Sibanye Stillwater Operations Australia Pty Ltd

Mt Lyell New Processing Plant EIS
air quality assessment

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Tarkarri Engineering

Air Quality • Acoustics • Environment • Vibration

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AIR QUALITY ASSESSMENT

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0	12/11/2025	Initial release
1	01/06/2026	EPA comments
2	11/06/2026	Edits
3	13/09/2026	Additional modelling

Distribution

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1	3	Project/Client File
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Keywords

particulate matter (PM) - *particle matter suspended in the air*.
PM_{10} - *particulate matter 10 micrometres or less in aerodynamic diameter.*
$PM_{2.5}$ - *particulate matter 2.5 micrometres or less in aerodynamic diameter.*
TSP - *Total suspended particulates*.
respirable crystalline silica - *Silica dust made up of small particles that can become airborne and can be inhaled deep into the lungs*.
Entrainment - *the process of making something part of a flow of something and carrying it along.*

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References

[1] Australian Government, Dept of Sustainability, Environment, Water, Population and Communities (January 2012) *National Pollutant Inventory Emission Estimation Technique Manual for Mining Version 3.1*.

[2] United States Environmental Protection Agency AP-42 *Compilation of Air Emissions Factors, Fifth Edition, Volume I, Chapter 13: Miscellaneous Sources,* (2006) *13.2.2 Unpaved Roads*.

[3] ACARP (2015) *Development of Australia-Specific PM10 Emission Factors for Coal Mines.* Australian Coal Association Research Program.

Executive summary

Tarkarri Engineering was commissioned by Sibanye Stillwater Operations Australia Pty Ltd to conduct an air quality assessment, as part of an Environmental Impact Statement for a proposed new processing plant at the Mt Lyell Mine, Queenstown Tasmania.

Modelling of potential dust emissions from the mine indicates that ground level concentrations above criteria levels for particulates don't extend beyond the boundary of the mine.

Predicted metals levels are also well below criteria levels at or beyond the boundary of the mine. Once the Prince Lyell Shaft is reinstated predicted levels are reduced while relocation of crushing underground provides further reduction.

Predicted crystalline silica levels from the processing plant show potential exceedances at boundary locations along the mining leases southern boundary, approx. 400 m west of residential areas of Queenstown.

Operations at the Mt Lyell mine would be likely to comply with the requirements of the *Environment Protection Policy (Air Quality) 2004* and the environmental values of the surrounding sensitive residential locations can be protected. Some potential risk in relation to crystalline silica emissions has been identified and would need to be managed through controls and monitoring of emissions.

Details in relation to haul road watering and control systems within the processing plant are provided. A dust management plan will be developed for the mine.

The following monitoring will be implemented to assist with active management of dust generation and control at the Mt Lyell mine:

- Real-time multi-channel particulate monitoring (e.g. nephelometer) of TSP, PM_{10} and $PM_{2.5}$ levels on the boundary of the mining lease to the south of the front gate. With analysis for metals and crystalline silica from retained sample material.
- Dust deposition monitoring at a minimum of 6 locations providing, total solids, insoluble solids & soluble solids at locations along the boundary of the mining lease to the north and south of the front gate. With analysis of retained material for metals.

1 Introduction

Tarkarri Engineering was commissioned by Sibanye Stillwater Operations Australia Pty Ltd (SSOA) to conduct an air quality assessment, as part of an Environmental Impact Statement (EIS) for a proposed new processing plant at the Mt Lyell Mine, Queenstown Tasmania.

A new processing plant next to the Prince Lyell shaft on the existing upper level, previously utilised for surface operations, would be developed while the existing thickener and tails pump station in the lower-level area would be retained. New mine vent fans to replace existing near the Prince Lyell shaft would be installed.

The Tasmanian Environmental Protection Authority (EPA) has issued project specific EIS guidelines with the relevant section provided below for reference:

6.2 Air quality

This air quality assessment should detail potential impacts of the new processing plant proposal on the local and regional air environment during construction and operation stages. Additionally, it should provide evidence that the activity will not cause environmental nuisance or harm, including to public health.

6.2.1 Existing Environment

- Provide a location map including the activity area, site boundary and the location of nearest receptors, including any areas of public amenity.
- Describe the existing environment including climatic/meteorological conditions, terrain, land use and air quality in the vicinity of the new processing plant proposal.
- Provide background information on dust deposition at/around the site boundary, including particle size distribution and the elemental composition of the dust. Background dust deposition monitoring and real-time dust monitoring should ideally cover four seasons at the site boundary and in nearby community areas prior to the start of construction.

6.2.2 Assessment

- Provide a site map showing the locations and names of all potential sources of atmospheric emissions from the proposed activity.
- Provide a detailed description of the new processing plant activities from the input of raw materials through to the transfer of concentrate and tailings to the existing concentrate building, including waste streams and waste handling as it pertains to air emissions. Include the proposed technologies, processes, materials (including chemicals), equipment to be used and the necessary infrastructure.
- Provide details of the materials handled and equipment used on-site. Include the chemical composition of the materials and the locations of the equipment.
- Describe all potential sources (point and fugitive) of atmospheric emissions and the composition of the atmospheric emissions, including dust and odour. This should cover emissions that may arise on the site during construction (including pipeline construction), operation and maintenance activities as well as from loading, unloading and transport of materials.
- Describe and assess the potential impacts of the atmospheric emissions from the new processing plant proposal on the environment in a context of the existing environment (local meteorology, terrain) and land use, particularly proximity of sensitive receptors. Consider the cumulative impact of the generated dust.

- Describe climate change projections relevant to the project area, and how the future climate may alter the local meteorology and air emissions from the new processing plant proposal.
- Provide information on the planned monitoring of the atmospheric emissions including dust and its elemental composition.
- Demonstrate that the assessment is consistent with the requirements of the *Tasmanian Environment Protection Policy (Air Quality) 2004* and any supplementary documents, including the *Air Pollutant Design Criteria - EPA Board Statement*.

6.2.3 Avoidance and Mitigation Measures

- Demonstrate application of accepted modern technology (AMT) for reduction of unavoidable emissions to the greatest extent practicable. All emission management measures to be employed must be described in detail.
- Describe measures to be implemented to mitigate all atmospheric emissions from the site that may cause environmental nuisance or harm at or beyond the site boundary especially during unfavourable meteorological conditions. These include but may not be limited to watering or sealing roads, covering truck loads, reducing vehicle speed, road surfacing/maintenance details, enclosures, water sprays, windbreaks, and revegetation/stabilisation. The use of dust monitoring instruments and a meteorological monitoring station capable of measuring and recording real-time wind speed and direction should be considered as part of the mitigation strategy to inform decisions on applying timely and appropriate mitigation measures.
- Discuss the ongoing requirement for an adequate water supply, considering both current and future climate conditions, including the potential for more frequent dry periods.

2 Site description

The Mt Lyell mine is located north-east of the township of Queenstown. The mining lease (9M/2013) bounds the township, Figure 2-1 presents an aerial view with the location of the mining lease (ML) shown. presents an aerial view of the mine and surrounds with salient features marked including the new processing plant and the activity area for this project.

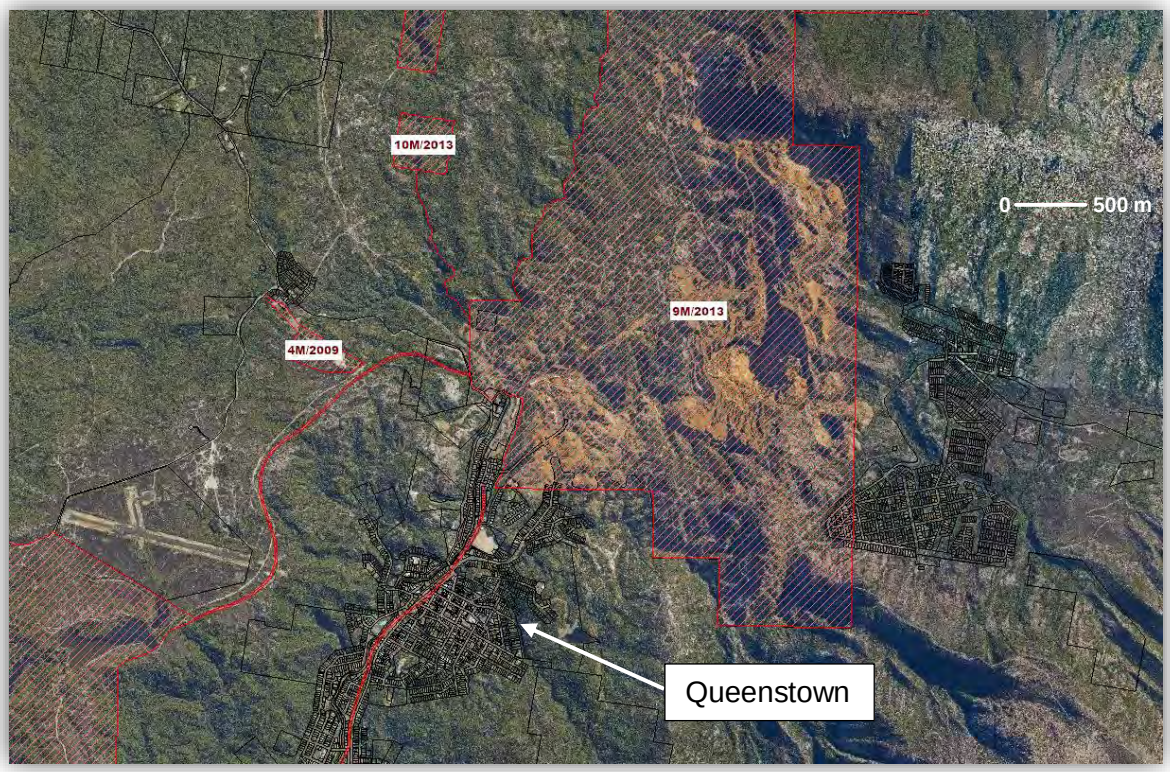


Figure 2-1: Aerial view of Mt Lyell mine lease and surrounds.

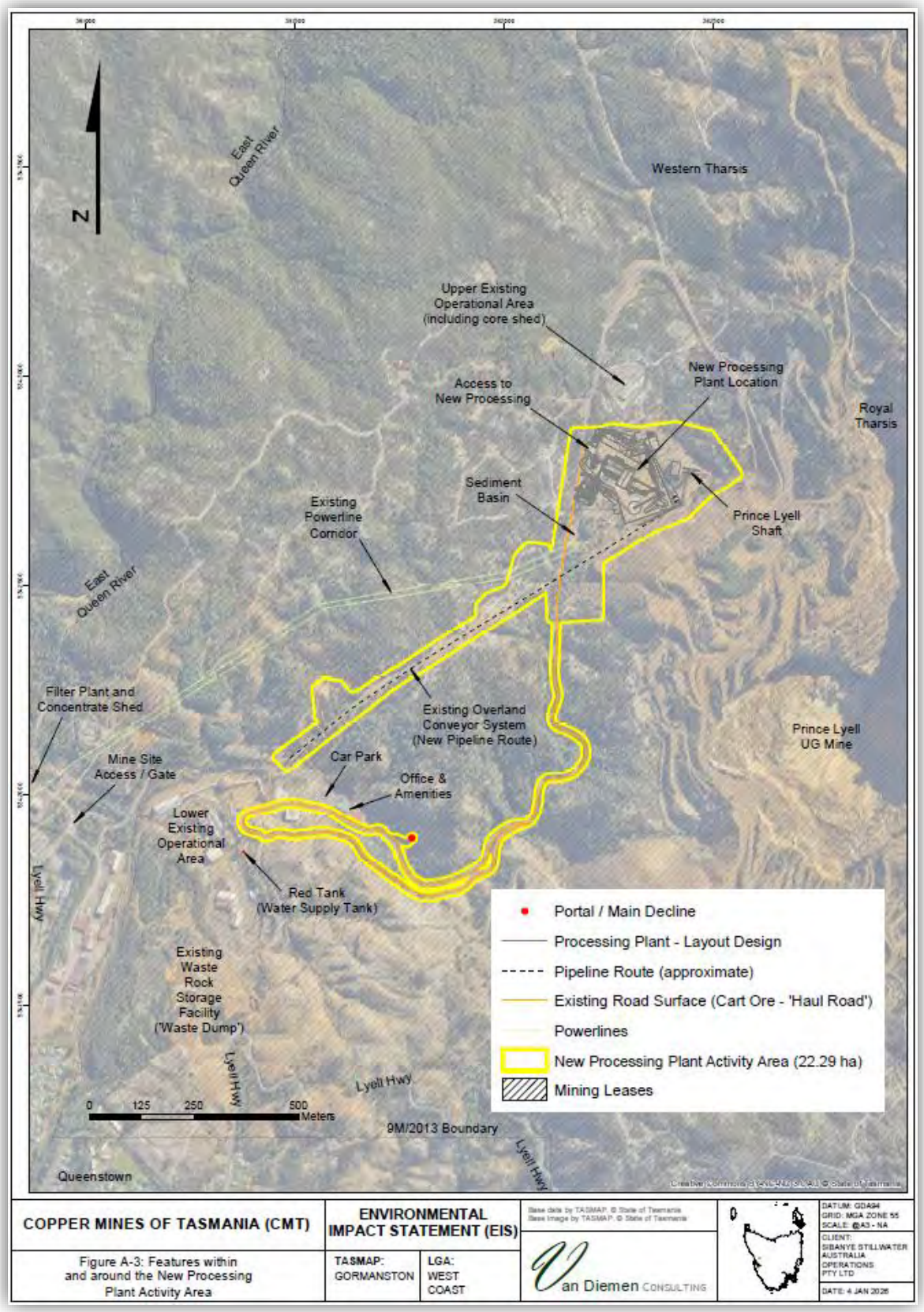


Figure 2-2: Arial view of Mt Lyell mine and surrounds with salient features marked (from VDC).

Ore will be transported to the new processing plant from the lower portal (from underground operations, not assessed here) to the new processing plant via mine truck until the Prince Lyell Headshaft is refurbished and becomes operational, avoiding the use of the internal haul road to cart ore to the processing plant. The various stages in the ore processing flows are described below:

- Primary crushing circuit into a single stage SAG mill grinding circuit
- Flotation and regrind, via rougher flotation tanks, regrind mill and cleaner circuit
- Thickening and filtration of concentrate, via standard thickeners and plate and frame filters
- Thickening of tailings via a standard thickener and pumping to existing TSF
- Concentrate handling via established road, rail, port, shipping routes and associated infrastructure.

The proposed processing circuit is a standard crush, grind and flotation process to produce copper concentrate.

NB: Once the Prince Lyell Headshaft is refurbished and becomes operational and above ground hauling of ore is no longer occurring the mine would move the primary crusher underground for operational efficiency. This would remove this source of potential air emissions from the surface environment. It should be noted that traffic movements on internal roads wouldn't cease entirely following the cessation of ore haulage, however, movements would be infrequent and heavy vehicle movements would occur predominantly during day shift and relate to maintenance activities.

Figures 2-3 and 2-4 present preliminary general arrangement drawings of the new processing plant.

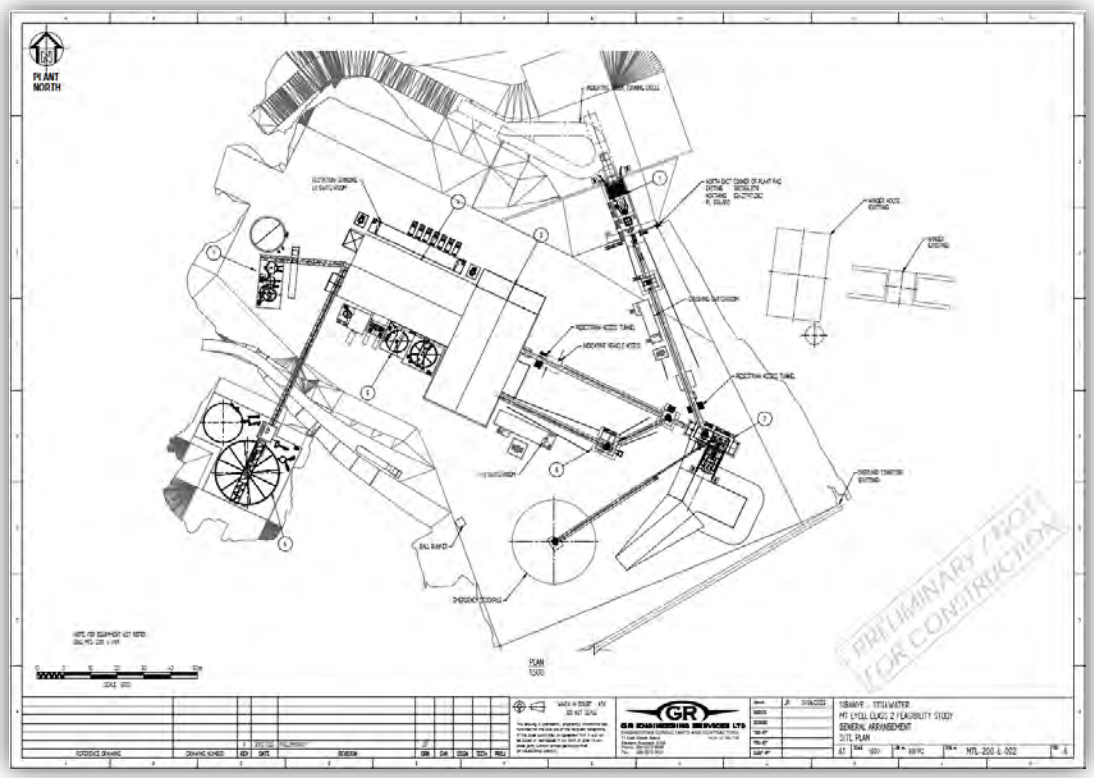


Figure 2-3: New processing plant, preliminary general arrangement, site plan.

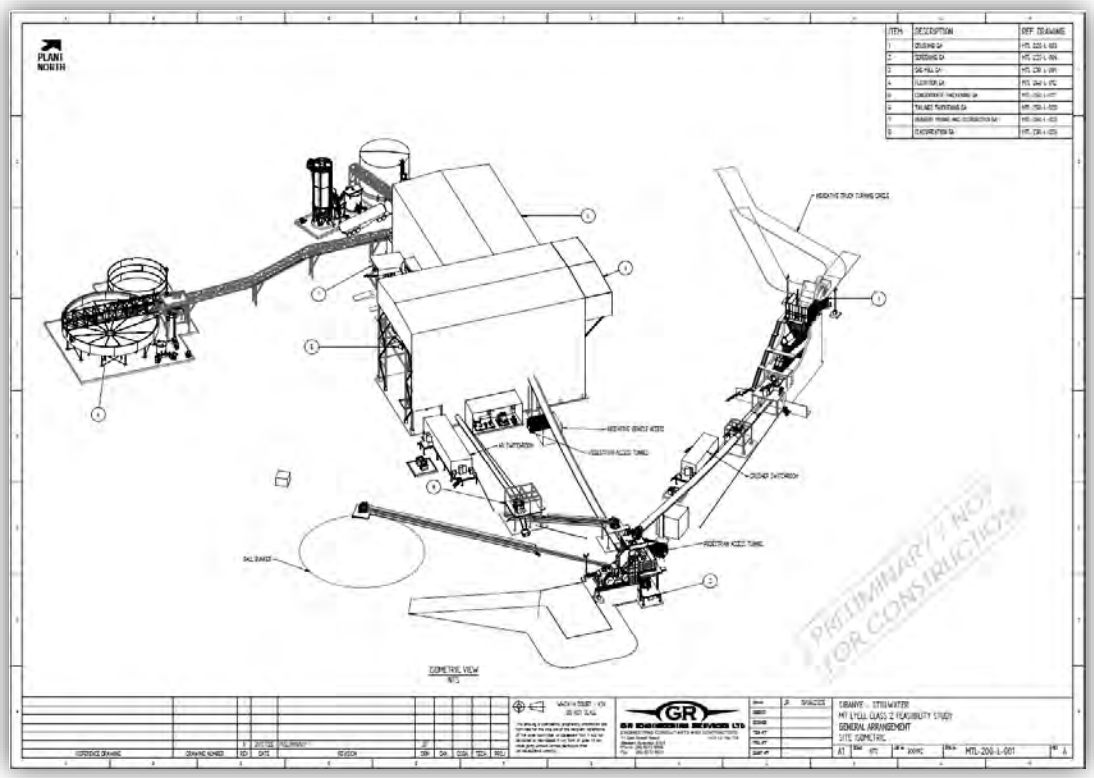


Figure 2-4: New processing plant, preliminary general arrangement, site isometric view.

Sixteen discrete receptors were identified from aerial photography and building polygon and point data on LISTmap in conjunction with local ground surveys. These locations are utilised here for the prediction of the air emission ground level concentrations (glcs).

Position location information is provided in Table 2-1 and Figure 2-5 presents an ariel view from the air emissions model (described below) with receptor locations marked.

Discrete receptor positions		
Number	Location	Coordinates (MGA94, Zone 55 G)
R1	15 Penghana Rd, Queenstown	380870 5341825
R2	17 Penghana Rd, Queenstown	380838 5341843
R3	22 Clark St, Queenstown	380879 5341575
R4	52 Wilsdon St, Queenstown	380845 5341376
R5	10 Huxley Cr, Queenstown	380964 5341383
R6	6 Darwin Cr, Queenstown	380894 5341220
R7	29 Sedgewick St, Queenstown	381056 5341139
R8	37 Sedgewick St, Queenstown	381127 5341044
R9	24 Sedgewick St, Queenstown (M2)	381049 5340926
R10	92-94 Batchelor St, Queenstown	381372 5341122
R11	52 Batchelor St, Queenstown	381199 5340836
R12	2 Penghana Rd, Queenstown	380608 5340681
R13	28 Esplanade, Queenstown (M1)	380299 5340586
R14	2 Bowes St, Queenstown	380949 5340489
R15	21 Montgomery St, Gormanston	383973 5341206
R16	23392 Lyell Hwy, Gormanston	384637 5342126

Table 2-1: Discrete receptor positions.

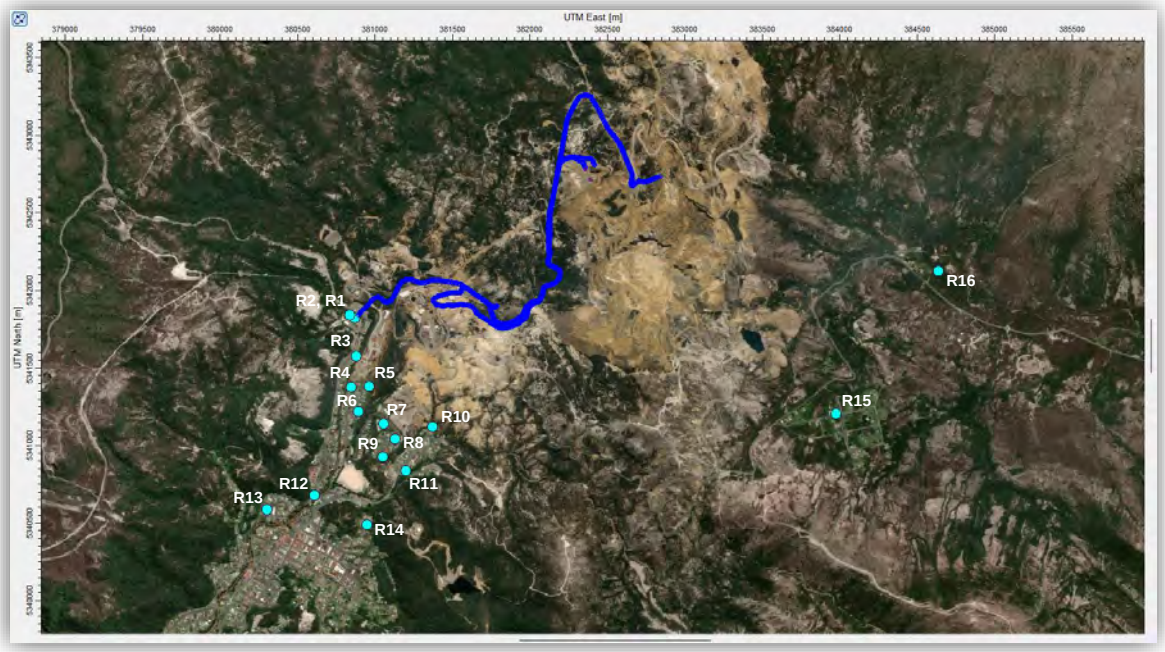


Figure 2-5: Model plan view of Mt Lyell mine and surrounds with the discrete receptor locations marked.

2.1 Terrain

Figure 2-6 below provides an aerial view of the terrain surrounding the Mt Lyell Mine (3D view with X2 exaggeration). The terrain overlay is from the CALMET model (see Section 4.2 of this report for details) and was processed from the SRTM-1 digital elevation model (30 m resolution) data produced by NASA.

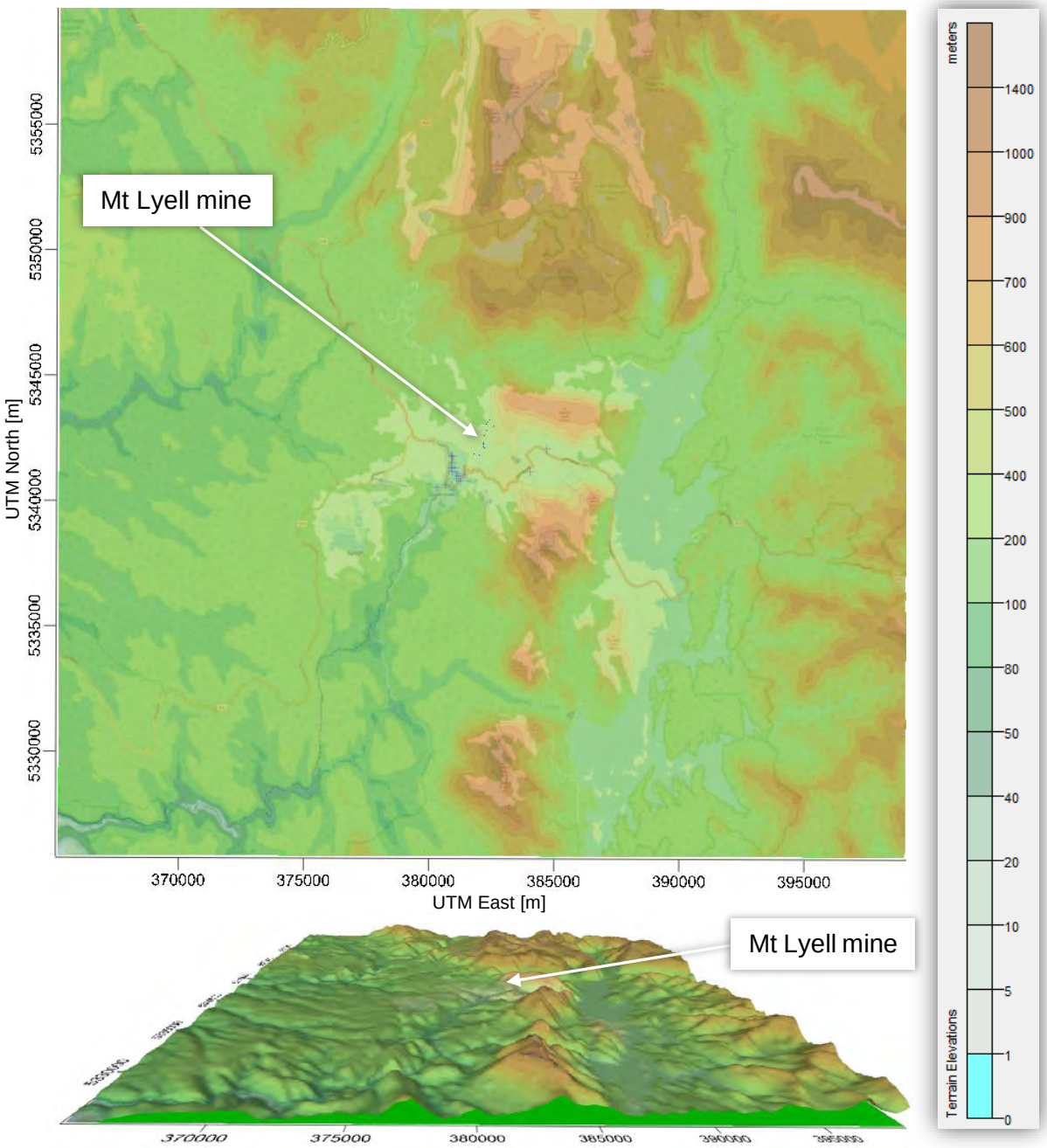


Figure 2-6: Aerial view of the Mt Lyell mine and surrounds with terrain overlay.

3 Legislative context

The *Environment Protection Policy (Air Quality) 2004* (Air Quality EPP), made under section 96K of the *Environmental Management and Pollution Control Act 1994*, provides a framework for the management and regulation of point and diffuse sources of emissions to air for pollutants with the potential to cause environmental harm (the sources of dust from the Mt Lyell mine are fugitive and therefore considered diffuse in nature). The policy protects environmental values, with values to be protected under this policy as follows:

- the life, health and well-being of humans at present and in the future;
- the life, health and well-being of other forms of life, including the present and future health, wellbeing and integrity of ecosystems and ecological processes;
- visual amenity; and
- the useful life and aesthetic appearance of buildings, structures, property and materials.

The Air Quality EPP outlines the following in relation to the management of diffuse air emission sources.

Management of diffuse sources of air pollution

16. (1) Regulatory authorities should manage and regulate diffuse sources of air pollution that have the potential to cause material or serious environmental harm or an environmental nuisance in such a manner as will protect the environmental values identified in this Policy.

    (2) Diffuse sources of air pollution should be managed using best practice environmental management so as to:

        (a) minimise emissions; and

        (b) manage those emissions that are unavoidable in a manner that minimises impacts on health, safety or amenity.

    (3) Diffuse sources of air pollution should be managed in accordance with any relevant guidelines published, adopted or endorsed by the Board for the purposes of this clause.

    (4) Diffuse sources of air pollution must be managed in accordance with any regulations made under the Act.

For the purposes of this assessment the modelling of fugitive dust from the mine will be modelled in accordance with the Schedule 2 – Design Criteria with the '...99.9 percentile peak concentration for averaging periods of one hour or less and the 100 percentile peak concentrations otherwise' considered.

Criteria for air constituent for the assessment of potential environmental harm / nuisance are taken from the Air Quality EPP and subsequent EPA Board Statement from January 2022, *Update to Air Pollutant Design Criteria used in the Environmental Impact Assessment Process*. Concentrations are reported for gas volumes at 25°C and 1 atmosphere. For total suspended particulates (TSP) and dust deposition criteria are taken from the NSW Environment Protection Authority (EPA) with criteria for these constituents not available in Tasmania and NSW standards considered best practice.

3.1 Particulate matter

In the atmosphere, particles range in size from 0.1 to 50 µm. Health impacts relate to the extent to which they can penetrate the respiratory tract. Particles with an aerodynamic diameter greater

than 10 µm, are generally screened out in the upper respiratory tract by adhering to mucus in the nose, mouth, pharynx and larger bronchi and are removed by either swallowing or expectorating. Very fine particles, in particular those less than 2.5 µm, can be deposited in the pulmonary region. It is these particles that are of greatest concern to health.

3.1.1 Particulate matter 10 micrometres or less in aerodynamic diameter (PM_{10})

Averaging period	Maximum concentration
1 day	50 µg/m^3
1 year	25 µg/m^3

3.1.2 Particulate matter 2.5 micrometres or less in aerodynamic diameter ($PM_{2.5}$)

Averaging period	Maximum concentration*
1 day	20 µg/m^3
1 year	7 µg/m^3

* National Environment Protection (Ambient Air Quality) Measure (Air NEPM) criteria.

3.1.3 TSP

NSW EPA criteria.

Averaging period	Maximum concentration
1 year	90 µg/m^3

3.1.4 Dust deposition

Deposition of insoluble solids, NSW EPA criteria

Maximum rate	Maximum increase
4 g/m^2/month	2 g/m^2/month

NB: Deposition wasn't modelled here with the risk of high levels of dust deposition at or beyond the boundary of the mine considered to be very low given the location of the new processing area and internal road systems relative to the boundary (see Figures 2-1 and 2-2).

3.1.5 Respirable crystalline silica

Inhaled in the form of quartz or cristobalite (measured as $PM_{2.5}$).

Averaging period	Maximum concentration
3-minute	3.3 µg/m^3

3.2 Heavy metals

Heavy metals are a group of metallic chemical elements that have relatively high densities with some toxic or poisonous at low concentrations.

Heavy Metal	Averaging period	Maximum concentration
Arsenic*	3 minutes	0.17 µg/m^3
Beryllium		0.07 µg/m^3
Cadmium		0.033 µg/m^3
Chromium		17 µg/m^3
Copper		33 µg/m^3
Lead	90 days	1.5 µg/m^3
	1 year	0.5 µg/m^3
Manganese	3 minutes	33 µg/m^3
Nickel		0.33 µg/m^3

* metalloid

4 Modelling methodology

CALPUFF was utlised here for the modelling of dust emissions from the mine. This is a non-steady-state Lagrangian Gaussian puff model. CALPUFF employs the three-dimensional meteorological fields generated from the CALMET model (non-steady-state diagnostic three-dimensional meteorological model) by simulating the effects of time and space varying meteorological conditions on pollutant transport, transformation and removal. Emission sources can be characterised as arbitrarily-varying point, area, volume and lines or any combination of the three within the modelling domain.

4.1 TAPM

To generate the broad scale meteorological inputs to run CALPUFF, this study has used The Air Pollution Model (TAPM), a 3-dimensional prognostic model developed by CSIRO. The output from TAPM is used to generate the appropriate meteorological data for the CALPUFF modelling system. TAPM (v 4.0.4) was configured as follows:

- Centre coordinates – 42˚ 3.500 S, 145˚ 34.500 E (UTM coordinates 382091, 5342765).
- Dates modelled – 1st January 2023 to 31st December 2023.
- Four nested grid domains of 30 km, 10 km, 3 km and 1 km.
- 41 x 41 grid points for all modelling domains.
- 30 vertical levels from 10 m to an altitude of 8000 m above sea level.
- The default TAPM databases for terrain, land use and meteorology were used in the model, including the *TasVeg250m* land use file.

4.2 CALMET

CALMET is an advanced non-steady-state diagnostic three-dimensional meteorological model with micrometeorological modules for overwater and overland boundary layers. The model is the meteorological preprocessor for the CALPUFF modelling system.

Version 6.5.0 of CALMET was used with the following key settings utlised:

- Domain area of 170 by 170 grid cells at 200 m spacing, SW corner coordinates 365091, 5325765.
- Twelve vertical levels: 20 m, 30 m, 40 m, 60 m, 80 m, 160 m, 320 m, 640 m, 1,200 m, 2,000 m, 3,000 m and 4,000 m.
- Dates modelled – 1st January 2023 to 31st December 2023.
- No observations mode, full prognostic wind fields from TAPM (1 km domain) input as MM5/3D.dat at surface and upper air for "initial guess" field.
- No extrapolation of surface winds observations.
- All other wind field options default.
- Mixing height parameters default.
- Terrain radius of influence 7.0 km.
- 3D Relative humidity and temperature from prognostic data.
- Gridded cloud cover from prognostic RH at all levels.
- Land use data was created using generic land use codes, with editing based on comparison with aerial photographic imagery.
- Terrain data from SRTM-1 digital elevation model (30 m resolution) data produced by NASA (see figure 2-2 for details).
- No data assimilation.
- All other options default.

Figure 4-1 provides an aerial view of the study area with an overlay of generic land use categories as assigned in CALMET.

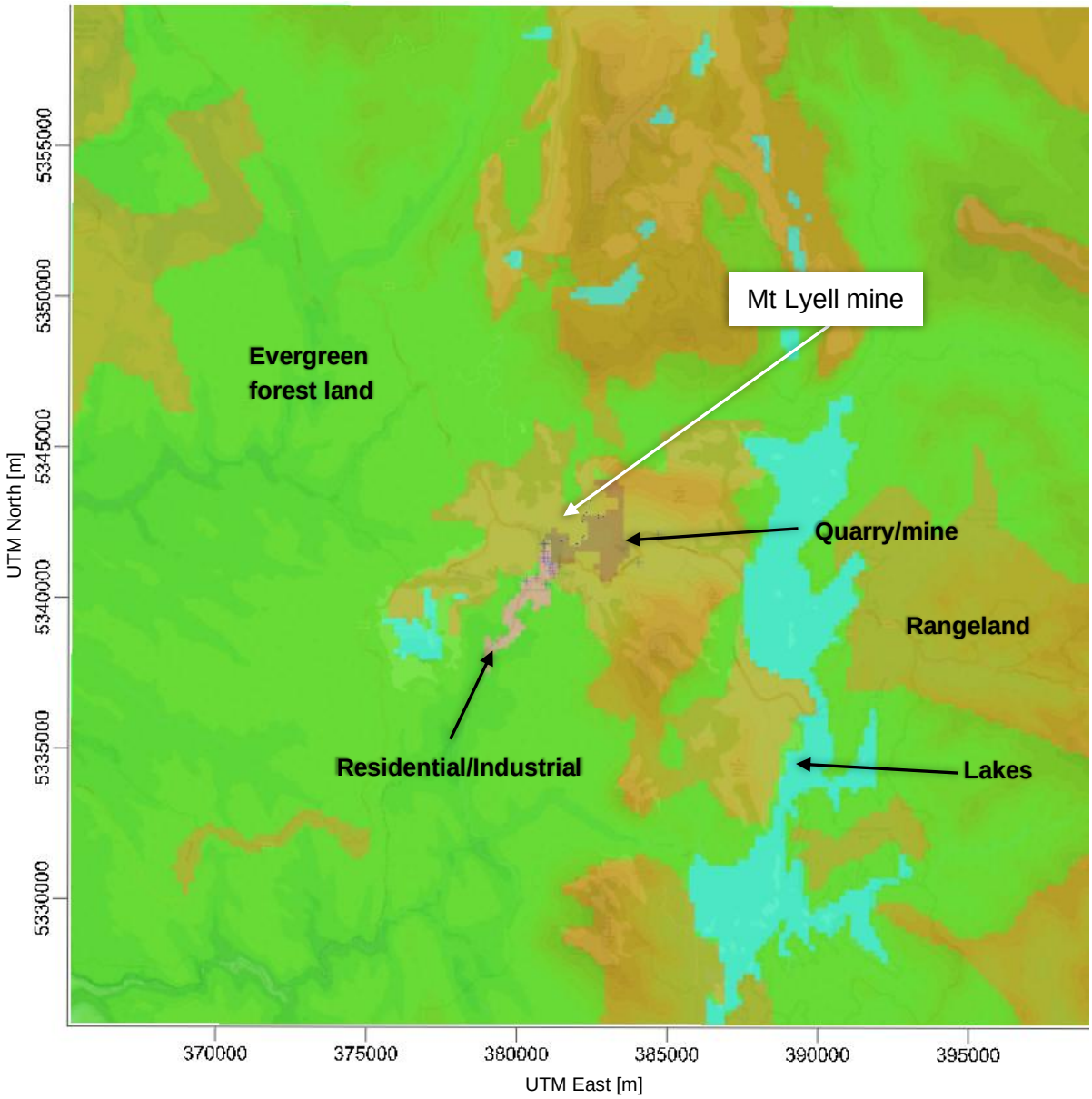


Figure 4-1: Aerial view of study area with land use overlay.

4.3 CALPUFF

Version 7.2.1 of CALPUFF was used with the following key settings utilised:

- Domain as for CALMET model
- 16 discrete receptors at residential locations and boundary receptors at 100 m spacing.
- Dates modelled – 1st January 2023 to 31st December 2023.
- Modelled species: PM10, type: particle, concentration modelled.
  TSP, type: particle, concentration modelled.
  PM2.5, type: particle, concentration modelled.
- Gridded 3D hourly-varying meteorological conditions generated by CALMET
- No chemical transformation modelled.

- Dispersion coefficients calculated using turbulence computed from micrometeorology with a probability density function (PDF) method used for sigma-z in the convective boundary layer.
- All other options default.
- Sampling grid domains at 2 x 2 km at 50 m resolution (computational grid cells: x-axis 78 to 85, y-axis 73 to 82) and 2 x 2 km at 50 m resolution (computational grid cells: x-axis 79 to 88, y-axis 73 to 82).

5 Meteorology

NB: Please note the use of letter designations for wind directions in the following subsections.

The nearest representative Bureau of Meteorology (BoM) weather station is located at the Queenstown (7XS) (Station number 097034), approx. 1 km SSW of the mine.

Long term weather data was obtained from the BoM weather station at the Queenstown (7XS) (1964 – 1995) and presented in Table 5-1. The mean temperature range is between 2 and 22 °C with the coldest month being July and the hottest months being January and February. The rainfall in the region is highest in Winter and lowest in late Summer. The mean annual rainfall is approx. 2404 mm.

Climate stats - QUEENSTOWN (7XS)									
Month	Mean temp (°C)		Rainfall (mm)	9 a.m. conditions			3 p.m. conditions		
	Max.	Min.		Temp (°C)	RH (%)	Wind speed (km/h)	Temp (°C)	RH (%)	Wind speed (km/h)
Jan	21.0	8.3	149.9	13.7	83	7.1	18.7	60	15.9
Feb	22.0	8.6	98.8	13.6	86	5.4	20.1	60	13.3
Mar	19.9	7.6	147.2	12.3	87	5.7	17.8	65	12.4
Apr	16.6	6.5	211.3	10.5	90	5.8	15.1	72	10.8
May	14.4	4.5	241.4	8.1	92	6.1	12.8	76	8.5
Jun	12.2	2.7	212.7	6.0	92	5.4	10.9	77	7.2
Jul	11.6	2.4	268.6	5.7	92	5.5	10.2	77	8.8
Aug	12.4	3.1	267.5	6.7	89	6.8	10.9	73	10.4
Sep	13.5	4.0	248.5	8.7	84	8.3	11.9	71	12.6
Oct	15.9	5.1	209.9	11.0	78	8.5	14.0	64	14.0
Nov	17.6	6.4	183.7	11.9	81	9.3	16.0	63	15.6
Dec	19.3	7.9	168.1	13.4	80	7.7	17.6	63	14.5
Annual	16.4	5.6	2404.1	10.1	86	6.8	14.7	68	12.0

Table 5-1: Long term climate statistics, BoM weather station QUEENSTOWN (7XS): 097034.

5.1.1 Wind roses

Figure 5-2 presents average 9 am and 3 pm wind roses for the Queenstown (7XS) station.

The 9 am BoM wind rose shows a high proportion of calm conditions with the most prominent wind direction the SW.

The 3 pm BoM wind rose shows a significant decrease in calm conditions with the SW again the most prominent wind direction.

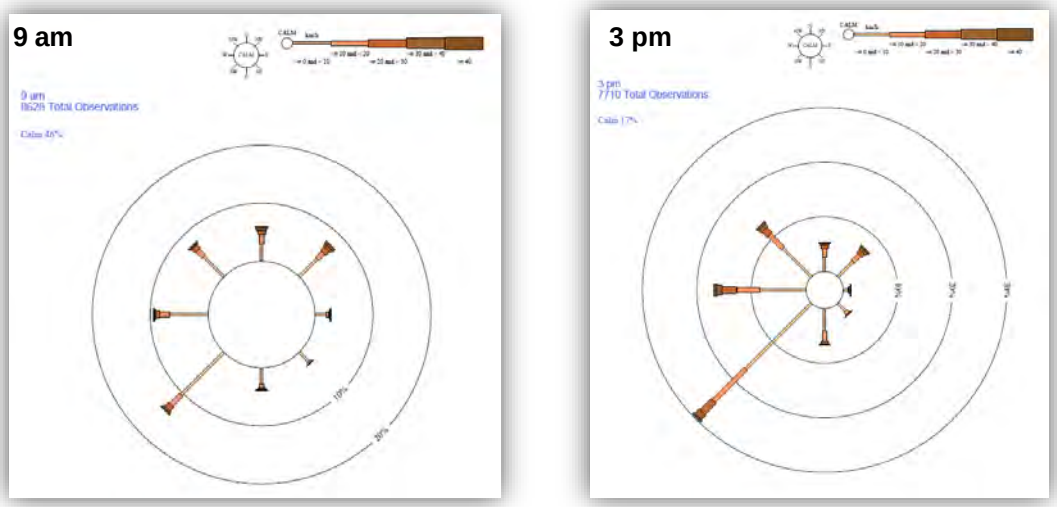


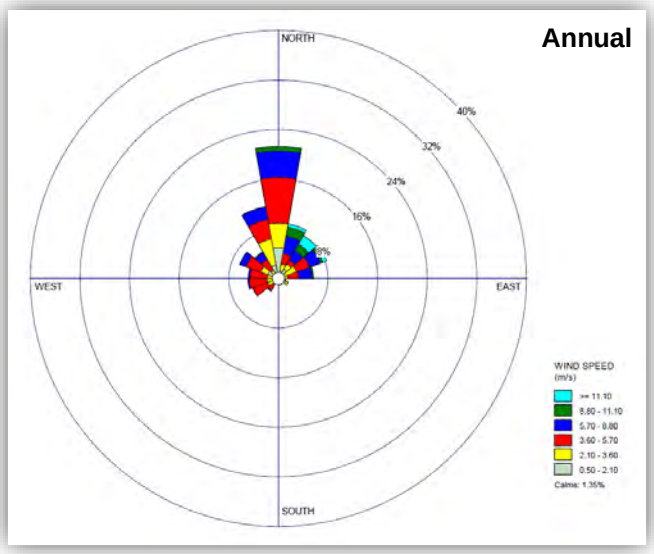
Figure 5-1: 9 am and 3 pm wind roses for the Queenstown (7XS) station.

5.1.2 CALMET meteorological outputs

5.1.2.1 Wind fields

Figure 5-2 and 5-3 present annual, seasonal and diurnal (day and night) CALMET wind roses from the Mt Lyell mine site. High wind speeds are generally most common from the N and NE, indicative of the local topographic influence on winds at the site (see Figure 2-5 for a representation of the local topography in the model). Winds are more common from the north in the Autumn and Winter. The very high wind speeds from the N and NE are more common at night.

NB: The proportion of calm conditions in the CALMET wind roses compared to the local BoM station is notable, this is a known issue with CALMET which as a tendency to under predict calm conditions.



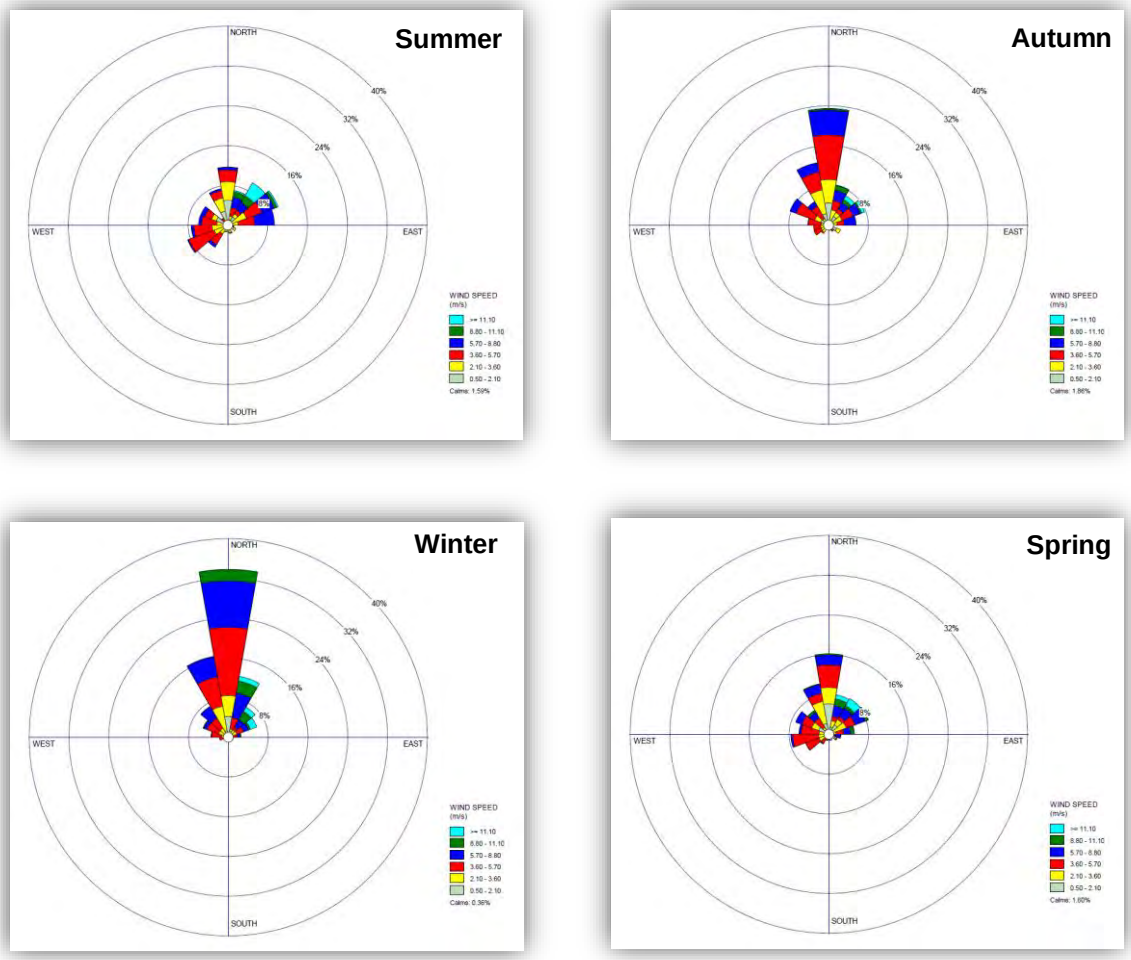


Figure 5-2: Annual and seasonal CALMET wind roses for the Mt Lyell mine.

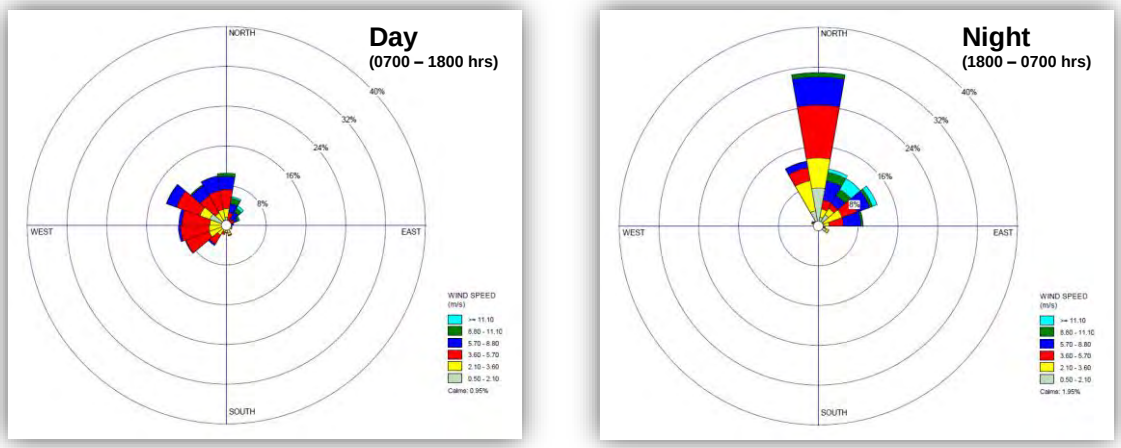


Figure 5-3: Day and night CALMET wind roses for the Mt Lyell mine.

Figures 5-4 and 5-5 present CALMET diurnal variation in wind speed and direction respectively at the mine site. Wind speeds are on average stronger and more variable during the day while the wind direction data shows winds are absent from the S and W during the night.

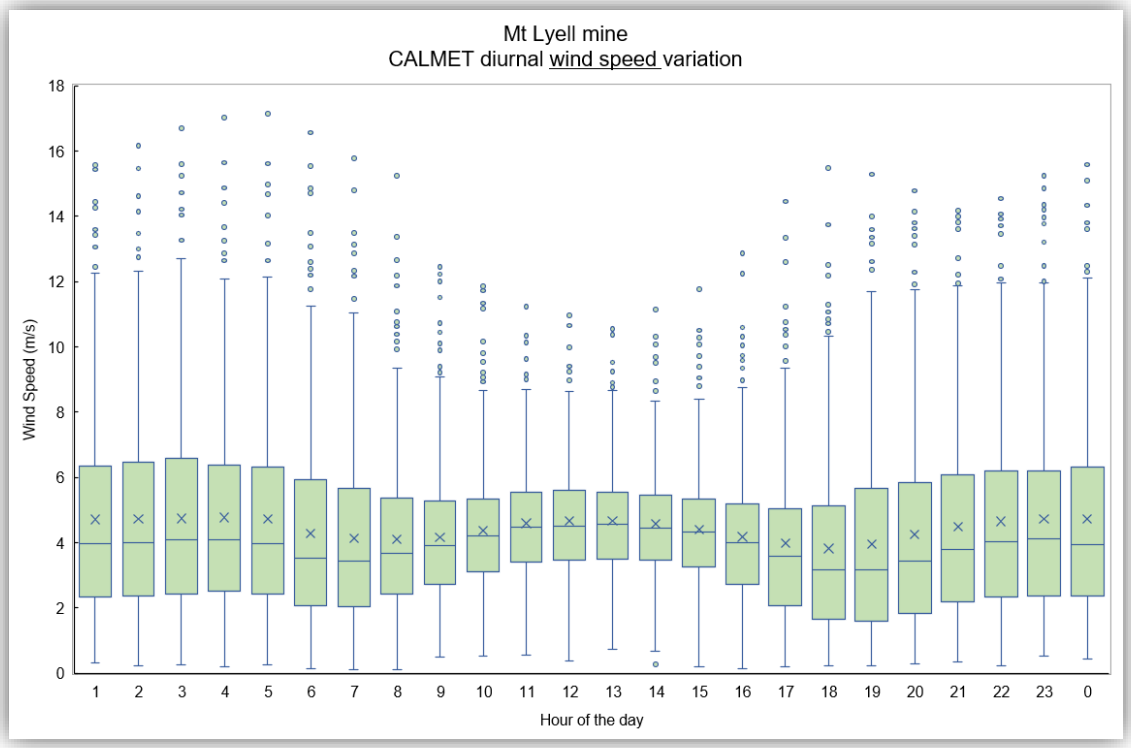


Figure 5-4: CALMET diurnal wind speed variation at the Mt Lyell mine.

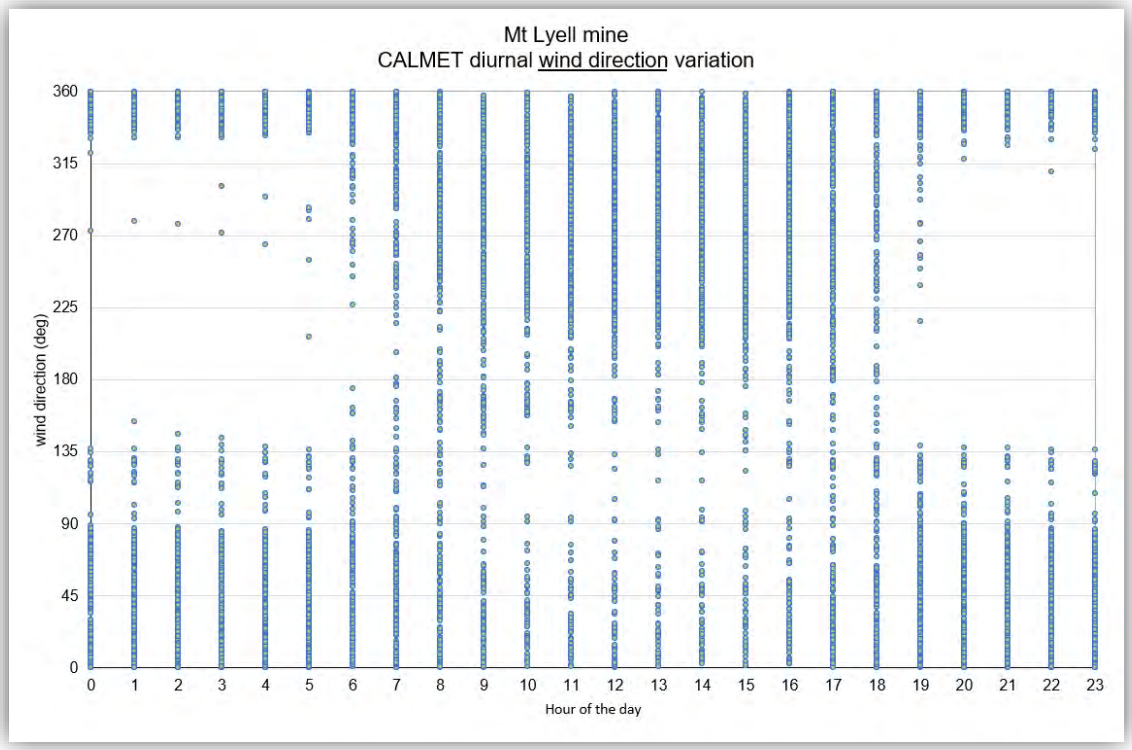


Figure 5-5: CALMET diurnal wind direction variation at the Mt Lyell mine.

5.1.2.2 Mixing height

The mixing height determines the height above ground that a pollutant emitted will be mixed by turbulent air flow, i.e. lower mixing height, less potential dispersion. CALMET diurnal variation in mixing height at the Mt Lyell mine is shown in Figure 5-6.

An increase in the mixing height is observed during the morning due to the increase in solar radiation following sunrise. Typically, maximum mixing heights occur in the mid to late afternoon and descends in the early evening. The mixing height is low during the night (typical of a valley location) and higher and more variable during the day under the influence of incoming solar radiation. Under these conditions dust dispersion is likely to be generally poor at night.

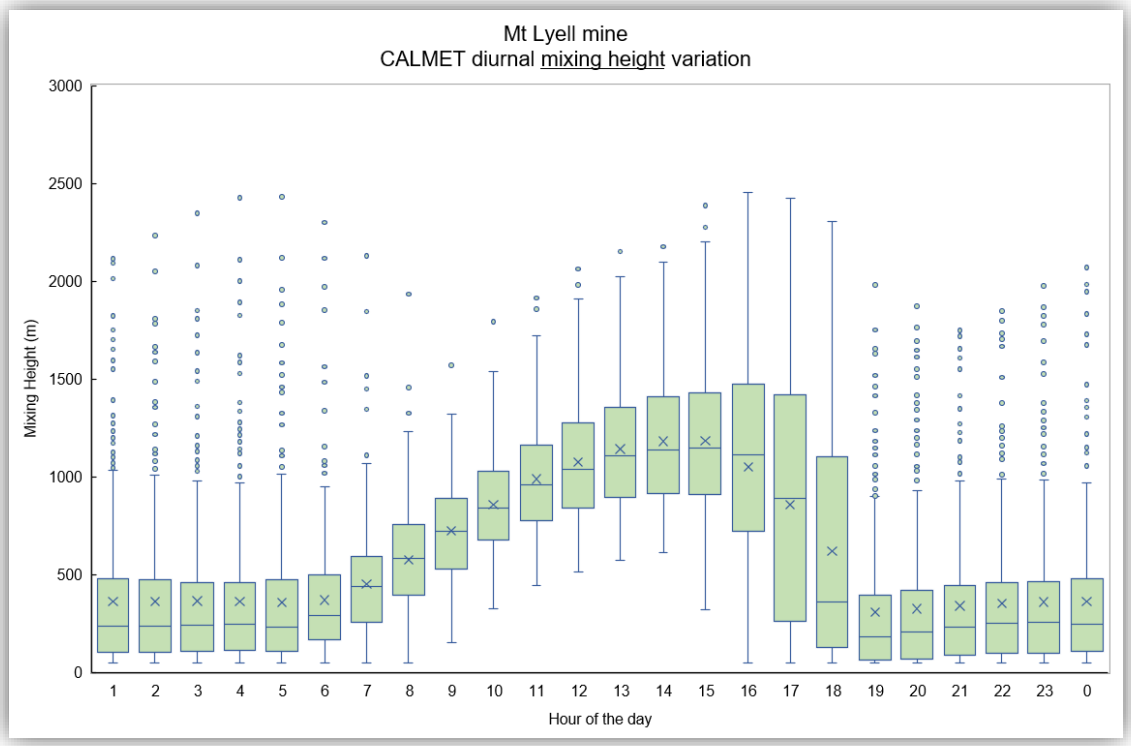


Figure 5-6: CALMET diurnal mixing height variation at the Mt Lyell mine.

5.1.2.3 Atmospheric stability

Atmospheric stability refers to the tendency of the atmosphere to lesson or augment vertical motion. Pasquill Stability Classes (stability classes A to F) categorise the degree of atmospheric stability. These classes characterise prevailing meteorological conditions and are an input into the air dispersion model. Figure 5-7 presents CALMET diurnal variation in atmospheric stability at the Mt Lyell mine. Table 5-2 provides the percent occurrence of each class across the modelled year along with a brief description of the class with regard to atmospheric stability.

The results in Figure 5-8 show that relatively unstable conditions are normal during the day, whilst stable to neutral conditions typically occur at night (i.e. less dispersive conditions at night). The data from Table 5-2 identifies that stability class D, representing neutral atmospheric conditions, as the most commonly occurring stability class throughout the year modelled.

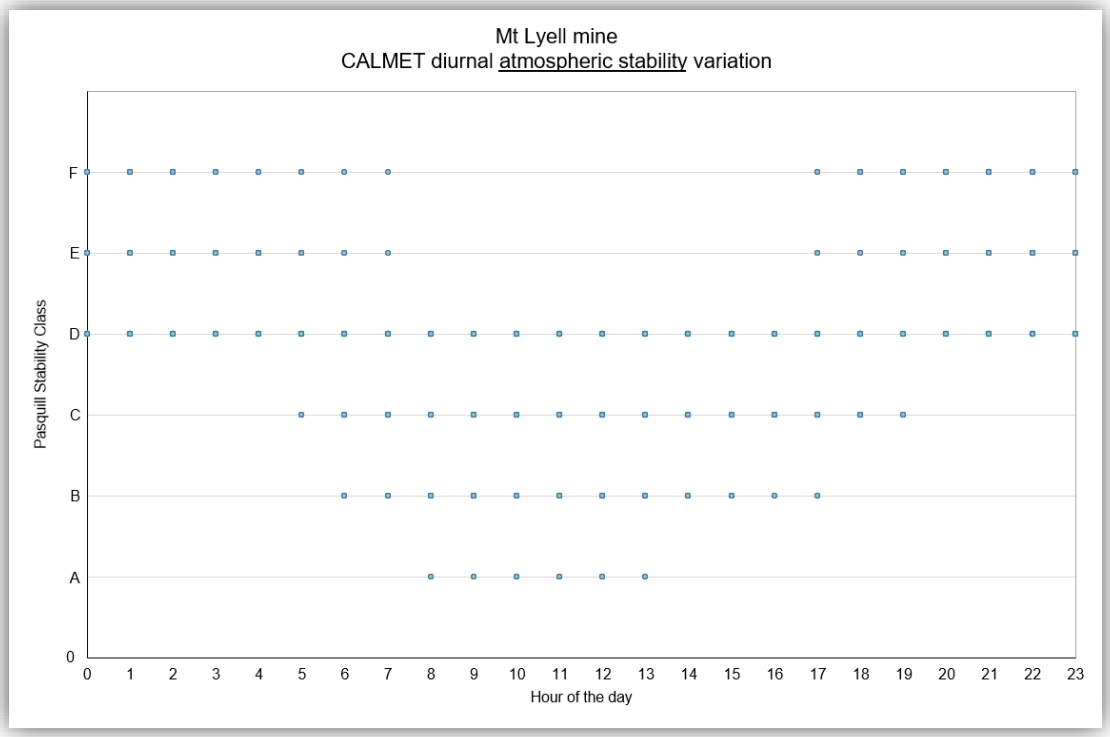


Figure 5-7: CALMET diurnal atmospheric stability variation at the Mt Lyell mine.

Pasquill stability class annual occurrence		
Stability class	Description	Percent occurrence (%)
A	Very unstable low wind, clear skies, hot daytime conditions	0.7
B	Unstable clear skies, daytime conditions	4.7
C	Moderately unstable moderate wind, slightly overcast daytime conditions	8.6
D	Neutral high winds or cloudy days and nights	75.2
E	Stable moderate wind, slightly overcast night-time conditions	5.7
F	Very stable low winds, clear skies, cold night-time conditions	5.2

Table 5-2: CALMET annual percent occurrence of atmospheric stability classes at the Mt Lyell mine.

6 Background concentrations

Information relating to the background constituent concentrations is provided by data from the Tasmanian Environmental Protection Authority (EPA) BLANkET station at Queenstown that provides PM_{10} and $PM_{2.5}$ monitoring data (noting this data is not reference validated by acknowledgement of the EPA). Background levels of these constituents of dust are generally taken as the 70th percentile of long-term monitoring data. From the past three years of data at the station the following are 70th percentile levels of 24 hr average concentrations.

- PM_{10}: 5.2 ug/m^3
- $PM_{2.5}$: 3.1 ug/m^3

Utilising the 1 hr average data collected at the station and 1 hr average weather data collected concurrently at the station the particulate concentrations were filtered to only consider samples when the wind was from the north-east (the direction of the Mt Lyell mine). This results in the following 70th percentile levels of 1 hr average concentrations

- PM_{10}: 5.0 ug/m^3
- $PM_{2.5}$: 2.7 ug/m^3

The levels are similar with the 1 hr average data from the north-east quadrant utilised here as background for the study.

While not considered in this study due to low-risk, dust deposition data from the Mt Lyell mine operations up to 2013, when the processing plant was located near the existing administration offices, showed that at boundary monitoring locations long term average deposition rates of approx. 2.5 g/m^2/month for insoluble solids. This is well below the criteria level of 4 g/m^2/month and showed no evidence of rises of 2 or more g/m^2/month. Noting that at the time of this monitoring the mine's processing plant was located close to the entry to the mine, significantly closer to the mining lease boundary than the new processing plant.

Figure 6-1 presents an aerial view from the *Dust Fallout Survey 2012* with the sampling locations marked while Table 6-1 presents summary results, average from 2009 to 2012, for the sampling locations shown in Figure 6-1.

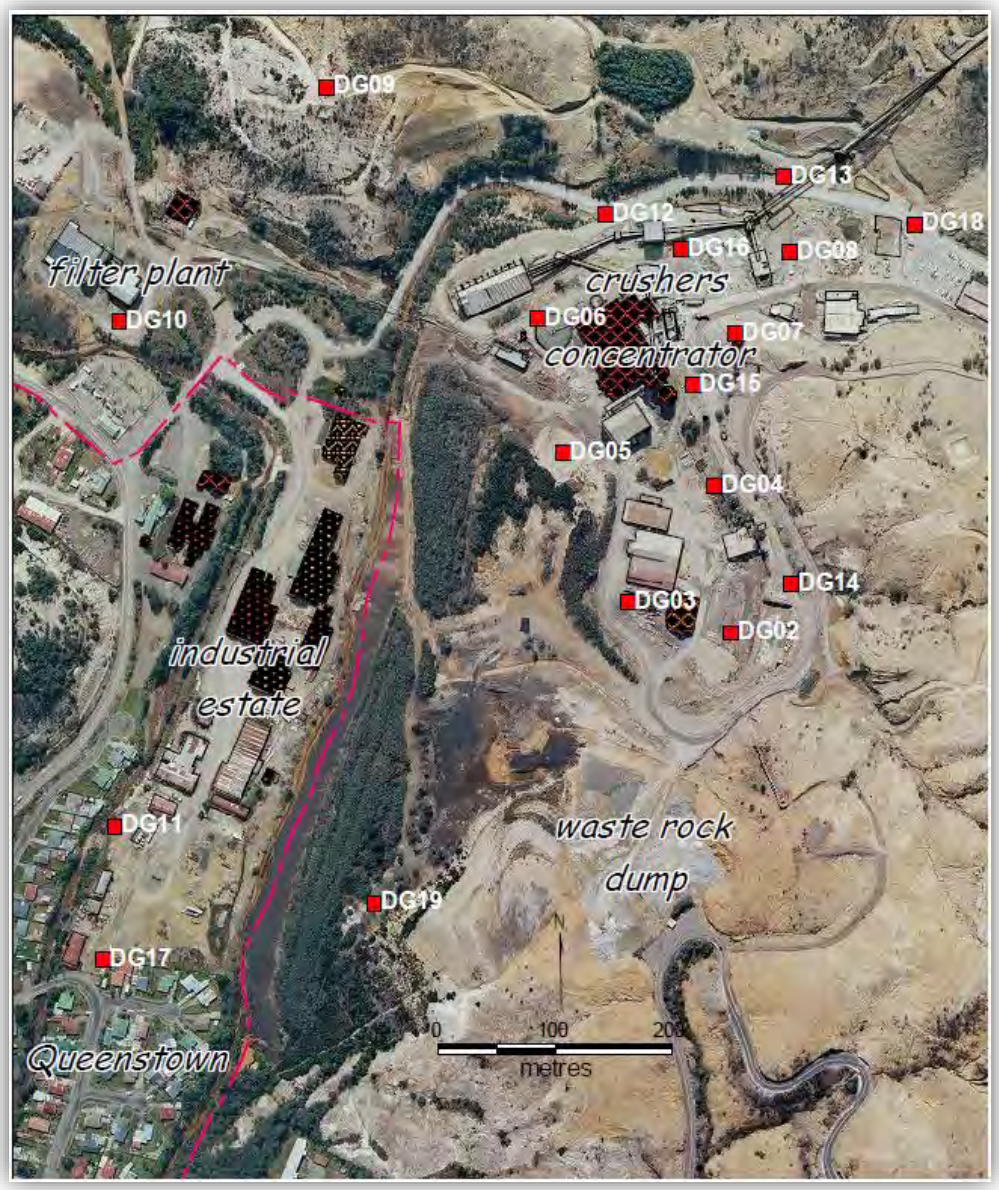


Figure 6-1: Aerial view from the *Dust Fallout Survey 2012* report showing dust gauge locations.

Sample ID		full data set July 2009 to Dec 2012 average total	insoluble	soluble
DG01	boundary	5.4	2.1	3.4
DG02	ambient	11.3	7.8	3.5
DG03	ambient	11.5	7.8	3.6
DG04	ambient	29.8	25.2	4.6
DG05	ambient	13.5	8.2	5.2
DG06	crushers	18.0	14.4	3.6
DG07	crushers	55.7	51.2	4.5
DG08	crushers	34.8	30.4	4.4
DG09	control	7.5	2.8	4.8
DG10	ambient	10.8	7.2	3.6
DG11	boundary	5.8	2.4	3.4
DG12	crushers	28.8	24.8	4.0
DG13	crushers	28.2	24.6	3.6
DG14	ambient	13.1	9.3	3.8
DG15	crushers	146.6	138.3	8.3
DG16	crushers	53.2	48.8	4.4
DG17	boundary	6.0	2.7	3.3
DG18	ambient	26.1	22.5	3.6
DG19	boundary	6.6	2.8	3.7
Grand Total		28.3	24.1	4.2

Summary

	full data set July 2009 to Dec 2012 average total	insoluble	soluble
control	7.5	2.8	4.8
boundary	6.0	2.5	3.5
ambient	16.6	12.6	4.0
crushers	52.2	47.5	4.7

Table 6-1: Summary dust data (average g/m^2/month) from the *Dust Fallout Survey 2012* report.

The summary results show elevated insoluble solids levels near to processing units and low levels, as described above, at boundary locations. Soluble solids show relatively uniform concentrations across the dust gauges, with the exception of gauge DG15 in close proximity to the crushers in the processing plant. This suggests a source of soluble solids that isn't associated with the mine's operations but rather it is from the broader airshed. Typically, in a location like Queenstown, this source would likely be coastal winds carry salt particles inland which are deposited on the gauges and dissolve in the collected liquid.

The following study was conducted in 2013 to …' characterise the mineralogical, geochemical and morphological features of dust collected at key sites across the CMT dust sampling network.'

> Noble, T, L. and Lottermoser, B, G. (2013) *Pilot Project Report, Characterisation of mineral dust properties at Mt Lyell, CMT*. CRC For Optimising Resource Extraction.

In the above study Inductively Coupled Plasma Mass Spectrometry (ICP-MS) was used to determine metal and metalloid concentrations in dust deposition samples at the Mt Lyell mine. Nobel and Lottermoser (2013) noted that 'In general the dust samples showed minor (>1000 mg/kg) Cu, Zn and Mn, subminor (>100 mg/kg) Pb and Co, and trace amounts of Be, Cd, Cr, Ni, As and Se.'

Table 6-2 below is from the report providing metal concentrations in mg/kg from each sampling location while Figure 6-2 presents an aerial view with the sampling locations marked. Those highlighted in the figure denote gauges from which metal and metalloid concentrations were determined.

mg/kg	DG03	DG06	DG09	DG10	DG13	DG14	DG15	DG17	DG19
Be	0.8	0.9	0.6	0.6	0.8	0.8	1.0	0.5	0.5
Cd	2.3	2.7	2.5	3.2	2.7	2.1	3.3	2.1	0.7
Pb	176	180	165	205	163	147	191	176	108
Cr	54.5	57.6	42.0	76.1	39.3	37.5	32.9	93.3	34.3
Mn	1202	1499	1142	476	1416	1102	1635	768	385
Co	108	135	81	52	111	87	157	54	37
Ni	36.7	33.9	49.0	24.6	25.7	24.0	32.7	56.2	17.0
Cu	13713	14581	12825	21362	13927	12105	18374	6416	3485
Zn	1516	1204	1831	1318	1080	1308	1102	2919	1663
As	34.1	38.1	22.5	22.8	25.4	22.0	43.9	18.7	6.1
Se	6.1	6.5	6.0	5.8	5.5	5.0	6.1	4.0	1.2

Table 6-2: Elemental concentrations from dust gauge samples as reported in Nobel and Lottermoser (2013).

Figure 6-2: Aerial view from Nobel and Lottermoser (2013) showing dust gauge locations.

7 Emission sources and boundary receptors

From information provided to Tarkarri Engineering in relation to the equipment to be utilised at the mine and internal vehicle movements dust emission modelling scenarios were developed and are described below. Emission rates for sources of fugitive dust emissions were calculated from the *National Pollutant Inventory Emission Estimation Technique Manual for Mining Version 3.1* (NPImining)[1] (calculation details are provided in the Appendix of this report).

Table 7-1 presents source input information with sources names designations denoting the following:

- CRU/SCR: crushing and screening in the processing plant.

  NB: The remaining processes in the processing plant are wet and wouldn't generate dust emissions. The calculation of emissions from the crushing and screening plant assumes that the ore is dry which is unlikely to be the case, resulting in emission rates that are conservative.

- HAUL 1: haul trucks portal to crusher
- HAUL 2: haul trucks crusher to portal
- HAUL 3: haul trucks portal to upper existing operational areas
- HAUL 4: haul trucks upper existing operational areas to portal
- TRUCK: truck from gate to processing

HAUL 3 and 4 are included to account for existing traffic not associated with ore transport to address cumulative traffic emissions from the site.

The emission calculations didn't have factors for $PM_{2.5}$. A ratio of PM_{10} to $PM_{2.5}$ from published data[1][2][3] of 0.2 was utilised to determine $PM_{2.5}$ emission rates.

From section 5.3 Table 4 of the NPImining[1] the following controls were modelled:

- Level 1 haul road watering (2 litres/m^2/h), 50 % reduction of vehicle movement generated emissions. This would only be required during periods when rainfall is low.

Model input emission source data								
Volume sources								
Emission source	Height (m)	Length of side (m)	Initial sigma Y (m)	Initial sigma Z (m)	Hours per year	Emission rate (kg/hr)		
						TSP	PM_{10}	$PM_{2.5}$
JAW CRU	5	2	0.93	0.93	8760	2.97000	1.18800	0.23760
SCR	3	2	0.93	0.93	8760	2.97000	1.18800	0.23760
Line volume sources								
Emission source	Height (m)	Length of side (m)	Initial sigma Z (m)	Config and type	Hours per year	Emission rate (kg/hr)		
						TSP	PM_{10}	$PM_{2.5}$
HAUL_1	1	20	2	Separated, surfaced-based	8760	10.23550	3.13330	0.62670
HAUL_2	1	20	2		8760	10.0420	3.07410	0.61480
HAUL_3	1	20	2		8760	1.07020	0.32760	0.06552
HAUL_4	1	20	2		8760	0.91230	0.21560	0.04311
TRUCK	0.75	20	1.5		8760	1.71820	0.52600	0.10520

Table 7-1: Model input source information.

Figures 7-1 and 7-2 show aerial views with the dust emission source locations marked. Figure 7-3 presents aerial view the extent of the modelled boundary receptor array marked (receptor every 100 m) representing the mining lease boundary to the east, south and west (the full extent of the northern mining lease boundary wasn't modelled).

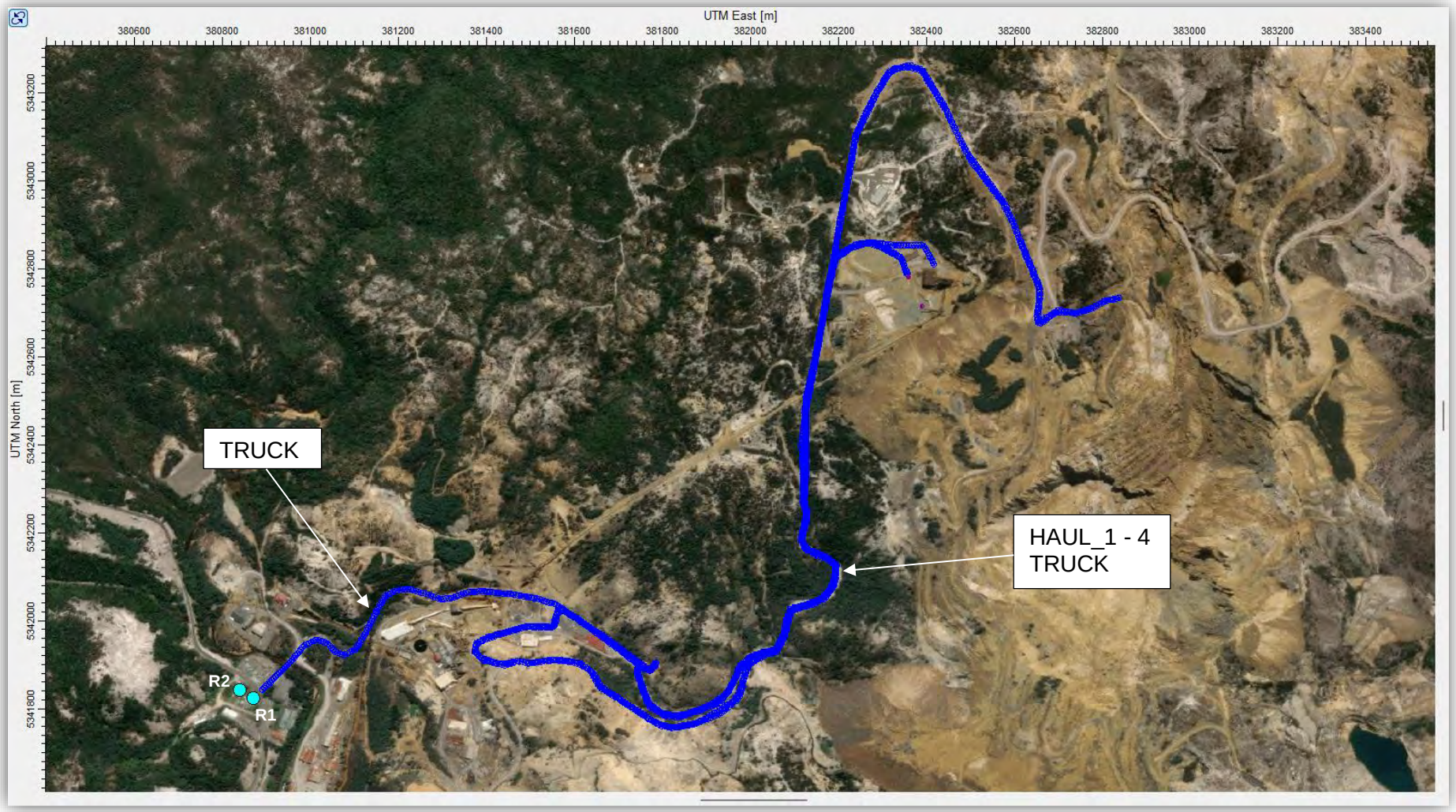


Figure 7-1: Aerial view showing dust emission source locations.

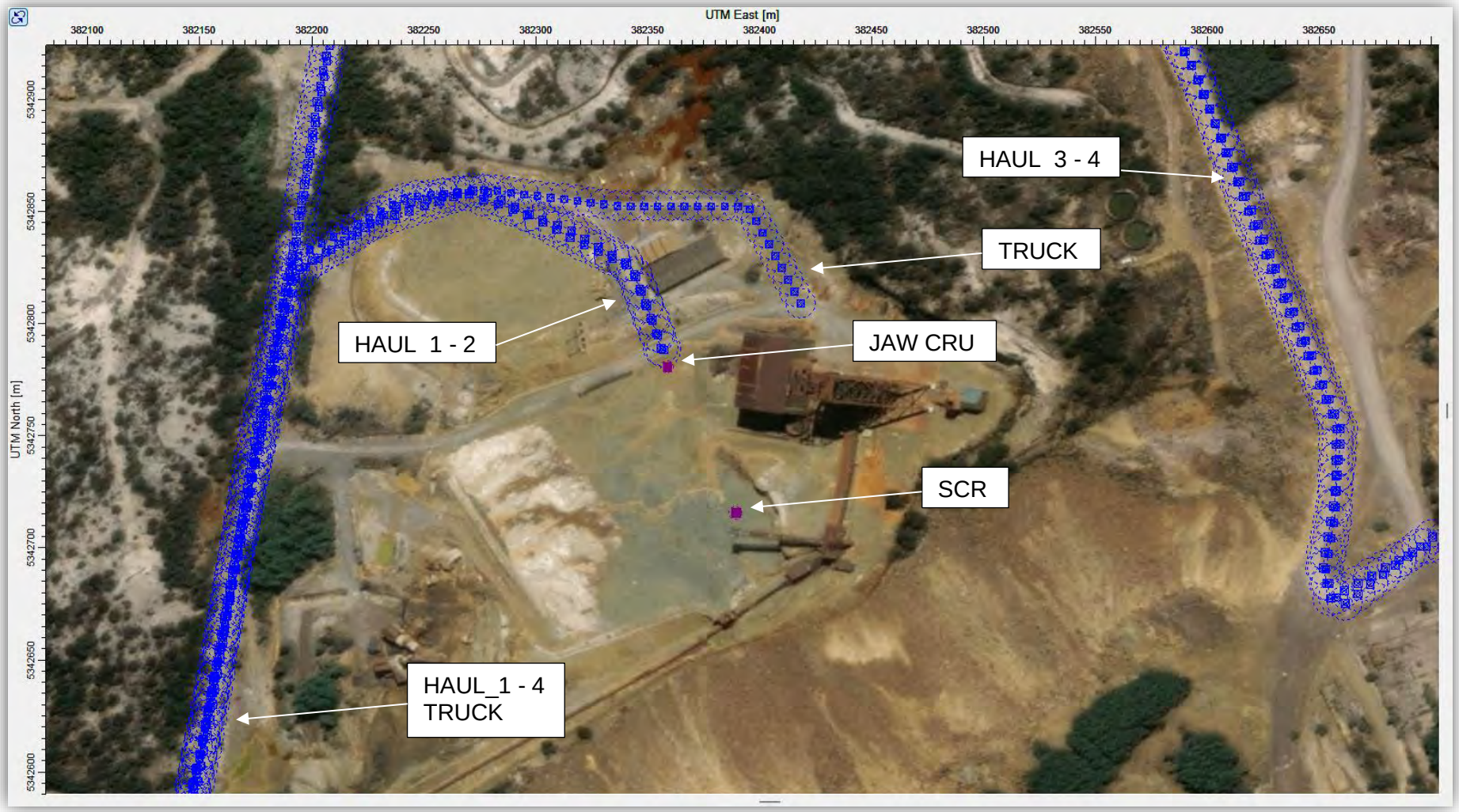


Figure 7-2: Aerial view showing dust emission source locations, Processing area.

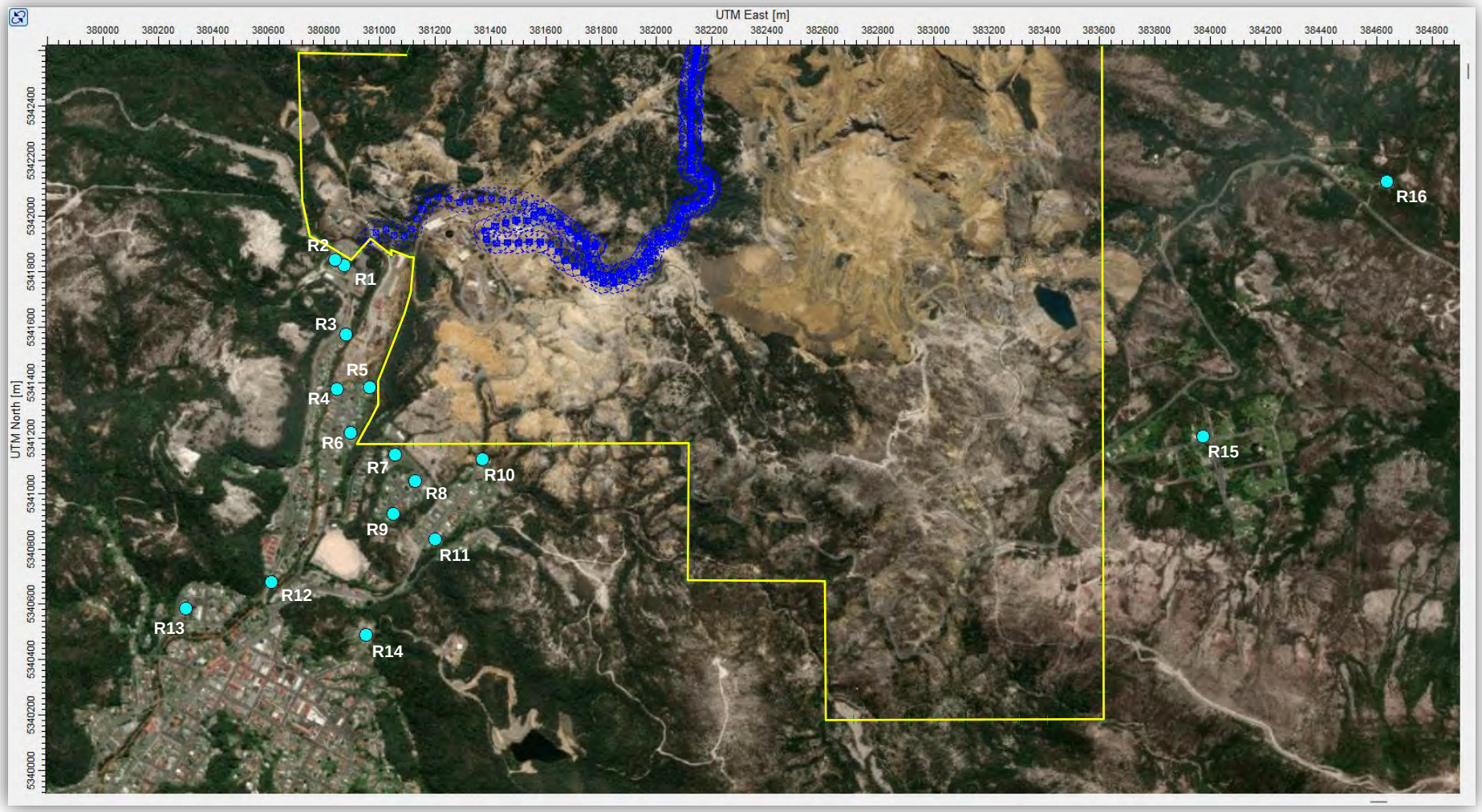


Figure 7-3: Aerial view showing the extent of the boundary receptor array.

8 Modelling results

Dispersion modelling of dust emissions from the Mt Lyell mine has been undertaken in accordance with the *Tasmanian Air Dispersion Modelling Guidelines*, utilising model set up parameters outlined in section 4 of this report, to assess the predicted 100th percentile 24-hr average ground level concentrations (glc's) for PM_{10} and $PM_{2.5}$ and annual average glc's for PM_{10}, $PM_{2.5}$ and TSP.

NB: The italicised values presented below include background concentrations of PM_{10} and $PM_{2.5}$ as detailed in section 6.

Tables 8-1 presents glc's for PM_{10}, TSP and $PM_{2.5}$ at the 16 discrete receptor locations (values in brackets in the column headers represent the criteria levels detailed in section 3) with exceedance of criteria levels highlighted in grey.

Discrete receptor location glcs (µg/m^3) particulates					
Recep.	PM_{10}		$PM_{2.5}$		TSP
	24-hr av. (50 µg/m^3)	Annual av. (25 µg/m^3)	24-hr av. (20 µg/m^3)	Annual av. (7 µg/m^3)	Annual av. (90 µg/m^3)
R1	17.5 *22.5*	2.1 *7.1*	6.8 *9.5*	0.4 *3.1*	6.8
R2	17.0 *22.0*	1.9 *6.9*	6.2 *8.9*	0.4 *3.1*	6.2
R3	20.7 *25.7*	2.6 *7.6*	8.3 *11.0*	0.5 *3.2*	8.3
R4	21.2 *26.2*	2.4 *7.4*	7.7 *10.4*	0.5 *3.2*	7.7
R5	19.4 *24.4*	2.4 *7.4*	7.8 *10.5*	0.5 *3.2*	7.8
R6	18.4 *23.4*	2.2 *7.2*	7.0 *9.7*	0.4 *3.1*	7.0
R7	15.5 *20.5*	2.3 *7.3*	7.5 *10.2*	0.5 *3.2*	7.5
R8	15.5 *20.5*	2.4 *7.4*	7.9 *10.6*	0.5 *3.2*	7.9
R9	13.9 *18.9*	2.0 *7.0*	6.3 *9.0*	0.4 *3.1*	6.3
R10	14.7 *19.7*	2.7 *7.7*	8.7 *11.4*	0.5 *3.2*	8.7
R11	13.8 *18.8*	1.8 *6.8*	5.9 *8.6*	0.4 *3.1*	5.9
R12	11.1 *16.1*	1.3 *6.3*	4.0 *6.7*	0.3 *3.0*	4.0
R13	8.3 *13.3*	0.8 *5.8*	2.7 *5.4*	0.2 *2.9*	2.7
R14	13.4 *18.4*	1.4 *6.4*	4.3 *7.0*	0.3 *3.0*	4.3
R15	2.3 *7.3*	0.5 *5.5*	1.4 *4.1*	0.1 *2.8*	1.4
R16	1.8 *6.8*	0.4 *5.4*	1.2 *3.9*	0.1 *2.8*	1.2

Table 8-1: Discrete receptor location glc values, particulates.

Utilising 99.9th percentile 1-hr av. PM_{10} levels extracted from the modelling results (multiplied by 1.6 to convert to 3-minite av. data) and the percentage of metals determined from concentrations presented in section 6 at location DG19, predicted metal glc's were calculated at each discrete receptor location, excepting lead with predicted 100th percentile 90-day and annual av. PM_{10} glc data from the model utilised. Dust gauge DG19 was selected due to its isolated location relative to dust sources, particularly trafficked areas and processing areas of the mine and nearby General Industrial area. The other dust gauge locations are located at very close to sources and are more likely to be skewed relative to the wider air shed impacts from dust generated within the mine boundary.

Table 8-2 presents percent mass concentration of metals in deposited dust gauge DG19.

Metals, percent mass concentration in deposited dust (DG19)	
Metal	% concentration
Be	< 0.001 %
Cd	< 0.001 %
Pb	0.011 %
Cr	0.003 %
Mn	0.039 %
Co	0.004 %
Ni	0.002 %
Cu	0.349 %
Zn	0.166 %
As	0.001 %
Se	< 0.001 %

Table 8-2: Percent mass concentration of metals in deposited dust.

NB: The use of dust deposition results to determine metal concentrations in predicted PM_{10} levels has the potential to skew results with the mass concentration of elements suspended air sample likely to vary from a deposited sample. However, no other information is available with regard to potential metal element concentrations in dust emissions from the mine. They are considered indicative only.

Table 8-3 presents the predicted results with exceedance of criteria levels highlighted in grey.

Discrete receptor location glcs (µg/m^3) metals									
Recep.	As	Be	Cd	Cr	Cu	Mn	Ni	Pb	
	3-minute av.							90-day av.	Annual av.
	0.17 µg/m^3	0.07 µg/m^3	0.033 µg/m^3	17 µg/m^3	33 µg/m^3	33 µg/m^3	0.33 µg/m^3	1.5 µg/m^3	0.5 µg/m^3
R1	< 0.001	< 0.001	< 0.001	0.004	0.422	0.047	0.002	< 0.001	< 0.001
R2	< 0.001	< 0.001	< 0.001	0.004	0.410	0.045	0.002	< 0.001	< 0.001
R3	< 0.001	< 0.001	< 0.001	0.005	0.482	0.053	0.002	< 0.001	< 0.001
R4	< 0.001	< 0.001	< 0.001	0.004	0.412	0.045	0.002	< 0.001	< 0.001
R5	< 0.001	< 0.001	< 0.001	0.004	0.403	0.045	0.002	< 0.001	< 0.001
R6	< 0.001	< 0.001	< 0.001	0.004	0.382	0.042	0.002	< 0.001	< 0.001
R7	< 0.001	< 0.001	< 0.001	0.003	0.344	0.038	0.002	< 0.001	< 0.001
R8	< 0.001	< 0.001	< 0.001	0.003	0.314	0.035	0.002	< 0.001	< 0.001
R9	< 0.001	< 0.001	< 0.001	0.003	0.319	0.035	0.002	< 0.001	< 0.001
R10	< 0.001	< 0.001	< 0.001	0.003	0.272	0.030	0.001	< 0.001	< 0.001
R11	< 0.001	< 0.001	< 0.001	0.003	0.263	0.029	0.001	< 0.001	< 0.001
R12	< 0.001	< 0.001	< 0.001	0.003	0.278	0.031	0.001	< 0.001	< 0.001
R13	< 0.001	< 0.001	< 0.001	0.002	0.204	0.023	< 0.001	< 0.001	< 0.001
R14	< 0.001	< 0.001	< 0.001	0.003	0.268	0.030	0.001	< 0.001	< 0.001
R15	< 0.001	< 0.001	< 0.001	< 0.001	0.040	0.004	< 0.001	< 0.001	< 0.001
R16	< 0.001	< 0.001	< 0.001	< 0.001	0.028	0.003	< 0.001	< 0.001	< 0.001

Table 8-3: Discrete receptor location glc values, metals.

Under the Air Quality EPP criteria levels (as detailed in section 3) apply at or beyond the boundary of the land on which the activity is occurring (in this case the mining lease boundary). The highest predicted glc's at or beyond the boundary of the mining lease from the model results are as follows (predicted glc's and the coordinate location are provided) with criteria exceedances highlighted in grey:

Particulates

- PM_{10}: 24-hr av. 28.5 *(33.5)* µg/m^3 (MGA coord. 381719, 5341179)
  Annual av. 5.8 *(10.8)* µg/m^3 (MGA coord. 380965, 5341920)
- $PM_{2.5}$: 24-hr av. 5.7 *(8.4)* µg/m^3 (MGA coord. 381719, 5341179)
  Annual av. 1.2 *(3.9)* µg/m^3 (MGA coord. 380965, 5341920)
- TSP: Annual av. 18.8 µg/m^3 (MGA coord. 380965, 5341920)

Metals

- As: 3-minute av. 0.001 µg/m^3 (MGA coord. 381719, 5341179)
- Be: 3-minute av. < 0.001 µg/m^3 (MGA coord. 381719, 5341179)
- Cd: 3-minute av. < 0.001 µg/m^3 (MGA coord. 381719, 5341179)
- Cr: 3-minute av. 0.005 µg/m^3 (MGA coord. 381719, 5341179)
- Cu: 3-minute av. 0.558 µg/m^3 (MGA coord. 381719, 5341179)
- Mn: 3-minute av. 0.062 µg/m^3 (MGA coord. 381719, 5341179)
- Ni: 3-minute av. 0.003 µg/m^3 (MGA coord. 381719, 5341179)
- Pb: 90-day av. 0.001 µg/m^3 (MGA coord. 380965, 5341920)
  Annual av. 0.001 µg/m^3 (MGA coord. 380965, 5341920)

The highest predicted metal glc is for copper with predicted contours provided in Figure 8-1 below for reference.

Figure 8-1: Aerial view with 99.9th percentile 3-minute av. Cu glc contours.

When dust emissions from the processing plant area are considered alone, then the predicted levels are significantly less. Below are the highest glc's at or beyond the boundary of the mine from the processing plant alone (simulating refurbishment of the Prince Lyell Shaft) with criteria exceedances highlighted in grey:

Particulates

- PM_{10}: 24-hr av. 7.9 µg/m^3 (MGA coord. 382117, 5341180)
  Annual av. 0.9 µg/m^3 (MGA coord. 382117, 5341180)
- $PM_{2.5}$: 24-hr av. 1.6 µg/m^3 (MGA coord. 382117, 5341180)
  Annual av. 0.17 µg/m^3 (MGA coord. 382117, 5341180)
- TSP: Annual av. 2.14 µg/m^3 (MGA coord. 382117, 5341180)

Metals

- As: 3-minute av. < 0.001 µg/m^3 (MGA coord. 382117, 5341180)
- Be: 3-minute av. < 0.001 µg/m^3 (MGA coord. 382117, 5341180)
- Cd: 3-minute av. < 0.001 µg/m^3 (MGA coord. 382117, 5341180)
- Cr: 3-minute av. 0.001 µg/m^3 (MGA coord. 382117, 5341180)
- Cu: 3-minute av. 0.114 µg/m^3 (MGA coord. 382117, 5341180)
- Mn: 3-minute av. 0.013 µg/m^3 (MGA coord. 382117, 5341180)
- Ni: 3-minute av. < 0.001 µg/m^3 (MGA coord. 382117, 5341180)
- Pb: 90-day av. < 0.001 µg/m^3 (MGA coord. 382117, 5341180)
  Annual av. < 0.001 µg/m^3 (MGA coord. 382117, 5341180)

There is also a potential for emission of respirable crystalline silica from the processing plant which has a criterion level under the EPA Board Statement from January 2022 of 3.3 µg/m^3 (as $PM_{2.5}$), again for a 3-minute average. Correcting the 99.9th percentile 1-hr av. $PM_{2.5}$ levels extracted from the modelling results of the new processing plant operations (with no haulage), multiplied by 1.6 to convert to a 3-minute av., and assuming a percentage of 75 % silica in the ore (this is a conservative assumption from the descriptive mineralogy which indicates that the percentage of crystalline quartz in the mineralogical samples varies between ~ 40 - 45 vol % to ~ 70 - 75 vol %) the highest predicted respirable crystalline silica glc at or beyond the boundary is 4.9 µg/m^3 at boundary location MGA coord. 382118, 5341180.

Figure 8-2 presents an aerial view with predicted respirable crystalline silica glcs contours. The criterion level contour of 3.3 µg/m^3 is shown in turquoise and extends beyond the boundary across an area 400 m to the east of any residential areas of Queenstown.

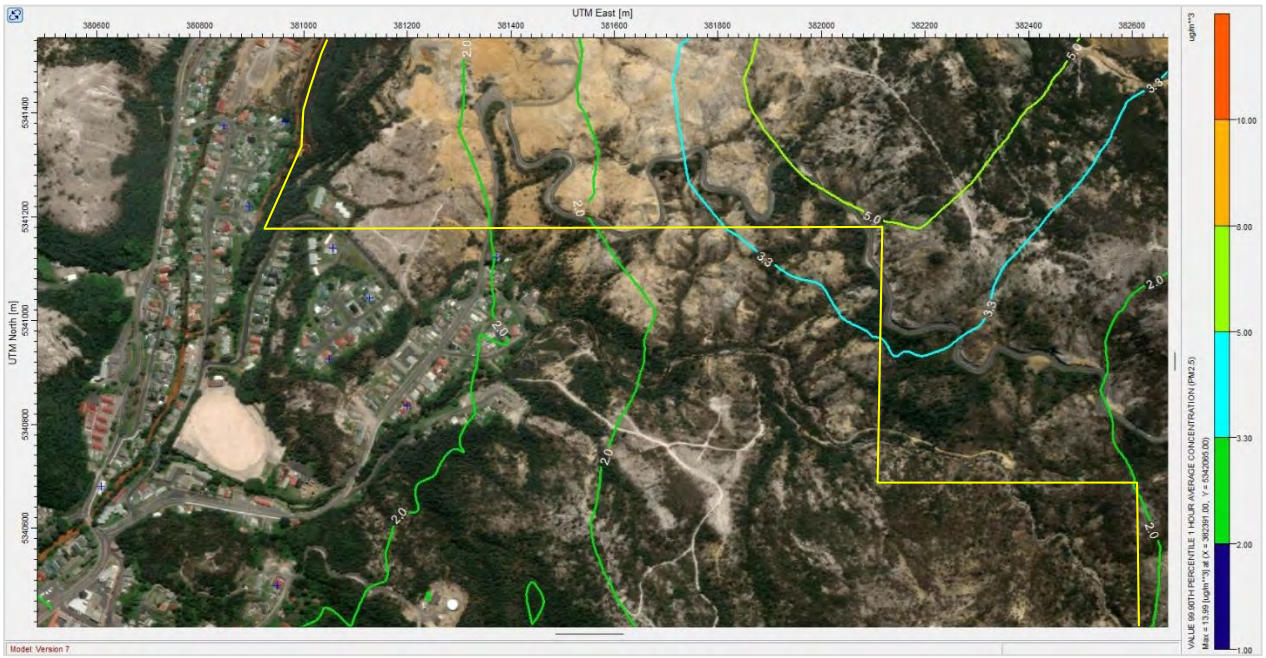


Figure 8-2: Aerial view with 99.9th percentile 3-minute av. respirable crystalline silica glc contours.

8.1 Additional data

Predicted 99.9th and 100th percentile 1-hr av. PM_{10} and $PM_{2.5}$ levels at discrete receptors and boundary receptors are provided in the Appendix. For the processing and hauling model scenario conversion to Cu predicted 1-hr av. levels is provided for the PM_{10} fraction. For the processing only model scenario the same is provided along with respirable crystalline silica (RCS) predicted 1-hr av. levels for the $PM_{2.5}$ fraction. Conversions are based on the assumptions provided above.

9 Discussion

The above results indicate that glc's above the criteria levels for PM_{10}, $PM_{2.5}$ and TSP don't extend beyond the boundary of the mine. Discrete receptor levels are also very low. This remains the case when background levels are also taken into account (i.e. cumulative total).

Predicted metals levels are also well below criteria levels at or beyond the boundary of the mine. Once the Prince Lyell Shaft is reinstated predicted levels are reduced while relocation of crushing underground (not modelled here) will provide further reduction.

Predicted crystalline silica levels from the processing plant show potential exceedances along the mining leases southern boundary, approx. 400 m east of residential areas of Queenstown. Relocation of crushing underground will provide reduction in these levels by up to potentially 50 % (based on the emission rates outlined in section 7).

The above indicates that operations at the Mt Lyell mine would be likely to comply with the requirements of the Air Quality EPP and the environmental values of the surrounding sensitive residential locations can be protected. Some potential risk in relation to crystalline silica emissions has been identified from the conservative air quality modelling conducted in this assessment and would need to be managed through controls and monitoring of emissions to manage the risk and maintain compliance with the requirements of the Air Quality EPP.

9.1 Dust emission controls

Haul road watering is considered in the modelling results presented for periods when dry and/or windy conditions prevail. To allow for the controls discussed to be implemented the operator will require access to an adequate water supply to maintain watering rates on haul roads during dry and/or windy conditions.

Water supply for haul road watering would be drawn from rainwater storage tanks at the new processing plant and from existing water supplies when required:

- Extracted from both the East Queen and West Queen catchments within the current licence conditions or from the proposed Queen River Offtake; and
- Storages: West Queen Dam 2 (157 ML), West Queen Dam 1 (20 ML), and the Hockey Field Dam (32 ML).

Water spray systems will be installed along the length haul roads, and a water cart will be available for wetting down specific areas of the haul routes and for wetting down other road surfaces in the mine not associated with hauling ore. Water spray systems will be managed manually initially with timer system installed and settings developed based on inputs from the weather station that is to be installed at the processing plant and weather forecasts for the area.

Controls within the processing plant will include:

Crusher

- Water sprays discharging across the top of the ROM Bin (i.e. grizzly panel extents) to wet-down material being dumped.

  NB: Water sprays will not normally run continuously, being triggered via proximity instruments detecting the presence of truck in dumping location.

- Crusher Dust Collector, insertable type with fan and reverse pulse jet cleaning. Draws air from the conveyor skirted area, collecting dust from the three transfer points (apron feeder dribble, vibrating grizzly underflow and crusher discharge).

Conveyors

- Outdoor belt conveyors include continuous hooped cladding weather cover and side-shrouding down to idler level

  NB: Not primarily for dust control, this configuration prevents cross-winds dislodging or activating fine material with any dust-making potential.
- Discharge head chutes fully enclosed.

Emergency Stockpile:

- Relocatable, manually activated sprinklers located on-ground. The amount of material stored at the Emergency Stockpile is highly variable (i.e. nominally empty when Process Plant is operating normally).

A dust management plan will be developed for the mine outlining actions and roles for key personnel and will be made available and understood by all relevant personnel.

9.2 Climate change

The Department of State Growth: Renewables, Climate and Future Industries Tasmania provides projected changes to Tasmania's climate by 2100 as follows based on a low and high emission projections from the United Nations Intergovernmental Panel on Climate Change (IPCC):

Temperature

- Average temperatures will continue to rise. Tasmanian temperatures are projected to rise by about 2.9° C under the high emissions scenario, and about 1.6° C under the low emissions scenario.
- Temperature increases in Tasmania are less than the projected global average temperature rise, due to the moderating influence of the Southern Ocean.

Rainfall

- There is no significant projected change to total statewide annual rainfall.
- However, significant changes are projected in the regional and seasonal pattern of rainfall across the State:
  - The West Coast is projected to experience a significant increase in rainfall in winter; and a significant decrease in rainfall in summer after 2050.
  - The central plateau district is projected to experience a steady decrease in rainfall in every season out to 2100.
  - The North-East Coast is projected to experience a steady increase in autumn and summer rainfall.
- Significant increase in pan evaporation.

Wind

- Increase in average wind speed across the State.

Extreme events

- Increased frequency and intensity of storm events.

- Increased instances of coastal erosion and coastal inundation.
- Longer fire seasons and more days at the highest range of fire danger.
- More hot summer days and more heatwaves.
- Drought in some parts of the State.
- River flooding in some catchments.

The above indicates that there is potential for higher temperatures and lower rainfall in Summer, increased wind speeds and increased risk of heatwave and drought as climate change progresses. These factors would act to increase the potential for an increased risk of fugitive dust emissions from the site and additional controls (e.g. sealing of surfaces, additional wetting of vehicle pathways …etc) may need to be considered.

9.3 Monitoring

The following monitoring will be implemented to assist with active management of dust generation and control at the Mt Lyell mine:

- Real-time multi-channel particulate monitoring (e.g. nephelometer) of TSP, PM_{10} and $PM_{2.5}$ levels on the boundary of the mining lease to the south of the front gate (exact location to be determined).

  NB: The monitor or co-located monitor will be utilised to study crystalline silica levels from the mine with $PM_{2.5}$ samples retained for laboratory analysis to determine the proportion of silica in the samples.

  NB: The monitor or co-located monitor will be utilised to study metals levels from the mine with TSP samples retained for laboratory analysis to determine the proportion of metals in the samples.

- Dust deposition monitoring at a minimum of 6 locations providing, total solids, insoluble solids & soluble solids (utilising dust deposition gauges) at locations along the boundary of the mining lease to the north and south of the front gate (exact locations to be determined).

  NB: Samples from multiple seasons of will be retained and analysed for metal contents replicating the study conducted in 2013 (Nobel and Lottermoser, 2013).

All monitoring and laboratory analysis (NATA certified) will be conducted in accordance with relevant Australian Standards and wind speed and direction will be measured at the mines weather station.

Where exceedances of criterion are identified, analysis of wind conditions though the period of exceedance will be undertaken. Where the analysis indicates that the likely source of the exceedance is emissions from mine operations (i.e. wind direction from the mine to the monitor) corrective actions should be undertaken to increase suppression (e.g. review of haul road watering practices and road conditions). These processes and actions will then be integrated into the dust management plan.

9.4 Construction emissions

There is a potential for the generation of dust emissions from the new processing plant during the construction processes noting that the new processing plant is located a significant distance from any mining lease boundary and sensitive receptor location. Onsite activities and equipment with the potential to generate dust emissions include truck and light vehicle movements for material and

personnel transport on internal roads; surface clearing and grading; removal of existing infrastructure (i.e. overland conveyor system).

The following mitigation factors would minimise the potential for environmental harm (including nuisance):

- A Construction Environmental Management Plan (CEMP) to be implemented, including but not limited to the following:
    - Use of water carts to damp down internal road surfaces and graded surfaces as necessary to minimise entrainment during vehicle and equipment traverses.
    - Avoidance of the use of long-term stockpiles on site wherever possible unless they perform the function of visual or noise screening. Under high wind conditions damp down stockpiles that show significant stripping of particulate matter.
    - Exhaust emissions minimised by ensuring that all equipment is in good working order and properly maintained.
    - Dust deposition monitoring at locations along the boundary processing plant area.

The new pipelines to be installed in place of the existing overland conveyor (see Figure 2-2 for pipeline corridor) will be constructed of high-density polyethylene (HDPE) pipes. There is a potential that during joint fusion of the pipeline sections the melting polymer will release volatile organic compounds (VOCs) and smoke from the heating element. However, these are generally considered minimal and there is significant buffer distance between the pipeline corridor and the mining lease boundary and sensitive receptors such that these emissions aren't expected cause environmental harm.

Appendix

Emission rate calculations					
Emission source	Emission Equation	Equation Inputs	Emission Factors		Processing rate
			TSP	PM_{10}	
JAW CRU/SCR X1 Jaw crusher X1 screen	-	-	0.01 kg/t	0.004 kg/t	297 t/hr
HAUL 1 (loaded)	$EF = k \times \left(\frac{s}{12}\right)^{0.7} \times \left(\frac{W}{3}\right)^{0.45} \times \left(\frac{281.9}{1000}\right) \times \left(\frac{365-p}{365}\right)$ kg/vehicle kilometres travelled (VKT) USEPA AP42 - Wheel Generated Dust from Unpaved Roads (2003) k = 4.9 (TSP) k = 1.5 (PM_{10}) s = silt content (%), W = vehicle gross mass (tonnes) p = number of days in year with rainfall greater than 0.25mm	S = 8 % W = 109 t (loaded) W = 43 t (unloaded) *p* = 180	2.6549 kg/VKT (loaded) 1.7469 kg/VKT (unloaded)	0.8127 kg/VKT (loaded) 0.5348 kg/VKT (unloaded)	7.7 VKT/hr
HAUL 2 (unloaded)					11.5 VKT/hr
HAUL 3 (loaded)					0.8 VKT/hr
HAUL 4 (unloaded)					1.0 VKT/hr
TRUCK		S = 8 % W = 20 t *p* = 180	1.2378 kg/VKT	0.3789 kg/VKT	2.8 VKT/hr

Notes:

- Processing rate of 297 t/hr provided by SSOA
- For HAUL sources VKT/hr determined from line volume source length and number of trips required per hour to transport 297 t with 66 t payload per truck (based on manufacturers data for vehicle loads).
- For the TRUCK source a single traverse is modelled for the line volume source length with a vehicle mass of 20 t assumed.
- Value for S based on upper end of mean values for silt content for 'Haul road to/from pit' road surfaces in USEPA AP42. Silt is defined under USEPA AP42 as material ≤ 75 µm in diameter.
- Final emission rates multiplied by 0.5 to represent Level 1 watering.

Hauling and Processing

Discrete receptor location glcs (µg/m^3) 1-hr av. 99th and 100th percentile data.							
Discrete Receptor	PM_{10}		$PM_{2.5}$			Cu*	
	99th	100th	99th	100th		99th	100th
R1	75.72	93.94	15.14	18.79		0.26	0.33
R2	73.60	91.02	14.72	18.20		0.26	0.32
R3	86.38	104.08	17.27	20.81		0.30	0.36
R4	73.80	102.15	14.76	20.43		0.26	0.36
R5	72.26	95.32	14.45	19.06		0.25	0.33
R6	68.49	92.97	13.70	18.59		0.24	0.32
R7	61.70	79.14	12.34	15.83		0.22	0.28
R8	56.24	71.97	11.25	14.39		0.20	0.25
R9	57.27	67.59	11.45	13.52		0.20	0.24
R10	48.70	54.13	9.74	10.83		0.17	0.19
R11	47.18	55.05	9.44	11.01		0.16	0.19
R12	49.81	61.45	9.96	12.29		0.17	0.21
R13	36.53	48.96	7.31	9.79		0.13	0.17
R14	48.14	56.29	9.63	11.26		0.17	0.20
R15	7.23	9.13	1.44	1.83		0.03	0.03
R16	4.98	5.73	1.00	1.15		0.02	0.02

* calculated form PM_{10} data.

Boundary receptor location glcs (µg/m^3) 1-hr av. 99th and 100th percentile data.								
UTM coords.		PM_{10}		$PM_{2.5}$			Cu*	
E	N	99th	100th	99th	100th		99th	100th
380707	5342593	36.15	49.64	7.23	9.93		0.13	0.17
380720	5342067	55.77	70.57	11.15	14.11		0.19	0.25
380739	5341973	63.48	76.93	12.70	15.39		0.22	0.27
380750	5341936	66.89	77.47	13.38	15.49		0.23	0.27
380778	5341914	66.72	80.39	13.35	16.08		0.23	0.28
380815	5341895	67.56	84.08	13.51	16.82		0.24	0.29
380859	5341863	72.82	89.85	14.56	17.97		0.25	0.31
380886	5341837	75.90	93.24	15.18	18.65		0.26	0.32
380965	5341920	79.02	92.19	15.80	18.44		0.28	0.32
381038	5341863	64.36	78.52	12.87	15.71		0.22	0.27
381040	5341881	63.37	78.53	12.67	15.71		0.22	0.27
381107	5341854	62.05	75.24	12.41	15.05		0.22	0.26
381123	5341853	62.07	74.06	12.41	14.81		0.22	0.26
381120	5341813	65.57	77.75	13.12	15.55		0.23	0.27
381108	5341729	69.89	82.55	13.98	16.51		0.24	0.29
381092	5341655	70.52	83.21	14.10	16.64		0.25	0.29
381075	5341608	71.58	82.33	14.32	16.47		0.25	0.29
381056	5341569	74.03	86.40	14.81	17.28		0.26	0.30
381035	5341516	71.18	89.46	14.24	17.89		0.25	0.31
381013	5341449	71.01	90.40	14.20	18.08		0.25	0.32
380997	5341408	73.01	92.91	14.60	18.58		0.25	0.32
380996	5341376	71.35	92.50	14.27	18.50		0.25	0.32
380994	5341331	67.19	90.03	13.44	18.01		0.23	0.31
380962	5341260	65.91	91.03	13.18	18.21		0.23	0.32
380922	5341178	65.33	91.22	13.07	18.24		0.23	0.32
382118	5341180	72.28	77.61	14.46	15.52		0.25	0.27
382111	5340687	47.29	57.58	9.46	11.52		0.16	0.20

382611	5340687	26.86	34.55	5.37	6.91		0.09	0.12
382611	5340184	26.34	36.79	5.27	7.36		0.09	0.13
383610	5340185	12.24	18.70	2.45	3.74		0.04	0.07
383611	5343785	5.49	9.81	1.10	1.96		0.02	0.03
380709	5342505	38.08	50.52	7.61	10.10		0.13	0.18
380711	5342417	40.38	53.05	8.07	10.61		0.14	0.18
380713	5342330	43.12	56.48	8.62	11.30		0.15	0.20
380715	5342242	46.47	60.80	9.29	12.16		0.16	0.21
380717	5342154	51.11	65.90	10.22	13.18		0.18	0.23
380926	5341879	78.05	92.53	15.61	18.50		0.27	0.32
381022	5341178	61.88	84.18	12.38	16.84		0.22	0.29
381122	5341178	59.84	77.22	11.97	15.44		0.21	0.27
381221	5341179	52.69	71.58	10.54	14.32		0.18	0.25
381321	5341179	53.15	62.55	10.63	12.51		0.19	0.22
381421	5341179	55.09	61.85	11.02	12.37		0.19	0.22
381520	5341179	75.98	86.22	15.20	17.24		0.26	0.30
381620	5341179	91.44	102.11	18.29	20.42		0.32	0.36
381719	5341179	100.04	109.62	20.01	21.92		0.35	0.38
381819	5341179	93.68	103.98	18.73	20.79		0.33	0.36
381919	5341179	89.04	95.44	17.81	19.09		0.31	0.33
382018	5341180	81.15	86.49	16.23	17.30		0.28	0.30
382116	5341081	60.09	70.27	12.02	14.05		0.21	0.24
382115	5340982	55.07	64.89	11.01	12.98		0.19	0.23
382114	5340884	51.17	61.89	10.23	12.38		0.18	0.22
382112	5340786	47.69	59.90	9.54	11.98		0.17	0.21
382194	5340687	42.82	53.18	8.57	10.64		0.15	0.19
382278	5340687	40.72	50.37	8.14	10.07		0.14	0.18
382361	5340687	36.37	45.68	7.27	9.14		0.13	0.16
382444	5340687	32.93	41.69	6.58	8.34		0.11	0.15
382528	5340687	29.71	37.61	5.94	7.52		0.10	0.13
382611	5340603	29.04	36.66	5.81	7.33		0.10	0.13
382611	5340520	29.13	38.08	5.82	7.62		0.10	0.13
382611	5340436	28.94	38.80	5.79	7.76		0.10	0.14
382611	5340352	28.60	38.76	5.72	7.75		0.10	0.14
382611	5340268	28.08	38.06	5.62	7.61		0.10	0.13
382711	5340184	24.70	35.45	4.94	7.09		0.09	0.12
382811	5340185	23.62	33.78	4.72	6.76		0.08	0.12
382911	5340185	22.10	31.87	4.42	6.37		0.08	0.11
383011	5340185	21.47	30.32	4.30	6.06		0.07	0.11
383111	5340185	19.50	28.37	3.90	5.67		0.07	0.10
383211	5340185	17.70	26.89	3.54	5.38		0.06	0.09
383311	5340185	16.33	25.25	3.27	5.05		0.06	0.09
383411	5340185	14.68	23.22	2.94	4.64		0.05	0.08
383510	5340185	13.40	20.99	2.68	4.20		0.05	0.07
383610	5340282	11.90	17.46	2.38	3.49		0.04	0.06
383610	5340379	11.91	16.78	2.38	3.35		0.04	0.06
383611	5340476	11.75	15.96	2.35	3.19		0.04	0.06
383611	5340574	10.76	15.03	2.15	3.00		0.04	0.05
383611	5340671	9.81	14.14	1.96	2.83		0.03	0.05
383611	5340768	9.64	13.17	1.93	2.63		0.03	0.05
383611	5340866	9.47	12.15	1.89	2.43		0.03	0.04
383611	5340963	9.25	11.58	1.85	2.32		0.03	0.04
383611	5341060	9.23	11.38	1.85	2.28		0.03	0.04
383611	5341157	9.13	11.15	1.83	2.23		0.03	0.04
383611	5341255	9.02	10.90	1.80	2.18		0.03	0.04
383611	5341352	8.97	11.72	1.79	2.34		0.03	0.04

383611	5341449	8.95	13.13	1.79	2.63		0.03	0.05
383611	5341546	8.97	13.95	1.79	2.79		0.03	0.05
383611	5341644	9.42	13.80	1.88	2.76		0.03	0.05
383611	5341741	9.88	13.55	1.98	2.71		0.03	0.05
383611	5341838	9.81	14.72	1.96	2.94		0.03	0.05
383611	5341936	9.66	14.63	1.93	2.93		0.03	0.05
383611	5342033	9.76	12.79	1.95	2.56		0.03	0.04
383611	5342130	9.45	11.81	1.89	2.36		0.03	0.04
383611	5342228	9.20	12.44	1.84	2.49		0.03	0.04
383611	5342325	9.25	13.27	1.85	2.65		0.03	0.05
383611	5342422	9.95	12.85	1.99	2.57		0.03	0.04
383611	5342520	10.20	12.98	2.04	2.60		0.04	0.05
383611	5342617	9.79	15.28	1.96	3.06		0.03	0.05
383611	5342714	10.59	15.78	2.12	3.16		0.04	0.05
383611	5342812	11.55	16.09	2.31	3.22		0.04	0.06
383611	5342909	12.67	15.55	2.53	3.11		0.04	0.05
383611	5343006	11.41	16.20	2.28	3.24		0.04	0.06
383611	5343104	9.75	14.72	1.95	2.94		0.03	0.05
383611	5343201	8.81	12.52	1.76	2.50		0.03	0.04
383611	5343298	7.31	12.29	1.46	2.46		0.03	0.04
383611	5343396	8.68	12.81	1.74	2.56		0.03	0.04
383611	5343493	9.16	13.96	1.83	2.79		0.03	0.05
383611	5343590	7.22	12.99	1.44	2.60		0.03	0.05
383611	5343688	5.55	10.02	1.11	2.00		0.02	0.03

* calculated form PM_{10} data.

Processing only

Discrete receptor location glcs (µg/m^3) 1-hr av. 99th and 100th percentile data.									
Discrete Receptor	PM_{10}		$PM_{2.5}$			Cu*		RCS^	
	99th	100th	99th	100th		99th	100th	99th	100th
R1	11.65	14.67	2.33	2.93		0.04	0.05	1.75	2.20
R2	11.45	15.66	2.29	3.13		0.04	0.05	1.72	2.35
R3	12.80	17.01	2.56	3.40		0.04	0.06	1.92	2.55
R4	12.51	18.10	2.50	3.62		0.04	0.06	1.88	2.71
R5	11.76	17.55	2.35	3.51		0.04	0.06	1.76	2.63
R6	11.74	17.63	2.35	3.53		0.04	0.06	1.76	2.64
R7	11.14	15.61	2.23	3.12		0.04	0.05	1.67	2.34
R8	10.16	13.69	2.03	2.74		0.04	0.05	1.52	2.05
R9	10.08	13.13	2.02	2.63		0.04	0.05	1.51	1.97
R10	8.30	10.73	1.66	2.15		0.03	0.04	1.24	1.61
R11	8.58	11.39	1.72	2.28		0.03	0.04	1.29	1.71
R12	9.27	12.18	1.85	2.44		0.03	0.04	1.39	1.83
R13	6.73	9.77	1.35	1.96		0.02	0.03	1.01	1.47
R14	8.91	11.38	1.78	2.28		0.03	0.04	1.34	1.71
R15	2.10	4.00	0.42	0.80		0.01	0.01	0.32	0.60
R16	1.70	1.99	0.34	0.40		0.01	0.01	0.25	0.30

* calculated form PM_{10} data. ^ calculated from $PM_{2.5}$ data.

Boundary receptor location glcs (µg/m^3) 1-hr av. 99th and 100th percentile data.										
UTM coords.		PM_{10}		$PM_{2.5}$			Cu*		RCS^	
E	N	99th	100th	99th	100th		99th	100th	99th	100th
380707	5342593	9.03	12.72	1.81	2.54		0.03	0.04	1.35	1.91
380720	5342067	11.42	19.05	2.28	3.81		0.04	0.07	1.71	2.86
380739	5341973	12.00	19.13	2.40	3.83		0.04	0.07	1.80	2.87
380750	5341936	11.36	18.65	2.27	3.73		0.04	0.06	1.70	2.80
380778	5341914	11.40	17.81	2.28	3.56		0.04	0.06	1.71	2.67
380815	5341895	11.27	16.77	2.25	3.35		0.04	0.06	1.69	2.52
380859	5341863	11.31	15.36	2.26	3.07		0.04	0.05	1.70	2.30
380886	5341837	11.37	14.40	2.27	2.88		0.04	0.05	1.71	2.16
380965	5341920	10.40	12.84	2.08	2.57		0.04	0.04	1.56	1.93
381038	5341863	10.13	12.48	2.03	2.50		0.04	0.04	1.52	1.87
381040	5341881	9.96	12.23	1.99	2.45		0.03	0.04	1.49	1.83
381107	5341854	9.37	11.83	1.87	2.37		0.03	0.04	1.41	1.78
381123	5341853	9.21	11.65	1.84	2.33		0.03	0.04	1.38	1.75
381120	5341813	9.48	12.16	1.90	2.43		0.03	0.04	1.42	1.82
381108	5341729	9.99	13.19	2.00	2.64		0.03	0.05	1.50	1.98
381092	5341655	10.57	13.97	2.11	2.79		0.04	0.05	1.59	2.10
381075	5341608	10.55	14.44	2.11	2.89		0.04	0.05	1.58	2.17
381056	5341569	10.74	15.10	2.15	3.02		0.04	0.05	1.61	2.26
381035	5341516	11.19	15.96	2.24	3.19		0.04	0.06	1.68	2.39
381013	5341449	11.28	16.76	2.26	3.35		0.04	0.06	1.69	2.51
380997	5341408	11.54	17.18	2.31	3.44		0.04	0.06	1.73	2.58
380996	5341376	11.49	17.30	2.30	3.46		0.04	0.06	1.72	2.59
380994	5341331	11.32	17.33	2.26	3.47		0.04	0.06	1.70	2.60
380962	5341260	11.41	17.44	2.28	3.49		0.04	0.06	1.71	2.62
380922	5341178	11.52	17.20	2.30	3.44		0.04	0.06	1.73	2.58
382118	5341180	20.37	23.46	4.07	4.69		0.07	0.08	3.06	3.52
382111	5340687	12.31	13.95	2.46	2.79		0.04	0.05	1.85	2.09

382611	5340687	8.28	9.80	1.66	1.96		0.03	0.03	1.24	1.47
382611	5340184	7.50	10.25	1.50	2.05		0.03	0.04	1.12	1.54
383610	5340185	3.36	5.06	0.67	1.01		0.01	0.02	0.50	0.76
383611	5343785	2.01	4.61	0.40	0.92		0.01	0.02	0.30	0.69
380709	5342505	9.55	14.21	1.91	2.84		0.03	0.05	1.43	2.13
380711	5342417	9.43	15.58	1.89	3.12		0.03	0.05	1.41	2.34
380713	5342330	9.96	16.38	1.99	3.28		0.03	0.06	1.49	2.46
380715	5342242	10.63	16.93	2.13	3.39		0.04	0.06	1.59	2.54
380717	5342154	11.27	18.05	2.25	3.61		0.04	0.06	1.69	2.71
380926	5341879	10.91	13.71	2.18	2.74		0.04	0.05	1.64	2.06
381022	5341178	11.23	16.36	2.25	3.27		0.04	0.06	1.68	2.45
381122	5341178	10.77	15.02	2.15	3.00		0.04	0.05	1.62	2.25
381221	5341179	9.71	13.25	1.94	2.65		0.03	0.05	1.46	1.99
381321	5341179	8.78	11.55	1.76	2.31		0.03	0.04	1.32	1.73
381421	5341179	7.76	10.32	1.55	2.06		0.03	0.04	1.16	1.55
381520	5341179	7.85	9.18	1.57	1.84		0.03	0.03	1.18	1.38
381620	5341179	8.89	10.00	1.78	2.00		0.03	0.03	1.33	1.50
381719	5341179	10.63	11.79	2.13	2.36		0.04	0.04	1.59	1.77
381819	5341179	14.07	15.62	2.81	3.12		0.05	0.05	2.11	2.34
381919	5341179	16.73	19.35	3.35	3.87		0.06	0.07	2.51	2.90
382018	5341180	18.41	20.86	3.68	4.17		0.06	0.07	2.76	3.13
382116	5341081	17.32	20.93	3.46	4.19		0.06	0.07	2.60	3.14
382115	5340982	14.60	18.32	2.92	3.66		0.05	0.06	2.19	2.75
382114	5340884	13.42	16.94	2.68	3.39		0.05	0.06	2.01	2.54
382112	5340786	12.66	15.39	2.53	3.08		0.04	0.05	1.90	2.31
382194	5340687	11.63	13.21	2.33	2.64		0.04	0.05	1.74	1.98
382278	5340687	11.51	13.38	2.30	2.68		0.04	0.05	1.73	2.01
382361	5340687	10.71	12.49	2.14	2.50		0.04	0.04	1.61	1.87
382444	5340687	9.86	11.86	1.97	2.37		0.03	0.04	1.48	1.78
382528	5340687	8.92	10.84	1.78	2.17		0.03	0.04	1.34	1.63
382611	5340603	8.61	10.11	1.72	2.02		0.03	0.04	1.29	1.52
382611	5340520	8.59	10.46	1.72	2.09		0.03	0.04	1.29	1.57
382611	5340436	8.52	10.71	1.71	2.14		0.03	0.04	1.28	1.61
382611	5340352	8.39	10.74	1.68	2.15		0.03	0.04	1.26	1.61
382611	5340268	8.02	10.58	1.60	2.12		0.03	0.04	1.20	1.59
382711	5340184	7.30	9.94	1.46	1.99		0.03	0.03	1.10	1.49
382811	5340185	6.70	9.52	1.34	1.90		0.02	0.03	1.00	1.43
382911	5340185	6.58	9.04	1.32	1.81		0.02	0.03	0.99	1.36
383011	5340185	6.09	8.64	1.22	1.73		0.02	0.03	0.91	1.30
383111	5340185	5.59	8.10	1.12	1.62		0.02	0.03	0.84	1.21
383211	5340185	5.09	7.48	1.02	1.50		0.02	0.03	0.76	1.12
383311	5340185	4.63	6.85	0.93	1.37		0.02	0.02	0.69	1.03
383411	5340185	4.21	6.30	0.84	1.26		0.01	0.02	0.63	0.95
383510	5340185	3.81	5.69	0.76	1.14		0.01	0.02	0.57	0.85
383610	5340282	3.38	4.85	0.68	0.97		0.01	0.02	0.51	0.73
383610	5340379	3.32	4.69	0.66	0.94		0.01	0.02	0.50	0.70
383611	5340476	3.30	5.11	0.66	1.02		0.01	0.02	0.49	0.77
383611	5340574	3.14	5.04	0.63	1.01		0.01	0.02	0.47	0.76
383611	5340671	3.00	4.43	0.60	0.89		0.01	0.02	0.45	0.67
383611	5340768	2.87	4.04	0.57	0.81		0.01	0.01	0.43	0.61
383611	5340866	2.68	3.62	0.54	0.72		0.01	0.01	0.40	0.54
383611	5340963	2.48	3.68	0.50	0.74		0.01	0.01	0.37	0.55
383611	5341060	2.36	3.94	0.47	0.79		0.01	0.01	0.35	0.59
383611	5341157	2.42	4.92	0.48	0.98		0.01	0.02	0.36	0.74
383611	5341255	2.56	5.84	0.51	1.17		0.01	0.02	0.38	0.88
383611	5341352	3.03	6.51	0.61	1.30		0.01	0.02	0.45	0.98

383611	5341449	3.29	7.19	0.66	1.44		0.01	0.03	0.49	1.08
383611	5341546	3.20	8.44	0.64	1.69		0.01	0.03	0.48	1.27
383611	5341644	3.15	8.93	0.63	1.79		0.01	0.03	0.47	1.34
383611	5341741	3.87	8.18	0.77	1.64		0.01	0.03	0.58	1.23
383611	5341838	3.86	5.39	0.77	1.08		0.01	0.02	0.58	0.81
383611	5341936	3.97	5.63	0.79	1.13		0.01	0.02	0.59	0.84
383611	5342033	4.41	6.18	0.88	1.24		0.02	0.02	0.66	0.93
383611	5342130	4.78	6.49	0.96	1.30		0.02	0.02	0.72	0.97
383611	5342228	5.38	6.53	1.08	1.31		0.02	0.02	0.81	0.98
383611	5342325	5.92	8.36	1.18	1.67		0.02	0.03	0.89	1.25
383611	5342422	6.15	8.82	1.23	1.76		0.02	0.03	0.92	1.32
383611	5342520	6.44	7.72	1.29	1.54		0.02	0.03	0.97	1.16
383611	5342617	6.62	9.74	1.32	1.95		0.02	0.03	0.99	1.46
383611	5342714	6.99	11.11	1.40	2.22		0.02	0.04	1.05	1.67
383611	5342812	7.94	11.80	1.59	2.36		0.03	0.04	1.19	1.77
383611	5342909	8.57	10.65	1.71	2.13		0.03	0.04	1.28	1.60
383611	5343006	7.40	10.58	1.48	2.12		0.03	0.04	1.11	1.59
383611	5343104	6.06	9.00	1.21	1.80		0.02	0.03	0.91	1.35
383611	5343201	5.25	8.24	1.05	1.65		0.02	0.03	0.79	1.24
383611	5343298	3.65	8.22	0.73	1.64		0.01	0.03	0.55	1.23
383611	5343396	4.49	8.18	0.90	1.64		0.02	0.03	0.67	1.23
383611	5343493	4.73	8.67	0.95	1.73		0.02	0.03	0.71	1.30
383611	5343590	3.21	7.55	0.64	1.51		0.01	0.03	0.48	1.13
383611	5343688	2.38	5.43	0.48	1.09		0.01	0.02	0.36	0.81

* calculated form PM_{10} data. ^ calculated from $PM_{2.5}$ data.