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CDM Smith Australia Pty Ltd

Isaac River Project Assessment

Air Quality Assessment

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EXECUTIVE SUMMARY

Bowen Coking Coal Limited (BCC) propose to develop the Isaac River Project (the Project) located in the Bowen Basin in Central Queensland, approximately 30 km west of Moranbah and 130 km southwest of Mackay. Vipac Engineers and Scientists Ltd (Vipac) was commissioned by CDM Smith Australia Pty Ltd (CDM Smith) to prepare an air quality assessment for the Project. This assessment evaluates the potential impacts of air pollutants generated from the construction and operational stages of the Project 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 for the proposed Project 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/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 can be summarised as follows:

- The highest annual TSP concentrations are below the 90 µg/m³ criterion at all receptors, with the results just above the background concentration of 40 µg/m³.
- The maximum 24-hour average cumulative ground-level PM_{10} concentration of 45 µg/m³ is predicted to occur at the nearest homestead identified as R5, which is well below the 50 µg/m³ criterion. The highest annual average cumulative ground-level PM_{10} concentration is 22.9 µg/m³, predicted to occur at the nearest homestead (R5), and is below the 25 µg/m³ criterion.
- The highest 24-hour average cumulative ground-level $PM_{2.5}$ concentration of 18.5 µg/m³ is also predicted to occur at the nearest homestead identified as R5, which is below the 25 µg/m³ criterion. The highest annual average cumulative ground-level $PM_{2.5}$ concentration is 3.8 µg/m³, predicted to occur at the nearest homestead (R5), and is below the 8 µg/m³ criterion.
- The predicted dust deposition impacts from construction are negligible with the cumulative deposition of 59 mg/m^2/day which is less than half of the 120 mg/m^2/day criterion.

Overall, it can clearly be seen that with the Project operating at 0.5 Mtpa the predicted pollutant concentrations are below the relevant criteria due to the distance between the Project and the sensitive receptors.

A greenhouse gas assessment has also been undertaken for the Project. This assessment determines the carbon dioxide equivalent (CO_2-e) emissions from the Project according to international and Federal guidelines. The estimated maximum annual operational phase emissions (48,742 tonnes CO_2-e) represent approximately 0.01% of Australia's latest greenhouse inventory estimates of 539 MtCO_2-E (2019).

Annual greenhouse gas rates are expected to exceed 25,000 t CO_2-e and therefore this Project will trigger NGER reporting requirements.

Overall, air quality should not be considered a constraint to the approval of this Project.

TABLE OF CONTENTS

1 INTRODUCTION

Vipac Engineers and Scientists Ltd (Vipac) was commissioned by CDM Smith Australia Pty Ltd (CDM Smith) to prepare an air quality assessment for the Isaac River Project (the Project). The purpose of this assessment is to evaluate the potential impacts of air pollutants generated from the construction and operational stages of the Project and to provide recommendations to mitigate any potential impacts that might have an effect on nearby sensitive receptors.

2 PROJECT DESCRIPTION

Bowen Coking Coal Limited (BCC) propose to develop the Isaac River Project (the Project) located in the Bowen Basin in Central Queensland, approximately 30 km west of Moranbah and 130 km southwest of Mackay (Figure 2-1). The Project will be located within Mining Lease (ML) Mineral Development Licence 444 ("MDL 444") and Exploration Permit for Coal 830 ("EPC 830"). BMA's (BHP Mitsubishi Alliance) Daunia Mine is located to the immediate west, and Peabody's Moorvale West resource is located to the immediate north of the Project. EPC 830 occurs south of MDL 444 and abuts Peabody's Olive Downs North Project (subject to a transaction with Pembroke Resources), and is approximately 3 km North of Rio Tinto's Winchester South project. The Project is well located relative to regional infrastructure with the Peak Downs Highway located 12 km north and the Goonyella rail system within 3 km of the Project.

2.1 PROPOSED OPERATIONS

The Project covers an area of 14 km^2 and consists of approximately 8.7Mt of primarily coking coal resource. The proposed coal mine layout and associated infrastructure is shown on Figure 2-2. The key components of the Project include:

- 1 open cut mine pit;
- 1 ROM Stockpile;
- Haulage and site access;
- 1 ROM Pad; and
- Associated infrastructure.

The mine will utilise an open cut mining technique where strips or blocks will be mined in succession, thus allowing waste from one strip or block to be dumped into a previously mined out area. Waste from an initial strip or box cut will be dumped into a predetermined out of pit dump. Stripped topsoil and box cut spoil will be stockpiled for later use in mine rehabilitation.

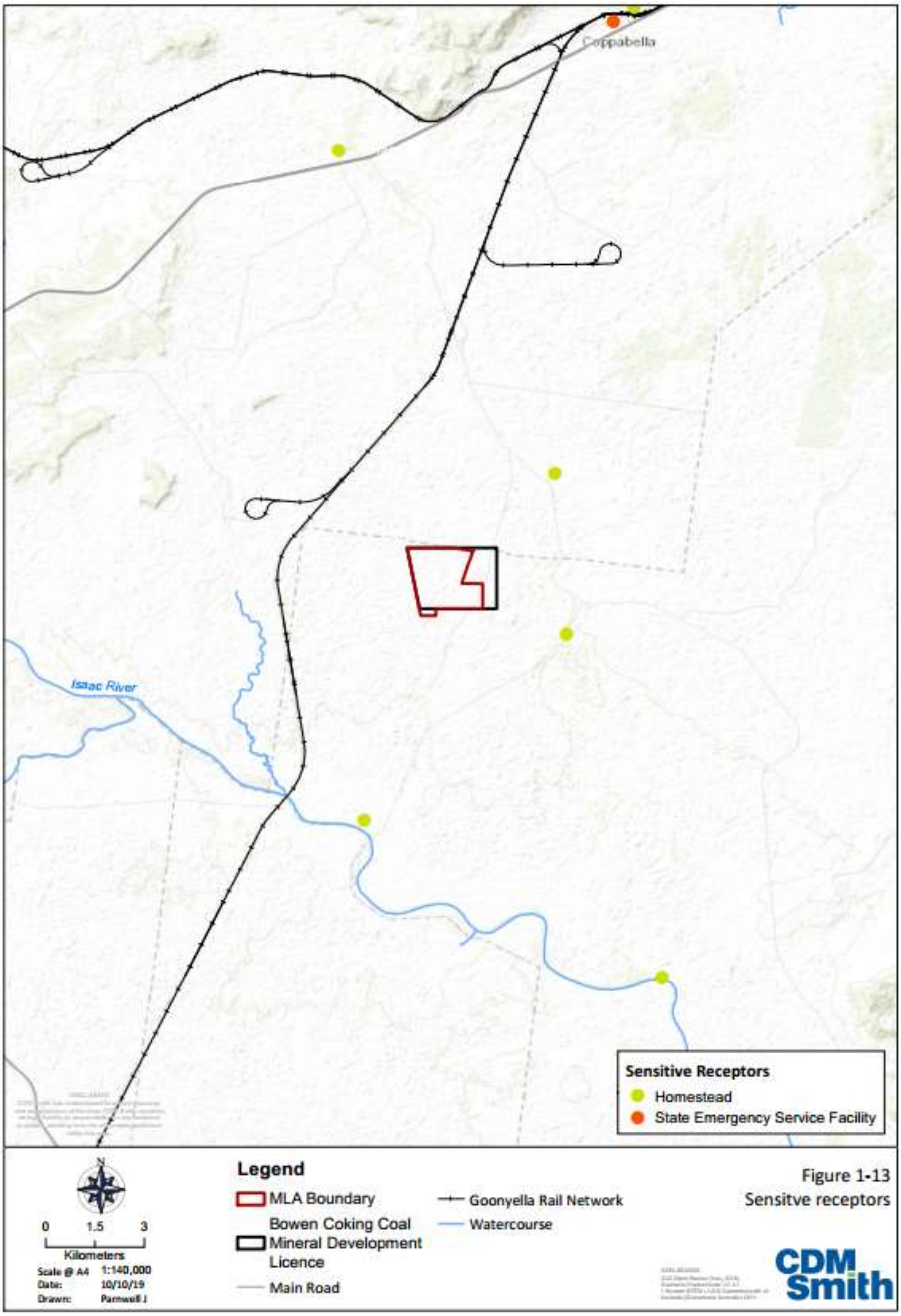


Figure 2-1: Isaac River Project Location [CDM Smith, October 2019]

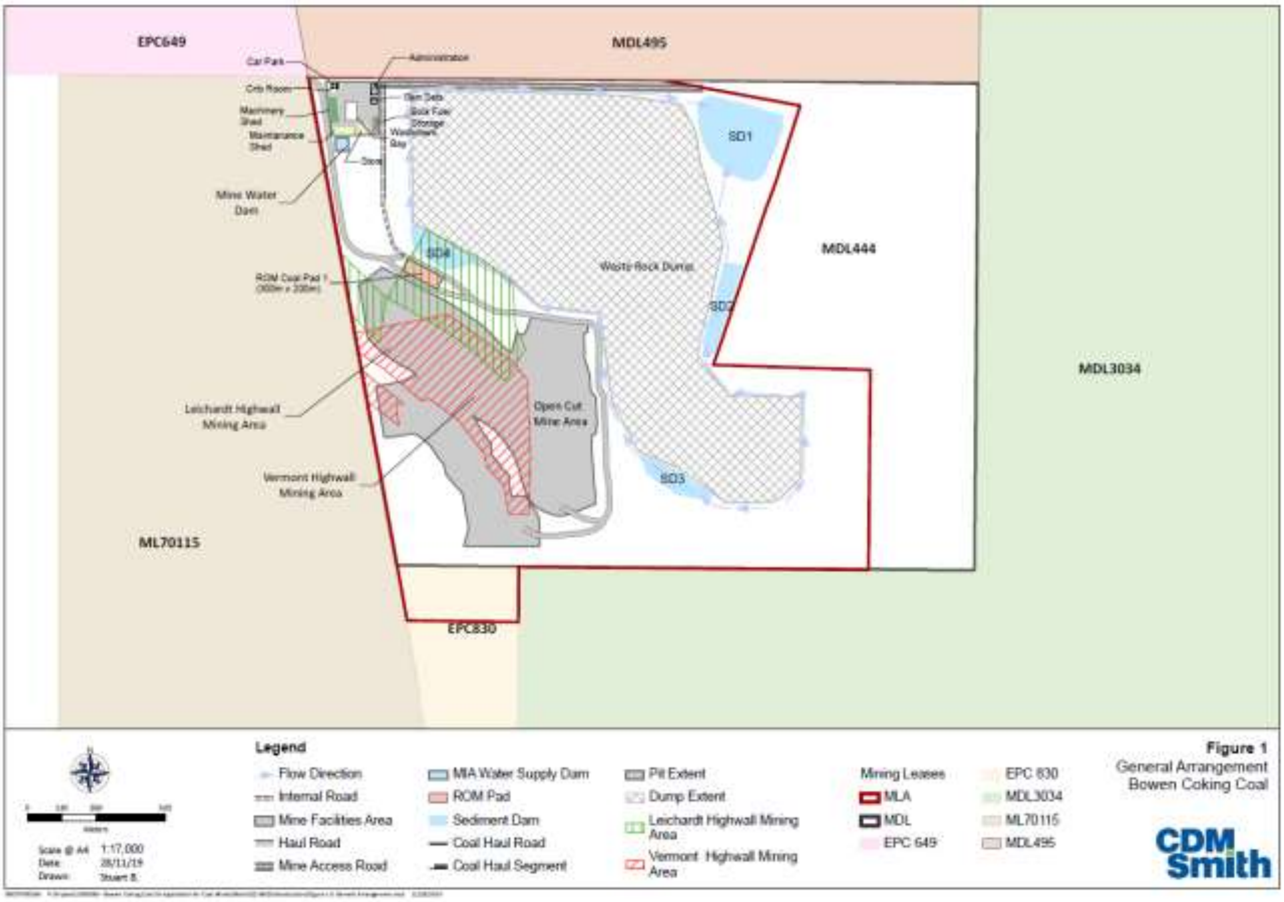


Figure 2-2: Isaac River Project Arrangement [CDM Smith, November, 2019]

After topsoil has been removed from a strip, the overburden waste material, where necessary, will be drilled and blasted and subsequently removed by a combination of truck/shovel, truck/excavator or dozer push methods in order to expose the top coal seam. Dozer ripping will be considered if the waste thickness is too thin for blasting.

The coal will be mined using front end loaders or small hydraulic excavators or surface miners and placed into rear dump trucks or B Double side tippers for haulage. The haul trucks will transport the coal along the strip or terrace, up a coal ramp out of the pit, then along a haul road to a ROM stockpile area ready for transport for processing.

Extraction is proposed to commence in 2021 and rehabilitation activities in 2026/2027 (Table 2-1).

Table 2-1: Proposed extraction rates

Year	ROM (t)	Overburden (bcm)
2021	500,000	7,176,449
2022	500,000	5,516,911
2023	500,000	5,433,373
2024	500,000	4,731,739
2025	500,000	-

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), 22019). 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 MODEL MINING CONDITIONS

The Queensland *Environmental Protection Act 2019* (EP Act) provides for the granting of environmental authorities for resource activities – mining activities. In giving approval under the EP Act, the administering authority must address the regulatory requirements set out in the Environmental Protection Regulation 2019 and the standard criteria contained in the EP Act.

In December 2014, the ‘*Guideline Mining - Model Mining Conditions (MMC)’ was* published by the Department of Environment and Heritage Protection. The purpose of this guideline is to provide a set of model conditions for general environmental protection commitments for the mining activities and the environmental authority conditions pursuant to the EP Act.

The Guideline states that the ‘*model conditions should be applied to all new mining project applications lodged after the guideline is approved’*, therefore the Project is subject to the air criteria outlined in the guidelines. The methodology to derive the Project specific air criteria is presented in Table 3-1.

Table 3-1: Air Criteria as Proposed by Model Mining Conditions [DEHP, 2014]

The Proponent shall ensure that all reasonable and feasible avoidance and mitigation measures are employed so that the dust and particulate matter emissions generated by the mining activities do not cause exceedances of the following levels when measured at any sensitive or commercial place: a) Dust deposition of 120 milligrams per square metre per day, averaged over one month; b) A concentration of particulate matter with an aerodynamic diameter of less than 10 micrometres (PM_{10}) suspended in the atmosphere of 50 micrograms per cubic metre over a 24-hour averaging time, for no more than five exceedances recorded each year; c) A concentration of particulate matter with an aerodynamic diameter of less than 2.5 micrometres ($PM_{2.5}$) suspended in the atmosphere of 25 micrograms per cubic metre over a 24-hour averaging time; and

d) A concentration of particulate matter suspended in the atmosphere of 90 micrograms per cubic metre over a 1 year averaging time.

3.4 PROJECT CRITERIA

From all of the regulations the strictest applicable criteria have been selected for this assessment and are presented in Table 3-2.

Table 3-2: Project Air Quality Goals

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
	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 $mg/m^2/day$	MMC	1-Month

4 EXISTING ENVIRONMENT

4.1 LOCAL SETTING

The Project covers an area of 14 km2 and is located in the Bowen Basin in Central Queensland, approximately 30 km west of Moranbah and 130 km southwest of Mackay. BHP Mitsubishi Alliance's ("BMA") Daunia Mine is located to the immediate west, and Peabody's Moorvale West resource is located to the immediate north of the Project. EPC 830 occurs south of MDL 444 and abuts Peabody's Olive Downs North Project (subject to a transaction with Pembroke Resources) and is approximately 3km North of Rio Tinto's Winchester South project.

4.2 SENSITIVE RECEPTORS

The locations of the nearest confirmed sensitive receptors to the Project were provided by CDM Smith. In total, 7 sensitive receptors are located within the locality of the proposed Project. These are shown in Figure 2-1 and identified in Table 4-1. Note that the entire township of Coppabella has been counted as one sensitive receptor.

It is anticipated that the Project personnel will be accommodated locally; however, if this is not practicable an accommodation camp will be constructed outside the ML.

Table 4-1: Sensitive Receptors

Receptor ID	Description	UTM Easting (m)	UTM Northing (m)
Sensitive Receptors			
R1	Homestead	641716	7577442
R2	Coppabella State Emergency Service Facility	641135	7577182
R3	Homestead	633385	7573285
R4	Homestead	639361	7563446
R5	Homestead	639700	7558594
R6	Homestead	633945	7552998
R7	Homestead	642247	7548130

4.3 DISPERSION METEOROLOGY

4.3.1 REGIONAL METEOROLOGY

The nearest long-term Bureau of Meteorology (BOM) station to the Project site is at the Moranbah Water Treatment Plant (Site number 034038), located approximately 30 km to the West. This monitoring station recorded data from 1972 to 2012 and a summary of the climate is presented in Table 4-2.

The long term mean temperature range is between 9.9°C and 34°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 666 mm. Rainfall reduces the dispersion of air emissions and therefore the potential impact on visual amenity and health.

Table 4-2: Long-term Weather Data for Moranbah [BOM]

Month	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	33.8	21.9	103.8	8.5	6.5	26.4	69	7.5	32.7	43	8.8
Feb	33.1	21.8	100.7	8.2	6.4	25.8	74	7.7	31.9	48	9.6
Mar	32.1	20.2	55.4	5.5	3.9	24.7	70	8.1	31.2	41	9.4
Apr	29.5	17.6	36.4	4.3	3.1	22.1	72	7.6	28.6	43	8.7
May	26.5	14.2	34.5	3.8	2.6	18.9	73	6.2	25.8	43	6.9
Jun	23.7	11.2	22.1	3.2	2.1	15.4	73	5.5	22.9	44	6.6
Jul	23.7	9.9	18	2.6	1.8	14.7	69	5.3	22.9	39	7
Aug	25.5	11.1	25	2.2	1.7	16.6	66	6.6	24.6	35	7.7
Sep	29.2	14.1	9.1	2.2	1.4	20.6	60	7.7	28.3	30	8.3
Oct	32.3	17.6	35.7	4	3.1	24	58	8.4	31.4	31	8.4
Nov	33.1	19.4	69.3	6.2	4.9	25.3	60	8.4	32.2	34	8.9
Dec	34	21.1	103.9	7.3	5.9	26.4	64	8.4	33	38	8.8
Annual	**29.7**	**16.7**	**614.2**	**58**	**43.4**	**21.7**	**67**	**7.3**	**28.8**	**39**	**8.3**

A review of the number of rainfall days per year at Moranbah show that on average rainfall is recorded on 58 days per year and the number of days where rainfall is ≥ 1 mm is 64-81% of the monthly rainfall days as presented in Figure 4-1.

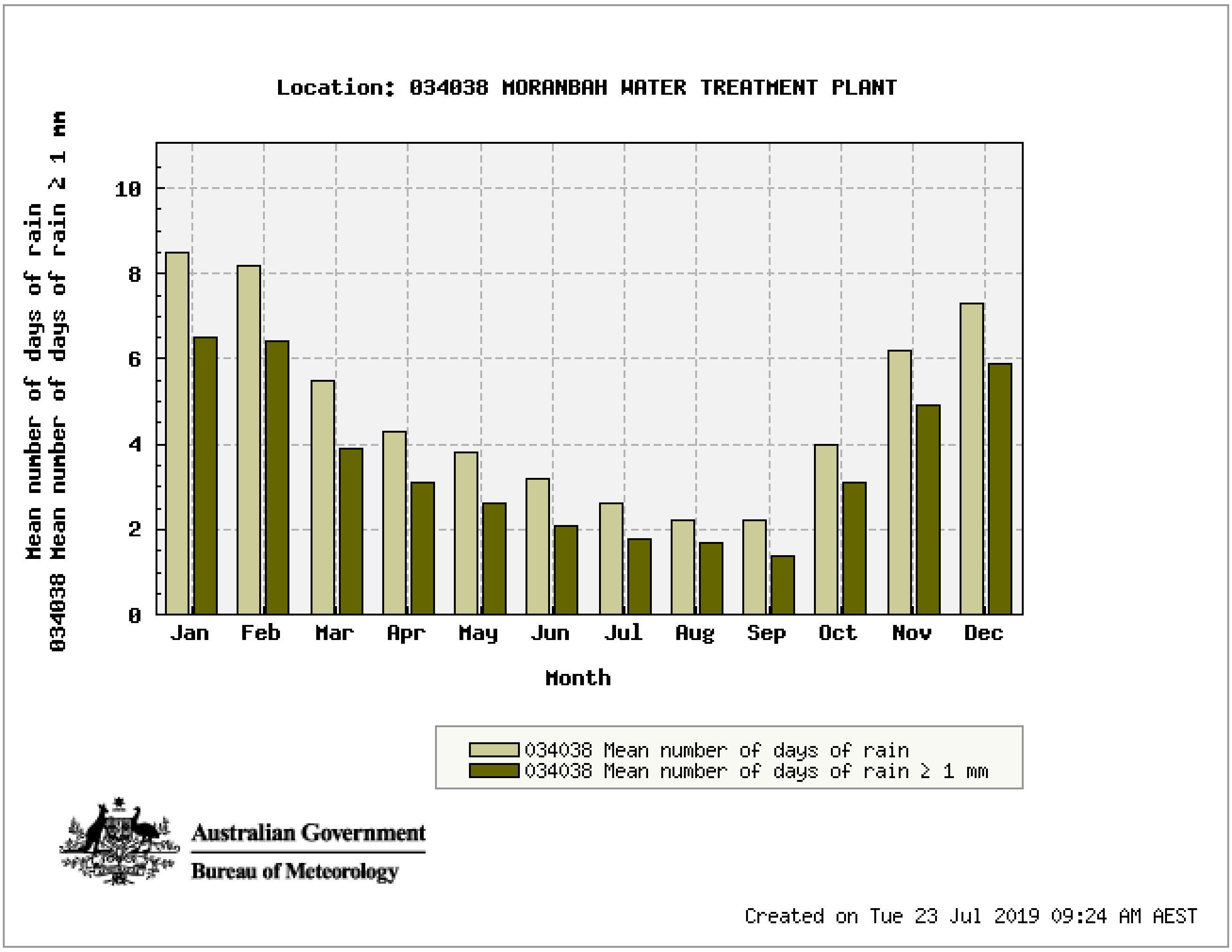
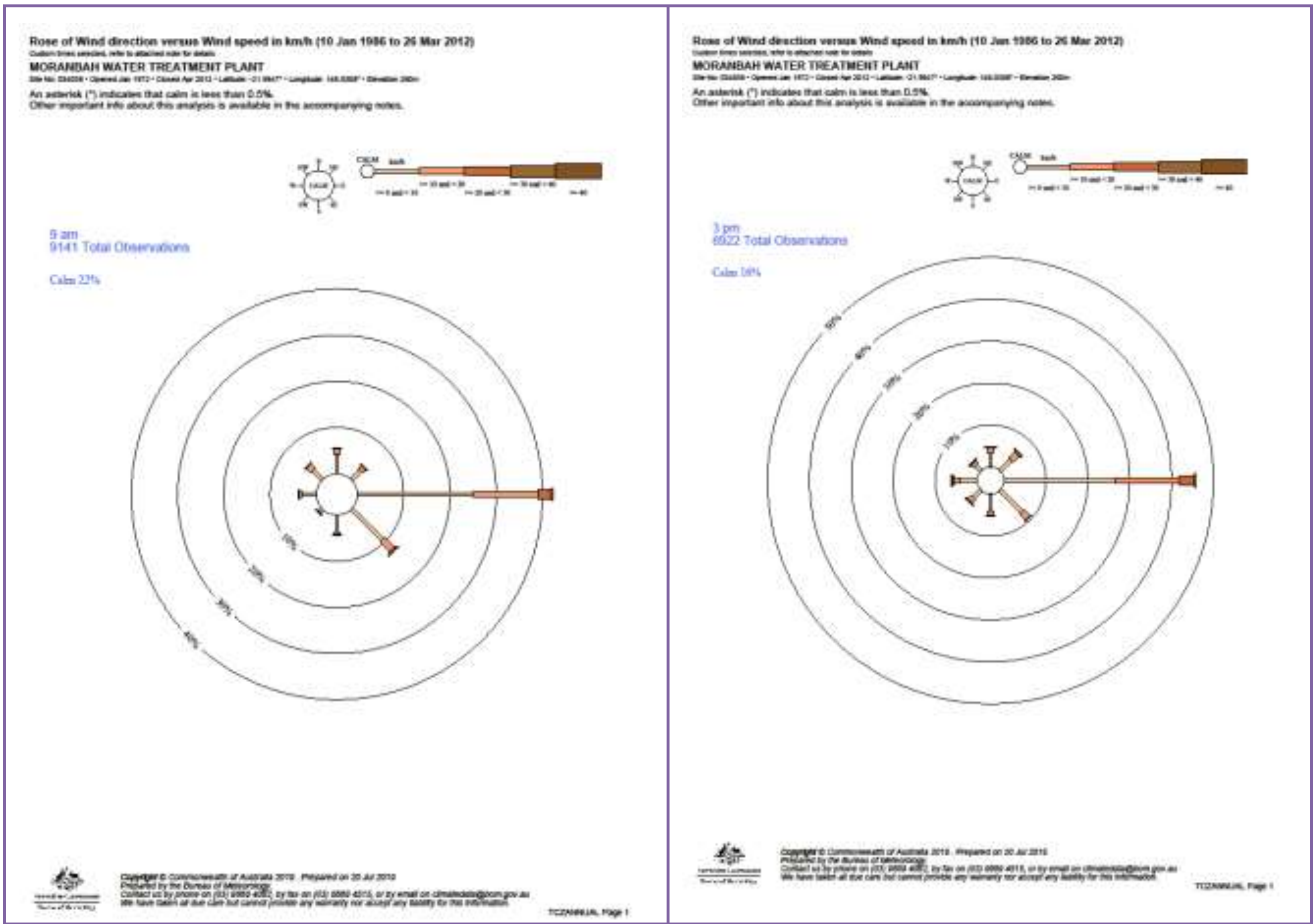


Figure 4-1: Mean Rainfall Days and Rainfall Days ≥ 1 mm at the Moranbah Weather Station

The long term wind roses recorded daily at the Moranbah station at 9am and 3pm are provided in Figure 4-2. Winds are shown to be primarily from the East at both times. Stronger winds (>40km/hr or >11.1m/s) occur infrequently.



Location: **Moranbah BoM Station**	**Data Period:** 1986 to 2012	**Data Type:** Measured Data

Figure 4-2: Annual Wind Roses for Moranbah Weather Station (1986 to 2012)

4.4 LOCAL METEOROLOGY

4.4.1 INTRODUCTION

A three dimensional meteorological field was required for the air dispersion modelling that includes a wind field generator accounting for slope flows, terrain effects and terrain blocking effects. 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 2013 and approximately centred at the proposed Project has been used to provide further information on the local meteorological influences. Details of the modelling approach are provided in Section 4.3.

4.4.2 WIND SPEED AND DIRECTION

The wind roses from the TAPM-CALMET derived dataset for the year 2013 are presented in Figure 4-3 and Figure 4-4 for the Project site. Figure 4-3 shows that the dominant wind direction is from Northeast during spring, East during the summer months. In autumn and winter the winds are primarily from the Southeasterly directions.

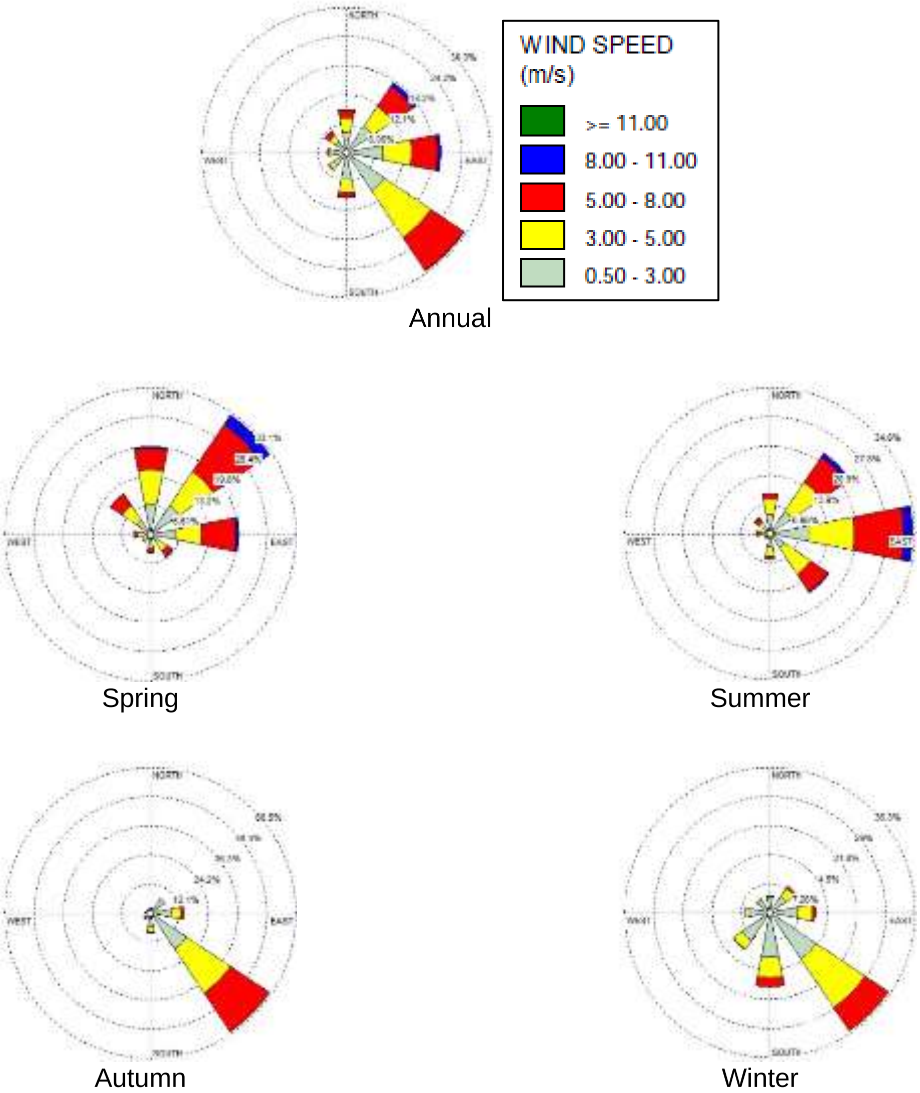


Figure 4-3: Site-Specific Wind Roses by Season for 2013

Figure 4-4 shows the wind roses for the time of day during the year for 2013. It can be seen that there are more frequent and stronger winds from the Northeast and East during the afternoon and evening periods.

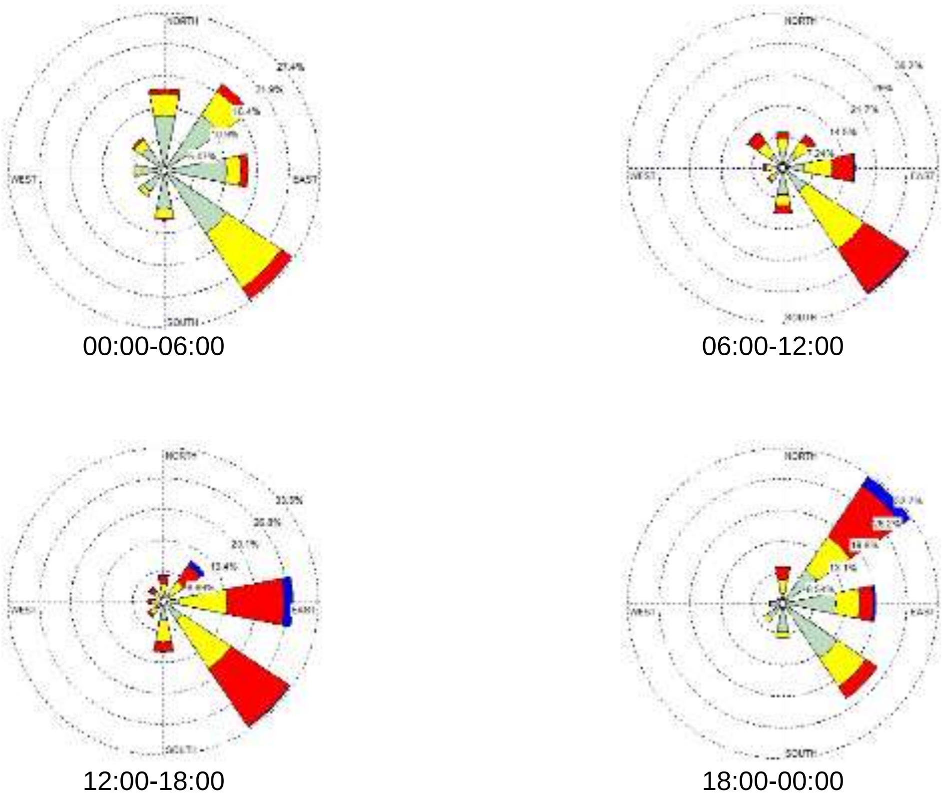
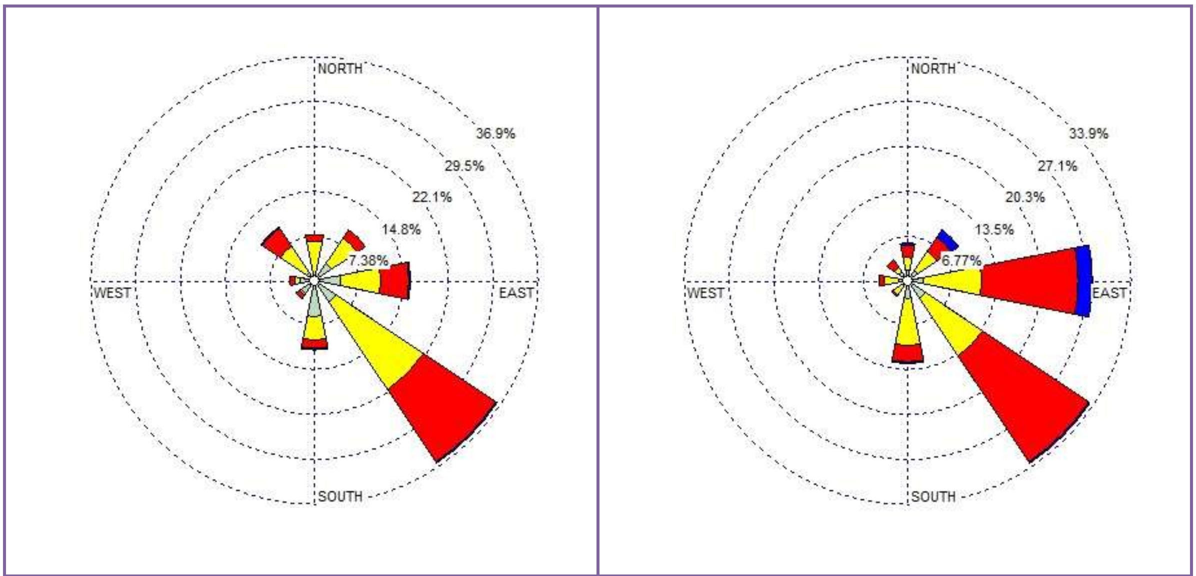


Figure 4-4: Site-Specific Wind Roses by Time of Day for 2013

A comparison of the wind roses at 09:00 and 15:00 hours for the TAPM-CALMET derived dataset (Figure 4-5) at the Project site was also undertaken with the BOM long-term wind roses at Moranbah. The wind roses from BOM and TAPM-CALMET are similar with differences in the percentage of time the wind blows from the Southeast. The BOM wind rose, based on 9,141 observations, identifies Easterly winds as the prevailing winds while TAPM-CALMET Southeasterly winds as prevailing with some Easterlies primarily in the afternoon. These differences in wind are influenced from the topography surrounding both the BOM monitoring station and the Project site. Overall, the meteorological data generated by TAPM-CALMET is considered to be representative of the site.



Location: **Project Site**	**Data Period:** 2013	**Data Type:** Modelled Data

Figure 4-5: Annual Wind Roses for the TAPM-CALMET derived dataset at the Project site, 2013

4.5 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. Temperature inversions are defined as Class F, these conditions only occur with clear and calm conditions during the evening and night time periods. The frequency of occurrence for each stability class for 2013 is detailed in Table 4-3.

Table 4-3: Annual Stability Class Distribution Predicted [TAPM-CALMET, 2013]

Stability Class	Description	Frequency of Occurrence (%)	Average Wind Speed (m/s)
A	Very unstable low wind, clear skies, hot daytime conditions	4.5	1.9
B	Unstable clear skies, daytime conditions	10.6	2.6
C	Moderately unstable moderate wind, slightly overcast daytime	21.2	3.3
D	Neutral high winds or cloudy days and nights	31.7	4.0
E	Stable moderate wind, slightly overcast night-time conditions	18.6	3.8
F	Very stable low winds, clear skies, cold night-time conditions	13.5	2.0

4.6 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 4-6. 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.

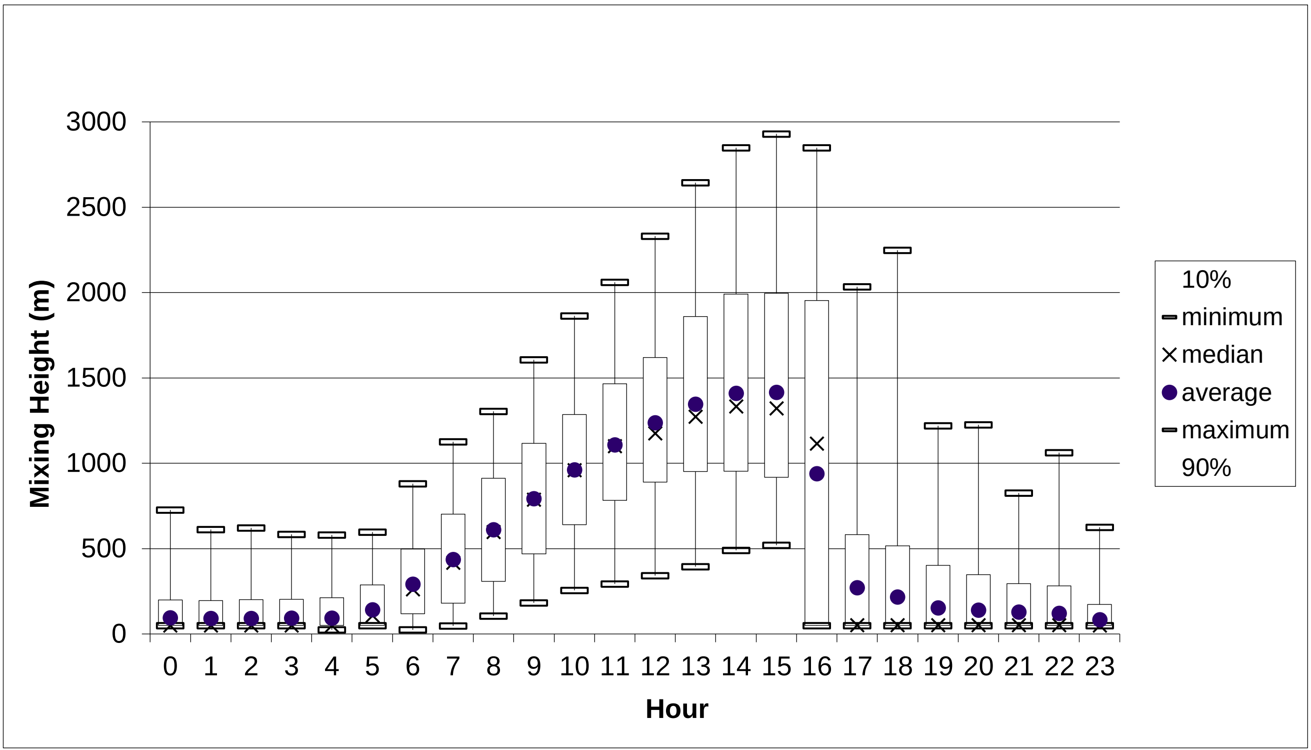


Figure 4-6: Mixing Height [TAPM-CALMET, 2013]

4.7 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.

There are currently no Department of Science, Information Technology and Innovation (DSITI) monitoring stations operating in the immediate vicinity of the Project. DSITI operates a monitoring station at Moranbah. The Moranbah station was established in order to assess the impact of coal mining operations on the Moranbah community and surrounding area. The station monitors for PM_{10} and is located in a residential area in Moranbah approximately 30km to the east.

The existing air quality for dust deposition, TSP, PM_{10} and $PM_{2.5}$ has been estimated by considering the Moranbah monitoring data and as reported in recent air quality assessments for other mines in Queensland. The following air quality assessments have been reviewed:

- Taroborah Coal Project (Katestone Environmental Pty Ltd, 2014). On-site monitoring for dust deposition was undertaken for five months at five locations in 2012. PM_{10} and $PM_{2.5}$ monitoring studies undertaken by Katestone for nearby mines have been reported including around Foxleigh Mine and Middlemount Mine;
- Baralaba Coal Mine (Todoroski Air Sciences Pty Ltd, 2014). On-site dust deposition monitoring was undertaken from 2010 to 2013 at seven locations. Additionally, PM_{10} monitoring at three locations using DustTraks was completed. TSP and $PM_{2.5}$ were based on assumptions; and
- Rolleston Coal Expansion Project (AECOM Australia Pty Ltd , 2013). A dust monitoring program was conducted by AECOM to quantify existing ambient PM_{10} concentrations at the project site using Beta Attenuation Monitors (BAMs). PM_{10} monitoring was conducted at a homestead approximately 10 km north east of the existing Rolleston Mine between October 2011 and March 2012. The PM_{10} concentrations were used to derive the TSP concentrations (200% of PM_{10}) and $PM_{2.5}$ concentrations (36% of PM_{10}). Dust deposition concentrations were measured at the mine in 2009.

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

Table 4-4: Assigned Background Levels for Recent EIS Assessments

Project	Assigned Background Levels					
	TSP (µg/m^3)	Dust Deposition (mg/m^2/day)	PM_{10} (µg/m^3)		$PM_{2.5}$ (µg/m^3)	
	Annual	30 days	24 Hour	Annual	24 Hour	Annual
Moranbah AQMS	n/a	n/a	26.5[A]	22.4	n/a	n/a
Baralaba Coal	34.1	59.1[A]	19.4	n/a	9.7	3.6
Taroborah Coal	28.0 [D]	33.0[B]	20.0[c]	n/a	5.4[D]	2.8 [D]
Rolleston Coal	36.6	50.0	20.0	n/a	7.2	6.6

[A] 70th percentile data for 2013 (consistent with modelled year)
[B] Reported as 1.8 g/m^2/month
[C] Average of dust deposition monitoring at Foxleigh residence (which is not influenced by Middlemount operations)
[D] 70th percentile PM_{10} 24-hour concentration at Middlemount Village
[E] Taken from Ensham Coal mine monitoring

A summary of the assigned background concentrations used in this study are presented in Table 4-5. These background concentrations will be added to the predicted incremental emissions from the Project to derive total potential concentrations.

Table 4-5: Assigned Background Concentrations

Parameter	Project Criteria	Period	Applied Background	Comments
TSP	90 µg/m^3	**Annual**	40 µg/m^3	Conservative assumption
PM_{10}	50 µg/m^3	**24 Hour**	26.5 µg/m^3	Moranbah AQMS
	25 µg/m^3	**Annual**	22.4 µg/m^3	
$PM_{2.5}$	25 µg/m^3	**24 Hour**	9.7 µg/m^3	Monitoring by Barabala Mine
	8 µg/m^3	**Annual**	3.6 µg/m^3	
Dust Deposition	120 mg/m^2/day	**24 Hour**	59 mg/m^2/day	Conservative assumption

It is noted that the assigned background concentrations are largely consistent with those adopted for the recently completed Olive Downs North Project EIS, approximately 3 km to the southeast.

5 METHODOLOGY

5.1 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 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 5.2.2).
- 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 5.3).
- The atmospheric dispersion modelling results were assessed against the air quality assessment criteria described in Section 3 as part of the impact assessment (Section 6). Air quality controls are applied to reduce emission rates where applicable.

5.2 ESTIMATED EMISSIONS

5.2.1 POLLUTION CAUSING ACTIVITIES

The air quality assessment takes into account dust generating activities from mining activities and disturbed surfaces within the mine lease application area 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:

- site clearance of areas for construction activities including vegetation clearance, topsoil removal and storage, and earthworks
- excavation of coal and overburden
- loading/unloading of haul trucks
- bulldozer and grader operations
- wind erosion from disturbed areas and stockpiles
- transfer points
- vehicle movements
- blasting and drilling
- diesel combustion

In addition, air pollutants from diesel combustion may release 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.

5.2.2 EMISSIONS ESTIMATION

5.2.2.1 EMISSIONS SCENARIOS

As discussed in Section 2.1, the Project life is proposed to be of short duration (i.e. ~ 6 years including rehabilitation). Maximum emissions to air are expected during the first year of operation (2021) when the largest extraction and movement of overburden material is proposed and activities are nearest to the sensitive receptors. In addition, as a short duration project, construction activities may be expected to occur simultaneously. The emissions scenarios from the proposed Project have therefore been included for this operating year.

This scenario is considered representative of worst case conditions.

5.2.2.2 EQUIPMENT

CDM Smith provided the major equipment list schedule for the operation of the Project. The equipment schedule is presented in Table 5-1 and locations of equipment are shown in Figure 5-1.

Table 5-1: Mining Equipment Schedule for Operation (Including Construction and Rehabilitation)

Equipment	Quantity
Specification	**Operations Year 1-5**
Hitachi EX3600-6 Excavator	1
Hitachi EX2500-6 Excavator	1
Hitachi ZX470LCH-5G (50-tonne) Excavator	1
Cat 789D Rear Dump Trucks	5
Driltech D40K Overburden Drill	1
Service Truck	1
Cat 992K Wheel Loader	1
Road train	2
Cat D10T2 Dozer	2
Cat 773G Water cart	2
Cat 24H Grader	1

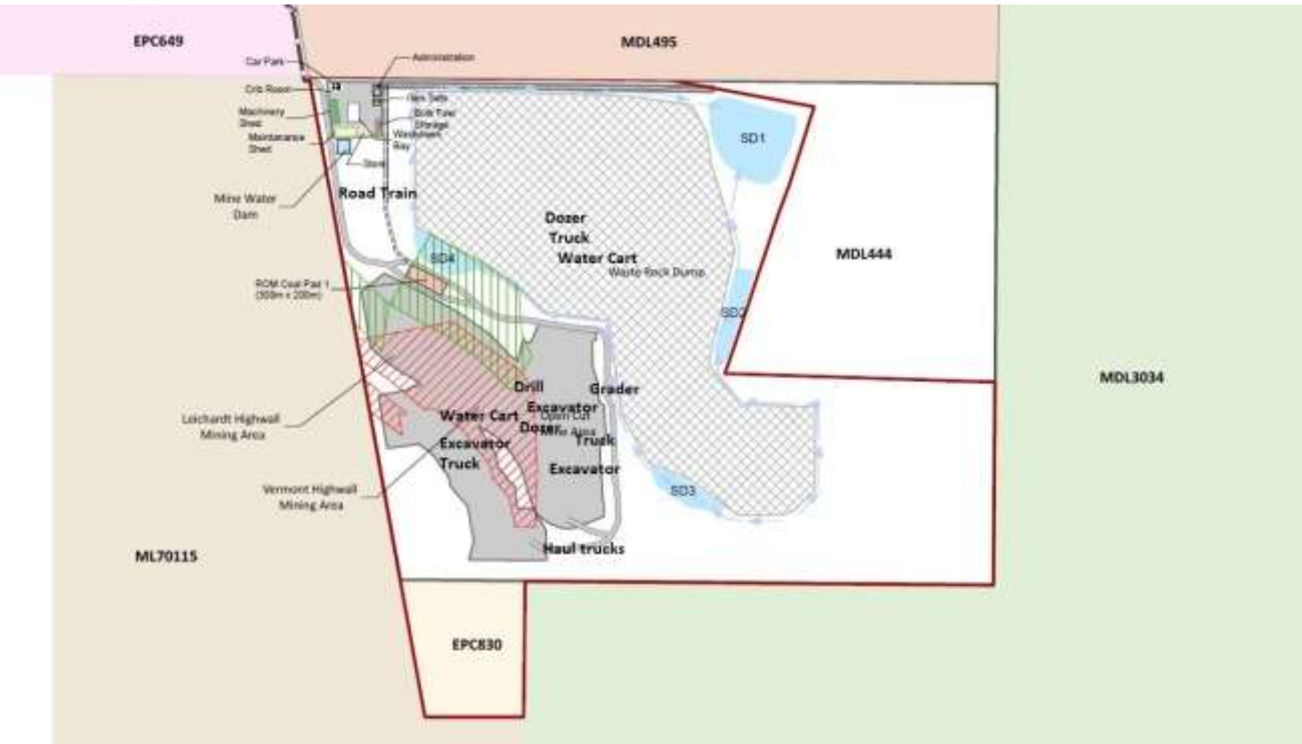


Figure 5-1: Equipment locations (as modelled)

5.2.2.3 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 CDM Smith.

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

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

Where:

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

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

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

$EF_{i\,l(kg/t)}$ = 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.

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

Table 5-2: Estimated emission rates (2021)

Source	Emission rate (g/s)		
	TSP	**PM10**	**PM2.5**
Waste handling (Waste Dumps)	8.6	2.8	0.9
Wind erosion (Pit & Waste Dumps)	14.9	6.0	1.6
Wheel generated dust (Hauling ROM & Waste)	4.1	2.2	0.1
Mining activities (Pit)	16.3	6.9	1.3
Blasting/drilling (Pit)	2.8	1.5	0.1
Power generation	0.07	0.07	0.07
TOTAL	**46.8**	**19.5**	**4.1**

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;
- 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.

While conservatively not adopted for modelling purposes the progressive rehabilitation of exposed areas will also allow for a 90% control of dust emissions from these sources.

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.

5.3 MODELLING METHODOLOGY

5.3.1 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 3-dimensional prognostic model developed and verified for air pollution studies by the CSIRO.

TAPM was configured as follows:

- Centre coordinates – 22˚ 4.5 S, 148˚ 23.5 E;
- Dates modelled – 30th December 2012 to 31st December 2013;
- Four nested grid domains of 20 km, 10 km, 3 km and 1 km;
- 41 x 41 grid points for all modelling domains;
- Hourly Moranbah BoM 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.

5.3.2 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.

5.3.3 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 5 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'*.

5.3.4 OTHER MODELLING INPUT PARAMETERS

5.3.4.1 PARTICLE SIZE DISTRIBUTION

CALPUFF requires particle distribution data (geometric mass mean diameter, standard deviation) to compute the dispersion of particulates (Table 5-3).

Table 5-3: 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

5.3.4.2 SOURCE TYPE AND INITIAL SOURCE STRUCTURE

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

- Generator, 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.

6 ASSESSMENT OF IMPACTS

6.1 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 nearest sensitive receptors are presented in Table 6-1. Contour plots of the predicted maximum ground-level concentrations are presented in Appendix C.

The results of the modelling can be summarised as follows:

- The highest annual TSP concentrations are below the 90 µg/m³ criterion at all receptors, with the results just above the background concentration of 40 µg/m³.
- The maximum 24-hour average cumulative ground-level PM_{10} concentration of 45 µg/m³ is predicted to occur at the nearest homestead identified as R5, which is well below the 50 µg/m³ criterion. The highest annual average cumulative ground-level PM_{10} concentration is 22.9 µg/m³, predicted to occur at the nearest homestead (R5), and is below the 25 µg/m³ criterion.
- The highest 24-hour average cumulative ground-level $PM_{2.5}$ concentration of 18.5 µg/m³ is also predicted to occur at the nearest homestead identified as R5, which is below the 25 µg/m³ criterion. The highest annual average cumulative ground-level $PM_{2.5}$ concentration is 3.8 µg/m³, predicted to occur at the nearest homestead (R5), and is below the 8 µg/m³ criterion.
- The predicted dust deposition impacts from construction are negligible with the cumulative deposition of 59 mg/m²/day which is less than half of the 120 mg/m²/day criterion.

Overall, it can clearly be seen that with the Project operating at 0.5 Mtpa the predicted pollutant concentrations are below the relevant criteria due to the distance between the Project and the sensitive receptors.

Table 6-1: Predicted maximum ground-level concentrations for the Project operation

Rec		In isolation						Cumulative				
	24 Hour $PM_{2.5}$ (µg/m^3)	Annual $PM_{2.5}$ (µg/m^3)	24 Hour PM_{10} (µg/m^3)	Annual PM_{10} (µg/m^3)	Annual TSP (µg/m^3)	Daily Dust Deposition (mg/m^2/day)	24 Hour $PM_{2.5}$ (µg/m^3)	Annual $PM_{2.5}$ (µg/m^3)	24 Hour PM_{10} [a] (µg/m^3)	Annual PM_{10} (µg/m^3)	Annual TSP (µg/m^3)	Daily Dust Deposition (mg/m^2/day)
R1	0.24	0.01	0.24	0.01	0.02	0.04	26.74	22.41	26.74	22.41	40.02	59.04
R2	0.27	0.01	0.27	0.01	0.02	0.05	26.77	22.41	26.77	22.41	40.02	59.05
R3	1.01	0.06	1.01	0.06	0.08	0.25	27.51	22.46	27.51	22.46	40.08	59.25
R4	14.05	0.45	14.05	0.45	0.68	1.95	40.55	22.85	40.55	22.85	40.68	60.95
R5	18.44	0.47	18.44	0.47	0.71	1.40	44.94	22.87	44.94	22.87	40.71	60.40
R6	5.18	0.39	5.18	0.39	0.54	1.35	31.68	22.79	31.68	22.79	40.54	60.35
R7	0.86	0.03	0.86	0.03	0.05	0.10	27.36	22.43	27.36	22.43	40.05	59.10
Criteria	**25**	**8**	**50**	**25**	**90**	**120**	**25**	**8**	**50**	**25**	**90**	**120**

7 MITIGATION

A summary of the proposed mitigation measures is provided in this section for both construction and operational phases of the Project.

7.1 CONSTRUCTION PHASE

Measures for the management of dust emissions during the construction phase to be employed include, but not necessarily be limited to the following:

- Water roads and exposed areas to reduce wheel-generated dust as required;
- Allow vegetation to establish on stockpiled overburden to prevent wind erosion;
- Minimisation of haul trips and trip distances, where practicable;
- Minimising speed of on-site traffic, where applicable, to minimise wheel generated dust;
- Ensure all vehicles are suitably fitted with exhaust systems that minimise gaseous and particulate emissions to meet vehicle design standards; and
- Where practicable limit vegetation and soil clearing to approved areas to minimise the area of exposed soil that may generate dust.

7.2 OPERATIONAL PHASE

The following operational controls to reduce dust emissions are recommended:

- It is recommended that the selected generator has low emissions of nitrogen oxides to reduce the potential exposure to pollutants in relation to Work Health and Safety requirements;
- 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.

7.2.1 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.

7.2.2 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.

7.2.3 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 not placed in the out of pit dumps will be placed back within the mined area; and
- Restrict vehicle movements to defined routes on overburden emplacement areas, with wet suppression applied to such routes as required.

7.2.4 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.

8 GREENHOUSE GAS

8.1 INTRODUCTION

Vipac Engineers and Scientists Ltd (Vipac) was commissioned by CDM Smith to prepare a greenhouse gas assessment for the Project.

This assessment determines the carbon dioxide equivalent (CO_2-e) emissions from the Project according to international and Federal guidelines.

8.2 BACKGROUND

Greenhouse gases are a natural part of the atmosphere; they absorb and re-radiate the sun's warmth, and maintain the Earth's surface temperature at a level necessary to support life. Human actions, particularly burning fossil fuels (coal, oil and natural gas), agriculture and land clearing, are increasing the concentrations of the greenhouse gases. This is the enhanced greenhouse effect, which is contributing to warming of the Earth.

Greenhouse gases include water vapour, carbon dioxide (CO_2), methane, nitrous oxide and some artificial chemicals such as chlorofluorocarbons (CFCs). Water vapour is the most abundant greenhouse gas. These gases vary in effect and longevity in the atmosphere, but scientists have developed a system called Global Warming Potential to allow them to be described in equivalent terms to CO_2 (the most prevalent greenhouse gas) called equivalent carbon dioxide emissions (CO_2-e). A unit of one tonne of CO_2-e (t CO_2-e) is the basic unit used in carbon accounting. An emissions inventory, or 'carbon footprint', is calculated as the sum of the emission rate of each greenhouse gas multiplied by the global warming potential.

8.3 LEGISLATION OVERVIEW

The *Commonwealth National Greenhouse and Energy Reporting Act 2007* (NGER Act) established a national framework for corporations to report greenhouse gas emissions and energy consumption. The NGER Act requires corporations to submit an annual report in energy consumption, energy production and greenhouse gas emissions, if any of the following thresholds are met:

- The facility consumes more than 100 terajoules of energy in a financial year or emits greenhouse gases above 25,000 tonnes CO_2-e (facility threshold); and
- All Australian facilities collectively consume more than 200 terajoules of energy in a financial year or emit greenhouse gases above 50,000 tonnes CO_2-e (corporate threshold).

A facility is defined as an activity, or a series of activities (including ancillary activities), if it involves the production of greenhouse gas emissions, the production of energy or the consumption of energy; and forms a single undertaking or enterprise and meets the requirements of the regulations.

8.4 METHODOLOGY

The Department of the Environment and Energy (DotEE) monitors and compiles databases on anthropogenic activities that produce greenhouse gases in Australia. The DotEE has published greenhouse gas emission factors for a range of anthropogenic activities. The DotEE methodology for calculating greenhouse gas emissions is published in the National Greenhouse Accounts (NGA) Factors workbook (DotEE, 2019). This workbook is updated regularly to reflect current compositions in fuel mixes and evolving information on emission sources.

The scope that emissions are reported, as defined by the NGA Factors Workbook is determined by whether the activity is within the organisation's boundary (Scope 1 – Direct Emissions) or outside the organisation's boundary (Scopes 2 and 3 – Indirect Emissions). The scopes are described below:

- Scope 1 Emissions: Direct (or point-source) emission factors give the kilograms of carbon dioxide equivalent (CO_2-e) emitted per unit of activity at the point of emission release (i.e. fuel use, energy use, manufacturing process activity, mining activity, on-site waste disposal, etc.);
- Scope 2 Emissions: Indirect emissions from the generation of the electricity purchased and consumed by an organisation as kilograms of CO_2-e per unit of electricity consumed; and
- Scope 3 Emissions: Indirect emissions for organisations that:
  a. Burn fossil fuels: to estimate their indirect emissions attributable to the extraction, production and transport of those fuels; or
  b. Consume purchased electricity: to estimate their indirect emissions from the extraction, production and transport of fuel burned at generation and the indirect emissions attributable to the electricity lost in delivery in the transmission and distribution network.

Scope 1 emissions include those from fuel use by vehicles, coal burnt in boilers and methane from wastewater systems. Scope 2 emissions are from any purchased electricity. Scope 3 emissions are from the emissions resulting from the energy required to manufacture products such as diesel and equipment.

The definition, methodologies and application of Scope 3 emission factors are currently subject to international discussions and have the potential to cause much confusion. Large uncertainty exists in the accurate quantification of these emissions.

Emission factors used in this assessment have been derived from either the DotEE, site-specific information or from operational details obtained from similar emission sources.

The majority of the emission factors used in this report have been sourced from the NGA Factors Workbook (DotEE, 2019) as indicated in Table 8-1.

Table 8-1: Emission Factors

Scope	Emission Source	Emission Factor	Source
1	Combustion emissions from diesel (stationary)	2.71 t CO_2-e / kL	NGA Factors Workbook, 2019
	Combustion for transport general (diesel)	2.72 t CO_2-e / kL	NGA Factors Workbook, 2019
	Combustion for transport general (gasoline)	2.38 t CO_2-e / kWh	NGA Factors Workbook, 2019
	Extraction of coal (fugitive) - Queensland	0.02 t CO_2-e / tonnes raw coal	NGA Factors Workbook, 2019

For this assessment Scope 1 and Scope 2 emissions have been calculated in accordance with the NGA Factors Workbook methodology.

8.5 QUANTIFICATION OF EMISSIONS

The modelling takes into account the worst case scenario, identified at Year 1 when peak production will occur and operations will be at their closest point to sensitive receptors. Furthermore, the GHG emissions estimation and impact assessment is based on the worst case scenario, which is when the project will be at its highest operational state. Table 8-2 outlines the estimated greenhouse gas emissions for the maximum operational phase (year 1) of the Project. The estimated total life of Project emissions are also conservatively provided on the basis of seven years of mine life. The following assumptions have been made for this assessment:

- The operational equipment list is in accordance with that specified in Table 5-1;
- 40 operational staff travelling approximately 20 km round-trip in 20 vehicles per day; and
- No electricity will be purchased from the grid.

Table 8-2: Estimated Greenhouse Gas Emissions (CO_2-e tonnes)

		Annual Emissions (t CO_2-e)	**Life of Project Emissions (t CO_2-e)**
Emission Source	**Scope**	**Operation (Year 1)**	
Staff Movements	1 (direct)	67.1	469.7
Equipment	1 (direct)	17,879	125,153
Generator	1 (direct)	1,417	9,919
Haulage	1 (direct)	19,379	135,653
Fugitive Coal	1 (direct)	10,000	50,000
		48,742	**321,195**

8.6 SUMMARY AND CONCLUSION

The results of the assessment of greenhouse gas emissions from the Project may be summarised as follows:

- During the operational phase the annual emissions are projected to be 48,742 tonnes $CO_{2\text{-}e}$, which is above the threshold of reporting of 25,000 tonnes $CO_{2\text{-}e}$. Therefore this Project will trigger NGER reporting requirements;
- The life of Project emissions are conservatively estimated to 321,195 tonnes $CO_{2\text{-}e}$; and
- The estimated maximum annual operational phase emissions (48,742 tonnes CO_2-e) represents approximately 0.01% of Australia's latest greenhouse inventory estimates of 539 MtCO_2-E (2019).

As the period of peak production has been modelled and the above figures represent the worst case scenario for greenhouse gas production associated with the project, assessing other years with lower emissions would only demonstrate a lower maximum estimated annual operating emissions. As noted the Project will be required to monitor greenhouse gas emissions in accordance with NGER reporting requirements.

9 CONCLUSION

This assessment evaluates the potential impacts of air pollutants generated from the construction and operational stages of the Isaac River Project and provides recommendations to mitigate any potential impacts that might have an effect on 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 can be summarised as follows:

- The highest annual TSP concentrations are below the 90 µg/m³ criterion at all receptors, with the results just above the background concentration of 40 µg/m³.
- The maximum 24-hour average cumulative ground-level PM_{10} concentration of 45 µg/m³ is predicted to occur at the nearest homestead identified as R5, which is well below the 50 µg/m³ criterion. The highest annual average cumulative ground-level PM_{10} concentration is 22.9 µg/m³, predicted to occur at the nearest homestead (R5), and is below the 25 µg/m³ criterion.
- The highest 24-hour average cumulative ground-level $PM_{2.5}$ concentration of 18.5 µg/m³ is also predicted to occur at the nearest homestead identified as R5, which is below the 25 µg/m³ criterion. The highest annual average cumulative ground-level $PM_{2.5}$ concentration is 3.8 µg/m³, predicted to occur at the nearest homestead (R5), and is below the 8 µg/m³ criterion.
- The predicted dust deposition impacts from construction are negligible with the cumulative deposition of 59 mg/m^2/day which is less than half of the 120 mg/m^2/day criterion.

Overall, it can clearly be seen that with the Project operating at 0.5 Mtpa the predicted pollutant concentrations are below the relevant criteria due to the distance between the Project and the sensitive receptors.

A greenhouse gas assessment has also been undertaken for the Project. This assessment determines the carbon dioxide equivalent (CO_2-e) emissions from the Project according to international and Federal guidelines. The estimated maximum annual operational phase emissions (48,742 tonnes CO_2-e) represent approximately 0.01% of Australia's latest greenhouse inventory estimates of 539 MtCO_2-E (2019).

Annual greenhouse gas rates are expected to exceed 25,000 t CO_2-e and therefore this Project will trigger NGER reporting requirements.

Overall, air quality should not be considered a constraint to the approval of this Project.

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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.
Carbon Dioxide Equivalent	A metric measure used to compare the emissions from various greenhouse gases based upon their global warming potential (expressed as CO_2-e).
Conveyor	Mechanical handling equipment (which may include a belt, chain or shaker) used to move ore or other materials from one location to another.
Deforestation	Conversion of forested lands for non-forest uses.
Deposited Matter	Any particulate matter that falls from suspension in the atmosphere
Dust	Generic term used to describe fine 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)
Fluorinated Gases	Powerful synthetic greenhouse gases such that are emitted from a variety of industrial processes.
Fluorocarbons	Carbon-fluorine compounds that often contain other elements such as hydrogen, chlorine, or bromine. Common fluorocarbons include chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), hydrofluorocarbons (HFCs), and perfluorocarbons (PFCs).
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
Global Warming Potential	Measure of the total energy that a gas absorbs over a particular period of time (usually 100 years), compared to carbon dioxide.
Greenhouse Gas	Any gas that absorbs infrared radiation in the atmosphere. Greenhouse gases include, carbon dioxide, methane, nitrous oxide, ozone, chlorofluorocarbons, hydrochlorofluorocarbons, hydrofluorocarbons, perfluorocarbons, sulfur hexafluoride.
Haul Roads	Roads used to transport extracted materials by truck around a mine site
Hydrocarbons	Substances containing only hydrogen and carbon. Fossil fuels are made up of hydrocarbons.
Hydrochlorofluorocarbons	Compounds containing hydrogen, fluorine, chlorine, and carbon atoms. Although ozone depleting substances, they are less potent at destroying stratospheric ozone than chlorofluorocarbons.

Hydrofluorocarbons (HFCs)	Compounds containing only hydrogen, fluorine, and carbon atoms. HFCs are emitted as by-products of industrial processes and are also used in manufacturing.
Methane (CH_4)	A hydrocarbon that is a greenhouse gas with a global warming potential most recently estimated at 25 times that of carbon dioxide (CO_2).
MIA	Mining Industrial Area
MLA	Mining Lease Area
mg	Milligram ($g \times 10^{-3}$)
Micron	Unit of measure μm ($metre \times 10^{-6}$)
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
$\mu g/m^3$	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

In the absence of measured physical parameters such as moisture and silt content, the default emission factors for all of the various operations at coal mines as specified in Table 2 of the National Pollutant Inventory Emission Estimation Technique Manual for Mining (January 2012) have been conservatively adopted (Table B-2). Table B-3 outlines the activity data applied in the emissions estimation.

Table B-2: Source type Emission Factors applied

Source type	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	$0.00022 \times A^{1.5}$	1760	0.52	kg/blast	No control
Wind erosion:					
stockpiles/ haul roads	0.4	-	0.5	kg/ha/h	Water sprays, 50%
Handling:					
Loading stockpiles	0.004	-	0.42	kg/t	Water sprays, 50%
Dozer on overburden	17	-	0.24	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%
Loading to trucks	0.0004	-	0.42	kg/t	No control
Diesel engine	1.6	-	1	kg/m^3	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

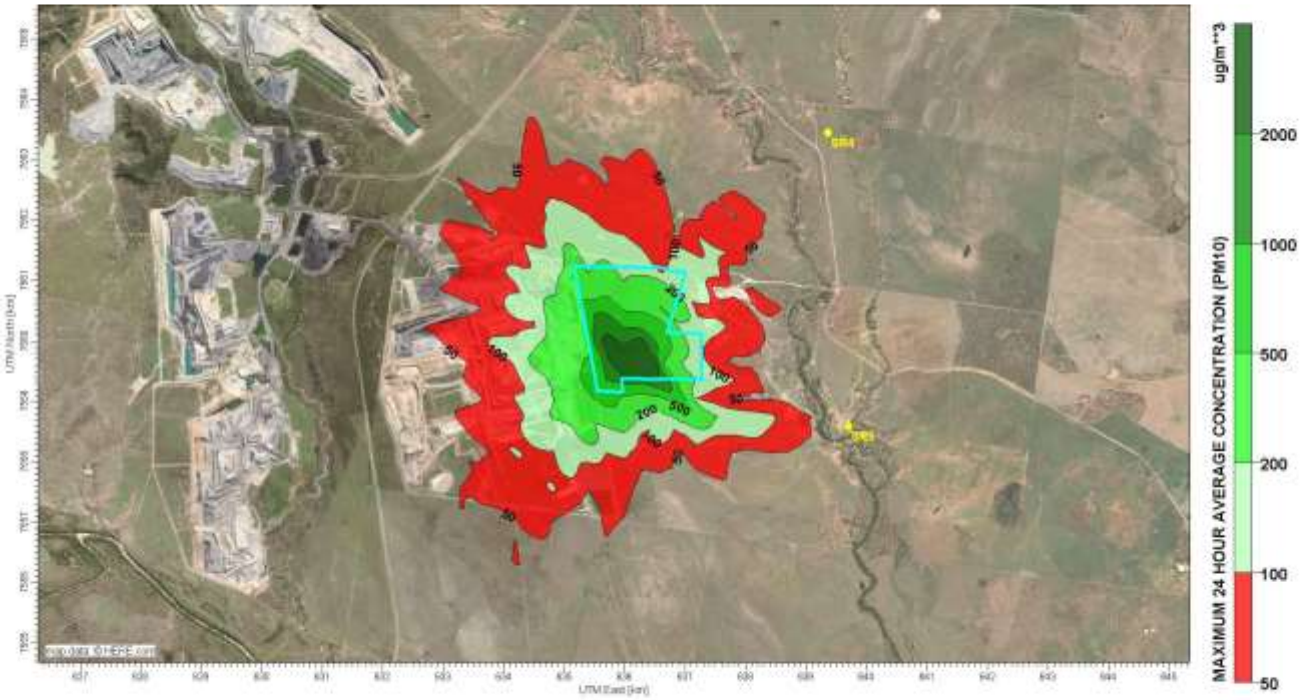
Parameter ID	Value	Units	Description	Data source
Hours	24	hours/day	Hours of operation	client supplied
Days	365	Days/year	Hours of operation	client supplied
W	181	t	Truck capacity	client supplied
Holes	625	Holes/blast	Holes drilled per blast	estimated
B	1	Blast/fortnight	Blasts per fortnight	client supplied
ROM	500,000	t/y	Extracted ROM	client supplied
Waste	7,176,449	bcm	Waste extracted/dumped	client supplied
Haul	1.28	VKT/hr	ROM haul for transport	estimated
Haul	2.2	VKT/hr	ROM internal haul to ROM pad	estimated
Haul	45.4	VKT/hr	Waste haul for dump	estimated

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.

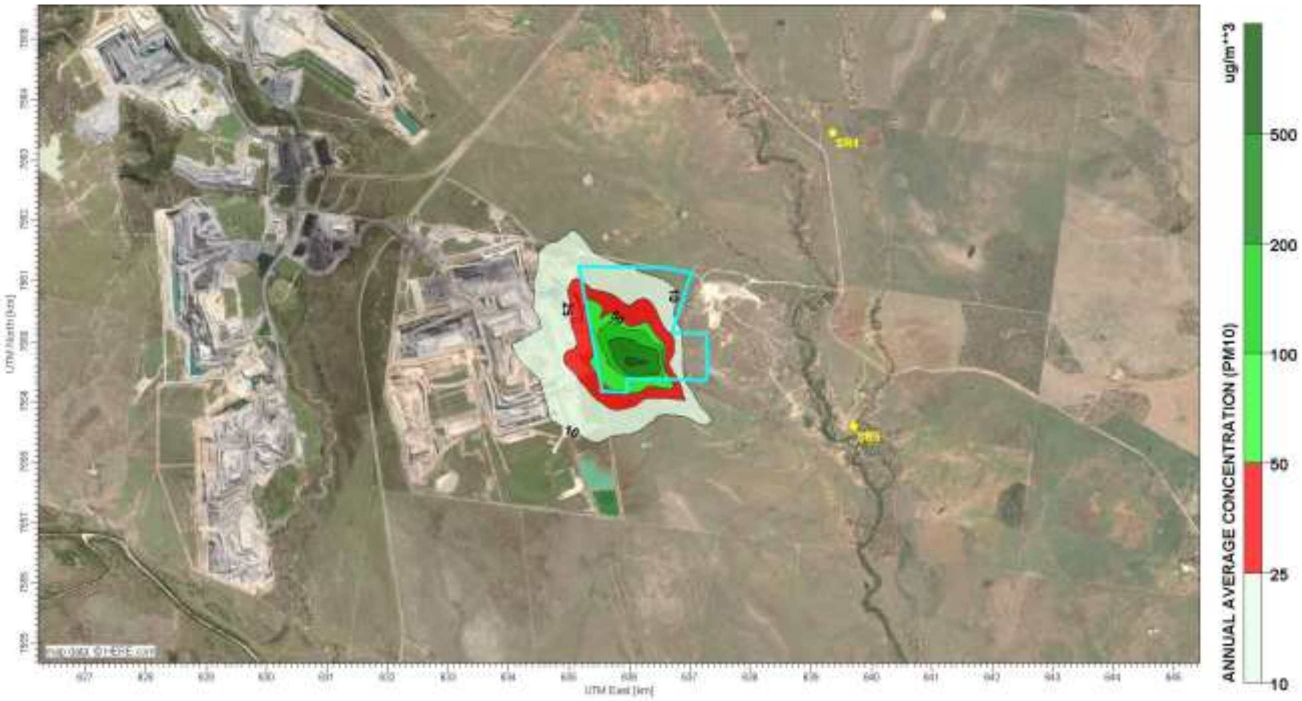
Pollutant:	Averaging Period:	Percentile:	Criteria:
TSP	Annual	MAX	90 µg/m^3

Scenario:
Year 1 Operations in Isolation



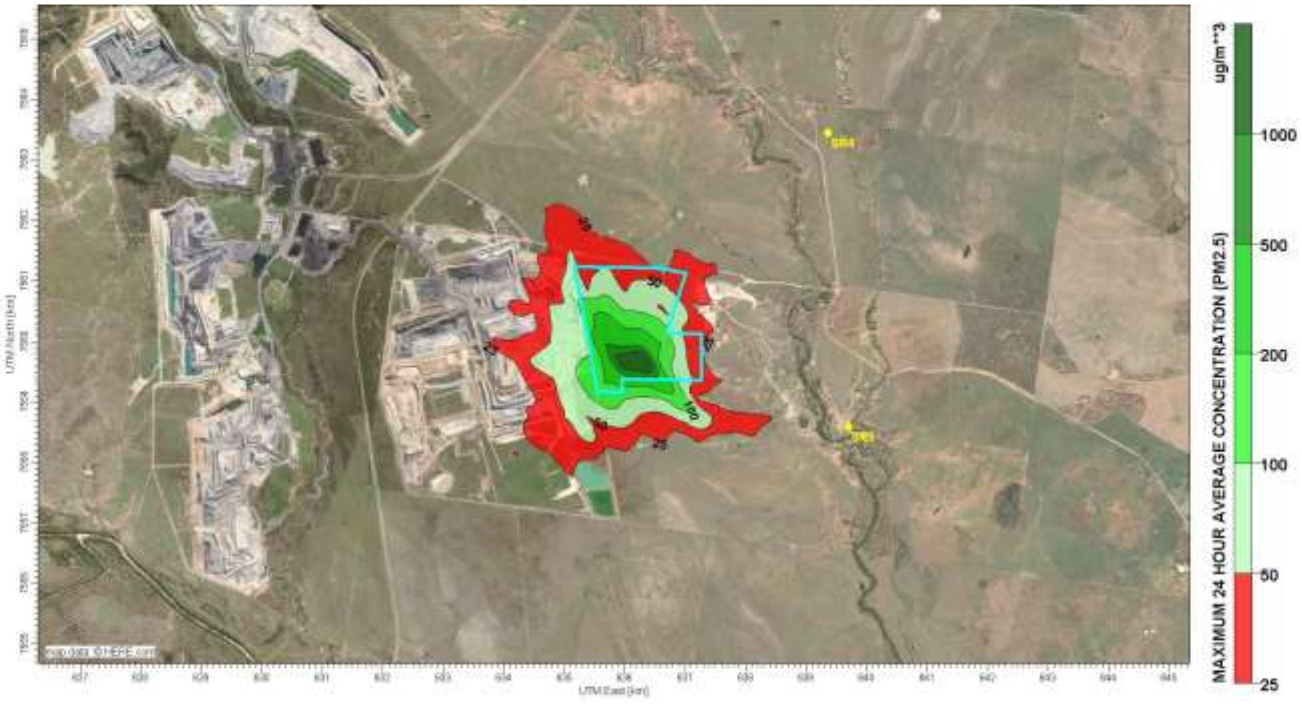
Pollutant:	Averaging Period:	Percentile:	Criteria:
PM_{10}	24 hour	MAX	50 µg/m^3

Scenario:
Year 1 Operation in Isolation



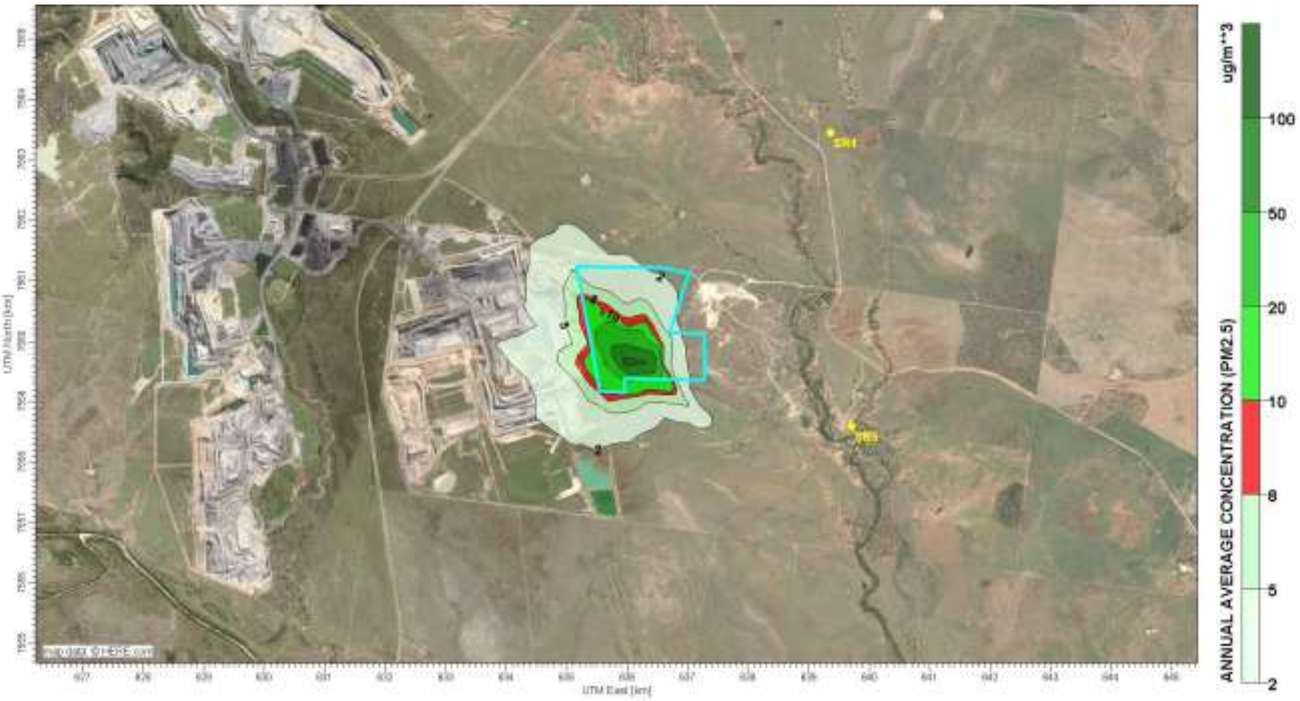
Pollutant:	Averaging Period:	Percentile:	Criteria:
PM_{10}	Annual	MAX	25 µg/m^3

Scenario:
Year 1 Operation in Isolation



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

Scenario:
Year 1 Operations in Isolation



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

Scenario:
Year 1 Operation in Isolation

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

Scenario:
Year 1 Operation in Isolation

Appendix D AIR QUALITY MANAGEMENT PLAN

Purpose and Scope

The purpose of the Plan is to:

- Comply with the expected conditions of the Approval;
- Provide a description of the measures to be implemented to mitigate air quality impacts; and
- Provide employees and/or contractors with a clear and concise description of their responsibilities in relation to air quality management during the operation of the Project.

Objectives

The Air Quality Management objectives of the Plan are to ensure that appropriate procedures and programs of work are in place to:

- Maintain an air quality monitoring system which can assess the air quality impact on surrounding sensitive receivers and performance against the legislative air pollution requirements;
- Detail the controls to be implemented to minimise dust generation from the site recognising that cumulative air quality is a key issue for the local community;
- Manage air quality related community complaints in a timely and effective manner; and
- Provide management commitments and strategies for dealing with air quality related issues.

Air Quality Management Controls

In order to mitigate any potential air quality impacts from the Project, a number of air quality management controls will be implemented throughout the life of the operation.

Change Management

Any significant change to operations, facilities, plant equipment and/or production processes will be assessed for impacts in air quality. The following items shall be recorded:

- Identify the change;
- Assess the potential risks associated with the change and develop a risk management plan;
- Approve the change subject to the risk management plan;
- Communicate and implement the change and risk management actions;
- Monitor and evaluate the change and risk management plan; and
- Document the change management process.

Training

General awareness training is provided to all new employees and contractors as part of the general induction program.

Air Quality Monitoring Program

Compliance with air quality criteria has been predicted by the modelling and a monitoring programme is not recommended. However, in the event that a complaint is made, it is recommended that any monitoring is undertaken in accordance with the Model Mining Conditions:

- Dust deposition to be monitored in accordance with the most recent version of Australian Standard *AS 3580.10.1 - Methods for sampling and analysis of ambient air—Determination of particulate matter—Deposited matter – Gravimetric method;*
- PM_{10} to be monitored in accordance with the most recent version of either:
  1. Australian Standard *AS 3580.9.6 - Methods for sampling and analysis of ambient air—Determination of suspended particulate matter—PM_{10} high volume sampler with size-selective inlet – Gravimetric method*, or
  2. Australian Standard *AS 3580.9.9 - Methods for sampling and analysis of ambient air—Determination of suspended particulate matter—PM_{10} low volume sampler—Gravimetric method*;
- $PM_{2.5}$ to be monitored in accordance with the most recent version of *AS/NZS 3580.9.10 - Methods for sampling and analysis of ambient air—Determination of suspended particulate matter—$PM_{2.5}$ low volume sampler—Gravimetric method; and*
- TSP to be monitored in accordance with the most recent version of *AS/NZS 3580.9.3:2003 - Methods for sampling and analysis of ambient air—Determination of suspended particulate matter—Total suspended particulate matter (TSP)—High volume sampler gravimetric method.*

Community Complaints

Community complaints management includes receipt of complaints, investigation, implementation of appropriate remedial action, and feedback to the complainant as well as communication to site management or personnel and notification to external bodies, such as the EHP.

Accountabilities

A generic list of roles and accountabilities for employees and contractors in relation to the Air Quality Management Plan are outlined below and will be incorporated into the Project's environmental licence conditions as required.

Person Responsible	Responsibilities
Operations Manager	• Approve appropriate resources for the implementation of this Plan. • Ensure the effective implementation of strategies designed to reduce air quality impacts from the operation. • Ensure air quality issues are reported in accordance with legal requirements. • Authorise internal reporting requirements of this plan.
Environment and Community Manager/Officer	• Provide that sufficient resources are allocated for the implementation of this program. • Identify air quality risks and impacts to the environment and assess resources required to mitigate identified risks and impacts within the site. • Ensure that the air quality management controls are implemented in accordance with this Plan. • Ensure that the results of monitoring are evaluated and reported to senior management and to relevant personnel for consideration as part of ongoing mine planning. • Ensure any potential or actual air quality is reported in accordance with legal requirements and the corporate standard. • Provide visible and proactive leadership in relation to the air quality management. • Ensure that operational changes consider the potential air quality impacts to adjacent private landowners. • Coordinate progressive rehabilitation to minimise disturbed areas. • Ensure monitoring equipment is operated in accordance with relevant industry standards and protocols.
Mine Managers, Supervisor, and Task Coordinators	• Provide that sufficient resources are allocated for the implementation of this Plan, as required. • Ensure adequate resources are budgeted for in relation to air quality. • Ensure that operational changes consider the potential impacts of dust emissions from the Project on the surrounding environment. • Monitor that team members and contractors carry out work appropriate monitoring and maintenance tasks. • Ensure any potential or actual air quality emissions are controlled. • Conduct daily inspections of the work area to monitor compliance with this plan. • Provide input to management on the adequacy and effectiveness of this plan. • Ensure the effective implementation of strategies designed to reduce air quality impacts from the Project. • Provide visible and proactive leadership in relation to air quality management. • Ensure personnel working at the operation are aware of the air quality management obligations whilst working.
All employees and Contractors	• Ensure the effective implementation of this Plan with respect to their work area. • Ensure any potential or actual air quality management issues, including environmental incidents, are reported to the Project Manager or Supervisor. • Ensure equipment (relevant to task/area of responsibility) is maintained and operated in a proper and efficient manner. • Where practicable, prevent the tracking of material onto sealed roads by washing material off vehicles prior to exiting site.