 September 2007 to 31 March 2010 are presented in **Figure 11**. Data have been truncated at 80µg/m^3 due to the presence of several high (>1000µg/m^3) values associated with the dust storms of September 2009.

The data indicates that the highest 24-hour average PM_{10} concentration recorded at the DECCW’s Tamworth air quality monitoring site was 1791.4µg/m^3 recorded on 23 September 2009. This recorded exceedance was attributable to one of the worst dust storms that has ever affected NSW.

The second highest PM_{10} concentration at Tamworth was 325µg/m^3, recorded on 9 December 2009. It is noted that this concentration is attributable to a bushfire affecting the area west of Tamworth and may therefore be considered as elevated for the region. Furthermore, the maximum 24-hour average PM_{10} concentrations for WCHV-1, WCHV-2 and WCHV-3 were all recorded on that same day. The average PM_{10} concentration for the Tamworth dataset was 20.0µg/m^3. For periods of missing data, the annual average PM_{10} concentration has been inserted.

To provide a comparison between the two datasets, concurrent concentrations recorded at the DECCW Tamworth monitoring station and the one-in-six day concentrations recorded surrounding the Project Site between September 2007 and March 2010 are presented in **Figure 12**.

Figure 11 NSW DECCW PM_{10} (24-Hour Average) Monitoring Results for Tamworth, September 2007 to March 2010

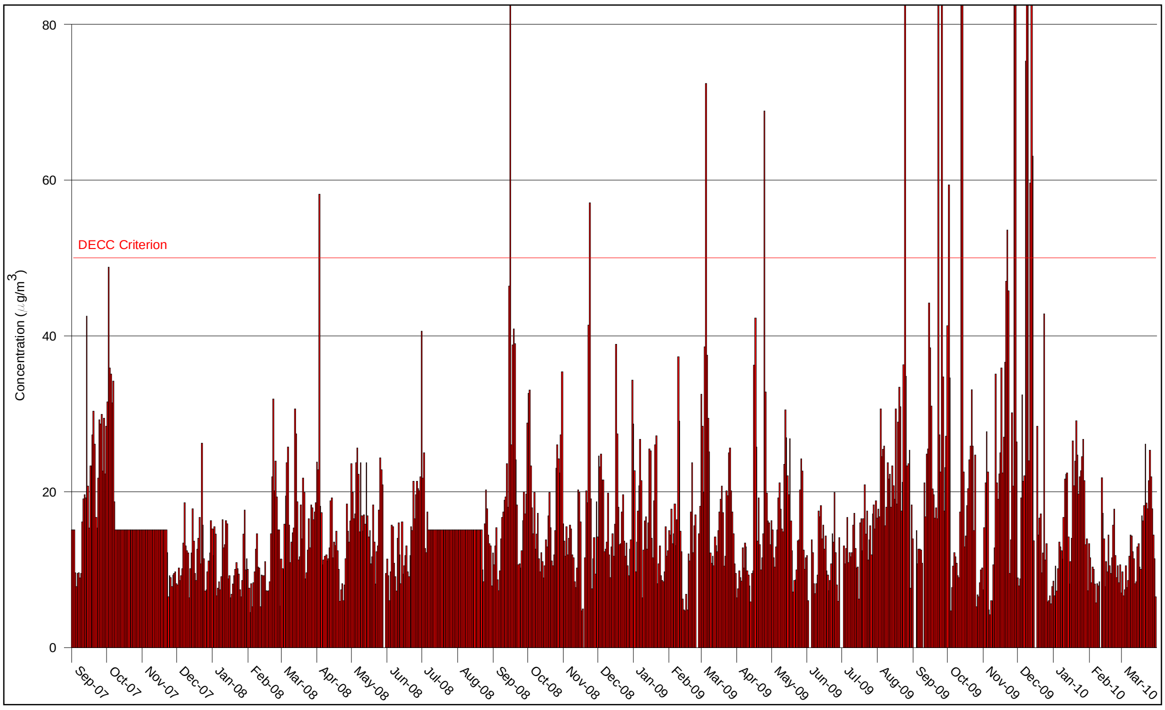
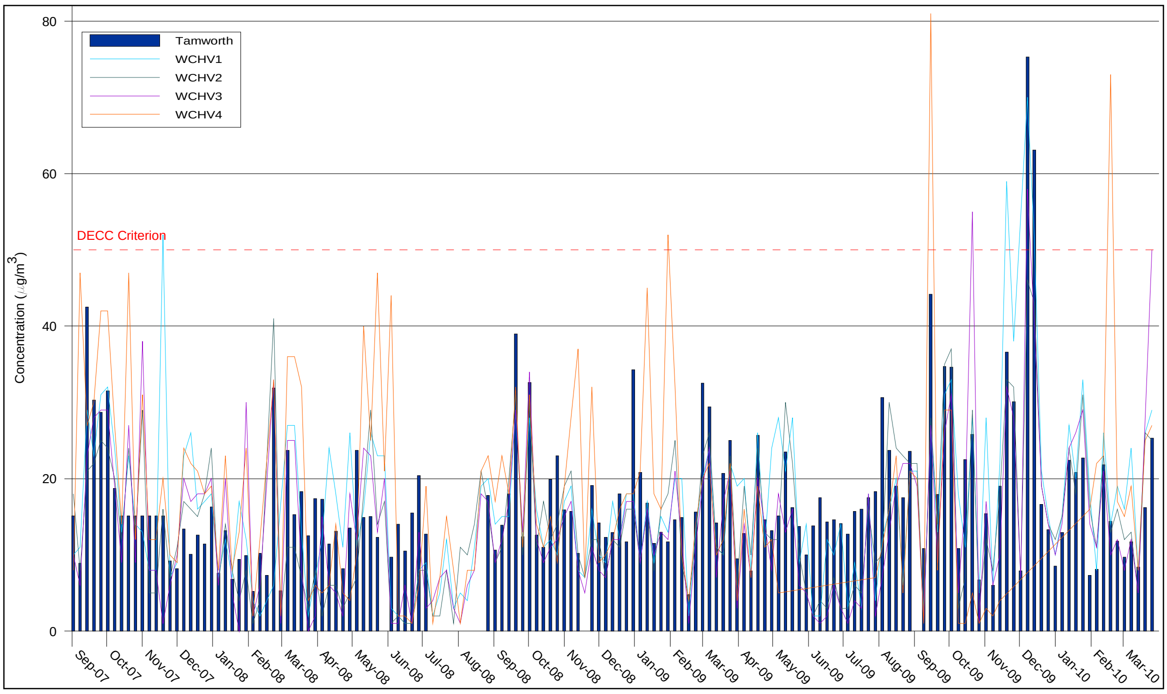


Figure 12 24-hour Average PM_{10} Comparison – Tamworth and Mine Site HVAS Data – September 2007 to March 2010

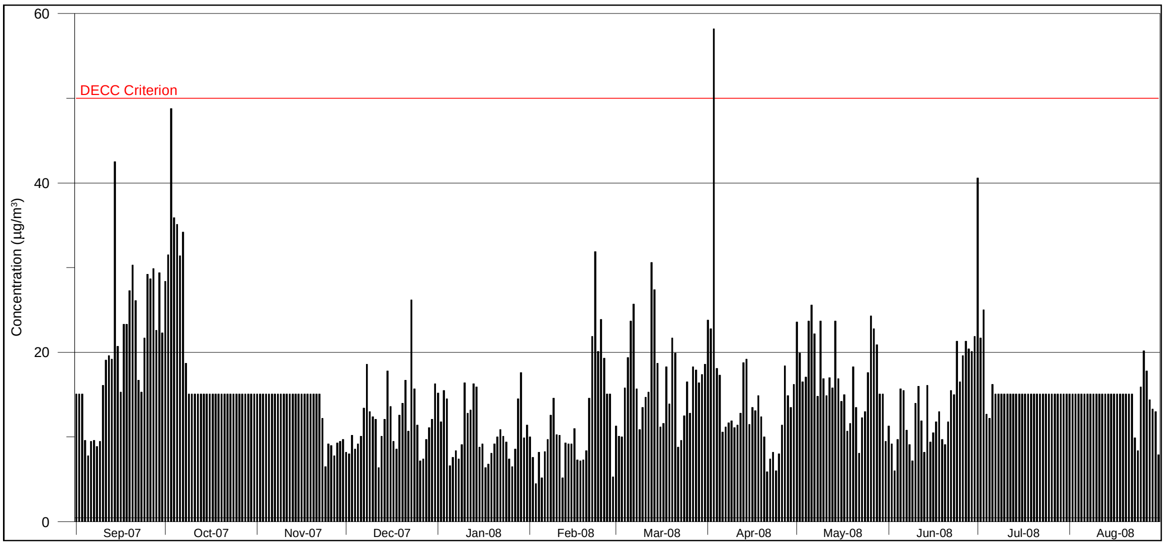


Review of **Figure 12** illustrates, that the Tamworth dataset correlates reasonably well with the PM_{10} concentrations measured around the Project Site, with the daily variation pattern mirrored across the comparison period. This would suggest that both datasets are detecting regionally generated concentrations of PM_{10} in addition to those from local sources.

The 24-hour average PM_{10} concentrations recorded at the Tamworth air quality monitoring station for the period 1 September 2007 to 31 August 2008 are presented in **Figure 13**. This dataset is concurrent with the meteorological data set used in the atmospheric dispersion modelling conducted for this assessment.

Figure 13 indicates that the highest 24-hour average PM_{10} concentration recorded at the DECCW's Tamworth air quality monitoring site was 58.2µg/m^3 recorded on 3 April 2008. It is likely that this recorded exceedance was attributable to an anomalous regional natural event, such as a bushfire or dust storm (refer to discussion below)

Figure 13 NSW DECCW PM_{10} (24-Hour Average) Monitoring Results for Tamworth, September 2007 to August 2008



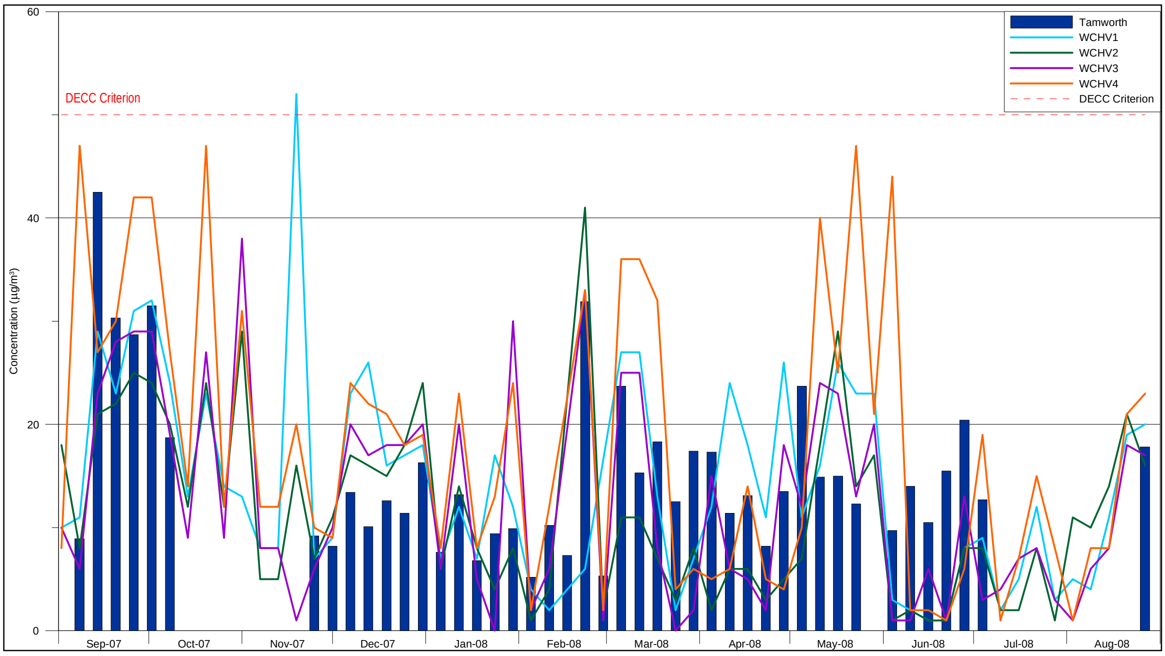
Note: During periods of missing data, the average of the dataset has been substituted.

The second highest PM_{10} concentration at Tamworth was 48.8µg/m^3 recorded on 3 October 2007. It is noted that this concentration is also likely attributable to an anomalous natural event and may be considered as elevated for the region. The annual average PM_{10} concentration for the Tamworth dataset was 15.1µg/m^3.

Concurrent concentrations recorded at the DECCW Tamworth air quality monitoring station and the one-in-six day concentrations recorded surrounding the Project Site during the modelling period are presented in **Figure 14**.

The 24-hour average PM_{10} concentrations recorded at the two closest HVAS locations to the Project Site, WCHV-1 and WCHV-4, are typically greater than concentrations recorded at the Tamworth station throughout the comparison period. The concentrations within the DECCW Tamworth PM_{10} dataset are predominantly greater than the corresponding concentrations recorded at WCHV-2 and WCHV-3.

Figure 14 24-hour Average PM_{10} Comparison – Tamworth and Mine Site HVAS Data – September 2007 to August 2008



If the data recorded at WCHV-2 is considered the best reflection of existing ambient concentrations of PM_{10} excluding emissions from the existing mining operations, it can therefore be concluded that the Tamworth DECCW PM_{10} dataset provides a conservative daily-varying representation of existing concentrations of PM_{10} in the vicinity of the Project Site, notwithstanding high regional background PM_{10} concentrations (see below). The use of the Tamworth dataset to account for existing PM_{10} concentrations without double counting emissions from existing operations is therefore considered appropriate.

The annual average PM_{10} concentration for the September 2007 to August 2008 Tamworth dataset was 15.1µg/m^3 compared to an average of 20.0µg/m^3 for the complete data record, due to a large number of anomalous regional natural events during 2009. It is noted that an increase in PM_{10} concentrations is also apparent surrounding the Project Site for the complete dataset (refer **Table 8**). Based on the above information, the 24-hour average PM_{10} Tamworth data for the 1 September 2007 to 31 August 2008 period is considered a reasonable estimate of background ambient levels for the dispersion modelling.

Examination of Maximum Background Concentrations

A detailed examination of the background PM_{10} concentrations to be used within the cumulative PM_{10} assessment for the LOM Project is necessary, as these concentrations have a large bearing on the number of predicted exceedances of the LOM Project criterion from the dispersion model. For example, even during those days where the dispersion model predicts a low incremental impact from LOM Project related activities, high background concentrations resulting from regional dust or smoke events can result in predicted cumulative exceedances of the LOM Project criterion.

Examination of NEPM annual compliance reports for 2007 and 2008 provide information on the likely particulate sources of exceedances of the 50µg/m^3 NEPM criteria for PM_{10}. Additionally, Emergency Management NSW (EMNSW) maintains a web resource which provides information including dates and general locations of natural disaster declarations, including bushfires and dust storms [http://www.emergency.nsw.gov.au/ndd]. These resources along with the PM_{10} monitoring data from the existing Werris Creek Coal Mine have been examined to identify the nature of the ten highest PM_{10} concentrations recorded at Tamworth between 1 September 2007 and 31 August 2008 (the modelling period).

The dates of the ten highest PM_{10} concentrations recorded at Tamworth during the modelling period are presented in **Table 9** along with the recorded concentration, and the average and maximum recorded PM_{10} concentrations across all four Werris Creek Coal Mine high volume air samplers on the date closest to the concentration recorded at Tamworth (as noted previously, the mine site data is available on a one-in-six day cycle). Comments provided in the NEPM compliance reports or the EMNSW web resource are also presented.

Table 9
Analysis of Maximum PM_{10} Background Concentrations, Tamworth September 2007 to August 2008

Rank	Date	PM_{10} Concentration (µg/m^3)			Date of Monitoring at Werris Creek	Comments
		Tamworth	Werris Creek (Average)	Werris Creek (Maximum)		
1	3/04/2008	58.2	2.5	8.0	30/03/2008	Dust Storm at Tamworth on 3rd April 2008 (NEPM, 2008)
2	3/10/2007	48.8	31.8	42.0	2/10/2007	Dust storm and smoke at Bathurst on 2nd Oct (NEPM, 2007) Bushfires Tamworth Region (EMNSW, 2007)
3	14/09/2007	42.5	25.0	29.0	14/09/2007	Dust Storm at Bathurst on 15 Sep (NEPM, 2007) Bushfires Tamworth Region (EMNSW, 2007)
4	1/07/2008	40.6	ND	ND	ND	Widespread Dust Storms across NSW (NEPM, 2008)
5	4/10/2007	35.9	31.8	42.0	2/10/2007	Dust storm and smoke at Bathurst on 2nd Oct (NEPM, 2007) Bushfires Tamworth Region (EMNSW, 2007)
6	5/10/2007	35.1	31.8	42.0	2/10/2007	Dust storm and smoke at Bathurst on 2nd Oct (NEPM, 2007) Bushfires Tamworth Region (EMNSW, 2007)
7	7/10/2007	34.2	22.5	27.0	8/10/2007	Dust storm and smoke at Bathurst on 2nd Oct (NEPM, 2007) Bushfires Tamworth Region (EMNSW, 2007)
8	23/02/2008	31.9	28.3	41.0	23/02/2008	No information
9	2/10/2007	31.5	31.8	42.0	2/10/2007	Dust storm and smoke at Bathurst on 2nd Oct (NEPM, 2007) Bushfires Tamworth Region (EMNSW, 2007)
10	6/10/2007	31.4	28.0	32.0	8/10/2007	Dust storm and smoke at Bathurst on 2nd Oct (NEPM, 2007) Bushfires Tamworth Region (EMNSW, 2007)
ND- - No data recorded +/- 4 days from Tamworth monitored concentration						

It can be seen from **Table 9** that elevated PM_{10} concentrations at Tamworth are often recorded on the same day, or within 2 or 3 days at the Werris Creek Coal Mine samplers. Analysis of the correlation covariance between the Tamworth and Werris Creek HVAS datasets shows that the correlation coefficient is between 0.5 (Tamworth and WCHV-1) and 0.7 (Tamworth and WCHV-2) indicating that generally, elevations in PM_{10} concentrations at Tamworth are mirrored by elevations in PM_{10} in the vicinity of the Project Site. Examination of the covariance (a measure of the tendency for high values in one dataset to be associated with high values in another dataset) between Tamworth data and that measured at the Werris Creek Coal Mine monitors indicates that covariance across all four Werris Creek Coal Mine high volume air samplers is between +40 and +56. This indicates positive covariance, where the variables in the two datasets tend to increase together. A zero covariance would indicate that the two datasets are independent of one another.

The data presented in **Table 9** and the analysis of the Tamworth and Werris Creek Coal Mine high volume air sampler datasets allows for the identification of nine of the ten highest PM_{10} concentrations recorded at Tamworth between 1 September 2007 and 31 August 2008 as being caused by particulate events of a regional nature. It is therefore considered to be appropriate to remove these events from the background dataset used in the assessment of cumulative PM_{10} concentrations resulting from the LOM Project. These values have been replaced with the annual average value of 15.1µg/m^3.

6.2.2 $PM_{2.5}$

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

6.3 BACKGROUND DUST DEPOSITION ENVIRONMENT

Dust deposition monitoring has been conducted at seven locations in the area surrounding the Project Site. Monthly dust deposition data for the period between September 2004 and December 2009 is presented in **Table 10** and **Figure 15**. The location of the seven dust deposition gauges surrounding the Project Site, identified as WCA1 to WCA7, are illustrated in **Figure 15**.

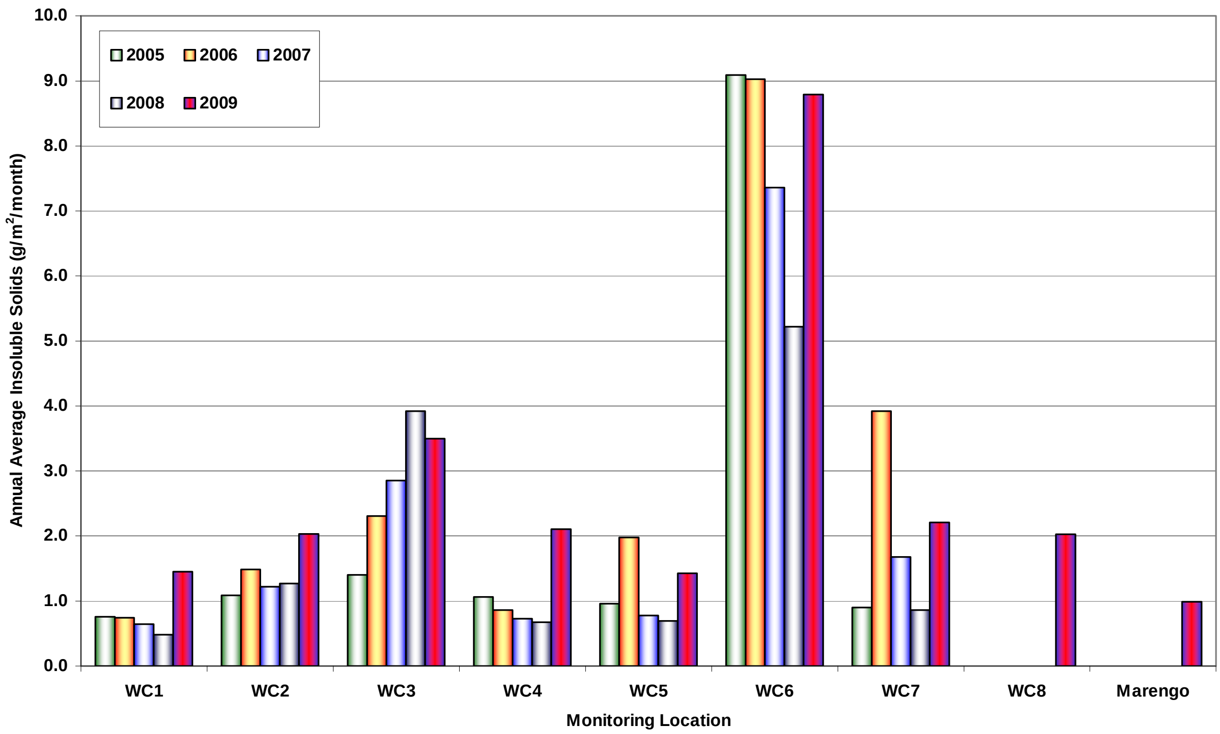
Given the distance of WC1 from the existing mine site, it may be considered that of the seven dust deposition locations available for the modelling period, the results obtained at WC1 are the best representation of background dust deposition levels, excluding mine site operations. The average dust deposition level at WC1 over the total monitoring period is 0.7 g/m^2/month and 0.6 g/m^2/month over the modelling period (September 2007 to August 2008).

The background dust deposition level for assessment purposes has therefore been assumed to be 0.6 g/m^2/month.

Table 10
Ambient Dust Deposition Monitoring Data – September 2004 to December 2009

Dust Deposition Gauge ID[1]	Number of Samples	Total Average (g/m^2/month)	Maximum 12 month Average (g/m^2/month)	Modelling Period (Sept 07-Aug 08) Average (g/m^2/month)
WC1 - Escott	60	0.7	5.8	0.6
WC2 - Cintra	62	1.3	5.9	1.3
WC3 - Colliery	60	2.7	9.6	3.4
WC4 - Hillview	59	1.0	7.9	0.7
WC5 - Railway View	62	1.1	11.9	0.6
WC6 – Southern Boundary	60	7.4	44.3	4.6
WC7 – Tonsley Park	56	1.9	15.3	1.2
WC8 – Plain View	10	2.0	8.8	N/O[2]
WC9 - Marengo	2	1.0	1.4	N/O
Note 1: see Figure 10 Note 2: N/O = Not Operational				
Source: Werris Creek Coal Pty Limited				

Figure 15 **Annual Average Dust Deposition Levels – WCCM Network – 2005 to 2009**



6.4 BACKGROUND AIR QUALITY FOR ASSESSMENT PURPOSES

For the purposes of assessing the potential air quality impacts from the LOM Project, an estimation of ambient air quality levels is required. The site-specific ambient air quality levels adopted for this assessment are summarised in **Table 11**.

Table 11
Ambient Air Quality Environment for Assessment Purposes

Air Quality Parameter	Averaging Period	Assumed Background Ambient Level	Data Source
TSP	Annual	30.2 µg/m^3	Proponent
PM_{10}	24-Hour	Daily Varying	DECCW
	Annual	15.1 µg/m^3	
$PM_{2.5}$	24-Hour	None assumed	-
	Annual	None assumed	-
Dust Deposition	Annual	0.6 g/m^2/month	Proponent

7. PARTICULATE SOURCES AND MODELLED SCENARIOS

The progressive mining of coal within the proposed LOM Project open cut area and placement of overburden on the proposed LOM Project overburden dump would vary spatially throughout the life of the mine. Three proposed operational scenarios have been selected to be modelled which would result in maximum air quality impacts at the representative residences/properties identified in **Table 3**.

The three scenarios selected for quantitative modelling are as follows:

1. **Scenario 1**

   Scenario 1 represents coal extraction at the southernmost point of the existing approved open cut area in approximately Year 3 of the LOM Project. It also represents coal processing operations in the existing location, prior to being relocated to the north, and prior to the shortening of the haul road between the Coal Processing Area and the coal load out.

   It is considered that Scenario 1 represents worst case air quality impacts at the identified residences and properties to the south of the Project Site (Residence/Property ID's 7, 8, 9, 12, 15, 17 and 24 – see **Table 3**).

2. **Scenario 2**

   Scenario 2 represents coal extraction in the mid-point of the proposed LOM Project life (approximately Year 7) and also represents a year where construction of the Acoustic and Visual Amenity Bund is to be undertaken. This scenario also represents the new location of the Coal Processing Area.

   It is considered that Scenario 2 represents worst case air quality impacts at the identified residences and properties to the east of the Project Site (Residence/Property ID's 96 and 98 – see **Table 3**) prior to construction of the amenity bund.

3. **Scenario 3**

   Scenario 3 represents coal extraction activities at the northernmost point of the proposed LOM Project open cut area in approximately Year 15 of the LOM Project.

It is considered that Scenario 3 represents worst case air quality impacts at the identified residences and properties to the north of the Project Site (Residence/Property ID's 14, 18, 20 and 21 – see **Table 3**).

Site layout plans for each of the above scenarios are presented in **Figure 16** to **Figure 18**. A full equipment list for each Scenario is provided in **Appendix D.**

7.1 ACTIVITY RATES AND MATERIAL COMPOSITION

7.1.1 Material Extraction Rates

7.1.1.1 Coal

The LOM Project is proposed to extract up to 2.5 million tonnes of coal per annum (Mtpa). This would be conducted by bulldozer ripping, loading into 130t capacity haul trucks by excavator and hauling to the Coal Processing Area via unsealed road for crushing and screening to the appropriate product size. The product would then be loaded onto product coal trucks each carrying approximately 30t of product. Up to 2.4Mtpa of the coal would be transported to the Product Coal Storage Area to the north of the Project Site by sealed road where it would be dumped, worked by bulldozers and loaded onto trains for transport to the Port of Newcastle. Up to 100 000 t of coal would be transported by public roads to domestic markets each year.

Coal extraction, haulage, processing and loading is proposed to be undertaken 24 hours per day, 7 days per week. Coal haulage by public roads to domestic markets would be undertaken Monday to Saturday only.

The coal has been assumed to contain 6% moisture and 7% silt as per the AQA (2009) for the LOM Project.

Coal located on the ROM pad and at the Product Coal Storage Area would be wet from water spraying which would occur within the crushing and screening plant subsequent to ROM pad storage. This would increase the moisture content of the coal from 6% to 9%. Midwest Research Institute (MRI) fugitive dust calculators includes a PM_{10} control efficiency for sprayed conveyor transfer points of 62% when increasing the moisture content 2-fold (from 1% to 2%). A 2-fold increase (i.e. from 6% to 12%) is considered to be unachievable with the restrictions on water use at the Project Site. In addition to this, coal moisture content needs to be maintained at a level which would not impede coal movement by bulldozer. It is considered that an increase of 3% to 9% moisture content for coal on the ROM pad and Product Coal Storage Area is realistic. Emission factors for bulldozers operating on the ROM pad and Coal Product Storage Area have been calculated using this coal moisture content accordingly.

7.1.1.2 Overburden

Overburden production would vary across the LOM Project life due to the variability in depth of the coal seam. The current approved operation produces approximately 17 million bank cubic metres (Mbcm) of overburden to produce 1.5Mt of ROM coal per annum. The proposed LOM Project is expected to produce an additional 130Mbcm of overburden over the 20 year LOM Project lifespan, or an additional 6.5Mbcm per annum. Total overburden production each year associated with the production of 2.5Mtpa of coal is therefore assumed for this assessment to be 23.5Mbcm per annum.

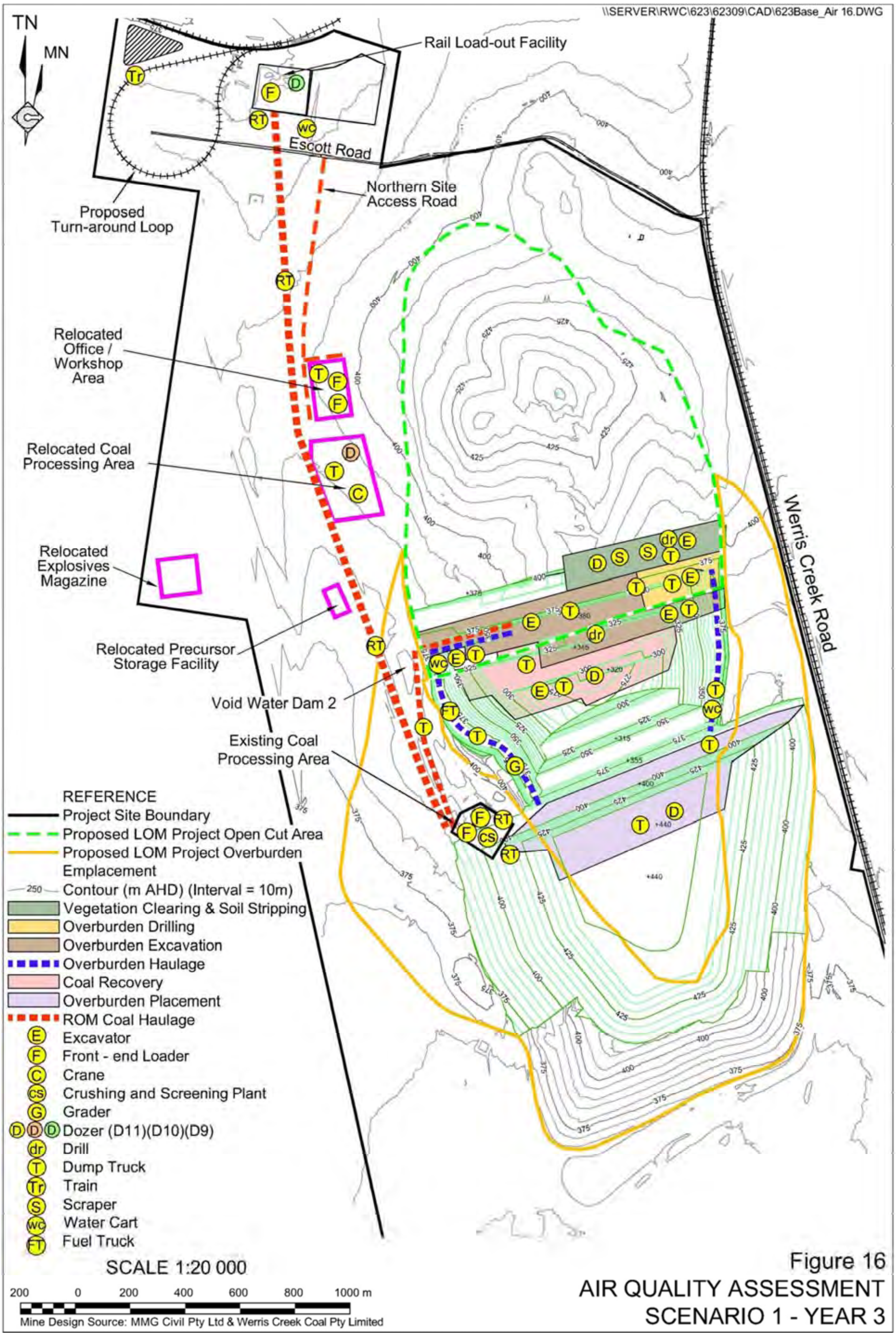


Figure 16
AIR QUALITY ASSESSMENT
SCENARIO 1 - YEAR 3

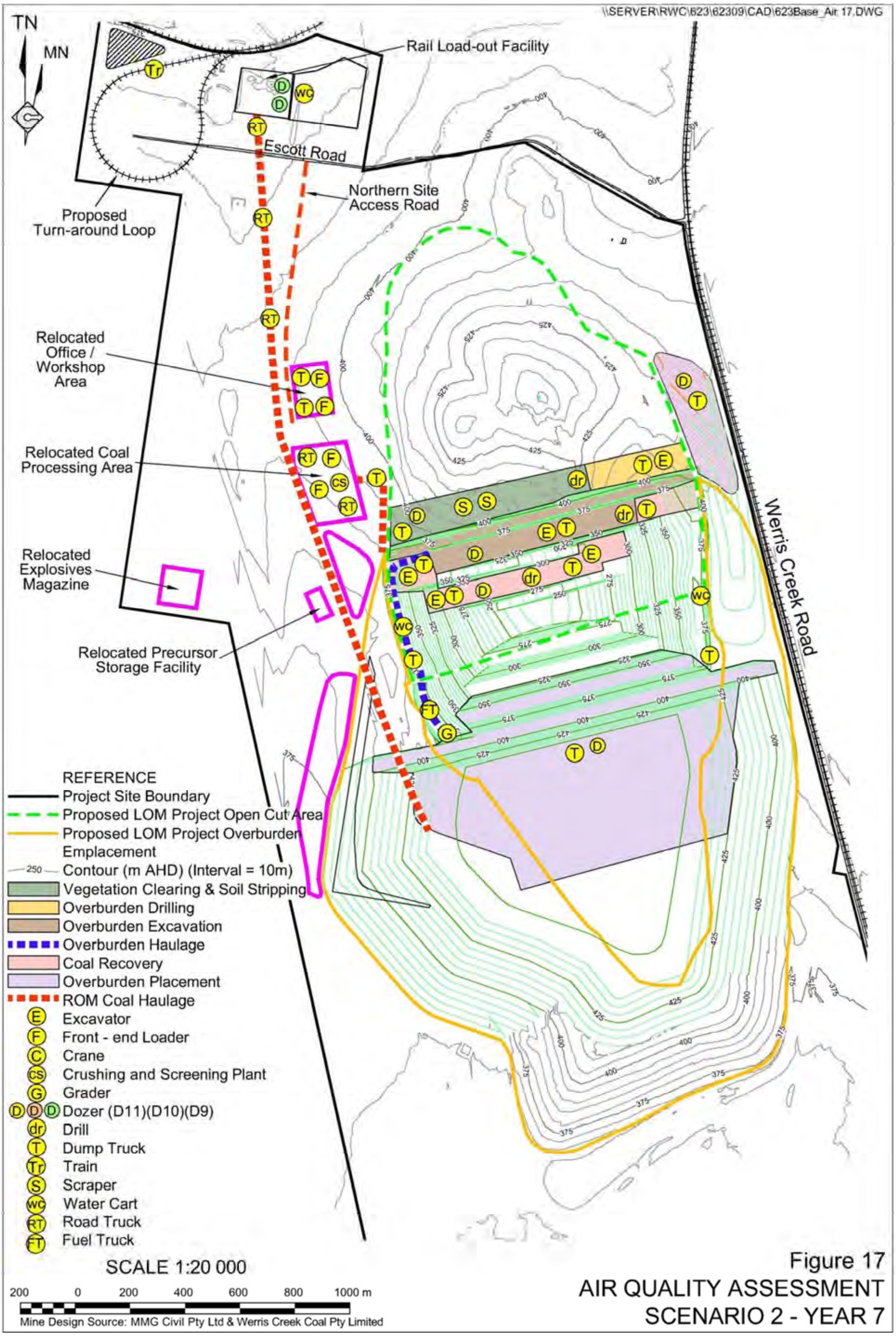


Figure 17
AIR QUALITY ASSESSMENT
SCENARIO 2 - YEAR 7

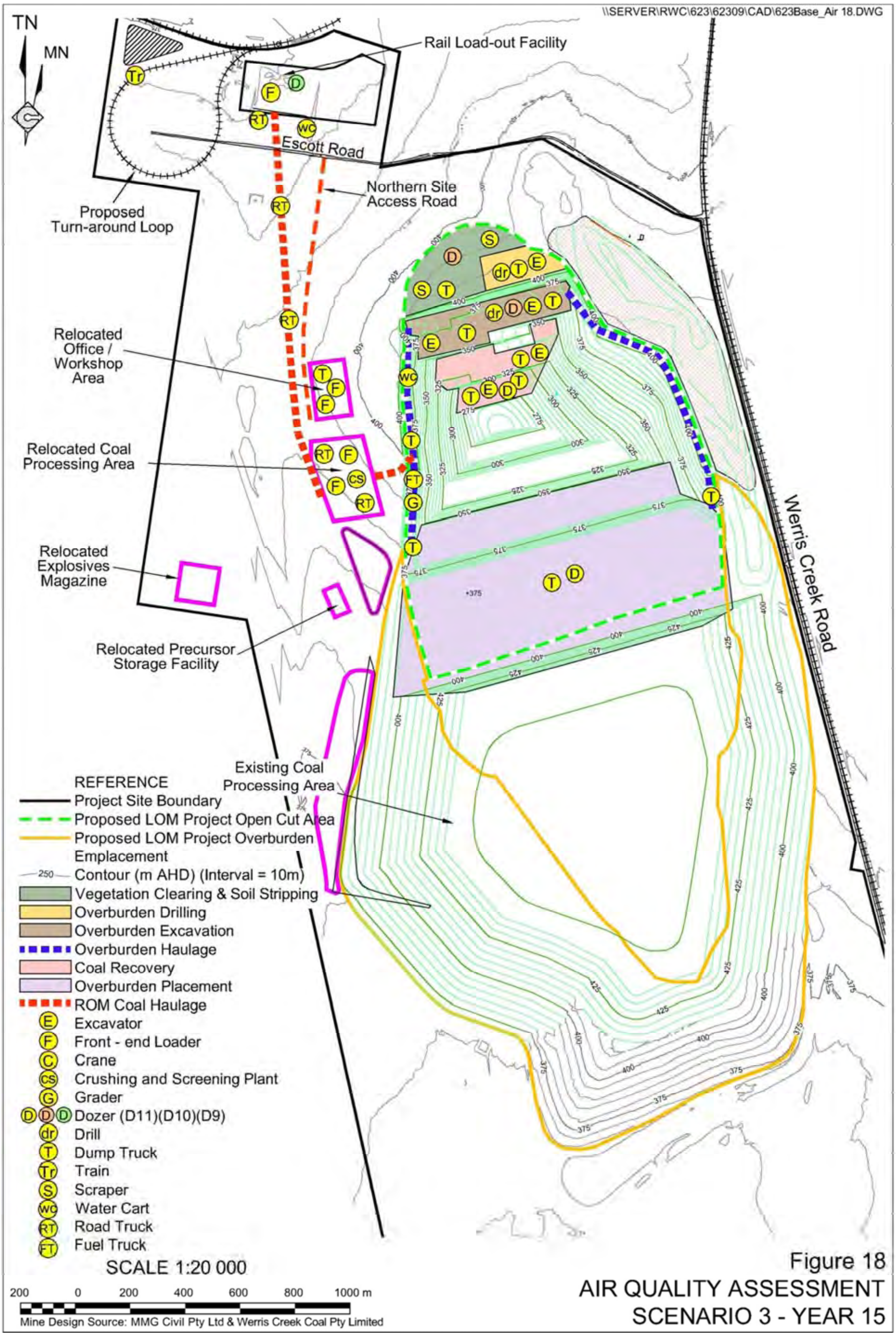


Figure 18
AIR QUALITY ASSESSMENT
SCENARIO 3 - YEAR 15

Density of overburden has been assumed to be 1.2t/m^3, which is consistent with the 2009 AQA for the Northern Extension. The resulting quantity of overburden moved each year has therefore been assumed to be 28.2 Mt.

Overburden would be removed through drilling and blasting, with a maximum of 148 holes drilled per day and a maximum of two blasts per day between the hours of 9.00am and 5.00pm, Monday to Friday. On average, 96 blasts would be initiated each year, with an average area of 538m^2 blasted during each blast. Blasting would be designed to throw blast a percentage of overburden into the mined-out void with the out of pit to in pit ratio estimates. Remaining overburden would be loaded by excavator into 130t capacity haul trucks and hauled via unsealed roads to the overburden dump, unloaded and spread by a bulldozer.

All operations on overburden, with the exception of blasting, are proposed to occur 24 hours per day, 7 days per week.

Overburden has been assumed to contain 5.5% moisture and 10% silt as per the AQA (2009) for the Northern Extension and confirmed by the Proponent. Studies undertaken on behalf of the Proponent have indicated that the maximum silt content within the materials on-site is 10% at a depth of 1.3 m below the surface (GCNRC, 2009).

During Scenario 2, an amount of overburden would be required for the construction of the Acoustic and Visual Amenity Bund. The Proponent has provided information which indicates that a total of 3.7Mbcm (4.4Mt) of overburden would be required to construct the Acoustic and Visual Amenity Bund. It has been assumed that 250t of overburden would be diverted from the overburden emplacement area each hour and used in the Acoustic and Visual Amenity Bund construction. This is considered to be a conservative assumption as, assuming 24/7 construction, the bund would be constructed in 2.2 years. Estimates from the Proponent indicate construction over an undetermined period of between 2 to 6 years.

7.1.2 Haulage Distances

In addition to the spatial variation in equipment between each scenario shown in, **Figure 16, 17** and **18**, lengths of haul roads also differ between the scenarios. Provided in **Table 12** are the haulage distances for each scenario.

Table 12
Haul Route Distances for each Modelled Scenario

Route	**Haul Route Length (m)**		
	Scenario 1	**Scenario 2**	**Scenario 3**
Pit to Coal Processing Area	1,034	366	164
Pit to Overburden Dump Western Route	1,031	821	829
Pit to Overburden Dump Eastern Route	593	-[1]	1,014
Coal Processing Area to Rail Load Out	2,708	1,421	1,421
Pit to Amenity Bund	-[2]	200	-
Total Haulage Distance[3]	**5,366**	**2,808**	**3,732**

Note 1: No Eastern Route to Overburden Dump during Scenario 2
Note 2: No amenity bund construction during Scenario 1
Note 3: Topsoil Stockpiles follow the existing routes – emissions have been added to the existing routes within the model.

Unsealed haul roads have been assumed to contain 1.1% moisture and 6.4% silt as per the AQA (2009) for the Northern Extension.

The sealed haul road from the Coal Processing Area to the Product Coal Storage Area has been assumed to contain a silt loading of 3 g/m^2 as per the AQA (2009) for the Northern Extension.

7.1.3 Disturbance Areas

Variations in disturbance areas for each scenario are presented in **Table 13**.

Table 13
Areas of Active Disturbance for each Modelled Scenario

Area	**Source Area (ha)**		
	Scenario 1	**Scenario 2**	**Scenario 3**
Coal Processing Area (ROM)	2.5	5.7	5.7
Coal Storage Area (Load-Out)	3.2	9.8	9.8
Active Disturbance[1,2]	147	196	91
Rehabilitation[3]	97	202	374
Total Area	**249.7**	**413.5**	**480.5**

Note 1: Includes open pit activities (active drilling area, active coal recovery area, active overburden excavation area, active overburden dumping area, amenity bund (where applicable)) and vegetation clearing and soil stripping areas

Note 2: Amenity Bund - 0 ha in Scenario 1, approximately 7.3 ha in Scenario 2 (Active) and approximately 22 ha in Scenario 4 (Rehabilitated)

Note 3: Includes topsoil stockpiles – assumed all rehabilitated

7.2 EMISSION CONTROLS

7.2.1 General Emission Controls

As detailed in Section 2.4, the Werris Creek Coal Mine currently implements specific measures to ensure that relevant air quality criteria are satisfied in accordance with the operational conditions of consent for the mine. The following measures of relevance to the current modelling assessment were implemented by the Werris Creek Coal Mine during 2008-2009 operations (WCC, 2009a) and would be implemented as part of the LOM Project. Notes in italics below the relevant measures indicate the percentage reduction in particulate employed within dispersion modelling for each source, where applicable.

- Application of water to exposed surfaces, with emphasis on those areas subject to frequent vehicle / equipment movements which may cause dust generation and dispersal (see also Section 7.2.2).
- Regular watering of internal haul roads (see also Section 7.2.2).
- Speed limit restrictions on all vehicles and equipment on the Project Site.

  Application of Level 1 Watering (2 litres/m^2/hour) to all unsealed haul roads on-site results in estimated emissions reductions of 50% (NPI, 2001). Furthermore, limiting vehicle speeds on site to 40 km/hour results in a further 44% reduction in modelled particulate emissions (MRI, 2001).
- Use of water injection on the drill rigs.

  Application of water sprays on drill rigs results in 70% reduction in modelled particulate emissions (NPI, 2001).

- Water application at the feed hopper, crusher and at all conveyor transfer and discharge points (see also Section 7.2.2).

  Application of water sprays on feed hopper, crusher and at all conveyor transfer and discharge points results in 50% reduction in particulate emissions (NPI, 2001).

- Cessation of mining activities during periods of concurrent high winds and temperatures which cause coal dust dispersal, independent of water applications.

- Moist Coal on the ROM and product coal stockpile.

  Coal located on the ROM pad and at the Product Coal Storage Area would be wet from water spraying which would occur within the crushing and screening plant subsequent to stockpile storage. This would result in 50% reduction in particulate emissions from wind erosion (NPI, 2001) if there is a sort residence time on the stockpile.

  Midwest Research Institute (MRI) fugitive dust calculators includes a PM_{10} control efficiency for sprayed conveyor transfer points of 62% when increasing the moisture content two fold (from 1% to 2%). This increase is considered to be unachievable with the restrictions on water use on site. Also, final coal moisture content needs to be maintained at a level which would not impede coal movement by bulldozer. It is considered that an increase of 3% to 9% moisture content for coal on stockpiles is realistic. Emission factors for bulldozers operating on the ROM and load out area have been calculated using this coal moisture content accordingly.

- All rehabilitated areas (refer **Table 13**) have been assumed to be revegetated and as such a 99% emission reduction factor has been applied (NPI, 2001).

- All activities occurring within the pit have been subject to emissions reductions (pit retention factors) of 50% for TSP and 5% for PM_{10} and $PM_{2.5}$ (NPI, 2001).

- An emission reduction of 26% has been applied to all paved roads on-site resulting from the use of a street sweeper (MRI, 2001).

- No emission reductions have been applied to active mining areas.

7.2.2 Dust Suppression

Based on an average haul road width of 8 m, 24 hour per day operations and a water use rate of 2 litres/m^2/hour, it is calculated that the quantities of water presented in **Table 14** would be required for dust suppression across the project Site during each Scenario.

Dust suppression in the 2008/2009 AEMR reporting period utilised 130ML of water. The 2009/2010 AEMR reported a total water use of 154.6ML for dust suppression purposes.

Table 14
Calculated Water Requirements for Unsealed Haul Road Watering

Route	**Haul Route Length (m)**		
	Scenario 1	**Scenario 2**	**Scenario 3**
Pit to Coal Processing Area	1,034	366	468
Pit to Overburden Dump Western Route	1,031	821	829
Pit to Overburden Dump Eastern Route	593	-	1,014
Total Unsealed Haulage Distance	**2,065**	**1,387**	**2,311**
Calculated Water Requirements (Million Litres [ML])	**289 ML**	**166 ML**	**281 ML**

Based on existing water use data supplied by the Proponent, the proportional use of water for dust suppression would be 83% for haul road watering, 1% for crushing and screening operations and 16% for processing plant and rail load-out facility hardstand and stockpiles (RWC, 2010).The calculations presented in **Table 14** do not take into account the reduction in evaporation during night-time hours or during the winter. Furthermore, it has been assumed that for haul road watering, the entire 8 m width of road is watered evenly. In practice, only the regularly trafficked portion of the road would be watered. In keeping with good site management practices, all vehicles would ensure that minimal fresh disturbance of haul roads occurs and only the watered portion of the road is trafficked.

Quantification of the effects of the above assumptions on water requirements for the Project is not possible. However, haul road lengths, hardstand surfaces and stockpiles at the WCCM are currently equivalent to those presented for Scenario 1 and Scenario 3 and sufficient water is currently available for haul road watering to meet the requirements of the current conditions of consent. As haul roads distances and water requirements in Scenario 2 are predicted to be reduced when compared to both the current situation and Scenario 1 and 3, it is considered that sufficient water would be available to ensure that Level 1 watering (2L/m^2/hour) could be undertaken throughout the life of the LOM Project.

8. EMISSIONS INVENTORY

8.1 OVERVIEW

Based on the information presented in Section 7, a particulate emissions inventory has been compiled for each modelled scenario. Full details of these inventories are provided in **Appendix D** with a summary of modelled emissions presented in **Table 19**.

Emission factors have been sourced from the Commonwealth of Australia Document "National Pollutant Inventory (NPI) for Mining, Version 2.3 (2001)" and US EPA AP42 Emission Factors where suitable factors do not exist within the NPI documentation.

The emission factors used are presented in **Table 15**, which were derived using the assumptions discussed in Section 7.1. Total calculated emissions of TSP, PM_{10} and $PM_{2.5}$ are presented in **Table 16** for plant and equipment sources, **Table 17** for wind erosion sources with a summary presented in **Table 18** and **Figure 19**.

Table 15
Emission Factor Equations

Activity	Emission Factor Equation	Units	Source	Variables	Controls Applied*
Drilling	Default of 0.59 for total suspended particulates (TSP)	kg/hole	NPI EETM v2.3 (p11)		Pit Retention - (50% for TSP, 5% for PM_{10})
	Default of 0.31 for particulate matter less than 10 microns in size (PM_{10})				
Blasting	$= 344 \times A^{0.8} \times M^{-1.9} \times D^{-1.8}$ for TSP	kg/blast	NPI EETM v2.3 (p11)	A = Area Blasted (m^2) M = Moisture content (%) D = Depth of blast holes (m)	Pit Retention - (50% for TSP, 5% for PM_{10})
	As above multiplied by 0.52 for PM_{10}				
Excavator on waste rock / overburden	$= k \times 0.0016 \times (U/2.2)^{1.3} \times (M/2)^{-1.4}$	kg/t	NPI EETM v2.3 (p11)	k = 0.74 (TSP) k = 0.35 (PM_{10}) U = mean wind speed (m/s) M = Moisture content (%)	Pit Retention - (50% for TSP, 5% for PM_{10})
Excavator / Front End Loader on coal	$= k \times 0.00596 \times M^{-0.9}$	kg/t	NPI EETM v2.3 (p11)	k = 1.56 (TSP) k = 0.75 (PM_{10}) M = Moisture content (%)	Pit Retention - (50% for TSP, 5% for PM_{10})
Unpaved haul route wheel dust	$EF = k \times \left(\frac{s}{12}\right)^{0.7} \times \left(\frac{W}{3}\right)^{0.45} \times \left(\frac{289}{1000}\right) \times \left(\frac{365-p}{365}\right)$	kg/vehicle kilometres travelled (VKT)	USEPA AP42 - Wheel Generated Dust from Unpaved Roads (2003)	k = 4.9 (TSP) k = 1.5 (PM_{10}) s = silt content (%), W = vehicle gross mass (tonnes) p = number of days in year with rainfall greater than 0.25mm	Pit Retention - (50% for TSP, 5% for PM_{10})) Level 1 watering (2 $l/m^2/hr$) - (50%) Speed Restrictions – (40 km/hr) 44%
Paved haul route wheel dust	$EF = k \times \left(\frac{sL}{2}\right)^{0.65} \times \left(\frac{W}{3}\right)^{1.5} - C$	kg/vehicle kilometres travelled (VKT)	USEPA AP42 - Wheel Generated Dust from Paved Roads (2006)	k = 24 (TSP) k = 4.6 (PM_{10}) sL = silt loading (g/m^2), W = vehicle gross mass (tonnes) C = emission factor for fleet vehicle exhaust, brake and tyre wear (0.2119 for TSP and PM_{10})	Road sweeping – 26%
Trucks dumping coal	Default of 0.01 for TSP	kg/t	NPI EETM v2.3 (p11)		
	Default of 0.0042 for PM_{10}				
Trucks dumping waste rock / overburden	Default of 0.012 for TSP	kg/t	NPI EETM v2.3 (p11)		

Table 15 (Cont'd)
Emission Factor Equations

Page 2 of 2

Activity	Emission Factor Equation	Units	Source	Variables	Controls Applied*
Dozer on coal	TSP $= 35.6 \times s^{1.2} \times M^{-1.4}$	kg/hr	NPI EETM v2.3 (p11)	s=silt content (%) M=Moisture content (%)	Pit Retention - (50% for TSP, 5% for PM_{10})
	$PM_{10} = 6.33 \times s^{1.5} \times M^{-1.4}$				
Dozer on material other than coal	TSP $= 2.6 \times s^{1.2} \times M^{-1.3}$	kg/hr	NPI EETM v2.3 (p11)	s=silt content (%) M=Moisture content (%)	
	$PM_{10} = 0.34 \times s^{1.5} \times M^{-1.4}$				
Scraper	TSP $= 7.6 \times 10^{-6} \times s^{1.3} \times W^{2.4}$	kg/VKT	NPI EETM v2.3 (p12)	s = silt content (%) W= vehicle gross mass in tonnes	Wet Soil – 50%
	$PM_{10} = 1.32 \times 10^{-6} \times s^{1.4} \times W^{2.5}$				
Grader	TSP $= 0.0034 \times S^{2.5}$	kg/VKT	NPI EETM v2.3 (p12)	S=mean vehicle speed (km/h)	Level 1 watering (2 l/m^2/hr) - (50%)
	$PM_{10} = 0.0034 \times S^{2.0}$				
Primary Crusher (includes emissions from screens, crusher, feeder, surge bin and conveyor transfer points)	Default of 0.01 for TSP (Emission Factor for Primary Crushing, High Moisture Ore)	kg/t	NPI EETM v2.3 (p14)		Water sprays – 50%
	Default of 0.004 for PM_{10} (Emission Factor for Primary Crushing, High Moisture Ore)				
Secondary Crusher (includes emissions from screens, crusher, feeder, surge bin and conveyor transfer points)	Default of 0.03 for TSP (Emission Factor for Secondary Crushing, High Moisture Content Ore)	kg/t	NPI EETM v2.3 (p14)		Water sprays – 50%
	Default of 0.0012 for PM_{10} (Emission Factor for Secondary Crushing, High Moisture Content Ore)				
Loading to trains	Default of 0.0004for TSP	kg/t	NPI EETM v2.3 (p12)		Water sprays – 50%
	Default of 0.00017 for PM_{10}				
Wind Erosion	TSP $= 58(u^* - u_t^*)^2 + 25(u^* - u_t^*)$ PM_{10}=As above multiplied by 0.5	kg/ha	USEPA AP42 – Industrial Wind Erosion (2006)	u^* = friction velocity (m/s) u_t^* = threshold friction velocity (m/s) – taken to be 0.54 for fine coal dust on concrete pad for all sources	Rehabilitation – 99% Water Sprays – 50%
	The calculation above has been performed for each hour of the year to identify the erosion potential (kg/ha/hr). CALPUFF (see **Section** Error! Reference source not found.) 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+ m/s. Calculated emissions potentials for each hour have been binned into the relevant wind speed category to allow a wind speed dependent emission to be modelled. Within this equation, a Particle Threshold Friction Velocity of 0.54 m/s (relating to fine coal dust on a concrete pad) was assumed. Hourly friction velocity was derived from on-site hourly wind speed data and the US EPA's conversion equation (US EPA, 2006). See Section 8.2.1 for further information				

* - Controls not applied to all sources, only to those of relevance e.g. pit retention control factor only applied to those sources within the pit.

Table 16
Particulate Emissions from Plant and Equipment Sources

Pollutant	**Modelled Scenario (tonnes per annum)**		
	Scenario 1	**Scenario 2**	**Scenario 3**
TSP	1,501	1,394	1,528
PM_{10}	407	474	579
$PM_{2.5}$	60	70	83

Table 17
Particulate Emissions from Wind Erosion Sources (refer Table 13)

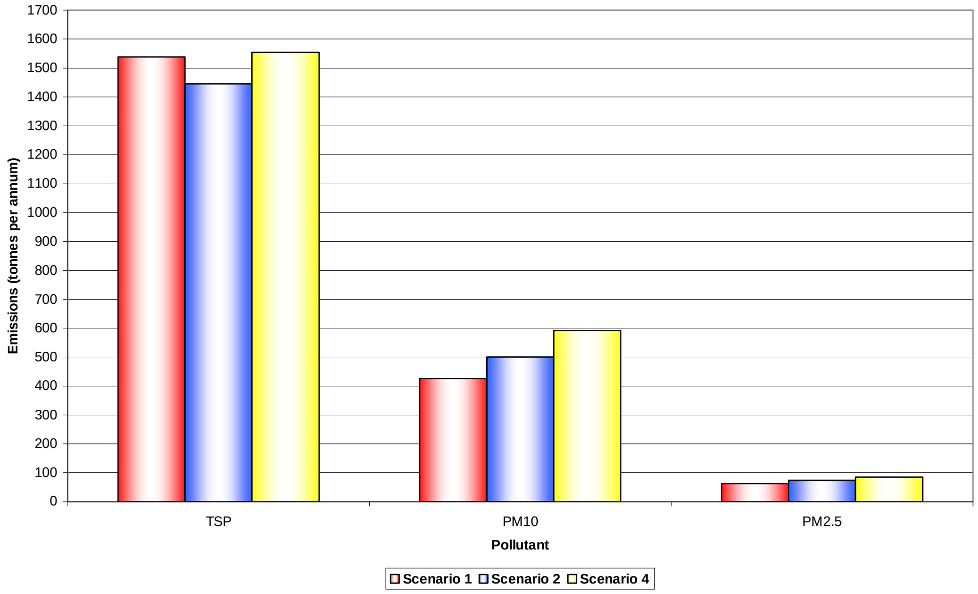
Pollutant	**Area**	**Modelled Scenario (tonnes per annum)**		
		Scenario 1	**Scenario 2**	**Scenario 3**
TSP	Active disturbance areas	36.6	48.8	22.7
	Rehabilitated Areas	0.24	0.50	0.93
	ROM	0.31	0.71	0.71
	Load Out	0.40	1.22	1.22
Total		**37.5**	**51.2**	**25.5**
PM_{10}	Active disturbance areas	18.4	24.5	11.4
	Rehabilitated Areas	0.12	0.25	0.47
	ROM	0.16	0.36	0.36
	Load Out	0.20	0.61	0.61
Total		**18.8**	**25.7**	**12.8**
$PM_{2.5}$	Active disturbance areas	2.8	3.7	1.7
	Rehabilitated Areas	0.02	0.04	0.07
	ROM	0.02	0.05	0.05
	Load Out	0.03	0.09	0.09
Total		**2.9**	**3.9**	**1.9**

Note: Emissions based on emission rates of 249 kg/ha/yr for TSP, 125 kg/ha/yr for PM_{10} and 19 kg/ha/yr for $PM_{2.5}$. Areas of each source taken from **Table 13**. Emissions controls applied – 99% for rehabilitated areas, 50% for water sprays of ROM and Load out area. No controls applied to active disturbance areas.

Table 18
Total Particulate Emissions from the LOM Project

Pollutant	**Modelled Scenario (tonnes per annum)**		
	Scenario 1	**Scenario 2**	**Scenario 3**
TSP	1,538	1,445	1,553
PM_{10}	426	500	592
$PM_{2.5}$	63	74	85

Figure 19 Total Particulate Emissions from the LOM Project



Section 8.2 provides a summary of the methodology used in the calculation and subsequent modelling of particulate matter emissions from sources subject to wind erosion is provided within the report. Section 8.3 provides more detail on the development of the emissions inventory for $PM_{2.5}$ emissions. Section 8.4 provides a summary of modifications made to the inventory following the incorporation of operational controls to be implemented by the Proponent to reduce emissions. Section 8.5 provides a summary of the methods used to estimate coal wagon emissions.

8.2 $PM_{2.5}$ EMISSION RATES

The *National Pollutant Inventory for Mining*, Version 2.3 (2001) and US EPA AP 42 contain emission factors for TSP and PM_{10}. No factors are provided within the NPI or US EPA AP 42 for $PM_{2.5}$ as little research has been undertaken to assess the fraction of PM_{10} from the wide range of sources which would be emitted as $PM_{2.5}$.

Limited research has been conducted by the Midwest Research Institute (MRI) on behalf of the Western Regional Air Partnership (WRAP) with findings published within the document entitled *'Background Document for Revisions to Fine Fraction Ratios Used for AP-42 Fugitive Dust Emission Factors'* (MRI, 2006). This document provides seven proposed $PM_{2.5}/PM_{10}$ ratios for fugitive dust source categories as presented in **Table 19**.

The $PM_{2.5}$ / PM_{10} ratios presented in **Table 19** have been used within this assessment to calculate the emissions of $PM_{2.5}$ attributable to the LOM Project. The most appropriate ratio has been applied to each piece of modelled plant or wind erosion source. Total calculated emissions are presented in **Table 16**, **Table 17** and **Table 18**.

Table 19
Proposed Particle Size Ratios for AP-42

Fugitive Dust Source	AP-42 Section	Proposed $PM_{2.5}$ / PM_{10} Ratio
Paved Roads	13.2.1	0.15
Unpaved Roads	13.2.2	0.1
Aggregate Handling and Storage Piles	13.2.4	0.1
Industrial Wind Erosion	13.2.5	0.15
Open Area Wind Erosion	-	0.15

8.3 MODIFIED PROJECT OPERATIONS

Initial model runs for Scenario 1 operations indicated slight but numerous exceedances of the 24-hour PM_{10} criterion at Residence/Property 15, to the immediate south of the Project Site. Source apportionment of the contributions of all plant and equipment to the highest 24-hour average PM_{10} concentrations revealed that dumping of overburden on the top lift of the overburden emplacement area had the potential to contribute up to 8µg/m^3 of PM_{10} at Residence/Property 15. Further examination of the meteorological dataset used within the modelling assessment showed that these high concentrations were associated with winds of a north northwesterly direction at or above 3 m/s wind speed.

Following discussions of these preliminary modelling results, the Proponent has indicated that during Scenario 1 operations, when winds are from a northerly direction and above 3 m/s for more than four consecutive 15 minute periods, they would suspend overburden dumping on the top lift of the overburden emplacement area. This would result in these emissions being contained within the pit or behind the overburden emplacement area. Emissions of particulate (TSP, PM_{10} and $PM_{2.5}$) associated with overburden dumping have therefore been removed from the modelling assessment during winds originating from the north-northwest and of greater than 3 m/s wind speed in Scenario 1. These wind conditions account for 69 hours within the meteorological dataset used in the dispersion modelling, or approximately 0.8% of operational hours for the LOM Project. It is noted that these conditions were not applied to Scenarios 2 and 3.

8.4 WIND EROSION ESTIMATION

The following steps have been undertaken in the calculation of wind erosion from all sources.

Step 1: Calculation of Friction Velocity

Friction velocity for each hour of the year has been calculated using site specific wind speed measurements. The fastest mile of wind has been calculated using the hourly wind speed (m/s) multiplied by 1.27, as quoted in Krayer and Marshall (1992). The equivalent friction velocity for each hour has then been calculated by multiplying the fastest mile of wind by 0.053, as quoted in the WRAPAIR fugitive dust handbook (Equation 4, Page 9-4). Based on 8760 hours of data, the mean and maximum friction velocities are 0.16 and 0.64, relating to average and maximum wind velocities of 2.4 m/s and 9.6 m/s, respectively.

Step 2: Calculation of Threshold Friction Velocity

The threshold friction velocity has been assumed to be 0.54 for each hour of the year, corresponding to fine coal dust on concrete pad (Table 9-2, Page 9-4, WRAPAIR fugitive dust handbook).

Step 3: Calculation of Emission Potential

Based on the hourly friction velocity and the threshold friction velocity, the erosion potential (P, g/m^2) has been calculated for each hour of the year.

Step 4: Calculation of Emission Rates

Based on the above calculations, it can be determined that emissions of particulate due to wind erosion are largely a result of wind speed and particle size in the area to be eroded. As per the US EPA equation, if the threshold friction velocity is not exceeded, then wind erosion is not initiated. In the case of fine coal dust on concrete pad, with a threshold friction velocity of 0.54, this relates to a initiating wind speed of 8 m/s.

The default wind speed categories (0-1.54, 1.54-3.09, 3.09-5.14, 5.14-8.23, 8.23-10.8 and 10.8+ m/s) have been used within the CALPUFF dispersion model. For each of these wind speed bands for each hour of the year, the erosion potential (P, g/m^2) has been summed and the emission rate ($g/m^2/s$) associated with each wind speed category has been calculated. Emissions in the lower wind speed categories are zero, as the threshold friction velocity is never exceeded, and wind erosion is not initiated.

Step 5: Application of Control Factors

The figures calculated above are uncontrolled emission factors, and can therefore be controlled by the application of water sprays, rehabilitation or sheilding from the wind, for example. Emission control factors are applied to each source with emissions control factors identified from Table 3 of the NPI Emission Estimation Techniques Manual for Mining.

The assumption within the methodology above is that the area susceptible to wind erosion is constantly disturbed, that is material is available for wind erosion, should the threshold friction velocity be exceeded. Additionally, the strength of the method over using default factors couched in terms of kg/ha/hour units, is that when wind speeds are particularly high, an appropriately large emission of material from wind erosion sources is initiated and reflected within the modelling assessment. Conversely, when emissions will not be observed from wind erosion sources due to low wind speeds, an emission is not applied within the model.

8.5 COAL WAGON EMISSIONS

Emissions from coal wagons have been quantitatively assessed within the Queensland Rail Report *Environmental Evaluation of Coal Dust Emissions* (QR, 2008). The report provides a literature review of the limited studies undertaken in this field, with examination of wind tunnel, Computational Fluid Dynamics (CFD) modelling and ambient monitoring data used to derive an estimate of TSP emissions from coal wagons.

Studies in the Canadian context (D Cope Enterprises, 2001) provided TSP emission estimates based on coal losses of 0.5% to 3% for uncontrolled trains travelling 1,100km on rough terrain during dry conditions. This is equivalent to an emission rate of 0.0045 kg/tonne/km to 0.027 kg/tonne/km. Preliminary dispersion modelling using these emissions rates (0.5% loss over a 1,100 km journey) indicated that this would result in peak ground level concentrations of TSP of 2,500µg/m^3 to 14,000µg/m^3 (1-hour average). This is substantially greater than has been measured beside coal freight lines in Queensland (QR, 2008), and it is considered that the same would apply beside coal freight lines in NSW.

In Portugal, Ferreira (2003) conducted measurements of coal dust emitted from coal trains during the transit between a port and power station. The average train speed for a 350km transit was estimated to be between 55 and 60km/hr. The total emission rate for uncontrolled coal wagons was found to be 9.6 g/km/wagon (Ferreira, 2003) equivalent to about 1/50 of that derived from the Canadian study. Preliminary dispersion modelling using the Ferreira emission rates indicates that peak 1-hour average TSP emissions would be the order of 300µg/m^3 to 400µg/m^3 at about 10 metres from the rail line, which is consistent with measurements made adjacent to coal freight lines in Queensland (QR, 2008).

The Queensland Rail report (2008) derived an air speed based emission factor equation based on the work undertaken by Ferreira (2003) and work carried out by Witt (1999) who examined quadratic relationships between air speed across a conveyor and dust emissions. The equation is presented below.

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

where:

m = mass emission rate of coal dust (as TSP) from the wagon surface in g/km/tonne of coal transported

k_1 = constant (0.0000378)

k_2 = constant (-0.000126)

k_3 = constant (0.000063)

v = air velocity travelling over the surface of the train (km/hr)

Wind speeds at the coal wagon surface would be influenced by ambient wind velocity and the speed of the train. It has been assumed that on sections of rail track between the Rail Load-out Facility and the immediate south of the Project Site, trains would be travelling at 40km/hr. Although this is lower than the average speed of coal freight trains in the Ferreira (2003) study (55 to 60 km/hr) it is considered that for the rail journey from the Project Site north to Werris Creek Station, then south, back past the eastern boundary of the Project Site, the train would not have sufficient opportunity to build up speed and 40km/hr is considered to be a highly conservative estimate of the train speed prior to heading south towards the Port of Newcastle. A quantitative assessment of rail wagon emissions as the train passes through the township of Quirindi has also been undertaken, with the speed of the train assumed to be 75km/hr on this section of track based on information supplied by Pacific National regarding the allowable train speed allowed on this portion of the track.

In the assessment of trains travelling at 40km/hr, it has been assumed that in all hours, ambient wind speeds are additive to the velocity of the train such that a worst case assessment of wind speed at the coal wagon surface has been made. Site specific ambient wind speed has been used as measured at the Project Site during the modelling period as outlined in Section 5.

In the assessment of trains travelling at 75km/hr through Quirindi, a more refined assessment has been undertaken which takes into account the heading and speed of the train through Quirindi and adjusts the wind speed at wagon surface according to the speed and direction of the ambient wind. E6B flight computer calculations (used by pilots to calculate true ground speed) have been adopted as follows:

$$V_g = \sqrt{V_a^{\,2} + V_w^{\,2} + 2V_aV_w\cos(w - d - \Delta a)}$$

where

V_g = True air speed over wagon surface (km/hr)

V_a = wind speed (km/hr)

V_w = train speed (km/hr)

w = wind direction (degrees)

d = train direction (degrees)

$a = w - d$

Based on the assumptions outlined above, the average emission rate of TSP from the coal wagons leaving the Project Site has been estimated to be 0.08 g/km/tonne for trains travelling at 40kph and 0.21 g/km/tonne for trains travelling at 75kph. Generally, a maximum number of three train load-outs and departures from the Project Site would occur on any one day. It has also been assumed that each train consists of 72 wagons and can carry a total of 5,400t of coal on each train.

In the assessment of particulate matter emissions from rail wagons travelling 40km/hr past the Project Site, a rail track length of 13km as shown in **Figure 20** has been quantitatively assessed using the assumptions above. A total of 65 volume sources have been included within the dispersion model (refer Section 9) to provide an incremental and cumulative assessment of emissions from coal wagons.

In the assessment of particulate matter emissions from rail wagons travelling 75 km/hr through Quirindi, a rail track length of 100m has been quantitatively assessed using the assumptions above (**Figure 21**). A total of 33 volume sources have been included within the dispersion model (refer Section 9) to provide an incremental and cumulative assessment of emissions from coal wagons. Due to the proximity of some residences/properties to the rail line in Quirindi (approximately 10m) and the requirement to use source spacing of one quarter that of the distance to the nearest residence (3m), a shorter section of rail line has been assessed in Quirindi. It is considered that this section of rail is representative of the passage of the rail line through the section of town where properties are closest to the rail line.

PM_{10} has been assumed to be 50% of the TSP emission with 10% of the PM_{10} emission being $PM_{2.5}$. No controls have been applied to the emission rate as no literature is available on the effect of coal wagon watering and the distance to which this control measure is effective. It is acknowledged that coal wagons would be watered prior to leaving the Project Site and as such, this assessment represents a worst case scenario with concentrations of particulate matter expected to be lower than those modelled.

Modelling results based on the emission factors described above are discussed in Section 10.

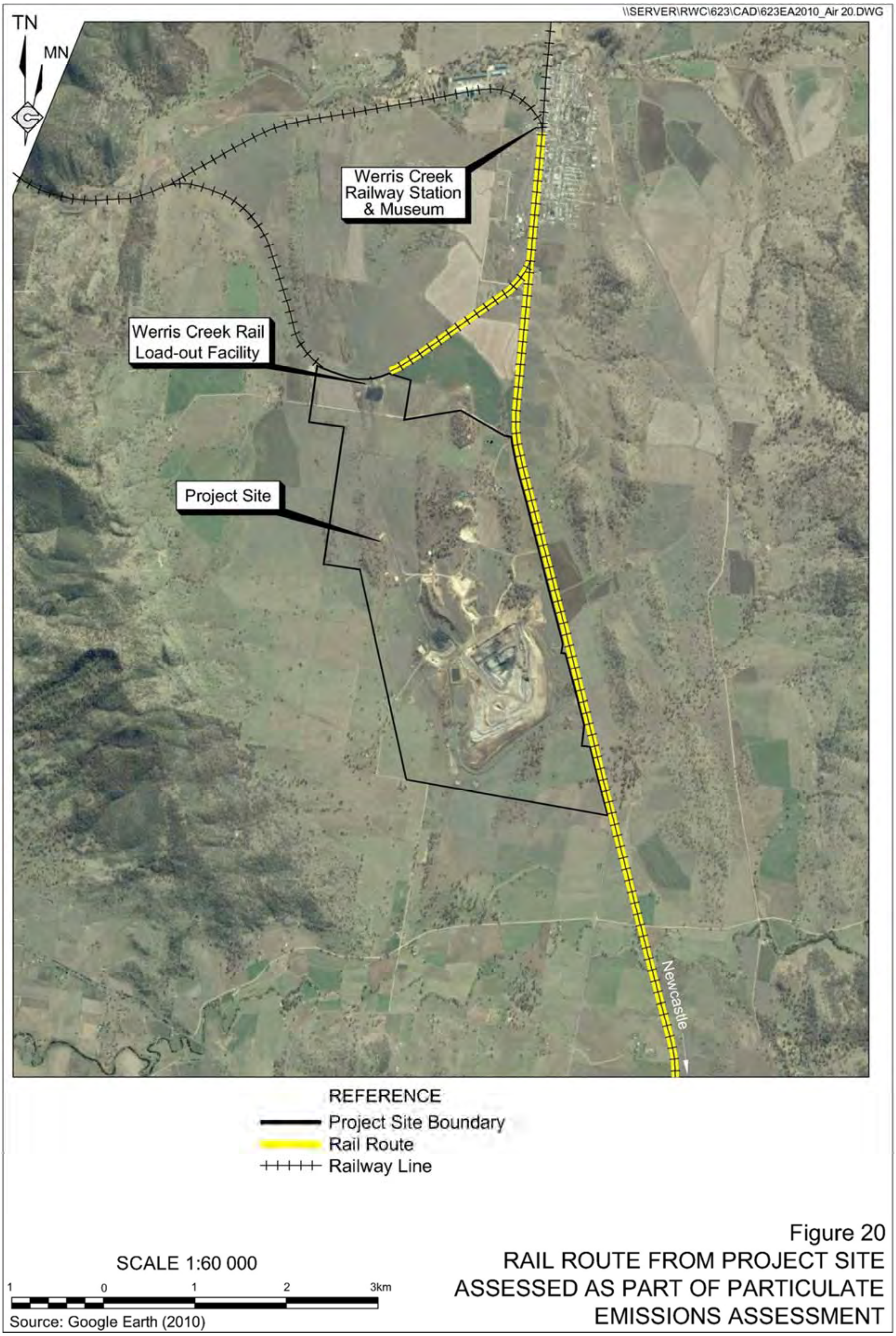
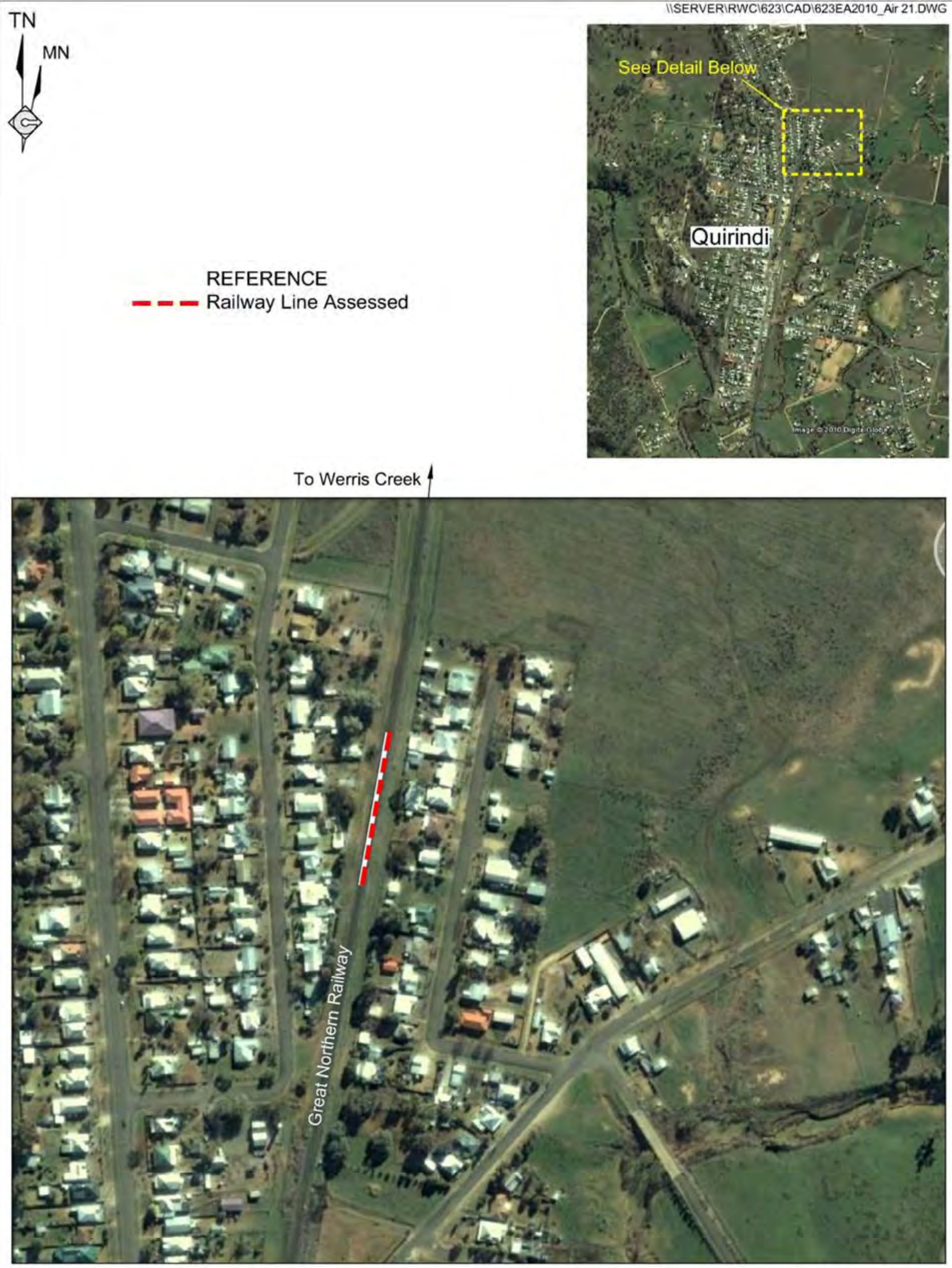


Figure 20
RAIL ROUTE FROM PROJECT SITE ASSESSED AS PART OF PARTICULATE EMISSIONS ASSESSMENT



SCALE 1:4 000

50 0 50 100 150 200 m

Source: Google Earth (2010)

Figure 21
RAIL ROUTE THROUGH QUIRINDI ASSESSED AS PART OF PARTICULATE EMISSIONS ASSESSMENT

9. AIR DISPERSION MODELLING METHODOLOGY

Activities associated with the approved operations with the potential to generate particulates have been identified in Section 2.4 of this report. As the LOM Project is proposed to be a continuation of approved Werris Creek Coal Mine operations, potential sources of dust are considered to be the same although at an incrementally higher rate due to the proposed increase in production. However the locations of mining activities would be altered as a result of the proposed LOM Project from what is currently approved as presented in **Figure 16**, **Figure 17** and **Figure 18**.

The particulate dispersion modelling carried out for the LOM Project utilises the DECCW and US EPA approved CALPUFF Dispersion Model software. CALPUFF is a transport and dispersion model that advects (or puffs) material emitted from modelled sources, simulating dispersion and transformation processes along the way. In doing so it typically uses the meteorological fields generated by CALMET, although can utilise a single station meteorological file generated by for example TAPM, as is the case within this assessment (refer Section 5.2). The primary output files from CALPUFF contain either hourly concentration or hourly deposition fluxes evaluated at selected receptor locations. The CALPOST is then used to process these files, producing tabulations that summarise results of the simulation.

The choice of the CALPUFF (Version 5.8) modelling system for the current assessment is based on the relatively uncomplicated terrain between the Project Site and residences/properties being modelled and is used in preference to models such as Ausplume. The advantages of using CALPUFF (rather than using a steady state Gaussian dispersion model such as Ausplume) is its ability to handle calm wind speeds (<0.5 m/s).

More advanced dispersion models (such as CALPUFF) are approved for use by the DECCW in situations where these models may be more appropriate than use of the Ausplume model. Such situations include those noted above (i.e. high frequency of calm wind conditions).

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

10. AIR QUALITY MODELLING RESULTS

10.1 CALPUFF MODELLING RESULTS

Dispersion modelling predictions of dust deposition and TSP, PM_{10} and $PM_{2.5}$ concentrations for the privately-owned residences/properties nominated in Section 3.2 attributable to the LOM Project are presented in Section 10.1.1 to Section 10.1.4

The results are presented as an increment due to on-site mining operations and rail transport operations and a cumulative value which is the sum of the increment plus the background concentrations adopted in Section 6.4.

Pollutant isopleth plots in **Appendix E** are also provided which show the maximum incremental (mining and rail sources combined) concentrations and depositions of the pollutants assessed.

For those residences identified in **Table 3** which have not been explicitly modelled within this assessment, an inferred pollutant concentration has been provided through examination of contour plots. These inferred results are presented as a table note.

10.1.1 Dust Deposition

Table 20 shows the results of the dispersion modelling for dust deposition from the LOM Project at each of the identified receptors using the emission rates calculated in Section 8.

Contour plots of the incremental increase in dust deposition attributable to each scenario are presented in **Appendix E**.

The results indicate that annual average dust deposition at all nominated residences/properties surrounding the LOM Project are predicted be to below the relevant criterion of 4g/m^2/month (cumulative dust deposition) when using a background deposition level of 0.6g/m^2/month. All predictions of dust deposition are also shown to be below the relevant criterion of 2 g/m^2/month as an increment only with maximum incremental dust deposition levels predicted to be 0.7 g/m^2/month during Scenario 3 at residence/property 14.

Coal transport operations by rail are included within the incremental predictions of dust deposition provided in **Table 20**. The incremental dust deposition predicted at each receptor in Werris Creek due to rail operations only are presented in **Table 21**. It is demonstrated that coal transport operations by rail contribute a maximum of 0.1 g/m^2/month to dust deposition levels, approximately 5% of the DECCW criterion for dust deposition. Results of dust deposition modelling due to rail transport through Quirindi are discussed in Section 10.1.5.

10.1.2 Total Suspended Particulate Matter (TSP)

Table 22 presents the results of the dispersion modelling for TSP from the LOM Project at each of the nominated residences/properties using the emission rates calculated in Section 8. As discussed in Section 6.4, a conservative background concentration of 30.2µg/m^3 has been assumed for the LOM Project.

Annual average TSP concentrations are well within the criterion of 90µg/m^3 at all modelled residences/properties. Contour plots of the incremental increase in TSP concentrations attributable to the LOM Project (Scenarios 1, 2 and 3) are presented in **Appendix E**.

Coal transport operations by rail are included within the incremental predictions of TSP provided in **Table 22**. The incremental TSP concentrations predicted at each receptor due to rail operations only are presented in **Table 23**. It is shown that coal transport operations by rail contribute a maximum of 1.9µg/m^3 to ambient TSP concentrations, approximately 2% of the DECCW criterion for TSP. Results of TSP modelling due to rail transport through Quirindi are discussed in Section 10.1.5.

Table 20
Predicted Incremental (Mining and Coal Transport Operations) and Cumulative Dust Deposition at Nearest Nominated Residences/Properties

Receptor ID	Ownership	Dust Deposition - Annual Average (g/m²/month)							
		Scenario 1		Scenario 2		Scenario 3		Assessment Criteria (g/m²/month)	
		Incr.	Cum.	Incr.	Cum.	Incr.	Cum.	Incr.	Cum.
5	R. & A. George	<0.1	0.6	<0.1	0.6	<0.1	0.6	2	4
7	P.R. & J.S. Andrews	0.1	0.7	0.1	0.7	<0.1	0.6	2	4
8	P.A. & T.M. Hird	0.1	0.7	0.1	0.7	<0.1	0.6	2	4
9	B.R. & A.J. Smith	0.1	0.7	0.1	0.7	<0.1	0.6	2	4
10	A. Blackwell	0.2	0.8	0.1	0.7	0.1	0.7	2	4
11	W.H. & S.I. Ryan	0.2	0.8	0.1	0.7	0.1	0.7	2	4
12	B.A. Fletcher	0.2	0.8	0.2	0.8	0.1	0.7	2	4
14	A.D. & C. Teskera	0.4	1	0.5	1.1	0.7	1.3	2	4
15	R.G. & A.R. Maxwell	0.4	1	0.3	0.9	0.2	0.8	2	4
17	M.M. Doolan & A.E. Hogan	0.1	0.7	0.1	0.7	0.1	0.7	2	4
18	R.F. & H.T. Withers	0.4	1	0.5	1.1	0.5	1.1	2	4
20	L. Patterson	0.5	1.1	0.6	1.2	0.5	1.1	2	4
21	G.J. Currey	0.4	1	0.4	1	0.4	1	2	4
22	L.F. & R.M. Parkes	0.1	0.7	0.1	0.7	<0.1	0.6	2	4
24	P. George	0.2	0.8	0.1	0.7	0.1	0.7	2	4
96	B. Davison	0.2	0.8	0.2	0.8	0.2	0.8	2	4
98	J. Colville	0.1	0.7	0.1	0.7	0.1	0.7	2	4
99	C. Colville	0.1	0.7	0.1	0.7	0.1	0.7	2	4
Inc = increment Attributable to the LOM Project			Cum = Cumulative level						

Residences A1, A103, A3, A101, A102 and A105 (refer **Table 3**) would be expected to experience incremental dust deposition associated with coal transport of <0.1 g/m²/month during Scenario 1, Scenario 2 and Scenario 3. Results are likely to be similar to those for Receptors 20 and 21.

10.1.3 Particulate Matter (PM_{10})

10.1.3.1 Annual Average PM_{10}

Presented in **Table 24** are the results of the dispersion modelling for annual average PM_{10} from the LOM Project at each of the nominated residences/properties using the emission rates calculated in Section 8.

An annual average background concentration of 15.1µg/m^3 has been applied to obtain an indication of the potential cumulative impacts associated with the LOM Project and to allow comparison with the annual average PM_{10} criterion of 30µg/m^3.

Table 21
Predicted Incremental Dust Deposition Associated with Coal Transport Operations by Rail

Receptor ID	Ownership	Dust Deposition - Annual Average (g/m^2/month)
		All Scenarios (1, 2 and 3)
5	R. & A. George	<0.1
7	P.R. & J.S. Andrews	<0.1
8	P.A. & T.M. Hird	<0.1
9	B.R. & A.J. Smith	<0.1
10	D.I. Athelston Bowd	<0.1
11	W.H. & S.I. Ryan	<0.1
12	B.A. Fletcher	0.1
14	A. & T. Haling	<0.1
15	R.G. & A.R. Maxwell	<0.1
17	M.M. Doolan & A.E. Hogan	<0.1
18	R.F. & H.T. Withers	0.1
20	L. Patterson	0.1
21	G.J. Currey	0.1
22	L.F. & R.M. Parkes	<0.1
24	P. & M. George	<0.1
96	B. Davison	<0.1
98	J. Colville	<0.1
99	C. Colville	<0.1

Residences A1, A103, A3, A101, A102 and A105 (refer **Table 3**) would be expected to experience incremental dust deposition associated with coal transport of <0.1 g/m^2/month during Scenario 1, Scenario 2 and Scenario 3. Results are likely to be similar to those for Receptors 20 and 21.

Annual average PM_{10} concentrations are predicted to satisfy the criterion of 30µg/m^3 at all the modelled residences/properties. Contour plots of the incremental increase in annual average PM_{10} concentrations attributable to the LOM Project (all scenarios) are presented in **Appendix E.**

Coal transport operations by rail are included within the incremental predictions of PM_{10} provided in **Table 24**. The incremental dust deposition levels predicted at each receptor due to rail operations only are presented in **Table 25**. It is shown that coal transport operations by rail contribute a maximum of 1.0µg/m^3 to incremental annual average PM_{10} concentrations, approximately 3% of the DECCW criterion. Results of annual average PM_{10} modelling due to rail transport through Quirindi are discussed in Section 10.1.5.

Table 22
Predicted Incremental (Mining and Coal Transport Operations) and Cumulative TSP Concentrations at Nearest Nominated Residences/Properties

Receptor ID	Ownership	TSP Concentration- Annual Average (µg/m³)						
		Scenario 1		Scenario 2		Scenario 3		Assessment Criteria (µg/m³)
		Incr.	Cum.	Incr.	Cum.	Incr.	Cum.	Cum.
5	R. & A. George	1.2	31.4	1.0	31.2	0.7	30.9	90
7	P.R. & J.S. Andrews	2.3	32.5	1.7	31.9	1.2	31.4	90
8	P.A. & T.M. Hird	2.3	32.5	1.7	31.9	1.2	31.4	90
9	B.R. & A.J. Smith	2.2	32.4	1.7	31.9	1.2	31.4	90
10	A. Blackwell	4.1	34.3	2.8	33.0	1.9	32.1	90
11	W.H. & S.I. Ryan	4.3	34.5	3.0	33.2	2.0	32.2	90
12	B.A. Fletcher	5.7	35.9	4.5	34.7	3.4	33.6	90
14	A.D. & C. Teskera	9.2	39.4	12.1	42.3	17.1	47.3	90
15	R.G. & A.R. Maxwell	10.6	40.8	6.3	36.5	4.2	34.4	90
17	M.M. Doolan & A.E. Hogan	3.0	33.2	2.3	32.5	1.6	31.8	90
18	R.F. & H.T. Withers	10.4	40.6	11.5	41.7	11.5	41.7	90
20	L. Patterson	12.6	42.8	13.8	44.0	13.1	43.3	90
21	G.J. Currey	9.8	40.0	10.6	40.8	10.4	40.6	90
22	L.F. & R.M. Parkes	2.1	32.3	1.6	31.8	1.1	31.3	90
24	P. George	3.9	34.1	2.7	32.9	1.9	32.1	90
96	B. Davison	5.7	35.9	4.9	35.1	4.2	34.4	90
98	J. Colville	2.4	32.6	2.4	32.6	2.0	32.2	90
99	C. Colville	1.6	31.8	1.8	32.0	1.8	32.0	90
Incr. = increment Attributable to the LOM Project				Cum. = Cumulative level				

Residences A1, A103, A3, A101, A102 and A105 (refer Table 3) would be expected to experience incremental TSP concentrations of <10 µg/m³ during Scenario 1, Scenario 2 and Scenario 3. Results are likely to be similar to those for Receptors 20 and 21.

10.1.3.2 Incremental 24-hour Maximum PM_{10}

Presented in **Table 26** are the results of the dispersion modelling for maximum 24-hour average PM_{10} from the LOM Project at each of the nominated residences/properties using the emission rates calculated in Section 8.

Table 23
Predicted Incremental TSP Concentrations Associated with Coal Transport Operations by Rail

Receptor ID	Ownership	TSP Concentrations - Annual Average (µg/m^3)
		All Scenarios (1, 2 and 3)
5	R. & A. George	<0.1
7	P.R. & J.S. Andrews	<0.1
8	P.A. & T.M. Hird	<0.1
9	B.R. & A.J. Smith	<0.1
10	D.I. Athelston Bowd	<0.1
11	W.H. & S.I. Ryan	<0.1
12	B.A. Fletcher	1.5
14	A. & T. Haling	0.2
15	R.G. & A.R. Maxwell	0.1
17	M.M. Doolan & A.E. Hogan	0.2
18	R.F. & H.T. Withers	1.6
20	L. Patterson	1.3
21	G.J. Currey	1.9
22	L.F. & R.M. Parkes	<0.1
24	P. & M. George	0.1
96	B. Davison	<0.1
98	J. Colville	<0.1
99	C. Colville	<0.1

Residences A1, A103, A3, A101, A102 and A105 (refer Table 3) would be expected to experience incremental TSP concentrations associated with coal transport of <2 µg/m^3 during Scenario 1, Scenario 2 and Scenario 3. Results are likely to be similar to those for Receptors 20 and 21.

As discussed in Section 6.2.1 a daily varying PM_{10} background concentration file from Tamworth was used in modelling to identify the cumulative impacts of the LOM Project on the surrounding environment. Examination of the highest PM_{10} concentrations within this background file alongside NEPM compliance reports and other resources allowed the identification of 9 of the top 10 concentrations as being of a regional nature (bushfires or dust storms). These concentrations have been removed from the background file. This approach is considered to be justified, as high background concentrations influenced by sources of a regional and uncontrollable nature (by the proponent) would result in high numbers of exceedances of the Project criterion.

Maximum 24-hour PM_{10} concentrations are predicted to satisfy the criterion of 50µg/m^3 at all the modelled residence/properties with the exception of three occasions at residence/property 14 in Scenario 3 (60.7µg/m^3, 52.8µg/m^3 and 51.2µg/m^3). These three exceedances of the 24-hour PM_{10} criterion occur during days with average south-southwesterly and west-southwesterly winds and wind speeds of between 2.4m/s and 5.2m/s. Residence/property 14 has not yet been constructed, but is likely to be located approximately 0.5km from the eastern boundary of the Project Site. During these wind conditions, particulate emissions from all sources at the Project Site (activities within the pit, haul roads, crushing and screening plant etc.) would impact upon this residence/property, during Scenario 3, when activities are proposed to be at the northern extent of the LOM Project Site boundary.

Table 24
Predicted Incremental (Mining and Coal Transport Operations) and Cumulative Annual Average PM_{10} Concentrations at Nearest Nominated Residences/Properties

Receptor ID	Ownership	PM_{10} Concentration- Annual Average ($\mu g/m^3$)						
		Scenario 1		Scenario 2		Scenario 3		Assessment Criteria ($\mu g/m^3$)
		Incr.	Cum.	Incr.	Cum.	Incr.	Cum.	Cum.
5	R. & A. George	0.5	15.6	0.4	15.5	0.3	15.4	30
7	P.R. & J.S. Andrews	0.8	15.9	0.7	15.8	0.5	15.6	30
8	P.A. & T.M. Hird	0.8	15.9	0.7	15.8	0.5	15.6	30
9	B.R. & A.J. Smith	0.8	15.9	0.7	15.8	0.5	15.6	30
10	A. Blackwell	1.5	16.6	1.1	16.2	0.8	15.9	30
11	W.H. & S.I. Ryan	1.6	16.7	1.2	16.3	0.8	15.9	30
12	B.A. Fletcher	2.3	17.4	1.9	17.0	1.5	16.6	30
14	A.D. & C. Teskera	3.2	18.3	4.3	19.4	6.1	21.2	30
15	R.G. & A.R. Maxwell	3.8	18.9	2.4	17.5	1.6	16.7	30
17	M.M. Doolan & A.E. Hogan	1.2	16.3	0.9	16.0	0.7	15.8	30
18	R.F. & H.T. Withers	3.7	18.8	4.2	19.3	4.3	19.4	30
20	L. Patterson	4.3	19.4	4.9	20.0	4.8	19.9	30
21	G.J. Currey	3.6	18.7	3.9	19.0	4.0	19.1	30
22	L.F. & R.M. Parkes	0.8	15.9	0.6	15.7	0.5	15.6	30
24	P. George	1.5	16.6	1.1	16.2	0.8	15.9	30
96	B. Davison	2.1	17.2	1.9	17.0	1.6	16.7	30
98	J. Colville	0.9	16.0	0.9	16.0	0.8	15.9	30
99	C. Colville	0.6	15.7	0.7	15.8	0.7	15.8	30

Incr. = increment Attributable to the LOM Project Cum. = Cumulative level

Residences A1, A103, A3, A101, A102 and A105 (refer Table 3) would be expected to experience incremental annual average PM_{10} concentrations of <5 $\mu g/m^3$ during Scenario 1, Scenario 2 and Scenario 3. Results are likely to be similar to those for Receptors 20 and 21.

These predicted high concentrations are shown to be greatly influenced by incremental concentrations from mining activities (39.4$\mu g/m^3$, 37.7$\mu g/m^3$ and 27.4$\mu g/m^3$, respectively). The Acoustic and Visual Amenity Bund would be constructed prior to Scenario 3 operations commencing and therefore, this 8m to 25m high bund, occupying a length of 2.2 km along the north eastern boundary of the LOM Project boundary would afford significant protection to this residence/property and assist in retaining a significant proportion of the generated particulate within the Project Site boundary. Explicit quantification of the protection provided by the bund is not possible within the dispersion modelling exercise.

Contour plots of the incremental increase in maximum 24-hour average PM_{10} concentrations attributable to the LOM Project (all Scenarios) are presented in **Appendix E**.

Table 25
Predicted Incremental Annual Average PM_{10} Concentrations Associated with Coal Transport Operations by Rail

Receptor ID	Ownership	PM_{10} Concentrations - Annual Average (µg/m^3)
		All Scenarios (1, 2 and 3)
5	R. & A. George	<0.1
7	P.R. & J.S. Andrews	<0.1
8	P.A. & T.M. Hird	<0.1
9	B.R. & A.J. Smith	<0.1
10	D.I. Athelston Bowd	<0.1
11	W.H. & S.I. Ryan	<0.1
12	B.A. Fletcher	0.7
14	A. & T. Haling	0.1
15	R.G. & A.R. Maxwell	0.1
17	M.M. Doolan & A.E. Hogan	0.1
18	R.F. & H.T. Withers	0.8
20	L. Patterson	0.6
21	G.J. Currey	1.0
22	L.F. & R.M. Parkes	<0.1
24	P. & M. George	<0.1
96	B. Davison	<0.1
98	J. Colville	<0.1
99	C. Colville	<0.1

Residences A1, A103, A3, A101, A102 and A105 (refer Table 3) would be expected to experience incremental annual average PM_{10} concentrations associated with coal transport of <1 µg/m^3 during Scenario 1, Scenario 2 and Scenario 3. Results are likely to be similar to those for Receptors 20 and 21.

Coal transport operations by rail are included within the incremental predictions of PM_{10} provided in **Table 26**. The incremental dust deposition levels predicted at each residence/property due to rail operations only are presented in **Table 27**. It is demonstrated that coal transport operations by rail contribute a maximum of 3.2µg/m^3 to incremental maximum 24-hour average PM_{10} concentrations, approximately 6% of the DECCW criterion. Results of maximum 24-hour PM_{10} modelling due to rail transport through Quirindi are discussed in Section 10.1.5.

10.1.4 Particulate Matter ($PM_{2.5}$)

10.1.4.1 Annual Average $PM_{2.5}$

Presented in **Table 28** are the results of the dispersion modelling for annual average $PM_{2.5}$ from the LOM Project at each of the nominated residences/properties using the emission rates calculated in Section 8.

Table 26
Predicted Incremental (Mining and Coal Transport Operations) and Cumulative Maximum 24-Hour Average PM_{10} Concentrations at Nearest Nominated Residences/Properties

Receptor ID	Ownership	PM_{10} Concentration- Maximum 24-Hour Average (µg/m³)						
		Scenario 1		Scenario 2		Scenario 3		Assessment Criteria (µg/m³)
		Incr.	Cum.	Incr.	Cum.	Incr.	Cum.	Cum.
5	R. & A. George	6.1	32.1	5.0	32.0	3.5	32.0	50
7	P.R. & J.S. Andrews	6.7	32.1	6.0	32.2	4.4	32.1	50
8	P.A. & T.M. Hird	6.9	32.1	6.2	32.2	4.4	32.1	50
9	B.R. & A.J. Smith	6.0	32.2	5.9	32.2	4.2	32.1	50
10	A. Blackwell	10.3	36.8	7.2	36.2	5.2	34.6	50
11	W.H. & S.I. Ryan	10.9	37.8	7.9	35.9	5.5	34.6	50
12	B.A. Fletcher	13.8	36.0	10.1	33.0	7.5	32.8	50
14	A.D. & C. Teskera	17.5	41.3	20.7	41.9	39.4	***60.7***	50
15	R.G. & A.R. Maxwell	28.1	47.7	17.9	37.5	13.7	35.5	50
17	M.M. Doolan & A.E. Hogan	8.7	34.8	6.7	32.2	5.0	32.0	50
18	R.F. & H.T. Withers	19.2	40.5	20.8	44.6	23.7	47.5	50
20	L. Patterson	21.4	41.8	27.3	41.8	24.7	44.9	50
21	G.J. Currey	16.4	38.4	20.7	39.6	18.4	42.2	50
22	L.F. & R.M. Parkes	6.1	32.1	5.6	32.2	4.2	32.1	50
24	P. George	12.3	34.9	8.9	34.4	6.5	34.0	50
96	B. Davison	12.5	37.7	13.7	36.3	11.2	33.9	50
98	J. Colville	7.2	32.6	6.2	32.7	5.8	32.2	50
99	C. Colville	6.2	32.8	5.3	32.6	6.8	32.6	50

Incr. = increment Attributable to the LOM Project Cum. = Cumulative level

Note: The 24-hour period showing maximum increment may not necessarily be associated with the 24-hour period associated with the maximum cumulative concentration.

Residences A1, A103, A3, A101, A102 and A105 (refer Table 3) would be expected to experience incremental 24-hour maximum PM_{10} concentrations of <25 µg/m³ during Scenario 1, Scenario 2 and Scenario 3. Results are likely to be similar to those for Receptors 20 and 21.

Due to a lack of $PM_{2.5}$ monitoring data or studies providing an appropriate ratio with which to calculate $PM_{2.5}$ concentrations from PM_{10} or TSP concentrations, predicted incremental concentrations of $PM_{2.5}$ only have been compared to the annual average Project criterion of 8µg/m³.

Annual average $PM_{2.5}$ concentrations are predicted to satisfy the criterion of 8µg/m³ at all the modelled residences/properties with the maximum predicted $PM_{2.5}$ concentration accounting for approximately 40% of the criterion. Contour plots of the incremental increase in annual average $PM_{2.5}$ concentrations attributable to the LOM Project (all Scenarios) are presented in **Appendix E**.

Table 27
Predicted Incremental Maximum 24-Hour Average PM_{10} Concentrations Associated with Coal Transport Operations by Rail

Receptor ID	Ownership	PM_{10} Concentrations – Maximum 24-hour Average ($\mu g/m^3$)
		All Scenarios (1, 2 and 3)
5	R. & A. George	<0.1
7	P.R. & J.S. Andrews	<0.1
8	P.A. & T.M. Hird	<0.1
9	B.R. & A.J. Smith	<0.1
10	D.I. Athelston Bowd	0.1
11	W.H. & S.I. Ryan	0.1
12	B.A. Fletcher	3.1
14	A. & T. Haling	0.4
15	R.G. & A.R. Maxwell	0.3
17	M.M. Doolan & A.E. Hogan	0.6
18	R.F. & H.T. Withers	2.4
20	L. Patterson	3.0
21	G.J. Currey	3.2
22	L.F. & R.M. Parkes	<0.1
24	P. & M. George	0.2
96	B. Davison	0.1
98	J. Colville	0.1
99	C. Colville	0.1

Residences A1, A103, A3, A101, A102 and A105 (refer Table 3) would be expected to experience incremental 24-hour maximum PM_{10} concentrations associated with coal transport of <3.5 $\mu g/m^3$ during Scenario 1, Scenario 2 and Scenario 3. Results are likely to be similar to those for Receptors 20 and 21.

10.1.4.2 Incremental 24-hour Maximum $PM_{2.5}$

Presented in **Table 29** are the results of the dispersion modelling for maximum 24-hour average $PM_{2.5}$ from the LOM Project at each of the nominated residences/properties using the emission rates calculated in Section 8.

Once again, no background data was available that could be used to perform a cumulative $PM_{2.5}$ assessment.

Maximum 24-hour $PM_{2.5}$ concentrations are predicted to satisfy the criterion of 25$\mu g/m^3$ at all the modelled residences/properties. It is noted that several predicted incremental $PM_{2.5}$ concentrations are greater than 75% of the criterion (18.7$\mu g/m^3$) and an addition of a small background concentration of approximately 7$\mu g/m^3$ would result in exceedances of the Project criterion. However, determining an appropriate background concentration of $PM_{2.5}$ is difficult for the reasons already noted. There is also uncertainty associated with the estimation of $PM_{2.5}$ emissions from PM_{10} estimates using broad ratios for ranges of sources.

Table 28
Predicted Incremental (Mining and Coal Transport Operations) Annual Average $PM_{2.5}$ Concentrations at Nearest Nominated Residences/Properties

Receptor ID	Ownership	$PM_{2.5}$ Concentration- Annual Average ($\mu g/m^3$)			
		Scenario 1	Scenario 2	Scenario 3	Assessment Criteria ($\mu g/m^3$)
		Increment	Increment	Increment	Cumulative
5	R. & A. George	0.8	0.5	0.4	8
7	P.R. & J.S. Andrews	1.0	0.7	0.6	8
8	P.A. & T.M. Hird	1.0	0.7	0.6	8
9	B.R. & A.J. Smith	1.0	0.7	0.6	8
10	A. Blackwell	1.4	0.9	0.8	8
11	W.H. & S.I. Ryan	1.4	1.0	0.8	8
12	B.A. Fletcher	1.5	1.1	0.9	8
14	A.D. & C. Teskera	2.8	2.7	3.1	8
15	R.G. & A.R. Maxwell	2.2	1.4	1.2	8
17	M.M. Doolan & A.E. Hogan	1.2	0.9	0.7	8
18	R.F. & H.T. Withers	2.6	2.4	2.4	8
20	L. Patterson	2.9	2.6	2.5	8
21	G.J. Currey	2.5	2.3	2.3	8
22	L.F. & R.M. Parkes	1.0	0.7	0.6	8
24	P. George	1.4	0.9	0.8	8
96	B. Davison	2.0	1.6	1.4	8
98	J. Colville	1.4	1.2	1.1	8
99	C. Colville	1.1	1.0	1.0	8

Residences A1, A103, A3, A101, A102 and A105 (refer Table 3) would be expected to experience incremental annual average $PM_{2.5}$ concentrations of <3 $\mu g/m^3$ during Scenario 1, Scenario 2 and Scenario 3. Results are likely to be similar to those for Receptors 20 and 21.

Table 29
Predicted Incremental (Mining and Coal Transport Operations) Maximum 24-hr Average $PM_{2.5}$ Concentrations at Nearest Nominated Residences/Properties

Receptor ID	Ownership	$PM_{2.5}$ Concentration- Maximum 24-hr Average (µg/m³)			Assessment Criteria (µg/m³)
		Scenario 1	Scenario 2	Scenario 3	
		Increment	Increment	Increment	Cumulative
5	R. & A. George	10.3	7.3	6.2	25
7	P.R. & J.S. Andrews	13.2	9.1	7.6	25
8	P.A. & T.M. Hird	13.1	9.1	7.5	25
9	B.R. & A.J. Smith	12.8	8.8	7.3	25
10	A. Blackwell	14.6	10.0	8.3	25
11	W.H. & S.I. Ryan	14.7	10.1	8.3	25
12	B.A. Fletcher	13.5	9.5	7.9	25
14	A.D. & C. Teskera	17.9	15.1	15.5	25
15	R.G. & A.R. Maxwell	19.5	13.5	11.3	25
17	M.M. Doolan & A.E. Hogan	11.0	7.8	6.5	25
18	R.F. & H.T. Withers	18.0	15.4	15.4	25
20	L. Patterson	19.0	16.4	16.4	25
21	G.J. Currey	17.5	15.1	15.1	25
22	L.F. & R.M. Parkes	12.6	8.7	7.2	25
24	P. George	13.5	9.3	7.7	25
96	B. Davison	15.0	11.5	10.0	25
98	J. Colville	10.3	8.7	8.4	25
99	C. Colville	8.5	7.2	7.0	25

Residences A1, A103, A3, A101, A102 and A105 (refer Table 3) would be expected to experience incremental 24-hour maximum $PM_{2.5}$ concentrations of <20 µg/m³ during Scenario 1, Scenario 2 and Scenario 3. Results are likely to be similar to those for Receptors 20 and 21.

The dispersion modelling predictions for $PM_{2.5}$ should therefore be viewed as indicative only, with an appropriate level of uncertainty attached. It is recommended that the Proponent undertake $PM_{2.5}$ monitoring on a 1-in-6 day cycle for a period of approximately 12 months at the "Tonsley Park" monitoring station (Residence/Property 20) to identify the absolute $PM_{2.5}$ concentrations and also site specific TSP / PM_{10} / $PM_{2.5}$ ratios associated with Project operations. This data would be invaluable in validating the findings of this assessment. Should $PM_{2.5}$ concentrations be shown to be consistently below the criterion, monitoring can be ceased. If $PM_{2.5}$ concentrations are shown to be consistently above the criterion then a detailed assessment of monitoring data and concurrent meteorological data should be performed to identify the most likely sources of $PM_{2.5}$ particles. Management measures could be applied to the identified sources, with success of implemented measures validated through continued monitoring.

Contour plots of the incremental increase in maximum 24-hour average $PM_{2.5}$ concentrations attributable to the LOM Project (all Scenarios) are presented in **Appendix E**.

Coal transport operations by rail are included within the incremental predictions of $PM_{2.5}$ provided in **Table 28**. The incremental $PM_{2.5}$ concentrations predicted at each residence/property due to rail operations only are presented in **Table 30**. It is shown that coal transport operations by rail contribute a maximum of 0.5µg/m^3 and 0.1µg/m^3 to incremental 24-hour maximum and annual average $PM_{2.5}$ concentrations, approximately 2% and 1.25% of the Project criterion, respectively. Results of annual average and 24-hour maximum $PM_{2.5}$ modelling due to rail transport through Quirindi are discussed in Section 10.1.5.

Table 30
Predicted Incremental Annual Average $PM_{2.5}$ Concentrations Associated with Coal Transport Operations by Rail

Receptor ID	Ownership	$PM_{2.5}$ Concentrations - All Scenarios (1, 2 and 3)	
		Max 24-hour Average	Annual Average (µg/m^3)
5	R. & A. George	<0.1	<0.1
7	P.R. & J.S. Andrews	<0.1	<0.1
8	P.A. & T.M. Hird	<0.1	<0.1
9	B.R. & A.J. Smith	<0.1	<0.1
10	D.I. Athelston Bowd	<0.1	<0.1
11	W.H. & S.I. Ryan	<0.1	<0.1
12	B.A. Fletcher	0.3	0.1
14	A. & T. Haling	0.2	<0.1
15	R.G. & A.R. Maxwell	0.1	<0.1
17	M.M. Doolan & A.E. Hogan	0.1	<0.1
18	R.F. & H.T. Withers	0.5	0.1
20	L. Patterson	0.4	0.1
21	G.J. Currey	0.5	0.1
22	L.F. & R.M. Parkes	<0.1	<0.1
24	P. & M. George	0.1	<0.1
96	B. Davison	0.1	<0.1
98	J. Colville	0.1	<0.1
99	C. Colville	0.1	<0.1

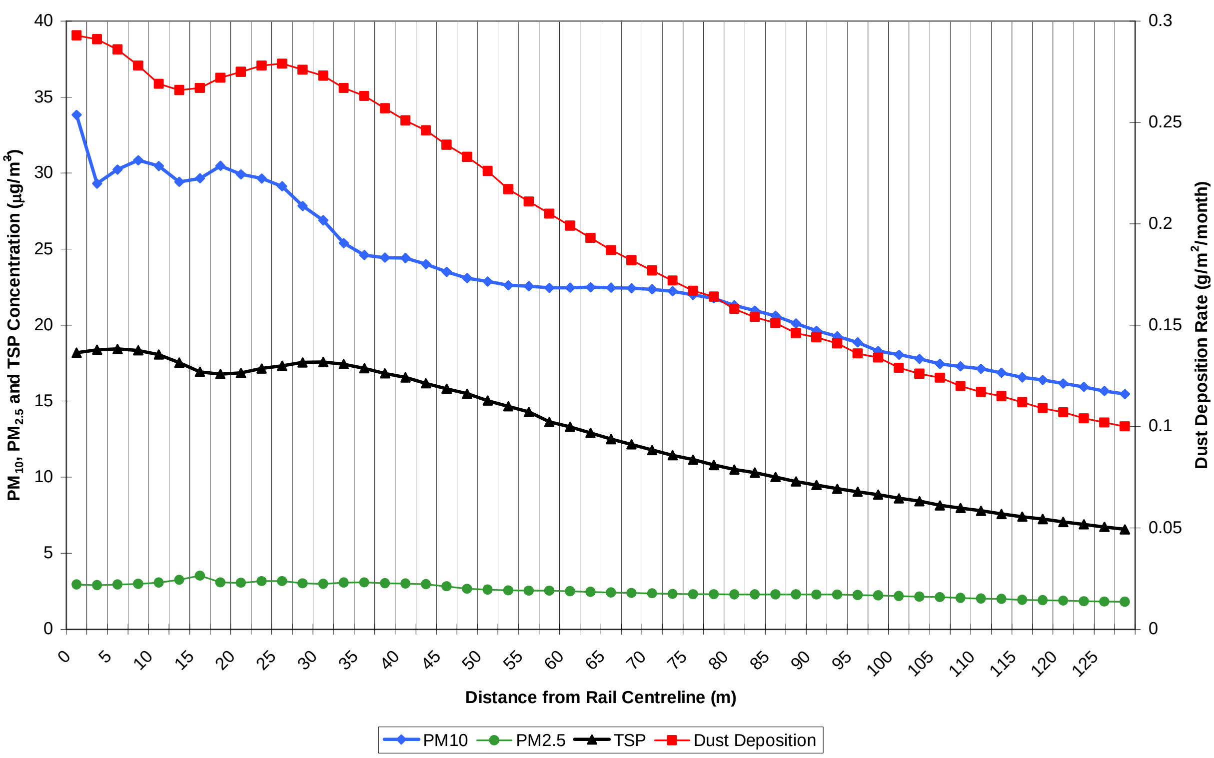
Residences A1, A103, A3, A101, A102 and A105 (refer Table 3) would be expected to experience $PM_{2.5}$ concentrations associated with coal transport of <0.5 µg/m^3 (maximum 24-hour average) and 0.1 µg/m^3 (annual average) during Scenario 1, Scenario 2 and Scenario 3. Results are likely to be similar to those for Receptors 20 and 21.

10.1.5 Assessment of Particulate Matter Impacts from LOM Project Related Rail Transport within Quirindi

As discussed in Section 8.3, an assessment of the impacts of coal wagon particulate emissions on the township of Quirindi has been undertaken. Results were predicted on a fine grid of receptors spaced at 3m intervals. The results are presented in **Figure 22** as a concentration (TSP annual average, and maximum 24 hour PM_{10} and $PM_{2.5}$ in µg/m^3) and deposition rate (TSP in g/m^2/month) at distances from rail centre line to 130m from rail centre line.

It is demonstrated that the incremental concentrations of PM_{10} (maximum 24-hour average) peak at approximately 34µg/m^3 at the rail centreline and decrease to 15µg/m^3 at 130m from the rail centre line. At a 10m distance from the rail centreline, incremental concentrations are in the order of 30µg/m^3. The addition of the maximum 24-hour average background concentration from Tamworth (31.9µg/m^3) results in some PM_{10} (maximum 24-hour average) concentrations exceeding the NSW DECCW criterion of 50µg/m3 at distances up to 100m from the rail centre line. This result represents a worst case assessment as the maximum incremental 24-hour average PM_{10} concentrations being assessed with the maximum 24-hour average background concentration from Tamworth being added. Therefore, the exceedance predicted is dependant on the maximum increment and maximum background occurring within the same 24-hour period and therefore the results of the modelling should be viewed as highly conservative.

Figure 22 Incremental Concentrations and Deposition Rate of TSP, PM_{10} and $PM_{2.5}$ from Rail Centreline in Quirindi



Note: PM_{10} and $PM_{2.5}$ concentrations are 24-hour maxima, TSP concentrations are annual averages and dust deposition rates are monthly averages

Incremental concentrations of $PM_{2.5}$ (maximum 24-hour average) are shown to be approximately 4µg/m^3 at rail centreline, reducing to approximately 2µg/m^3 at 110m. These are shown to be well below the PM2.5 advisory criterion of 25µg/m^3. Incremental annual average TSP concentrations peak at 18µg/m^3 at the rail centreline, reducing to 6µg/m^3 at 130m. With the addition of a background concentration of 30.2µg/m3 (refer Section 6.2.1) results in the Project criterion being met at all distances from the rail centreline for annual average TSP.

Incremental dust deposition is shown to be approximately 0.3g/m^2/month at the rail centreline. Deposition decreases away from the centreline, reaching levels of 0.1g/m^2/month at 130m. The addition of a background concentration of 0.6g/m^2/month (refer Section 6.3) results in the Project criterion of 4g/m^2/month being met at all distances from the rail centreline for dust deposition.

Several items are of note with regard to the assessment of rail wagon emissions within Quirindi.

Firstly, the predicted rail movements (maximum of three trains per day from Werris Creek Mine) are the same number as what occurs currently. Therefore, no additional air quality impacts would be experienced within Quirindi due to the rail transport of coal from the Werris Creek Mine through Quirindi for the LOM Project. It is also noted that the three trains from the LOM Project represent only a small percentage of the number of trains that may utilise the rail line through Quirindi on any given day.

Secondly, as previously discussed, rail wagons would be sprayed with water prior to departing the Werris Creek Coal Mine. This would act to suppress emissions of particulate from the surface of the rail wagons, although it is not clear at what distance from the Project Site the action of this suppression would begin to be reduced through evaporation. The most important factor in the emission rate of particulate from the rail wagon surface is train speed. Emissions rates of particulate matter are approximately 2.5 times higher for trains travelling at 75km per hour (as they have been modelled running through Quirindi as based on advice from Pacific National) compared to trains travelling at 40km/hr. A reduction in train speeds through Quirindi would certainly result in lower particulate concentrations, however, the carrier, Pacific National, are responsible for the operation of these trains and therefore the Proponent has no control over the speeds the trains may travel.

The assessment of impacts of coal dust emissions from Werris Creek coal transportation has indicated that, in the case of PM_{10}, exceedances of the cumulative DECCW criteria (50µg/m^3) may be experienced (that is with the addition of background concentrations). Maximum incremental concentrations of PM_{10} due to the passage of 3 trains within a 24 hour period have been predicted to be in the region of 30µg/m^3 at 10 metres from the rail centre line.

Cumulative Impacts of Particulate Matter Impacts from Rail Transport within Quirindi

The total number of trains passing through Werris Creek and Quirindi each day is of the order of 26, with coal, grain and other products being transported in quantities unknown to the proponent. If the conservative assumption is made that all 26 train passages are coal wagons (from Werris Creek and other mines), and the coal is of the same quality and state of process (crushed and screened), then the broad assumption could be made that the maximum incremental 24 hour average PM_{10} concentration could be up to 260µg/m^3 at 10m from the rail centreline (26/3 x 30 µg/m3), with emissions from Werris Creek coal wagons contributing 11.5% to this total. The addition of a background concentration of 30.2µg/m^3 results in a potential cumulative 24 hour average PM_{10} concentration of up to 291µg/m^3 at 10m from the rail centreline.

The broad assessment of cumulative particulate impacts from coal wagons presented above clearly shows that the responsibility for particulate management and mitigation is a shared one. Whitehaven Coal is committed to engaging in discussions with rail network management (Australian Rail Track Corporation Ltd [ARTC]) and the rail freight carrier (Pacific National [PN]) and have written to ARTC and PN on 22 November 2010 to engage them in dialogue regarding the possibilities of initiating air quality monitoring within Quirindi and to discuss any potential control strategies which could be initiated on site to reduce the impact of dust from loaded coal wagons on this, and other communities.

10.1.6 Recommendations Based on Air Quality Assessment

Predictions of the potential impacts on air quality at residences/properties resulting from the operation of the proposed Werris Creek Mine LOM Project have been made. These predictions have been made for PM_{10}, $PM_{2.5}$, TSP and dust deposition.

It is recommended that the current air quality monitoring network be maintained. It is also recommended that co-location of a new High Volume Air Sampler, monitoring for $PM_{2.5}$ be located at the 'Tonsley Park' residence (Residence 20) to the north of the Werris Creek Mine. This data would assist in the validation of the findings presented within this report which suggest that $PM_{2.5}$ concentrations may be over 75% of the advisory criterion for $PM_{2.5}$ from Project sources alone. As previously discussed, the addition of an appropriate background concentration is not possible to achieve with any certainty. Furthermore, the $PM_{2.5}$ emission rates used within the modelling assessment are also highly uncertain. The wide range of uncertainty is therefore required to be reduced through ongoing monitoring. Monitoring on a 1-in-6 day cycle, as is currently undertaken for PM_{10} and TSP would be recommended as this would allow a detailed assessment of the proportion of $PM_{2.5}$ which is measured as PM_{10} at Tonsley Park, and would allow an assessment of the likely source locations of this finer particulate material.

To ensure that PM_{10} concentrations are appropriately minimised at Residence 15 during Scenario 1 of the proposed LOM Project, the Proponent has indicated that during Scenario 1 operations, when winds are from a northerly direction and above 3 m/s for more than four consecutive 15 minute periods, they would limit overburden dumping on the top lift of the overburden emplacement area. This would result in these emissions being contained within the pit or behind the overburden emplacement area. These actions are not predicted to be required in Scenario 2 or 3 of the proposed LOM Project.

It is acknowledged that the foregoing management measure is reactive and DoP require a more proactive approach to particulate management and mitigation. To this end, in addition to the existing air quality monitoring network, real-time particulate monitors (TEOM) are to be purchased and incorporated into the monitoring network prior to commencement of LOM Project operations. The exact number and location of the monitors is to be decided and will be the subject of a detailed Air Quality Monitoring and Management Plan. However, the aim of the real time instruments is to provide information on increasing particulate concentrations. The real time nature of the instruments will, in conjunction with onsite meteorology, allow upwind/downwind concentrations of PM_{10} to be assessed, and mine contributions to ambient concentrations calculated. Should concentrations be noted to be approaching trigger criteria, relevant and contributing project operations would be identified and activity appropriately reduced until such time as the monitoring information provided confidence that concentrations had been reduced.

Predictions of air quality impacts within Quirindi from emissions from rail transport from the Project Site have indicated that maximum 24-hour average PM_{10} concentrations during days with high background concentrations may be exceeded on some occasions. Although the results of the assessment should be viewed with an appropriate level of caution, it is recommended that the Proponent discuss with the rail transport companies the possibility of the rail transport companies conducting an air quality monitoring campaign to gain an understanding of the air quality impacts of coal transport through Quirindi. These measurements would assist in validating the findings of the air quality assessment presented within this report and provide guidance as to the requirement or otherwise to continue monitoring or if the rail transport companies may need to implement further mitigation measures over and above those currently implemented by the Proponent.

11. GREENHOUSE GAS ASSESSMENT

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

11.1 DIRECT AND INDIRECT EMISSIONS (EMISSION SCOPES)

The National Greenhouse Accounts Factors (NGA Factors) (DCC, 2009) defines two types of greenhouse gas emissions:

> ***Direct emissions*** *are produced from sources within the boundary of an organisation and as a result of the organisation's activities.*
>
> ***Indirect emissions*** *are emission generated in the wider economy as a consequence of an organisation's activities (particularly from its demand for goods and services), but which are physically produced by the activities of another organisation.*

The NGA Factors identifies three 'scopes' of emissions for greenhouse gas accounting and reporting purposes, defined as follows:

- *Direct (or point-source) emission factors give the kilograms of carbon dioxide equivalent (CO2-e) emitted per unit of activity at the point of emission release (i.e. fuel use, energy use, manufacturing process activity, mining activity, on-site waste disposal, etc.). These factors are used to calculate scope 1 emissions.*
- *Indirect emission factors are used to calculate scope 2 emissions from the generation of the electricity purchased and consumed by an organisation as kilograms of CO2-e per unit of electricity consumed. Scope 2 emissions are physically produced by the burning of fuels (coal, natural gas, etc.) at the power station.*
- *Various emission factors can be used to calculate scope 3 emissions. For ease of use, specific 'scope 3' emission factors are reported 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.*

11.2 GREENHOUSE GAS CALCULATION METHODOLOGY

Quantification of potential emissions from the LOM Project 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); and
- nitrous oxide (N_2O): GWP of 310 (310 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 LOM 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 LOM Project greenhouse gas emission sources is provided in **Table 31**.

Table 31
Summary of Potential LOM Project Greenhouse Gas Emissions

Project Component	Direct Emissions	Indirect Emissions	
	Scope 1	Scope 2	Scope 3
Fugitive Emissions	Emissions from the release of coal bed methane and CO_2 as a result of the LOM Project.	N/A	N/A
Diesel	Emissions from the combustion of diesel at the LOM Project (stationary energy and transport purposes).	N/A	Estimated emissions attributable to the extraction, production and transport of diesel consumed at the LOM Project.
Explosives	Emissions from explosives used as part of the LOM Project.	N/A	N/A
Electricity	N/A	Emissions associated with the consumption of generated and purchased electricity at the LOM Project.	Estimated emissions from the extraction, production and transport of fuel burned for the generation of electricity consumed at the LOM Project Site and the electricity lost in delivery in the transmission and distribution network.
Combustion of Coal	N/A	N/A	Emissions from the combustion of coal from the LOM Project.

N/A = Not applicable

11.2.1 Activity Data

To assess the GHG impact of the proposed LOM Project (to 2.5 Mtpa extraction rate), activity data has been scaled as outlined in **Table 32**. Activity data for the year 2008/2009, associated with 1.2 Mtpa coal extraction rate has been provided by the Proponent and scaled to reflect the 2.5 Mtpa extraction rate proposed as part of the LOM Project.

Table 32
Summary of Project Related Activity Data Relevant to GHG Emissions (Current and Proposed Operations)

Activity	Quantity (Operations – July 2008 to June 2009 [1.2 Mtpa])	Quantity (LOM Project [2.5 Mtpa])	Scaling Factor Applied
Annual ROM production (Mt)	1.2 Mtpa	2.5 Mtpa	2.08 (2.5 Mt/1.2 Mt)
Annual Electricity Consumption (kWh)	1,019,149	2,086,710	2.08
Annual Diesel Consumption (kilolitres [kL]) On-site	9,030	18,489	2.08
Annual Diesel Consumption (kL) Product transport by Rail	1,718	3,906	Extrapolated from fuel used for transportation of 2 Mtpa
Annual Diesel Consumption (kL) Product transport by Road	92	209	Extrapolated from fuel used for transportation of 2 Mtpa
Explosive Use (tonnes)	6,702	13,722	2.08
Employee Vehicle Movements	22,721	25,458	Assumed employee increase from 83 to 93 with 75% working on any one day

Information provided by the Proponent has indicated that the end uses of the coal from the LOM Project would be as outlined in **Table 33**. Back calculation of current end uses has been performed to allow comparison of current and LOM Project GHG emissions.

11.2.1.1 Scope 1: Direct Emissions

Fugitive emissions - Coal Bed Methane and Carbon Dioxide

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

The NGA Factors provides default emission factors for CO_2-e (as methane) resulting from fugitive emissions at open-cut coal mines. These emission factors are provided on a State and Territory specific basis, based on the variation in coal-bed methane content. Table 8 of the NGA Factors (DCC, 2009) provides a default figure for NSW open-cut coal mines of 0.045 t CO_2-e per t of raw coal (t CO_2-e/t raw coal).

Table 33
End Uses of LOM Project Product Coal

End Use	Quantity (tonnes) Current	Quantity (tonnes) LOM Project
Domestic PCI for Charcoal Production	60,000	125,000
Domestic Use in Hospital Furnace	12,000	25,000
Steel Making (Coking coal)	120,000	250,000
Electricity Generation (Thermal coal)	1,008,000	2,100,000
Total	**1,200,000**	**2,500,000**

Diesel Usage

Scope 1 greenhouse gas emissions attributable to diesel relate to the use of on-site machinery and transport.

The primary fuel source for the vehicles, plant and equipment operating at the LOM Project is diesel. Diesel consumption for all mobile and fixed equipment for the LOM Project is estimated as 18,489,000 litres (L) for on-site transport fuel purposes. Diesel usage for off-site product transport is estimated to be 209,000 L per annum for road transport sources and 3,906,000 L for rail transport sources.

It has been assumed that road transport sources are within direct control of the Proponent and have therefore been calculated as Scope 1 emissions. All fuel combusted by the rail contractor has been calculated as a Scope 3 emission.

The annual emissions of CO_2 and other greenhouse gas from this source have been estimated using emission factors for diesel-fuelled vehicles (as a worst case) contained in Tables 3 and 4 of the NGA Factors (DCC, 2009). It has been assumed that the energy content of diesel is 38.6 mega joules per litre (MJ/L) (DCC, 2009).

Explosives

The use of explosives in mining leads to the release of greenhouse gases. The activity level is the mass of explosive used (in tonnes). The quantity of explosives to be used as part of the LOM Project are detailed within **Table 32**.

The current edition of the NGA Factors (DCC, 2009) does not include emission factors for CO_2-e resulting from the use of ANFO or emulsion explosives. However, an emission factor of 0.17 t CO_2-e per t of explosive (t CO_2-e/t explosive) has been sourced from the February 2008 edition of the NGA Factors for use in this assessment.

11.2.1.2 Scope 2: Electricity Indirect Emissions

Emissions of GHG result from the consumption of purchased electricity generated at off-site locations.

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 for the LOM Project has been calculated as (approximately) 2.09 Megawatt-hours (MWh).

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.

11.2.1.3 Scope 3: Other Indirect Emissions

Combustion of Product Coal

Indirect emissions of greenhouse gases from the combustion of product coal are expected "downstream" due to the combustion of coal produced by the LOM Project. Up to 2.5 Mtpa of ROM coal would be produced by the LOM Project, with the majority destined to be used in electricity generation (refer **Table 33**). Other end uses are coking coal, use in hospital furnaces and in charcoal production.

The greenhouse gas emissions from combustion of product coal by other (non Werris Creek Coal Mine) entities have been based on a coal energy content of 30 gigajoules per tonne (GJ/t) for coking coal and 27 GJ/t for thermal (black) coal (or coal used to produce anything other than coke) (Table 1 of the NGA Factors [DCC, 2009]). Standard emission factors for Scope 1 emissions from coal combustion have been taken from Table 1 of the NGA Factors and reported as a Scope 3 emission.

Transport via Road

Indirect emissions of greenhouse gases would occur from the transportation of product coal from the LOM Project to market. The annual consumption of diesel associated with this activity has been estimated at 209kL.

The annual emissions of CO_2 and other greenhouse gases from this source have been estimated using emission factors contained in Tables 3 and 4 of the NGA Factors (DCC, 2009). It has been assumed that the energy content of diesel is 38.6 megajoules per litre (MJ/L) (DCC, 2009).

Transport via Rail

Based on data provided by the Proponent, the assumed diesel consumption by trains in the transportation of product coal from the LOM Project to Newcastle is projected to be approximately 3.9 ML per annum.

The annual emissions of CO_2 and other greenhouse gases from this source have been estimated using Table 4 of the NGA Factors (DCC, 2009). It has been assumed that the energy content of diesel is 38.6 MJ/L (DCC, 2009).

Extraction, Production and Transport of Diesel Consumed at the LOM Project

Scope 3 greenhouse gas emissions attributable to diesel used at the LOM 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).

Vehicle Use by Employees

Based on information provided by the Proponent, employees at the LOM Project travel an average of 26 km to work (calculated based on 50% of workforce living in Tamworth, 50% in Werris Creek or Quirindi). The number of employees associated with the LOM Project would be 93, an increase of 10 from current operations. As per roster arrangements, 75% of these employees would work on any given day. Based on these assumptions, employees would travel approximately 3,627km to and from work per day as part of the LOM Project operations, or 1,323,855 km each year. Assuming a diesel fuel consumption rate of 10 litres/100km, this employee travel would result in the combustion of 132 385 litres of diesel fuel per annum.

11.3 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 LOM Project are presented in **Table 34**, **Table 35** and **Table 36** respectively. Total annual LOM Project emissions have been calculated and are presented in **Table 37**. Also presented are the emissions calculated to be attributable to operations of 1.2Mtpa coal extraction, for comparison.

Table 34
Scope 1 Greenhouse Gas Emissions from the LOM Project

Emissions Source	Activity Rate		Units	Emission Factor	Units	Calculated Emissions t CO_2-e (/annum)		
	1.2 Mtpa	2.5 Mtpa LOM Project				1.2 Mtpa	2.5 Mtpa LOM Project	Difference
Fugitive emissions	1.2	2.5	Mtpa	0.045	t CO_2-e / t ROM	54,000	112,500	58,500
Diesel Combustion - Onsite	9,030	18,489	kL	69.9	kg CO_2-e/GJ	24,364	49,886	25,522
Diesel Combustion - Road Transport	92	209	kL	69.9	kg CO_2-e /GJ	248	564	316
Explosive Use	6,702	13,722	tonnes	0.17	t CO_2-e /t	1,139	2,333	1,193
Total Scope 1						**79,752**	**165,283**	**85,531**

Table 35
Scope 2 Greenhouse Gas Emissions from the LOM Project

Emissions Source	Activity Rate		Units	Emission Factor	Units	Calculated Emissions t CO_2-e (/annum)		
	1.2 Mtpa	2.5 Mtpa LOM Project				1.2 Mtpa	2.5 Mtpa LOM Project	Difference
Electricity Consumption	1,019,149	2,086,710	kwh	0.89	kg CO_2-e /kwh	907	1,857	950
Total Scope 2						**907**	**1,857**	**950**

The most significant direct emissions are associated with fugitive emissions of methane resulting from coal extraction and the combustion of diesel in site vehicles. The total direct (Scope 1) emissions from the LOM Project are estimated to be approximately 0.16Mt CO_2-e per annum, an increase of approximately 85,000 tonnes per annum, on the 1.2Mtpa coal extraction rate.

Indirect (Scope 3) emissions would be released mainly through end use of the coal. The total indirect emissions (Scope 3) from all Scope 3 emissions sources are estimated to be 6Mt CO_2-e per annum for the LOM Project, an increase of approximately 3Mtpa on the 1.2Mtpa coal extraction rate.

Table 36
Scope 3 Greenhouse Gas Emissions from the LOM Project

Emissions Source	**Activity Rate**		**Units**	**Emission Factor**	**Units**	**Calculated Emissions t CO_2-e (/annum)**		
	1.2 Mtpa	**2.5 Mtpa LOM Project**				**1.2 Mtpa**	**2.5 Mtpa LOM Project**	**Difference**
Electricity Consumption	1,019,149	2,086,710	kwh	0.18	kg CO_2-e /kwh	183	376	192
Diesel Combustion - Onsite	9,030	18,489	kL	5.3	kg CO_2-e /GJ	1,847	3,782	1,935
Diesel Combustion - Road Transport	92	209	kL	5.3	kg CO_2-e /GJ	19	43	24
Diesel Combustion - Rail Transport	1,718	3,906	kL	5.3	kg CO_2-e /GJ	351	799	448
Diesel Combustion - employees	118.1505	132.3855	kL	5.3	kg CO_2-e /GJ	24	27	3
End Use- Product Coal								
Domestic PCI for Charcoal Production	60,000	125,000	t	88.43	kg CO_2-e /GJ	143,257	298,451	155,195
Domestic Use in Hospital Furnace	12,000	25,000	t	88.43	kg CO_2-e /GJ	28,651	59,690	31,039
Steel Making (Coking coal)	120,000	250,000	t	90.22	kg CO_2-e /GJ	324,792	676,650	351,858
Electricity Generation (Thermal coal)	1,008,000	2,100,000	t	88.43	kg CO_2-e /GJ	2,406,711	5,013,981	2,607,270
Total Scope 3						**2,905,836**	**6,053,800**	**3,147,963**

Table 37
Scope 1, 2 and 3 Greenhouse Gas Emissions Attributable to the LOM Project (t CO_{2-e}/annum)

Operations	GHG Emissions t CO_{2-e}/annum			
	Scope 1	**Scope 2**	**Scope 3**	**Total**
1.2 Mtpa	79,752	907	2,905,836	2,986,495
2.5 Mtpa LOM Project	165,283	1,857	6,053,800	6,220,939
Emission Increase	**85,531**	**950**	**3,147,963**	**3,234,444**

A comparison of the predicted direct (Scope 1) emissions against Australia's 2007 net emissions of 597Mt CO_2-e demonstrates the LOM Project would represent approximately 0.03 % of the total annual Australian emissions (DCC, 2008). A comparison of the predicted Scope 1 emissions against NSW emissions in 2007 (162.7 Mt CO_2-e) demonstrates that the LOM Project would represent approximately 0.1% of NSW emissions (DCC, 2007).

11.4 GREENHOUSE GAS MITIGATION MEASURES

The Proponent is committed to reducing greenhouse gas emissions. In the next *Annual Environmental Monitoring Report* period, the Proponent has committed to investigate the following ideas for energy and greenhouse gas emissions reductions (WCC, 2010).

- A review of the air compressor system.
- Upgrade of the crushing plant to reduce the number of conveyors and remove diesel power packs.
- Investigate replacing coal transport by semi-trailers with conveyor system.

Some of the above measures have been proposed as part of the project description for the LOM Project.

At this stage, there have been no cost effective opportunities identified for the LOM Project to reduce Scope 3 emissions, however the Proponent would continue to look for these opportunities on an ongoing basis, if for example new technology arises to reduce scope 3 emissions.

12. RECOMMENDATIONS BASED ON GREENHOUSE GAS ASSESSMENT

It is recommended that the Proponent continue to monitor consumption of diesel fuel, explosives, electricity and the destination of product coal. Continual calculation of GHG emissions resulting from both current and proposed LOM operations will allow the identification of those areas where opportunities exist for reduction.

13. CONCLUSIONS

An AQA for the LOM Project has been undertaken as part of the *Environmental Assessment* for the proposed LOM Project.

The results of the dispersion modelling conducted for the LOM Project indicate the potential for exceedance of the DECCW 24-hour PM_{10} assessment criteria at the nearest non-Project related receptor to the east of the site, the yet to be constructed Residence 14. However, the modelled scenario presents a conservative prediction of emissions likely to be generated by the proposed LOM Project. The predicted emissions are therefore likely to be higher than those that would actually occur.

Maximum 24-hour $PM_{2.5}$ concentrations are predicted to satisfy the criterion of 25µg/m^3 at all the modelled residences/properties. However, it is noted that several predicted incremental $PM_{2.5}$ concentrations are greater than 75% of the criterion (18.7µg/m^3) and an addition of a small background concentration of approximately 7µg/m^3 would result in exceedances of the Project criterion. However, determining an appropriate background concentration of $PM_{2.5}$ is difficult for the reasons already noted. There is also uncertainty associated with the estimation of $PM_{2.5}$ emissions from PM_{10} estimates using broad ratios for ranges of sources.

Predictions of air quality impacts within Quirindi from emissions from rail transport from the Project Site have indicated that maximum 24-hour average PM_{10} concentrations during days with high background concentrations may be exceeded on some occasions. Although the results of the assessment should be viewed with an appropriate level of caution, it is recommended that the Proponent discuss with the rail transport companies the possibility of the rail transport companies conducting an air quality monitoring campaign to gain an understanding of the air quality impacts of coal transport through Quirindi. These measurements would assist in validating the findings of the air quality assessment presented within this report and provide guidance as to the requirement or otherwise to continue monitoring or if the rail transport companies may need to implement further mitigation measures over and above those currently implemented by the Proponent.

All other modelling results predicted that emissions as a result of the LOM Project would be within accepted criteria.

Continuation of air quality monitoring at the surrounding PM_{10} and dust deposition monitoring network for the life of the modified operations would validate modelling results. Additionally, the commencement of $PM_{2.5}$ monitoring would assist in the validation of the findings of the $PM_{2.5}$ assessment, which is necessarily highly uncertain.

Greenhouse gas emissions for the proposed LOM Project were also calculated. Direct (Scope 1) emissions were calculated to total approximately 165,000t of CO_2 equivalent (CO_2-e) annually. This represents an increase of less than 0.03% on Australia's national net 2007 emissions. Scope 1, 2 and 3 emissions were calculated to total approximately 3.2 Mt per annum.

14. REFERENCES

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

Brewer, I. and P. Tombach. 2005. BART Modelling Protocol for Vistas, US EPA

Commonwealth of Australia (2001) "National Pollutant Inventory Emission Estimation Technique Manual for Mining Version 2.3".

Department of Climate Change (2007) "Australia's National Greenhouse Accounts, State and Territory Greenhouse Gas Inventories".

Department of Climate Change (2008) "Australia's National Greenhouse Accounts", the Australian Government's Initial Report under the Kyoto Protocol.

Department of Climate Change (2009) "National Greenhouse Accounts (NGA) Factors".

Department of Environment and Climate Change (2008) "National Environment Protection (Ambient Air Quality) Measure New South Wales Annual Compliance Report 2007".

Department of Environment and Climate Change (2008) "National Environment Protection (Ambient Air Quality) Measure New South Wales Annual Compliance Report 2008".

Heggies Pty Ltd (2004), Proposed Werris Creek Coal Mine Air Quality Impact Assessment

Heggies Pty Ltd (2009) "Proposed Modification to the Werris Creek Coal Mine"

Intergovernmental Panel on Climate Change (1996) "Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories".

National Environmental Protection Council (1998) "Ambient Air Quality National Environment Protection Measure".

NSW Department of Environment, Climate Change and Water (2010), PM_{10} data from the DECCW's Tamworth monitoring site for September 2007 to August 2008.

NSW Department of Environment, Climate Change and Water (2005) "Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales".

NSW Department of Environment, Climate Change and Water (2007) "Approved Methods for the Sampling and Analysis of Air Pollutants in NSW".

United States Environmental Protection Authority (2000) "Meteorological Monitoring Guidance for Regulatory Modelling Applications".

United States Environmental Protection Authority (2003) Compilation of Air Pollutant Emission Factors AP-42 - Chapter 13.2.2 Unpaved Roads.

United States Environmental Protection Authority (2006) Compilation of Air Pollutant Emission Factors AP-42 - Chapter 13.2.1 Paved Roads.

United States Environmental Protection Authority (2006) Compilation of Air Pollutant Emission Factors AP-42 (Chapter 13, Section 13.2.5 Industrial Wind Erosion).

Werris Creek Coal Pty Limited (2010), Dust Deposition, PM_{10} and Meteorological Monitoring Data from established monitoring equipment at Project Site.

Werris Creek Coal Pty Limited – Annual Environmental Monitoring Report, 2008/2009

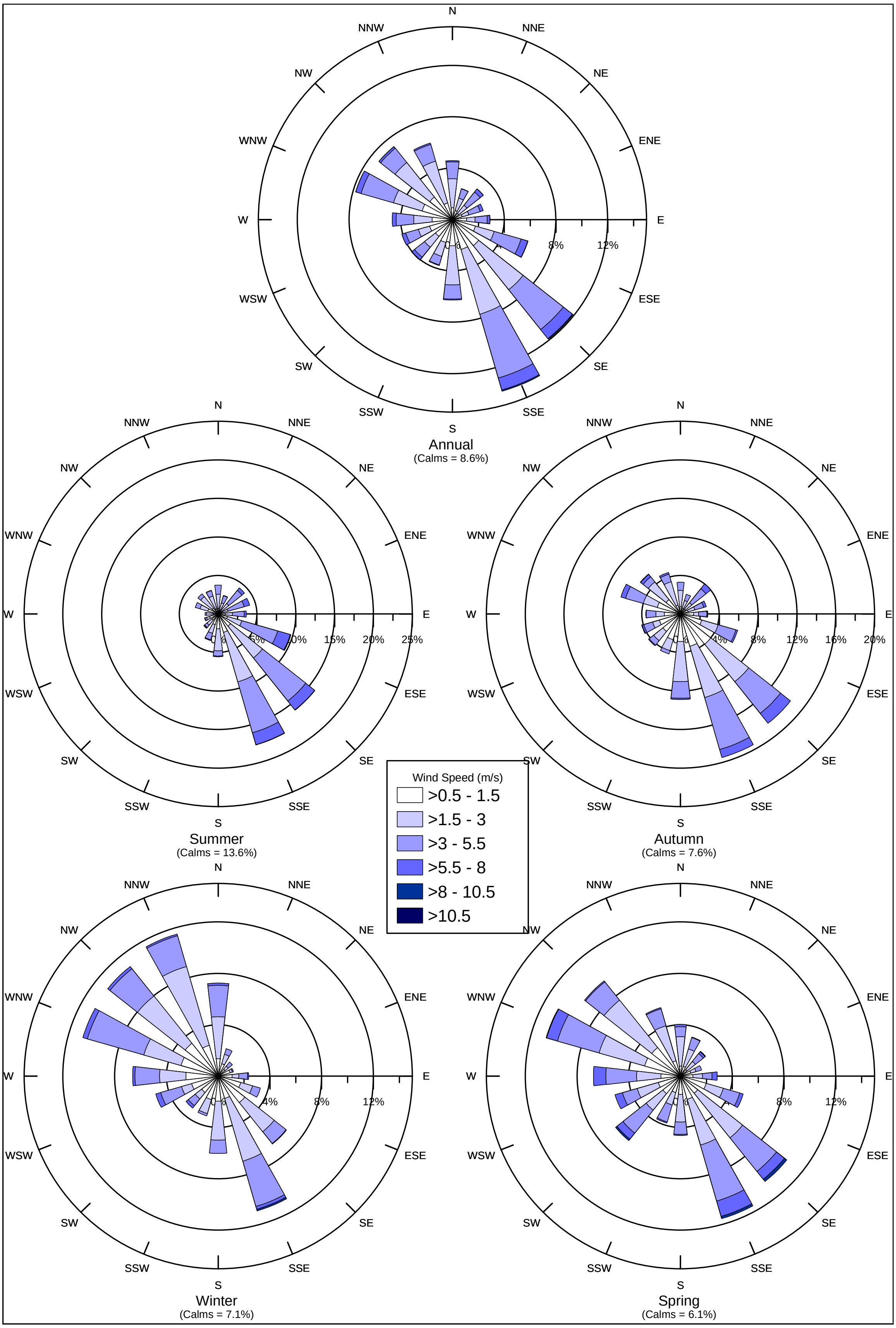
Werris Creek Coal Pty Limited – Annual Environmental Monitoring Report, 2009/2010

Appendix A

Annual and Seasonal Wind Roses – Project Site

(No of Pages Including Blank Pages = 2)

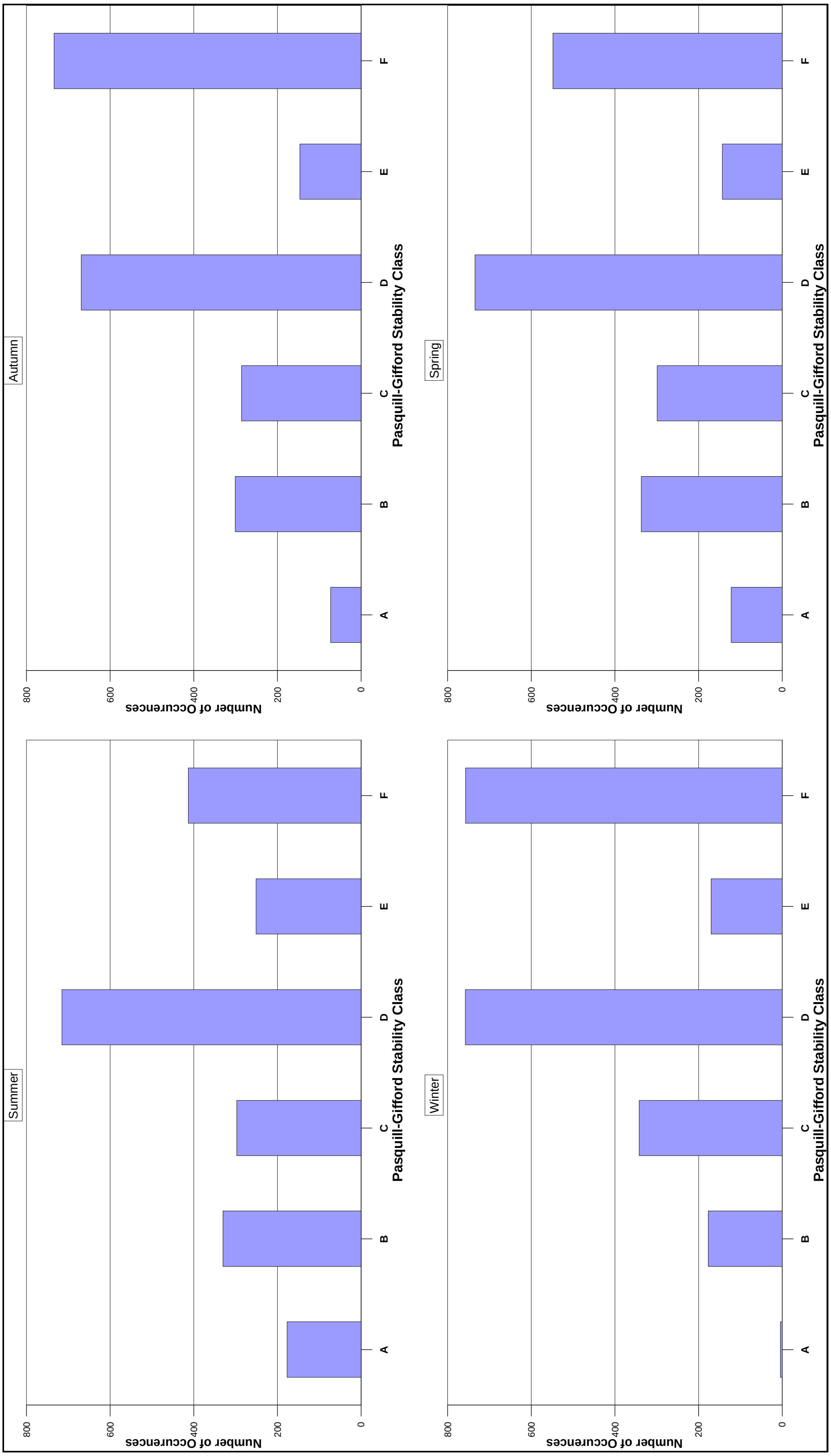
Please Note A Colour Copy of all Appendices is Available on the Project CD


N
NNE
NE
ENE
E
ESE
SE
SSE
S
SSW
SW
WSW
W
WNW
NW
NNW
8%
12%
Annual
(Calms = 8.6%)
15%
20%
25%
Summer
(Calms = 13.6%)
8%
12%
16%
20%
Autumn
(Calms = 7.6%)
Wind Speed (m/s)
>0.5 - 1.5
>1.5 - 3
>3 - 5.5
>5.5 - 8
>8 - 10.5
>10.5
4%
8%
12%
Winter
(Calms = 7.1%)
8%
12%
Spring
(Calms = 6.1%)

Appendix B

CALCULATED SEASONAL VARIATION IN ATMOSPHERIC STABILITY CLASS

(No of Pages Including Blank Pages = 2)


Summer
Autumn
Winter
Spring
Number of Occurrences
Pasquill-Gifford Stability Class
A
B
C
D
E
F
0
200
400
600
800

Appendix C

EQUIPMENT LISTS

(No of Pages Including Blank Pages = 4)

Scenario 1

ACTIVITY	LOCATION	EQUIPMENT	ELEVATION (AHD)
A. Vegetation Clearing and Soil Stripping		D11 Bulldozer	400m
		Scraper (x2)	410m & 400m
B. Overburden drilling (Surface)		Excavator (190t)	405m
		Haul Truck	405m
		Drill	405m
C. Overburden drilling (in-pit)	Bench 1 (380m AHD)	Excavator (360t)	360m
		Excavator (190t)	
		Haul Trucks (x2)	
	Bench 2 (360m AHD)	Drill	380m
		Excavator (360t)	
		Haul Trucks (x2)	
D. Coal Recovery	Bench 2 (360m AHD)	Excavator (37.5t)	360m
		Haul Trucks	
	Bench 3 (340m AHD)	D11 Bulldozer	340m
		Excavator 190t	
		Haul Truck	
E. Overburden placement and Management	Main Overburden Emplacement	D10 Dozer	440 m
		Haul Trucks (x2)	400m & 440m
F Haulage	To Overburden Emplacement	Haul Trucks (x2)	380m
	To ROM Pad	Haul Truck	390m
	To Product Coal Stockpile Area	Road Trucks (x2)	390m
G ROM Coal Processing	Existing Coal Processing Area	FEL (x2)	390m
		Road Truck x2	390m
		Crushing and Screening Plant	390m
H. Product Coal Loading	Product Coal Stockpile Area	Road Truck	380m
		D9 Bulldozer	
		Train	
		Water Cart	
		Rail Load-out Facility	
I. Construction	Relocated Coal Processing Area	D10 Bulldozer	400m
		Haul Truck	
		Crane	
J. Miscellaneous	Main Haul Road	Fuel Truck	390m
		Water Cart x2	
	Relocated Workshop	Small FEL (x2)	390m
		Haul Truck Maintenance	390m

Scenario 2

ACTIVITY	LOCATION	EQUIPMENT	ELEVATION (AHD
A. Vegetation Clearing and Soil Stripping		D10 Bulldozer	410m
		Scraper (x2)	410m & 420m
B. Overburden Drilling and Management (Surface)		Drill	410m
		Excavator (190t)	410m
		Haul Truck (23)	410m
C. Overburden Drilling and Management (In-pit ops)	Bench 1 (380m)	D11 Dozer	380m AHD
		Excavator (360t)	
		Haul Truck (x2)	
	Bench 2 (360m)	Drill	360m
		Haul Truck	
		Excavator (190t)	
D. Coal Recovery	Bench 1 (300m)	Excavator (190t)	380m
		Haul Truck	
		Excavator (37.5t)	
	Bench 2 (360m)	D11 Dozer	360m
		Excavator (360t)	
		Haul Truck	
E. Overburden Placement/ Management	Main Overburden Emplacement	D10 Dozer	440m
		Haul Truck	
	Acoustic and Visual Amenity Bund	D10 Dozer	415m
		Haul Truck	415m
F Haulage	To Overburden Emplacement	Haul Trucks (x2)	380m
	To ROM Pad	Haul Truck	390m
	To Product Coal Stockpile Area	Road Trucks (x2)	390m
G ROM Coal Processing	New Coal Processing Area	FEL (x2)	400m
		Road Trucks (x2)	
		Crushing and Screening Plant	
H. Product Coal Loading	Product Coal Stockpile Area	D9 Bulldozer (x2)	380m
		Train	
		Rail Load-out Facility	
		Water Cart added	
		Road Truck	
I. Miscellaneous	Main Haul Road	Grader	390m
		Water Cart x2 added	
		Fuel Truck	
	Workshop	Small FEL (x2)	390m
		Haul Truck Maintenance (x2)	

Scenario 3

ACTIVITY	LOCATION	EQUIPMENT	ELEVATION (AHD)
A. Vegetation Clearing and Soil Stripping		D10 Bulldozer	410m
		Scraper (x2)	400m & 410m
B. Overburden Drilling & Management (surface)		Drill	410m
		Excavator (190t)	410m
		Haul Trucks (x2)	410m
C. Overburden Drilling and Management (in-pit)	Bench 1 (380m)	Drill	380m
		D11 Bulldozer	
		Excavator (360t)	
		Excavator (190t)	
		Haul Trucks (x2)	
D. Coal Recovery	Bench 2 (360m)	Excavator (37.5t)	360m
		Haul Truck	
	Bench 3 (340m)	Excavator (190t)	340m
		D11 Bulldozer	
		Haul Trucks (x2)	
E. Overburden Placement/ Management	Main Overburden Emplacement	D10 Bulldozer	400m
		Haul Truck	400m & 380m
F Haulage	To Overburden Emplacement	Haul Trucks (x2)	380m
	To ROM Pad	Haul Truck	390m
	To Product Coal Stockpile Area	Road Trucks (x2)	390m
G ROM Coal Processing	New Coal Processing Area	FEL (x2)	400m
		Road Trucks (x2)	
		Crushing and Screening Plant Train	
H. Product Coal Loading	Product Coal Stockpile Area	D9 Bulldozer (x2)	380m
		Rail Load-out Facility	
		Water Cart	
		Road Truck	
I. Miscellaneous	Rail Load-out Road	Grader	390m
		Water Cart (x2)	
		Fuel Truck	
	Workshop	Haul Truck Maintenance	390m
		Small FEL (x2)	

Appendix D

EMISSIONS INVENTORY FOR SCENARIOS 1, 2 AND 3

(No of Pages Including Blank Pages = 4)

Job Number: 10-8775
Job Title: Werris Creek LOM Project
Scenario No: 1

			Emission Factors					Activity		Operation			Uncontrolled Emissions (kg/annum)			Control Factor (%)			Controlled Emissions (kg/annum)		
Descriptor	Source Type	Model Re	EF_{TSP}	EF_{PM10}	$EF_{PM2.5}$	Units	Source	per hour	Units	Hr/Day	Day/Year	OpHrs	$E_{kpy,TSP}$	$E_{kpy,PM10}$	$E_{kpy,PM2.5}$	CF_{TSP}	CF_{PM10}	$CF_{PM2.5}$	$EC_{kpy,TSP}$	$EC_{kpy,PM10}$	$EC_{kpy,PM2.5}$
A Bulldozer D11	Bulldozers on material other than coal	N-BULO1	4.49	0.988	0.148	kg/h	NPI	0.75	hrs	24	365	8760	29,500	6,490	972	100%	100%	100%	29,500	6,490	970
C Drill 1	Drilling	N-DRIL3	0.59	0.31	0.0465	kg/hole	NPI	1	holes	24	365	8760	5,170	2,720	407	50%	95%	95%	2,580	2,580	390
C Drill 2	Drilling	N-DRIL4	0.59	0.31	0.0465	kg/hole	NPI	1	holes	24	365	8760	5,170	2,720	407	50%	95%	95%	2,580	2,580	390
C Excavator 360 t	Excavator on overburden	N-ESFO1	0.00033	0.00016	2.3E-05	kg/t	NPI	1,073	tonnes	24	365	8760	3,070	1,460	218	50%	95%	95%	1,540	1,380	210
C Excavator 190 t	Excavator on overburden	N-ESFO2	0.00033	0.00016	2.3E-05	kg/t	NPI	1,073	tonnes	24	365	8760	3,070	1,460	218	50%	95%	95%	1,540	1,380	210
C Excavator 360t 2	Excavator on overburden	N-ESFO3	0.00033	0.00016	2.3E-05	kg/t	NPI	1,073	tonnes	24	365	8760	3,070	1,460	218	50%	95%	95%	1,540	1,380	210
D Excavator 37.5t	Excavator on coal	N-ESFC1	0.0129	0.00619	0.00093	kg/t	NPI	143	tonnes	24	365	8760	16,100	7,740	1,160	50%	95%	95%	8,060	7,350	1,100
D Bulldozer D11	Bulldozers on coal	N-BULC1	17	5.41	0.811	kg/h	NPI	0.69	hrs	24	365	8760	103,000	32,700	4,900	50%	95%	95%	51,400	31,100	4,700
D Excavator 190t	Excavator on coal	N-ESFC2	0.0129	0.00619	0.00093	kg/t	NPI	143	tonnes	24	365	8760	16,100	7,740	1,160	50%	95%	95%	8,060	7,350	1,100
E Bulldozer D10	Bulldozers on material other than coal	N-BULO2	4.49	0.988	0.148	kg/h	NPI	0.75	hrs	24	365	8760	29,500	6,490	972	100%	100%	100%	29,500	6,490	970
G FEL 1	FEL on coal	N-FELC1	0.0129	0.00619	0.00093	kg/t	NPI	143	tonnes	24	365	8760	16,100	7,740	1,160	100%	100%	100%	16,100	7,740	1,160
G FEL 2	FEL on coal	N-FELC2	0.0129	0.00619	0.00093	kg/t	NPI	143	tonnes	24	365	8760	16,100	7,740	1,160	100%	100%	100%	16,100	7,740	1,160
G Crush	Primary crushing - HMCO - Default Factor	N-PCRHN	0.01	0.004	0.0006	kg/t	NPI	500	tonnes	24	365	8760	43,800	17,500	2,630	50%	50%	50%	21,900	8,760	1,310
G Screen	Screening - LMCO	N-SCREE	0.08	0.06	0.009	kg/t	NPI	500	tonnes	24	365	8760	350,000	263,000	39,400	50%	50%	50%	175,000	131,000	20,000
H Bulldozer D9	Bulldozers on coal	N-BULC2	17	5.41	0.811	kg/h	NPI	0.69	hrs	24	365	8760	103,000	32,700	4,900	100%	100%	100%	103,000	32,700	4,900
H Rail Load Out	Loading to trains - Default Factor	N-LTRA1	0.0004	0.00017	2.6E-05	kg/t	NPI	533	tonnes	24	365	8760	1,870	794	119	50%	50%	50%	934	397	60
I Bulldozer D10	Bulldozers on material other than coal	N-BULO3	4.49	0.988	0.148	kg/h	NPI	1	hrs	24	365	8760	29,500	6,490	972	100%	100%	100%	29,500	6,490	970
BLAST	Blasting - overburden	N-BLAO1	9.39	4.88	0.732	kg/blast	NPI	2	blasts	1	365	365	6,850	3,560	534	100%	100%	100%	6,850	3,560	534
E DUMP	Truck dumping overburden	N-TRUO1	0.012	0.0043	0.00065	kg/t	NPI	2,253	tonnes	24	365	8760	237,000	84,900	12,700	100%	100%	100%	237,000	84,900	12,700
G DUMP	Truck dumping coal	N-TRUC1	0.01	0.0042	0.00063	kg/t	NPI	285	tonnes	24	365	8760	25,000	10,500	1,580	100%	100%	100%	25,000	10,500	1,600
H TRUCK LOAD	Miscellaneous transfer points - coal	N-MTPC1	0.00016	7.8E-05	1.2E-05	kg/t	NPI	11	tonnes	24	365	8760	16	8	1	50%	50%	50%	8	4	1
H Truck Unload	Truck dumping coal	N-TRUC2	0.01	0.0042	0.00063	kg/t	NPI	285	tonnes	24	365	8760	25,000	10,500	1,580	100%	100%	100%	25,000	10,500	1,600
H Bulldozer D9 (2)	Bulldozers on coal	N-BULC3	17	5.41	0.811	kg/h	NPI	0.69	hrs	24	365	8760	103,000	32,700	4,900	100%	100%	100%	103,000	32,700	4,900
A Scraper 1	Scraper	ASCRAP	1.02	0.25	0.04	VKT/hr	NPI	1.5	VKT/hr	24	365	8760	13,393	3,247	487	50%	50%	50%	6,700	1,620	244
A Scraper 2	Scraper		1.02	0.25	0.04	VKT/hr	NPI	1.5	VKT/hr	24	365	8760	13,393	3,247	487	50%	50%	50%	6,700	1,620	244
Pit to CPA	Haul Road	ROM	5.64	1.52	0.15	VKT/hr	AP42	4.3	VKT/hr	24	365	8760	212,289	57,309	5,731	28%	28%	28%	59,400	16,000	1,600
Pit to Dump W	Haul Road	W	6.23	1.68	0.17	VKT/hr	AP42	16	VKT/hr	24	365	8760	872,912	235,649	23,565	28%	28%	28%	244,000	66,000	6,600
Pit to Dump E	Haul Road	E	5.64	1.52	0.15	VKT/hr	AP42	12	VKT/hr	24	365	8760	592,434	159,932	15,993	28%	28%	28%	166,000	44,800	4,480
CPA to Load Out	Haul Road	CPA	1.01	0.19	0.05	VKT/hr	AP42	53	VKT/hr	24	365	8760	470,032	90,010	21,449	74%	74%	74%	348,000	66,600	15,900
Pit to CPA GRADER	Grader		0.35	0.14	0.02	VKT/hr	NPI	5	VKT/hr	24	365	8760	15,431	6,100	915	50%	50%	50%	7,720	3,050	457
Pit to Dump 1 GRADER	Grader		0.35	0.14	0.02	VKT/hr	NPI	5	VKT/hr	24	365	8760	15,431	6,100	915	50%	50%	50%	7,720	3,050	457
Pit to Dump 2 GRADER	Grader		0.35	0.14	0.02	VKT/hr	NPI	5	VKT/hr	24	365	8760	15,431	6,100	915	50%	50%	50%	7,720	3,050	457
Soil Stockpiles	Haul Road		5.58	1.51	0.15	VKT/hr	AP42	0.02	VKT/hr	24	365	8760	978	264	26	100%	100%	100%	978	264	26

Job Number: 10-8775
Job Title: Werris Creek LOM Project
Scenario No: 2

			Emission Factors					Activity		Operation			Uncontrolled Emissions (kg/annum)			Control Factor (%)			Controlled Emissions (kg/annum)		
Descriptor	Source Type	Model Ref	EF_{TSP}	EF_{PM10}	$EF_{PM2.5}$	Units	Source	A	Units	Hr/Day	Day/Year	OpHrs	$E_{kpy,TSP}$	$E_{kpy,PM10}$	$E_{kpy,PM2.5}$	CE_{TSP}	CE_{PM10}	$CE_{PM2.5}$	$EC_{kpy,TSP}$	$EC_{kpy,PM10}$	$EC_{kpy,PM2.5}$
A Bulldozer D10	Bulldozers on material other than coal	N-BULO1	4.49	0.988	0.148	kg/h	NPI	1	hrs	24	365	8760	29,500	6,490	972	100%	100%	100%	29,500	6,490	970
C Excavator 360 t	Excavator on overburden	N-ESFO1	0.000327	0.000155	0.0000232	kg/t	NPI	1,610	tonnes	24	365	8760	4,610	2,190	327	50%	95%	95%	2,310	2,080	310
C Excavator 190 t	Excavator on overburden	N-ESFO2	0.000327	0.000155	0.0000232	kg/t	NPI	1,610	tonnes	24	365	8760	4,610	2,190	327	50%	95%	95%	2,310	2,080	310
C Drill 3	Drilling	N-DRIL5	0.59	0.31	0.0465	kg/hole	NPI	1	holes	24	365	8760	5,170	2,720	407	50%	95%	95%	2,580	2,580	390
C Drill 4	Drilling	N-DRIL6	0.59	0.31	0.0465	kg/hole	NPI	1	holes	24	365	8760	5,170	2,720	407	50%	95%	95%	2,580	2,580	390
D Excavator 37.5t	Excavator on coal	N-ESFC1	0.0185	0.00891	0.00134	kg/t	NPI	143	tonnes	24	365	8760	23,100	11,100	1,680	50%	95%	95%	11,600	10,600	1,600
D Bulldozer D11	Bulldozers on coal	N-BULC1	29.9	9.54	1.43	kg/h	NPI	1	hrs	24	365	8760	181,000	57,700	8,640	50%	95%	95%	90,400	54,800	8,200
D Excavator 190t	Excavator on coal	N-ESFC2	0.0185	0.00891	0.00134	kg/t	NPI	143	tonnes	24	365	8760	23,100	11,100	1,680	50%	95%	95%	11,600	10,600	1,600
E Bulldozer D10	Bulldozers on material other than coal	N-BULO2	4.49	0.988	0.148	kg/h	NPI	1	hrs	24	365	8760	29,500	6,490	972	100%	100%	100%	29,500	6,490	970
G FEL 1	FEL on coal	N-FELC1	0.0185	0.00891	0.00134	kg/t	NPI	143	tonnes	24	365	8760	23,100	11,100	1,680	100%	100%	100%	23,100	11,100	1,700
G FEL 2	FEL on coal	N-FELC2	0.0185	0.00891	0.00134	kg/t	NPI	143	tonnes	24	365	8760	23,100	11,100	1,680	100%	100%	100%	23,100	11,100	1,700
G Crush	Primary crushing - HMCO - Default Fact	N-PCRHM1	0.01	0.004	0.0006	kg/t	NPI	500	tonnes	24	365	8760	43,800	17,500	2,630	50%	50%	50%	21,900	8,760	1,310
G Screen	Screening - LMCO	N-SCREEN1	0.08	0.06	0.009	kg/t	NPI	500	tonnes	24	365	8760	350,000	263,000	39,400	50%	50%	50%	175,000	131,000	20,000
H Bulldozer D9	Bulldozers on coal	N-BULC2	29.9	9.54	1.43	kg/h	NPI	1	hrs	24	365	8760	181,000	57,700	8,640	100%	100%	100%	181,000	57,700	8,600
H Rail Load Out	Loading to trains - Default Factor	N-LTRA1	0.0004	0.00017	0.0000255	kg/t	NPI	533	tonnes	24	365	8760	1,870	794	119	50%	50%	50%	934	397	60
BLAST	Blasting - overburden	N-BLAO1	9.39	4.88	0.732	kg/blast	NPI	1	blasts	1	365	365	3,430	1,780	267	100%	100%	100%	3,430	1,780	267
E DUMP	Truck dumping overburden	N-TRUO1	0.012	0.0043	0.000645	kg/t	NPI	2,003	tonnes	24	365	8760	211,000	75,500	11,300	100%	100%	100%	211,000	75,500	11,300
G DUMP	Truck dumping coal	N-TRUC1	0.01	0.0042	0.00063	kg/t	NPI	285	tonnes	24	365	8760	25,000	10,500	1,580	100%	100%	100%	25,000	10,500	1,600
H TRUCK LOAD	Miscellaneous transfer points - coal	N-MTPC1	0.00029	0.000137	0.0000206	kg/t	NPI	11	tonnes	24	365	8760	29	14	2	50%	50%	50%	15	7	1
H Truck Unload	Truck dumping coal	N-TRUC2	0.01	0.0042	0.00063	kg/t	NPI	285	tonnes	24	365	8760	25,000	10,500	1,580	100%	100%	100%	25,000	10,500	1,600
C Dozer	Bulldozers on material other than coal	N-BULO3	4.49	0.988	0.148	kg/h	NPI	1	hrs	24	365	8760	29,500	6,490	972	50%	95%	95%	14,700	3,250	920
Acoustic bund dozer	Bulldozers on material other than coal	N-BULO4	4.49	0.988	0.148	kg/h	NPI	1	hrs	24	365	8760	29,500	6,490	972	100%	100%	100%	29,500	6,490	970
H Bulldozer D9 (2)	Bulldozers on coal	N-BULC3	29.9	9.54	1.43	kg/h	NPI	1	hrs	24	365	8760	181,000	57,700	8,640	100%	100%	100%	181,000	57,700	8,600
Amenity dump construction	Truck dumping overburden	N-TRUO2	0.012	0.0043	0.000645	kg/t	NPI	250	tonnes	24	365	8760	26,300	9,420	1,410	100%	100%	100%	26,300	9,420	1,410
A Scraper 1	Scraper		1.02	0.25	0.04	kg/VKT	NPI	1.5	VKT/hr	24	365	8760	13,393	3,247	487	50%	50%	50%	6,696	1,624	1,624
A Scraper 2	Scraper		1.02	0.25	0.04	kg/VKT	NPI	1.5	VKT/hr	24	365	8760	13,393	3,247	487	50%	50%	50%	6,696	1,624	1,624
Pit to CPA	Haul Road		5.64	1.52	0.15	kg/VKT	AP42	1.5	VKT/hr	24	365	8760	74,054	19,991	1,999	28%	28%	28%	20,735	5,598	5,598
Pit to Dump W	Haul Road		6.23	1.68	0.17	kg/VKT	AP42	20	VKT/hr	24	365	8760	1,091,140	294,561	29,456	28%	28%	28%	305,519	82,477	82,477
CPA to Load Out	Haul Road		1.01	0.19	0.05	kg/VKT	AP42	28	VKT/hr	24	365	8760	248,319	47,552	11,332	74%	74%	74%	183,756	35,189	35,189
Pit to CPA GRADER	Grader		0.35	0.14	0.02	kg/VKT	NPI	5	VKT/hr	24	365	8760	15,431	6,100	915	50%	50%	50%	7,716	3,050	3,050
Pit to Dump 1 GRADER	Grader		0.35	0.14	0.02	kg/VKT	NPI	5	VKT/hr	24	365	8760	15,431	6,100	915	50%	50%	50%	7,716	3,050	3,050
Pit to Dump 2 GRADER	Grader		0.35	0.14	0.02	kg/VKT	NPI	5	VKT/hr	24	365	8760	15,431	6,100	915	50%	50%	50%	7,716	3,050	3,050
To Soil Stock	Haul Road		5.58	1.51	0.15	kg/VKT	AP42	0.02	VKT/hr	24	365	8760	978	264	26	28%	28%	28%	274	74	74
To Amenity Bund	Haul Road		5.64	1.52	0.15	kg/VKT	AP42	1.1	VKT/hr	24	365	8760	54,306	14,660	1,466	28%	28%	28%	15,206	4,105	4,105

Job Number: 10-8775
Job Title: Werris Creek LOM Project
Scenario No: 3

			Emission Factors					Activity		Operation			Uncontrolled Emissions (kg/annum)			Control Factor (%)			Controlled Emissions (kg/annum)		
Descriptor	Source Type	Model Ref	EF_{TSP}	EF_{PM10}	$EF_{PM2.5}$	Units	Source	A	Units	Hr/Day	Day/Year	OpHrs	$E_{kpy,TSP}$	$E_{kpy,PM10}$	$E_{kpy,PM2.5}$	CE_{TSP}	CE_{PM10}	$CE_{PM2.5}$	$EC_{kpy,TSP}$	$EC_{kpy,PM10}$	$EC_{kpy,PM2.5}$
A Bulldozer D10	Bulldozers on material other than coal	N-BULO1	4.49	0.988	0.148	kg/h	NPI	1	hrs	24	365	8,760	29,500	6,490	972	100%	100%	100%	29,500	6,490	970
C Drill 1	Drilling	N-DRIL3	0.59	0.31	0.0465	kg/hole	NPI	1	holes	24	365	8,760	5,170	2,720	407	50%	95%	95%	2,580	2,580	390
C Drill 2	Drilling	N-DRIL4	0.59	0.31	0.0465	kg/hole	NPI	1	holes	24	365	8,760	5,170	2,720	407	50%	95%	95%	2,580	2,580	390
C Excavator 360 t	Excavator on overburden	N-ESFO1	0.000327	0.000155	0.0000232	kg/t	NPI	1,610	tonnes	24	365	8,760	4,610	2,190	327	50%	95%	95%	2,310	2,080	310
C Excavator 190 t	Excavator on overburden	N-ESFO2	0.000327	0.000155	0.0000232	kg/t	NPI	1,610	tonnes	24	365	8,760	4,610	2,190	327	50%	95%	95%	2,310	2,080	310
D Excavator 37.5t	Bulldozers on material other than coal	N-BULO2	0.0165	0.00891	0.00134	kg/t	NPI	143	tonnes	24	365	8,760	23,100	11,100	1,680	50%	95%	95%	11,600	10,600	1,600
D Bulldozer D11	FEL on coal	N-FELC1	29.9	9.54	1.43	kg/h	NPI	1	hrs	24	365	8,760	181,000	57,700	8,640	50%	95%	95%	90,400	54,800	8,200
D Excavator 190t	FEL on coal	N-FELC2	0.0185	0.00891	0.00134	kg/t	NPI	143	tonnes	24	365	8,760	23,100	11,100	1,680	50%	95%	95%	11,600	10,600	1,600
E Bulldozer D10	Primary crushing - HMCO - Default Fact	N-PCRHM1	4.49	0.988	0.148	kg/h	NPI	1	hrs	24	365	8,760	29,500	6,490	972	100%	100%	100%	29,500	6,490	970
G FEL 1	Screening - LMCO	N-SCREEN1	0.0185	0.00891	0.00134	kg/t	NPI	143	tonnes	24	365	8,760	23,100	11,100	1,680	100%	100%	100%	23,100	11,100	1,700
G FEL 2	Bulldozers on coal	N-BULC2	0.0185	0.00891	0.00134	kg/t	NPI	143	tonnes	24	365	8,760	23,100	11,100	1,680	100%	100%	100%	23,100	11,100	1,700
G Crush	Loading to trains - Default Factor	N-LTRA1	0.01	0.004	0.0006	kg/t	NPI	500	tonnes	24	365	8,760	43,800	17,500	2,630	50%	50%	50%	21,900	8,760	1,310
G Screen	Blasting - overburden	N-BLAO1	0.08	0.06	0.009	kg/t	NPI	500	tonnes	24	365	8,760	350,000	263,000	39,400	50%	50%	50%	175,000	131,000	20,000
H Bulldozer D9	Truck dumping overburden	N-TRUO1	29.9	9.54	1.43	kg/h	NPI	1	hrs	24	365	8,760	181,000	57,700	8,640	100%	100%	100%	181,000	57,700	8,600
H Rail Load Out	Truck dumping coal	N-TRUC1	0.0004	0.00017	0.0000255	kg/t	NPI	533	tonnes	24	365	8,760	1,870	794	119	50%	50%	50%	934	397	60
BLAST	Truck dumping coal	N-TRUC2	9.39	4.88	0.732	kg/blast	NPI	1	blasts	1	365	365	3,430	1,780	267	100%	100%	100%	3,430	1,780	267
E DUMP			0.012	0.0043	0.000645	kg/t	NPI	2,253	tonnes	24	365	8,760	237,000	84,900	12,700	100%	100%	100%	237,000	84,900	12,700
G DUMP			0.01	0.0042	0.00063	kg/t	NPI	285	tonnes	24	365	8,760	25,000	10,500	1,580	100%	100%	100%	25,000	10,500	1,600
H TRUCK LOAD			0.00029	0.000137	0.0000206	kg/t	NPI	11	tonnes	24	365	8,760	29	14	2	50%	50%	50%	15	7	1
H Truck Unload			0.01	0.0042	0.00063	kg/t	NPI	285	tonnes	24	365	8,760	25,000	10,500	1,580	100%	100%	100%	25,000	10,500	1,600
A Scraper 1	Scraper		1.02	0.25	0.04	kg/VKT	NPI	1.5	VKT/hr	24	365	8,760	13,393	3,247	487	50%	50%	50%	6,696	1,624	1,624
A Scraper 2	Scraper		1.02	0.25	0.04	kg/VKT	NPI	1.5	VKT/hr	24	365	8,760	13,393	3,247	487	50%	50%	50%	6,696	1,624	1,624
Pit to CPA	Haul Road		5.64	1.52	0.15	kg/VKT	AP42	1.5	VKT/hr	24	365	8,760	74,054	19,991	1,999	28%	28%	28%	20,735	5,598	5,598
Pit to Dump W	Haul Road		6.23	1.68	0.17	kg/VKT	AP42	10	VKT/hr	24	365	8,760	545,570	147,280	14,728	28%	28%	28%	152,760	41,239	41,239
Pit to Dump E	Haul Road		5.64	1.52	0.15	kg/VKT	AP42	16	VKT/hr	24	365	8,760	789,911	213,242	21,324	28%	28%	28%	221,175	59,708	59,708
CPA to Load Out	Haul Road		1.01	0.19	0.05	kg/VKT	AP42	28	VKT/hr	24	365	8,760	248,319	47,552	11,332	74%	74%	74%	183,756	35,189	35,189
Pit to CPA GRADER	Grader		0.35	0.14	0.02	kg/VKT	NPI	5	VKT/hr	24	365	8,760	15,431	6,100	915	50%	50%	50%	7,716	3,050	3,050
Pit to Dump 1 GRADI	Grader		0.35	0.14	0.02	kg/VKT	NPI	5	VKT/hr	24	365	8,760	15,431	6,100	915	50%	50%	50%	7,716	3,050	3,050
Pit to Dump 2 GRADI	Grader		0.35	0.14	0.02	kg/VKT	NPI	5	VKT/hr	24	365	8,760	15,431	6,100	915	50%	50%	50%	7,716	3,050	3,050
To Soil Stockpile	Haul Road		5.58	1.51	0.15	kg/VKT	AP42	0.02	VKT/hr	24	365	8,760	978	264	26	100%	100%	100%	978	264	264

Appendix E

Incremental Dust Deposition Figures

(No of Pages Including Blank Pages = 20)

Figure E1 **Incremental Dust Deposition (g/m^2/month) Mine plus Rail Operations – Scenario 1**

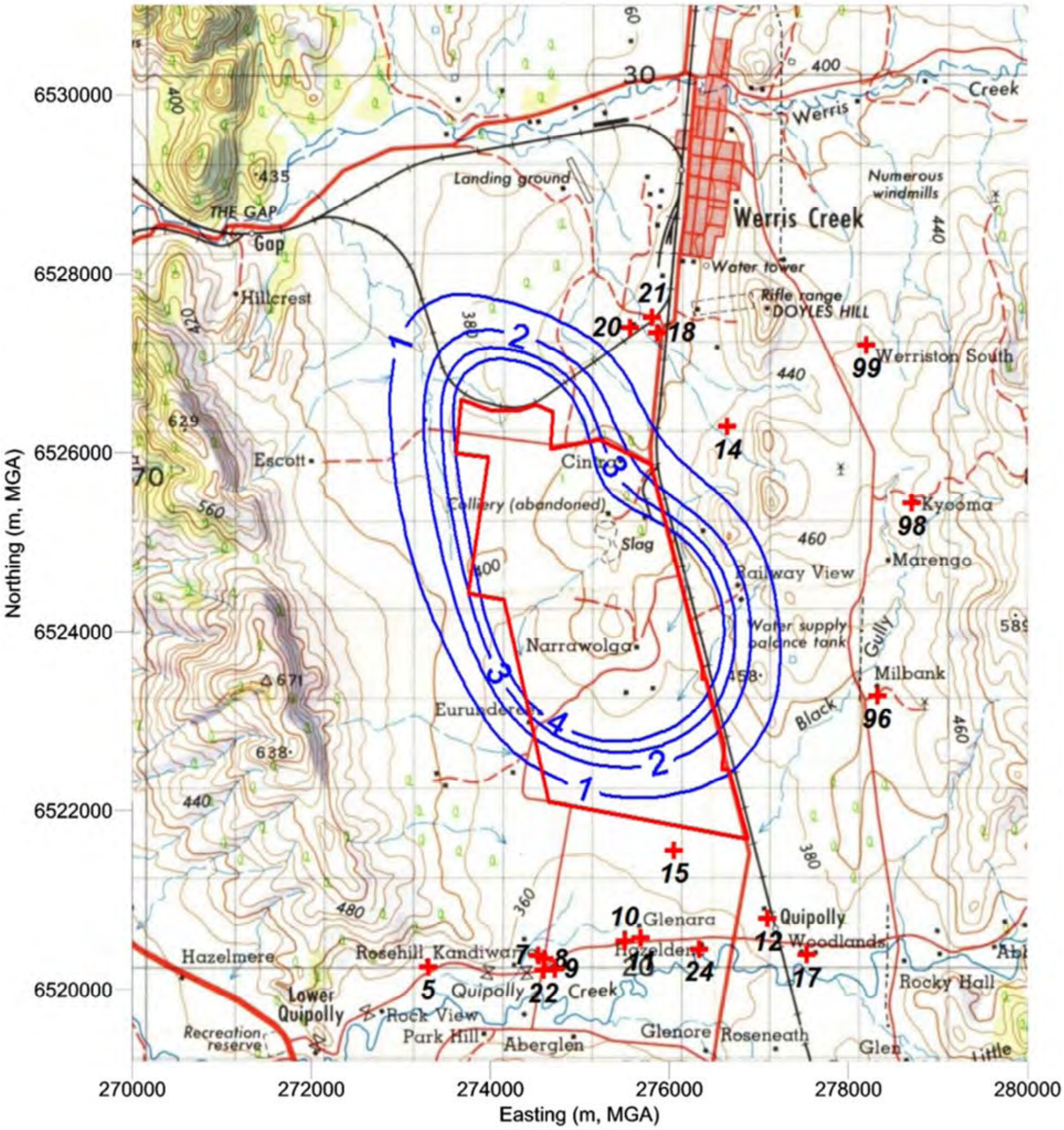


Figure E2 Incremental Dust Deposition (g/m²/month) Mine plus Rail Operations – Scenario 2

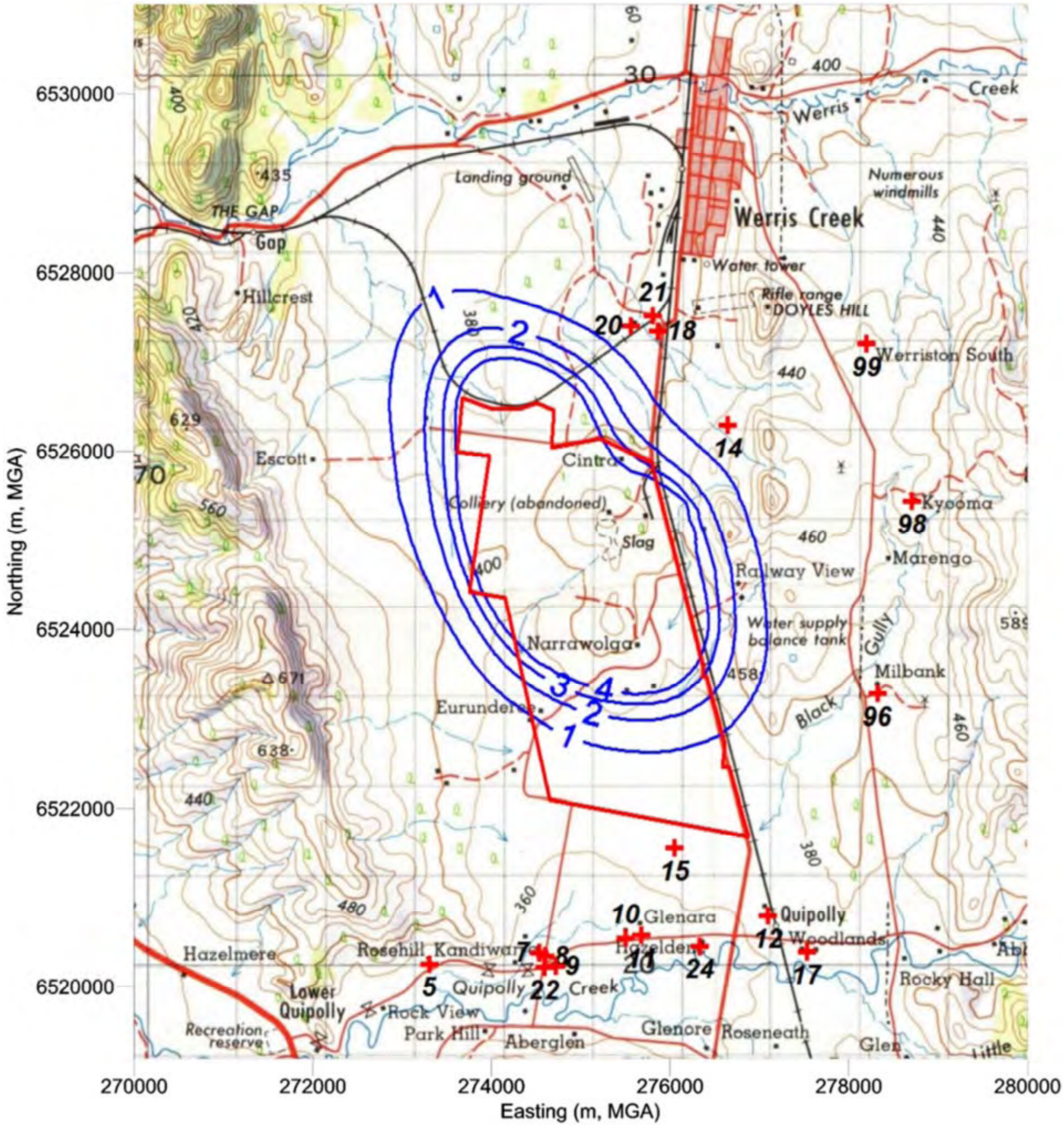


Figure E3 **Incremental Dust Deposition (g/m^2/month) Mine plus Rail Operations – Scenario 3**

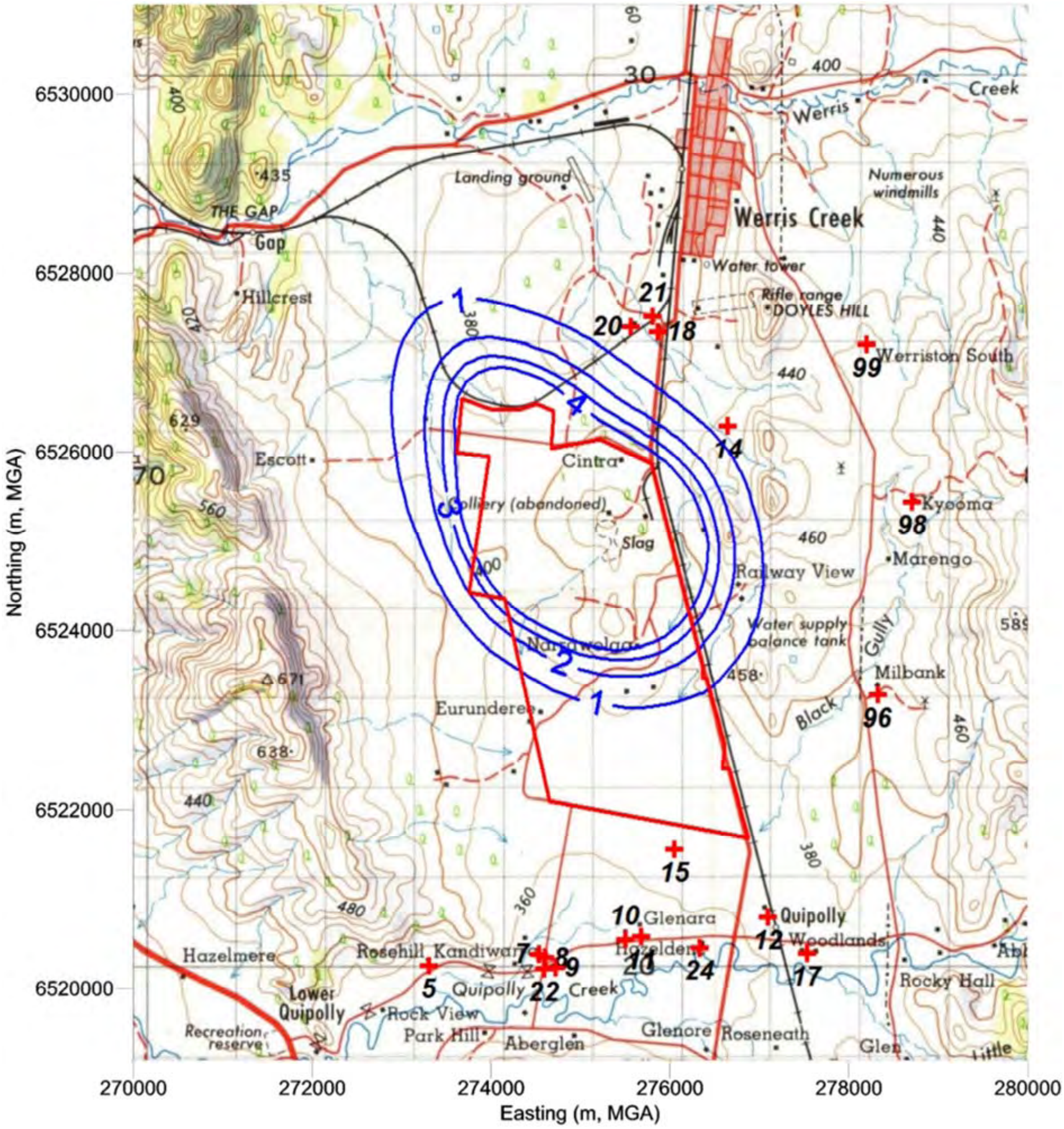


Figure E4 **Incremental Annual Average TSP Concentration (µg/m³) Mine plus Rail Operations – Scenario 1**

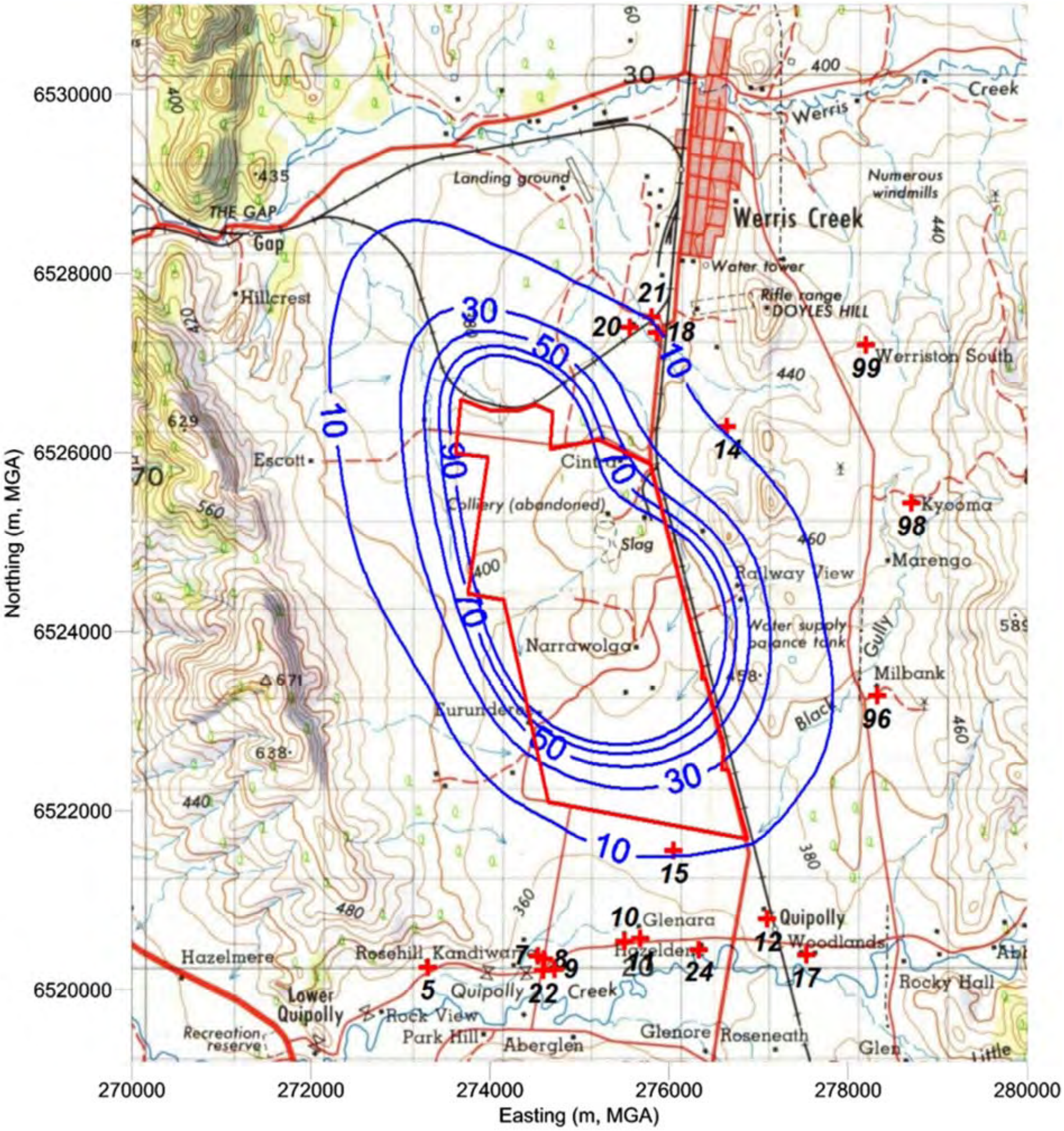


Figure E5 **Incremental Annual Average TSP Concentration (µg/m³) Mine plus Rail Operations – Scenario 2**

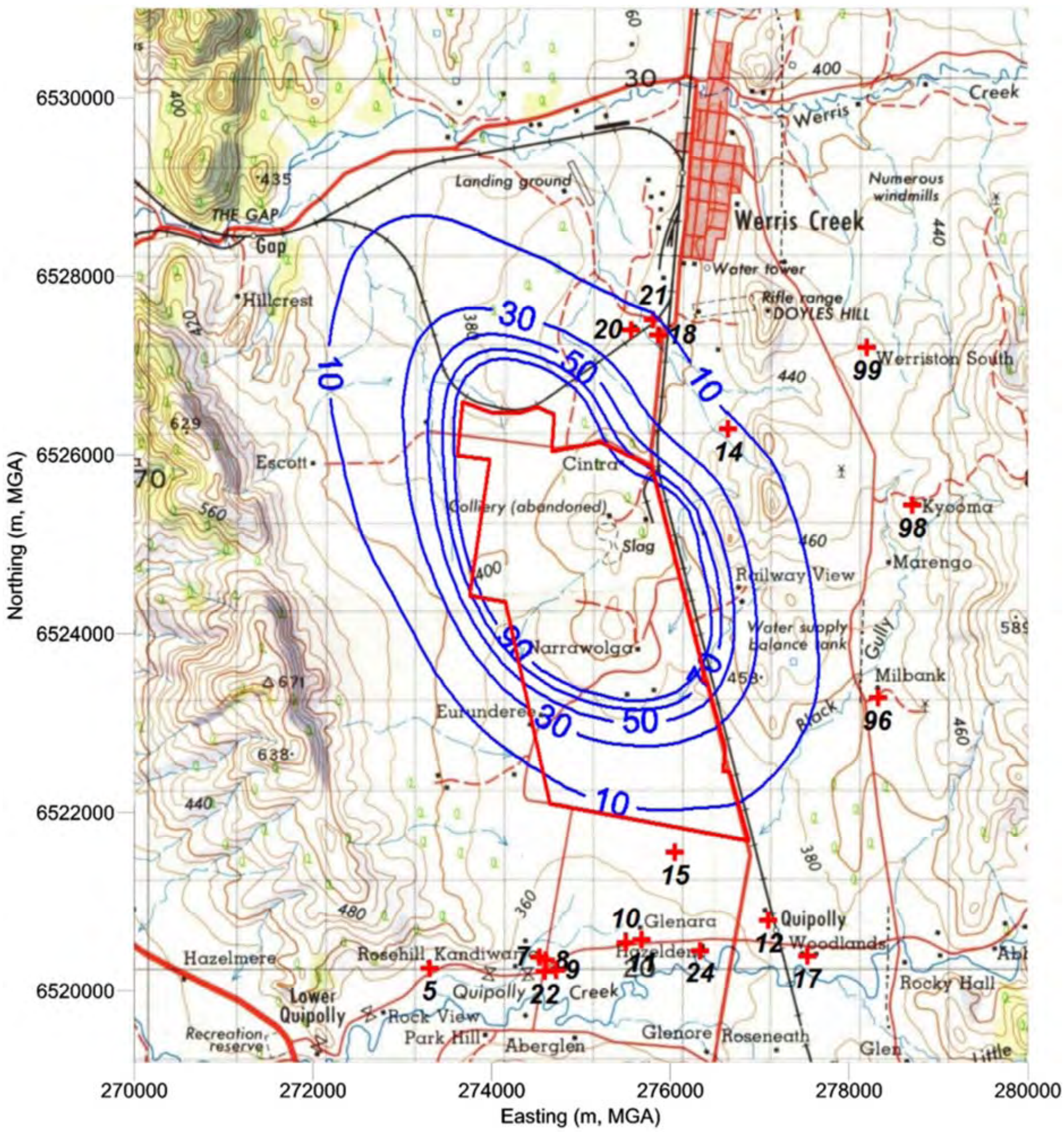


Figure E6 **Incremental Annual Average TSP Concentration (µg/m³) Mine plus Rail Operations – Scenario 3**

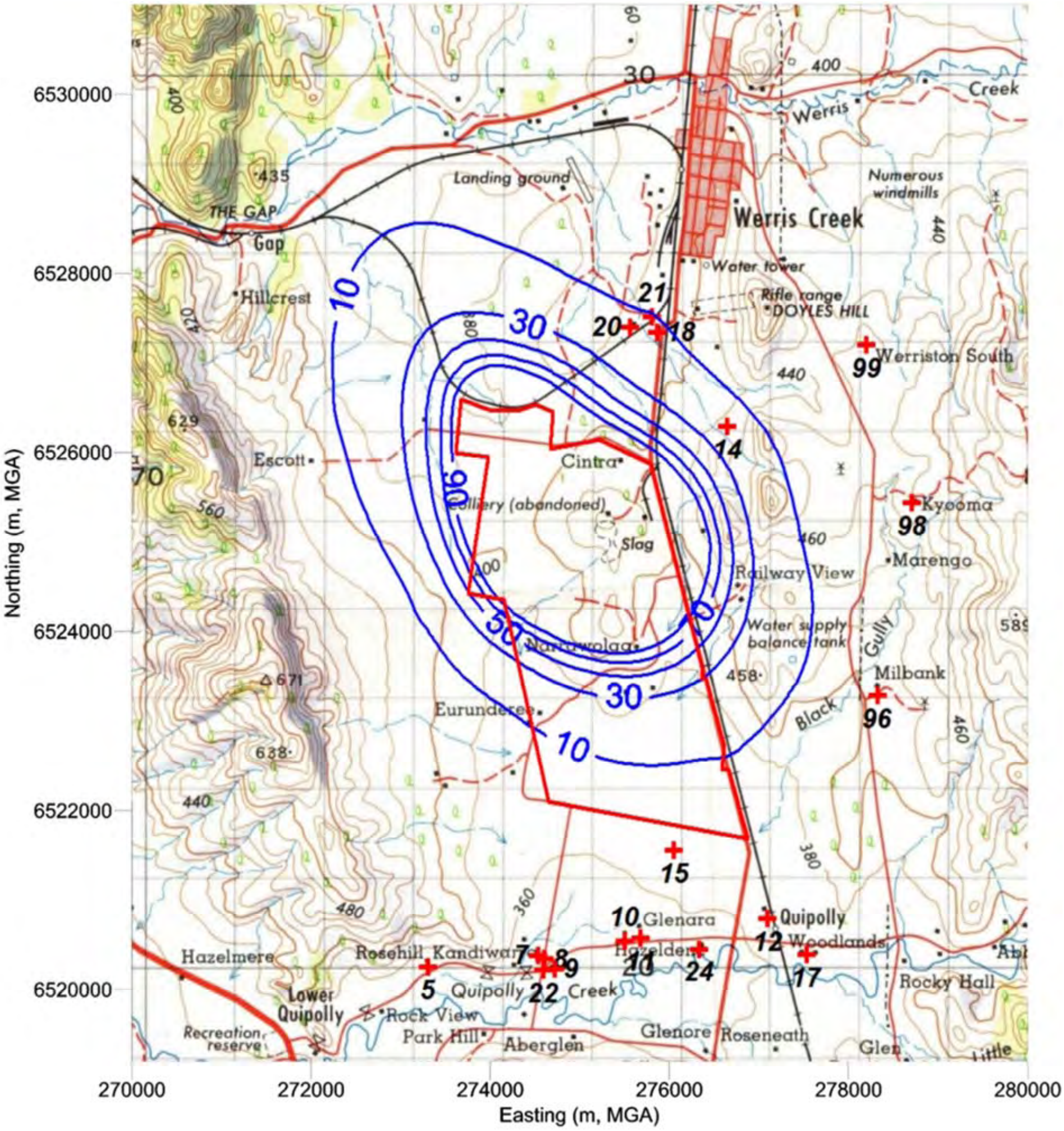


Figure E7 **Incremental Annual Average PM_{10} Concentration ($\mu g/m^3$) Mine plus Rail Operations – Scenario 1**

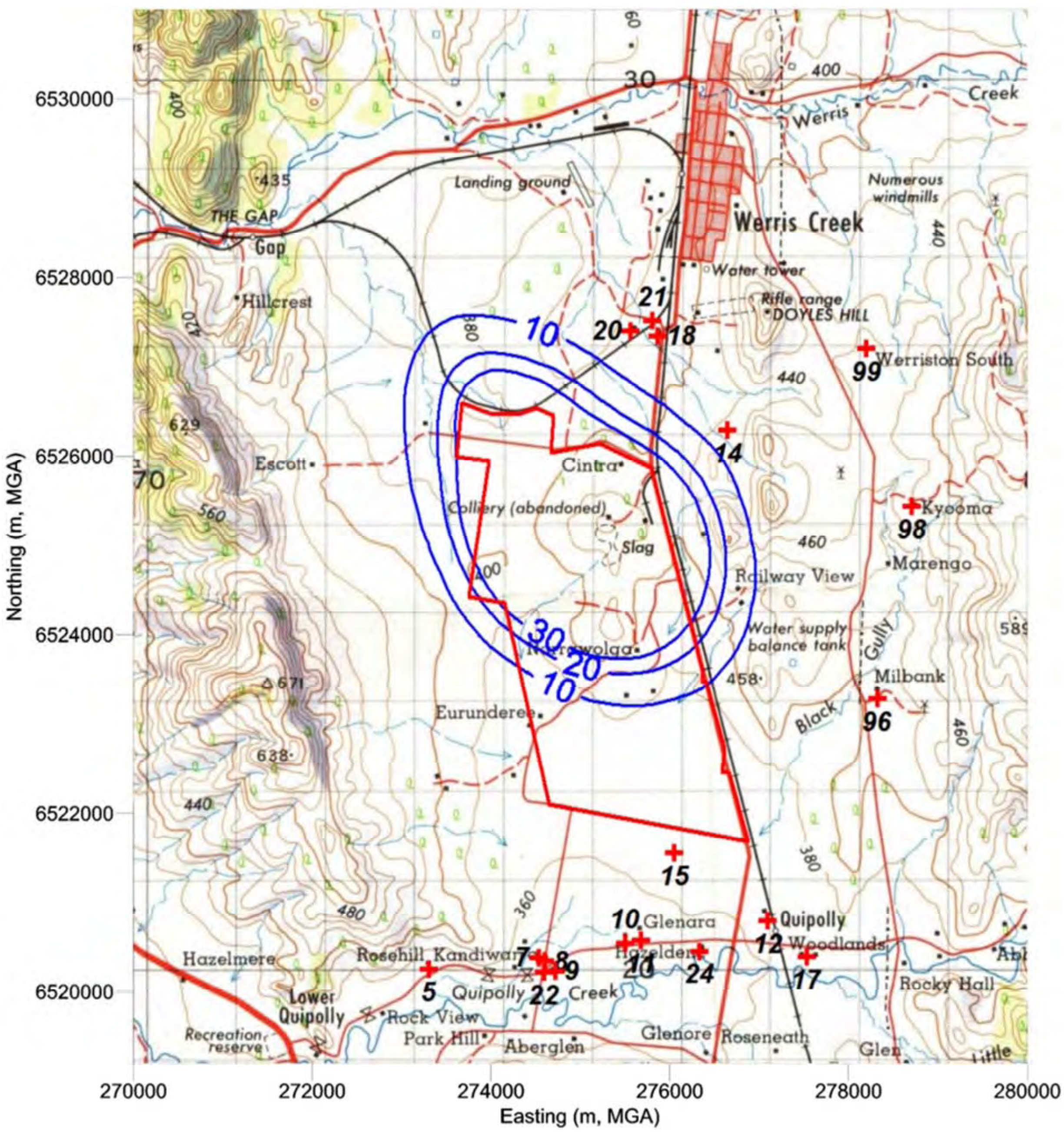


Figure E8 **Incremental Annual Average PM_{10} Concentration (µg/m^3) Mine plus Rail Operations – Scenario 2**

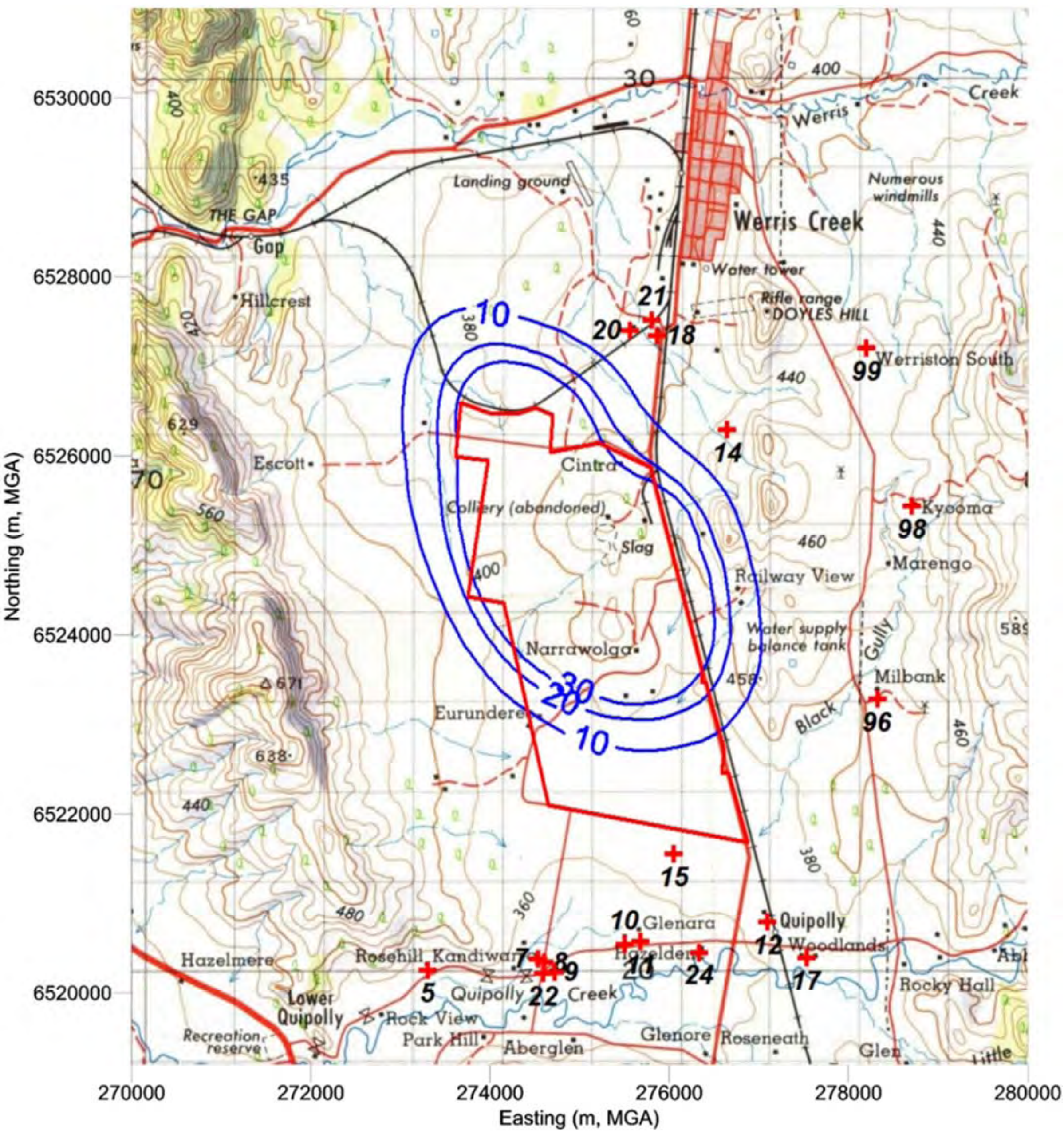


Figure E9 **Incremental Annual Average PM_{10} Concentration ($\mu g/m^3$) Mine plus Rail Operations – Scenario 3**

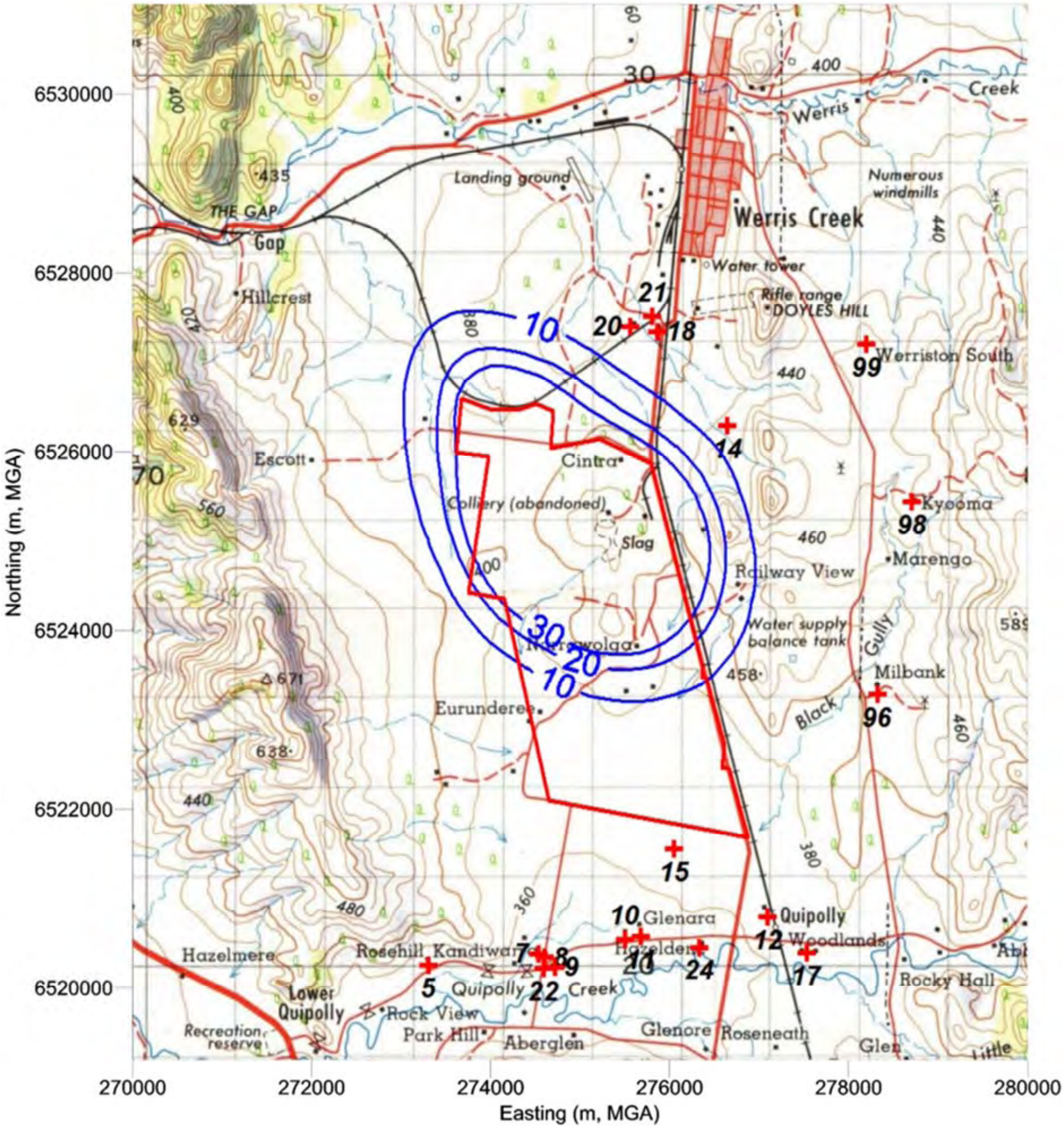


Figure E10 Incremental Maximum 24-hour PM_{10} Concentration (µg/m^3) Mine plus Rail Operations – Scenario 1

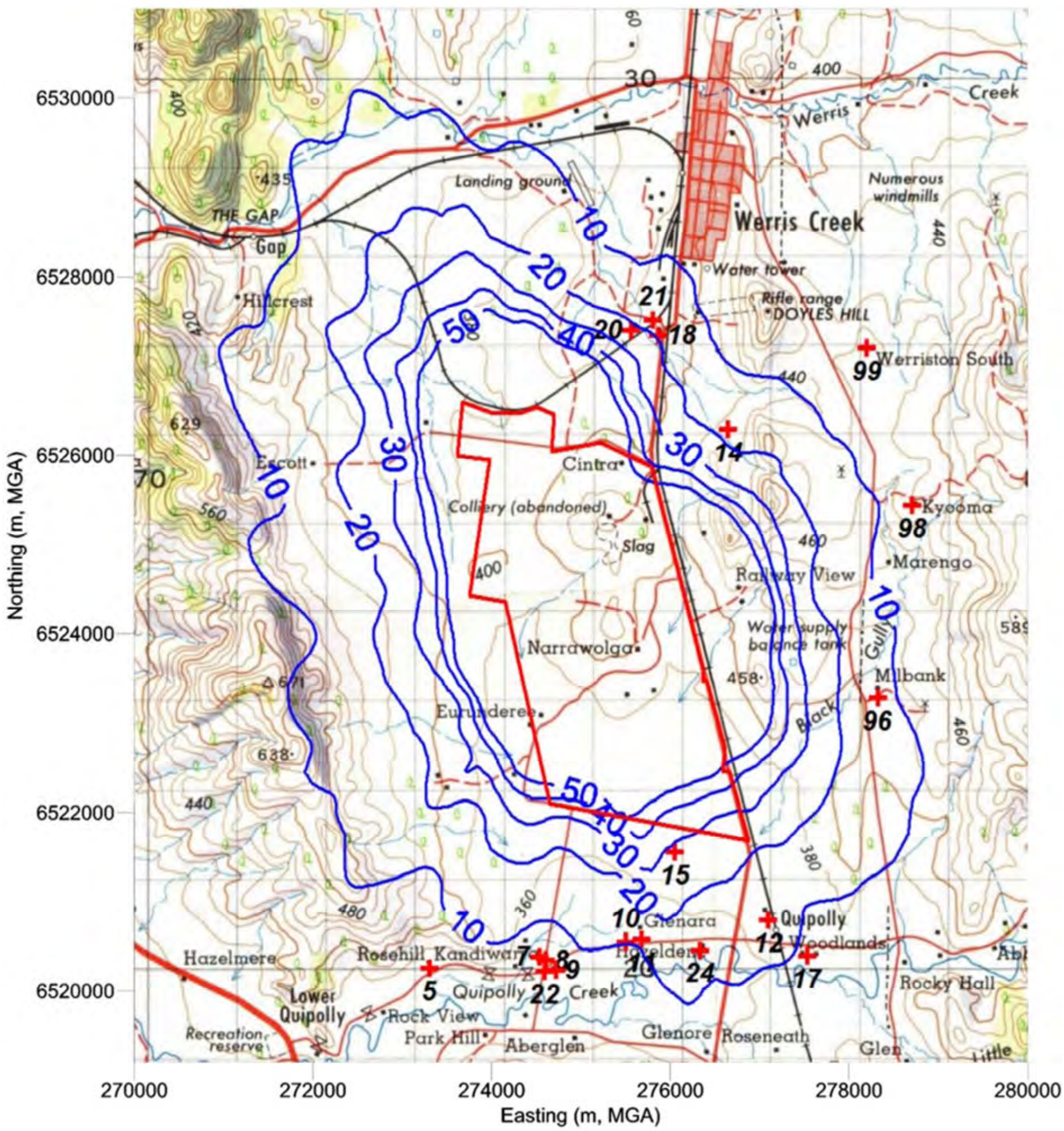


Figure E11 Incremental Maximum 24-hour PM_{10} Concentration (µg/m^3) Mine plus Rail Operations – Scenario 2

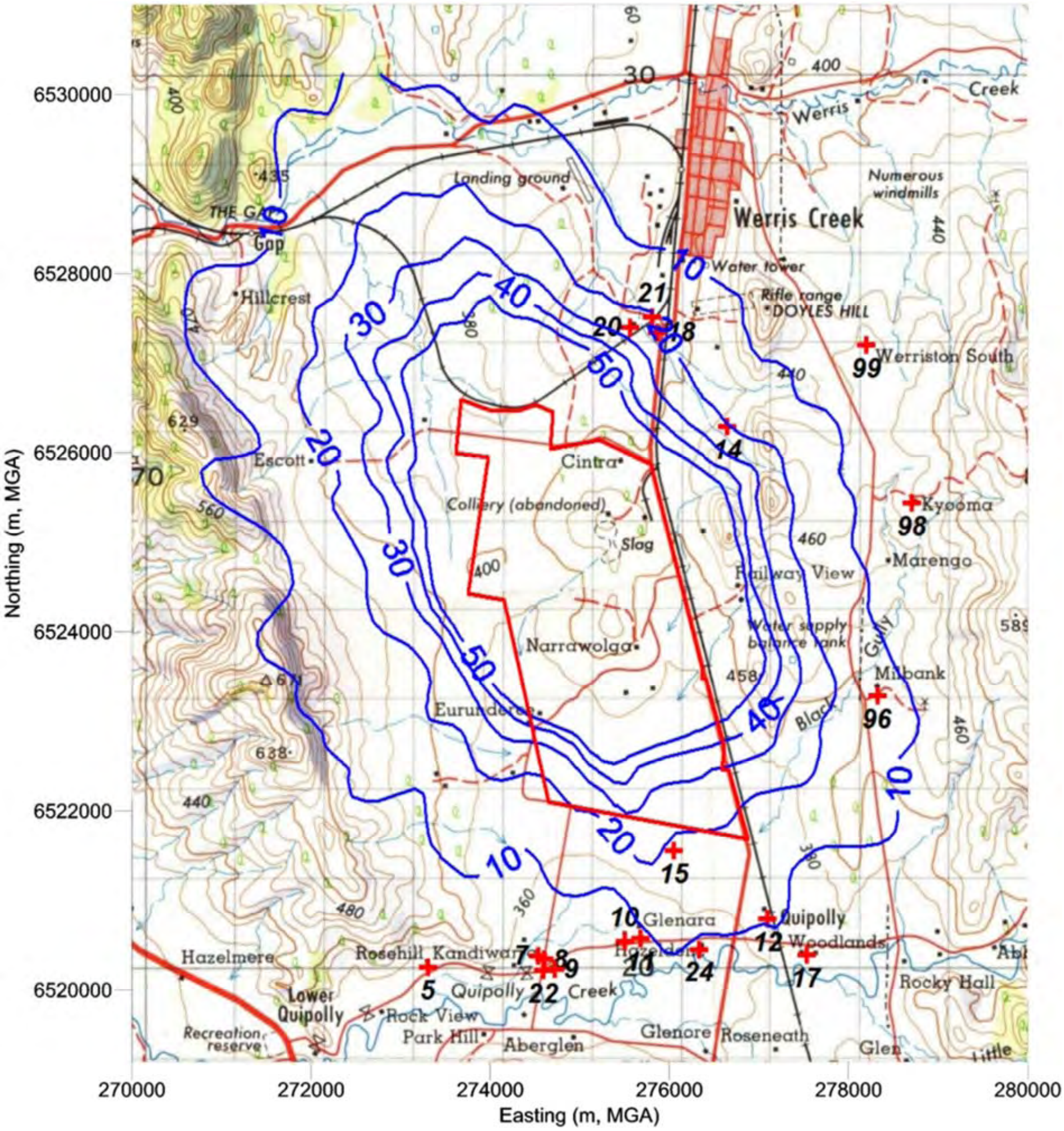


Figure E12 Incremental Maximum 24-hour PM_{10} Concentration ($\mu g/m^3$) Mine plus Rail Operations – Scenario 4

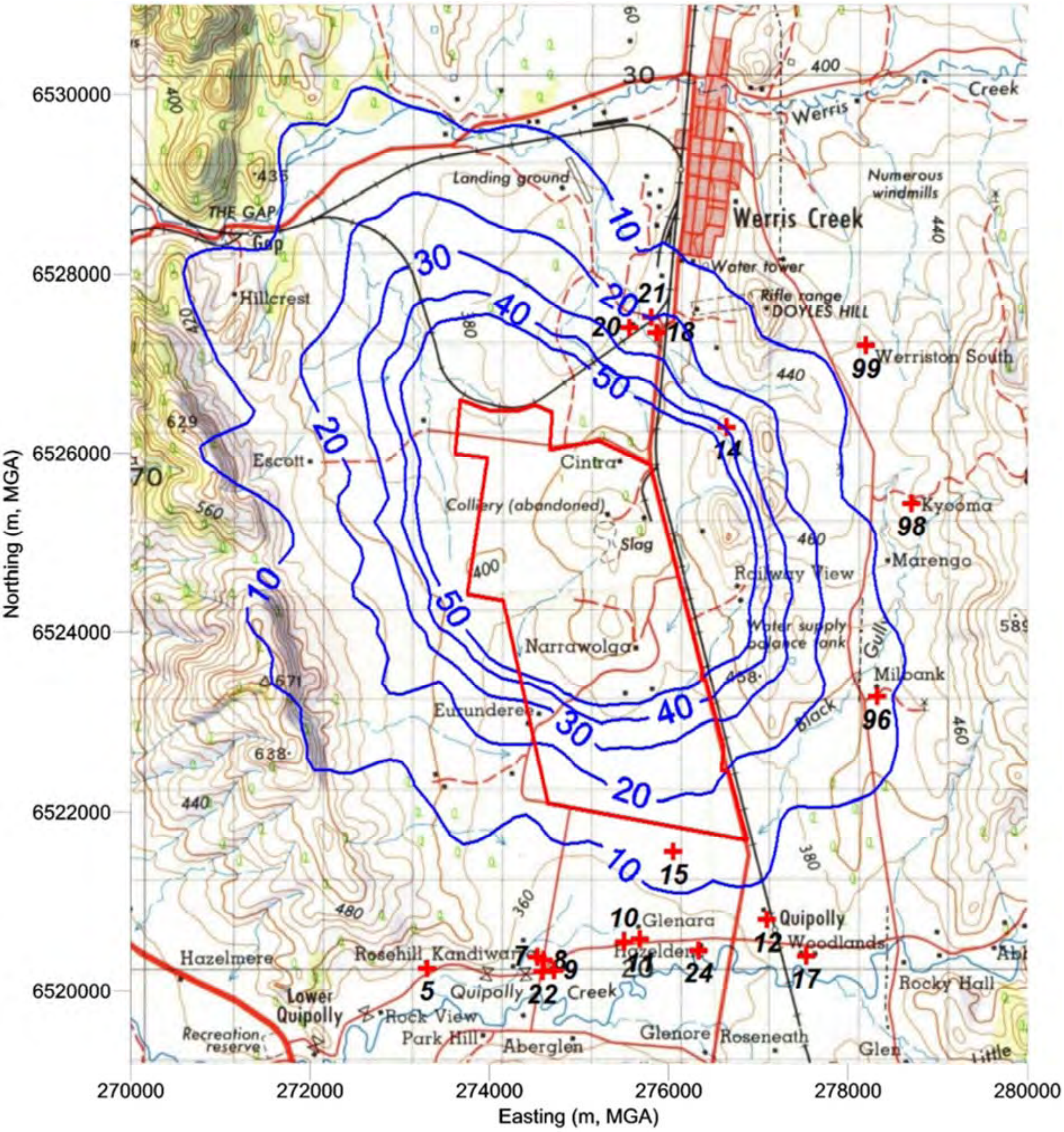


Figure E13 Incremental Annual Average $PM_{2.5}$ Concentration (µg/m^3) Mine plus Rail Operations – Scenario 1

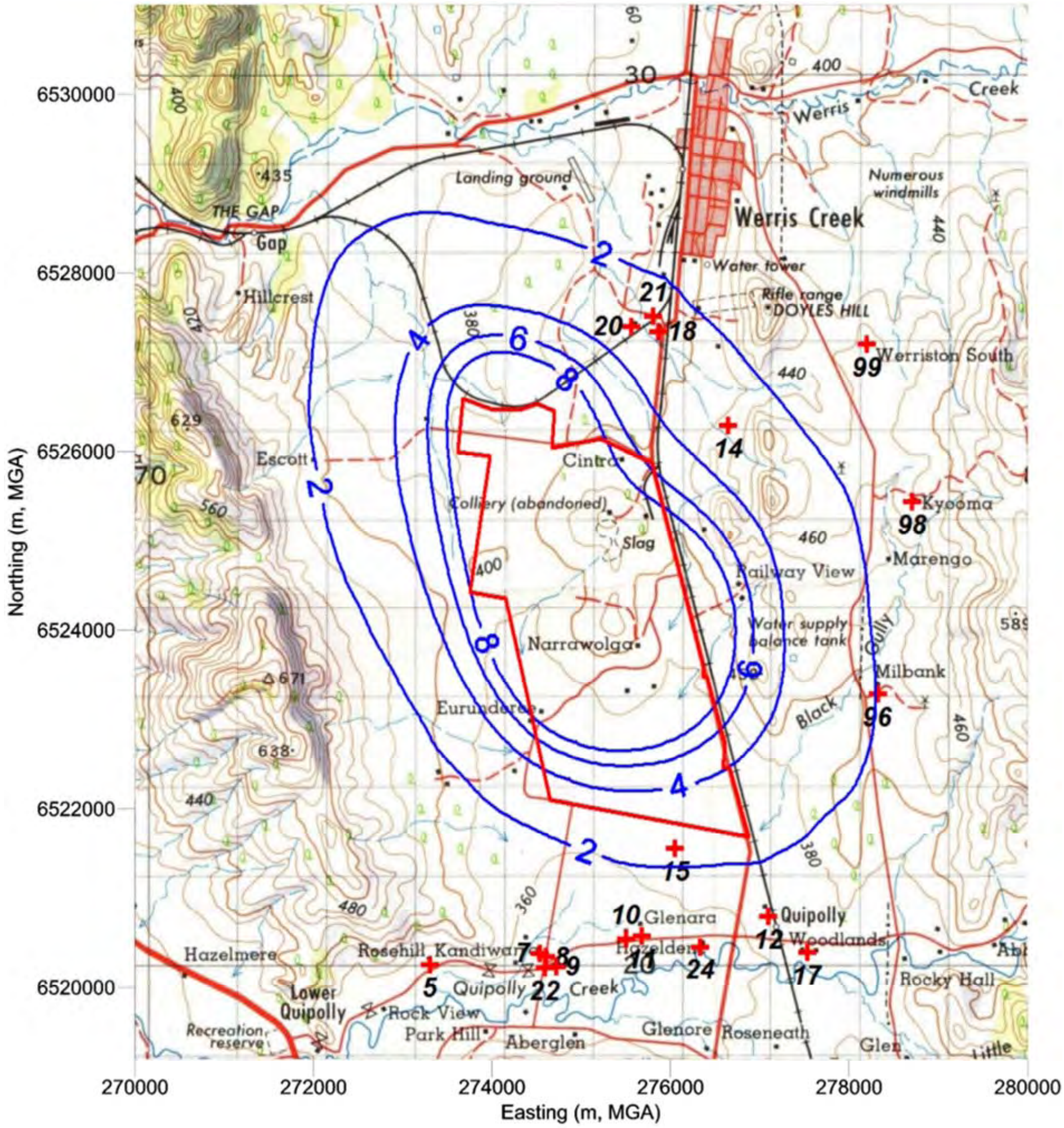


Figure E14 Incremental Annual Average $PM_{2.5}$ Concentration ($\mu g/m^3$) Mine plus Rail Operations – Scenario 2

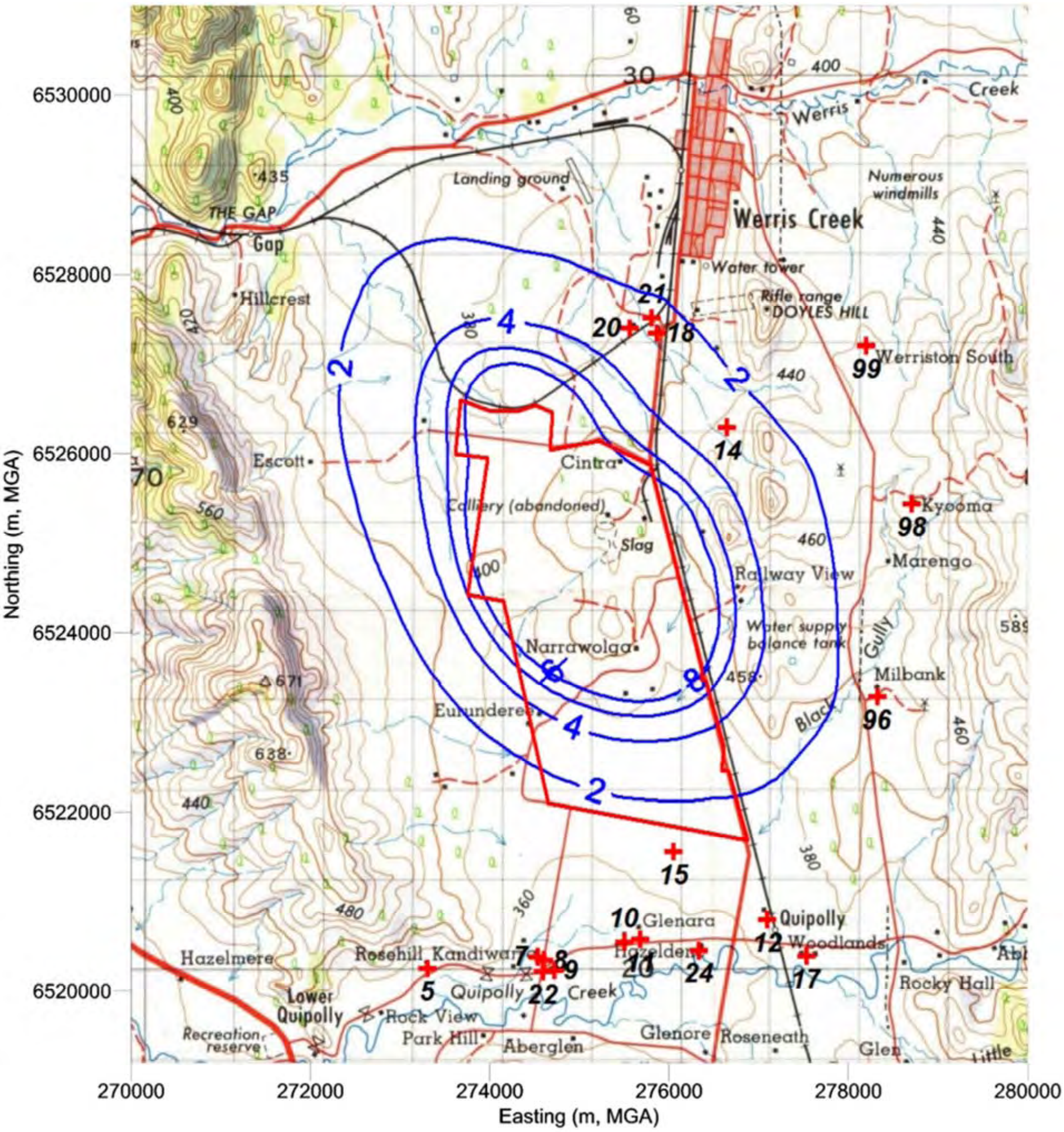


Figure E15 Incremental Annual Average $PM_{2.5}$ Concentration (µg/m^3) Mine plus Rail Operations – Scenario 4

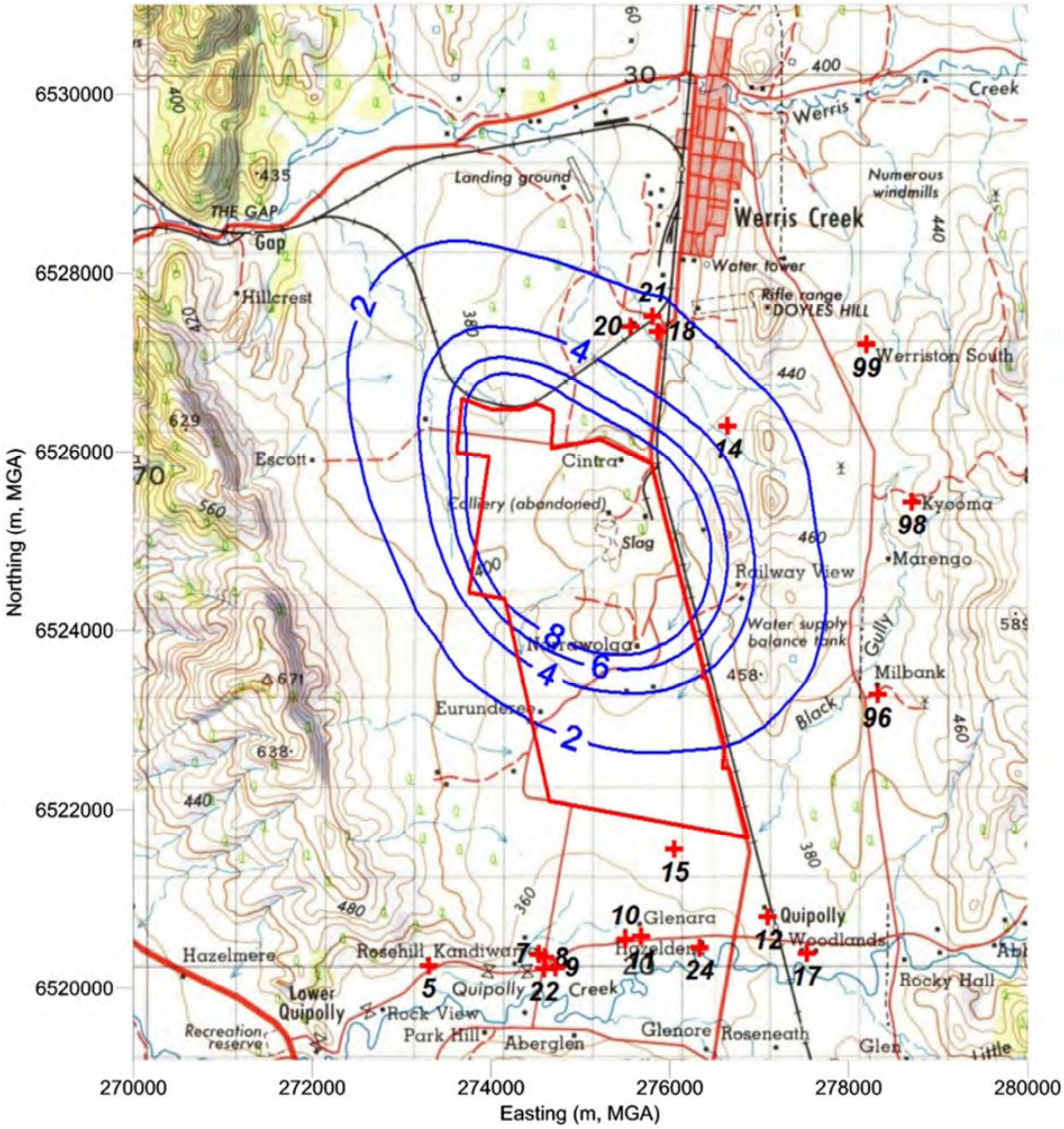


Figure E16 Incremental Maximum 24-hour $PM_{2.5}$ Concentration (µg/m³) Mine plus Rail Operations – Scenario 1

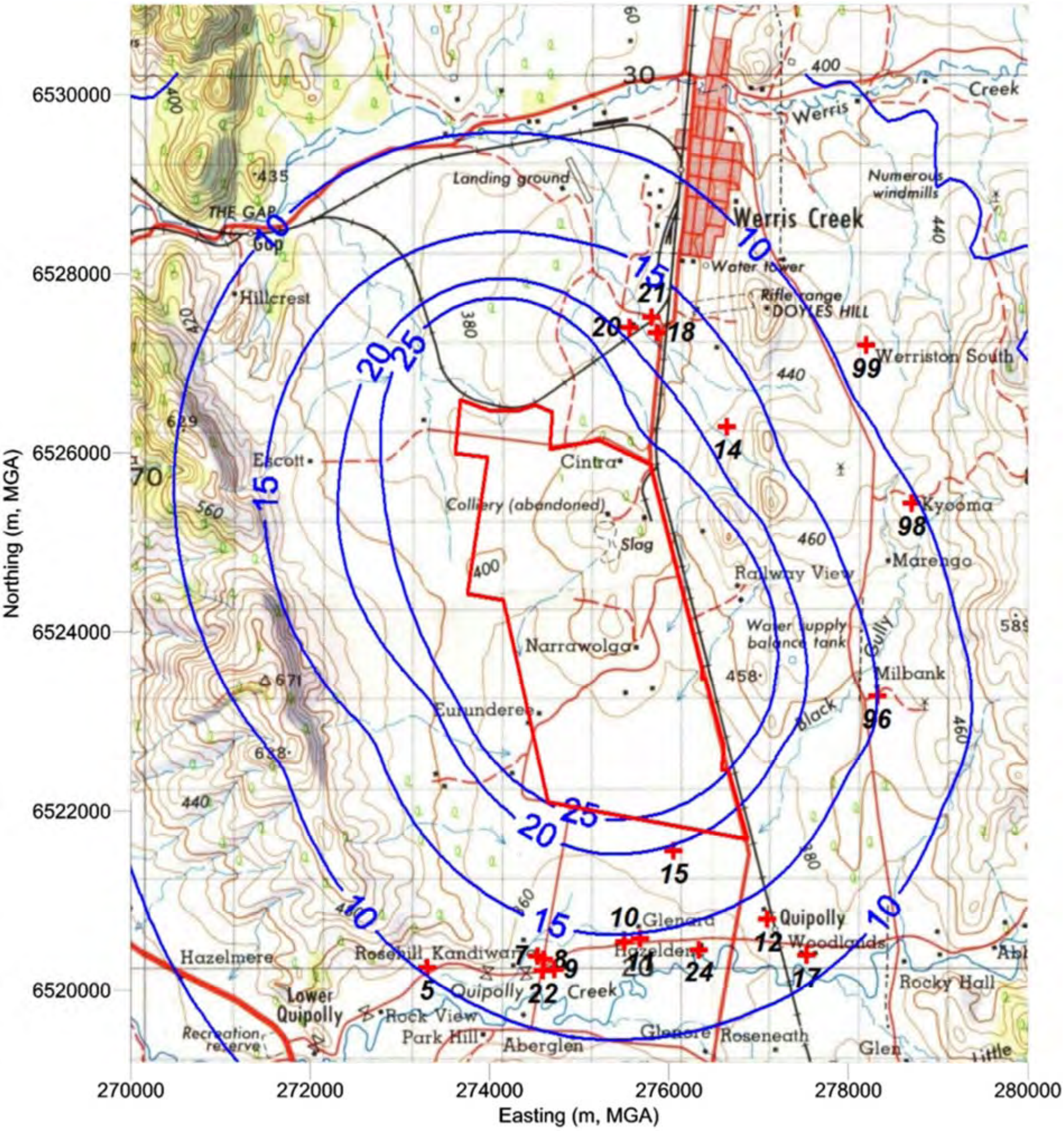


Figure E17 Incremental Maximum 24-hour $PM_{2.5}$ Concentration ($\mu g/m^3$) Mine plus Rail Operations – Scenario 2

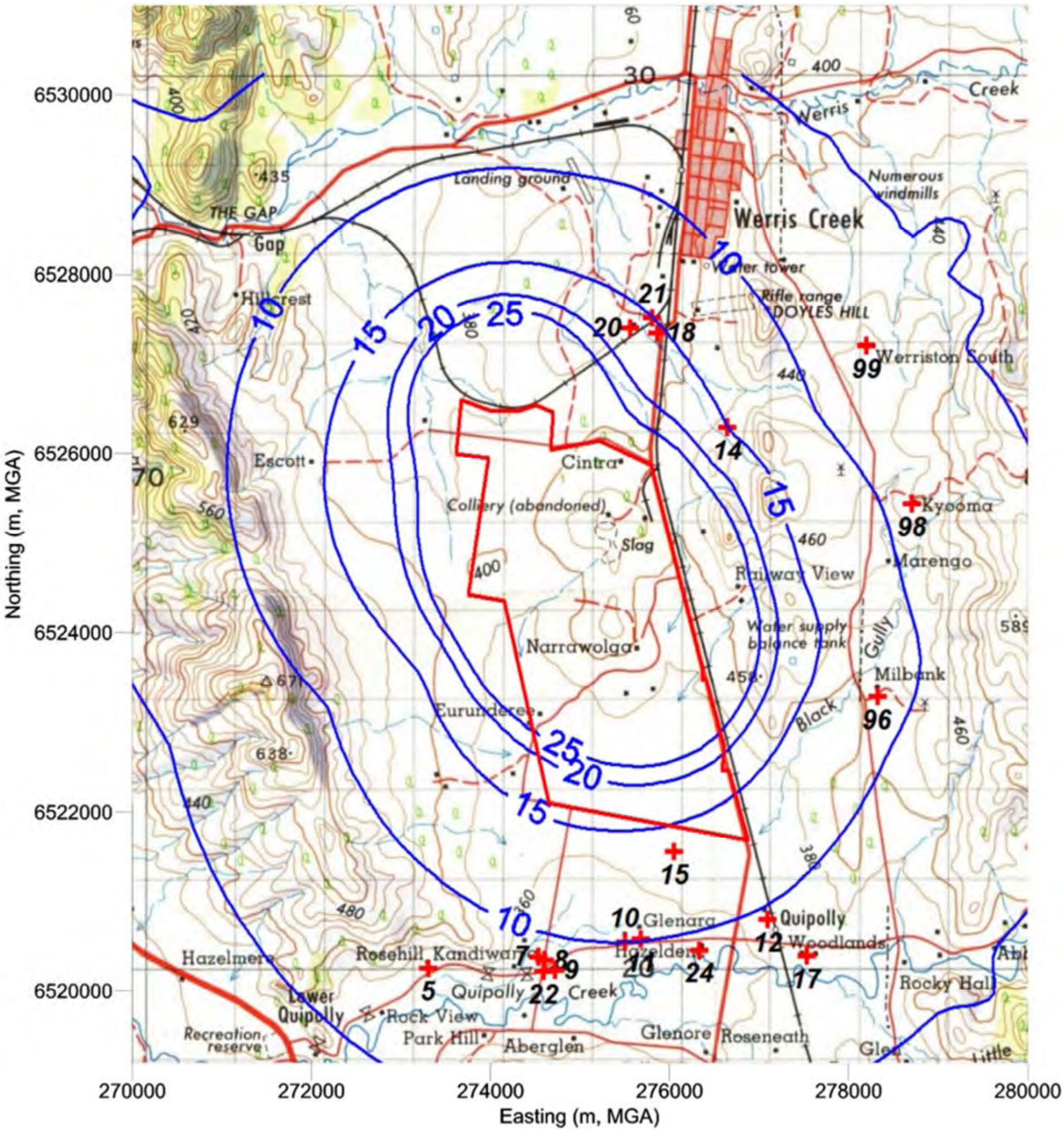
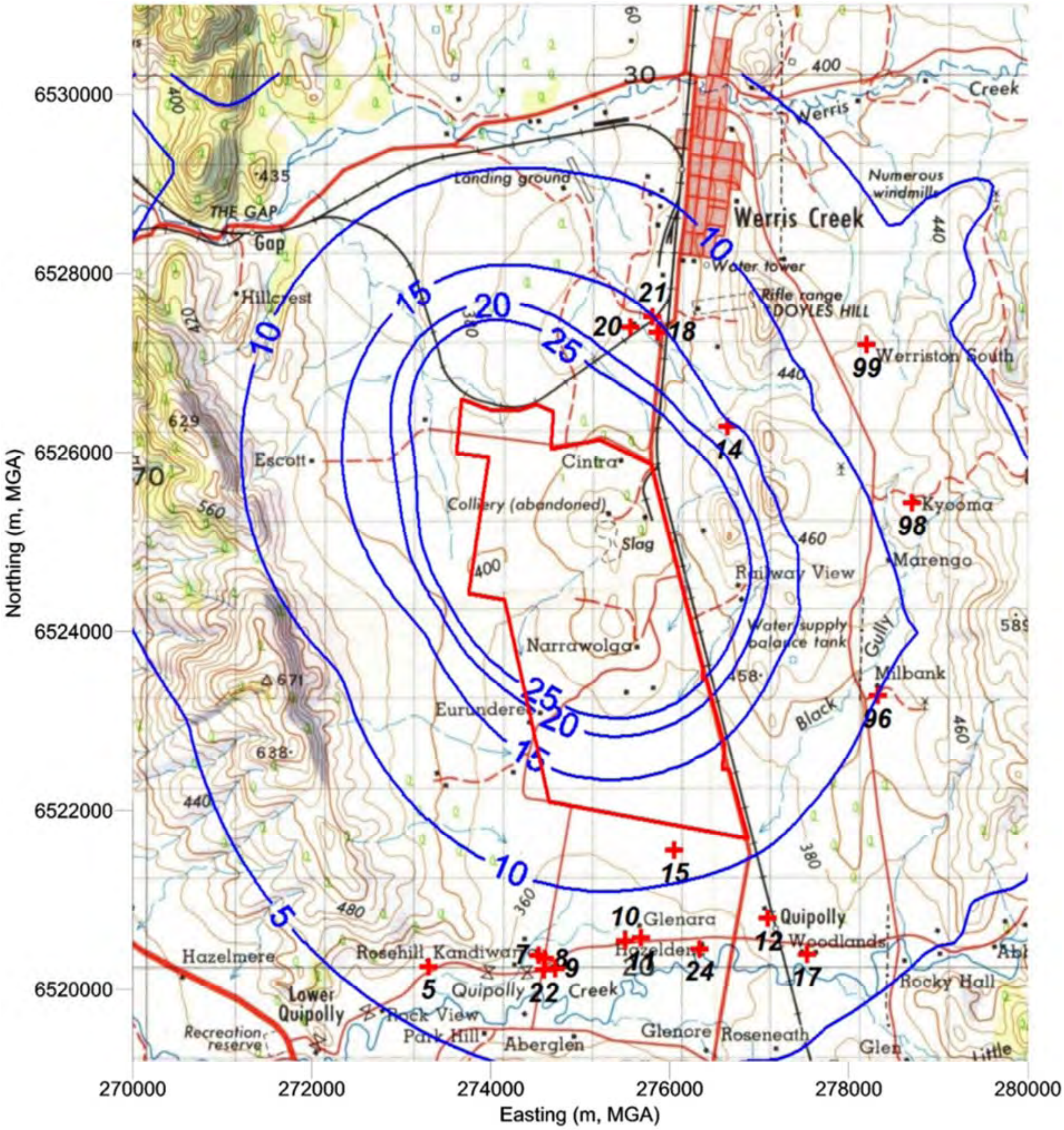


Figure E18 Incremental Maximum 24-hour $PM_{2.5}$ Concentration (µg/m³) Mine plus Rail Operations – Scenario 4



This page has intentionally been left blank