Newmont Boddington – Residue Disposal Area 2 Development

Dust Modelling Assessment

Final Report
Version 3

Prepared for CDMSmith on behalf of Newmont

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Project Number: 1404

Newmont Boddington – Residue Disposal Area 2 Development

Final Report

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Approval for Release

Name	Position	File Reference
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Signature		

Executive Summary

Newmont Boddington Gold Pty Ltd (Newmont) operates the Newmont Boddington Goldmine (NBG) 11km to the north-west of Boddington township within the Darling Range and within the Peel region of Western Australia. NBG achieved commercial production in 2009 and is projected to operate until at least 2041. NBG is currently composed of:

- Two pits, North Pit and South Pit
- A series of Waste Rock Deposits (WRDs)
- A Residue Disposal Area (RDA1) composed of several combined RDAs (F1, F3, F4).
- Multiple dam sites including D5 and D6.

Newmont is currently seeking to develop a second Residue Disposal Area (RDA2). This development requires multiple steps:

- Initial mining of sub-surface bauxite deposits (in 2025 to 2026)
- Followed by vegetation clearing and topsoil stripping (2027-2028)
- And finally the construction of embankments (2027-2029)

Off-site dust impacts are a potential concern given the proximity of the NBG operations to surrounding ecological and heritage values as well as the Boddington townsite and other residences in the area.

Overview of assessment

An air dispersion modelling study has been undertaken to inform the assessment of potential air quality impacts of the Project upon the local communities. The air dispersion modelling study incorporated site-specific meteorological data, emissions information, source characteristics, and the location of model receptors. Potential impact was evaluated through comparison to relevant ambient air quality assessment criteria protective of human health and amenity (dust nuisance).

The scope of the modelling assessment is summarised below.

Modelled meteorological period	2022 calendar year. This is the period most representative of longer-term climatic averages.
Meteorological data	Three-dimensional prognostic meteorological data developed using the Weather Research and Forecasting (WRF) model.
Model selection	CALMET/CALPUFF model suite, coupled with WRF prognostic meteorological data.
Key Pollutants	Particulate matter (PM) - including PM_{10} and $PM_{2.5}$ size fractions, Total Suspended Particulates (TSP) - dry deposition.

Background Air Quality	Air quality monitoring data from NBG's Communications Hill site was reviewed and used as a suitable proxy of existing (baseline) concentrations for key pollutants.
Project Emissions	Emissions for the Project operations have been estimated for three operational scenarios representing different stages of the RDA development.
Sensitive Receptors	Discrete sensitive (human, ecological, heritage) receptor locations were nominated to represent the local community of Boddington, and other sensitive locations in proximity of the Project.
Model Scenarios	The predicted impacts were considered for the Project only with scenarios defining different stages of RDA development: • Scenario 1: vegetation clearing and topsoil stripping (2027-2028) • Scenario 2: mining of sub-surface bauxite deposits (in 2025 to 2026) • Scenario 3: Construction of dam embankments (2027-2029) Potential cumulative impacts were also assessed using ambient air quality monitoring data collected at NBG and surrounding stations. Abatements were considered for some sources as appropriate.

Key findings

The model predictions, for each of the three modelled scenarios, indicate that for:

- TSP:
  - No human health or amenity related receptors are predicted to observe a TSP value above the criteria when including background or isolated.
  - Several ecological receptors have predicted concentrations above the 24-hour averaged criteria of 90 µg/m^3:
- PM_{10}:
  - No residential receptors are predicted to observe a PM_{10} concentration above the criteria when including background or isolated.
- For $PM_{2.5}$:
  - No receptor was predicted to have a maximum 24-hour or annual average concentration above the criteria.
- For deposition:
  - No sensitive receptors were predicted to have dust deposition rates above the 2 g/m^2/month criteria.

Air dispersion models are a tool for the assessment and management of air quality impacts. However, it is important to recognise that they represent a simplification of the many complex processes involved in determining ground-level concentrations of pollutants. To ensure that potential impacts are not underestimated, conservative assumptions have been applied as appropriate, to provide over-predictions rather than under-predictions of ground-level concentrations.

The estimation of emissions is a significant source of model uncertainty, particularly when generic emission factors are applied to complex processes, with many assumptions and simplifications necessary to simulate mining related fugitive dust generation. Predicted concentrations are proportional to emission rates, hence any errors in the emission rates will cause a proportional error in the model's predictions.

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1 Introduction

1.1 Background

Newmont Boddington Gold Pty Ltd (Newmont) operates the Newmont Boddington Goldmine (NBG) approximately 110km southwest of Perth (Figure 1-1). NBG achieved commercial production in 2009 and is projected to operate until at least 2041. NBG is currently composed of:

- Two pits, North Pit and South Pit
- A series of Waste Rock Deposits (WRDs)
- A Residue Disposal Area (RDA1) composed of several combined RDAs (F1, F3, F4).
- Multiple dam sites including D5 and D6.

Newmont is currently seeking to develop a second Residue Disposal Area (RDA2). This development requires multiple steps:

- Initial mining of sub-surface bauxite deposits (in 2025 to 2026)
- Followed by vegetation clearing and topsoil stripping (2027-2028)
- And finally the construction of embankments (2027-2029)

Off-site dust impacts are a potential concern given the proximity of the NBG operations to surrounding ecological and heritage values as well as the Boddington townsite and other residences in the area.

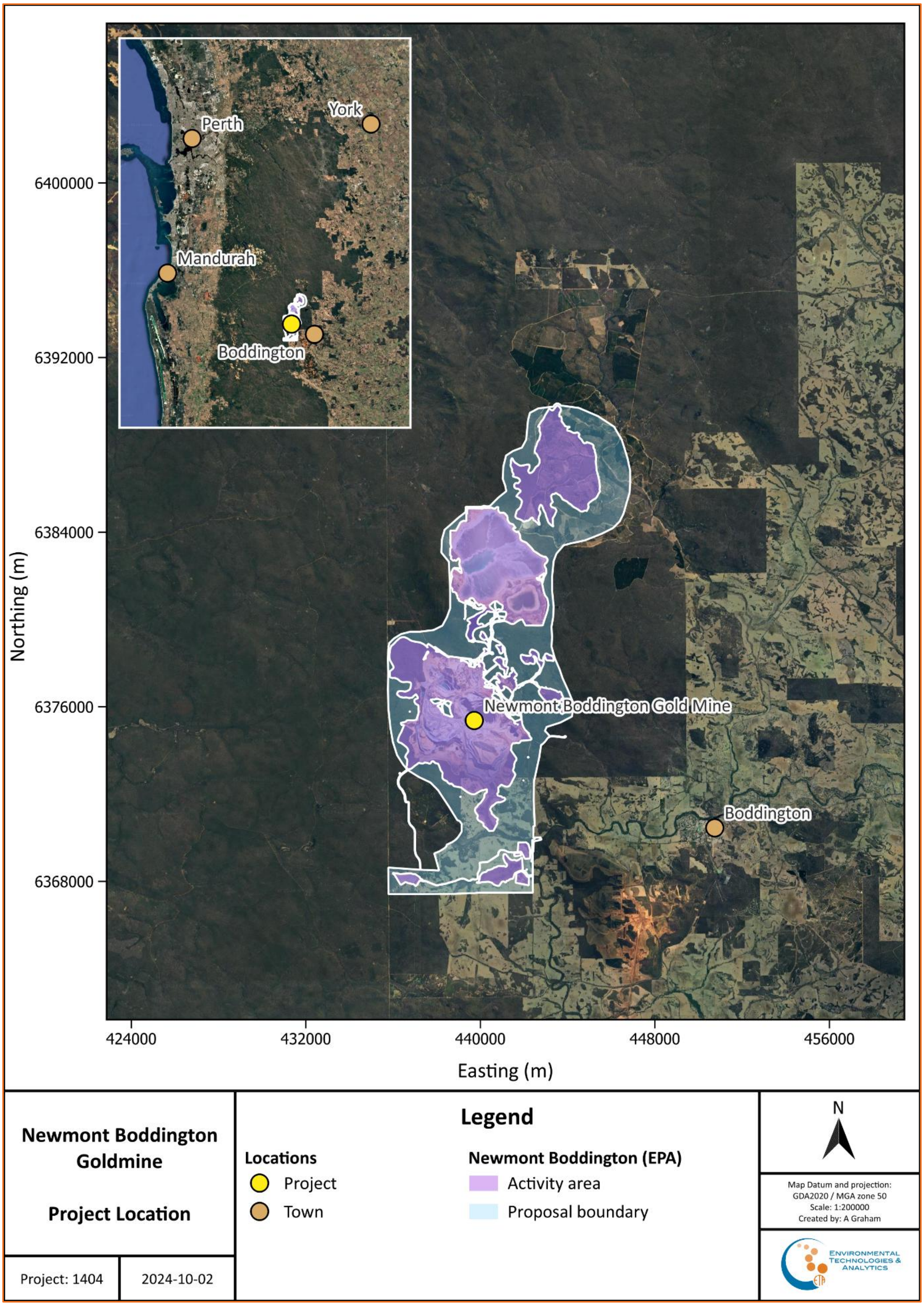


Figure 1-1: Project location and setting.

1.2 Project Description

Newmont propose to construct RDA2 over the course of 5 years (2025 to 2030). This development requires multiple steps as listed below, along with identified dust generating activities:

- Vegetation clearing and topsoil removal:
    - Vegetation clearing with bulldozers and excavators
    - Topsoil stripping with scrapers and graders
- As part of their requirements, identified bauxite deposits are removed ahead of clearing and construction operations. Thus, identified sub-surface bauxite deposits will be mined first (in 2025 to 2026). Activities include:
    - Bulldozing
    - Loading of material and waste
    - Haulage of material to on-site and offsite ore and waste landforms.
- The construction of embankments (2027-2029) will commence including related infrastructure. Activities include:
    - Haulage and unloading of wall material.
    - Wall construction using Front end loaders
    - Contouring and wetting of wall material as well as placement of waterproofing which is unlikely to generate dust due to the high moisture level of the dam wall.

This air quality assessment outlines the methodology and model results for each one of these components to inform the assessment of potential air quality (dust) impacts from the Project upon nearby receptors.

1.3 Structure of report

This report describes the methods and findings of an assessment of the potential impacts to the air environment arising from the Project operations. The assessment includes:

- Characterisation of site meteorology, terrain, and local air quality in Section 2
- Outline of the assessment framework in Section 3
- Model selection and set up in Section 4
- Emissions estimation and model scenarios considered in Section 5
- Predicted concentrations and interpretation of the potential impact of the Project in Section 6
- Conclusions of the assessment are presented in Section 7.

The appendices contain supporting information.

2 Site Characteristics

2.1 Climate and Meteorology

Boddington has a hot summer Mediterranean climate, with hot dry summers and cool wet winters. The meteorology of Boddington is well represented by the Automatic Weather Station (AWS) at Wandering (Station ID 10917), located approximately 25 km east of NBG. While data quality at the Wandering AWS is high, the wind characteristics are not representative of the surrounding region due to the placement of the station within a valley. A summary of the long-term meteorological conditions as measured at the Wandering AWS are presented in the following sections.

2.1.1 Temperature

The long-term temperature statistics from the BoM station at Wandering AWS are presented in Figure 2-1.

At Wandering, the measured mean monthly maximum temperatures ranging from a high of 31.7 degrees Celsius (°C) in January to 16.2°C in July. The mean monthly minimum temperatures range from 15.5°C in January down to 3.8°C in July.

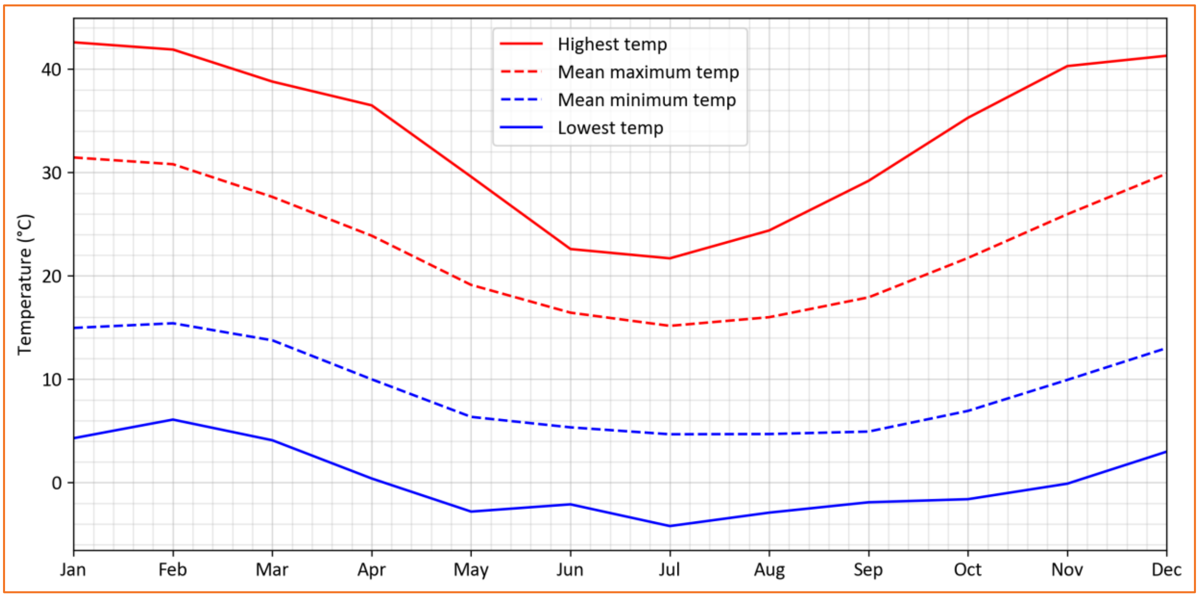


Figure 2-1: Mean Temperature 2011-01-01 to 2022-12-31 (BoM Wandering).

2.1.2 Rainfall

The amount, and seasonality, of rainfall is important for understanding the periods in which natural dust suppression occurs from windblown sources associated with surface and open pit mining and material handling activities. The long-term rainfall data measured at the BoM station at Wandering AWS are presented in Figure 2-2.

This data highlights the Hot Mediterranean climate of the region – relatively dry summers with wet winters. The rainfall patterns in the region are influenced by a range of factors, including ocean currents, atmospheric pressure systems, and local topography. The region experiences distinct seasons with the rainfall varying as follows

- Summer (December to February): Summers in Wandering are generally dry. The region receives the least amount of rainfall during this season, with sporadic and occasional thunderstorms. The average monthly rainfall during summer is 22.5 millimetres (mm).
- Autumn (March to May): Autumn in Wandering brings a slight increase in rainfall. The region experiences occasional showers and thunderstorms as the season progresses. Rainfall amounts gradually rise during autumn, with average monthly rainfall ranging between 24.8 mm and 66.4 mm.
- Winter (June to August): Winters in Wandering are the peak of the rain season, and the region receives most of its annual rainfall during this time. Rainfall intensifies, with regular rain events, drizzles, and occasional storms. Average monthly rainfall during winter ranges from 80.2 mm and 100.0 mm.
- Spring (September to November): Spring in Wandering brings a gradual decrease in rainfall. The region experiences occasional showers and thunderstorms at the beginning of the season, but as spring progresses, rainfall tapers off. Average monthly rainfall during spring ranges between 21.2 mm and 59.6 mm.

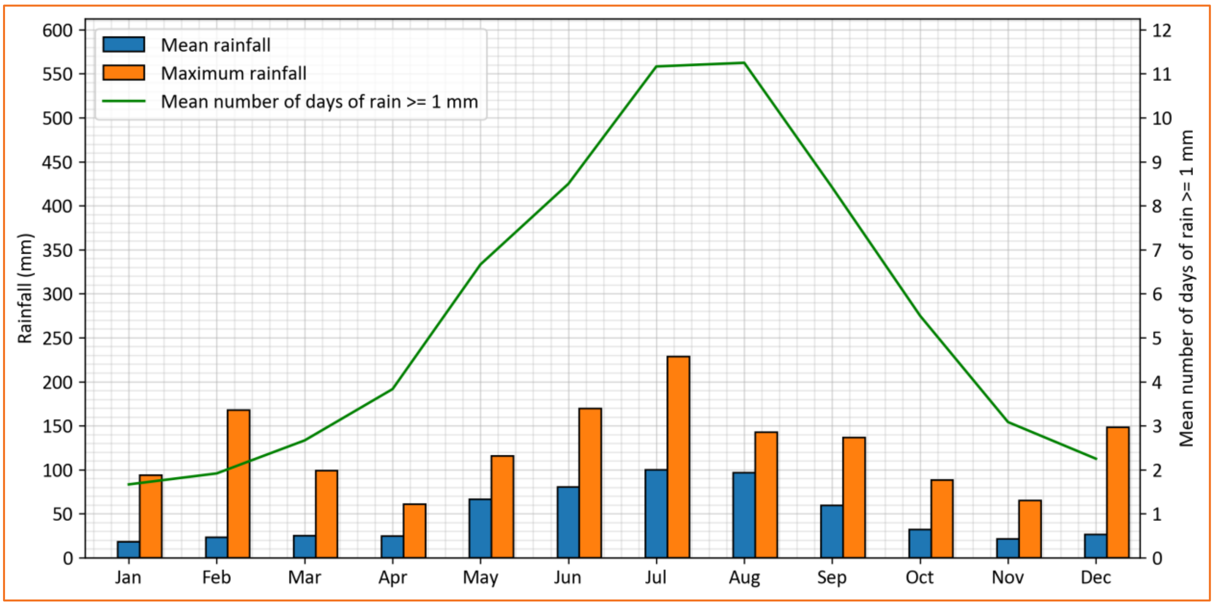


Figure 2-2: Rainfall 2011-01-01 to 2022-12-31 (BoM Wandering).

2.1.3 Wind speed/direction

The annual wind rose, derived from the Wandering AWS measurement data from 2010 to 2022, is presented in Figure 2-3. At the BoM Wandering AWS the following pointed are noted:

- Winds are channelled by the north-west to south-east axis of the Wandering valley and thus are not representative of regional wind characteristics.
- Winds follow distinct seasonal patterns reflecting the dominant Australian High in summer which is replaced by strong cold fronts in winter.
- In Summer winds come from the south-east and there is a mean wind speed of 3.8 m/s.
- In Autumn winds come from the north-west and south-east and there is a mean wind speed of 2.7 m/s.
- In Winter winds come from the north-west and there is a mean wind speed of 2.5 m/s.

- In Spring winds come from the north-west and south-east and there is a mean wind speed of 3.0 m/s.

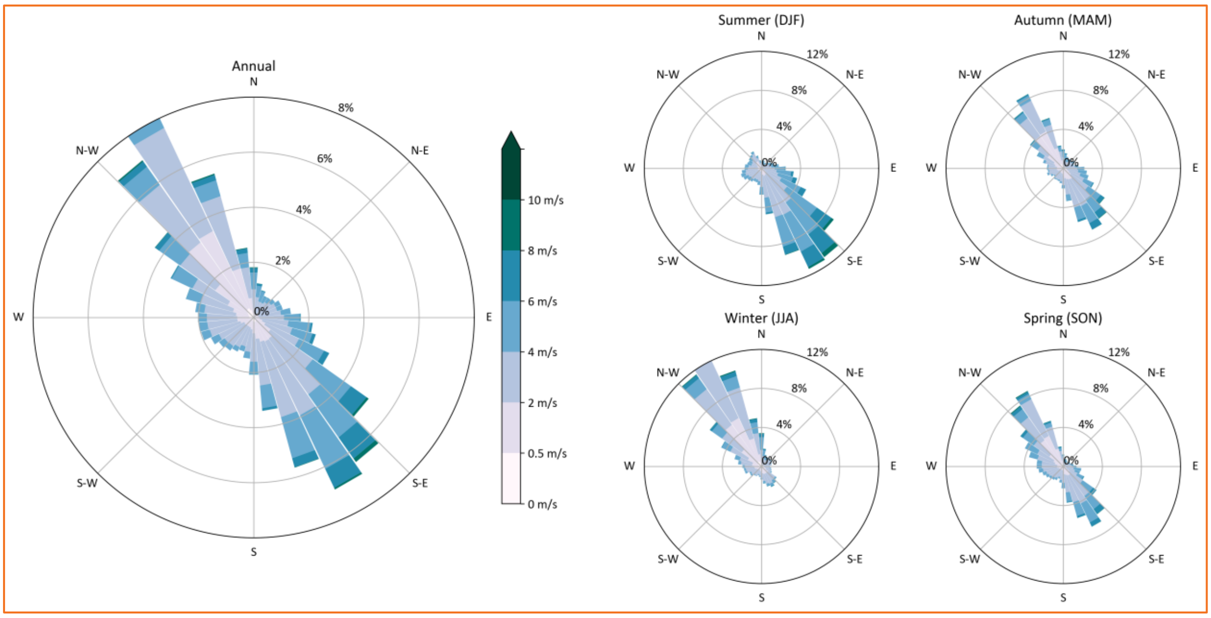


Figure 2-3: Annual and seasonal windrose from 2011 to 2022 (BoM Wandering).

2.2 Terrain

The Project site and surrounds are relatively complex (150 to 400 m above sea level). Additionally, the immediately adjacent landscape has been altered by excavation and formation of WRDs and a RDA from mining activities. This may cause terrain induced effects on local winds under calm and light wind conditions.

A 3-dimensional terrain elevation for the area surrounding the Project, derived from Shuttle Radar Topography Mission (SRTM) data with 30 m resolution, is presented in Figure 2-4.

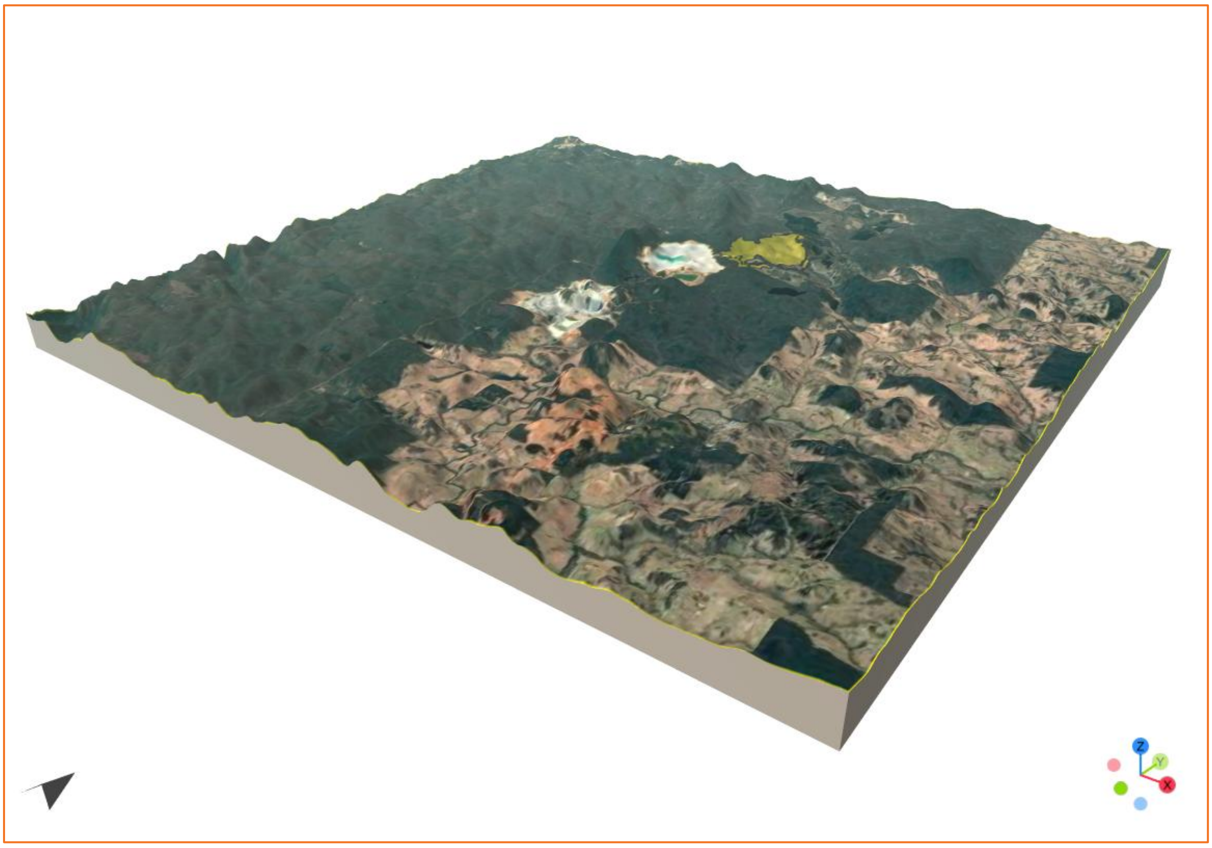


Figure 2-4: Three-dimensional terrain elevation.

2.3 Local air quality

The background air quality of the region may be influenced periodically by localised anthropogenic sources such as vehicle traffic on unsealed roads and wind erosion from exposed surfaces. On a more regional scale, airborne particulates from wind erosion of crustal surfaces are also expected to influence air quality. In some cases, these background sources are substantial contributors to ambient air quality.

The existing operations at NBG are also expected to be a source of airborne particulate. Background ambient air quality monitoring data is available from on-site monitoring at NBG and is used here to determine suitable background air quality for use in the cumulative results presentation.

NBG operate four monitors as shown in Figure 2-5. Of note is that:

- A Tapered Element Oscillating Microbalance (TEOM) monitor at Communications Hill, which was used in this study to represent 'background' concentrations, including those from the existing mining operations.
- Data was provided for approximately two years between March 2022 and May 2024.
- This monitor is co-located with an on-site meteorological station.
- Monitoring is also conducted using three Osiris real-time monitors, though this data was not utilised in this assessment.

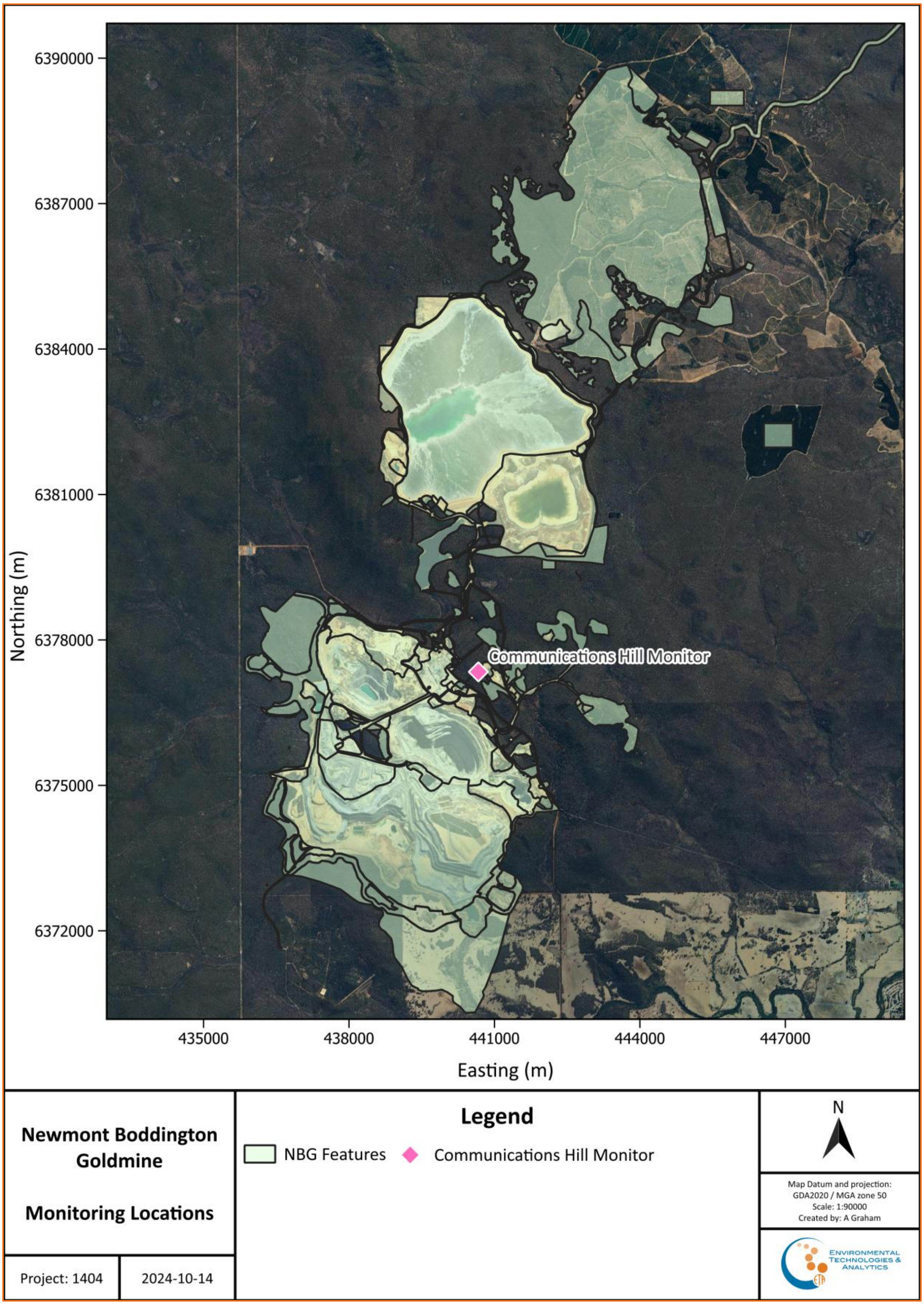


Figure 2-5: Ambient dust monitoring locations.

To determine a 'background' concentration for this assessment the 70th percentile concentration from the Communications Hill TEOM monitor was determined for both PM_{10} and $PM_{2.5}$. The 70th percentile is considered a suitably conservative statistic to define typical short-term (24-hour average) background concentrations of PM_{10} and $PM_{2.5}$ for evaluating the potential cumulative impacts of the project, and the annual average is used for the longer-term assessment period. It is noted that relevant procedures published by the Victorian Government (2001) specify the use of the 70th percentile of measured ambient concentrations as a constant background for air modelling.

Monthly recovery, defined as the percentage of hours with valid data for a given variable, is presented for wind speed and PM_{10} in Figure 2-6. From this it is clear that:

- Wind speed and PM_{10} have very similar patterns of data recovery.
- Data recovery is generally high, especially in 2023 where the lowest percentage is 98%.
- Data recovery is lowest in February 2022 (67%) and November 2022 (69%).

A timeseries of 24-hour averaged PM_{10} and $PM_{2.5}$ concentrations, from the Communications Hill TEOM, are presented in Figure 2-7. Of note is that:

- Excursions above the relevant national ambient air quality standards for PM_{10} and $PM_{2.5}$ were recorded at the NBG monitoring station on multiple occasions.
- Daily $PM_{2.5}$ concentrations appear to be generally low with occasional brief spikes.
- Daily PM_{10} concentrations are highly variable with peak values showing a seasonal trend. The highest concentrations occurring in late summer and early autumn which is typically the driest time of year (Section 2.1.2).

After establishing that data quality was sufficient and that the monitoring was representative of site emissions, the 70th percentile was used as an appropriately conservative background concentration for use in cumulative results. Values are presented in Table 2-1, noting that TSP is taken to be twice the PM_{10} value.

Table 2-1: Selected background concentrations for use in cumulative model results.

Particulate	70th Percentile
TSP (taken as 2 times PM_{10})	45.44
PM_{10}	22.72
$PM_{2.5}$	4.45

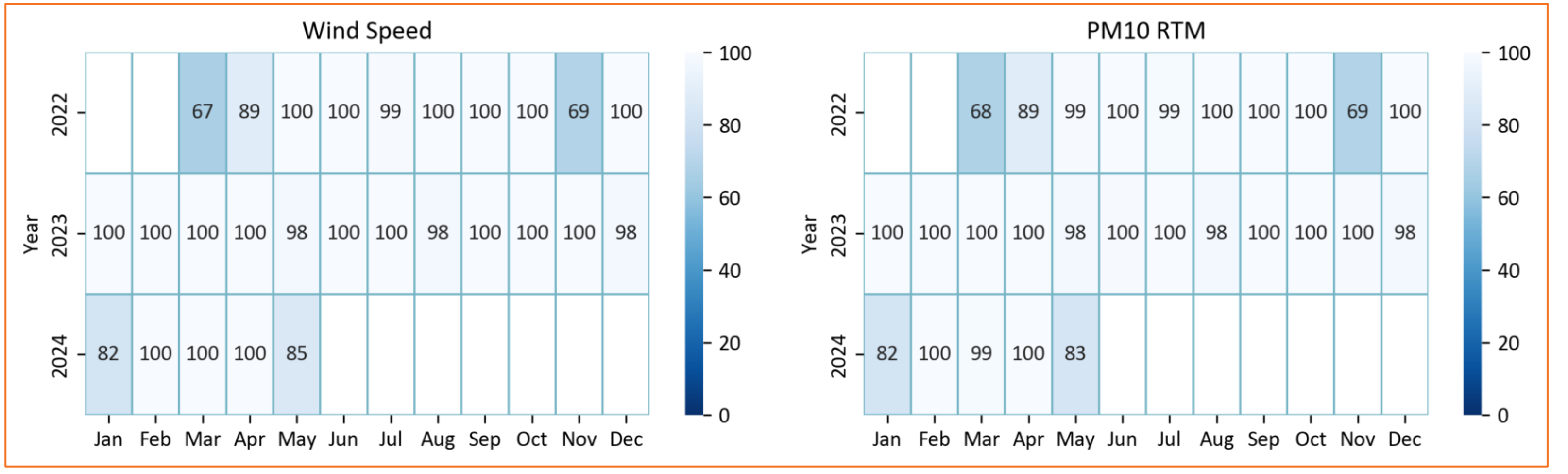


Figure 2-6: Data completeness for the NBG monitor.

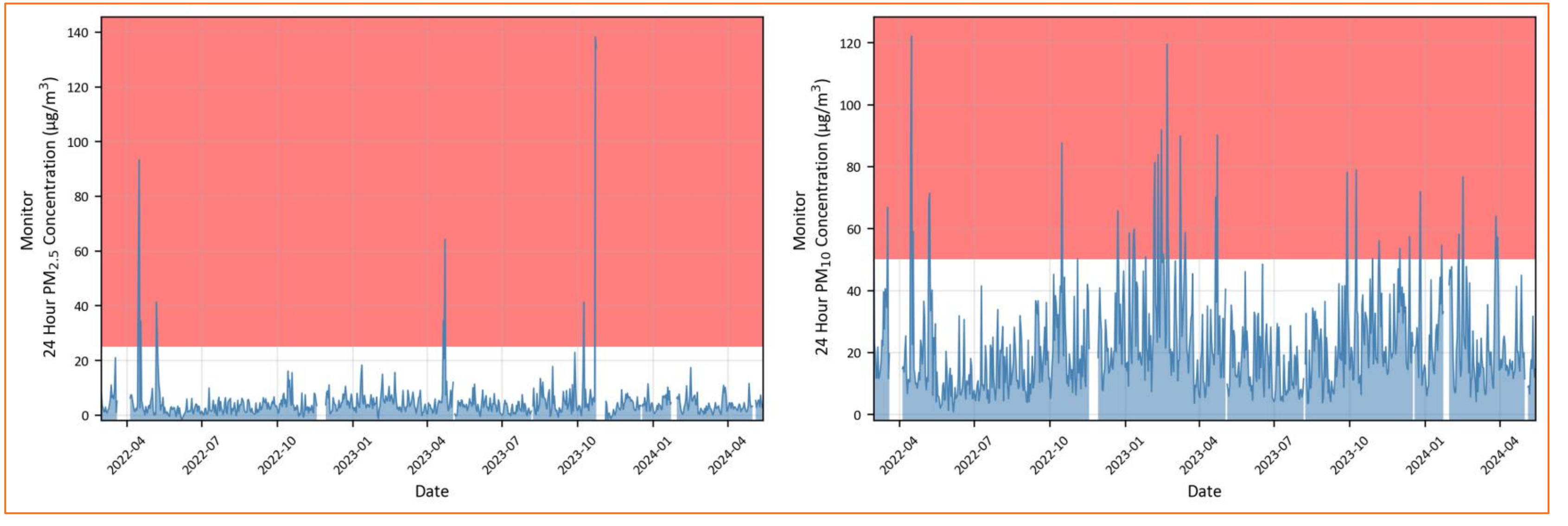


Figure 2-7: Timeseries of 24-hour averaged $PM_{2.5}$ and PM_{10} measured at NBG monitor site.

3 Assessment Framework

3.1 Air pollutants of interest

Airborne particles are a broad class of diverse substances that may be solid or liquid (liquid particles are often called aerosols) and are produced by a wide range of natural and human activities. Airborne particles are commonly classified by their size as total suspended particles (TSP), inhalable particles (coarse fraction PM_{10} and fine fraction $PM_{2.5}$). An image of the various particle sizes is presented in Figure 3-1.

Dust generated from mining activities is made up of airborne particles that are comprised of these various size ranges. Dust from mining activities is predominantly of crustal origin, with diesel PM (from diesel fuel combustion) a less significant contributor.

Dust has the potential to impact the environment, health and welfare of the community, as well as the local amenity, causing a nuisance to surrounding land users, in particular the adjacent community of Boddington. Therefore, managing air quality for the protection of human health and amenity (including nuisance) requires consideration of dust in the context of human health and other environmental effects.

The focus of the dust modelling assessment undertaken for this Project is on the management of potential health impacts upon the adjacent communities considered of primary concern, with the secondary concern being amenity (dust nuisance) impacts.

Air quality from a human health perspective is measured according to the concentration of PM_{10} and $PM_{2.5}$ in ambient air (µg/m^3). Dust nuisance is measured according to the rate of deposited dust on surfaces (dust deposition) (g/m^2/month).

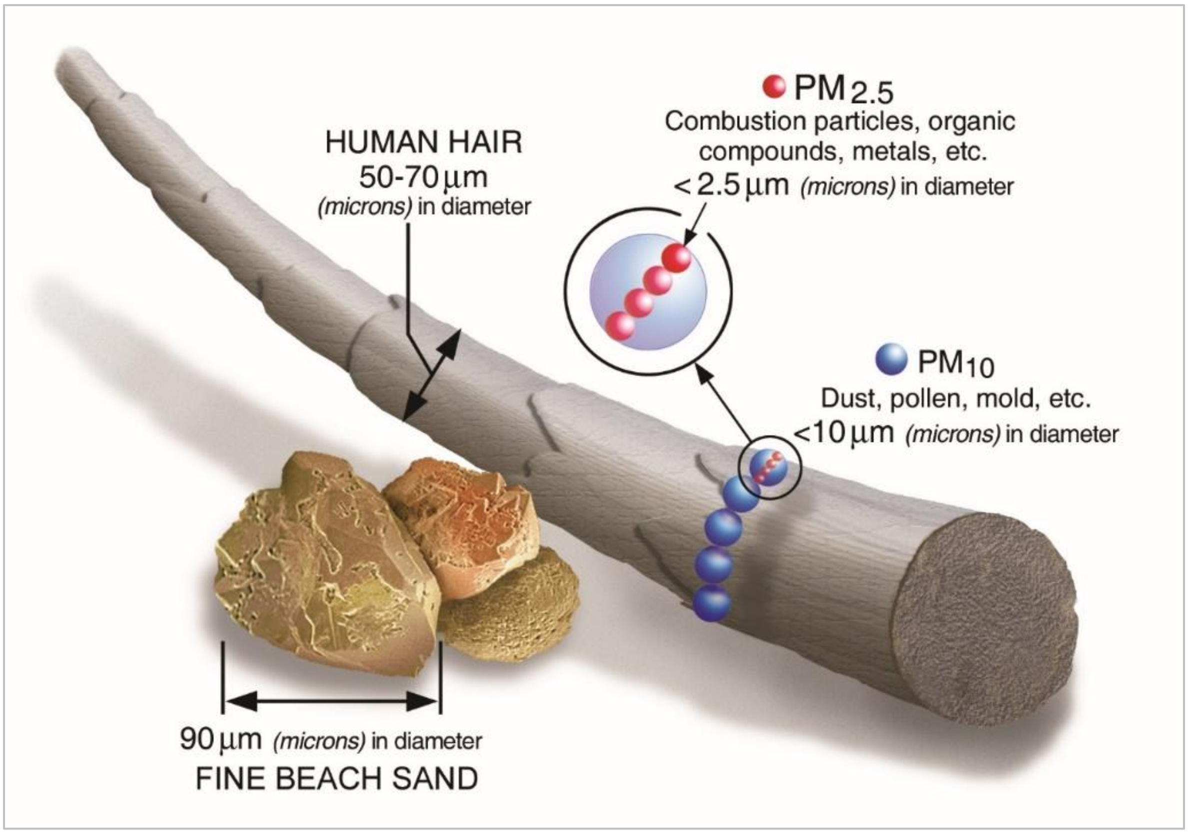


Figure 3-1: Example of particle sizes (from epa.gov/pm-pollution/particulate-matter-pm-basics).

3.1.1 Human health effects

There are many health effects from exposure to particulate matter (PM). Numerous scientific studies have linked exposure to PM to a range of adverse health effects which can occur after both short and long-term exposure. Despite extensive epidemiological research, there is currently no evidence of a threshold below which exposure to PM does not cause any health effects. The size of particles affects their potential to cause health problems, as summarised in Table .

Table 3-1: Summary of potential health effects from exposure to particulate matter

Particle Size	Potential Health Effects
PM_{10}	Inhalable particles are grouped into two size categories: those with a diameter of up to 10 µm (PM_{10}) and those with a diameter of up to 2.5 µm ($PM_{2.5}$). Inhalable particles are associated with increases in respiratory illnesses such as asthma, bronchitis and emphysema, with an increase in risk related to their size, chemical composition and concentration. Particles in the PM_{10} size fraction have been strongly associated with increases in the daily prevalence of respiratory symptoms, hospital admissions and mortality.
$PM_{2.5}$	Particles in the $PM_{2.5}$ size fraction can be inhaled more deeply into the lungs than PM_{10} and can enter into the bloodstream. $PM_{2.5}$ has been associated with health effects similar to those of PM_{10}, although there is some evidence to suggest that $PM_{2.5}$ might be more deleterious to health. No lower limit for the onset of adverse health effects has yet been observed.
TSP	TSP refers to the total amount of the PM suspended in air, typically up to 50 µm. These larger particles are primarily associated with amenity or visibility issues and are likely to be removed by gravitational settling within a short time of being emitted (i.e. they settle to the ground or other surfaces fairly quickly).

3.1.2 Other environmental effects

Airbourne particles can be carried by wind and settle out on surfaces due to gravitational settling. The deposited dust can potentially have an adverse impact upon the natural environment, such as vegetation or waterways, and amenity values (dust nuisance). Airbourne particles are also a potential cause of reduced visibility, either locally or on a regional scale (haze).

3.2 Ambient Air Quality Assessment Criteria

Ambient air quality standards and guidelines are the numerical values generally adopted as the measure of acceptable air quality. These are set out in Table for information purposes, noting these are applicable to all contributing sources (i.e. cumulative).

The National Environment Protection Measure (NEPM) for Ambient Air Quality (NEPC, 2021) specifies standards that have been derived for the adequate protection of human health and well-being. They cover a range of common air pollutants including (but not limited to) particulates (as PM_{10} and $PM_{2.5}$).

The Ambient Air Quality NEPM has recently been updated to reflect the latest scientific understanding and to allow for an adequate level of health protection. As part of a framework for continuous improvement, increasingly more stringent standards for $PM_{2.5}$ apply from 2025.

The Ambient Air Quality NEPM provides a framework for a nationally consistent approach to monitoring and reporting of ambient air quality in Australia, supporting the formulation of air quality management policies. Whilst the Ambient Air Quality NEPM does not directly regulate the activities of individuals or businesses (NEPC, 2021a), the standards have been widely referenced by State and Territory jurisdictions as regulatory instruments, including in the draft Air Emissions Guideline for Western Australia (DWER, 2019).

Table 3-2 Summary of Air Quality Assessment Criteria (Cumulative Impact)

Parameter	Air quality assessment criteria		Averaging period	Reference
	At 0ºC	At 25ºC		
TSP	90 µg/m^3	80	24-hour average	DWER (2019)
PM_{10}	50 µg/m^3	46 µg/m^3	24-hour average	
	25 µg/m^3	23 µg/m^3	annual average	
$PM_{2.5}$	25 µg/m^3	23 µg/m^3	24-hour average	
	20 µg/m^3	18 µg/m^3	24-hour average	
	8 µg/m^3	7 µg/m^3	annual average	
	7 µg/m^3	6 µg/m^3	annual average	

Notes:

1. Shaded cells indicate the increasingly more stringent criteria for $PM_{2.5}$ that will apply from 2025 under NEPC (2021).

The dust deposition criteria relevant for the assessment of amenity (dust nuisance) impacts are based on the criteria adopted in the draft Dust Emissions Guideline (DWER, 2021), presented in Table .

Table 3-3 Summary of Dust Deposition Assessment Criteria

Parameter	Dust deposition assessment criteria		Averaging period	Reference
	Maximum Increase [1]	Maximum Total [2]		
Deposited Dust	2 g/m^2/month	4 g/m^2/month	annual	DWER (2021) [3]

Notes:

1. Maximum increase in deposited dust (above background level).
2. Maximum total deposited dust (when background level is unknown).
3. DWER (2021) references NSW EPA (2016) as one of the original sources of these criteria, which has been referred to for this table. NSW EPA (2016) is superseded by NSW EPA (2022), however there has been no change to the deposited dust criteria. DWER (2019) does not reference the annual averaging period specified in NSW EPA (2016 & 2022).

3.3 Sensitive Receptors

The modelling assessment considers the potential air quality impacts at discrete sensitive (human) receptor locations. These have been selected to represent locations where people reside either on a permanent or temporary basis, including areas with residences, hospitals, and accommodation. The sensitive receptor locations in proximity of the Project considered for this assessment are listed in Table 3-4 and shown in Figure 3-2.

Table 3-4: Summary of discrete sensitive receptor locations (GDA2020 UTM Zone 50)

ID	Description	Type	Easting (m) [1]	Northing (m) [1]
R1	North RDA Monitor #1 Monitor	Monitor	438,872	6,384,324
R2	North RDA Monitor #2 Monitor	Monitor	439,180	6,384,560
R3	Communications Hill Monitor	Monitor	440,669	6,377,339
R4	Village Receptor	Residential	448,501	6,372,501
R5	Boddington Township	Residential	449,501	6,370,501
R6	Bannister Housing & Road Receptor	Residential	450,501	6,374,501
R7	North East Establishment #1 Receptor	Misc	450,201	6,381,471
R8	North East Establishment #2 Receptor	Misc	450,501	6,389,001
R9	HEA01	Heritage	434,905	6,385,430
R10	Dandalup River 1	Heritage	434,180	6,382,515
R11	Dandalup River 2	Heritage	434,313	6,382,915
R12	Dandalup River 3	Heritage	440,187	6,387,945
R13	Kittys Grave	Heritage	455,575	6,384,838
R14	Pollards Possum Tree	Heritage	456,684	6,384,616
R15	Gnamma Hole	Heritage	456,995	6,381,997
R16	Forest 36	Heritage	442,066	6,377,647
R17	Forest 43	Heritage	444,167	6,380,148
R18	Hotham River	Heritage	438,500	6,367,852
R19	Tullis	Heritage	443,427	6,370,334
R20	Oldfield BLK 91	Heritage	445,347	6,370,523
R21	Forest 01	Heritage	446,490	6,373,834
R22	Eco1	Ecological	442,443	6,388,728
R23	Eco2	Ecological	442,391	6,388,317
R24	Eco3	Ecological	440,113	6,387,585
R25	Eco4	Ecological	446,146	6,384,751
R26	Eco5	Ecological	445,998	6,383,568
R27	Eco6	Ecological	446,856	6,389,353
R28	Eco7	Ecological	447,381	6,388,554
R29	Eco8	Ecological	448,180	6,386,283
R30	Eco9	Ecological	443,481	6,392,856

ID	Description	Type	Easting (m) [1]	Northing (m) [1]
R31	Neighbour	Residential	447,290	6,371,159
R32	Neighbour	Residential	452,374	6,386,170
R33	Neighbour	Residential	451,159	6,388,268
R34	Town	Residential	450,867	6,370,684
R35	Roadhouse	Residential	447,858	6,395,128
R36	Bibbulmun Track Campsite	Amenity	447,838	6,396,426
R37	Bibbulmun Track Campsite	Amenity	437,775	6,381,884
R38	Bibbulmun Track Campsite	Amenity	437,690	6,391,859
R39	Neighbour	Amenity	442,414	6,371,378

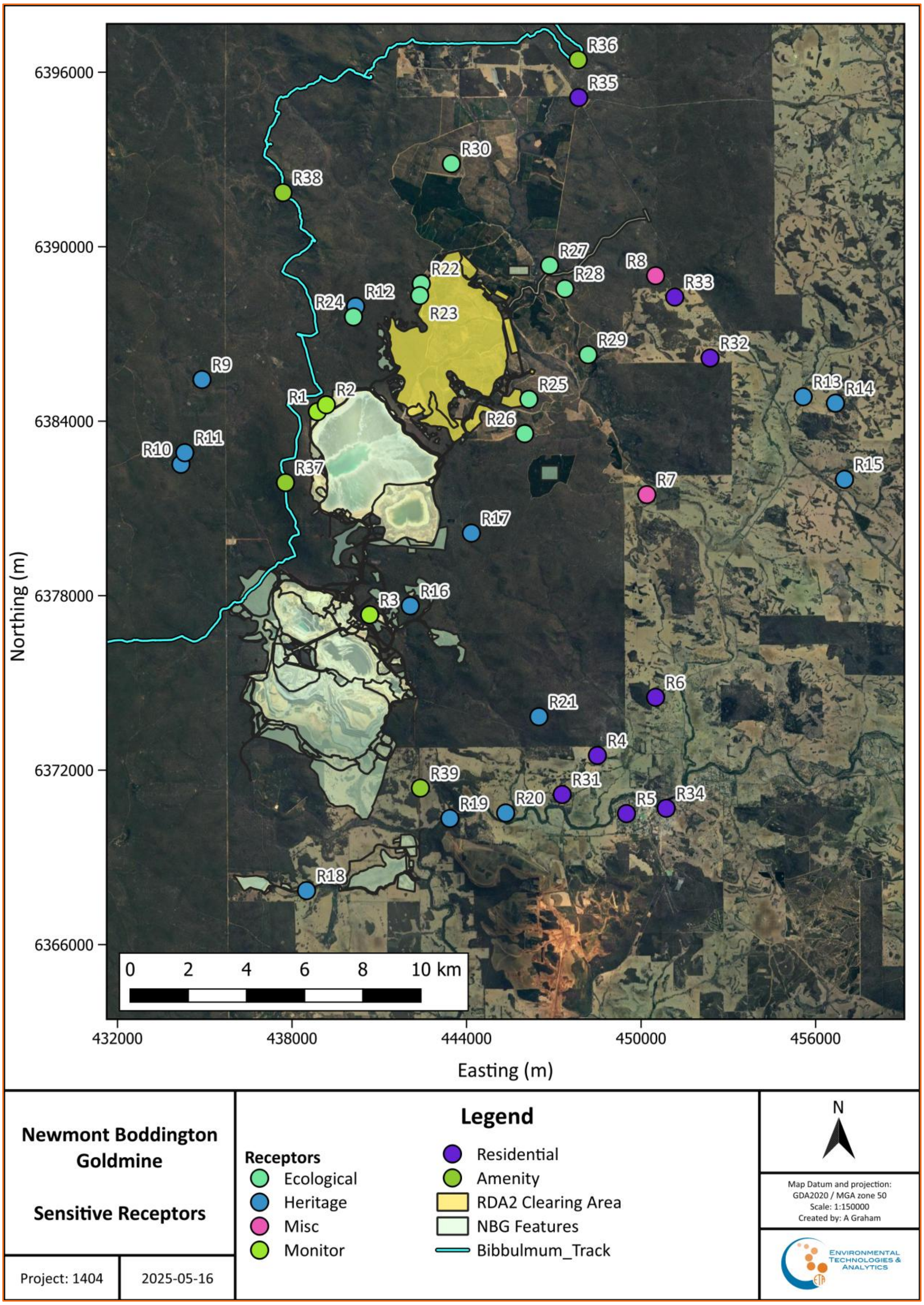


Figure 3-2: Sensitive receptor locations.

4 Modelling Methodology

4.1 Overview

For this assessment, air dispersion modelling has been conducted using the CALMET/CALPUFF suite of models with meteorological data produced from the WRF prognostic model. The CALMET meteorological model has been used to develop the required meteorological inputs, and the CALPUFF model has been used to predict the concentrations at ground-level across the model domain and at nominated discrete receptor locations. Meteorological measurements from the Wandering AWS station have been used to assess the accuracy of the meteorological inputs generated by WRF and CALMET for the modelling.

An overview of the air quality modelling approach is shown in Figure 4-1.

Further details of model settings and input parameters are provided in the subsections following.

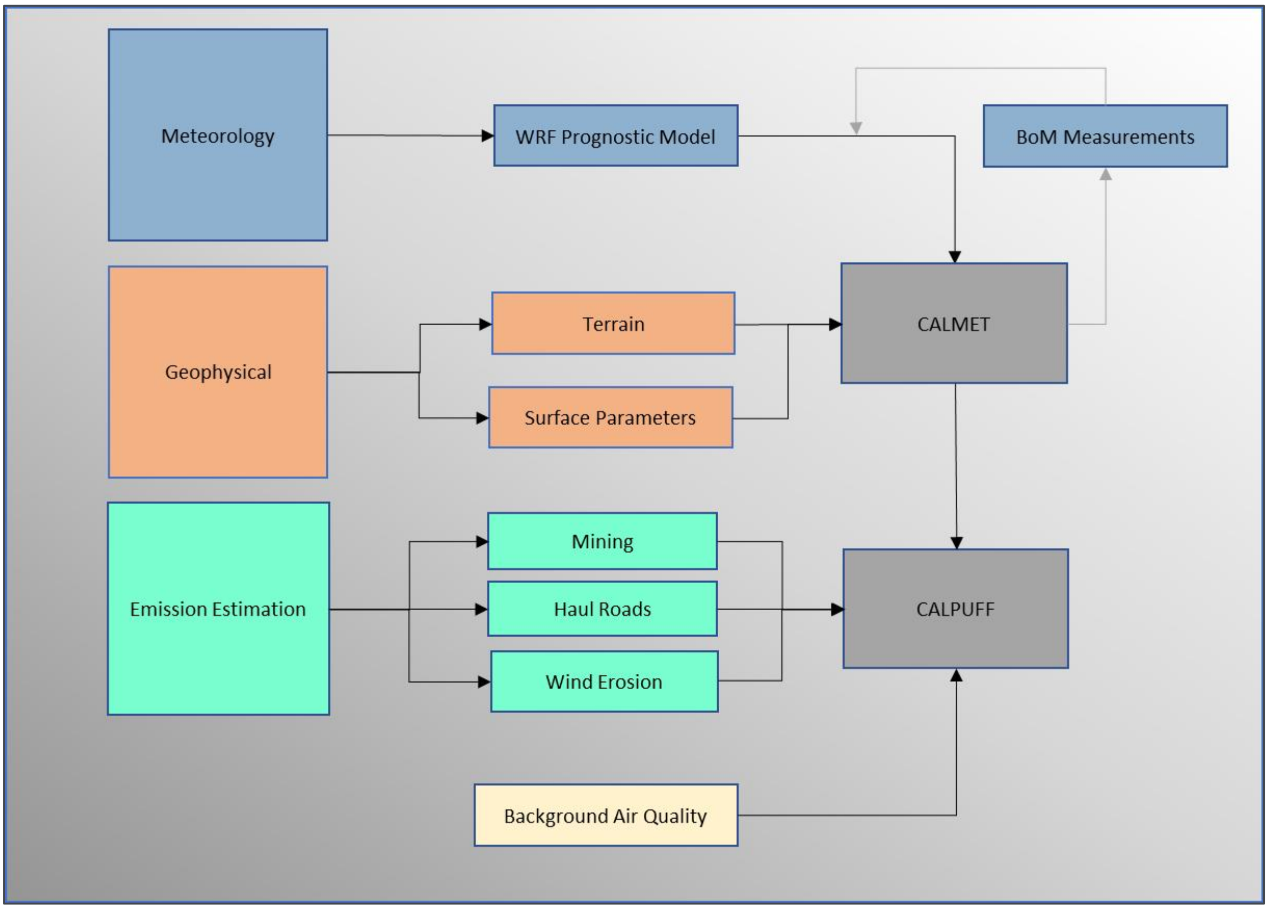


Figure 4-1: Air quality assessment – study approach.

4.2 Meteorology

4.2.1 Selection of representative year

Generally, a minimum of one year of meteorological data is acceptable for dispersion modelling in Australia and New Zealand. The data must, however, adequately represent worst-case meteorological conditions and the data should be assessed in terms of representativeness against climatic averages. In other words, the meteorology for selected years must be deemed representative of the "normal" range of conditions in the area.

To determine the year of meteorological data to use for the dispersion modelling, 14-years of historical surface observations from the BoM weather station at Wandering AWS (2014 to 2023 inclusive) were reviewed. The 2020 calendar year was selected for modelling based on visual and statistical tests for representativity against long-term average conditions. The results of the statistical analysis performed to support selection of the representative year is presented in Appendix A.

4.2.2 Meteorological Models

4.2.2.1 The Weather Research and Forecast (WRF) model

In the absence of adequate meteorological data to produce an accurate 3-dimensional representation of the dispersion meteorology over the area, the Weather Research and Forecast (WRF V4.1) model (http://wrf-model.org/index.php) was used to generate hourly 3-dimensional data for the region. WRF is the next-generation mesoscale numerical weather prediction system primarily designed to serve both operational forecasting and atmospheric research. WRF features multiple dynamical cores, a 3-dimensional data assimilation system and a software architecture allowing for computational parallelism. Further information on WRF is provided in Appendix A.

4.2.2.2 CALMET

The 3-Dimensional meteorological data generated by WRF was input to CALMET (Version 6.42 Level: 110325) for further processing to the finer resolution used in the dispersion modelling. This procedure will be referred to as the 'WRF-CALMET methodology'. The output from the CALMET meteorological model is then used to drive the pollution dispersion in the CALPUFF model.

CALMET is a three-dimensional meteorological pre-processor that includes a wind field generator containing objective analysis and parameterised treatments of slope flows, terrain effects and terrain blocking effects. The pre-processor produces fields of wind components, air temperature, relative humidity, mixing height and other micro-meteorological variables to produce the three-dimensional, spatially- and temporal-varying meteorological fields that are utilised in the CALPUFF dispersion model.

CALMET requires several datasets to resolve the surface and upper air meteorology occurring for each hour of the year:

- surface observations and upper air observations or gridded prognostic meteorological model data.
- land use and topographical data.

CALMET was run for a 165 x 160 grid domain at a spatial resolution of 250 m. Vertically, the model consists of 12 levels extending to 3,000 m. The southwest corner coordinates of the domain have an Easting of 419,594 m and a Northing of 6,359,367 m.

The 90 m resolution Shuttle Radar Topography Mission (SRTM) dataset was used as input into the CALMET model to indicate terrain heights within the model domain.

CALMET also requires geophysical data including gridded fields of land use categories. The CALMET land use is sourced from the 100 m spatial resolution Copernicus Global Land “CGLOPS-1” dataset (Buchhorn et al, 2020), and converted to the 52-category United States Geological Service land use and land cover classification system required by CALMET.

The configuration of CALMET is detailed in Appendix A.3 and CALMET performance evaluation and selected results are provided in Appendix A.4 and Appendix A.5.

4.3 CALPUFF

CALPUFF is the dispersion module of the CALMET/CALPUFF suite of models. It is a multi-layer, multi species, non-steady-state puff dispersion model that can simulate the effects of time-varying and space-varying meteorological conditions on pollutant transport, transformation and removal. The model contains algorithms for near-source effects such as building downwash, partial plume penetration, sub-grid scale interactions as well as longer range effects such as pollutant removal, chemical transformation, vertical wind shear and coastal interaction effects. The model employs dispersion equations based on a Gaussian distribution of pollutants across released puffs and considers the complex arrangement of emissions from point, area, volume and line sources (Scire et al., 2011).

It is listed by the USEPA as an alternative regulatory dispersion model for assessing certain near-field applications involving complex meteorological conditions and long-range transport of pollutants (US EPA, 2024). The CALPUFF model is used extensively throughout Australia for regulatory assessments of mining projects.

The CALPUFF model was set to calculate concentrations on a set grid (gridded receptors). The model domain was defined as 41 km in the east–west and 40 km north-south direction at a spacing of 250 m x 250 m.

4.4 Particle Sizing | Gravitational Settling

CALPUFF was set up to model depletion of the dust plume concentration through gravitational settling and dry deposition of pollutants at the surface. To simulate gravitational settling of airborne particles, information on the particle size distribution (PSD) is required as input to the model. A particle size distribution for TSP, PM_{10} and $PM_{2.5}$ was estimated using a composite from the USEPA AP-42 manuals for ‘aggregated handling and storage piles’, ‘industrial wind erosion’ and ‘unpaved roads’. The PSD used for the modelling are shown in Table .

Table 4-1: Particle size distribution (USEPA, 2006).

Size range (µm)	Representative size	TSP	PM_{10}	$PM_{2.5}$
<2.5	1.3	6	15	100
2.5 – 5.0	3.5	14	36	-
5.0 – 10.0	7.5	19	48	-
10.0 – 15.0	12.5	14	-	-
15.0 – 30.0	22.5	29	-	-
30.0 – 50.0	37.5	18	-	-

4.5 Model Uncertainty

Atmospheric dispersion models represent a simplification of the many complex processes involved in approximating ground-level concentrations of substances. The model uncertainty is therefore composed of uncertainties associated with model chemistry and physics, data, and stochastic uncertainties. There are also inherent uncertainties in the behaviour of the random turbulence of the atmosphere.

As with any modelling assessment of this nature, there are areas of uncertainty in this air quality assessment. To ensure that potential air quality impacts are not underestimated, conservative assumptions have been applied as appropriate, to provide over-predictions rather than under-predictions of ground-level concentrations.

Factors contributing to the general uncertainty in model results include:

- the turbulent (random) nature of dispersion in the turbulent atmosphere
- inaccuracies in the mathematical description of the physical and chemical processes that occur in the atmosphere (i.e. uncertainties in the numerical solutions)
- stochastic uncertainties, as models predict 'ensemble mean' concentrations (i.e. they predict the mean concentrations that would result from a large set of observations under the specific conditions being modelled)
- data uncertainty or variability, particularly in emission information and meteorological data inputs.

The uncertainty in modelling of extreme events, such as the maximum 1-hour ground-level concentration, is greater than the uncertainty in predicting concentrations averaged over a longer time period. Similarly, uncertainty in modelling the maximum predicted ground-level concentration at a discrete location is greater than the uncertainty in the maximum concentration predicted across the entire modelled domain. This is because the modelled concentration at a particular location is very sensitive to small changes in wind direction.

From the results of numerous studies of model accuracy, the US EPA (2005) summarises:

- models are more reliable for estimating longer time-averaged concentrations than for estimating short-term concentrations at specific locations; and
- models are reasonably reliable in estimating the magnitude of highest concentrations occurring sometime, somewhere within an area. For example, errors in highest estimated concentrations of ± 10 to 40 percent are found to be typical i.e., certainly well within the often-quoted factor-of-two accuracy that has long been recognised for models.

A combination of modelled ground-level concentration statistics (i.e. maximum, 2nd and 6th highest, 95th percentile, 90th percentile and 70th percentile) has been used to evaluate potential impacts, and to account for unusual (stochastic) events (i.e. infrequent adverse meteorology) that can result in significantly higher maximum predicted ground-level concentrations at discrete locations compared to other predicted statistics.

5 Emissions Information

5.1 Introduction

This section outlines the emission estimation process used to develop the emission inventory for the Project. It includes the emissions generated from:

- Vegetation clearing and stripping:
  - Vegetation clearing with bulldozers and excavators
  - Topsoil stripping with scrapers and graders
- Bauxite mining including:
  - Bulldozing
  - Loading of material and waste
  - Haulage of material to on-site and offsite ore and waste landforms.
- Construction of embankments including:
  - Haulage and unloading of wall material.
  - Wall construction using Front end loaders

Emissions scenarios were defined as:

- Scenario 1: Vegetation clearing and stripping
- Scenario 2: Bauxite mining
- Scenario 3: Dam construction.

For each stage of the project the period of highest activity or tonnage was selected to inform emissions estimation. Specifically;

- All vegetation clearing and topsoil stripping will occur within a calendar year.
- The entire forecast tonnage for bauxite of 4 mega-tonnes (Mt) was assumed to be mined in a single calendar year.
- Major embankment works will occur within a single calendar year.

The locations of activities will move around as operations progress. Where possible, sources were considered when closest to nominated receptor locations.

While construction emissions are modelled in this project, smaller construction related emissions are excluded. This is due to their short term and transient nature, and therefore the potential air quality impacts are not well described or represented with dispersion modelling. The management of dust during the construction phase is most effectively addressed through the development and implementation of the Dust Management and Monitoring Plan.

5.2 Modelled Scenarios

The key emission sources of dust for the operating phase of the Project are described here, and their locations shown in Figure 5-1.

5.2.1 Scenario 1: Vegetation Clearing and Topsoil Removal

For vegetation clearing and topsoil removal sources considered were:

- Bulldozers (Clearing)
- Excavators (Clearing)

- Graders (Topsoil removal)
- Scrapers (Topsoil removal)
  - Both travelling and scraping modes were considered.
- Wind erosion.

Tonnage was determined by overlaying a regular 500m grid over the site and nominating 48 perimeter sites as representative of emissions. The size of the disturbed area within each block determined relative emissions for the four sources in that block. The probability of source activity for any given hour was held at 20% to reflect relatively low frequency activity for any given source, meaning that, on average, 10 blocks were active for any modelled hour.

Wind erosion sources were nominated for a set of 8 blocks and used the area of that block to inform emissions.

5.2.2 Scenario 2: Bauxite Mining

Sources considered were:

- Loading of ore at the bauxite deposits.
  - Loading tonnage at each of the nominated loading sites was determined by dividing the bauxite areas between sites based on Voronoi polygons and then distributing tonnage by the relative size of the area.
- Bulldozer activity at bauxite deposits.
- Unloading and bulldozer activity at the staging pad at the southern edge of the active area.
- Haul roads moving ore from loading sites to either the staging pad or offsite.
  - Haul road tonnage corresponds to the Loading tonnages for a given route.
- Wind erosion sites were also considered at the same sites as loading sources and the total bauxite deposit area for each Voronoi polygon was used. For the staging pad the area of the staging pad was used.

5.2.3 Scenario 3: Dam construction

Emissions sources considered for dam construction were:

- Unloading sites for dam wall material.
- Front end loader activity considering movement of still dry material.
- Haul roads transporting wall material to each embankment construction site.
- No wind erosion was considered as wall construction is primarily a wet process and other open areas are encompassed by the clearing scenario.

Tonnage inputs for these sources was determined by:

- Taking an estimate of the embankment wall height at 100 meter intervals around the perimeter of the RDA footprint, then
- Getting the difference between the maximum height and the height at each point.
- Excluding points less than 15 meters from the maximum height.
- Assuming an isosceles triangle shape for the wall with a base length of 200 meters, calculate the volume for each valid point’s height and summing together the results.

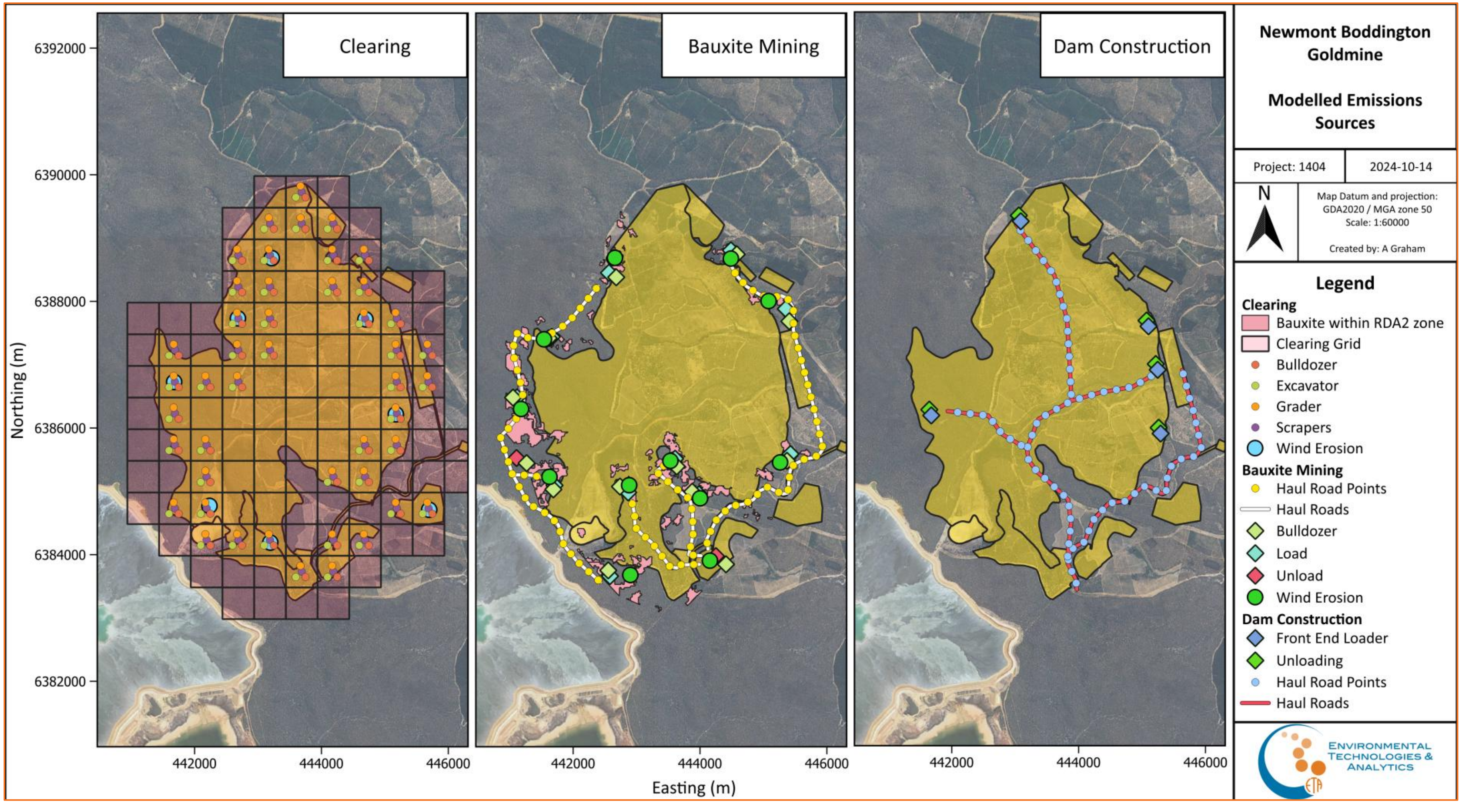


Figure 5-1: Project modelled dust sources.

5.3 Emission estimation methods

Emissions from the Project sources have been derived using accepted methods of emission estimation, primarily referencing the National Pollutant Inventory (NPI) Emission Estimation Technique Manual for Mining (Version 3.1) (EET for Mining) (Environment Australia, 2012), together with information provided by Newmont. The methods and equations used for estimating emissions are outlined in this section.

The estimation of emissions is a significant source of model uncertainty, particularly when generic emission factors are applied to complex processes, with many assumptions and simplifications necessary to simulate mining related fugitive dust generation. Predicted concentrations are proportional to emission rates, hence any errors in the emission rates will cause a proportional error in the model's predictions.

To ensure that potential impacts are not underestimated, conservative assumptions have been incorporated as appropriate, to provide over-estimates rather than under-estimates of the emission rates used in the modelling.

5.3.1 Loading ore/waste/dam material

Emissions for loading ore and waste have been calculated using the default value for excavators and front-end loaders on overburden of:

- TSP: 0.025 kg/t
- PM_{10}: 0.012 kg/t

The emission factor for $PM_{2.5}$ emissions is taken as 28% of the PM_{10} emissions. The statistics of the annual emissions for loading for PM_{10} are contained in Appendix C.

5.3.2 Unloading ore/waste/dam material

Emissions for unloading ore and waste have been calculated using the default values of:

- TSP: 0.012 kg/t
- PM_{10}: 0.0043 kg/t

The emission factor for $PM_{2.5}$ emissions is taken as 28% of the PM_{10} emissions. The statistics of the annual emissions for loading for PM_{10} are contained in Appendix C.

5.3.3 Front end loaders

Emissions for the operation of front end loaders used the default emission factor listed in Appendix A of the EETM for Mining (EA, 2012) for overburden. These factors are:

- TSP: 0.025 kg/tonne
- PM_{10}: 0.012 kg/tonne

The emission factor for $PM_{2.5}$ emissions is taken as 30% of the PM_{10} emissions. The statistics of the annual emissions for loading for PM_{10} are contained in Appendix C.

5.3.4 Bulldozing

Emissions for the operation of bulldozers on both ore and waste have been determined using Equation 16 and 17 outlined in Appendix A of the EETM for Mining (Environment Australia, 2012). The silt contents used were the defaults listed in the manual (2% silt) along with 5% moisture used for bulldozers during clearing and 8% moisture during bauxite mining.

The emission factor for $PM_{2.5}$ emissions is taken as 30% of the PM_{10} emissions. The statistics of the annual PM_{10} emissions for bulldozing are contained in Appendix C.

5.3.5 Haul Roads

To determine emissions from wheel generated dust along the haul roads the default equation for 'unpaved roads from wheels' was utilised (Equation 2). The weight of the haul trucks was taken as 241 tonnes – being the average of an empty and fully laden KOM730E haul truck and the default silt content of 10% was utilised.

Equation 1: $$EF_{(kg/VKT)} = \frac{0.4536}{1.6093} \times k \times \left(\frac{s_{(\%)}}{12}\right)^{a} \times \left(\frac{W_{(t)}}{3}\right)^{b}$$

Where: k = constant (TSP = 4.9, PM_{10} = 1.5)
$s_{(\%)}$ = silt content (%)
$W_{(t)}$ = vehicle mass (t)
a = constant (TSP = 0.7, PM_{10} = 0.9)
b = constant (0.45)

5.3.6 Wind erosion

The default emission factor for wind erosion in the EETM for Mining (Environment Australia, 2012) is a constant emission of 0.2 kg/ha/hr which, while potentially suitable for the calculation of annual emissions, is not suitable for inclusion in atmospheric modelling. This assessment used the modified Shao equation outlined in SKM (2005) which is represented as Equation 3:

Equation 2: $$PM_{10(g/m^2/s)} = k \times \left\{WS^3 \times \left(1 - \left(WS_O{}^2/WS^2\right)\right)\right\} \qquad WS > WS_O$$

$$PM_{10(g/m^2/s)} = 0 \qquad WS < WS_O$$

Where: WS = wind speed (m/s)
WS_0 = threshold for particulate matter lift off (m/s)
K is a constant

For this assessment the wind speed threshold (WS_0) was set at 5.4 m/s and the k constants were set at 1.2×10^{-6}. This results in an overall emission rate of 0.4 kg/ha/hr for PM_{10} from open areas, which is higher than the emission rate of 0.2 kg/ha/hr specified in the EETM for Mining (Environment Australia, 2012).

The emission factor for TSP is taken as twice that of the PM_{10} emissions while $PM_{2.5}$ emissions are taken as 15% of the PM_{10} emissions (Table 5.1).

5.4 Emission controls

Emissions controls (for dust abatement) were included in the emissions estimation based on standard mining industry dust control practices, and control practices proposed for the Project as determined in consultation with NBG. These controls are summarised in Table 5-1, along with the percentage emission reduction applied to each source type.

Table 5-1: Dust Control Factors (included in model).

Scenario	Source Type	Dust abatement description	Emissions reduction (%)
Clearing and stripping	Excavators clearing	No abatements possible due to nature of clearing and scraping activities.	None
	Scraper (scraping mode)		
	Scraper (travel mode)		
	Grader topsoil removal		
	Bulldozer topsoil removal		
Dam construction	Unloading material for Dam	No abatement possible	None
	Front-end-loader on Dam	Level 1 watering with water truck	50%
	Haul roads (wheel generated dust)	Level 1 watering with water truck of unsealed roads.	50%
Bauxite mining	Unload Bauxite at ROM	No abatement applied	None
	Bulldozers at ROM	No abatement applied	
	Loading Bauxite at deposit	No abatement applied	
	Bulldozers at Bauxite deposit	No abatement applied	
	Haul roads (wheel generated dust)	Level 1 watering with water truck of unsealed roads.	50%

5.5 Summary of estimated emissions

A summary of the estimated annual emissions from the Project for the Standard and Proposed dust control scenarios are shown in Table. The locations are illustrated in Figure 5-1.

Table 5-2: Estimate of TSP, PM_{10} and $PM_{2.5}$ annual particulate emissions from the Project operations (kg/yr).

Source Scenarios	Source Type	Standard Controls	
		TSP	PM_{10}
Scenario 1: Clearing	Excavators	25,902	12,433
	Graders	134,293	60,058
	Bulldozers	623,658	129,563
	Scrapers (scraping)	90,137	22,690
	Scrapers (travelling)	214,905	29,549
	Wind Erosion	145,239	72,619
Scenario 2: Bauxite mining	Bulldozers	561,018	118,898
	Loading ore	93,100	44,688
	Unloading ore	44,622	15,990
	Haul roads (wheel generated)	444,718	131,263
	Wind Erosion	136,818	68,409
Scenario 3: Dam Construction	Unloading (wall material)	91,250	32,698
	Front end loaders	95,052	45,625
	Haul roads (wheel generated)	1,691,373	499,227
Grand Total		4,392,085	1,142,682

6 Predicted Air Quality Impacts

This section presents the results of the modelling in terms of predicted ground-level concentrations and potential air quality impacts, evaluated by comparison to the adopted ambient air quality assessment criteria (refer to Section 3.2).

- To assess potential cumulative impacts, the predicted PM_{10} and $PM_{2.5}$ concentrations for the Project together with an assumed contribution to account for existing dust levels in the region are also presented ("background").
    - The assumed existing dust levels for the Project site have been derived using the available air quality monitoring data at NBG (refer to Section 2.3).
- The predicted ground-level concentrations at residential/human health related discrete receptor locations (refer to Section 3.3) are presented for each scenario and pollutant of interest.
    - The modelled concentration statistics (i.e. maximum, 2nd highest, 6th highest, 99th percentile, 95th percentile, 90th percentile and 70th percentile) are tabulated.
- Contours of the modelled maximum ground-level concentrations predicted across the model domain are also presented, overlain on an aerial of the Project site and surrounds. Contours shown in red represent the adopted ambient air quality assessment criteria.

Regulatory summary statistics for some additional receptors are contained in Table 6-1.

6.1 TSP

The model results for TSP are summarised in the following:

- Predicted concentrations at sensitive receptors that are related to human health or amenity are presented in Table 6-1. Results are presented separately for each of the three scenarios. Only the cumulative results are shown in Table 6-1 for convenience.
    - The results for all sensitive receptors are contained in Appendix D.
- Contours of the highest 24-hour average (in Figure 6-1) concentrations are also presented.

To assess the potential air quality impact, modelled TSP concentrations are compared to the following criteria, referenced to the Ambient Air Quality NEPM (NEPC, 2021):

- 24-hour average of 90 µg/m³.

The modelling results indicate that:

- No human health or amenity related receptors are predicted to observe a TSP value above the criteria when including background or isolated.
- However, several other receptors have predicted concentrations above the 24-hour averaged criteria of 90 µg/m³:
    - For the Dam scenario every receptor within 2km of operations had at least one exceedance.
    - For the Clearing scenario receptors R22, R23, and R25 had exceedances.
    - For the Mining scenario receptors R22, R23, and R25 had exceedances.
    - Outside of the 2km buffer, the following scenarios had at least one predicted exceedance:
        - Clearance: no receptors outside the 2km buffer had a predicted exceedance
        - Dam: R1, R2, R17
        - Mining: R1, R2

- When considering the modelled TSP concentration without background, there were some receptors within 2km of operations above the criteria, but no receptors beyond 2km were predicted to be above the TSP criteria.

Table 6-1: Predicted 24-hour averaged TSP ground-level concentrations (µg/m³) – each scenario. Shading indicates exceedance of the criterion.

Receptor	Description	Scenarios	Cumulative?	Max	2nd	6th	95th	90th	70th	Annual Mean	No. days above criteria	Criteria
R4	Village	Clearing	Isolated	6	4	3	1	0	0	0	0	90
			Cumulative	52	50	48	46	46	45	46	0	90
		Dam	Isolated	13	12	6	1	0	0	0	0	90
			Cumulative	58	57	51	47	46	45	46	0	90
		Mining	Isolated	20	19	10	2	1	0	0	0	90
			Cumulative	65	64	55	48	46	45	46	0	90
R5	Boddington Township	Clearing	Isolated	5	3	2	0	0	0	0	0	90
			Cumulative	50	49	48	46	46	45	46	0	90
		Dam	Isolated	10	9	4	1	0	0	0	0	90
			Cumulative	56	54	50	47	46	45	46	0	90
		Mining	Isolated	16	14	8	2	1	0	0	0	90
			Cumulative	62	59	53	47	46	45	46	0	90
R6	Bannister Housing & Road	Clearing	Isolated	6	4	2	1	0	0	0	0	90
			Cumulative	51	49	47	46	46	45	46	0	90
		Dam	Isolated	9	9	4	2	0	0	0	0	90
			Cumulative	55	54	50	47	46	45	46	0	90
		Mining	Isolated	20	16	8	3	1	0	1	0	90
			Cumulative	65	61	54	49	46	45	46	0	90

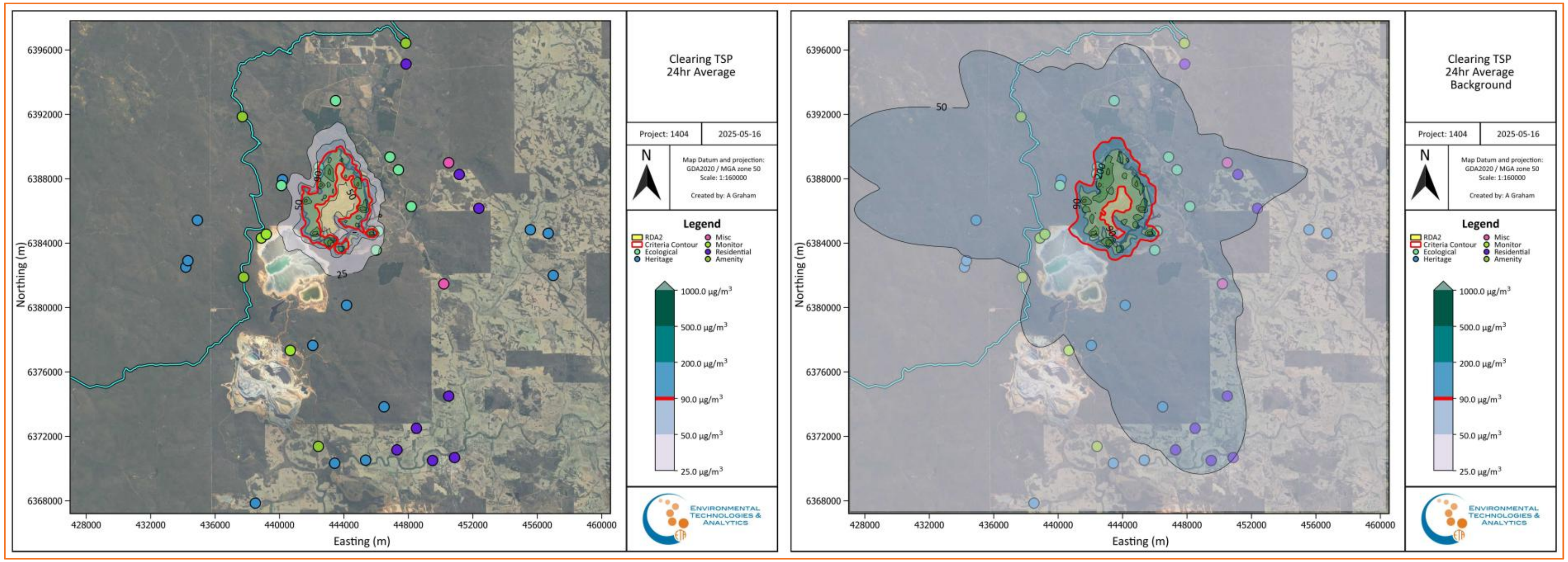


Figure 6-1: Scenario 1: Predicted maximum 24-hour TSP concentration contours (µg/m³) – Clearing and Topsoil Removal.

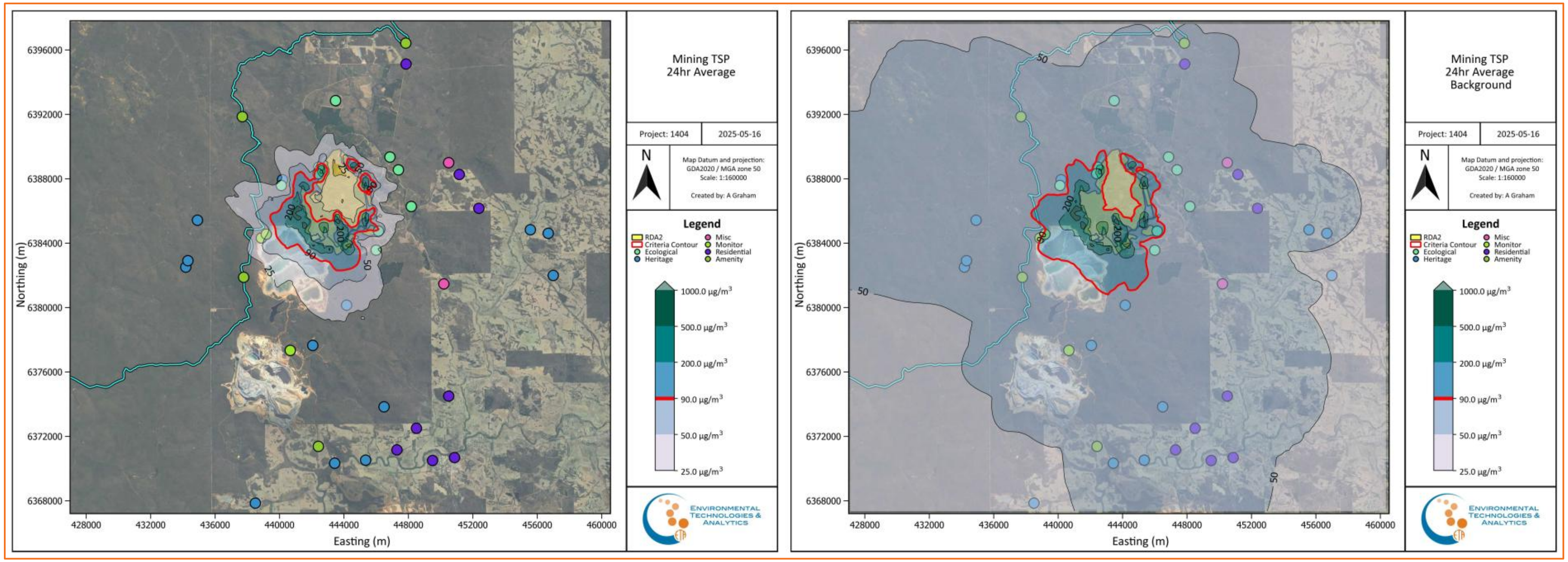


Figure 6-2 Scenario 2: Predicted maximum 24-hour TSP concentration contours (µg/m³) – Bauxite Mining.

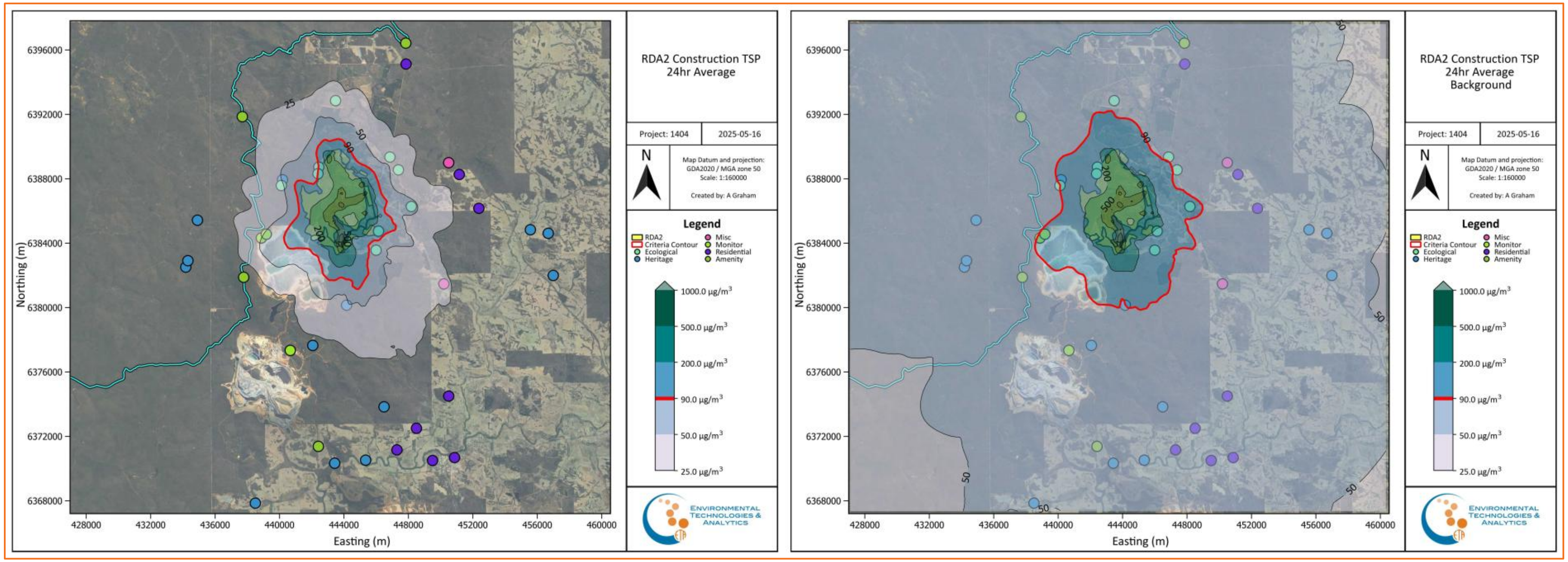


Figure 6-3 Scenario 3: Predicted maximum 24-hour TSP concentration contours (µg/m³) – Dam Construction.

6.2 PM_{10}

The model results for PM_{10} are summarised in the following:

- Predicted concentrations at sensitive receptors within 2km of the RDA2 disturbance area are presented in
- Table 6-2. Results are presented separately for each of the three scenarios. Only the cumulative results are shown in
- Table 6-2 for convenience.
    - The results for all sensitive receptors are contained in Appendix D.
- Contours of the highest 24-hour average (in Figure 6-4, Figure 6-5 and Figure 6-6) and annual average (in Figure 6-7, Figure 6-8 and Figure 6-9) concentrations are also presented.

To assess the potential air quality impact, modelled PM_{10} concentrations are compared to the following criteria, referenced to the Ambient Air Quality NEPM (NEPC, 2021):

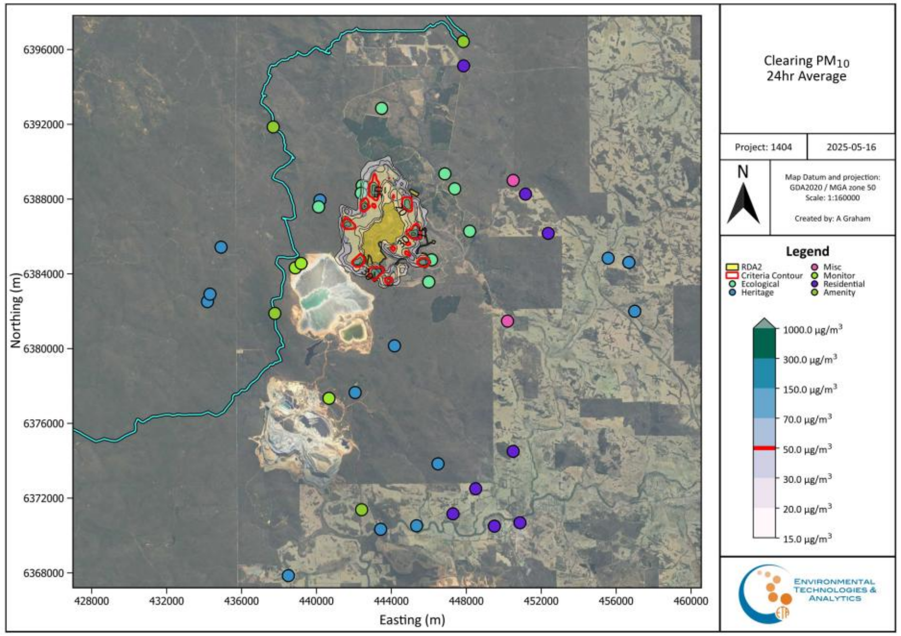
- 24-hour average of 50 µg/m³.
- Annual average of 25 µg/m³.

The modelling results indicate that:

- No human health or amenity related receptors are predicted to observe a PM_{10} value above the criteria when including background or isolated.
- When including background, the ecological receptors R22, R23, and R25 were predicted to have at least one 24-hour PM_{10} concentration above the 50 µg/m³ criteria. All three of these receptors were above the criteria for the Dam scenario. While R23 was also above the criteria for 17 days in the mining scenario.

Table 6-2: Predicted 24-hour averaged PM_{10} ground-level concentrations (µg/m³) – each scenario. Shading indicates exceedance of the criterion.

Receptor	Description	Scenarios	Cumulative?	Max	2nd	6th	95th	90th	70th	Annual Mean	No. days above criteria	Criteria
R4	Village	Clearing	Isolated	1	1	1	0	0	0	0	0	50
			Cumulative	28	27	27	26	26	26	26	0	50
		Dam	Isolated	3	3	2	0	0	0	0	0	50
			Cumulative	30	29	28	27	26	26	26	0	50
		Mining	Isolated	6	6	3	1	0	0	0	0	50
			Cumulative	32	32	29	27	26	26	26	0	50
R5	Boddington Township	Clearing	Isolated	1	1	1	0	0	0	0	0	50
			Cumulative	27	27	27	26	26	26	26	0	50
		Dam	Isolated	3	2	1	0	0	0	0	0	50
			Cumulative	29	29	27	27	26	26	26	0	50
		Mining	Isolated	5	4	2	1	0	0	0	0	50
			Cumulative	31	30	29	27	26	26	26	0	50
R6	Bannister Housing & Road	Clearing	Isolated	1	1	1	0	0	0	0	0	50
			Cumulative	28	27	27	26	26	26	26	0	50
		Dam	Isolated	3	2	1	1	0	0	0	0	50
			Cumulative	29	29	27	27	26	26	26	0	50
		Mining	Isolated	6	5	3	1	0	0	0	0	50
			Cumulative	32	31	29	27	26	26	26	0	50



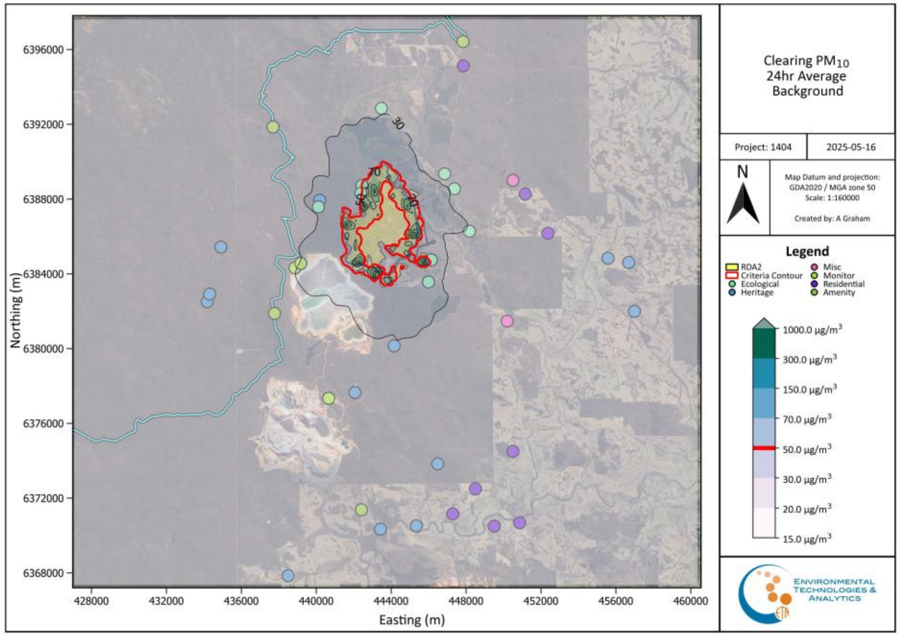


Figure 6-4: Scenario 1: Predicted maximum 24-hour PM_{10} concentration contours (µg/m³) – Clearing and Topsoil Removal.

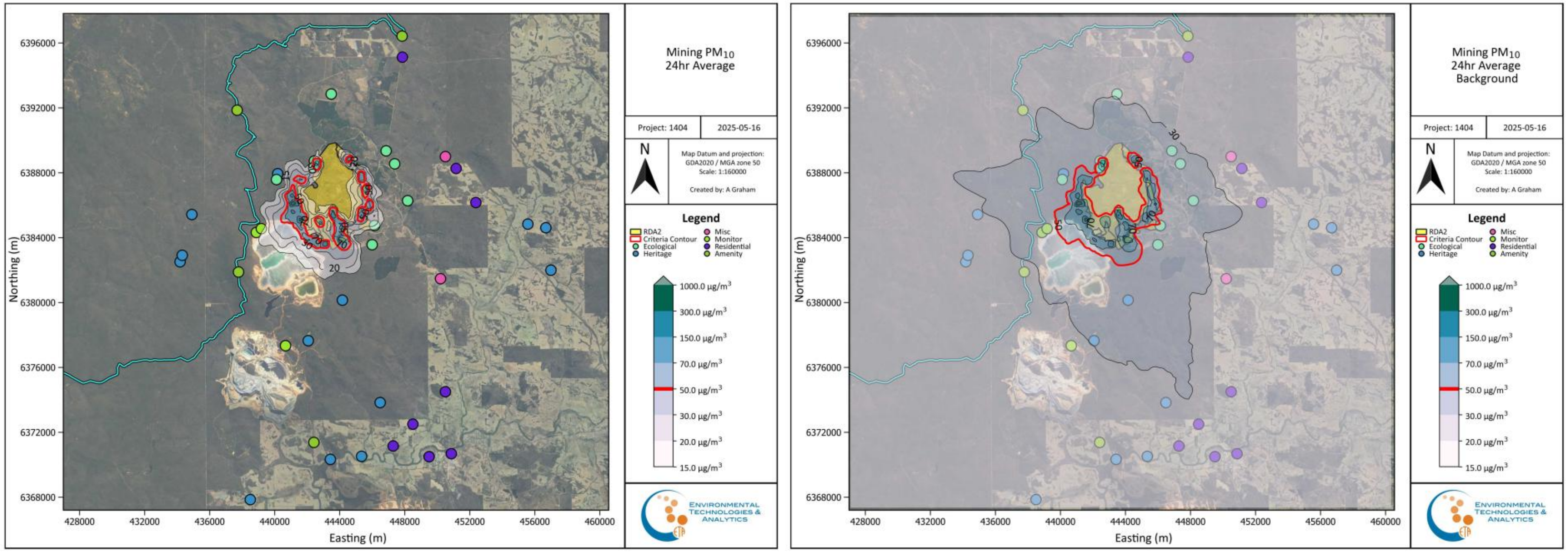


Figure 6-5 Scenario 2: Predicted maximum 24-hour PM_{10} concentration contours (µg/m³) – Bauxite Mining.

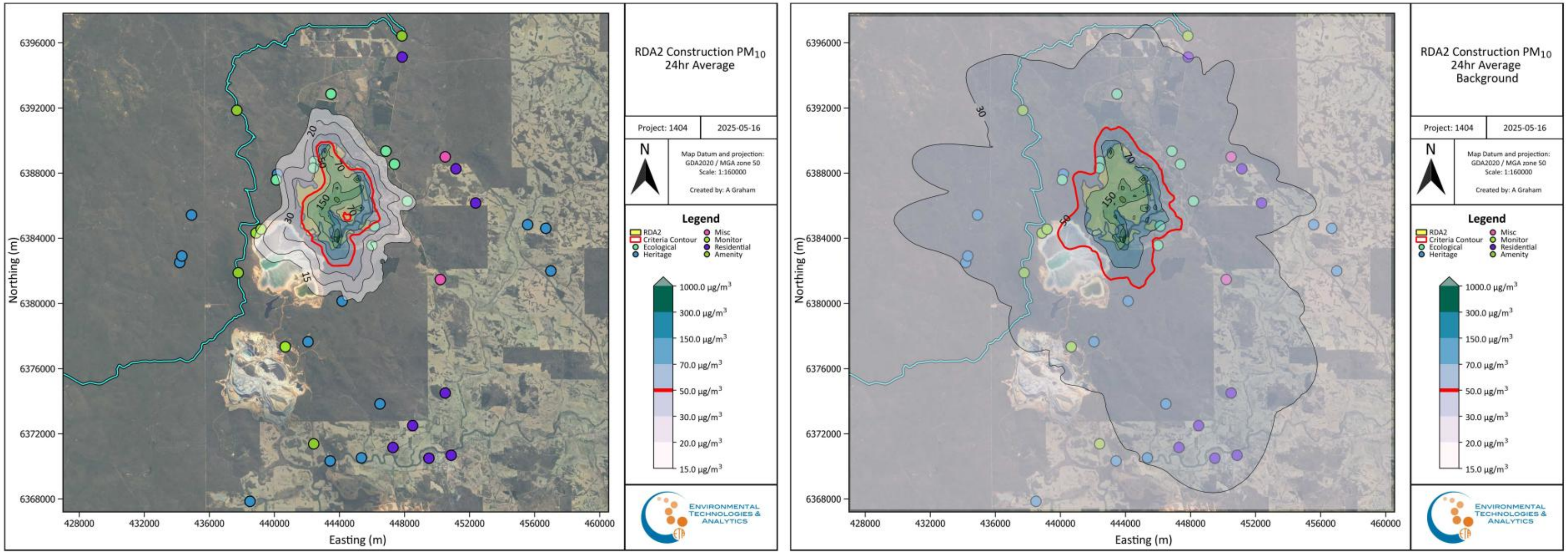


Figure 6-6 Scenario 3: Predicted maximum 24-hour PM_{10} concentration contours ($\mu g/m^3$) – Dam Construction.

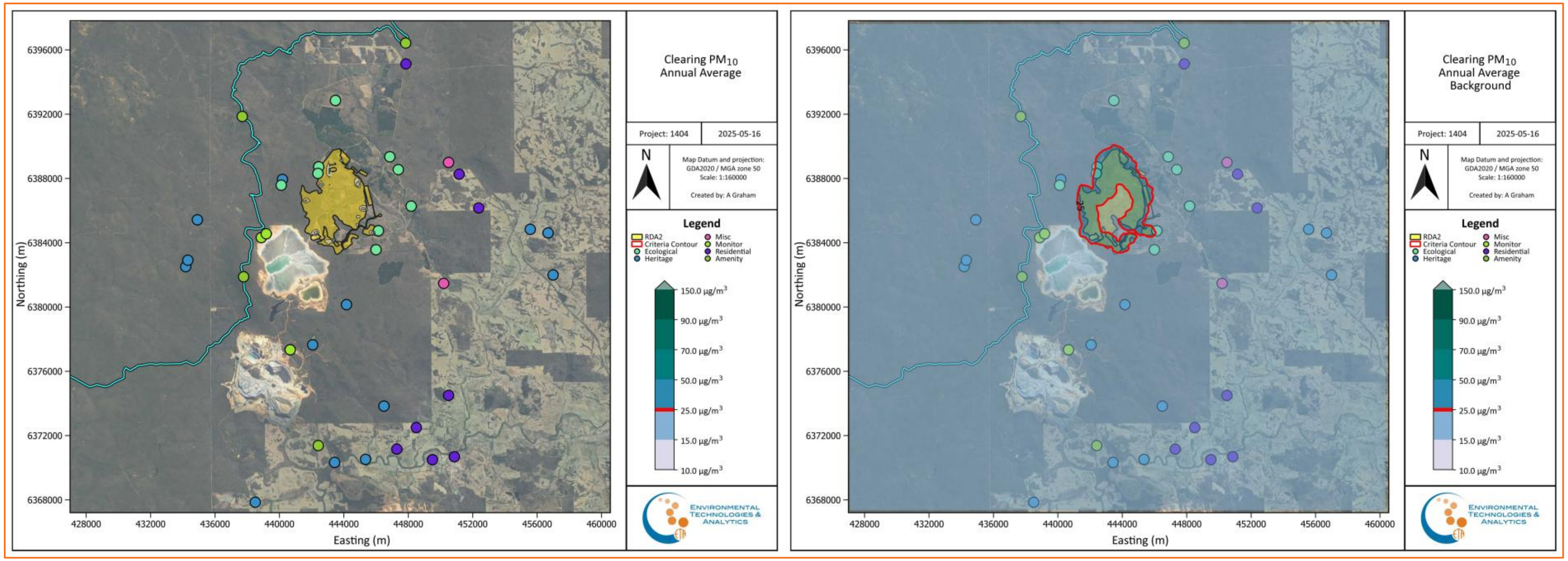


Figure 6-7: Scenario 1: Predicted annual average PM_{10} concentration contours ($\mu g/m^3$) – Clearing and Topsoil Removal.

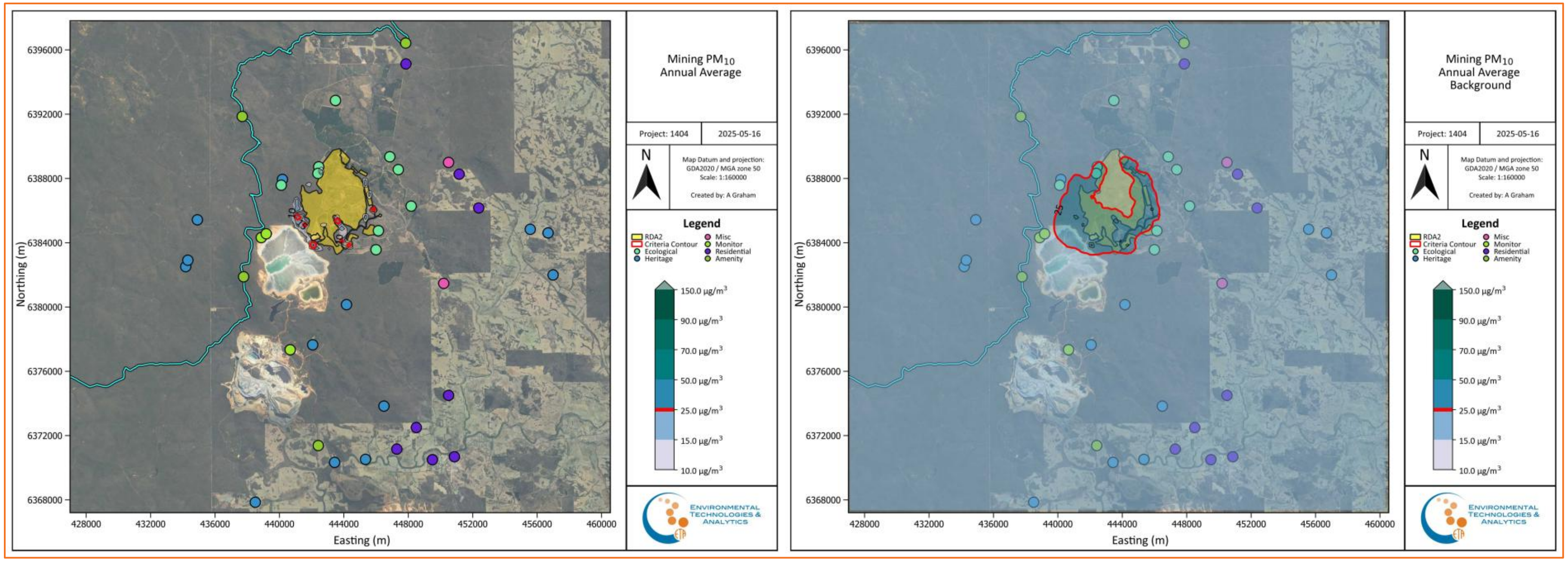


Figure 6-8 Scenario 2: Predicted annual average PM_{10} concentration contours (µg/m^3) – Bauxite Mining.

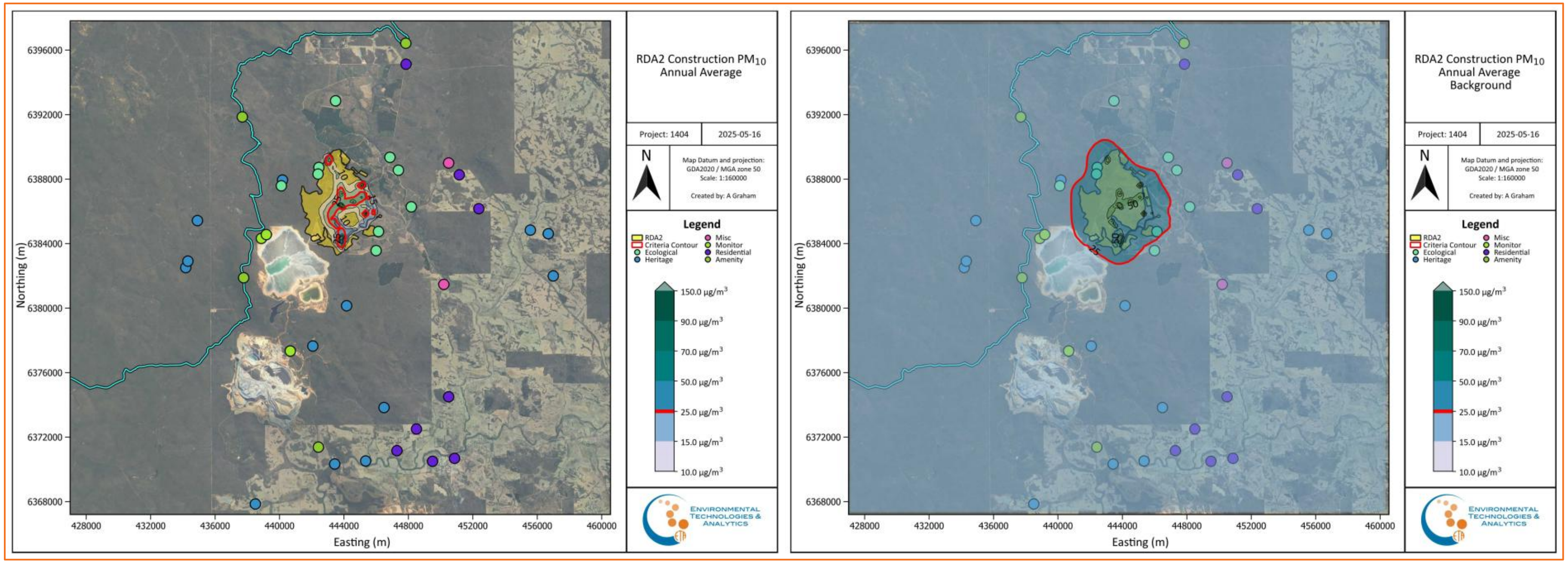


Figure 6-9 Scenario 3: Predicted annual average PM_{10} concentration contours ($\mu g/m^3$) – Dam Construction.

6.3 $PM_{2.5}$

The model results for $PM_{2.5}$ are summarised in the following:

- Predicted concentrations at sensitive receptors within 2km of the RDA2 disturbance area are presented in Table 6-3. Results are presented separately for each of the three scenarios. Only the cumulative results are shown in Table 6-3 for convenience.
    - The results for all sensitive receptors are contained in Appendix D.
- Contours of the highest 24-hour average (in Figure 6-10, Figure 6-11 and Figure 6-12) and annual average (in Figure 6-13, Figure 6-14 and Figure 6-15) concentrations are also presented.

To assess the potential air quality impact, modelled $PM_{2.5}$ concentrations are compared to the following criteria, referenced to the Ambient Air Quality NEPM (NEPC, 2021):

- 24-hour average of 25 µg/m³.
- Annual average of 8 µg/m³.

The modelling results indicate that:

- No applicable receptor was predicted to have a maximum 24-hour or annual average above the criteria.

Table 6-3: Predicted 24-hour averaged $PM_{2.5}$ ground-level concentrations (µg/m³) – each scenario. Shading indicates exceedance of the criterion.

Receptor	Description	Scenarios	Cumulative?	Max	2nd	6th	95th	90th	70th	Mean	No. days above criteria	Criteria
R4	Village	Clearing	Isolated	0	0	0	0	0	0	0	0	25
			Cumulative	5	5	5	5	5	5	5	0	25
		Dam	Isolated	1	0	0	0	0	0	0	0	25
			Cumulative	5	5	5	5	5	5	5	0	25
		Mining	Isolated	1	1	0	0	0	0	0	0	25
			Cumulative	6	6	5	5	5	5	5	0	25
R5	Boddington Township	Clearing	Isolated	0	0	0	0	0	0	0	0	25
			Cumulative	5	5	5	5	5	5	5	0	25
		Dam	Isolated	0	0	0	0	0	0	0	0	25
			Cumulative	5	5	5	5	5	5	5	0	25
		Mining	Isolated	1	1	0	0	0	0	0	0	25
			Cumulative	6	5	5	5	5	5	5	0	25
R6	Bannister Housing & Road	Clearing	Isolated	0	0	0	0	0	0	0	0	25
			Cumulative	5	5	5	5	5	5	5	0	25
		Dam	Isolated	0	0	0	0	0	0	0	0	25
			Cumulative	5	5	5	5	5	5	5	0	25
		Mining	Isolated	1	1	0	0	0	0	0	0	25
			Cumulative	6	6	5	5	5	5	5	0	25

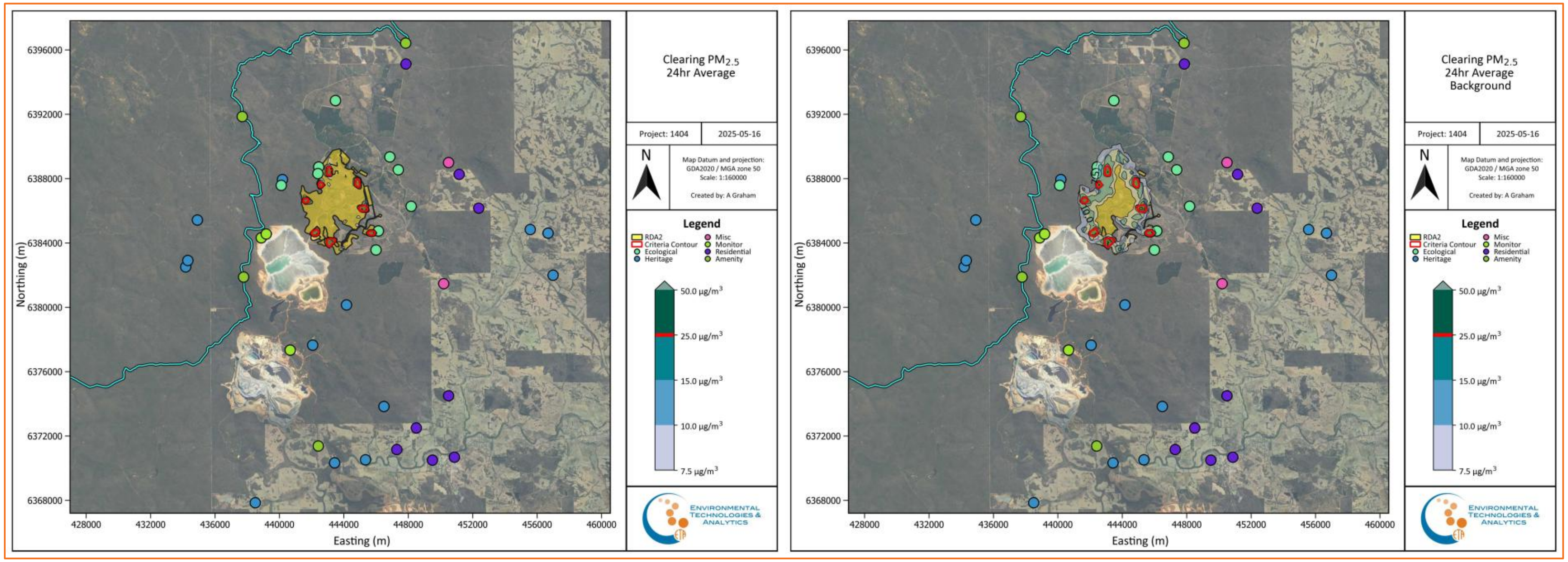


Figure 6-10: Scenario 1: Predicted maximum 24-hour $PM_{2.5}$ concentration contours ($\mu g/m^3$) – Clearing and Topsoil Removal.

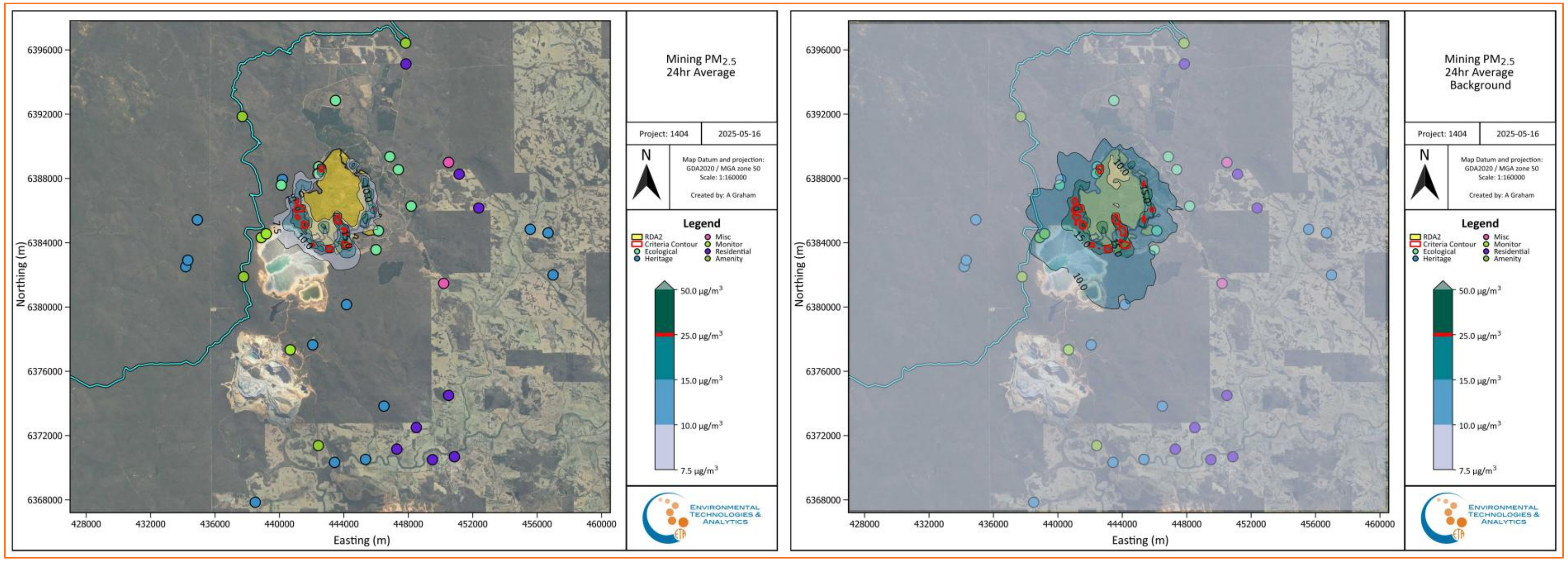


Figure 6-11 Scenario 2: Predicted maximum 24-hour $PM_{2.5}$ concentration contours (µg/m^3) – Bauxite Mining.

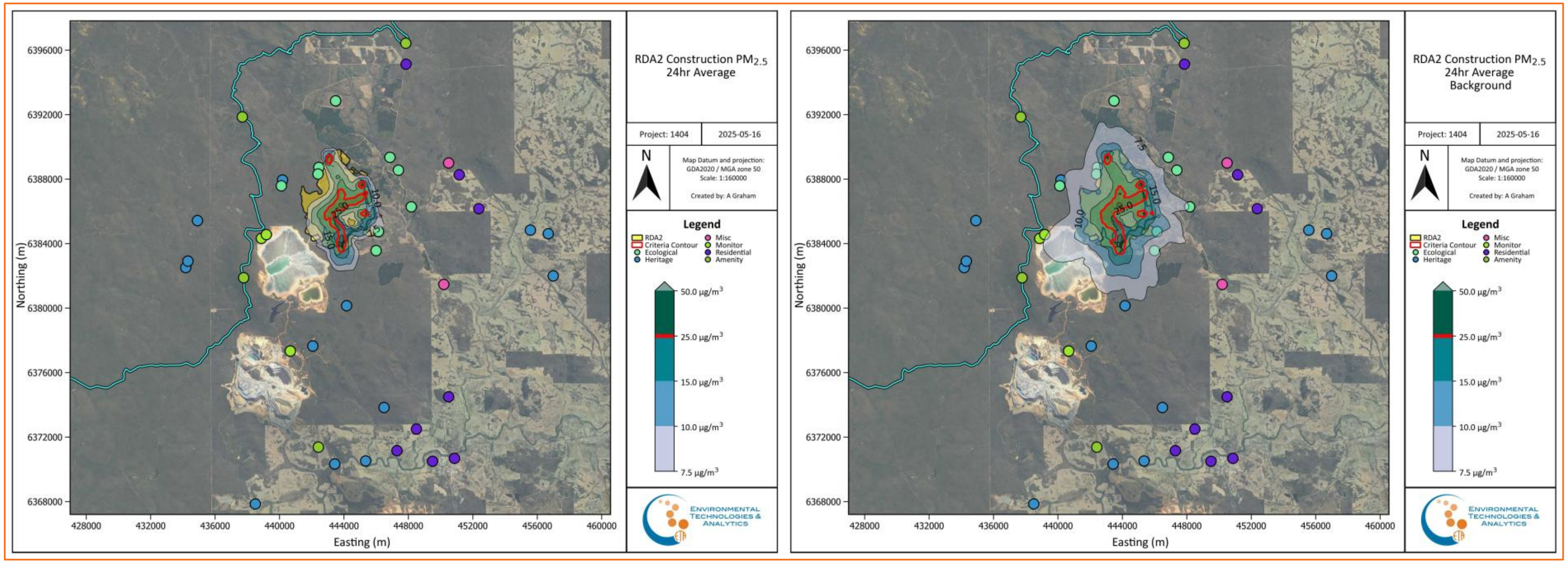


Figure 6-12 Scenario 3: Predicted maximum 24-hour $PM_{2.5}$ concentration contours (µg/m^3) – Dam Construction.

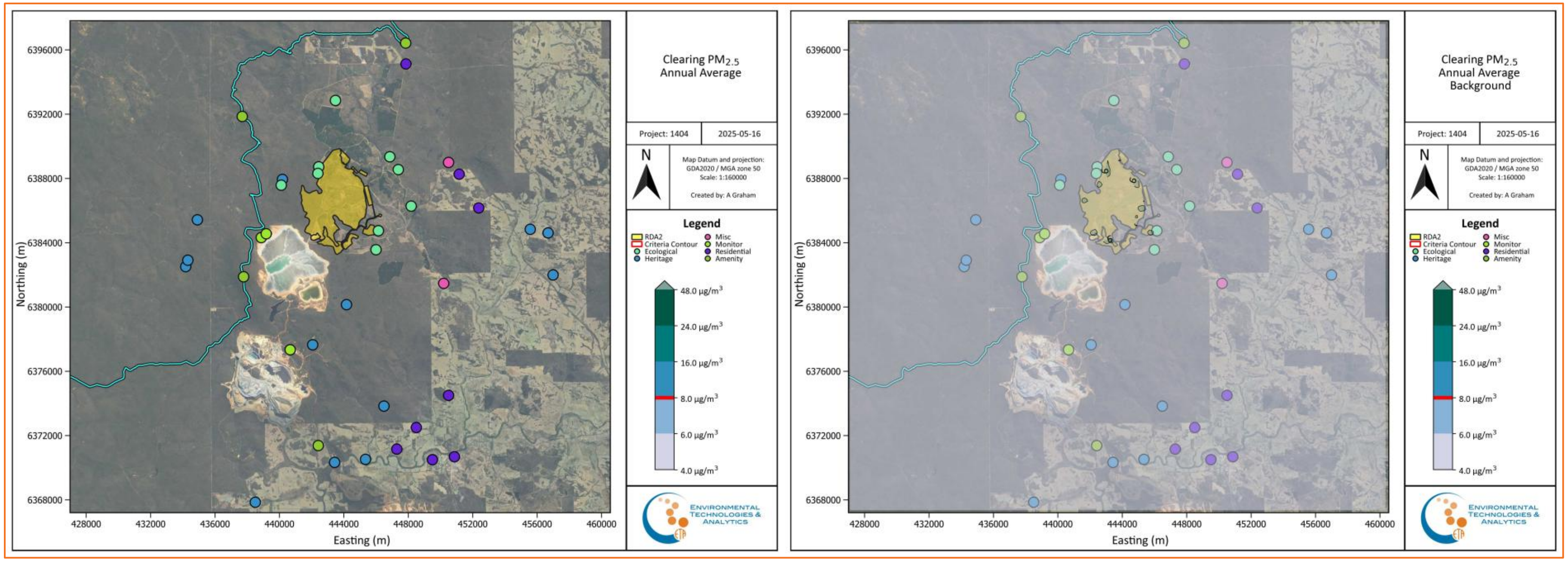


Figure 6-13: Scenario 1: Predicted annual average $PM_{2.5}$ concentration contours ($\mu g/m^3$) – Clearing and Topsoil Removal.

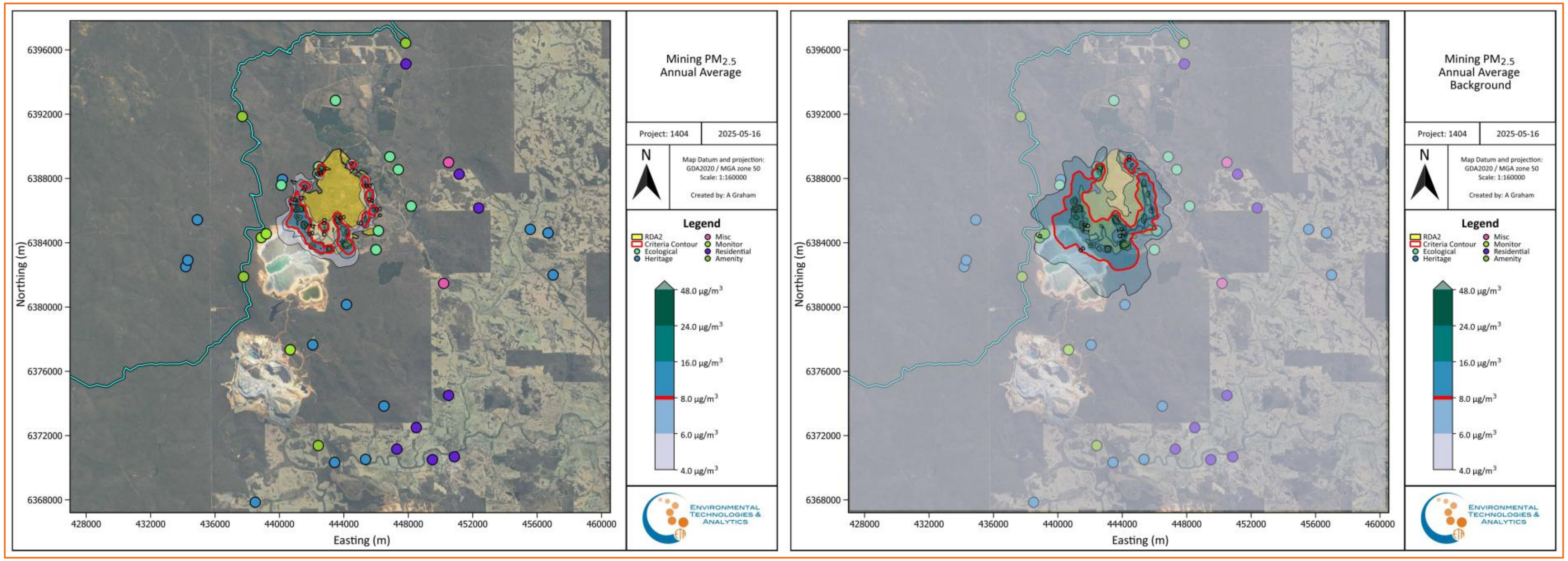


Figure 6-14 Scenario 2: Predicted annual average $PM_{2.5}$ concentration contours (µg/m³) – Bauxite Mining.

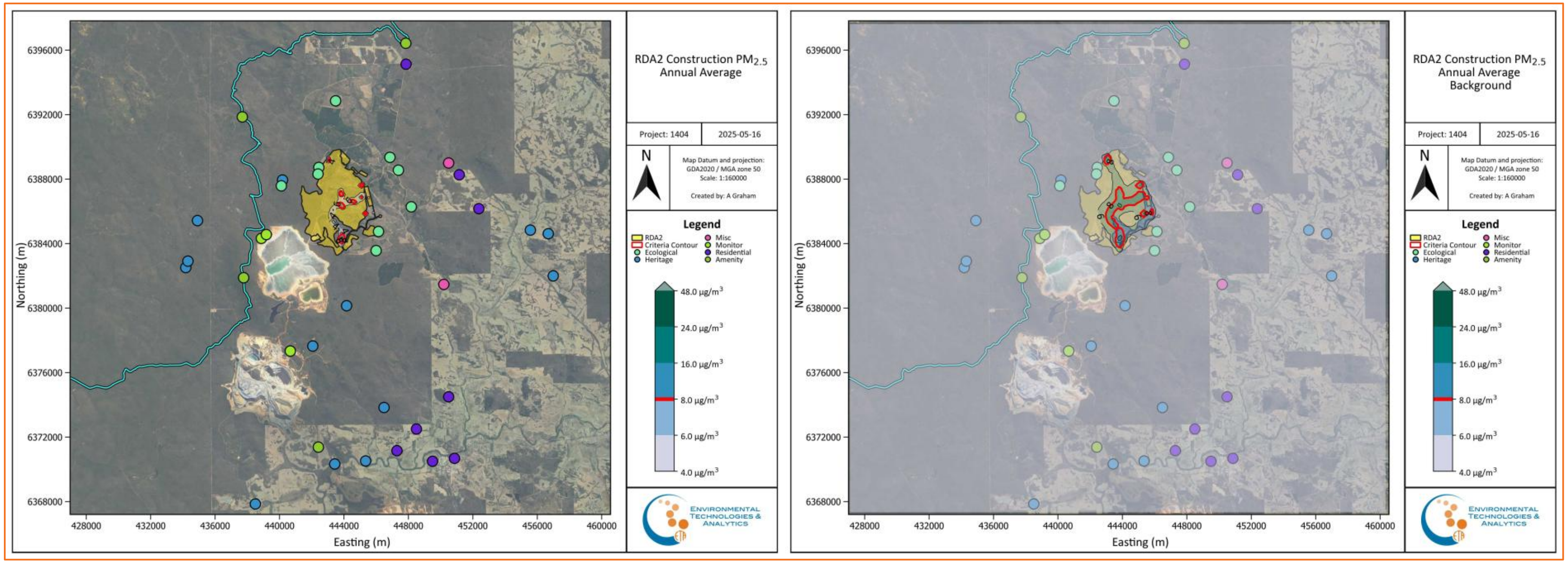


Figure 6-15 Scenario 3: Predicted annual average $PM_{2.5}$ concentration contours (µg/m³) – Dam Construction.

6.4 Dry Deposition

The model prediction for the maximum dry deposition rate (g/m^2/month) are summarised for the discrete receptors in Table 6-4. The dry deposition rate predicted at the discrete receptor locations are presented for the Project only. The potential cumulative impacts have not been assessed for dry deposition. Contours of the annual average dry deposition rate of TSP predicted across the model domain are presented in Figure 6-16 for each scenario.

To assess the potential impact upon amenity (dust nuisance), modelled TSP dry deposition rates are compared to the following criteria, referenced to the draft Dust Emissions Guideline (DWER, 2021[1]):

- Annual average of 2 g/m^2/month (incremental contribution above background).

The results for dry deposition are presented in units of g/m^2/month[2] for reference to the criterion.

The results of the dispersion modelling study show that at sensitive receptors the monthly dry deposition rates are predicted to be below the dust deposition criterion (maximum increase) at all receptors.

The contours of dry deposition show:

- predicted exceedance of the dust deposition criterion is limited to the disturbance envelope.
- Some dust deposition above an annual average rate of 0.2 g/m^2/month is predicted to occur to the west of RDA2.

[1] Original source used NSW EPA (2016).

[2] g/m^2/month is calculated from model output in µg/s per m^2 x (3600 x 24 x 365 s/year)/(12 month/year)/(1000,000 µg/g) = µg/s per m^2 x 2.628.(g/µg)/(s/month).

Table 6-4: Predicted maximum dry deposition rate of TSP (g/m²/month).

Receptor	Easting	Northing	Criteria	Dry Deposition (g/m²/month)		
				Dam	Mining	Clearing
R1	438,872	6,384,325	2	0.03	0.06	0.10
R2	439,180	6,384,561		0.04	0.08	0.13
R3	440,669	6,377,339		0.01	0.02	0.01
R4	448,501	6,372,501		0.00	0.00	0.00
R5	449,501	6,370,501		0.00	0.00	0.00
R6	450,501	6,374,501		0.00	0.00	0.00
R7	450,201	6,381,472		0.01	0.01	0.01
R8	450,501	6,389,001		0.02	0.03	0.02
R9	434,905	6,385,430		0.02	0.05	0.05
R10	434,180	6,382,515		0.01	0.03	0.02
R11	434,313	6,382,915		0.01	0.03	0.02
R12	440,187	6,387,945		0.20	0.25	0.34
R13	455,575	6,384,838		0.00	0.01	0.00
R14	456,685	6,384,616		0.00	0.01	0.00
R15	456,995	6,381,998		0.00	0.00	0.00
R16	442,066	6,377,647		0.01	0.02	0.01
R17	444,167	6,380,148		0.01	0.04	0.02
R18	438,500	6,367,853		0.00	0.00	0.00
R19	443,427	6,370,334		0.00	0.00	0.00
R20	445,347	6,370,523		0.00	0.00	0.00
R21	446,490	6,373,833		0.00	0.01	0.00
R22	442,443	6,388,728		0.95	0.45	1.19
R23	442,392	6,388,317		1.00	0.45	1.13
R24	440,113	6,387,585		0.20	0.26	0.40
R25	446,146	6,384,751		0.27	0.29	0.13
R26	445,998	6,383,568		0.06	0.14	0.07
R27	446,856	6,389,353		0.05	0.09	0.04
R28	447,382	6,388,554		0.05	0.10	0.04
R29	448,181	6,386,283		0.03	0.09	0.03
R30	443,481	6,392,856		0.02	0.04	0.02
R31	447,290	6,371,159		0.00	0.00	0.00
R32	452,374	6,386,170		0.02	0.01	0.01
R33	451,159	6,388,268		0.02	0.01	0.01
R34	450,867	6,370,684		0.00	0.00	0.00

Receptor	Easting	Northing	Criteria	Dry Deposition (g/m^2/month)		
				Dam	Mining	Clearing
R35	447,858	6,395,128		0.01	0.01	0.01
R36	447,838	6,396,426		0.01	0.01	0.01
R37	437,775	6,381,884		0.04	0.04	0.02
R38	437,690	6,391,859		0.08	0.06	0.06
R39	442,414	6,371,378		0.00	0.00	0.00

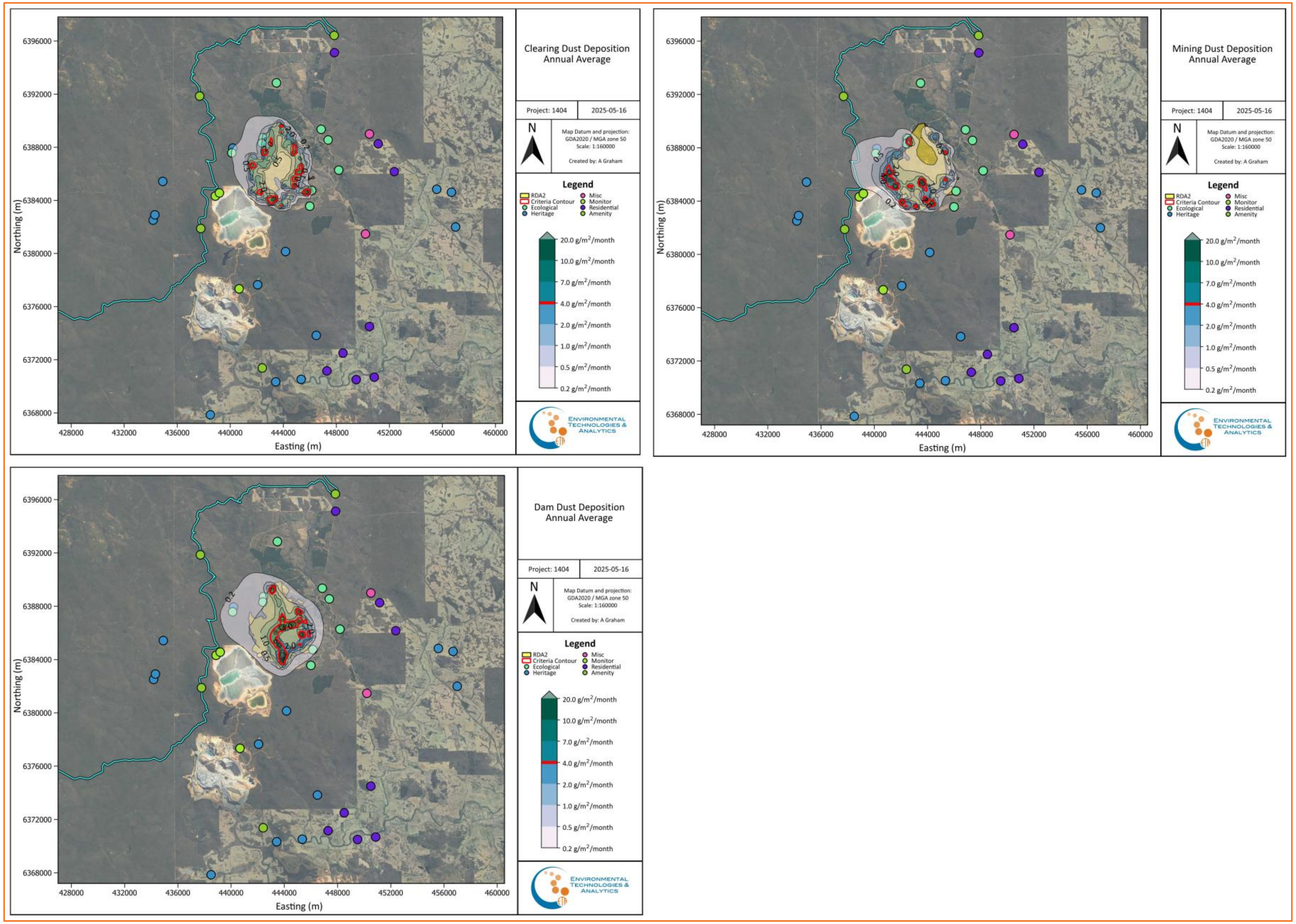


Figure 6-16: Predicted maximum monthly dry deposition contours (g/m^2/month) – each scenario.

7 Conclusions

Newmont Boddington Gold Pty Ltd operates the NBG and seek to develop a second Residue Disposal Area (RDA2). ETA was contracted to develop an air quality model of potential dust emissions from the operations. This development requires multiple steps which were split into separate model scenarios with unique sources:

- Scenario 1: Initial vegetation clearing and topsoil stripping (2027-2028)
- Scenario 2: Followed by mining of sub-surface bauxite deposits (in 2025 to 2026)
- Scenario 3: Construction of dam embankments (2027-2029)

Off-site dust impacts are a potential concern given the proximity of the NBG operations to surrounding ecological and heritage values as well as the Boddington townsite and other residences in the area.

Total Suspended Particulate was examined for all three scenarios, modelling indicates that:

- No human health or amenity related receptors are predicted to observe a TSP value above the criteria when including background or isolated.
- However, several ecological receptors have predicted concentrations above the 24-hour averaged criteria of 90 µg/m³:
    - For the Dam scenario every receptor within 2km of operations had at least one exceedance.
    - For the Clearing scenario ecological receptors R22, R23, and R25 had exceedances.
    - For the Mining scenario the ecological receptors R22, R23, and R25 had exceedances.
    - Outside of the 2km buffer, the following scenarios had at least one predicted exceedance:
        - Clearance: no receptors outside the 2km buffer had a predicted exceedance
        - Dam: R1, R2, R17
        - Mining: R1, R2
- When considering the modelled TSP concentration without background, there were some receptors within the 2km buffer above the criteria, but no receptors beyond the buffer were predicted to be above the TSP criteria.

PM_{10} was modelled for all three scenarios, which predicts that:

- No human health or amenity related receptors are predicted to observe a PM_{10} concentration above the criteria when including background or isolated.
- When including background, the ecological receptors R22, R23, and R25 were predicted to have at least one 24-hour PM_{10} concentration above the 50 µg/m³ criteria. All three receptors were above the criteria for the Dam scenario. While R23 was also above the criteria for 17 days in the mining scenario.

$PM_{2.5}$ was modelled for all three scenarios, which predicts that:

- No receptor was predicted to have a maximum 24-hour or annual average concentration above the criteria.

Dust deposition was modelled, with results expressed as g/m²/month and it was found that:

- predicted exceedance of the dust deposition criterion is limited to the disturbance envelope.
- Some dust deposition above an annual average rate of 0.2 g/m²/month is predicted to occur to the west of RDA2.
- No sensitive receptors were predicted to have dust deposition rates above the 2 g/m²/month criteria.

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9 Acronyms and Glossary

Acronym	Description
BoM	Bureau of Meteorology
C	Degrees Celsius (temperature)
DWER	Department of Water and Environmental Regulation
EE	Emissions estimation
EET	Emissions Estimation Technique
EETM	Emissions Estimation Technique Manual
EF	Emission factor
EPAV	Environmental Protection Authority Victoria, Australia
ETA	Environmental Technologies& Analytics Pty Ltd
FEL	Front end loader
GLC	Ground Level Concentration
g/m^2/month	Grams per square metre per month
g/s	grams per second
h/yr	Hours per year
kg	kilogram
kg/t	kilogram per tonne
kg/yr	kilograms per year
kPa	kiloPascals
km	kilometre
m	metre
m/s	metres per second
mm	millimetre
Mt	Million tonnes
Mtpa	Million tonnes per annum
NEPC	National Environment Protection Council
NEPM	National Environmental Protection Measure
NPI	National Pollutant Inventory
NSW	New South Wales
PM	Particulate matter, small particles and liquid droplets that can remain suspended in air.
$PM_{2.5}$	Particulate matter with an aerodynamic diameter of 10 µm or less.
PM_{10}	Particulate matter with an aerodynamic diameter of 2.5 µm or less.
t	Tonnes
t/h	Tonnes per hour
tpa	tonnes per annum
tph	tonnes per hour
TSP	Total suspended particulates
$\mu g/m^3$	micro grams (one millionth of a gram) per cubic metre
µm	micrometre
USEPA	United States Environment Protection Agency

10 Appendices

Appendix A – Meteorology

A.1 Selection of Representative Year

For this assessment, air dispersion modelling has been conducted using the CALMET/CALPUFF suite of models with meteorological data produced from the WRF prognostic model. The CALMET meteorological model has been used to develop the required meteorological inputs, and the CALPUFF model has been used to predict the concentrations at ground-level across the model domain and at nominated discrete sensitive receptor locations. Meteorological measurements representative of the region has been used to verify and refine the meteorological inputs for the modelling.

Generally, a minimum of one year of meteorological data is acceptable for dispersion modelling in Australia. The data must, however, adequately represent worst-case meteorological conditions and the data should be assessed in terms of representativeness against climatic averages. In other words, the meteorology for selected years must be deemed representative of the "normal" range of conditions in the area.

To determine the year of meteorological data to use for the dispersion modelling, 14-years of historical hourly [3] surface observations from the nearest BoM station at Wandering AWS (2010 to 2023 inclusive) were reviewed. The Chi^2 Goodness of Fit test was used to statistically identify the representative modelling year based on recorded meteorological parameters including wind speed, wind direction, temperature, and rainfall.

The Chi^2 goodness of fit test was used to statistically identify the representative modelling year based on recorded meteorological parameters including wind speed, wind direction and temperature. The Chi^2 goodness of fit test is a non-parametric hypothesis test used to determine whether a variable is likely to come from a specified distribution or not. It is often used to evaluate whether sample data (in this case, an individual year) is representative of the full population (e.g. multiple years). The null hypothesis is that there is no significant difference between hourly values in an individual year and the hourly averages for long term average values. If values fall within the vertical lines (at 5% confidence interval, two tailed), then accept the null hypothesis (Appendix Figure 1).

The results of the statistical analysis performed to support selection of the representative year is described in the following sub-sections.

Wind Direction

The Chi^2 test results for wind direction for 2010 to 2023 at BoM AWS are compared in Appendix Figure . From this figure it is apparent that with the exception of 2010 and 2016, the wind direction frequency distributions of the remaining years were not significantly different to the long-term wind direction frequency distribution.

Wind Speed

The basic statistics for average wind speed for the 14-year period and individual years are shown in Appendix Table . With the exception of 2021 and 2022, average wind speeds are within 0.6 km/hr of long-term averages.

[3] Calculated from 1-minute data.

The Chi^2 test results for wind speed are presented in Appendix Figure . This figure indicates that 2010 to 2020 and 2023 were representative of 14-year average conditions at the 5% confidence interval.

Appendix Table 1: Annual wind speed statistics for BOM AWS (2010-2023).

Year	Mean	Standard Deviation	% <5 hm/h	% >20 km/h
14-yr average	15.0	7.3	8.3	2.5
2010	15.4	8.7	6.2	2.2
2011	15.0	7.4	7.4	1.6
2012	14.7	8.0	8.4	2.5
2013	14.6	8.5	9.4	2.5
2014	14.5	8.1	9.6	2.4
2015	14.8	8.8	8.4	2.2
2016	14.6	8.2	9.2	2.7
2017	14.5	8.2	9.9	2.1
2028	14.6	8.2	9.6	2.6
2019	14.8	9.3	7.9	1.9
2020	15.3	8.1	7.0	3.5
2021	15.7	8.0	7.8	3.3
2022	15.7	8.1	6.9	3.0
2023	15.3	8.6	7.9	2.1

Temperature

The basic statistics for average temperature for the 14-year period and individual years are shown in Appendix Table . With the exception of 2011 and 2019, the average temperature for the years between 2010 to 2023 are within 0.7°C of the 14-year average.

The Chi^{2}test results for temperature are presented in Appendix Figure 4. From this figure it is apparent that the hourly temperature frequency distributions during 2011 and 2019 were significantly different to the long-term frequency distribution.

Appendix Table 2: Annual temperature statistics for Wandering AWS (2010-2023).

Year	Mean	Standard Deviation	% <5°C	% >35°C
14-yr average	21.3	8.3	1.6	5.7
2010	21.4	8.7	1.6	7.0
2011	20.4	7.4	0.7	3.1
2012	20.6	8.0	2.5	3.9
2013	21.8	8.5	1.0	6.7
2014	21.5	8.1	1.8	4.5
2015	21.7	8.8	1.2	8.1
2016	20.5	8.2	1.8	4.5
2017	20.7	8.2	2.3	4.3
2018	21.0	8.2	1.9	4.8
2019	22.7	9.3	1.9	10.2
2020	21.8	8.1	1.1	5.8
2021	20.9	8.0	1.3	4.3
2022	21.1	8.1	1.0	5.7
2023	22.0	8.6	1.8	6.9

Rainfall

The annual rainfall at Wandering, available for the extended period 1993-2023, and displayed for 2021 to 2023 is shown in Appendix Figure 5. There is some variation in rainfall between each year which is to be expected for the region. The years 2011, 2017, 2019 and 2023 have annual rainfall that just fall outside the 10th and 90th percentile[4] long-term (30 year) rainfall totals.

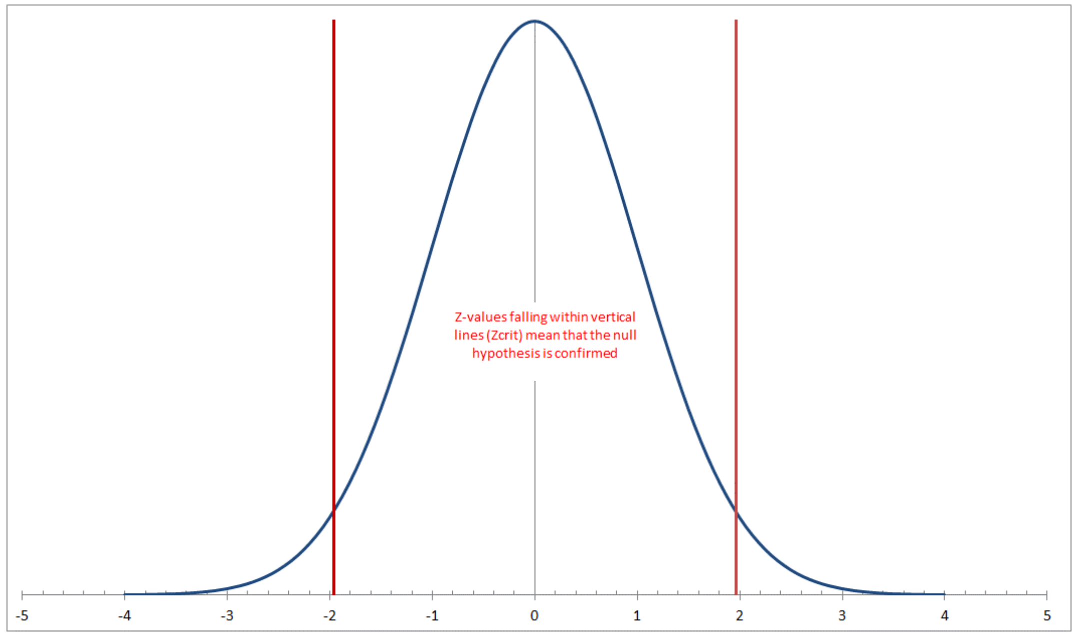
Conclusions

It is important to note that it is highly unusual for multiple climatological parameters to all fall within "representative" levels. With that in mind, the following conclusions can be made for the period reviewed:

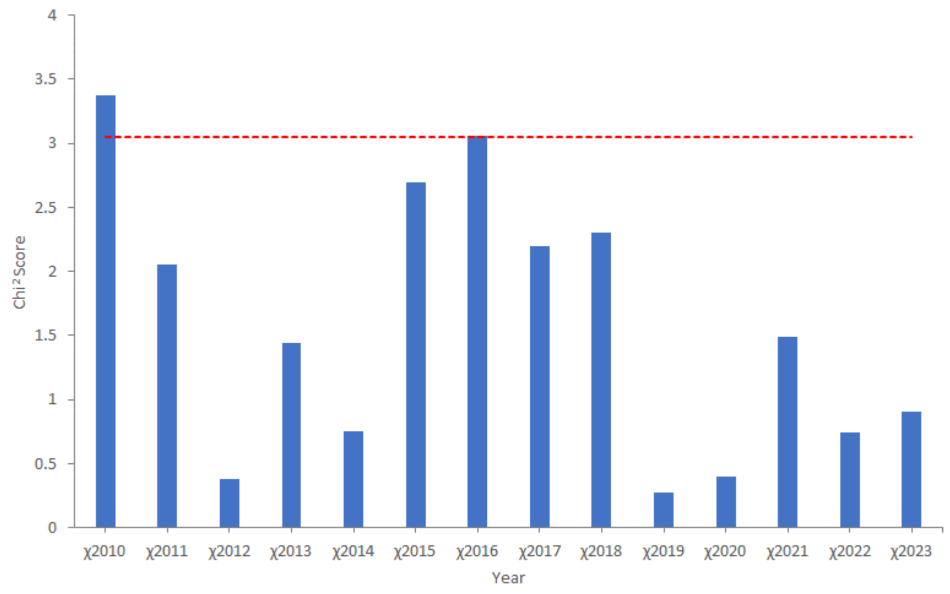
[4] The 10th and 90th percentile values are classed as well below and well above average according to the Bureau of Meteorology

- All years, with the exception of 2011 and 2019 are representative of longer-term (14 year) temperature average frequency distribution at the 99% significance level.
- The year 2010 to 2020, 2022 and 2023 are representative of longer-term wind speed average frequency distribution at the 99% significance level.
- For wind direction, frequency distributions during 2011, 2012, 2013, 2014, 2015, 2017, 2018, 2019, 2020, 2021, 2022 and 2023 are representative of longer-term direction frequency distributions at the 99% significance level.
- For annual rainfall at Wandering, all years except 2011, 2017, 2019 and 2023 fall within the longer-term 10th and 90th percentile values.

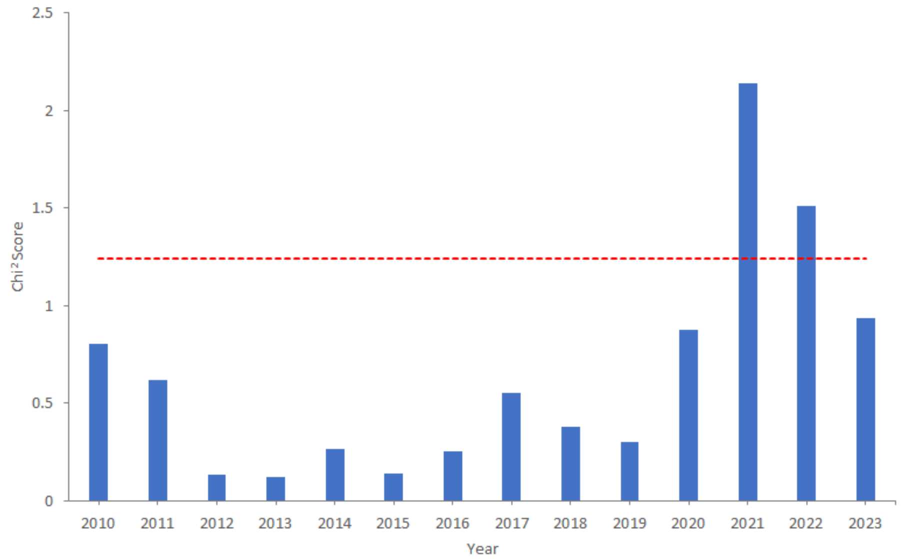
Based on the above analysis, 2013, 2014, 2018 and 2020 are representative of longer-term conditions for all parameters examined. It was however decided to use the more recent 2020 as the modelling year as the meteorological variables affecting dispersion, namely wind speed, wind direction, temperature, compare favourably to the long-term average conditions. The slightly drier conditions will produce marginally more conservative dust emissions.



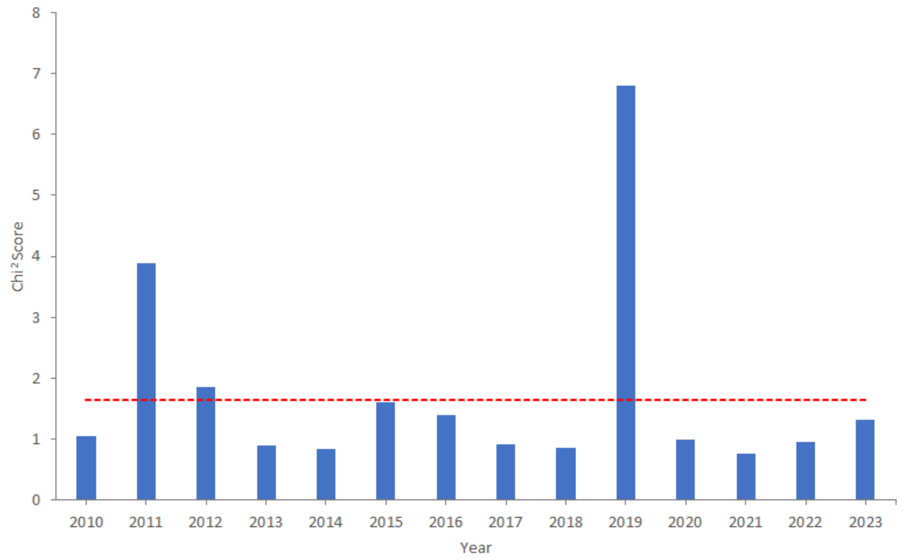
Appendix Figure 1: Null Hypothesis for Chi² test.



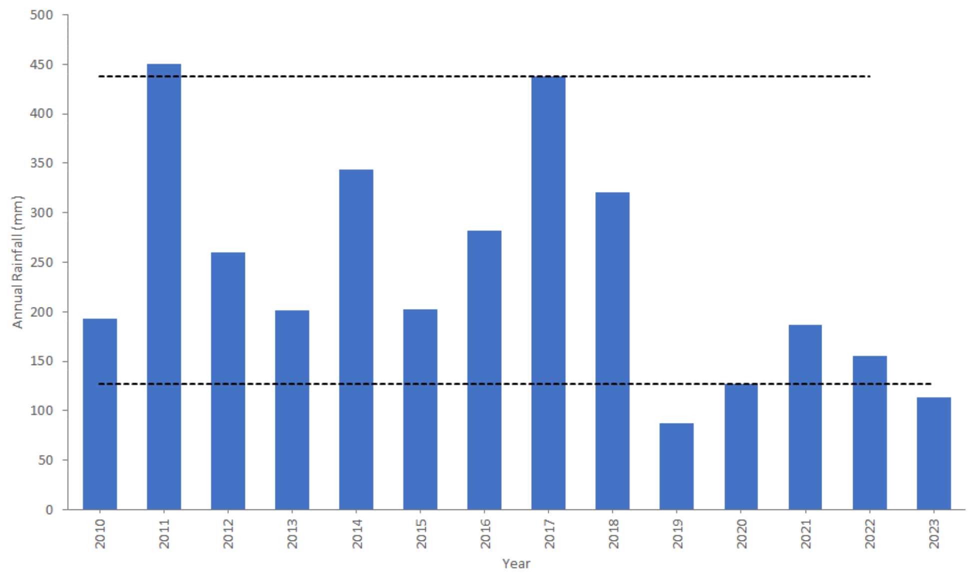
Appendix Figure 2: Chi² test result for wind direction at Wandering (2010-2023).



Appendix Figure 3: Chi² test result for wind speed at Wandering (2010-2023).



Appendix Figure 4: Chi² test result for temperature at Wandering (2010-2023).



Appendix Figure 5: Annual rainfall at Wandering (2010-2023).

A.2 Weather Research and Forecast Model

WRF was developed (and continues to be developed) in the United States by a collaborative partnership including the National Center for Atmospheric Research (NCAR), the National Oceanic and Atmospheric Administration (the National Center for Environmental Prediction (NCEP), the Forecast Systems Laboratory (FSL), the Air Force Weather Agency (AFWA), the Naval Research Laboratory, the University of Oklahoma, the Federal Aviation Administration (FAA) and others (Skamarock et al., 2019).

WRF is a fully compressible, Eulerian, non-hydrostatic meso-scale numerical model developed by the National Center for Atmospheric Research (NCAR) and the National Oceanic and Atmospheric Administration (NOAA) in the United States. WRF is suitable for a broad spectrum of applications across scales ranging from metres to thousands of kilometres. The model utilises global reanalysis[5] data to produce fine-scale 3-dimensional meteorological fields that considers local terrain and land-use effects.

WRF was run with a three-nest structure (16 km, 4 km, and 1 km horizontal grid space resolution) centred on 28.897207°S and 121.325703°E. This is shown in Appendix Figure . The model vertical resolution consists of 50 hybrid-eta levels[6].

Physics options in WRF are to represent atmospheric radiation, surface, and boundary layer as well as cloud and precipitation processes. WRF can be run with a variety of model physics options which can lead to varying results and hence it is crucial for the most appropriate model setup for a particular purpose over a given region/domain. WRF can be run with a wide variety of model physics options which can lead to varying results and hence it is crucial for selection of the most appropriate physics suites for a given region/domain. The choice of radiation, cumulus, planetary boundary layer (PBL) schemes and land surface model (LSM) can strongly influence near surface temperature, moisture and winds. A sensitivity study (not presented here) was undertaken on determining the most accurate combination of physics options, with the best combination of physics options, found to produce the most accurate results, summarised in Appendix Table 3.

Appendix Figure 6: Three nest structure, WRF model.

[5] Global modelling using observed climate data for temperature, wind speed, and pressure. The observations are analysed; interpolated onto a system of grids and the model initialised with this data.
[6] Terrain-following close to the earth's surface and pressure levels higher in the atmosphere.

Appendix Table 3: WRF Physics Options Selected for Model.

	Domain 1	Domain 2	Domain 3	Explanatory Notes
mp_physics	4	4	4	WRF Single–moment 5–class Scheme
ra_lw_physics	1	1	1	Rapid radiative transfer model scheme
ra_sw_physics	1	1	1	Dudhia scheme for cloud and clear sky absorption and scattering
Radt	10	10	10	Time step for radiation schemes
sf_sfclay_physics	1	1	1	MM5 based on MOST
sf_surface_physics	2	2	2	Noah land surface model with 6 soil layers
bl_pbl_physics	1	1	1	Non-local K-scheme with entrainment layer
bldt	0	0	0	Boundary layer time step (0=every time step)
cu_physics	1	1	0	Kain-Fritch scheme using mass flux approach for domain 1 only.
cudt	5	5	5	Cumulus physics time step (minutes)

Six-hourly global final analysis[7] synoptic data (from http://nomads.ncdc.noaa.gov/data/gfsanl/) was used to initialise the model and provide boundary conditions.

Land-use and terrain data were sourced from the United State Geological Services (USGS) database. Inspection of the land-use indicates an acceptable resolution and category for the model area with shrub land being the dominant vegetation type.

The selection of an appropriate Land Surface Model (LSM) is critically important to provide the boundary conditions at the land-atmosphere interface because:

- The Planetary Boundary Layer (PBL) schemes are sensitive to surface fluxes.
- The cloud/cumulus schemes are sensitive to the PBL structures.
- There is a need to capture mesoscale circulations forced by surface variability in albedo, soil moisture/temperature and land use.

The Noah Land-Surface Model was selected in this case to account for the sub-grid-scale fluxes. This sophisticated scheme provides 4 quantities to the parent atmospheric model (WRF), namely:

- surface sensible heat flux
- surface latent heat flux
- upward longwave radiation, and
- upward (reflected) shortwave radiation.

[7] Final analysis data is global modelled data that has been retrospectively corrected using surface, upper air and satellite measurements.

A.3 CALMET

Selected CALMET model switches and settings used in the modelling are summarised in Appendix Table 4. These specifically show settings that deviate from the model default values.

Appendix Table 4: Selected CALMET Settings and switches.

Code	Setting	Explanatory Notes
NOOBS	2	Use MM4/MM5/3D.DAT for surface, overwater, and upper air data
ICLOUD	4	Gridded cloud cover from Prognostic Rel. Humidity
IWFCOD	1	Diagnostic wind module
IFRADJ	1	Froude number adjustment
ISLOPE	1	Compute slope flow effects
IEXTRP	1	No surface wind observation extrapolation to upper layers
IPROG	14	Use gridded prognostic wind field model output fields as input to the diagnostic wind field model as initial guess field
RMAX1	0.01	Maximum radius of influence over land in the surface layer
RMAX2	0.01	Maximum radius of influence over land aloft
TERRAD	1.3	Radius of influence of terrain features
R1	0.01	Relative weighting of the first guess field and observations in the SURFACE layer
R2	0.01	Relative weighting of the first guess field and observations in the layers ALOFT

The geophysical data used in CALMET is critical for simulating deflection, blocking, and channelling of the air flow. In addition, other parameters such as roughness length, albedo and Bowen ratio are important for the simulation of turbulence, and heat fluxes (used to determine the growth of the mixing height, *inter alia*).

The default United States Geological Service (USGS) geophysical parameters used in CALMET are based on North American vegetation types and is often unrepresentative of Australian vegetation types. It was therefore decided to calculate these parameters, where possible, for the local vegetation specifically, based on Ozflux flux tower measurement data at Great Western Woodlands[8] for savanna/woodland and at Mulga for shrubland[9] (Cleverley, 2013, Prober et al, 2023) (Appendix Figure). Measurements at these sites include wind speed, direction, friction velocity, heat fluxes (sensible and latent) as well as incoming and outgoing radiation.

[8] Located 160 km SW of Leonora.
[9] Located near Alice Springs but considered representative of Western Australian Mulga shrublands.

Appendix Figure 7: Flux towers at Mulga (top), Great Western Woodlands (bottom) (source: Cleverley, 2013, Prober et al, 2023).

Roughness length is a critical parameter in dispersion modelling as it affects nocturnal mixing heights as well as dispersion rate of the plume through dispersion coefficients. The following relationship was used to calculate roughness length[10] (z_o) from friction velocity (u_*), wind speed (u) and anemometer height (z) at the two locations:

$$z_0 = (z - D)^{\frac{-kU(z)}{u*}}$$

The local roughness lengths thus determined are shown in Appendix Table .

Bowen ratios[11] for 2020/2021 were obtained from 30-minute average latent and sensible heat flux measurements for woodland, and shrub land cover types (Cleverley, 2013, Prober et al, 2023), and were calculated as follows:

$$\beta = \frac{Q_h}{Q_e}$$

[10] Roughness length is related to the roughness characteristics of the terrain.

[11] Bowen ratio is important in determining the degree of convective turbulence.

Where Q_H and Q_e are sensible and latent heat fluxes, respectively.

The local Bowen ratios thus determined are shown in Appendix Table .

Local albedo[12] was calculated from the ratio of outgoing shortwave (i.e., reflected) radiation to incoming radiation and are shown in Appendix Table 5.

Geophysical parameters for the remaining land-use categories were sourced from Hagermann (2002) and Peel *et al* (2005) and are also presented in Appendix Table .

Seasonal geophysical (geo.dat) files were utilised in the modelling to reflect the changing geophysical parameters between the wet and dry seasons.

Appendix Table 5: Seasonal roughness length (zo), albedo (α) and Bowen ratio (β) for predominant land cover

	zo	α	β
Shrubs and Trees (calculated)			
Summer	0.82	0.14	2.85
Autumn	0.48	0.14	2.40
Winter	0.17	0.14	2.07
Spring	0.76	0.14	2.63
Shrubland (calculated)			
Summer	0.53	0.13	1.63
Autumn	0.56	0.14	3.62
Winter	0.56	0.15	6.34
Spring	0.53	0.14	4.42
Grassland (from Peel et al, 2005)			
Non-seasonal varying	0.04	0.2	0.5
Barren (from Hagermann, 2002)			
Non-seasonal varying	0.005	0.28	4

[12] The albedo is the degree to which a surface will reflect incoming shortwave solar radiation and is used in the model to determine the radiation balance.

A.4 Performance Evaluation

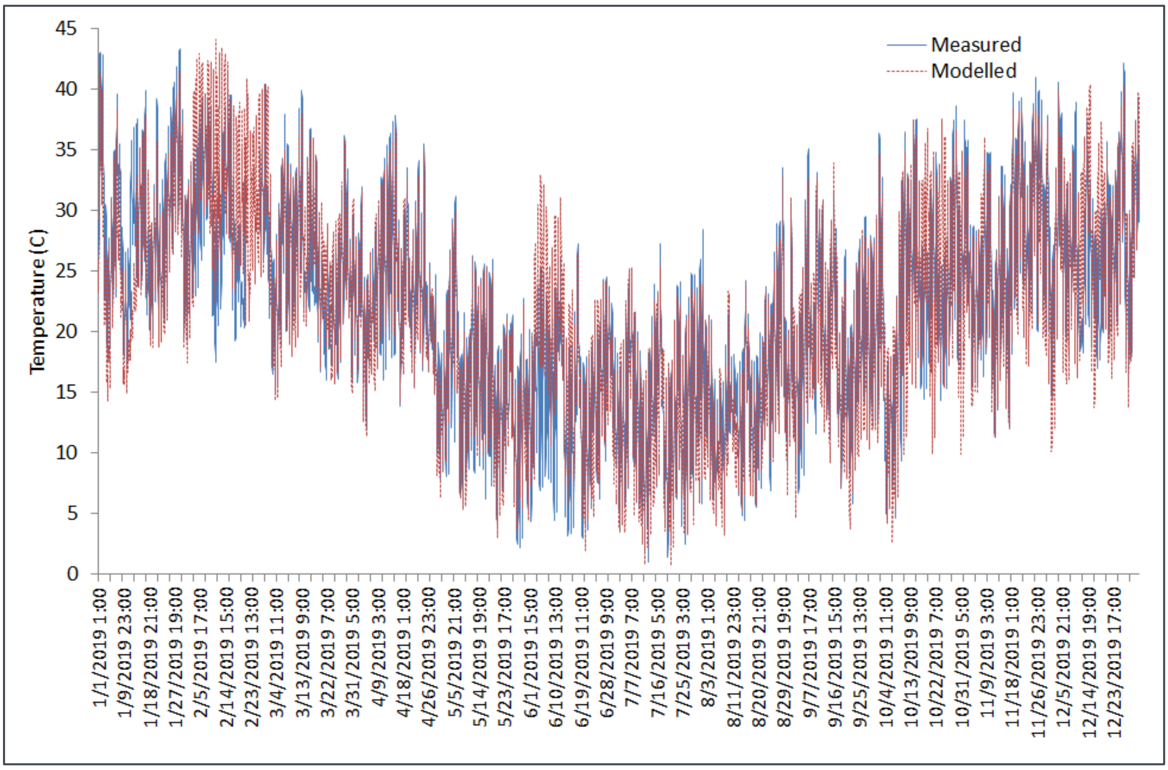
The CALMET model simulation using WRF as an initial guess field is validated against corresponding hourly average measurements at the Bureau of Meteorology Wandering weather stations for the period January 2020 to December 2020.

The time series of hourly modelled and measured temperature is shown in Appendix Figure . By inspection, the modelled trends, maxima, and minima reflect measured values well. The frequency plot of temperature in Appendix Figure shows modelled and measured temperature frequency distributions are comparable.

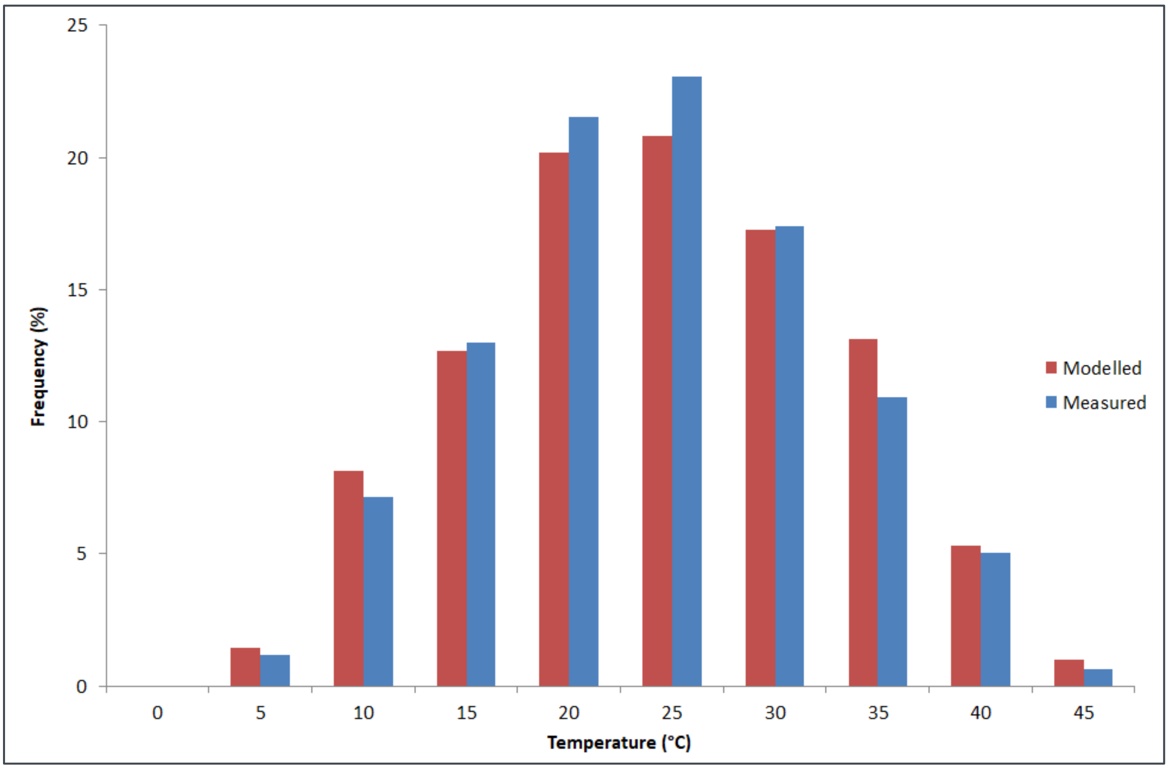
The wind speed time series and frequency plot are shown in Appendix Figure and Appendix Figure respectively. The model reflects the trend, maxima and minima in wind speeds well but significantly overpredicted maximum wind speeds between 10 and 20 February. The frequency plot of modelled wind speed generally reflects measured frequencies, although the model overprediction of higher wind speeds during February is evident in the frequency plot.

The annual wind direction radar plot (Appendix Figure 12) shows that the model generally simulates the predominant wind directions well. It slightly overpredicts the frequency of southeasterly winds and underpredicts the frequency of east-southeasterly winds.

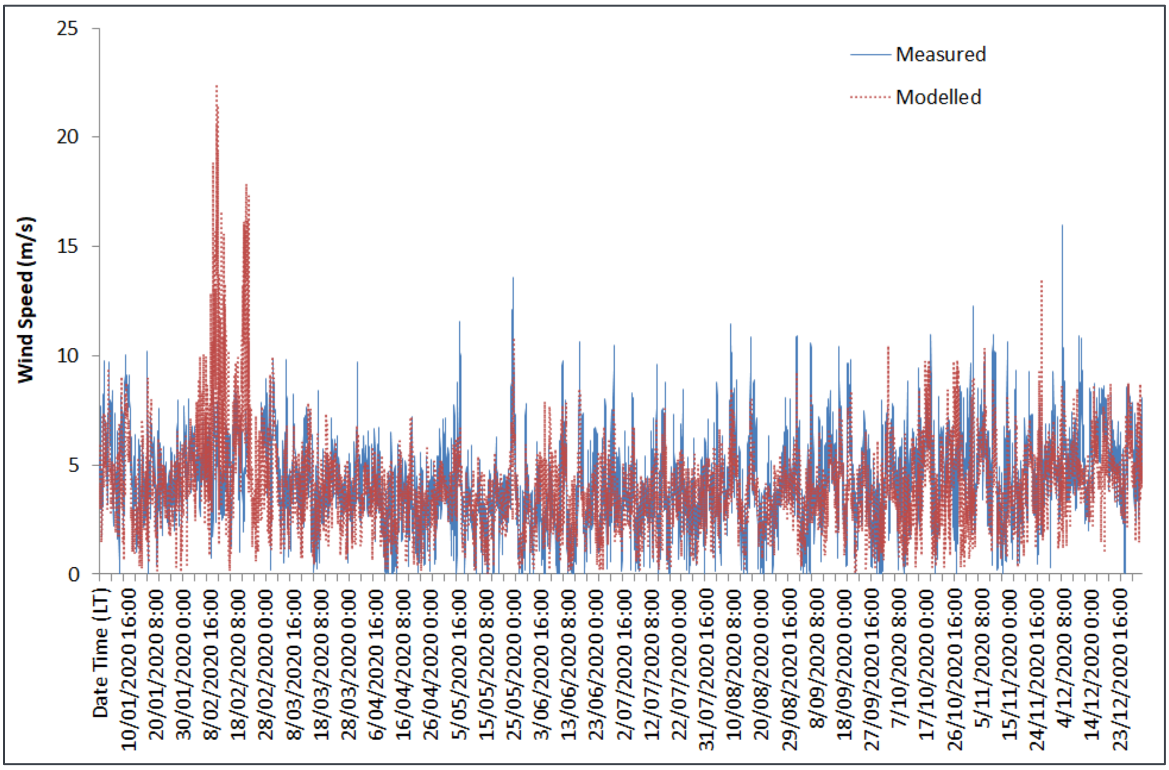
The hourly rainfall time series is shown in Appendix Figure . The model does not always predict rainfall events. This is expected owing to the "hit and miss" nature of precipitation in the region.



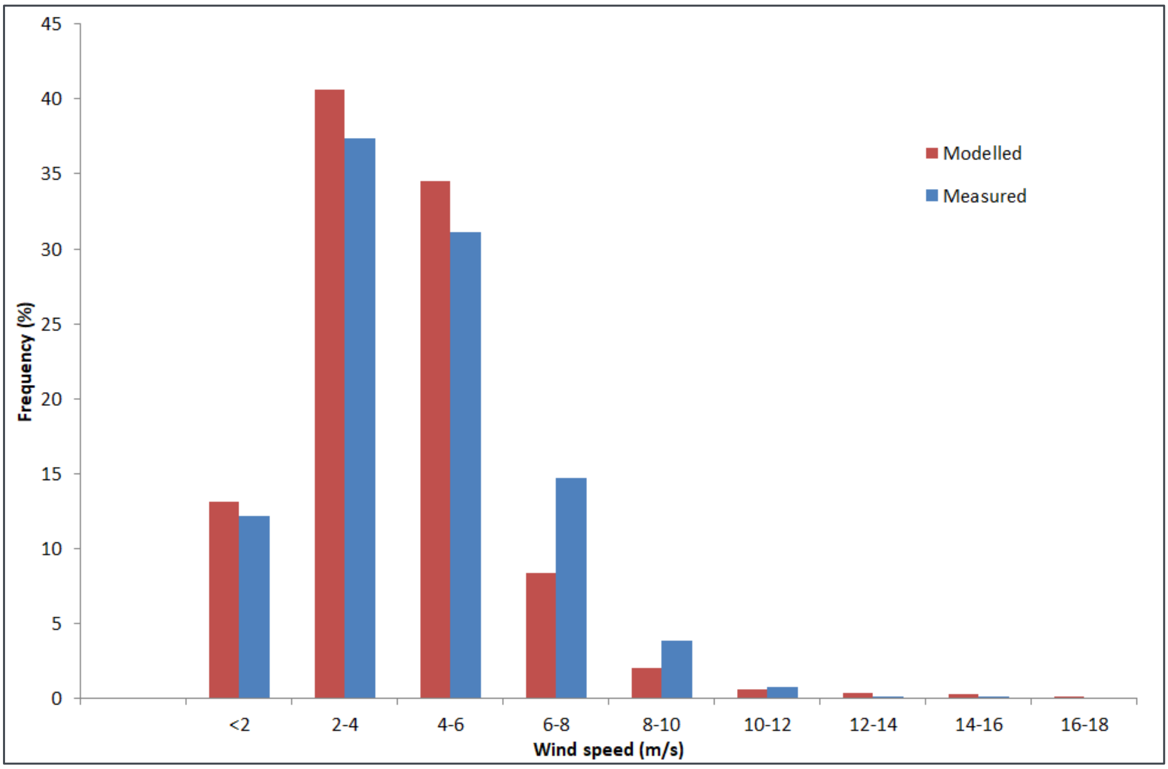
Appendix Figure 8: Time series of CALMET modelled and measured temperature at Wandering.



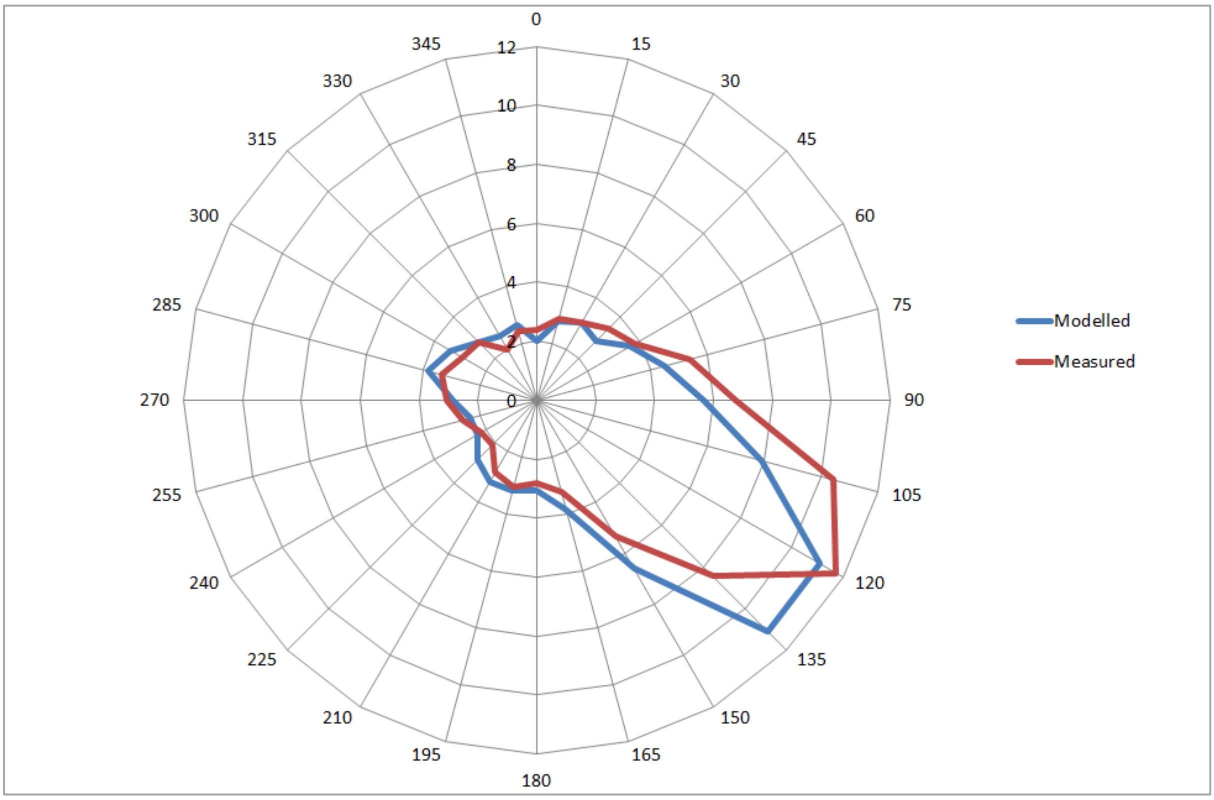
Appendix Figure 9: Frequency plot of CALMET modelled and measured temperature at Wandering.



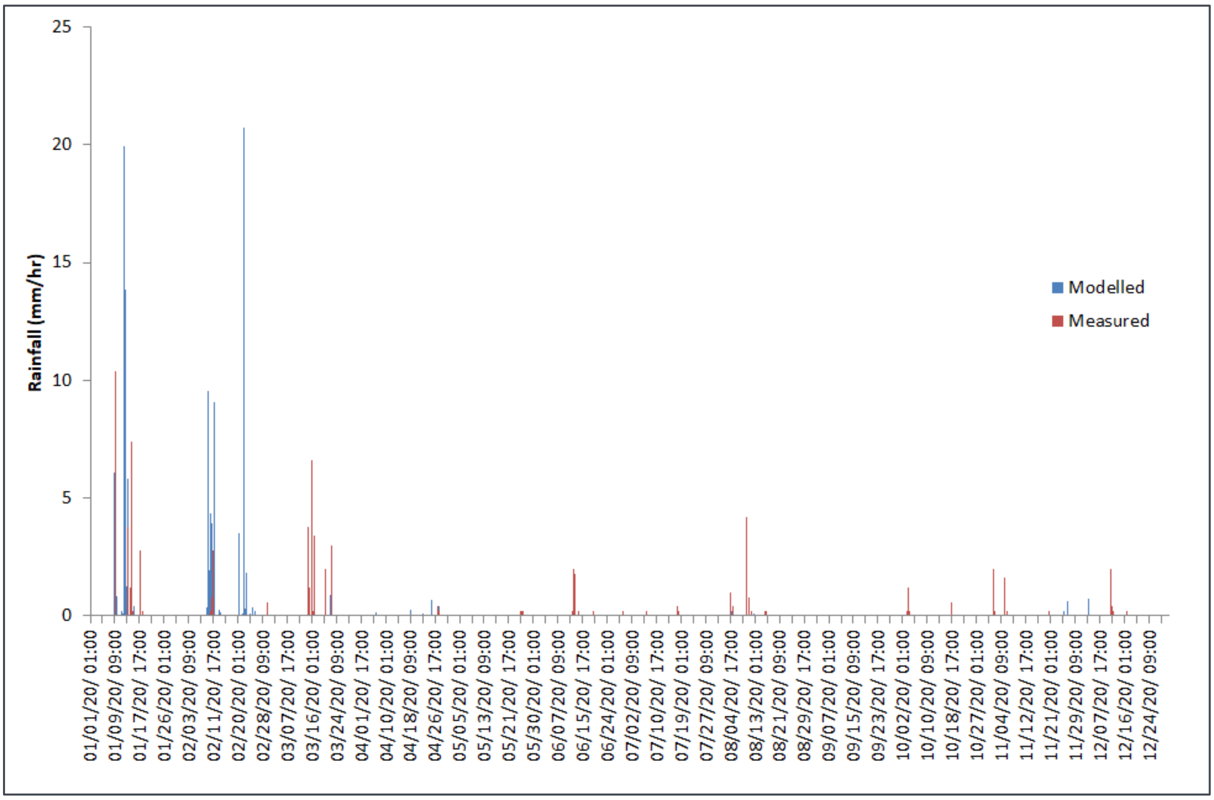
Appendix Figure 10: Time series of CALMET modelled and measured 10m wind speed at Wandering.



Appendix Figure 11: Frequency of CALMET modelled and measured wind speed at Wandering.



Appendix Figure 12: Annual measured and CALMET modelled wind direction radar plot at Wandering.



Appendix Figure 13: Time series of measured and CALMET modelled hourly rainfall at Wandering.

More objective methods to evaluate model performance are assessed using statistical tests that have been specifically developed for this purpose. These tests used are discussed in detail below.

Model Bias

The model bias (MB) is the mean error and is given by:

$$MB = \frac{1}{n}\sum_{i=1}^{n}(O_i - P_i)$$

Where:

n	=	the number of pairs of observed data
O_i	=	the observed value for the i-th hour
P_i	=	the predicted value for the i-th hour

The ideal value for the bias is zero.

Gross Error

The gross error (GE) is the mean of absolute error and is given by:

$$GE = \frac{1}{n}\sum_{i=1}^{n} | O_i - P_i |$$

Where:

n	=	the number of pairs of observed data
O_i	=	the observed value for the i-th hour
P_i	=	the predicted value for the i-th hour

The ideal value for gross error is zero. GE is greater than MB, representing the expected error for each hourly observation.

Root Mean Square Error

The Root Mean Square Error (RMSE) is the standard deviation of the difference for hourly predicted and observed pairings. Overall, the RSME is a good overall measure of model performance, but since large errors are weighted heavily (due to squaring), its value can be distorted. The RMSE is given by:

$$RMSE = \sqrt{\frac{1}{n}\sum_{i=1}^{n} (O_i - P_i)^2}$$

Where:

n	=	the number of pairs of data
O_i	=	the observed (measured) value for the i-th hour
P_i	=	the predicted (modelled) value for the i-th hour

While the ideal RMSE value is 0, large errors in a small section of the data may produce a large RMSE even though errors may be small elsewhere.

Index of Agreement

The index of agreement (IOA) is the measure of how well the model estimates departure from the observed mean.

$$IOA = 1 - \left[\frac{n(RMSE)^2}{\sum_{i=1}^{n}\{|(P_i - \overline{O})| + |(O_i - \overline{O})|\}^2}\right]$$

Where:

n	=	the number of pairs of observed data
O_i	=	the observed value for the i-th hour
P_i	=	the predicted (modelled) value for the i-th hour
$\bar{O}$	=	the mean observed value

The index of agreement has a theoretical range of 0 to 1. The ideal value for IOA is 1.

A perfect score is 1 and 0 indicates no skill (https://cawcr.gov.au/projects/verification/).

Rainfall Accuracy

The rainfall accuracy statistical test assesses what fraction of the rainfall forecasts are correct and is calculated as follows:

$$Accuracy = \frac{hits + correct\ negatives}{total}$$

Where:

hits = when a forecast event did occur

correct negatives = event forecast not to occur, and did not occur

A perfect score is 1 and 0 indicates no skill (https://cawcr.gov.au/projects/verification/).

Probability of Detection (POD) for Rainfall

This rainfall statistic determines what fraction of observed rainfall events were correctly forecast:

$$POD = \frac{hits}{hits + misses}$$

Where:

hits = when a forecast event did occur

misses = event forecast not to occur, but did occur

A perfect score is 1 and 0 indicates no skill (https://cawcr.gov.au/projects/verification/).

Odds Ratio Skill Score (ORSS) for Rainfall

This rainfall statistic determines the improvement of the rainfall forecast over random chance:

$$ORSS = \frac{hits \times correct\ negatives - misses\ \times false\ alarms}{hits \times correct\ negatives + misses\ \times false\ alarms}$$

Where:

hits = when a forecast event did occur

misses = event forecast not to occur, but did occur

correct negatives = event forecast not to occur, and did not occur

false alarms = event forecast to occur, but did not occur

A perfect score is 1 and 0 indicates no skill (https://cawcr.gov.au/projects/verification/).

Validation Benchmarks

A set of benchmarks were set for mesoscale model evaluation by Emery *et al.* (2001) and Teschke *et al.* (2001) and were adopted by the US EPA in 2002. They are listed in the table below.

Parameter	Test	Benchmark
Wind Speed	RMSE	≤2 m/s
	BIAS	≤± 0.5 m/s
	IOA	≥0.6
Temp	Gross Error	≤2 K
	BIAS	≤± 0.5 K
	IOA	≥0.8
Wind Direction	Gross Error	≤30°
	BIAS	≤10°

The results of the statistical verification tests are shown in Appendix Table 6. The wind speed scores all fall within ideal benchmark score values although temperature statistics show less accuracy, namely for the Gross Error, reflecting the model overprediction during parts of June. Wind direction meets the Bias benchmark criterion and just falls outside the Gross Error criterion. This indicates acceptable model performance for this parameter.

To determine model performance with respect to rainfall, the success of the model in predicting hourly rainfall or no-rainfall was assessed using a contingency table. For example, when a specific hour had both prediction and corresponding observation indicating zero rain, this was marked as a “correct negative” and when there was both measured and modelled rain, this was marked as a “hit”. When the hourly modelled and observed rain/no rain event did not coincide, this was marked as a “miss”. Based on this approach, a model accuracy rate of 0.96 is calculated. However, this statistic is misleading as the large number of ‘no rain’ hours can bias the outcome. Instead, it was decided to assess the frequency that measured rainfall was both predicted and occurred. Using this analysis method, a model success (or probability of detection) rate of only 0.25 is calculated. It is worth noting that rainfall in semi-arid to arid regions is difficult to predict at a particular location owing to the hit and miss nature of the main rain producing storms. No model can predict the exact location of rain with precise accuracy.

Appendix Table 6: Statistical benchmark scores at Wandering.

Variable	Performance Criteria	Benchmark Range	Statistic	
			Score	Meets Benchmark
Wind Speed	RMSE	<±2 m/s	2.0	yes
	BIAS	<± 0.5 m/s	0.2	yes
	IOA	>0.6	0.7	yes
Wind Direction	Gross error	<30 °	33.5	no
	BIAS	<10 °	7.3	yes
Temp	Gross error	<±2 K	2.6	no
	BIAS	<± 0.5 K	-0.1	yes
	IOA	>0.8	0.9	yes

A.5 Modelled Dispersion Meteorology

Wind Direction and Speed

Selected meteorological variable were extracted from the gridded CALMET output for a point corresponding to Wandering. The general features of the 10 m winds illustrated in the annual and seasonal wind rose diagrams for the 12-month period from January 2020 – December 2020[13] are shown in Appendix Figure 14.

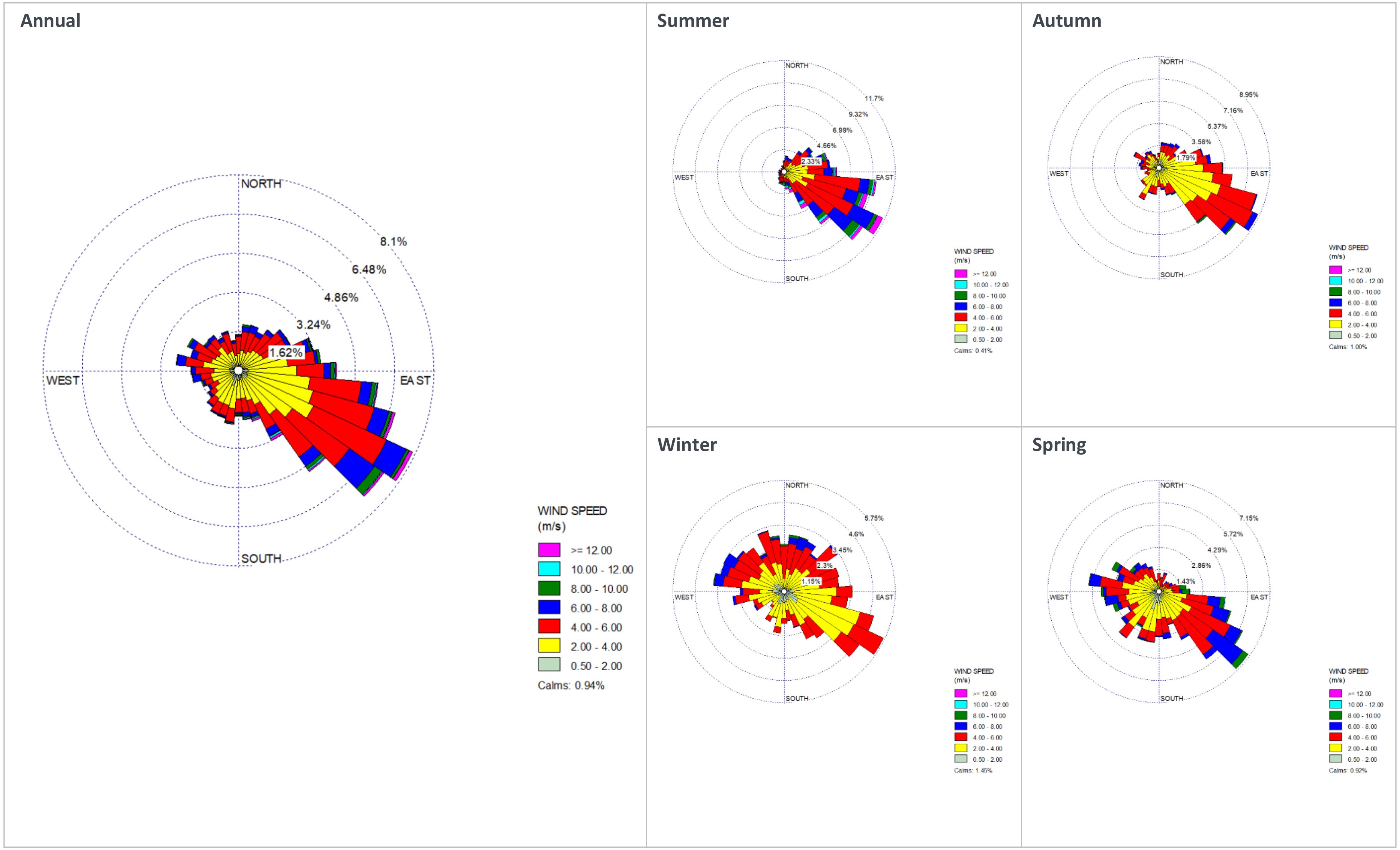
The wind roses show the frequency of occurrence of winds by direction and strength. The bars correspond to the 16 compass points – N, NNE, NE, etc. The bar at the top of each wind rose diagram represents winds blowing from the north (i.e. northerly winds), and so on. The length of the bar represents the frequency of occurrence of winds from that direction, and the widths of the bar sections correspond to wind speed categories, the narrowest representing the lightest winds.

The major features of the wind rose are as follows:

- Annual wind direction is predominantly from the southeast with secondary maxima from the northwest.
- Autumn is characterised by winds from the southeast, and slightly increased frequency of northwesterly and southwesterly winds.
- During the winter months, winds from the west and northwest increase in frequency.
- Spring winds are from the northwest to southwest with increased frequency of southeasterly winds.
- Average wind speeds are 4.0 m/s with strongest modelled hourly wind speed of 22 m/s.
- Light winds (< 1 m/s) occur for 3% (306 hours) of the year.
- Stronger winds (> 6 m/s) occur for 12 % (1040 hours) of the year.

The spatial variation of wind direction, as modelled by WRF-CALMET, is shown in Appendix Figure 15. Terrain influence on the prevailing airflow is evident, with deflection due to the waste rock dumps.

[13] The selected representative meteorological year (as determined previously).



Appendix Figure 14: Annual and seasonal wind roses generated from WRF/CALMET for Wandering

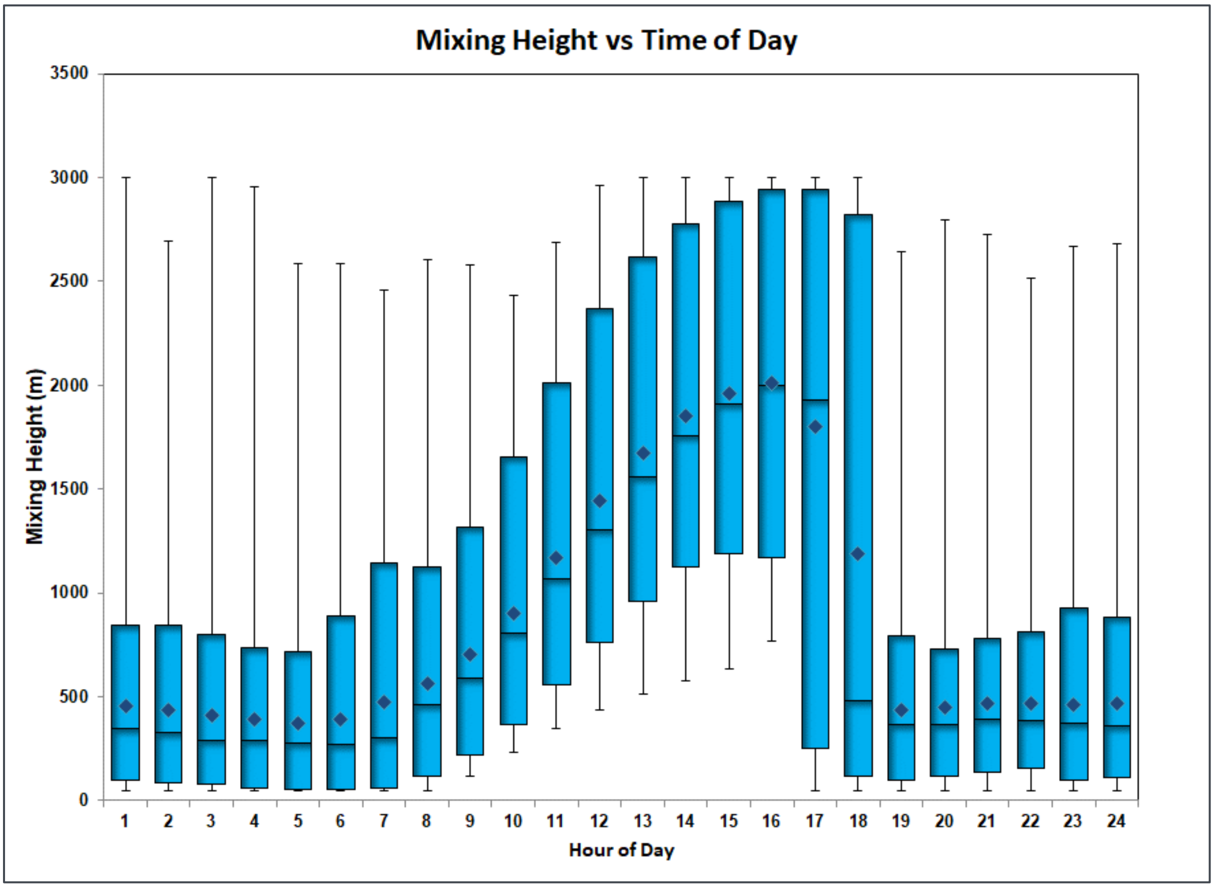
Mixing Height

Mixing height is the depth of the atmospheric surface layer beneath an elevated temperature inversion. It is an important parameter within air pollution meteorology. Vertical diffusion or mixing of a plume is limited by the mixing height, as the air above this layer tends to be stable, with restricted vertical motion.

A series of internal algorithms within CALMET is used to calculate mixing heights for the subject site where it is assumed that mixing height is formed through mechanical means (wind speed) at night and through a mixture of mechanical and convective means (wind speed and solar radiation) during the day (Scire et al. 2011). During the night and early morning when the convective mixed layer is absent or small, the full depth of the planetary boundary layer (PBL) may be controlled by mechanical turbulence. During the day, the height of the PBL during convective conditions is then taken as the maximum of the estimated (or measured if available) convective boundary layer height and the estimated (or measured if available) mechanical mixing height. It is calculated from the early morning potential temperature sounding (prior to sunrise), and the time varying surface heat flux to calculate the time evolution of the convective boundary layer.

The hourly variation of mixing height at the facility is summarised in Appendix Figure [14] with the diurnal cycle evident. At night, mixing height is relatively low (average of 400 m) and after sunrise it typically increases to between 100 m and 3,000 m in response to convective mixing generated by solar heating of the Earth's surface. A rapid reduction in mixing height commences around sunset when convective mixing ceases and a mechanical mixing regime is re-established.

[14] The blue bars depict the 10th and 90th percentile values while the diamond shape show the average conditions. The whiskers indicate minimum and maximum values of the data, and the line within the blue bar indicates the median.



Appendix Figure 16: Simulated annual statistics of hourly mixing heights, Wandering

Stability

An important aspect of pollutant dispersion is the level of turbulence in the lowest 1 km or so of the atmosphere, known as the planetary boundary layer (PBL). Turbulence controls how effectively a plume is diffused into the surrounding air and hence diluted. It acts by increasing the cross-sectional area of the plume due to random motions. With stronger turbulence, the rate of plume diffusion increases. Weak turbulence limits diffusion and contributes to high plume concentrations downwind of a source.

Turbulence is generated by both thermal and mechanical effects to varying degrees. Thermally driven turbulence occurs when the surface is being heated, in turn transferring heat to the air above by convection. Mechanical turbulence is caused by the frictional effects of wind moving over the earth's surface and depends on the roughness of the surface as well as the flow characteristics.

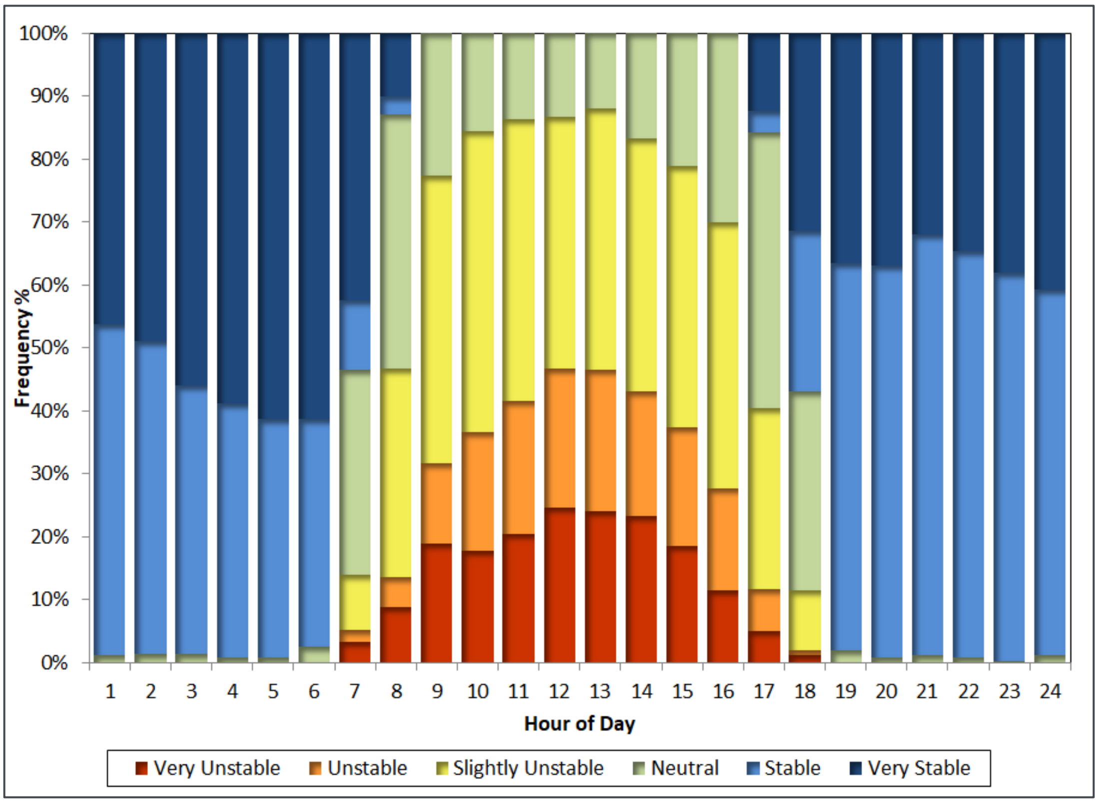
Turbulence in the boundary layer is influenced by the vertical temperature gradient, which is one of several indicators of stability. Plume models use indicators of atmospheric stability in conjunction with other meteorological data to estimate the dispersion conditions in the atmosphere.

Stability can be described across a spectrum ranging from highly unstable through neutral to highly stable. A highly unstable boundary layer is characterised by strong surface heating and relatively light winds, leading to intense convective turbulence and enhanced plume diffusion. At the other extreme, very stable conditions are often associated with strong temperature inversions and light winds, which commonly occur under clear skies at night and in the early morning. Under these conditions, plumes can remain relatively undiluted for considerable distances downwind. Neutral conditions are linked to windy and/or cloudy weather, and short periods around sunset and sunrise, when surface rates of heating or cooling are very low.

The stability of the atmosphere plays a significant role in determining the dispersion of a plume and it is important to have it correctly represented in the dispersion model. CALPUFF uses the Monin-Obukhov Similarity Theory (MOST) to characterise turbulence and other processes in the PBL. One of the measures of the PBL is the Monin-Obukhov length (L), which approximates the height at which turbulence is generated equally by thermal and mechanical effects (Seinfeld and Pandis 2006). It is a measure of the relative importance of mechanical and thermal forcing on atmospheric turbulence.

Because values of L diverge to + and–- infinity as stability approaches neutral from the stable and unstable sides, respectively, it is often more convenient to use the inverse of L (i.e. 1/L) when describing stability.

The hourly averaged stability computed from all data in the CALMET surface file is presented in Appendix Figure 17. This plot indicates that the PBL is stable to very stable overnight becoming very unstable (reaching maximum instability between 11:00 am and 2:00 pm) as radiation from the sun heats the surface layer of the atmosphere and drives convection.



Appendix Figure 17: Simulated annual statistics of hourly stability, Wandering

Appendix B – Emission Sources and Parameters

Table 10-1: Dam Haul Roads.

Source	East	North	Effective Ht	Sigma Y	Sigma Z

Source	East	North	Effective Ht	Sigma Y	Sigma Z
HR1	443,962	6,383,532	4.34	16.74	4.03
HR2	443,894	6,383,717	4.34	16.74	4.03
HR3	443,840	6,383,901	4.34	16.74	4.03
HR4	443,912	6,384,081	4.34	16.74	4.03
HR5	444,084	6,384,180	4.34	16.74	4.03
HR6	444,163	6,384,359	4.34	16.74	4.03
HR7	444,244	6,384,540	4.34	16.74	4.03
HR8	444,379	6,384,687	4.34	16.74	4.03
HR9	444,531	6,384,802	4.34	16.74	4.03
HR10	444,729	6,384,826	4.34	16.74	4.03
HR11	444,884	6,384,947	4.34	16.74	4.03
HR12	445,040	6,385,060	4.34	16.74	4.03
HR13	445,224	6,384,997	4.34	16.74	4.03
HR14	445,383	6,384,995	4.34	16.74	4.03
HR15	445,397	6,385,192	4.34	16.74	4.03
HR16	445,464	6,385,381	4.34	16.74	4.03
HR17	445,620	6,385,495	4.34	16.74	4.03
HR18	445,814	6,385,532	4.34	16.74	4.03
HR19	445,935	6,385,674	4.34	16.74	4.03
HR20	445,894	6,385,869	4.34	16.74	4.03
HR21	445,851	6,386,065	4.34	16.74	4.03
HR22	445,809	6,386,260	4.34	16.74	4.03
HR23	445,753	6,386,452	4.34	16.74	4.03
HR24	445,702	6,386,646	4.34	16.74	4.03
HR25	445,650	6,386,839	4.34	16.74	4.03
HR26	443,829	6,383,956	4.34	16.74	4.03
HR27	443,847	6,384,155	4.34	16.74	4.03
HR28	443,869	6,384,354	4.34	16.74	4.03
HR29	443,873	6,384,553	4.34	16.74	4.03
HR30	443,848	6,384,751	4.34	16.74	4.03
HR31	443,765	6,384,920	4.34	16.74	4.03
HR32	443,617	6,385,054	4.34	16.74	4.03
HR33	443,469	6,385,188	4.34	16.74	4.03
HR34	443,323	6,385,324	4.34	16.74	4.03
HR35	443,210	6,385,487	4.34	16.74	4.03

Source	East	North	Effective Ht	Sigma Y	Sigma Z
HR36	443,197	6,385,683	4.34	16.74	4.03
HR37	443,268	6,385,870	4.34	16.74	4.03
HR38	443,339	6,386,057	4.34	16.74	4.03
HR39	443,479	6,386,185	4.34	16.74	4.03
HR40	443,653	6,386,283	4.34	16.74	4.03
HR41	443,828	6,386,380	4.34	16.74	4.03
HR42	444,015	6,386,449	4.34	16.74	4.03
HR43	444,207	6,386,505	4.34	16.74	4.03
HR44	444,400	6,386,554	4.34	16.74	4.03
HR45	444,597	6,386,588	4.34	16.74	4.03
HR46	444,794	6,386,622	4.34	16.74	4.03
HR47	444,974	6,386,704	4.34	16.74	4.03
HR48	445,147	6,386,804	4.34	16.74	4.03
HR49	443,885	6,386,514	4.34	16.74	4.03
HR50	443,874	6,386,714	4.34	16.74	4.03
HR51	443,864	6,386,914	4.34	16.74	4.03
HR52	443,852	6,387,114	4.34	16.74	4.03
HR53	443,841	6,387,313	4.34	16.74	4.03
HR54	443,829	6,387,513	4.34	16.74	4.03
HR55	443,815	6,387,712	4.34	16.74	4.03
HR56	443,760	6,387,904	4.34	16.74	4.03
HR57	443,705	6,388,097	4.34	16.74	4.03
HR58	443,650	6,388,289	4.34	16.74	4.03
HR59	443,565	6,388,467	4.34	16.74	4.03
HR60	443,446	6,388,627	4.34	16.74	4.03
HR61	443,326	6,388,787	4.34	16.74	4.03
HR62	443,206	6,388,947	4.34	16.74	4.03
HR63	443,084	6,389,106	4.34	16.74	4.03
HR64	443,096	6,385,710	4.34	16.74	4.03
HR65	442,923	6,385,810	4.34	16.74	4.03
HR66	442,765	6,385,927	4.34	16.74	4.03
HR67	442,646	6,386,087	4.34	16.74	4.03
HR68	442,491	6,386,187	4.34	16.74	4.03
HR69	442,293	6,386,209	4.34	16.74	4.03
HR70	442,094	6,386,232	4.34	16.74	4.03

Table 10-2: Dam Construction Sources.

Name	Effective Height	Sigma Y	Sigma Z	Easting	Northing
Unload1	2	3	0.93	445,073	6,387,681
Unload2	2	3	0.93	445,218	6,386,995
Unload3	2	3	0.93	445,264	6,385,987
Unload4	2	3	0.93	443,058	6,389,341
Unload5	2	3	0.93	441,647	6,386,273
FrontEndLoader1	2	125	0.93	445,103	6,387,590
FrontEndLoader2	2	125	0.93	445,248	6,386,903
FrontEndLoader3	2	125	0.93	445,294	6,385,896
FrontEndLoader4	2	125	0.93	443,089	6,389,249
FrontEndLoader5	2	125	0.93	441,677	6,386,182

Table 10-3: Clearing Sources.

Name	Effective Height	Sigma Y	Sigma Z	Easting	Northing
ex1	441,598	6,387,145	2	125	0.93
ex2	441,598	6,386,645	2	125	0.93
ex3	441,598	6,386,145	2	125	0.93
ex4	441,598	6,385,645	2	125	0.93
ex5	441,598	6,384,645	2	125	0.93
ex6	442,098	6,386,645	2	125	0.93
ex7	442,098	6,385,645	2	125	0.93
ex8	442,098	6,385,145	2	125	0.93
ex9	442,098	6,384,645	2	125	0.93
ex10	442,098	6,384,145	2	125	0.93
ex11	442,598	6,388,645	2	125	0.93
ex12	442,598	6,388,145	2	125	0.93
ex13	442,598	6,387,645	2	125	0.93
ex14	442,598	6,387,145	2	125	0.93
ex15	442,598	6,386,645	2	125	0.93
ex16	442,598	6,384,145	2	125	0.93
ex17	443,098	6,389,145	2	125	0.93
ex18	443,098	6,388,645	2	125	0.93
ex19	443,098	6,388,145	2	125	0.93
ex20	443,098	6,387,645	2	125	0.93
ex21	443,098	6,387,145	2	125	0.93
ex22	443,098	6,384,145	2	125	0.93
ex23	443,598	6,389,645	2	125	0.93
ex24	443,598	6,389,145	2	125	0.93
ex25	443,598	6,383,645	2	125	0.93
ex26	444,098	6,389,145	2	125	0.93
ex27	444,098	6,388,645	2	125	0.93
ex28	444,098	6,388,145	2	125	0.93
ex29	444,098	6,385,145	2	125	0.93
ex30	444,098	6,384,145	2	125	0.93
ex31	444,098	6,383,645	2	125	0.93
ex32	444,598	6,388,645	2	125	0.93
ex33	444,598	6,388,145	2	125	0.93
ex34	444,598	6,387,645	2	125	0.93
ex35	444,598	6,385,645	2	125	0.93

Name	Effective Height	Sigma Y	Sigma Z	Easting	Northing
ex36	444,598	6,385,145	2	125	0.93
ex37	444,598	6,384,145	2	125	0.93
ex38	445,098	6,387,645	2	125	0.93
ex39	445,098	6,387,145	2	125	0.93
ex40	445,098	6,386,645	2	125	0.93
ex41	445,098	6,386,145	2	125	0.93
ex42	445,098	6,385,645	2	125	0.93
ex43	445,098	6,384,645	2	125	0.93
ex44	445,598	6,387,145	2	125	0.93
ex45	445,598	6,386,645	2	125	0.93
ex46	445,598	6,384,645	2	125	0.93
scraper1	441,690	6,387,231	3.57	16.74	3.32
scraper2	441,690	6,386,731	3.57	16.74	3.32
scraper3	441,690	6,386,231	3.57	16.74	3.32
scraper4	441,690	6,385,731	3.57	16.74	3.32
scraper5	441,690	6,384,731	3.57	16.74	3.32
scraper6	442,190	6,386,731	3.57	16.74	3.32
scraper7	442,190	6,385,731	3.57	16.74	3.32
scraper8	442,190	6,385,231	3.57	16.74	3.32
scraper9	442,190	6,384,731	3.57	16.74	3.32
scraper10	442,190	6,384,231	3.57	16.74	3.32
scraper11	442,690	6,388,731	3.57	16.74	3.32
scraper12	442,690	6,388,231	3.57	16.74	3.32
scraper13	442,690	6,387,731	3.57	16.74	3.32
scraper14	442,690	6,387,231	3.57	16.74	3.32
scraper15	442,690	6,386,731	3.57	16.74	3.32
scraper16	442,690	6,384,231	3.57	16.74	3.32
scraper17	443,190	6,389,231	3.57	16.74	3.32
scraper18	443,190	6,388,731	3.57	16.74	3.32
scraper19	443,190	6,388,231	3.57	16.74	3.32
scraper20	443,190	6,387,731	3.57	16.74	3.32
scraper21	443,190	6,387,231	3.57	16.74	3.32
scraper22	443,190	6,384,231	3.57	16.74	3.32
scraper23	443,690	6,389,731	3.57	16.74	3.32
scraper24	443,690	6,389,231	3.57	16.74	3.32

Name	Effective Height	Sigma Y	Sigma Z	Easting	Northing
scraper25	443,690	6,383,731	3.57	16.74	3.32
scraper26	444,190	6,389,231	3.57	16.74	3.32
scraper27	444,190	6,388,731	3.57	16.74	3.32
scraper28	444,190	6,388,231	3.57	16.74	3.32
scraper29	444,190	6,385,231	3.57	16.74	3.32
scraper30	444,190	6,384,231	3.57	16.74	3.32
scraper31	444,190	6,383,731	3.57	16.74	3.32
scraper32	444,690	6,388,731	3.57	16.74	3.32
scraper33	444,690	6,388,231	3.57	16.74	3.32
scraper34	444,690	6,387,731	3.57	16.74	3.32
scraper35	444,690	6,385,731	3.57	16.74	3.32
scraper36	444,690	6,385,231	3.57	16.74	3.32
scraper37	444,690	6,384,231	3.57	16.74	3.32
scraper38	445,190	6,387,731	3.57	16.74	3.32
scraper39	445,190	6,387,231	3.57	16.74	3.32
scraper40	445,190	6,386,731	3.57	16.74	3.32
scraper41	445,190	6,386,231	3.57	16.74	3.32
scraper42	445,190	6,385,731	3.57	16.74	3.32
scraper43	445,190	6,384,731	3.57	16.74	3.32
scraper44	445,690	6,387,231	3.57	16.74	3.32
scraper45	445,690	6,386,731	3.57	16.74	3.32
scraper46	445,690	6,384,731	3.57	16.74	3.32
grader1	441,670	6,387,324	3.91	16.74	3.64
grader2	441,670	6,386,824	3.91	16.74	3.64
grader3	441,670	6,386,324	3.91	16.74	3.64
grader4	441,670	6,385,824	3.91	16.74	3.64
grader5	441,670	6,384,824	3.91	16.74	3.64
grader6	442,170	6,386,824	3.91	16.74	3.64
grader7	442,170	6,385,824	3.91	16.74	3.64
grader8	442,170	6,385,324	3.91	16.74	3.64
grader9	442,170	6,384,824	3.91	16.74	3.64
grader10	442,170	6,384,324	3.91	16.74	3.64
grader11	442,670	6,388,824	3.91	16.74	3.64
grader12	442,670	6,388,324	3.91	16.74	3.64
grader13	442,670	6,387,824	3.91	16.74	3.64

Name	Effective Height	Sigma Y	Sigma Z	Easting	Northing
grader14	442,670	6,387,324	3.91	16.74	3.64
grader15	442,670	6,386,824	3.91	16.74	3.64
grader16	442,670	6,384,324	3.91	16.74	3.64
grader17	443,170	6,389,324	3.91	16.74	3.64
grader18	443,170	6,388,824	3.91	16.74	3.64
grader19	443,170	6,388,324	3.91	16.74	3.64
grader20	443,170	6,387,824	3.91	16.74	3.64
grader21	443,170	6,387,324	3.91	16.74	3.64
grader22	443,170	6,384,324	3.91	16.74	3.64
grader23	443,670	6,389,824	3.91	16.74	3.64
grader24	443,670	6,389,324	3.91	16.74	3.64
grader25	443,670	6,383,824	3.91	16.74	3.64
grader26	444,170	6,389,324	3.91	16.74	3.64
grader27	444,170	6,388,824	3.91	16.74	3.64
grader28	444,170	6,388,324	3.91	16.74	3.64
grader29	444,170	6,385,324	3.91	16.74	3.64
grader30	444,170	6,384,324	3.91	16.74	3.64
grader31	444,170	6,383,824	3.91	16.74	3.64
grader32	444,670	6,388,824	3.91	16.74	3.64
grader33	444,670	6,388,324	3.91	16.74	3.64
grader34	444,670	6,387,824	3.91	16.74	3.64
grader35	444,670	6,385,824	3.91	16.74	3.64
grader36	444,670	6,385,324	3.91	16.74	3.64
grader37	444,670	6,384,324	3.91	16.74	3.64
grader38	445,170	6,387,824	3.91	16.74	3.64
grader39	445,170	6,387,324	3.91	16.74	3.64
grader40	445,170	6,386,824	3.91	16.74	3.64
grader41	445,170	6,386,324	3.91	16.74	3.64
grader42	445,170	6,385,824	3.91	16.74	3.64
grader43	445,170	6,384,824	3.91	16.74	3.64
grader44	445,670	6,387,324	3.91	16.74	3.64
grader45	445,670	6,386,824	3.91	16.74	3.64
grader46	445,670	6,384,824	3.91	16.74	3.64
scrapertravel1	441,794	6,387,300	3.57	16.74	3.32
scrapertravel2	441,794	6,386,800	3.57	16.74	3.32

Name	Effective Height	Sigma Y	Sigma Z	Easting	Northing
scrapertravel3	441,794	6,386,300	3.57	16.74	3.32
scrapertravel4	441,794	6,385,800	3.57	16.74	3.32
scrapertravel5	441,794	6,384,800	3.57	16.74	3.32
scrapertravel6	442,294	6,386,800	3.57	16.74	3.32
scrapertravel7	442,294	6,385,800	3.57	16.74	3.32
scrapertravel8	442,294	6,385,300	3.57	16.74	3.32
scrapertravel9	442,294	6,384,800	3.57	16.74	3.32
scrapertravel10	442,294	6,384,300	3.57	16.74	3.32
scrapertravel11	442,794	6,388,800	3.57	16.74	3.32
scrapertravel12	442,794	6,388,300	3.57	16.74	3.32
scrapertravel13	442,794	6,387,800	3.57	16.74	3.32
scrapertravel14	442,794	6,387,300	3.57	16.74	3.32
scrapertravel15	442,794	6,386,800	3.57	16.74	3.32
scrapertravel16	442,794	6,384,300	3.57	16.74	3.32
scrapertravel17	443,294	6,389,300	3.57	16.74	3.32
scrapertravel18	443,294	6,388,800	3.57	16.74	3.32
scrapertravel19	443,294	6,388,300	3.57	16.74	3.32
scrapertravel20	443,294	6,387,800	3.57	16.74	3.32
scrapertravel21	443,294	6,387,300	3.57	16.74	3.32
scrapertravel22	443,294	6,384,300	3.57	16.74	3.32
scrapertravel23	443,794	6,389,800	3.57	16.74	3.32
scrapertravel24	443,794	6,389,300	3.57	16.74	3.32
scrapertravel25	443,794	6,383,800	3.57	16.74	3.32
scrapertravel26	444,294	6,389,300	3.57	16.74	3.32
scrapertravel27	444,294	6,388,800	3.57	16.74	3.32
scrapertravel28	444,294	6,388,300	3.57	16.74	3.32
scrapertravel29	444,294	6,385,300	3.57	16.74	3.32
scrapertravel30	444,294	6,384,300	3.57	16.74	3.32
scrapertravel31	444,294	6,383,800	3.57	16.74	3.32
scrapertravel32	444,794	6,388,800	3.57	16.74	3.32
scrapertravel33	444,794	6,388,300	3.57	16.74	3.32
scrapertravel34	444,794	6,387,800	3.57	16.74	3.32
scrapertravel35	444,794	6,385,800	3.57	16.74	3.32
scrapertravel36	444,794	6,385,300	3.57	16.74	3.32
scrapertravel37	444,794	6,384,300	3.57	16.74	3.32

Name	Effective Height	Sigma Y	Sigma Z	Easting	Northing
scrapertravel38	445,294	6,387,800	3.57	16.74	3.32
scrapertravel39	445,294	6,387,300	3.57	16.74	3.32
scrapertravel40	445,294	6,386,800	3.57	16.74	3.32
scrapertravel41	445,294	6,386,300	3.57	16.74	3.32
scrapertravel42	445,294	6,385,800	3.57	16.74	3.32
scrapertravel43	445,294	6,384,800	3.57	16.74	3.32
scrapertravel44	445,794	6,387,300	3.57	16.74	3.32
scrapertravel45	445,794	6,386,800	3.57	16.74	3.32
scrapertravel46	445,794	6,384,800	3.57	16.74	3.32
cbull1	441,749	6,387,145	2	125	0.93
cbull2	441,749	6,386,645	2	125	0.93
cbull3	441,749	6,386,145	2	125	0.93
cbull4	441,749	6,385,645	2	125	0.93
cbull5	441,749	6,384,645	2	125	0.93
cbull6	442,249	6,386,645	2	125	0.93
cbull7	442,249	6,385,645	2	125	0.93
cbull8	442,249	6,385,145	2	125	0.93
cbull9	442,249	6,384,645	2	125	0.93
cbull10	442,249	6,384,145	2	125	0.93
cbull11	442,749	6,388,645	2	125	0.93
cbull12	442,749	6,388,145	2	125	0.93
cbull13	442,749	6,387,645	2	125	0.93
cbull14	442,749	6,387,145	2	125	0.93
cbull15	442,749	6,386,645	2	125	0.93
cbull16	442,749	6,384,145	2	125	0.93
cbull17	443,249	6,389,145	2	125	0.93
cbull18	443,249	6,388,645	2	125	0.93
cbull19	443,249	6,388,145	2	125	0.93
cbull20	443,249	6,387,645	2	125	0.93
cbull21	443,249	6,387,145	2	125	0.93
cbull22	443,249	6,384,145	2	125	0.93
cbull23	443,749	6,389,645	2	125	0.93
cbull24	443,749	6,389,145	2	125	0.93
cbull25	443,749	6,383,645	2	125	0.93
cbull26	444,249	6,389,145	2	125	0.93

Name	Effective Height	Sigma Y	Sigma Z	Easting	Northing
cbull27	444,249	6,388,645	2	125	0.93
cbull28	444,249	6,388,145	2	125	0.93
cbull29	444,249	6,385,145	2	125	0.93
cbull30	444,249	6,384,145	2	125	0.93
cbull31	444,249	6,383,645	2	125	0.93
cbull32	444,749	6,388,645	2	125	0.93
cbull33	444,749	6,388,145	2	125	0.93
cbull34	444,749	6,387,645	2	125	0.93
cbull35	444,749	6,385,645	2	125	0.93
cbull36	444,749	6,385,145	2	125	0.93
cbull37	444,749	6,384,145	2	125	0.93
cbull38	445,249	6,387,645	2	125	0.93
cbull39	445,249	6,387,145	2	125	0.93
cbull40	445,249	6,386,645	2	125	0.93
cbull41	445,249	6,386,145	2	125	0.93
cbull42	445,249	6,385,645	2	125	0.93
cbull43	445,249	6,384,645	2	125	0.93
cbull44	445,749	6,387,145	2	125	0.93
cbull45	445,749	6,386,645	2	125	0.93
cbull46	445,749	6,384,645	2	125	0.93

Appendix C – Estimated Emission Statistics

Table 10-4: Dam Haul roads

Source	Max	99%	95%	90%	70%	mean	min	Total emissions (kg/yr)
HR1	0.22	0.22	0.22	0.22	0.22	0.17	-	5,235
HR2	0.22	0.22	0.22	0.22	0.22	0.17	-	5,235
HR3	0.22	0.22	0.22	0.22	0.22	0.17	-	5,235
HR4	0.22	0.22	0.22	0.22	0.22	0.17	-	5,235
HR5	0.22	0.22	0.22	0.22	0.22	0.17	-	5,235
HR6	0.22	0.22	0.22	0.22	0.22	0.17	-	5,235
HR7	0.22	0.22	0.22	0.22	0.22	0.17	-	5,235
HR8	0.22	0.22	0.22	0.22	0.22	0.17	-	5,235
HR9	0.22	0.22	0.22	0.22	0.22	0.17	-	5,235
HR10	0.22	0.22	0.22	0.22	0.22	0.17	-	5,235
HR11	0.22	0.22	0.22	0.22	0.22	0.17	-	5,235
HR12	0.22	0.22	0.22	0.22	0.22	0.17	-	5,235
HR13	0.22	0.22	0.22	0.22	0.22	0.17	-	5,235
HR14	0.22	0.22	0.22	0.22	0.22	0.17	-	5,235
HR15	0.22	0.22	0.22	0.22	0.22	0.17	-	5,235
HR16	0.22	0.22	0.22	0.22	0.22	0.17	-	5,235
HR17	0.22	0.22	0.22	0.22	0.22	0.17	-	5,235
HR18	0.22	0.22	0.22	0.22	0.22	0.17	-	5,235
HR19	0.22	0.22	0.22	0.22	0.22	0.17	-	5,235
HR20	0.22	0.22	0.22	0.22	0.22	0.17	-	5,235
HR21	0.22	0.22	0.22	0.22	0.22	0.17	-	5,235
HR22	0.22	0.22	0.22	0.22	0.22	0.17	-	5,235
HR23	0.22	0.22	0.22	0.22	0.22	0.17	-	5,235
HR24	0.22	0.22	0.22	0.22	0.22	0.17	-	5,235
HR25	0.22	0.22	0.22	0.22	0.22	0.17	-	5,235
HR26	0.63	0.63	0.63	0.63	0.63	0.47	-	14,681
HR27	0.63	0.63	0.63	0.63	0.63	0.47	-	14,681
HR28	0.63	0.63	0.63	0.63	0.63	0.47	-	14,681
HR29	0.63	0.63	0.63	0.63	0.63	0.47	-	14,681
HR30	0.63	0.63	0.63	0.63	0.63	0.47	-	14,681
HR31	0.63	0.63	0.63	0.63	0.63	0.47	-	14,681
HR32	0.63	0.63	0.63	0.63	0.63	0.47	-	14,681
HR33	0.63	0.63	0.63	0.63	0.63	0.47	-	14,681
HR34	0.63	0.63	0.63	0.63	0.63	0.47	-	14,681

Source	Max	99%	95%	90%	70%	mean	min	Total emissions (kg/yr)
HR35	0.63	0.63	0.63	0.63	0.63	0.47	-	14,681
HR36	0.62	0.62	0.62	0.62	0.62	0.46	-	14,482
HR37	0.62	0.62	0.62	0.62	0.62	0.46	-	14,482
HR38	0.62	0.62	0.62	0.62	0.62	0.46	-	14,482
HR39	0.62	0.62	0.62	0.62	0.62	0.46	-	14,482
HR40	0.62	0.62	0.62	0.62	0.62	0.46	-	14,482
HR41	0.62	0.62	0.62	0.62	0.62	0.46	-	14,482
HR42	0.45	0.45	0.45	0.45	0.45	0.33	-	10,495
HR43	0.45	0.45	0.45	0.45	0.45	0.33	-	10,495
HR44	0.45	0.45	0.45	0.45	0.45	0.33	-	10,495
HR45	0.45	0.45	0.45	0.45	0.45	0.33	-	10,495
HR46	0.45	0.45	0.45	0.45	0.45	0.33	-	10,495
HR47	0.45	0.45	0.45	0.45	0.45	0.33	-	10,495
HR48	0.45	0.45	0.45	0.45	0.45	0.33	-	10,495
HR49	0.17	0.17	0.17	0.17	0.17	0.13	-	3,986
HR50	0.17	0.17	0.17	0.17	0.17	0.13	-	3,986
HR51	0.17	0.17	0.17	0.17	0.17	0.13	-	3,986
HR52	0.17	0.17	0.17	0.17	0.17	0.13	-	3,986
HR53	0.17	0.17	0.17	0.17	0.17	0.13	-	3,986
HR54	0.17	0.17	0.17	0.17	0.17	0.13	-	3,986
HR55	0.17	0.17	0.17	0.17	0.17	0.13	-	3,986
HR56	0.17	0.17	0.17	0.17	0.17	0.13	-	3,986
HR57	0.17	0.17	0.17	0.17	0.17	0.13	-	3,986
HR58	0.17	0.17	0.17	0.17	0.17	0.13	-	3,986
HR59	0.17	0.17	0.17	0.17	0.17	0.13	-	3,986
HR60	0.17	0.17	0.17	0.17	0.17	0.13	-	3,986
HR61	0.17	0.17	0.17	0.17	0.17	0.13	-	3,986
HR62	0.17	0.17	0.17	0.17	0.17	0.13	-	3,986
HR63	0.17	0.17	0.17	0.17	0.17	0.13	-	3,986
HR64	0.01	0.01	0.01	0.01	0.01	0.01	-	200
HR65	0.01	0.01	0.01	0.01	0.01	0.01	-	200
HR66	0.01	0.01	0.01	0.01	0.01	0.01	-	200
HR67	0.01	0.01	0.01	0.01	0.01	0.01	-	200
HR68	0.01	0.01	0.01	0.01	0.01	0.01	-	200

Source	Max	99%	95%	90%	70%	mean	min	Total emissions (kg/yr)
HR69	0.01	0.01	0.01	0.01	0.01	0.01	-	200
HR70	0.01	0.01	0.01	0.01	0.01	0.01	-	200

Table 10-5: Dam Construction.

Source Name	Max	99%	95%	90%	70%	50%	Mean	Total Emissions (Sum Kg/Yr)
FrontEndLoader 1	0.51	0.51	0.51	0.51	0.51	0.51	0.38	11,992
FrontEndLoader 2	0.51	0.51	0.51	0.51	0.51	0.51	0.38	12,026
FrontEndLoader 3	0.51	0.51	0.51	0.51	0.51	0.51	0.38	12,017
FrontEndLoader 4	0.39	0.39	0.39	0.39	0.39	0.39	0.29	9,132
FrontEndLoader 5	0.02	0.02	0.02	0.02	0.02	0.02	0.01	457
Unload1	0.37	0.37	0.37	0.37	0.37	0.37	0.27	8,594
Unload2	0.37	0.37	0.37	0.37	0.37	0.37	0.27	8,619
Unload3	0.37	0.37	0.37	0.37	0.37	0.37	0.27	8,612
Unload4	0.28	0.28	0.28	0.28	0.28	0.28	0.21	6,545
Unload5	0.01	0.01	0.01	0.01	0.01	0.01	0.01	328

Table 10-6: Clearing sources.

Source Name	Max	99%	95%	90%	70%	50%	Mean	Total Emissions (Sum Kg/Yr)
cbull1	0.55	0.55	0.55	0.55	0.00	0.00	0.07	2,339
cbull10	0.55	0.55	0.55	0.55	0.00	0.00	0.08	2,431
cbull11	0.58	0.58	0.58	0.58	0.00	0.00	0.08	2,434
cbull12	0.68	0.68	0.68	0.68	0.00	0.00	0.09	2,915
cbull13	0.81	0.81	0.81	0.81	0.00	0.00	0.11	3,453
cbull14	0.63	0.63	0.63	0.63	0.00	0.00	0.09	2,751
cbull15	0.81	0.81	0.81	0.81	0.00	0.00	0.11	3,608
cbull16	0.73	0.73	0.73	0.73	0.00	0.00	0.10	3,215
cbull17	0.75	0.75	0.75	0.75	0.00	0.00	0.10	3,177
cbull18	0.81	0.81	0.81	0.81	0.00	0.00	0.11	3,448
cbull19	0.81	0.81	0.81	0.81	0.00	0.00	0.11	3,552
cbull2	0.81	0.81	0.81	0.81	0.00	0.00	0.11	3,590

Source Name	Max	99%	95%	90%	70%	50%	Mean	Total Emissions (Sum Kg/Yr)
cbull20	0.81	0.81	0.81	0.81	0.00	0.00	0.11	3,506
cbull21	0.81	0.81	0.81	0.81	0.00	0.00	0.11	3,453
cbull22	0.79	0.79	0.79	0.79	0.00	0.00	0.11	3,323
cbull23	0.52	0.52	0.52	0.52	0.00	0.00	0.07	2,309
cbull24	0.81	0.81	0.81	0.81	0.00	0.00	0.11	3,461
cbull25	0.74	0.74	0.74	0.74	0.00	0.00	0.10	3,179
cbull26	0.57	0.57	0.57	0.57	0.00	0.00	0.08	2,447
cbull27	0.50	0.50	0.50	0.50	0.00	0.00	0.07	2,212
cbull28	0.81	0.81	0.81	0.81	0.00	0.00	0.12	3,628
cbull29	0.73	0.73	0.73	0.73	0.00	0.00	0.10	3,016
cbull3	0.73	0.73	0.73	0.73	0.00	0.00	0.10	3,239
cbull30	0.45	0.45	0.45	0.45	0.00	0.00	0.06	1,893
cbull31	0.45	0.45	0.45	0.45	0.00	0.00	0.06	1,890
cbull32	0.25	0.25	0.25	0.25	0.00	0.00	0.03	1,079
cbull33	0.62	0.62	0.62	0.62	0.00	0.00	0.08	2,625
cbull34	0.81	0.81	0.81	0.81	0.00	0.00	0.11	3,343
cbull35	0.81	0.81	0.81	0.81	0.00	0.00	0.11	3,378
cbull36	0.80	0.80	0.80	0.80	0.00	0.00	0.11	3,392
cbull37	0.29	0.29	0.29	0.29	0.00	0.00	0.04	1,244
cbull38	0.46	0.46	0.46	0.46	0.00	0.00	0.06	1,981
cbull39	0.73	0.73	0.73	0.73	0.00	0.00	0.10	3,126
cbull4	0.73	0.73	0.73	0.73	0.00	0.00	0.10	3,076
cbull40	0.68	0.68	0.68	0.68	0.00	0.00	0.09	2,820
cbull41	0.75	0.75	0.75	0.75	0.00	0.00	0.10	3,186
cbull42	0.69	0.69	0.69	0.69	0.00	0.00	0.10	3,030
cbull43	0.29	0.29	0.29	0.29	0.00	0.00	0.04	1,191
cbull44	0.22	0.22	0.22	0.22	0.00	0.00	0.03	959
cbull45	0.40	0.40	0.40	0.40	0.00	0.00	0.05	1,721
cbull46	0.74	0.74	0.74	0.74	0.00	0.00	0.10	3,234
cbull5	0.74	0.74	0.74	0.74	0.00	0.00	0.10	3,149
cbull6	0.74	0.74	0.74	0.74	0.00	0.00	0.10	3,226
cbull7	0.74	0.74	0.74	0.74	0.00	0.00	0.10	3,208
cbull8	0.74	0.74	0.74	0.74	0.00	0.00	0.10	3,019
cbull9	0.74	0.74	0.74	0.74	0.00	0.00	0.10	3,083
ex1	0.04	0.04	0.04	0.04	0.00	0.00	0.01	227
ex10	0.03	0.03	0.03	0.03	0.00	0.00	0.01	195
ex11	0.04	0.04	0.04	0.04	0.00	0.00	0.01	242

Source Name	Max	99%	95%	90%	70%	50%	Mean	Total Emissions (Sum Kg/Yr)
ex12	0.05	0.05	0.05	0.05	0.00	0.00	0.01	279
ex13	0.06	0.06	0.06	0.06	0.00	0.00	0.01	333
ex14	0.05	0.05	0.05	0.05	0.00	0.00	0.01	261
ex15	0.06	0.06	0.06	0.06	0.00	0.00	0.01	337
ex16	0.05	0.05	0.05	0.05	0.00	0.00	0.01	301
ex17	0.05	0.05	0.05	0.05	0.00	0.00	0.01	313
ex18	0.06	0.06	0.06	0.06	0.00	0.00	0.01	338
ex19	0.06	0.06	0.06	0.06	0.00	0.00	0.01	335
ex2	0.06	0.06	0.06	0.06	0.00	0.00	0.01	333
ex20	0.06	0.06	0.06	0.06	0.00	0.00	0.01	337
ex21	0.06	0.06	0.06	0.06	0.00	0.00	0.01	334
ex22	0.06	0.06	0.06	0.06	0.00	0.00	0.01	324
ex23	0.04	0.04	0.04	0.04	0.00	0.00	0.01	216
ex24	0.06	0.06	0.06	0.06	0.00	0.00	0.01	330
ex25	0.05	0.05	0.05	0.05	0.00	0.00	0.01	306
ex26	0.04	0.04	0.04	0.04	0.00	0.00	0.01	234
ex27	0.03	0.03	0.03	0.03	0.00	0.00	0.01	206
ex28	0.06	0.06	0.06	0.06	0.00	0.00	0.01	338
ex29	0.05	0.05	0.05	0.05	0.00	0.00	0.01	304
ex3	0.05	0.05	0.05	0.05	0.00	0.00	0.01	324
ex30	0.03	0.03	0.03	0.03	0.00	0.00	0.01	188
ex31	0.03	0.03	0.03	0.03	0.00	0.00	0.01	185
ex32	0.02	0.02	0.02	0.02	0.00	0.00	0.00	104
ex33	0.04	0.04	0.04	0.04	0.00	0.00	0.01	258
ex34	0.06	0.06	0.06	0.06	0.00	0.00	0.01	333
ex35	0.06	0.06	0.06	0.06	0.00	0.00	0.01	334
ex36	0.06	0.06	0.06	0.06	0.00	0.00	0.01	330
ex37	0.02	0.02	0.02	0.02	0.00	0.00	0.00	118
ex38	0.03	0.03	0.03	0.03	0.00	0.00	0.01	189
ex39	0.05	0.05	0.05	0.05	0.00	0.00	0.01	301
ex4	0.04	0.04	0.04	0.04	0.00	0.00	0.01	214
ex40	0.05	0.05	0.05	0.05	0.00	0.00	0.01	280
ex41	0.05	0.05	0.05	0.05	0.00	0.00	0.01	312
ex42	0.05	0.05	0.05	0.05	0.00	0.00	0.01	282
ex43	0.02	0.02	0.02	0.02	0.00	0.00	0.00	119
ex44	0.02	0.02	0.02	0.02	0.00	0.00	0.00	90
ex45	0.03	0.03	0.03	0.03	0.00	0.00	0.01	168

Source Name	Max	99%	95%	90%	70%	50%	Mean	Total Emissions (Sum Kg/Yr)
ex46	0.05	0.05	0.05	0.05	0.00	0.00	0.01	304
ex5	0.04	0.04	0.04	0.04	0.00	0.00	0.01	212
ex6	0.06	0.06	0.06	0.06	0.00	0.00	0.01	335
ex7	0.06	0.06	0.06	0.06	0.00	0.00	0.01	333
ex8	0.06	0.06	0.06	0.06	0.00	0.00	0.01	332
ex9	0.06	0.06	0.06	0.06	0.00	0.00	0.01	339
grader1	0.10	0.10	0.10	0.10	0.10	0.00	0.04	1,296
grader10	0.10	0.10	0.10	0.10	0.10	0.00	0.04	1,278
grader11	0.10	0.10	0.10	0.10	0.10	0.00	0.04	1,309
grader12	0.10	0.10	0.10	0.10	0.10	0.00	0.04	1,278
grader13	0.10	0.10	0.10	0.10	0.10	0.00	0.04	1,304
grader14	0.10	0.10	0.10	0.10	0.10	0.00	0.04	1,295
grader15	0.10	0.10	0.10	0.10	0.10	0.00	0.04	1,293
grader16	0.10	0.10	0.10	0.10	0.10	0.00	0.04	1,301
grader17	0.10	0.10	0.10	0.10	0.10	0.00	0.04	1,317
grader18	0.10	0.10	0.10	0.10	0.10	0.00	0.04	1,311
grader19	0.10	0.10	0.10	0.10	0.10	0.00	0.04	1,310
grader2	0.10	0.10	0.10	0.10	0.10	0.00	0.04	1,298
grader20	0.10	0.10	0.10	0.10	0.10	0.00	0.04	1,328
grader21	0.10	0.10	0.10	0.10	0.10	0.00	0.04	1,322
grader22	0.10	0.10	0.10	0.10	0.10	0.00	0.04	1,315
grader23	0.10	0.10	0.10	0.10	0.10	0.00	0.04	1,303
grader24	0.10	0.10	0.10	0.10	0.10	0.00	0.04	1,303
grader25	0.10	0.10	0.10	0.10	0.10	0.00	0.04	1,297
grader26	0.10	0.10	0.10	0.10	0.10	0.00	0.04	1,303
grader27	0.10	0.10	0.10	0.10	0.10	0.00	0.04	1,319
grader28	0.10	0.10	0.10	0.10	0.10	0.00	0.04	1,304
grader29	0.10	0.10	0.10	0.10	0.10	0.00	0.04	1,326
grader3	0.10	0.10	0.10	0.10	0.10	0.00	0.04	1,321
grader30	0.10	0.10	0.10	0.10	0.10	0.00	0.04	1,295
grader31	0.10	0.10	0.10	0.10	0.10	0.00	0.04	1,327
grader32	0.10	0.10	0.10	0.10	0.10	0.00	0.04	1,318
grader33	0.10	0.10	0.10	0.10	0.10	0.00	0.04	1,287
grader34	0.10	0.10	0.10	0.10	0.10	0.00	0.04	1,304
grader35	0.10	0.10	0.10	0.10	0.10	0.00	0.04	1,307
grader36	0.10	0.10	0.10	0.10	0.10	0.00	0.04	1,273
grader37	0.10	0.10	0.10	0.10	0.10	0.00	0.04	1,308

Source Name	Max	99%	95%	90%	70%	50%	Mean	Total Emissions (Sum Kg/Yr)
grader38	0.10	0.10	0.10	0.10	0.10	0.00	0.04	1,322
grader39	0.10	0.10	0.10	0.10	0.10	0.00	0.04	1,308
grader4	0.10	0.10	0.10	0.10	0.10	0.00	0.04	1,324
grader40	0.10	0.10	0.10	0.10	0.10	0.00	0.04	1,310
grader41	0.10	0.10	0.10	0.10	0.10	0.00	0.04	1,282
grader42	0.10	0.10	0.10	0.10	0.10	0.00	0.04	1,304
grader43	0.10	0.10	0.10	0.10	0.10	0.00	0.04	1,315
grader44	0.10	0.10	0.10	0.10	0.10	0.00	0.04	1,273
grader45	0.10	0.10	0.10	0.10	0.10	0.00	0.04	1,303
grader46	0.10	0.10	0.10	0.10	0.10	0.00	0.04	1,309
grader5	0.10	0.10	0.10	0.10	0.10	0.00	0.04	1,302
grader6	0.10	0.10	0.10	0.10	0.10	0.00	0.04	1,310
grader7	0.10	0.10	0.10	0.10	0.10	0.00	0.04	1,321
grader8	0.10	0.10	0.10	0.10	0.10	0.00	0.04	1,310
grader9	0.10	0.10	0.10	0.10	0.10	0.00	0.04	1,289
scraper1	0.07	0.07	0.07	0.07	0.00	0.00	0.01	415
scraper10	0.06	0.06	0.06	0.06	0.00	0.00	0.01	357
scraper11	0.07	0.07	0.07	0.07	0.00	0.00	0.01	441
scraper12	0.09	0.09	0.09	0.09	0.00	0.00	0.02	510
scraper13	0.10	0.10	0.10	0.10	0.00	0.00	0.02	609
scraper14	0.08	0.08	0.08	0.08	0.00	0.00	0.02	478
scraper15	0.10	0.10	0.10	0.10	0.00	0.00	0.02	615
scraper16	0.09	0.09	0.09	0.09	0.00	0.00	0.02	550
scraper17	0.09	0.09	0.09	0.09	0.00	0.00	0.02	572
scraper18	0.10	0.10	0.10	0.10	0.00	0.00	0.02	618
scraper19	0.10	0.10	0.10	0.10	0.00	0.00	0.02	611
scraper2	0.11	0.11	0.11	0.11	0.00	0.00	0.02	609
scraper20	0.10	0.10	0.10	0.10	0.00	0.00	0.02	616
scraper21	0.10	0.10	0.10	0.10	0.00	0.00	0.02	610
scraper22	0.10	0.10	0.10	0.10	0.00	0.00	0.02	592
scraper23	0.07	0.07	0.07	0.07	0.00	0.00	0.01	395
scraper24	0.11	0.11	0.11	0.11	0.00	0.00	0.02	603
scraper25	0.10	0.10	0.10	0.10	0.00	0.00	0.02	559
scraper26	0.07	0.07	0.07	0.07	0.00	0.00	0.01	427
scraper27	0.06	0.06	0.06	0.06	0.00	0.00	0.01	377
scraper28	0.10	0.10	0.10	0.10	0.00	0.00	0.02	618
scraper29	0.09	0.09	0.09	0.09	0.00	0.00	0.02	554

Source Name	Max	99%	95%	90%	70%	50%	Mean	Total Emissions (Sum Kg/Yr)
scraper3	0.10	0.10	0.10	0.10	0.00	0.00	0.02	591
scraper30	0.06	0.06	0.06	0.06	0.00	0.00	0.01	343
scraper31	0.06	0.06	0.06	0.06	0.00	0.00	0.01	337
scraper32	0.03	0.03	0.03	0.03	0.00	0.00	0.01	190
scraper33	0.08	0.08	0.08	0.08	0.00	0.00	0.01	472
scraper34	0.10	0.10	0.10	0.10	0.00	0.00	0.02	607
scraper35	0.11	0.11	0.11	0.11	0.00	0.00	0.02	611
scraper36	0.11	0.11	0.11	0.11	0.00	0.00	0.02	603
scraper37	0.04	0.04	0.04	0.04	0.00	0.00	0.01	217
scraper38	0.06	0.06	0.06	0.06	0.00	0.00	0.01	346
scraper39	0.09	0.09	0.09	0.09	0.00	0.00	0.02	550
scraper4	0.07	0.07	0.07	0.07	0.00	0.00	0.01	390
scraper40	0.09	0.09	0.09	0.09	0.00	0.00	0.02	511
scraper41	0.10	0.10	0.10	0.10	0.00	0.00	0.02	569
scraper42	0.09	0.09	0.09	0.09	0.00	0.00	0.02	515
scraper43	0.04	0.04	0.04	0.04	0.00	0.00	0.01	218
scraper44	0.03	0.03	0.03	0.03	0.00	0.00	0.01	164
scraper45	0.05	0.05	0.05	0.05	0.00	0.00	0.01	306
scraper46	0.10	0.10	0.10	0.10	0.00	0.00	0.02	556
scraper5	0.07	0.07	0.07	0.07	0.00	0.00	0.01	387
scraper6	0.11	0.11	0.11	0.11	0.00	0.00	0.02	612
scraper7	0.11	0.11	0.11	0.11	0.00	0.00	0.02	609
scraper8	0.11	0.11	0.11	0.11	0.00	0.00	0.02	606
scraper9	0.10	0.10	0.10	0.10	0.00	0.00	0.02	619
scrapertravel1	0.09	0.09	0.09	0.09	0.00	0.00	0.02	541
scrapertravel10	0.08	0.08	0.08	0.08	0.00	0.00	0.01	465
scrapertravel11	0.09	0.09	0.09	0.09	0.00	0.00	0.02	575
scrapertravel12	0.11	0.11	0.11	0.11	0.00	0.00	0.02	664
scrapertravel13	0.14	0.14	0.14	0.14	0.00	0.00	0.03	793
scrapertravel14	0.11	0.11	0.11	0.11	0.00	0.00	0.02	622
scrapertravel15	0.13	0.13	0.13	0.13	0.00	0.00	0.03	801

Source Name	Max	99%	95%	90%	70%	50%	Mean	Total Emissions (Sum Kg/Yr)
scrapertravel16	0.12	0.12	0.12	0.12	0.00	0.00	0.02	717
scrapertravel17	0.12	0.12	0.12	0.12	0.00	0.00	0.02	745
scrapertravel18	0.14	0.14	0.14	0.14	0.00	0.00	0.03	805
scrapertravel19	0.14	0.14	0.14	0.14	0.00	0.00	0.03	796
scrapertravel2	0.14	0.14	0.14	0.14	0.00	0.00	0.03	793
scrapertravel20	0.13	0.13	0.13	0.13	0.00	0.00	0.03	802
scrapertravel21	0.14	0.14	0.14	0.14	0.00	0.00	0.03	795
scrapertravel22	0.13	0.13	0.13	0.13	0.00	0.00	0.02	772
scrapertravel23	0.09	0.09	0.09	0.09	0.00	0.00	0.02	515
scrapertravel24	0.14	0.14	0.14	0.14	0.00	0.00	0.02	785
scrapertravel25	0.13	0.13	0.13	0.13	0.00	0.00	0.02	729
scrapertravel26	0.10	0.10	0.10	0.10	0.00	0.00	0.02	556
scrapertravel27	0.08	0.08	0.08	0.08	0.00	0.00	0.02	491
scrapertravel28	0.13	0.13	0.13	0.13	0.00	0.00	0.03	804
scrapertravel29	0.12	0.12	0.12	0.12	0.00	0.00	0.02	722
scrapertravel3	0.13	0.13	0.13	0.13	0.00	0.00	0.02	770
scrapertravel30	0.08	0.08	0.08	0.08	0.00	0.00	0.01	447
scrapertravel31	0.07	0.07	0.07	0.07	0.00	0.00	0.01	440
scrapertravel32	0.04	0.04	0.04	0.04	0.00	0.00	0.01	248
scrapertravel33	0.11	0.11	0.11	0.11	0.00	0.00	0.02	615
scrapertravel34	0.13	0.13	0.13	0.13	0.00	0.00	0.03	791

Source Name	Max	99%	95%	90%	70%	50%	Mean	Total Emissions (Sum Kg/Yr)
scrapertravel35	0.14	0.14	0.14	0.14	0.00	0.00	0.03	796
scrapertravel36	0.14	0.14	0.14	0.14	0.00	0.00	0.02	785
scrapertravel37	0.05	0.05	0.05	0.05	0.00	0.00	0.01	282
scrapertravel38	0.08	0.08	0.08	0.08	0.00	0.00	0.01	451
scrapertravel39	0.12	0.12	0.12	0.12	0.00	0.00	0.02	717
scrapertravel4	0.09	0.09	0.09	0.09	0.00	0.00	0.02	509
scrapertravel40	0.11	0.11	0.11	0.11	0.00	0.00	0.02	666
scrapertravel41	0.13	0.13	0.13	0.13	0.00	0.00	0.02	741
scrapertravel42	0.12	0.12	0.12	0.12	0.00	0.00	0.02	670
scrapertravel43	0.05	0.05	0.05	0.05	0.00	0.00	0.01	284
scrapertravel44	0.04	0.04	0.04	0.04	0.00	0.00	0.01	214
scrapertravel45	0.07	0.07	0.07	0.07	0.00	0.00	0.01	399
scrapertravel46	0.12	0.12	0.12	0.12	0.00	0.00	0.02	724
scrapertravel5	0.08	0.08	0.08	0.08	0.00	0.00	0.02	504
scrapertravel6	0.14	0.14	0.14	0.14	0.00	0.00	0.03	797
scrapertravel7	0.14	0.14	0.14	0.14	0.00	0.00	0.03	793
scrapertravel8	0.14	0.14	0.14	0.14	0.00	0.00	0.03	789
scrapertravel9	0.14	0.14	0.14	0.14	0.00	0.00	0.03	807

Appendix D – Discrete Receptor Modelled Ground Level Concentrations

Appendix Table D-1: TSP summary statistics for discrete receptors

Source ID	Scenario	Cumulative	Max	2nd	6th	95th	90th	70th	mean	No. days above criteria	Criteria
R1	Clearing	Isolated	14	9	7	5	3	1	1	0	90
		With Background	59	54	53	50	49	46	46	0	90
	Mining	Isolated	42	32	23	15	10	4	3	0	90
		With Background	87	78	68	60	56	49	49	0	90
	Dam	Isolated	50	26	21	14	9	2	3	0	90
		With Background	95	71	67	59	54	48	48	1	90
R2	Clearing	Isolated	15	12	8	5	4	1	1	0	90
		With Background	61	58	54	51	49	47	47	0	90
	Mining	Isolated	48	43	27	18	13	5	4	0	90
		With Background	94	88	72	63	58	51	50	1	90
	Dam	Isolated	55	27	23	16	10	3	3	0	90
		With Background	101	73	69	61	55	48	49	1	90
R3	Clearing	Isolated	4	4	2	1	1	0	0	0	90
		With Background	50	49	47	47	46	45	46	0	90
	Mining	Isolated	11	6	4	3	1	0	0	0	90
		With Background	56	52	50	48	47	46	46	0	90
	Dam	Isolated	18	13	8	5	2	0	1	0	90
		With Background	63	58	54	50	47	46	46	0	90

Source ID	Scenario	Cumulative	Max	2nd	6th	95th	90th	70th	mean	No. days above criteria	Criteria
R4	Clearing	Isolated	6	4	3	1	0	0	0	0	90
		With Background	52	50	48	46	46	45	46	0	90
	Mining	Isolated	13	12	6	1	0	0	0	0	90
		With Background	58	57	51	47	46	45	46	0	90
	Dam	Isolated	20	19	10	2	1	0	0	0	90
		With Background	65	64	55	48	46	45	46	0	90
R5	Clearing	Isolated	5	3	2	0	0	0	0	0	90
		With Background	50	49	48	46	46	45	46	0	90
	Mining	Isolated	10	9	4	1	0	0	0	0	90
		With Background	56	54	50	47	46	45	46	0	90
	Dam	Isolated	16	14	8	2	1	0	0	0	90
		With Background	62	59	53	47	46	45	46	0	90
R6	Clearing	Isolated	6	4	2	1	0	0	0	0	90
		With Background	51	49	47	46	46	45	46	0	90
	Mining	Isolated	9	9	4	2	0	0	0	0	90
		With Background	55	54	50	47	46	45	46	0	90
	Dam	Isolated	20	16	8	3	1	0	1	0	90
		With Background	65	61	54	49	46	45	46	0	90
R7	Clearing	Isolated	6	5	3	1	1	0	0	0	90
		With Background	51	51	49	47	46	46	46	0	90
	Mining	Isolated	10	8	5	2	1	0	0	0	90
		With Background	55	53	51	48	47	46	46	0	90

Source ID	Scenario	Cumulative	Max	2nd	6th	95th	90th	70th	mean	No. days above criteria	Criteria
	Dam	Isolated	28	22	16	5	3	0	1	0	90
		With Background	74	68	62	50	48	46	46	0	90
R8	Clearing	Isolated	6	5	3	2	2	0	0	0	90
		With Background	52	50	49	47	47	46	46	0	90
	Mining	Isolated	9	7	5	3	2	0	1	0	90
		With Background	54	53	50	49	47	46	46	0	90
	Dam	Isolated	15	15	10	7	5	1	1	0	90
		With Background	60	60	56	53	50	46	47	0	90
R9	Clearing	Isolated	8	5	3	2	1	0	0	0	90
		With Background	53	51	49	47	47	46	46	0	90
	Mining	Isolated	13	7	6	3	2	1	1	0	90
		With Background	59	52	51	49	48	46	46	0	90
	Dam	Isolated	18	9	8	4	3	1	1	0	90
		With Background	64	55	53	50	48	46	46	0	90
R10	Clearing	Isolated	4	4	2	1	1	0	0	0	90
		With Background	50	49	48	47	46	46	46	0	90
	Mining	Isolated	7	4	4	2	1	0	0	0	90
		With Background	53	50	49	48	47	46	46	0	90
	Dam	Isolated	13	7	5	3	2	0	1	0	90
		With Background	58	52	51	49	47	46	46	0	90
R11	Clearing	Isolated	4	4	2	1	1	0	0	0	90
		With Background	50	49	48	47	46	46	46	0	90

Source ID	Scenario	Cumulative	Max	2nd	6th	95th	90th	70th	mean	No. days above criteria	Criteria
	Mining	Isolated	8	4	4	3	1	0	0	0	90
		With Background	53	50	49	48	47	46	46	0	90
	Dam	Isolated	14	6	5	3	2	0	1	0	90
		With Background	59	51	51	49	47	46	46	0	90
R12	Clearing	Isolated	20	16	11	8	6	3	2	0	90
		With Background	66	62	57	54	51	49	48	0	90
	Mining	Isolated	26	26	23	16	12	5	4	0	90
		With Background	71	71	69	61	57	51	50	0	90
	Dam	Isolated	52	39	31	19	11	5	5	0	90
		With Background	98	85	76	64	56	51	50	1	90
R13	Clearing	Isolated	3	2	1	1	1	0	0	0	90
		With Background	48	48	47	46	46	46	46	0	90
	Mining	Isolated	6	4	3	1	1	0	0	0	90
		With Background	51	49	48	47	46	46	46	0	90
	Dam	Isolated	11	6	5	3	2	0	0	0	90
		With Background	56	52	51	48	47	46	46	0	90
R14	Clearing	Isolated	2	2	1	1	0	0	0	0	90
		With Background	48	48	47	46	46	45	46	0	90
	Mining	Isolated	5	3	2	1	1	0	0	0	90
		With Background	51	48	48	47	46	45	46	0	90
	Dam	Isolated	10	6	5	2	1	0	0	0	90
		With Background	55	51	50	48	47	46	46	0	90

Source ID	Scenario	Cumulative	Max	2nd	6th	95th	90th	70th	mean	No. days above criteria	Criteria
R15	Clearing	Isolated	2	1	1	1	0	0	0	0	90
		With Background	48	47	47	46	46	45	46	0	90
	Mining	Isolated	4	4	2	1	1	0	0	0	90
		With Background	49	49	48	47	46	45	46	0	90
	Dam	Isolated	7	6	4	2	1	0	0	0	90
		With Background	53	52	50	47	47	46	46	0	90
R16	Clearing	Isolated	6	5	2	1	1	0	0	0	90
		With Background	51	50	48	47	46	45	46	0	90
	Mining	Isolated	15	10	6	3	2	0	0	0	90
		With Background	60	55	51	48	47	46	46	0	90
	Dam	Isolated	21	11	8	5	2	0	1	0	90
		With Background	66	57	54	50	47	46	46	0	90
R17	Clearing	Isolated	13	11	5	2	1	0	0	0	90
		With Background	59	57	51	48	47	46	46	0	90
	Mining	Isolated	29	25	13	5	3	0	1	0	90
		With Background	74	70	59	50	48	46	46	0	90
	Dam	Isolated	44	40	22	10	4	0	2	0	90
		With Background	89	85	67	55	50	46	47	0	90
R18	Clearing	Isolated	2	1	1	1	0	0	0	0	90
		With Background	47	47	46	46	46	45	46	0	90
	Mining	Isolated	3	3	2	1	0	0	0	0	90
		With Background	48	48	47	46	46	45	46	0	90

Source ID	Scenario	Cumulative	Max	2nd	6th	95th	90th	70th	mean	No. days above criteria	Criteria
	Dam	Isolated	5	4	3	1	1	0	0	0	90
		With Background	50	49	48	47	46	45	46	0	90
R19	Clearing	Isolated	4	3	2	1	0	0	0	0	90
		With Background	49	48	47	46	46	45	46	0	90
	Mining	Isolated	7	5	3	1	0	0	0	0	90
		With Background	53	51	48	47	46	45	46	0	90
	Dam	Isolated	11	9	4	2	1	0	0	0	90
		With Background	56	55	49	47	46	45	46	0	90
R20	Clearing	Isolated	4	3	1	1	0	0	0	0	90
		With Background	50	49	47	46	46	45	46	0	90
	Mining	Isolated	9	8	4	1	0	0	0	0	90
		With Background	55	53	49	46	46	45	46	0	90
	Dam	Isolated	13	11	6	2	1	0	0	0	90
		With Background	58	57	51	47	46	45	46	0	90
R21	Clearing	Isolated	6	5	2	1	0	0	0	0	90
		With Background	52	51	48	46	46	45	46	0	90
	Mining	Isolated	12	12	5	2	1	0	0	0	90
		With Background	58	58	51	47	46	45	46	0	90
	Dam	Isolated	18	18	8	3	1	0	1	0	90
		With Background	63	63	53	48	47	45	46	0	90
R22	Clearing	Isolated	55	54	45	30	23	14	11	0	90
		With Background	100	100	91	75	69	59	57	6	90

Source ID	Scenario	Cumulative	Max	2nd	6th	95th	90th	70th	mean	No. days above criteria	Criteria
	Mining	Isolated	83	77	60	41	29	14	12	0	90
		With Background	128	122	105	86	75	59	57	13	90
	Dam	Isolated	91	62	55	41	32	14	12	1	90
		With Background	136	107	101	87	77	59	57	13	90
R23	Clearing	Isolated	55	51	46	30	25	13	11	0	90
		With Background	100	97	92	76	70	58	56	6	90
	Mining	Isolated	195	181	131	84	49	15	19	17	90
		With Background	241	227	176	130	95	61	64	43	90
	Dam	Isolated	91	65	52	42	31	14	12	1	90
		With Background	137	110	98	87	76	60	58	12	90
R24	Clearing	Isolated	20	15	11	8	6	3	2	0	90
		With Background	66	60	57	53	51	49	48	0	90
	Mining	Isolated	27	26	21	17	13	6	5	0	90
		With Background	72	71	67	62	59	51	50	0	90
	Dam	Isolated	44	43	31	17	12	6	5	0	90
		With Background	89	89	77	63	57	51	50	0	90
R25	Clearing	Isolated	53	36	28	19	12	4	4	0	90
		With Background	98	82	74	64	57	50	50	1	90
	Mining	Isolated	79	48	35	25	16	3	5	0	90
		With Background	125	93	80	70	62	49	50	2	90
	Dam	Isolated	136	94	72	53	36	8	11	2	90
		With Background	181	140	118	99	81	54	56	27	90

Source ID	Scenario	Cumulative	Max	2nd	6th	95th	90th	70th	mean	No. days above criteria	Criteria
R26	Clearing	Isolated	27	20	13	7	5	1	2	0	90
		With Background	73	65	59	53	50	47	47	0	90
	Mining	Isolated	27	26	20	12	8	2	2	0	90
		With Background	73	71	66	58	53	47	48	0	90
	Dam	Isolated	63	61	49	30	15	2	5	0	90
		With Background	108	107	95	76	61	48	51	6	90
R27	Clearing	Isolated	12	11	8	5	4	1	1	0	90
		With Background	57	57	54	51	50	47	47	0	90
	Mining	Isolated	18	18	13	8	5	1	2	0	90
		With Background	63	63	58	53	51	47	47	0	90
	Dam	Isolated	39	39	33	20	12	2	4	0	90
		With Background	85	84	78	65	57	48	49	0	90
R28	Clearing	Isolated	14	11	8	6	4	1	1	0	90
		With Background	59	56	54	51	50	47	47	0	90
	Mining	Isolated	17	15	12	8	5	1	2	0	90
		With Background	63	61	57	53	51	46	47	0	90
	Dam	Isolated	39	32	30	20	13	2	4	0	90
		With Background	85	77	75	65	58	48	49	0	90
R29	Clearing	Isolated	14	12	7	5	3	1	1	0	90
		With Background	60	58	52	50	49	46	46	0	90
	Mining	Isolated	21	21	12	7	4	1	1	0	90
		With Background	66	66	58	53	50	46	47	0	90

Source ID	Scenario	Cumulative	Max	2nd	6th	95th	90th	70th	mean	No. days above criteria	Criteria
	Dam	Isolated	58	56	38	21	11	2	4	0	90
		With Background	103	102	83	66	57	47	49	2	90
R30	Clearing	Isolated	13	10	6	4	3	1	1	0	90
		With Background	58	55	52	49	48	46	46	0	90
	Mining	Isolated	13	11	8	5	3	1	1	0	90
		With Background	58	57	53	50	48	46	46	0	90
	Dam	Isolated	36	32	18	11	7	1	2	0	90
		With Background	81	78	63	56	52	47	47	0	90
R31	Clearing	Isolated	5							0	90
		With Background	50							0	90
	Mining	Isolated	11							0	90
		With Background	56							0	90
	Dam	Isolated	16							0	90
		With Background	62							0	90
R32	Clearing	Isolated	4							0	90
		With Background	50							0	90
	Mining	Isolated	9							0	90
		With Background	54							0	90
	Dam	Isolated	17							0	90
		With Background	63							0	90
R33	Clearing	Isolated	6							0	90
		With Background	51							0	90

Source ID	Scenario	Cumulative	Max	2nd	6th	95th	90th	70th	mean	No. days above criteria	Criteria
	Mining	Isolated	7							0	90
		With Background	53							0	90
	Dam	Isolated	15							0	90
		With Background	61							0	90
R34	Clearing	Isolated	4							0	90
		With Background	50							0	90
	Mining	Isolated	8							0	90
		With Background	53							0	90
	Dam	Isolated	15							0	90
		With Background	60							0	90
R35	Clearing	Isolated	3							0	90
		With Background	48							0	90
	Mining	Isolated	5							0	90
		With Background	51							0	90
	Dam	Isolated	12							0	90
		With Background	57							0	90
R36	Clearing	Isolated	2							0	90
		With Background	48							0	90
	Mining	Isolated	5							0	90
		With Background	50							0	90
	Dam	Isolated	9							0	90
		With Background	54							0	90

Source ID	Scenario	Cumulative	Max	2nd	6th	95th	90th	70th	mean	No. days above criteria	Criteria
R37	Clearing	Isolated	4							0	90
		With Background	49							0	90
	Mining	Isolated	8							0	90
		With Background	53							0	90
	Dam	Isolated	17							0	90
		With Background	63							0	90
R38	Clearing	Isolated	6							0	90
		With Background	51							0	90
	Mining	Isolated	9							0	90
		With Background	54							0	90
	Dam	Isolated	19							0	90
		With Background	65							0	90
R39	Clearing	Isolated	3							0	90
		With Background	48							0	90
	Mining	Isolated	7							0	90
		With Background	52							0	90
	Dam	Isolated	10							0	90
		With Background	55							0	90

Appendix Table D-2: PM_{10} summary statistics for discrete receptors

Source ID	Scenario	Cumulative	Max	2nd	6th	95th	90th	70th	mean	No. days above criteria	Criteria
R1	Clearing	Isolated	4	2	2	1	1	0	0	0	50
		With Background	30	28	28	27	27	26	26	0	50
	Mining	Isolated	12	8	6	4	3	1	1	0	50
		With Background	38	35	32	30	29	27	27	0	50
	Dam	Isolated	15	8	6	4	3	1	1	0	50
		With Background	41	34	33	30	29	27	27	0	50
R2	Clearing	Isolated	4	3	2	1	1	0	0	0	50
		With Background	30	29	28	28	27	27	27	0	50
	Mining	Isolated	13	11	7	5	4	1	1	0	50
		With Background	40	37	33	31	30	28	27	0	50
	Dam	Isolated	17	8	7	5	3	1	1	0	50
		With Background	43	34	33	31	29	27	27	0	50
R3	Clearing	Isolated	1	1	0	0	0	0	0	0	50
		With Background	27	27	27	27	26	26	26	0	50
	Mining	Isolated	3	2	1	1	0	0	0	0	50
		With Background	29	28	27	27	27	26	26	0	50
	Dam	Isolated	5	4	3	1	1	0	0	0	50
		With Background	32	30	29	28	27	26	26	0	50
R4	Clearing	Isolated	1	1	1	0	0	0	0	0	50
		With Background	28	27	27	26	26	26	26	0	50
	Mining	Isolated	3	3	2	0	0	0	0	0	50

Source ID	Scenario	Cumulative	Max	2nd	6th	95th	90th	70th	mean	No. days above criteria	Criteria
		With Background	30	29	28	27	26	26	26	0	50
	Dam	Isolated	6	6	3	1	0	0	0	0	50
		With Background	32	32	29	27	26	26	26	0	50
R5	Clearing	Isolated	1	1	1	0	0	0	0	0	50
		With Background	27	27	27	26	26	26	26	0	50
	Mining	Isolated	3	2	1	0	0	0	0	0	50
		With Background	29	29	27	27	26	26	26	0	50
	Dam	Isolated	5	4	2	1	0	0	0	0	50
		With Background	31	30	29	27	26	26	26	0	50
R6	Clearing	Isolated	1	1	1	0	0	0	0	0	50
		With Background	28	27	27	26	26	26	26	0	50
	Mining	Isolated	3	2	1	1	0	0	0	0	50
		With Background	29	29	27	27	26	26	26	0	50
	Dam	Isolated	6	5	3	1	0	0	0	0	50
		With Background	32	31	29	27	26	26	26	0	50
R7	Clearing	Isolated	1	1	1	0	0	0	0	0	50
		With Background	28	28	27	27	26	26	26	0	50
	Mining	Isolated	3	3	2	1	0	0	0	0	50
		With Background	29	29	28	27	27	26	26	0	50
	Dam	Isolated	9	7	5	1	1	0	0	0	50
		With Background	35	33	31	28	27	26	26	0	50
R8	Clearing	Isolated	2	1	1	1	0	0	0	0	50

Source ID	Scenario	Cumulative	Max	2nd	6th	95th	90th	70th	mean	No. days above criteria	Criteria
		With Background	28	27	27	27	27	26	26	0	50
	Mining	Isolated	2	2	2	1	1	0	0	0	50
		With Background	29	28	28	27	27	26	26	0	50
	Dam	Isolated	5	5	3	2	1	0	0	0	50
		With Background	31	31	29	28	28	26	27	0	50
R9	Clearing	Isolated	2	1	1	0	0	0	0	0	50
		With Background	28	27	27	27	26	26	26	0	50
	Mining	Isolated	4	2	2	1	1	0	0	0	50
		With Background	30	28	28	27	27	26	26	0	50
	Dam	Isolated	6	3	2	1	1	0	0	0	50
		With Background	32	29	29	27	27	26	26	0	50
R10	Clearing	Isolated	1	1	1	0	0	0	0	0	50
		With Background	27	27	27	27	26	26	26	0	50
	Mining	Isolated	2	1	1	1	0	0	0	0	50
		With Background	28	27	27	27	27	26	26	0	50
	Dam	Isolated	4	2	2	1	1	0	0	0	50
		With Background	30	28	28	27	27	26	26	0	50
R11	Clearing	Isolated	1	1	1	0	0	0	0	0	50
		With Background	27	27	27	27	26	26	26	0	50
	Mining	Isolated	2	1	1	1	0	0	0	0	50
		With Background	29	27	27	27	27	26	26	0	50
	Dam	Isolated	4	2	2	1	1	0	0	0	50

Source ID	Scenario	Cumulative	Max	2nd	6th	95th	90th	70th	mean	No. days above criteria	Criteria
		With Background	30	28	28	27	27	26	26	0	50
R12	Clearing	Isolated	5	5	4	2	2	1	1	0	50
		With Background	31	31	30	28	28	27	27	0	50
	Mining	Isolated	8	7	7	5	3	2	1	0	50
		With Background	34	33	33	31	30	28	27	0	50
	Dam	Isolated	16	12	9	6	3	2	1	0	50
		With Background	42	38	35	32	30	28	28	0	50
R13	Clearing	Isolated	1	1	0	0	0	0	0	0	50
		With Background	27	27	27	26	26	26	26	0	50
	Mining	Isolated	2	1	1	0	0	0	0	0	50
		With Background	28	27	27	27	26	26	26	0	50
	Dam	Isolated	3	2	2	1	1	0	0	0	50
		With Background	30	28	28	27	27	26	26	0	50
R14	Clearing	Isolated	1	1	0	0	0	0	0	0	50
		With Background	27	27	27	26	26	26	26	0	50
	Mining	Isolated	2	1	1	0	0	0	0	0	50
		With Background	28	27	27	27	26	26	26	0	50
	Dam	Isolated	3	2	1	1	0	0	0	0	50
		With Background	29	28	28	27	27	26	26	0	50
R15	Clearing	Isolated	0	0	0	0	0	0	0	0	50
		With Background	27	27	27	26	26	26	26	0	50
	Mining	Isolated	1	1	1	0	0	0	0	0	50

Source ID	Scenario	Cumulative	Max	2nd	6th	95th	90th	70th	mean	No. days above criteria	Criteria
		With Background	27	27	27	27	26	26	26	0	50
	Dam	Isolated	2	2	1	1	0	0	0	0	50
		With Background	28	28	28	27	27	26	26	0	50
R16	Clearing	Isolated	2	1	1	0	0	0	0	0	50
		With Background	28	27	27	27	26	26	26	0	50
	Mining	Isolated	4	3	2	1	0	0	0	0	50
		With Background	30	29	28	27	27	26	26	0	50
	Dam	Isolated	6	3	3	1	1	0	0	0	50
		With Background	33	30	29	28	27	26	26	0	50
R17	Clearing	Isolated	3	3	1	1	0	0	0	0	50
		With Background	30	29	28	27	26	26	26	0	50
	Mining	Isolated	8	7	4	1	1	0	0	0	50
		With Background	34	33	30	28	27	26	26	0	50
	Dam	Isolated	13	12	7	3	1	0	0	0	50
		With Background	39	38	33	29	28	26	27	0	50
R18	Clearing	Isolated	0	0	0	0	0	0	0	0	50
		With Background	27	27	26	26	26	26	26	0	50
	Mining	Isolated	1	1	0	0	0	0	0	0	50
		With Background	27	27	27	26	26	26	26	0	50
	Dam	Isolated	1	1	1	0	0	0	0	0	50
		With Background	28	27	27	27	26	26	26	0	50
R19	Clearing	Isolated	1	1	0	0	0	0	0	0	50

Source ID	Scenario	Cumulative	Max	2nd	6th	95th	90th	70th	mean	No. days above criteria	Criteria
		With Background	27	27	27	26	26	26	26	0	50
	Mining	Isolated	2	1	1	0	0	0	0	0	50
		With Background	28	28	27	27	26	26	26	0	50
	Dam	Isolated	3	3	1	0	0	0	0	0	50
		With Background	29	29	27	27	26	26	26	0	50
R20	Clearing	Isolated	1	1	0	0	0	0	0	0	50
		With Background	27	27	27	26	26	26	26	0	50
	Mining	Isolated	3	2	1	0	0	0	0	0	50
		With Background	29	28	27	27	26	26	26	0	50
	Dam	Isolated	4	3	2	1	0	0	0	0	50
		With Background	30	30	28	27	26	26	26	0	50
R21	Clearing	Isolated	1	1	1	0	0	0	0	0	50
		With Background	28	28	27	26	26	26	26	0	50
	Mining	Isolated	3	3	1	0	0	0	0	0	50
		With Background	30	29	28	27	26	26	26	0	50
	Dam	Isolated	5	5	2	1	0	0	0	0	50
		With Background	32	32	29	27	27	26	26	0	50
R22	Clearing	Isolated	17	16	13	9	7	4	3	0	50
		With Background	43	42	39	35	33	30	29	0	50
	Mining	Isolated	22	21	18	14	9	4	4	0	50
		With Background	48	47	45	40	35	31	30	0	50
	Dam	Isolated	28	19	18	13	10	4	4	0	50

Source ID	Scenario	Cumulative	Max	2nd	6th	95th	90th	70th	mean	No. days above criteria	Criteria
		With Background	54	46	44	40	36	31	30	1	50
R23	Clearing	Isolated	16	14	13	9	7	4	3	0	50
		With Background	42	41	39	35	33	30	29	0	50
	Mining	Isolated	50	49	35	23	14	4	5	0	50
		With Background	76	76	61	50	40	31	32	17	50
	Dam	Isolated	28	19	17	13	10	5	4	0	50
		With Background	54	46	43	39	36	31	30	1	50
R24	Clearing	Isolated	5	4	3	2	2	1	1	0	50
		With Background	31	30	30	29	28	27	27	0	50
	Mining	Isolated	9	8	7	5	4	2	1	0	50
		With Background	35	34	33	31	30	28	28	0	50
	Dam	Isolated	13	13	9	5	4	2	1	0	50
		With Background	39	39	36	31	30	28	28	0	50
R25	Clearing	Isolated	11	8	6	5	3	1	1	0	50
		With Background	38	35	33	31	29	27	27	0	50
	Mining	Isolated	21	14	10	7	5	1	1	0	50
		With Background	47	40	36	34	31	27	28	0	50
	Dam	Isolated	42	30	23	17	11	2	3	0	50
		With Background	68	56	49	43	37	29	29	5	50
R26	Clearing	Isolated	7	5	4	2	1	0	0	0	50
		With Background	33	31	30	28	28	26	27	0	50
	Mining	Isolated	7	7	6	4	2	1	1	0	50

Source ID	Scenario	Cumulative	Max	2nd	6th	95th	90th	70th	mean	No. days above criteria	Criteria
		With Background	34	33	32	30	28	27	27	0	50
	Dam	Isolated	20	19	15	9	5	1	2	0	50
		With Background	46	45	41	36	31	27	28	0	50
R27	Clearing	Isolated	3	3	2	1	1	0	0	0	50
		With Background	29	29	28	28	27	27	27	0	50
	Mining	Isolated	5	5	4	2	2	0	0	0	50
		With Background	31	31	30	28	28	27	27	0	50
	Dam	Isolated	12	12	10	6	4	1	1	0	50
		With Background	39	38	36	33	30	27	27	0	50
R28	Clearing	Isolated	3	3	2	1	1	0	0	0	50
		With Background	30	29	28	28	27	26	26	0	50
	Mining	Isolated	5	4	4	2	2	0	0	0	50
		With Background	31	30	30	29	28	27	27	0	50
	Dam	Isolated	12	10	9	6	4	1	1	0	50
		With Background	39	36	36	33	30	27	27	0	50
R29	Clearing	Isolated	4	3	2	1	1	0	0	0	50
		With Background	30	29	28	27	27	26	26	0	50
	Mining	Isolated	8	7	5	3	1	0	0	0	50
		With Background	34	33	31	29	28	26	27	0	50
	Dam	Isolated	18	18	12	7	3	1	1	0	50
		With Background	44	44	38	33	30	27	27	0	50
R30	Clearing	Isolated	3	2	2	1	1	0	0	0	50

Source ID	Scenario	Cumulative	Max	2nd	6th	95th	90th	70th	mean	No. days above criteria	Criteria
		With Background	29	29	28	27	27	26	26	0	50
	Mining	Isolated	4	3	2	1	1	0	0	0	50
		With Background	30	29	28	28	27	26	26	0	50
	Dam	Isolated	11	10	6	3	2	0	1	0	50
		With Background	37	36	32	30	28	27	27	0	50
R31	Clearing	Isolated	1						0	0	50
		With Background	27						22	0	50
	Mining	Isolated	2						0	0	50
		With Background	29						22	0	50
	Dam	Isolated	5						0	0	50
		With Background	31						22	0	50
R32	Clearing	Isolated	1						0	0	50
		With Background	27						22	0	50
	Mining	Isolated	2						0	0	50
		With Background	28						22	0	50
	Dam	Isolated	5						0	0	50
		With Background	31						22	0	50
R33	Clearing	Isolated	1						0	0	50
		With Background	27						22	0	50
	Mining	Isolated	2						0	0	50
		With Background	28						22	0	50
	Dam	Isolated	4						0	0	50

Source ID	Scenario	Cumulative	Max	2nd	6th	95th	90th	70th	mean	No. days above criteria	Criteria
		With Background	31						22	0	50
R34	Clearing	Isolated	1						0	0	50
		With Background	27						22	0	50
	Mining	Isolated	2						0	0	50
		With Background	28						22	0	50
	Dam	Isolated	4						0	0	50
		With Background	30						22	0	50
R35	Clearing	Isolated	0						0	0	50
		With Background	27						22	0	50
	Mining	Isolated	1						0	0	50
		With Background	27						22	0	50
	Dam	Isolated	3						0	0	50
		With Background	29						22	0	50
R36	Clearing	Isolated	0						0	0	50
		With Background	26						22	0	50
	Mining	Isolated	1						0	0	50
		With Background	27						22	0	50
	Dam	Isolated	2						0	0	50
		With Background	29						22	0	50
R37	Clearing	Isolated	1						0	0	50
		With Background	27						22	0	50
	Mining	Isolated	2						0	0	50

Source ID	Scenario	Cumulative	Max	2nd	6th	95th	90th	70th	mean	No. days above criteria	Criteria
		With Background	28						22	0	50
	Dam	Isolated	5						0	0	50
		With Background	31						22	0	50
R38	Clearing	Isolated	2						0	0	50
		With Background	28						22	0	50
	Mining	Isolated	2						0	0	50
		With Background	29						22	0	50
	Dam	Isolated	6						0	0	50
		With Background	32						22	0	50
R39	Clearing	Isolated	0						0	0	50
		With Background	27						22	0	50
	Mining	Isolated	1						0	0	50
		With Background	28						22	0	50
	Dam	Isolated	3						0	0	50
		With Background	29						22	0	50

Appendix Table D-3: $PM_{2.5}$ summary statistics for discrete receptors

Source ID	Scenario	Cumulative	Max	2nd	6th	95th	90th	70th	mean	No. days above criteria	Criteria
R1	Clearing	Isolated	1	0	0	0	0	0	0	0	25
		With Background	5	5	5	5	5	5	5	0	25
	Mining	Isolated	2	1	1	1	0	0	0	0	25
		With Background	7	6	6	5	5	5	5	0	25
	Dam	Isolated	2	1	1	1	0	0	0	0	25
		With Background	7	6	6	5	5	5	5	0	25
R2	Clearing	Isolated	1	0	0	0	0	0	0	0	25
		With Background	5	5	5	5	5	5	5	0	25
	Mining	Isolated	2	2	1	1	1	0	0	0	25
		With Background	7	6	6	6	5	5	5	0	25
	Dam	Isolated	3	1	1	1	0	0	0	0	25
		With Background	7	6	6	6	5	5	5	0	25
R3	Clearing	Isolated	0	0	0	0	0	0	0	0	25
		With Background	5	5	5	5	5	5	5	0	25
	Mining	Isolated	0	0	0	0	0	0	0	0	25
		With Background	5	5	5	5	5	5	5	0	25
	Dam	Isolated	1	1	0	0	0	0	0	0	25
		With Background	6	5	5	5	5	5	5	0	25
R4	Clearing	Isolated	0	0	0	0	0	0	0	0	25
		With Background	5	5	5	5	5	5	5	0	25
	Mining	Isolated	1	0	0	0	0	0	0	0	25

Source ID	Scenario	Cumulative	Max	2nd	6th	95th	90th	70th	mean	No. days above criteria	Criteria
		With Background	5	5	5	5	5	5	5	0	25
	Dam	Isolated	1	1	0	0	0	0	0	0	25
		With Background	6	6	5	5	5	5	5	0	25
R5	Clearing	Isolated	0	0	0	0	0	0	0	0	25
		With Background	5	5	5	5	5	5	5	0	25
	Mining	Isolated	0	0	0	0	0	0	0	0	25
		With Background	5	5	5	5	5	5	5	0	25
	Dam	Isolated	1	1	0	0	0	0	0	0	25
		With Background	6	5	5	5	5	5	5	0	25
R6	Clearing	Isolated	0	0	0	0	0	0	0	0	25
		With Background	5	5	5	5	5	5	5	0	25
	Mining	Isolated	0	0	0	0	0	0	0	0	25
		With Background	5	5	5	5	5	5	5	0	25
	Dam	Isolated	1	1	0	0	0	0	0	0	25
		With Background	6	6	5	5	5	5	5	0	25
R7	Clearing	Isolated	0	0	0	0	0	0	0	0	25
		With Background	5	5	5	5	5	5	5	0	25
	Mining	Isolated	0	0	0	0	0	0	0	0	25
		With Background	5	5	5	5	5	5	5	0	25
	Dam	Isolated	1	1	1	0	0	0	0	0	25
		With Background	6	6	6	5	5	5	5	0	25
R8	Clearing	Isolated	0	0	0	0	0	0	0	0	25

Source ID	Scenario	Cumulative	Max	2nd	6th	95th	90th	70th	mean	No. days above criteria	Criteria
		With Background	5	5	5	5	5	5	5	0	25
	Mining	Isolated	0	0	0	0	0	0	0	0	25
		With Background	5	5	5	5	5	5	5	0	25
	Dam	Isolated	1	1	0	0	0	0	0	0	25
		With Background	6	5	5	5	5	5	5	0	25
R9	Clearing	Isolated	0	0	0	0	0	0	0	0	25
		With Background	5	5	5	5	5	5	5	0	25
	Mining	Isolated	1	0	0	0	0	0	0	0	25
		With Background	5	5	5	5	5	5	5	0	25
	Dam	Isolated	1	0	0	0	0	0	0	0	25
		With Background	6	5	5	5	5	5	5	0	25
R10	Clearing	Isolated	0	0	0	0	0	0	0	0	25
		With Background	5	5	5	5	5	5	5	0	25
	Mining	Isolated	0	0	0	0	0	0	0	0	25
		With Background	5	5	5	5	5	5	5	0	25
	Dam	Isolated	1	0	0	0	0	0	0	0	25
		With Background	5	5	5	5	5	5	5	0	25
R11	Clearing	Isolated	0	0	0	0	0	0	0	0	25
		With Background	5	5	5	5	5	5	5	0	25
	Mining	Isolated	0	0	0	0	0	0	0	0	25
		With Background	5	5	5	5	5	5	5	0	25
	Dam	Isolated	1	0	0	0	0	0	0	0	25

Source ID	Scenario	Cumulative	Max	2nd	6th	95th	90th	70th	mean	No. days above criteria	Criteria
		With Background	5	5	5	5	5	5	5	0	25
R12	Clearing	Isolated	1	1	1	0	0	0	0	0	25
		With Background	6	6	5	5	5	5	5	0	25
	Mining	Isolated	1	1	1	1	1	0	0	0	25
		With Background	6	6	6	5	5	5	5	0	25
	Dam	Isolated	2	2	1	1	0	0	0	0	25
		With Background	7	7	6	6	5	5	5	0	25
R13	Clearing	Isolated	0	0	0	0	0	0	0	0	25
		With Background	5	5	5	5	5	5	5	0	25
	Mining	Isolated	0	0	0	0	0	0	0	0	25
		With Background	5	5	5	5	5	5	5	0	25
	Dam	Isolated	0	0	0	0	0	0	0	0	25
		With Background	5	5	5	5	5	5	5	0	25
R14	Clearing	Isolated	0	0	0	0	0	0	0	0	25
		With Background	5	5	5	5	5	5	5	0	25
	Mining	Isolated	0	0	0	0	0	0	0	0	25
		With Background	5	5	5	5	5	5	5	0	25
	Dam	Isolated	0	0	0	0	0	0	0	0	25
		With Background	5	5	5	5	5	5	5	0	25
R15	Clearing	Isolated	0	0	0	0	0	0	0	0	25
		With Background	5	5	5	5	5	5	5	0	25
	Mining	Isolated	0	0	0	0	0	0	0	0	25

Source ID	Scenario	Cumulative	Max	2nd	6th	95th	90th	70th	mean	No. days above criteria	Criteria
		With Background	5	5	5	5	5	5	5	0	25
	Dam	Isolated	0	0	0	0	0	0	0	0	25
		With Background	5	5	5	5	5	5	5	0	25
R16	Clearing	Isolated	0	0	0	0	0	0	0	0	25
		With Background	5	5	5	5	5	5	5	0	25
	Mining	Isolated	1	0	0	0	0	0	0	0	25
		With Background	5	5	5	5	5	5	5	0	25
	Dam	Isolated	1	1	0	0	0	0	0	0	25
		With Background	6	5	5	5	5	5	5	0	25
R17	Clearing	Isolated	1	0	0	0	0	0	0	0	25
		With Background	5	5	5	5	5	5	5	0	25
	Mining	Isolated	1	1	1	0	0	0	0	0	25
		With Background	6	6	5	5	5	5	5	0	25
	Dam	Isolated	2	2	1	0	0	0	0	0	25
		With Background	7	7	6	5	5	5	5	0	25
R18	Clearing	Isolated	0	0	0	0	0	0	0	0	25
		With Background	5	5	5	5	5	5	5	0	25
	Mining	Isolated	0	0	0	0	0	0	0	0	25
		With Background	5	5	5	5	5	5	5	0	25
	Dam	Isolated	0	0	0	0	0	0	0	0	25
		With Background	5	5	5	5	5	5	5	0	25
R19	Clearing	Isolated	0	0	0	0	0	0	0	0	25

Source ID	Scenario	Cumulative	Max	2nd	6th	95th	90th	70th	mean	No. days above criteria	Criteria
		With Background	5	5	5	5	5	5	5	0	25
	Mining	Isolated	0	0	0	0	0	0	0	0	25
		With Background	5	5	5	5	5	5	5	0	25
	Dam	Isolated	0	0	0	0	0	0	0	0	25
		With Background	5	5	5	5	5	5	5	0	25
R20	Clearing	Isolated	0	0	0	0	0	0	0	0	25
		With Background	5	5	5	5	5	5	5	0	25
	Mining	Isolated	0	0	0	0	0	0	0	0	25
		With Background	5	5	5	5	5	5	5	0	25
	Dam	Isolated	1	1	0	0	0	0	0	0	25
		With Background	5	5	5	5	5	5	5	0	25
R21	Clearing	Isolated	0	0	0	0	0	0	0	0	25
		With Background	5	5	5	5	5	5	5	0	25
	Mining	Isolated	0	0	0	0	0	0	0	0	25
		With Background	5	5	5	5	5	5	5	0	25
	Dam	Isolated	1	1	0	0	0	0	0	0	25
		With Background	6	6	5	5	5	5	5	0	25
R22	Clearing	Isolated	2	2	2	1	1	1	0	0	25
		With Background	7	7	7	6	6	5	5	0	25
	Mining	Isolated	3	3	3	2	1	1	1	0	25
		With Background	8	8	8	7	6	5	5	0	25
	Dam	Isolated	4	3	3	2	2	1	1	0	25

Source ID	Scenario	Cumulative	Max	2nd	6th	95th	90th	70th	mean	No. days above criteria	Criteria
		With Background	9	8	7	7	6	5	5	0	25
R23	Clearing	Isolated	2	2	2	1	1	1	0	0	25
		With Background	7	7	7	6	6	5	5	0	25
	Mining	Isolated	7	7	5	4	2	1	1	0	25
		With Background	12	12	10	8	7	5	6	0	25
	Dam	Isolated	4	3	2	2	1	1	1	0	25
		With Background	9	8	7	7	6	5	5	0	25
R24	Clearing	Isolated	1	1	1	0	0	0	0	0	25
		With Background	6	5	5	5	5	5	5	0	25
	Mining	Isolated	1	1	1	1	1	0	0	0	25
		With Background	6	6	6	5	5	5	5	0	25
	Dam	Isolated	2	2	1	1	1	0	0	0	25
		With Background	7	7	6	6	5	5	5	0	25
R25	Clearing	Isolated	2	1	1	1	0	0	0	0	25
		With Background	7	6	6	5	5	5	5	0	25
	Mining	Isolated	3	2	2	1	1	0	0	0	25
		With Background	8	7	6	6	6	5	5	0	25
	Dam	Isolated	6	4	3	2	2	0	0	0	25
		With Background	11	9	8	7	6	5	5	0	25
R26	Clearing	Isolated	1	1	1	0	0	0	0	0	25
		With Background	6	6	5	5	5	5	5	0	25
	Mining	Isolated	1	1	1	1	0	0	0	0	25

Source ID	Scenario	Cumulative	Max	2nd	6th	95th	90th	70th	mean	No. days above criteria	Criteria
		With Background	6	6	6	5	5	5	5	0	25
	Dam	Isolated	3	3	2	1	1	0	0	0	25
		With Background	8	8	7	6	6	5	5	0	25
R27	Clearing	Isolated	0	0	0	0	0	0	0	0	25
		With Background	5	5	5	5	5	5	5	0	25
	Mining	Isolated	1	1	1	0	0	0	0	0	25
		With Background	6	5	5	5	5	5	5	0	25
	Dam	Isolated	2	2	2	1	1	0	0	0	25
		With Background	7	7	6	6	5	5	5	0	25
R28	Clearing	Isolated	1	0	0	0	0	0	0	0	25
		With Background	5	5	5	5	5	5	5	0	25
	Mining	Isolated	1	1	1	0	0	0	0	0	25
		With Background	6	5	5	5	5	5	5	0	25
	Dam	Isolated	2	2	1	1	1	0	0	0	25
		With Background	7	6	6	6	5	5	5	0	25
R29	Clearing	Isolated	1	0	0	0	0	0	0	0	25
		With Background	5	5	5	5	5	5	5	0	25
	Mining	Isolated	1	1	1	0	0	0	0	0	25
		With Background	6	6	6	5	5	5	5	0	25
	Dam	Isolated	3	3	2	1	1	0	0	0	25
		With Background	7	7	7	6	5	5	5	0	25
R30	Clearing	Isolated	0	0	0	0	0	0	0	0	25

Source ID	Scenario	Cumulative	Max	2nd	6th	95th	90th	70th	mean	No. days above criteria	Criteria
		With Background	5	5	5	5	5	5	5	0	25
	Mining	Isolated	1	0	0	0	0	0	0	0	25
		With Background	5	5	5	5	5	5	5	0	25
	Dam	Isolated	2	2	1	1	0	0	0	0	25
		With Background	6	6	6	5	5	5	5	0	25
R31	Clearing	Isolated	0						0	0	25
		With Background	4						4	0	25
	Mining	Isolated	4						0	0	25
		With Background	9						4	0	25
	Dam	Isolated	0						0	0	25
		With Background	5						4	0	25
R32	Clearing	Isolated	0						0	0	25
		With Background	4						4	0	25
	Mining	Isolated	4						0	0	25
		With Background	9						4	0	25
	Dam	Isolated	0						0	0	25
		With Background	5						4	0	25
R33	Clearing	Isolated	0						0	0	25
		With Background	5						4	0	25
	Mining	Isolated	4						0	0	25
		With Background	9						4	0	25
	Dam	Isolated	0						0	0	25

Source ID	Scenario	Cumulative	Max	2nd	6th	95th	90th	70th	mean	No. days above criteria	Criteria
		With Background	5						4	0	25
R34	Clearing	Isolated	0						0	0	25
		With Background	4						4	0	25
	Mining	Isolated	4						0	0	25
		With Background	9						4	0	25
	Dam	Isolated	0						0	0	25
		With Background	5						4	0	25
R35	Clearing	Isolated	0						0	0	25
		With Background	4						4	0	25
	Mining	Isolated	4						0	0	25
		With Background	8						4	0	25
	Dam	Isolated	0						0	0	25
		With Background	5						4	0	25
R36	Clearing	Isolated	0						0	0	25
		With Background	4						4	0	25
	Mining	Isolated	4						0	0	25
		With Background	8						4	0	25
	Dam	Isolated	0						0	0	25
		With Background	5						4	0	25
R37	Clearing	Isolated	0						0	0	25
		With Background	4						4	0	25
	Mining	Isolated	4						0	0	25

Source ID	Scenario	Cumulative	Max	2nd	6th	95th	90th	70th	mean	No. days above criteria	Criteria
		With Background	9						4	0	25
	Dam	Isolated	0						0	0	25
		With Background	5						4	0	25
R38	Clearing	Isolated	0						0	0	25
		With Background	5						4	0	25
	Mining	Isolated	4						0	0	25
		With Background	9						4	0	25
	Dam	Isolated	0						0	0	25
		With Background	5						4	0	25
R39	Clearing	Isolated	0						0	0	25
		With Background	4						4	0	25
	Mining	Isolated	4						0	0	25
		With Background	9						4	0	25
	Dam	Isolated	0						0	0	25
		With Background	5						4	0	25