Mulga Downs Iron Ore Mine

Air Quality Assessment

Final

Version 1

Prepared for HanRoy

December 2025

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Mulga Downs Iron Ore Mine – Final Report

[redacted]

Executive Summary

HanRoy is proposing to develop the Mulga Downs Iron Ore Project located approximately 260 kilometres south of Port Hedland in the Pilbara region of Western Australia. The purpose of the air quality assessment is to assist in determining the potential impacts of the proposed operations on environmental receptors (inclusive of local communities) within the region.

Overview of assessment

The potential air quality impacts of the Project Area were determined through a dispersion modelling study, which incorporated prognostic meteorological data, and emissions information estimates for the project based on equipment design specifications supplied by the client. The scope of the modelling assessment is summarised below.

Parameter	Comment
Modelled meteorological period	12-month period from January 2020 – December 2020
Model selection	WRF/CALMET/CALPUFF model suite
Key Pollutants	Particulate matter (PM) - including Total Suspended Particulates (TSP), PM_{10} and $PM_{2.5}$ size fractions, and dust deposition.
Meteorological data	Three-dimensional prognostic meteorological data developed using the Weather Research and Forecasting (WRF) model.
Background Air Quality	Published air quality monitoring data for the Pilbara has been reviewed and used as a suitable proxy of existing (baseline) concentrations for key pollutants.
Project Emissions	For the maximum material handling year (2031).
Sensitive Receptors	Discrete receptor locations were nominated to represent: • Human receptors (health and amenity) including Youngaleena and Wirrilimarra Communities • Heritage receptors • Ecological receptors, including Fauna (habitat) and protected Flora (vegetation of importance).
Model Scenarios	The model scenarios that have been included in the assessment: • Scenario 1: Baseline operational activity in highest tonnage year, without dust abatement . • Scenario 2: Baseline operational activity in highest tonnage year, with dust abatement .

Key findings

The key findings of the modelling assessment, in relation to the potential environmental impact, assessed by comparison to assessment criteria are:

- For TSP:
  - For Scenario 1 (operations without dust abatement measures)
    - No excursions of the TSP criteria at either of the communities.
    - Elevated concentrations are predicted to occur at HanRoy receptors in close proximity to the operations.
  - For Scenario 2 (operations with dust abatement measures):
    - No excursions of the TSP criteria at either of the communities.
    - The introduction of 'standard' dust abatement does result in a reduction in predicted ground level concentrations though elevated concentrations are still predicted to occur at HanRoy receptors in close proximity to the operations.
- For PM_{10}:
  - For Scenario 1 (operations without dust abatement measures):
    - No excursions of the PM_{10} criteria at either of the communities.
    - Elevated concentrations are predicted to occur at HanRoy receptors in close proximity to the operations.
  - For Scenario 2 (operations with dust abatement measures):
    - No excursions of the PM_{10} criteria at either of the communities.
    - The introduction of 'standard' dust abatement does result in a reduction in predicted ground level concentrations though elevated concentrations are still predicted to occur at HanRoy receptors in close proximity to the operations.
- For $PM_{2.5}$:
  - For Scenario 1 (operations without dust abatement measures)
    - No excursions of the $PM_{2.5}$ criteria at either of the communities.
    - Elevated concentrations are predicted to occur at HanRoy receptors in close proximity to the operations.
  - For Scenario 2 (operations with dust abatement measures):
    - No excursions of the $PM_{2.5}$ criteria at either of the communities.
    - The introduction of 'standard' dust abatement does result in a reduction in predicted ground level concentrations though elevated concentrations are still predicted to occur at HanRoy receptors in close proximity to the operations.
- Deposition:
  - For Scenario 1 (operations without dust abatement measures):
    - No excursions of the deposition criteria at either of the communities.
    - Some receptors within close proximity to the planned operations are forecast to have a monthly deposition rate greater than 2 g/m^2/month.
  - For Scenario 2 (operations with dust abatement measures):
    - No excursions of the deposition criteria at either of the communities.
    - Some receptors within close proximity to the planned operations are forecast to have a monthly deposition rate greater than 2 g/m^2/month, though to a lower extent than for Scenario 1.

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1 Introduction

1.1 Background

HanRoy, a Hancock Prospecting company, is proposing to develop the Mulga Downs Iron Ore Project (the Project) located within the Mulga Downs pastoral station in the Pilbara region of Western Australia, approximately 260 kilometres from Port Hedland and 250 kilometres from Newman (Figure 1-1). The Project involves open cut mining operations, on-site ore processing, waste storage facilities, workshops, access and service roads, and an airport.

This assessment is designed to incorporate potential impacts on the following receptor types:

- Impacts on communities within the region.
- Social Surroundings, where the primary concerns include Cultural values and heritage sites.
- Flora and vegetation, where the primary concern is for degradation of vegetation through dust deposition and altered bushfire regimes (noting the latter is not considered in the modelling).

1.2 Scope of work

The purpose of this air quality assessment is to evaluate the potential dust levels from the proposed operations on nearby sensitive receptors with a focus on community receptors. The model methodology and approach is to be consistent with the EPA/ Department of Water and Environment Regulation (DWER) Air Quality and Air Pollution Modelling Guidance Notes and includes:

- Identification of key pollutants, assessment criteria, and sensitive receptor locations.
- Estimation of background or baseline air quality for the Project Area (including natural background and anthropogenic activities), particularly at sensitive receiver locations.
- Operational emission scenario modelled.
- Dispersion Modelling for a single operational phase – with and without dust controls.
- Assess impact and compliance with ambient air quality assessment criteria.
- Assess the modelled impacts on sensitive receptors.

For mining operations, emissions were determined for:

- Mining,
- Haulage,
- Processing, and
- Wind erosion.

The ambient air quality and potential impacts are assessed in terms of the following particulate sizes:

- Total Suspended Particulates (TSP) (including deposition).
- PM_{10} (particulate matter with an aerodynamic diameter of 10 microns (µm) or less).
- $PM_{2.5}$ (particulate matter with an aerodynamic diameter of 2.5 µm or less).

In preparing this assessment reference has been made to the following key regulatory policy and guidance:

- Air Quality Modelling Guidance Notes (DoE 2006)
- Guideline - Air Emissions, draft for external consultation (DWER 2019)

- Guideline - Dust Emissions, draft for external consultation (DWER 2021)
- Environmental Factor Guideline – Air Quality (EPA 2020)
- Environmental Factor Guideline – Social Surroundings (EPA 2023a)
- Technical Guidance: Environmental Impact Assessment of Social Surroundings – Aboriginal Cultural Heritage (EPA 2023b).

1.3 Structure of report

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

- The study approach and methodology, including the regional climate, pollutants of interest and sensitive receptors in the immediate region, in Section 2.
- Impact assessment criteria for human health and amenity, ecological/biological, and heritage (Section 3).
- Atmospheric dispersion modelling of the emissions using CALPUFF (Section 4).
- Project emission estimation and inventory in Section 5.
- An evaluation of the potential impact from the Project, for particulates (Section 6).
- Conclusions of the assessment are presented in Section 7.

The appendices contain supporting information, specifically:

- The analysis to determine the representative meteorological year for modelling.
- The detailed configuration for WRF and CALMET.
- Emission parameters and emission rates for each source modelled.

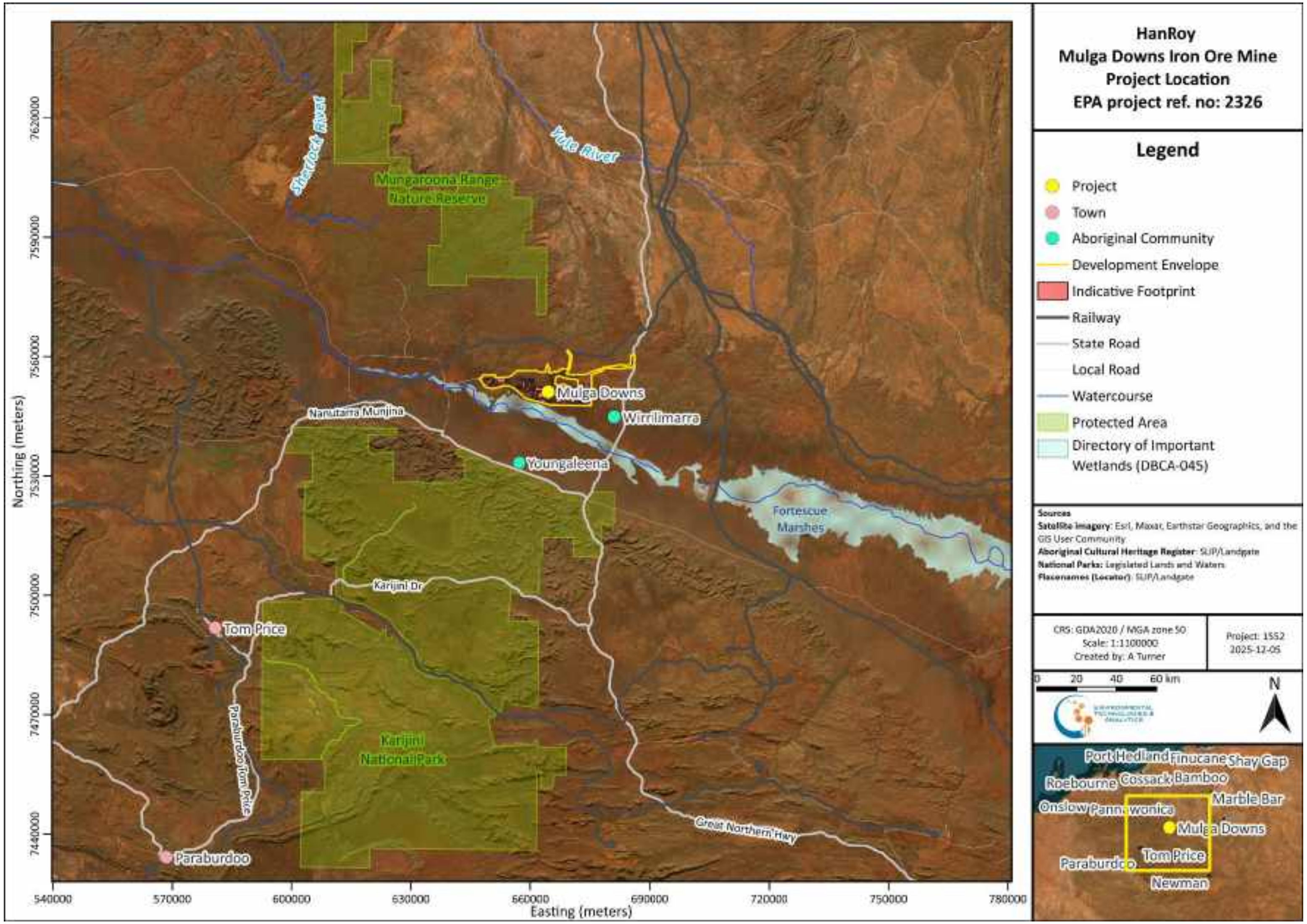

Figure 1-1: Project location and setting.

2 Assessment Methodology

This section outlines the air quality study and assessment approach. It includes the methodology applied to define the meteorological characteristics of the Project area relevant to the assessment, the emission estimation, the dispersion, and the ambient assessment criteria selected for the purposes of determining the significance of the dispersion model results, and therefore the potential impact.

The study structure is shown in Figure 2-1 and detailed in the following subsections.

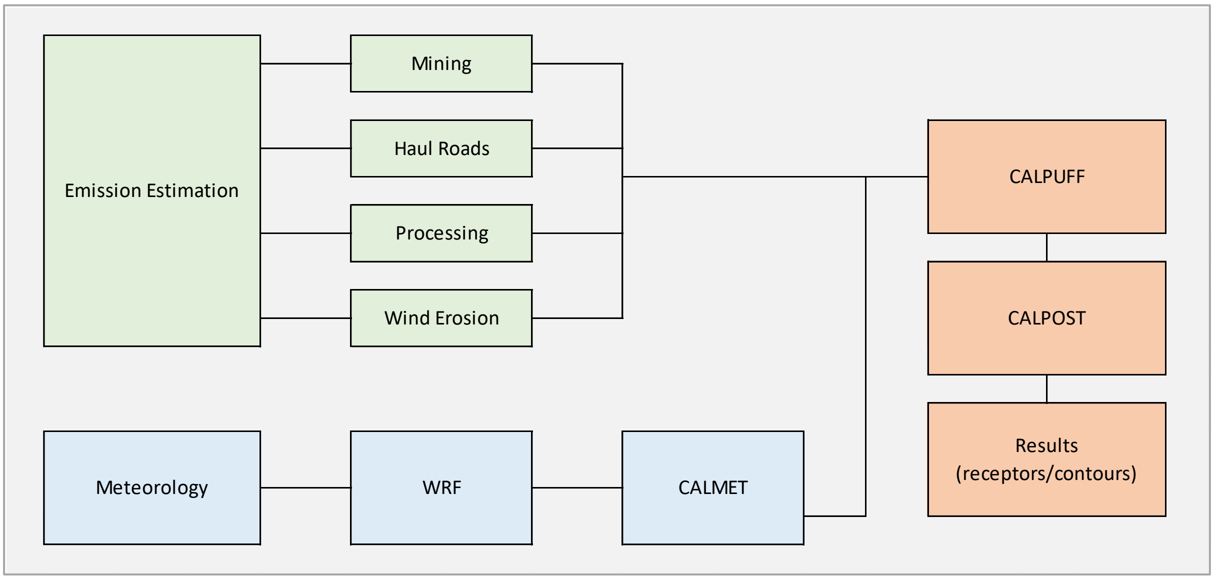

Figure 2-1: Air quality assessment – study approach.

2.1 Climate and meteorology

This section outlines the key climate and meteorological characteristics of the region important for the dispersion, transformation, and removal (or deposition) of pollutants from the atmosphere, and therefore ambient air quality.

The Project area is located approximately 250 km northwest of Newman, in the inland Pilbara region of Western Australia. This region has a desert climate (arid), characterised by hot dry days and cold clear nights, with unreliable rainfall occurring during the year. The climate is classified according to the Köppen-Geiger climate classification system as BWh (Arid, Desert, Hot) (Kottek et al. 2006). Two seasons are used to distinguish the general conditions:

- A hot wet season period extending from November to April, with an unreliable monsoonal wet season from January to March, and
- A mild dry season from May to October.

The nearest meteorological station is the Bureau of Meteorology (BoM) automatic weather station (AWS) at Karijini North, located approximately 20 km south of the Project area. However, as this station has only been operational since late 2018, it provides insufficient information for determining long-term averages.

As such, meteorological data from the BoM Newman Airport AWS station will be used for this assessment. Given the regional nature of meteorological patterns of the Pilbara, the climatic conditions captured by this station are representative of the Project area. A summary of the long-term meteorological conditions as measured at the BoM Newman Aero AWS from 1 January 2010 to 31 December 2024 is presented in the following sections.

2.1.1 Temperature

As presented in Figure 2-2 it is evident that the temperature in the inland Pilbara region is characterised by high maxima, and the diurnal difference can be extreme. At the Newman Airport AWS the measured mean monthly maximum temperatures range from a high of 37.8 degrees Celsius (°C) in January to 22.8°C in July. The mean monthly minimum temperatures range from 25.6°C in January down to 7.2°C in July.

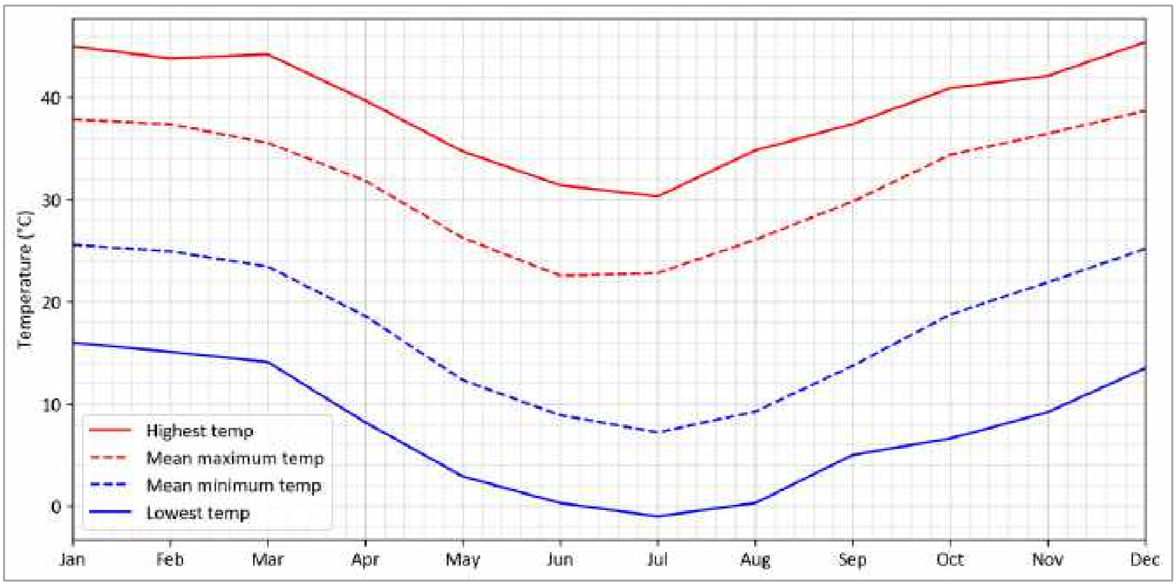

Figure 2-2: Mean Temperature 2010 to 2024 (BoM Newman Airport).

2.1.2 Humidity

The mean monthly relative humidity, recorded at 9am and 3pm, at the Newman Aero AWS is presented in Figure 2-3. The higher mean humidity levels are associated with the summer months, however the monthly averages tend to be relatively low all year round, reflecting the arid climate.

Figure 2-3: Mean Relative Humidity 2010 to 2024 (BoM Newman Aero).

2.1.3 Rainfall

The long-term rainfall data measured at the BoM Newman Airport AWS is presented in Figure 2-4. This data highlights the hot desert 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:

- Dry Season (May to October): The dry season is characterised by cooler, dry temperatures. The average monthly rainfall is 11.4 millimetres (mm). Some sporadic rainfall occurs from September onwards.
- Wet Season (November to April): The region receives increased rainfall during this season due to an unreliable monsoonal pattern, with occasional thunderstorms and tropical lows. The average monthly rainfall during the wet season is 45.0 millimetres (mm).

It is important to note that these descriptions provide a general overview of the seasonal rainfall patterns in Newman. Weather patterns can vary from year to year, and some seasons may experience more or less rainfall than average.

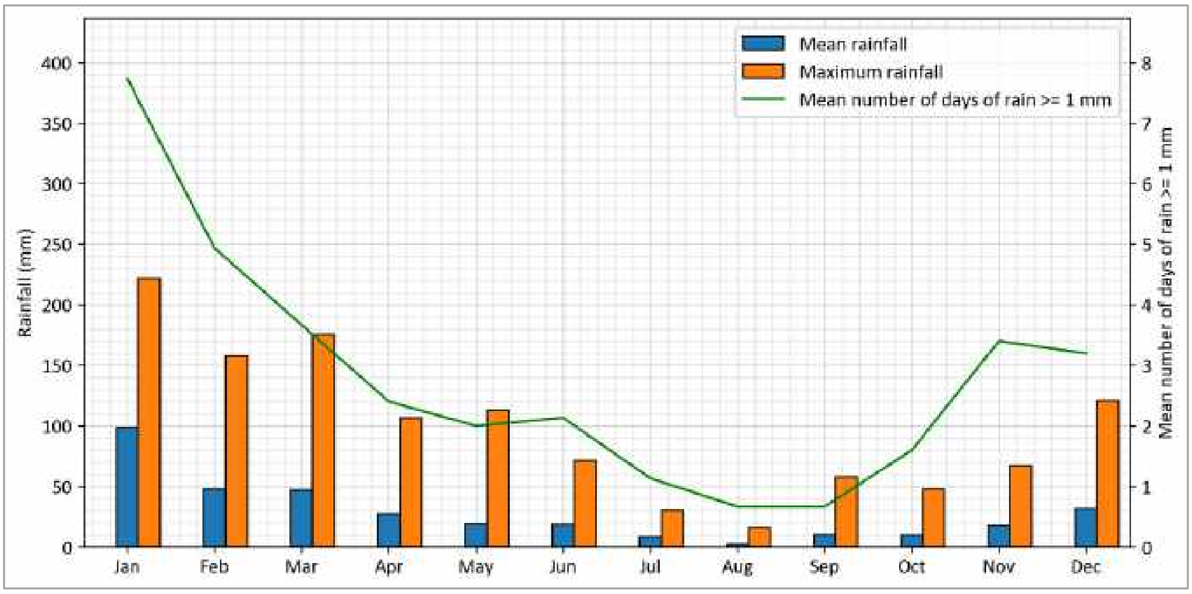

Figure 2-4: Rainfall 2010 to 2024 (BoM Newman Airport).

2.1.4 Wind speed/direction

The wind characteristics for the Newman Airport AWS are presented as annual and seasonal wind roses in Figure 2-5. The annual wind direction highlights that the prevailing wind direction is from the south-east.

On a seasonal basis the wind roses indicate that:

- Dry season observes a relatively uniform distribution of winds. Prevailing winds are predominantly from the south-west and east-southeast. Wind speeds are generally lower to moderate, with a mean wind speed of 3.7 m/s. with a higher percentage of stronger wind speeds than the wet season.
- During the wet season, there is a similarly even distribution of winds, with a concentration of winds from the east southeast. Wind speeds are generally lower in the wet season, with mean wind speed being 3.2 m/s.

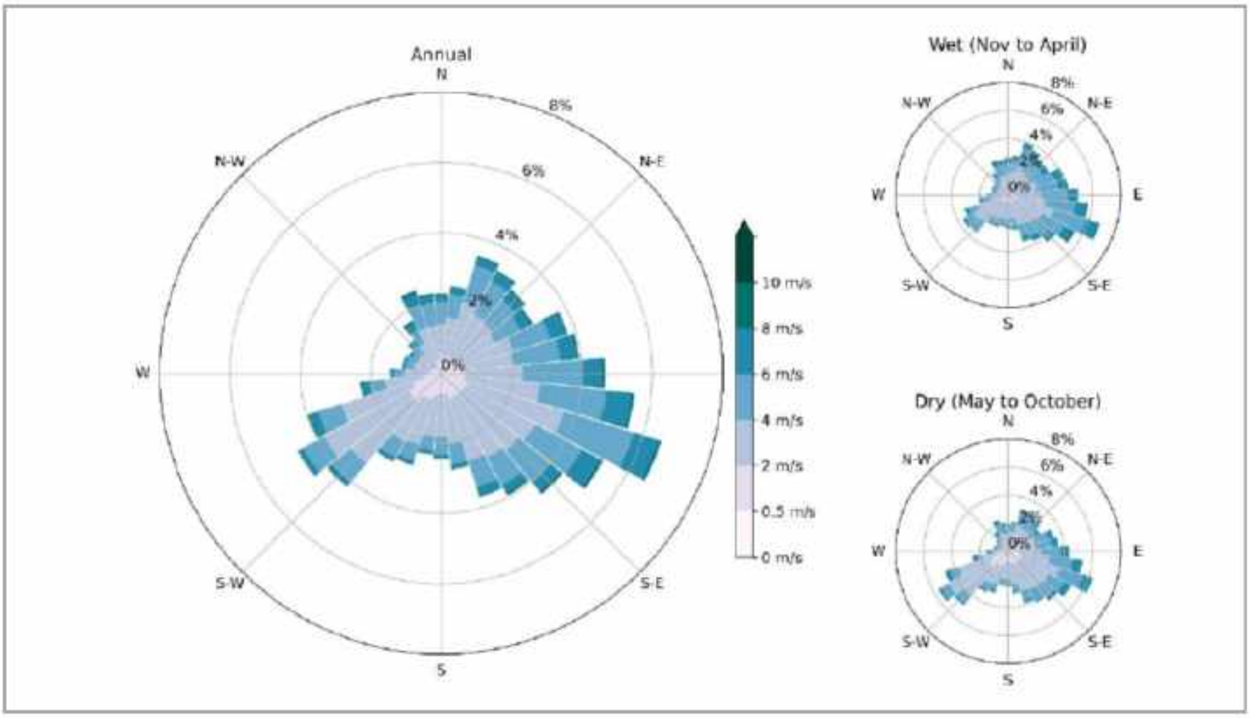

Figure 2-5: Annual and seasonal wind roses from 2010 to 2024 (BoM Newman Airport).

2.2 Pollutants of interest

Based on the description of the Project and key processes considered, the key pollutants of interest to be assessed are summarised in Table 2-1.

Table 2-1: Air pollutants of interest from the Project.

Pollutant to be Assessed		
Particulate Matter	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), and inhalable particles (coarse fraction PM_{10} and fine fraction $PM_{2.5}$). An image of their respective sizes is presented in Figure 2-6. **Project sources are principally from mining, handling of ore/waste, processing and wind generated surface erosion.**	
	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 have been associated with health effects similar to those of PM_{10}. There is some evidence to suggest that $PM_{2.5}$ might be more deleterious to health than other size fractions. No lower limit for the onset of adverse health effects has yet been observed.

Pollutant to be Assessed		
	TSP	Total suspended particulates (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 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).
	Deposited Dust	Deposited matter refers to any dust that falls out of suspension in the atmosphere.

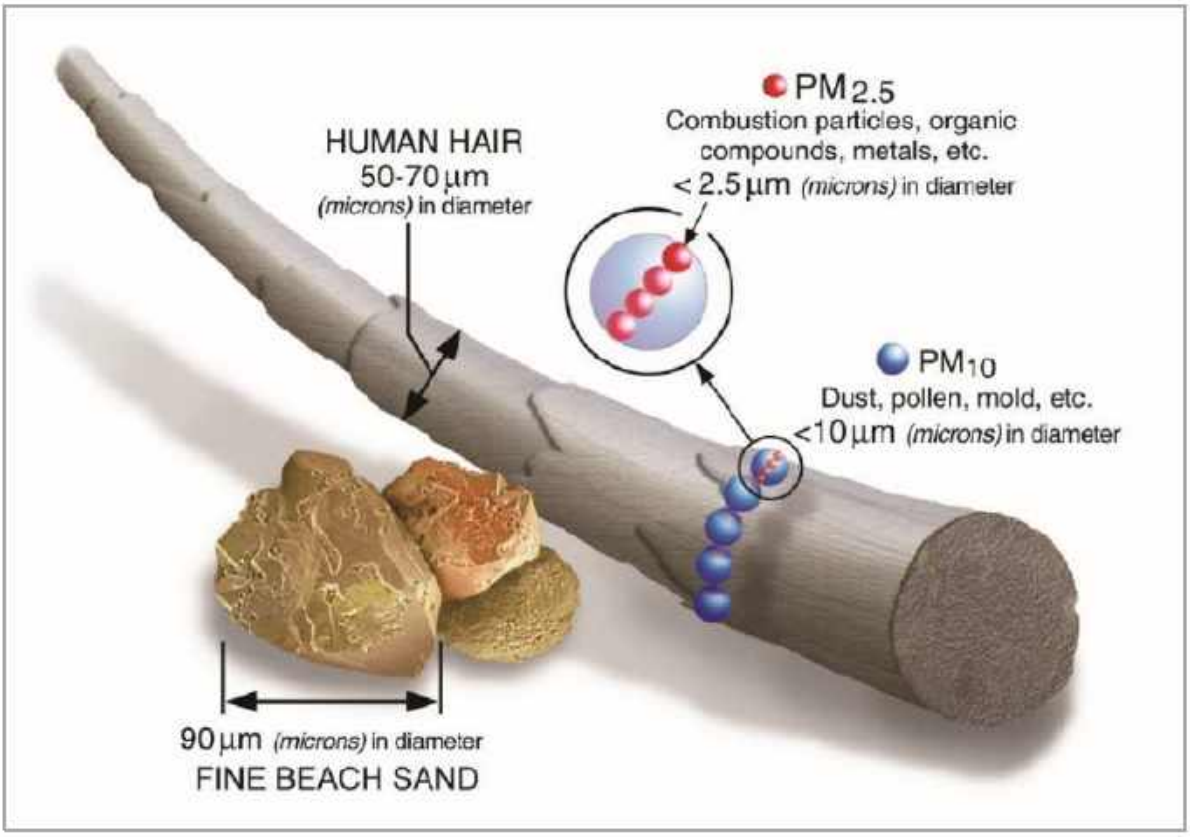

Figure 2-6: Example of particle sizes (USEPA 2002).

2.3 Existing | background air quality

The Pilbara region is a naturally dusty environment with wind-blown dust being a significant contributor to the particulate loading. Within the aggregated emission inventory for the Pilbara, undertaken by SKM in 2000 for the 1999/2000 financial year, it was calculated that approximately 170,000 tonnes were emitted as a result of wind erosion (SKM 2003). Wildfires also account for a significant amount of the emissions with approximately 195,000 tonnes of particulates emitted. Note that these are calculated values and will vary on an annual basis depending on a range of factors including the extent of erodible areas, area burnt, rainfall, and wind speed.

HanRoy has been undertaking an ambient air quality monitoring program adjacent to the Youngaleena community. This monitoring was undertaken with a non-regulatory Environmental Beta Attenuation Monitor (E-BAM) fitted with a PM_{10} size selective inlet, along with wind speed and direction

The 1-hour and 24-hour averaged statistics from 1 August 2024 to 23 September 2025 from this monitoring program are presented in Table 2-2. Analysis of this data reveals several quality concerns that limit its suitability for the determination of background concentration:

- The average wind speed at the HanRoy monitoring site was 1.9 m/s, which is lower than expected for the region. From Table 2-3 it can be seen that than annual average wind speed recorded at the BoM Karijini North AWS is around 5 m/s which is significantly higher than that recorded at the HanRoy monitor. It should be noted that differences in the monitoring heights of the wind speed and local site conditions may account for some variation.
- On a 24-hour basis the HanRoy monitor has only a 80.9% valid data return indicating poor data availability over the monitoring period.

Table 2-2: Monitoring statistics from the HanRoy program.

Statistic	PM_{10} (μg/m³)		Wind speed (m/s)
	1-hour	24-hour	1-hour
Maximum	387.3	35.8	7.2
99 percentile	56.5	26.3	5.1
95 percentile	30.8	17.4	4.1
90 percentile	22.5	15.6	3.5
70 percentile	12.1	11.9	2.4
Average	9.7	9.9	1.9
Data Recovery (%)	86.0	80.9	99.9

Table 2-3: BoM Karijini North AWS Station annual wind speed statistics (2020-2024).

Statistic	2020	2021	2022	2023	2024
Maximum	12.7	11.9	11.6	10.6	11.8
99 percentile	9.3	9.1	9	9.1	9.4
95 percentile	7.6	7.8	7.5	7.7	7.9
90 percentile	6.8	6.9	6.6	6.8	7.1
70 percentile	5	5	4.9	4.9	5.2
Average	4	4.1	4	4	4.2

Based on the low wind speeds and poor availability of PM_{10} (24-hour) monitoring data, the potential contribution of existing or background concentrations were determined using information within the BHP Strategic Environmental Assessment (SEA) (BHP, 2015), noting that the BHP SEA study does not include any indication of potential background dust deposition rates. As part of this SEA assessment BHP, through an analysis of their particulate monitoring network in the region, determined the following constant background concentrations:

- PM_{10}: 18.2 μg/m³ (24-hour average)
- $PM_{2.5}$: 2.7 μg/m³ (24-hour average) (represents the ratio of $PM_{2.5}$:PM_{10} used in the emission estimation as presented in Section 4.2.2)
- TSP: 33.1 μg/m³ (24-hour average)

These concentrations are utilised in this assessment to represent background concentrations, maintaining consistency in assumptions. For deposition there is no available background deposition rates for the Pilbara region.

2.4 Sensitive receptors and environmental values

This modelling assessment considers the potential air quality impacts on relevant environmental values and sensitive receptors, consistent with EPA (EPA 2020) and DWER (DWER 2019), noting that the current DWER guidelines excludes the consideration of on-site project related receptors as sensitive receptors. A sensitive receptor, as outlined in the EPA's assessment framework (EPA 2005), is defined as a receptor that is '*potentially sensitive to emissions from industry and infrastructure including residential developments, hospitals…caravan parks, schools, nursing homes…playgrounds and some public buildings*.'.

The definition of environment in the EP Act includes social surroundings, where "*environment, subject to subsection (2) means living things, their physical, biological and social surroundings, and interactions between all of these (Subsection 3(1)).*" (EPA 1986). Social surroundings, as outlined in the EPA guidelines (EPA 2023a, 2023b) includes Aboriginal heritage and culture, natural and historical heritage, amenity values.

It is important to note that each environmental value is therefore inherently aligned to specific particle sizes for the evaluation of potential air quality impacts on sensitive receptors, environmental values and social surroundings.

This modelling assessment considers the potential air quality impacts on a range of receptor types where the environmental values are present:

- Homesteads in the model domain, and non-HanRoy related accommodation villages for potential human health and amenity impact.
- Youngaleena and Wirrilimarra Communities
- Ecological / biological values being represented by –
    - Impacts to protected fauna for potential ecological (habitat) impact.
    - Permanent pools.
- Protected flora (i.e. vegetation of importance).
- Aboriginal Cultural Heritage
- HanRoy receptors which are primarily accommodation villages – for potential human health and amenity impact.

It is noted that the current DWER guidelines excludes the consideration of on-site Project related receptors as sensitive receptors, however the HanRoy accommodation village have been included for information purposes.

The location of the identified sensitive receptors in the region are presented in Figure 2-7 and are defined in full in Appendix B.

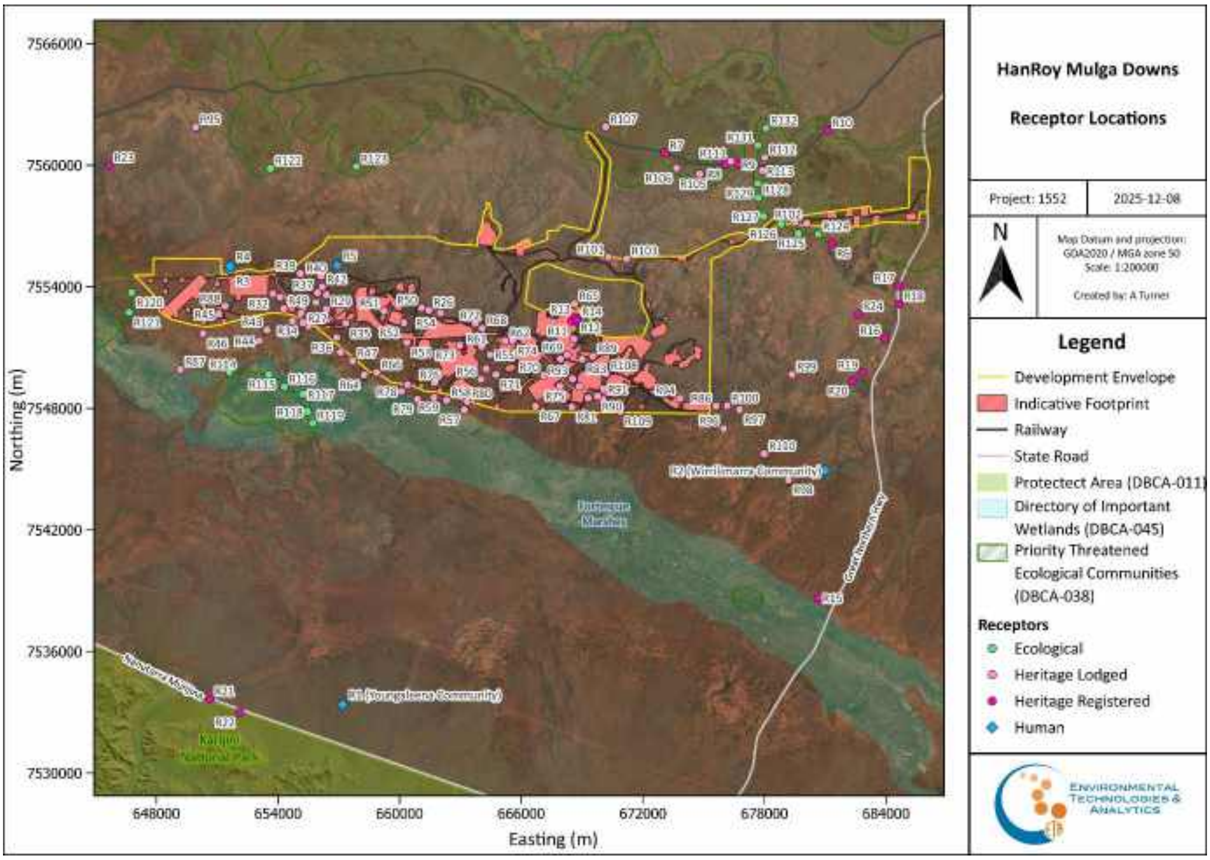

Figure 2-7: Discrete sensitive receptor locations.

3 Impact Assessment Methodology

Ground-level concentrations of particulates (as TSP, PM_{10} and $PM_{2.5}$) and dust deposition, predicted at nominated receptors and the surrounding environment were compared with the relevant air quality assessment criteria. This assessment has considered the potential impact attributable to the operations, as well as the cumulative (background) impact (i.e. in conjunction with the existing emission sources in the area).

Modelling results, at nominated receptors, are compared to the numerical value of the criteria, and assessed as being either above or below the numerical value (nominated criteria). It is important to note that not all potential impacts has a known assessment criteria, and in these circumstances a “proxy” criteria is used as an indicator. It is important to note that, as a risk based assessment approach is normally applied to the assessment of air quality, a modelled result above the numerical value is not an indicator of unacceptable impact, but is an indication that the potential risk for impact requires further consideration.

3.1 Human health impact assessment and amenity criteria

Modelled ground level concentrations for particulates have been compared to ambient air quality assessment criteria to determine the potential changes in impact resulting from the Project.

The assessment criteria adopted for this study (for particulates) are primarily based on the DWER (2019, 2021) guidelines, which also reference the numerical values from the national ambient air quality standards specified in the Ambient Air Quality National Environment Protection Measure (NEPM) (NEPC 2021).

In their current draft form, the DWER (2019) guidelines for TSP/PM_{10}/$PM_{2.5}$ (defined as *criteria pollutants* in the guideline) require the criteria to generally be ‘…met at all existing and future offsite sensitive receptors in the modelling domain’. DWER (2021) draft guidelines address the settling or deposition of dust, noting that at the time of this assessment both guidelines are draft and subject to post-public consultation finalisation.

3.2 Ecological / Biological impact assessment criteria

With respect to important or protected fauna within the region there is limited published research available as to the ecological impact of dust on bats (including Ghost and Leaf-Nosed Bats), and the dust (particulate) concentrations at which the bats may experience a noticeable or negative impact. The *Conservation Advice* (May 2016) of the Threatened Species Scientific Committee for the Ghost Bat references the impact of mining on the Ghost Bat but does not reference any specific impact associated with bat exposure to dust (TSSC 2016). A further report (Wildcare Australia Inc 2014) states that microbats exposed to smoke and / or dust inhalation will exhibit shallow or difficulty in breathing and will have wings outstretched. Again, the guidance does not extend to advise on the concentrations or exposure levels that may be of concern.

The Project intersects with a known priority ecological community (PEC), the Freshwater Claypans of the Fortescue Valley (P1 PEC). These freshwater claypans are ephemeral and typically inundated only for short durations following significant rainfall and runoff events (Pinder *et al*. 2017). There is no established criteria to represent the ecological impact of dust on the claypans, and the dust (particulate) concentrations at which the claypans may experience a noticeable or negative impact. In the absence of any documented criteria for assessing air quality impact on the claypans, the ambient air quality assessment criteria intended to protect human amenity and nuisance values, are assumed to be conservatively protective of this environmental value, and are used in this assessment as a “proxy” value. A modelling result that is higher than the assessment criteria should not be interpreted as a predicted impact or loss of environmental value but is an indication that results may need further consideration for the sensitive receptor location, such as monitoring for determining baseline conditions and environmental change.

3.3 Impact on vegetation criteria

With respect to vegetation health, research on the effects of dust deposition has been undertaken in Australia by Doley (2006). Doley concluded that *"critical dust loads that result in significant alterations in the most sensitive plant functions vary with the particle size distribution and colour of the dust, from about 1 g/m² for carbon black with a median diameter of about 0.15 µm to about 8 g/m² for coarse road or limestone dusts with median diameters greater than about 50 µm. The critical loads vary with the plant function, and it is not possible to predict precisely the nature of one plant response from the knowledge of another"* (Doley 2006). For mineral dust, Farmer (1993) showed that direct physical effects of mineral dusts on vegetation became apparent only at relatively high surface loads (e.g. greater than 7 g/m²).

For this study, 7 g/m²/month is used as an indicative criterion for potential effects on vegetation, however the Butler (2009) work shows that this is probably very conservative. A modelling result that is higher than the assessment criteria is interpreted as an indication that results may need further consideration for the sensitive receptor, and is not necessarily a predicted impact or loss of environmental value.

3.4 Impact on Aboriginal Cultural Heritage

EPA's Technical Guidance for Aboriginal cultural heritage (EPA 2023b) provides the framework for considering potential impacts that may arise due to air quality including dust. To date there are no published air quality ambient guidelines that would guide evaluation of Aboriginal Cultural Heritage (ACH) specifically. In the absence of any documented criteria for assessing air quality impact ACH, the ambient air quality assessment criteria intended to protect human amenity and nuisance values, are assumed to be protective of this environmental value, and are used in this assessment as a "proxy" value. A modelling result that is higher than the assessment criteria should not be interpreted as a predicted impact or loss of value but is an indication that results may need further consideration for the sensitive receptor location, such as monitoring for determining baseline conditions and environmental change. It is essential that Traditional Owners be consulted to ensure there is appropriate alignment between the specific ACH value of a location, and that the proxy assessment criteria is considered suitable.

3.5 Summary of applied assessment criteria

A consolidated summary of the applicable assessment criteria and relevant receptor application is provided in Table 3-1.

Table 3-1: Summary of adopted assessment criteria.

Pollutant	Air quality assessment criteria					Reference
	Concentration [1]	Concentration [2]	Averaging Period	Allowable Exceedances	Environmental value protected	
PM_{10}	50 µg/m³	46 µg/m³	24-hour	exception event	Human health	DWER (2019) consistent with NEPM (NEPC, 2021)
	25 µg/m³	23 µg/m³	annual	none		
$PM_{2.5}$	25 µg/m³	23 µg/m³	24-hour	exception event		
	8 µg/m³	8 µg/m³	annual	none		
TSP	90 µg/m³	82 µg/m³	24-hour	none	Amenity	DWER (2019)

Pollutant	Air quality assessment criteria					Reference
	Concentration [1]	Concentration [2]	Averaging Period	Allowable Exceedances	Environmental value protected	
					Proxy for protection of ecological values	
Dust deposition	2 g/m²/30 days		30-days	Maximum increase above background	Human Amenity | Nuisance | Heritage (ACH and other)	DWER (2021) referencing (NZ MfE 2016)
	4 g/m²/30 days		30-days	Maximum		DWER (2021) referencing (NSW EPA 2017)
	7 g/m²/30 days		30-days	None	Proxy for protection of ecological values (protected fauna species) Ecological (vegetation/leaf) impact	Doley (2006)

Notes:

1 Concentrations referenced to 0ºC (excluding reference to dust deposition)

2 Concentrations referenced to 25ºC (excluding reference to dust deposition)

4 Model Assessment

For this assessment, air dispersion modelling has been conducted using WRF and CALMET in conjunction with CALPUFF. The model has been used to predict ground level concentrations across the model domain and at identified sensitive receptor locations. The potential air quality impacts associated with the Project have been considered in isolation of other emission sources, as well as cumulatively with existing air quality of the region. The model was configured to predict the ground-level concentrations on a rectangular grid. The model domain was defined with the Southwest corner of the grid cell at 644.500 km Easting and 7532.000 km Northing (UTM Zone 50 S). Specifics for the modelling configuration are described further in this section.

4.1 Meteorological model

The meteorology component of a dispersion model is a key element for the effectiveness or representativeness of the dispersion model outputs. Both upper air and surface information are needed for modelling.

4.1.1 WRF model

In the absence of adequate onsite meteorological data, the Weather Research and Forecast (WRF V3.7) 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. The model was primarily designed to serve both operational forecasting and atmospheric research. WRF features multiple dynamical cores, a 3-dimensional variational data assimilation system and a software architecture allowing for computational parallelism and system extensibility. Further details on WRF are provided in Appendix A.

4.1.2 CALMET

The 3-Dimensional meteorological data generated by WRF was input to CALMET 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 temporally 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 162 x 122 grid domain at a spatial resolution of 250 m. Vertically, the model consisted of 11 levels extending to 3,000 m. The southwest corner coordinates of the domain were 644.500 km Easting and 7532.000 km Northing (UTM Zone 50 S).

Shuttle Radar Topography Mission (SRTM) data with 90 m resolution was input into the CALMET model to indicate terrain heights within the model domain (Figure 4-1). CALMET also requires geophysical data including gridded fields of land use categories. The default US Geological Survey (USGS) land use classification system

(14 category system) was substituted with a more up to date, finer resolution data (300 m) obtained from the European Space Agency Climate Change Initiative Land cover (ESACCI-LC) dataset.

The CALMET results are provided in Appendix A.

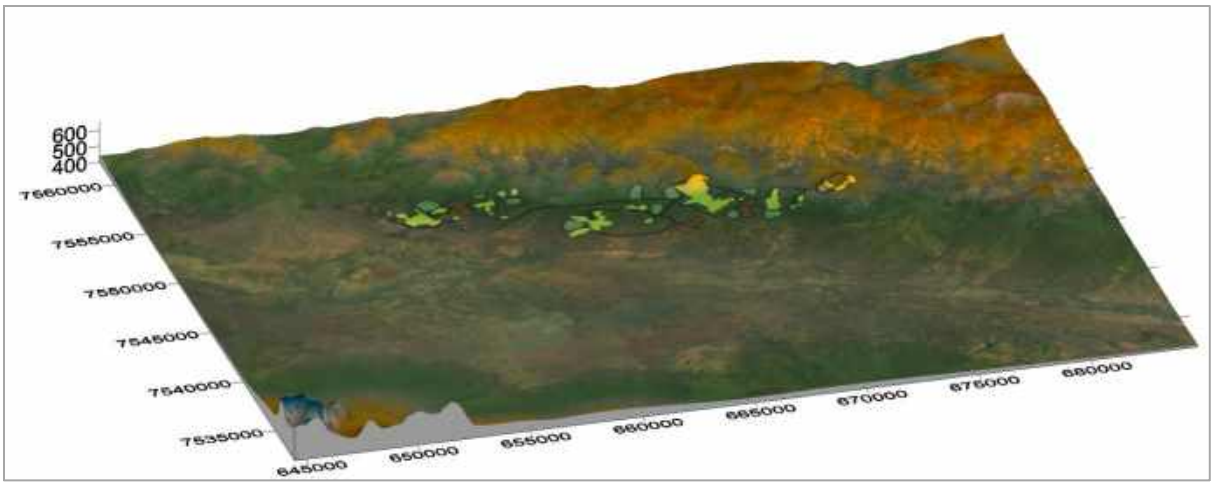

Figure 4-1: Image of SRTM terrain elevation used in CALMET (vertical height is exaggerated).

4.2 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. 2000).

The CALPUFF model was set to calculate concentrations both on a set grid (gridded receptors) and at 21 specified locations (discrete receptors). The model domain was defined as 40 km in the east–west direction and 30 km in the north-south direction at a spacing of 250 m.

4.2.1 Emission sources – Mulga Downs

Each emission source for the Proposal was characterised as either area sources or volume sources in the dispersion model. Area sources were assigned to open areas while volume sources were assigned to mining activities in the pits and haul roads following the USEPA recommendations (USEPA, 2012) The locations of sources are presented in Appendix B as coordinates (GDA2020, zone 50).

4.2.2 Particle size distribution

CALPUFF was set up to model depletion of the dust plume concentration through deposition. Since dust is subject to gravitation settling as well as deposition, information on particle size is critical. 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'. These are shown in Table 4-1.

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

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	-	-

5 Emissions to Air Estimation

When determining the potential impact of a facility, either existing or proposed, one of the critical inputs to the dispersion model is the source emission file, based on the project emission inventory. The following sections outline the process whereby potential sources are identified and quantified based on the forecast throughput tonnage of the facility to form the basis of the project emission inventory.

5.1 Emission source inventory | scenarios

For this assessment, the following model scenarios were considered:

- Mining operations baseline (2031 – year of highest tonnage (Appendix C)):
  - Scenario 1: Model with baseline mine activities information for all operations in the Mulga Downs project area, specifically across Anticline Hill (AH), Murrays Hill (MH) and Fridge Hill (FH) pits, with no dust abatement measures applied.
  - Scenario 2: Model with baseline mine activities information for all operations in the Mulga Downs project area, specifically across Anticline Hill (AH), Murrays Hill (MH) and Fridge Hill (FH) pits, with dust abatement measures applied.

The key emission sources are associated with:

- drilling and blasting
- material handling from loading and unloading activities involving:
  - loading trucks
  - unloading trucks
  - loading trains
  - bulldozing
- material transport and processing:
  - transportation by conveyors
  - transfer stations
  - crushing
  - stacking
- wheel generated dust from roads and haul roads
- wind erosion from stockpiles and open areas.

Emissions sources for these model scenarios are presented in Appendix D.

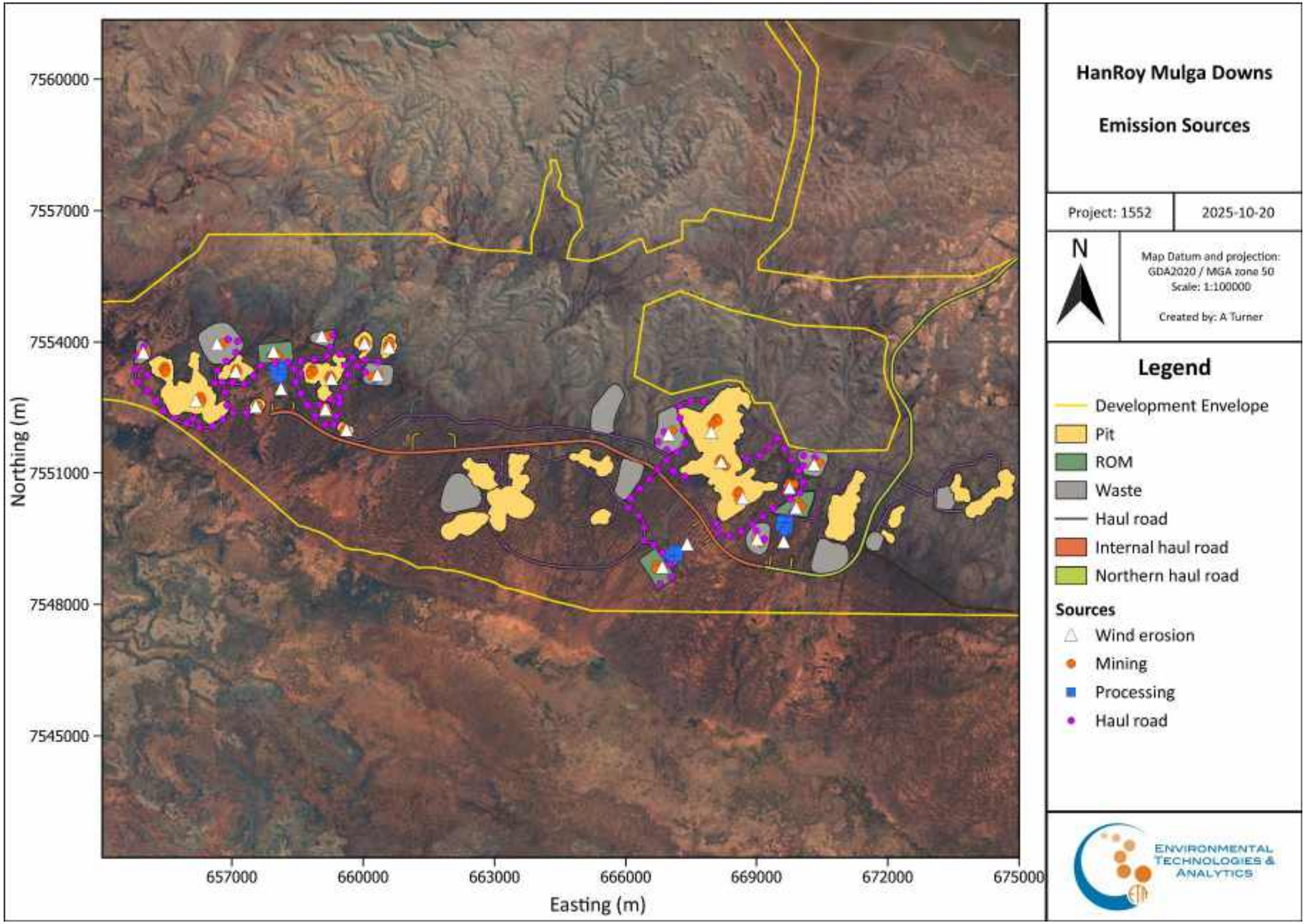

Figure 5-1: Emissions sources for Operations.

5.2 Emission estimates

This section outlines the emission estimation process for the Project. Emission estimates are sourced from the project emission inventory for inclusion in the dispersion model. It includes the emissions from mine operations, facilities and associated infrastructure including the road network. Emissions from all key sources have been identified according to accepted methods. The emphasis of the emission estimation and modelling is on the potential impact from the operating phase of the various operations within the Project.

5.2.1 Drilling

Emissions for drilling have been calculated using the default emissions contained within the Emissions Estimation Technique Manual (EETM) for Mining (Environment Australia 2012). The default values are:

- TSP: 0.59 kg/hole
- PM_{10}: 0.31 kg/hole
- $PM_{2.5}$: 28% of PM_{10} emissions

The statistics of the annual emissions from drilling for PM_{10} are contained in 0.

5.2.2 Blasting

Emissions for drilling have been calculated using Equation 19 outlined in Appendix A of the EETM for Mining (Environment Australia 2012). This is represented by Equation 1:

Equation 1: $$\boldsymbol{EF_{TSP\,(kg/blast)} = 0.00022 \times A^{1.5}}$$

Where A = blast area (m^2)

The emission factor for PM_{10} is taken as 52% of the TSP emission and the $PM_{2.5}$ emissions are taken as 15% of the PM_{10} emissions. The statistics of the annual emissions for blasting for PM_{10} are contained in 0.

5.2.3 Loading ore/waste

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 15% of the PM_{10} emissions. The statistics of the annual emissions for loading for PM_{10} are contained in 0.

5.2.4 Unloading ore/waste

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 15% of the PM_{10} emissions. The statistics of the annual emissions for loading for PM_{10} are contained in 0.

5.2.5 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 and moisture contents used were the defaults listed in the manual (10% moisture, 2% silt).

The emission factor for $PM_{2.5}$ emissions is taken as 15% of the PM_{10} emissions. The statistics of the annual PM_{10} emissions for bulldozing are contained in 0.

5.2.6 Front end loaders

Emissions for the operation of front end loaders, at the Run of Mine (ROM) pad, used the default emission factor listed in Appendix A of the EETM for Mining (Environment Australia 2012) for overburden. These factors are:

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

The emission factor for $PM_{2.5}$ emissions is taken as 15% of the PM_{10} emissions. The statistics of the annual emissions for loading for PM_{10} are contained in 0.

5.2.7 Crushing (primary/secondary/tertiary)

The emissions for crushing (primary, secondary and tertiary) were determined using the default emission factors for high moisture content ores from Table 3 of the EETM for Mining (Environment Australia 2012).

The emission factor for $PM_{2.5}$ emissions is taken as 15% of the PM_{10} emissions. The statistics of the annual emissions for crushing for PM_{10} are contained in 0.

5.2.8 Material handling (transfer stations, stackers, reclaimers, rail load out)

The emissions for the handling and transferring, including stacking and reclaiming, were determined using the default emission factors for high moisture content ores from Table 3 of the EETM for Mining (Environment Australia 2012).

The emission factor for $PM_{2.5}$ emissions is taken as 15% of the PM_{10} emissions. The statistics of the annual emissions for crushing for PM_{10} are contained in 0.

5.2.9 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 272 tonnes – being the average of an empty and fully laden CAT793E haul truck and the default silt content of 10% was utilised.

Equation 2: $$EF_{(kg/VKT)} = \frac{0.4536}{1.6093} \times k \times \left(\frac{s_{(\%)}}{12}\right)^{a} \times \left(\frac{W_{(t)}}{3}\right)^{b}$$

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)

5.2.10 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 3:

$$PM_{10_{(g/m^2/s)}} = k \times \left\{ WS^3 \times \left(1 - \left(WS_0{}^2 / WS^2\right)\right)\right\} \qquad WS > WS_0$$

$$PM_{10_{(g/m^2/s)}} = 0 \qquad WS < WS_0$$

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 6 m/s and the k constants were set at 3.38×10^{-7}. 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).

5.3 Emission controls

Emissions controls (for dust abatement) were included in the emissions estimation and these controls are summarised in Table 5-1, along with the percentage reduction applied to each source type.

Table 5-1: Dust abatement included in the model.

Source	Equipment	Dust abatement description	Emission reduction
Mining	Bulldozing	None	0%
	Loading ore and waste	In pit reduction	5% (PM_{10}) 50% (TSP)
	Unloading waste	None	0%
	Unloading ore at ROM pad	None	0%
	Loading ore at ROM pad	Watering	50%
	Drilling	In pit reduction	5% (PM_{10}) 50% (TSP)
	Blasting	In pit reduction	5% (PM_{10}) 50% (TSP)
	Wind erosion (in pit)	In pit	5% (PM_{10}) 50% (TSP)
	Wind erosion (all other)	Watering	50%
Haul road	Hauling	Level 1 watering	50%
Processing Facility	Unloading ore into primary crusher by front end loader	Watering	50%
	Primary crushing of ore	Enclosure	70%
	Transfer stations	Enclosure	70%

Source	Equipment	Dust abatement description	Emission reduction
	Secondary crusher	Enclosed with watering	85%
	Tertiary crusher	Enclosed with watering	85%
	Screening	Enclosed with extraction	90%
	Stacker	Watering	50%
	Loading road train	None	0%

5.4 Emission summary

A summary of the estimated annual emissions from the Project are shown in Table 5-2 for operational (mining and processing) related emissions. The emission sources along with the model parameters are presented in Appendix D while the PM_{10} emission statistics for each source are presented in 0.

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

Source	TSP	PM_{10}	$PM_{2.5}$
Drilling	7,442	7,429	1,114
Blasting	6,861	6,779	1,017
Load ore (pit)	128,551	117,239	17,586
Load ore (RoM)	257,103	123,409	18,511
Load waste	201,688	183,939	27,591
Unload ore (RoM)	123,409	44,222	6,633
Unload waste	193,621	69,381	10,407
Bulldozers (waste)	194,783	47,419	7,113
Bulldozers (RoM)	96,044	23,382	3,507
Haul Roads	3,105,971	916,761	137,514
Wind erosion	750,301	559,983	83,997
Primary crushing	30,852	12,341	1,851
Secondary crushing	23,139	9,256	1,388
Tertiary crushing	4,628	1,543	231
Screening	123,409	92,557	13,884
Stackers	25,710	10,284	1,543
Transfer stations	102,841	41,136	6,170
Loading road train	257,103	123,409	18,511
Total	**5,633,457**	**2,390,470**	**358,570**

Based on the emission estimation presented in Table 5-2 the primary emission sources, for operations, are associated with:

- Haul road emissions associated with the movement of haul trucks,

- Wind erosion from open areas and within the mining pits, and
- Loading of ore/waste into haul trucks in the mining pits and ROM.

6 Predicted Air Quality Impact

Comparison of the modelled results to the assessment criteria is intended to provide an objective evaluation of the potential impact of the operations at the nearest sensitive receptors.

For this assessment there two model scenarios:

- Scenario 1: Mulga Downs Project Mining operations baseline (2031 – year of highest tonnage) with no dust abatement measures applied,
- Scenario 2: Mulga Downs Project Mining operations baseline (2031 – year of highest tonnage) with dust abatement measures applied,

The results of the modelling are presented in two formats:

- Project only: modelled results for the project scenarios described above, representing the "project only" potential impact.
- Background (cumulative sources): the project emissions inclusive of the background concentrations as referenced in Section 2.3.

6.1 Scenario 1 – No dust abatement

6.1.1 TSP

As outlined in Section 3 the criteria for TSP is primarily designed for the protection of human amenity, and as a proxy for the protection of ecological values generally (e.g. habitat for protected fauna species, pools (i.e. surface water).

The isopleths for the maximum predicted 24-hour TSP concentrations for the no abatement scenario, with background concentrations (Section 2.3), are presented in Figure 6-1. The red contour line represents the assessment criteria concentration. The concentration contours show that for this scenario:

- The maximum 24-hour TSP concentrations are predicted be elevated around, and outwards, from the forecast mining areas.

The statistics of the predicted 24-hour TSP concentrations, for sensitive receptors, are presented in Table 6-1. The results for all receptors are contained in Appendix F.

The results indicate that at the nominated sensitive receptors for human amenity:

- There is the potential for elevated concentrations at the Mulga Downs Airport (R3) up to 323 µg/m^3.
  - The frequency of the elevated concentrations is equivalent to 45 days in the modelled year.
- There is the potential for elevated concentrations at the accommodation camp (R5) up to 629 µg/m^3.
  - The frequency of the elevated concentrations is equivalent to 196 days in the modelled year.

The results indicate that at the nominated sensitive receptors for protecting ecological values, where the proxy TSP criteria is applied:

- Elevated concentrations are predicted to occur at the majority of the receptors identified. Maximums above 250 µg/m^3 are common.
- Generally the closer the receptor is to the operations the higher the potential ground level concentration of TSP.

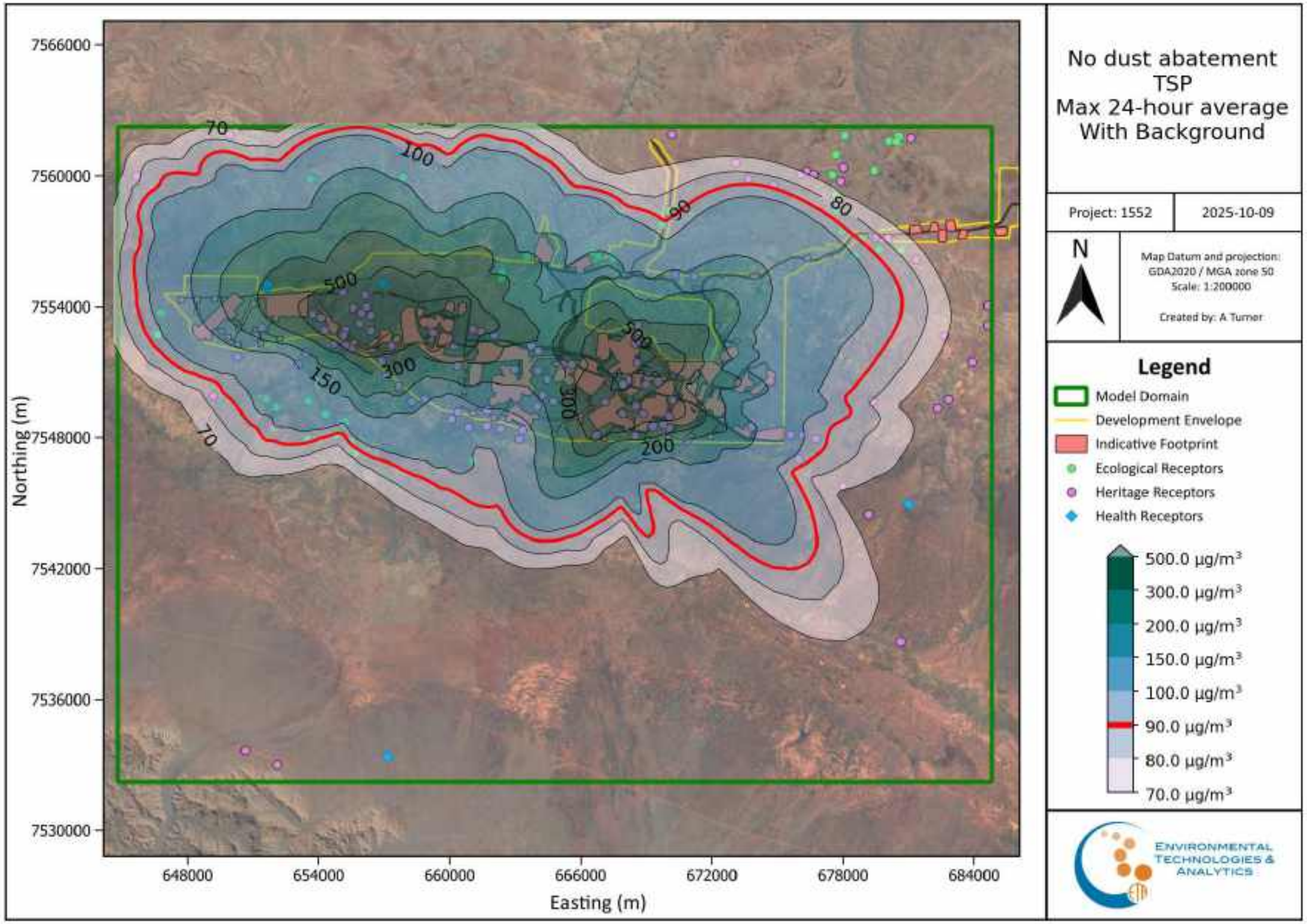

Figure 6-1: Scenario 1: TSP – maximum predicted 24-hour concentrations with background concentrations (µg/m³).

Table 6-1: Scenario 1: Statistics of 24-hour TSP concentration at selected receptor locations – including background (µg/m³).

Receptor No.	Receptor Name	Type	Maximum [1]	99th %ile	95th %ile	90th %ile	70th %ile	Average	Days >90 [2]
R1	Youngaleena Community	Human	41	38	35	34	33	33	0
R2	Wirrilimarra Community	Human	61	56	43	40	35	35	0
R3	Mulga Downs Airport	Human	323	145	107	94	69	59	45
R4	Homestead	Human	317	156	109	95	71	60	45
R5	Accommodation	Human	629	340	264	201	123	113	196

Notes:

[1] Model results are presented as the maximum modelled result, and lower percentiles (i.e. %ile) to provide an indication of the range of predicted ground level concentrations at each receptor. This provides an indication of whether predicted excursions are isolated events or indicative of a potential ongoing issue.

[2] The criteria used for this assessment for TSP is sourced from DWER (2019) and references the Kwinana Environmental Protection Policy Area C criteria of 90 µg/m³ equivalent to 82 µg/m³ at 25° C for modelling purposes (Section 3.5).

6.1.2 PM_{10}

As outlined in Section 3 the 24-hour (50 µg/m^3) and annual criteria (25 µg/m^3) for PM_{10} are based on the protection of human health and the criterion used in this assessment it is applicable to community receptors.

The isopleths for the annual average predicted PM_{10} concentrations are presented in Figure 6-2 while the isopleths for the maximum predicted 24-hour PM_{10} concentrations are presented in Figure 6-3. The red contour indicates the assessment criteria. The concentration contours show that:

- The maximum predicted 24-hour PM_{10} concentrations are predicted to occur in close proximity to the forecast mining areas.

The statistics of the predicted 24-hour PM_{10} concentrations, for the applicable sensitive receptors, are presented in Table 6-2 (with background concentrations (Section 2.3)). The results indicate that at the sensitive receptors where the primary impact of concern is the impact on human health (i.e. where community is present):

- For the HanRoy related community receptors the model is predicting –
  - There is the potential for excursions of the applicable criteria at the Mulga Downs Airport (R3).
  - The frequency of the elevated concentrations is equivalent to 9 days in the modelled year.
  - There is the potential for elevated concentrations at the accommodation camp (R5) up to 227 µg/m^3.
  - The frequency of the elevated concentrations is equivalent to 108 days in the modelled year.

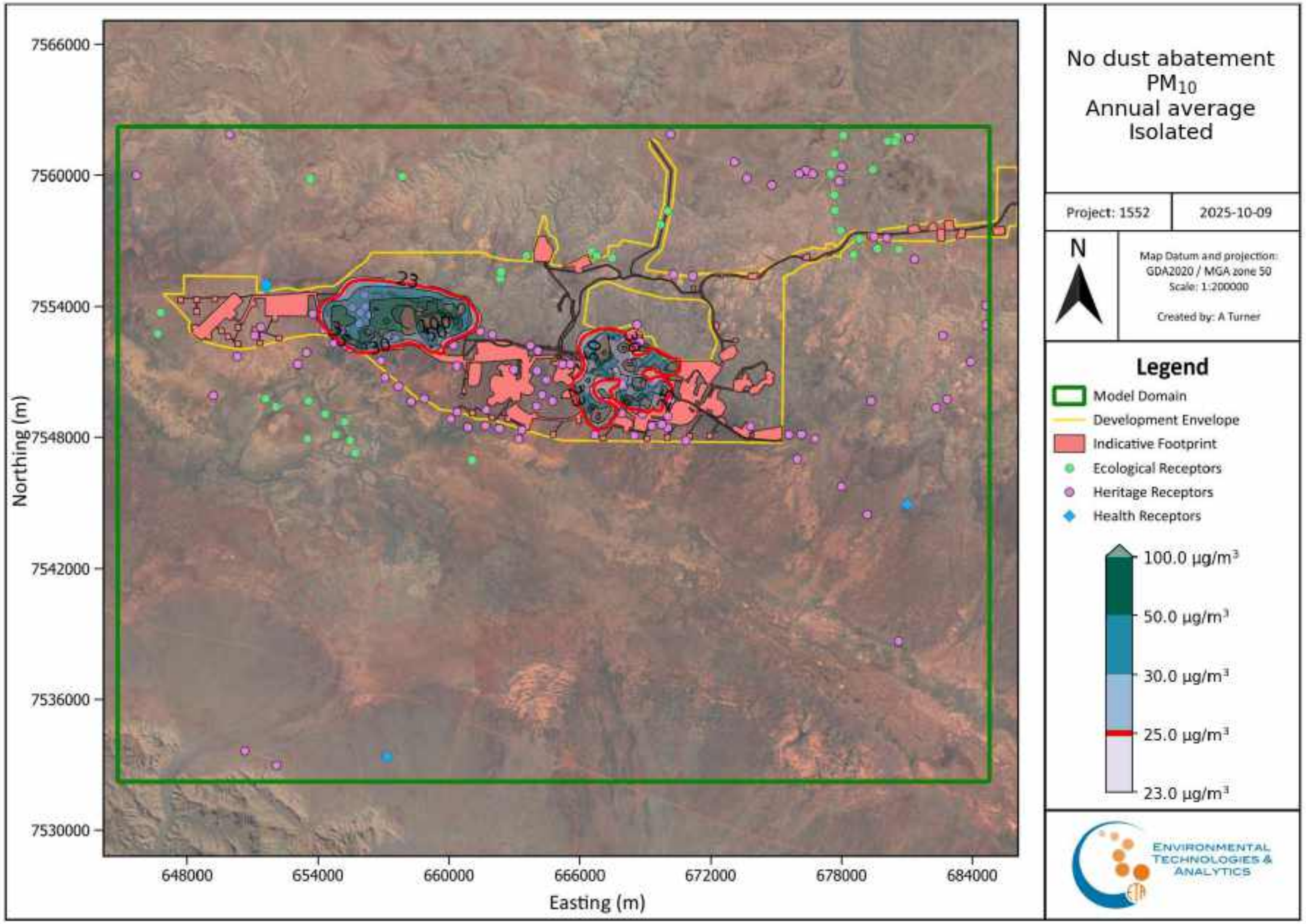

Figure 6-2: Scenario 1 PM_{10} – annual average concentrations with background concentrations (µg/m³).

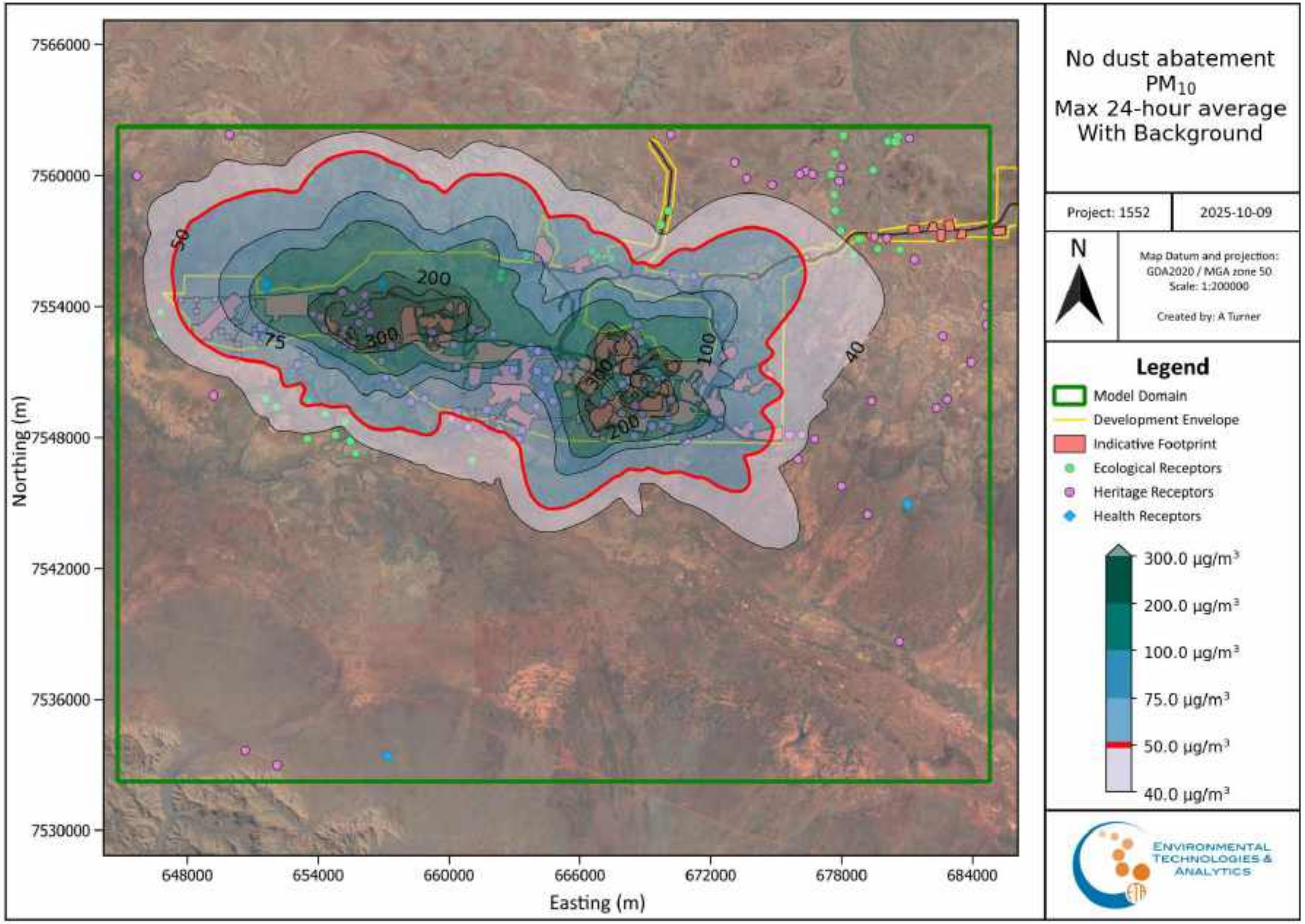

Figure 6-3: Scenario 1 PM_{10} – maximum predicted 24-hour concentrations with background concentrations (µg/m³).

Table 6-2: Scenario 1: Statistics of 24-hour PM_{10} concentration at selected receptor locations – including background (μg/m³).

Receptor No.	Receptor Name	Type	Maximum [1]	99th %ile	95th %ile	90th %ile	70th %ile	Average	Days >50 [2]
R1	Youngaleena Community	Human	21	20	19	19	18	18	0
R2	Wirrilimarra Community	Human	28	26	22	20	19	19	0
R3	Mulga Downs Airport	Human	116	56	43	39	30	27	9
R4	Homestead	Human	114	60	44	39	31	27	10
R5	Accommodation	Human	227	123	98	79	49	46	108

Notes:

[1] Model results are presented as the maximum modelled result, and lower percentiles (i.e. %ile) to provide an indication of the range of predicted ground level concentrations at each receptor. This provides an indication of whether predicted excursions are isolated events or an indicative of a potential ongoing issue.

[2] The criteria used for this assessment for PM_{10} is sourced from DWER (2019) and references the criteria at 0° C (50 μg/m³ at 0° C equivalent to 46 μg/m³ at 25° C for modelling purposes (Section 3.5).

6.1.3 $PM_{2.5}$

As outlined in Section 3 the 24-hour (25 µg/m^3) and annual criteria (8 µg/m^3) for $PM_{2.5}$ are based on the protection of human health and the criterion used in this assessment is applicable to community receptors.

The isopleths for the annual average predicted $PM_{2.5}$ concentrations are presented in Figure 6-4 while the isopleths for the maximum predicted 24-hour $PM_{2.5}$ concentrations are presented in Figure 6-5. The concentration contours show that:

- Elevated 24-hour $PM_{2.5}$ concentrations are only predicted to occur in relatively close proximity to the mining areas.

The statistics of the predicted 24-hour $PM_{2.5}$ concentrations, for sensitive receptors, is presented in Table 6-3 (with background concentrations (Section 2.3)). The results indicate that at the sensitive receptors where the primary impact of concern is the impact on human health (i.e. where community is present):

- For the HanRoy related community receptors the model is predicting that:
    - There are potential excursions of the applicable criteria at the accommodation camp (R5).
    - The frequency of the elevated concentrations is equivalent to 3 days in the modelled year.

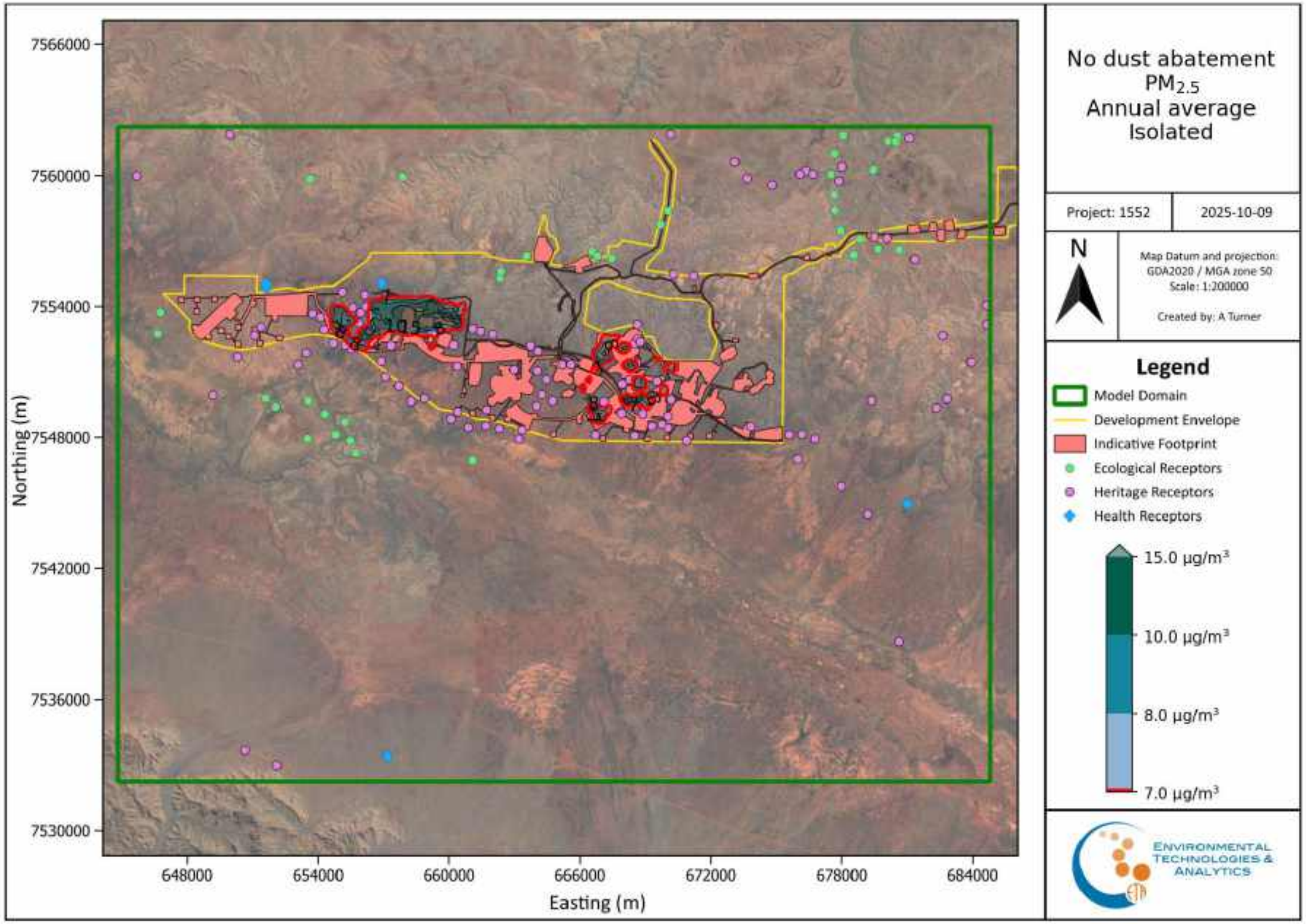

Figure 6-4: Scenario 1 $PM_{2.5}$ – annual average concentrations with background concentrations (µg/m³).

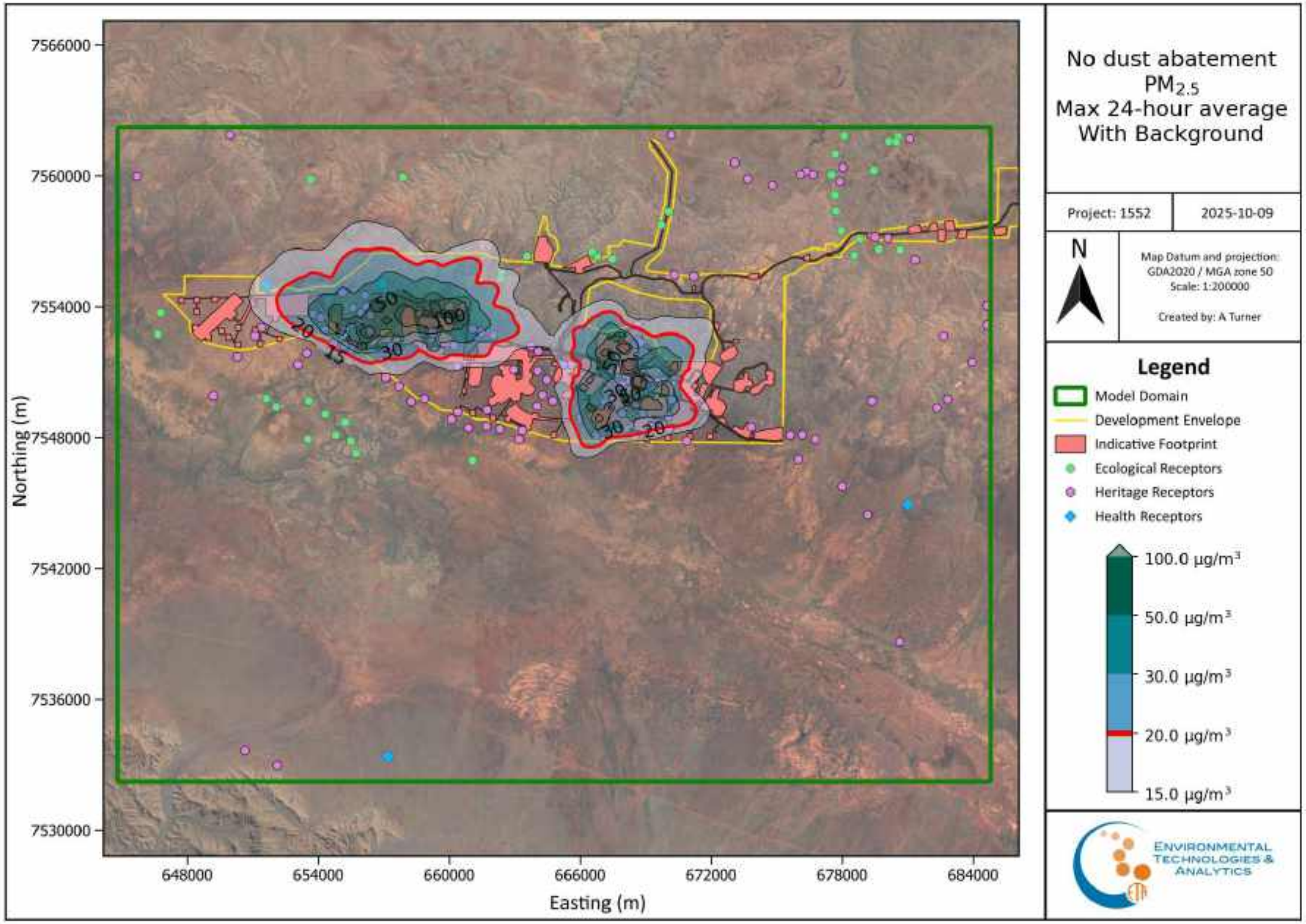

Figure 6-5: Scenario 1 $PM_{2.5}$ – maximum predicted 24-hour concentrations with background concentrations (µg/m³).

Table 6-3: Scenario 1: Statistics of 24-hour $PM_{2.5}$ concentration at selected receptor locations – including background (µg/m³).

Receptor No.	Receptor Name	Type	Maximum [1]	99th %ile	95th %ile	90th %ile	70th %ile	Average	Days >25 [2]
R1	Youngaleena Community	Human	3	3	3	3	3	3	0
R2	Wirrilimarra Community	Human	4	4	3	3	3	3	0
R3	Mulga Downs Airport	Human	17	8	6	6	4	4	0
R4	Homestead	Human	17	9	7	6	5	4	0
R5	Accommodation	Human	34	18	15	12	7	7	3

Notes:

[1] Model results are presented as the maximum modelled result, and lower percentiles (i.e. %ile) to provide an indication of the range of predicted ground level concentrations at each receptor. This provides an indication of whether predicted excursions are isolated events or indicative of a potential ongoing issue.

[2] The number of days in the modelled year estimated to be higher than the assessment criteria. The criteria used for this assessment for $PM_{2.5}$ is sourced from DWER (2019) and references the criteria at 0° C (25 µg/m³ at 0° C equivalent to 23 µg/m³ at 25° C for modelling purposes (Section 3.5)).

6.1.4 Deposition

As outlined in Section 3 the dust deposition criteria of 2 g/m^2/month is used in this assessment for amenity and Heritage receptors and ecological / biological values (fauna and surface water (i.e. pools)), while for the protection of ecological / biological values (flora (i.e. vegetation)) a proxy value of 7 g/m^2/month is utilised.

The isopleths for the predicted maximum monthly dust deposition are presented in Figure 6-6. In this figure the red contour line represents the predicted 2 g/m^2/month deposition rate. The deposition contours show that:

- Regions above the criteria (2 g/m^2/month) are only predicted to occur in relatively close proximity to the mining areas.
- There are receptors in close proximity to the planned mining areas and which are forecast to have a monthly deposition rate greater than 2 g/m^2/month.

The statistics of the predicted maximum monthly deposition, for sensitive receptors, are presented in Table 6-4. Receptors with a predicted monthly deposition rate potentially higher than the criteria have been highlighted. The results indicate that at the sensitive receptors where the primary impact of concern is deposition:

- For the Youngaleena community (R1) and Wirrilimarra community (R2), the model is not predicting excursions of the deposition criteria.

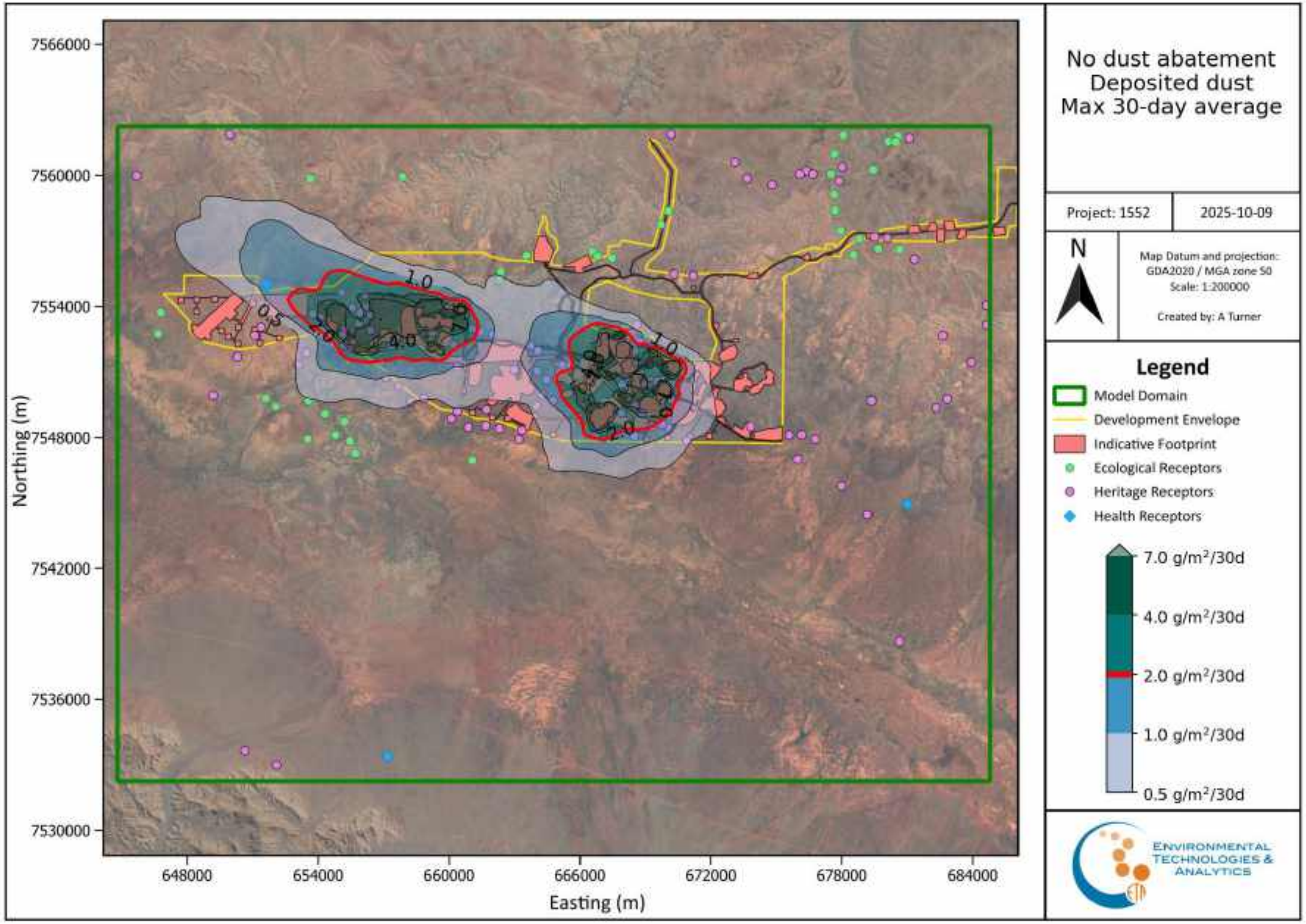

Figure 6-6: Scenario 1 Maximum monthly deposition no dust abatement – Project (g/m²/month). .

Table 6-4: Maximum predicted monthly deposition rates (g/m²/month).

Receptor No.	Receptor Name	Type	Deposition
R1	Youngaleena Community	Human	0.02
R2	Wirrilimarra Community	Human	0.07
R3	Mulga Downs Airport	Human	1.20
R4	Homestead	Human	1.22
R5	Accommodation	Human	2.02
R114	Freshwater claypans downstream of the Fortescue Marsh	Ecological	0.27
R115	Freshwater claypans downstream of the Fortescue Marsh	Ecological	0.49
R116	Freshwater claypans downstream of the Fortescue Marsh	Ecological	0.44
R117	Freshwater claypans downstream of the Fortescue Marsh	Ecological	0.33
R118	Freshwater claypans downstream of the Fortescue Marsh	Ecological	0.23
R119	Freshwater claypans downstream of the Fortescue Marsh	Ecological	0.18
R120	Freshwater claypans downstream of the Fortescue Marsh	Ecological	0.03
R121	Freshwater claypans downstream of the Fortescue Marsh	Ecological	0.03
R122	Four plant assemblages of the Wona Land system	Ecological	0.03
R123	Four plant assemblages of the Wona Land system	Ecological	0.02
R124	Threatened Ecological Community	Ecological	0.02
R125	Threatened Ecological Community	Ecological	0.11
R126	Threatened Ecological Community	Ecological	0.07
R127	Threatened Ecological Community	Ecological	0.20
R128	Threatened Ecological Community	Ecological	0.12
R129	Threatened Ecological Community	Ecological	0.03
R130	Threatened Ecological Community	Ecological	0.03
R131	Threatened Ecological Community	Ecological	0.03
R132	Threatened Ecological Community	Ecological	0.03

Note:

Shading indicates modelled result higher than the assessment criteria.

6.2 Scenario 2 – with dust abatement

Scenario 2, as outlined in the Section 5.1, represents the predicted impacts for the highest mining tonnage year (2031) within the immediate region. The model results for this scenario are presented in the following sections as TSP, PM_{10} and $PM_{2.5}$ along with dust deposition.

6.2.1 TSP

As outlined in Section 3 the criteria for TSP is primarily designed for the protection of human amenity, and as a proxy for the protection of ecological values generally (e.g. habitat for protected fauna species, pools (i.e. surface water).

The isopleths for the maximum predicted 24-hour TSP concentrations, with background concentrations (Section 2.3), are presented in Figure 6-7Figure 6-1. The red contour line represents the assessment criteria concentration. The concentration contours show that for this scenario:

- The maximum 24-hour TSP concentrations are predicted be elevated around, and outwards, from the forecast mining areas.

The statistics of the predicted 24-hour TSP concentrations, for sensitive receptors, are presented in Table 6-5 for Scenario 2. The results for all receptors are contained in Appendix G.

The results indicate that at the nominated sensitive receptors for human amenity:

- There is the potential for elevated concentrations at the Mulga Downs Airport (R3) up to 212 µg/m^3
    - The frequency of the elevated concentrations is equivalent to 8 days in the modelled year.
- There is the potential for elevated concentrations at the accommodation camp (R5) up to 427 µg/m^3.
    - The frequency of the elevated concentrations is equivalent to 108 days in the modelled year.

The results indicate that at the nominated sensitive receptors for protecting ecological values, where the proxy TSP criteria is applied:

- Elevated concentrations are predicted to occur at the majority of the receptors identified. Maximums above 250 µg/m^3 are common, with some location being above 1,000 µg/m^3.
- Generally the closer the receptor is to the operations the higher the potential ground level concentrations of TSP.

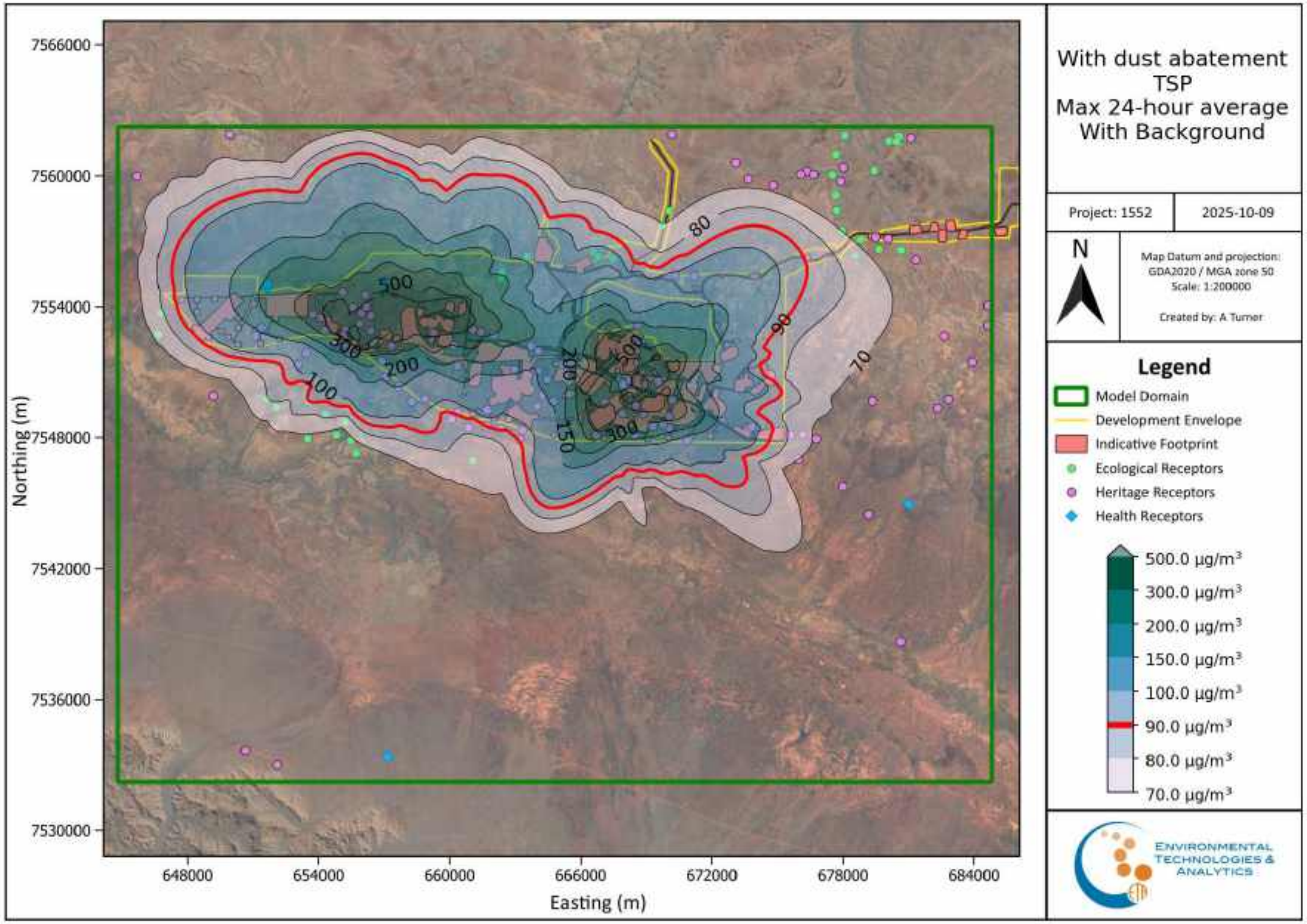

Figure 6-7: Scenario 2 TSP – maximum predicted 24-hour concentrations with background concentrations (µg/m³).

Table 6-5: Statistics of 24-hour TSP concentration at selected receptor locations – including background (μg/m³).

Receptor No.	Receptor Name	Type	Maximum [1]	99th %ile	95th %ile	90th %ile	70th %ile	Average	Days >90 [2]
R1	Youngaleena Community	Human	38	36	34	34	33	33	0
R2	Wirrilimarra Community	Human	49	46	39	37	34	34	0
R3	Mulga Downs Airport	Human	212	100	76	69	53	48	8
R4	Homestead	Human	209	106	77	69	55	49	10
R5	Accommodation	Human	427	227	182	144	89	84	108

Notes:

[1] Model results are presented as the maximum modelled result, and lower percentiles (i.e. %ile) to provide an indication of the range of predicted ground level concentrations at each receptor. This provides an indication of whether predicted excursions are isolated events or indicative of a potential ongoing issue.

[2] The criteria used for this assessment for TSP is sourced from DWER (2019) and references the Kwinana Environmental Protection Policy Area C criteria of 90 μg/m³ equivalent to 82 μg/m³ at 25° C for modelling purposes (Section 3.5).

6.2.2 PM_{10}

As outlined in Section 3 the 24-hour (50 µg/m^3) and annual criteria (25 µg/m^3) for PM_{10} are based on the protection of human health and the criterion used in this assessment it is applicable to community receptors.

The isopleths for the annual average predicted PM_{10} concentrations are presented in Figure 6-8Figure 6-9, while the isopleths for the maximum predicted 24-hour PM_{10} concentrations are presented in Figure 6-9. The red contour indicates the assessment criteria. The concentration contours show that:

- The maximum predicted 24-hour PM_{10} concentrations are predicted to occur in close proximity to the forecast mining areas.

The statistics of the predicted 24-hour PM_{10} concentrations, for the applicable sensitive receptors, are presented in Table 6-6 (with background concentrations (Section 2.3)). The results indicate that at the sensitive receptors where the primary impact of concern is the impact on human health (i.e. where community is present):

- For the HanRoy related community receptors the model is predicting –
    - There is the potential for excursions of the applicable criteria at the Mulga Downs Airport (R3). The frequency of the elevated concentrations is equivalent to 2 days in the modelled year.
    - There is the potential for elevated concentrations at the accommodation camp (R5) up to 176 µg/m^3. The frequency of the elevated concentrations is equivalent to 64 days in the modelled year.

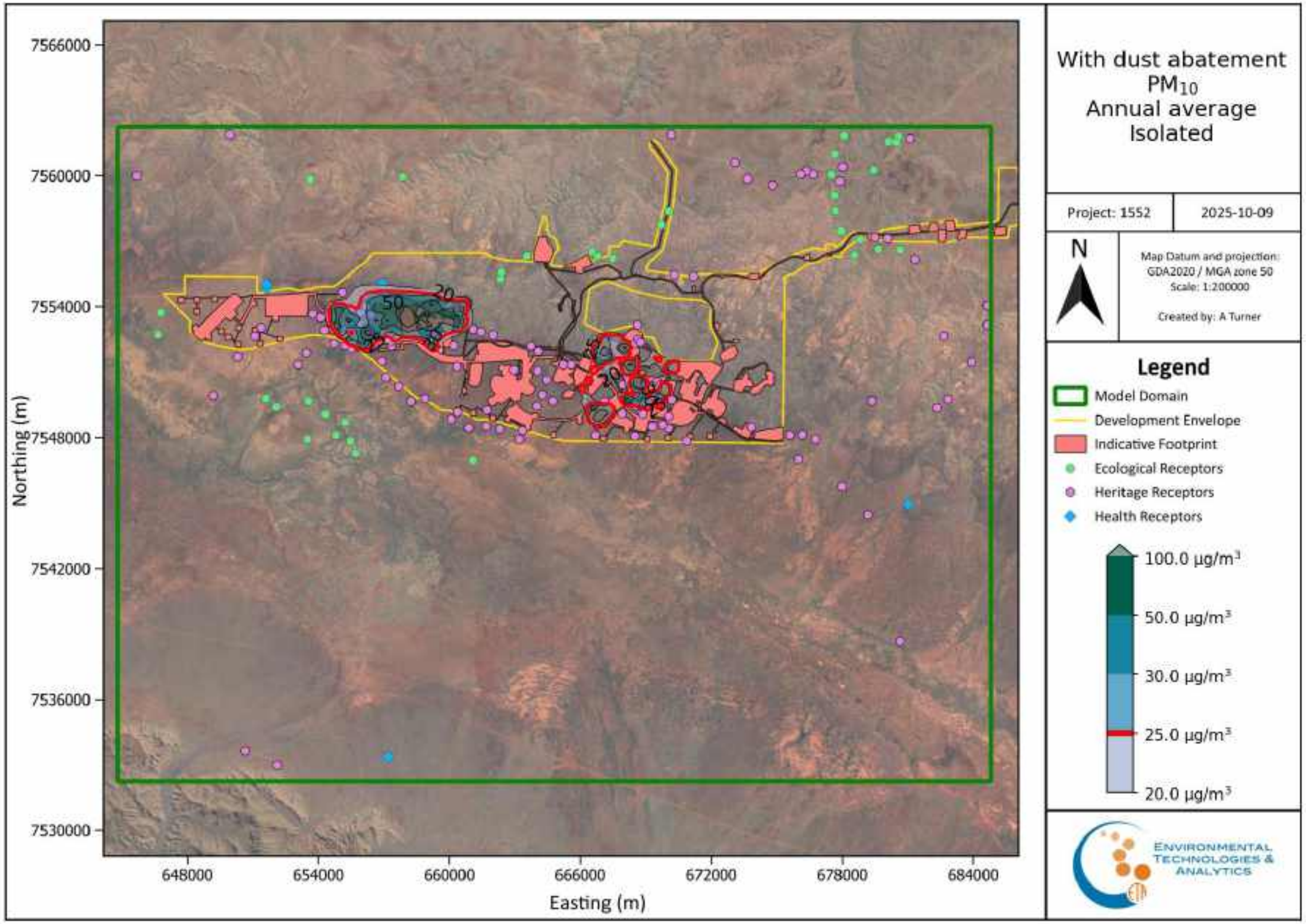

Figure 6-8: Scenario 2 PM_{10} – annual average concentrations with background concentrations (µg/m³).

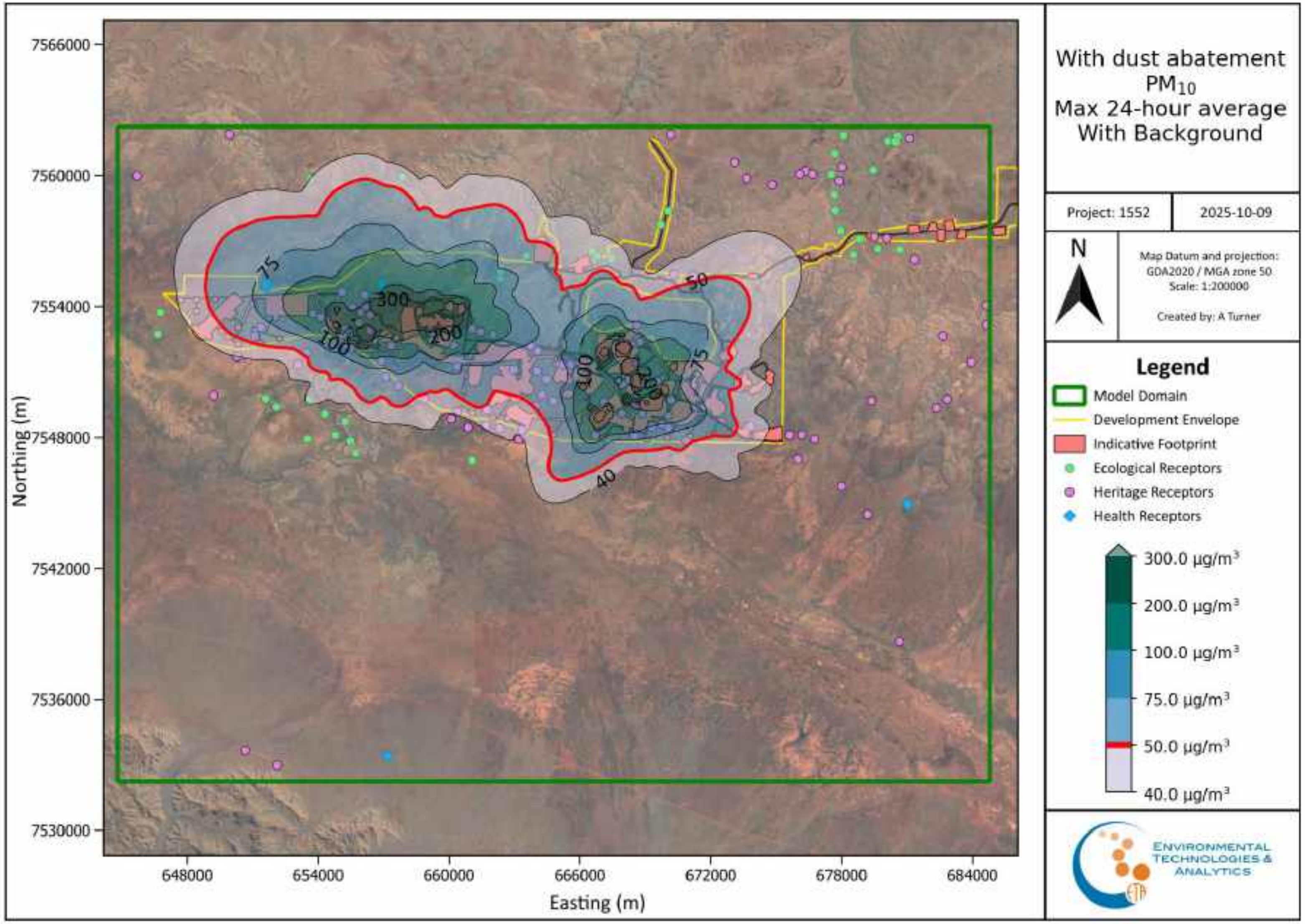

Figure 6-9: Scenario 2 PM_{10} – maximum predicted 24-hour concentrations with background concentrations (µg/m³).

Table 6-6: Statistics of 24-hour PM_{10} concentration at selected receptor locations – including background (µg/m³).

Receptor No.	Receptor Name	Type	Maximum[1]	99th %ile	95th %ile	90th %ile	70th %ile	Average	Days >50 [2]
R1	Youngaleena Community	Human	20	19	19	19	18	18.3	0
R2	Wirrilimarra Community	Human	24	23	21	20	19	18.7	0
R3	Mulga Downs Airport	Human	84	43	34	31	26	23.8	2
R4	Homestead	Human	82	45	35	32	26	24.0	2
R5	Accommodation	Human	176	93	73	63	40	37.3	64

Notes:

[1] Model results are presented as the maximum modelled result, and lower percentiles (i.e. %ile) to provide an indication of the range of predicted ground level concentrations at each receptor. This provides an indication of whether predicted excursions are isolated events or an indicative of a potential ongoing issue.

[2] The criteria used for this assessment for PM_{10} is sourced from DWER (2019) and references the criteria at 0° C (50 µg/m³ at 0° C equivalent to 46 µg/m³ at 25° C for modelling purposes (Section 3.5).

6.2.3 $PM_{2.5}$

As outlined in Section 3 the 24-hour (25 µg/m^3) and annual criteria (8 µg/m^3) for $PM_{2.5}$ are based on the protection of human health and the criterion used in this assessment is applicable to community receptors.

The isopleths for the annual average predicted $PM_{2.5}$ concentrations are presented in Figure 6-10Figure 6-4 while the isopleths for the maximum predicted 24-hour $PM_{2.5}$ concentrations are presented in Figure 6-11. The concentration contours show that:

- Elevated 24-hour $PM_{2.5}$ concentrations are only predicted to occur in relatively close proximity to the mining areas.

The statistics of the predicted 24-hour $PM_{2.5}$ concentrations, for sensitive receptors, is presented in Table 6-7 (with background concentrations (Section 2.3)). The results indicate that at the sensitive receptors where the primary impact of concern is the impact on human health (i.e. where community is present):

- For the HanRoy related community receptors the model is predicting that:
  - There are excursions of the applicable criteria at the accommodation camp (R5).
  - The frequency of the elevated concentrations is equivalent to 3 days in the modelled year.

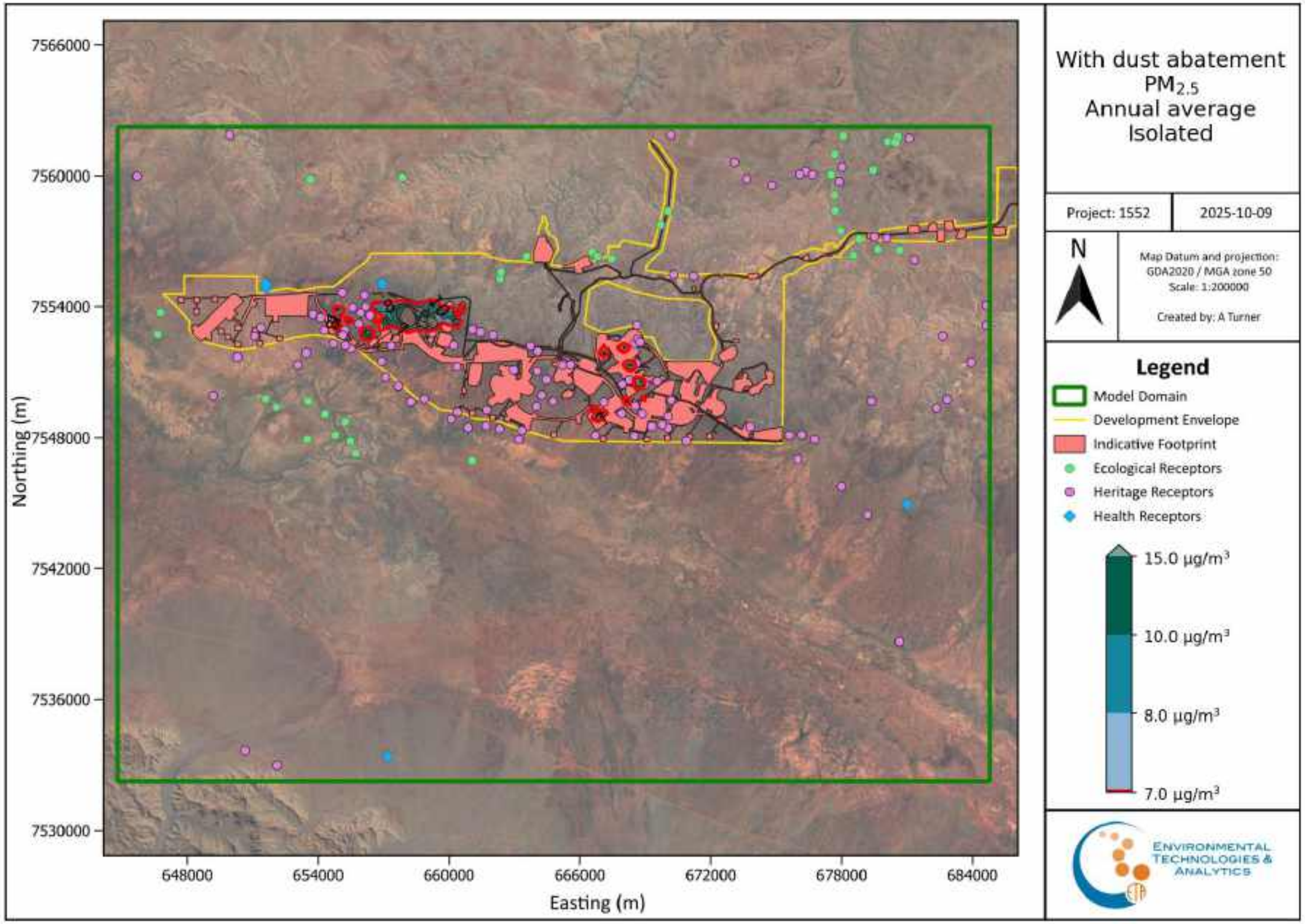

Figure 6-10: Scenario 2 $PM_{2.5}$ – annual average concentrations with background concentrations (µg/m³).

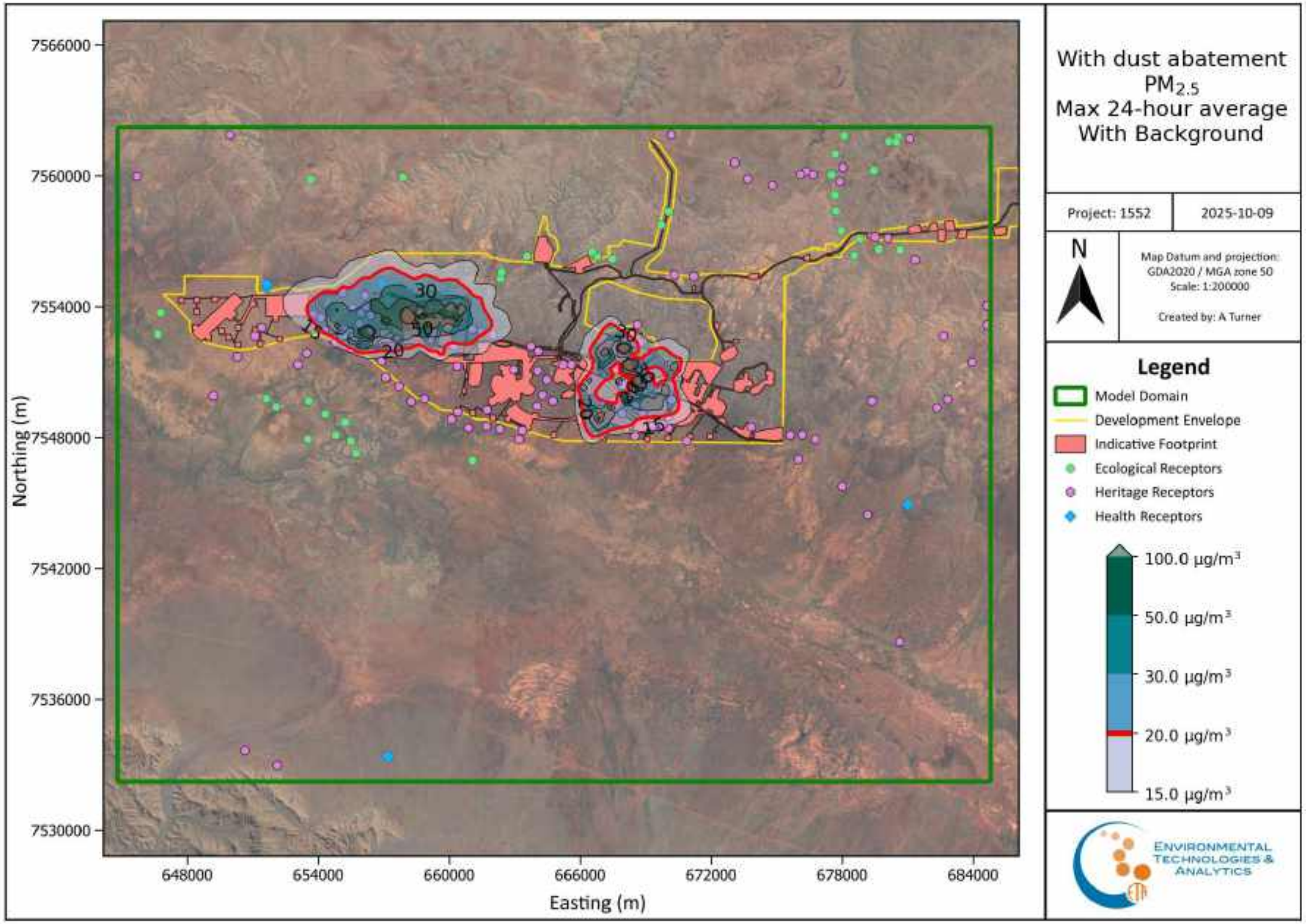

Figure 6-11: Scenario 2 $PM_{2.5}$ – maximum predicted 24-hour concentrations with background concentrations (µg/m³).

Table 6-7: Statistics of 24-hour $PM_{2.5}$ concentration at selected receptor locations for Scenario 2 – including background (µg/m3).

Receptor No.	Receptor Name	Type	Maximum [1]	99th %ile	95th %ile	90th %ile	70th %ile	Average	Days >25 [2]
R1	Youngaleena Community	Human	3.0	2.9	2.8	2.7	2.7	2.7	0
R2	Wirrilimarra Community	Human	3.6	3.4	3.0	2.9	2.8	2.8	0
R3	Mulga Downs Airport	Human	12.5	6.5	5.1	4.7	3.8	3.5	0
R4	Homestead	Human	12	7	5	5	4	4	0
R5	Accommodation	Human	26.4	13.8	10.9	9.4	5.9	5.6	3

Notes:

[1] Model results are presented as the maximum modelled result, and lower percentiles (i.e. %ile) to provide an indication of the range of predicted ground level concentrations at each receptor. This provides an indication of whether predicted excursions are isolated events or indicative of a potential ongoing issue.

[2] The number of days in the modelled year estimated to be higher than the assessment criteria. The criteria used for this assessment for $PM_{2.5}$ is sourced from DWER (2019) and references the criteria at 0° C (25 µg/m^3 at 0° C equivalent to 23 µg/m^3 at 25° C for modelling purposes (Section 3.5).

6.2.4 Deposition

As outlined in Section 3 the dust deposition criteria of 2 g/m^2/month is used in this assessment for amenity and Heritage receptors and ecological / biological values (fauna and surface water (i.e. pools)), while for the protection of ecological / biological values (flora (i.e. vegetation)) a proxy value of 7 g/m^2/month is utilised.

The isopleths for the predicted maximum monthly dust deposition are presented in Figure 6-6. In this figure the red contour line represents the predicted 2 g/m^2/month deposition rate. The deposition contours show that:

- Regions above the criteria (2 g/m^2/month) are only predicted to occur in relatively close proximity to the mining areas.
- There are receptors in close proximity to the planned mining area and which are forecast to have a monthly deposition rate greater than 2 g/m^2/month.

The statistics of the predicted maximum monthly deposition, for sensitive receptors, are presented in Table 6-8. Receptors with a predicted monthly deposition rate potentially higher than the criteria have been highlighted. The results indicate that at the sensitive receptors where the primary impact of concern is deposition:

- For the Youngaleena community (R1) and Wirrilimarra community (R2), the model is not predicting excursions of the deposition criteria.

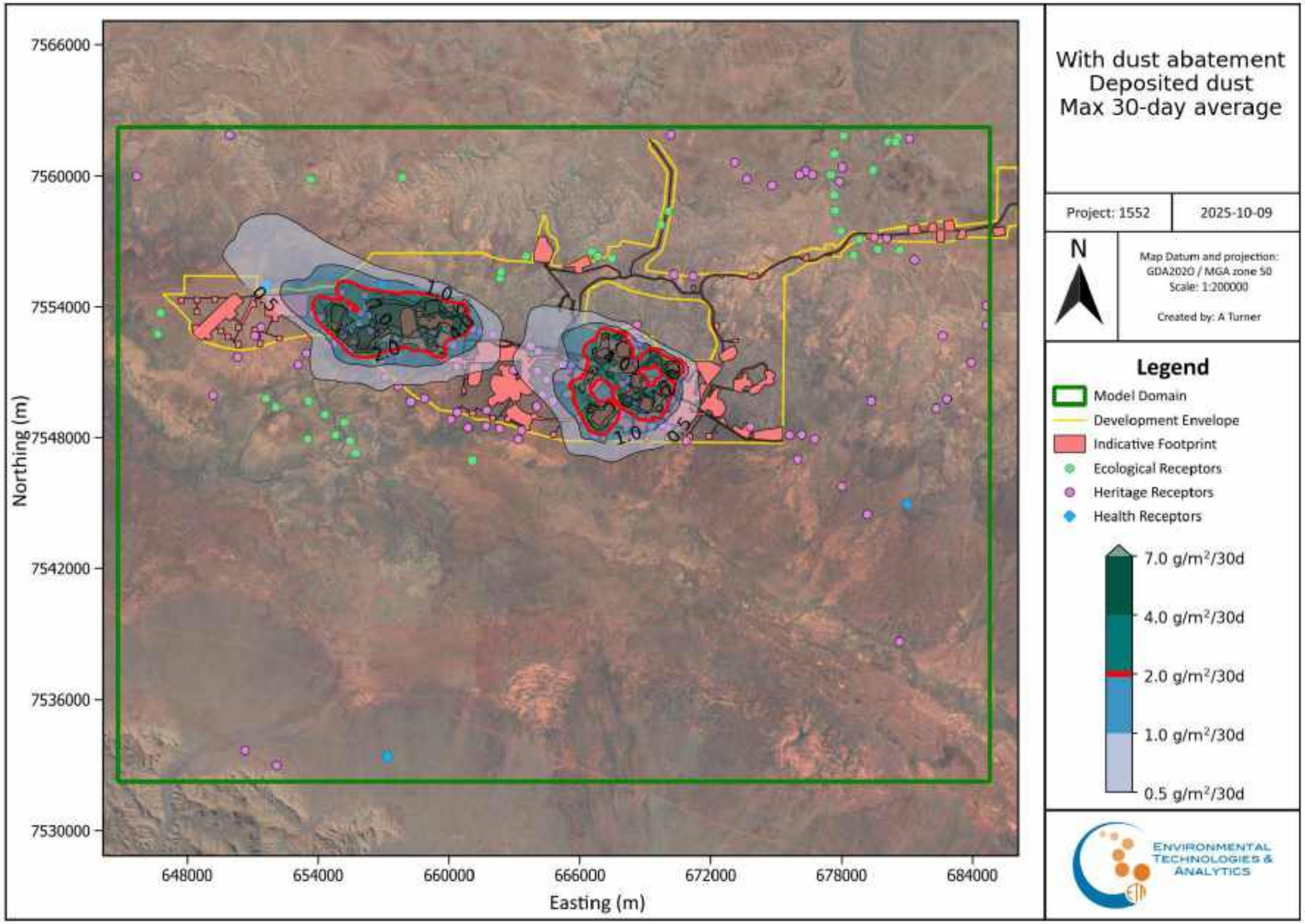

Figure 6-12: Scenario 2 maximum monthly deposition – Project (g/m^2/month).

Table 6-8: Maximum predicted monthly deposition rates (g/m²/month).

Receptor No.	Receptor Name	Type	Deposition
R1	Youngaleena Community	Human	0.02
R2	Wirrilimarra Community	Human	0.04
R3	Mulga Downs Airport	Human	0.71
R4	Homestead	Human	0.74
R5	Accommodation	Human	1.21
R114	Freshwater claypans downstream of the Fortescue Marsh	Ecological	0.18
R115	Freshwater claypans downstream of the Fortescue Marsh	Ecological	0.34
R116	Freshwater claypans downstream of the Fortescue Marsh	Ecological	0.29
R117	Freshwater claypans downstream of the Fortescue Marsh	Ecological	0.22
R118	Freshwater claypans downstream of the Fortescue Marsh	Ecological	0.15
R119	Freshwater claypans downstream of the Fortescue Marsh	Ecological	0.12
R120	Freshwater claypans downstream of the Fortescue Marsh	Ecological	0.02
R121	Freshwater claypans downstream of the Fortescue Marsh	Ecological	0.02
R122	Four plant assemblages of the Wona Landsystem	Ecological	0.02
R123	Four plant assemblages of the Wona Landsystem	Ecological	0.02
R124	Threatened Ecological Community	Ecological	0.01
R125	Threatened Ecological Community	Ecological	0.06
R126	Threatened Ecological Community	Ecological	0.04
R127	Threatened Ecological Community	Ecological	0.12
R128	Threatened Ecological Community	Ecological	0.07
R129	Threatened Ecological Community	Ecological	0.02
R130	Threatened Ecological Community	Ecological	0.02
R131	Threatened Ecological Community	Ecological	0.02
R132	Threatened Ecological Community	Ecological	0.02

7 Conclusions

HanRoy is proposing to develop the Mulga Downs Iron Ore Project located approximately 260 kilometres south of Port Hedland in the Pilbara region of Western Australia. The purpose of the air quality assessment is to assist in determining the potential impacts of the proposed operations on communities within the region.

For this assessment two scenarios were investigated:

- Mining operations baseline for the Proposal (2031 – year of highest tonnage):
  - Model with baseline mine activities information for HanRoy operations in the Mulga Downs project area, without dust abatement measures applied.
  - Model with baseline mine activities information for HanRoy operations in the Mulga Downs project area, with dust abatement measures applied.

Modelled ground level concentrations for the key pollutants (particles as TSP, PM_{10}, $PM_{2.5}$ and dust deposition) have been compared to relevant ambient air quality assessment criteria to determine the potential impact on key sensitive receptors. The sensitive receptors considered in the assessment include human, heritage and ecological receptor locations.

Modelling impacts for both scenarios was undertaken using the CALMET/CAPUFF modelling suite. In the absence of onsite meteorological measurements, the Weather Research and Forecast (WRF) model was used to simulate the meteorology over the region for a representative year (2020) and was then input to the CALMET model to generate fine-resolution three-dimensional meteorological fields. Fine resolution terrain elevation (SRTM) data with 90 m resolution was used in conjunction with ESACCI-LU land-use data to characterise the geophysical environment.

The emission estimation was calculated utilising emission factors from the EETM for Mining (Environment Australia 2012) and input into the CALPUFF dispersion model as volume sources to simulate mining, haulage and processing, and area sources to simulate wind-blown dust. Background concentrations were also included for TSP, PM_{10} and $PM_{2.5}$ to provide an indication of the potential cumulative impact from the existing operations.

The key findings of the modelling assessment, in relation to the potential environmental impact, assessed by comparison to assessment criteria are:

- For TSP:
  - For Scenario 1 (operations without dust abatement measures)
    - No excursions of the TSP criteria at either of the communities.
    - Elevated concentrations are predicted to occur at HanRoy receptors in close proximity to the operations.
  - For Scenario 2 (operations with dust abatement measures):
    - No excursions of the TSP criteria at either of the communities.
    - The introduction of 'standard' dust abatement does result in a reduction in predicted ground level concentrations though elevated concentrations are still predicted to occur at HanRoy receptors in close proximity to the operations.
- For PM_{10}:
  - For Scenario 1 (operations without dust abatement measures):
    - No excursions of the PM_{10} criteria at either of the communities.
    - Elevated concentrations are predicted to occur at HanRoy receptors in close proximity to the operations.
  - For Scenario 2 (operations with dust abatement measures):

        - No excursions of the PM_{10} criteria at either of the communities.
        - The introduction of 'standard' dust abatement does result in a reduction in predicted ground level concentrations though elevated concentrations are still predicted to occur at HanRoy receptors in close proximity to the operations.
- For $PM_{2.5}$:
    - For Scenario 1 (operations without dust abatement measures)
        - No excursions of the $PM_{2.5}$ criteria at either of the communities.
        - Elevated concentrations are predicted to occur at HanRoy receptors in close proximity to the operations.
    - For Scenario 2 (operations with dust abatement measures):
        - No excursions of the $PM_{2.5}$ criteria at either of the communities.
        - The introduction of 'standard' dust abatement does result in a reduction in predicted ground level concentrations though elevated concentrations are still predicted to occur at HanRoy receptors in close proximity to the operations.
- Deposition:
    - For Scenario 1 (operations without dust abatement measures):
        - No excursions of the deposition criteria at either of the communities.
        - Some receptors within close proximity to the planned operations are forecast to have a monthly deposition rate greater than 2 $g/m^2/month$.
    - For Scenario 2 (operations with dust abatement measures):
        - No excursions of the deposition criteria at either of the communities.
        - Some receptors within close proximity to the planned operations are forecast to have a monthly deposition rate greater than 2 $g/m^2/month$, though to a lower extent than for Scenario 1.

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9 Acronyms and Glossary

Acronym	Description
AWS	Automatic Weather Station
BoM	Bureau of Meteorology
BWS	Belt wash station
C	Degrees Celsius (temperature)
CV	Conveyor
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

Acronym	Description
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
TS	Transfer station
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: WRF

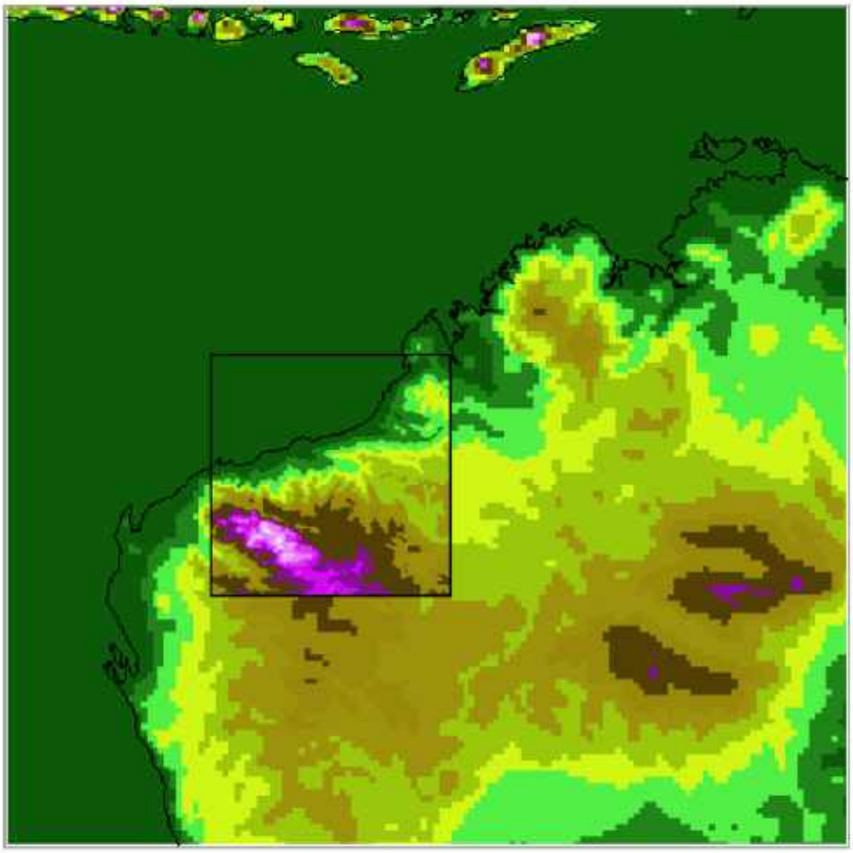
WRF was developed (and continues to be developed) in the United States by a collaborative partnership including the National Center for Atmospheric Research (NCAR), the National Oceanic and Atmospheric Administration (the National Center for Environmental Prediction (NCEP), the Forecast Systems Laboratory (FSL), the Air Force Weather Agency (AFWA), the Naval Research Laboratory, the University of Oklahoma, the Federal Aviation Administration (FAA) and others (WRF, 2012).

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[1] data to produce fine-scale 3-dimensional meteorological fields that considers local terrain and land-use effects.

WRF was run with a two-nest structure (80 km and 6 km horizontal grid space resolution) centred on 23.055°S and 119.25°E. This is shown in Appendix Figure 1. The model vertical resolution consists of 34 eta levels[2].

[1] 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.

[2] Eta levels are terrain-following vertical coordinates.



Appendix Figure 1: WRF model domains showing terrain elevation.

Physics options in WRF are to represent atmospheric radiation, surface and boundary layer as well as cloud and precipitation processes. The physics options selected for the modelling are summarised in Appendix Table 1.

Appendix Table 1: WRF Physics Options Selected for Model.

	Domain 1	Domain 2	Explanatory Notes
mp_physics	3	3	WRF single moment 3-class scheme
ra_lw_physics	1	1	Rapid radiative transfer model scheme
ra_sw_physics	1	1	Dudhia scheme for cloud and clear sky absorption and scattering
Radt	30	15	Time step for radiation schemes
sf_sfclay_physics	1	1	MM5 based on MOST
sf_surface_physics	2	2	Noah land surface model with 6 soil layers
bl_pbl_physics	1	1	Non-local K-scheme with entrainment layer
bldt	0	0	Boundary layer time step (0=every time step)
cu_physics	1	1	Kain-Fritch scheme using mass flux approach for domain 1 only.
cudt	5	5	Cumulus physics time step (minutes)

Six-hourly global final analysis 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 was 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. A review of the Vegparm.tbl[3] reveals that these are based on North American parameterisations, with marked seasonal differences to allow for winter snow cover. These are clearly inappropriate for the Pilbara region. A non-seasonally varying roughness length value of 0.4 m was assigned to the shrub land category based on a study by Peel *et al*. (2005) for Spinifex vegetation in the Pilbara. Albedo was also set to 0.2 based on values cited in Peel *et al*. (2005). Other parameters such as Bowen ratio were adjusted to allow for the drier climate of the Pilbara.

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
- upward (reflected) shortwave radiation.

[3] A table consisting of land-use specific surface roughness, albedo and Bowen ratio.

A.2: CALMET

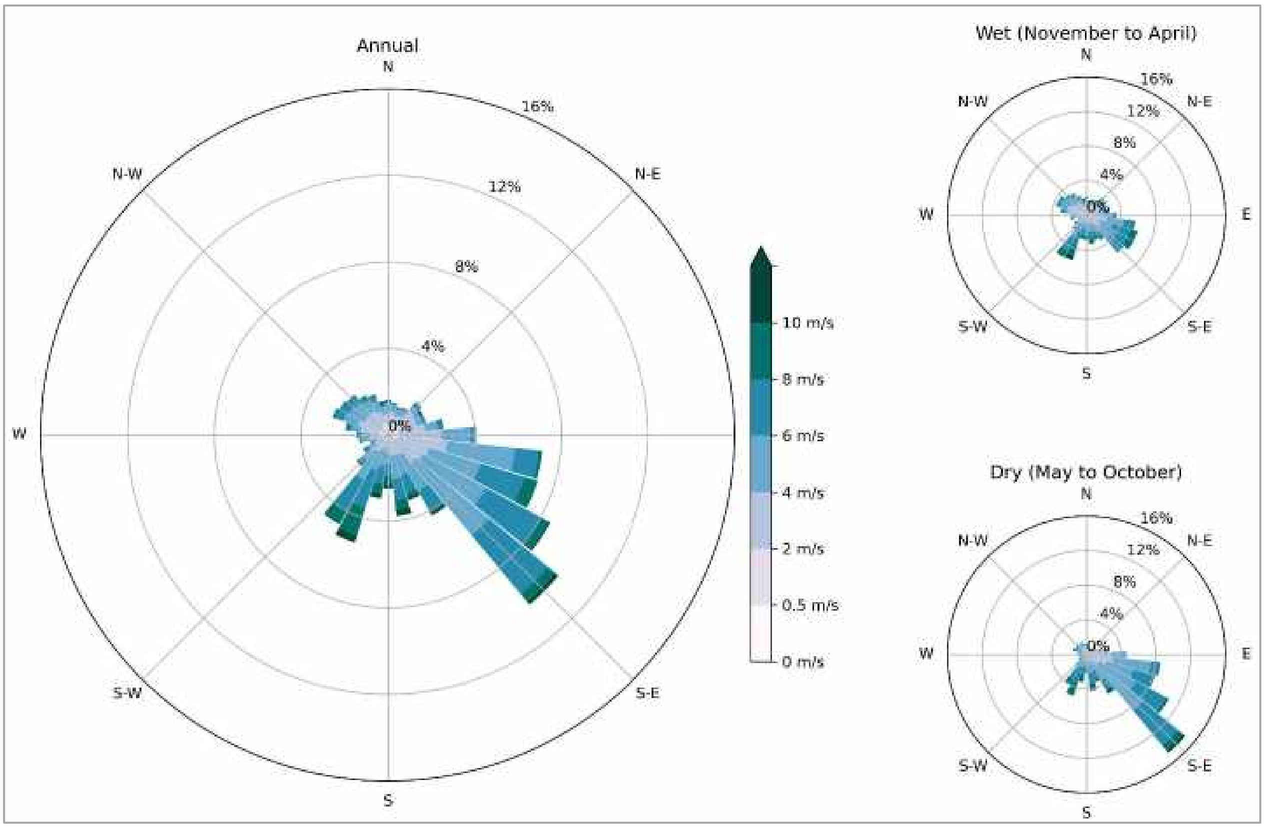
CALMET Results

Wind

Selected meteorological variables were extracted from the gridded CALMET output for a point corresponding to Mulga Downs. The diurnal characteristics of the 10 m winds are illustrated in the annual and seasonal wind rose diagrams for the 12-month period from January 2020 – December 2020. These are shown in Appendix Figure 2. The wind roses show the frequency of occurrence of winds by direction and strength.

The major features of the wind roses are as follows:

- Wind direction is predominantly from the east for the summer, autumn and winter months.
- Spring is a transitional month with winds from the west to southwest.



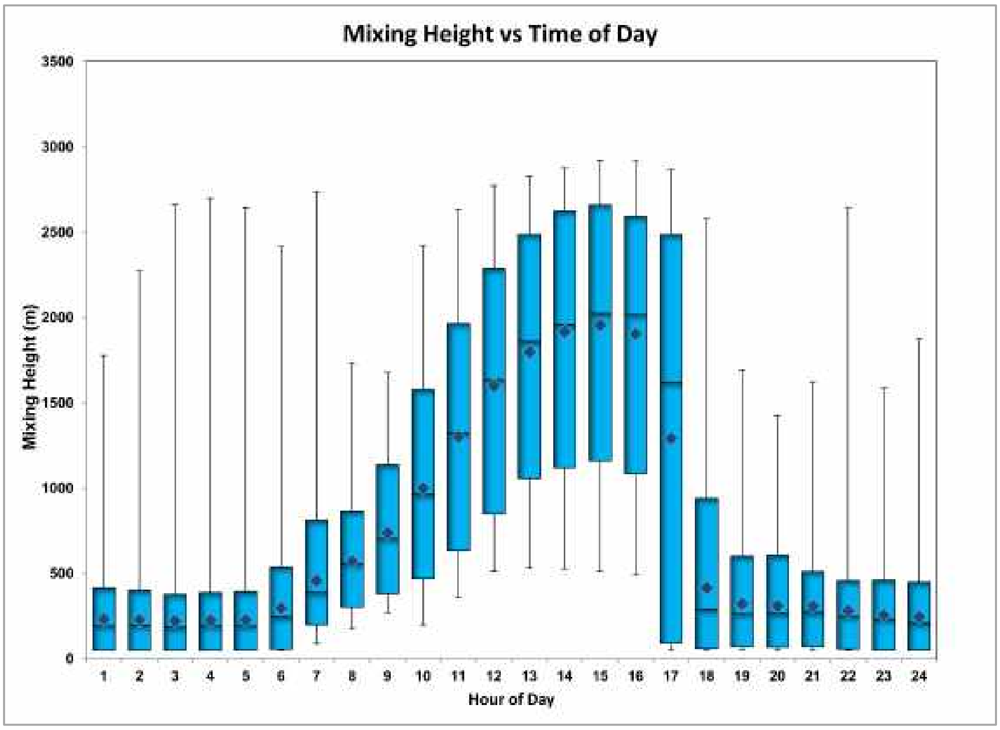
Appendix Figure 2: Annual Wind roses for a CALMET extract at Mulga Downs.

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. 2008). 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 Mulga Downs are summarised in Appendix Figure 3. At night, mixing height is normally low and after sunrise it typically increases to between 1,000 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. The diurnal mixing height profile is clearly defined owing to the inland, sheltered location of the mine.



Appendix Figure 3: Simulated annual statistics [4] of hourly mixing heights at Mulga Downs.

[4] The bars in the figure depicts 10th and 90th percentile values while the tringles show the average conditions. The whiskers indicate minimum and maximum values.

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.

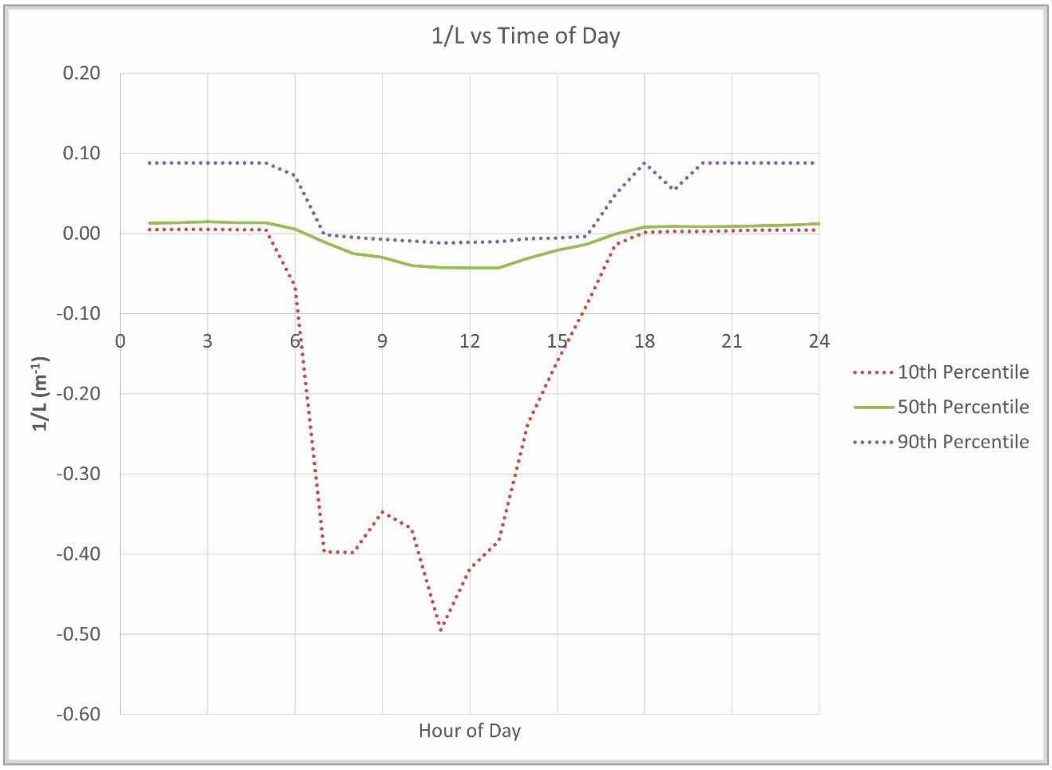
Turbulence in the boundary layer is influenced by the vertical temperature gradient, which is one of several indicators of stability. Plume models use indicators of atmospheric stability in conjunction with other meteorological data to estimate the dispersion conditions in the atmosphere.

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 1/L for Mulga Downs computed from all data in the CALMET surface file is presented in Appendix Figure 4. This plot indicates that the PBL is stable overnight and reaches maximum instability midday unstable as radiation from the sun heats the surface layer of the atmosphere and drives convection.



Appendix Figure 4: Simulated annual statistics of hourly stability at Mulga Downs.

Appendix B – Receptor Locations and Description

As outlined in Section 2.4 the location of the identified sensitive receptors in the region are presented in Appendix Table 2.

Appendix Table 2: Receptor locations and description (GDA2020 MGA Zone 50).

ID	Easting	Northing	Name / Description	Environmental Value Protected	Source	Relevant form of PM to be assessed			
						TSP	PM_{10}	$PM_{2.5}$	Deposition
R1	657188	7533384	Youngaleena Community	Health	HanRoy	✓			✓
R2	681011	7544946	Wirrilimarra Community	Health	HanRoy	✓			✓
R3	651629	7554850	Mulga Downs Airport	Health	HanRoy	✓			✓
R4	651633	7555021	Homestead	Health	HanRoy	✓			✓
R5	656924	7555064	Accomodation	Health	HanRoy	✓			✓
R6	681340	7556156	ACH-00008422. Engraving	Heritage	DPLH-099	✓			✓
R7	673095	7560604	ACH-00029427. Artefacts / Scatter	Heritage	DPLH-099	✓			✓
R8	676077	7560063	ACH-00029428. Artefacts / Scatter	Heritage	DPLH-099	✓			✓
R9	676675	7560059	ACH-00029430. Artefacts / Scatter	Heritage	DPLH-099	✓			✓
R10	681106	7561711	ACH-00029431. Artefacts / Scatter	Heritage	DPLH-099	✓			✓
R11	668504	7552313	ACH-00040450	Heritage	DPLH-099	✓	✓	✓	✓
R12	668698	7552477	ACH-00040448	Heritage	DPLH-099	✓	✓	✓	✓
R13	668652	7552511	ACH-00040581. Artefacts / Scatter; Rock Shelter	Heritage	DPLH-099	✓			✓
R14	668758	7552381	ACH-00040449	Heritage	DPLH-099	✓			✓
R15	680640	7538656	ACH-00007317. Artefacts / Scatter	Heritage	DPLH-099	✓			✓
R16	683940	7551456	ACH-00010696. Artefacts / Scatter; Painting	Heritage	DPLH-099	✓			✓
R17	684640	7554056	ACH-00010697. Burial; Sub surface cultural material; Artefacts / Scatter; Other; Painting	Heritage	DPLH-099	✓			✓
R18	684640	7553156	ACH-00012060. Artefacts / Scatter	Heritage	DPLH-099	✓			✓
R19	682840	7549756	ACH-00007805. Artefacts / Scatter	Heritage	DPLH-099	✓			✓
R20	682340	7549356	ACH-00007555. Artefacts / Scatter	Heritage	DPLH-099	✓			✓
R21	650640	7533656	ACH-00007806. Artefacts / Scatter; Quarry	Heritage	DPLH-099	✓			✓

ID	Easting	Northing	Name / Description	Environmental Value Protected	Source	Relevant form of PM to be assessed			
						TSP	PM_{10}	$PM_{2.5}$	Deposition
R22	652103	7532990	ACH-00007807. Artefacts / Scatter; Rock Shelter	Heritage	DPLH-099	✓			✓
R23	645682	7559992	ACH-00007808. Artefacts / Scatter; Rock Shelter	Heritage	DPLH-099	✓			✓
R24	682640	7552656	ACH-00011280. Artefacts / Scatter; Repository / Storage Place	Heritage	DPLH-099	✓			✓
R25	655869	7553235	Clustered points. Sub surface cultural material; Rock Shelter; Sub surface cultural material; Artefacts / Scatter; Grinding areas / Grooves; Rock Shelter; Modified Tree; Artefacts / Scatter; Artefacts / Scatter; Modified Tree; Artefacts / Scatter; Quarry	Heritage	DPLH-100	✓			✓
R26	661445	7552850	Clustered points. Artefacts / Scatter	Heritage	DPLH-100	✓			✓
R27	655221	7552941	Clustered points. Artefacts / Scatter	Heritage	DPLH-100	✓			✓
R28	655124	7552694	Clustered points. Artefacts / Scatter	Heritage	DPLH-100	✓			✓
R29	656388	7552898	Clustered points. Modified Tree; Plant Resource; Modified Tree	Heritage	DPLH-100	✓			✓
R30	655500	7552070	Clustered points. Artefacts / Scatter	Heritage	DPLH-100	✓			✓
R31	654110	7553496	Clustered points. Artefacts / Scatter	Heritage	DPLH-100	✓			✓
R32	653747	7553661	Clustered points. Artefacts / Scatter	Heritage	DPLH-100	✓			✓
R33	655232	7552225	Clustered points. Artefacts / Scatter	Heritage	DPLH-100	✓			✓
R34	654711	7552314	Artefacts / Scatter	Heritage	DPLH-100	✓			✓
R35	657345	7552202	ACH-00035284. Artefacts / Scatter	Heritage	DPLH-100	✓			✓
R36	656896	7551499	ACH-00035337. Artefacts / Scatter; Modified Tree	Heritage	DPLH-100	✓			✓
R37	655949	7553717	ACH-00032902. Modified Tree; Rock Shelter	Heritage	DPLH-100	✓			✓
R38	656392	7553607	ACH-00034919. Modified Tree	Heritage	DPLH-100	✓			✓
R39	655097	7554661	ACH-00032897. Artefacts / Scatter	Heritage	DPLH-100	✓			✓

ID	Easting	Northing	Name / Description	Environmental Value Protected	Source	Relevant form of PM to be assessed			
						TSP	PM_{10}	$PM_{2.5}$	Deposition
R40	656127	7554536	ACH-00032900. Artefacts / Scatter	Heritage	DPLH-100	✓			✓
R41	655577	7553954	ACH-00032898. Artefacts / Scatter; Grinding areas / Grooves	Heritage	DPLH-100	✓			✓
R42	656182	7554000	ACH-00032901. Artefacts / Scatter	Heritage	DPLH-100	✓			✓
R43	653453	7551879	ACH-00034521. Artefacts / Scatter	Heritage	DPLH-100	✓			✓
R44	653075	7551342	ACH-00034522. Artefacts / Scatter	Heritage	DPLH-100	✓			✓
R45	651087	7552663	ACH-00034517. Artefacts / Scatter	Heritage	DPLH-100	✓			✓
R46	650296	7551697	ACH-00034518. Artefacts / Scatter	Heritage	DPLH-100	✓			✓
R47	657684	7550350	Clustered points. Artefacts / Scatter	Heritage	DPLH-100	✓			✓
R48	657086	7550772	Clustered points. Artefacts / Scatter	Heritage	DPLH-100	✓			✓
R49	654278	7552930	Clustered points. Artefacts / Scatter	Heritage	DPLH-100	✓			✓
R50	661076	7552966	ACH-00035299. Artefacts / Scatter	Heritage	DPLH-100	✓			✓
R51	659239	7552811	ACH-00034944. Artefacts / Scatter	Heritage	DPLH-100	✓			✓
R52	660208	7552227	Clustered points. Artefacts / Scatter	Heritage	DPLH-100	✓			✓
R53	660359	7551260	Clustered points. Artefacts / Scatter	Heritage	DPLH-100	✓			✓
R54	662012	7552713	Clustered points. Rock Shelter; Sub surface cultural material; Artefacts / Scatter; Grinding areas / Grooves; Rock Shelter	Heritage	DPLH-100	✓			✓
R55	664468	7550655	Clustered points	Heritage	DPLH-100	✓			✓
R56	664011	7549437	Clustered points	Heritage	DPLH-100	✓			✓
R57	663189	7547923	Clustered points	Heritage	DPLH-100	✓			✓
R58	662318	7548406	Clustered points	Heritage	DPLH-100	✓			✓
R59	661689	7548532	Clustered points	Heritage	DPLH-100	✓			✓
R60	664266	7549957	Clustered points. Artefacts / Scatter	Heritage	DPLH-100	✓			✓
R61	664044	7551055	Clustered points. Artefacts / Scatter	Heritage	DPLH-100	✓			✓
R62	665210	7551336	ACH-00032886. Modified Tree	Heritage	DPLH-100	✓			✓
R63	667936	7550440	ACH-00032887. Artefacts / Scatter	Heritage	DPLH-100	✓			✓
R64	658249	7549656	ACH-00034915. Artefacts / Scatter	Heritage	DPLH-100	✓			✓

ID	Easting	Northing	Name / Description	Environmental Value Protected	Source	Relevant form of PM to be assessed			
						TSP	PM_{10}	$PM_{2.5}$	Deposition
R65	668622	7553166	ACH-00034940. Artefacts / Scatter; Rock Shelter	Heritage	DPLH-100	✓			✓
R66	658865	7549779	ACH-00034951. Artefacts / Scatter	Heritage	DPLH-100	✓			✓
R67	666703	7548106	ACH-00034952. Artefacts / Scatter	Heritage	DPLH-100	✓			✓
R68	664071	7551959	ACH-00035287. Artefacts / Scatter; Camp	Heritage	DPLH-100	✓			✓
R69	668265	7550636	ACH-00035295. Artefacts / Scatter	Heritage	DPLH-100	✓			✓
R70	667105	7549639	ACH-00035296. Artefacts / Scatter	Heritage	DPLH-100	✓			✓
R71	664756	7549674	ACH-00035298. Artefacts / Scatter	Heritage	DPLH-100	✓			✓
R72	663731	7552199	ACH-00035309. Artefacts / Scatter	Heritage	DPLH-100	✓			✓
R73	662962	7551109	ACH-00035310	Heritage	DPLH-100	✓			✓
R74	665577	7551345	ACH-00035311. Artefacts / Scatter	Heritage	DPLH-100	✓			✓
R75	667910	7549104	ACH-00035318. Artefacts / Scatter	Heritage	DPLH-100	✓			✓
R76	661721	7549268	ACH-00035904. Artefacts / Scatter	Heritage	DPLH-100	✓			✓
R77	660385	7549172	ACH-00035905. Artefacts / Scatter	Heritage	DPLH-100	✓			✓
R78	660091	7548845	ACH-00035906. Artefacts / Scatter	Heritage	DPLH-100	✓			✓
R79	660879	7548460	ACH-00035910. Artefacts / Scatter	Heritage	DPLH-100	✓			✓
R80	663336	7548336	ACH-00035925. Artefacts / Scatter	Heritage	DPLH-100	✓			✓
R81	668501	7548076	ACH-00035931. Artefacts / Scatter	Heritage	DPLH-100	✓			✓
R82	668870	7549081	ACH-00032889. Artefacts / Scatter	Heritage	DPLH-100	✓			✓
R83	669001	7550428	ACH-00032891. Artefacts / Scatter	Heritage	DPLH-100	✓			✓
R84	668600	7551424	ACH-00034128. Artefacts / Scatter	Heritage	DPLH-100	✓			✓
R85	670039	7548437	ACH-00032894. Artefacts / Scatter	Heritage	DPLH-100	✓			✓
R86	675609	7548119	ACH-00034128. Artefacts / Scatter	Heritage	DPLH-100	✓			✓
R87	649185	7549925	ACH-00034519. Artefacts / Scatter	Heritage	DPLH-100	✓			✓
R88	651383	7553047	ACH-00034524. Artefacts / Scatter	Heritage	DPLH-100	✓			✓
R89	669533	7550572	ACH-00034914. Modified Tree	Heritage	DPLH-100	✓			✓
R90	669764	7548600	ACH-00035305. Artefacts / Scatter	Heritage	DPLH-100	✓			✓

ID	Easting	Northing	Name / Description	Environmental Value Protected	Source	Relevant form of PM to be assessed			
						TSP	PM_{10}	$PM_{2.5}$	Deposition
R91	670044	7548977	ACH-00035306. Artefacts / Scatter	Heritage	DPLH-100	✓			✓
R92	669300	7548519	ACH-00035930. Artefacts / Scatter	Heritage	DPLH-100	✓			✓
R93	668537	7549463	ACH-00035935. Artefacts / Scatter	Heritage	DPLH-100	✓			✓
R94	673824	7548503	ACH-00035940. Traditional Structure	Heritage	DPLH-100	✓			✓
R95	649938	7561887	ACH-00032948. Artefacts / Scatter; Grinding areas / Grooves	Heritage	DPLH-100	✓			✓
R96	675985	7547004	ACH-00034129. Artefacts / Scatter	Heritage	DPLH-100	✓			✓
R97	676774	7547935	ACH-00034130. Artefacts / Scatter	Heritage	DPLH-100	✓			✓
R98	679185	7544470	ACH-00034133. Artefacts / Scatter	Heritage	DPLH-100	✓			✓
R99	679364	7549679	ACH-00034950. Sub surface cultural material; Artefacts / Scatter; Traditional Structure; Rock Shelter	Heritage	DPLH-100	✓			✓
R100	676168	7548132	ACH-00034956. Artefacts / Scatter	Heritage	DPLH-100	✓			✓
R101	670306	7555468	ACH-00036362. Artefacts / Scatter	Heritage	DPLH-100	✓			✓
R102	679504	7557193	ACH-00036364. Artefacts / Scatter	Heritage	DPLH-100	✓			✓
R103	671201	7555391	ACH-00036366. Artefacts / Scatter	Heritage	DPLH-100	✓			✓
R104	680083	7557136	ACH-00036373. Artefacts / Scatter	Heritage	DPLH-100	✓			✓
R105	674809	7559569	Clustered points. Artefacts / Scatter; Artefacts / Scatter; Grinding areas / Grooves	Heritage	DPLH-100	✓			✓
R106	673657	7559860	Clustered points. Artefacts / Scatter; Grinding areas / Grooves; Artefacts / Scatter	Heritage	DPLH-100	✓			✓
R107	670167	7561892	Clustered points. Grinding areas / Grooves; Artefacts / Scatter; Grinding areas / Grooves; Artefacts / Scatter; Engraving	Heritage	DPLH-100	✓			✓
R108	670188	7549727	Clustered points. Artefacts / Scatter	Heritage	DPLH-100	✓			✓

ID	Easting	Northing	Name / Description	Environmental Value Protected	Source	Relevant form of PM to be assessed			
						TSP	PM_{10}	$PM_{2.5}$	Deposition
R109	670882	7547853	Clustered points. Artefacts / Scatter	Heritage	DPLH-100	✓			✓
R110	677992	7545766	Clustered points. Artefacts / Scatter	Heritage	DPLH-100	✓			✓
R111	676344	7560206	Clustered points. Engraving; Artefacts / Scatter	Heritage	DPLH-100	✓			✓
R112	678020	7560391	Clustered points. Artefacts / Scatter	Heritage	DPLH-100	✓			✓
R113	677887	7559744	Clustered points. Grinding areas / Grooves	Heritage	DPLH-100	✓			✓
R114	651602	7549783	Freshwater claypans downstream of the Fortescue Marsh	Ecological	DBCA-038	✓			✓
R115	653544	7549676	Freshwater claypans downstream of the Fortescue Marsh	Ecological	DBCA-038	✓			✓
R116	654313	7549069	Freshwater claypans downstream of the Fortescue Marsh	Ecological	DBCA-038	✓			✓
R117	655221	7548713	Freshwater claypans downstream of the Fortescue Marsh	Ecological	DBCA-038	✓			✓
R118	655464	7547849	Freshwater claypans downstream of the Fortescue Marsh	Ecological	DBCA-038	✓	✓	✓	✓
R119	655709	7547272	Freshwater claypans downstream of the Fortescue Marsh	Ecological	DBCA-038	✓			✓
R120	646779	7553724	Freshwater claypans downstream of the Fortescue Marsh	Ecological	DBCA-038	✓			✓
R121	646653	7552737	Freshwater claypans downstream of the Fortescue Marsh	Ecological	DBCA-038	✓			✓
R122	653629	7559846	Four plant assemblages of the Wona Landsystem	Ecological	DBCA-038	✓			✓
R123	657868	7559942	Four plant assemblages of the Wona Landsystem	Ecological	DBCA-038	✓			✓
R124	680656	7556604	Clustered points	Ecological	DBCA-038	✓			✓
R125	679661	7556633	Clustered points	Ecological	DBCA-038	✓			✓
R126	678817	7557095	Clustered points	Ecological	DBCA-038	✓			✓
R127	677952	7557479	Clustered points	Ecological	DBCA-038	✓			✓
R128	677691	7558405	Clustered points	Ecological	DBCA-038	✓			✓

ID	Easting	Northing	Name / Description	Environmental Value Protected	Source	Relevant form of PM to be assessed			
						TSP	PM_{10}	$PM_{2.5}$	Deposition
R129	677665	7559109	Clustered points	Ecological	DBCA-038	✓			✓
R130	677507	7560053	Clustered points	Ecological	DBCA-038	✓	✓	✓	✓
R131	677672	7560991	Clustered points	Ecological	DBCA-038	✓	✓	✓	✓
R132	678082	7561837	Clustered points	Ecological	DBCA-038	✓	✓	✓	✓

Appendix C – Forecast Tonnage

The summary of forecast tonnages for the Proposal, used in identifying the model year, are summarised in Appendix Table 3.

Appendix Table 3: Forecast mining tonnages 2027–2043 (Mtpa).

Pit	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
AH		1.42	6.13	1.87	10.46	1.49	3.31	2.82									
AS																	
FC												4.17	2.49				
FH		2.32	6.73	9	8.57	5.69	6.26	1.87	7.34	12.45	12.06	6.34	7.54	9.77	8.94	9.01	9.1
FW	8.46	3.66										7.07	7.34	8.16	6.17	5.32	4.24
HH															3.26	5.22	2.64
HS																	
HW		1.52	0.2			8.52	7.43	7.66	2.33	2.68	2.83						
MF																	
MH		10.21	4.4	9.58	7.4	7.93	1.27	5.85	6.7								
Total	8.46	19.14	17.46	20.45	26.42	23.63	18.26	18.19	16.37	15.13	14.89	17.57	17.37	17.93	18.36	19.55	15.98

Appendix D – Operational Emission Sources and Parameters

This appendix contains the following:

- Appendix Table 4: Wind erosion sources.
- Appendix Table 5: Haul road sources.
- Appendix Table 6: Mining sources.
- Appendix Table 7: Processing sources.

Appendix Table 4: Wind erosion sources.

Source ID	Easting1	Easting2	Easting3	Easting4	Northing1	Northing2	Northing3	Northing4	Effective radius	Effective height	Sigma Z
WE_1	660494	660683	660683	660494	7553983	7553983	7553794	7553794	107	1	0.47
WE_2	659936	660126	660126	659936	7554067	7554067	7553877	7553877	107	1	0.47
WE_3	659109	659442	659442	659109	7553334	7553334	7553001	7553001	188	1	0.47
WE_4	659090	659190	659190	659090	7552519	7552519	7552419	7552419	56	1	0.47
WE_5	659552	659686	659686	659552	7552066	7552066	7551932	7551932	76	1	0.47
WE_6	656978	657201	657201	656978	7553445	7553445	7553222	7553222	126	1	0.47
WE_7	655915	656444	656444	655915	7552938	7552938	7552409	7552409	299	1	0.47
WE_8	657478	657612	657612	657478	7552599	7552599	7552465	7552465	76	1	0.47
WE_9	667974	668422	668422	667974	7551481	7551481	7551034	7551034	252	1	0.47
WE_10	667746	668193	668193	667746	7552172	7552172	7551725	7551725	252	1	0.47
WE_11	668465	668912	668912	668465	7550651	7550651	7550204	7550204	252	1	0.47
WE_12	669709	669809	669809	669709	7550719	7550719	7550619	7550619	56	1	0.47
WE_13	660199	660453	660453	660199	7553377	7553377	7553123	7553123	143	1	0.47
WE_14	658960	659147	659147	658960	7554231	7554231	7554043	7554043	106	1	0.47
WE_15	656473	656854	656854	656473	7554151	7554151	7553770	7553770	215	1	0.47
WE_16	654884	655065	655065	654884	7553855	7553855	7553673	7553673	102	1	0.47
WE_17	666828	667159	667159	666828	7552065	7552065	7551734	7551734	187	1	0.47
WE_18	670190	670448	670448	670190	7551329	7551329	7551070	7551070	146	1	0.47
WE_19	668892	669151	669151	668892	7549616	7549616	7549357	7549357	146	1	0.47
WE_20	669777	670038	670038	669777	7550333	7550333	7550072	7550072	147	1	0.47
WE_21	669493	669754	669754	669493	7549564	7549564	7549303	7549303	147	1	0.47
WE_22	666705	666995	666995	666705	7549000	7549000	7548710	7548710	164	1	0.47
WE_23	667274	667564	667564	667274	7549525	7549525	7549235	7549235	164	1	0.47
WE_24	657817	658083	658083	657817	7553917	7553917	7553651	7553651	150	1	0.47
WE_25	657990	658256	658256	657990	7553072	7553072	7552806	7552806	150	1	0.47

Appendix Table 5: Haul road sources.

Source ID	Easting	Northing	Effective Ht	Sigma Y	Sigma Z
HR1	660342	7553550	5.2	16.7	4.9
HR2	660046	7553596	5.2	16.7	4.9
HR3	659751	7553651	5.2	16.7	4.9
HR4	659461	7553730	5.2	16.7	4.9
HR5	659168	7553679	5.2	16.7	4.9
HR6	658878	7553608	5.2	16.7	4.9
HR7	658580	7553573	5.2	16.7	4.9
HR8	658282	7553543	5.2	16.7	4.9
HR9	657983	7553517	5.2	16.7	4.9
HR10	657871	7553693	5.2	16.7	4.9
HR11	659859	7553453	5.2	16.7	4.9
HR12	660048	7553322	5.2	16.7	4.9
HR13	660272	7553140	5.2	16.7	4.9
HR14	659267	7552689	5.2	16.7	4.9
HR15	659454	7552757	5.2	16.7	4.9
HR16	659576	7552976	5.2	16.7	4.9
HR17	659660	7553264	5.2	16.7	4.9
HR18	659329	7552129	5.2	16.7	4.9
HR19	659131	7552127	5.2	16.7	4.9
HR20	658904	7552324	5.2	16.7	4.9
HR21	658723	7552562	5.2	16.7	4.9
HR22	658580	7552826	5.2	16.7	4.9
HR23	658461	7553100	5.2	16.7	4.9
HR24	658425	7553393	5.2	16.7	4.9
HR25	658996	7552582	5.2	16.7	4.9
HR26	658579	7553295	5.2	16.7	4.9
HR27	659389	7552317	5.2	16.7	4.9
HR28	659465	7552607	5.2	16.7	4.9
HR29	659585	7553470	5.2	16.7	4.9
HR30	659247	7553884	5.2	16.7	4.9
HR31	659315	7554157	5.2	16.7	4.9
HR32	656112	7552244	5.2	16.7	4.9
HR33	655965	7552147	5.2	16.7	4.9
HR34	655688	7552261	5.2	16.7	4.9
HR35	655438	7552428	5.2	16.7	4.9
HR36	655266	7552665	5.2	16.7	4.9
HR37	655067	7552884	5.2	16.7	4.9

Source ID	Easting	Northing	Effective Ht	Sigma Y	Sigma Z
HR38	654860	7553099	5.2	16.7	4.9
HR39	654798	7553381	5.2	16.7	4.9
HR40	654830	7553678	5.2	16.7	4.9
HR41	654989	7553906	5.2	16.7	4.9
HR42	655061	7553263	5.2	16.7	4.9
HR43	656600	7553056	5.2	16.7	4.9
HR44	656663	7553349	5.2	16.7	4.9
HR45	656871	7553565	5.2	16.7	4.9
HR46	657092	7553767	5.2	16.7	4.9
HR47	657128	7554022	5.2	16.7	4.9
HR48	656916	7554062	5.2	16.7	4.9
HR49	657335	7552380	5.2	16.7	4.9
HR50	657035	7552387	5.2	16.7	4.9
HR51	656888	7552557	5.2	16.7	4.9
HR52	656851	7552854	5.2	16.7	4.9
HR53	656771	7553089	5.2	16.7	4.9
HR54	656263	7552057	5.2	16.7	4.9
HR55	656558	7552080	5.2	16.7	4.9
HR56	656792	7552236	5.2	16.7	4.9
HR57	657016	7553084	5.2	16.7	4.9
HR58	657277	7553053	5.2	16.7	4.9
HR59	657493	7553235	5.2	16.7	4.9
HR60	657653	7553466	5.2	16.7	4.9
HR61	667795	7552662	5.2	16.7	4.9
HR62	667507	7552657	5.2	16.7	4.9
HR63	667246	7552552	5.2	16.7	4.9
HR64	667258	7552272	5.2	16.7	4.9
HR65	667342	7551984	5.2	16.7	4.9
HR66	667369	7551689	5.2	16.7	4.9
HR67	667182	7551478	5.2	16.7	4.9
HR68	666953	7551285	5.2	16.7	4.9
HR69	666742	7551072	5.2	16.7	4.9
HR70	666532	7550858	5.2	16.7	4.9
HR71	666324	7550642	5.2	16.7	4.9
HR72	666122	7550419	5.2	16.7	4.9
HR73	666061	7550209	5.2	16.7	4.9
HR74	666296	7550022	5.2	16.7	4.9
HR75	666410	7549764	5.2	16.7	4.9

Source ID	Easting	Northing	Effective Ht	Sigma Y	Sigma Z
HR76	666414	7549467	5.2	16.7	4.9
HR77	666643	7549349	5.2	16.7	4.9
HR78	666852	7549157	5.2	16.7	4.9
HR79	667024	7548911	5.2	16.7	4.9
HR80	667045	7548613	5.2	16.7	4.9
HR81	666799	7548473	5.2	16.7	4.9
HR82	667366	7550926	5.2	16.7	4.9
HR83	667108	7551046	5.2	16.7	4.9
HR84	668781	7551340	5.2	16.7	4.9
HR85	669069	7551423	5.2	16.7	4.9
HR86	669290	7551608	5.2	16.7	4.9
HR87	669480	7551810	5.2	16.7	4.9
HR88	669645	7551560	5.2	16.7	4.9
HR89	669810	7551309	5.2	16.7	4.9
HR90	669970	7551056	5.2	16.7	4.9
HR91	670069	7550790	5.2	16.7	4.9
HR92	669997	7550549	5.2	16.7	4.9
HR93	669773	7550402	5.2	16.7	4.9
HR94	669814	7550105	5.2	16.7	4.9
HR95	669656	7550575	5.2	16.7	4.9
HR96	668081	7549845	5.2	16.7	4.9
HR97	668126	7549642	5.2	16.7	4.9
HR98	668370	7549568	5.2	16.7	4.9
HR99	668656	7549661	5.2	16.7	4.9
HR100	668904	7549826	5.2	16.7	4.9
HR101	669145	7550005	5.2	16.7	4.9
HR102	669388	7550180	5.2	16.7	4.9
HR103	666953	7551538	5.2	16.7	4.9
HR104	666754	7551731	5.2	16.7	4.9
HR105	666896	7551955	5.2	16.7	4.9
HR106	670073	7551169	5.2	16.7	4.9
HR107	670074	7551415	5.2	16.7	4.9
HR108	670333	7551364	5.2	16.7	4.9
HR109	668995	7549679	5.2	16.7	4.9
HR110	669183	7549494	5.2	16.7	4.9

Appendix Table 6: Mining sources.

Source ID	Easting	Northing	Effective Ht	Sigma Y	Sigma Z
AH_loadOre1	660615	7553907	5	81.4	2.3
AH_loadOre2	660063	7553975	5	81.4	2.3
AH_loadOre3	658869	7553338	5	93	2.3
AH_loadOre4	659286	7553186	5	93	2.3
AH_loadOre5	659177	7552449	5	58.1	2.3
AH_loadOre6	659620	7551978	5	69.8	2.3
MH_loadOre7	657134	7553329	5	81.4	2.3
MH_loadOre8	655498	7553378	5	93	2.3
MH_loadOre9	656318	7552696	5	93	2.3
MH_loadOre10	657622	7552508	5	69.8	2.3
FH_loadOre11	668124	7552201	5	116.3	2.3
FH_loadOre12	668214	7551260	5	116.3	2.3
FH_loadOre13	668624	7550521	5	116.3	2.3
FH_loadOre14	669781	7550690	5	46.5	2.3
AH_loadWaste1	660603	7554028	5	81.4	2.3
AH_loadWaste2	660017	7553880	5	81.4	2.3
AH_loadWaste3	658794	7553264	5	93	2.3
AH_loadWaste4	659254	7553124	5	93	2.3
AH_loadWaste5	659146	7552408	5	58.1	2.3
AH_loadWaste6	659591	7551943	5	69.8	2.3
MH_loadWaste7	657110	7553254	5	81.4	2.3
MH_loadWaste8	655474	7553302	5	93	2.3
MH_loadWaste9	656294	7552621	5	93	2.3
MH_loadWaste10	657598	7552433	5	69.8	2.3
FH_loadWaste11	667987	7552119	5	116.3	2.3
FH_loadWaste12	668303	7551150	5	116.3	2.3
FH_loadWaste13	668604	7550377	5	116.3	2.3
FH_loadWaste14	669863	7550738	5	46.5	2.3
AH_blast1	660553	7553908	20	81.4	9.3
AH_blast2	659995	7553980	20	81.4	9.3
AH_blast3	658799	7553341	20	93	9.3
AH_blast4	659211	7553185	20	93	9.3
AH_blast5	659109	7552451	20	58.1	9.3
AH_blast6	659552	7551981	20	69.8	9.3
MH_blast7	657066	7553332	20	81.4	9.3
MH_blast8	655430	7553380	20	93	9.3
MH_blast9	656250	7552698	20	93	9.3

Source ID	Easting	Northing	Effective Ht	Sigma Y	Sigma Z
MH_blast10	657554	7552511	20	69.8	9.3
FH_blast11	668056	7552204	20	116.3	9.3
FH_blast12	668146	7551262	20	116.3	9.3
FH_blast13	668556	7550523	20	116.3	9.3
FH_blast14	669713	7550692	20	46.5	9.3
AH_drill1	660584	7553961	1.5	81.4	0.7
AH_drill2	660026	7554035	1.5	81.4	0.7
AH_drill3	658837	7553399	1.5	93	0.7
AH_drill4	659245	7553245	1.5	93	0.7
AH_drill5	659147	7552517	1.5	58.1	0.7
AH_drill6	659590	7552046	1.5	69.8	0.7
MH_drill7	657104	7553397	1.5	81.4	0.7
MH_drill8	655468	7553446	1.5	93	0.7
MH_drill9	656288	7552764	1.5	93	0.7
MH_drill10	657592	7552576	1.5	69.8	0.7
FH_drill11	668094	7552269	1.5	116.3	0.7
FH_drill12	668183	7551328	1.5	116.3	0.7
FH_drill13	668594	7550589	1.5	116.3	0.7
FH_drill14	669751	7550758	1.5	46.5	0.7
UnloadOre_3	658068	7553688	2	116.3	0.9
UnloadOre_2	666805	7548819	2	116.3	0.9
UnloadOre_1	670043	7550236	2	116.3	0.9
AH_UnloadWaste_1	660354	7553283	2	93	0.9
AH_UnloadWaste2	659093	7554084	2	93	0.9
MH_UnloadWaste3	656699	7553929	2	116.3	0.9
MH_UnloadWaste4	654921	7553748	2	93	0.9
FH_UnloadWaste5	667085	7551993	2	116.3	0.9
FH_UnloadWaste6	670288	7551181	2	93	0.9
FH_UnloadWaste7	668987	7549485	2	93	0.9
dozer_ROM1	669929	7550224	2	116.3	0.9
dozer_ROM2	666692	7548807	2	116.3	0.9
dozer_ROM3	657955	7553676	2	116.3	0.9
AH_dozer_1	660207	7553224	2	125	0.9
AH_dozer_2	659199	7554137	2	125	0.9
MH_dozer_1	656805	7553982	2	125	0.9
MH_dozer_2	655027	7553801	2	125	0.9
FH_dozer_1	666969	7551860	2	125	0.9
FH_dozer_2	670451	7551237	2	125	0.9

Source ID	Easting	Northing	Effective Ht	Sigma Y	Sigma Z
FH_dozer_3	669098	7549404	2	125	0.9
Load_ROM1	669953	7550319	5	125	2.3
Load_ROM2	666716	7548903	5	125	2.3
Load_ROM3	657978	7553771	5	125	2.3

Appendix Table 7: Processing sources.

Source	Easting	Northing	Effective Ht	Sigma Y	Sigma Z
PrimaryCrusher_RoM1	669748	7549950	6	5	2.8
PrimaryCrusher_RoM2	666948	7549119	6	5	2.8
PrimaryCrusher_RoM3	658132	7553480	6	5	2.8
SecondaryCrusher_RoM1	667026	7549076	5	10	2.3
SecondaryCrusher_RoM2	669663	7549923	5	10	2.3
SecondaryCrusher_RoM3	658058	7553430	5	10	2.3
TertiaryCrusher_RoM1	669660	7549913	5	10	2.3
TertiaryCrusher_RoM2	667036	7549081	5	10	2.3
TertiaryCrusher_RoM3	658058	7553420	5	10	2.3
Screening_RoM1_1	669736	7549898	5	6.3	2.3
Screening_RoM2_1	666994	7549146	5	6.3	2.3
Screening_RoM2_1	658135	7553427	5	6.3	2.3
Screening_RoM1_2	669634	7549762	5	6.3	2.3
Screening_RoM2_2	667164	7549165	5	6.3	2.3
Screening_RoM2_2	658075	7553268	5	6.3	2.3
Stacker_ROM1	669704	7549696	8	57.5	3.7
Stacker_ROM2	667164	7549262	8	57.5	3.7
Stacker_ROM3	658161	7553223	8	57.5	3.7
TransferStation_ROM1_1	669567	7549931	3	2	1.4
TransferStation_ROM2_1	667087	7549000	3	2	1.4
TransferStation_ROM3_1	657963	7553411	3	2	1.4
TransferStation_ROM1_2	669538	7549776	3	2	1.4
TransferStation_ROM2_2	667219	7549086	3	2	1.4
TransferStation_ROM3_2	657979	7553254	3	2	1.4
TransferStation_ROM1_3	669715	7549755	3	2	1.4
TransferStation_ROM2_3	667113	7549229	3	2	1.4
TransferStation_ROM3_3	658155	7553284	3	2	1.4
LoadRoadTrain_ROM1	669625	7549673	5	125	2.3
LoadRoadTrain_ROM2	667235	7549219	5	125	2.3
LoadRoadTrain_ROM3	658091	7553180	5	125	2.3

Appendix E– Operational PM_{10} Emission Rates

This appendix contains the following:

- Appendix Table 5: Mining sources PM10 emissions – with dust abatement.
- Appendix Table 7: Wind erosion PM10 emissions (g/sec) – with dust abatement.
- Appendix Table 8: Haul road PM_{10} emissions – with dust abatement.

Appendix Table 5: Mining sources PM10 emissions – with dust abatement.

Source ID	Maximum	99%	95%	90%	70%	Mean
AH_loadOre1	1	1	1	1	0	0.3
AH_loadOre2	1	1	1	1	0	0.3
AH_loadOre3	1.5	1.5	1.5	1.5	0	0.4
AH_loadOre4	1.5	1.5	1.5	1.5	0	0.4
AH_loadOre5	0.3	0.3	0.3	0.3	0	0.1
AH_loadOre6	0.5	0.5	0.5	0.5	0	0.1
MH_loadOre7	0.6	0.6	0.6	0.6	0	0.1
MH_loadOre8	1.7	1.7	1.7	1.7	0	0.4
MH_loadOre9	1.7	1.7	1.7	1.7	0	0.4
MH_loadOre10	0.2	0.2	0.2	0.2	0	0.1
FH_loadOre11	1.6	1.6	1.6	1.6	0	0.4
FH_loadOre12	1.6	1.6	1.6	1.6	0	0.4
FH_loadOre13	1.6	1.6	1.6	1.6	0	0.4
FH_loadOre14	0.1	0.1	0.1	0.1	0	0
AH_loadWaste1	1.6	1.6	1.6	1.6	0	0.4
AH_loadWaste2	1.5	1.5	1.5	1.5	0	0.4
AH_loadWaste3	2.4	2.4	2.4	2.4	0	0.6
AH_loadWaste4	2.4	2.4	2.4	2.4	0	0.6
AH_loadWaste5	0.4	0.4	0.4	0.4	0	0.1
AH_loadWaste6	0.8	0.8	0.8	0.8	0	0.2
MH_loadWaste7	0.9	0.9	0.9	0.9	0	0.2
MH_loadWaste8	2.7	2.7	2.7	2.7	0	0.7
MH_loadWaste9	2.7	2.7	2.7	2.7	0	0.7
MH_loadWaste10	0.3	0.3	0.3	0.3	0	0.1
FH_loadWaste11	2.5	2.5	2.5	2.5	0	0.6
FH_loadWaste12	2.5	2.5	2.5	2.5	0	0.6
FH_loadWaste13	2.5	2.5	2.5	2.5	0	0.6
FH_loadWaste14	0.1	0.1	0.1	0.1	0	0
AH_blast1	13.5	0	0	0	0	0
AH_blast2	13.5	0	0	0	0	0

Source ID	Maximum	99%	95%	90%	70%	Mean
AH_blast3	13.5	0	0	0	0	0
AH_blast4	13.5	0	0	0	0	0
AH_blast5	13.5	0	0	0	0	0
AH_blast6	13.5	0	0	0	0	0
MH_blast7	13.5	0	0	0	0	0
MH_blast8	13.5	0	0	0	0	0
MH_blast9	13.5	0	0	0	0	0
MH_blast10	13.5	0	0	0	0	0
FH_blast11	13.5	0	0	0	0	0
FH_blast12	13.5	0	0	0	0	0
FH_blast13	13.5	0	0	0	0	0
FH_blast14	0	0	0	0	0	0
AH_drill1	0.4	0.4	0	0	0	0
AH_drill2	0.4	0.4	0	0	0	0
AH_drill3	0.4	0.4	0	0	0	0
AH_drill4	0.4	0.4	0	0	0	0
AH_drill5	0.4	0.4	0	0	0	0
AH_drill6	0.4	0.4	0	0	0	0
MH_drill7	0.4	0.4	0	0	0	0
MH_drill8	0.4	0.4	0	0	0	0
MH_drill9	0.4	0.4	0	0	0	0
MH_drill10	0.4	0.4	0	0	0	0
FH_drill11	0.4	0.4	0	0	0	0
FH_drill12	0.4	0.4	0	0	0	0
FH_drill13	0.4	0.4	0	0	0	0
FH_drill14	0.4	0.4	0	0	0	0
FH_UnloadWaste5	0.9	0.9	0.9	0.9	0	0.2
FH_UnloadWaste7	0.9	0.9	0.9	0.9	0	0.2
dozer_ROM1	1.1	1.1	1.1	0	0	0.1
dozer_ROM2	1.1	1.1	1.1	1.1	0	0.2
dozer_ROM3	1.1	1.1	1.1	1.1	1.1	0.5
AH_dozer_1	1.1	1.1	1.1	1.1	0	0.3
AH_dozer_2	1.1	1.1	1.1	1.1	1.1	0.3
MH_dozer_1	1.1	1.1	1.1	0	0	0.1
MH_dozer_2	1.1	1.1	1.1	1.1	1.1	0.3
FH_dozer_1	1.1	1.1	1.1	1.1	0	0.2
FH_dozer_2	1.1	1.1	1.1	1.1	0	0.2
FH_dozer_3	1.1	1.1	1.1	1.1	0	0.2

Source ID	Maximum	99%	95%	90%	70%	Mean
Load_ROM1	0.6	0.6	0.6	0.6	0.6	0.4
Load_ROM2	1.2	1.2	1.2	1.2	1.2	0.8
Load_ROM3	3.8	3.8	3.8	3.8	3.8	2.6
AH_UnloadWaste2	2	2	1.8	1.1	0.9	0.5
UnloadOre_1	0.6	0.6	0.6	0.6	0	0.2
UnloadOre_3	3.2	2.5	2	1.8	1.2	0.9
FH_UnloadWaste6	1	1	1	0.9	0	0.2
UnloadOre_2	1.2	1.2	1.2	0.6	0.6	0.3
MH_UnloadWaste4	2	2	2	1	1	0.5
MH_UnloadWaste3	0.5	0.5	0.5	0.4	0.1	0.1
AH_UnloadWaste_1	1.5	1.5	1.2	0.9	0.6	0.4

Appendix Table 6: Processing sources PM10 emissions – with dust abatement.

Source ID	Maximum	99%	95%	90%	70%	Mean
PrimaryCrusher_RoM1	0.1	0.1	0.1	0.1	0.1	0
PrimaryCrusher_RoM2	0.1	0.1	0.1	0.1	0.1	0.1
PrimaryCrusher_RoM3	0.4	0.4	0.4	0.4	0.4	0.3
SecondaryCrusher_RoM1	0	0	0	0	0	0
SecondaryCrusher_RoM2	0.1	0.1	0.1	0.1	0.1	0.1
SecondaryCrusher_RoM3	0.3	0.3	0.3	0.3	0.3	0.2
TertiaryCrusher_RoM1	0	0	0	0	0	0
TertiaryCrusher_RoM2	0	0	0	0	0	0
TertiaryCrusher_RoM3	0	0	0	0	0	0
Screening_RoM1_1	0.3	0.3	0.3	0.3	0.3	0.2
Screening_RoM2_1	0.6	0.6	0.6	0.6	0.6	0.4
Screening_RoM3_1	1.9	1.9	1.9	1.9	1.9	1.3
Screening_RoM1_2	0.2	0.2	0.2	0.2	0.2	0.1
Screening_RoM2_2	0.3	0.3	0.3	0.3	0.3	0.2
Screening_RoM3_2	1	1	1	1	1	0.7
Stacker_ROM1	0.1	0.1	0.1	0.1	0.1	0
Stacker_ROM2	0.1	0.1	0.1	0.1	0.1	0.1
Stacker_ROM3	0.3	0.3	0.3	0.3	0.3	0.2
TransferStation_ROM1_1	0.1	0.1	0.1	0.1	0.1	0
TransferStation_ROM2_1	0.1	0.1	0.1	0.1	0.1	0.1
TransferStation_ROM3_1	0.3	0.3	0.3	0.3	0.3	0.2
TransferStation_ROM1_2	0.1	0.1	0.1	0.1	0.1	0
TransferStation_ROM2_2	0.1	0.1	0.1	0.1	0.1	0.1

Source ID	Maximum	99%	95%	90%	70%	Mean
TransferStation_ROM3_2	0.3	0.3	0.3	0.3	0.3	0.2
TransferStation_ROM1_3	0.1	0.1	0.1	0.1	0.1	0.1
TransferStation_ROM2_3	0.2	0.2	0.2	0.2	0.2	0.1
TransferStation_ROM3_3	0.6	0.6	0.6	0.6	0.6	0.4
LoadRoadTrain_ROM1	0.5	0.5	0.5	0.5	0.5	0.4
LoadRoadTrain_ROM2	1	1	1	1	1	0.8
LoadRoadTrain_ROM3	3.3	3.3	3.3	3.3	3.3	2.6

Appendix Table 7: Wind erosion PM10 emissions (g/sec) – with dust abatement.

Source ID	Maximum	99th %ile	95th %ile	90th %ile	70th %ile	Mean
WE_1	40.9	7.4	2.1	0.8	0	0.4
WE_2	40.9	7.4	2.1	0.8	0	0.4
WE_3	126	22.9	6.4	2.5	0	1.2
WE_4	11.3	2.1	0.6	0.2	0	0.1
WE_5	20.4	3.7	1	0.4	0	0.2
WE_6	56.7	10.3	2.9	1.1	0	0.5
WE_7	317.7	57.8	16.2	6.2	0	3
WE_8	20.4	3.7	1	0.4	0	0.2
WE_9	227	41.3	11.6	4.4	0	2.1
WE_10	227	41.3	11.6	4.4	0	2.1
WE_11	227	41.3	11.6	4.4	0	2.1
WE_12	11.3	2.1	0.6	0.2	0	0.1
WE_13	38.5	7	2	0.8	0	0.4
WE_14	20.9	3.8	1.1	0.4	0	0.2
WE_15	86.7	15.8	4.4	1.7	0	0.8
WE_16	19.6	3.6	1	0.4	0	0.2
WE_17	65.4	11.9	3.3	1.3	0	0.6
WE_18	40	7.3	2	0.8	0	0.4
WE_19	40	7.3	2	0.8	0	0.4
WE_20	40.6	7.4	2.1	0.8	0	0.4
WE_21	40.6	7.4	2.1	0.8	0	0.4
WE_22	50.2	9.1	2.6	1	0	0.5
WE_23	50.2	9.1	2.6	1	0	0.5
WE_24	42.3	7.7	2.2	0.8	0	0.4
WE_25	42.3	7.7	2.2	0.8	0	0.4

Appendix Table 8: Haul road PM_{10} emissions – with dust abatement.

Source ID	Maximum	99th %ile	95th %ile	90th %ile	70th %ile	Mean
HR1	0.9	0.9	0.9	0.9	0	0.22
HR2	1.7	1.7	1.7	0.9	0.9	0.44
HR3	2.2	2	1.7	1.7	0.7	0.55
HR4	2.2	2	1.7	1.7	0.7	0.55
HR5	2	1.7	1.3	1.2	0.8	0.51
HR6	2	1.7	1.3	1.2	0.8	0.51
HR7	2	1.7	1.3	1.2	0.8	0.51
HR8	2	1.5	1.2	1	0.7	0.5
HR9	2.9	2.2	1.8	1.6	1.1	0.85
HR10	2.9	2.2	1.8	1.6	1.1	0.85
HR11	1.3	1.3	1.1	0.8	0.5	0.33
HR12	1.3	1.3	1.1	0.8	0.5	0.33
HR13	1.3	1.3	1.1	0.8	0.5	0.33
HR14	0.2	0.2	0.2	0.2	0	0.06
HR15	0.1	0.1	0.1	0.1	0	0.04
HR16	0.4	0.4	0.4	0.3	0.1	0.1
HR17	0.4	0.4	0.4	0.3	0.1	0.1
HR18	0.4	0.4	0.4	0.4	0	0.11
HR19	0.2	0.2	0.2	0.2	0	0.04
HR20	0.2	0.2	0.2	0.2	0	0.04
HR21	0.3	0.3	0.3	0.2	0.1	0.07
HR22	0.3	0.3	0.3	0.2	0.1	0.07
HR23	0.3	0.3	0.3	0.2	0.1	0.07
HR24	1.6	1.6	1.5	1.4	0.3	0.4
HR25	0.1	0.1	0.1	0.1	0	0.02
HR26	1.3	1.3	1.3	1.3	0	0.34
HR27	0.3	0.3	0.3	0.3	0	0.07
HR28	0.3	0.3	0.3	0.3	0	0.07
HR29	1.3	1.3	1.3	1.3	0	0.34
HR30	1.8	1.8	1.6	1	0.8	0.45
HR31	1.8	1.8	1.6	1	0.8	0.45
HR32	0.9	0.9	0.9	0.9	0	0.22
HR33	1.5	1.5	1.5	0.9	0.6	0.37
HR34	1.5	1.5	1.5	0.9	0.6	0.37
HR35	1.5	1.5	1.5	0.9	0.6	0.37
HR36	1.5	1.5	1.5	0.9	0.6	0.37
HR37	1.5	1.5	1.5	0.9	0.6	0.37

Source ID	Maximum	99th %ile	95th %ile	90th %ile	70th %ile	Mean
HR38	2.4	2.4	2.4	1.5	0.9	0.59
HR39	1.8	1.8	1.8	0.9	0.9	0.45
HR40	1.8	1.8	1.8	0.9	0.9	0.45
HR41	1.8	1.8	1.8	0.9	0.9	0.45
HR42	1.5	1.5	1.5	1.5	0	0.37
HR43	0.6	0.6	0.6	0.6	0	0.14
HR44	0.4	0.4	0.4	0.3	0.1	0.11
HR45	0.4	0.4	0.4	0.3	0.1	0.11
HR46	0.4	0.4	0.4	0.3	0.1	0.11
HR47	0.4	0.4	0.4	0.3	0.1	0.11
HR48	0.4	0.4	0.4	0.3	0.1	0.11
HR49	0.2	0.2	0.2	0.2	0	0.05
HR50	0.2	0.2	0.2	0.2	0	0.05
HR51	0.8	0.8	0.8	0.6	0.2	0.19
HR52	0.8	0.8	0.8	0.6	0.2	0.19
HR53	1	1	0.9	0.7	0.3	0.25
HR54	0.6	0.6	0.6	0.6	0	0.14
HR55	0.6	0.6	0.6	0.6	0	0.14
HR56	0.6	0.6	0.6	0.6	0	0.14
HR57	1.8	1.7	1.2	1.1	0.6	0.43
HR58	1.4	1.4	1.2	0.8	0.6	0.35
HR59	1.4	1.4	1.2	0.8	0.6	0.35
HR60	1.4	1.4	1.2	0.8	0.6	0.35
HR61	1.4	1.4	1.4	1.4	0	0.35
HR62	1.4	1.4	1.4	1.4	0	0.35
HR63	1.4	1.4	1.4	1.4	0	0.35
HR64	1.4	1.4	1.4	1.4	0	0.35
HR65	1.4	1.4	1.4	1.4	0	0.35
HR66	1.4	1.4	1.4	1.4	0	0.35
HR67	1.4	1.4	1.4	1.4	0	0.35
HR68	1.1	1.1	1.1	0.5	0.5	0.27
HR69	1.1	1.1	1.1	0.5	0.5	0.27
HR70	1.1	1.1	1.1	0.5	0.5	0.27
HR71	1.1	1.1	1.1	0.5	0.5	0.27
HR72	1.1	1.1	1.1	0.5	0.5	0.27
HR73	1.1	1.1	1.1	0.5	0.5	0.27
HR74	1.1	1.1	1.1	0.5	0.5	0.27
HR75	1.1	1.1	1.1	0.5	0.5	0.27

Source ID	Maximum	99th %ile	95th %ile	90th %ile	70th %ile	Mean
HR76	1.1	1.1	1.1	0.5	0.5	0.27
HR77	1.1	1.1	1.1	0.5	0.5	0.27
HR78	1.1	1.1	1.1	0.5	0.5	0.27
HR79	1.1	1.1	1.1	0.5	0.5	0.27
HR80	1.1	1.1	1.1	0.5	0.5	0.27
HR81	1.1	1.1	1.1	0.5	0.5	0.27
HR82	0.5	0.5	0.5	0.5	0	0.13
HR83	0.5	0.5	0.5	0.5	0	0.13
HR84	0.8	0.8	0.8	0.8	0	0.21
HR85	0.8	0.8	0.8	0.8	0	0.21
HR86	0.8	0.8	0.8	0.8	0	0.21
HR87	0.8	0.8	0.8	0.8	0	0.21
HR88	0.8	0.8	0.8	0.8	0	0.21
HR89	0.8	0.8	0.8	0.8	0	0.21
HR90	0.9	0.9	0.9	0.8	0	0.22
HR91	0	0	0	0	0	0.01
HR92	0	0	0	0	0	0.01
HR93	0.6	0.6	0.6	0.5	0.1	0.15
HR94	0.6	0.6	0.6	0.5	0	0.14
HR95	0.1	0.1	0.1	0.1	0	0.02
HR96	1.4	1.4	1.4	1.4	0	0.35
HR97	1.4	1.4	1.4	1.4	0	0.35
HR98	1.4	1.4	1.4	1.4	0	0.35
HR99	1.4	1.4	1.4	1.4	0	0.35
HR100	1.4	1.4	1.4	1.4	0	0.35
HR101	0.5	0.5	0.5	0.5	0	0.13
HR102	0.5	0.5	0.5	0.5	0	0.13
HR103	0.9	0.9	0.9	0.9	0	0.21
HR104	0.9	0.9	0.9	0.9	0	0.21
HR105	0.9	0.9	0.9	0.9	0	0.21
HR106	0.9	0.9	0.9	0.8	0	0.22
HR107	0.9	0.9	0.9	0.8	0	0.22
HR108	0.9	0.9	0.9	0.8	0	0.22
HR109	0.8	0.8	0.8	0.8	0	0.21
HR110	0.8	0.8	0.8	0.8	0	0.21

Appendix F– Scenario 1 model results

This appendix contains the following:

- Appendix Table 9: TSP with background model results - No dust abatement.
- Appendix Table 10: Maximum predicted monthly deposition rates ($g/m^2/month$) - No dust abatement

Appendix Table 9: TSP with background model results - No dust abatement.

Receptor No.	Receptor Name	Type	Maximum	99th %ile	95th %ile	90th %ile	70th %ile	Average	Days >90 [2]
R1	Youngaleena Community	Human	41	38	35	34	33	33	0
R2	Wirrilimarra Community	Human	61	56	43	40	35	35	0
R3	Mulga Downs Airport	Human	323	145	107	94	69	59	45
R4	Homestead	Human	317	156	109	95	71	60	45
R5	Accomodation	Human	629	340	264	201	123	113	196
R6	ACH-00008422	Heritage	75	49	43	39	34	35	0
R7	ACH-00029427	Heritage	74	54	43	40	35	35	0
R8	ACH-00029428	Heritage	72	47	43	38	34	35	0
R9	ACH-00029430	Heritage	69	45	42	38	34	35	0
R10	ACH-00029431	Heritage	46	39	37	35	34	34	0
R11	ACH-00040450	Heritage	630	321	198	155	100	91	131
R12	ACH-00040448	Heritage	497	333	181	143	86	80	104
R13	ACH-00040581	Heritage	498	325	181	145	85	80	101
R14	ACH-00040449	Heritage	502	351	182	141	89	83	108
R15	ACH-00007317	Heritage	63	45	38	36	34	34	0
R16	ACH-00010696	Heritage	58	50	43	39	34	35	0
R17	ACH-00010697	Heritage	55	42	39	37	34	34	0
R18	ACH-00012060	Heritage	56	44	40	37	34	34	0
R19	ACH-00007805	Heritage	57	55	45	40	35	35	0
R20	ACH-00007555	Heritage	59	57	46	41	35	36	0
R21	ACH-00007806	Heritage	39	37	35	34	33	33	0
R22	ACH-00007807	Heritage	38	37	35	34	33	33	0
R23	ACH-00007808	Heritage	78	74	66	59	48	43	0
R24	ACH-00011280	Heritage	71	51	45	40	34	35	0
R25		Heritage Lodged	855	567	332	265	147	139	207
R26		Heritage Lodged	556	410	221	182	95	93	117
R27		Heritage Lodged	895	712	438	349	207	177	250

Receptor No.	Receptor Name	Type	Maximum	99th %ile	95th %ile	90th %ile	70th %ile	Average	Days >90 [2]
R28		Heritage Lodged	1,059	731	512	418	302	243	305
R29		Heritage Lodged	2,786	1,234	617	407	242	236	316
R30		Heritage Lodged	570	482	269	210	109	101	138
R31		Heritage Lodged	745	398	261	206	144	116	203
R32		Heritage Lodged	635	279	204	171	116	96	166
R33		Heritage Lodged	606	417	303	215	104	101	143
R34		Heritage Lodged	452	300	207	152	75	75	82
R35	ACH-00035284	Heritage Lodged	741	420	266	192	117	104	165
R36	ACH-00035337	Heritage Lodged	392	282	176	118	70	68	69
R37	ACH-00032902	Heritage Lodged	867	494	330	264	155	145	254
R38	ACH-00034919	Heritage Lodged	1,073	602	385	301	181	167	294
R39	ACH-00032897	Heritage Lodged	663	309	229	182	119	104	182
R40	ACH-00032900	Heritage Lodged	601	425	288	238	162	136	253
R41	ACH-00032898	Heritage Lodged	715	477	346	251	151	138	234
R42	ACH-00032901	Heritage Lodged	847	460	321	276	161	148	278
R43	ACH-00034521	Heritage Lodged	197	166	88	72	44	46	18
R44	ACH-00034522	Heritage Lodged	152	119	73	61	40	42	11
R45	ACH-00034517	Heritage Lodged	202	101	68	54	40	41	5
R46	ACH-00034518	Heritage Lodged	129	83	56	46	37	38	2
R47		Heritage Lodged	225	162	97	73	49	49	24
R48		Heritage Lodged	256	193	114	81	52	52	27
R49		Heritage Lodged	688	399	220	183	113	99	161
R50	ACH-00035299	Heritage Lodged	687	502	290	223	111	108	136
R51	ACH-00034944	Heritage Lodged	897	669	399	310	210	174	255
R52		Heritage Lodged	464	348	200	163	99	89	131
R53		Heritage Lodged	275	177	137	103	64	61	45
R54		Heritage Lodged	461	343	183	149	86	83	98
R55		Heritage Lodged	253	204	121	102	72	68	56

Receptor No.	Receptor Name	Type	Maximum	99th %ile	95th %ile	90th %ile	70th %ile	Average	Days >90 [2]
R56		Heritage Lodged	185	131	91	76	51	51	21
R57		Heritage Lodged	130	90	67	56	42	42	4
R58		Heritage Lodged	124	98	68	58	43	42	8
R59		Heritage Lodged	118	104	69	56	42	42	8
R60		Heritage Lodged	218	152	101	89	63	59	34
R61		Heritage Lodged	240	185	114	97	70	66	51
R62	ACH-00032886	Heritage Lodged	311	253	151	130	84	81	96
R63	ACH-00032887	Heritage Lodged	374	339	234	179	110	103	161
R64	ACH-00034915	Heritage Lodged	166	131	81	64	45	45	15
R65	ACH-00034940	Heritage Lodged	383	242	161	109	63	62	51
R66	ACH-00034951	Heritage Lodged	156	137	80	68	46	46	15
R67	ACH-00034952	Heritage Lodged	690	238	148	108	62	62	55
R68	ACH-00035287	Heritage Lodged	259	232	117	105	75	71	70
R69	ACH-00035295	Heritage Lodged	383	332	227	180	113	104	162
R70	ACH-00035296	Heritage Lodged	667	410	250	199	109	105	153
R71	ACH-00035298	Heritage Lodged	243	184	110	95	67	62	42
R72	ACH-00035309	Heritage Lodged	283	222	126	109	75	71	70
R73	ACH-00035310	Heritage Lodged	237	150	106	87	63	61	32
R74	ACH-00035311	Heritage Lodged	340	289	179	141	92	88	115
R75	ACH-00035318	Heritage Lodged	756	321	227	171	101	88	130
R76	ACH-00035904	Heritage Lodged	147	111	77	62	45	45	12
R77	ACH-00035905	Heritage Lodged	128	113	76	59	44	44	12
R78	ACH-00035906	Heritage Lodged	117	107	70	58	42	42	11
R79	ACH-00035910	Heritage Lodged	114	99	69	55	42	42	8
R80	ACH-00035925	Heritage Lodged	139	94	72	60	43	43	8
R81	ACH-00035931	Heritage Lodged	364	165	113	99	59	56	46
R82	ACH-00032889	Heritage Lodged	685	317	197	155	94	83	120
R83	ACH-00032891	Heritage Lodged	806	466	301	211	121	121	186

Receptor No.	Receptor Name	Type	Maximum	99th %ile	95th %ile	90th %ile	70th %ile	Average	Days >90 [2]
R84	ACH-00034128	Heritage Lodged	606	424	308	243	157	140	266
R85	ACH-00032894	Heritage Lodged	359	172	126	90	60	56	36
R86	ACH-00034128	Heritage Lodged	110	81	62	52	39	39	2
R87	ACH-00034519	Heritage Lodged	84	62	45	41	35	36	0
R88	ACH-00034524	Heritage Lodged	250	129	73	61	42	43	9
R89	ACH-00034914	Heritage Lodged	531	407	257	199	122	118	197
R90	ACH-00035305	Heritage Lodged	423	189	135	99	65	59	51
R91	ACH-00035306	Heritage Lodged	597	232	148	120	70	65	72
R92	ACH-00035930	Heritage Lodged	423	199	130	104	68	61	58
R93	ACH-00035935	Heritage Lodged	1,418	629	405	283	155	141	200
R94	ACH-00035940	Heritage Lodged	157	112	72	62	43	42	9
R95	ACH-00032948	Heritage Lodged	74	62	53	50	42	40	0
R96	ACH-00034129	Heritage Lodged	96	74	54	48	38	38	2
R97	ACH-00034130	Heritage Lodged	94	73	58	49	38	38	2
R98	ACH-00034133	Heritage Lodged	62	57	44	40	35	35	0
R99	ACH-00034950	Heritage Lodged	79	67	52	47	36	37	0
R100	ACH-00034956	Heritage Lodged	101	78	60	50	38	39	2
R101	ACH-00036362	Heritage Lodged	155	97	73	62	41	42	7
R102	ACH-00036364	Heritage Lodged	82	51	44	40	35	35	0
R103	ACH-00036366	Heritage Lodged	164	101	74	58	40	41	7
R104	ACH-00036373	Heritage Lodged	78	49	43	39	34	35	0
R105		Heritage Lodged	87	52	46	41	35	35	0
R106		Heritage Lodged	86	54	45	42	35	36	0
R107		Heritage Lodged	57	48	41	39	34	35	0
R108		Heritage Lodged	666	285	204	168	91	80	112
R109		Heritage Lodged	193	134	88	71	49	47	17
R110		Heritage Lodged	72	64	47	42	36	36	0
R111		Heritage Lodged	69	46	42	38	34	35	0

Receptor No.	Receptor Name	Type	Maximum	99th %ile	95th %ile	90th %ile	70th %ile	Average	Days >90 [2]
R112		Heritage Lodged	56	43	40	38	34	34	0
R113		Heritage Lodged	64	45	42	38	34	35	0
R114	Freshwater claypans downstream of the Fortescue Marsh	Ecological	112	80	51	45	36	37	3
R115	Freshwater claypans downstream of the Fortescue Marsh	Ecological	128	93	57	48	37	39	7
R116	Freshwater claypans downstream of the Fortescue Marsh	Ecological	118	93	58	47	37	38	5
R117	Freshwater claypans downstream of the Fortescue Marsh	Ecological	102	87	62	46	37	38	4
R118	Freshwater claypans downstream of the Fortescue Marsh	Ecological	92	78	55	43	36	37	1
R119	Freshwater claypans downstream of the Fortescue Marsh	Ecological	85	71	52	43	36	37	0
R120	Freshwater claypans downstream of the Fortescue Marsh	Ecological	84	51	45	40	35	35	0
R121	Freshwater claypans downstream of the Fortescue Marsh	Ecological	74	47	43	39	34	35	0
R122	Four plant assemblages of the Wona Landsystem	Ecological	64	44	42	38	34	35	0
R123	Four plant assemblages of the Wona Landsystem	Ecological	57	42	40	37	34	34	0
R124		Ecological	51	40	38	36	34	34	0
R125		Ecological	107	62	46	43	37	37	1
R126		Ecological	97	55	45	41	36	36	1
R127		Ecological	130	101	73	60	46	44	8
R128		Ecological	141	90	70	56	43	42	4
R129		Ecological	78	49	43	40	34	35	0
R130		Ecological	86	52	44	41	35	35	0
R131		Ecological	89	54	45	40	35	35	0

Receptor No.	Receptor Name	Type	Maximum	99th %ile	95th %ile	90th %ile	70th %ile	Average	Days >90 [2]
R132		Ecological	93	55	47	40	35	36	1

Notes:

[1] Model results are presented as the maximum, and lower percentiles (i.e. %ile) to provide an indication of the range of predicted ground level concentrations at each receptor. This provides an indication of whether predicted excursions are isolated events or indicative of a potential ongoing issue.

[2] The criteria used for this assessment for TSP is sourced from DWER (2019) and references the Kwinana Environmental Protection Policy Area C criteria of 90 µg/m³ equivalent to 82 µg/m³ at 25° C for modelling purposes (Section 3.5).

Appendix Table 10: Maximum predicted monthly deposition rates (g/m²/month) - No dust abatement.

Receptor No.	Receptor Name	Type	Deposition
R1	Youngaleena Community	Human	0.02
R2	Wirrilimarra Community	Human	0.07
R3	Mulga Downs Airport	Human	1.20
R4	Homestead	Human	1.22
R5	Accommodation	Human	2.02
R6	ACH-00008422	Heritage	0.03
R7	ACH-00029427	Heritage	0.03
R8	ACH-00029428	Heritage	0.03
R9	ACH-00029430	Heritage	0.03
R10	ACH-00029431	Heritage	0.01
R11	ACH-00040450	Heritage	2.02
R12	ACH-00040448	Heritage	1.56
R13	ACH-00040581	Heritage	1.57
R14	ACH-00040449	Heritage	1.63
R15	ACH-00007317	Heritage	0.04
R16	ACH-00010696	Heritage	0.03
R17	ACH-00010697	Heritage	0.02
R18	ACH-00012060	Heritage	0.02
R19	ACH-00007805	Heritage	0.05
R20	ACH-00007555	Heritage	0.05
R21	ACH-00007806	Heritage	0.03
R22	ACH-00007807	Heritage	0.02
R23	ACH-00007808	Heritage	0.33
R24	ACH-00011280	Heritage	0.03
R25		Heritage Lodged	4.09
R26		Heritage Lodged	1.75
R27		Heritage Lodged	7.08
R28		Heritage Lodged	18.74
R29		Heritage Lodged	78.84
R30		Heritage Lodged	4.73
R31		Heritage Lodged	4.57
R32		Heritage Lodged	3.30
R33		Heritage Lodged	3.82
R34		Heritage Lodged	1.85
R35	ACH-00035284	Heritage Lodged	4.12
R36	ACH-00035337	Heritage Lodged	1.90
R37	ACH-00032902	Heritage Lodged	3.38
R38	ACH-00034919	Heritage Lodged	5.32
R39	ACH-00032897	Heritage Lodged	3.42
R40	ACH-00032900	Heritage Lodged	4.40
R41	ACH-00032898	Heritage Lodged	2.69

Receptor No.	Receptor Name	Type	Deposition
R42	ACH-00032901	Heritage Lodged	4.97
R43	ACH-00034521	Heritage Lodged	0.73
R44	ACH-00034522	Heritage Lodged	0.56
R45	ACH-00034517	Heritage Lodged	0.18
R46	ACH-00034518	Heritage Lodged	0.14
R47		Heritage Lodged	0.73
R48		Heritage Lodged	0.97
R49		Heritage Lodged	2.86
R50	ACH-00035299	Heritage Lodged	2.91
R51	ACH-00034944	Heritage Lodged	6.50
R52		Heritage Lodged	2.38
R53		Heritage Lodged	0.98
R54		Heritage Lodged	1.06
R55		Heritage Lodged	1.47
R56		Heritage Lodged	0.60
R57		Heritage Lodged	0.38
R58		Heritage Lodged	0.37
R59		Heritage Lodged	0.37
R60		Heritage Lodged	0.94
R61		Heritage Lodged	1.27
R62	ACH-00032886	Heritage Lodged	1.74
R63	ACH-00032887	Heritage Lodged	2.79
R64	ACH-00034915	Heritage Lodged	0.52
R65	ACH-00034940	Heritage Lodged	0.71
R66	ACH-00034951	Heritage Lodged	0.51
R67	ACH-00034952	Heritage Lodged	2.39
R68	ACH-00035287	Heritage Lodged	1.22
R69	ACH-00035295	Heritage Lodged	3.48
R70	ACH-00035296	Heritage Lodged	3.35
R71	ACH-00035298	Heritage Lodged	1.14
R72	ACH-00035309	Heritage Lodged	1.07
R73	ACH-00035310	Heritage Lodged	0.78
R74	ACH-00035311	Heritage Lodged	1.92
R75	ACH-00035318	Heritage Lodged	2.44
R76	ACH-00035904	Heritage Lodged	0.42
R77	ACH-00035905	Heritage Lodged	0.47
R78	ACH-00035906	Heritage Lodged	0.42
R79	ACH-00035910	Heritage Lodged	0.38
R80	ACH-00035925	Heritage Lodged	0.41
R81	ACH-00035931	Heritage Lodged	1.55
R82	ACH-00032889	Heritage Lodged	5.57
R83	ACH-00032891	Heritage Lodged	14.90

Receptor No.	Receptor Name	Type	Deposition
R84	ACH-00034128	Heritage Lodged	7.47
R85	ACH-00032894	Heritage Lodged	1.13
R86	ACH-00034128	Heritage Lodged	0.18
R87	ACH-00034519	Heritage Lodged	0.14
R88	ACH-00034524	Heritage Lodged	0.24
R89	ACH-00034914	Heritage Lodged	3.72
R90	ACH-00035305	Heritage Lodged	1.51
R91	ACH-00035306	Heritage Lodged	1.63
R92	ACH-00035930	Heritage Lodged	2.06
R93	ACH-00035935	Heritage Lodged	7.13
R94	ACH-00035940	Heritage Lodged	0.26
R95	ACH-00032948	Heritage Lodged	0.12
R96	ACH-00034129	Heritage Lodged	0.16
R97	ACH-00034130	Heritage Lodged	0.15
R98	ACH-00034133	Heritage Lodged	0.08
R99	ACH-00034950	Heritage Lodged	0.07
R100	ACH-00034956	Heritage Lodged	0.17
R101	ACH-00036362	Heritage Lodged	0.11
R102	ACH-00036364	Heritage Lodged	0.03
R103	ACH-00036366	Heritage Lodged	0.11
R104	ACH-00036373	Heritage Lodged	0.03
R105		Heritage Lodged	0.04
R106		Heritage Lodged	0.04
R107		Heritage Lodged	0.03
R108		Heritage Lodged	2.45
R109		Heritage Lodged	0.55
R110		Heritage Lodged	0.11
R111		Heritage Lodged	0.03
R112		Heritage Lodged	0.03
R113		Heritage Lodged	0.03
R114	Freshwater claypans downstream of the Fortescue Marsh	Ecological	0.27
R115	Freshwater claypans downstream of the Fortescue Marsh	Ecological	0.49
R116	Freshwater claypans downstream of the Fortescue Marsh	Ecological	0.44
R117	Freshwater claypans downstream of the Fortescue Marsh	Ecological	0.33
R118	Freshwater claypans downstream of the Fortescue Marsh	Ecological	0.23
R119	Freshwater claypans downstream of the Fortescue Marsh	Ecological	0.18
R120	Freshwater claypans downstream of the Fortescue Marsh	Ecological	0.03
R121	Freshwater claypans downstream of the Fortescue Marsh	Ecological	0.03
R122	Four plant assemblages of the Wona Landsystem	Ecological	0.03
R123	Four plant assemblages of the Wona Landsystem	Ecological	0.02
R124		Ecological	0.02
R125		Ecological	0.11

Receptor No.	Receptor Name	Type	Deposition
R126		Ecological	0.07
R127		Ecological	0.20
R128		Ecological	0.12
R129		Ecological	0.03
R130		Ecological	0.03
R131		Ecological	0.03
R132		Ecological	0.03

Note:

Shading indicates modelled result higher than the assessment criteria.

Appendix G – Scenario 2 model results

This appendix contains the following:

- Appendix Table 11: TSP with background model results - With dust abatement.
- Appendix Table 12: Maximum predicted monthly deposition rates (g/m^2/month) – with dust abatement.

Appendix Table 11: TSP with background model results - With dust abatement.

Receptor No.	Receptor Name	Type	Maximum[1]	99th %ile	95th %ile	90th %ile	70th %ile	Average	Days >90 [2]
R1	Youngaleena Community	Human	38	36	34	34	33	33	0
R2	Wirrilimarra Community	Human	49	46	39	37	34	34	0
R3	Mulga Downs Airport	Human	212	100	76	69	53	48	8
R4	Homestead	Human	209	106	77	69	55	49	10
R5	Accommodation	Human	427	227	182	144	89	84	108
R6	ACH-00008422	Heritage	59	42	39	37	34	34	0
R7	ACH-00029427	Heritage	58	45	39	37	34	34	0
R8	ACH-00029428	Heritage	57	41	39	37	34	34	0
R9	ACH-00029430	Heritage	55	41	39	36	34	34	0
R10	ACH-00029431	Heritage	41	37	35	34	33	34	0
R11	ACH-00040450	Heritage	371	199	131	105	71	67	52
R12	ACH-00040448	Heritage	305	200	117	98	63	60	45
R13	ACH-00040581	Heritage	306	195	119	99	63	60	45
R14	ACH-00040449	Heritage	307	210	120	95	66	62	45
R15	ACH-00007317	Heritage	50	40	36	35	34	34	0
R16	ACH-00010696	Heritage	48	43	39	37	34	34	0
R17	ACH-00010697	Heritage	47	38	37	35	34	34	0
R18	ACH-00012060	Heritage	47	39	37	36	34	34	0
R19	ACH-00007805	Heritage	48	46	41	37	34	34	0
R20	ACH-00007555	Heritage	48	47	41	38	34	35	0
R21	ACH-00007806	Heritage	37	36	34	34	33	33	0
R22	ACH-00007807	Heritage	36	35	34	34	33	33	0

Receptor No.	Receptor Name	Type	Maximum[1]	99th %ile	95th %ile	90th %ile	70th %ile	Average	Days >90 [2]
R23	ACH-00007808	Heritage	61	58	53	49	42	39	0
R24	ACH-00011280	Heritage	57	44	40	37	34	34	0
R25		Heritage Lodged	538	360	218	178	105	98	140
R26		Heritage Lodged	362	273	156	123	73	70	78
R27		Heritage Lodged	505	394	247	197	128	111	164
R28		Heritage Lodged	587	408	284	228	172	142	263
R29		Heritage Lodged	2,775	1,187	507	340	196	193	265
R30		Heritage Lodged	324	273	161	133	73	70	80
R31		Heritage Lodged	451	235	162	131	93	79	117
R32		Heritage Lodged	393	173	131	112	79	68	77
R33		Heritage Lodged	347	241	177	129	73	70	73
R34		Heritage Lodged	266	182	126	96	56	56	47
R35	ACH-00035284	Heritage Lodged	443	262	171	125	84	74	98
R36	ACH-00035337	Heritage Lodged	231	172	111	82	55	54	29
R37	ACH-00032902	Heritage Lodged	567	309	215	175	110	102	160
R38	ACH-00034919	Heritage Lodged	682	381	241	198	122	115	207
R39	ACH-00032897	Heritage Lodged	400	209	156	129	88	78	106
R40	ACH-00032900	Heritage Lodged	407	292	200	165	116	99	187
R41	ACH-00032898	Heritage Lodged	479	306	226	169	108	99	146
R42	ACH-00032901	Heritage Lodged	575	303	220	186	116	107	191
R43	ACH-00034521	Heritage Lodged	126	110	66	56	40	41	6
R44	ACH-00034522	Heritage Lodged	104	84	56	50	37	38	3
R45	ACH-00034517	Heritage Lodged	135	73	54	46	37	38	1

Receptor No.	Receptor Name	Type	Maximum[1]	99th %ile	95th %ile	90th %ile	70th %ile	Average	Days >90 [2]
R46	ACH-00034518	Heritage Lodged	91	62	47	41	35	36	1
R47		Heritage Lodged	150	107	74	57	43	42	10
R48		Heritage Lodged	160	132	82	61	44	44	11
R49		Heritage Lodged	406	235	138	117	76	69	77
R50	ACH-00035299	Heritage Lodged	446	324	191	148	84	79	95
R51	ACH-00034944	Heritage Lodged	590	442	270	213	144	122	199
R52		Heritage Lodged	301	235	138	115	74	68	72
R53		Heritage Lodged	184	124	96	77	52	50	23
R54		Heritage Lodged	294	229	127	104	65	63	56
R55		Heritage Lodged	160	130	84	74	56	54	14
R56		Heritage Lodged	123	90	68	59	44	44	4
R57		Heritage Lodged	91	67	53	47	38	38	1
R58		Heritage Lodged	91	73	54	47	39	39	1
R59		Heritage Lodged	90	79	56	47	39	39	1
R60		Heritage Lodged	144	99	74	66	52	49	7
R61		Heritage Lodged	150	119	80	71	55	53	12
R62	ACH-00032886	Heritage Lodged	189	156	99	88	63	60	32
R63	ACH-00032887	Heritage Lodged	233	214	153	119	79	75	77
R64	ACH-00034915	Heritage Lodged	114	94	63	52	40	40	5
R65	ACH-00034940	Heritage Lodged	221	150	106	77	51	50	26
R66	ACH-00034951	Heritage Lodged	111	96	63	53	41	41	6
R67	ACH-00034952	Heritage Lodged	405	161	105	78	51	51	27
R68	ACH-00035287	Heritage Lodged	162	148	84	75	58	55	14

Receptor No.	Receptor Name	Type	Maximum[1]	99th %ile	95th %ile	90th %ile	70th %ile	Average	Days >90 [2]
R69	ACH-00035295	Heritage Lodged	240	215	156	128	86	81	95
R70	ACH-00035296	Heritage Lodged	387	267	168	137	80	78	90
R71	ACH-00035298	Heritage Lodged	161	117	79	71	55	51	13
R72	ACH-00035309	Heritage Lodged	177	151	90	78	58	56	20
R73	ACH-00035310	Heritage Lodged	156	105	77	65	51	50	12
R74	ACH-00035311	Heritage Lodged	204	173	116	94	67	64	44
R75	ACH-00035318	Heritage Lodged	453	207	162	127	80	69	83
R76	ACH-00035904	Heritage Lodged	107	82	59	51	40	40	3
R77	ACH-00035905	Heritage Lodged	92	84	58	49	40	40	1
R78	ACH-00035906	Heritage Lodged	85	79	56	48	39	39	0
R79	ACH-00035910	Heritage Lodged	83	75	54	46	38	38	0
R80	ACH-00035925	Heritage Lodged	96	68	57	50	39	39	1
R81	ACH-00035931	Heritage Lodged	230	116	85	73	50	47	14
R82	ACH-00032889	Heritage Lodged	413	219	126	110	72	64	58
R83	ACH-00032891	Heritage Lodged	795	368	195	149	96	93	129
R84	ACH-00034128	Heritage Lodged	368	251	185	150	102	94	143
R85	ACH-00032894	Heritage Lodged	227	120	89	68	50	47	17
R86	ACH-00034128	Heritage Lodged	79	62	51	45	37	37	0
R87	ACH-00034519	Heritage Lodged	63	50	40	38	34	35	0
R88	ACH-00034524	Heritage Lodged	163	89	57	49	38	39	4
R89	ACH-00034914	Heritage Lodged	310	265	172	133	90	86	110
R90	ACH-00035305	Heritage Lodged	265	125	97	74	53	50	22
R91	ACH-00035306	Heritage Lodged	357	151	105	88	57	53	35

Receptor No.	Receptor Name	Type	Maximum[1]	99th %ile	95th %ile	90th %ile	70th %ile	Average	Days >90 [2]
R92	ACH-00035930	Heritage Lodged	268	132	95	77	55	50	23
R93	ACH-00035935	Heritage Lodged	765	346	238	177	104	95	142
R94	ACH-00035940	Heritage Lodged	107	79	58	51	39	39	2
R95	ACH-00032948	Heritage Lodged	58	51	45	43	39	37	0
R96	ACH-00034129	Heritage Lodged	70	57	46	42	36	36	0
R97	ACH-00034130	Heritage Lodged	69	58	48	43	36	36	0
R98	ACH-00034133	Heritage Lodged	50	47	40	37	34	34	0
R99	ACH-00034950	Heritage Lodged	61	53	45	41	35	35	0
R100	ACH-00034956	Heritage Lodged	74	60	50	44	36	37	0
R101	ACH-00036362	Heritage Lodged	101	71	58	50	38	38	2
R102	ACH-00036364	Heritage Lodged	63	44	40	37	34	34	0
R103	ACH-00036366	Heritage Lodged	112	72	57	48	37	38	2
R104	ACH-00036373	Heritage Lodged	61	43	39	37	34	34	0
R105		Heritage Lodged	66	44	41	38	34	34	0
R106		Heritage Lodged	65	45	40	38	34	35	0
R107		Heritage Lodged	48	42	38	36	34	34	0
R108		Heritage Lodged	409	197	141	121	72	64	75
R109		Heritage Lodged	127	94	66	57	43	42	5
R110		Heritage Lodged	56	51	42	39	35	35	0
R111		Heritage Lodged	55	41	38	36	34	34	0
R112		Heritage Lodged	47	39	37	36	34	34	0
R113		Heritage Lodged	51	40	38	36	34	34	0

Receptor No.	Receptor Name	Type	Maximum[1]	99th %ile	95th %ile	90th %ile	70th %ile	Average	Days >90 [2]
R114	Freshwater claypans downstream of the Fortescue Marsh	Ecological	79	62	44	40	35	36	0
R115	Freshwater claypans downstream of the Fortescue Marsh	Ecological	90	68	48	42	36	36	0
R116	Freshwater claypans downstream of the Fortescue Marsh	Ecological	82	68	48	42	35	36	0
R117	Freshwater claypans downstream of the Fortescue Marsh	Ecological	73	65	51	41	35	36	0
R118	Freshwater claypans downstream of the Fortescue Marsh	Ecological	67	60	47	39	35	36	0
R119	Freshwater claypans downstream of the Fortescue Marsh	Ecological	63	56	44	39	35	35	0
R120	Freshwater claypans downstream of the Fortescue Marsh	Ecological	64	44	40	37	34	34	0
R121	Freshwater claypans downstream of the Fortescue Marsh	Ecological	58	41	39	37	34	34	0
R122	Four plant assemblages of the Wona Landsystem	Ecological	52	40	38	36	34	34	0
R123	Four plant assemblages of the Wona Landsystem	Ecological	47	39	37	36	34	34	0
R124		Ecological	44	37	36	35	34	34	0
R125		Ecological	78	50	41	39	35	35	0
R126		Ecological	72	46	40	38	35	35	0
R127		Ecological	91	75	58	50	41	40	1
R128		Ecological	101	70	56	47	39	39	2
R129		Ecological	60	42	39	37	34	34	0
R130		Ecological	66	44	40	38	34	34	0
R131		Ecological	68	45	40	38	34	35	0

Receptor No.	Receptor Name	Type	Maximum[1]	99th %ile	95th %ile	90th %ile	70th %ile	Average	Days >90 [2]
R132		Ecological	70	46	41	38	34	35	0

Notes:

[1] Model results are presented as the maximum modelled result, and lower percentiles (i.e. %ile) to provide an indication of the range of predicted ground level concentrations at each receptor. This provides an indication of whether predicted excursions are isolated events or indicative of a potential ongoing issue.

[2] The criteria used for this assessment for TSP is sourced from DWER (2019) and references the Kwinana Environmental Protection Policy Area C criteria of 90 µg/m³ equivalent to 82 µg/m³ at 25° C for modelling purposes (Section 3.5).

Appendix Table 12: Maximum predicted monthly deposition rates ($g/m^2/month$) – with dust abatement.

Receptor No.	Receptor Name	Type	Deposition
R1	Youngaleena Community	Human	0.02
R2	Wirrilimarra Community	Human	0.04
R3	Mulga Downs Airport	Human	0.71
R4	Homestead	Human	0.74
R5	Accommodation	Human	1.21
R6	ACH-00008422	Heritage	0.02
R7	ACH-00029427	Heritage	0.02
R8	ACH-00029428	Heritage	0.02
R9	ACH-00029430	Heritage	0.02
R10	ACH-00029431	Heritage	0.01
R11	ACH-00040450	Heritage	1.21
R12	ACH-00040448	Heritage	0.88
R13	ACH-00040581	Heritage	0.89
R14	ACH-00040449	Heritage	0.92
R15	ACH-00007317	Heritage	0.02
R16	ACH-00010696	Heritage	0.02
R17	ACH-00010697	Heritage	0.01
R18	ACH-00012060	Heritage	0.01
R19	ACH-00007805	Heritage	0.03
R20	ACH-00007555	Heritage	0.03
R21	ACH-00007806	Heritage	0.02
R22	ACH-00007807	Heritage	0.02
R23	ACH-00007808	Heritage	0.21
R24	ACH-00011280	Heritage	0.02
R25		Heritage Lodged	2.62
R26		Heritage Lodged	1.07
R27		Heritage Lodged	3.68
R28		Heritage Lodged	9.49
R29		Heritage Lodged	76.96
R30		Heritage Lodged	2.99
R31		Heritage Lodged	2.49
R32		Heritage Lodged	1.83
R33		Heritage Lodged	2.30
R34		Heritage Lodged	1.09
R35	ACH-00035284	Heritage Lodged	2.59
R36	ACH-00035337	Heritage Lodged	1.19
R37	ACH-00032902	Heritage Lodged	2.06
R38	ACH-00034919	Heritage Lodged	3.10
R39	ACH-00032897	Heritage Lodged	2.27
R40	ACH-00032900	Heritage Lodged	2.93
R41	ACH-00032898	Heritage Lodged	1.69

Receptor No.	Receptor Name	Type	Deposition
R42	ACH-00032901	Heritage Lodged	3.50
R43	ACH-00034521	Heritage Lodged	0.46
R44	ACH-00034522	Heritage Lodged	0.35
R45	ACH-00034517	Heritage Lodged	0.10
R46	ACH-00034518	Heritage Lodged	0.09
R47		Heritage Lodged	0.48
R48		Heritage Lodged	0.64
R49		Heritage Lodged	1.52
R50	ACH-00035299	Heritage Lodged	1.77
R51	ACH-00034944	Heritage Lodged	4.77
R52		Heritage Lodged	1.52
R53		Heritage Lodged	0.62
R54		Heritage Lodged	0.65
R55		Heritage Lodged	0.85
R56		Heritage Lodged	0.36
R57		Heritage Lodged	0.24
R58		Heritage Lodged	0.23
R59		Heritage Lodged	0.23
R60		Heritage Lodged	0.60
R61		Heritage Lodged	0.73
R62	ACH-00032886	Heritage Lodged	0.95
R63	ACH-00032887	Heritage Lodged	2.12
R64	ACH-00034915	Heritage Lodged	0.33
R65	ACH-00034940	Heritage Lodged	0.41
R66	ACH-00034951	Heritage Lodged	0.32
R67	ACH-00034952	Heritage Lodged	1.45
R68	ACH-00035287	Heritage Lodged	0.68
R69	ACH-00035295	Heritage Lodged	2.89
R70	ACH-00035296	Heritage Lodged	2.01
R71	ACH-00035298	Heritage Lodged	0.74
R72	ACH-00035309	Heritage Lodged	0.60
R73	ACH-00035310	Heritage Lodged	0.47
R74	ACH-00035311	Heritage Lodged	1.04
R75	ACH-00035318	Heritage Lodged	1.67
R76	ACH-00035904	Heritage Lodged	0.26
R77	ACH-00035905	Heritage Lodged	0.30
R78	ACH-00035906	Heritage Lodged	0.27
R79	ACH-00035910	Heritage Lodged	0.24
R80	ACH-00035925	Heritage Lodged	0.26
R81	ACH-00035931	Heritage Lodged	0.94
R82	ACH-00032889	Heritage Lodged	3.26
R83	ACH-00032891	Heritage Lodged	14.17

Receptor No.	Receptor Name	Type	Deposition
R84	ACH-00034128	Heritage Lodged	3.84
R85	ACH-00032894	Heritage Lodged	0.68
R86	ACH-00034128	Heritage Lodged	0.11
R87	ACH-00034519	Heritage Lodged	0.09
R88	ACH-00034524	Heritage Lodged	0.14
R89	ACH-00034914	Heritage Lodged	2.33
R90	ACH-00035305	Heritage Lodged	0.91
R91	ACH-00035306	Heritage Lodged	1.00
R92	ACH-00035930	Heritage Lodged	1.24
R93	ACH-00035935	Heritage Lodged	4.12
R94	ACH-00035940	Heritage Lodged	0.16
R95	ACH-00032948	Heritage Lodged	0.07
R96	ACH-00034129	Heritage Lodged	0.10
R97	ACH-00034130	Heritage Lodged	0.09
R98	ACH-00034133	Heritage Lodged	0.05
R99	ACH-00034950	Heritage Lodged	0.04
R100	ACH-00034956	Heritage Lodged	0.11
R101	ACH-00036362	Heritage Lodged	0.07
R102	ACH-00036364	Heritage Lodged	0.02
R103	ACH-00036366	Heritage Lodged	0.06
R104	ACH-00036373	Heritage Lodged	0.02
R105		Heritage Lodged	0.02
R106		Heritage Lodged	0.02
R107		Heritage Lodged	0.02
R108		Heritage Lodged	1.66
R109		Heritage Lodged	0.35
R110		Heritage Lodged	0.06
R111		Heritage Lodged	0.02
R112		Heritage Lodged	0.02
R113		Heritage Lodged	0.02
R114	Freshwater claypans downstream of the Fortescue Marsh	Ecological	0.18
R115	Freshwater claypans downstream of the Fortescue Marsh	Ecological	0.34
R116	Freshwater claypans downstream of the Fortescue Marsh	Ecological	0.29
R117	Freshwater claypans downstream of the Fortescue Marsh	Ecological	0.22
R118	Freshwater claypans downstream of the Fortescue Marsh	Ecological	0.15
R119	Freshwater claypans downstream of the Fortescue Marsh	Ecological	0.12
R120	Freshwater claypans downstream of the Fortescue Marsh	Ecological	0.02
R121	Freshwater claypans downstream of the Fortescue Marsh	Ecological	0.02
R122	Four plant assemblages of the Wona Landsystem	Ecological	0.02
R123	Four plant assemblages of the Wona Landsystem	Ecological	0.02
R124		Ecological	0.01
R125		Ecological	0.06

Receptor No.	Receptor Name	Type	Deposition
R126		Ecological	0.04
R127		Ecological	0.12
R128		Ecological	0.07
R129		Ecological	0.02
R130		Ecological	0.02
R131		Ecological	0.02
R132		Ecological	0.02

Note:

Shading indicates modelled result higher than the assessment criteria.

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