MOOLARBEN COAL PROJECT

APPENDIX 3

Air Quality Impact Assessment

AIR QUALITY AND GREENHOUSE GAS ASSESSMENT: PROPOSED MOOLARBEN OPEN CUT MINE, NEAR ULAN, NSW

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Prepared for
Moolarben Coal Mines Pty Ltd/Wells Environmental Services

by

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CONTENTS

LIST OF TABLES

LIST OF FIGURES (all figures are at the end of the report)

19. Predicted maximum 24-hour average PM_{10} concentrations for Moolarben in Year 10 - $\mu g/m^3$

20. Predicted annual average PM_{10} concentrations due to emissions from Moolarben Year 10 - $\mu g/m^3$

21. Predicted annual average TSP concentrations due to emissions from Moolarben in Year 10 - $\mu g/m^3$

22. Predicted annual average dust (insoluble solids) deposition due to emissions from Moolarben in Year 10 - g/m^2

1 INTRODUCTION

Moolarben Coal Mines Pty Limited (MCM) proposes to develop an open cut coal mine in the area to the south of the village of Ulan and the existing Ulan Coal Mine (see **Figure 1**). The mine is planned to recover up to 127 Mt of coal reserves from three open cut pits over a 21 year life at a production rate of up to 8 Mtpa Run of Mine (ROM) coal.

This report has been prepared by Holmes Air Sciences on behalf of Wells Environmental Services who are preparing an Environmental Assessment for MCM. Its purpose is to assess the issues associated with air quality and greenhouse gas emissions that relate to the proposal.

The report provides information on the following:

- a description of the project focussing on aspects relevant for air quality;
- a review of air quality monitoring data undertaken with a view to describing existing air quality conditions and establishing background air quality;
- an analysis of the project and the development of an inventory of dust emissions in a form that can be used as input to a dispersion model;
- a description of the modelling approach used to predict the concentrations of particulate matter (PM) and dust deposition for comparison with ambient air quality assessment criteria;
- estimates of greenhouse gas emissions; and
- a discussion of methods that will be used to control dust and mitigate its impacts.

Those parts of the assessment dealing with air quality follow the New South Wales' Department of Conservation and Environment's (NSW DEC) "*Approved Methods for the Assessment of Air Pollutants in New South Wales*" (**DEC, 2005**)

2 LOCAL SETTING AND PROJECT DESCRIPTION

Figure 3 shows the lease area and locally significant features. The local land use consists of forests (uncleared land), small farms, grazing and some cropping, small mining operations (mining clay, slate and sandstone). Apart from the village of Ulan which supports residences, a school, a hotel and other community facilities, there are a number of isolated rural residences most of which are associated with agricultural enterprises.

The topography is characterised by undulating terrain, which is steep in parts. Cliff-lines and steep sided valleys are prevalent throughout the area. These are mainly associated with small water courses.

The Ulan mine currently produces approximately 10 Mt/y ROM coal by underground and open cut means. The recently approved Wilipinjong open cut mine, located approximately 15 km to the east, is scheduled to produce approximately 8 Mtpa.

3 AIR QUALITY ASSESSMENT CRITERIA

The project will result in the liberation of particulate matter (PM) described as total suspended particulate matter (TSP)[1], particulate matter with equivalent aerodynamic diameters 10 µm or less

[1] TSP is particulate matter suspended in the air and is measured using a high volume sampler operated according to AS2724.3-1984. The size range of particles is indeterminate and depend on the measurement conditions. TSP is usually

(PM_{10})[2] and particles with equivalent aerodynamic diameters of 2.5 μm and less ($PM_{2.5}$). These emissions would occur primarily as fugitive dust from mining activities. In addition there will be emissions from vehicles including carbon monoxide (CO) and minor quantities of sulphur dioxide (SO_2) and nitrogen dioxide (NO_2), which will also occur from vehicle exhausts. These are the relevant emissions that are considered in this air quality assessment.

In practice emissions of CO, SO_2 and NO_2 will occur from diesel-powered equipment. Emissions on open cut mines are too small and too widely dispersed to give rise to significant off-site concentrations. For this reason these pollutants are not considered further in this report.

3.1 Particulate matter

For the reasons discussed above, the focus of this study is on the potential effects of particulate matter. Particulate matter has the capacity to affect health and to cause nuisance effects.

This section provides information on the air quality criteria used to assess the impact of emissions. The assessment criteria provide benchmarks, which if met, are intended to protect the community against the adverse effects of air pollutants. These criteria are generally considered to reflect current Australian community standards for the protection of health and protection against nuisance effects. To assist in interpreting the significance of predicted concentration and deposition levels some background discussion on the potential harmful effects is provided below.

Particulate matter can be categorised by size and/or by chemical composition. The potential harmful effects depend on both.

The human respiratory system has in-built defensive systems that prevent particles larger than approximately 10 μm from reaching the more sensitive parts of the respiratory system. Particles with aerodynamic diameters less than 10 μm are referred to as PM_{10}. Particles larger than 10 μm, while not able to affect health, can soil materials and generally degrade aesthetic elements of the environment. For this reason air quality goals make reference to measures of the total mass of all particles suspended in the air. This is referred to as Total Suspended Particulate matter (TSP). In practice particles larger than 30 to 50 μm settle out of the atmosphere too quickly to be regarded as air pollutants. The upper size range for TSP is usually taken to be 30 μm. TSP includes PM_{10}.

The health-based assessment criteria used by DEC have, to a large extent, been developed by reference to epidemiological studies undertaken in urban areas with large populations where the primary pollutants are the products of combustion. This means that, in contrast to dust of crustal[3] origin, the particulate matter would be composed of smaller particles and would generally contain acidic and carcinogenic substances that are associated with combustion.

Table 1 and **Table 2** summarise the air quality goals that are relevant to this study. The air quality goals relate to the total dust burden in the air and not just the dust from the project. In other words, consideration of background dust levels needs to be made when using these goals to assess impacts. This is discussed further in **Section 4**.

Table 1: Air quality standards/goals for particulate matter concentrations

taken to comprise particles in the size range up to 0 to 50 μm. Particles larger than 50 μm are generally too large to remain suspended in the air for long enough to be considered as air pollutants.

[2] A particle is said to have an equivalent aerodynamic diameter of x μm if its dynamical behavior in the atmosphere is the same as a sphere of diameter x and with density 1 g/cm^3.

[3] The term crustal dust is used to refer to dust generated from materials that constitute the earth's crust.

POLLUTANT	STANDARD / GOAL	AVERAGING PERIOD	AGENCY
Total suspended particulate matter (TSP)	90 µg/m^3	Annual mean	NHMRC
Particulate matter < 10 µm (PM_{10})	50 µg/m^3	24-hour maximum	NSW EPA (assessment criteria)
	30 µg/m^3	Annual mean	NSW EPA (long-term reporting goal)
	50 µg/m^3	(24-hour average, 5 exceedances permitted per year)	NEPM

µg/m^3 – micrograms per cubic metre
µm - micrometre

3.2 Dust deposition

In addition to health impacts, airborne dust also has the potential to cause nuisance effects by depositing on surfaces and possibly vegetation/crops. **Table 2** shows the maximum acceptable increase in dust deposition over the existing dust levels from an amenity perspective. These criteria for dust fallout levels are set to protect against nuisance impacts (**NSW EPA, 2001**).

Table 2: DEC criteria for dust (insoluble solids) fallout

Pollutant	Averaging period	Maximum increase in deposited dust level	Maximum total deposited dust level
Deposited dust	Annual	2 g/m^2/month	4 g/m^2/month

4 EXISTING AIR QUALITY

Air quality in the area around the proposed mine has been monitored since January 2005 using a network of dust eight dust deposition monitors operated in accordance with Australian Standard 2222 and a PM10 monitor operated in accordance with Australian Standard 2222. The locations of the monitoring sites are shown in **Figure 2**.

These monitors measure the existing dust deposition and PM10 concentration levels in the air due to emissions from all sources that contribute to dust in the air. These sources would include emissions from existing mining at the Ulan open cut and underground mines, emissions from agricultural and natural emission sources in the area.

The results of the monitoring are discussed below.

4.1 Dust deposition

Table 3 summarises the insoluble solids deposition levels monitored since monitoring commenced. Field notes that accompany the monitoring data indicate that many of the samples were contaminated with material such as bird droppings, insects and/or seeds. Those samples affected by any of these have been excluded from the averages of the reported dust deposition. Samples that are reported to be only affected by dust from farming, grazing, mining or roadway emissions would not be excluded. They would still be considered as dust.

Table 3. Monitored dust (insoluble solids) deposition levels from the Moolarben Monitoring Network - g/m^2/month

Date	D1 - Bobadeen	D2 - Hillview	D3 - Oakey Park	D4 - Ulan Hotel	D5 - Glenmoor	D6 – Barcoo	D7 - Hillside	D8 - Croydon
14-Jan-05	1.5	[1,2,5] 11.4	1.8	3.1	1.3	1.0	4.1	1.0
12-Feb-05	[1,2,4,5] 3.0	[1,2,3] 20.0	2.1	[1,2,3,4,5] 21.0	2.2	1.8	[1,2,4,5] 25.0	2.2
14-Mar-05	[1,2,5] 4.0	13.7	[1,5] 3.5	2.2	1.6	2.0	[1,2,5] 2.0	[1,5] 6.8
15-Apr-05	1.5	1.9	[1,5] 3.0	[1,5] 5.1	0.7	0.4	1.2	[1,2,5] 37.0
16-May-05	0.8	0.8	[1,5] 1.5	[1,2,4,5] 2.5	0.5	0.6	[2,5] 2.4	1.0
15-Jun-05	1.3	1.0	1.4	1.6	0.7	0.6	0.7	[2,5] 3.5
13-Jul-05	0.4	0.8	3.7	2.1	1.3	1.1	1.1	[1,2,5] 6.1
12-Aug-05	2.4	2.8	[1,2] 6.5	1.8	2.7	0.5	1.8	[1,2] 3.6
15-Sep-05	[1,2,5] 2.5	1.1	1.9	2.0	[1,2] 3.6	0.7	0.7	0.5
14-Oct-05	[1,2,5] 4.1	2.9	[1,2,5] 13.6	1.8	2.9	1.0	1.9	0.8
Nov								
Dec								
Year 2005	**2.2**	**5.6**	**3.9**	**4.3**	**1.8**	**1.0**	**4.1**	**6.3**
17-Jan-06	0.8	[1,2] 6.1	[1,2] 8.6	1.0	0.7	0.8	3.5	1.3
15-Feb-06	0.2	[1,2,5] 3.2	[1,2,5] 10.1	1.7	2.9	0.4	1.1	0.4
15-Mar-06	1.0	[1,2,5] 4.4	[1,2,5] 5.8	1.5	1.3	1.3	[1,2,5] 6.6	1.1
13-Apr-06	[1,2,5] 1.5	[2,5] 4.0	[2,5] 1.7	[2,5] 4.0	[1,2,5] 1.1	[1,2,5] 0.7	[1,2,5] 0.6	[1,2,5] 0.6
12-May-06	1.2	[1,2,5] 8.3	[1,2] 14.4	[1,2,3,5] 6.1	0.6	1.0	0.7	[1,2,3,5] 4.4
14-Jun-06	1.4	2.4	[1,2] 7.4	[1,2,3] 3.3	[1,2,3] 9.7	[1,2] 3.2	2.2	1.5
13-Jul-06	0.4	0.6	2.5	[1,2,5] 3.7	2	[1,2] 6.3	0.6	0.3
Year August 2005 to July 2006 excluding contaminated samples by either [1, 2, or 3]	**1.1**	**2.0**	**1.9**	**1.6**	**1.9**	**0.8**	**1.3**	**0.8**

[1] Insects, [2] Bird dropping, [3] Vegetation seeds [4] Farming, [5] Grazing, [6] Mining, [7] Road dust

The data show that the level of dust deposition in the existing environment is low and in all areas the acceptable increase in annual average dust deposition would be 2 g/m^2/month.

4.2 Particulate matter concentrations (PM_{10})

Concentrations of PM_{10} measured over 24-hours every sixth day are made at the site marked PM10-1 on F**igure 2**.

The results are presented in **Table 4**. The average over all data collected to date has been 15.6 μg/m^3 (up from the 13.3 μg/m^3 that applied in the previous review that considered data up to 3 August-2006) and the maximum 24-hour concentration has been 34.3 μg/m^3 (up from the 30.5 μg/m^3 recorded up to 3 August 2006).

Table 4. Monitored 24-hour average PM_{10} concentrations from PM10-1 (see Figure 2)

Date	Concentration - μg/m3
28-Oct-05	10.1
5-Nov-05	3.8
11-Nov-05	10

Date	Concentration - μg/m3
17-Nov-05	13.2
25-Nov-05	8.6
29-Nov-05	8.6
5-Dec-05	6.4
11-Dec-05	8.8
17-Dec-05	13.5
23-Dec-05	21.5
29-Dec-05	22.1
3-Jan-06	16.7
4-Jan-06	30.5
10-Jan-06	16.2
16-Jan-06	9.2
23-Jan-06	14.4
28-Jan-06	9.9
3-Feb-06	16.7
9-Feb-06	No data
15-Feb-06	No data
21-Feb-06	No data
27-Feb-06	No data
5-Mar-06	No data
11-Mar-06	No data
17-Mar-06	No data
23-Mar-06	No data
1-Apr-06	20.4
4-Apr-06	21.8
10-Apr-06	31.1
16-Apr-06	9.8
22-Apr-06	13.7
28-Apr-06	22.4
4-May-06	16.3
10-May-06	18.7
16-May-06	34.3
22-May-06	20.1
28-May-06	15.9
3-Jun-06	11.2
9-Jun-06	24.9
15-Jun-06	13.5
21-Jun-06	12.7
27-Jun-06	20.1
3-Jul-06	7.6
9-Jul-06	19.7
15-Jul-06	4.6
21-Jul-06	10.3
27-Jul-06	13.7
2-Aug-06	14.3
8-Aug-06	20.9
Average	**15.6**

These measurements can be compared with the DEC's annual average and 24-hour average assessment criteria for PM_{10} concentrations which are 30 and 50 μg/m^3 respectively.

5 CLIMATE AND METEOROLOGY

Meteorological data for the area are available from several sources. Relevant information is reviewed below. The most important data from the point of view of dust impact assessment is data on wind speed and wind direction and consequently most attention has been paid to this information.

5.1 Wind speed and direction

Wind data are currently being collected from two sites (Met 1 and Met 2 see **Figure 2**). At this stage the data available from Site 1 does not cover a 12 month period. Because the data from Site 1 do not cover a full year they need to be supplemented by additional data. To do this a set of site-specific, synthetic meteorological data for Site 1 has been created using The Air Pollution Model (TAPM) developed by CSIRO.

TAPM is a prognostic model which includes synoptic information determined from the six hourly Limited Area Prediction System (LAPS) (**Puri et al., 1997**). The model is discussed further in the user manual which accompanies the model (see **Hurley, 2002)**.

Windroses prepared from the supplemented Site 1 data and the Site 2 data are shown in **Figure 4** and **5**.

On an annual basis, it can be seen that the most common winds for the area are generally from the west and east with some winds from the northeast and east-northeast at Site 1, and from the southwest at Site 2. This pattern of winds is evident in all seasons with winds from the west being more common in winter and spring.

To use the wind data to assess dispersion, it is necessary to also have data on atmospheric stability. **Table 5** shows the frequency of occurrence of the stability categories expected in the area. The most common stability occurrences were calculated to be the D (37%) and E (19%) class stabilities.

Joint wind speed, wind direction and stability class frequency tables for the two sites are presented in **Appendix A**.

Table 5 : Frequency of occurrence of stability classes		
Stability Class	**2005 – Site 1 (composite data TAPM plus onsite)**	**2005 – Site 2 (all onsite data)**
A	3.4	2.4
B	8.4	4.1
C	10.8	7.7
D	35.2	45.7
E	21.2	22.5
F	21.0	17.6
Total	**100**	**100**

5.2 Local Climatic Conditions

The Bureau of Meteorology also collects climatic information in the vicinity of the study area. A range of climatic information collected from Gulgong Post Office (located approximately 30 km from the Project) is presented in **Table 6** (**Bureau of Meteorology, 2005**). Temperature and humidity data consist of monthly averages of 9 am and 3 pm readings. Also presented are monthly averages of maximum and minimum temperatures. Rainfall data consist of mean and median monthly rainfall and the average number of rain days per month.

5.3 Temperature, humidity and rainfall

Bureau of Meteorology records of temperature and humidity collected over 30 years, and rainfall over 120 years, are also available from Gulgong. Gulgong is at an elevation of 475 m and Ulan Village at 420 m above sea-level. The 55 m difference in elevation would be expected to have a minor effect on temperature, humidity and rainfall but the data are less likely to be affected by local factors than the wind data and have been used to describe conditions at the mine site. The data are presented in **Table 6**. It can be seen that January is on average the warmest month with a mean maximum of 30.8 ^{o}C and mean minimum of 16.5 ^{o}C. July is the coolest month with an average maximum of 14.6 ^{o}C and mean minimum of 2.5 ^{o}C.

Early morning (9 am) humidity is greatest in July when it is 83%, and lowest in December when it is 61%. Afternoon (3 pm) humidity is greatest in June when it is 57%, and lowest in December when it is 36%.

Table 6 also presents Bureau of Meteorology rainfall data for Gulgong. Mean annual rainfall is 649 mm and the mean number of raindays (days when rainfall was at least 0.25 mm) is 73. January is the wettest month with a rainfall average of 71.2 mm.

Table 6 : Climate Information for the Study Area

Element	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Mean 9 am dry-bulb temperature (deg C)	21.5	20.6	19.1	15.8	11.4	7.6	6.6	8.5	12.5	16.3	18.1	20.8	14.9
Mean 9 am wet-bulb temperature (deg C)	17.2	17.2	15.6	12.9	9.8	6.4	5.4	6.8	9.7	12.4	14.2	16.2	11.9
Mean 9 am humidity (%)	65	70	69	71	80	84	83	77	70	63	63	61	72
Mean 3 pm dry-bulb temperature (deg C)	29.1	28.3	26.1	22	17.7	14.2	13.6	15.3	18.4	21.8	24.7	28	21.7
Mean 3 pm wet-bulb temperature (deg C)	19.4	19.6	17.8	15	12.6	10.1	9.2	10.1	12.1	14.2	16.3	18.1	14.6
Mean 3 pm relative humidity (%)	38	42	43	46	52	57	53	48	46	42	39	36	45
Mean daily maximum temperature (deg C)	30.8	29.8	27.3	23.3	18.9	15.4	14.6	16.3	19.3	23.2	26.3	29.7	22.8
Mean daily minimum temperature (deg C)	16.5	16.3	13.6	9.8	6.5	3.4	2.5	3.4	6.1	9.1	11.9	14.9	9.4
Mean rainfall (mm)	71.2	60.7	54.8	45.2	45.9	50	48.5	47.2	46.3	57	57.9	63.9	648.6
Median rainfall (mm)	63.7	43.2	37.8	33.4	35.8	43.8	43.4	42.6	39.1	49.7	51	51.2	635
Mean number of rain days	5.9	5.1	5	4.5	5.6	7.1	7.3	6.8	6.6	6.6	6.1	6	72.5

Climate averages for Station: 062013; Commenced: 1881, Last record: 2004; Latitude (deg S): -32.3634; Longitude (deg E): 149.5329.
Source : ***Bureau of Meteorology (2005)***

6 APPROACH TO ASSESSMENT

6.1 Overview

In August 2005, the DEC published new guidelines for the assessment of air pollution sources using dispersion models (**DEC, 2005**). The guidelines specify how assessments based on the use of air dispersion models should be undertaken. This includes guidelines for the preparation of meteorological data to be used in dispersion models, the way in which emissions should be estimated and the relevant air quality criteria for assessing the significance of predicted concentration and deposition rates from the proposal. The approach taken in this assessment follows as closely as possible the approaches suggested by the guidelines.

This section is provided so that technical reviewers can appreciate how the modelling of different particle size categories was carried out.

The model used was a modified version of the US EPA ISC model (see later). The ISC model is fully described in the user manual and the accompanying technical description (**US EPA, 1995**). The modelling has been based on the use of three particle-size categories (0 to 2.5 µm - referred to as $PM_{2.5}$ (fine particulate matter FP), 2.5 to 10 µm - referred to as CM (coarse matter) and 10 to 30 µm - referred to as the Rest). Emission rates of TSP have been calculated using emission factors derived from **US EPA (1985)** and **NERDDC (1988)** work (see **Appendix B**).

The distribution of particles has been derived from measurements in the **SPCC (1986)** study. The distribution of particles in each particle size range is as follows:

- $PM_{2.5}$ (FP) is 4.68% of the TSP;
- $PM_{2.5-10}$ (CM) is 34.4% of TSP; and
- PM_{10-30} (Rest) is 60.9% of TSP.

Modelling was done using three ISC source groups. Each group corresponded to a particle size category. Each source in the group was assumed to emit at the full TSP emission rate and to deposit from the plume in accordance with the deposition rate appropriate for particles with an aerodynamic diameter equal to the geometric mean of the limits of the particle size range, except for the $PM_{2.5}$ group, which was assumed to have a particle size of 1 µm. The predicted concentration in the three plot output files for each group were then combined according to the weightings above to determine the concentration of PM_{10} and TSP.

The ISC model also has the capacity to take into account dust emissions that vary in time, or with meteorological conditions. This has proved particularly useful for simulating emissions on mining or quarry operations where wind speed is an important factor in determining the rate at which dust is generated.

For the current study, the operations were represented by a series of volume sources located according to the location of activities for the modelled scenario. **Figure 6** shows the location of the modelled sources for each year of assessment. Estimates of emissions for each source were developed on an hourly time step taking into account the activities that would take place at that location. Thus, for each source, for each hour, an emission rate was determined which depended upon the level of activity and the wind speed. It is important to do this in the ISC model to ensure that long-term average emission rates are not combined with worst-case dispersion conditions which are associated with light winds. Light winds at a mine site would correspond with periods of low dust generation (because wind erosion and other wind dependent emissions rates will be low) and also correspond with periods of poor dispersion. If these measures are not taken then the model has the potential to significantly overstate impacts.

Dust concentrations and deposition rates have been predicted over the area shown in **Figure 7**. Local terrain has been included in the modelling.

The modelling has been performed using the meteorological data discussed in **Section 5.1** and the dust emission estimates from **Section 7**. Dust emissions from wind erosion sources have been modelled for 24 hours per day in all modelling scenarios. Model predictions have been made at 432 discrete receptors, including residential locations, located in the study area. The location of these receptors has been chosen to provide finer resolution closer to the dust sources and nearby receptors.

The ISC model input files will be provided in electronic form on request and example file is provided in **Appendix C**.

6.2 Prediction of 24-hour PM_{10} concentrations

It has been apparent for a number of years that the ISC model has a tendency to overestimate the 24-hour PM_{10} concentrations, while still predicting the longer term average concentrations reasonably accurately. In recent years the DEC have permitted the use of a calibration factor to correct for the tendency of ISC to over-predict 24-hour average PM_{10}concentrations. In most instances, the DEC has required site-specific calibration factor be developed from local model and monitoring results.

On eof the earliest calibration studies was undertaken as part of the EIS for the Warkworth mine in the Hunter Valley (**Holmes Air Sciences, 2002**). The calibration was done by comparing the predicted maximum 24-hour average PM_{10} concentrations at the several mine operated monitors. The maximum measured PM_{10} concentrations were then determined by inspection of the monitoring data. From these investigations the average extent of over-prediction was found to be a factor of 2.6; that is, unadjusted model predictions appear to over predict 24-hour PM_{10} concentrations by 260%. This factor was used to adjust the model predictions for the Warkworth EIS downwards to obtain a calibrated prediction of the worst-case 24-hour PM_{10} concentrations for all scenarios that were assessed. Other studies undertaken at other locations have derived different calibration factors, both larger and smaller than 2.6. Further studies to develop a more scientifically robust methodology for dealing with the over-prediction of short-term concentrations by the ISC model are to be conducted as part of the approval conditions for the Mt Owen Mine.

Comparisons between ISC and AUSPLUME (see **Holmes Air Sciences, 2005** for example) have suggested that a correction factor is appropriate for short term (that is, 24-hour average) ISC predictions. Although the comparison between AUSPLUME and ISCS shows varying difference, AUSPLUME has consistently predicted almost 50% lower than uncorrected ISC predictions. Thus, AUSPLUME may have some advantages over ISC in that it more accurately predicts 24-hour average concentrations of PM_{10}, which are known to be consistently overestimated by ISC.

Results from a simplified model comparison of AUSPLUME and ISC suggested that 1-hour average PM_{10} concentrations downwind of a source and along the plume centreline were between 2.8 and 3.5 times higher using ISC than for AUSPLUME (see Appendix C of **Holmes Air Sciences, 2006**). The difference between the models depends on the meteorological conditions. Different results from the two models were largely explained by the way in which each model has interpreted the plume dispersion curves.

These studies, and the recently completed calibration study undertaken as part of the Mt Owen Mine's conditions of approval, have lead to a better understanding of the reasons for the over-prediction. It appears that a substantial fraction of effect is due to the fact that the dispersion curves used in the ISC model have not been adjusted for differences in averaging times and the effects of the aerodynamic roughness. For most model runs for a particular sites these will be different from the conditions where the original dispersion curves were developed.

To overcome this difficultly the ISC model has been modified to create a model that will be referred to as ISCMOD. ISCMOD is identical to ISC except that the horizontal plume spreading dispersion curves have been modified to adopt the recommendations of the American Meteorological Society's (AMS) expert panel on dispersion curves (**Hanna, 1977**) and the suggestions made by **Arya (1999)**. The suggested changes were recommended because, as the AMS panel notes, the original horizontal dispersion curves relate to an averaging time of three minutes and they recommend that these be adjusted to the one hour curves required by ISC. The change involves increasing the horizontal plume widths by a factor of 1.82 $(60 \text{ minutes} / 3 \text{ minute})^{0.2}$.

A similar adjustment has been applied to account for the local surface roughness being different at Moolarben compared with the site where the original curves were developed. Moolarben has been taken to have a surface roughness of 0.3 m compared with 0.03 m for the original curves. The adjustment leads to an increase in the horizontal and vertical curves by a factor of $(0.3 \text{ m}/ 0.03 \text{ m})^{0.2}$ namely 1.6.

7 ESTIMATED DUST EMISSIONS

Total dust emissions due to the proposed mine have been estimated by analysing the activities taking place at the site during selected years of operation.

The operations which apply in each case have been combined with emission factors developed, both locally and by the US EPA, to estimate the amount of dust produced by each activity. There have been significant revisions to the US EPA emission factors for mining operations in 2003. The emission factors applied are considered to be the most up to date methods for determining dust generation rates. The fraction of TSP in each of three size ranges for each activity has been estimated and used in the dispersion modelling.

The assessment has considered four selected years during the proposed mining (Year 2, 5, 8 and 10. These cover impacts arising for a range of product coal and overburden quantities. The selected years also cover mining activities in various locations of the Project area . The operational description for the project has been used to determine haul road distances and routes, stockpile and pit areas, activity operating hours, truck sizes and other details that are necessary to estimate dust emissions for each year of assessment.

The most significant dust generating activities from the proposed operations have been identified and the dust emission estimates during the four years are presented below in **Table 7**.

Details of the calculations of the dust emissions are presented in **Appendix B**. The estimated emissions take account of proposed air pollution controls including passive controls such as those inbuilt into the mine plan, e.g. stockpile size and alignment, length of haul roads and active controls, which would include the intensity of watering and extent of rehabilitation.

Table 7 : Estimated dust emissions due to proposed mining operations

ACTIVITY	Year 2 (2008)	Year 5	Year 8	Year 10
OB - Stripping topsoil - Pit 1	4,471	5,110	-	-
OB - Stripping topsoil - Pit 2	-	-	4,804	-
OB - Stripping topsoil - Pit 3_1	-	-	306	4,178
OB - Stripping topsoil - Pit 3_2	-	-	-	932
OB - Drilling - Pit 1	8,321	12,427	-	-
OB - Drilling - Pit 2	-	-	6,664	-
OB - Drilling - Pit 3_1	-	-	424	10,007
OB - Drilling - Pit 3_2	-	-	-	2,232
OB - Blasting - Pit 1	2,524	4,026	-	-
OB - Blasting - Pit 2	-	-	6,099	-
OB - Blasting - Pit 3_1	-	-	388	11,397
OB - Blasting - Pit 3_2	-	-	-	2,542
OB - Sh/Ex/FELs loading - Pit 1	62,112	119,180	-	-
OB - Sh/Ex/FELs loading - Pit 2	-	-	64	-
OB - Sh/Ex/FELs loading - Pit 3_1	-	-	4,066	95,968
OB - Sh/Ex/FELs loading - Pit 3_2	-	-	-	21,405
OB - Hauling to emplacement - from Pit 1	370,475	710,865	-	-
OB - Hauling to emplacement - from Pit 2	-	-	381	-
OB - Hauling to emplacement - from Pit 3_1	-	-	24,250	572,417
OB - Hauling to emplacement - from Pit 3_2	-	-	-	127,674
OB - Emplacing at dumps - Pit 1	62,112	119,180	-	-
OB - Emplacing at dumps - Pit 2	-	-	64	-
OB - Emplacing at dumps - Pit 3_1	-	-	4,066	95,968
OB - Emplacing at dumps - Pit 3_2	-	-	-	21,405
OB - Dozers on O/B - Pit 1	335,803	383,775	-	-
OB - Dozers on O/B - Pit 2	-	-	360,822	-
OB - Dozers on O/B - Pit 3_1	-	-	22,952	31,387
OB - Dozers on O/B - Pit 3_2	-	-	-	69,988
CL - Drilling - Pit 1	3,263	3,729	-	-
CL - Drilling - Pit 2	-	-	3,506	-
CL - Drilling - Pit 3_1	-	-	223	3,049
CL - Drilling - Pit 3_2	-	-	-	680
CL - Blasting - Pit 1	1,113	1,208	-	-
CL - Blasting - Pit 2	-	-	3,209	-
CL - Blasting - Pit 3_1	-	-	204	5,126
CL - Blasting - Pit 3_2	-	-	-	1,143

ACTIVITY	Year 2 (2008)	Year 5	Year 8	Year 10
CL - Dozers ripping - Pit 1	-	305,600	-	-
CL - Dozers ripping - Pit 2	-	-	287,323	-
CL - Dozers ripping - Pit 3_1	-	-	18,277	249,868
CL - Dozers ripping - Pit 3_2	-	-	-	55,731
CL - Loading ROM to trucks - Pit 1	472,873	540,426	-	-
CL - Loading ROM to trucks - Pit 2	-	-	508,105	-
CL - Loading ROM to trucks - Pit 3_1	-	-	32,321	441,870
CL - Loading ROM to trucks - Pit 3_2	-	-	-	98,556
CL - Hauling ROM coal to dump hopper - Pit 1	288,235	329,412	-	-
CL - Hauling ROM coal to dump hopper - Pit 2	-	-	309,711	-
CL - Hauling ROM coal to dump hopper - Pit 3_1	-	-	19,701	2,093,139
CL - Hauling ROM coal to dump hopper - Pit 3_2	-	-	-	466,861
CL - unloading ROM coal at pile/hopper - All pits	70,000	80,000	80,000	80,000
CL - ROM rehandle pile to hopper (FEL)	7,000	8,000	8,000	8,000
CL - Handling coal at CHPP	21,007	24,008	24,008	24,008
CL - Dozer/FEL pushing ROM coal	76,400	76,400	76,400	76,400
CL - Dozers pushing product coal	28,590	28,590	28,590	28,590
CL - Loading rejects	-	-	-	-
CL - Transporting rejects	51,852	59,259	59,259	59,259
CL - Unloading rejects	-	-	-	-
CL - Loading product coal stockpile	1,798	2,055	2,055	2,055
WE - OB spoil area - Pit 1	316,800	336,082	179,621	-
WE - OB spoil area - Pit 2	-	-	408,060	-
WE - OB spoil area - Pit 3_1	-	-	-	496,122
WE - OB spoil area - Pit 3_2	-	-	-	105,809
WE - Open pit - Pit 1	370,331	579,729	-	-
WE - Open pit - Pit 2	-	-	61,334	-
WE - Open pit - Pit 3_1	-	-	465,302	148,919
WE - Open pit - Pit 3_2	-	-	-	122,766
WE - ROM stockpiles	10,178	10,178	10,178	10,178
WE - Product stockpiles	8,143	8,143	8,143	8,143
Loading coal to trains	1,573	2,055	2,055	2,055
Grading roads	36,928	36,928	36,928	36,928
Total	2,611,901	**3,786,364**	**3,067,863**	**5,692,758**
Ratio of TSP emission to ROM coal production (kg/t)	0.37	**0.47**	**0.38**	**0.71**

Key: OB= Operations on overburden, CL = Operations on coal, WE = Dust due to wind erosion

8 ASSESSMENT OF IMPACTS

A modified version of the ISC model (ISCMOD) has been used with estimated emissions for Years 2, 5, 8 and 10 and meteorological data for 2005. The area covered by the model predictions is shown in **Figures 7** to **22**. The results show the estimated:

- maximum 24-hour PM_{10} concentrations;
- annual average PM_{10} concentrations;
- annual average TSP concentrations; and
- annual average dust (insoluble solids) deposition rates

for each of the four years.

The years selected for presentation are intended to illustrate the area affected by the mine over its lifetime. The significance of the predicted levels has been assessed by comparing the values with the DEC's assessment criteria. In each case, the predictions show the contribution that will be made by emissions from the Moolarben open cut and underground mines. In the case of the predicted maximum 24-hour PM_{10} concentrations the predicted levels can be compared with the DEC's 50 $\mu g/m^3$ 24-hour PM_{10} assessment criterion provided the mines employ best-practice dust controls, which include real-time management for mitigating short-term impacts. Similarly, DEC's annual average increment of 2 g/m^2/month for dust (insoluble solids) deposition may be interpreted as the limit that applies to the effect of the mine by itself. However, for all the other assessment criteria the predicted values due to the project must be combined with the estimated existing background levels. The annual average background PM_{10} concentrations have been taken to be 15.6 $\mu g/m^3$. For annual average TSP concentrations, the value has been taken to be 39 $\mu g/m^3$ and for annual average deposition (insoluble solids) the value has been taken to be 1.4 g/m^2/month, which is the average across all the deposition gauges for the most recent 12-months of data with contaminated results being excluded.

Background dust levels would be expected to change as other mining projects are brought into production. It has been assumed that the current monitoring data take account of the effects of mining nearby mines and all other sources. Changes to future operations at nearby mines would be taken into account when these changes undergo the environmental assessment process. The approved mining project at Wilpinjong will cause changes to background levels in the Ulan area, which can be taken account of using information published in the Wilpinjong Mine environmental assessment.

Mining at Wipinjong will progress from west to east and the disturbed area will be approximately 12 km to the southeast of Ulan Village at the end of the Wilpinjong project. Thus, the potential for cumulative effects in the Ulan area will increase with time. The closest residence to the Wilpinjong Mine is Residence 14. A review of the model predictions for Year 9 at Wilpinjong, indicates that annual average PM_{10} and TSP concentrations will be less than 2 $\mu g/m^3$ at Residence 14 and the concentrations at the Ulan Village area will be approximately 1 $\mu g/m^3$. (Note the PM_{10} and TSP concentrations will be similar because the coarser particles will have settled from the plume at this distance from the source.)

The increase in annual average deposition levels in the Ulan area due to emissions from the Wilpinjong Mine will be less than 0.1 g/m^2/month and thus have been assumed to be negligible.

To account for emissions from Wilpinjong, the predicted PM_{10} and TSP concentrations due to emissions from Moolarben, have been increased by 2 $\mu g/m^3$ (over and above the existing background levels). This has been done for the eastern most residences which have been taken to be Residences 2, 7, 8, 16, 15 and 14, 46C and 46D. For all other residences the, an allowance of 1 $\mu g/m^3$ has been added.

As will be seen later in the following sections there are a significant number of residences that are predicted to experience 24-hour average PM_{10} concentrations above the DEC's 50 µg/m^3 assessment criterion. In principle, short-term impacts can be managed by real-time management strategies in which modifications to mining operations are made to accommodate changing whether conditions. It is proposed that such a plan be applied in the current case, but in addition, a condition of consent requiring the mine to offer to acquire affected residences should monitoring indicate that the residence has experienced more than five exceedances of the 50 µg/m^3 level in any 12 month period, where emissions from the mine are the main contributor to the exceedance.

All residences located in areas where annual average concentrations or deposition levels are predicted to exceed the DEC assessment criteria have been assessed as being affected and would be subject to negotiated agreements with the owners.

Finally, the predictions made in this modelling study include estimates of $PM_{2.5}$ concentrations for Years 2, 5, 8 and 10. $PM_{2.5}$ concentrations do not have formal assessment criteria in NSW, however they have been used as the basis of a health risk assessment which is provided as an appendix elsewhere in the EIS.

8.1 Moolarben Project in Isolation and with background levels (cumulative effects)

8.1.1 Year 2

In Year 2 mining will be occurring in the east-west oriented pit located at the northern end of the project area. The pit will be advancing to the north and waste emplacement will be occurring in the pit on the southern edge.

Initial modelling studies indicated that the mine would have difficulty meeting the annual average PM_{10} assessment criterion of 30 µg/m^3 and that there would be some exceedances of the 24-hour PM_{10} assessment criterion under low wind speed conditions. While exceedances of the short-term goal can be managed via the use of a real-time monitoring program and the use of real-time adjustments to mining activity it was necessary to modify the mine plan to meet the annual PM_{10} criterion. This has been done by reducing the ROM coal production rate from 8 Mtpa to 7 Mtpa.

Figures 7 to **10** show respectively the predicted:

- Maximum 24-hour average PM_{10} concentrations;
- Predicted annual average PM_{10} concentrations;
- Predicted annual average TSP concentrations;
- Predicted annual average (insoluble solids) deposition levels.

The figures show the effects of emissions from the project taken in isolation.

While the figures are a useful way of showing the effects of the project, tabular summaries are a more useful way of testing for compliance (or non-compliance) with the assessment criteria at particular locations, in particular at individual residences. **Table 8** summarises the impacts at all residential locations and community centres. Those areas which are predicted to experience either concentration or deposition levels above the DEC's assessment criteria are shown in bold.

Table 8. Summary of predicted air quality impacts for Year 2

UTM Zone 55 Coordinates		ID	Project in isolation				Project with background (cumulative)			
Easting (m)	Northing (m)	Refer to figures	24-hour PM_{10} (µg/m^3)	Annual average PM_{10} (µg/m^3)	Annual average TSP (µg/m^3)	Annual average (insoluble solids) dep. (g/m^2/month)	24-hour PM_{10} (µg/m^3)	Annual average PM_{10} (µg/m^3)	Annual average TSP (µg/m^3)	Annual average (insoluble solids) dep. (g/m^2/month)
758171	6424610	46A	**74.3**	14.9	30.3	1.5	n/a	**31.5**	70.3	2.9
757370	6423594	49	**63.3**	9.5	17.5	1.0	n/a	26.1	57.5	2.4
757478	6422930	9	**115.9**	6.9	10.9	0.5	n/a	23.5	50.9	1.9
757342	6421298	22	**60.7**	2.6	3.3	0.1	n/a	19.2	43.3	1.5
759764	6420796	5	42.9	1.7	2.2	0.1	n/a	18.3	42.2	1.5
759147	6422220	46B	**71.2**	4.8	7.8	0.3	n/a	21.4	47.8	1.7
760008	6416123	31	11.3	0.4	0.4	0.0	n/a	17.0	40.4	1.4
760388	6416975	36	13.3	0.5	0.6	0.0	n/a	17.1	40.6	1.4
763590	6413194	32	4.7	0.2	0.3	0.0	n/a	16.8	40.3	1.4
760293	6413734	47	7.4	0.2	0.3	0.0	n/a	16.8	40.3	1.4
758435	6416631	30	11.5	0.5	0.6	0.0	n/a	17.1	40.6	1.4
757110	6421102	23	**54.0**	2.3	2.9	0.1	n/a	18.9	42.9	1.5
756926	6419919	58	30.0	1.2	1.5	0.0	n/a	17.8	41.5	1.4
758295	6421382	20	**56.6**	2.8	3.5	0.1	n/a	19.4	43.5	1.5
758351	6425038	160A	**78.5**	9.8	18.7	0.8	n/a	26.4	58.7	2.2
758427	6423790	25	**156.9**	28.0	60.9	3.6	n/a	**44.6**	**100.9**	**5.0**
765574	6412269	48	4.2	0.2	0.3	0.0	n/a	16.8	40.3	1.4
763756	6415963	29A	7.5	0.4	0.5	0.0	n/a	17.0	40.5	1.4
762840	6415591	29B	6.9	0.4	0.5	0.0	n/a	17.0	40.5	1.4
759316	6416451	28	9.3	0.4	0.5	0.0	n/a	17.0	40.5	1.4
763424	6421248	2	25.0	1.3	1.9	0.1	n/a	18.9	42.9	1.5
763220	6422900	8	27.9	1.9	2.9	0.1	n/a	19.5	43.9	1.5
761480	6422256	7	**74.2**	3.4	5.4	0.3	n/a	21.0	46.4	1.7
764184	6424816	16	27.0	2.2	3.2	0.1	n/a	19.8	44.2	1.5
763884	6423532	46C	26.6	1.9	2.9	0.1	n/a	19.5	43.9	1.5
763904	6424204	46D	29.6	2.2	3.3	0.2	n/a	19.8	44.3	1.6
764864	6425885	14	30.4	2.1	2.8	0.1	n/a	19.7	43.8	1.5
763608	6426397	12	31.2	3.9	5.2	0.2	n/a	21.5	46.2	1.6
763860	6426113	13	31.1	3.4	4.4	0.2	n/a	20.0	44.4	1.6
764496	6425257	15	28.3	2.2	3.1	0.1	n/a	19.8	44.1	1.5
762910	6431699	10A	15.7	1.3	1.5	0.0	n/a	17.9	41.5	1.4
762881	6431819	10B	15.5	1.3	1.5	0.0	n/a	17.9	41.5	1.4
765265	6431931	11	10.5	1.3	1.4	0.0	n/a	17.9	41.4	1.4
758663	6425526	46E	**70.2**	6.7	12.0	0.5	n/a	23.3	52.0	1.9
758339	6425214	162	**77.5**	8.3	15.1	0.6	n/a	24.9	55.1	2.0
757430	6423706	26	**62.8**	10.4	19.6	1.1	n/a	27.0	59.6	2.5
758311	6425114	161	**78.1**	9.0	16.8	0.7	n/a	25.6	56.8	2.1
758279	6425022	160B	**77.4**	9.9	18.9	0.8	n/a	26.5	58.9	2.2
758431	6425114	148	**79.3**	9.0	17.0	0.7	n/a	25.6	57.0	2.1
758391	6425134	167	**78.9**	8.8	16.5	0.7	n/a	25.4	56.5	2.1
758271	6425286	165	**75.7**	8.0	14.5	0.6	n/a	24.6	54.5	2.0
758235	6425134	159	**77.1**	9.0	16.5	0.7	n/a	25.6	56.5	2.1

UTM Zone 55 Coordinates		ID	Project in isolation				Project with background (cumulative)			
Easting (m)	Northing (m)	Refer to figures	24-hour PM_{10} (µg/m³)	Annual average PM_{10} (µg/m³)	Annual average TSP (µg/m³)	Annual average (insoluble solids) dep. (g/m²/month)	24-hour PM_{10} (µg/m³)	Annual average PM_{10} (µg/m³)	Annual average TSP (µg/m³)	Annual average (insoluble solids) dep. (g/m²/month)
758243	6425158	41C	**77.3**	8.7	15.9	0.7	n/a	25.3	55.9	2.1
758199	6425198	157	**76.1**	8.6	15.6	0.6	n/a	25.2	55.6	2.0
758111	6425214	154	**74.4**	8.8	15.7	0.7	n/a	25.4	55.7	2.1
758095	6425122	155	**74.8**	9.4	17.1	0.7	n/a	26.0	57.1	2.1
758071	6425074	156	**74.4**	9.9	18.0	0.8	n/a	26.5	58.0	2.2
757999	6425110	153	**73.5**	9.7	17.5	0.8	n/a	26.3	57.5	2.2
757943	6425078	150	**72.8**	10.0	18.0	0.8	n/a	26.6	58.0	2.2
758371	6425110	168	**78.7**	9.1	17.0	0.7	n/a	25.7	57.0	2.1
757979	6425062	151	**73.3**	10.1	18.2	0.8	n/a	26.7	58.2	2.2
757835	6424894	158	**71.7**	11.6	21.1	1.0	n/a	28.2	61.1	2.4
757462	6425554	46F	**65.4**	8.1	12.9	0.5	n/a	24.7	52.9	1.9
756626	6424030	169	**51.9**	8.2	14.2	0.7	n/a	24.8	54.2	2.1
756822	6421246	41A	**61.6**	2.5	3.2	0.1	n/a	19.1	43.2	1.5
756822	6421246	57	**61.6**	2.5	3.2	0.1	n/a	19.1	43.2	1.5

In summary, during Year 2, it is predicted that 33 residences (see **Table 8**) will experience some days where the 24-hour average PM_{10} concentration exceeds the DEC's 50 µg/m³ assessment criterion. Residence 25 is also predicted to exceed the DEC's annual average PM_{10} criterion of 30 µg/m³. Residence 25 is also predicted to experience annual TSP and deposition levels above the DEC's assessment criteria.

8.1.2 Year 5

In Year 5, mining will be occurring in the pit located at the northern end of the project area. The pit will be advancing to the north and waste emplacement will be occurring in the pit and on the area to the south.

As before, **Figures 11** to **14** show respectively the predicted:

- maximum 24-hour average PM_{10} concentrations;
- annual average PM_{10} concentrations;
- annual average TSP concentrations;
- annual average (insoluble solids) deposition levels.

The figures show the effects of emissions from the project taken in isolation.

The figures are a useful way of showing the effects of the project; however, tabular summaries are a more useful way of testing for compliance or non-compliance with the assessment criteria at particular locations, in particular at individual residences. **Table 9** summarises the impacts at all residential locations and community centres. Those areas which are predicted the experience either concentration or deposition levels above the DEC's assessment criteria are shown in bold.

Table 9. Summary of predicted air quality impacts for Year 5

UTM Zone 55 Coordinates		ID	Project in isolation				Project with background (cumulative)			
Easting (m)	Northing (m)	Refer to figures	24-hour PM_{10} ($\mu g/m^3$)	Annual average PM_{10} ($\mu g/m^3$)	Annual average TSP ($\mu g/m^3$)	Annual average (insoluble solids) dep. ($g/m^2/month$)	24-hour PM_{10} ($\mu g/m^3$)	Annual average PM_{10} ($\mu g/m^3$)	Annual average TSP ($\mu g/m^3$)	Annual average (insoluble solids) dep. ($g/m^2/month$)
758171	6424610	46A	**95.5**	5.4	8.3	0.4	n/a	22.0	48.3	1.8
757370	6423594	49	**82.9**	3.5	4.6	0.2	n/a	20.1	44.6	1.6
757478	6422930	9	**95.1**	3.0	3.8	0.1	n/a	19.6	43.8	1.5
757342	6421298	22	35.9	1.5	1.8	0.0	n/a	18.1	41.8	1.4
759764	6420796	5	25.5	1.4	1.6	0.0	n/a	18.0	41.6	1.4
759147	6422220	46B	**54.5**	2.3	2.7	0.1	n/a	18.9	42.7	1.5
760008	6416123	31	11.1	0.5	0.5	0.0	n/a	17.1	40.5	1.4
760388	6416975	36	11.5	0.5	0.6	0.0	n/a	17.1	40.6	1.4
763590	6413194	32	6.7	0.3	0.3	0.0	n/a	16.9	40.3	1.4
760293	6413734	47	7.1	0.3	0.3	0.0	n/a	16.9	40.3	1.4
758435	6416631	30	10.0	0.5	0.6	0.0	n/a	17.1	40.6	1.4
757110	6421102	23	33.0	1.4	1.7	0.0	n/a	18.0	41.7	1.4
756926	6419919	58	23.1	1.0	1.1	0.0	n/a	17.6	41.1	1.4
758295	6421382	20	38.8	1.6	1.9	0.0	n/a	18.2	41.9	1.4
758351	6425038	160A	**65.3**	7.1	12.2	0.7	n/a	23.7	52.2	2.1
758427	6423790	25	**149.5**	5.1	6.9	0.2	n/a	21.7	46.9	1.6
765574	6412269	48	5.6	0.2	0.3	0.0	n/a	16.8	40.3	1.4
763756	6415963	29A	8.7	0.4	0.5	0.0	n/a	17.0	40.5	1.4
762840	6415591	29B	10.3	0.4	0.4	0.0	n/a	17.0	40.4	1.4
759316	6416451	28	11.1	0.5	0.6	0.0	n/a	17.1	40.6	1.4
763424	6421248	2	23.4	1.4	2.0	0.1	n/a	19.0	43.0	1.5
763220	6422900	8	45.9	2.8	4.3	0.2	n/a	20.4	45.3	1.6
761480	6422256	7	48.7	2.2	2.8	0.1	n/a	19.8	43.8	1.5
764184	6424816	16	**61.6**	4.3	6.8	0.3	n/a	21.9	47.8	1.7
763884	6423532	46C	**69.9**	3.1	4.9	0.2	n/a	20.7	45.9	1.6
763904	6424204	46D	**65.7**	3.9	6.2	0.3	n/a	21.5	47.2	1.7
764864	6425885	14	**68.2**	4.7	7.1	0.4	n/a	22.3	48.1	1.8
763608	6426397	12	**171.0**	12.7	18.7	0.8	n/a	**30.3**	59.7	2.2
763860	6426113	13	**126.8**	9.3	14.1	0.7	n/a	25.9	54.1	2.1
764496	6425257	15	**65.0**	4.6	7.1	0.4	n/a	22.2	48.1	1.8
762910	6431699	10A	38.6	2.7	3.2	0.1	n/a	19.3	43.2	1.5
762881	6431819	10B	37.7	2.6	3.1	0.1	n/a	19.2	43.1	1.5
765265	6431931	11	20.5	2.4	2.8	0.1	n/a	19.0	42.8	1.5
758663	6425526	46E	**86.2**	12.0	21.8	1.2	n/a	28.6	61.8	2.6
758339	6425214	162	**57.9**	8.0	13.9	0.8	n/a	24.6	53.9	2.2
757430	6423706	26	**83.5**	3.6	4.9	0.2	n/a	20.2	44.9	1.6
758311	6425114	161	**58.8**	7.3	12.6	0.7	n/a	23.9	52.6	2.1
758279	6425022	160B	**63.0**	6.8	11.5	0.6	n/a	23.4	51.5	2.0
758431	6425114	148	**63.9**	7.8	13.6	0.7	n/a	24.4	53.6	2.1
758391	6425134	167	**60.9**	7.8	13.5	0.7	n/a	24.4	53.5	2.1
758271	6425286	165	**57.2**	8.1	14.1	0.8	n/a	24.7	54.1	2.2
758235	6425134	159	**56.4**	7.2	12.4	0.7	n/a	23.8	52.4	2.1

UTM Zone 55 Coordinates		ID	Project in isolation				Project with background (cumulative)			
Easting (m)	Northing (m)	Refer to figures	24-hour PM_{10} ($\mu g/m^3$)	Annual average PM_{10} ($\mu g/m^3$)	Annual average TSP ($\mu g/m^3$)	Annual average (insoluble solids) dep. ($g/m^2/month$)	24-hour PM_{10} ($\mu g/m^3$)	Annual average PM_{10} ($\mu g/m^3$)	Annual average TSP ($\mu g/m^3$)	Annual average (insoluble solids) dep. ($g/m^2/month$)
758243	6425158	41C	**55.2**	7.3	12.7	0.7	n/a	23.9	52.7	2.1
758199	6425198	157	**55.1**	7.5	12.9	0.7	n/a	24.1	52.9	2.1
758111	6425214	154	**55.0**	7.4	12.6	0.7	n/a	24.0	52.6	2.1
758095	6425122	155	**56.3**	6.9	11.7	0.6	n/a	23.5	51.7	2.0
758071	6425074	156	**57.8**	6.7	11.3	0.6	n/a	23.3	51.3	2.0
757999	6425110	153	**55.6**	6.7	11.3	0.6	n/a	23.3	51.3	2.0
757943	6425078	150	**55.6**	6.5	10.8	0.6	n/a	23.1	50.8	2.0
758371	6425110	168	**61.6**	7.6	13.1	0.7	n/a	24.2	53.1	2.1
757979	6425062	151	**56.6**	6.5	10.8	0.6	n/a	23.1	50.8	2.0
757835	6424894	158	**59.7**	5.6	9.1	0.5	n/a	22.2	49.1	1.9
757462	6425554	46F	49.0	7.2	11.7	0.6	n/a	23.8	51.7	2.0
756626	6424030	169	**52.9**	3.0	4.3	0.2	n/a	19.6	44.3	1.6
756822	6421246	41A	35.9	1.5	1.8	0.0	n/a	18.1	41.8	1.4
756822	6421246	57	35.9	1.5	1.8	0.0	n/a	18.1	41.8	1.4

In summary, for Year 5, it is predicted that 33 residences (see **Table 9**) will experience some days where the 24-hour average PM_{10} concentration exceeds the DEC's 50 $\mu g/m^3$ assessment criterion. In addition Residence 12 is predicted to experience annual average PM_{10} concentrations marginally above the DEC's assessment criterion of 30 $\mu g/m^3$. No other assessment criterion is predicted to be exceeded.

8.1.3 Year 8

In Year 8, mining will be occurring in two pits located in the central parts of the project area. Waste emplacement will be occurring in the pits and in out-of pit emplacement areas adjacent or close to the pits.

As before, **Figures 15** to **18** show respectively the predicted:

- Maximum 24-hour average PM_{10} concentrations;
- Predicted annual average PM_{10} concentrations;
- Predicted annual average TSP concentrations;
- Predicted annual average (insoluble solids) deposition levels.

The figures show the effects of emissions from the project taken in isolation.

While the figures area are useful way of showing the effects of the project. Tabular summaries are a more useful way of testing for compliance or non-compliance with the assessment criteria at particular locations, in particular at individual residences. **Table 10** summarises the impacts at all residential locations and community centres. Those areas which are predicted to experience either concentration or deposition levels above the DEC's assessment criteria are shown in bold.

Table 10. Summary of predicted air quality impacts for Year 8

UTM Zone 55 Coordinates		ID	Project in isolation				Project with background (cumulative)			
Easting (m)	Northing (m)	Refer to figures	24-hour PM_{10} (µg/m^3)	Annual average PM_{10} (µg/m^3)	Annual average TSP (µg/m^3)	Annual average (insoluble solids) dep. (g/m^2/month)	24-hour PM_{10} (µg/m^3)	Annual average PM_{10} (µg/m^3)	Annual average TSP (µg/m^3)	Annual average (insoluble solids) dep. (g/m^2/month)
758171	6424610	46A	23.5	3.1	5.3	0.2	n/a	19.7	45.3	1.6
757370	6423594	49	20.3	2.9	4.3	0.2	n/a	19.5	44.3	1.6
757478	6422930	9	26.7	3.6	5.1	0.2	n/a	20.2	45.1	1.6
757342	6421298	22	29.4	5.9	9.3	0.5	n/a	22.5	49.3	1.9
759764	6420796	5	**91.7**	15.8	33.3	1.9	n/a	**32.4**	73.3	3.3
759147	6422220	46B	30.9	4.3	7.9	0.3	n/a	20.9	47.9	1.7
760008	6416123	31	14.1	1.2	1.6	0.1	n/a	17.8	41.6	1.5
760388	6416975	36	28.3	2.9	4.8	0.2	n/a	19.5	44.8	1.6
763590	6413194	32	11.1	0.5	0.7	0.0	n/a	17.1	40.7	1.4
760293	6413734	47	8.7	0.4	0.5	0.0	n/a	17.0	40.5	1.4
758435	6416631	30	17.3	1.3	1.8	0.1	n/a	17.9	41.8	1.5
757110	6421102	23	30.5	5.5	8.8	0.4	n/a	22.1	48.8	1.8
756926	6419919	58	25.7	3.7	6.0	0.3	n/a	20.3	46.0	1.7
758295	6421382	20	36.4	7.5	12.0	0.5	n/a	24.1	52.0	1.9
758351	6425038	160A	22.2	3.8	6.6	0.3	n/a	20.4	46.6	1.7
758427	6423790	25	36.2	3.7	6.3	0.3	n/a	20.3	46.3	1.7
765574	6412269	48	9.1	0.4	0.5	0.0	n/a	17.0	40.5	1.4
763756	6415963	29A	21.0	1.2	2.0	0.1	n/a	17.8	42.0	1.5
762840	6415591	29B	21.0	1.1	1.8	0.1	n/a	17.7	41.8	1.5
759316	6416451	28	13.7	1.3	1.9	0.1	n/a	17.9	41.9	1.5
763424	6421248	2	37.4	4.9	7.4	0.3	n/a	22.5	48.4	1.7
763220	6422900	8	18.2	3.4	4.9	0.2	n/a	21.0	45.9	1.6
761480	6422256	7	**54.9**	6.3	9.1	0.3	n/a	23.9	50.1	1.7
764184	6424816	16	11.2	2.2	2.9	0.1	n/a	19.8	43.9	1.5
763884	6423532	46C	13.9	2.7	3.7	0.1	n/a	20.3	44.7	1.5
763904	6424204	46D	12.1	2.4	3.2	0.1	n/a	20.0	44.2	1.5
764864	6425885	14	9.9	1.8	2.4	0.1	n/a	19.4	43.4	1.5
763608	6426397	12	14.6	2.6	3.5	0.1	n/a	20.2	44.5	1.5
763860	6426113	13	14.6	2.4	3.1	0.1	n/a	19.0	43.1	1.5
764496	6425257	15	10.8	2.0	2.7	0.1	n/a	19.6	43.7	1.5
762910	6431699	10A	11.8	0.9	1.0	0.0	n/a	17.5	41.0	1.4
762881	6431819	10B	11.5	0.8	1.0	0.0	n/a	17.4	41.0	1.4
765265	6431931	11	7.9	0.8	0.9	0.0	n/a	17.4	40.9	1.4
758663	6425526	46E	20.0	4.7	8.2	0.4	n/a	21.3	48.2	1.8
758339	6425214	162	21.0	4.0	6.9	0.3	n/a	20.6	46.9	1.7
757430	6423706	26	20.2	2.9	4.3	0.2	n/a	19.5	44.3	1.6
758311	6425114	161	21.3	3.8	6.7	0.3	n/a	20.4	46.7	1.7
758279	6425022	160B	21.7	3.7	6.3	0.3	n/a	20.3	46.3	1.7
758431	6425114	148	22.5	4.1	7.2	0.4	n/a	20.7	47.2	1.8
758391	6425134	167	22.0	4.0	7.1	0.4	n/a	20.6	47.1	1.8
758271	6425286	165	20.2	3.8	6.5	0.3	n/a	20.4	46.5	1.7
758235	6425134	159	20.8	3.7	6.4	0.3	n/a	20.3	46.4	1.7
758243	6425158	41C	20.6	3.8	6.5	0.3	n/a	20.4	46.5	1.7

UTM Zone 55 Coordinates		ID	Project in isolation				Project with background (cumulative)			
Easting (m)	Northing (m)	Refer to figures	24-hour PM_{10} ($\mu g/m^3$)	Annual average PM_{10} ($\mu g/m^3$)	Annual average TSP ($\mu g/m^3$)	Annual average (insoluble solids) dep. ($g/m^2/month$)	24-hour PM_{10} ($\mu g/m^3$)	Annual average PM_{10} ($\mu g/m^3$)	Annual average TSP ($\mu g/m^3$)	Annual average (insoluble solids) dep. ($g/m^2/month$)
758199	6425198	157	20.4	3.7	6.3	0.3	n/a	20.3	46.3	1.7
758111	6425214	154	20.1	3.6	6.0	0.3	n/a	20.2	46.0	1.7
758095	6425122	155	20.4	3.5	5.9	0.3	n/a	20.1	45.9	1.7
758071	6425074	156	20.5	3.5	5.8	0.3	n/a	20.1	45.8	1.7
757999	6425110	153	20.1	3.4	5.7	0.3	n/a	20.0	45.7	1.7
757943	6425078	150	19.9	3.3	5.5	0.3	n/a	19.9	45.5	1.7
758371	6425110	168	21.9	3.9	6.9	0.3	n/a	20.5	46.9	1.7
757979	6425062	151	20.1	3.4	5.6	0.3	n/a	20.0	45.6	1.7
757835	6424894	158	20.1	3.2	5.1	0.2	n/a	19.8	45.1	1.6
757462	6425554	46F	17.7	2.8	4.3	0.2	n/a	19.4	44.3	1.6
756626	6424030	169	18.1	2.6	3.7	0.1	n/a	19.2	43.7	1.5
756822	6421246	41A	29.1	5.1	7.9	0.4	n/a	21.7	47.9	1.8
756822	6421246	57	29.1	5.1	7.9	0.4	n/a	21.7	47.9	1.8

In summary, for Year 8, it is predicted that two residences (see **Table 10**) will experience some days where the 24-hour average PM_{10} concentration exceeds the DEC's 50 $\mu g/m^3$ assessment criterion. In addition, it is predicted that one residence (Residence 5) will experience annual an average PM_{10} concentration above the 30 $\mu g/m^3$ annual average PM_{10} criterion. No other assessment criterion is predicted to be exceeded.

8.1.4 Year 10

In Year 10, mining will be occurring at a pit located in the southern part of the project area. Waste emplacement will be occurring in the pits and in out-of pit emplacement areas adjacent or close to the pits.

As before, **Figures 19** to **22** show respectively the predicted:

- Maximum 24-hour average PM_{10} concentrations;
- Predicted annual average PM_{10} concentrations;
- Predicted annual average TSP concentrations;
- Predicted annual average (insoluble solids) deposition levels.

The figures show the effects of emissions from the project taken in isolation.

While the figures area are useful way of showing the effects of the project. Tabular summaries are a more useful way of testing for compliance or non-compliance with the assessment criteria at particular locations, in particular at individual residences. **Table 11** summarises the impacts at all residential locations and community centres. Those areas which are predicted to experience either concentration or deposition levels above the DEC's assessment criteria are shown in bold.

Table 11. Summary of predicted air quality impacts for Year 10

UTM Zone 55 Coordinates		ID	Project in isolation				Project with background (cumulative)			
Easting (m)	Northing (m)	Refer to figures	24-hour PM_{10} ($\mu g/m^3$)	Annual average PM_{10} ($\mu g/m^3$)	Annual average TSP ($\mu g/m^3$)	Annual average (insoluble solids) dep. ($g/m^2/month$)	24-hour PM_{10} ($\mu g/m^3$)	Annual average PM_{10} ($\mu g/m^3$)	Annual average TSP ($\mu g/m^3$)	Annual average (insoluble solids) dep. ($g/m^2/month$)
758171	6424610	46A	15.0	1.7	2.7	0.1	n/a	18.3	42.7	1.5
757370	6423594	49	13.8	1.5	2.2	0.1	n/a	18.1	42.2	1.5
757478	6422930	9	16.6	1.7	2.2	0.1	n/a	18.3	42.2	1.5
757342	6421298	22	11.6	1.8	2.3	0.1	n/a	18.4	42.3	1.5
759764	6420796	5	22.6	3.0	5.2	0.2	n/a	19.6	45.2	1.6
759147	6422220	46B	16.2	2.0	3.3	0.1	n/a	18.6	43.3	1.5
760008	6416123	31	**75.4**	6.3	12.1	0.8	n/a	22.9	52.1	2.2
760388	6416975	36	**68.6**	11.0	19.0	1.0	n/a	27.6	59.0	2.4
763590	6413194	32	26.9	1.4	2.1	0.1	n/a	18.0	42.1	1.5
760293	6413734	47	32.0	1.7	2.4	0.1	n/a	18.3	42.4	1.5
758435	6416631	30	**50.7**	4.4	7.7	0.5	n/a	21.0	47.7	1.9
757110	6421102	23	12.3	1.8	2.3	0.1	n/a	18.4	42.3	1.5
756926	6419919	58	17.9	2.4	3.2	0.1	n/a	19.0	43.2	1.5
758295	6421382	20	12.5	2.0	2.6	0.1	n/a	18.6	42.6	1.5
758351	6425038	160A	13.2	2.0	3.3	0.1	n/a	18.6	43.3	1.5
758427	6423790	25	28.1	2.1	3.3	0.1	n/a	18.7	43.3	1.5
765574	6412269	48	21.2	1.0	1.5	0.1	n/a	17.6	41.5	1.5
763756	6415963	29A	**246.3**	19.1	44.3	**3.2**	n/a	**35.7**	84.3	**4.6**
762840	6415591	29B	**468.4**	59.9	128.3	**7.2**	n/a	**76.5**	**168.3**	**8.6**
759316	6416451	28	**64.9**	5.4	10.3	0.7	n/a	22.0	50.3	2.1
763424	6421248	2	18.8	2.0	2.7	0.1	n/a	19.6	43.7	1.5
763220	6422900	8	10.6	1.4	2.0	0.1	n/a	19.0	43.0	1.5
761480	6422256	7	16.0	2.3	3.0	0.1	n/a	19.9	44.0	1.5
764184	6424816	16	9.0	1.2	1.6	0.0	n/a	18.8	42.6	1.4
763884	6423532	46C	10.4	1.3	1.7	0.1	n/a	18.9	42.7	1.5
763904	6424204	46D	9.3	1.3	1.6	0.0	n/a	18.9	42.6	1.4
764864	6425885	14	8.4	1.1	1.4	0.0	n/a	18.7	42.4	1.4
763608	6426397	12	11.1	1.7	2.3	0.1	n/a	19.3	43.3	1.5
763860	6426113	13	9.8	1.5	1.9	0.1	n/a	18.1	41.9	1.5
764496	6425257	15	8.7	1.2	1.5	0.0	n/a	18.8	42.5	1.4
762910	6431699	10A	6.0	0.6	0.7	0.0	n/a	17.2	40.7	1.4
762881	6431819	10B	5.9	0.6	0.7	0.0	n/a	17.2	40.7	1.4
765265	6431931	11	5.1	0.6	0.7	0.0	n/a	17.2	40.7	1.4
758663	6425526	46E	11.8	2.7	4.5	0.2	n/a	19.3	44.5	1.6
758339	6425214	162	12.7	2.1	3.4	0.1	n/a	18.7	43.4	1.5
757430	6423706	26	14.0	1.6	2.2	0.1	n/a	18.2	42.2	1.5
758311	6425114	161	13.0	2.0	3.3	0.1	n/a	18.6	43.3	1.5
758279	6425022	160B	13.3	1.9	3.1	0.1	n/a	18.5	43.1	1.5
758431	6425114	148	13.0	2.1	3.5	0.2	n/a	18.7	43.5	1.6
758391	6425134	167	12.9	2.1	3.5	0.2	n/a	18.7	43.5	1.6
758271	6425286	165	12.5	2.0	3.3	0.1	n/a	18.6	43.3	1.5
758235	6425134	159	12.8	2.0	3.2	0.1	n/a	18.6	43.2	1.5
758243	6425158	41C	12.8	2.0	3.2	0.1	n/a	18.6	43.2	1.5

UTM Zone 55 Coordinates		ID	Project in isolation				Project with background (cumulative)			
Easting (m)	Northing (m)	Refer to figures	24-hour PM_{10} ($\mu g/m^3$)	Annual average PM_{10} ($\mu g/m^3$)	Annual average TSP ($\mu g/m^3$)	Annual average (insoluble solids) dep. (g/m^2/month)	24-hour PM_{10} ($\mu g/m^3$)	Annual average PM_{10} ($\mu g/m^3$)	Annual average TSP ($\mu g/m^3$)	Annual average (insoluble solids) dep. (g/m^2/month)
758199	6425198	157	12.6	2.0	3.2	0.1	n/a	18.6	43.2	1.5
758111	6425214	154	12.6	1.9	3.0	0.1	n/a	18.5	43.0	1.5
758095	6425122	155	12.7	1.9	3.0	0.1	n/a	18.5	43.0	1.5
758071	6425074	156	12.8	1.9	2.9	0.1	n/a	18.5	42.9	1.5
757999	6425110	153	12.6	1.8	2.9	0.1	n/a	18.4	42.9	1.5
757943	6425078	150	12.6	1.8	2.8	0.1	n/a	18.4	42.8	1.5
758371	6425110	168	13.0	2.1	3.4	0.1	n/a	18.7	43.4	1.5
757979	6425062	151	12.7	1.8	2.8	0.1	n/a	18.4	42.8	1.5
757835	6424894	158	12.8	1.7	2.6	0.1	n/a	18.3	42.6	1.5
757462	6425554	46F	11.9	1.6	2.3	0.1	n/a	18.2	42.3	1.5
756626	6424030	169	11.0	1.3	1.8	0.1	n/a	17.9	41.8	1.5
756822	6421246	41A	13.4	1.8	2.3	0.1	n/a	18.4	42.3	1.5
756822	6421246	57	13.4	1.8	2.3	0.1	n/a	18.4	42.3	1.5

In summary, for Year 10, it is predicted that six residences (**Table 11**) will experience some days where the 24-hour average PM_{10} concentration exceeds the DEC's 50 $\mu g/m^3$ assessment criterion. In addition, Residences 29A and 29B are predicted to experience annual average PM_{10} concentrations above the DEC's 30 $\mu g/m^3$ assessment criterion and the 2 and 4 g/m^2/month (annual average) criterion. Residence 29B is predicted to exceed the 90 $\mu g/m^3$ annual average TSP criterion.

9 GREENHOUSE GAS EMISSIONS

Greenhouse gas inventories are calculated according to a number of different methods. The procedures specified under the Kyoto Protocol United Nations Framework Convention on Climate Change are the most common.

The protocol identifies greenhouse gases as follows:

- Carbon dioxide (CO_2)
- Methane (CH_4)
- Nitrous oxide (N_2O)
- Hydrofluorocarbons (HFCs)
- Perfluorocarbons (PFCs)
- Sulphur hexafluoride (SF_6).

Carbon dioxide and N_2O are formed and released during the combustion of gaseous, liquid and solid fuels. The most significant gases for the current proposal are CO_2 and N_2O, which will be liberated when fuels are burnt in diesel power equipment and in the generation of the electrical energy that will be used by the project. In addition there will be emissions of CH_4 and CO_2 from exposed coal in the open cut mine and from the underground mine ventilation air. The coal seams to be mined are not particularly gassy.

Inventories of greenhouse gas emissions can be calculated using published emission factors. Different gases have different greenhouse warming effects (potentials) and emission factors take into account the global warming potentials of the gases created during combustion.

The global warming potentials assumed in the Australian Greenhouse Office (AGO) (**2005**) emission factors are as follows:

- CO_2 – 1
- CH_4 – 21
- N_2O – 310
- NO_2 – not included.

When the global warming potentials are applied to the estimated emissions then the resulting estimate is referred to in terms of CO_2-equivalent emissions.

The emission factors published by the Australian Greenhouse Office (AGO) (**2005**) have been used to convert fuel usage and electricity consumption into CO_2-equivalent emissions. The relevant emission factors are:

1. 3.0 kg CO_2-equivalent/litre for diesel usage – based on full fuel cycle analysis (see Table 3 of **AGO (2005)**)
2. 0.985 kg CO_2-equivalent/kWh of electrical energy used in NSW.

The project will liberate greenhouse gases as a result of the combustion of diesel to power earthmoving equipment and the use of electrical energy. Information on fuel and electricity consumption available for this study include the following:

1. Consumption of 12 ML/year of diesel; and
2. 74,000 MWh of electrical energy over a year.

The average annual greenhouse gas emissions from the consumption of energy for mining will then be 112,220,000 kg of CO_2-equivalent per year [12,000,000 L x 3.0 kg/L +74,000 MWh x 1,030 kg/MWh]

The **AGO (2005)** workbook (Table 6 in the Workbook) suggests that for open cut mines in NSW the CO_2-equivalent emission factor is 45.5 kg/t of ROM coal and for underground operations the emission factor for less gassy mines is 11.3 kg/t of ROM coal.

Assuming that the open cut produces 8 Mtpa and the underground operations 4 Mtpa the average annual greenhouse gas emissions from CH_4 liberated as the coal is mined will be 272,400,000 kg of CO_2-equivalent per year [4,000,000 Mtpa x 45.5 kg/t + 8,000,000 Mtpa x 11.3 kg/t].

Total annual emission of CO_2-equivalent will therefore be 384,620,000 kg/year.

10 MONITORING AND MITIGATION

The modelling results presented above are based on the assumption that the project is operated using a standard of dust control that would meet the definition of best practice for current open cut mining in NSW. The residential areas to west and east of the Proposal are in the prevailing downwind direction. Because of this, it will be necessary to ensure that dust emissions are kept to the minimum practicable level. This section outlines procedures proposed for the management and control of dust emissions.

The following procedures are proposed for the management of dust emissions from the mine. The aim of these procedures is to minimise the emission of dust and the effects of these are included in the model simulations. Dust can be generated from two primary sources, these being:

i) wind blown dust from exposed areas, and
ii) dust generated by mining activities.

Table 12 and
Table 13 list the different sources of wind blown and mining generated dust respectively, and the proposed controls.

Table 12. Control procedures for wind blown dust

Source	Control Procedures
Areas disturbed by mining	Disturb only the minimum area necessary for mining. Reshape, topsoil and rehabilitate completed overburden emplacement areas as soon as practicable after the completion of overburden tipping.
Coal handling areas / stockpiles	Maintain coal-handling areas / stockpiles in a moist condition using water carts to minimise wind blown and traffic generated dust.
ROM Coal Stockpiles	Have available water sprays on ROM coal stockpiles and use sprays to reduce airborne dust, as required.

Table 13. Mine generated dust and controls

Source	Control procedures
Haul Road Dust	All roads and trafficked areas will be watered using water carts to minimise the generation of dust. All haul roads will have edges clearly defined with marker posts or equivalent to control their locations, especially when crossing large overburden emplacement areas. Obsolete roads will be ripped and re-vegetated.
Minor roads	Development of minor roads will be limited and the locations of these will be clearly defined. Minor roads used regularly for access etc will be watered. Obsolete roads will be, ripped and re-vegetated.
Topsoil Stripping	Access tracks used by topsoil stripping equipment during their loading and unloading cycle will be watered.
Topsoil Stockpiling	Long term topsoil stockpiles, not used for over 6 months will be re-vegetated.
Drilling	Dust aprons will be lowered during drilling. Drills will be equipped with dust extraction cyclones, or water injection systems. Water injection or dust suppression sprays will be used when high levels of dust are being generated.
Blasting	Appropriate stemming will be used in all blasts.

It is envisaged that the monitoring program necessary to verify environmental performance will incorporate the following.

- One meteorological station.
- Two high volume PM_{10} monitors.
- The current network of deposition gauges, or as otherwise approved by the DEC, would be used to monitor dust fallout.

In addition in the early years it will be necessary to employ real-time management procedures to minimise the incidence of short term high concentrations of PM_{10} in the residential are to the west of the Northern Open Cut. This will involve the continuous monitoring of PM_{10} concentrations and contingency plans to reduce emissions should monitoring indicate that the 24-hour average PM_{10} concentrations exceed the DEC assessment criterion of 50 $\mu g/m^3$ due to emissions from Moolarben.

11 CONCLUSIONS

This report has assessed the potential air quality impacts of the proposed Moolarben Open Cut Mine near Ulan. It is concluded that the project has the potential to cause a number of exceedances of the DEC's 24-hour PM_{10} assessment criteria at approximately 35 residences located to the west of the mining area in the earlier years of the project's life. The applications of a real-time dust management strategy could be used to manage these short-term impacts. However it is recognised that a condition of consent requiring the project to negotiate and acquire affected properties will be necessary.

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APPENDIX A:
JOINT WIND SPEED, WIND DIRECTION AND STABILITY CLASS FREQUENCY TABLES FOR METEOROLOGICAL STATIONS AT SITES 1 AND 2

STATISTICS FOR FILE: C:\Jobs\Moolar\Met\MERGE05.isc
MONTHS: All
HOURS : All
OPTION: Frequency

PASQUILL STABILITY CLASS 'A'

Wind Speed Class (m/s)

WIND SECTOR	0.50 TO 1.50	1.50 TO 3.00	3.00 TO 4.50	4.50 TO 6.00	6.00 TO 7.50	7.50 TO 9.00	9.00 TO 10.50	GREATER THAN 10.50	TOTAL
NNE	0.001027	0.001027	0.000228	0.000000	0.000000	0.000000	0.000000	0.000000	0.002283
NE	0.001370	0.002055	0.000228	0.000000	0.000000	0.000000	0.000000	0.000000	0.003653
ENE	0.000799	0.002740	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.003653
E	0.000571	0.001712	0.000913	0.000000	0.000000	0.000000	0.000000	0.000000	0.003196
ESE	0.000685	0.000571	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.001256
SE	0.000342	0.000228	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000571
SSE	0.000342	0.000457	0.000342	0.000000	0.000000	0.000000	0.000000	0.000000	0.001142
S	0.000685	0.000571	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.001370
SSW	0.000000	0.000913	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000913
SW	0.001712	0.000457	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.002283
WSW	0.000228	0.000228	0.000228	0.000000	0.000000	0.000000	0.000000	0.000000	0.000685
W	0.000571	0.000342	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.001027
WNW	0.000457	0.000228	0.000228	0.000000	0.000000	0.000000	0.000000	0.000000	0.000913
NW	0.000342	0.000685	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.001027
NNW	0.000228	0.000342	0.000342	0.000000	0.000000	0.000000	0.000000	0.000000	0.000913
N	0.000685	0.000685	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.001484
CALM									0.007877
TOTAL	0.010046	0.013242	0.003082	0.000000	0.000000	0.000000	0.000000	0.000000	0.034247

MEAN WIND SPEED (m/s) = 1.56
NUMBER OF OBSERVATIONS = 300

PASQUILL STABILITY CLASS 'B'

Wind Speed Class (m/s)

WIND SECTOR	0.50 TO 1.50	1.50 TO 3.00	3.00 TO 4.50	4.50 TO 6.00	6.00 TO 7.50	7.50 TO 9.00	9.00 TO 10.50	GREATER THAN 10.50	TOTAL
NNE	0.000799	0.000799	0.000913	0.000000	0.000000	0.000000	0.000000	0.000000	0.002511
NE	0.001256	0.003311	0.000457	0.000228	0.000000	0.000000	0.000000	0.000000	0.005251
ENE	0.001027	0.005365	0.002397	0.000228	0.000000	0.000000	0.000000	0.000000	0.009018
E	0.000457	0.009703	0.007763	0.002511	0.000000	0.000000	0.000000	0.000000	0.020434
ESE	0.000457	0.001826	0.001712	0.000342	0.000000	0.000000	0.000000	0.000000	0.004338
SE	0.000114	0.001256	0.000799	0.000000	0.000000	0.000000	0.000000	0.000000	0.002169
SSE	0.000457	0.000913	0.000457	0.000000	0.000000	0.000000	0.000000	0.000000	0.001826
S	0.000685	0.000913	0.000685	0.000000	0.000000	0.000000	0.000000	0.000000	0.002283
SSW	0.000342	0.001027	0.001370	0.000342	0.000000	0.000000	0.000000	0.000000	0.003082
SW	0.000457	0.001370	0.002626	0.001142	0.000000	0.000000	0.000000	0.000000	0.005594
WSW	0.000342	0.000571	0.004224	0.002055	0.000000	0.000000	0.000000	0.000000	0.007192
W	0.000457	0.000685	0.001256	0.000342	0.000000	0.000000	0.000000	0.000000	0.002740
WNW	0.000342	0.001256	0.000913	0.000000	0.000000	0.000000	0.000000	0.000000	0.002511
NW	0.000228	0.001826	0.001027	0.000913	0.000000	0.000000	0.000000	0.000000	0.003995
NNW	0.000457	0.001142	0.000571	0.000342	0.000000	0.000000	0.000000	0.000000	0.002511
N	0.000457	0.001712	0.000571	0.000000	0.000000	0.000000	0.000000	0.000000	0.002740
CALM									0.005365
TOTAL	0.008333	0.033676	0.027740	0.008447	0.000000	0.000000	0.000000	0.000000	0.083562

MEAN WIND SPEED (m/s) = 2.84
NUMBER OF OBSERVATIONS = 732

PASQUILL STABILITY CLASS 'C'

Wind Speed Class (m/s)

WIND SECTOR	0.50 TO 1.50	1.50 TO 3.00	3.00 TO 4.50	4.50 TO 6.00	6.00 TO 7.50	7.50 TO 9.00	9.00 TO 10.50	GREATER THAN 10.50	TOTAL
NNE	0.000685	0.000457	0.000685	0.000114	0.000000	0.000000	0.000000	0.000000	0.001941
NE	0.000457	0.000571	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.001027
ENE	0.000799	0.000685	0.000342	0.000000	0.000000	0.000000	0.000000	0.000000	0.001826
E	0.000457	0.002169	0.011073	0.009132	0.002169	0.000000	0.000000	0.000000	0.025000
ESE	0.001370	0.003539	0.003539	0.002169	0.001027	0.000685	0.000000	0.000000	0.012329
SE	0.001142	0.001598	0.001370	0.000000	0.000000	0.000000	0.000000	0.000000	0.004110
SSE	0.001142	0.000913	0.001142	0.000342	0.000000	0.000000	0.000000	0.000000	0.003539
S	0.000913	0.000685	0.001598	0.000000	0.000000	0.000000	0.000000	0.000000	0.003196
SSW	0.000799	0.001256	0.001598	0.000799	0.000000	0.000000	0.000000	0.000000	0.004452
SW	0.001256	0.000571	0.002169	0.002055	0.000571	0.000114	0.000000	0.000000	0.006735
WSW	0.000342	0.000342	0.001142	0.005137	0.002283	0.000457	0.000000	0.000000	0.009703
W	0.000799	0.000799	0.002626	0.003311	0.002283	0.000571	0.000000	0.000000	0.010388
WNW	0.000228	0.001370	0.002055	0.001027	0.001826	0.000342	0.000000	0.000000	0.006849
NW	0.000342	0.000457	0.000799	0.000799	0.001826	0.000342	0.000000	0.000000	0.004566
NNW	0.000342	0.000571	0.000799	0.001027	0.000685	0.000000	0.000000	0.000000	0.003425
N	0.000228	0.000685	0.000342	0.000799	0.000114	0.000000	0.000000	0.000000	0.002169
CALM									0.006393
TOTAL	0.011301	0.016667	0.031279	0.026712	0.012785	0.002511	0.000000	0.000000	0.107648

MEAN WIND SPEED (m/s) = 3.88
NUMBER OF OBSERVATIONS = 943

PASQUILL STABILITY CLASS 'D'

Wind Speed Class (m/s)

WIND SECTOR	0.50 TO 1.50	1.50 TO 3.00	3.00 TO 4.50	4.50 TO 6.00	6.00 TO 7.50	7.50 TO 9.00	9.00 TO 10.50	GREATER THAN 10.50	TOTAL
NNE	0.003425	0.004680	0.000342	0.000000	0.000000	0.000000	0.000000	0.000000	0.008447
NE	0.002169	0.007420	0.003539	0.000571	0.000000	0.000000	0.000000	0.000000	0.013699
ENE	0.002169	0.006050	0.006393	0.003881	0.000457	0.000000	0.000000	0.000000	0.018950
E	0.001826	0.006393	0.014498	0.015639	0.010845	0.001826	0.001712	0.000000	0.052740
ESE	0.001941	0.009132	0.017466	0.014954	0.010731	0.004224	0.000342	0.000000	0.058790
SE	0.001712	0.005479	0.003311	0.002283	0.000114	0.000000	0.000000	0.000000	0.012900
SSE	0.003082	0.004566	0.002169	0.000799	0.000114	0.000000	0.000000	0.000000	0.010731
S	0.003196	0.003995	0.002740	0.001484	0.000114	0.000000	0.000000	0.000000	0.011530
SSW	0.007763	0.004224	0.002968	0.001256	0.000228	0.000228	0.000000	0.000000	0.016667
SW	0.013584	0.004566	0.004224	0.003539	0.001256	0.000799	0.000571	0.000114	0.028653
WSW	0.003425	0.002397	0.005708	0.005479	0.004680	0.003539	0.002055	0.000114	0.027397
W	0.001027	0.001941	0.002397	0.006393	0.003425	0.002740	0.001712	0.001598	0.021233
WNW	0.000913	0.002968	0.002169	0.003196	0.002283	0.001142	0.000913	0.000342	0.013927
NW	0.000799	0.002397	0.004224	0.002854	0.001826	0.000799	0.001598	0.000228	0.014726
NNW	0.000913	0.001712	0.001598	0.002626	0.001027	0.000457	0.000228	0.000000	0.008562
N	0.001142	0.001826	0.001712	0.000571	0.000228	0.000000	0.000000	0.000000	0.005479
CALM									0.027968
TOTAL	0.049087	0.069749	0.075457	0.065525	0.037329	0.015753	0.009132	0.002397	0.352397

MEAN WIND SPEED (m/s) = 3.84
NUMBER OF OBSERVATIONS = 3087

PASQUILL STABILITY CLASS 'E'

Wind Speed Class (m/s)

WIND SECTOR	0.50 TO 1.50	1.50 TO 3.00	3.00 TO 4.50	4.50 TO 6.00	6.00 TO 7.50	7.50 TO 9.00	9.00 TO 10.50	GREATER THAN 10.50	TOTAL
NNE	0.001256	0.001826	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.003082
NE	0.000685	0.001712	0.004566	0.000342	0.000000	0.000000	0.000000	0.000000	0.007306
ENE	0.000799	0.001826	0.007192	0.003425	0.000000	0.000000	0.000000	0.000000	0.013242
E	0.000457	0.002169	0.012557	0.005023	0.000000	0.000000	0.000000	0.000000	0.020205
ESE	0.000228	0.003425	0.031050	0.005822	0.000000	0.000000	0.000000	0.000000	0.040525
SE	0.001484	0.003082	0.006050	0.001027	0.000000	0.000000	0.000000	0.000000	0.011644
SSE	0.001142	0.000913	0.006050	0.000913	0.000000	0.000000	0.000000	0.000000	0.009018
S	0.000799	0.001370	0.010274	0.001941	0.000000	0.000000	0.000000	0.000000	0.014384
SSW	0.001484	0.002055	0.011301	0.001256	0.000000	0.000000	0.000000	0.000000	0.016096
SW	0.003539	0.004110	0.016210	0.002740	0.000000	0.000000	0.000000	0.000000	0.026598
WSW	0.002169	0.001941	0.005137	0.000685	0.000000	0.000000	0.000000	0.000000	0.009932
W	0.000457	0.001598	0.004338	0.001484	0.000000	0.000000	0.000000	0.000000	0.007877
WNW	0.000799	0.003311	0.002283	0.000114	0.000000	0.000000	0.000000	0.000000	0.006507
NW	0.000571	0.001826	0.002968	0.000228	0.000000	0.000000	0.000000	0.000000	0.005594
NNW	0.000114	0.001598	0.001826	0.000799	0.000000	0.000000	0.000000	0.000000	0.004338
N	0.000228	0.001941	0.000342	0.000000	0.000000	0.000000	0.000000	0.000000	0.002511
CALM									0.013128
TOTAL	0.016210	0.034703	0.122146	0.025799	0.000000	0.000000	0.000000	0.000000	0.211986

MEAN WIND SPEED (m/s) = 3.30
NUMBER OF OBSERVATIONS = 1857

PASQUILL STABILITY CLASS 'F'

Wind Speed Class (m/s)

WIND SECTOR	0.50 TO 1.50	1.50 TO 3.00	3.00 TO 4.50	4.50 TO 6.00	6.00 TO 7.50	7.50 TO 9.00	9.00 TO 10.50	GREATER THAN 10.50	TOTAL
NNE	0.000228	0.001598	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.001826
NE	0.000571	0.002968	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.003539
ENE	0.000685	0.004680	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.005365
E	0.000571	0.003425	0.001484	0.000000	0.000000	0.000000	0.000000	0.000000	0.005479
ESE	0.001142	0.018037	0.016667	0.000000	0.000000	0.000000	0.000000	0.000000	0.035845
SE	0.001142	0.017466	0.008333	0.000000	0.000000	0.000000	0.000000	0.000000	0.026941
SSE	0.000228	0.007648	0.004566	0.000000	0.000000	0.000000	0.000000	0.000000	0.012443
S	0.002397	0.005708	0.004680	0.000000	0.000000	0.000000	0.000000	0.000000	0.012785
SSW	0.001826	0.009589	0.005023	0.000000	0.000000	0.000000	0.000000	0.000000	0.016438
SW	0.005137	0.011644	0.005365	0.000000	0.000000	0.000000	0.000000	0.000000	0.022146
WSW	0.002968	0.007306	0.004224	0.000000	0.000000	0.000000	0.000000	0.000000	0.014498
W	0.000913	0.005023	0.001256	0.000000	0.000000	0.000000	0.000000	0.000000	0.007192
WNW	0.000228	0.004110	0.002055	0.000000	0.000000	0.000000	0.000000	0.000000	0.006393
NW	0.000571	0.002740	0.001142	0.000000	0.000000	0.000000	0.000000	0.000000	0.004452
NNW	0.000228	0.003082	0.001256	0.000000	0.000000	0.000000	0.000000	0.000000	0.004566
N	0.001142	0.001826	0.000342	0.000000	0.000000	0.000000	0.000000	0.000000	0.003311
CALM									0.026941
TOTAL	0.019977	0.106849	0.056393	0.000000	0.000000	0.000000	0.000000	0.000000	0.210160

MEAN WIND SPEED (m/s) = 2.33
NUMBER OF OBSERVATIONS = 1841

ALL PASQUILL STABILITY CLASSES

Wind Speed Class (m/s)

WIND SECTOR	0.50 TO 1.50	1.50 TO 3.00	3.00 TO 4.50	4.50 TO 6.00	6.00 TO 7.50	7.50 TO 9.00	9.00 TO 10.50	GREATER THAN 10.50	TOTAL
NNE	0.007420	0.010388	0.002169	0.000114	0.000000	0.000000	0.000000	0.000000	0.020091
NE	0.006507	0.018037	0.008790	0.001142	0.000000	0.000000	0.000000	0.000000	0.034475
ENE	0.006279	0.021347	0.016438	0.007534	0.000457	0.000000	0.000000	0.000000	0.052055
E	0.004338	0.025571	0.048288	0.032306	0.013014	0.001826	0.001712	0.000000	0.127055
ESE	0.005822	0.036530	0.070434	0.023288	0.011758	0.004909	0.000342	0.000000	0.153082
SE	0.005936	0.029110	0.019863	0.003311	0.000114	0.000000	0.000000	0.000000	0.058333
SSE	0.006393	0.015411	0.014726	0.002055	0.000114	0.000000	0.000000	0.000000	0.038699
S	0.008676	0.013242	0.020091	0.003425	0.000114	0.000000	0.000000	0.000000	0.045548
SSW	0.012215	0.019064	0.022260	0.003653	0.000228	0.000228	0.000000	0.000000	0.057648
SW	0.025685	0.022717	0.030708	0.009475	0.001826	0.000913	0.000571	0.000114	0.092009
WSW	0.009475	0.012785	0.020662	0.013356	0.006963	0.003995	0.002055	0.000114	0.069406
W	0.004224	0.010388	0.011986	0.011530	0.005708	0.003311	0.001712	0.001598	0.050457
WNW	0.002968	0.013242	0.009703	0.004338	0.004110	0.001484	0.000913	0.000342	0.037100
NW	0.002854	0.009932	0.010160	0.004795	0.003653	0.001142	0.001598	0.000228	0.034361
NNW	0.002283	0.008447	0.006393	0.004795	0.001712	0.000457	0.000228	0.000000	0.024315
N	0.003881	0.008676	0.003425	0.001370	0.000342	0.000000	0.000000	0.000000	0.017694
CALM									0.087671
TOTAL	0.114954	0.274886	0.316096	0.126484	0.050114	0.018265	0.009132	0.002397	1.000000

MEAN WIND SPEED (m/s) = 3.25
NUMBER OF OBSERVATIONS = 8760

FREQUENCY OF OCCURENCE OF STABILITY CLASSES

A : 3.4%
B : 8.4%
C : 10.8%
D : 35.2%
E : 21.2%
F : 21.0%

STABILITY CLASS BY HOUR OF DAY

Hour	A	B	C	D	E	F
01	0000	0000	0000	0063	0160	0142
02	0000	0000	0000	0062	0161	0142
03	0000	0000	0000	0062	0143	0160
04	0000	0000	0000	0062	0142	0161
05	0000	0000	0000	0060	0133	0172
06	0000	0000	0000	0188	0081	0096
07	0004	0001	0043	0232	0035	0050
08	0005	0020	0096	0244	0000	0000
09	0012	0074	0097	0182	0000	0000
10	0018	0105	0094	0148	0000	0000
11	0029	0123	0076	0137	0000	0000
12	0045	0102	0087	0131	0000	0000
13	0049	0082	0086	0148	0000	0000
14	0051	0076	0088	0150	0000	0000
15	0046	0062	0091	0166	0000	0000
16	0035	0043	0091	0196	0000	0000
17	0006	0044	0058	0214	0019	0024
18	0000	0000	0036	0184	0071	0074
19	0000	0000	0000	0156	0096	0113
20	0000	0000	0000	0053	0154	0158
21	0000	0000	0000	0061	0151	0153
22	0000	0000	0000	0059	0171	0135
23	0000	0000	0000	0062	0174	0129
24	0000	0000	0000	0067	0166	0132

STABILITY CLASS BY MIXING HEIGHT

Mixing height	A	B	C	D	E	F
<=500 m	0028	0231	0365	1726	1768	1796
<=1000 m	0082	0240	0257	0766	0052	0026
<=1500 m	0077	0120	0148	0361	0037	0019
<=2000 m	0076	0086	0110	0141	0000	0000
<=3000 m	0031	0047	0047	0070	0000	0000
>3000 m	0006	0008	0016	0023	0000	0000

MIXING HEIGHT BY HOUR OF DAY

Hour	0000 to 0100	0100 to 0200	0200 to 0400	0400 to 0800	0800 to 1600	1600 to 3200	Greater than 3200
01	0119	0109	0093	0029	0003	0012	0000
02	0117	0099	0105	0034	0002	0008	0000
03	0114	0102	0109	0034	0001	0005	0000
04	0125	0097	0104	0036	0002	0001	0000
05	0139	0086	0103	0033	0003	0001	0000
06	0148	0085	0099	0029	0003	0001	0000
07	0158	0082	0110	0013	0002	0000	0000
08	0114	0096	0100	0055	0000	0000	0000
09	0087	0054	0123	0099	0002	0000	0000
10	0019	0061	0084	0165	0035	0001	0000
11	0003	0020	0069	0136	0125	0012	0000
12	0001	0005	0034	0139	0154	0032	0000
13	0002	0003	0020	0079	0204	0054	0003
14	0002	0003	0019	0063	0194	0078	0006
15	0005	0001	0025	0054	0185	0087	0008
16	0005	0006	0024	0050	0177	0093	0010
17	0012	0024	0044	0050	0141	0085	0009
18	0086	0055	0038	0036	0088	0058	0004
19	0130	0075	0111	0037	0007	0005	0000
20	0166	0081	0087	0025	0000	0006	0000
21	0174	0083	0077	0020	0003	0008	0000
22	0155	0100	0073	0027	0003	0007	0000
23	0136	0111	0081	0028	0001	0008	0000
24	0115	0120	0093	0023	0003	0011	0000

STATISTICS FOR FILE: C:\Jobs\Moolar\Met\RAY2005.isc
MONTHS: All
HOURS : All
OPTION: Frequency

ALL PASQUILL STABILITY CLASSES

Wind Speed Class (m/s)

WIND SECTOR	0.50 TO 1.50	1.50 TO 3.00	3.00 TO 4.50	4.50 TO 6.00	6.00 TO 7.50	7.50 TO 9.00	9.00 TO 10.50	GREATER THAN 10.50	TOTAL
NNE	0.027795	0.020341	0.003411	0.000253	0.000000	0.000000	0.000000	0.000000	0.051800
NE	0.021352	0.036639	0.021099	0.000379	0.000000	0.000000	0.000000	0.000000	0.079469
ENE	0.025521	0.033481	0.006317	0.000000	0.000000	0.000000	0.000000	0.000000	0.065319
E	0.037397	0.063677	0.010992	0.000000	0.000000	0.000000	0.000000	0.000000	0.112066
ESE	0.042198	0.022110	0.002527	0.000000	0.000000	0.000000	0.000000	0.000000	0.066835
SE	0.049905	0.005306	0.000126	0.000000	0.000000	0.000000	0.000000	0.000000	0.055338
SSE	0.030828	0.004675	0.000253	0.000000	0.000000	0.000000	0.000000	0.000000	0.035755
S	0.022110	0.006443	0.001263	0.000253	0.000126	0.000000	0.000000	0.000000	0.030196
SSW	0.016677	0.013645	0.003285	0.001263	0.000000	0.000000	0.000000	0.000000	0.034870
SW	0.012634	0.020088	0.014403	0.006822	0.002780	0.000379	0.000126	0.000000	0.057233
WSW	0.008465	0.021731	0.024258	0.010613	0.003917	0.001263	0.000253	0.000000	0.070499
W	0.007960	0.017814	0.013645	0.004043	0.001516	0.000379	0.000000	0.000000	0.045357
WNW	0.009349	0.012887	0.006696	0.004927	0.000253	0.000000	0.000000	0.000000	0.034112
NW	0.008086	0.007581	0.005306	0.001895	0.001011	0.000000	0.000000	0.000000	0.023879
NNW	0.013898	0.009476	0.005938	0.001769	0.000505	0.000505	0.000000	0.000000	0.032091
N	0.024763	0.014150	0.004043	0.002906	0.000884	0.000000	0.000000	0.000000	0.046747
CALM									0.158433
TOTAL	0.358939	0.310044	0.123563	0.035123	0.010992	0.002527	0.000379	0.000000	1.000000

MEAN WIND SPEED (m/s) = 1.83
NUMBER OF OBSERVATIONS = 7915

PASQUILL STABILITY CLASS 'A'

Wind Speed Class (m/s)

WIND SECTOR	0.50 TO 1.50	1.50 TO 3.00	3.00 TO 4.50	4.50 TO 6.00	6.00 TO 7.50	7.50 TO 9.00	9.00 TO 10.50	GREATER THAN 10.50	TOTAL
NNE	0.000884	0.000505	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.001390
NE	0.000379	0.000126	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000505
ENE	0.000505	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000505
E	0.000379	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000379
ESE	0.000505	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000505
SE	0.000126	0.000126	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000253
SSE	0.000758	0.000126	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000884
S	0.000632	0.000126	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000758
SSW	0.000126	0.000379	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000505
SW	0.000000	0.000758	0.000000	0.000253	0.000000	0.000000	0.000000	0.000000	0.001011
WSW	0.000253	0.001516	0.001263	0.000253	0.000000	0.000000	0.000000	0.000000	0.003285
W	0.000632	0.001516	0.000253	0.000000	0.000000	0.000000	0.000000	0.000000	0.002401
WNW	0.000379	0.000126	0.000253	0.000126	0.000000	0.000000	0.000000	0.000000	0.000884
NW	0.000379	0.000126	0.000379	0.000505	0.000000	0.000000	0.000000	0.000000	0.001390
NNW	0.000505	0.000253	0.000758	0.000126	0.000000	0.000000	0.000000	0.000000	0.001642
N	0.001390	0.000505	0.000000	0.000253	0.000000	0.000000	0.000000	0.000000	0.002148
CALM									0.005812
TOTAL	0.007833	0.006191	0.002906	0.001516	0.000000	0.000000	0.000000	0.000000	0.024258

MEAN WIND SPEED (m/s) = 1.72
NUMBER OF OBSERVATIONS = 192

PASQUILL STABILITY CLASS 'B'

Wind Speed Class (m/s)

WIND SECTOR	0.50 TO 1.50	1.50 TO 3.00	3.00 TO 4.50	4.50 TO 6.00	6.00 TO 7.50	7.50 TO 9.00	9.00 TO 10.50	GREATER THAN 10.50	TOTAL
NNE	0.001011	0.001769	0.000253	0.000000	0.000000	0.000000	0.000000	0.000000	0.003032
NE	0.000758	0.003285	0.003159	0.000126	0.000000	0.000000	0.000000	0.000000	0.007328
ENE	0.000126	0.001263	0.000632	0.000000	0.000000	0.000000	0.000000	0.000000	0.002021
E	0.000632	0.000379	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.001011
ESE	0.000505	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000505
SE	0.000884	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000884
SSE	0.000253	0.000126	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000379
S	0.000126	0.000126	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000253
SSW	0.000632	0.000126	0.000253	0.000126	0.000000	0.000000	0.000000	0.000000	0.001137
SW	0.000505	0.000884	0.000505	0.000505	0.000000	0.000000	0.000000	0.000000	0.002401
WSW	0.000632	0.001642	0.002653	0.000632	0.000000	0.000000	0.000000	0.000000	0.005559
W	0.000253	0.001642	0.000758	0.000000	0.000000	0.000000	0.000000	0.000000	0.002653
WNW	0.000632	0.000758	0.000505	0.000884	0.000000	0.000000	0.000000	0.000000	0.002780
NW	0.001011	0.000379	0.000126	0.000126	0.000000	0.000000	0.000000	0.000000	0.001642
NNW	0.000505	0.001390	0.000632	0.000126	0.000000	0.000000	0.000000	0.000000	0.002653
N	0.000758	0.001390	0.000126	0.000000	0.000000	0.000000	0.000000	0.000000	0.002274
CALM									0.004043
TOTAL	0.009223	0.015161	0.009602	0.002527	0.000000	0.000000	0.000000	0.000000	0.040556

MEAN WIND SPEED (m/s) = 2.32
NUMBER OF OBSERVATIONS = 321

PASQUILL STABILITY CLASS 'C'

Wind Speed Class (m/s)

WIND SECTOR	0.50 TO 1.50	1.50 TO 3.00	3.00 TO 4.50	4.50 TO 6.00	6.00 TO 7.50	7.50 TO 9.00	9.00 TO 10.50	GREATER THAN 10.50	TOTAL
NNE	0.001895	0.003285	0.000758	0.000000	0.000000	0.000000	0.000000	0.000000	0.005938
NE	0.002274	0.006949	0.005180	0.000253	0.000000	0.000000	0.000000	0.000000	0.014656
ENE	0.001769	0.004422	0.001642	0.000000	0.000000	0.000000	0.000000	0.000000	0.007833
E	0.001895	0.004422	0.001895	0.000000	0.000000	0.000000	0.000000	0.000000	0.008212
ESE	0.000884	0.001516	0.000126	0.000000	0.000000	0.000000	0.000000	0.000000	0.002527
SE	0.001011	0.000253	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.001263
SSE	0.001137	0.000884	0.000126	0.000000	0.000000	0.000000	0.000000	0.000000	0.002148
S	0.000505	0.000758	0.000632	0.000000	0.000000	0.000000	0.000000	0.000000	0.001895
SSW	0.000379	0.000253	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000632
SW	0.000884	0.002021	0.001642	0.000253	0.000000	0.000000	0.000000	0.000000	0.004801
WSW	0.000379	0.001769	0.002021	0.000126	0.000000	0.000000	0.000000	0.000000	0.004296
W	0.000505	0.001516	0.001011	0.000000	0.000000	0.000000	0.000000	0.000000	0.003032
WNW	0.001137	0.000884	0.000000	0.000505	0.000000	0.000000	0.000000	0.000000	0.002527
NW	0.001390	0.000884	0.000126	0.000126	0.000000	0.000000	0.000000	0.000000	0.002527
NNW	0.001895	0.001390	0.000253	0.000000	0.000000	0.000000	0.000000	0.000000	0.003538
N	0.002401	0.002021	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.004422
CALM									0.006822
TOTAL	0.020341	0.033228	0.015414	0.001263	0.000000	0.000000	0.000000	0.000000	0.077069

MEAN WIND SPEED (m/s) = 2.06
NUMBER OF OBSERVATIONS = 610

PASQUILL STABILITY CLASS 'D'

Wind Speed Class (m/s)

WIND SECTOR	0.50 TO 1.50	1.50 TO 3.00	3.00 TO 4.50	4.50 TO 6.00	6.00 TO 7.50	7.50 TO 9.00	9.00 TO 10.50	GREATER THAN 10.50	TOTAL
NNE	0.012382	0.008970	0.001642	0.000126	0.000000	0.000000	0.000000	0.000000	0.023121
NE	0.008339	0.015161	0.011876	0.000000	0.000000	0.000000	0.000000	0.000000	0.035376
ENE	0.009728	0.015540	0.003664	0.000000	0.000000	0.000000	0.000000	0.000000	0.028932
E	0.015919	0.033354	0.007833	0.000000	0.000000	0.000000	0.000000	0.000000	0.057107
ESE	0.018572	0.008465	0.002021	0.000000	0.000000	0.000000	0.000000	0.000000	0.029059
SE	0.018825	0.002021	0.000126	0.000000	0.000000	0.000000	0.000000	0.000000	0.020973
SSE	0.010613	0.001642	0.000126	0.000000	0.000000	0.000000	0.000000	0.000000	0.012382
S	0.009223	0.002653	0.000505	0.000253	0.000126	0.000000	0.000000	0.000000	0.012761
SSW	0.006317	0.002906	0.001642	0.001137	0.000000	0.000000	0.000000	0.000000	0.012003
SW	0.004422	0.006191	0.008970	0.005054	0.002780	0.000379	0.000126	0.000000	0.027922
WSW	0.002906	0.006191	0.011497	0.008086	0.003917	0.001263	0.000253	0.000000	0.034112
W	0.003159	0.007707	0.008086	0.003664	0.001516	0.000379	0.000000	0.000000	0.024510
WNW	0.003411	0.005685	0.004801	0.003032	0.000253	0.000000	0.000000	0.000000	0.017183
NW	0.003917	0.003664	0.003538	0.001137	0.001011	0.000000	0.000000	0.000000	0.013266
NNW	0.006949	0.004169	0.003664	0.001516	0.000505	0.000505	0.000000	0.000000	0.017309
N	0.011371	0.006191	0.002148	0.002527	0.000884	0.000000	0.000000	0.000000	0.023121
CALM									0.067846
TOTAL	0.146052	0.130512	0.072142	0.026532	0.010992	0.002527	0.000379	0.000000	0.456980

MEAN WIND SPEED (m/s) = 2.11
NUMBER OF OBSERVATIONS = 3617

PASQUILL STABILITY CLASS 'E'

Wind Speed Class (m/s)

WIND SECTOR	0.50 TO 1.50	1.50 TO 3.00	3.00 TO 4.50	4.50 TO 6.00	6.00 TO 7.50	7.50 TO 9.00	9.00 TO 10.50	GREATER THAN 10.50	TOTAL
NNE	0.005938	0.002527	0.000758	0.000126	0.000000	0.000000	0.000000	0.000000	0.009349
NE	0.004548	0.006696	0.000884	0.000000	0.000000	0.000000	0.000000	0.000000	0.012129
ENE	0.007707	0.007202	0.000379	0.000000	0.000000	0.000000	0.000000	0.000000	0.015287
E	0.013013	0.013140	0.001263	0.000000	0.000000	0.000000	0.000000	0.000000	0.027416
ESE	0.014656	0.004675	0.000379	0.000000	0.000000	0.000000	0.000000	0.000000	0.019709
SE	0.018067	0.001137	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.019204
SSE	0.010865	0.001769	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.012634
S	0.007202	0.000505	0.000126	0.000000	0.000000	0.000000	0.000000	0.000000	0.007833
SSW	0.005306	0.003664	0.001390	0.000000	0.000000	0.000000	0.000000	0.000000	0.010360
SW	0.004043	0.004927	0.003285	0.000758	0.000000	0.000000	0.000000	0.000000	0.013013
WSW	0.002780	0.005559	0.006822	0.001516	0.000000	0.000000	0.000000	0.000000	0.016677
W	0.002148	0.003159	0.003538	0.000379	0.000000	0.000000	0.000000	0.000000	0.009223
WNW	0.002401	0.003538	0.001137	0.000379	0.000000	0.000000	0.000000	0.000000	0.007454
NW	0.001011	0.001137	0.001137	0.000000	0.000000	0.000000	0.000000	0.000000	0.003285
NNW	0.002274	0.001011	0.000632	0.000000	0.000000	0.000000	0.000000	0.000000	0.003917
N	0.004043	0.001642	0.001769	0.000126	0.000000	0.000000	0.000000	0.000000	0.007581
CALM									0.030196
TOTAL	0.106001	0.062287	0.023500	0.003285	0.000000	0.000000	0.000000	0.000000	0.225268

MEAN WIND SPEED (m/s) = 1.55
NUMBER OF OBSERVATIONS = 1783

PASQUILL STABILITY CLASS 'F'

Wind Speed Class (m/s)

WIND SECTOR	0.50 TO 1.50	1.50 TO 3.00	3.00 TO 4.50	4.50 TO 6.00	6.00 TO 7.50	7.50 TO 9.00	9.00 TO 10.50	GREATER THAN 10.50	TOTAL
NNE	0.005685	0.003285	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.008970
NE	0.005054	0.004422	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.009476
ENE	0.005685	0.005054	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.010739
E	0.005559	0.012382	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.017941
ESE	0.007075	0.007454	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.014529
SE	0.010992	0.001769	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.012761
SSE	0.007202	0.000126	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.007328
S	0.004422	0.002274	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.006696
SSW	0.003917	0.006317	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.010234
SW	0.002780	0.005306	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.008086
WSW	0.001516	0.005054	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.006570
W	0.001263	0.002274	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.003538
WNW	0.001390	0.001895	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.003285
NW	0.000379	0.001390	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.001769
NNW	0.001769	0.001263	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.003032
N	0.004801	0.002401	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.007202
CALM									0.043714
TOTAL	0.069488	0.062666	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.175869

MEAN WIND SPEED (m/s) = 1.26
NUMBER OF OBSERVATIONS = 1392

FREQUENCY OF OCCURENCE OF STABILITY CLASSES

A : 2.4%
B : 4.1%
C : 7.7%
D : 45.7%
E : 22.5%
F : 17.6%

STABILITY CLASS BY HOUR OF DAY

Hour	A	B	C	D	E	F
01	0000	0000	0000	0102	0125	0102
02	0000	0000	0000	0094	0134	0102
03	0000	0000	0000	0105	0129	0096
04	0000	0000	0000	0097	0125	0108
05	0000	0000	0000	0098	0136	0096
06	0003	0001	0003	0110	0124	0089
07	0019	0017	0042	0142	0062	0048
08	0037	0018	0047	0191	0024	0013
09	0022	0014	0044	0250	0000	0000
10	0006	0018	0056	0250	0000	0000
11	0003	0017	0059	0251	0000	0000
12	0007	0025	0068	0230	0000	0000
13	0009	0042	0074	0205	0000	0000
14	0015	0050	0069	0196	0000	0000
15	0020	0049	0073	0188	0000	0000
16	0025	0046	0063	0190	0006	0000
17	0023	0022	0011	0195	0060	0019
18	0003	0002	0001	0154	0109	0061
19	0000	0000	0000	0109	0108	0113
20	0000	0000	0000	0102	0117	0111
21	0000	0000	0000	0090	0120	0119
22	0000	0000	0000	0082	0136	0111
23	0000	0000	0000	0090	0132	0107
24	0000	0000	0000	0096	0136	0097

STABILITY CLASS BY MIXING HEIGHT

Mixing height	A	B	C	D	E	F
<=500 m	0056	0035	0070	1123	1667	1309
<=1000 m	0039	0047	0248	1404	0033	0008
<=1500 m	0097	0239	0292	1011	0083	0075
<=2000 m	0000	0000	0000	0054	0000	0000
<=3000 m	0000	0000	0000	0024	0000	0000
>3000 m	0000	0000	0000	0001	0000	0000

MIXING HEIGHT BY HOUR OF DAY

Hour	0000 to 0100	0100 to 0200	0200 to 0400	0400 to 0800	0800 to 1600	1600 to 3200	Greater than 3200
01	0114	0121	0038	0036	0016	0004	0000
02	0118	0124	0046	0028	0012	0002	0000
03	0120	0112	0047	0039	0008	0004	0000
04	0135	0113	0045	0027	0006	0004	0000
05	0134	0114	0043	0026	0009	0004	0000
06	0120	0111	0070	0020	0003	0006	0000
07	0098	0072	0115	0041	0003	0001	0000
08	0000	0069	0125	0136	0000	0000	0000
09	0000	0000	0099	0183	0048	0000	0000
10	0000	0000	0000	0235	0095	0000	0000
11	0000	0000	0000	0135	0195	0000	0000
12	0000	0000	0000	0083	0247	0000	0000
13	0000	0000	0000	0005	0325	0000	0000
14	0000	0000	0000	0000	0330	0000	0000
15	0000	0000	0000	0000	0330	0000	0000
16	0000	0000	0000	0000	0330	0000	0000
17	0000	0003	0003	0004	0317	0003	0000
18	0009	0053	0025	0012	0216	0015	0000

19	0044	0110	0037	0028	0100	0011	0000
20	0085	0121	0049	0029	0038	0008	0000
21	0105	0123	0039	0035	0026	0001	0000
22	0105	0137	0036	0031	0018	0002	0000
23	0104	0130	0043	0029	0022	0001	0000
24	0104	0132	0038	0029	0023	0003	0000

APPENDIX B
ESTIMATING DUST EMISSIONS

The dust emissions from the mine have been estimated from the operational description of the proposed mining activities provided by Iluka using emission factor equations that relate the quantity of dust liberated from particular activities to the intensity of the activity and the properties of the material being handled and/or the prevailing meteorological conditions. Estimated emissions are presented for all significant dust generating activities associated with the operations. The relevant emission factors used for the study are described below.

Stripping topsoil
This is done using a scoop and it has been assumed that the scoop generates 1.5 times the dust that a grader does undertaking a similar operation at 8 km/h.

Estimated TSP emissions from grading roads have been made using the US EPA (1985 and updates) emission factor equation (Equation 1).

Equation 1

$$E_{TSP} = 0.0034 \times S^{2.5} \qquad \text{kg/VKT}$$

where,
S = speed of the grader in km/h (taken to be 8 km/h)
VKT = Vehicle kilometres travelled

Loading coal and overburden
Each tonne of material loaded will generate a quantity of TSP that will depend on the wind speed and the moisture content. Equation 2 shows the relationship between these variables.

Equation 2

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

where,
E_{TSP} = *TSP emissions*
$k = 0.74$
U = *wind speed (m/s)*
M = *moisture content (%)*
[where $0.25 \le M \le 4.8$]

Hauling ore and overburden on unsealed surfaces
The uncontrolled emission factor for vehicles travelling on unsealed road is estimated to be 4 kg/VKT (SPCC, 1983). Buonicore and Davis (1992) (refer Page 144) show the level of control that can be achieved through the application of water and or chemical stabilisers (such as DustMag™). Controls of up to 95% can be achieved provided the moisture content of the surface material is maintained at 9%. For the current assessment a control of 90% has been assumed which will require moisture levels of approximately 7%. Proprietary chemical stabilisers will be used on some sections of haul roads as required.

Dozers on overburden
Emissions from dozers on overburden have been calculated using the US EPA emission factor equation (US EPA, 1985 and updates). The equation is as follows:

Equation 3

$$\mathrm{E_{TSP}} = 2.6 \times \frac{s^{1.2}}{M^{1.3}} \qquad \text{kg/hour}$$

where,

$\mathrm{E_{TSP}} = \mathit{TSP\ emissions}$

s = silt content (%), and

M = moisture (%)

Wind erosion
The emission factor for wind erosion is given in Equation 4 below.

Equation 4

$$\mathrm{E_{TSP}} = 1.9 \times \left(\frac{s}{1.5}\right) \times \left(\frac{365 - p}{235}\right) \times \left(\frac{f}{15}\right) \qquad \text{kg/ha/day}$$

where,
s = silt content (%)
p = number of raindays per year, and
f = percentage of the time that wind speed is above 5.4 m/s

Grading roads
Estimated TSP emissions from grading roads have been made using the US EPA (1985 and updates) emission factor equation (Equation 5).

Equation 5

$$\mathrm{E_{TSP}} = 0.0034 \times S^{2.5} \qquad \text{kg/VKT}$$

where,
S = speed of the grader in km/h (taken to be 8 km/h)

Using these equations emissions have been estimated for the main dust generating activity associated with mining. The tables below summarise the estimates.

The apportionment of the emissions to particular locations on the ground is shown in **Figures 6** and **7**, which should be examined in reference to the tabulated data below the tables.

ESTIMATED EMISSIONS: MOOLARBEN

Year 2

ACTIVITY	TSP emission/year	Intensity	units	Emission factor	units	Var 1	units	Var 2	units	Var 3	units
OB - Stripping topsoil - Pit 1	4,471	319	h/y	14.0	kg/h						
OB - Stripping topsoil - Pit 2	-	-	h/y	14.0	kg/h						
OB - Stripping topsoil - Pit 3_1	-	-	h/y	14.0	kg/h						
OB - Stripping topsoil - Pit 3_2	-	-	h/y	14.0	kg/h						
OB - Drilling - Pit 1	8,321	14,104	holes/y	0.59	kg/hole						
OB - Drilling - Pit 2	-	-	holes/y	0.59	kg/hole						
OB - Drilling - Pit 3_1	-	-	holes/y	0.59	kg/hole						
OB - Drilling - Pit 3_2	-	-	holes/y	0.59	kg/hole						
OB - Blasting - Pit 1	2,524	70	blasts/y	36	kg/blast	3000	Area of blast in square metres				
OB - Blasting - Pit 2	-	-	blasts/y	36	kg/blast	3000	Area of blast in square metres				
OB - Blasting - Pit 3_1	-	-	blasts/y	36	kg/blast	3000	Area of blast in square metres				
OB - Blasting - Pit 3_2	-	-	blasts/y	36	kg/blast	3000	Area of blast in square metres				
OB - Sh/Ex/FELs loading - Pit 1	62,112	22,228,487	t/y	0.00279	kg/t	2.36	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %		
OB - Sh/Ex/FELs loading - Pit 2	-	-	t/y	0.00279	kg/t	2.36	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %		
OB - Sh/Ex/FELs loading - Pit 3_1	-	-	t/y	0.00279	kg/t	2.36	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %		
OB - Sh/Ex/FELs loading - Pit 3_2	-	-	t/y	0.00279	kg/t	2.36	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %		
OB - Hauling to emplacement - from Pit 1	370,475	22,228,487	t/y	0.01667	kg/t	240	t/truck load	4	km/return trip	1.0	kg/VKT
OB - Hauling to emplacement - from Pit 2	-	-	t/y	0.01667	kg/t	240	t/truck load	4	km/return trip	1.0	kg/VKT
OB - Hauling to emplacement - from Pit 3_1	-	-	t/y	0.01667	kg/t	240	t/truck load	4	km/return trip	1.0	kg/VKT
OB - Hauling to emplacement - from Pit 3_2	-	-	t/y	0.01667	kg/t	240	t/truck load	4	km/return trip	1.0	kg/VKT
OB - Emplacing at dumps - Pit 1	62,112	22,228,4	t/y	0.00279	kg/t	2.36	average of (wind	2	moisture content		

ACTIVITY	TSP emission/year	Intensity	units	Emission factor	units	Var 1	units	Var 2	units	Var 3	units
		87					speed/2.2)^1.3 in m/s		in %		
OB - Emplacing at dumps - Pit 2	-	-	t/y	0.00279	kg/t	2.36	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %		
OB - Emplacing at dumps - Pit 3_1	-	-	t/y	0.00279	kg/t	2.36	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %		
OB - Emplacing at dumps - Pit 3_2	-	-	t/y	0.00279	kg/t	2.36	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %		
OB - Dozers on O/B - Pit 1	335,803	20,066	h/y	16.7	kg/h	10	silt content in %	2	moisture content in %		
OB - Dozers on O/B - Pit 2	-	-	h/y	16.7	kg/h	10	silt content in %	2	moisture content in %		
OB - Dozers on O/B - Pit 3_1	-	-	h/y	16.7	kg/h	10	silt content in %	2	moisture content in %		
OB - Dozers on O/B - Pit 3_2	-	-	h/y	16.7	kg/h	10	silt content in %	2	moisture content in %		
CL - Drilling - Pit 1	3,263	5,531	holes/y	0.59	kg/hole						
CL - Drilling - Pit 2	-	-	holes/y	0.59	kg/hole						
CL - Drilling - Pit 3_1	-	-	holes/y	0.59	kg/hole						
CL - Drilling - Pit 3_2	-	-	holes/y	0.59	kg/hole						
CL - Blasting - Pit 1	1,113	35	blasts/y	36	kg/blast	3000	Area of blast in square metres				
CL - Blasting - Pit 2	-	-	blasts/y	36	kg/blast	3000	Area of blast in square metres				
CL - Blasting - Pit 3_1	-	-	blasts/y	36	kg/blast	3000	Area of blast in square metres				
CL - Blasting - Pit 3_2	-	-	blasts/y	36	kg/blast	3000	Area of blast in square metres				
CL - Dozers ripping - Pit 1	-	-	h/y	20.0	kg/h	5	silt content in %	6	moisture content in %		
CL - Dozers ripping - Pit 2	-	-	h/y	20.0	kg/h	5	silt content in %	6	moisture content in %		
CL - Dozers ripping - Pit 3_1	-	-	h/y	20.0	kg/h	5	silt content in %	6	moisture content in %		
CL - Dozers ripping - Pit 3_2	-	-	h/y	20.0	kg/h	5	silt content in %	6	moisture content in %		
CL - Loading ROM to trucks - Pit 1	472,873	7,000,000	t/y	0.06755	kg/t	6	moisture content of coal in %				
CL - Loading ROM to trucks - Pit 2	-	-	t/y	0.06755	kg/t	6	moisture content of coal in %				
CL - Loading ROM to trucks - Pit	-	-	t/y	0.06755	kg/t	6	moisture content of coal in %				

ACTIVITY	TSP emission/year	Intensity	units	Emission factor	units	Var 1	units	Var 2	units	Var 3	units
3_1											
CL - Loading ROM to trucks - Pit 3_2	-	-	t/y	0.06755	kg/t	6	moisture content of coal in %				
CL - Hauling ROM coal to dump hopper - Pit 1	288,235	7,000,000	t/y	0.04118	kg/t	170	t/load	7	km/return trip	1.0	kg/VKT
CL - Hauling ROM coal to dump hopper - Pit 2	-	-	t/y	0.04118	kg/t	170	t/load	7	km/return trip	1.0	kg/VKT
CL - Hauling ROM coal to dump hopper - Pit 3_1	-	-	t/y	0.04118	kg/t	170	t/load	7	km/return trip	1.0	kg/VKT
CL - Hauling ROM coal to dump hopper - Pit 3_2	-	-	t/y	0.04118	kg/t	170	t/load	7	km/return trip	1.0	kg/VKT
CL - unloading ROM coal at pile/hopper - All pits	70,000	7,000,000	t/y	0.01	kg/t						
CL - ROM rehandle pile to hopper (FEL)	7,000	700,000	t/y	0.01	kg/t						
CL - Handling coal at CHPP	21,007	7,000,000	t/y	0.00300	kg/t	2.36	average of (wind speed/2.2)^1.3 in m/s	6	moisture content of coal in %		
CL - Dozer/FEL pushing ROM coal	76,400	3,822	h/y	20.0	kg/h	5	silt content in %	6	moisture content in %		
CL - Dozers pushing product coal	28,590	3,822	h/y	7.5	kg/h	4	silt content in %	10	moisture content in %		
CL - Loading rejects	-	875,000	t/y								
CL - Transporting rejects	51,852	875,000	t/y	0.05926	kg/t	135	t/load	8	km/return trip	1.0	kg/VKT
CL - Unloading rejects	-	875,000	t/y								
CL - Loading product coal stockpile	1,798	6,125,000	t/y	0.00029	kg/t	2.36	average of (wind speed/2.2)^1.3 in m/s	10	moisture content of coal in %		
WE - OB spoil area - Pit 1	316,800	47	ha	6785.5	kg/ha/y	72.5	Average number of raindays	10	silt content in %	17.6873	% of winds above 5.4 m/s
WE - OB spoil area - Pit 2	-	-	ha	6785.5	kg/ha/y	72.5	Average number of raindays	10	silt content in %	17.6873	% of winds above 5.4 m/s
WE - OB spoil area - Pit 3_1	-	-	ha	6785.5	kg/ha/y	72.5	Average number of raindays	10	silt content in %	17.6873	% of winds above 5.4 m/s
WE - OB spoil area - Pit 3_2	-	-	ha	6785.5	kg/ha/y	72.5	Average number of raindays	10	silt content in %	17.6873	% of winds above 5.4 m/s
WE - Open pit - Pit 1	370,331	54.58	ha	6785.5	kg/ha/y	72.5	Average number	10	silt content in %	17.6873	% of winds

ACTIVITY	TSP emission/year	Intensity	units	Emission factor	units	Var 1	units	Var 2	units	Var 3	units
							of raindays				above 5.4 m/s
WE - Open pit - Pit 2	-	-	ha	6785.5	kg/ha/y	72.5	Average number of raindays	10	silt content in %	17.6873	% of winds above 5.4 m/s
WE - Open pit - Pit 3_1	-	-	ha	6785.5	kg/ha/y	72.5	Average number of raindays	10	silt content in %	17.6873	% of winds above 5.4 m/s
WE - Open pit - Pit 3_2	-	-	ha	6785.5	kg/ha/y	72.5	Average number of raindays	10	silt content in %	17.6873	% of winds above 5.4 m/s
WE - ROM stockpiles	10,178	3.00	ha	3392.8	kg/ha/y	72.5	Average number of raindays	5	silt content in %	17.6873	% of winds above 5.4 m/s
WE - Product stockpiles	8,143	3.00	ha	2714.2	kg/ha/y	72.5	Average number of raindays	4	silt content in %	17.6873	% of winds above 5.4 m/s
Loading coal to trains	1,573	5,359,375	t/y	0.00029	kg/t	2.36	average of (wind speed/2.2)^1.3 in m/s	10	moisture content of coal in %		
Grading roads	36,928	60,000	km	0.61547	kg/VKT	8	speed of graders in km/h				
Total	2,611,901										
TSP/ROM coal ratio (kg of TSP/t of ROM coal)	0.33										

Year 5

ACTIVITY	TSP emission/year	Intensity	units	Emission factor	units	Var 1	units	Var 2	units	Var 3	units
OB - Stripping topsoil - Pit 1	5,110	365	h/y	14.0	kg/h						
OB - Stripping topsoil - Pit 2	-	-	h/y	14.0	kg/h						
OB - Stripping topsoil - Pit 3_1	-	-	h/y	14.0	kg/h						
OB - Stripping topsoil - Pit 3_2	-	-	h/y	14.0	kg/h						
OB - Drilling - Pit 1	12,427	21,063	holes/y	0.59	kg/hole						
OB - Drilling - Pit 2	-	-	holes/y	0.59	kg/hole						
OB - Drilling - Pit 3_1	-	-	holes/y	0.59	kg/hole						
OB - Drilling - Pit 3_2	-	-	holes/y	0.59	kg/hole						
OB - Blasting - Pit 1	4,026	92	blasts/y	44	kg/blast	3400	Area of blast in square metres				
OB - Blasting - Pit 2	-	-	blasts/y	44	kg/blast	3400	Area of blast in square metres				
OB - Blasting - Pit 3_1	-	-	blasts/y	44	kg/blast	3400	Area of blast in square metres				
OB - Blasting - Pit 3_2	-	-	blasts/y	44	kg/blast	3400	Area of blast in square metres				
OB - Sh/Ex/FELs loading - Pit 1	119,180	42,651,92 6	t/y	0.00279	kg/t	2.36	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %		
OB - Sh/Ex/FELs loading - Pit 2	-	-	t/y	0.00279	kg/t	2.36	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %		
OB - Sh/Ex/FELs loading - Pit 3_1	-	-	t/y	0.00279	kg/t	2.36	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %		
OB - Sh/Ex/FELs loading - Pit 3_2	-	-	t/y	0.00279	kg/t	2.36	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %		
OB - Hauling to emplacement - from Pit 1	710,865	42,651,92 6	t/y	0.01667	kg/t	240	t/truck load	4	km/return trip	1.0	kg/VKT
OB - Hauling to emplacement - from Pit 2	-	-	t/y	0.01667	kg/t	240	t/truck load	4	km/return trip	1.0	kg/VKT
OB - Hauling to emplacement - from Pit 3_1	-	-	t/y	0.01667	kg/t	240	t/truck load	4	km/return trip	1.0	kg/VKT
OB - Hauling to emplacement - from Pit 3_2	-	-	t/y	0.01667	kg/t	240	t/truck load	4	km/return trip	1.0	kg/VKT
OB - Emplacing at dumps - Pit 1	119,180	42,651,92 6	t/y	0.00279	kg/t	2.36	average of (wind speed/2.2)^1.3 in	2	moisture content in %		

ACTIVITY	TSP emission/year	Intensity	units	Emission factor	units	Var 1	units	Var 2	units	Var 3	units
							m/s				
OB - Emplacing at dumps - Pit 2	-	-	t/y	0.00279	kg/t	2.36	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %		
OB - Emplacing at dumps - Pit 3_1	-	-	t/y	0.00279	kg/t	2.36	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %		
OB - Emplacing at dumps - Pit 3_2	-	-	t/y	0.00279	kg/t	2.36	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %		
OB - Dozers on O/B - Pit 1	383,775	22,932	h/y	16.7	kg/h	10	silt content in %	2	moisture content in %		
OB - Dozers on O/B - Pit 2	-	-	h/y	16.7	kg/h	10	silt content in %	2	moisture content in %		
OB - Dozers on O/B - Pit 3_1	-	-	h/y	16.7	kg/h	10	silt content in %	2	moisture content in %		
OB - Dozers on O/B - Pit 3_2	-	-	h/y	16.7	kg/h	10	silt content in %	2	moisture content in %		
CL - Drilling - Pit 1	3,729	6,321	holes/y	0.59	kg/hole						
CL - Drilling - Pit 2	-	-	holes/y	0.59	kg/hole						
CL - Drilling - Pit 3_1	-	-	holes/y	0.59	kg/hole						
CL - Drilling - Pit 3_2	-	-	holes/y	0.59	kg/hole						
CL - Blasting - Pit 1	1,208	28	blasts/y	44	kg/blast	3400	Area of blast in square metres				
CL - Blasting - Pit 2	-	-	blasts/y	44	kg/blast	3400	Area of blast in square metres				
CL - Blasting - Pit 3_1	-	-	blasts/y	44	kg/blast	3400	Area of blast in square metres				
CL - Blasting - Pit 3_2	-	-	blasts/y	44	kg/blast	3400	Area of blast in square metres				
CL - Dozers ripping - Pit 1	305,600	15,288	h/y	20.0	kg/h	5	silt content in %	6	moisture content in %		
CL - Dozers ripping - Pit 2	-	-	h/y	20.0	kg/h	5	silt content in %	6	moisture content in %		
CL - Dozers ripping - Pit 3_1	-	-	h/y	20.0	kg/h	5	silt content in %	6	moisture content in %		
CL - Dozers ripping - Pit 3_2	-	-	h/y	20.0	kg/h	5	silt content in %	6	moisture content in %		
CL - Loading ROM to trucks - Pit 1	540,426	8,000,000	t/y	0.06755	kg/t	6	moisture content of coal in %				
CL - Loading ROM to trucks - Pit 2	-	-	t/y	0.06755	kg/t	6	moisture content of coal in %				
CL - Loading ROM to trucks - Pit 3_1	-	-	t/y	0.06755	kg/t	6	moisture content of coal in %				

ACTIVITY	TSP emission/year	Intensity	units	Emission factor	units	Var 1	units	Var 2	units	Var 3	units
CL - Loading ROM to trucks - Pit 3_2	-	-	t/y	0.06755	kg/t	6	moisture content of coal in %				
CL - Hauling ROM coal to dump hopper - Pit 1	329,412	8,000,000	t/y	0.04118	kg/t	170	t/load	7	km/return trip	1.0	kg/VKT
CL - Hauling ROM coal to dump hopper - Pit 2	-	-	t/y	0.04118	kg/t	170	t/load	7	km/return trip	1.0	kg/VKT
CL - Hauling ROM coal to dump hopper - Pit 3_1	-	-	t/y	0.04118	kg/t	170	t/load	7	km/return trip	1.0	kg/VKT
CL - Hauling ROM coal to dump hopper - Pit 3_2	-	-	t/y	0.04118	kg/t	170	t/load	7	km/return trip	1.0	kg/VKT
CL - unloading ROM coal at pile/hopper - All pits	80,000	8,000,000	t/y	0.01	kg/t						
CL - ROM rehandle pile to hopper (FEL)	8,000	800,000	t/y	0.01	kg/t						
CL - Handling coal at CHPP	24,008	8,000,000	t/y	0.00300	kg/t	2.36	average of (wind speed/2.2)^1.3 in m/s	6	moisture content of coal in %		
CL - Dozer/FEL pushing ROM coal	76,400	3,822	h/y	20.0	kg/h	5	silt content in %	6	moisture content in %		
CL - Dozers pushing product coal	28,590	3,822	h/y	7.5	kg/h	4	silt content in %	10	moisture content in %		
CL - Loading rejects	-	1,000,000	t/y								
CL - Transporting rejects	59,259	1,000,000	t/y	0.05926	kg/t	135	t/load	8	km/return trip	1.0	kg/VKT
CL - Unloading rejects	-	1,000,000	t/y								
CL - Loading product coal stockpile	2,055	7,000,000	t/y	0.00029	kg/t	2.36	average of (wind speed/2.2)^1.3 in m/s	10	moisture content of coal in %		
WE - OB spoil area - Pit 1	336,082	49.53	ha	6785.5	kg/ha/y	72.5	Average number of raindays	10	silt content in %	17.6873	% of winds above 5.4 m/s
WE - OB spoil area - Pit 2	-	-	ha	6785.5	kg/ha/y	72.5	Average number of raindays	10	silt content in %	17.6873	% of winds above 5.4 m/s
WE - OB spoil area - Pit 3_1	-	-	ha	6785.5	kg/ha/y	72.5	Average number of raindays	10	silt content in %	17.6873	% of winds above 5.4 m/s
WE - OB spoil area - Pit 3_2	-	-	ha	6785.5	kg/ha/y	72.5	Average number of raindays	10	silt content in %	17.6873	% of winds above 5.4 m/s
WE - Open pit - Pit 1	579,729	85.44	ha	6785.5	kg/ha/y	72.5	Average number of raindays	10	silt content in %	17.6873	% of winds above 5.4 m/s

ACTIVITY	TSP emission/year	Intensity	units	Emission factor	units	Var 1	units	Var 2	units	Var 3	units
WE - Open pit - Pit 2	-	-	ha	6785.5	kg/ha/y	72.5	Average number of raindays	10	silt content in %	17.6873	% of winds above 5.4 m/s
WE - Open pit - Pit 3_1	-	-	ha	6785.5	kg/ha/y	72.5	Average number of raindays	10	silt content in %	17.6873	% of winds above 5.4 m/s
WE - Open pit - Pit 3_2	-	-	ha	6785.5	kg/ha/y	72.5	Average number of raindays	10	silt content in %	17.6873	% of winds above 5.4 m/s
WE - ROM stockpiles	10,178	3.00	ha	3392.8	kg/ha/y	72.5	Average number of raindays	5	silt content in %	17.6873	% of winds above 5.4 m/s
WE - Product stockpiles	8,143	3.00	ha	2714.2	kg/ha/y	72.5	Average number of raindays	4	silt content in %	17.6873	% of winds above 5.4 m/s
Loading coal to trains	2,055	7,000,000	t/y	0.00029	kg/t	2.36	average of (wind speed/2.2)^1.3 in m/s	10	moisture content of coal in %		
Grading roads	36,928	60,000	km	0.61547	kg/VKT	8	speed of graders in km/h				
Total	3,786,364										
TSP/ROM coal ratio (kg of TSP/t of ROM coal)	0.47										

Year 8

ACTIVITY	TSP emission/year	Intensity	units	Emission factor	units	Var 1	units	Var 2	units	Var 3	units
OB - Stripping topsoil - Pit 1	-	-	h/y	14.0	kg/h						
OB - Stripping topsoil - Pit 2	4,804	343	h/y	14.0	kg/h						
OB - Stripping topsoil - Pit 3_1	306	22	h/y	14.0	kg/h						
OB - Stripping topsoil - Pit 3_2	-	-	h/y	14.0	kg/h						
OB - Drilling - Pit 1	-	-	holes/y	0.59	kg/hole						
OB - Drilling - Pit 2	6,664	11,295	holes/y	0.59	kg/hole						
OB - Drilling - Pit 3_1	424	719	holes/y	0.59	kg/hole						
OB - Drilling - Pit 3_2	-	-	holes/y	0.59	kg/hole						
OB - Blasting - Pit 1	-	-	blasts/y	82	kg/blast	5200	Area of blast in square metres				
OB - Blasting - Pit 2	6,099	74	blasts/y	82	kg/blast	5200	Area of blast in square metres				
OB - Blasting - Pit 3_1	388	5	blasts/y	82	kg/blast	5200	Area of blast in square metres				
OB - Blasting - Pit 3_2	-	-	blasts/y	82	kg/blast	5200	Area of blast in square metres				
OB - Sh/Ex/FELs loading - Pit 1	-	-	t/y	0.00279	kg/t	2.36	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %		
OB - Sh/Ex/FELs loading - Pit 2	64	22,872	t/y	0.00279	kg/t	2.36	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %		
OB - Sh/Ex/FELs loading - Pit 3_1	4,066	1,454,976	t/y	0.00279	kg/t	2.36	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %		
OB - Sh/Ex/FELs loading - Pit 3_2	-	-	t/y	0.00279	kg/t	2.36	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %		
OB - Hauling to emplacement - from Pit 1	-	-	t/y	0.01667	kg/t	240	t/truck load	4	km/return trip	1.0	kg/VKT
OB - Hauling to emplacement - from Pit 2	381	22,872	t/y	0.01667	kg/t	240	t/truck load	4	km/return trip	1.0	kg/VKT
OB - Hauling to emplacement - from Pit 3_1	24,250	1,454,976	t/y	0.01667	kg/t	240	t/truck load	4	km/return trip	1.0	kg/VKT
OB - Hauling to emplacement - from Pit 3_2	-	-	t/y	0.01667	kg/t	240	t/truck load	4	km/return trip	1.0	kg/VKT
OB - Emplacing at dumps - Pit 1	-	-	t/y	0.00279	kg/t	2.36	average of (wind speed/2.2)^1.3 in	2	moisture content in %		

ACTIVITY	TSP emission/year	Intensity	units	Emission factor	units	Var 1	units	Var 2	units	Var 3	units
							m/s				
OB - Emplacing at dumps - Pit 2	64	22,872	t/y	0.00279	kg/t	2.36	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %		
OB - Emplacing at dumps - Pit 3_1	4,066	1,454,976	t/y	0.00279	kg/t	2.36	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %		
OB - Emplacing at dumps - Pit 3_2	-	-	t/y	0.00279	kg/t	2.36	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %		
OB - Dozers on O/B - Pit 1	-	-	h/y	16.7	kg/h	10	silt content in %	2	moisture content in %		
OB - Dozers on O/B - Pit 2	360,822	21,561	h/y	16.7	kg/h	10	silt content in %	2	moisture content in %		
OB - Dozers on O/B - Pit 3_1	22,952	1,371	h/y	16.7	kg/h	10	silt content in %	2	moisture content in %		
OB - Dozers on O/B - Pit 3_2	-	-	h/y	16.7	kg/h	10	silt content in %	2	moisture content in %		
CL - Drilling - Pit 1	-	-	holes/y	0.59	kg/hole						
CL - Drilling - Pit 2	3,506	5,943	holes/y	0.59	kg/hole						
CL - Drilling - Pit 3_1	223	378	holes/y	0.59	kg/hole						
CL - Drilling - Pit 3_2	-	-	holes/y	0.59	kg/hole						
CL - Blasting - Pit 1	-	-	blasts/y	82	kg/blast	5200	Area of blast in square metres				
CL - Blasting - Pit 2	3,209	39	blasts/y	82	kg/blast	5200	Area of blast in square metres				
CL - Blasting - Pit 3_1	204	2	blasts/y	82	kg/blast	5200	Area of blast in square metres				
CL - Blasting - Pit 3_2	-	-	blasts/y	82	kg/blast	5200	Area of blast in square metres				
CL - Dozers ripping - Pit 1	-	-	h/y	20.0	kg/h	5	silt content in %	6	moisture content in %		
CL - Dozers ripping - Pit 2	287,323	14,374	h/y	20.0	kg/h	5	silt content in %	6	moisture content in %		
CL - Dozers ripping - Pit 3_1	18,277	914	h/y	20.0	kg/h	5	silt content in %	6	moisture content in %		
CL - Dozers ripping - Pit 3_2	-	-	h/y	20.0	kg/h	5	silt content in %	6	moisture content in %		
CL - Loading ROM to trucks - Pit 1	-	-	t/y	0.06755	kg/t	6	moisture content of coal in %				
CL - Loading ROM to trucks - Pit 2	508,105	7,521,546	t/y	0.06755	kg/t	6	moisture content of coal in %				
CL - Loading ROM to trucks - Pit 3_1	32,321	478,454	t/y	0.06755	kg/t	6	moisture content of coal in %				

ACTIVITY	TSP emission/year	Intensity	units	Emission factor	units	Var 1	units	Var 2	units	Var 3	units
CL - Loading ROM to trucks - Pit 3_2	-	-	t/y	0.06755	kg/t	6	moisture content of coal in %				
CL - Hauling ROM coal to dump hopper - Pit 1	-	-	t/y	0.04118	kg/t	170	t/load	7	km/return trip	1.0	kg/VKT
CL - Hauling ROM coal to dump hopper - Pit 2	309,711	7,521,546	t/y	0.04118	kg/t	170	t/load	7	km/return trip	1.0	kg/VKT
CL - Hauling ROM coal to dump hopper - Pit 3_1	19,701	478,454	t/y	0.04118	kg/t	170	t/load	7	km/return trip	1.0	kg/VKT
CL - Hauling ROM coal to dump hopper - Pit 3_2	-	-	t/y	0.04118	kg/t	170	t/load	7	km/return trip	1.0	kg/VKT
CL - unloading ROM coal at pile/hopper - All pits	80,000	8,000,000	t/y	0.01	kg/t						
CL - ROM rehandle pile to hopper (FEL)	8,000	800,000	t/y	0.01	kg/t						
CL - Handling coal at CHPP	24,008	8,000,000	t/y	0.00300	kg/t	2.36	average of (wind speed/2.2)^1.3 in m/s	6	moisture content of coal in %		
CL - Dozer/FEL pushing ROM coal	76,400	3,822	h/y	20.0	kg/h	5	silt content in %	6	moisture content in %		
CL - Dozers pushing product coal	28,590	3,822	h/y	7.5	kg/h	4	silt content in %	10	moisture content in %		
CL - Loading rejects	-	1,000,000	t/y								
CL - Transporting rejects	59,259	1,000,000	t/y	0.05926	kg/t	135	t/load	8	km/return trip	1.0	kg/VKT
CL - Unloading rejects	-	1,000,000	t/y								
CL - Loading product coal stockpile	2,055	7,000,000	t/y	0.00029	kg/t	2.36	average of (wind speed/2.2)^1.3 in m/s	10	moisture content of coal in %		
WE - OB spoil area - Pit 1	179,621	26.47	ha	6785.5	kg/ha/y	72.5	Average number of raindays	10	silt content in %	17.6873	% of winds above 5.4 m/s
WE - OB spoil area - Pit 2	408,060	60.14	ha	6785.5	kg/ha/y	72.5	Average number of raindays	10	silt content in %	17.6873	% of winds above 5.4 m/s
WE - OB spoil area - Pit 3_1	-	-	ha	6785.5	kg/ha/y	72.5	Average number of raindays	10	silt content in %	17.6873	% of winds above 5.4 m/s
WE - OB spoil area - Pit 3_2	-	-	ha	6785.5	kg/ha/y	72.5	Average number of raindays	10	silt content in %	17.6873	% of winds above 5.4 m/s
WE - Open pit - Pit 1	-	-	ha	6785.5	kg/ha/y	72.5	Average number of raindays	10	silt content in %	17.6873	% of winds above 5.4 m/s

ACTIVITY	TSP emission/year	Intensity	units	Emission factor	units	Var 1	units	Var 2	units	Var 3	units
WE - Open pit - Pit 2	61,334	9.04	ha	6785.5	kg/ha/y	72.5	Average number of raindays	10	silt content in %	17.6873	% of winds above 5.4 m/s
WE - Open pit - Pit 3_1	465,302	68.57	ha	6785.5	kg/ha/y	72.5	Average number of raindays	10	silt content in %	17.6873	% of winds above 5.4 m/s
WE - Open pit - Pit 3_2	-	-	ha	6785.5	kg/ha/y	72.5	Average number of raindays	10	silt content in %	17.6873	% of winds above 5.4 m/s
WE - ROM stockpiles	10,178	3.00	ha	3392.8	kg/ha/y	72.5	Average number of raindays	5	silt content in %	17.6873	% of winds above 5.4 m/s
WE - Product stockpiles	8,143	3.00	ha	2714.2	kg/ha/y	72.5	Average number of raindays	4	silt content in %	17.6873	% of winds above 5.4 m/s
Loading coal to trains	2,055	7,000,000	t/y	0.00029	kg/t	2.36	average of (wind speed/2.2)^1.3 in m/s	10	moisture content of coal in %		
Grading roads	36,928	60,000	km	0.61547	kg/VKT	8	speed of graders in km/h				
Total	3,067,863										
TSP/ROM coal ratio (kg of TSP/t of ROM coal)	0.38										

Year 10

ACTIVITY	TSP emission/year	Intensity	units	Emission factor	units	Var 1	units	Var 2	units	Var 3	units
CL - Drilling - Pit 2	-	-	holes/y	0.59	kg/hole						
CL - Drilling - Pit 3_1	3,049	5,168	holes/y	0.59	kg/hole						
CL - Drilling - Pit 3_2	680	1,153	holes/y	0.59	kg/hole						
CL - Blasting - Pit 1	-	-	blasts/y	152	kg/blast	7800	Area of blast in square metres				
CL - Blasting - Pit 2	-	-	blasts/y	152	kg/blast	7800	Area of blast in square metres				
CL - Blasting - Pit 3_1	5,126	34	blasts/y	152	kg/blast	7800	Area of blast in square metres				
CL - Blasting - Pit 3_2	1,143	8	blasts/y	152	kg/blast	7800	Area of blast in square metres				
CL - Dozers ripping - Pit 1	-	-	h/y	20.0	kg/h	5	silt content in %	6	moisture content in %		
CL - Dozers ripping - Pit 2	-	-	h/y	20.0	kg/h	5	silt content in %		6	moisture content in %	
CL - Dozers ripping - Pit 3_1	249,868	12,500	h/y	20.0	kg/h	5	silt content in %		6	moisture content in %	
CL - Dozers ripping - Pit 3_2	55,731	2,788	h/y	20.0	kg/h	5	silt content in %		6	moisture content in %	
CL - Loading ROM to trucks - Pit 1	-	-	t/y	0.06755	kg/t	6	moisture content of coal in %				
CL - Loading ROM to trucks - Pit 2	-	-	t/y	0.06755	kg/t	6	moisture content of coal in %				
CL - Loading ROM to trucks - Pit 3_1	441,870	6,541,061	t/y	0.06755	kg/t	6	moisture content of coal in %				
CL - Loading ROM to trucks - Pit 3_2	98,556	1,458,939	t/y	0.06755	kg/t	6	moisture content of coal in %				
CL - Hauling ROM coal to dump hopper - Pit 1	-	-	t/y	0.32000	kg/t	50	t/load	16	km/return trip	1.0	kg/VKT
CL - Hauling ROM coal to dump hopper - Pit 2	-	-	t/y	0.32000	kg/t	50	t/load	16	km/return trip	1.0	kg/VKT
CL - Hauling ROM coal to dump hopper - Pit 3_1	2,093,139	6,541,061	t/y	0.32000	kg/t	50	t/load	16	km/return trip	1.0	kg/VKT
CL - Hauling ROM coal to dump hopper - Pit 3_2	466,861	1,458,939	t/y	0.32000	kg/t	50	t/load	16	km/return trip	1.0	kg/VKT

ACTIVITY	TSP emission/year	Intensity	units	Emission factor	units	Var 1	units	Var 2	units	Var 3	units
CL - unloading ROM coal at pile/hopper - All pits	80,000	8,000,000	t/y	0.01	kg/t						
CL - ROM rehandle pile to hopper (FEL)	8,000	800,000	t/y	0.01	kg/t						
CL - Handling coal at CHPP	24,008	8,000,000	t/y	0.00300	kg/t	2.36	average of (wind speed/2.2)^1.3 in m/s	6	moisture content of coal in %		
CL - Dozer/FEL pushing ROM coal	76,400	3,822	h/y	20.0	kg/h	5	silt content in %	6	moisture content in %		
CL - Dozers pushing product coal	28,590	3,822	h/y	7.5	kg/h	4	silt content in %	10	moisture content in %		
CL - Loading rejects	-	1,000,000	t/y								
CL - Transporting rejects	59,259	1,000,000	t/y	0.05926	kg/t	135	t/load	8	km/return trip	1.0	kg/VKT
CL - Unloading rejects	-	1,000,000	t/y								
CL - Loading product coal stockpile	2,055	7,000,000	t/y	0.00029	kg/t	2.36	average of (wind speed/2.2)^1.3 in m/s	10	moisture content of coal in %		
WE - OB spoil area - Pit 1	-	-	ha	6785.5	kg/ha/y	72.5	Average number of raindays	10	silt content in %	17.6873	% of winds above 5.4 m/s
WE - OB spoil area - Pit 2	-	-	ha	6785.5	kg/ha/y	72.5	Average number of raindays	10	silt content in %	17.6873	% of winds above 5.4 m/s
WE - OB spoil area - Pit 3_1	496,122	73.11	ha	6785.5	kg/ha/y	72.5	Average number of raindays	10	silt content in %	17.6873	% of winds above 5.4 m/s
WE - OB spoil area - Pit 3_2	105,809	15.59	ha	6785.5	kg/ha/y	72.5	Average number of raindays	10	silt content in %	17.6873	% of winds above 5.4 m/s
WE - Open pit - Pit 1	-	-	ha	6785.5	kg/ha/y	72.5	Average number of raindays		10	silt content in %	17.6873
WE - Open pit - Pit 2	-	-	ha	6785.5	kg/ha/y	72.5	Average number of raindays		10	silt content in %	17.6873
WE - Open pit - Pit 3_1	148,919	21.95	ha	6785.5	kg/ha/y	72.5	Average number of raindays		10	silt content in %	17.6873
WE - Open pit - Pit 3_2	122,766	18.09	ha	6785.5	kg/ha/y	72.5	Average number of raindays		10	silt content in %	17.6873

ACTIVITY	TSP emission/year	Intensity	units	Emission factor	units	Var 1	units	Var 2	units	Var 3	units
WE - ROM stockpiles	10,178	3.00	ha	3392.8	kg/ha/y	72.5	Average number of raindays	5	silt content in %	17.6873	% of winds above 5.4 m/s
WE - Product stockpiles	8,143	3.00	ha	2714.2	kg/ha/y	72.5	Average number of raindays	4	silt content in %	17.6873	% of winds above 5.4 m/s
Loading coal to trains	2,055	7,000,000	t/y	0.00029	kg/t	2.36	average of (wind speed/2.2)^1.3 in m/s	10	moisture content of coal in %		
Grading roads	36,928	60,000	km	0.61547	kg/VKT	8	speed of graders in km/h				
Total	5,692,758										
TSP/ROM coal ratio (kg of TSP/t of ROM coal)	0.71										
CL - Drilling - Pit 2	-	-	holes/y	0.59	kg/hole						
CL - Drilling - Pit 3_1	3,049	5,168	holes/y	0.59	kg/hole						
CL - Drilling - Pit 3_2	680	1,153	holes/y	0.59	kg/hole						
CL - Blasting - Pit 1	-	-	blasts/y	152	kg/blast	7800	Area of blast in square metres				
CL - Blasting - Pit 2	-	-	blasts/y	152	kg/blast	7800	Area of blast in square metres				
CL - Blasting - Pit 3_1	5,126	34	blasts/y	152	kg/blast	7800	Area of blast in square metres				
CL - Blasting - Pit 3_2	1,143	8	blasts/y	152	kg/blast	7800	Area of blast in square metres				
CL - Dozers ripping - Pit 1	-	-	h/y	20.0	kg/h	5	silt content in %	6	moisture content in %		
CL - Dozers ripping - Pit 2	-	-	h/y	20.0	kg/h	5	silt content in %	6	moisture content in %		
CL - Dozers ripping - Pit 3_1	249,868	12,500	h/y	20.0	kg/h	5	silt content in %	6	moisture content in %		
CL - Dozers ripping - Pit 3_2	55,731	2,788	h/y	20.0	kg/h	5	silt content in %	6	moisture content in %		
CL - Loading ROM to trucks - Pit 1	-	-	t/y	0.06755	kg/t	6	moisture content of coal in %				
CL - Loading ROM to trucks - Pit 2	-	-	t/y	0.06755	kg/t	6	moisture content of coal in %				
CL - Loading ROM to trucks - Pit 3_1	441,870	6,541,061	t/y	0.06755	kg/t	6	moisture content of coal in %				
CL - Loading ROM to trucks - Pit 3_2	98,556	1,458,939	t/y	0.06755	kg/t	6	moisture content of coal in %				

ACTIVITY	TSP emission/year	Intensity	units	Emission factor	units	Var 1	units	Var 2	units	Var 3	units
CL - Hauling ROM coal to dump hopper - Pit 1	-	-	t/y	0.32000	kg/t	50	t/load	16	km/return trip	1.0	kg/VKT
CL - Hauling ROM coal to dump hopper - Pit 2	-	-	t/y	0.32000	kg/t	50	t/load	16	km/return trip	1.0	kg/VKT
CL - Hauling ROM coal to dump hopper - Pit 3_1	2,093,139	6,541,061	t/y	0.32000	kg/t	50	t/load	16	km/return trip	1.0	kg/VKT
CL - Hauling ROM coal to dump hopper - Pit 3_2	466,861	1,458,939	t/y	0.32000	kg/t	50	t/load	16	km/return trip	1.0	kg/VKT
CL - unloading ROM coal at pile/hopper - All pits	80,000	8,000,000	t/y	0.01	kg/t						
CL - ROM rehandle pile to hopper (FEL)	8,000	800,000	t/y	0.01	kg/t						
CL - Handling coal at CHPP	24,008	8,000,000	t/y	0.00300	kg/t	2.36	average of (wind speed/2.2)^1.3 in m/s	6	moisture content of coal in %		
CL - Dozer/FEL pushing ROM coal	76,400	3,822	h/y	20.0	kg/h	5	silt content in %	6	moisture content in %		
CL - Dozers pushing product coal	28,590	3,822	h/y	7.5	kg/h	4	silt content in %	10	moisture content in %		
CL - Loading rejects	-	1,000,000	t/y								
CL - Transporting rejects	59,259	1,000,000	t/y	0.05926	kg/t	135	t/load	8	km/return trip		1.0
CL - Unloading rejects	-	1,000,000	t/y								
CL - Loading product coal stockpile	2,055	7,000,000	t/y	0.00029	kg/t	2.36	average of (wind speed/2.2)^1.3 in m/s	10	moisture content of coal in %		
WE - OB spoil area - Pit 1	-	-	ha	6785.5	kg/ha/y	72.5	Average number of raindays	10	silt content in %	17.6873	% of winds above 5.4 m/s

APPENDIX C:
EXAMPLE OF ISC INPUT FILE
(Note: to save space only a portion of the output is provided. The complete files can be provided on request.)

```
**  ISC model input runstream : Dust
CO STARTING
   TITLEONE ISC Dust Model Run - Case 2A (i.e. Year 2 at 7 Mtpa)
   MODELOPT RURAL CONC DDEP DRYDPLT
   AVERTIME 24 PERIOD
   POLLUTID TSP
   ERRORFIL Error.MSG
   TERRHGTS ELEV
   RUNORNOT RUN
CO FINISHED

SO STARTING
   LOCATION  POINT1  VOLUME  759725.7 6423512.4 486.7
   LOCATION  POINT2  VOLUME  759538.9 6423559.1 466.0
   LOCATION  POINT3  VOLUME  759398.8 6423594.1 455.0
   LOCATION  POINT4  VOLUME  759772.4 6423629.2 485.9
   LOCATION  POINT5  VOLUME  759620.6 6423687.5 471.2
   LOCATION  POINT6  VOLUME  759468.8 6423722.6 457.8
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   SRCGROUP  CM  POINT37-POINT72
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Deleted information

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RE FINISHED

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   SURFDATA  99999 2005
   UAIRDATA  99999 2005
ME FINISHED

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   PLOTFILE  24 CM FIRST  CM1D.PLO
   PLOTFILE  24 REST FIRST  RE1D.PLO
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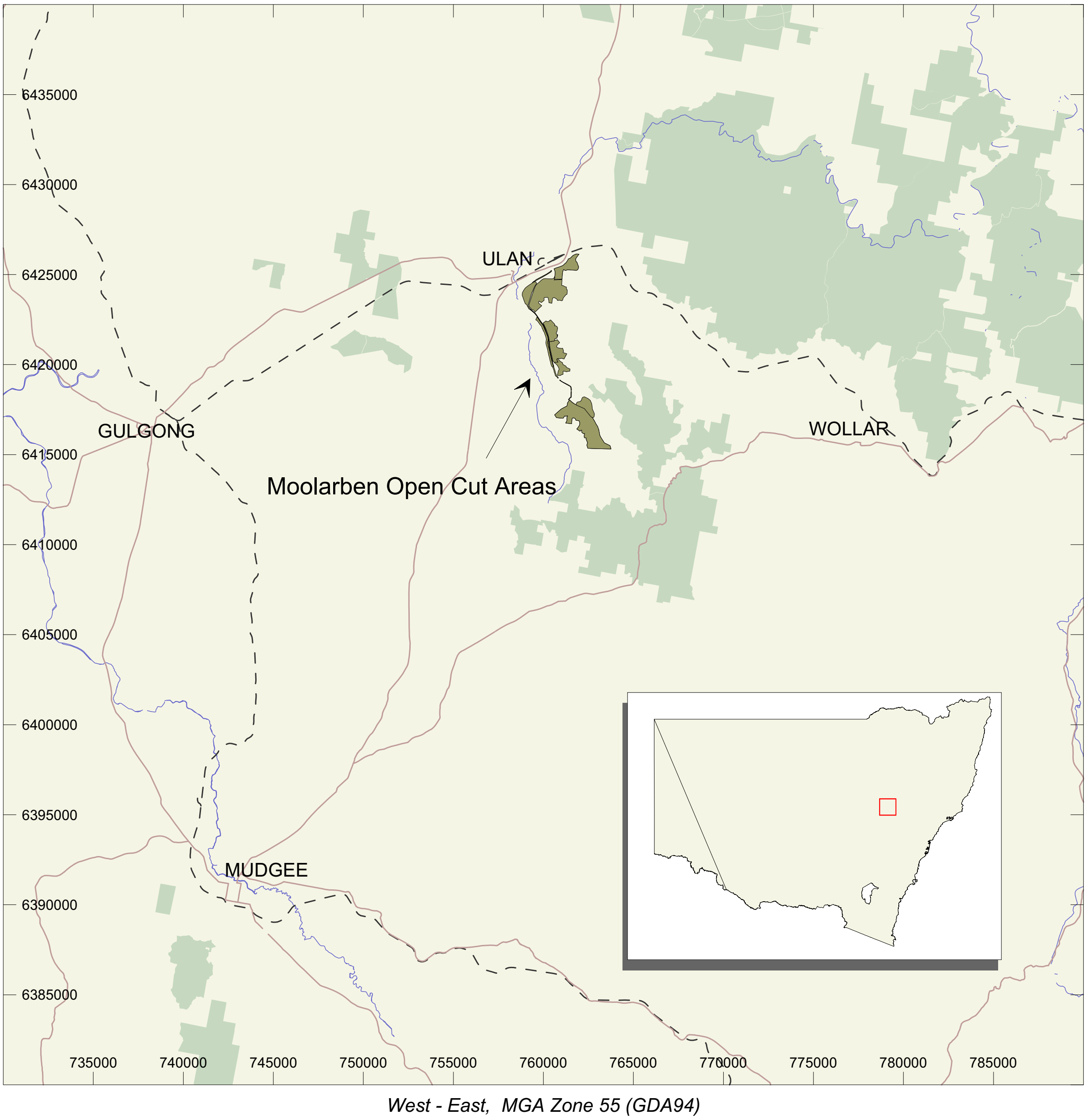
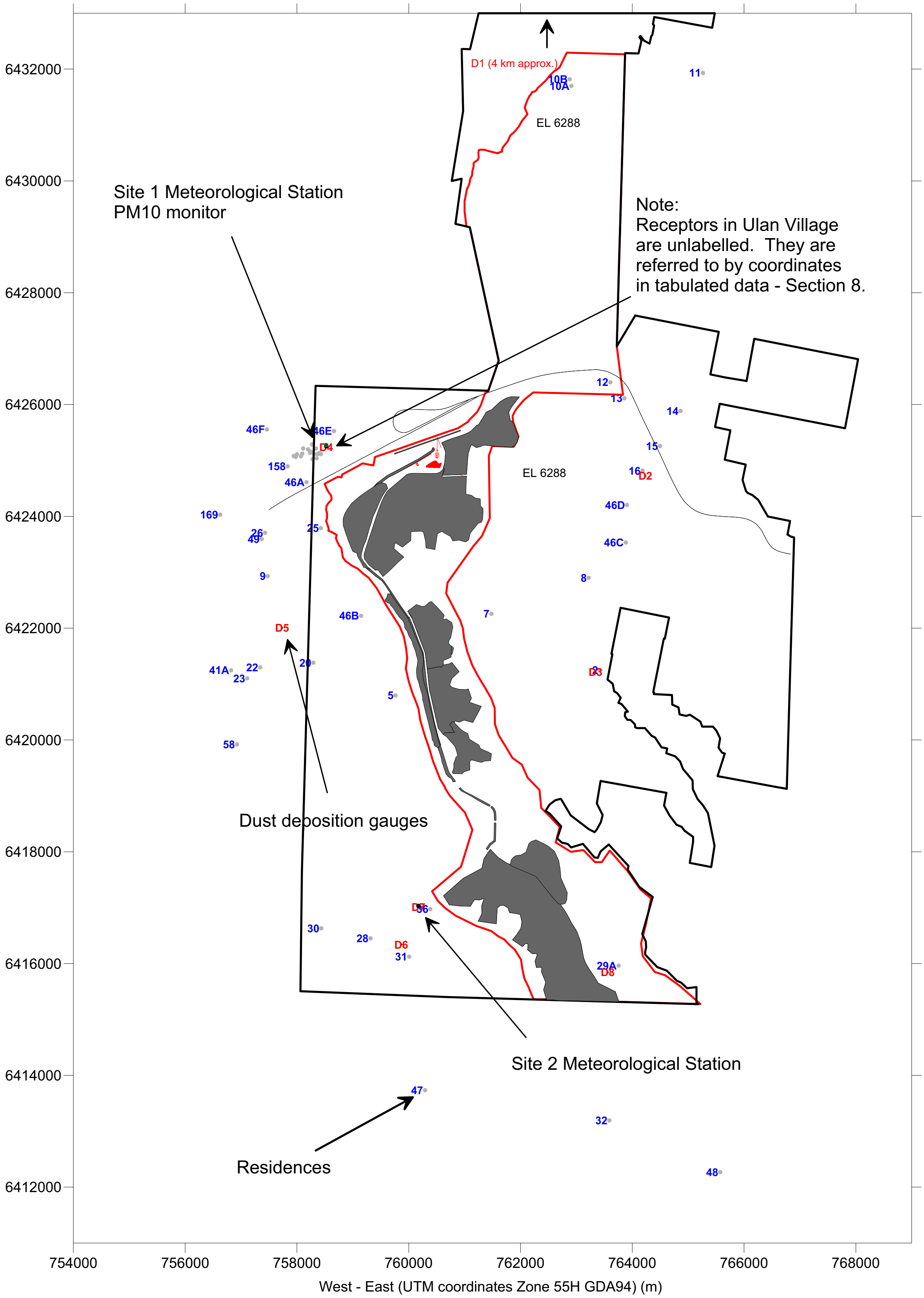
FIGURES



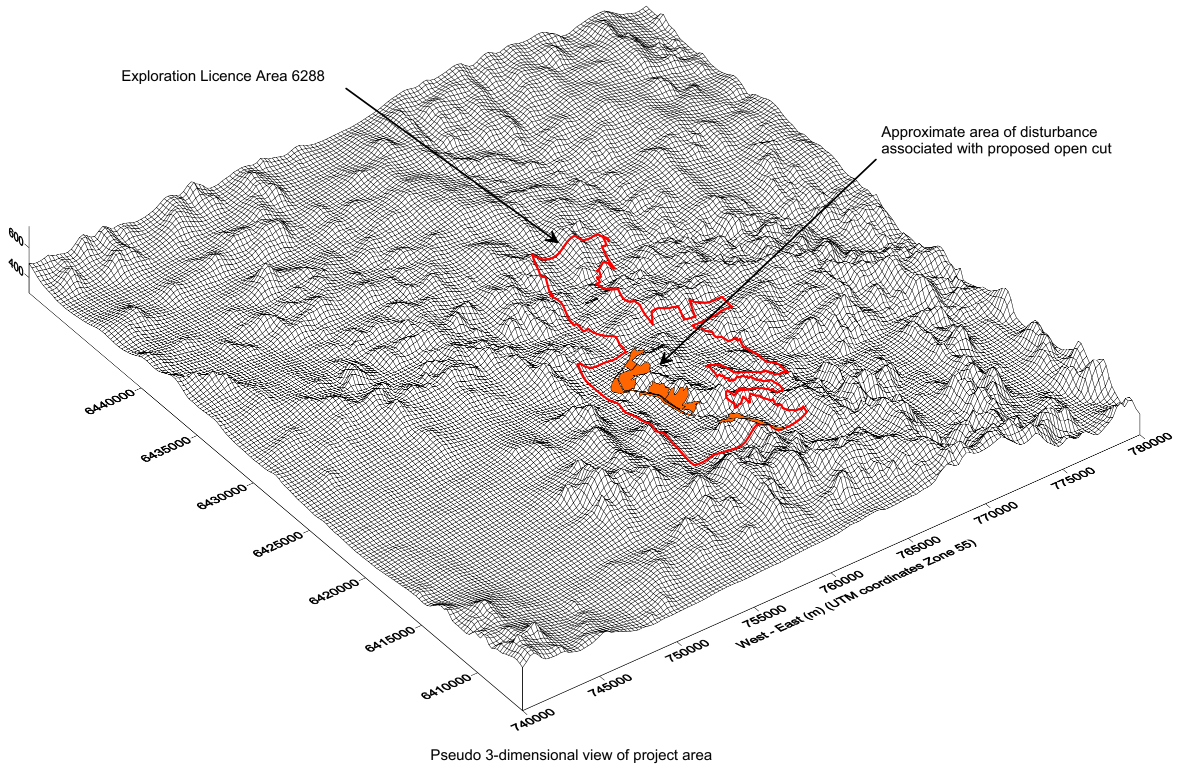
Project location

FIGURE 1



Monitoring sites and nearby residences

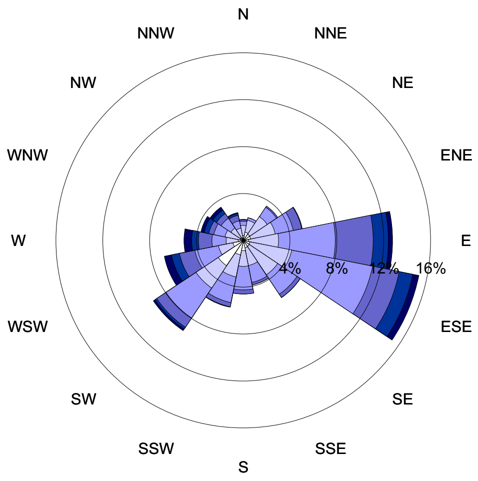
FIGURE 2



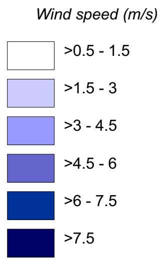
Pseudo 3-dimensional view of project area

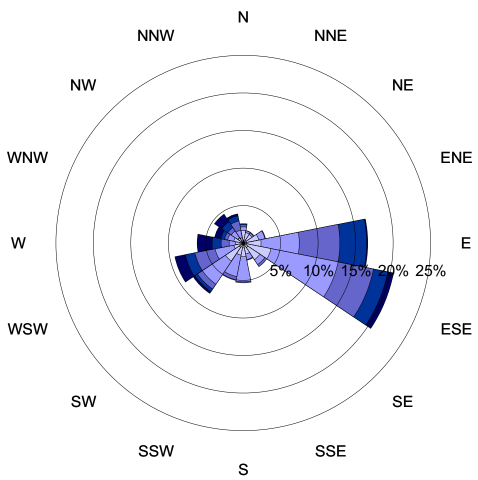
FIGURE 3

Annual and seasonal windroses for northern pit area (Site 1) (Composite of TAPM data for 2005 and onsite data for 2005)

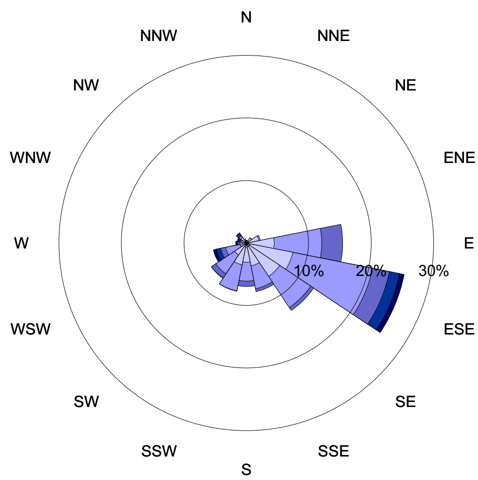


Annual
Calms = 8.8%

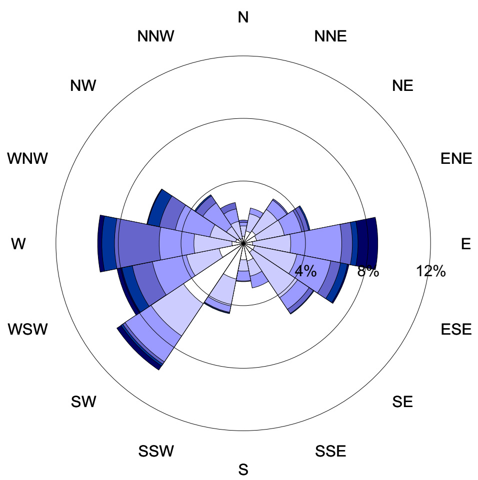




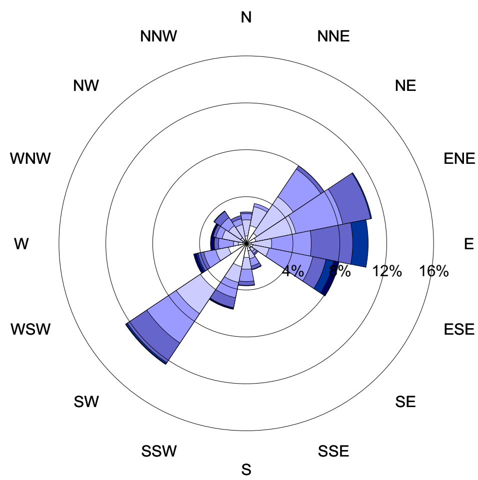
Summer
Calms = 1.6%



Autumn
Calms = 1.1%



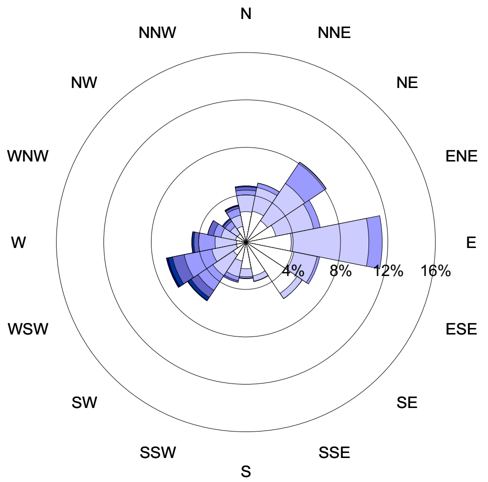
Winter
Calms = 17.5%



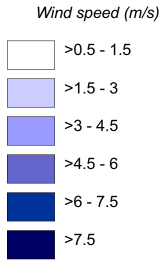
Spring
Calms = 14.8%

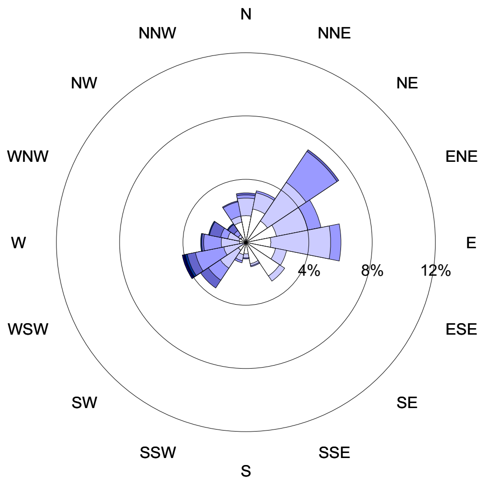
FIGURE 4

Annual and seasonal windroses for southern pit area (Site 2) derived from onsite data for 2005

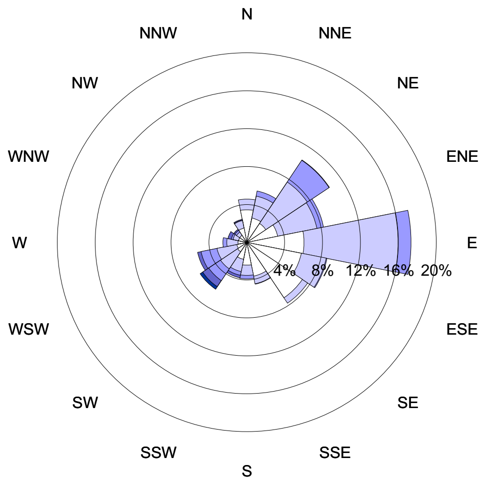


Annual
Calms = 15.8%

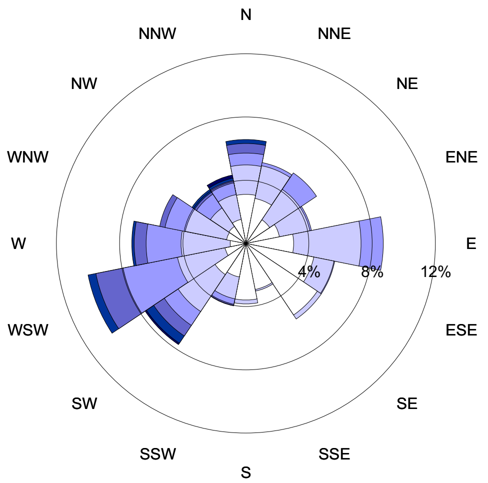




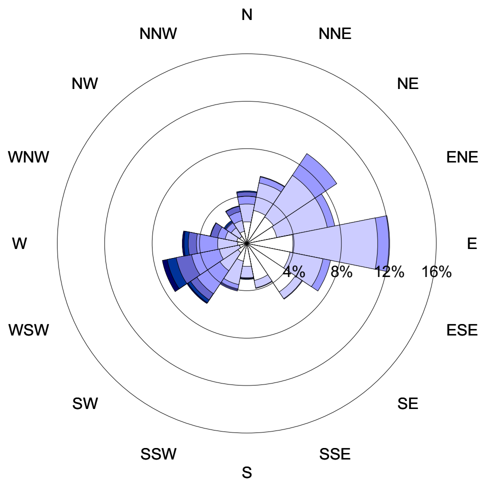
Summer
Calms = 49.2%



Autumn
Calms = 5.5%

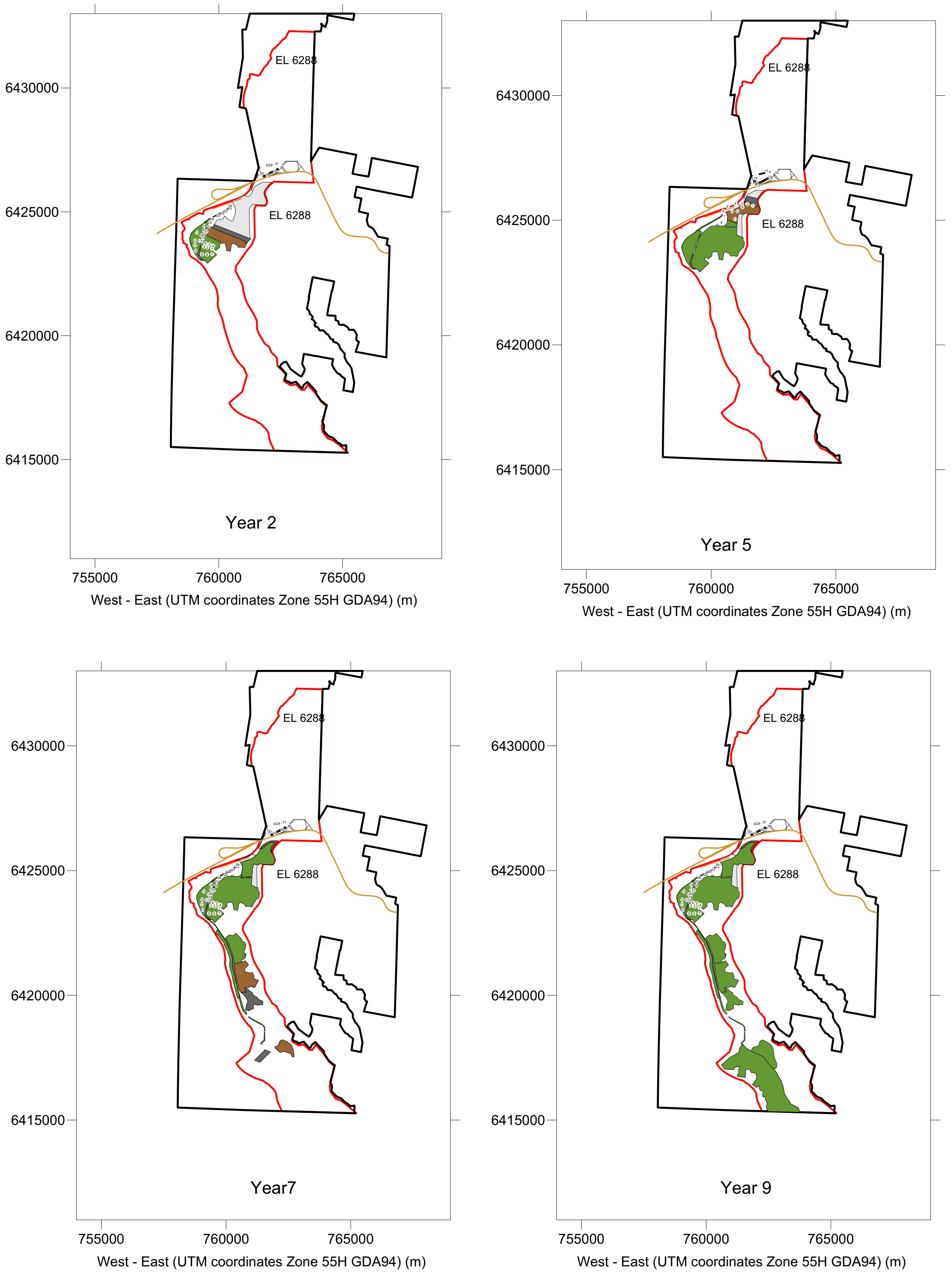


Winter
Calms = 8.4%



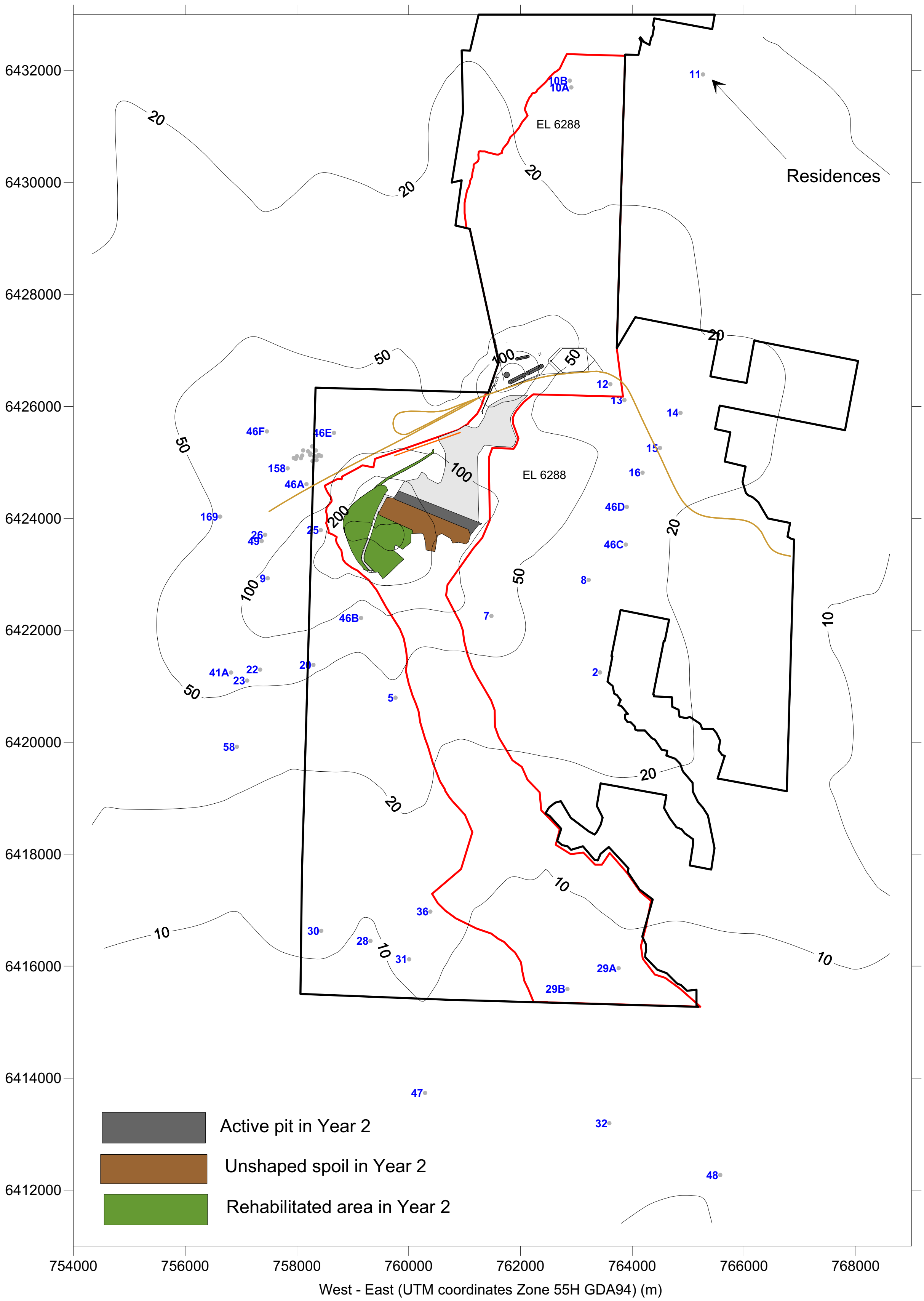
Spring
Calms = 9.8%

FIGURE 5



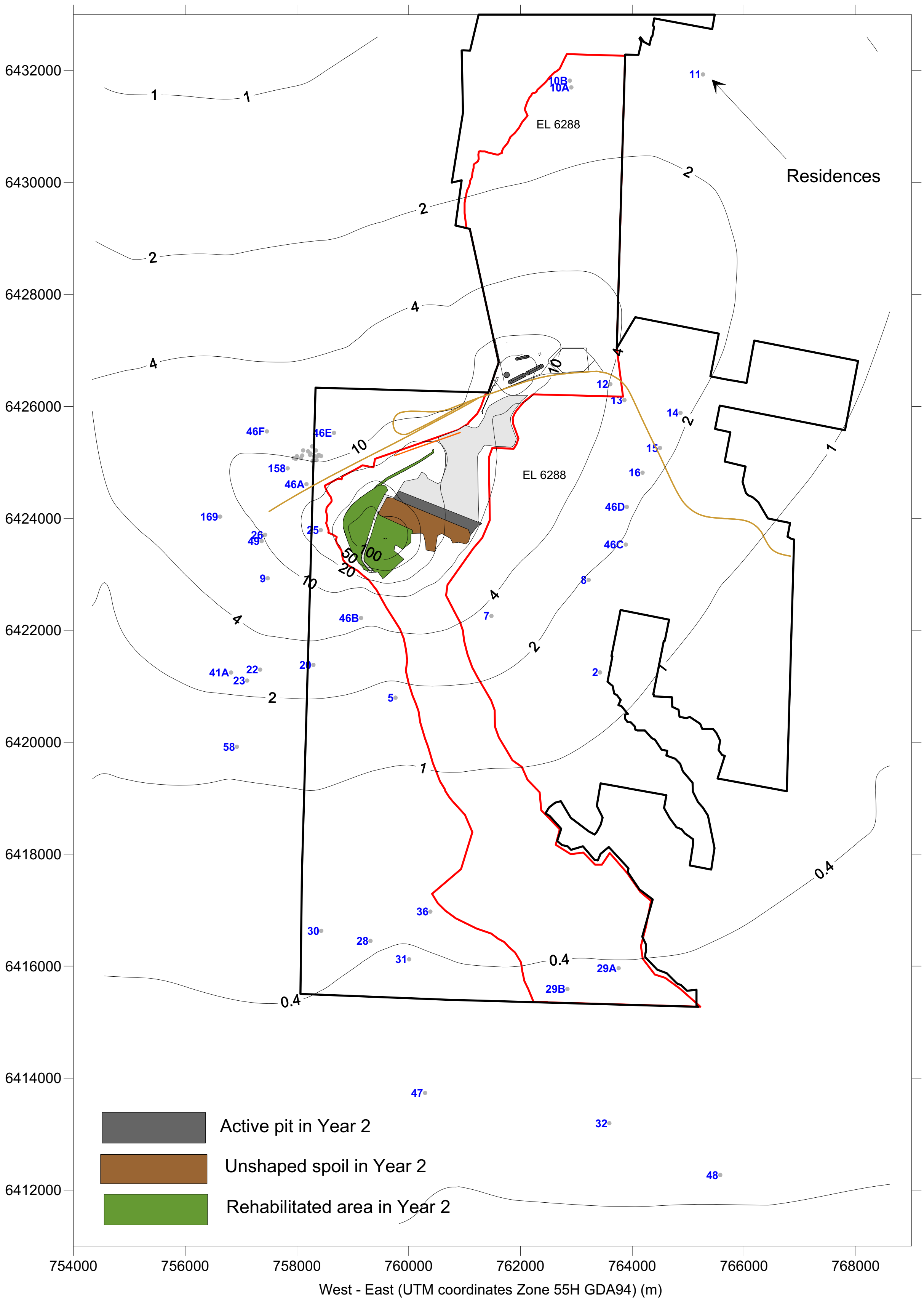
Location of modelled dust sources for all modelling scenarios

FIGURE 6



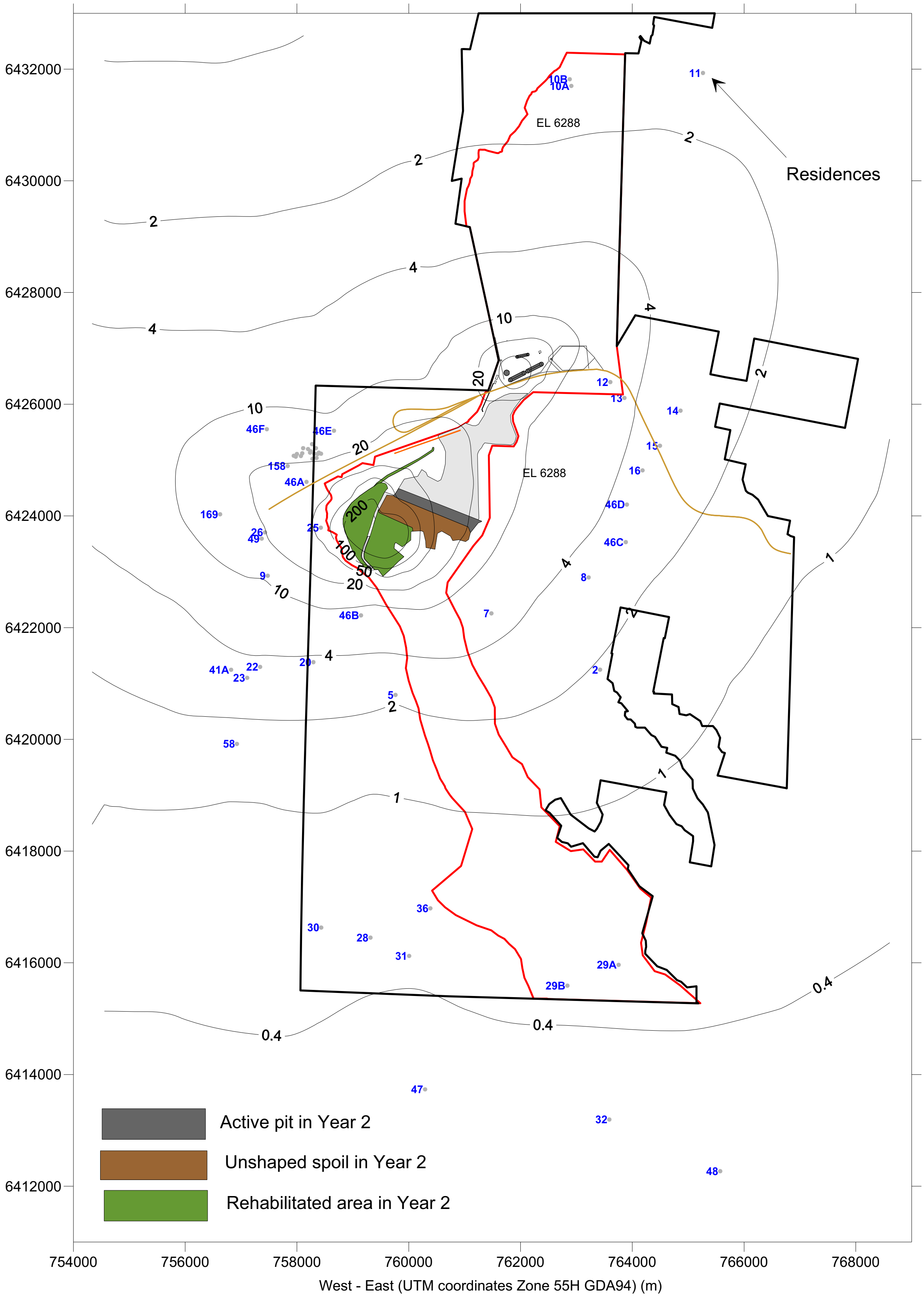
Predicted maximum 24-hour average PM_{10} concentrations due to emissions from Moolarben in Year 2 - µg/m^3

FIGURE 7



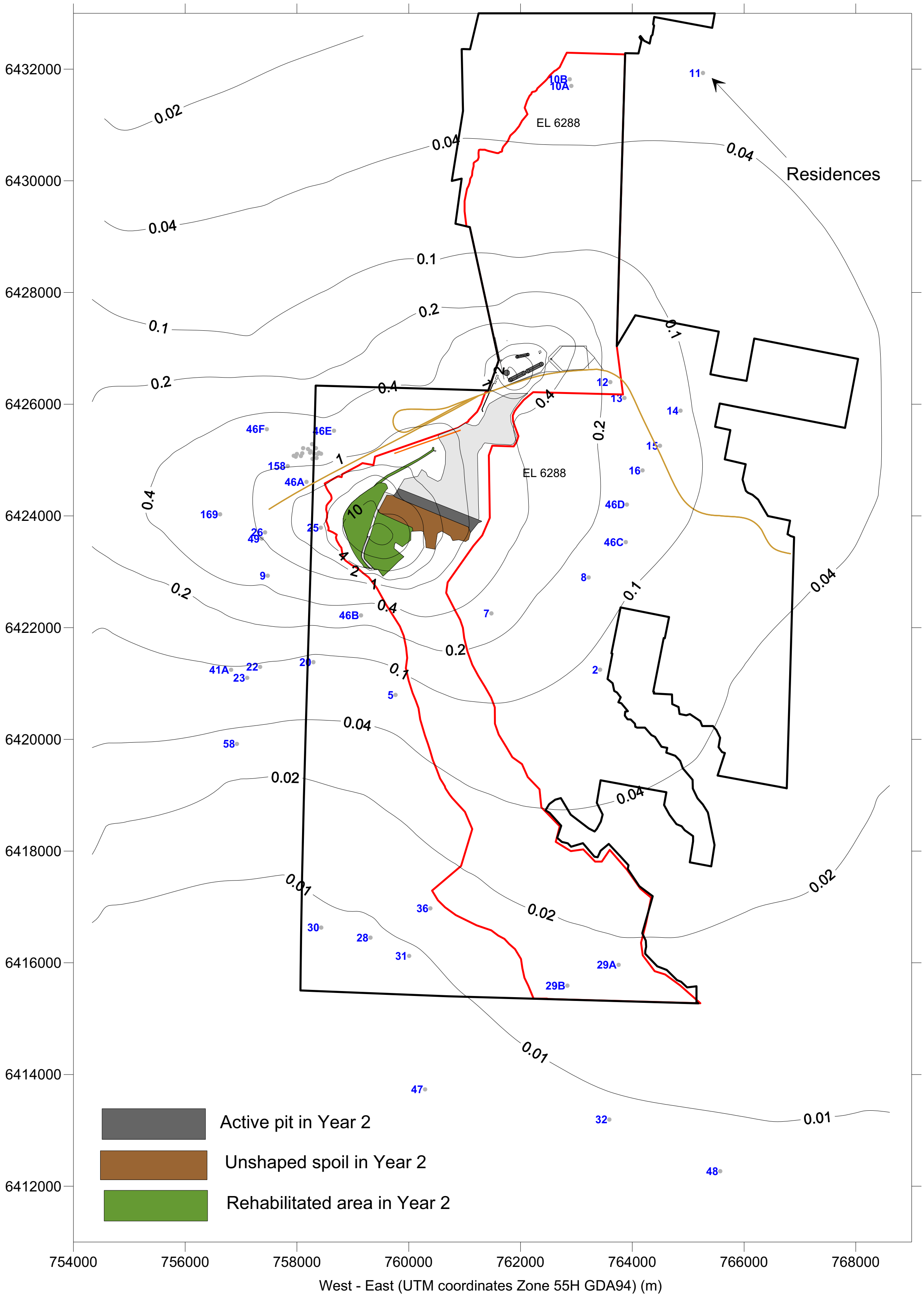
Predicted annual average PM_{10} concentrations due to emissions from Moolarben in Year 2 - $\mu g/m^3$

FIGURE 8



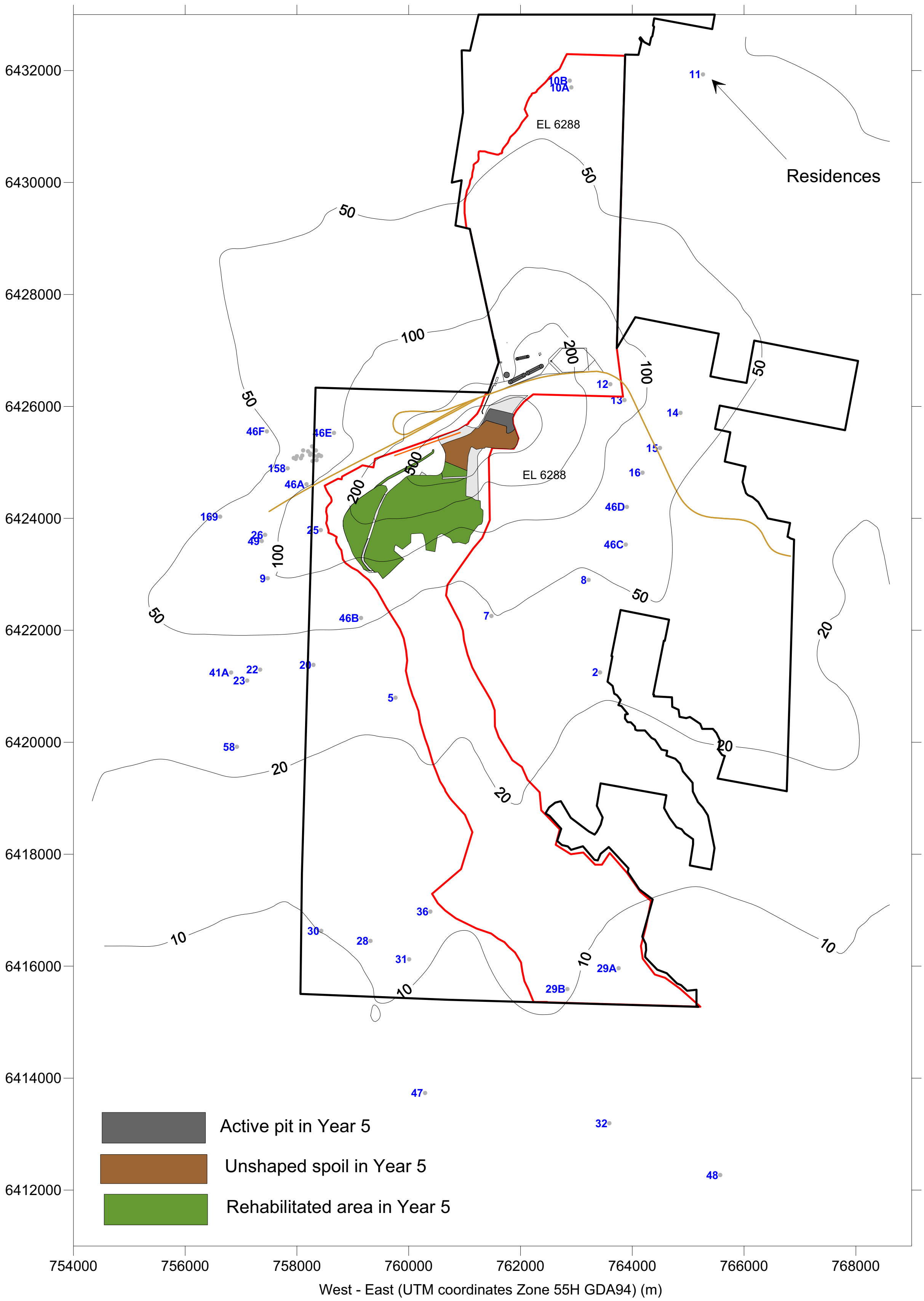
Predicted annual average TSP concentrations due to emissions from Moolarben in Year 2 - µg/m^3

FIGURE 9



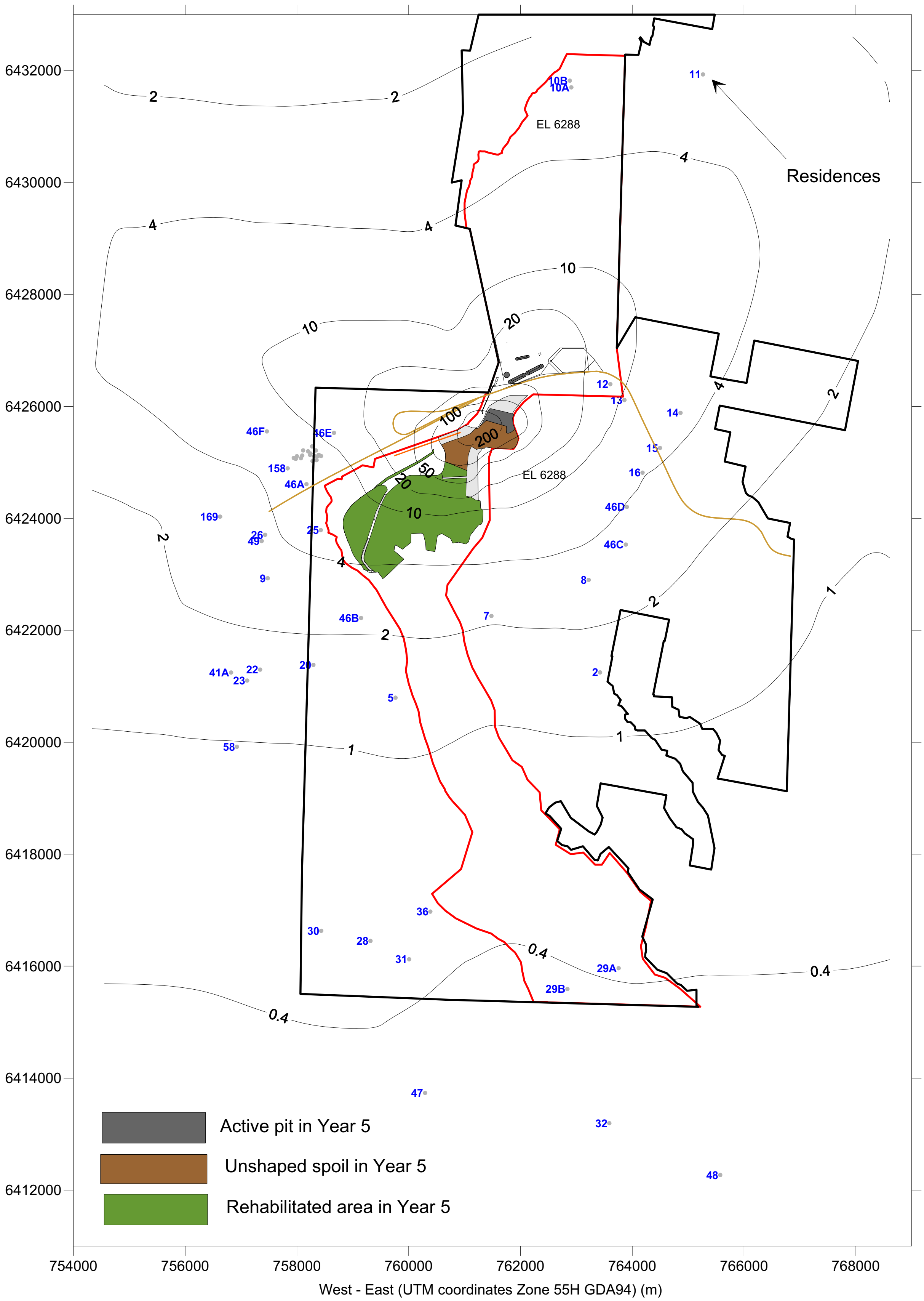
Predicted annual average dust (insoluble solids) deposition due to emissions from Moolarben in Year 2 - g/m^2/month

FIGURE 10



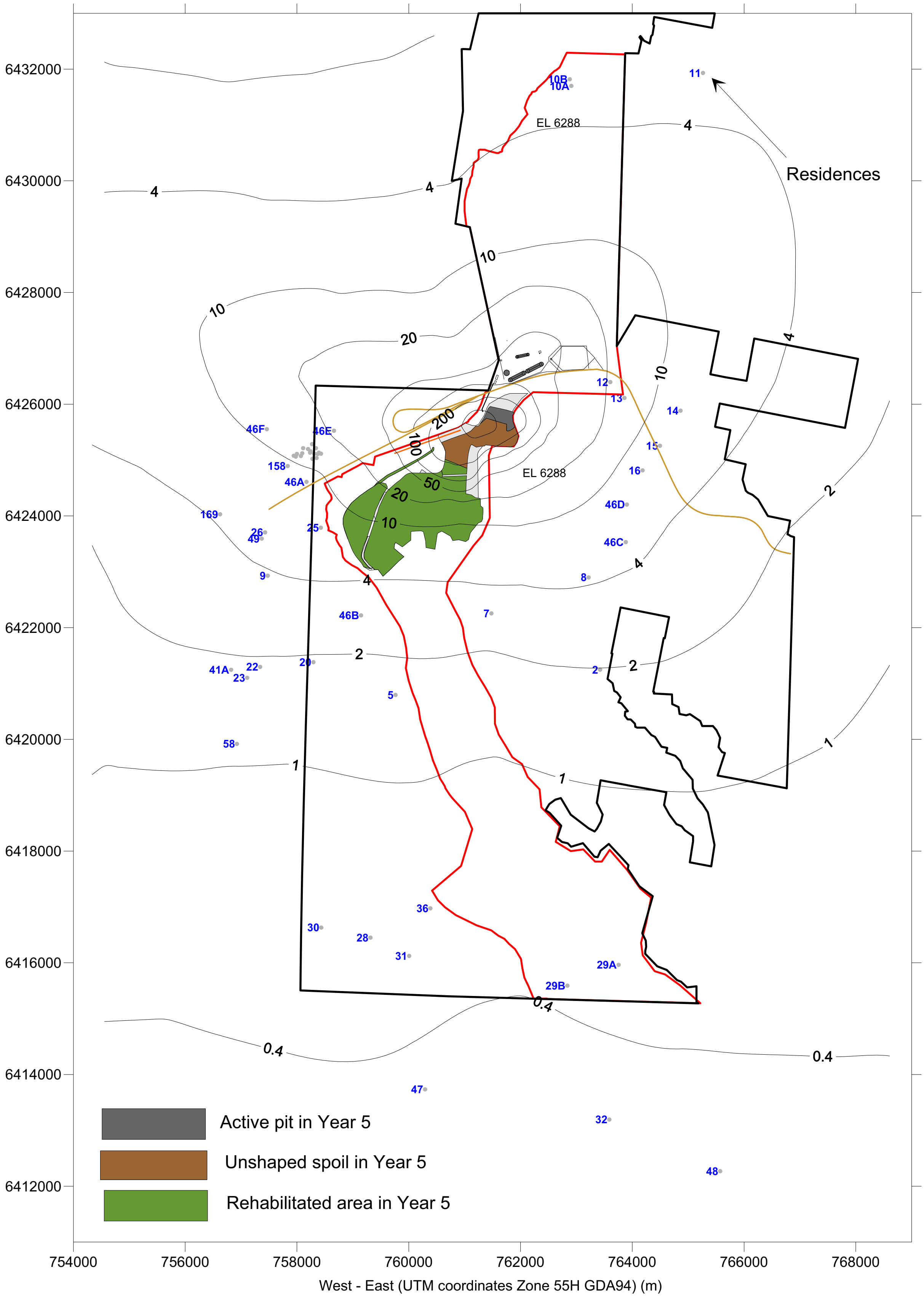
Predicted maximum 24-hour average PM_{10} concentrations due to emissions from Moolarben in Year 5 - µg/m^3

FIGURE 11



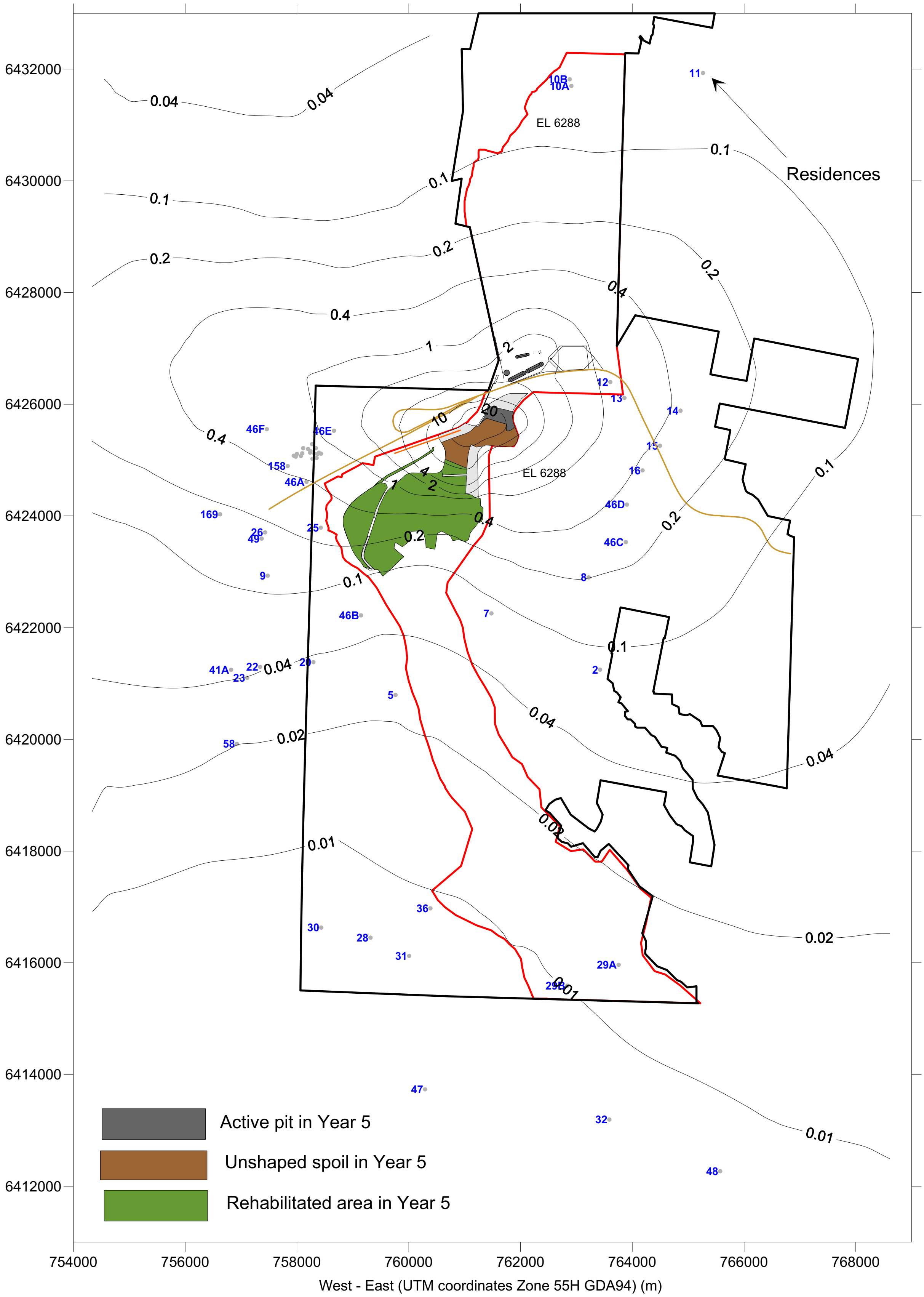
Predicted annual average PM_{10} concentrations due to emissions from Moolarben in Year 5 - μg/m^3

FIGURE 12



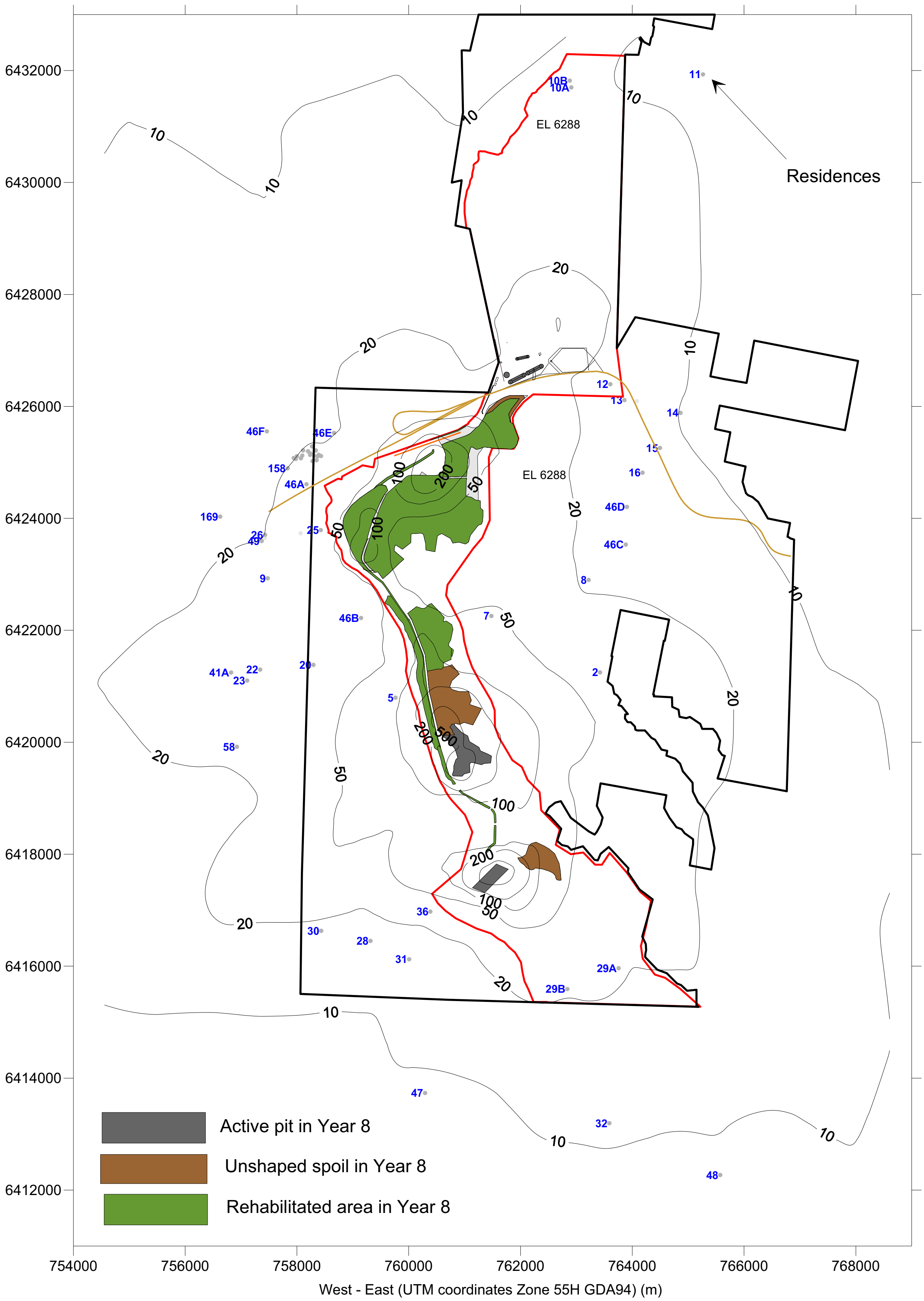
Predicted annual average TSP concentrations due to emissions from Moolarben in Year 5 - µg/m^3

FIGURE 13



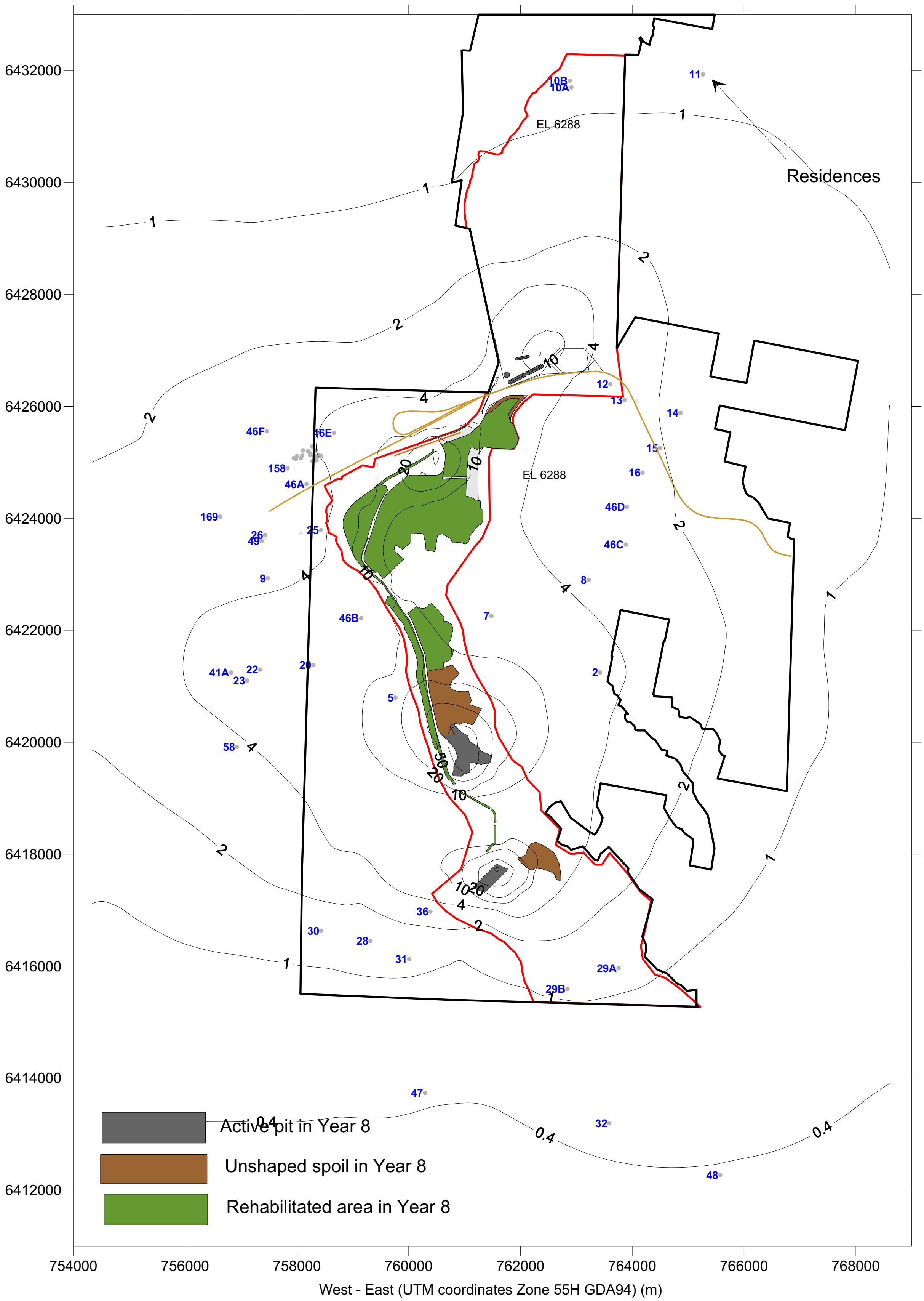
Predicted annual average dust (insoluble soilds) deposition due to emissions from Moolarben in Year 5 - g/m^2 /month

FIGURE 14



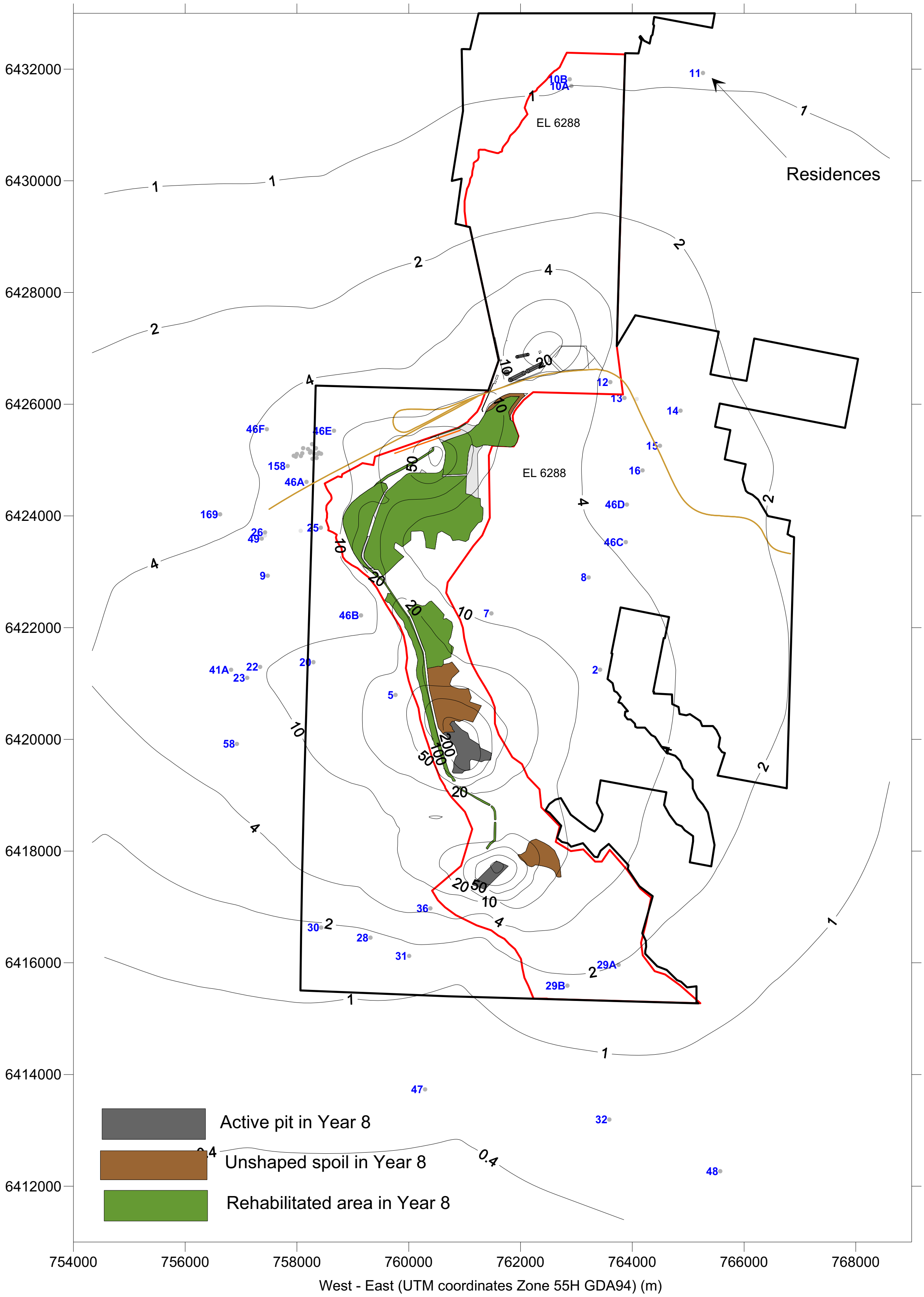
Predicted maximum 24-hour average PM_{10} concentrations due to emissions from Moolarben in Year 8 - µg/m^3

FIGURE 15



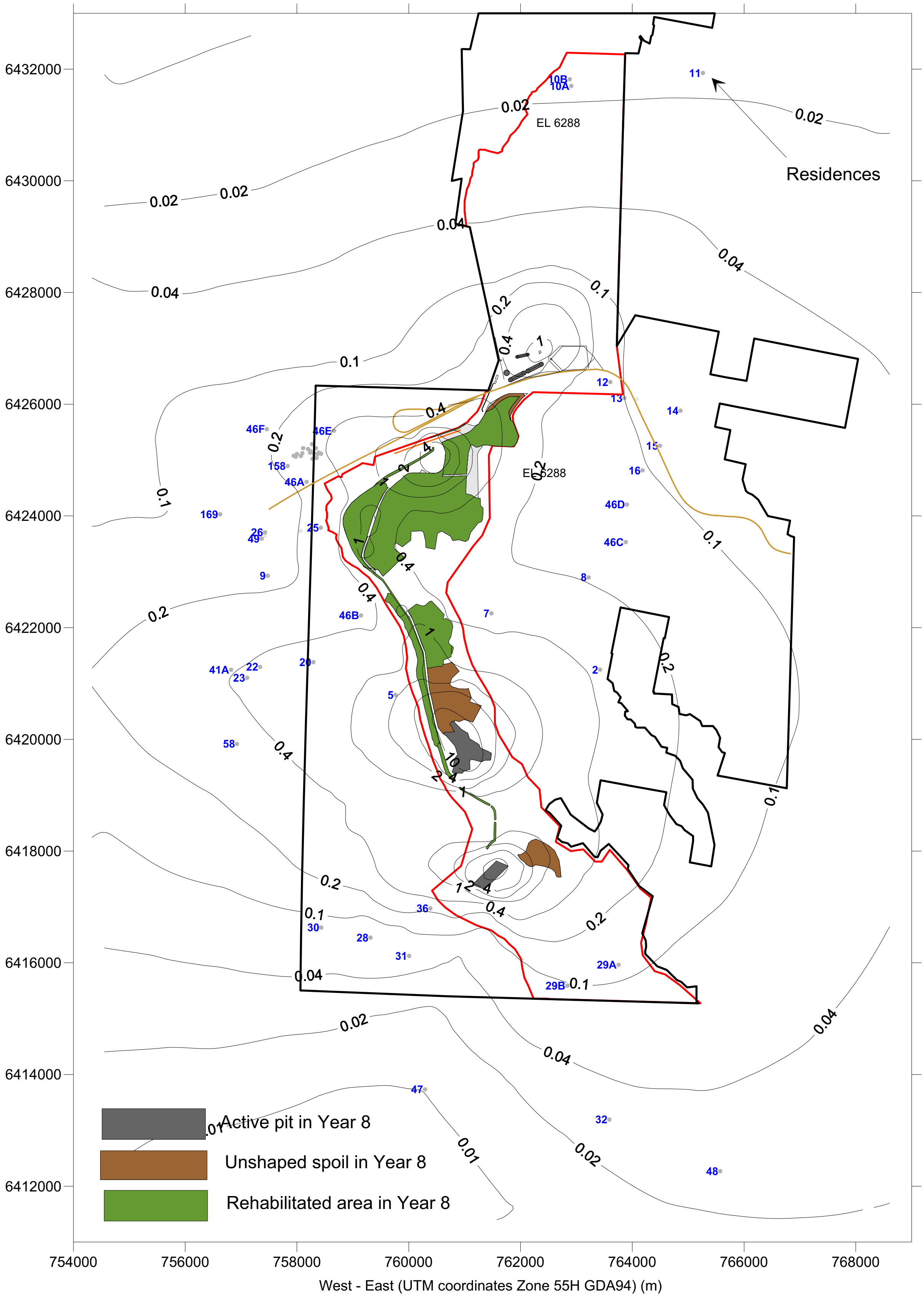
Predicted annual average PM_{10} concentrations due to emissions from Moolarben in Year 8 - $\mu g/m^3$

FIGURE 16



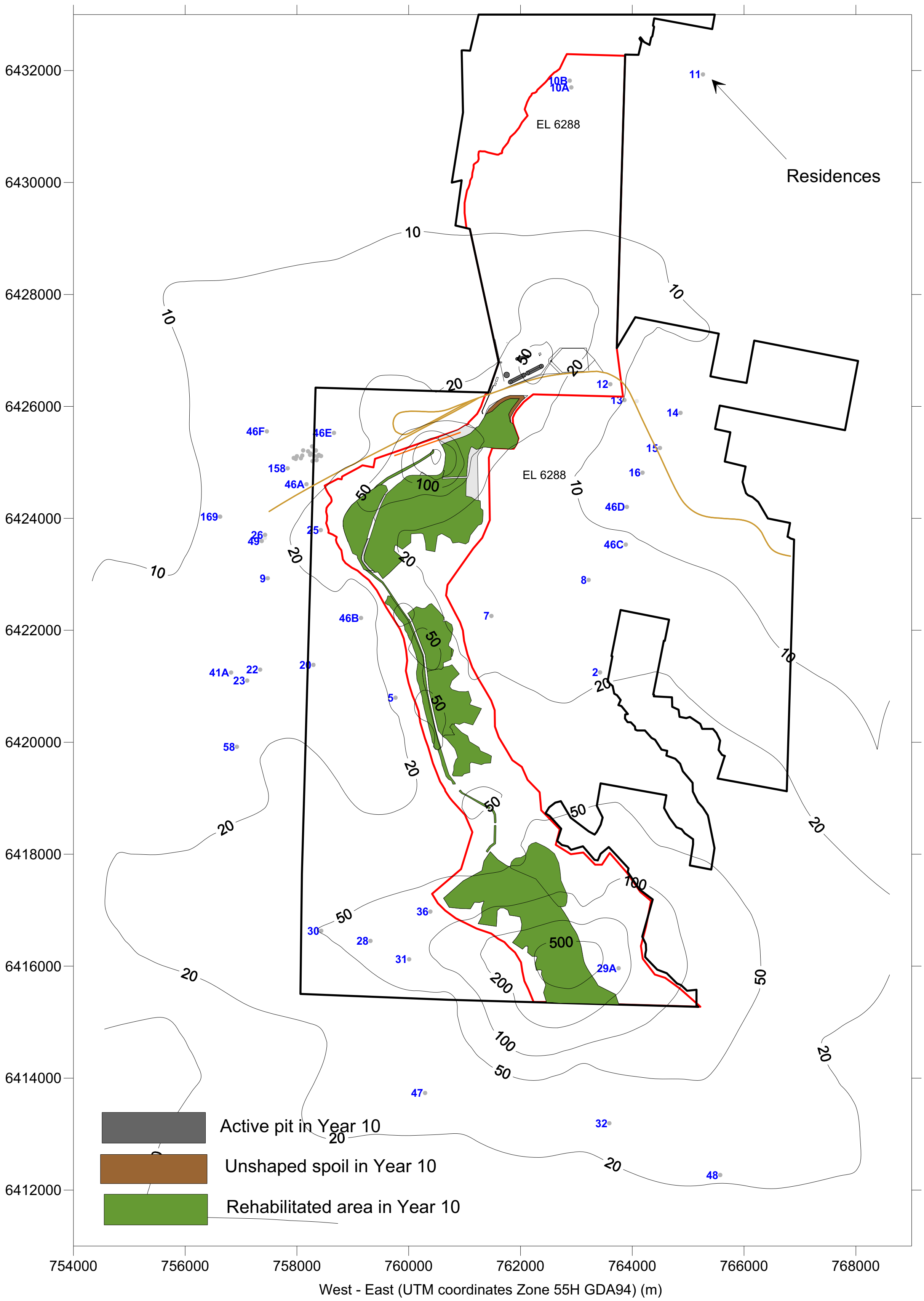
Predicted annual average TSP concentrations due to emissions from Moolarben in Year 8 - µg/m^3

FIGURE 17



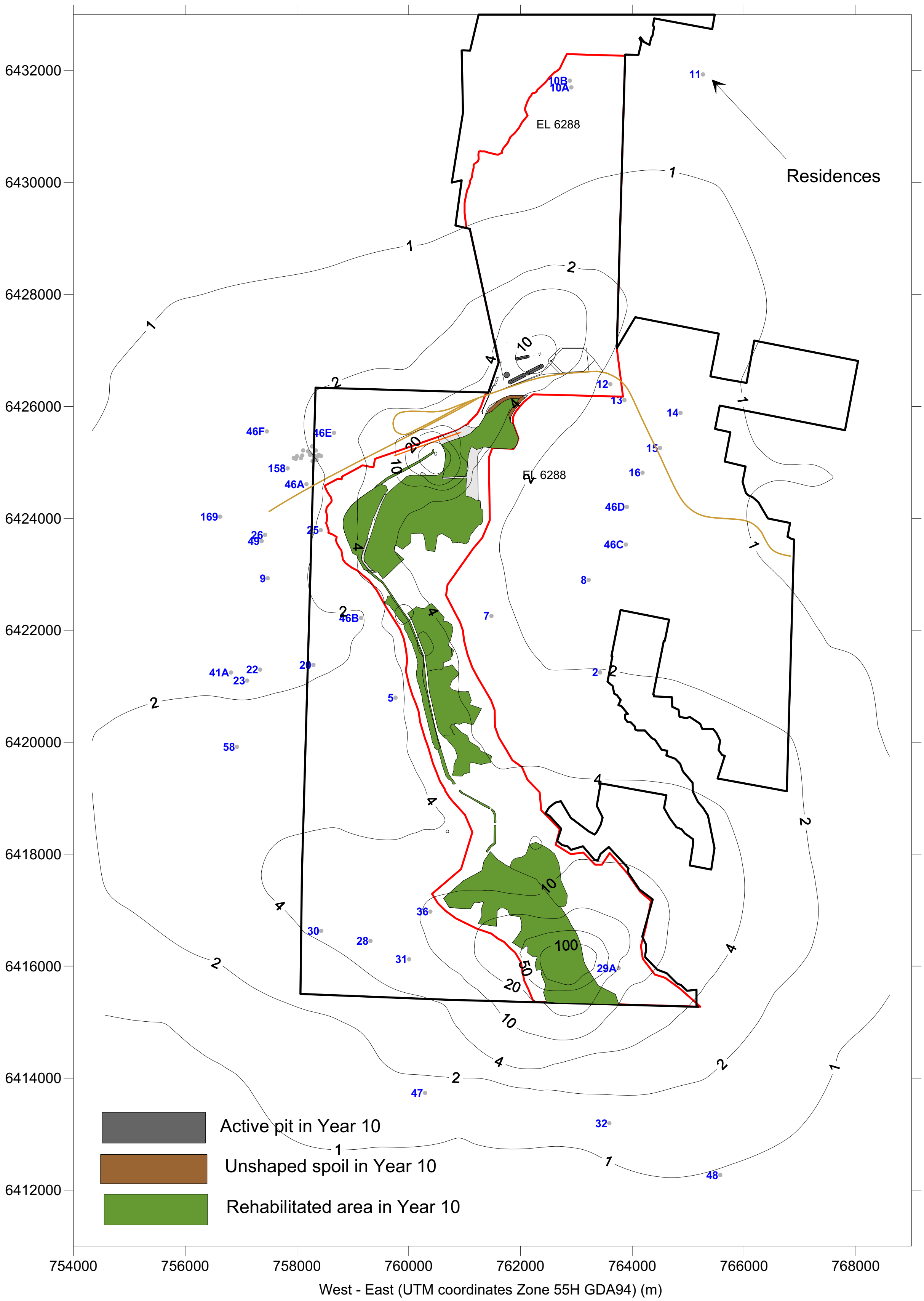
Predicted annual average dust (insoluble solids) deposition due to emissions from Moolarben in Year 8 - g/m^2/month

FIGURE 18



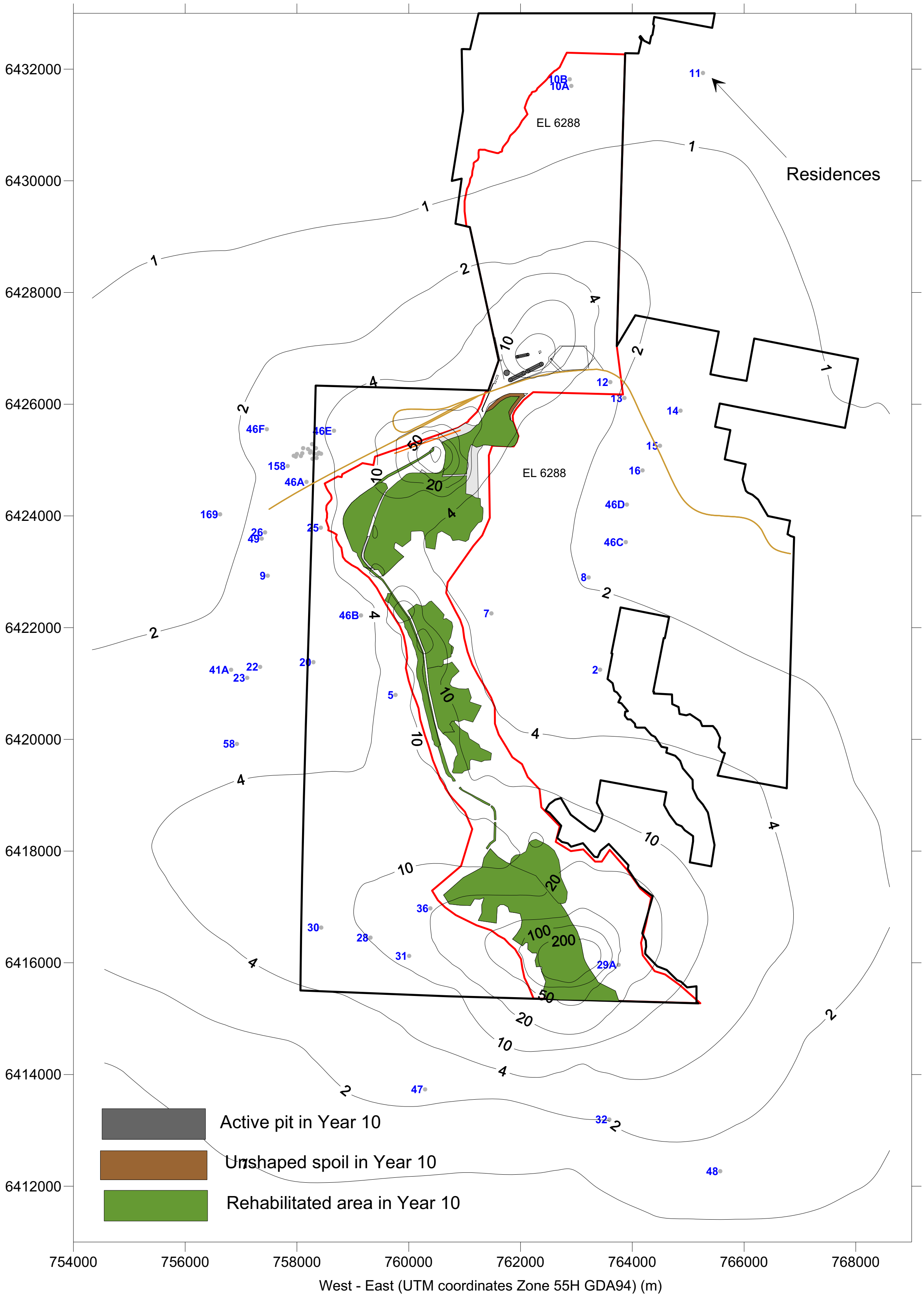
Predicted maximum 24-hour average PM_{10} concentrations due to emissions from Moolarben in Year 10 - μg/m^3

FIGURE 19



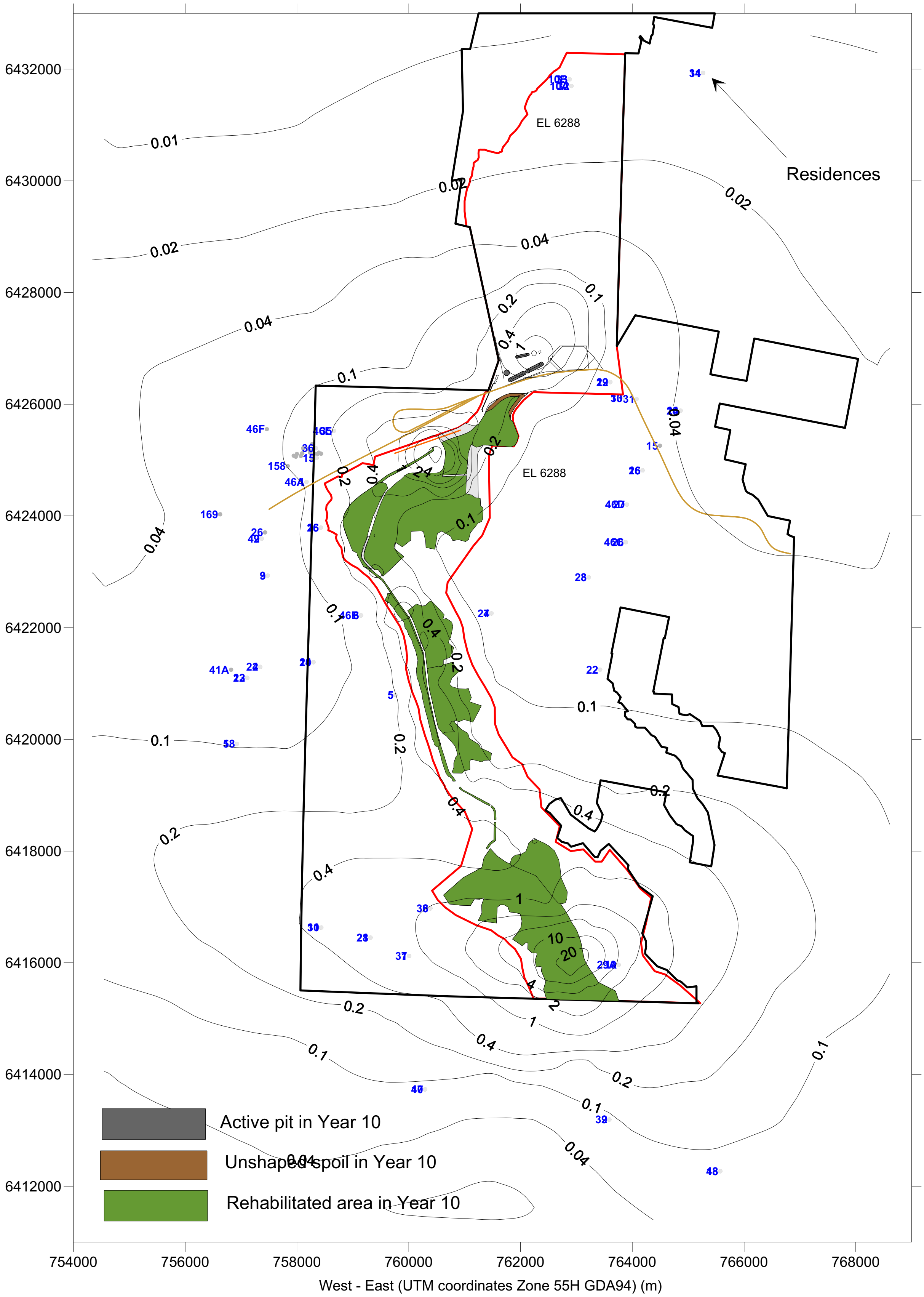
Predicted annual average PM_{10} concentrations due to emissions from Moolarben in Year 10 - µg/m^3

FIGURE 20



Predicted annual average TSP concentrations due to emissions from Moolarben in Year 10 - µg/m3

FIGURE 21



Predicted annual average dust (insoluble solids) deposition due to emissions from Moolarben in Year 10 - g/m^2/month

FIGURE 22