Central Queensland Coal Project

Appendix 7 – Air Quality and GHG Technical Report

Environmental Impact Statement

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CDM Smith Australia Pty Ltd

Styx Coal EIS - Air and Noise

Air Quality Assessment

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EXECUTIVE SUMMARY

Styx Coal Proprietary Limited (Styx Coal) and Fairway Coal Proprietary Limited (Fairway Coal) (the joint Proponent), propose to develop the Styx Coal Project (the Project) located 130 km northwest of Rockhampton in the Styx Basin in Central Queensland. 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 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;
- 90% control for revegetation of exposed areas;
- 75% control for level 2 watering of haul routes (>2 litres/m^2/h); and
- 70% control for water sprays applied to drilling.

The results of the construction stage 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 5th highest 24-hour average cumulative ground-level PM_{10} concentration of 21 µg/m³ is predicted to occur at the Tooloombah Creek Service Station (R8), which is well below the 50 µg/m³ criterion.
- The highest 24-hour average cumulative ground-level $PM_{2.5}$ concentration of 15.4 µg/m³ is predicted to occur at the Tooloombah Creek Service Station (R8), which is below the 25 µg/m³ criterion. The highest annual average cumulative ground-level $PM_{2.5}$ concentration is 4.8 µg/m³, predicted to occur at the Tooloombah Creek Service Station (R8), 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 predicted pollutant concentrations from the construction of the Project are well below the relevant criteria.

The results of the operational stage 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 5th highest 24-hour average cumulative ground-level PM_{10} concentration of 42 µg/m³ is predicted to occur at the Tooloombah Creek Service Station (R8), which is well below the 50 µg/m³ criterion. The predicted incremental increase in PM_{10} due to the operation of the Project is approximately 22 µg/m³ at the Tooloombah Creek Service Station receptor.
- The highest 24-hour average cumulative ground-level $PM_{2.5}$ concentration of 19.4 µg/m³ is predicted to occur at Tooloombah Creek Service Station (R8), which is below the 25 µg/m³ criterion. The highest annual average cumulative ground-level $PM_{2.5}$ concentration is 5.9 µg/m³, predicted to occur at the Tooloombah Creek Service Station (R8), and is below the 8 µg/m³ criterion.
- The highest daily dust deposition results show that an incremental increase of 1.9 mg/m^2/day will occur at the Brussels receptor, with a total deposition of 60.9 mg/m^2/day which is well below the 120 mg/m^2/day criterion.

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 (479,814 tonnes CO_2-e) represent approximately 0.09% of Australia's latest greenhouse gas inventory estimates of 527 MtCO_2-E (2015).

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 Styx Coal 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

Styx Coal Proprietary Limited (Styx Coal) and Fairway Coal Proprietary Limited (Fairway Coal) (the joint Proponent), propose to develop the Styx Coal Project (the Project) located 130 km northwest of Rockhampton in the Styx Basin in Central Queensland (Figure 2-1). The Project will be located within Mining Lease (ML) 80178 and ML 700022, which are adjacent to Mineral Development Licence (MDL) 468 and Exploration Permit for Coal (EPC) 1029.

2.1 PROPOSED OPERATIONS

The Project will involve mining a maximum combined tonnage of up to 10 million tonnes per annum (Mtpa) of semi-soft coking coal (SSCC) and high grade thermal coal (HGTC). Development of the Project is expected to commence in 2018 and extend for approximately 20 years until the current reserve is depleted.

The Project comprises three open cut pit operations that will be mined using a truck and shovel methodology. The run-of-mine (ROM) coal will ramp up to 2 Mtpa with during Stage 1 (Year 1-4), where coal will be crushed, screened and washed SSCC grade with an estimated 80% yield. Stage 2 of the Project (Year 4-20) will include further processing of up to an additional 4 Mtpa ROM coal within another coal handling and preparation plant (CHPP) to SSCC and up to 4 Mtpa of HGTC with an estimated 95% yield. At full production two CHPPs, one servicing Open Cut 1 and the other servicing Open Cut 2 and 4, will be in operation.

A new train loadout facility (TLF) will be developed to connect into the existing Queensland Rail North Coast Rail Line which will allow transport of the product coal to the established coal loading infrastructure at the Dalrymple Bay Coal Terminal (DBCT).

The proposed coal mine layout and associated infrastructure is shown on Figure 2-2. The key components of the Project include:

- 3 open cut mine pits;
- 2 CHPPs and product coal stockpiles;
- Haulage and site access;
- Rail facilities and Train Loadout Facility; and
- Mine Industrial Area.

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: Styx Coal Project Location [CDM Smith, July 2017]

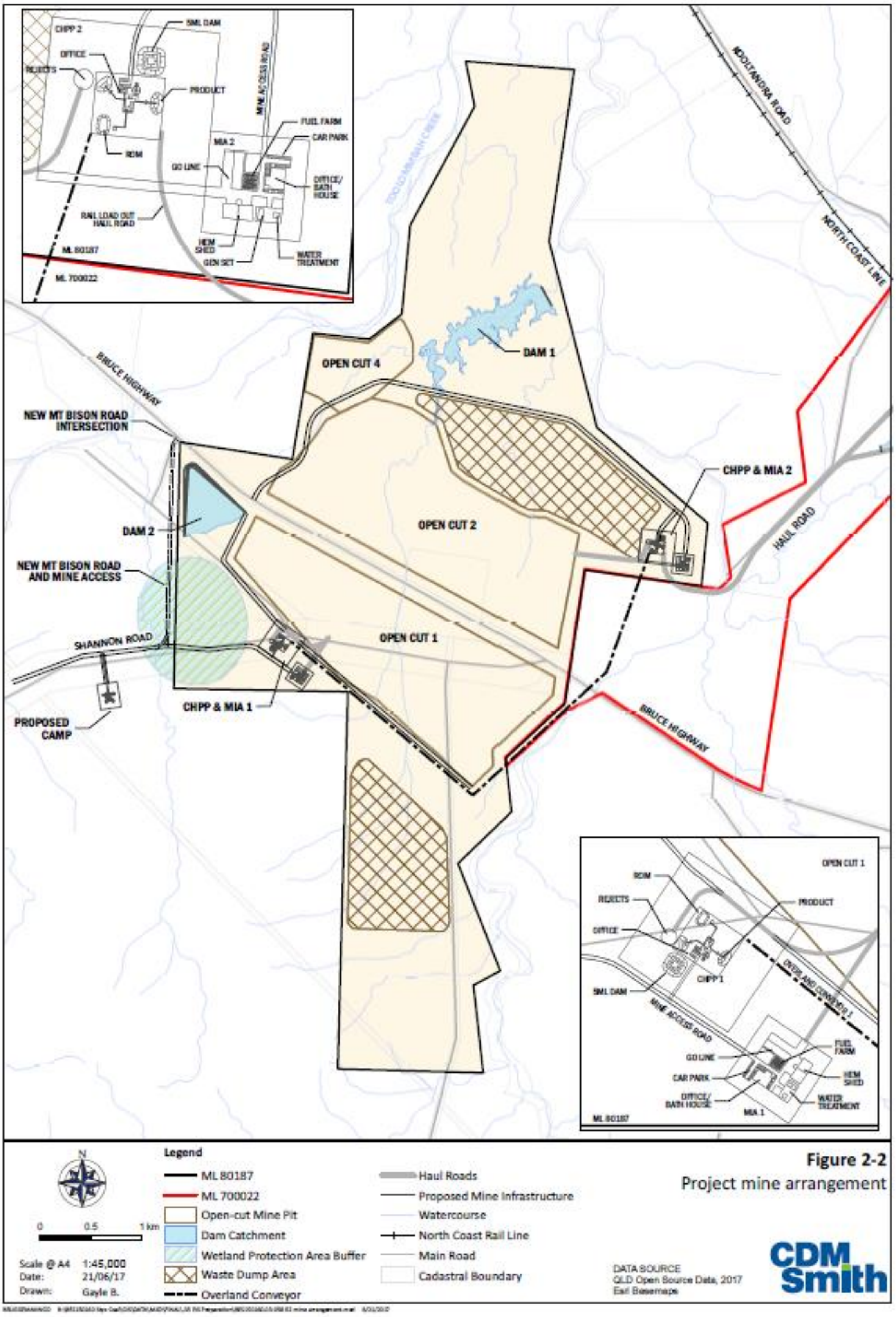


Figure 2-2: Styx Coal Mine Arrangement and Haul Road Corridor [CDM Smith, July 2017]

Three open cut pits will be developed – two on the northern side of the Bruce Highway (Open Cut 2 and Open Cut 4) and one on the southern side of the Bruce Highway (Open Cut 1). 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 located adjacent to the MIA. The coal will be dumped onto a stockpile or, if certain coal quality requirements are met, may be dumped directly into the ROM hopper where it will be crushed and conveyed to the CHPP feed stockpile ready for processing.

Figure 2-3 shows the proposed mining sequence of the Project.

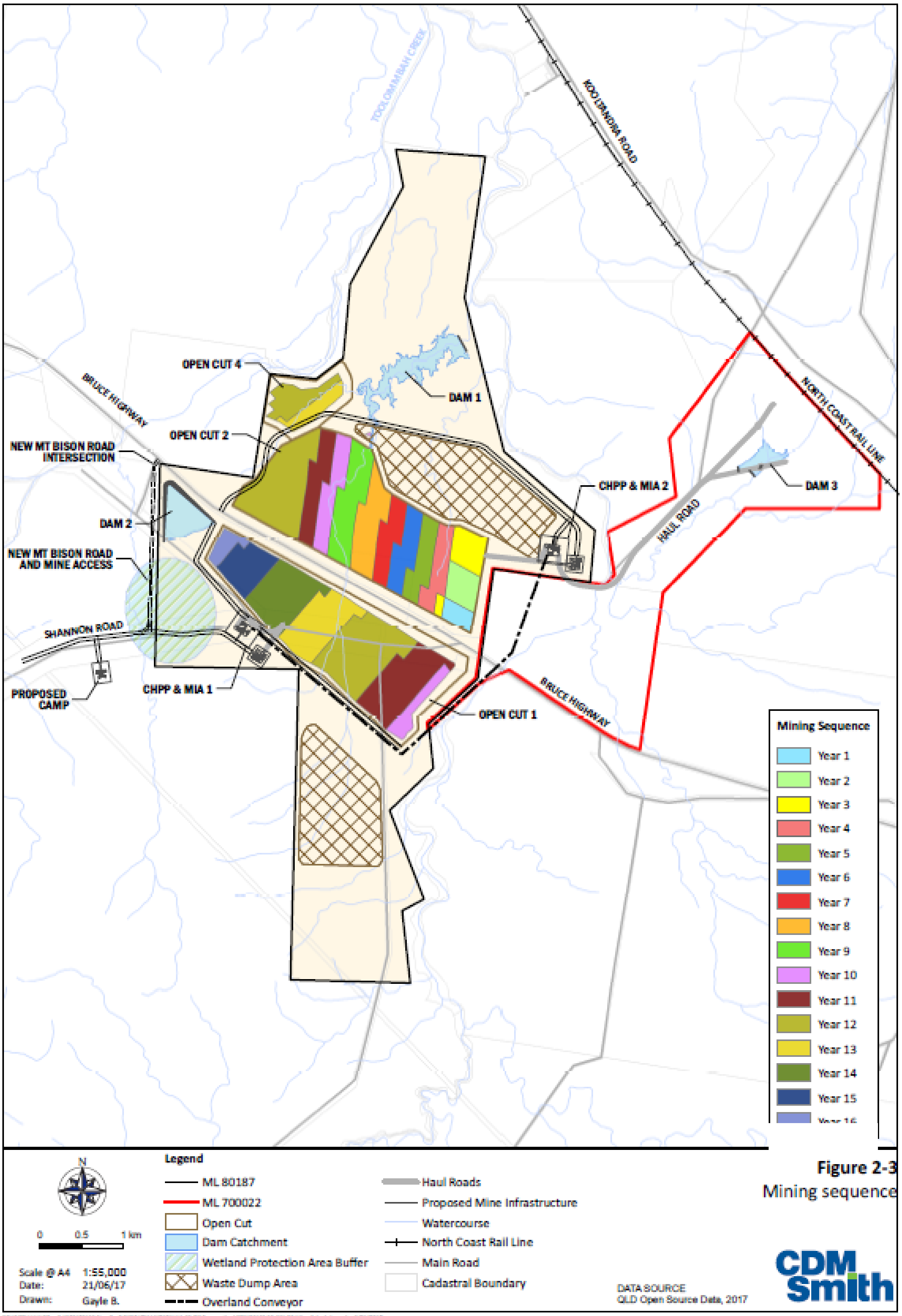


Figure 2-3: Mining sequence

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 2008 (EPP (Air)) (EPP (Air), 2008). The policy was developed to meet air quality objectives for Queensland’s air environment as outlined in the Environmental Protection Act 1994 (EP Act, 1994).

The object of the Environmental Protection Act 1994 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) 2008 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 1994, i.e. ecologically sustainable development.

3.3 MODEL MINING CONDITIONS

The Queensland *Environmental Protection Act 1994* (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 2008 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	Exceedances*
TSP	Human Health	90 $\mu g/m^3$	MMC	1-year	-
PM_{10}	Human Health	50 $\mu g/m^3$	MMC	24-hour	Five days per year
$PM_{2.5}$	Human Health	25 $\mu g/m^3$	MMC	24-hour	-
	Human Health	8 $\mu g/m^3$	EPP Air	Annual	-
Dust deposition	Amenity	120 $mg/m^2/day$	MMC	1-Month	-

** Allowance intended for natural events such as dust storms or bushfires*

4 EXISTING ENVIRONMENT

4.1 LOCAL SETTING

The Project is located within the Livingstone Shire Council (LSC) Local Government Area and is located on gently undulating plains and slopes. The nearest major regional centre is Rockhampton, located approximately 130 km to the south of the Project. The Project is generally located on the Mamelon property, described as real property Lot 11 on MC23, Lot 10 on MC493 and Lot 9 on MC496. A small section of the haul road to the TLF is located on the Brussels property described as real property Lot 85 on SP164785, with the remainder of the haul road and TLF being located on the Strathmuir property described as real property Lot 9 on MC230.

Based on the SRTM1 data, elevations within the MLA area vary between 4.5 m and 155 m AHD, with the disturbance area located between 11.4 and 43.8 mAHD. Further inland the terrain increases to 584 m west of the MLA.

4.2 SENSITIVE RECEPTORS

The locations of the nearest confirmed sensitive and commercial receptors to the Project were provided by CDM Smith on 30 May 2017. In total, 8 sensitive receptors are located within the locality of the proposed Project. These are shown in Figure 4-1 and identified in Table 4-1. Note that the entire township of Ogmore has been counted as one noise 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. The accommodation camp will be owned by the proponent to accommodate the Project workforce and visitors. Under the Model Mining Conditions a camp associated with the Project is not considered a sensitive receptor and has not been assessed in this report.

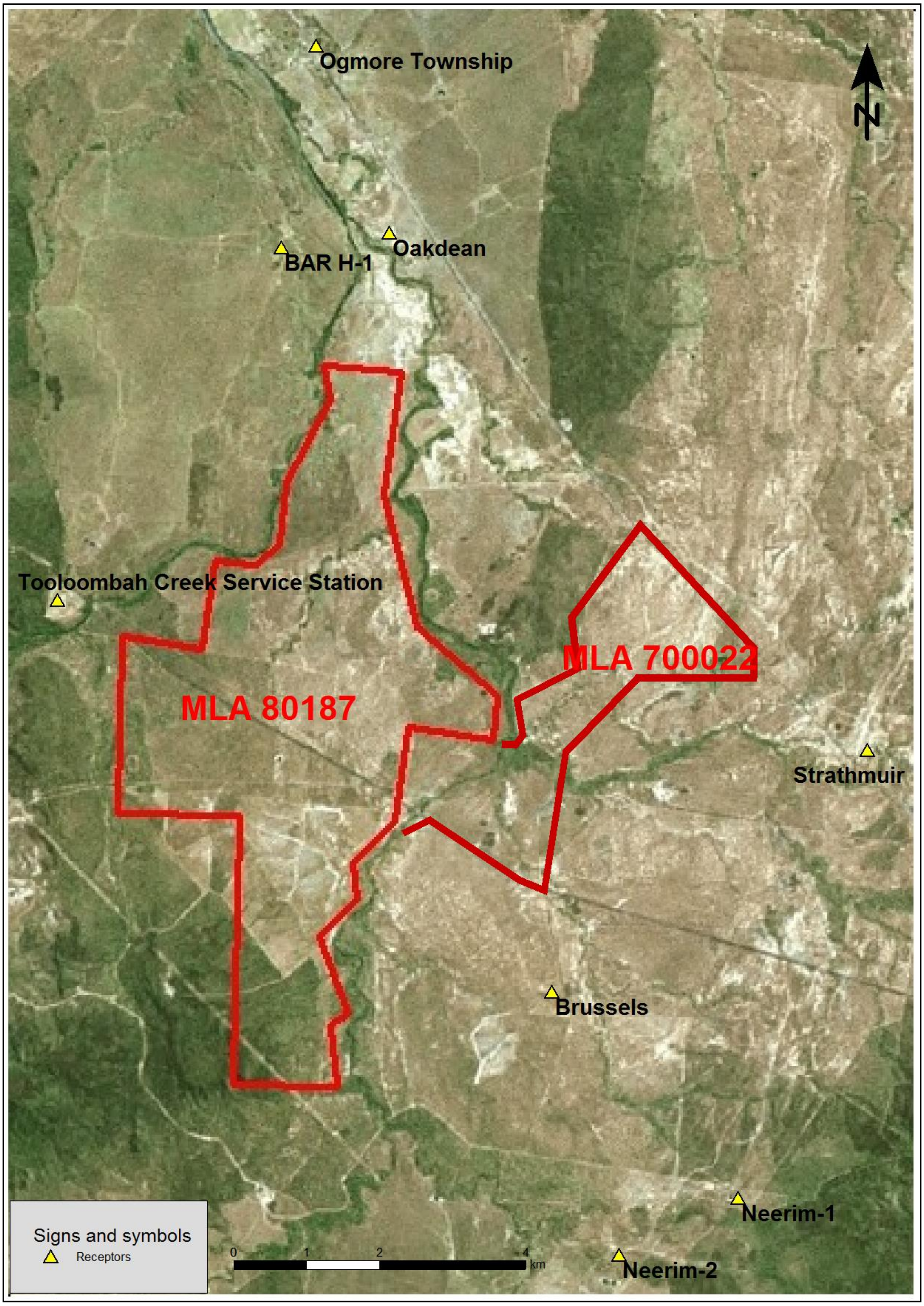


Figure 4-1: Receptor Locations Surrounding the MLA

Table 4-1: Sensitive Receptors

Receptor ID	Description	UTM Easting (km)	UTM Northing (km)
R1	BAR-H1	772.758	7493.364
R2	Brussels	776.456	7483.199
R3	Neerim-1	778.997	7480.376
R4	Neerim-2	777.37	7479.6
R5	Oakdean	774.226	7493.572
R6	Ogmore	773.232	7496.125
R7	Strathmuir	780.772	7486.501
R8	Tooloombah Creek Service Station	769.689	7488.548

4.3 DISPERSION METEOROLOGY

4.3.1 REGIONAL METEOROLOGY

The nearest Bureau of Meteorology (BOM) station is at St Lawrence (Site number 033065), located approximately 32 km NNW from the Project site. This monitoring station has recorded data since 1870 and a summary of the climate is presented in Table 4-2.

The long term mean temperature range is between 23.8^{o}C and 31.7^{o}C with the coldest month being July and the hottest months being December to February. 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 March. Rainfall is lowest between July and September, with a mean annual rainfall of 1018 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 St Lawrence [BOM]

Month	Temperature		Rainfall		9 am Conditions			3 pm Conditions		
	Max (°C)	Min (°C)	Mean Rain Days	No. of Days ≥ 1 mm	Temp (°C)	RH (%)	Wind Speed (km/h)	Temp (°C)	Mean RH (%)	Wind Speed (km/h)
Jan	31.7	22.5	10.9	8.2	27.6	70.0	9.6	30.3	60.0	14.6
Feb	31.4	22.5	10.9	8.4	27.0	74.0	9.4	29.9	62.0	13.8
Mar	30.9	21.1	9.3	6.9	26.0	73.0	9.7	29.5	59.0	13.4
Apr	29.3	18.4	6.3	4.2	23.7	71.0	10.5	27.9	55.0	13.6
May	26.7	15.1	5.7	3.7	20.5	71.0	11.1	25.5	52.0	12.6
Jun	24.3	12.2	5.1	3.5	17.5	70.0	11.7	23.2	51.0	12.4
Jul	23.8	10.9	4.0	2.7	16.7	68.0	11.7	22.8	47.0	13.6
Aug	25.0	11.8	3.4	2.2	18.4	66.0	11.3	23.9	46.0	15.5
Sep	27.0	14.4	3.3	2.2	21.9	62.0	11.8	25.7	48.0	17.9
Oct	28.9	17.7	4.4	3.1	25.0	60.0	12.3	27.3	53.0	19.0
Nov	30.4	20.2	6.5	4.6	26.8	62.0	11.7	28.9	55.0	17.8
Dec	31.5	21.7	8.3	6.3	27.8	65.0	9.9	30.0	58.0	15.7
Annual	**28.4**	**17.4**	**78.1**	**56.0**	**23.2**	**68.0**	**10.9**	**27.1**	**54.0**	**15.0**

A review of the number of rainfall days per year at St Lawrence shows that on average rainfall, is recorded on 78 days per year and the number of days where rainfall is ≥ 1 mm is 65-76% of the monthly rainfall days are ≥ 1 mm as presented in Figure 4-2.

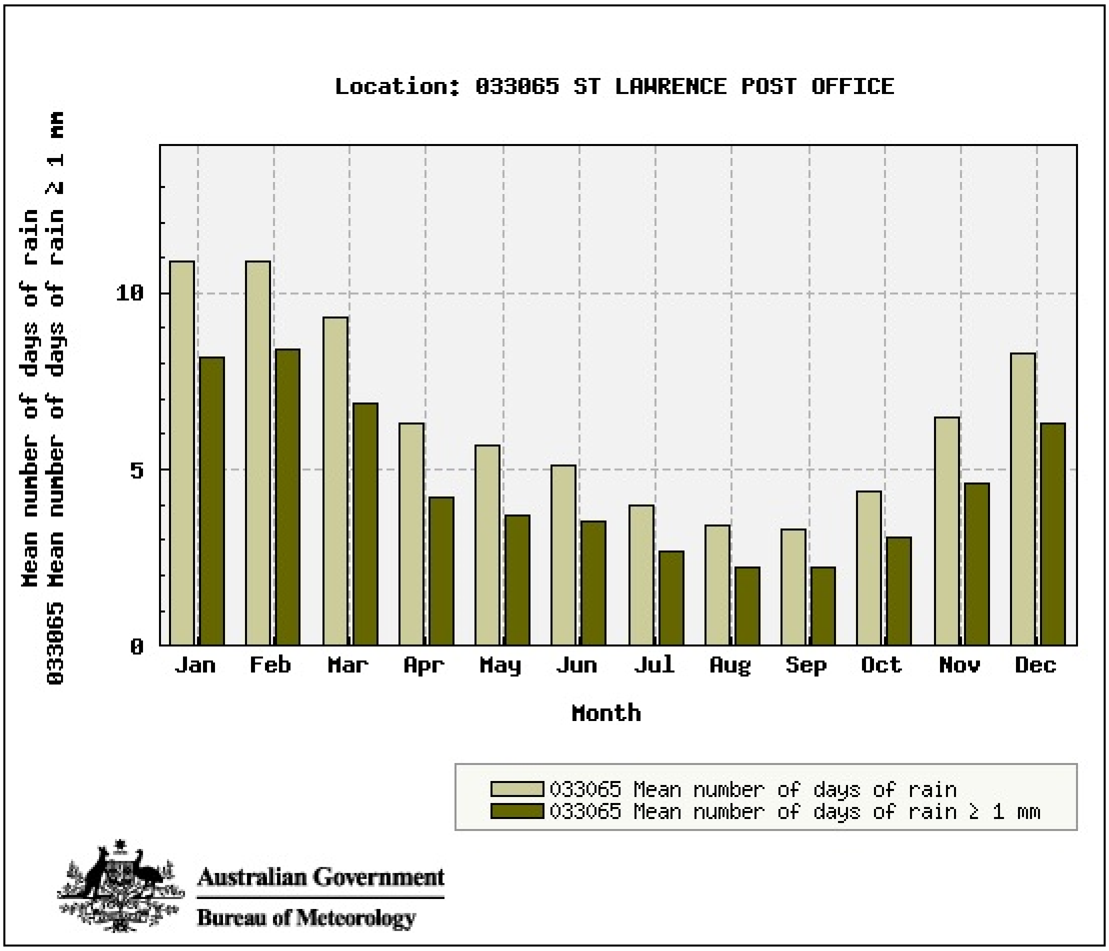
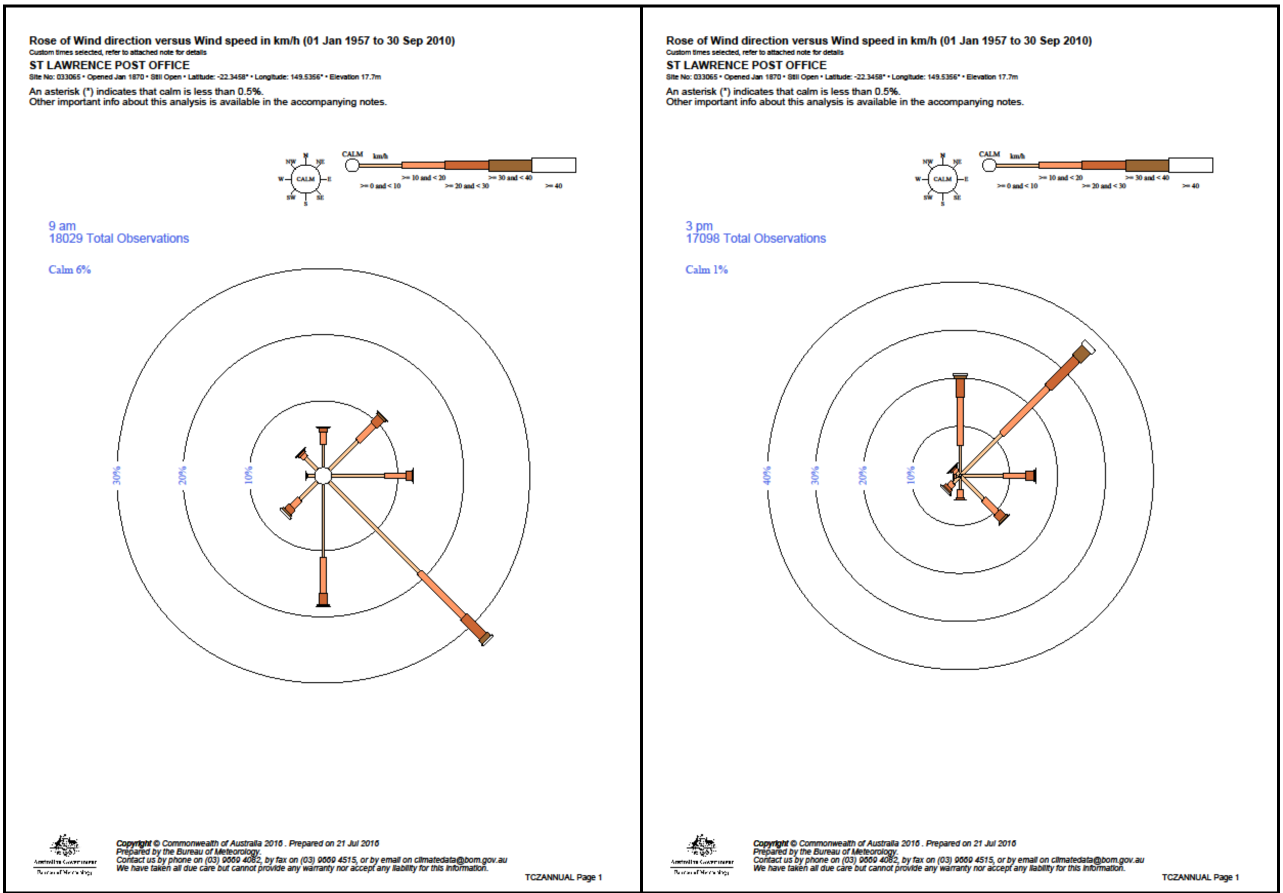


Figure 4-2: Mean Rainfall Days and Rainfall Days ≥ 1 mm at St Lawrence Weather Stations

The long term wind roses recorded daily at the St Lawrence station at 9am and 3pm are provided in Figure 4-3. Winds are shown to be primarily from the south and southeast at 9am and from the north and northeast directions at 3pm. Stronger winds (>40km/hr or >11.1m/s) occur infrequently mostly from the north and northeast at 3pm.



Location: **St Lawrence BoM Station**	**Data Period:** 1957 to 2010	**Data Type:** Measured Data

Figure 4-3: Annual Wind Roses for St Lawrence Weather Station (1957 to 2010)

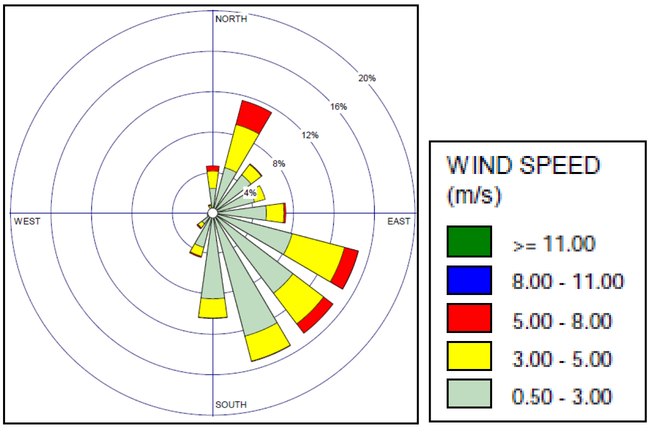
4.3.2 LOCAL METEOROLOGY

4.3.2.1 INTRODUCTION

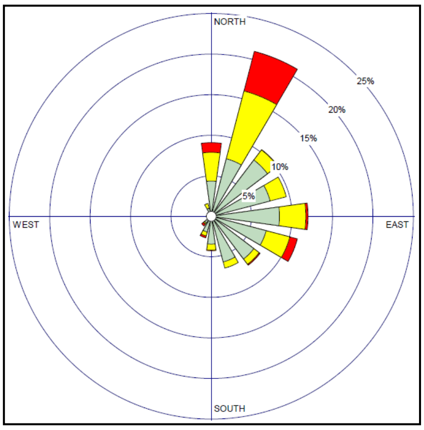
A three dimensional meteorological field was required for the air dispersion modelling that includes a wind field generator accounting for slope flows, terrain effects and terrain blocking effects. The Air Pollution Model, or TAPM, is a three-dimensional meteorological and air pollution model developed 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 2014 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 5.3.

4.3.2.2 WIND SPEED AND DIRECTION

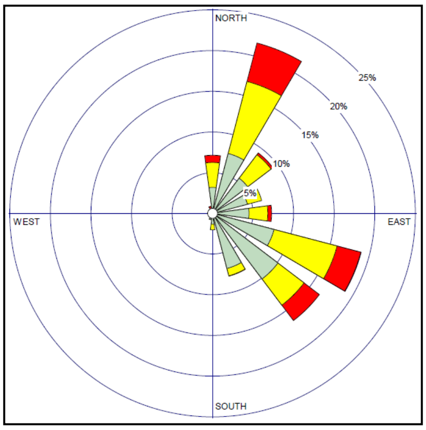
The wind roses from the TAPM derived dataset for the year 2014 are presented in Figure 4-4 and Figure 4-5 for the Project site. Figure 4-4 shows that the dominant wind direction is from NNE during spring, NNE and SE during the summer months. In autumn, the winds are primarily from the south easterly directions, southerly and SSE winds are more frequent during the winter season.



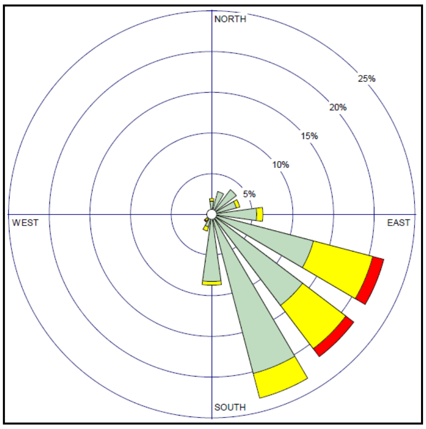
Annual (Calm – 0.97%)



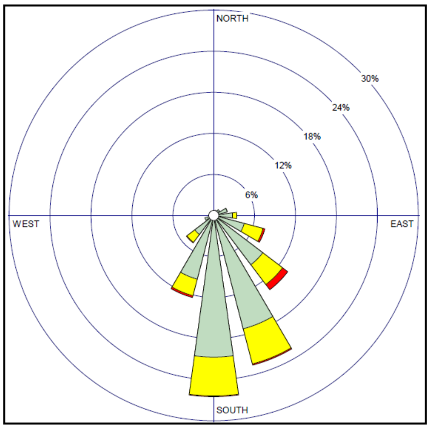
Spring (Calm – 1.10%)



Summer (Calm – 0.51%)



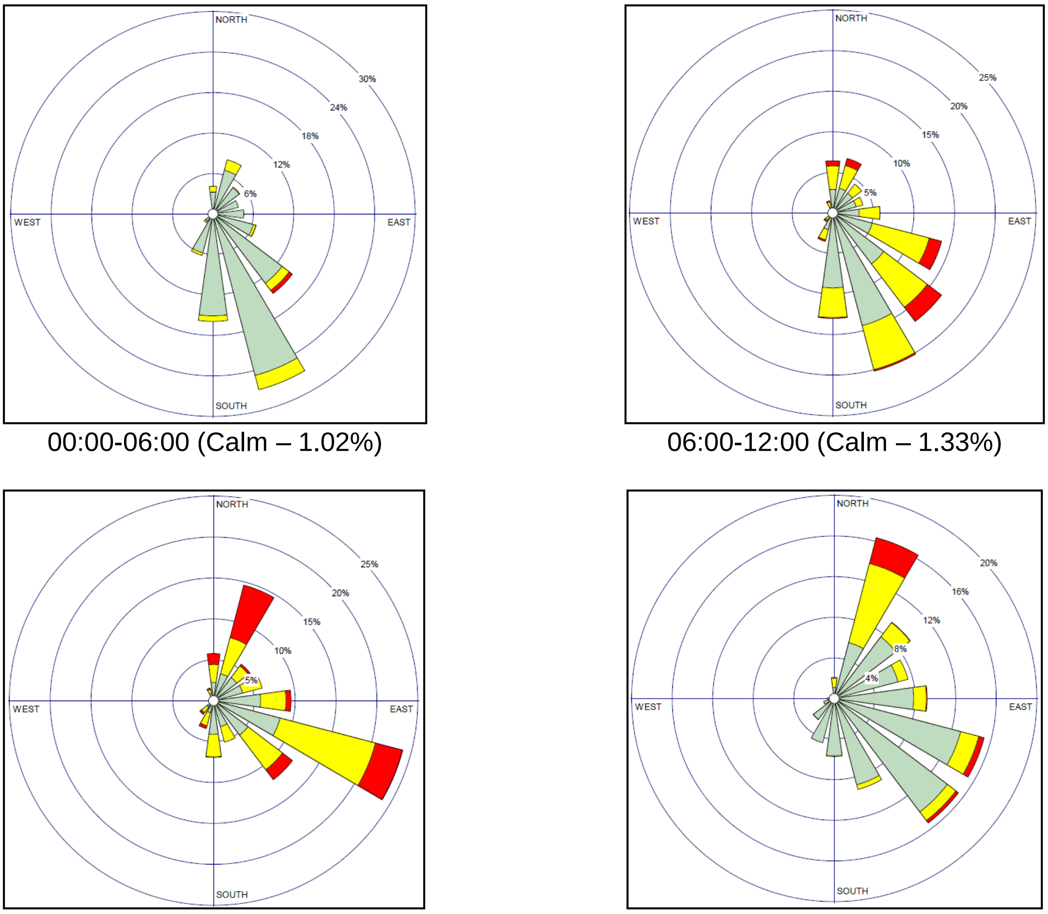
Autumn (Calm – 1.00%)



Winter (Calm – 1.27%)

Figure 4-4: Site-Specific Wind Roses by Season for 2014

Figure 4-5 shows the wind roses for the time of day during the year for 2014. It can be seen that there are more frequent and stronger winds from the NNE during the afternoon and evening periods.

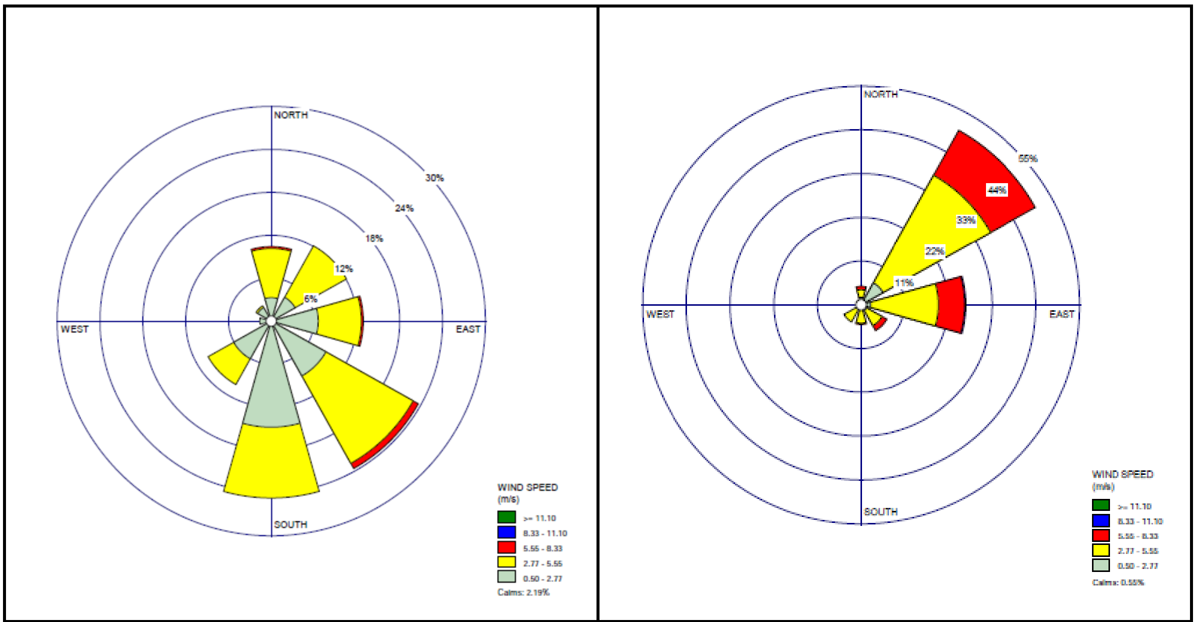


00:00-06:00 (Calm – 1.02%) 06:00-12:00 (Calm – 1.33%)

12:00-18:00 (Calm – 1.14%) 18:00-00:00 (Calm – 0.31%)

Figure 4-5: Site-Specific Wind Roses by Time of Day for 2014

A comparison of the wind roses at 09:00 and 15:00 hours for the TAPM derived dataset (Figure 4-6) at the Project site was also undertaken with the BOM long-term wind roses at St Lawrence. The 09:00 hours wind roses from BOM and TAPM are very similar with slight differences in the percentage of time the wind blows from the SW; the BOM wind rose, based on 18,029 observations, identifies easterly winds accounting for 7% of the time whereas TAPM identifies the south westerlies accounting for 3% of the hours. The 15:00 hours wind roses are similar; the BOM wind rose shows a lower frequency of easterly winds (12%) to TAPM (21%). These slight 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 is considered to be representative of the site.



Location: **Project Site**	**Data Period:** 2014	**Data Type:** Modelled Data

Figure 4-6: Annual Wind Roses for the TAPM-derived dataset at the Project site, 2014

Key features of the winds are therefore:

- The winds were calm for 1% of the year;
- The winds were 0.5 - 3 m/s for 67% of the year;
- The winds were 3 - 5 m/s for 25% of the year;
- The winds were greater than 5 m/s for 7% of the year; and
- The 9am and 3pm wind roses for the TAPM modelled data are generally consistent with the measured data from the St Lawrence BoM Weather Station.

4.3.2.3 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 2014 is detailed in Table 4-3.

Table 4-3: Annual Stability Class Distribution Predicted [TAPM, 2014]

Stability Class	Description	Frequency of Occurrence (%)	Average Wind Speed (m/s)
A	Very unstable low wind, clear skies, hot daytime conditions	0.6%	2.1
B	Unstable clear skies, daytime conditions	5.0%	3.0
C	Moderately unstable moderate wind, slightly overcast daytime	16.7%	3.4
D	Neutral high winds or cloudy days and nights	43.6%	2.5
E	Stable moderate wind, slightly overcast night-time conditions	15.5%	2.1
F	Very stable low winds, clear skies, cold night-time conditions	18.6%	2.1

4.3.2.4 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 4-7. 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.

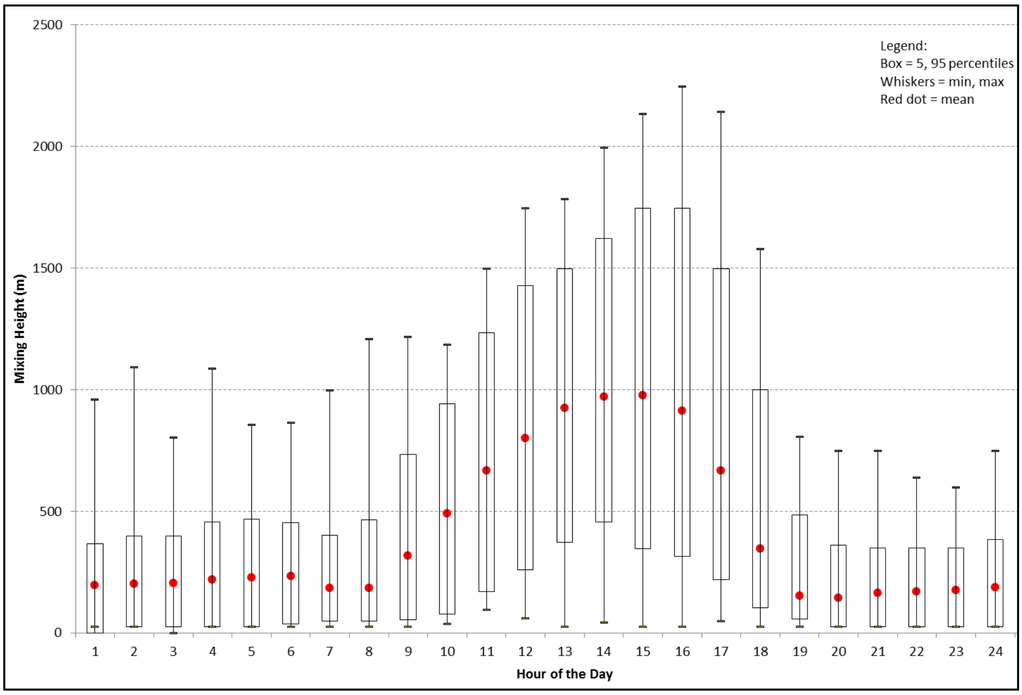


Figure 4-7: Mixing Height [TAPM, 2014]

4.4 EXISTING AIR QUALITY

The Project is located within the Styx Coal Basin region in central Queensland. The Styx Coal Basin is an area of historical mining and grazing related communities in Central Queensland that extends over approximately 300 square kilometres (km^2) onshore and 500 km^2 offshore, under water depths of up to 100 metres.

A review of the NPI emissions database has determined there are facilities within 100 km of the Project, as listed in Table 4-4. In addition, there is Brolga Mine located 64 km from the Project site, however no emissions were reported to the NPI in 2014-2015.

Table 4-4: NPI Reported Emissions for 2014-2015

Facility	Distance from the Project (km)	Emissions (kg/annum)			
		PM_{10}	$PM_{2.5}$	NO_X	SO_2
QLD Magnesia Mine	56	432,230	15,431	211,518	112
Foxleigh Coal Mine	93	14,207,290	104,020	1,674,000	1,354
Middlemount Coal Mine	100	4,521,653	90,107	1,460,065	1,417

The emissions of the facilities listed in Table 4-4 are not expected to have a significant impact on the local background concentrations due to the distances from the Project.

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 EHP monitoring stations operating in the locality of the Project. The existing air quality for dust deposition, TSP, PM_{10} and $PM_{2.5}$ has been estimated by considering the monitoring data 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 4-5 presents the assigned background concentrations for each assessment identified above.

Table 4-5: Assigned Background Levels for Recent EIS Assessments

Project	Assigned Background Levels				
	TSP ($\mu g/m^3$)	Dust Deposition ($mg/m^2/day$)	PM_{10} ($\mu g/m^3$)	$PM_{2.5}$ ($\mu g/m^3$)	
	Annual	30 days	24 Hour	24 Hour	Annual

Baralaba Coal	34.1	59.1[A]	19.4	9.7	3.6
Taroborah Coal	28.0[D]	33.0[B]	20.0[C]	5.4[D]	2.8[D]
Rolleston Coal	36.6	50.0	20.0	7.2	6.6

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

A summary of the assigned background concentrations used in this study are presented in Table 4-6. These background concentrations will be added to the predicted incremental emissions from the Project to derive total potential concentrations.

Table 4-6: Assigned Background Concentrations

Parameter	Air Quality Objective	Regulation	Period	Applied Background	Comments
TSP	90 $\mu g/m^3$	EPP (Air)	**Annual**	40 $\mu g/m^3$	Conservative assumption
PM_{10}	50 $\mu g/m^3$	EPP (Air)	**24 Hour**	20 $\mu g/m^3$	Monitoring at Middlemount Mine
$PM_{2.5}$	25 $\mu g/m^3$	EPP (Air)	**24 Hour**	9.7 $\mu g/m^3$	Monitoring by Barabala Mine
	8 $\mu g/m^3$	EPP (Air)	**Annual**	3.6 $\mu g/m^3$	
Dust Deposition	120 $mg/m^2/day$	EPP (Air)	**24 Hour**	59 $mg/m^2/day$	Conservative assumption

5 METHODOLOGY

5.1 OVERVIEW

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

- An emissions inventory of TSP, PM10, PM2.5, 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
- conveyors
- crushing and screening
- vehicle movements
- blasting and drilling

In addition, air pollutants from diesel combustion may release other air pollutants such as particulate matter, (PM10 and PM2.5), 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

Emissions to air from two stages of the proposed Project have been included in this assessment as follows:

- Construction Stage
- Stage 2, 12 years following commencement of operation (up to ~10 Mtpa ROM)

5.2.2.2 EQUIPMENT

CDM Smith provided the mobile plant equipment list schedule for the construction and operation of the Project . The equipment schedules for construction and operation are presented in Table 5-1 and Table 5-2 respectively.

Table 5-1: Equipment Schedule for Construction

Equipment	Quantity
Generator (1MW)	1
CAT 631G Scrapper	2
785D Haul Truck	4
789D Haul Truck	4
793D Haul Truck	5
RH170 Excavator	1
Liebherr 996 Excavator	1
EX1200 Excavator	1
960 Front End Loader	1
980 Front End Loader	1
992 Front End Loader	1
Volvo Semi-Tippers	8
UDR800 Drill	1
D9 Dozer	1
D11 Dozer	1
D10 Dozer	1
HD605 Water Cart	1
16 Grader	1
Service Truck	1
Pump Truck	1
Fuel Truck	1
Franner Crane	1

Table 5-2: Mining Equipment Schedule for Operation

Equipment	Quantity			
Specification	**Operation Year 4**	**Operation Year 8**	**Operation Year 12 (Stage 2)**	**Operation Year 14**
CAT 631G Scrapper	1	1	1	1
789D Haul Truck	4	4	8	4
793D Haul Truck	8	12	36	4
RH170 Excavator	1	1	2	1
Leibherr 996 Excavator	2	3	9	1
SKS 270mm Drill	1	2	4	1
MD5150C Track Drill	1	2	3	1
D9 Dozer	1	4	4	1
D10 Dozer	2	3	5	2
D11 Dozer	2	3	4	2
HD605 Water Cart	2	3	4	2
16M Grader	2	2	2	2
24H Grader	1	2	2	1
B-Double Coal Haulage Units	2	3	8	2
992 Front End Loader	3	4	6	3
Service Truck	1	2	2	1
Pump Truck	1	2	2	1
Fuel Truck	1	1	3	1
Franner Crane	1	1	2	1
Service vehicles	10	14	19	10
Generator (520kVA)	3	6	6	3
Generator (300kVA)	3	5	5	3

The scenario assessed for Stage 2 of operations represents near maximum capacity (i.e. 10 Mtpa compared with 2 - 5 Mtpa) with maximum equipment usage. The Stage 2 open cut mining operations at Open Cut 4 and Open Cut 2 are closest to the sensitive receptors to the north. Mining of Open Cut 1 during Stage 2 is towards the southern end of the pit. This scenario is considered representative of worst case conditions.

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 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

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

CE_i = overall control efficiency for pollutant

The emission factors and methodology used to estimate emissions for each source types outlined above are discussed in Appendix B.

Table 5-3 and Table 5-4 summarise the annual emission rates estimated for the main sources of air emissions from the mining activities during the construction and year 12 of operations (Stage 2).

Table 5-3: Construction stage emission rates

Source	Emission rate (g/s)		
	TSP	**PM10**	**PM2.5**
Wind erosion	0.09	0.04	0.01
Wheel generated dust	4.29	0.99	0.10
Site clearance activities	2.51	0.59	0.27
TOTAL	**6.89**	**1.62**	**0.38**

Table 5-4: Operational Stage 2 emission rates

Source	Emission rate (g/s)		
	TSP	**PM10**	**PM2.5**
CHPP operations	7.3	3.1	0.7
Waste handling	6.3	2.3	0.7
Wind erosion	0.12	0.05	0.02
Wheel generated dust	64.4	16.5	1.7
Mining operations	27.8	8.8	0.9
Blasting/drilling	40.8	21.2	1.2
TOTAL	**146.72**	**51.95**	**5.22**

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;
- 90% control for revegetation of exposed areas;
- 75% control for level 2 watering of haul routes (>2 litres/m^2/h); and
- 70% control for water sprays applied to drilling.

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˚ 39.0 S, 149˚ 38.0 E;
- Dates modelled – 1st January 2014 to 31st December 2014;
- Four nested grid domains of 20 km, 10 km, 3 km and 1 km;
- 70 x 70 grid points for all modelling domains;
- 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 5-5).

Table 5-5: 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:

- Wheel-generated dust from trucks travelling on the haul roads was modelled as a number of volume sources that were spread out along the entire haul road route. The emissions for each road section were determined as a proportion of total emissions on that haul road using the ratio of the section length to the total haul road length.
- Coal handling and processing and train load out 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 CONSTRUCTION IMPACTS

Discharges to air (in particular, dust) during the construction phase are primarily a management issue and can be minimised with good management practices. The control of the emissions from the construction phase is discussed in Section 7.1.

The predicted ground-level concentrations of TSP, PM_{10}, $PM_{2.5}$ and dust deposition at the nearest sensitive receptors in isolation and with background levels are presented in Table 6-1.

Contour plots of the predicted maximum ground-level concentrations are presented in Appendix C.

The model results show:

- 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 5th highest 24-hour average cumulative ground-level PM_{10} concentration of 21 µg/m³ is predicted to occur at the Tooloombah Creek Service Station (R8), which is well below the 50 µg/m³ criterion.
- The highest 24-hour average cumulative ground-level $PM_{2.5}$ concentration of 15.4 µg/m³ is predicted to occur at the Tooloombah Creek Service Station (R8), which is below the 25 µg/m³ criterion. The highest annual average cumulative ground-level $PM_{2.5}$ concentration is 4.8 µg/m³, predicted to occur at the Tooloombah Creek Service Station (R8), 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 predicted pollutant concentrations from the construction of the Project are well below the relevant criteria.

6.2 OPERATIONAL IMPACTS

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 6-2.

Contour plots of the predicted maximum ground-level concentrations are presented in Appendix C.

The model results show:

- 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 5th highest 24-hour average cumulative ground-level PM_{10} concentration of 42 µg/m³ is predicted to occur at the Tooloombah Creek Service Station (R8), which is well below the 50 µg/m³ criterion. The predicted incremental increase in PM_{10} due to the operation of the Project is approximately 22 µg/m³ at the Tooloombah Creek Service Station receptor.
- The highest 24-hour average cumulative ground-level $PM_{2.5}$ concentration of 19.4 µg/m³ is predicted to occur at Tooloombah Creek Service Station (R8), which is below the 25 µg/m³ criterion. The highest annual average cumulative ground-level $PM_{2.5}$ concentration is 5.9 µg/m³, predicted to occur at the Tooloombah Creek Service Station (R8), and is below the 8 µg/m³ criterion.
- The highest daily dust deposition results show that an incremental increase of 1.9 mg/m^2/day will occur at the Brussels receptor, with a total deposition of 60.9 mg/m^2/day which is well below the 120 mg/m^2/day criterion.

Overall, it can clearly be seen that with the Project operating at 10 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 construction

Receptor	In isolation					Cumulative				
	24 Hour $PM_{2.5}$ ($\mu g/m^3$)	Annual $PM_{2.5}$ ($\mu g/m^3$)	24 Hour PM_{10} [a] ($\mu g/m^3$)	Annual TSP ($\mu g/m^3$)	Daily Dust Deposition ($mg/m^2/day$)	24 Hour $PM_{2.5}$ ($\mu g/m^3$)	Annual $PM_{2.5}$ ($\mu g/m^3$)	24 Hour PM_{10} ($\mu g/m^3$)	Annual TSP ($\mu g/m^3$)	Daily Dust Deposition ($mg/m^2/day$)
R1	3.28	0.34	0.53	0.04	-	13.0	3.9	20.5	40.04	59
R2	1.22	0.02	0.10	0.00	-	10.9	3.6	20.1	40.00	59
R3	0.54	0.01	0.02	0.00	-	10.2	3.6	20.0	40.00	59
R4	0.34	0.01	0.03	0.00	-	10.0	3.6	20.0	40.00	59
R5	2.81	0.15	0.48	0.02	-	12.5	3.7	20.5	40.02	59
R6	2.01	0.15	0.35	0.01	-	11.7	3.8	20.4	40.01	59
R7	0.71	0.01	0.04	0.00	-	10.4	3.6	20.0	40.00	59
R8	5.73	1.16	1.00	0.16	-	15.4	4.8	21.0	40.16	59
Criteria	**25**	**8**	**50**	**90**	**120**	**25**	**8**	**50**	**90**	**120**

a 5th highest prediction for comparison with criteria

Table 6-2: Predicted maximum ground-level concentrations for the Project operation

Receptor	In isolation					Cumulative				
	24 Hour $PM_{2.5}$ (µg/m³)	Annual $PM_{2.5}$ (µg/m³)	24 Hour PM_{10} [a] (µg/m³)	Annual TSP (µg/m³)	Daily Dust Deposition (mg/m²/day)	24 Hour $PM_{2.5}$ (µg/m³)	Annual $PM_{2.5}$ (µg/m³)	24 Hour PM_{10} [a] (µg/m³)	Annual TSP (µg/m³)	Daily Dust Deposition (mg/m²/day)
R1	8.4	1.1	15.0	1.4	0.04	18.1	4.7	35.0	41.4	59.0
R2	3.6	0.1	5.7	0.2	1.92	13.3	3.7	25.7	40.2	60.9
R3	1.3	0.0	0.7	0.0	0.70	11.0	3.6	20.6	40.0	59.7
R4	1.0	0.0	1.4	0.0	0.92	10.7	3.6	21.4	40.0	59.9
R5	6.9	0.6	14.7	0.7	0.04	16.6	4.2	34.7	40.7	59.0
R6	4.5	0.5	9.7	0.4	0.02	14.2	4.1	29.7	40.4	59.0
R7	1.8	0.0	1.6	0.0	0.16	11.5	3.6	21.6	40.0	59.2
R8	9.7	2.3	22.0	3.8	0.15	19.4	5.9	42.0	43.8	59.2
Criteria	**25**	**8**	**50**	**90**	**120**	**25**	**8**	**50**	**90**	**120**

a 5th highest prediction for comparison with criteria

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;
- So far as practical, erect physical barriers such as bunds and or wind breaks around stockpiles or areas where earth moving is required;
- 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;
- Overburden will be revegetated progressively; 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, 2016). 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, 2016) as indicated in Table 8-1.

Table 8-1:: Emission Factors

Scope	Emission Source	Emission Factor	Source
1	Combustion emissions from ULP (stationary)	2.38 t CO_2-e / kL	NGA Factors Workbook, 2016
	Combustion emissions from diesel (stationary)	2.68 t CO_2-e / kL	NGA Factors Workbook, 2016
	Combustion for transport (general)	2.69 t CO_2-e / kWh	NGA Factors Workbook, 2016
	Extraction of coal (fugitive) - Queensland	0.02 t CO_2-e / tonnes raw coal	NGA Factors Workbook, 2016

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

Table 8-2 outlines the estimated greenhouse gas emissions for the construction and maximum operational phase (year 12) of the Project. The estimated total life of Project emissions are also provided. The following assumptions have been made for this assessment:

- The construction stage will require four months for completion;
- The construction and operational equipment list is in accordance with that specified in Table 5-1;
- 100 construction staff travelling approximately 1.8 km round-trip in 10 vehicles per day;
- 500 operational staff travelling approximately 1.8 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**	**Construction**	**Operation (Year 12)**	
Staff Movements	1 (direct)	4.1	24.9	125
Equipment	1 (direct)	17,574	216,748	1,512,483
Generator	1 (direct)	3.3	3,759	47,324
Haulage	1 (direct)	-	59,282	85,670
Fugitive Coal	1 (direct)	-	200,000	683,523
		17,581	**479,814**	**2,329,125**

8.6 SUMMARY AND CONCLUSION

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

- The total emissions during the construction phase are 17,581 tonnes CO_2-e, with the majority of the emissions from the diesel consumption by the construction equipment;
- During the operational phase the annual emissions are projected to be 479,814 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 estimated to be 2,329,125 tonnes $CO_{2\text{-e}}$; and
- The estimated maximum annual operational phase emissions (479,814 tonnes CO_2-e) represents approximately 0.09% of Australia's latest greenhouse inventory estimates of 537 $MtCO_2$-E (2015).

9 CONCLUSION

This assessment evaluates the potential impacts of air pollutants generated from the construction and operational stages of the Styx Coal 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, PM10, PM2.5, 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 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;
- 90% control for revegetation of exposed areas;
- 75% control for level 2 watering of haul routes (>2 litres/m^2/h); and
- 70% control for water sprays applied to drilling.

The results of the construction stage 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 5th highest 24-hour average cumulative ground-level PM_{10} concentration of 21 µg/m³ is predicted to occur at the Tooloombah Creek Service Station (R8), which is well below the 50 µg/m³ criterion.
- The highest 24-hour average cumulative ground-level $PM_{2.5}$ concentration of 15.4 µg/m³ is predicted to occur at the Tooloombah Creek Service Station (R8), which is below the 25 µg/m³ criterion. The highest annual average cumulative ground-level $PM_{2.5}$ concentration is 4.8 µg/m³, predicted to occur at the Tooloombah Creek Service Station (R8), 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 predicted pollutant concentrations from the construction of the Project are well below the relevant criteria.

The results of the operational stage 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 5th highest 24-hour average cumulative ground-level PM_{10} concentration of 42 µg/m³ is predicted to occur at the Tooloombah Creek Service Station (R8), which is well below the 50 µg/m³ criterion. The predicted incremental increase in PM_{10} due to the operation of the Project is approximately 22 µg/m³ at the Tooloombah Creek Service Station receptor.

- The highest 24-hour average cumulative ground-level $PM_{2.5}$ concentration of 19.4 µg/m³ is predicted to occur at Tooloombah Creek Service Station (R8), which is below the 25 µg/m³ criterion. The highest annual average cumulative ground-level $PM_{2.5}$ concentration is 5.9 µg/m³, predicted to occur at the Tooloombah Creek Service Station (R8), and is below the 8 µg/m³ criterion.
- The highest daily dust deposition results show that an incremental increase of 1.9 mg/m^2/day will occur at the Brussels receptor, with a total deposition of 60.9 mg/m^2/day which is well below the 120 mg/m^2/day criterion.

Overall, it can clearly be seen that with the Project operating at 10 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 (479,814 tonnes CO_2-e) represent approximately 0.09% of Australia's latest greenhouse inventory estimates of 537 $MtCO_2$-E (2015).

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.

10 BIBLIOGRAPHY

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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
µg/m^3	Micrograms per cubic metre

Appendix B EMISSION ESTIMATION EQUATIONS

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.

Excavation on Overburden and Scrapers (Removing Topsoil)

The default emission rates in the NPI EET for Mining have been used for this emission factor.

Screening

The default emission rates in the AP42 11.19.2 have been used.

Graders

The dust emission rate from graders has been calculated using the following equation:

$$Emissions = k \ x \ S^{a} \text{ kg /VKT}$$

Where:

k = 0.0034 for TSP and $PM_{10.}$ A scaling factor of 0.031 has been applied to the TSP emission to derive the $PM_{2.5}$

a = 2.5 for TSP and 2.0 for PM_{10}

Haul Roads

The dust emission rate from haul roads has been calculated using the following equation:

$$Emissions = \left(\frac{0.4536}{1.6093}\right) x \ k \ x \ \left(\frac{s_{(\%)}}{12}\right)^{\alpha} x \ \left(\frac{W_{(t)}}{3}\right)^{0.45} \text{ kg /VKT}$$

Where:

k = 4.9 for TSP, 1.5 for PM_{10} and 0.15 for $PM_{2.5}$.

$s_{(\%)}$ = surface material silt content (5.0%)

W = mean vehicle weight

a = 0.7 for TSP, 0.9 for PM_{10} and $PM_{2.5}$

Conveyors

The dust emission rate from conveyor transfer points has been calculated using the following equation:

$$Emissions = k \ x \ 0.0016 \ \frac{(U/_{2.2})^{1.3}}{(M/_{2})^{1.4}} \text{ kg /transfer point}$$

Where:

k = 0.74 for TSP, 0.35 for PM_{10} and 0.074 for $PM_{2.5}$

U = mean wind speed (3.1m/s)

M = material moisture content (10% - borehole data)

Truck Unloading at Stockpiles

Data from the boreholes show the ore has high moisture content which differs to the NPI EET for bauxite. The default NPI EET data for high moisture ore has been used.

Wind Erosion

The emission rate for dust from stockpile has been calculated using the following equation for TSP:

$$Emissions = 1.9 \ x \ \left(\frac{s_{(\%)}}{1.5}\right) \ x \ 365 \ x \ \left(\frac{365-p}{235}\right) \ x \ \left(\frac{f_{(\%)}}{15}\right) \text{ kg /ha /yr}$$

Where:

$s_{(\%)}$ = silt content (% by weight). A soil moisture content of 5% has been used.

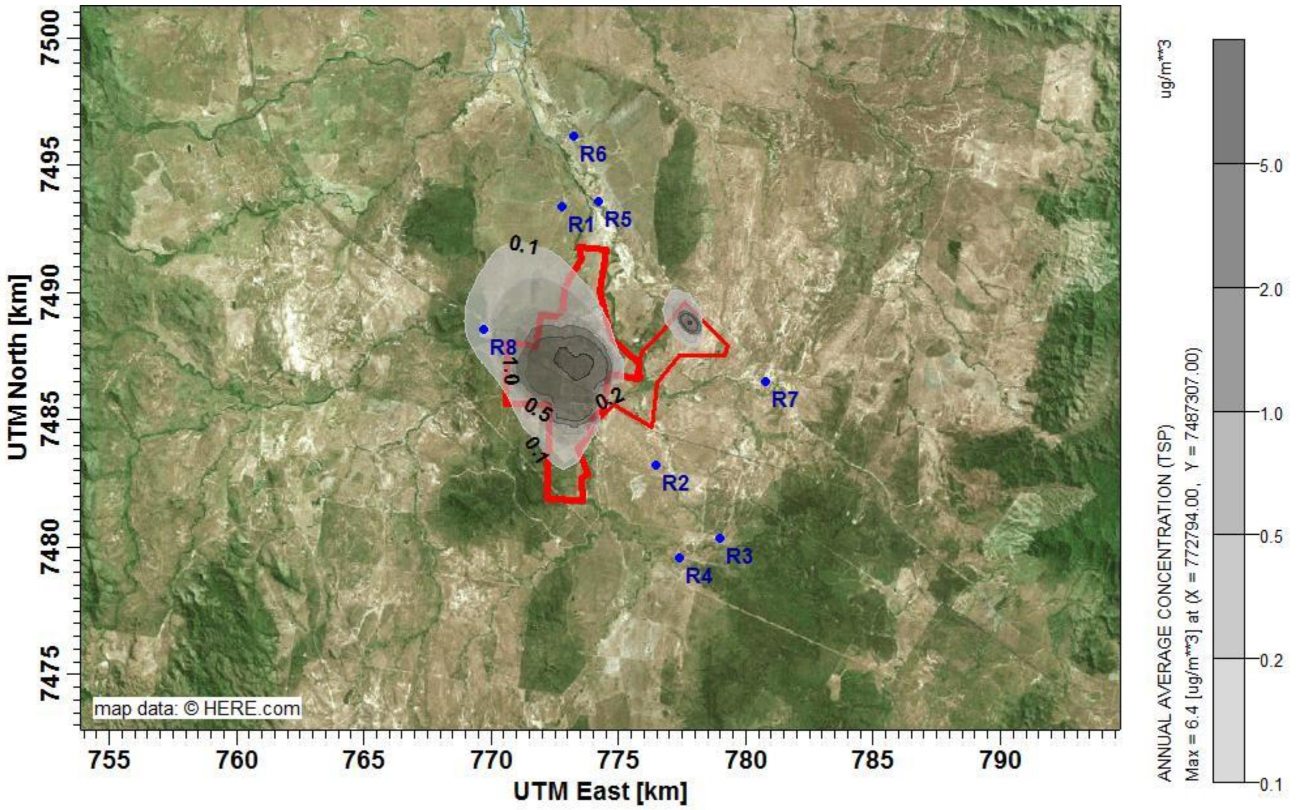
P = number of days per year when rainfall is greater than 0.25 mm. A review of the long term meteorological data from Bureau of Meteorology has determined there are 122 rainfall days per year. With the wet season removed, this is reduced to 34 days per year.

$f_{(\%)}$ = percentage of time that wind speed is greater than 5.4 m/s at the mean height of the stockpile. The frequency of wind speed >5.4 m/s has been determined to be 4.9%.

The fraction of PM_{10} and $PM_{2.5}$ in TSP are 50% and 75% respectively. These fractions derive from AP42 chapter 13.2.5.

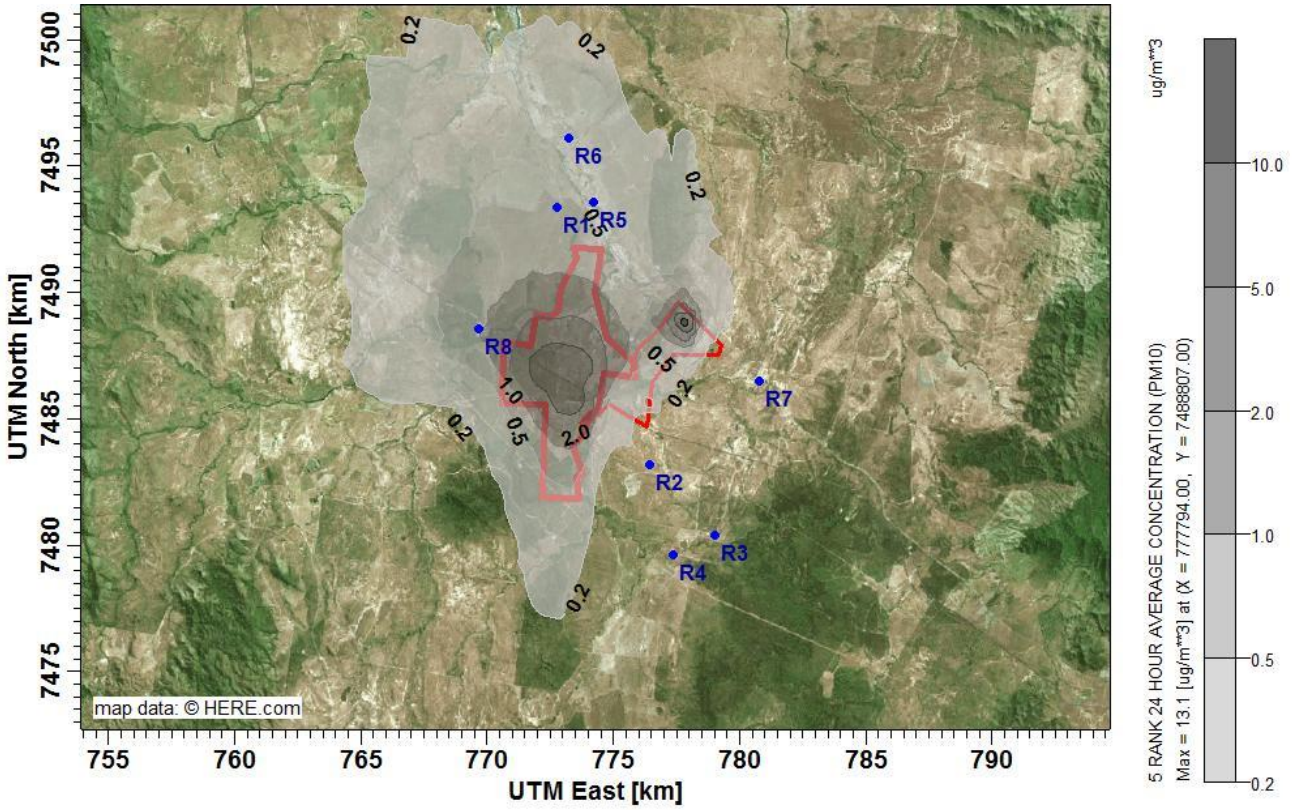
Appendix C POLLUTION PREDICTION CONTOURS

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.



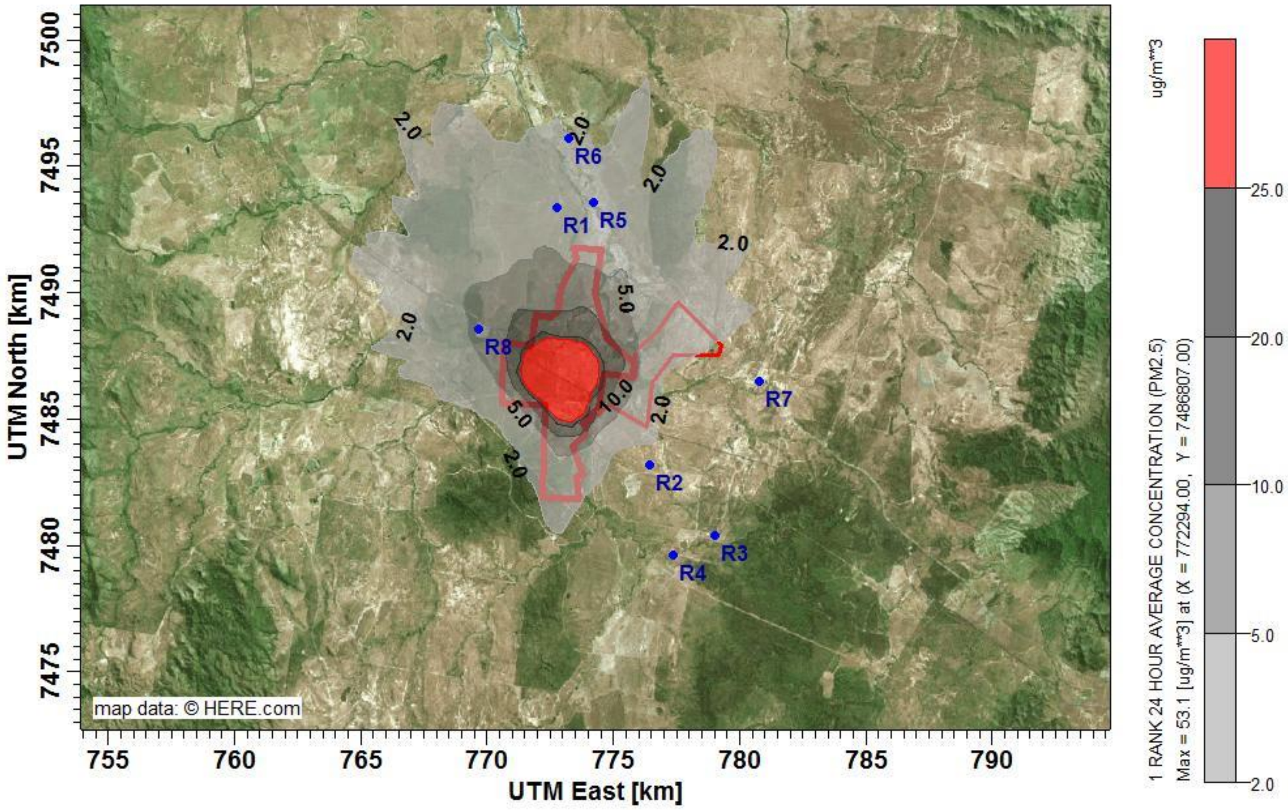
Pollutant: TSP	Averaging Period: Annual	Percentile: MAX	Criteria: 90 µg/m^3

Scenario:
Construction stage in Isolation



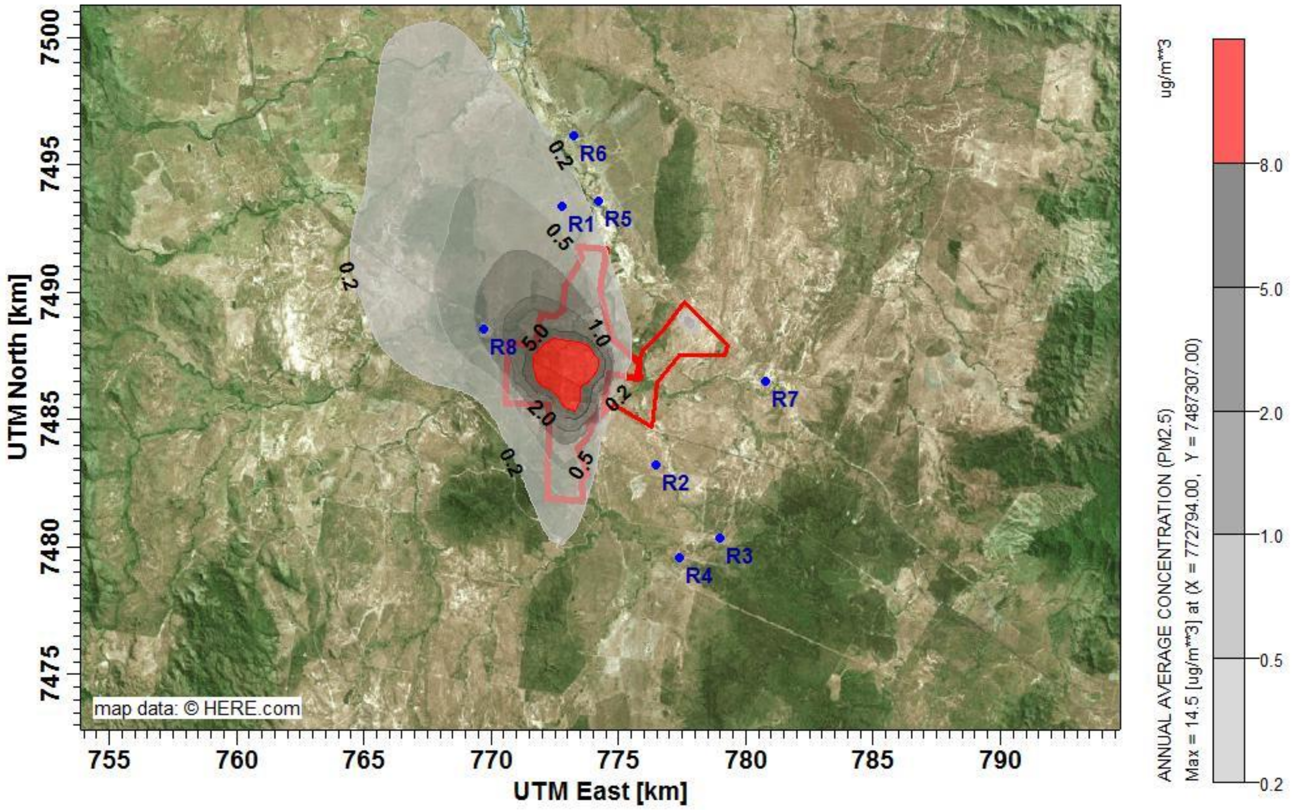
Pollutant:	Averaging Period:	Percentile:	Criteria:
PM_{10}	24 hour	5^{th} highest	50 µg/m^3

Scenario:
Construction stage in Isolation



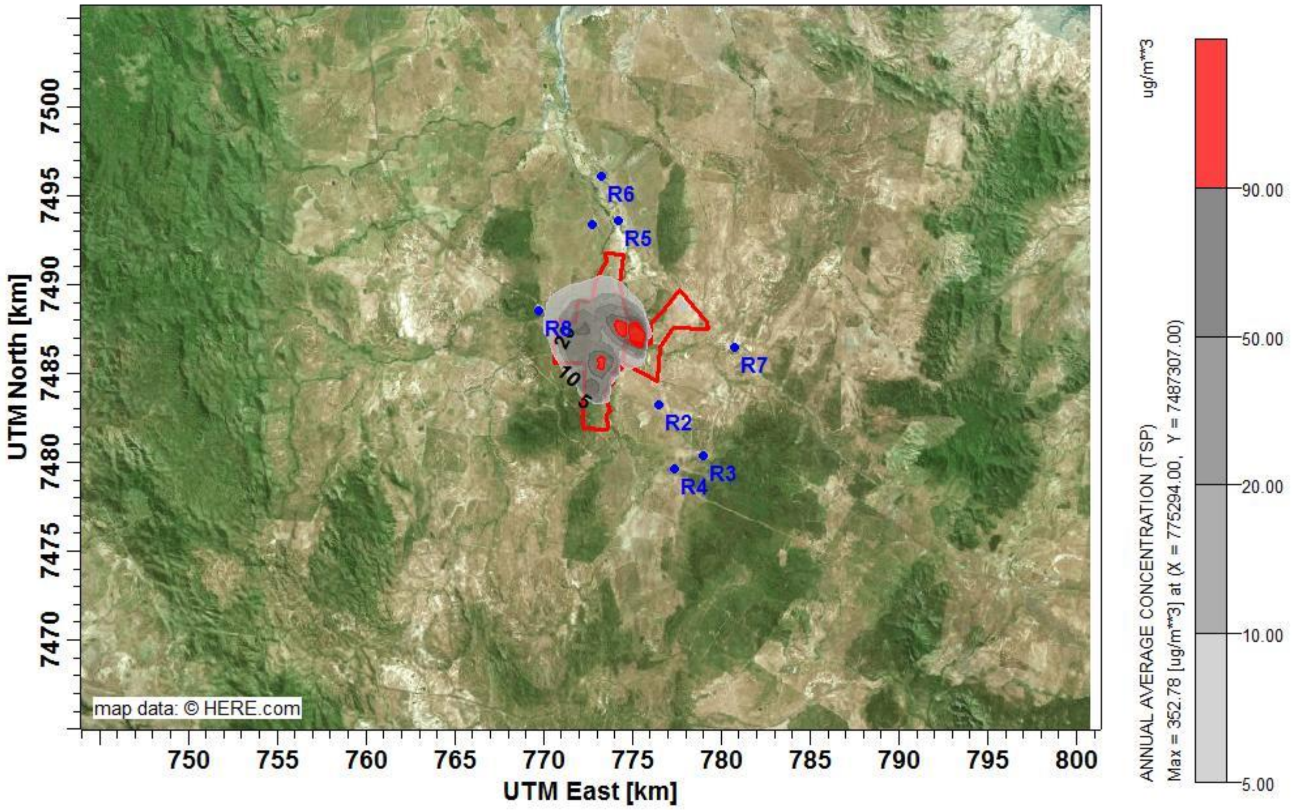
Pollutant: PM$_{2.5}$	**Averaging Period:** 24 hour	**Percentile:** MAX	**Criteria:** 25 µg/m^3

Scenario:
Construction stage in Isolation



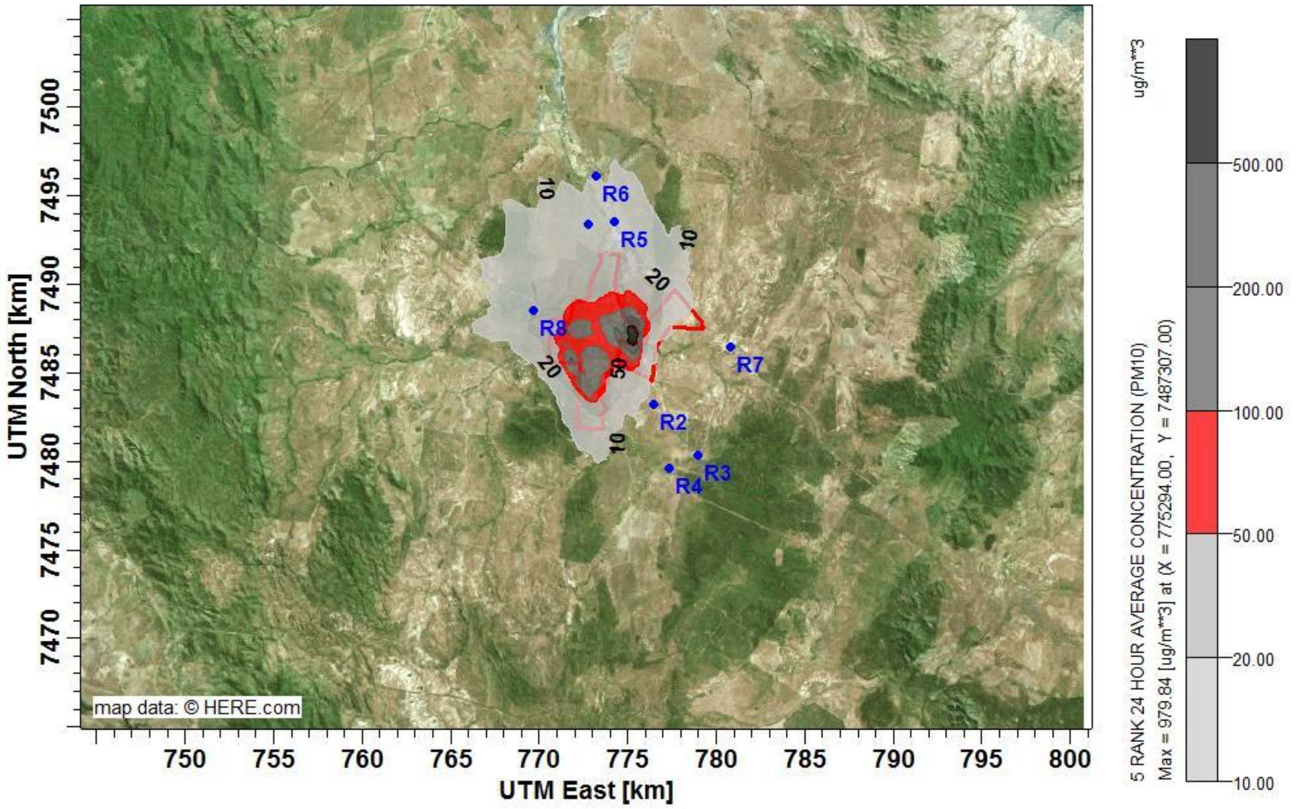
Pollutant:	Averaging Period:	Percentile:	Criteria:
$PM_{2.5}$	1 year	MAX	8 µg/m^3

Scenario:
Construction stage in Isolation



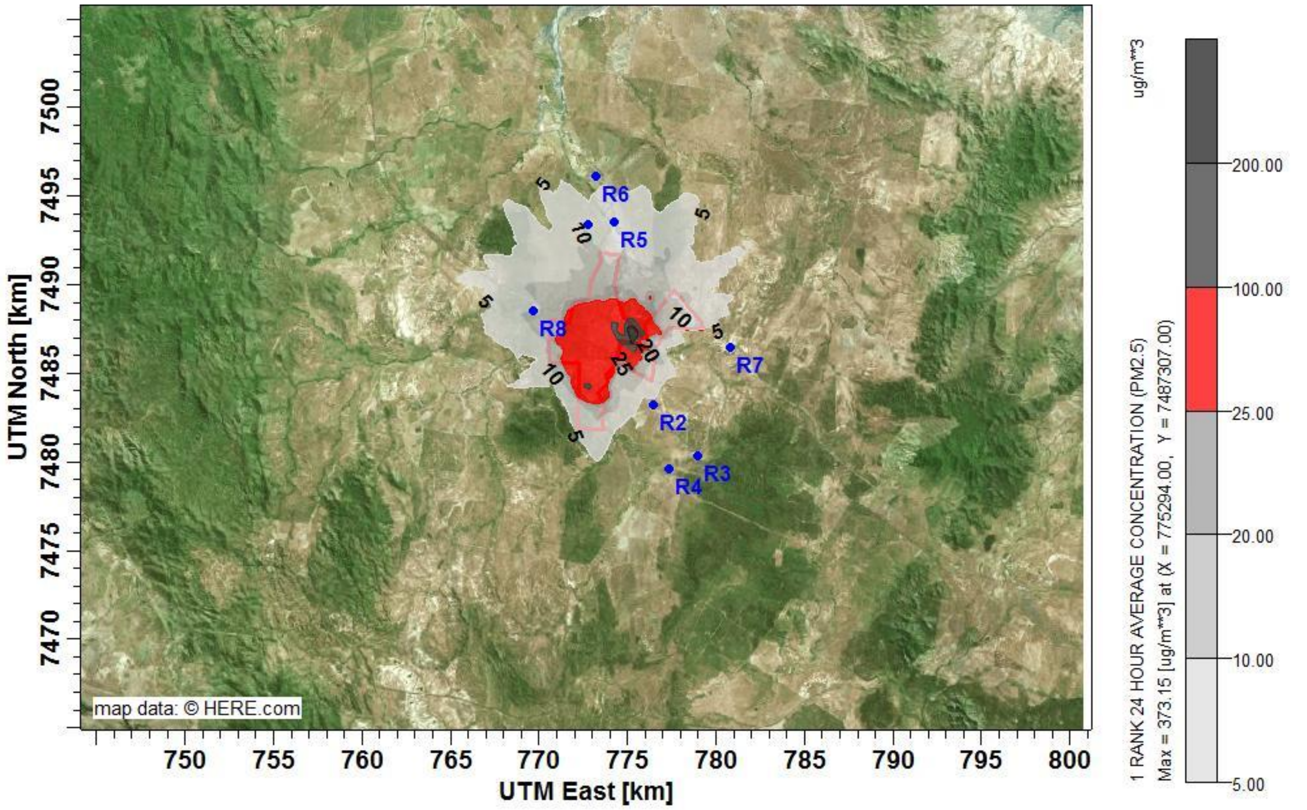
Pollutant:	Averaging Period:	Percentile:	Criteria:
TSP	Annual	MAX	90 µg/m^3

Scenario:
Year 12 Operations in Isolation



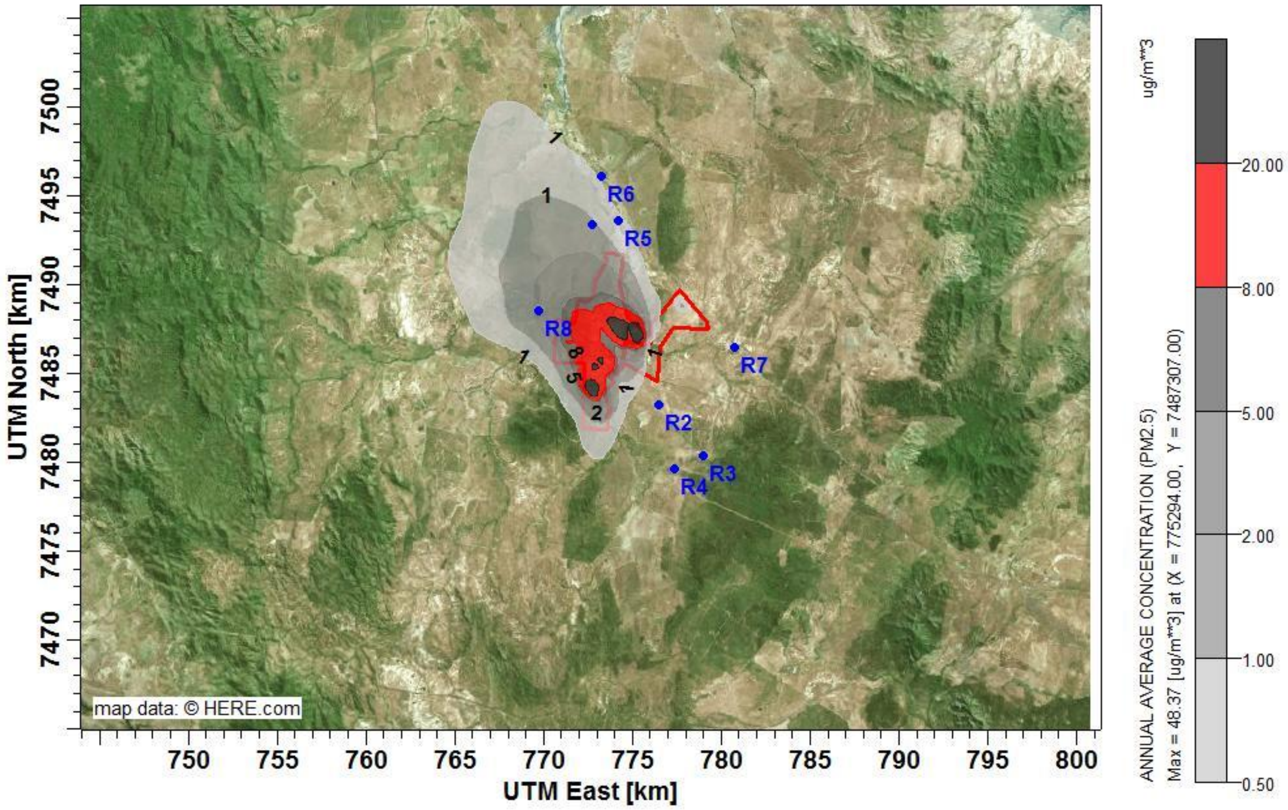
Pollutant: PM$_{10}$	**Averaging Period:** 24 hour	**Percentile:** 5th highest	**Criteria:** 50 µg/m^3

Scenario:
Year 12 Operations in Isolation



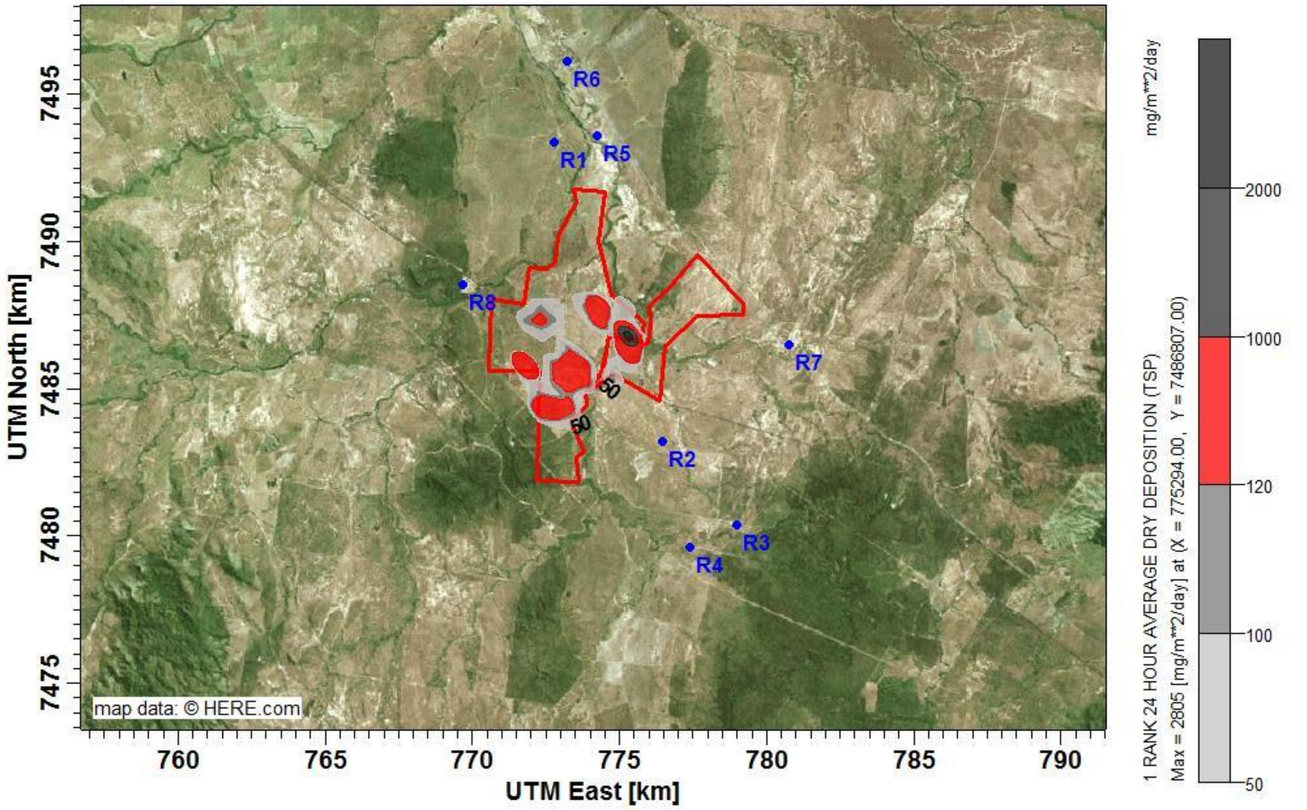
Pollutant:	Averaging Period:	Percentile:	Criteria:
$PM_{2.5}$	24 hour	MAX	25 µg/m^3

Scenario:
Year 12 Operations in Isolation



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

Scenario:
Year 12 Operations in Isolation



Pollutant:	Averaging Period:	Percentile:	Criteria:
Dust Deposition	24 hour	MAX	120 mg/m^2/day

Scenario:
Year 12 Operations 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.