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Mining & Energy Technical Services Pty Ltd

Spring Creek North Continuation Project

Air Quality Assessment

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Executive Summary

Vipac Engineers and Scientists Ltd was commissioned by Mining & Energy Technical Services Pty Ltd, on behalf of Glencore Coal Assets Australia (GCAA), to prepare an air quality assessment for the Spring Creek North Continuation Project (SCNCP, the Project). This assessment evaluates the potential impacts of air pollutants generated from the worst-case operational stage of the SCNCP and provides recommendations to mitigate any potential impacts that might have an effect on nearby sensitive receptors.

The air quality impact assessment has been carried out as follows:

- An emissions inventory of TSP, PM_{10}, $PM_{2.5}$, and deposited dust and gaseous blasting emissions for the proposed Project and rehabilitation of Meteor Downs South (MDS) Mine was compiled using National Pollutant Inventory (NPI) and United States Environmental Protection Agency (USEPA) AP-42 emissions estimation methodology for the construction and maximum operational stages of the Project.
- Estimated emissions data was used as input for air dispersion modelling. The modelling techniques were based on a combination of The Air Pollution Model (TAPM) prognostic meteorological model (developed by CSIRO), and the CALMET model suite used to generate a three-dimensional meteorological dataset for use in the CALPUFF dispersion model.
- The atmospheric dispersion modelling results were assessed against air quality assessment criteria as part of the impact assessment. Air quality controls are applied to reduce emission rates where applicable.

The following controls were applied to the dust sources for the estimation of emissions in accordance with the NPI Emission Estimation Technique Manual for Mining v3.0:

- 50% control for water sprays applied to stockpiles and exposed areas;
- 75% control for level 2 watering of haul routes (>2 litres/m²/h);
- 44% control for limiting vehicle speeds on haul routes < 50 km/h; and
- 70% control for water sprays applied to drilling.

The results of the modelling can be summarised as follows:

- The highest annual cumulative TSP concentrations are below the 90 µg/m³ criterion at all sensitive receptors modelled.
- The maximum 24-hour average cumulative ground-level PM_{10} concentrations are predicted to occur at SR3 (Inderi) and is above the 50 µg/m³ criterion (i.e. the EPP (Air)). The 5th highest predictions are all below the relevant EA Condition criterion at these sensitive receptors.
- The annual average cumulative ground-level PM_{10} are predicted to be lower than the criterion at all the all sensitive receptors modelled.
- The maximum 24-hour average cumulative ground-level $PM_{2.5}$ are predicted to be lower than the criterion at all sensitive receptors modelled.
- The annual average cumulative ground-level $PM_{2.5}$ are predicted to be lower than the criterion at all sensitive receptors modelled.
- The predicted dust deposition impacts from the mine activities are below the 120 mg/m^2/day criterion at all sensitive receptors modelled.

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1 Introduction

Vipac Engineers and Scientists Ltd (Vipac) was commissioned by Mining & Energy Technical Services Pty Ltd (METServe) on behalf of GCAA (the Proponent) to prepare an air quality assessment for the Spring Creek North Continuation Project (SCNCP, the Project). The purpose of this assessment is to evaluate the potential impacts of air pollutants generated from the worst-case operational stage of the Project and to provide recommendations to mitigate any potential impacts that might have an effect on nearby sensitive receptors.

2 Project Description

2.1 Overview

The Rolleston Open Cut (ROC) thermal coal mine has been in operation since 2005 and has approval to mine up to 19 million tonnes (Mt) run-of-mine (ROM) coal per annum. The Project proposes to extend the mining area of the existing operations by mining north of the current Spring Creek pit on mining lease's (ML's) 70415 and 70307 as shown in Figure 2-1.

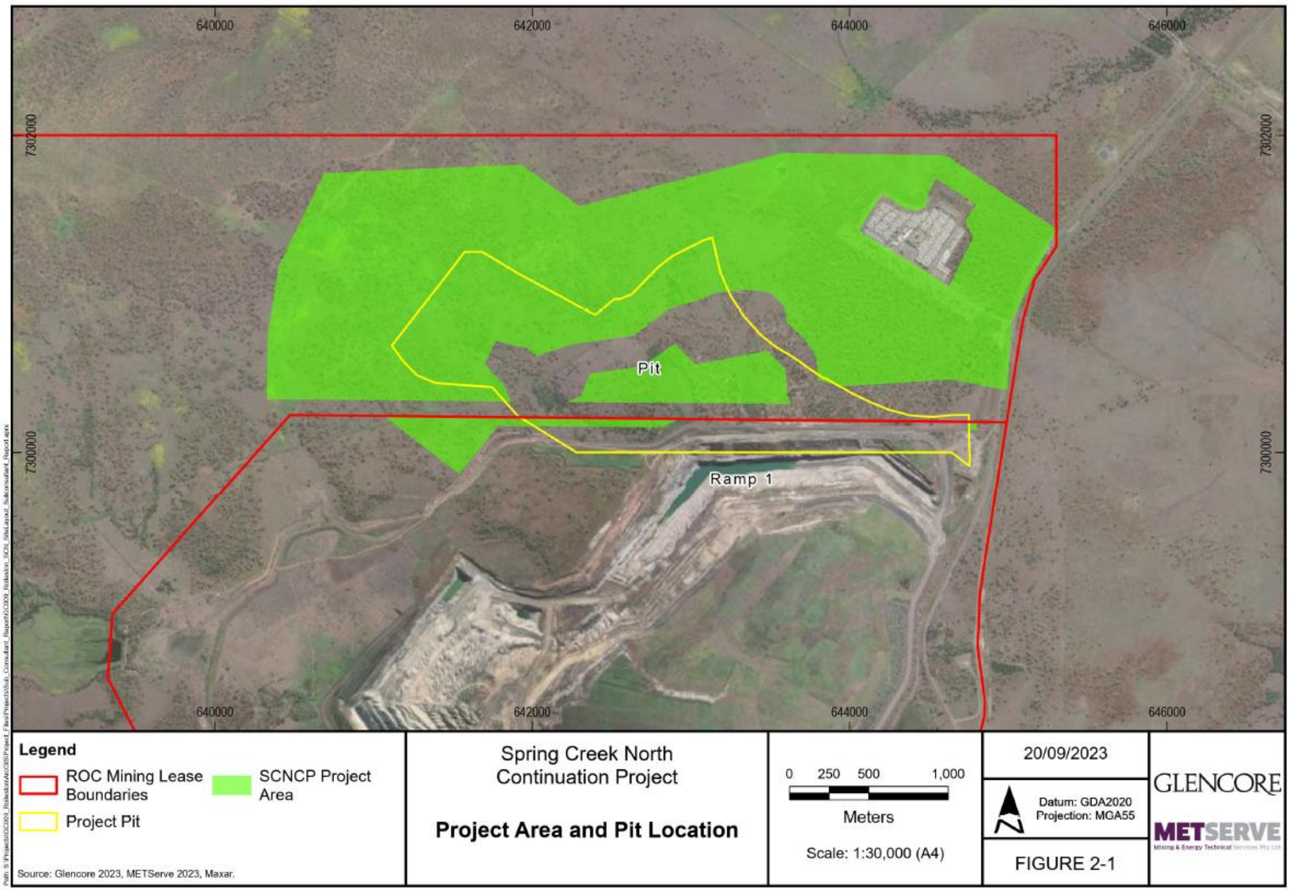


Figure 2-1 Project Area and Pit Location

2.2 Surrounding Environment

The Project is situated approximately 275 km west of Gladstone and approximately 16 km west of the town of Rolleston in the Central Highlands Regional Council area. The surrounding environment is dominated by existing ROC activities and rural farmland. Figure 2-2 shows the SCNCP regional location.

The nearest air sensitive receptors consist of homesteads and Albinia National Park. Locations as provided by the Proponent are shown in Figure 2-3[1] and Figure 2-4, and coordinates provided in Table 2-1.

[1] It is noted that five sensitive receptors furthest from the Project in the northerly direction identified in the regional map were outside of the modelling domain and therefore excluded from the modelling. There are a number of sensitive receptors closer to the Project in this direction which may be considered representative of the excluded sensitive receptors.

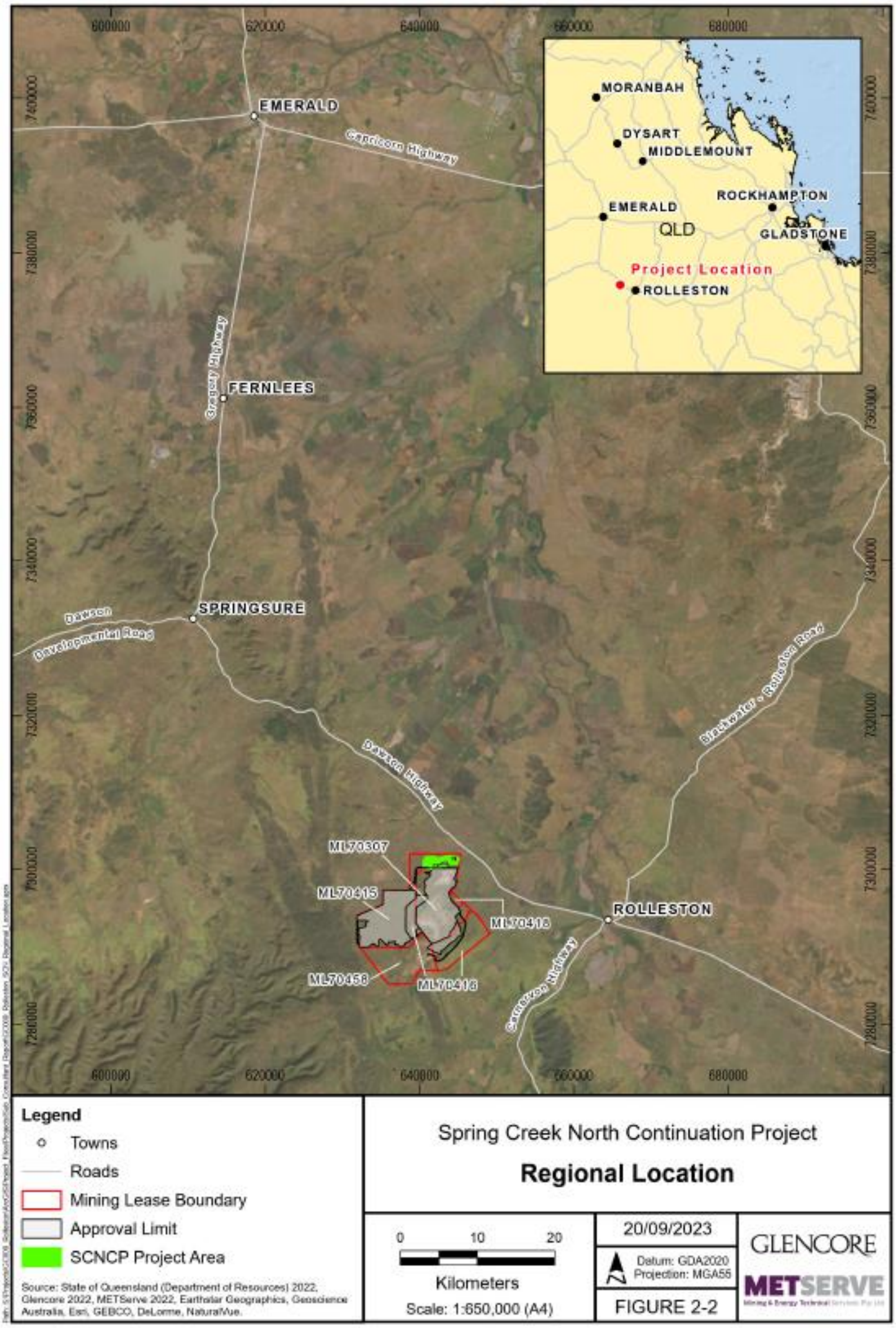


Figure 2-2: Spring Creek North Continuation Project Regional Location

Table 2-1 Nearest Air Sensitive Receptors

Receptor ID	Sensitive Receptor	Distance from Project (km)	UTM Zone 55S	
			East (m)	South (m)
SR1	Meteor Downs	5.5	635124	7302750
SR2	Albinia Downs	5.7	650271	7298160
SR3	Inderi	7.3	644889	7308673
SR4	Croydon Hills	10.6	630818	7305673
SR5	Springwood	17.4	634445	7283926
SR6	Bottle Tree Downs	14.4	650168	7287015
SR7	Belmundi	12.3	634426	7312367
SR8	Maria Downs	13	633990	7312989
NA	Myrtle Vale	14.6	634474	7314944
SR9	Canopus Park	10.4	638217	7311895
NA	Orana Downs	14.1	639828	7315824
NA	Wandana	14	640337	7315780
SR10	Starlee	12	656300	7306109
SR11	Karonga	9.9	643371	7311792
NA	Cambridge Downs	13	645299	7314743
NA	Maxmoor	14.7	650490	7315396
SR12	Carnarvan View	14.7	659268	7297067
SR13	The Pocket	14.3	655717	7290964
SR14	Albinia National Park	9.5	652317	7293882

NA – Not assessed. Five sensitive receptors furthest from the Project in the northerly direction identified in the regional map were outside of the modelling domain and therefore excluded from the modelling. There are a number of sensitive receptors closer to the Project in this direction which may be considered representative of the excluded sensitive receptors

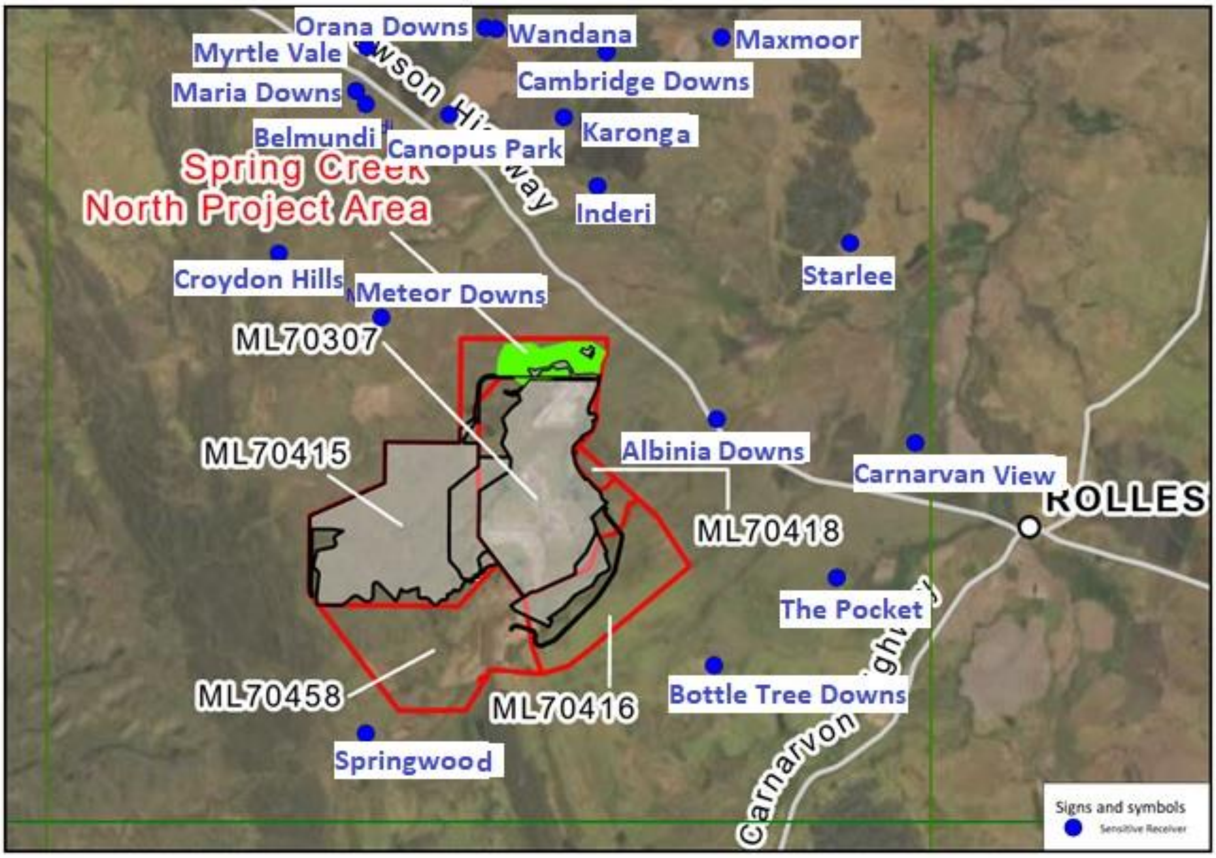


Figure 2-3 Nearest Air Sensitive Receptors (Homesteads)

Figure 2-4: Air Sensitive Receptor – Albinia National Park

2.3 Proposed Project Operations

The Project will not increase the mine's production rate or extend the life of the mine. No change in the method of mining is proposed and operating hours will remain unchanged with the mine operating 24 hours per day, 7 days per week. The Project proposes to utilise existing infrastructure, and contribution to air quality levels from mine infrastructure sources are expected to remain unchanged.

The pit area will be mined by open cut methods with the mining strips generally 50 to 70 m wide, depending on depth and other constraints. Coal will be loaded onto trains within ML70418 and transported to coal domestic/ export facilities in Gladstone via the rail network referred to as the Blackwater System.

The Project has been designed to utilise the existing approved ROC infrastructure wherever practical. This approach reduces the disturbance footprint by utilising approved ancillary infrastructure such as electricity lines, water supply pipelines, coal handling facility (CHF), train load out facility (TLO), haul roads and rail infrastructure.

As shown in Table 2-2, year 4 of the Project has been identified by the Proponent to be representative of the worst-case scenario for potential air quality impacts as the second highest total extraction volume is expected to be moved in that year and with a dragline and three other excavation machines active in the SCNCP.

Table 2-2: Proposed extraction rates

Source Pit	**SCN (bcm)**		**SCN Total**	**Grand Total**
Process	**Dragline**	**Excavator**		
Year 1	-	26,252,370	26,252,370	26,252,370
Year 2	28,094,846	27,917,048	56,011,894	56,011,894
Year 3	28,119,224	34,274,182	62,393,407	62,393,407
Year 4	28,718,422	34,350,966	63,069,388	63,069,388
Year 5	28,506,190	37,294,074	65,800,263	65,800,263
Year 6	24,797,682	29,288,814	54,086,496	54,086,496
Year 7	24,895,872	18,753,366	43,649,237	43,649,237
Year 8	8,448,797	51,888	8,500,685	8,500,685
Grand Total	**171,581,032**	**208,182,708**	**379,763,740**	**379,763,740**

2.4 Pollutants of Concern

The main emissions to air from Project operations are caused by wind-borne dust, vehicle usage, materials handling and transfers.

Dust is a generic term used to describe particles that are suspended in the atmosphere. The dust emissions considered in this report are particulate matter in various sizes:

- Total Suspended Particles (TSP) - Particulate matter with a diameter up to 50 microns;
- PM_{10} - Particulate matter less than 10 microns in size;
- $PM_{2.5}$ - Particulate matter less than 2.5 microns in size; and
- Dust Deposition – deposited matter that falls out of the atmosphere.

3 Regulatory Framework

This section outlines the regulatory requirements the Project will be assessed against.

3.1 National Environment Protection Measure for Ambient Air Quality

Australia's first national ambient air quality standards were outlined in 1998 as part of the National Environment Protection Measure for Ambient Air Quality.

The Ambient Air Measure sets national standards for the key air pollutants; carbon monoxide, ozone, sulfur dioxide, nitrogen dioxide, lead and particles (PM_{10} and $PM_{2.5}$). The Air NEPM requires the state governments to monitor air quality and to identify potential air quality problems.

3.2 Queensland Environmental Protection (Air) Policy

The Queensland Department of Environment and Resource Management (DERM) has set air quality goals as part of their Environmental Protection (Air) Policy 2019 (EPP (Air)) (EPP (Air), 2019). The policy was developed to meet air quality objectives for Queensland’s air environment as outlined in the Environmental Protection Act 2019 (EP Act, 2019).

The object of the Environmental Protection Act 2019 is to protect Queensland's environment while allowing for development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends. The objective of the EPP (Air) 2019 is to identify the environmental values of the air environment to be enhanced or protected and to achieve the object of the Environmental Protection Act 2019, i.e. ecologically sustainable development.

3.3 Environmental Authority EPML00370013 Conditions

Schedule B of Environmental Authority (EA) EPML00370013 sets out conditions relevant to dust nuisance at the ROC inclusive of ML70415 as follows.

Table 3-1: EA Conditions

Schedule B – Air	
Condition Number	Condition
B1	Dust nuisance When a complaint is received, the holder of this environmental authority must ensure that all reasonable and feasible avoidance and mitigation measures were employed so that the dust and particulate matter emissions generated by the mining activities do not exceed the following levels when measured at any sensitive or commercial place: a) Dust deposition of 120 milligrams per square metre per day, averaged over 1 month, when monitored in accordance with the most recent version of Australian Standard AS3580.10.1 Methods for sampling and analysis of ambient air—Determination of particulate matter— Deposited matter – Gravimetric method. b) A concentration of particulate matter with an aerodynamic diameter of less than 10 micrometres (PM10) suspended in the atmosphere of 50 micrograms per cubic metre over a 24-hour averaging time, for no more than 5 exceedances recorded each year, when monitored in accordance with the most recent version of either: 1. Australian Standard AS3580.9.6 Methods for sampling and analysis of ambient air— Determination of suspended particulate matter—PM10 high volume sampler with size selective inlet – Gravimetric method; or 2. Australian Standard AS3580.9.9 Methods for sampling and analysis of ambient air— Determination of suspended particulate matter—PM10 low volume sampler— Gravimetric method.

3.4 Project Criteria

The applicable criteria selected from the regulatory framework for this assessment are presented in Table 3-2.

Table 3-2: Project Criteria

Pollutant	Basis	Criteria	Source	Averaging Time
TSP	Human Health	90 $\mu g/m^3$	EPP (Air)	1-year
PM_{10}	Human Health	50 $\mu g/m^3$	EPP (Air)	24-hour
		50 $\mu g/m^3$	EA	24-hour[1]
	Human Health	25 $\mu g/m^3$	EPP (Air)	Annual
$PM_{2.5}$	Human Health	25 $\mu g/m^3$	EPP (Air)	24-hour
	Human Health	8 $\mu g/m^3$	EPP (Air)	Annual
Dust deposition	Amenity	120 mg/m^2/day	EA	1-Month

1 Not to be exceeded by more than 5 times per year.

3.5 Existing Environment

3.5.1 Regional Historical Meteorology

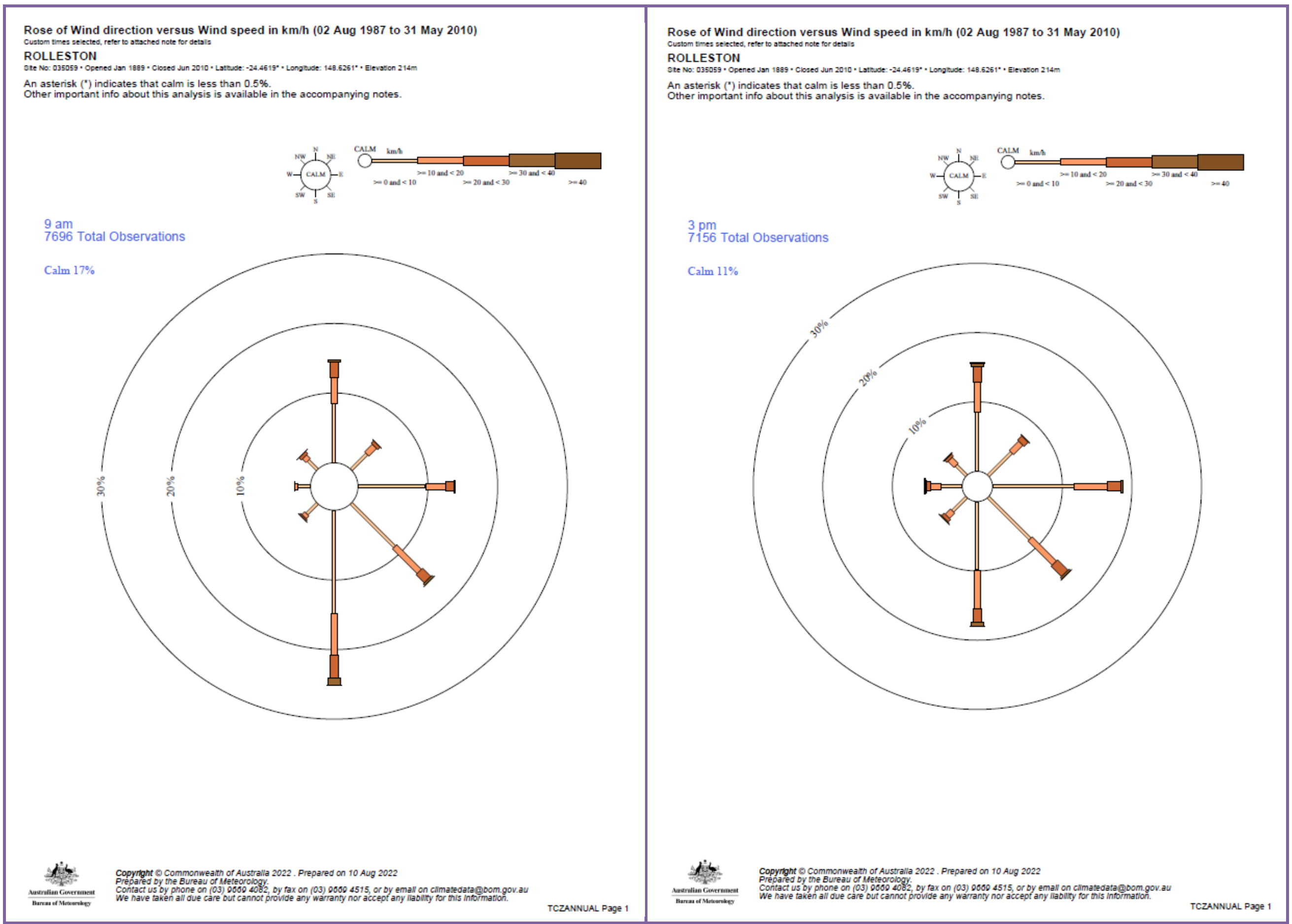
The nearest long-term Bureau of Meteorology (BOM) station to the Project site is at the Rolleston Airport (Site number 035059), located approximately 20 km to the south east. This monitoring station commenced collecting data from 1889 and closed in 2010. A summary of the historical climate statistics is presented in Table 3-3.

The long term mean temperature range is between 5.6°C and 34.8°C with the coldest month being July and the hottest months being October to March. The rainfall in the region is variable, with most rainfall in the warmer months. On average, most of the annual rainfall is received between December and February. Rainfall is lowest between April and October, with a mean annual rainfall of 636 mm. Rainfall reduces the dispersion of air emissions and therefore the potential impact on visual amenity and health.

Table 3-3: Long-term Weather Data for Rolleston [BOM]

Month	Mean Temperature		Rainfall			9 am Conditions			3 pm Conditions		
	Max (°C)	Min (°C)	Mean Rain (mm)	Mean Rain Days	No. of Days ≥ 1 mm	Temp (°C)	RH (%)	Wind Speed (km/h)	Temp (°C)	Mean RH (%)	Wind Speed (km/h)
Jan	34.8	21	93.2	7	6.5	27	66	10.2	33.4	44	11.3
Feb	33.7	20.8	94	6.3	5.6	26.2	70	10.2	32.2	49	11.3
Mar	32.8	18.4	61.3	5.1	4.5	24.9	67	9.7	31.7	43	10.5
Apr	29.7	14.8	41.1	3.3	2.9	22.1	66	9.2	28.5	43	10.6
May	26.1	10.6	35.4	3.2	2.8	17.5	68	9.2	24.9	43	9.8
Jun	23	7.1	36.2	3.1	2.8	13.9	74	8.9	22.1	46	11.2
Jul	22.9	5.6	28.9	2.9	2.5	12.8	68	8.1	21.9	38	10.9
Aug	24.8	6.8	23.2	2.6	2.2	15.1	61	9.8	24	33	12.2
Sep	28.5	10.6	26.7	2.9	2.6	19.8	55	11.4	27.5	31	12.2
Oct	31.7	15	46	4.7	4.1	23.4	55	12.2	30.4	33	12.8
Nov	33	17.7	63.8	5.7	5	25	58	11.6	31.7	38	12.4
Dec	34.3	19.8	88.4	6.6	6	26.5	61	10.8	32.8	40	11.6
Annual	**29.6**	**14**	**635.8**	**53.4**	**47.5**	**21.2**	**64**	**10.1**	**28.4**	**40**	**11.4**

The long term wind roses recorded daily at the Rolleston station at 9am and 3pm are provided in Figure 3-1. Winds are shown to be primarily from the south, south east, east and north at both times. Stronger winds (>40km/hr or >11.1m/s) with the potential to disturb dust occur infrequently.



Location: Rolleston BoM Station	**Data Period:** 1987 to 2010	**Data Type:** Measured Data

Figure 3-1: Annual Wind Roses for Rolleston Weather Station (1987 to 2010)

3.5.2 Local Meteorology

3.5.3 Introduction

GCAA collects various hourly meteorological data including wind speed and direction, ambient temperature, relative humidity, pressure and solar radiation intensity at the ROC. This data was used to generate a three-dimensional meteorological field required for the air dispersion modelling that includes a wind field generator accounting for slope flows, terrain effects and terrain blocking effects (see Section 4.3). The Air Pollution Model, or TAPM, is a three-dimensional meteorological and air pollution model developed by the CSIRO Division of Atmospheric Research and can be used as a precursor to CALMET which produces fields of wind components, air temperature, relative humidity, mixing height and other micro-meteorological variables for each hour of the modelling period. The TAPM-CALMET derived dataset for 12 continuous months of hourly data from the year 2019 and approximately centred at the proposed Project has been used to provide further information on the local meteorological influences. As discussed in the following sections, this dataset has been demonstrated to be representative of long-term site conditions. Details of the modelling approach are provided in Section 4.3.

3.5.4 Wind Speed and Direction

The wind roses from the TAPM-CALMET derived dataset for the year 2019 are presented in Figure 3-2 and Figure 3-3 for the Project site. Figure 3-2 shows that the dominant wind direction is from north east and south west during spring, east and north east during the summer months. In autumn and winter the winds are primarily from the south west direction.

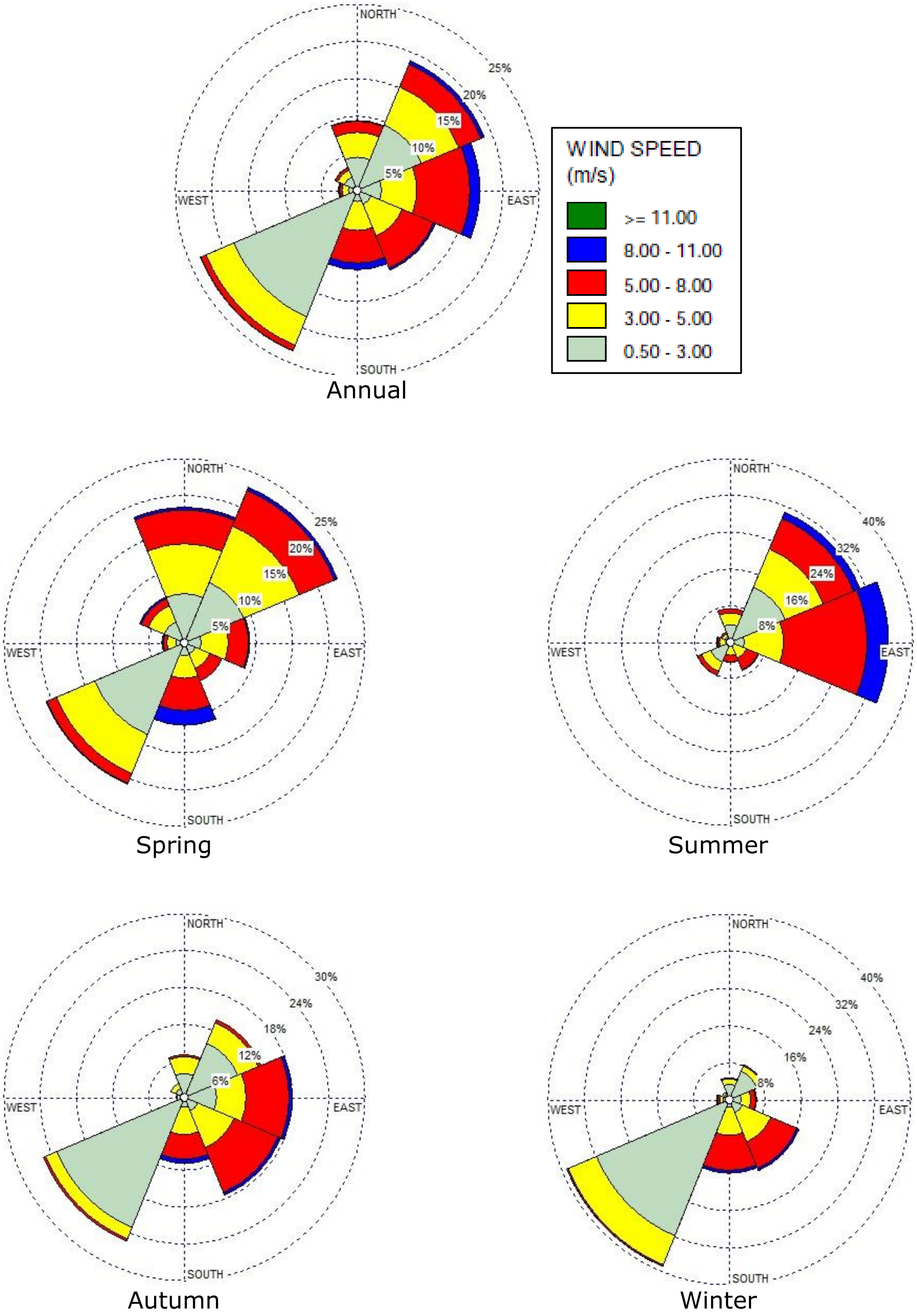


Figure 3-2: Site-Specific Wind Roses by Season for 2019

Figure 3-3 shows the wind roses for the time of day during the year for 2019. It can be seen that there are more frequent and stronger winds from the east during the daytime periods.

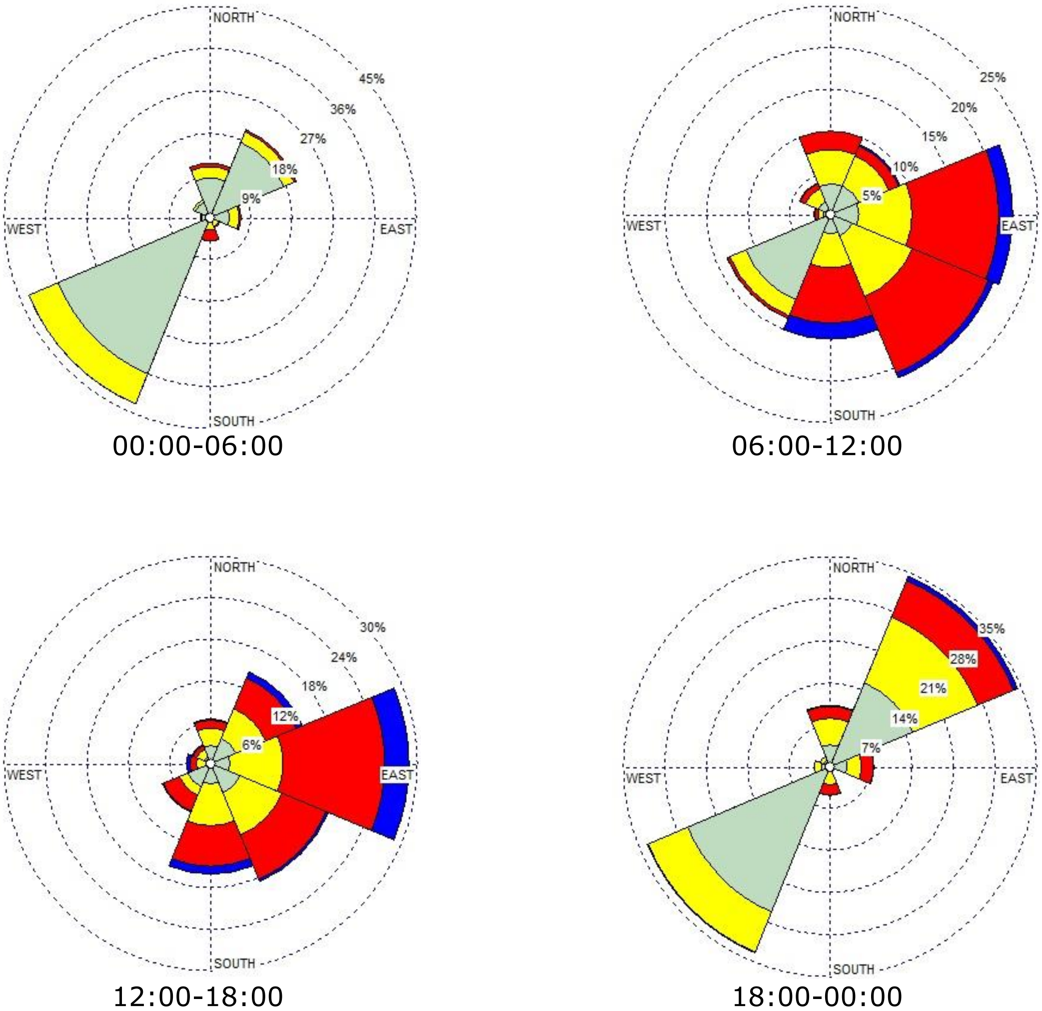
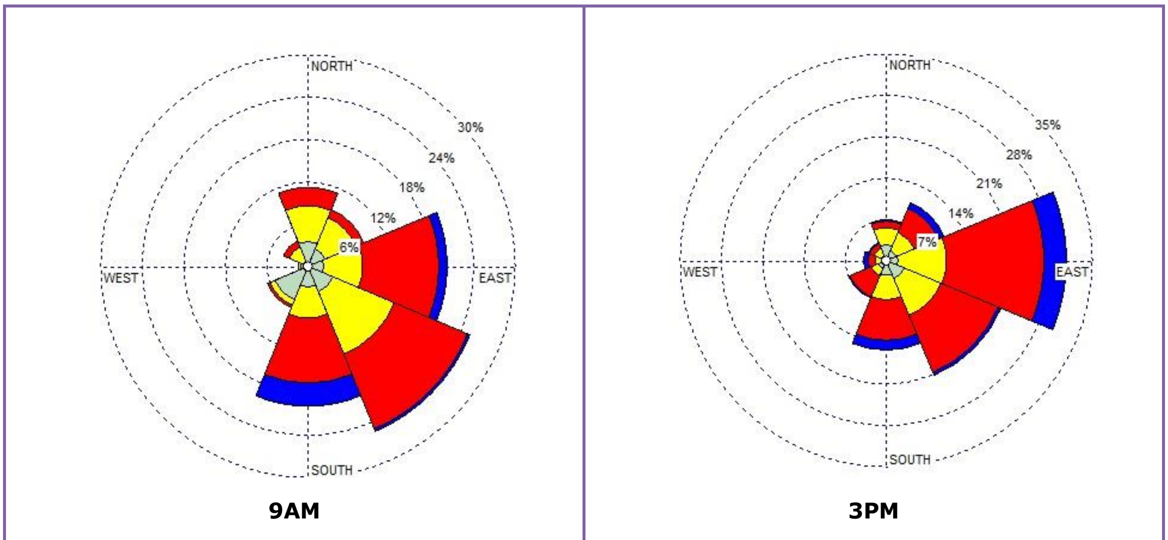


Figure 3-3: Site-Specific Wind Roses by Time of Day for 2019

A comparison of the wind roses at 09:00 and 15:00 hours for the TAPM-CALMET derived dataset (Figure 3-4) at the Project site was also undertaken with the BOM long-term wind roses at Rolleston. The wind roses from BOM and TAPM-CALMET are similar with prevailing winds from the south, south east and east at both times. Overall, the meteorological data generated by TAPM-CALMET is considered to be representative of the site.



Location: Project Site	**Data Period:** 2019	**Data Type:** Modelled Data

Figure 3-4: Annual 9AM and 3PM Wind Roses for the TAPM-CALMET derived dataset at the Project site, 2019

3.6 Atmospheric Stability

Atmospheric stability refers to the tendency of the atmosphere to resist or enhance vertical motion of pollutants. The Pasquill-Turner assignment scheme identifies six Stability Classes (Stability Classes A to F) to categorise the degree of atmospheric stability. These classes indicate the characteristics of the prevailing meteorological conditions and are used in various air dispersion models. The frequency of occurrence for each stability class for 2019 is shown in Figure 3-5. Temperature inversions are defined as Class F which is the prevailing stability class condition that occur with clear and calm conditions during the evening and night time periods.

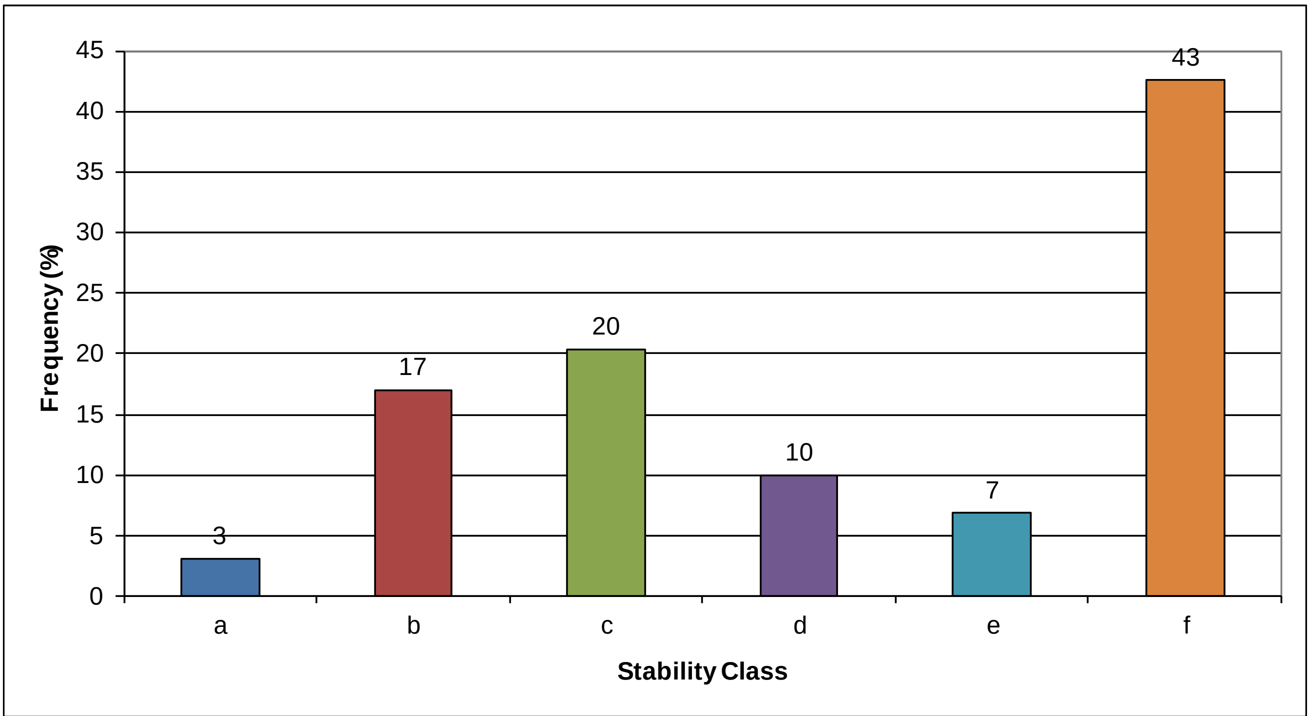


Figure 3-5: Stability Class

3.7 Mixing Height

Mixing height refers to the height above ground within which particulates or other pollutants released at or near ground can mix with ambient air. During stable atmospheric conditions, the mixing height is often quite low and particulate dispersion is limited to within this layer.

Diurnal variations in mixing depths are illustrated in Figure 3-6. As would be expected, an increase in the mixing depth during the morning is apparent, arising due to the onset of vertical mixing following sunrise. Maximum mixing heights occur in the mid to late afternoon, due to the dissipation of ground-based temperature inversions and the growth of convective mixing layer.

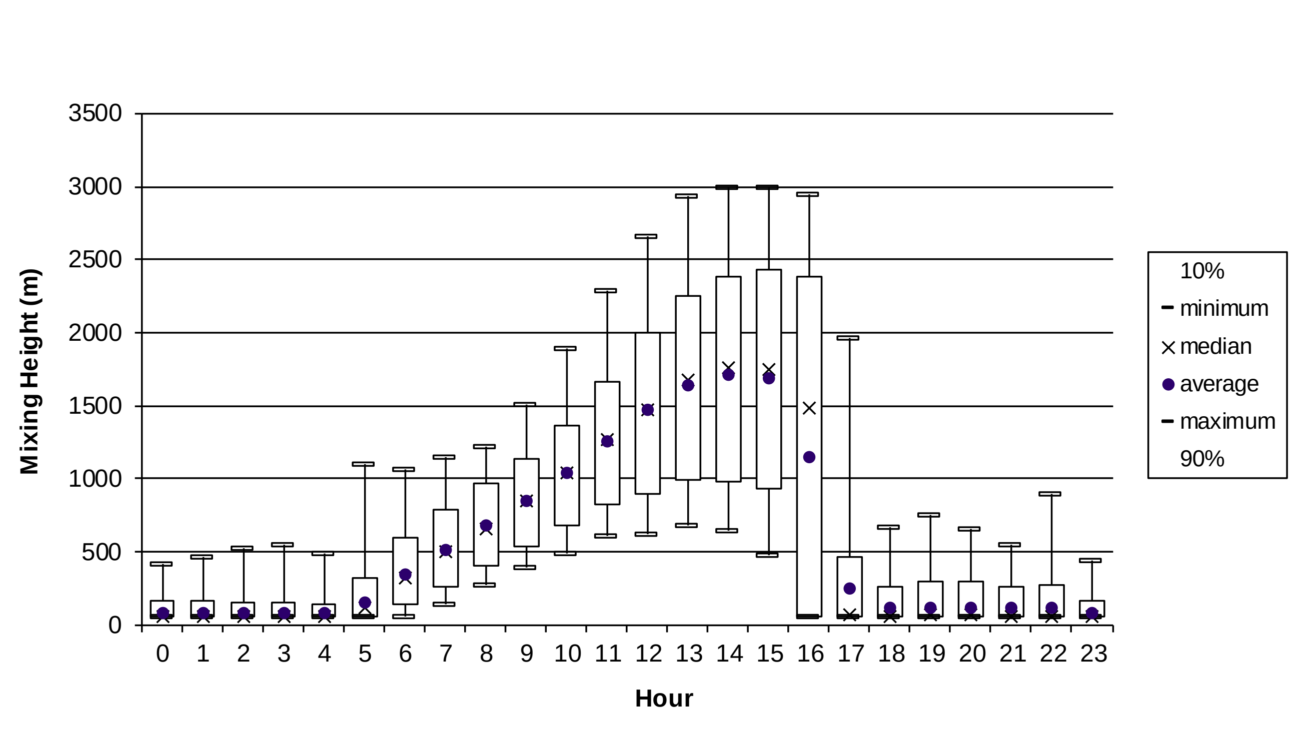


Figure 3-6: Mixing Height [TAPM-CALMET, 2019]

3.8 Existing Air Quality

In line with common practice, to quantify and qualify the impact of a proposed mine on environmental values, the incremental impact is quantified and added to existing background pollutant concentrations.

ROC has been operating real time PM_{10} monitoring stations at two locations in the vicinity of the Project area since 2013. These stations were established to assess the impact of coal mining operations on the surrounding area. The stations collect real time PM_{10} using Beta Attenuation Monitors and are located at Meteor Downs and Bootes West. However, the data is affected by mining activities and so is not representative of background which, as discussed in Section 2.2, is largely rural farmland.

Background air quality for dust deposition, TSP, PM_{10} and $PM_{2.5}$ has instead been estimated by considering the monitoring program conducted by ROC at Meteor Downs from 2011 to 2012, as reported in the AECOM 'Air Quality Technical Report' (AECOM, 2013). In addition, cumulative impacts from potential air quality emissions of rehabilitation activities associated with the Meteor Downs South mine which may overlap with the project between 2027 and 2030 have been included in the background estimations of emissions and are also added as a modelling scenario(see Section 4.2.2).

Table 3-4 presents the assigned background concentrations for each assessment identified above.

Table 3-4: Assigned Background Levels

Pollutant	Units	Averaging Period	Concentration

TSP	µg/m³	Annual	36.6
PM_{10}	µg/m³	24 Hour	20.0
	µg/m³	Annual	15.3
$PM_{2.5}$	µg/m³	24 Hour	7.2
	µg/m³	Annual	6.6
Dust Deposition	mg/m²/day	30 days	50

4 Methodology

4.1 Overview

The air quality impact assessment has been carried out as follows:

- An emissions inventory of TSP, PM_{10}, $PM_{2.5}$, and deposited dust for the proposed Project and rehabilitation of Meteor Downs South (MDS) Mine[2] was compiled using National Pollutant Inventory (NPI) and United States Environmental Protection Agency (USEPA) AP-42 emissions estimation methodology for the construction and operational stages of the Project (outlined in Section 4.2.2).
- Estimated emissions data was used as input for air dispersion modelling. The modelling techniques were based on a combination of The Air Pollution Model (TAPM) prognostic meteorological model (developed by CSIRO), and the CALMET model suite used to generate a three dimensional meteorological dataset for use in the CALPUFF dispersion model (Section 4.3).
- The atmospheric dispersion modelling results were assessed against the air quality assessment criteria described in Section 3 as part of the cumulative impact assessment of Project, background and MDS mine emissions (Section 5). Air quality controls are applied to reduce emission rates where applicable.

4.2 Estimated Emissions

4.2.1 Pollution Causing Activities

The air quality assessment takes into account dust generating activities from mining activities and disturbed surfaces within the ML boundaries. The main emissions to air are dust and particulate matter generated by the onsite construction and mining activities which primarily occur as a result of the following activities:

- topsoil scraping
- excavation of coal and overburden using excavators
- excavating overburden by dragline
- loading/unloading of haul trucks
- dumping on overburden dumps
- dumping coal onto ROM dump
- coal processing activities
- Loading trains
- bulldozer and grader operations
- wind erosion from disturbed areas and stockpiles
- transfer points
- vehicle movements
- blasting and drilling

In addition, air pollutants from diesel combustion may release particulate matter and other air pollutants such as sulphur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO) and trace quantities of volatile organic compounds. These substances are not considered to be emitted in sufficient quantities to affect air quality at sensitive receptors beyond the Project boundary; and have not been modelled in the air quality assessment.

[2] Cumulative impacts have also been assessed for potential air quality emissions from rehabilitation activities associated with the Meteor Downs South mine which may overlap with the project between 2027 and 2030.

4.2.2 Emissions Estimation

4.2.2.1 Emissions Scenarios

As discussed in Section 2.3 maximum emissions to air are expected during year 4 when the second largest extraction and movement of overburden material is proposed and activities are nearest to the sensitive receptors. The emissions scenarios from the proposed Project have therefore been included for this operating year.

This scenario is considered representative of worst-case conditions.

4.2.2.2 Equipment

ROC provided the major equipment list schedule for the operation of the Project. The equipment list is presented in Table 4-1.

Table 4-1: Mining Equipment

LOCATION	MACHINE	TASK	TRUCK #	TRUCK TYPE	DIGGER Depth from Topo	INDICATIVE TRUCK Locations [See following pictures]
SCN\49\9\230\OB	SH01	Prestrip	6.0	Caterpillar 793F_220t	~31 m	1 x Digger, 1 x Dump face 1 x Queue, 2 x loaded haul, 1 x empty haul
SCN\50\9\250\OB	EX06	Prestrip	4.0	Caterpillar 793F_220t	~10m	1 x Digger, 1 x Dump face, 1 x loaded haul, 1 x empty haul
SCN\45\10\2\B	EX07	Coal	6.0	Caterpillar 789C Flat Floor_190t	~70m	1 x Digger, 1 x lowwall ramp, 1 x ROM, 2 x Loaded haul, 1 x empty haul
SCN\45\8\1\DL	DL02	Interburden			~75m	
RW2_1\12\7\240\OB	EX04	Prestrip	5.0	Caterpillar 793F_220t	~5m	1 x Digger, 1 x Dump face, 2 x loaded haul, 1 x empty haul
RW2_1\11\6\230\OB	SH02	Prestrip	9.0	Caterpillar 795F-AC_313t	~15m	1 x Digger, 1 x Dump face, 1 x Queue, 4 x loaded haul, 2 x empty haul
RW1_C\5\7\2\B	EX03	Coal	6.0	Caterpillar 789C Flat Floor_190t	~60m	1 x Digger, 1 x Ramp, 2 x Loaded haul, 1 x Rom, 1 x empty haul
RW1_C\8\7\230\OB	SH03	Prestrip	7.0	Caterpillar 795F-AC_313t	~25m	1 x Digger, 1 x Dump face, 1 x Queue, 2 x loaded haul, 1 x empty haul
RW1_C\4\5\1\D	DL01	Interburden			~50m	
TOTAL:			43.0	Mixed Fleet		

*DL: Dragline, SH: Shovel, EX: Excavator

The applicable mining scenario is shown in Figure 4-1, showing approximate equipment locations in SCNCP, Rolleston West 1 (RW1), and Rolleston West 2 (RW2).

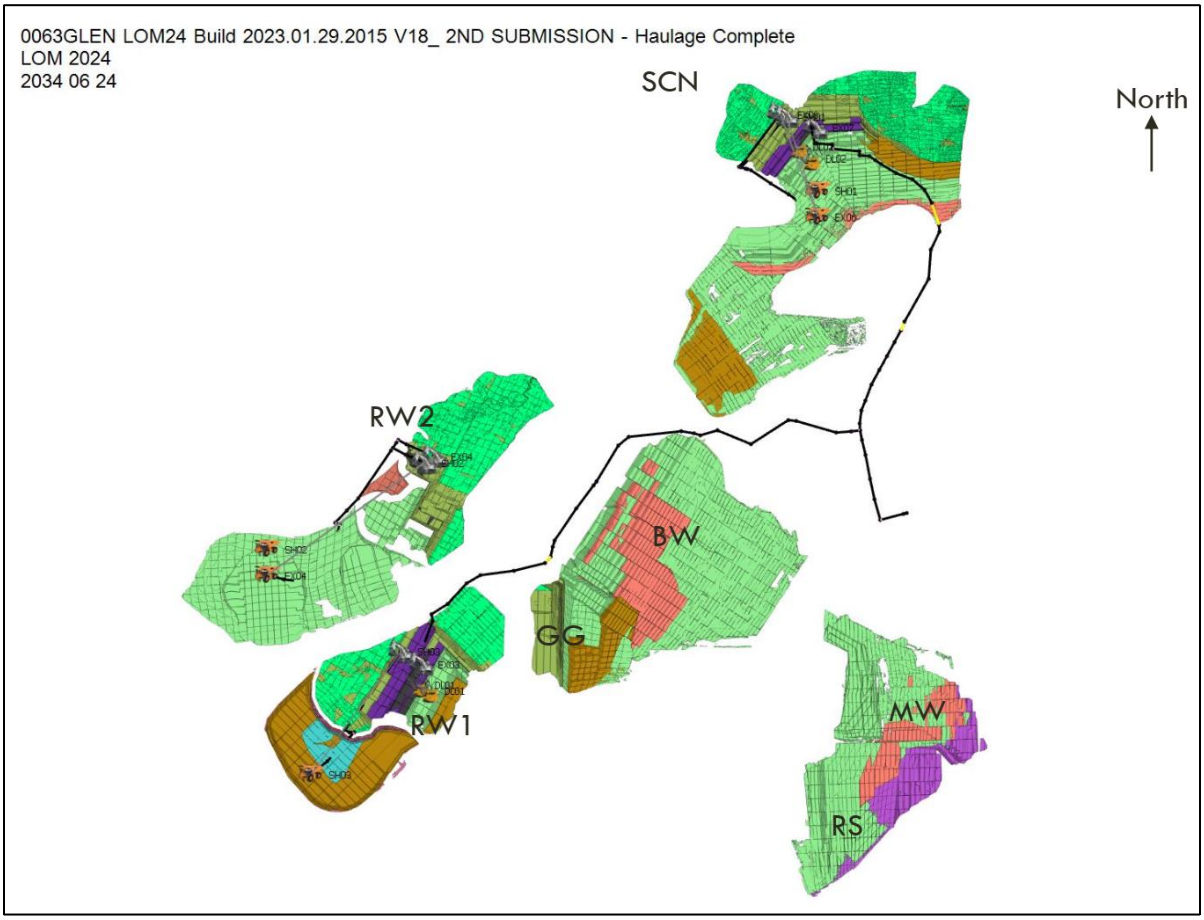


Figure 4-1 Mining Scenario Year 4

For the cumulative assessment inclusive of the rehabilitation activities at the Meteor Downs South mine the following additional equipment have been modelled in and around the pit and overburden dump:

- Excavator (Cat 6040)
- Trucks x 4 (Cat 789)
- Dozers x 4 (Cat D10, Cat D11)

4.2.2.3 Emissions Estimation

The National Pollutant Inventory (NPI) Emission Estimation Technique Manual for Mining v3.0 (NPI, 2011) provides data on emissions of air pollutants during typical coal mine operations. This data is based on measurements of dust emissions from coal mines in Australia or adopted from US EPA AP-42 emission estimates. The default emission factors adopted from the NPI Emission Estimation Technique Manual for Mining v3.0 and US EPA AP-42 have been used to provide data to estimate the amount of TSP, PM10 and PM2.5 emitted from the various mine activities, based on the amount of coal and overburden material mined as provided by the proponent.

Emission factors are used to estimate a facility's emissions by the general equation:

$$E_{i\,(kg/yr)} = \left[A_{(t/h)} \times OP_{(h/yr)} \right] \times EF_{i\,I(kg/t)} \times \left[1 - \frac{CE_i}{100} \right]$$

Where:

$E_{i\,(kg/yr)}$ = Emission rate of pollutant

$A_{(t/h)}$ = Activity rate

$OP_{(h/yr)}$ = operating hours

$EF_{i\,I(kg/t)}$ = uncontrolled emission factor of pollutant

CE_i = overall control efficiency for pollutant

The emission factors and activity data used to estimate emissions for each source types outlined above are discussed in Appendix B. It is noted that maximum hourly extraction rates have been used to derive the estimated emission rates and modelled for the entire year. This is considered an extremely conservative approach.

Table 4-2 summarise the emission rates estimated for the main sources of air emissions from the mining activities during year 5.

Table 4-2: Estimated emission rates – Project and MDS Mine

Source	Emission rate (g/s)		
	TSP	**PM_{10}**	**$PM_{2.5}$**
Project			
Waste handling/extraction	113.8	37.7	7.3
Coal handling/extraction	36.4	9.7	0.7
coal processing	4.6	1.8	0.3
wind erosion	57.8	28.9	6.1
misc mining activities	3.4	1.7	0.1
Total	**216.0**	**79.9**	**14.3**
MDS Mine			
Wind erosion	57.9	28.9	6.1
Soil handling activities	5.6	2.1	0.6

The following controls were applied to the dust sources for the estimation of Project emissions in accordance with the NPI Emission Estimation Technique Manual for Mining v3.0:

- 50% control for water sprays applied to stockpiles;
- 75% control for level 2 watering of haul routes (>2 litres/m^2/h);
- 44% control for limiting vehicle speeds on haul routes < 50 km/h; and
- 70% control for water sprays applied to drilling.

An additional control factor of 50% for TSP and 5% for PM_{10} has been applied to in-pit activities to account for pit retention.

4.3 Modelling Methodology

4.3.1 TAPM

A 3-dimensional dispersion wind field model, CALPUFF, has been used to simulate the impacts from the Project. CALPUFF is an advanced non-steady-state meteorological and air quality modelling system developed and distributed by Earth Tech, Inc. The model has been approved for use in the '*Guideline on Air Quality Models*' (Barclay and Scire, 2011) as a preferred model for assessing applications involving complex meteorological conditions such as calm conditions.

To generate the broad scale meteorological inputs to run CALPUFF, this study has used the model The Air Pollution Model (TAPM), which is a three-dimensional prognostic model developed and verified for air pollution studies by the CSIRO.

TAPM was configured as follows:

- Centre coordinates – 24.45° S, 148.4666° E;
- Dates modelled – 30th December 2018 to 31st December 2019;
- Four nested grid domains of 20 km, 10 km, 3 km and 1 km;
- 41 x 41 grid points for all modelling domains;
- Hourly Rolleston station data incorporated for nudging;
- 25 vertical levels from 10 m to an altitude of 8000 m above sea level; and
- The default TAPM databases for terrain, land use and meteorology were used in the model.

4.3.2 CALMET

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

The TAPM generated meteorological data is utilised in this model. The CALMET simulation was set up in accordance with the best practice guidelines for NSW (Barclay and Scire, 2011). The CALMET simulation was run as No-Obs simulation with the gridded TAPM three-dimensional wind field data from the innermost grid. CALMET then adjusts the prognostic data for the kinematic effects of terrain, slope flows, blocking effects and three-dimensional divergence minimisation.

4.3.3 CALPUFF

CALPUFF is a non-steady-state Lagrangian Gaussian puff model. CALPUFF employs the three-dimensional meteorological fields generated from the CALMET model by simulating the effects of time and space varying meteorological conditions on pollutant transport, transformation and removal.

Emission sources can be characterised as arbitrarily-varying point, area, volume and lines or any combination of those sources within the modelling domain.

Due to the limited change in topography as discussed in Section 2.6, the radius of influence of terrain features was set at 20 km while the minimum radius of influence was set as 0.1 km. The terrain data incorporated into the model had a resolution of 1 arc-second (approximately 30 m) in accordance with the *Generic Guidance and Optimum Model Settings for the CALPUFF Modelling System for Inclusion into the 'Approved Methods for the Modelling and Assessments of Air Pollutants in NSW, Australia'*.

4.3.4 Other Modelling Input Parameters

4.3.4.1 Particle Size Distribution

CALPUFF requires particle distribution data (geometric mass mean diameter, standard deviation) to compute the dispersion of particulates (Table 4-3).

Table 4-3: Particle size distribution data

Particle size	Mean particle diameter (μm)	Geometric standard deviation (μm)
TSP	15	2
PM_{10}	4.88	1
$PM_{2.5}$	0.89	1

4.3.4.2 Source Type and Initial Source Structure

The following source types were modelled as part of the assessment:

- Extraction, handling, blasting and drilling activities were also modelled as volume sources as they represent dust emissions which are at ambient temperatures and are already mixed with the surrounding air.
- Dust emissions from other sources including wind erosion from ROM stockpiles, haul roads, pit and overburden dump areas were modelled as area sources.

5 Assessment of Impacts

5.1 Assessment of Impacts on Sensitive Receptors

The predicted ground-level concentrations of TSP, PM_{10}, $PM_{2.5}$ and dust deposition for the operation of the Project at the modelled sensitive receptors are presented in Table 5-1. Contour plots of the predicted cumulative maximum ground-level concentrations are presented in Appendix C.

The results of the modelling at the sensitive receptors can be summarised as follows:

- The highest annual cumulative TSP concentrations are below the 90 µg/m³ criterion at all sensitive receptors modelled.
- The maximum 24-hour average cumulative ground-level PM_{10} concentrations are predicted to occur at SR3 (Inderi) and is above the 50 µg/m³ criterion (i.e. the EPP (Air)). The 5th highest predictions are all below the relevant EA Condition criterion at these sensitive receptors.
- The annual average cumulative ground-level PM_{10} are predicted to be lower than the criterion at all the all sensitive receptors modelled.
- The maximum 24-hour average cumulative ground-level $PM_{2.5}$ are predicted to be lower than the criterion at all sensitive receptors modelled.
- The annual average cumulative ground-level $PM_{2.5}$ are predicted to be lower than the criterion at all sensitive receptors modelled.
- The predicted dust deposition impacts from the mine activities are below the 120 mg/m²/day criterion at all sensitive receptors modelled.

Table 5-1: Predicted ground-level concentrations for the Project operation

Rec	In isolation							Cumulative						
	24 Hour $PM_{2.5}$ (µg/m³)	Annual $PM_{2.5}$ (µg/m³)	24 Hour PM_{10} (µg/m³)		Annual PM_{10} (µg/m³)	Annual TSP (µg/m³)	Dust Dep (mg/m²/d)	24 Hour $PM_{2.5}$ (µg/m³)	Annual $PM_{2.5}$ (µg/m³)	24 Hour PM_{10} (µg/m³)		Annual PM_{10} (µg/m³)	Annual TSP (µg/m³)	Dust Dep (mg/m²/d)
	Max	**Max**	**Max**	**5th**	**Max**	**Max**	**Max**	**Max**	**Max**	**Max**	**5th**	**Max**	**Max**	**Max**
SR1	6.8	0.6	30.5	15.3	2.5	0.40	3.2	14.0	7.2	50.5	35.3	17.8	37.0	53.2
SR2	6.4	0.2	25.7	12.0	0.7	0.06	0.3	13.6	6.8	45.7	32.0	16.0	36.7	50.3
SR3	8.2	0.9	35.1	28.0	3.7	0.61	2.9	15.4	7.5	55.1	48.0	19.0	37.2	52.9
SR4	3.5	0.3	9.9	6.8	1.1	0.15	1.4	10.7	6.9	29.9	26.8	16.4	36.7	51.4
SR5	1.8	0.1	5.6	4.8	0.5	0.06	0.4	9.0	6.7	25.6	24.8	15.8	36.7	50.4
SR6	1.1	0.0	4.5	2.4	0.2	0.03	0.2	8.3	6.6	24.5	22.4	15.5	36.6	50.2
SR7	3.8	0.2	16.9	9.1	1.0	0.14	0.9	11.0	6.8	36.9	29.1	16.3	36.7	50.9
SR8	3.6	0.2	16.0	7.8	0.9	0.12	0.8	10.8	6.8	36.0	27.8	16.2	36.7	50.8
SR9	3.2	0.4	14.2	10.8	1.8	0.28	1.6	10.4	7.0	34.2	30.8	17.1	36.9	51.6
SR10	1.2	0.0	4.2	2.2	0.1	0.02	0.2	8.4	6.6	24.2	22.2	15.4	36.6	50.2
SR11	4.0	0.4	18.0	12.8	1.9	0.36	1.8	11.2	7.0	38.0	32.8	17.2	37.0	51.8
SR12	0.8	0.0	2.3	1.3	0.1	0.01	0.1	8.0	6.6	22.3	21.3	15.4	36.6	50.1
SR13	0.7	0.0	3.3	1.3	0.1	0.01	0.1	7.9	6.6	23.3	21.3	15.4	36.6	50.1
SR14	1.1	0.0	4.4	2.7	0.2	0.02	0.2	8.3	6.6	24.4	22.7	15.5	36.6	50.2
Criteria	**25**	**8**	**50**	**50**	**25**	**90**	**120**	**25**	**8**	**50**	**50**	**25**	**90**	**120**

6 Mitigation

6.1 General Controls

The following operational controls to reduce dust emissions are recommended:

- Regular watering of active mining areas, stockpiles areas and haul roads that are subject to frequent vehicle movements;
- All equipment utilised on site will be maintained in an efficient and effective manner;
- Where practicable limit vegetation and soil clearing to reflect the operational requirements;
- Where practicable reuse cleared vegetation during the rehabilitation phase of the Project to minimise burning; and
- Progressive site rehabilitation and revegetation, as proposed.

6.2 Unsealed Roads

In addition to the general operational controls preventative measures will be applied, where practicable, to prevent material being deposited on haul roads, such as:

- Avoid overloading which could result in spillage;
- General speed on unsealed haul roads will be limited;
- In the event that road dust is visible above haul truck wheel height, truck operators are to call for additional wet suppression;
- Visual dust monitoring will be undertaken by supervisory staff to ensure effective dust control; and
- Conduct regular maintenance of haul roads including scheduled grading.

6.3 Stockpiles

The following controls are recommended to reduce dust emissions from stockpiles:

- Visual monitoring of stockpiles for dust emissions will be conducted by personnel; and
- Apply water suppression around all active stockpile areas, when required.

6.4 Overburden Areas

The following controls are recommended to reduce dust emissions from overburden emplacement areas based on the assessment of risk and the potential for generation of dust:

- After initial extraction, all overburden material to be placed in the inpit dumps, as proposed; and
- Restrict vehicle movements to defined routes on overburden emplacement areas, with wet suppression applied to such routes as required.

6.5 General Material Extraction and Dumping

The following controls are recommended to reduce dust emissions from material extraction and dumping:

- Minimise double handling of material;
- Identify material types that contain fine and/or friable material, and implement a risk based approach for effective dust mitigation, e.g. minimisation of topsoil stripping during adverse weather conditions; and
- Prepare work areas prior to commencement of mining activities to minimise dust generation potential, e.g. watering of extraction areas.

7 Conclusion

This assessment evaluates the potential impacts of air pollutants generated from the worst-case scenario of the operational stage of the SCNCP and provides recommendations to mitigate any potential impacts that might have an effect nearby sensitive receptors.

The following controls were applied to the dust sources for the estimation of emissions in accordance with the NPI Emission Estimation Technique Manual for Mining v3.0:

- 50% control for water sprays applied to stockpiles and exposed areas;
- 75% control for level 2 watering of haul routes (>2 litres/m^2/h);
- 44% control for limiting vehicle speeds on haul routes < 50 km/h; and
- 70% control for water sprays applied to drilling.

The results of the modelling at the sensitive receptors can be summarised as follows:

- The highest annual cumulative TSP concentrations are below the 90 µg/m³ criterion at all sensitive receptors modelled.
- The maximum 24-hour average cumulative ground-level PM_{10} concentrations are predicted to occur at SR3 (Inderi) and is above the 50 µg/m³ criterion (i.e. the EPP (Air)). The 5th highest predictions are all below the relevant EA Condition criterion at these sensitive receptors.
- The annual average cumulative ground-level PM_{10} are predicted to be lower than the criterion at all the all sensitive receptors modelled.
- The maximum 24-hour average cumulative ground-level $PM_{2.5}$ are predicted to be lower than the criterion at all sensitive receptors modelled.
- The annual average cumulative ground-level $PM_{2.5}$ are predicted to be lower than the criterion at all sensitive receptors modelled.
- The predicted dust deposition impacts from the mine activities are below the 120 mg/m^2/day criterion at all sensitive receptors modelled.

8 References

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Appendix A Glossary

Ambient Monitoring	Ambient monitoring is the assessment of pollutant levels by measuring the quantity and types of certain pollutants in the surrounding, outdoor air.
Conveyor	Mechanical handling equipment (which may include a belt, chain or shaker) used to move ore or other materials from one location to another.
Deposited Matter	Any particulate matter that falls from suspension in the atmosphere
Dust	Generic term used to describe particles that are suspended in the atmosphere. The term is nonspecific with respect to the size, shape and chemical composition of the particles.
EHP	Department of Environment, Heritage and Protection (Queensland)
Emissions	Release of a substance (usually a gas) into the atmosphere.
Emissions Factor	Unique value for scaling emissions to activity data in terms of a standard rate of emissions per unit of activity (e.g., grams emitted per litre of fossil fuel consumed)
Fugitive Dust	Dust derived from a mixture of not easily defined sources. Mine dust is commonly derived from such non-point sources such as vehicular traffic on unpaved roads, materials transport and handling
Haul Roads	Roads used to transport extracted materials by truck around a mine site
MIA	Mining Industrial Area
MLA	Mining Lease Area
mg	Milligram (g × 10^{-3})
Micron	Unit of measure µm (metre × 10^{-6})
Nuisance Dust	Dust which reduces environmental amenity without necessarily resulting in material environmental harm. Nuisance dust generally comprises particles greater than 10 micrograms.
Open Cut Mining	Mining carried out on, and by excavating, the Earth's surface for the purpose of extracting ore/coal, but does not include underground mining
Overburden	Material of any nature that overlies a deposit of useful materials, ores or coal - especially those deposits mined from the surface by open cuts
PM_{10}	Particulate matter less than 10 microns in size
$PM_{2.5}$	Particulate matter less than 2.5 microns in size
TSP	Total Suspended Particles is particulate matter with a diameter up to 50 microns
µg/m^3	Micrograms per cubic metre

Appendix B Emission Estimation

The major air emission from surface mining is fugitive dust. Emission factors can be used to estimate emissions of TSP, PM_{10} and $PM_{2.5}$ to the air from various sources. Emission factors relate the quantity of a substance emitted from a source to some measure of activity associated with the source. Common measures of activity include distance travelled, quantity of material handled, or the duration of the activity.

The National Pollutant Inventory Emission Estimation Technique Manual for Mining (January 2012) provides the equations and emission factors to determine the emissions of TSP and PM_{10} from mining activities. These emission factors incorporate emission factors published by the USEPA in their AP-42 documentation.

$PM_{2.5}$ emission factors were derived from the ratio of $PM_{2.5}$ to TSP published in the relevant US AP42 Chapter tables. Table B- 1 summarises the $PM_{2.5}$ to TSP ratio adopted for the emissions estimations.

Table B- 1: Ratio of PM2.5 to TSP ratio adopted for the emissions estimations

Source	Ratio $PM_{2.5}$/TSP
Blasting	0.03
Drilling	0.105
Truck loading	0.105
Bulldozing on coal	0.022
Bulldozing on overburden	0.022
Wheel generated dust	0.017
Wind erosion	0.105

Where available, measured parameters are adopted to derive the emission factors as specified in Table 2 of the National Pollutant Inventory Emission Estimation Technique Manual for Mining (January 2012). Where unavailable, default emissions factors have been conservatively used (Table B-2). Table B-3 outlines the activity data applied in the Project emissions estimation and Table B-4 outlines the activity data applied in the MDS Mine estimations.

Table B-2: Source type Emission Factors applied

Source type	Default TSP Emission factor	Derived TSP Emission factor	PM_{10}/TSP ratio	Units	Controls applied
Blasting/drilling:					
Drilling	0.59	-	0.52	kg/hole	Water sprays, 70%
Blasting		1440	0.52	kg/blast	No control
Wind erosion:					
Pit/stockpiles/ haul roads	0.4	-	0.5	kg/ha/h	No control
Handling:					
Loading stockpiles	0.004	-	0.42	kg/t	Water sprays, 50%
Dozer on overburden	-	3.2	0.24	kg/h/veh	No control
Dozer on coal	-	4.5	0.29	kg/h/veh	No control
Excavators/FEL on overburden	0.025	-	0.48	kg/t	No control
Unloading stockpiles	0.03	-	0.42	kg/t	Water sprays, 50%
Trucks dumping overburden	0.012	-	0.35	kg/t	Water sprays, 70%
Trucks dumping coal	0.01	-	0.35	kg/t	Water sprays, 70%
Loading to trucks	0.0004	-	0.42	kg/t	No control
Draglines in overburden	-	0.036	0.43	kg/m^3	No control
Misc transfer points incl conveying	0.00032	-	0.47	kg/t	No control
Wheel generated dust:					
Unpaved roads	4.23		0.3	kg/VKT	75% for level 2 watering, 44% limit vehicle speeds <50km/h

Table B-3: Parameters applied in emissions estimation – Project emissions

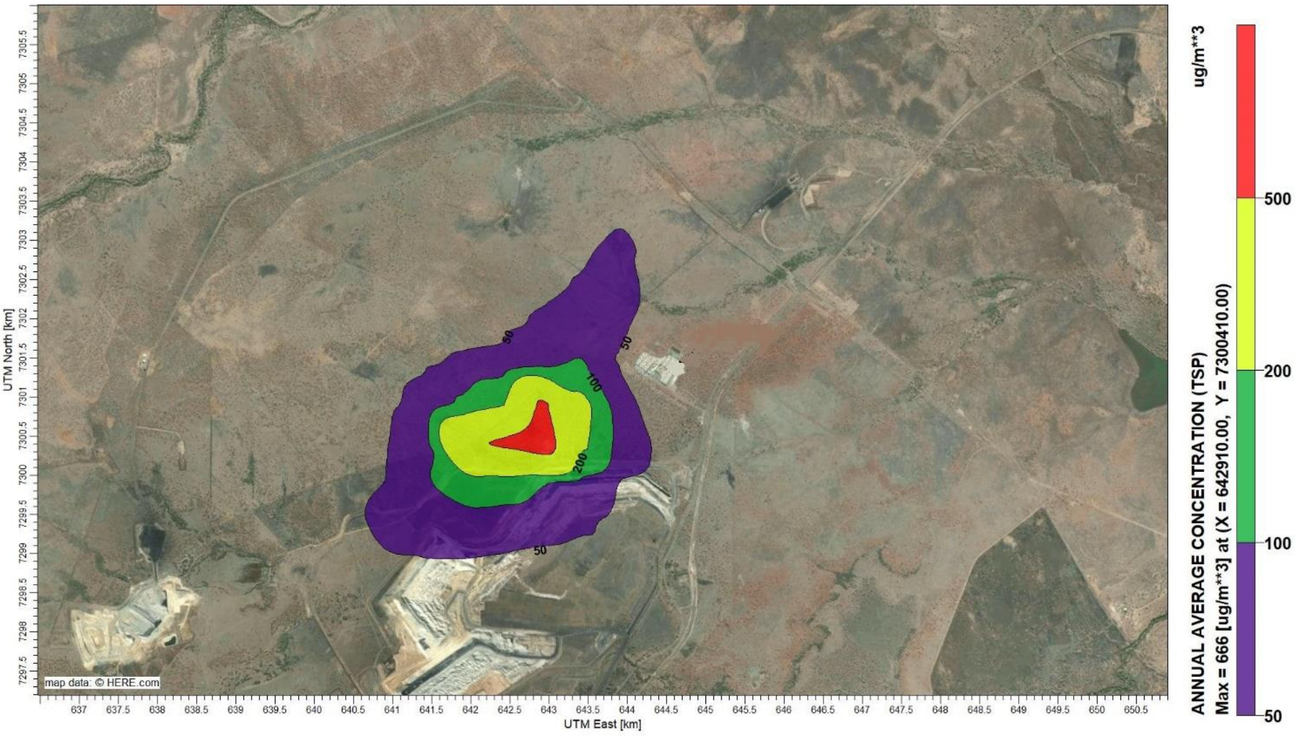
Parameter ID	Value	Units	Description	Data source
Hours	24	hours/day	Hours of operation	client supplied
Days	365	Days/year	Hours of operation	client supplied
W1	177	t	Truck capacity	client supplied
W2	231	t	Truck capacity	client supplied
Holes	1,000	Holes/blast	Holes drilled per blast	client supplied
B	6	Blast/month	Maximum Blasts per month	client supplied
Coal	1,700	t/h	Maximum Extracted Coal	client supplied
OB Dragline	4,400	t/h	Maximum Extracted OB by dragline	client supplied
OB Excavator	3,300	t/h	Maximum Extracted OB by excavator	client supplied
Haul	164	VKT/hr	Maximum ROM internal haul to CEF pad	estimated
Haul	190	VKT/hr	Maximum Waste haul for dump	estimated

Table B-4: Parameters applied in emissions estimation – Meteor Downs South Mine emissions

Parameter ID	Value	Units	Description	Data source
Hours	12	hours/day	Hours of operation	client supplied based on consultation with MDS
Days	183	Days/year	Hours of operation	Meteor Downs South Revised Strategic Cropping Land Restoration Plan
Disturbed area	521	Ha	Total disturbed area for rehabilitation	Meteor Downs South Revised Strategic Cropping Land Restoration Plan
Soil handled	683,000	m^3	Volume soil handled	Meteor Downs South Revised Strategic Cropping Land Restoration Plan

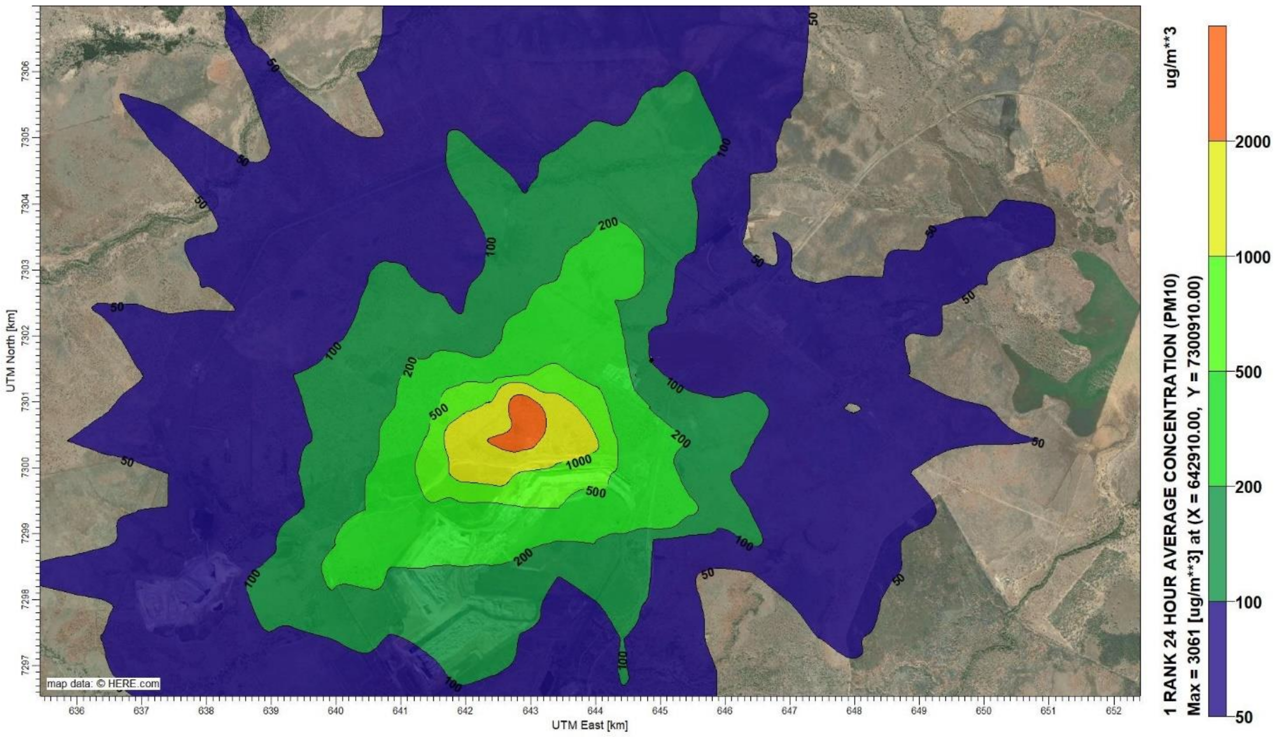
Appendix C Pollution Prediction Contours

Contour plots illustrate the spatial distribution of ground-level concentrations across the modelling domain for each time period of interest. However, this process of interpolation causes a smoothing of the base data that can lead to minor differences between the contours and discrete model predictions. It is also noted that the plots are magnified close to the source for better visual presentation and therefore excluding the sensitive receptors at greater distance from the Project.



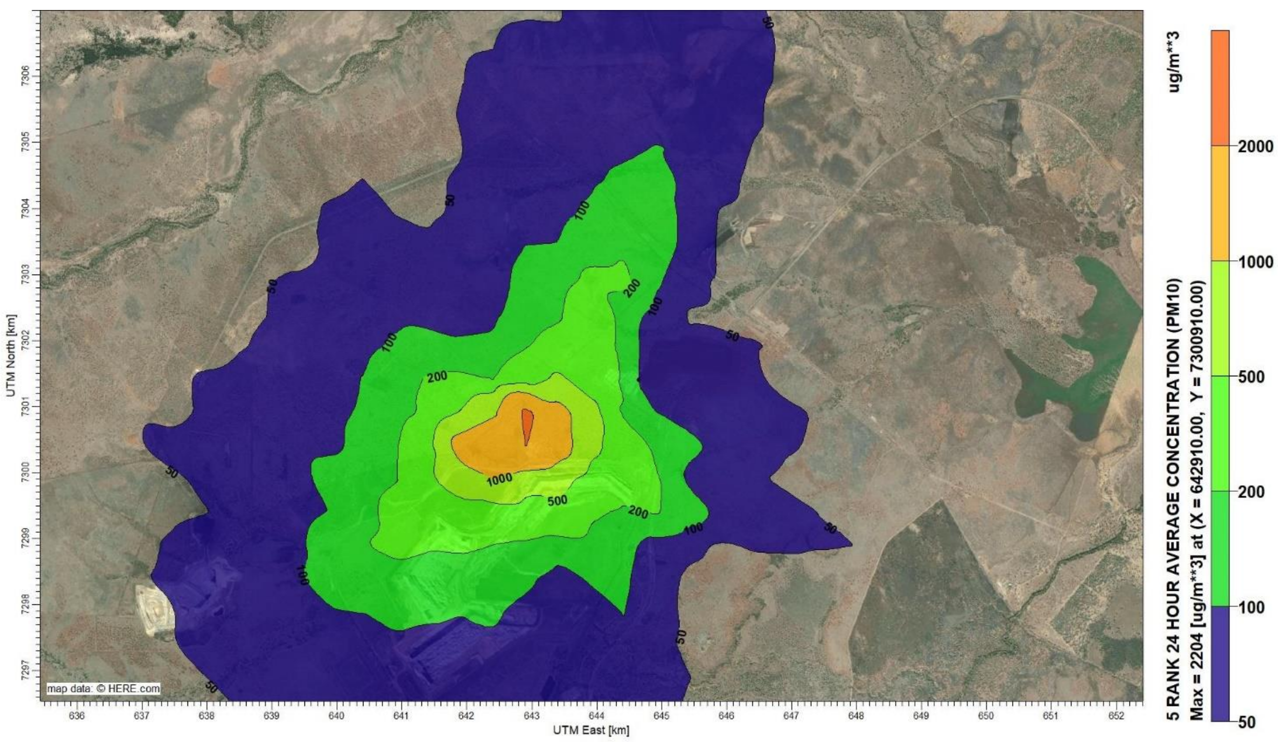
Pollutant:	Averaging Period:	Percentile:	Criteria:
TSP	Annual	MAX	90 µg/m^3

Scenario:
Year 4 Operations Cumulative



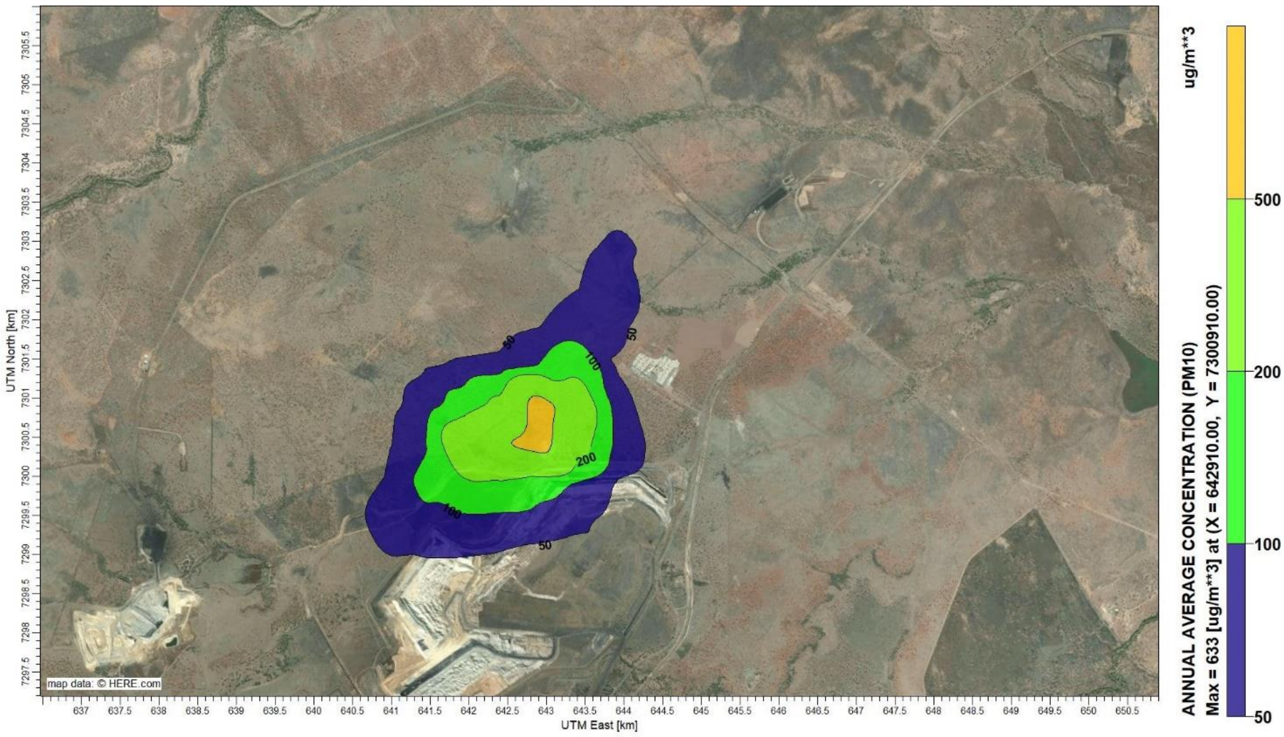
Pollutant:	Averaging Period:	Percentile:	Criteria:
PM_{10}	24 hour	MAX	50 µg/m^3

Scenario:
Year 4 Operation Cumulative



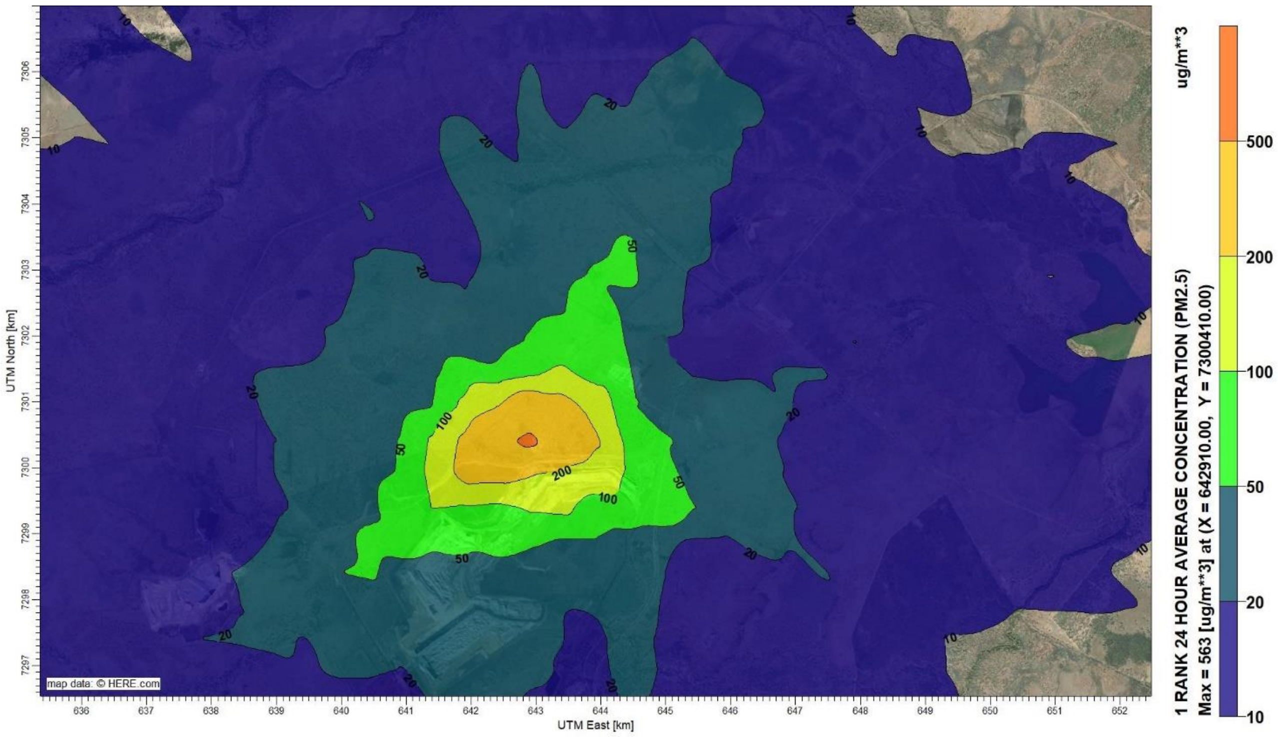
Pollutant: PM_{10}	Averaging Period: 24 hour	Percentile: 5th highest	Criteria: 50 µg/m³

Scenario:
Year 4 Operation Cumulative



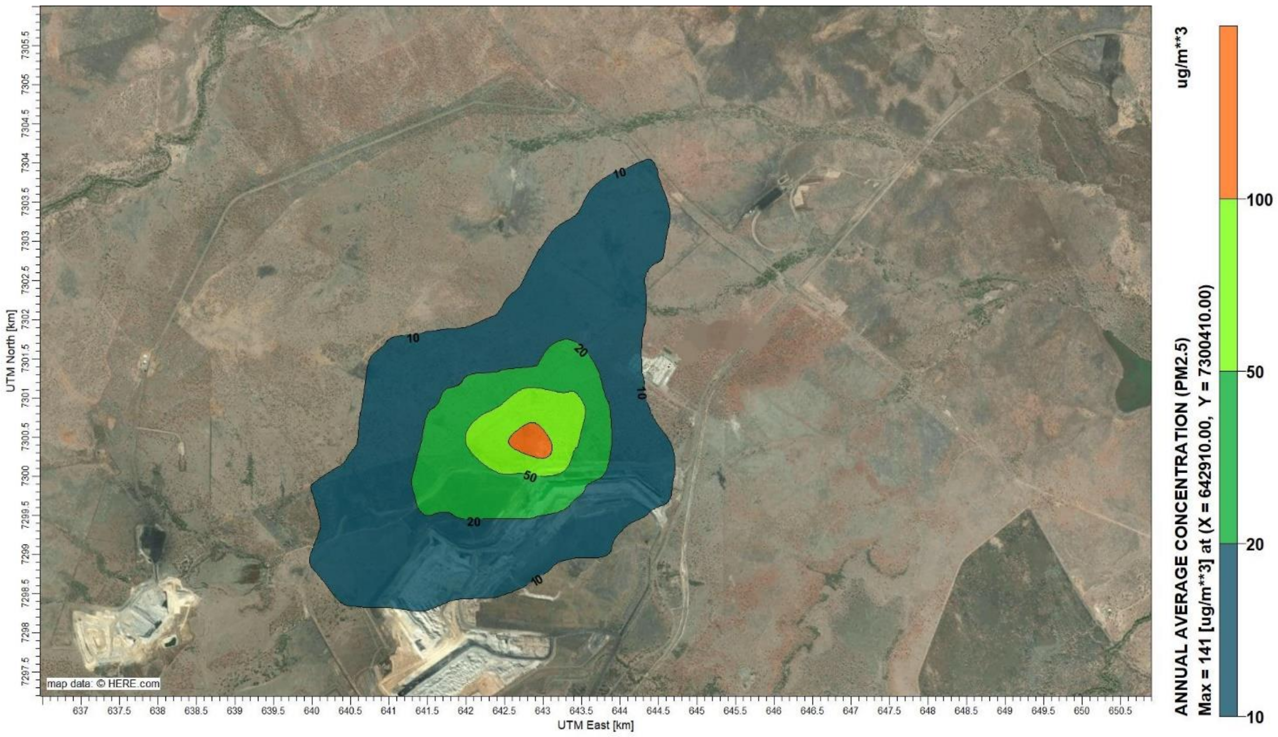
Pollutant:	**Averaging Period:**	**Percentile:**	**Criteria:**
PM_{10}	Annual	MAX	25 µg/m^3

Scenario:
Year 4 Operation Cumulative



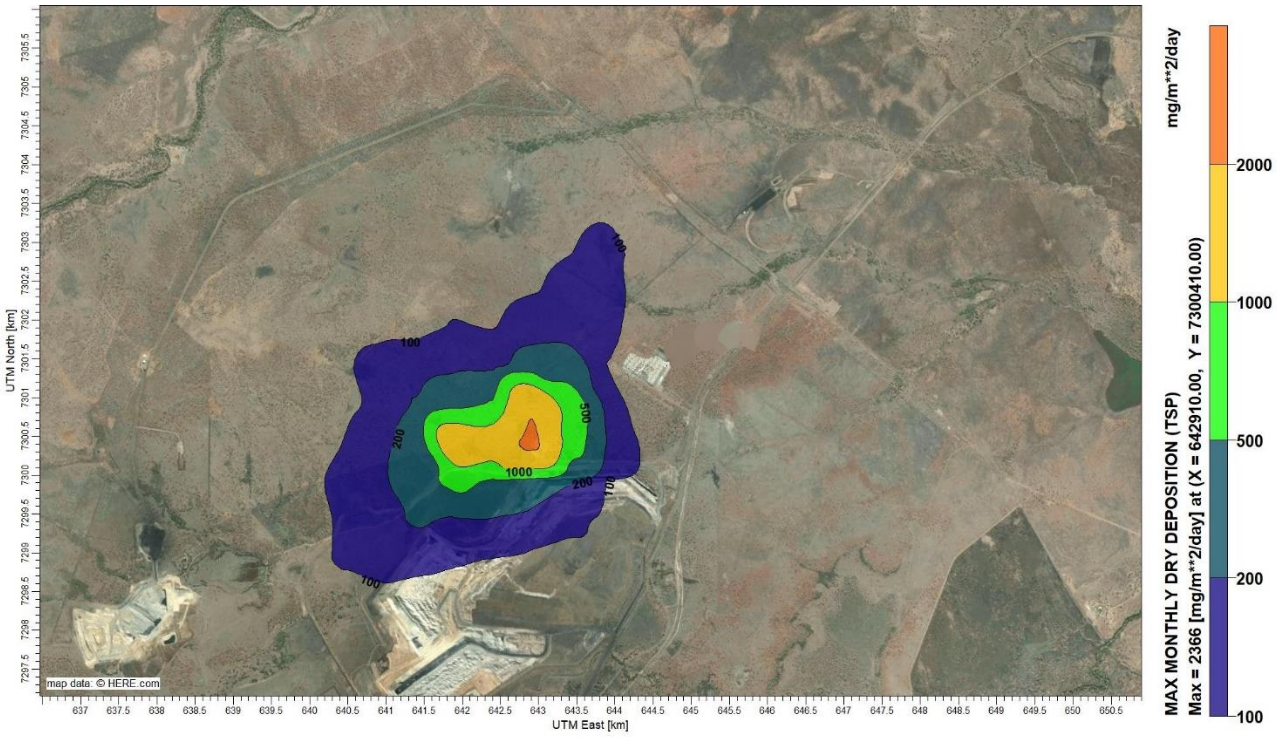
Pollutant: PM$_{2.5}$	**Averaging Period:** 24 hour	**Percentile:** MAX	**Criteria:** 25 µg/m^3

Scenario:
Year 4 Operations Cumulative



Pollutant:	Averaging Period:	Percentile:	Criteria:
$PM_{2.5}$	1 year	MAX	8 µg/m^3

Scenario:
Year 4 Operation Cumulative



Pollutant: Dust Deposition	Averaging Period: 1 month	Percentile: MAX	Criteria: 120 mg/m^2/day

Scenario:
Year 4 Operation Cumulative