

SARAJI EAST MINING LEASE PROJECT

Environmental Impact Statement

Appendix H-1 Air Quality Technical Report



BHP Mitsubishi Alliance

SARAJI EAST MINING LEASE PROJECT

AIR QUALITY ASSESSMENT

Report # 103004.1

Prepared for:

AECOM Australia Pty Ltd

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On behalf of:

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Abbreviations

AECOM	AECOM Australia Pty Ltd
AED	Advanced Environmental Dynamics Pty Ltd
BAU	Business as Usual
BHP	BHP
BM	BHP Mitsubishi
BMA	BM Coal Alliance Operations Pty Ltd
BoM	Bureau of Meteorology
c.	Circa (approximately)
CALMET	California Meteorological Model
CALPUFF	California Plume Dispersion Model
CHPP	Coal Handling and Processing Plant
CMSH	Coal Mining Safety and Health
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CVM	Caval Ridge Mine
DES	Department of Environment and Science
EETM	Emission Estimation Technique Manual
EIS	Environmental Impact Statement
EPA	Environmental Protection Authority
EPP(Air)	Environmental Protection (Air) Policy
FY	Financial year
MIA	Mine industrial area
ML	Mining lease
MLA	Mining lease application
NASA	National Aeronautics and Space Administration
NEPM	National Environmental Protection Measure
NPI	National Pollutant Inventory
PM ₁₀	Particulate matter with an aerodynamic diameter less than 10 microns
PM _{2.5}	Particulate matter with an aerodynamic diameter less than 2.5 microns

QLD	Queensland
ROM	Run of mine
SRTM	Shuttle Radar Topography Mission
TAPM	The Air Pollution Model
TEOM	Tapered Element Oscillating Microbalance
TSP	Total suspended particulates
USEPA	United States Environmental Protection Agency
V	Version
Y	Year

Units

hr	hour
km	kilometre
m	metre
m ²	square metres
mg	milligrams
µg/m ³	Micrograms per cubic metre
Mtpa	Million tonnes per annum
tph	Tonnes per hour

1. Introduction

Advanced Environmental Dynamics Pty Ltd (AED) was commissioned by AECOM Australia Pty Ltd (AECOM) on behalf of BM Alliance Coal Operations Pty Ltd (BMA) to undertake an air quality assessment of the Saraji East Mining Lease Project (the Project) in support of the Project's Environmental Impact Statement (EIS).

The proposed new Saraji East underground mine will be situated adjacent to BMA's Saraji Mine in the Bowen Basin Queensland (Figure 1).

The Project will utilise existing infrastructure associated with Saraji's open cut mining operations as appropriate. However, the Project will also include the construction of a new coal handling and processing plant (CHPP) that will have the capacity to process 7 million tonnes per annum (Mtpa) of run-of-mine (ROM) coal. With a maximum Project production rate of 11 Mtpa, excess ROM coal will be trucked from the Project CHPP to the existing Saraji Mine CHPP for processing.

With ROM coal transported from the mine portal to the Project CHPP by conveyor, the key dust emission sources from the Project are associated with the material handling and processing of coal at the CHPP and the transport of excess coal via haul trucks from the CHPP to the Saraji Mine CHPP.

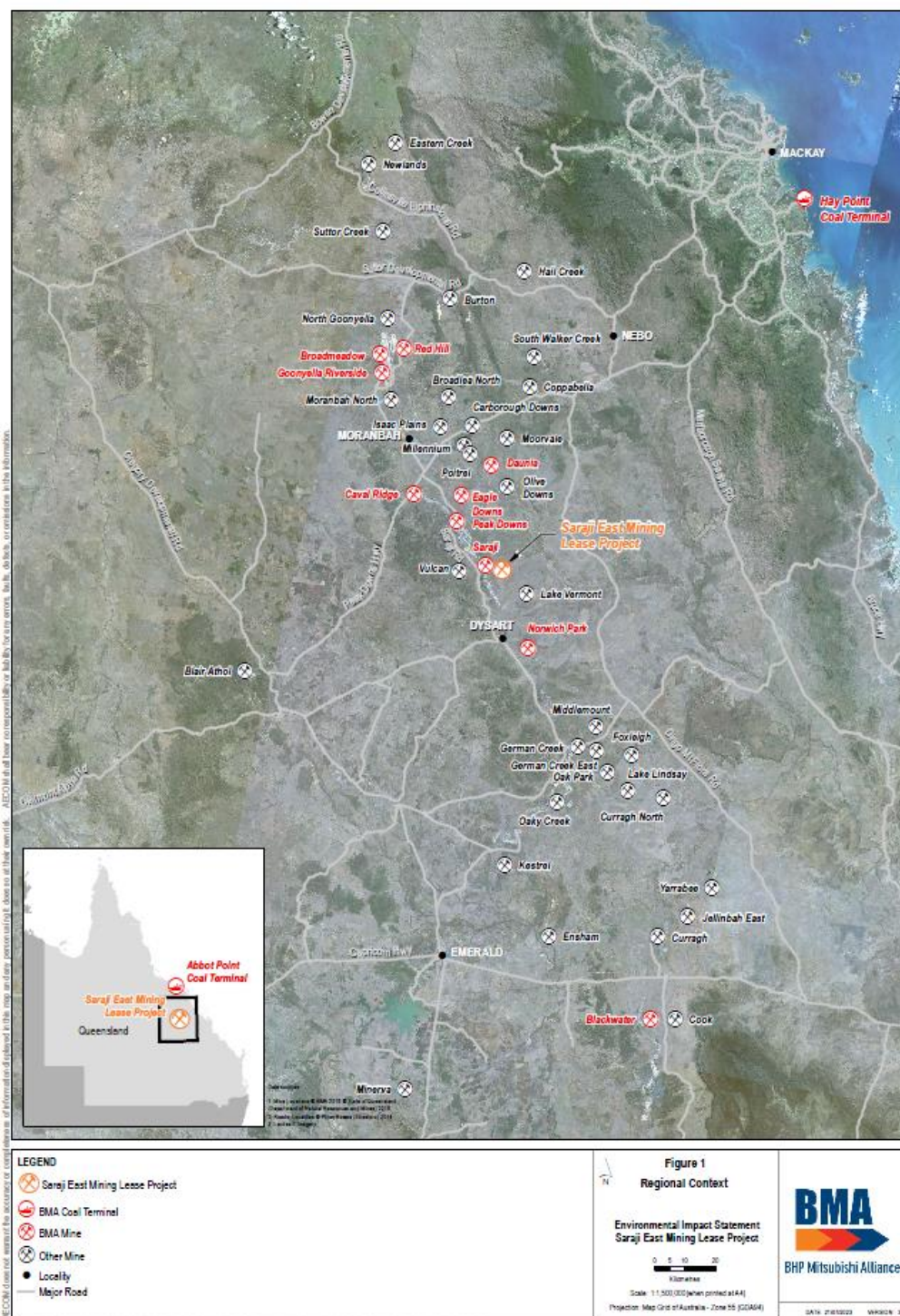
The Project includes significant dust reduction measures. Most notably, the transport of ROM coal from the portal to the CHPP by conveyor will generate significantly less dust than would be produced if the coal were transported by haul trucks.

Two dust emission scenarios have been considered corresponding to a maximum CHPP throughput of 800 tonnes per hour (tph) with a further 500 tph of ROM coal processed at the Saraji Mine CHPP. The first emissions scenario includes typical (i.e. business as usual BAU) dust mitigation practices. The second considers potential impacts associated with upset conditions based on reduced water availability.

Cumulative impacts have been considered using two approaches. The first is based on a comparison of publically available information reported to the National Pollutant Inventory (NPI) for SRM, PDM, and LVM with estimates of dust emissions from the Project. The second is based on the explicit modelling of PM₁₀ associated with SRM, PDM and the Project, combined with an estimate of non-anthropogenic background dust levels. Results of the cumulative impact assessment based on dispersion modelling has been used to highlight the nature and extent of additional dust control measures that may be required in order to mitigate the risk of additional exceedances of the EPP(Air) objective for PM₁₀.

This report outlines the methodology and findings of the air quality assessment including a proposed ambient air monitoring network to support the management of air quality outcomes at neighbouring locations of interest to the regulating authority.

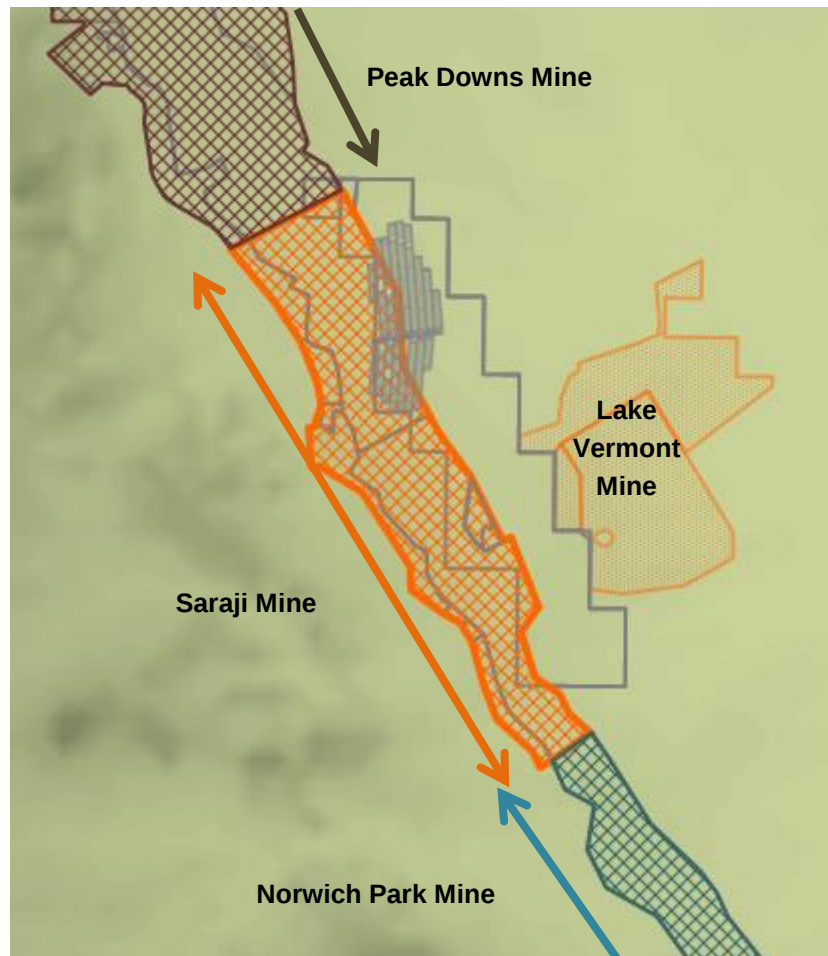
Figure 1: Regional Setting of Saraji East Mine Lease Project within the Bowen Basin



2. Project Background

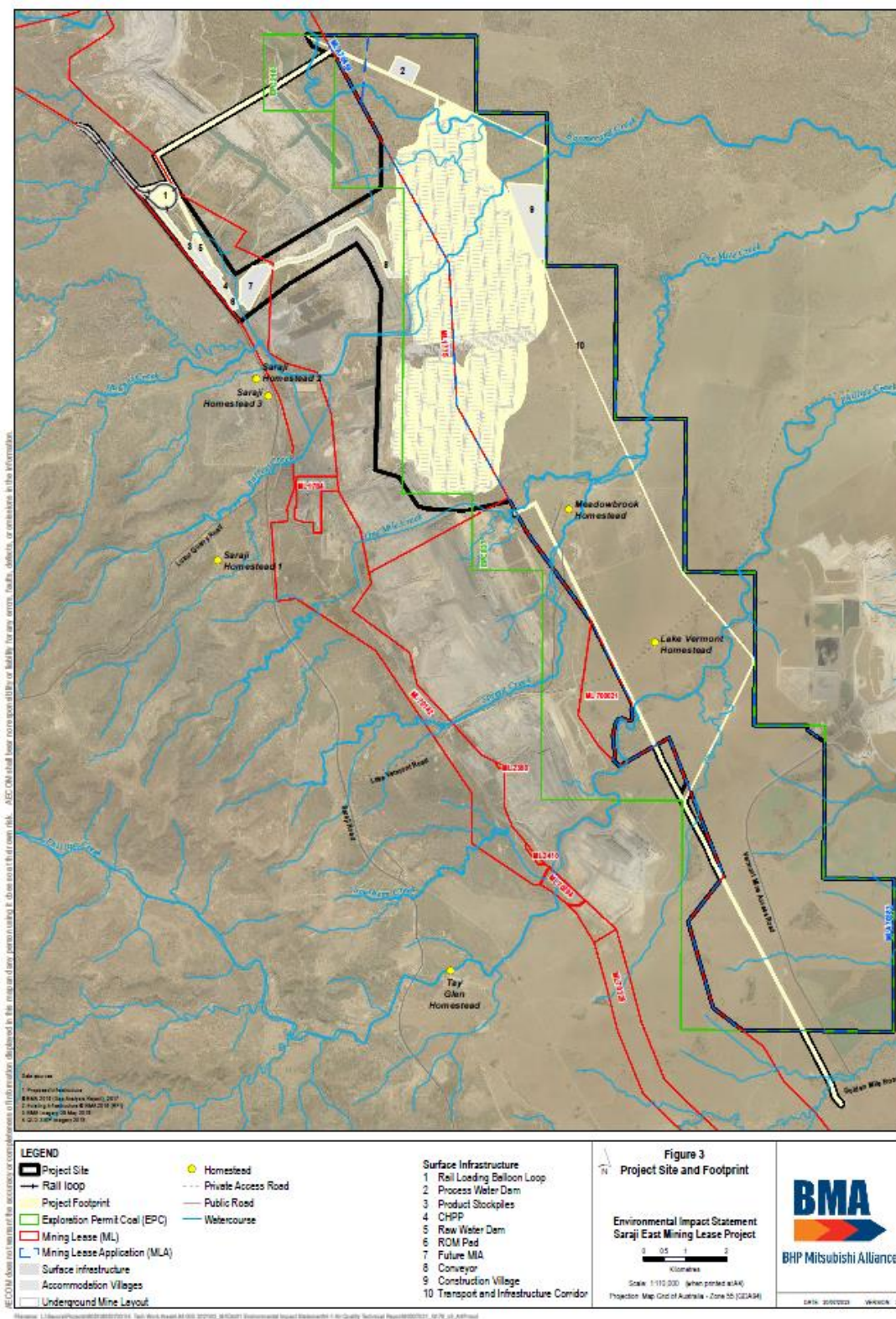
BMA's proposed Saraji East underground mine will be located in the Bowen Basin, Central Queensland. The mine will be situated immediately to the east of BMA's Saraji Mine with BMA's Peak Downs Mine to the north and Norwich Park Mine to the south. Jellinbah Group's Lake Vermont Mine is located to the southeast (Figure 2).

Figure 2: Local Setting of Saraji East Mine



The Project Site and footprint (Figure 3) includes components on Mine Lease Application (MLA) 70383, MLA 70459, Mine Lease (ML) 1775, ML 1782, ML70328, ML 70294, ML70298, and ML 1784.

Figure 3: Project Site and Footprint



The Project will mine up to 11 Mtpa of ROM coal and produce up to 8.2 Mtpa of metallurgical product coal over a life of approximately 20 years. The following components would support the Project (Figure 4):

- A new mine industrial area (MIA) located on ML 1775;
- A new CHPP with a capacity of 7 Mtpa located on ML 70142;
- A conveyor system and haul road to deliver coal from the underground portal to the CHPP and product coal to the rail loading facilities, located over both ML 1775 and ML 70142;
- A ROM stockpile and product stockpile pads located on ML 70142;
- A new rail spur and balloon loop and signalling system located on ML 70142;
- Dewatered tailings and reject disposal within spoil on the Saraji Mine; and
- A construction accommodation village located on MLA 70383.

2.1 Pollutant Emission Sources

From a life of project perspective, the potential for the generation of dust begins with the commencement of construction activities and ends after mine closure, when the rehabilitation of exposed areas has been completed and the final landform has been achieved.

In general, an underground mine is associated with significantly less dust generation when compared with an open cut mine alternative. Although both mining methods may share a number of common dust generating sources such as ROM stockpiles, breaker stations, conveyors, and stacker/reclaimers, the release of fugitive dust emissions associated with material handling by open cut mining methods are replaced by the release of dust to the atmosphere via ventilation shafts in the underground mine.

Another of the key dust emission sources associated with open cut mining that is absent when implementing underground mining methods, is the potential for significant amounts of windblown dust due to waste spoil dumps and pit-related disturbance areas.

For this Project, the extent of the disturbance footprint is established early, i.e. during the construction phase of the project and remains relatively stable throughout the life of the Project. That part of the disturbance footprint associated with the construction of the accommodation village (for example) can be minimised through the stabilising of at risk surfaces (such as roads, paths, etc.) and the rehabilitation of surfaces as soon as practicable.

This report focuses on the construction and operation phases of the Project. Although not identified specifically, the decommissioning and commissioning phases of the Project may be considered conservatively represented by the earliest and latter stages of the mining operations. The potential for substantial quantities of dust to be generated during these stages of the project (e.g. commissioning, decommissioning, rehabilitation) is considered to be low and where necessary, may be adequately managed through air quality management practices typical of mining operations.

2.1.1 Construction Phase

Construction is anticipated to take approximately three years with the majority of the construction work expected to occur during year 1 through year 3.

Emission sources during the construction phase of the project include those associated with the construction of: the mine entry portal, construction accommodation camp; gas drainage infrastructure; raw water dam and process water dam; powerlines; mine industrial area (MIA); coal handling and processing plant (CHPP); rail loop and load out; ventilation shafts; and water pipelines.

The main pollutant of concern during construction will be the generation of dust associated with material handling, heavy vehicle movements, land clearing, and wind erosion. Small amounts of other pollutants (such as oxides of nitrogen and volatile organic compounds) may be released in association with the combustion of diesel fuel by plant and equipment, although these sources of pollutants are anticipated to be relatively minor.

2.1.2 Operational Phase

The operational phase of the Project will potentially emit a range of pollutants associated with (but may not be limited to) the following:

- Conveying of coal from the mine portal to the CHPP including transfer points and surge bins;
- Processing of coal including sizing at the breaker stations (Project CHPP and Saraji Mine CHPP);
- Stacking/reclaiming of stockpiles (Project CHPP and Saraji Mine CHPP);
- Dozer activities on stockpiles (Project CHPP);
- Wheel generated dust associated with the transport of coal via haul trucks from the Project CHPP to the Saraji Mine CHPP;
- Truck dumping of coal at the Saraji Mine CHPP ROM stockpile;
- Wheel generated dust associated with rejects hauling (Project CHPP and Saraji Mine CHPP);
- Exhaust gas associated with the underground ventilation outlets;
- Flaring and/or venting of off-gases; and
- Combustion of diesel and petrol fuels in mobile and/or fixed plant and equipment.

Pollutants that may be emitted into the airshed as a result of the Project include:

- Dust (as total suspended particulates (TSP), particulate matter with an aerodynamic diameter less than 10 microns (PM_{10}), and particulate matter with an aerodynamic diameter less than 2.5 microns ($PM_{2.5}$));
- Oxides of nitrogen, carbon monoxide and volatile organic compounds (e.g. combustion of fuels);
- Methane (venting of incidental mine gas);
- Carbon dioxide (e.g. flaring of incidental mine gas).

2.2 Pollutants Considered in this Assessment

Although the Project incorporates a number of significant dust reduction features (e.g. the transport of ROM coal by conveyor from the mine portal to the CHPP), the risk of adverse impacts of dust on the air quality environment associated with coal handling is likely to exceed those from other activities such as the combustion of diesel fuel. Thus the focus of this assessment is the quantification of Project-related impacts for TSP, PM₁₀, PM_{2.5} and dust deposition.

Potential impacts and management options associated with the emission of greenhouse gases from the Project (e.g. methane, carbon dioxide, etc.) have been addressed in the Project EIS Chapter 11 Air Quality and *Greenhouse Gas Emissions*.

3. Environmental Values

3.1 Legislative Framework

Ambient air quality objectives that have been adopted for the Project have been sourced from both national and state legislative goals, objectives and standards for air quality. As the primary pollutant of concern from the Project is dust, the presentation of ambient air objectives is focused on TSP, PM₁₀, PM_{2.5} and dust deposition. With the exception of dust deposition, the criteria pertaining to levels of particulate levels are health-based. The criterion for dust deposition is based on the protection of environmental amenity.

3.1.1 National Legislation

National ambient air quality standards and goals are set by the National Environmental Protection Council (NEPC) and are specified within the Ambient Air Quality National Environmental Protection Measure (NEPM) (Ambient Air Quality NEPM) Variation 2015, effective February 3, 2016.

A summary of the current Ambient Air Quality NEPM standards and goals for dust are presented in Table 1.

Table 1: Ambient Air Quality NEPM Standards

Pollutant	Averaging Period	Maximum Concentration (µg/m ³)	Maximum allowable exceedances	Comment
PM ₁₀	24 hour	50	None	Current Standard
	Annual	25	None	Current Standard
PM _{2.5}	24 hour	25	None	Current Standard
	Annual	8	None	Current Standard

3.1.2 Queensland Legislation

In Queensland (QLD), air quality is managed under the *Environmental Protection Act 1994*, the *Environmental Protection Regulation 2008* and the *Environmental Protection (Air) Policy 2008 (EPP(Air))* which came into effect on 1 September, 2019. The EPP(Air) includes ambient air quality objectives for PM₁₀, PM_{2.5} and TSP, these are summarised in Table 2.

In addition to the ambient air objectives for suspended particulates, the QLD Department of Environment and Science (DES) has adopted a guideline of 120 mg/m²/day for deposited dust following the guideline set in New South Wales for the protection of environmental amenity.

Table 2: Queensland Ambient Air Quality Goals

Pollutant	Averaging Period	Project Goal	Allowable exceedances	Source
TSP	Annual	90 µg/m ³	None	QLD EPP(Air)
PM ₁₀	24 hour	50 µg/m ³	None	QLD EPP(Air)
	Annual	25 µg/m ³	None	QLD EPP(Air)
PM _{2.5}	24 hour	25 µg/m ³	None	QLD EPP(Air)
	Annual	8 µg/m ³	None	QLD EPP(Air)
Dust deposition	30 day	120 mg/m ² /day	None	QLD DES

It is noted that the air quality objectives specified in the EPP (Air) do not extend to workplaces as defined in the *Work Health and Safety Act 2011* (Section 8 of the EPP (Air)). Although the *Coal Mining Safety and Health Act 1999* (CMSH Act) is not explicitly specified in the EPP (Air), it is considered that the EPP (Air) does not apply to occupational exposure to dust. Occupational exposure to dust at all on-lease locations is managed by BMA under the CMSH Act. Hence, the air quality assessment presented in this report addresses off-site ambient air quality impacts only and does not cover workplace health and safety exposure.

3.1.3 Project Adopted Ambient Air Quality Goals

For the assessment of potential impacts of dust from the Project, ambient air quality goals were adopted in consideration of both national and state legislation. These goals are summarised in Table 3.

Table 3: Project Ambient Air Quality Goals

Pollutant	Averaging Period	Project Goal	Allowable exceedances	Source
TSP	Annual	90 µg/m ³	None	QLD EPP(Air)
PM ₁₀	24 hour	50 µg/m ³	None	QLD EPP(Air)
	Annual	25 µg/m ³	None	QLD EPP(Air)
PM _{2.5}	24 hour	25 µg/m ³	None	QLD EPP(Air)
	Annual	8 µg/m ³	None	QLD EPP(Air)
Dust deposition	30 day	120 mg/m ² /day	None	QLD DES

3.2 Assessment Locations

Locations considered as part of this assessment are illustrated in Figure 5. With the exception of the Lake Vermont and Meadowbrook Homesteads which are located to the east of the

Project, all assessment locations are privately owned (Table 4). There are currently co-existence agreements in place between BMA and landholders at Saraji Homestead 2 and Saraji Homestead 3 and Meadowbrook Homestead has been vacated. Discussions between BMA and the Saraji Homestead 1 landholder concerning a co-existence agreement have commenced. Nonetheless, all homesteads within the vicinity of the Project have been assessed.

As noted in Section 3.1.2, this assessment focuses on dust impacts at off-site locations and therefore excludes the proposed construction village (Figure 5).

Figure 5: Assessment Locations

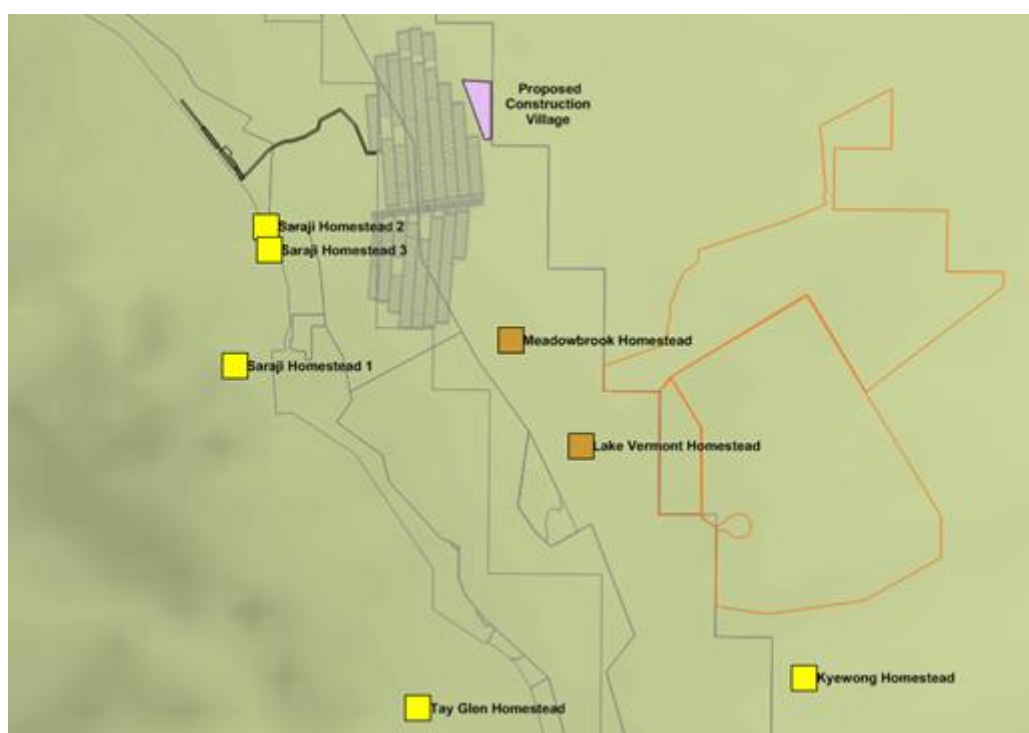


Table 4: Assessment Locations

Location ID	Property Reference	Ownership	Easting	Northing
1	Kyewong Homestead	Private landholder	646706	7509901
2	Lake Vermont Homestead	BMA	639957	7516899
3	Saraji Homestead 1	Private landholder	629541	7519310
4	Saraji Homestead 2	Private landholder	630486	7523522
5	Saraji Homestead 3	Private landholder	630569	7522801
6	Tay Glen Homestead	Private landholder	635066	7508977
7	Meadowbrook Homestead	BMA - unoccupied	637853	7520080

3.3 Existing Air Quality Environment

The quantification of air quality at assessment locations and throughout the local airshed is complicated as it is the result of a combination of natural and anthropogenic dust emission sources, the impacts from which are both temporally and spatially varying. Adding to the complexity of the interpretation of current dust levels within the study area (the area in which is defined by the model domain) is the existence of both BMA owned/operated (i.e. Saraji Mine, Peak Downs Mine and Norwich Park Mine) and non-BMA owned/operated (i.e. Lake Vermont Mine) open-cut coal mining operations (Figure 2).

3.3.1 Estimate of Background Levels of Dust

In theory, background levels of pollutants are the concentrations that would occur in the absence of all anthropogenic emission sources. In practice, the practicalities and limitations associated with the establishment of an ambient air monitoring stations means that they are rarely sited at locations which are not influenced to some degree by anthropogenic emission sources.

Estimating background levels is further complicated by the fact that, although the Victorian Environment Protection Authority (EPA) recommend the use of the 70th percentile as an estimate for the background level, in reality background levels will be spatially and temporally varying as the emission rate of pollutants from natural sources are often functions of a number of factors including for example, frequency of rain, wind speed, and atmospheric stability.

These limitations noted, for this assessment (and in the absence of suitable site-specific data from which to calculate background levels of dust) estimates of background levels (Table 5) were developed using data from the Caval Ridge Mine Site 2 ambient air monitoring station (c. -22,0349, 148.0465) located c. 4 km north-west of the Moranbah Airport, 2.5 km south of Moranbah (Figure 6) and 38 km north-northwest of the Project. This location is considered to be sufficiently representative of the background level of dust that would occur in the vicinity of the Project in the absence of anthropogenic activities.

Established as part of the Caval Ridge Mine Environmental Authority, the Site 2 monitoring site is part of a comprehensive monitoring network surrounding the mine and includes continuous monitoring of particulate matter (TSP, PM₁₀ and PM_{2.5}) using tapered element oscillating microbalances (TEOMs), as well as the monitoring of meteorological parameters. This data set has the distinct advantage of providing data by which to estimate background levels of all suspended particulate sizes without the need to infer values for one particulate size from another (e.g. inferring TSP levels from PM₁₀ data).

The 70th percentile of the data set for the period 12/11/2013 through 31/03/2015 (AED 2015) has been used to estimate background levels for the 24 hour average concentration of PM₁₀ and PM_{2.5} (Table 5). The estimates of background levels for the annual averages of TSP, PM₁₀ and PM_{2.5} are based on the average values.

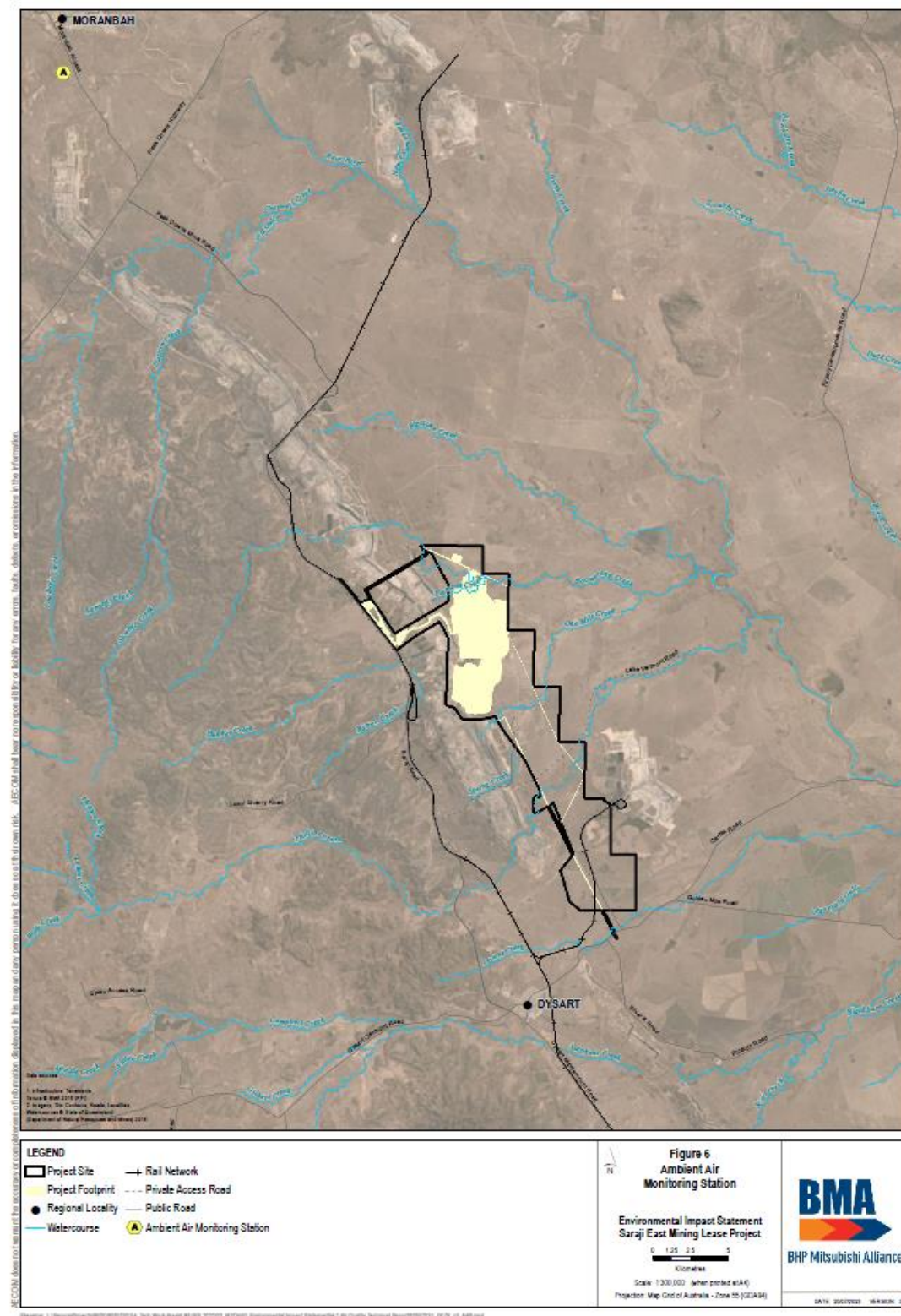
The estimate of background levels of dust deposition is based on an average of data from the Site 2 monitoring station for the period February 2014 through November 2015.

Included in the table is the percentage of the Project goal that is represented by the estimated background level which ranges from 36% for dust deposition to 91% for the annual average concentration of PM₁₀ (Ambient Air NEPM standard).

Table 5: Estimates of Background Levels

Pollutant	Averaging Period	Estimated Background Level	Percentage of Goal	Source
TSP	Annual	39.4 µg/m ³	44%	BMA CVM Site 2
PM ₁₀	24 hour	24.7 µg/m ³	49%	BMA CVM Site 2
	Annual	22.8 µg/m ³	91%	BMA CVM Site 2
PM _{2.5}	24 hour	18.8 µg/m ³	75%	BMA CVM Site 2
	Annual	4.1 µg/m ³	51%	BMA CVM Site 2
Dust deposition	Monthly	43.6 mg/m ² /day	36%	BMA CVM Site 2

Figure 6: Location of the CVM Site 2 Ambient Air Monitoring Station, Moranbah



3.3.2 Contributions to the Current Air Quality Environment due to Existing Mining Operations

As noted in Section 3.3, in addition to naturally occurring sources of dust, the Project is proposed to be located within an airshed that includes BMA's Saraji Mine (SRM), Peak Downs Mine (PDM) and Norwich Park Mine (NPM), as well as Jellinbah Group's Lake Vermont Mine (LVM).

Impacts on the local air quality environment attributable to BMA mining operations in the vicinity of assessment locations (Figure 5) would be most significantly influenced by SRM and PDM.

In order to highlight the relative scale of predicted air quality impacts associated with the Project compared with existing open cut mining operation, two approaches have been considered:

- a comparison of the Projects dust emissions inventory with publically available information for fugitive emissions of PM₁₀ from SRM, PDM and LVM, is presented in Section 5.3.1.
- Results from dispersion modelling for PM₁₀ that includes the explicit modelling of dust emission sources from the Project, Saraji Mine (SRM) and Peak Downs Mine (PDM) based on detailed mine planning information is presented in Section 5.3.2.

4. Overview of Assessment Methodology

In order to highlight the nature and extent of potential impacts from the Project, results from the dust dispersion modelling focuses on those for the Project in isolation of other potential dust generating sources within the local airshed.

A comparison of the Project's dust emissions inventory developed in Section 4.4.2, with publically available information for fugitive emissions of TSP, PM₁₀ and PM_{2.5} from Saraji Mine, Peak Downs Mine and Lake Vermont mines, is presented in Section 5.3. Results from the assessment of cumulative impacts based on dispersion modelling of the Project, SRM and PDM, is also presented in Section 5.3

4.1 Dust Emission Sources

4.1.1 Construction Phase

As discussed in Section 2.1 the main pollutant of concern during construction will be the generation of dust associated with heavy vehicle movements, land clearing, and wind erosion.

With the construction of the mine entry portal, conveyor, and CHPP occurring at already disturbed areas within the SRM ML, the generation of dust associated with these activities will be immaterial compared to other localised activities.

The main dust generating activity that will occur at locations off the SRM ML is the clearing of land associated with the construction of the proposed accommodation village.

4.1.2 Operation Phase

The Project dust emission sources that have been explicitly modelled include:

- The conveying of coal from the underground mine portal to the Project CHPP
- The sizing of ROM coal
- The stacking and reclaiming of coal
- Use of a dozer to assist reclaiming at the Project CHPP
- Wind erosion from stockpiles located at the Project CHPP
- The transport of excess ROM coal to the Saraji Mine CHPP
- The dumping of ROM coal at the Saraji Mine CHPP
- Stacking/reclaiming and sizing of coal at the Saraji Mine CHPP

- Ventilation outlets

The following potential air emission sources have not been explicitly modelled:

- Emissions associated with the flaring of off-gases. (Note that the emission of greenhouse gases have been addressed in the Project EIS *Appendix J-1 Greenhouse Gas Inventory and Assessment Report*.)
- Emissions of dust associated with the handling of product coal which is considered to be immaterial due to its relatively high moisture content.

4.2 Emissions Scenarios

4.2.1 Construction Phase

Estimates of dust emissions associated with land clearing during the construction phase of the project are included in Section 4.4.1 with dust management strategies during construction discussed in Section 6.1.

4.2.2 Operational Phase

In order to highlight the impact of dust emissions associated with the Operational Phase of the Project, three types of dust emission scenarios has been explicitly modelled:

- **Project-Only Case (Peak BAU Case):** Underground mining at a rate of 11 Mtpa ROM coal. As this is representative of the maximum annual production rate of coal from the Project, this scenario is considered to be conservative and representative of peak as opposed to typical operations. Results from the dispersion modelling for this scenario will be presented in isolation of any other dust emission sources, i.e. results will not include an estimate of current or future dust levels as a result of other dust emission sources that exist within the local airshed. Dust mitigation measures that are included as part of business as usual (BAU) are as discussed in Section 4.2
- **Project-Only Case (Peak Upset Case):** As per the Peak Case but incorporating less dust reduction measures, for example reduced haul road watering capacity. As these conditions are considered atypical, results for this scenario are only presented for the 24-hour average concentration of PM₁₀ and PM_{2.5}.
- **Cumulative Impacts (Peak Mitigated Case):** As per the Peak Case but incorporating additional dust reduction measures, for example reducing heavy vehicle movements on the haul road between the Project CHPP and the SRM CHPP during adverse meteorological conditions. Additional mitigation options are

considered as part of the cumulative impacts assessment (Section 5.3). Results for this case are only presented for the 24-hour average concentration of PM₁₀.

4.3 Dust Controls

4.3.1 Construction Phase

When estimating windblown dust associated with land clearing during the construction phase of the Project (Section 4.4.1), no dust controls have been assumed. However, dust management strategies during construction are discussed in Section 6.1.

4.3.2 Operations Phase

Business as Usual

Dust reduction measures that have been adopted into the dispersion model for the Project and are indicative of typical operating practices (i.e. business as usual (BAU)) are:

- Watering of haul roads at a rate of more than 2 litres/m²/hour (i.e. level 2 watering);
- Water sprays during crushing; and
- Water sprays on stockpiles.

Upset Conditions

From an air quality perspective, upset conditions could arise in relation to a failure of dust controls resulting in an increase in the amount of dust released into the atmosphere. As dust reduction measures typically rely on the availability of adequate water supply, any constraints in relation to water availability and/or the ability to deliver the required level of dust suppression (in particular) to haul routes, may lead to dust impacts in excess of that predicted based on BAU operating conditions. Upset conditions as a result of water constraints have been considered in this assessment.

Additional Dust Mitigation Options

As a result of adverse environmental conditions such as drought, there may be circumstances when the Project's BAU dust management practices require supplementing with additional dust management strategies in order to comply with environmental licencing requirements. A suite of options will be available to the Project including (but not limited to) the following which may be applied on an as required basis:

- Reducing heavy vehicle movements between the Project CHPP and the SRM CHPP and the associated reducing in coal handling at the Project CHPP and dumping of ROM coal at the SRM ROM dump.

-
- Reducing throughput through the Project CHPP breaker station.
 - Reducing dozer activities at the Project CHPP.

The predicted level of improved outcomes associated with the implementation of these dust reduction measures been considered in this assessment as part of the cumulative impact assessment (Section 5.3).

4.4 Dust Emissions Inventory

The National Pollutant Inventory (NPI) has produced a series of Emission Estimation Technique Manuals that are intended to provide data on emissions of air pollutants from a wide variety of industries/activities.

For this assessment, the NPI Emission Estimation Technique Manual (EETM) for Mining V3.1 (NPI, 2012) has been used to provide data to estimate the amount of dust emitted from the various activities associated with the Project incorporating site-specific information where available.

Emission factors from the NPI EETM for Mining were supplemented with those from the US EPA's AP42 (USEPA, 1995) when required and/or considered appropriate.

4.4.1 Construction Phase

With reference to Section 4.1.1 and Section 4.2.1, with the exception of the Project accommodation village, the balance of Project related construction will occur in areas that are already disturbed.

The disturbance footprint of the proposed construction village will be within an area of c. 9 hectares (Figure 4). In comparison, estimates of current disturbance areas (based on publically available information) for open cut mines within the study area (Table 6) suggest that the disturbance footprint of the proposed accommodation village contributes less than 0.1% of the total disturbance area. Thus, within the context of the surrounding environment, the emissions associated with the proposed construction accommodation village are immaterial.

Table 6: Disturbance Emission Estimates

Mine	Ha	TSP (kg/year)	PM ₁₀ (kg/year)	PM _{2.5} (kg/year)
Project	10	11,000	5,500	1,100
Saraji Mine	4163	5,120	2,600,000	510,000

Mine	Ha	TSP (kg/year)	PM ₁₀ (kg/year)	PM _{2.5} (kg/year)
Peak downs	4801	5,900	2,950,000	590,000
Lake Vermont	1369	1,680	840,000	126,000
Notes: Emissions based on:				
- NPI – Default value of 0.4 kg/ha/hr for TSP - An assumed 50% of TSP as PM₁₀ - An assumed 20% PM₁₀ as PM_{2.5}				

4.4.2 Operational Phase

As noted in Section 2, the Project will mine a maximum of 11 Mtpa ROM coal. The Project CHPP will have the capacity to process 7 Mtpa ROM coal with excess ROM coal trucked from the CHPP to the Saraji Mine CHPP for processing. For the purposes of this assessment, an hourly peak throughput of 800 tph through the Project CHPP and 500 tph through the Saraji Mine CHPP has been assumed.

A summary of the dust emission estimates for the Project is presented in Table 7 (and Figure 7) for the Peak BAU case and in Table 8 (and Figure 8) for the Peak Upset case.

Note that when developing estimates for PM_{2.5} it has been conservatively assumed that 20% of PM₁₀ is in the form of PM_{2.5}.

Table 7: Project-Only Case: Summary of Emissions Inventory (Peak BAU Case)

Emission Source	Control	TSP (kg/year)	PM ₁₀ (kg/year)	PM _{2.5} (kg/year)
Operations Phase (Peak BAU)				
Activities at Project CHPP				
Conveying of coal	50% Ushaped	1,659	829	166
Coal processing (breaker station)	50% water spray	139,810	50,589	10,118
Stacking/reclaiming coal	50% water spray	26,192	11,388	2,278
Dozers on coal	No controls	87,554	25,230	5,046
Wind erosion of stockpiles	No controls	2,393	1,197	239
Transport of excess ROM coal to Saraji CHPP	75% Level 2 watering	175,200	43,800	8,760
Activities at Saraji Mine CHPP				
Dumping of coal	50% water spray	21,900	9,198	1,840
Coal processing (breaker station)	50% water spray	33,288	12,045	2,409
Stacking/reclaiming coal	50% water spray	10,074	4,380	876
Underground Ventilation Outlets	No controls	49,720	24,860	4,972
Project Total (kg/year)		547,790	183,516	36,703

Figure 7: Project-Only Case: Summary of Emissions Inventory (Peak BAU Case)

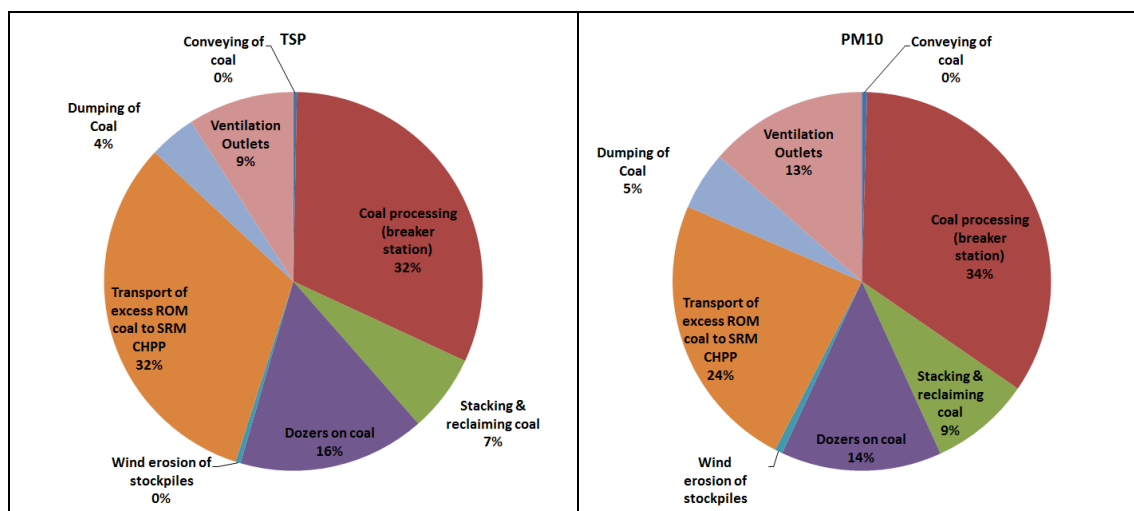
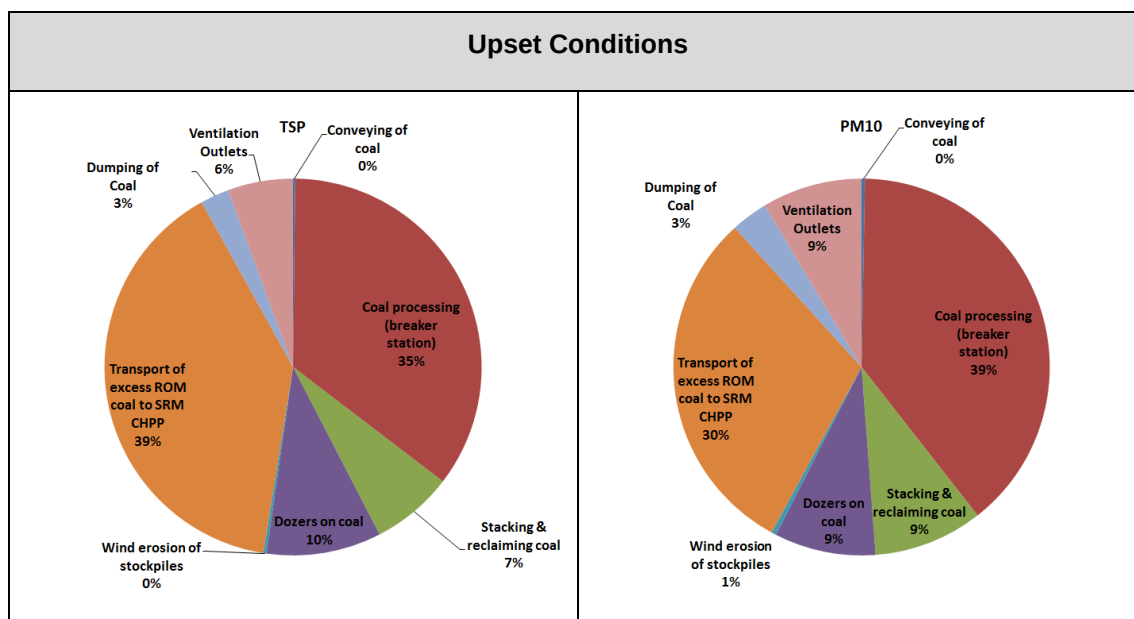


Table 8: Project-Only Case: Summary of Emissions Inventory (Peak Upset Case)

Emission Source	Control	TSP (kg/year)	PM ₁₀ (kg/year)	PM _{2.5} (kg/year)
Operations Phase (Upset Conditions)				
Activities at Project CHPP				
Conveying of coal	50% Ushaped	1,659	829	166
Coal processing (breaker station)	No controls	279,619	101,178	20,236
Stacking/reclaiming coal	No controls	52,385	22,776	4,555
Dozers on coal	No controls	87,554	25,230	5,046
Wind erosion of stockpiles	No controls	2,393	1,197	239
Transport of excess ROM coal to Saraji CHPP	50% Level 1 watering	350,400	87,600	17,520
Activities at Saraji Mine CHPP				
Dumping of coal	50% water spray	21,900	9,198	1,840
Coal processing (breaker station)	50% water spray	33,288	12,045	2,409
Stacking/reclaiming coal	50% water spray	10,074	4,380	876
Underground Ventilation Outlets	No controls	49,720	24,860	4,972
Project Total (kg/year)		888,992	289,293	57,859

Figure 8: Project-Only Case: Summary of Emissions Inventory (Peak Upset Case)



4.5 Dust Dispersion Modelling

The dispersion model that was used for this assessment is based on the CALMET/CALPUFF suite of modelling tools.

Regional, three-dimensional wind fields that are used as input into the dispersion model were prepared using a combination of The Air Pollution Model (TAPM) developed by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) (Hurley, 2008), and CALMET (Scirer, 2000), the meteorological pre-cursor for CALPUFF (2011). Due to the large areal extent of the model domain and the lack of observational data, data assimilation was not undertaken. Numerically simulated, hourly meteorology was developed for 2019 (Figure 9).

The dust emissions inventory developed in Section 4.4.2 (and Appendix C) was used as input into the dispersion modelling. Source locations are indicated in Figure 10.

Figure 9: Location of Meteorological Data extracted from CALMET (left) and corresponding Wind Rose for 2019 (right)

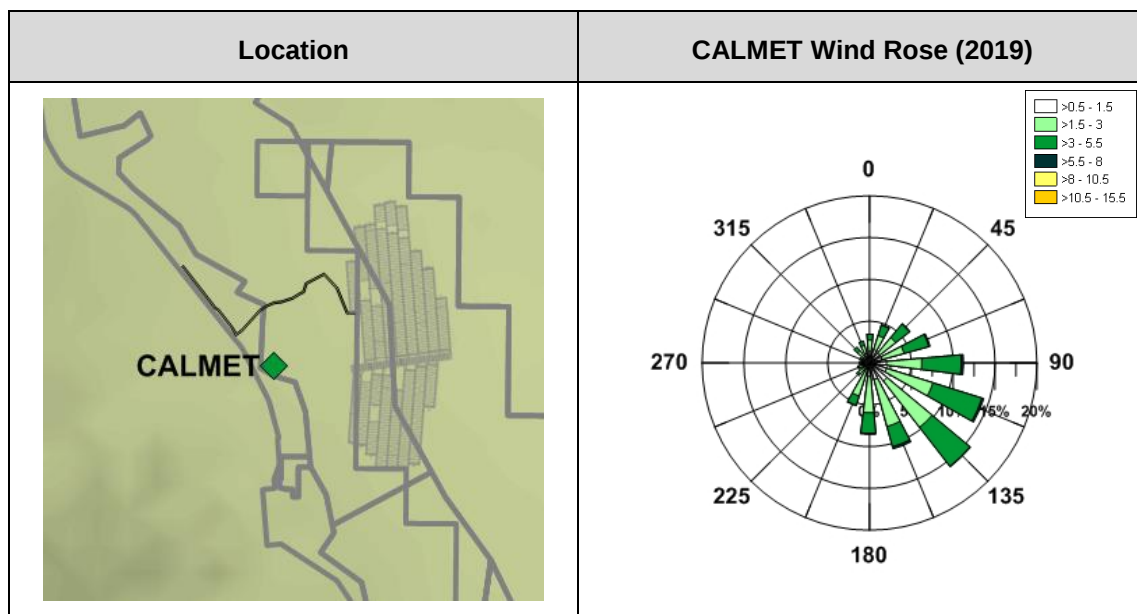


Figure 10: Source Locations Included in the Dispersion Modelling



4.5.1 Modelling Assumptions and Implications

A necessary component of any air quality assessment is the need to incorporate a wide range of assumptions, the consequence(s) of which can be difficult to quantify. Nonetheless, a summary of some of the key assumptions that have been incorporated into the dust dispersion modelling methodology utilised for this assessment, the implication(s) of these assumptions and comments are summarised in Table 9.

Table 9: Modelling Assumptions and Implications

Category	Assumption	Implication and Comments
Background levels	Single value applicable for all locations and all times of the year	The use of a single value for background levels of masks the spatial and temporal variability particularly of these parameters.
Impact of rain days	Rainfall not included	The dust dispersion model methodology adopted for this assessment does not explicitly include rainfall as the validation of rainfall frequency and intensity would add another level of uncertainty when interpreting results. The omission of rainfall from the assessment methodology would suggest that results presented are likely to be more representative of drier years and conservative during periods of above average rainfall. In general, the wet/dry season may affect the number of predicted exceedances via: - The reduction/elevation of background levels of dust. - The reduction/elevation of the potential for windblown dust from exposed areas. - The seasonal variation of topsoil moisture content. - (To a lesser extent) the potential for seasonal variation in overburden moisture content although dust generation from the material handling of overburden is likely to be highly influenced by material type as well as any possible seasonal variation in moisture content.
Emission Factors	Based on the NPI Emission Estimation Technique Manual for Mining V3.1 (NPI EETM)	The NPI EETM (NPI, 2012) has been used to estimate the amount of PM₁₀ emitted from the various mining activities and were supplemented with those from the US EPA's AP42 (USEPA, 1995) as required and/or considered appropriate. Important parameters that are used in the NPI EETM emission factor formulas associated with material handling include silt and moisture content. However, as there was no site-specific data pertaining to these parameters for overburden (as an example), adopted values have been assumed based on information

Category	Assumption	Implication and Comments
		contained in the US EPA AP42 (1995). It is acknowledged that the lack of site-specific material parameter information may limit the representativeness of the emission factors developed for this assessment. A seasonal site-based sampling program could be implemented however, a robust data set would require several seasons worth of data and good data/meteorological correlation.
PM ₁₀ as PM _{2.5}	20% of PM ₁₀ emissions are in the form of PM _{2.5}	Results presented for potential impacts of emissions of PM_{2.5} associated with the Project are likely to be highly conservative based on the fact that the Project is primarily associated with mechanically generated dust (i.e. not combustion related generation of PM_{2.5}). It is noted that only combustion related PM_{2.5} and not mechanically generated emissions of PM_{2.5} are required to be reported by mining operations annually to the NPI.
Dispersion model output correction factors (PM ₁₀) for SRM and PDM	The findings of the analysis based on c. 15 months of data are sufficiently robust for the purposes intended.	The development of correction factors for temperature inversion (not provided) that were applied to the PM₁₀ dispersion modelling results for SRM and PDM open cut mining operations, was based on the results of an analysis of data from the CVM monitoring network including data from the site' temperature inversion towers.
Mitigation Scenarios	The predicted improvement in air quality outcomes associated with the modelled dust mitigation scenarios is representative of outcomes in practice.	The mitigation scenarios considered assume that the mitigation effectiveness as modelled is representative of the environmental benefit that would be realised in practice if implemented when required. In relation to the Project, the nature of the dust emission sources (i.e. primarily associated with CHPP related activities) suggests that the modelled outcomes may be more representative of potential improvement in environmental outcomes than compared to open cut mining operations for which dust emissions are dominated by mobile sources. In relation to mitigation scenarios applied to the open cut mines PDM and SRM (for the purposes of the cumulative impact assessment) it is noted that in practice, daily varying mine intensities and locations may differ from the annual average mine intensity and locations that are used in the dispersion.

5. Interpretation of Predicted Dust Impacts

Presented in Section 5.1 and Section 5.2 are the results for the annual average concentration of TSP, the 24 hour and annual average concentrations of PM₁₀ and PM_{2.5}, as well as the monthly average dust deposition for the Project-only Peak BAU Case.

Results for the cumulative impact assessment are presented in Section 5.3.

5.1 Health Related Criteria

5.1.1 Results for TSP

Presented in Table 10 are the results for the annual average concentration of TSP based on 2019 meteorology.

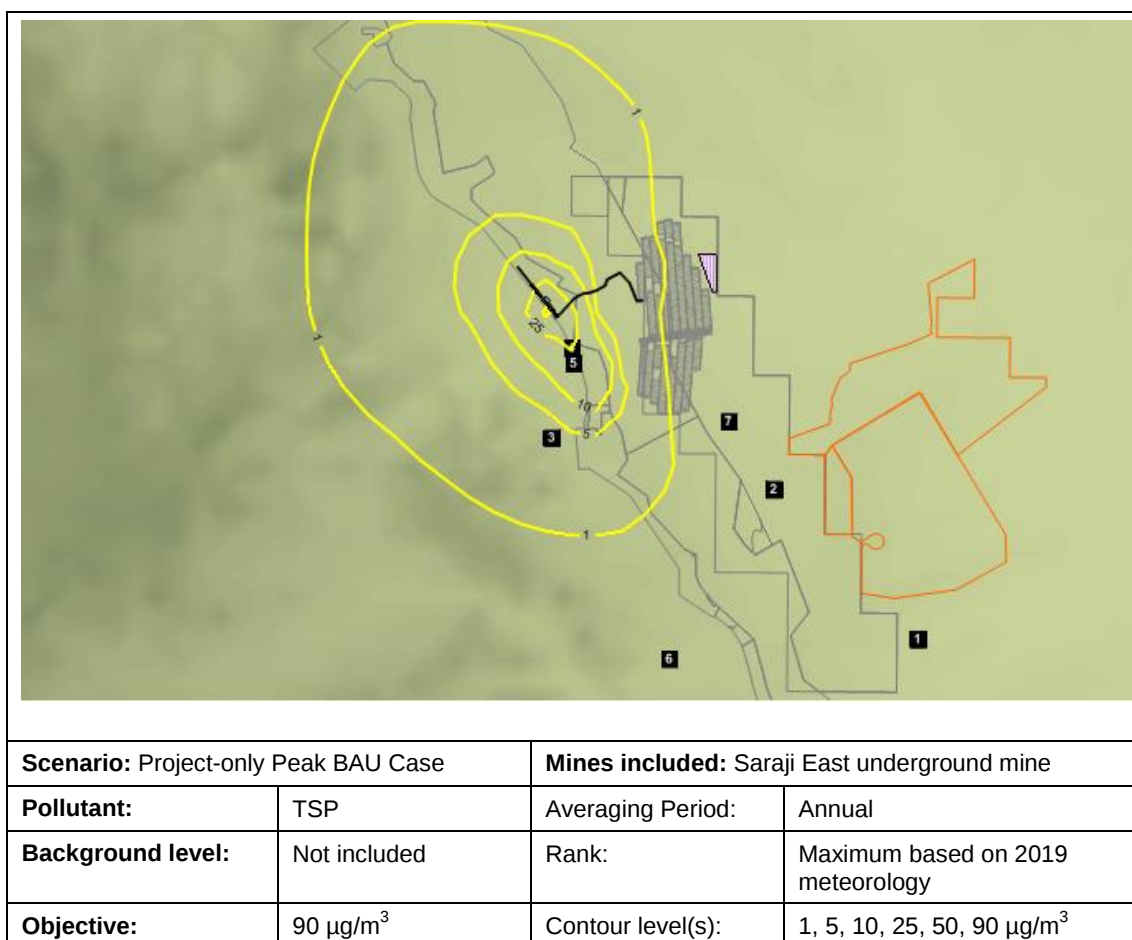
Results of the dispersion modelling do not highlight any significant issues in relation to emission of TSP from the Project (in isolation) with annual concentrations predicted to be less than c. 28% of the Project goal of 90 µg/m³ (EPP(Air) and Ambient Air Quality NEPM) at assessment locations.

Presented in Figure 11 is a contour plot of the annual average concentration of TSP.

Table 10: Project-Only Peak BAU Case: Results for TSP

ID	Description	Averaging Period	Project-Only (µg/m ³)	Percentage of Goal
1	Kyewong Homestead	Annual	0.0	0%
2	Lake Vermont Homestead	Annual	0.1	0%
3	Saraji Homestead 1	Annual	3.6	4%
4	Saraji Homestead 2	Annual	25.3	28%
5	Saraji Homestead 3	Annual	20.3	23%
6	Tay Glen Homestead	Annual	0.3	0%
7	Meadowbrook Homestead	Annual	0.4	0%

Figure 11: Project-Only Peak BAU Case: Annual Average Concentration of TSP



5.1.2 Results for PM₁₀

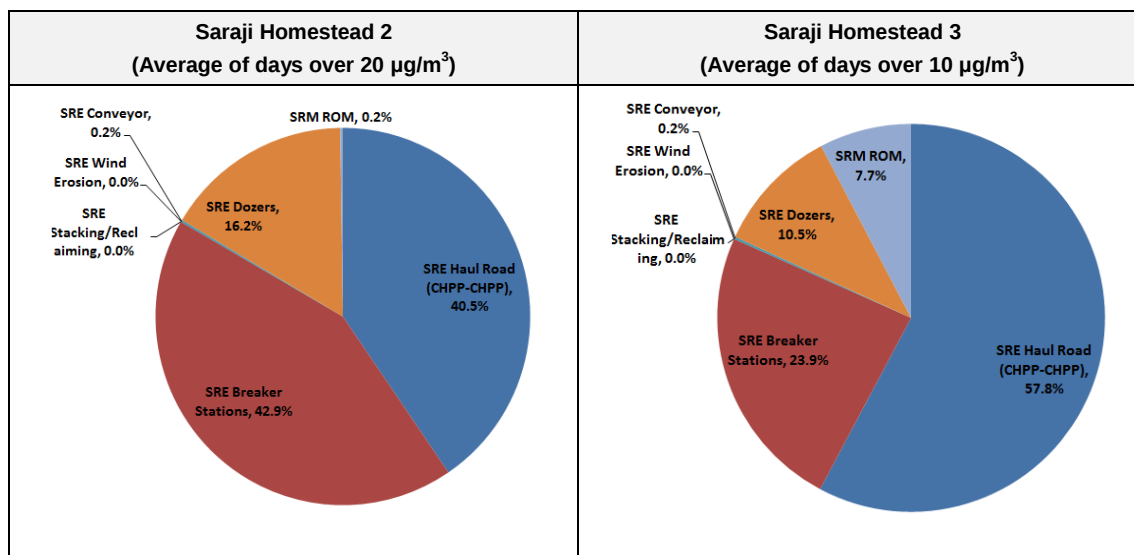
Presented in Table 11 is the maximum predicted 24 hour average and annual average concentration of PM₁₀ at the assessment locations as a result of emissions of dust from the Project in isolation of other dust emissions sources. Results for both the Peak BAU Case and Peak Upset Case (Section 4.2) are included in the table. It is noted that the results presented exclude estimates of background levels of dust (Section 3.3.1).

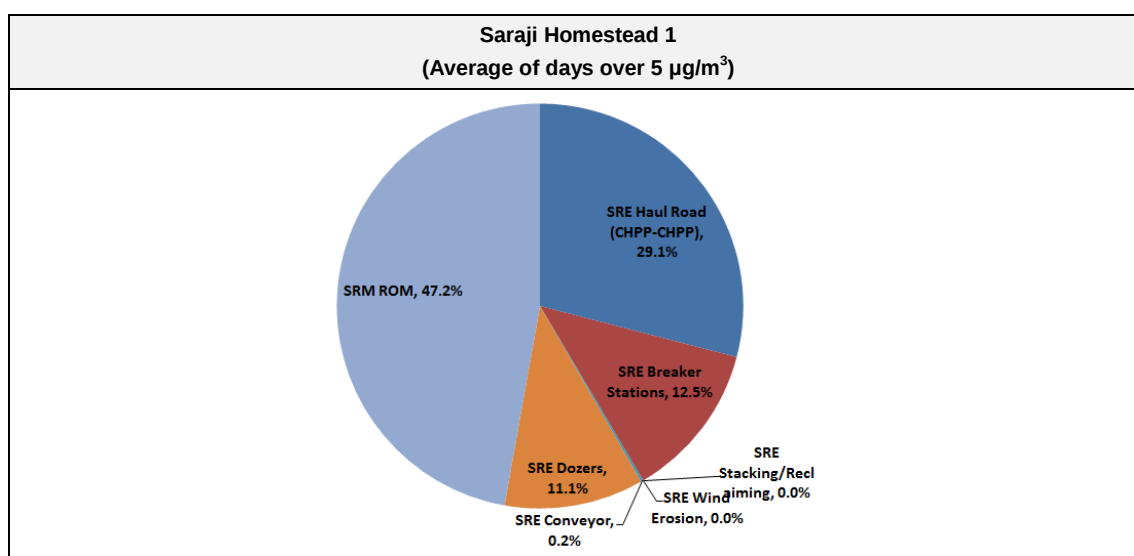
Under peak operating conditions, the Project-only contributions to the maximum 24 hour average concentration are not predicted to exceed the project goal of 50 µg/m³ (EPP(Air) and Ambient Air Quality NEPM) at any assessment locations. It is noted that Saraji Homestead 2 is predicted to reach 60% and Saraji Homestead 3 is predicted to reach 40% of the project goal. These two assessment locations are located in close proximity to the Project CHPP (Figure 5). As background levels for the 24 hour average concentration of PM₁₀ (in the absence of anthropogenic contribution) is estimated to be 24.7 µg/m³ or 49% of the Project goal, results of the dispersion modelling suggest that additional dust reduction measures (c.f.

to the BAU case) may be required to mitigate the risk of additional exceedances i.e. in addition to those that be attributable to non-Project related dust emission sources such as regional dust events or open cut mining operations that operate within the local airshed (Section 5.3).

Presented in Figure 7 is a breakdown of the average percentage contribution from the Project's dust emission sources to predicted impacts at the location of the three Saraji Homesteads based on an average of all days for which the Project is predicted to contribute more than the indicated amount ($\mu\text{g}/\text{m}^3$) to the 24 hour average concentration of PM_{10} (i.e. $5 \mu\text{g}/\text{m}^3$, $10 \mu\text{g}/\text{m}^3$ or $20 \mu\text{g}/\text{m}^3$). Results presented are based on the Project-Only Peak BAU Case and it is noted that the relative contribution of the key drivers to predicted dust impacts varies from location to location.

Figure 12: Project-Only Peak BAU Case: Summary of Key Drivers





Results of the dispersion modelling based on the Project-Only Peak Upset Case (Table 9) highlight the potential risk of dust impacts at both Saraji Homestead 2 and Saraji Homestead 3 based on Project dust emission sources.

Presented in Figure 13 is a contour plot of the maximum 24 hour average concentration of PM_{10} for the Project-Only Peak BAU Case. A contour plot for the Project-Only Peak Upset Case is included as Figure 14.

Presented in Figure 15 is a contour plot of the maximum annual average concentration of PM_{10} for the Project-Only Peak BAU Case based on 2019 meteorology.

Table 11: Project-Only Case: Results for PM_{10}

ID	Description	Averaging Period	Peak BAU Case		Peak Upset Case	
			Project-Only $\mu\text{g}/\text{m}^3$	Percentage of Goal	Project-Only $\mu\text{g}/\text{m}^3$	Percentage of Goal
1	Kyewong Homestead	24 hour	0.5	1%	0.8	2%
		Annual	0.0	0%	-	-
2	Lake Vermont Homestead	24 hour	1.4	3%	2.3	5%
		Annual	0.1	0%	-	-
3	Saraji Homestead 1	24 hour	8.7	17%	12.2	24%
		Annual	1.2	5%	-	-
4	Saraji Homestead 2	24 hour	30.2	60%	55.8	112%
		Annual	7.0	28%	-	-

ID	Description	Averaging Period	Peak BAU Case		Peak Upset Case	
			Project-Only $\mu\text{g}/\text{m}^3$	Percentage of Goal	Project-Only $\mu\text{g}/\text{m}^3$	Percentage of Goal
5	Saraji Homestead 3	24 hour	21.7	43%	39.5	79%
		Annual	5.6	22%	-	-
6	Tay Glen Homestead	24 hour	1.5	3%	2.4	5%
		Annual	0.1	0%	-	-
7	Meadowbrook Homestead	24 hour	2.1	4%	3.4	7%
		Annual	0.1	0%	-	-

Figure 13: Project-Only Peak BAU Case: Maximum 24 Hour Average Concentration of PM_{10}

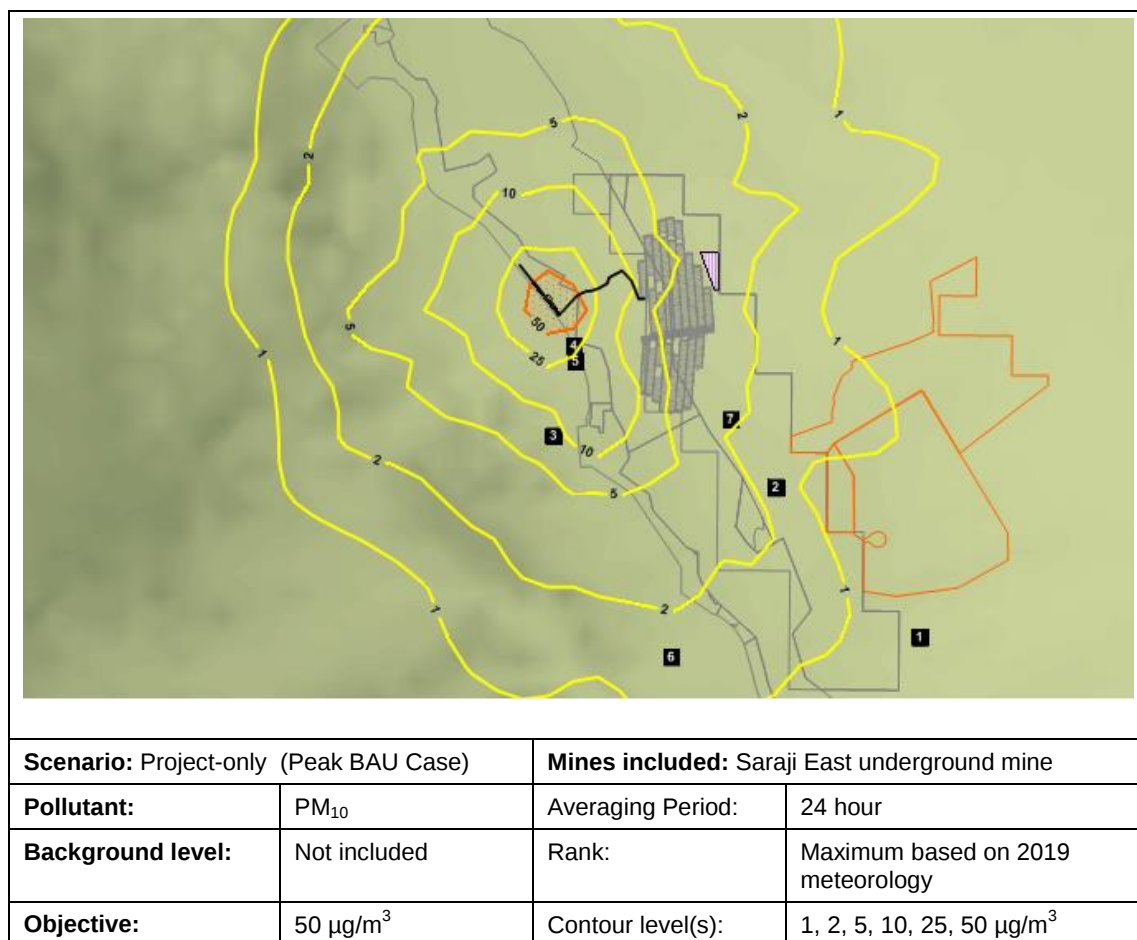


Figure 14: Project-Only Peak Upset Case: Maximum 24 Hour Average Concentration of PM₁₀

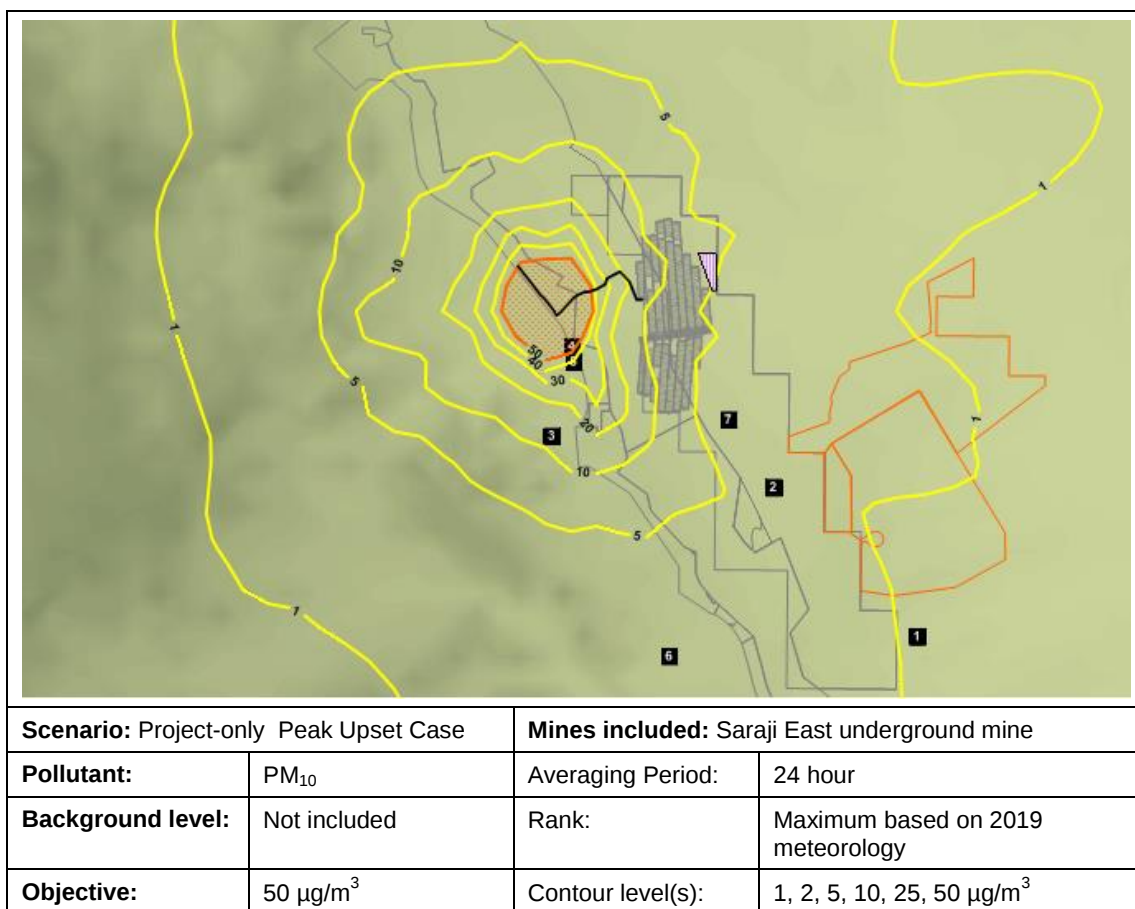
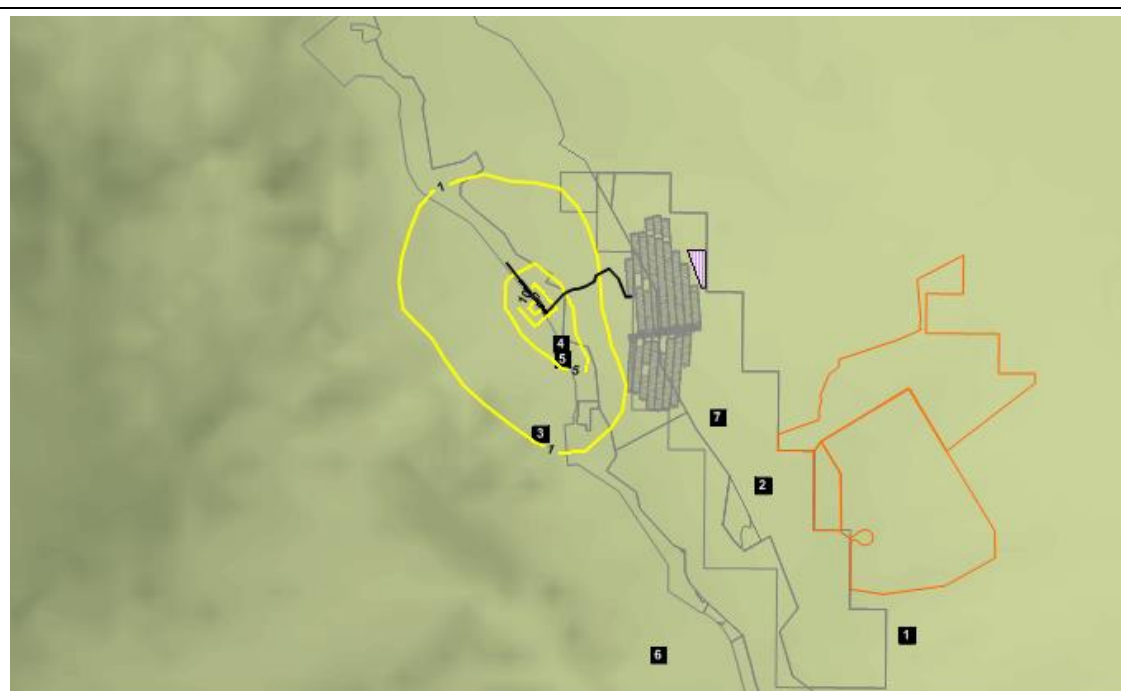


Figure 15: Project-Only Peak BAU Case: Annual Average Concentration of PM₁₀

Scenario: Project-only Peak BAU Case		Mines included: Saraji East underground mine	
Pollutant:	PM ₁₀	Averaging Period:	Annual
Background level:	Not included	Rank:	Maximum based on 2019 meteorology
Objective:	25 µg/m ³	Contour level(s):	1, 5, 10, 15, 20, 25 µg/m ³

5.1.3 Results for PM_{2.5}

Presented in Table 12 are the results for the maximum 24 hour average concentration of PM_{2.5} for the Project-Only Peak BAU Case and the Project-Only Peak Upset Case at assessment locations. Included in the table are results for the annual average concentration of PM_{2.5} for the Project-Only Peak BAU Case. Results for the annual average of PM_{2.5} for the Peak Upset Case are not provided due to the infrequent occurrence of upset conditions.

Project-only contributions to the 24 hour average concentrations of PM_{2.5} (Peak BAU Case) at the Saraji 2 Homestead and Saraji 3 Homestead, which are located in close proximity to the Project CHPP, are predicted to be c. 24% and 17% of the Project goal of 25 µg/m³ (EPP(Air) and Ambient Air NEPM). These results are considered to be conservative based on the assumption that 20% of PM₁₀ is in the form of PM_{2.5}. As background levels for the 24 hour average concentration of PM_{2.5} (in the absence of anthropogenic contribution) is estimated to be 17.7 µg/m³ or 75% of the Project goal, results of the dispersion modelling suggest that exceedances of the Project goal may occur as a result of cumulative impacts. Project-only

contribution to impacts at all other locations is predicted to be small with ambient air quality predicted to be well below the Project goal of 25 $\mu\text{g}/\text{m}^3$.

A contour plot of the 24 hour average concentration of $\text{PM}_{2.5}$ is presented in Figure 16 for the Project-Only Peak BAU Case and in Figure 17 for the Project-Only Peak Upset Case.

Table 12: Project-Only Peak BAU Case: Results for $\text{PM}_{2.5}$

ID	Description	Averaging Period	Peak BAU Case		Peak Upset Case	
			Project Only ($\mu\text{g}/\text{m}^3$)	Percentage of Goal	Project Only ($\mu\text{g}/\text{m}^3$)	Percentage of Goal
1	Kyewong Homestead	24 hour	0.1	0%	0.2	1%
		Annual	0.0	0%	-	-
2	Lake Vermont Homestead	24 hour	0.3	1%	0.5	2%
		Annual	0.0	0%	-	-
3	Saraji Homestead 1	24 hour	1.7	7%	2.4	10%
		Annual	0.2	3%	-	-
4	Saraji Homestead 2	24 hour	6.0	24%	11.2	45%
		Annual	1.4	17%	-	-
5	Saraji Homestead 3	24 hour	4.3	17%	7.9	32%
		Annual	1.1	14%	-	-
6	Tay Glen Homestead	24 hour	0.3	0%	0.5	2%
		Annual	0.0	0%	-	-
7	Meadowbrook Homestead	24 hour	0.4	0%	0.7	3%
		Annual	0.0	0%	-	-

No significant air quality issues attributable to the Project have been identified in relation to the maximum annual average concentration of $\text{PM}_{2.5}$ with Project-only contributions predicted to be less than 17% of the Project goal of 8 $\mu\text{g}/\text{m}^3$ (EPP(Air) and Ambient Air NEPM) (Table 12). A contour plot is presented in Figure 18 for the annual average concentration of $\text{PM}_{2.5}$.

Figure 16: Project-Only Peak BAU Case: Maximum 24 Hour Average Concentration of PM_{2.5}

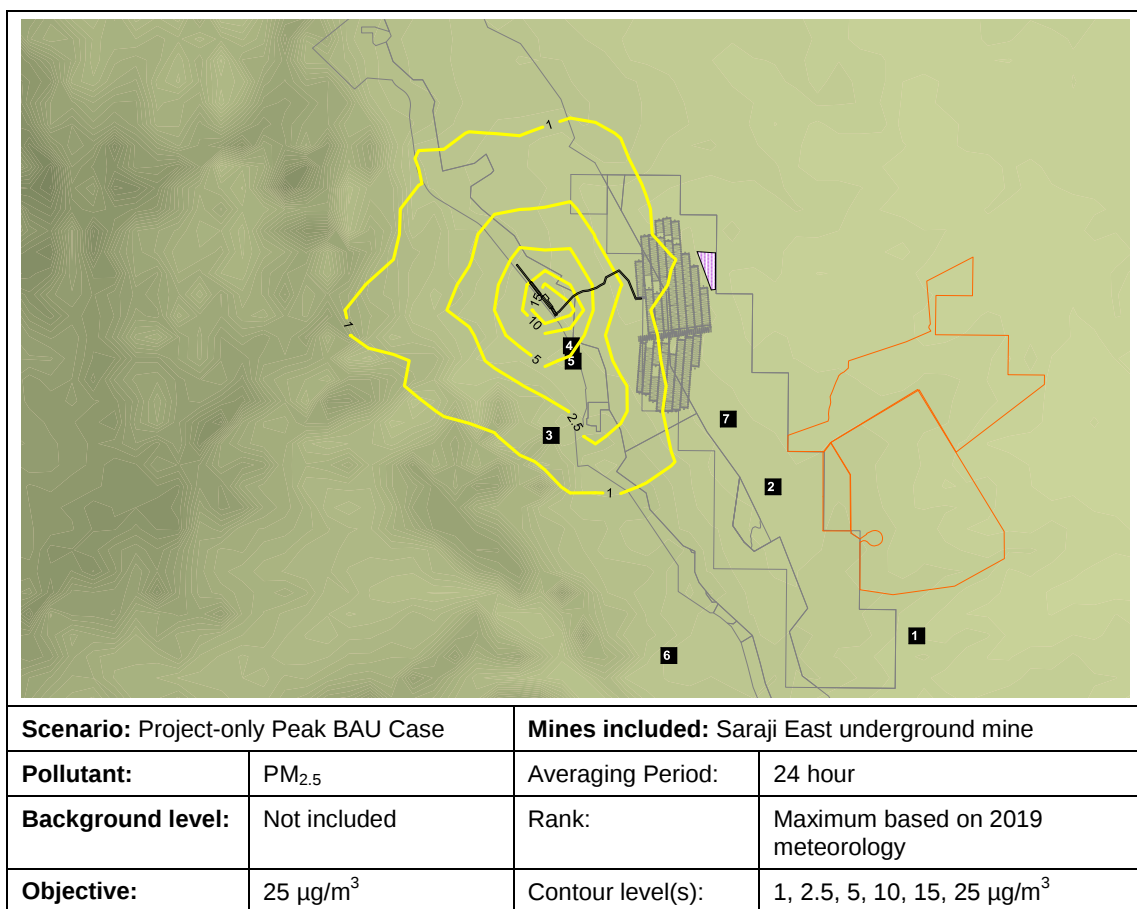


Figure 17: Project-Only Peak Upset Case: Maximum 24 Hour Average Concentration of PM_{2.5}

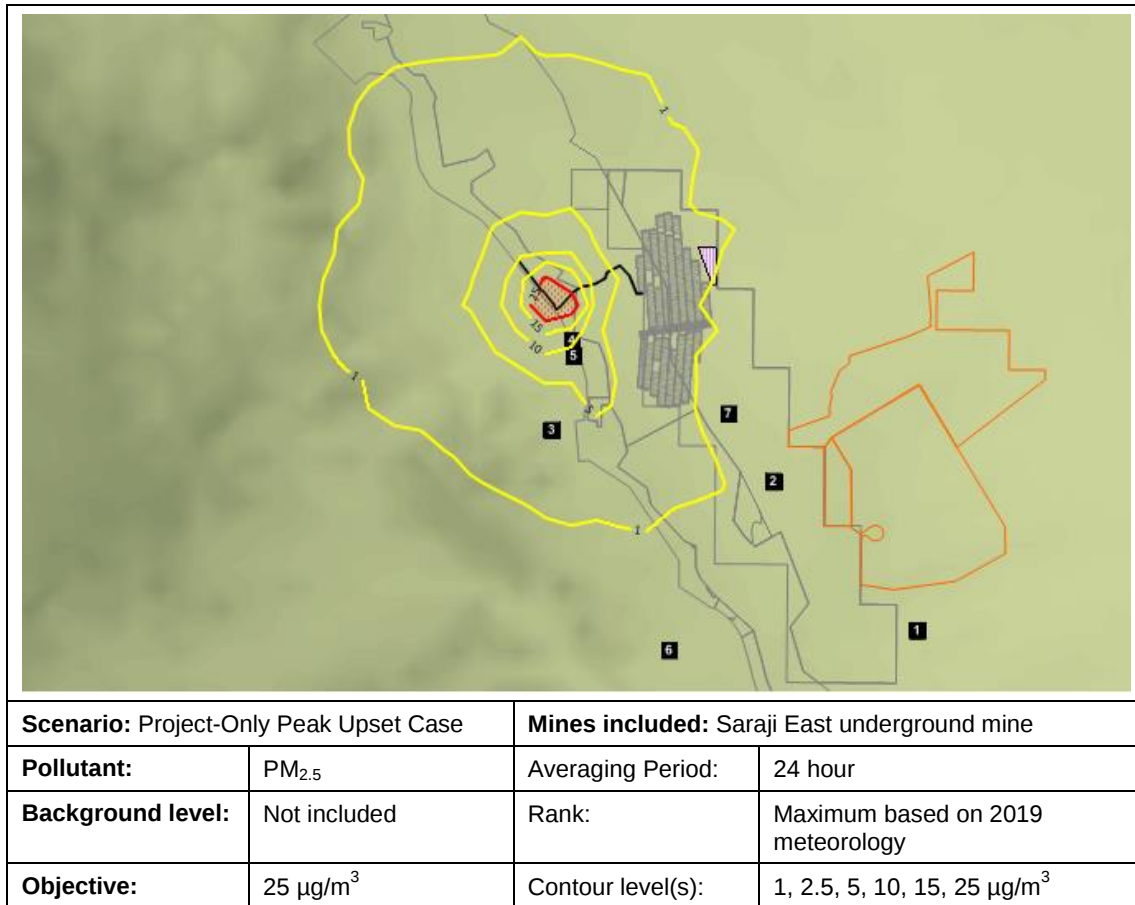
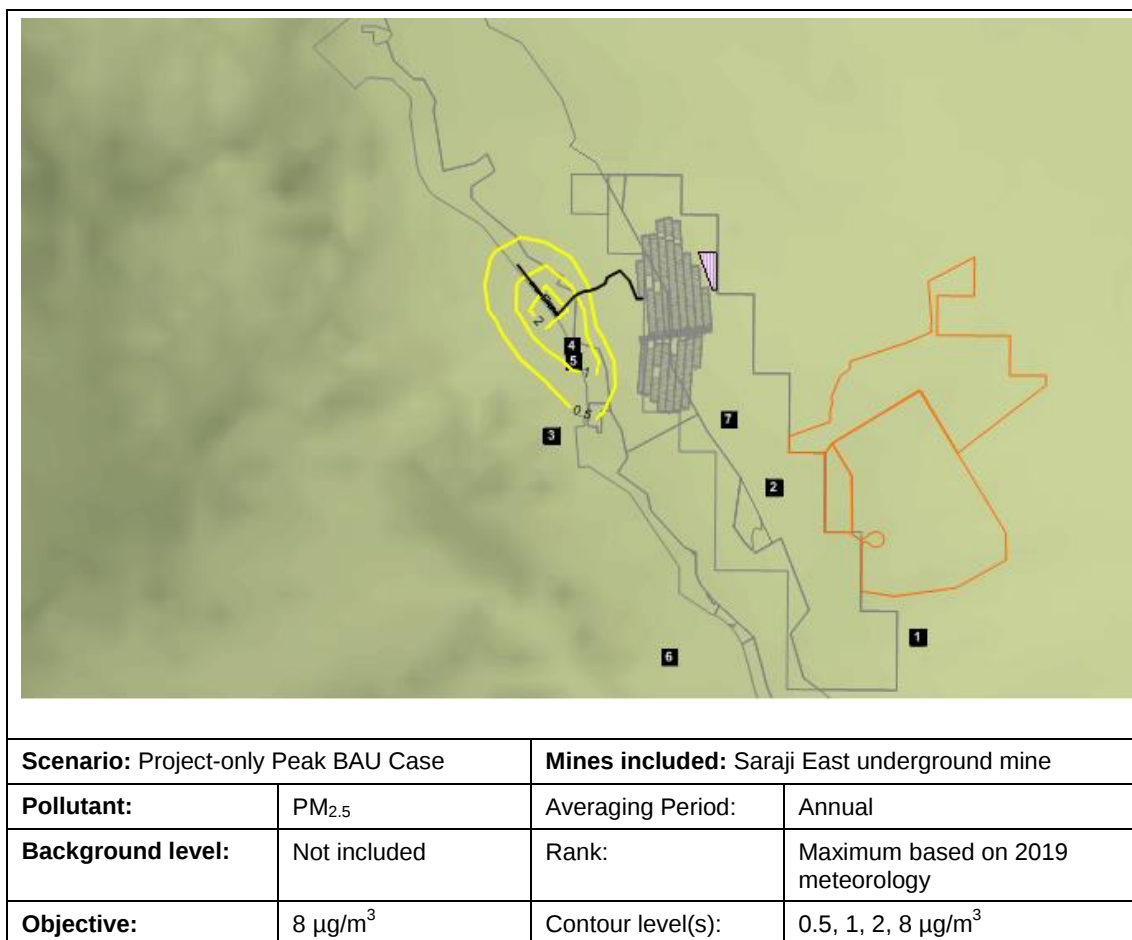


Figure 18: Project-Only Peak BAU Case: Annual Average Concentration of PM_{2.5}



5.2 Nuisance-Related Criteria

5.2.1 Results for Dust Deposition

Presented in Table 13 are the results for dust deposition for the Project-Only Case.

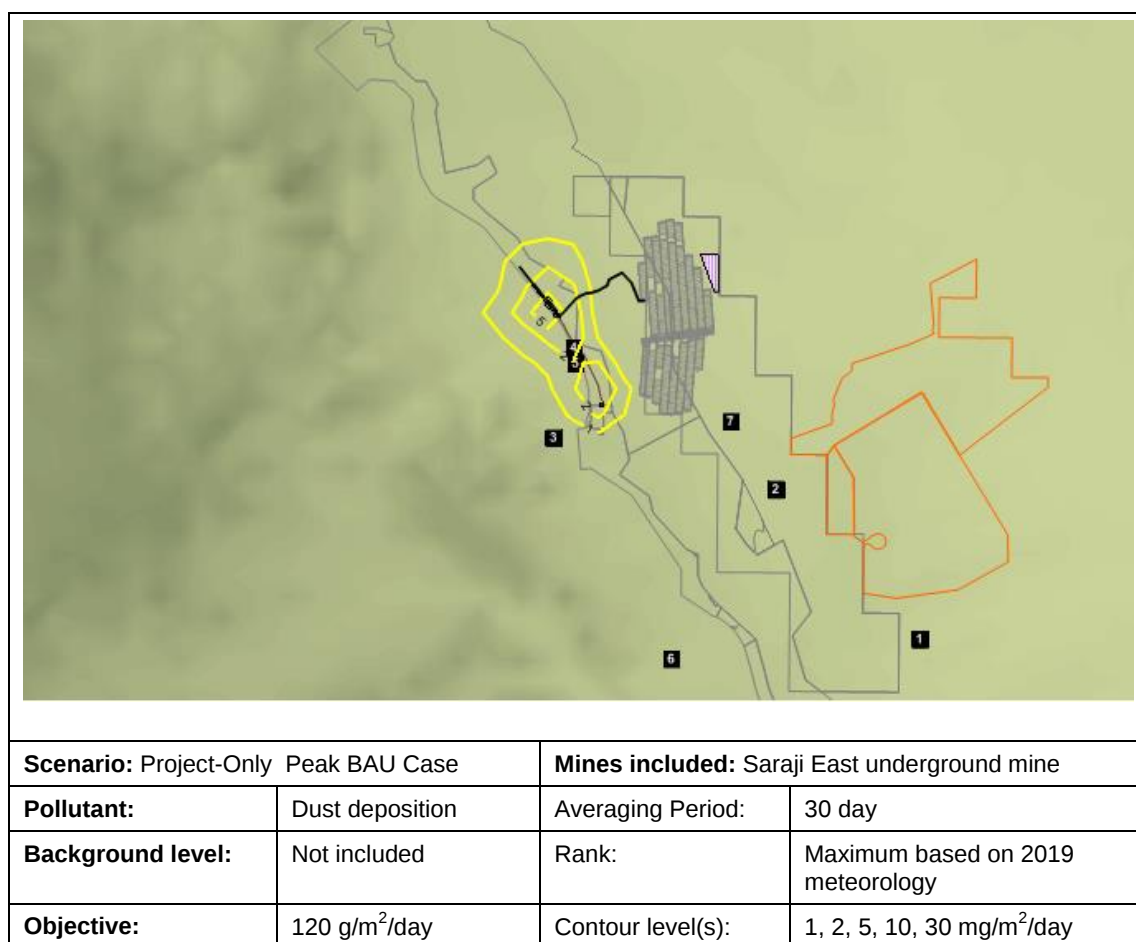
No air quality issues have been identified with Project-only contributions predicted to be less than c. 2% of the Project goal at all locations.

A contour plot based on 2019 meteorology is included as Figure 19.

Table 13: Project-Only Peak BAU Case: Results for Dust Deposition

ID	Description	Averaging Period	Project-Only (mg/m ³ /day)	Percentage of Goal
1	Kyewong Homestead	30 day	0.0	0%
2	Lake Vermont Homestead	30 day	0.0	0%
3	Saraji Homestead 1	30 day	0.5	0%
4	Saraji Homestead 2	30 day	2.4	2%
5	Saraji Homestead 3	30 day	2.0	2%
6	Tay Glen Homestead	30 day	0.1	0%
7	Meadowbrook Homestead	30 day	0.0	0%

Figure 19: Project-Only Peak BAU Case: Maximum 30 Day Average Dust Deposition



5.3 The Future Environment and Cumulative Impacts

As noted in Section 2, the airshed within which the Project will exist is complicated, with a number of existing open cut mining operations which will continue to be significant sources of dust throughout the life of the Project.

5.3.1 Comparison with Emissions reported to the NPI

Presented in Table 14 is a comparison of fugitive emissions of PM₁₀ from the Project with those reported to the National Pollutant Inventory (NPI) for FY22 by Saraji Mine, Peak Downs Mine and Lake Vermont Mine (Figure 2).

Based on NPI reported fugitive emissions to air (FY22), emissions of PM₁₀ associated with the Project are estimated (Table 7) to be less than 2.5% of those released by the neighbouring Saraji Mine and less than 0.6% of the total airshed loading from all four mining operations combined. Future increases or decreases in open cut mining production rates may have a significant influence on airshed loading of PM₁₀ whilst the Project contribution (i.e. an estimated 184 tonnes/year) is anticipated to be relatively consistent. Thus impacts on local air quality that are attributable to the Project are considered to be immaterial when compared to the air quality environment resulting from neighbouring open cut mining operations.

Table 14: NPI Reported Fugitive Emissions of PM₁₀ from Local Mining Operations

Mine	Mining Method	Fugitive PM ₁₀ Emission (tonnes/year)	Source
Saraji Mine	Open cut	7,313	NPI FY22
Peak Downs Mine	Open cut	12,205	NPI FY22
Lake Vermont Mine	Open cut	10,561	NPI FY22
The Project	Underground	184	Table 7
Total		30,079	

In relation to emissions of TSP and PM₁₀, it is noted that annual reporting to the NPI is not required for emissions of TSP and only combustion-related emissions are required to be reported for PM_{2.5}. Thus a similar comparison of Project emissions with other significant dust emissions sources within the local airshed is not able to be undertaken based on NPI data.

However, based on a review of Table 2 of the *NPI Emissions Estimation Technique Manual for Mining Version 3.1 (January 2012)* (NPI EETM Mining), a ratio of PM₁₀ to TSP of 0.4 (or c. 40% of TSP is in the particulate size of PM₁₀) has been used to estimate TSP emissions from the open cut mining operations listed in Table 14 with results presented in Table 15.

In order to estimate emissions of PM_{2.5} from the open cut mining operations, an estimate of 20% of PM₁₀ is assumed to be in the form of PM_{2.5} has been adopted (Table 16).

Table 15: Fugitive Emissions of TSP from Local Mining Operations

Mine	Mining Method	Fugitive TSP Emission (tonnes/year)	Source
Saraji Mine	Open cut	18,282	NPI EETM Mining
Lake Vermont Mine	Open cut	26,402	NPI EETM Mining
Peak Downs Mine	Open cut	30,512	NPI EETM Mining
The Project	Underground	584	Table 7
Total		75,196	

Table 16: Fugitive Emissions of PM_{2.5} from Local Mining Operations

Mine	Mining Method	Fugitive PM _{2.5} Emission (tonnes/year)	Source
Saraji Mine	Open cut	1,462	Estimate
Lake Vermont Mine	Open cut	2,112	Estimate
Peak Downs Mine	Open cut	2,441	Estimate
The Project	Underground	37	Table 7
Total		6,016	

5.3.2 Cumulative Impacts based on Dispersion Modelling

To complement the analysis of NPI fugitive emissions to air presented in Section 5.3.1, detailed dispersion modelling of the 24 hour average concentration of PM₁₀ has been undertaken for emission sources associated with BMA's SRM and PDM. Results from the dispersion modelling have been combined with impacts associated with the Project and estimates of background levels (Section 3.3.1).

Due to the lack of publically available detailed mine plan information the explicit modelling of Lake Vermont Mine (LVM) was not undertaken as part of this cumulative impact assessment. It is noted however that assessment locations located to the west of SRM will be principally affected by dust from the Project and/or SRM. At assessment locations to the east of the Project and SRM, and west of LVM, the dominate contributors of dust impacts will be able to be identified as originating from a BMA operation or LVM based on wind direction data recorded at ambient air monitoring locations between the BMA and non-BMA operations where/if required. For the purposes of this cumulative impact assessment it is assumed that

operations at LVM will manage dust emissions in accordance with EPP(Air) objectives at locations of interest to the regulating authority. (The reader is directed to the following website for information in relation to the recent Lake Vermont Meadowbrook Extension Environmental Impact Statement <https://jellinbah.com.au/environment/LV-Meadowbrook-Extension-EIS/>)

Detailed life of mine (LOM) mine plan information was provided by BMA for SRM and PDM. Dust emission sources that were explicitly modelled included:

- SRM:
 - Material handling of overburden by Truck & Shovel (loading, hauling, dumping)
 - Material handling of overburden by dragline
 - Material handling of coal (loading, hauling dumping)
 - Material handling of rejects (hauling)
 - CHPP (stacking, reclaiming, crushing)
 - Wind erosion of exposed areas
- PDM:
 - Material handling of overburden by Truck & Shovel (loading, hauling, dumping)
 - Material handling of overburden by dragline
 - Material handling of coal (loading, hauling dumping)
 - Material handling of rejects (hauling)
 - Wind erosion of exposed areas

Dispersion modelling was undertaken for a suite of dust emissions scenarios (referred to herein as 'mitigated' cases) for both SRM and PDM that ranged from BAU (Section 4.2) to the ceasing of activities in key areas during adverse meteorological conditions. A preliminary investigation into the key drivers of dust impacts from the open cut mining operations highlighted material handling by truck and shovel as having a major influence on predicted air quality outcomes. Therefore modelled dust reduction scenarios focused on mitigation measures that target waste handling by truck shovel mining methods. A summary of the mitigation scenarios that were investigated is provided in Table 17.

It is noted that the percentage reduction of dust for the mitigation scenarios listed in the table may be achieved using one or more of a combination of dust mitigation options for example:

- Reducing haul distances where possible
- Reducing vehicle speed and thus vehicle kilometres travelled (VKT) per hour

- Reducing the number of operating trucks
- Reducing the front end loader drop height of material when loading trucks

Two additional mitigation scenarios have been included in Table 17 that focus on dust mitigation strategies other than truck and shovel mining methods:

- Draglines only in operation in key areas on high risk days.
- The cessation of all mining activities in key areas on high risk days.

Table 17: SRM and PDM Mitigation Scenarios Investigated

Scenario	Description	Comments
BAU	• All of site operating based on business as usual dust management practices	• All activities, all locations.
25% Reduction in Waste Material Handling	• A reduction in dust emissions associated with Truck & Shovel activity (including loading, hauling and dumping of waste material) by 25% in key source areas on high risk days	• Assumes all other activities are operating as per BAU in key source areas on high risk days
50% Reduction in Waste Material Handling	• A reduction in dust emissions associated with Truck & Shovel activity (including loading, hauling and dumping of waste material) by 50% in key source areas on high risk days	• Assumes all other activities are operating as per BAU in key source areas on high risk days
75% Reduction in Waste Material Handling	• A reduction in dust emissions associated with Truck & Shovel activity (including loading, hauling and dumping of waste material) by 75% in key source areas on high risk days	• Assumes all other activities are operating as per BAU in key source areas on high risk days
100% Reduction in Waste Material Handling	• A reduction in dust emissions associated with Truck & Shovel activity by 100% (i.e. stopped operating) in key source areas on high risk days	• Assumes all other activities are operating as per BAU in key source areas on high risk days
Dragline Only	• Dragline operations (only) with a maximum 6m dragline drop height.	• Assumes all other activities have ceased operating in key areas of site on high risk days
Shutdown	• All mining activities have ceased in key source areas on high risk days	• Assumes all activities in key source areas on high risk days have ceased operating.

The interpretation of results from the dispersion modelling for cumulative impacts focused on the nature and extent of dust mitigation measures (Section 6.2) that may be required to be implemented by the Project in order to mitigate 'additional' exceedances of the EPP(Air) objective of $50 \mu\text{g}/\text{m}^3$ for the 24 hour average concentration of PM_{10} . Here, 'additional' exceedances refers to exceedances in excess of any residual exceedances (on average over

the LOMs) that are predicted to occur as a result of the combined impacts of PDM (mitigated), SRM (mitigated) and a background concentration of $24.7 \mu\text{g}/\text{m}^3$ (Section 3.3.1).

Results presented in Section 5.1.2 highlighted Saraji Homestead 2 as being the most affected assessment location based on cumulative impacts. Thus it will be the management of dust impacts at this location that will determine the frequency for which additional dust management strategies (above BAU) will be required to be implemented by the Project.

Presented in Table 18 is a summary of the results from the cumulative impact assessment for each of the assessment locations. Included in the table are the number of residual exceedances of the EPP(Air) objective of $50 \mu\text{g}/\text{m}^3$ for the 24 hour average concentration of PM_{10} based on non-Project dust emission sources. Residual exceedances may be attributed (for example) to wind erosion associated with significant wind events.

Results presented in the table suggest that the Project will infrequently be required to implement additional mitigation measures in order to manage its dust impacts at key assessment location, with reducing the hauling of ROM coal between the Project CHPP and the SRM CHPP (for example) sufficient to mitigate additional exceedance risk during adverse conditions.

Table 18: Summary of Results – Additional Exceedances Attributable to the Project

ID	Description	Project Dust Sources		Non-Project Dust Sources	
		Case	Additional Exceedances (average/year LOM)	Case	Residual Exceedances (average/year LOM)
1	Kyewong Homestead	BAU	0.0	BAU	0.0
2	Lake Vermont Homestead	BAU	0.0	mitigated	1.2
3	Saraji Homestead 1	BAU	0.3	mitigated	3.7
4	Saraji Homestead 2	Mitigated (haul roads)	0.1	mitigated	7.9
5	Saraji Homestead 3	Mitigated (haul roads)	0.3	mitigated	8.3
6	Tay Glen Homestead	BAU	0.1	mitigated	2.7
7	Meadowbrook Homestead	BAU	0.0	mitigated	1.5
Note: Results include a background level of $24.7 \mu\text{g}/\text{m}^3$ for the 24 hour average concentration of PM_{10}					

6. Mitigation Measures and Management Strategies

As noted in Section 2.1.1 dust will be the primary pollutant emitted during both the construction phase and the operations phase of the Project. Although dust emissions are predicted to be minimal relative to the open cut mining activities at the adjacent Saraji Mine, in line with good practice, opportunities to minimise the release of pollutants during all phases of the Project will be incorporated into an Air Management Plan to be developed prior to construction.

6.1 Construction Phase

In practice, the application of water as/when required to minimise visible dust emissions will be one of the primary mitigation measures available to the Project.

General management strategies for the minimisation of pollutant generation during construction may include (but not limited to):

- The stabilising of at risk surfaces (such as roads, paths, etc.);
- The rehabilitation of surfaces as soon as practicable;
- Minimising the extent of exposed areas;
- Use of water sprays on haul routes, exposed areas and stockpiles;
- Reducing vehicle speed;
- Strict adherence to plant and equipment maintenance programs;
- Minimising haulage distances;
- Addressing equipment under performance in a timely manner; and
- Ensuring all personnel are familiar with the objectives and requirements of the Project's environmental management systems.

6.2 Operational Phase

As noted in Section 2.2, the Project incorporates a number of key dust reduction features most notably the transport of ROM coal by conveyor from the mine portal to the Project CHPP. Although dust emissions from the Project are predicted to have a small incremental impact on air quality at assessment locations, dust mitigation should be considered during the detailed design phase in order to capitalise on opportunities to minimise overall dust emissions. Examples of engineering options are included in Table 19 which, where feasible,

may be considered for the Project during the design phase. Engineering solutions incorporated during the design phase of the Project will typically be more cost effective than retro-fitting solutions once the Project is constructed.

Table 19: Engineering Design Options

Emission Source	Mitigation Options
Conveyors	Partial or full enclosure
	Belt scrapers
	Water sprays / foggers
Transfer Points	Partial or full enclosure
	Water sprays
	Belt scrapers
Bins	Limit drop height into surge bin
	Enclose chute
Stacking and Reclaiming	Water sprays
	Use of low dust-generating techniques such as telescopic stackers with chutes and scraper reclaimers
Sizing stations	Partial or full enclosure
	Water sprays
ROM dump	Partial or full enclosure
	Water sprays
Ventilation Outlets	Use of dust collection system
Flares	Ensure use of high destruction efficiency flares
Rail haul to export	Load profiling
	Veneering

Management options for the minimisation of emission of pollutants to the atmosphere during the operational phase of the Project to be incorporated into the site's environmental management system may include (but are not limited to):

- Minimising vehicle speed;
- Watering of haul roads;
- Optimising the use of water sprays;

- Reducing heavy vehicle movements between the Project CHPP and the SRM CHPP and the associated reducing in coal handling at the Project CHPP and dumping of ROM coal at the SRM ROM dump.
- Reducing throughput through the Project CHPP breaker station.
- Reducing dozer activities at the Project CHPP.
- Strict adherence to plant and equipment maintenance schedules;
- Address equipment under performance in a timely manner; and
- Ensuring all personnel are familiar with the objectives and requirements of the relevant operational management plans.

As noted in Section 5.3.2, results of the cumulative impact assessment suggest that infrequent implementation of additional dust management strategies (i.e. in excess of BAU) may be required to be implemented during adverse conditions, in order for the Project to manage its dust impacts at the nearest assessment location (i.e. Saraji Homestead 2).

7. Ambient Air Monitoring Program

Results of the air quality assessment (Section 5) did not highlight any significant issues in relation to Project dust emission sources and therefore in relation to emissions of dust, a complaints based monitoring program is proposed.

In support of operations with the identification of potential adverse conditions, continuous monitoring of meteorological parameters at the location of the Project CHPP is recommended. Both a 10 m weather station and a minimum 50 m temperature inversion tower is recommended (Figure 20, and Table 20).

Figure 20: Proposed Meteorological Monitoring Program



Table 20: Summary of Proposed Continuous Monitoring Program

Site	Location Description	Type	Parameters Measured	Comment
SRE Met	Project CHPP	Operational support	Wind speed, wind direction, temperature, RH, rainfall, solar radiation, pressure	- Full met station located at/near the MIA/CHPP - Wind speed, wind direction at 10 m.
SRE Tower	Co-located with SRE Met	Operational support	Minimum 50 m Temperature inversion Tower	Temperature inversion tower located at/near MIA/CHPP
Notes: - All parameters to be measured in accordance with relevant Australian Standards - All parameters to be measured as 5 minute averages. 2D Ultrasonic wind sensors to be used for wind speed wind direction measurements. - Temperature inversion tower to be equipped (as a minimum) with temperature sensors at 2m, 10m, 20m, 30m, 40m ,50m				

8. Summary

AED has undertaken an air quality assessment of the Saraji East Mining Lease Project (the Project) in support of the Project's Environmental Impact Statement. This assessment has focused on impacts associated with the emission of dust from the Project on the receiving environment.

In order to highlight the nature and extent of potential impacts, results from the dispersion modelling considered those for the Project in isolation of other dust generating sources within the local airshed which includes Saraji, Peak Downs and Lake Vermont open cut mining operations as well as cumulative impacts.

Two dust emissions scenarios were modelled:

- **(Peak BAU Case):** Peak operating conditions based on a mining rate of 11 Mtpa ROM coal incorporating business as usual (BAU) dust management practices; and
- **(Peak Upset Case):** Upset conditions based on a mining rate of 11 Mtpa ROM coal with an assumed reduced dust mitigation capacity. Due to the short term nature of upset conditions, predicted impacts for the 24 hour average concentration of PM₁₀ only, were provided.

Cumulative impacts have been considered using two approaches:

- Comparison of publically available information reported to the National Pollutant Inventory (NPI) for SRM, PDM, and LVM with estimates of dust emissions from the Project
- Explicit modelling of the 24 hour average concentration of PM₁₀ associated with SRM, PDM and the Project, combined with an estimate of non-anthropogenic background dust levels.

The predicted level of improved air quality outcomes in relation to the implementation of additional dust mitigation measures (i.e. above BAU) associated with the Project were investigated as part of the cumulative impact assessment. A range of mitigation measures were considered (**Peak Mitigated Case**), focusing on the hauling of ROM coal between the Project CHPP and the SRM CHPP and the generation of dust associated with the processing of ROM coal at the Project CHPP.

Results of the dispersion modelling for the Project Peak BAU Case have not highlighted any significant risk of adverse impacts of dust at the nearest assessment locations due to the Project (in isolation) during peak operations.

Results from the cumulative impact assessment, suggested that the suite of mitigation measures available to the Project and in particular, those targeting improved outcomes related to the hauling of ROM coal between the CHPPs, will be sufficient to mitigate the risk of additional exceedances of the EPP(Air) objective for the 24 hour average concentration of PM_{10} under adverse conditions.

Due to the scale of predicted impacts associated with the Project, a complaints based dust monitoring program is proposed. To support operations to identify adverse meteorological conditions the commissioning of both a weather station and a temperature inversion tower are recommended.

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Appendix A. Dispersion Modelling Methodology

Development of Representative Meteorological Wind Fields

Dispersion modelling typically requires a meteorological dataset representative of the local airshed on an hourly timescale. Parameters required include wind speed, wind direction, temperature, atmospheric stability and mixing height. In general, meteorological observations typically include hourly wind speed, wind direction, temperature, rainfall and humidity. However additional parameters, such as atmospheric stability class and mixing height, are difficult to measure and are often generated through the use of meteorological models. For this assessment the TAPM and CALMET/CALPUFF suite of modelling tools has been used.

TAPM

The meteorological model 'The Air Pollution Model' (TAPM) developed by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) was used to predict initial three-dimensional meteorology for the local airshed. TAPM is a prognostic model used to predict three dimensional meteorological observations, with no local inputs required. The model predicts meteorological datasets consisting of parameters like wind speed, wind direction, temperature, water vapour, cloud, rain, mixing height, atmospheric stability classes etc. that are required for dispersion modelling.

Technical details of the model equations, parameterisations and numerical methods are described in the technical paper by Hurley (2008).

The details of TAPM configuration are summarised in Table 21.

Table 21: TAPM Configuration

Parameter	Units	Value
TAPM version	-	v4.0.5
Years modelled	-	2019
Grid centre	Lat.(degrees), Lon. (degrees)	-22.45833, 148.225
Local centre coordinates	UTM zone 55 S (m)	626042, 7515926
Number of nested grids	-	3
Grid dimensions (nx, ny)	-	41,41
Number of vertical grid levels (nz)	-	25
Grid 1 spacing (dx, dy)	km	30,30
Grid 2 spacing (dx, dy)	km	10,10
Grid 3 spacing (dx, dy)	km	3,3
Local hour	-	GMT + 10

Parameter	Units	Value
Synoptic wind speed maximum	m/s	30
Local met assimilation	-	No
Surface vegetation database	-	Default TAPM V4 database at 3-minute grid spacing (Australian vegetation and soil type data provided by CSIRO Wildlife and Ecology).
Terrain database	-	Default TAPM V4 database at 9-second grid spacing (Australian terrain height data from Geoscience Australia)

CALMET

CALMET (version 6.326) was used to simulate meteorological conditions for the local airshed. CALMET is a diagnostic three dimensional meteorological pre-processor for the CALPUFF modelling system (developed by Earth Tech, Inc.).

Prognostic output from TAPM was used as an initial guess field for the CALMET model. Using high resolution geophysical datasets CALMET then adjusts the initial guess field for the kinematic effects of terrain, slope flows, blocking effects and 3-dimensional divergence minimisation, as well as differential heating and surface roughness associated with different land uses across the modelling domain.

The CALMET model requires three input files along with the control file where the CALMET run parameters are specified and involve:

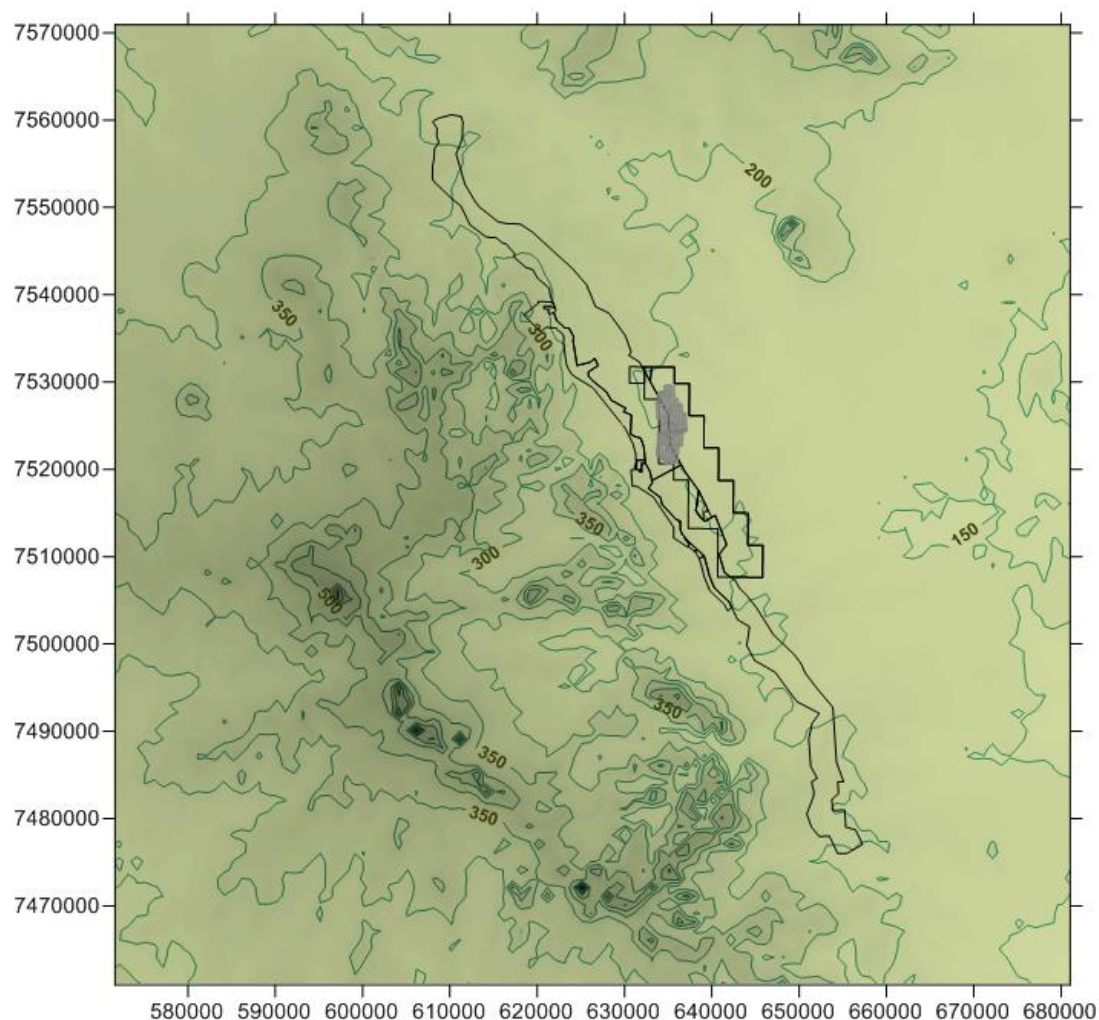
- Geophysical data;
- Upper air meteorological data; and
- Surface meteorological data.

The Geophysical dataset contain terrain and land use information for the modelling domain.

The terrain information for the project was extracted from 3-arc second (90m) spaced elevation data obtained via NASA's Shuttle Radar Topography Mission (SRTM) in 2000. (Downloaded from USGS website http://dds.cr.usgs.gov/srtm/version2_1/SRTM3/Australia/)

Final terrain data for Geophysical dataset for CALMET is shown in Figure 21.

Figure 21: Terrain data for CALMET Geophysical Dataset



The land use or land cover data for the modelling domain was derived from 300 m resolution Globcover land cover map (© ESA 2010 and UCLouvain, published by European Space science, Dec 2010). Manual edits were performed to take into account the latest mine progressions and urban development within the modelling domain. The ESA classification system was mapped to adopt the user defined CALMET classification system. The Geotechnical parameters for the user defined land use classification were adopted from a combination of closest CALMET and AERMET land use categories.

User defined land use classification and geotechnical parameters used in CALMET are shown in Figure 22 and summarised in Table 22.

Figure 22: Land use classification included in CALMET

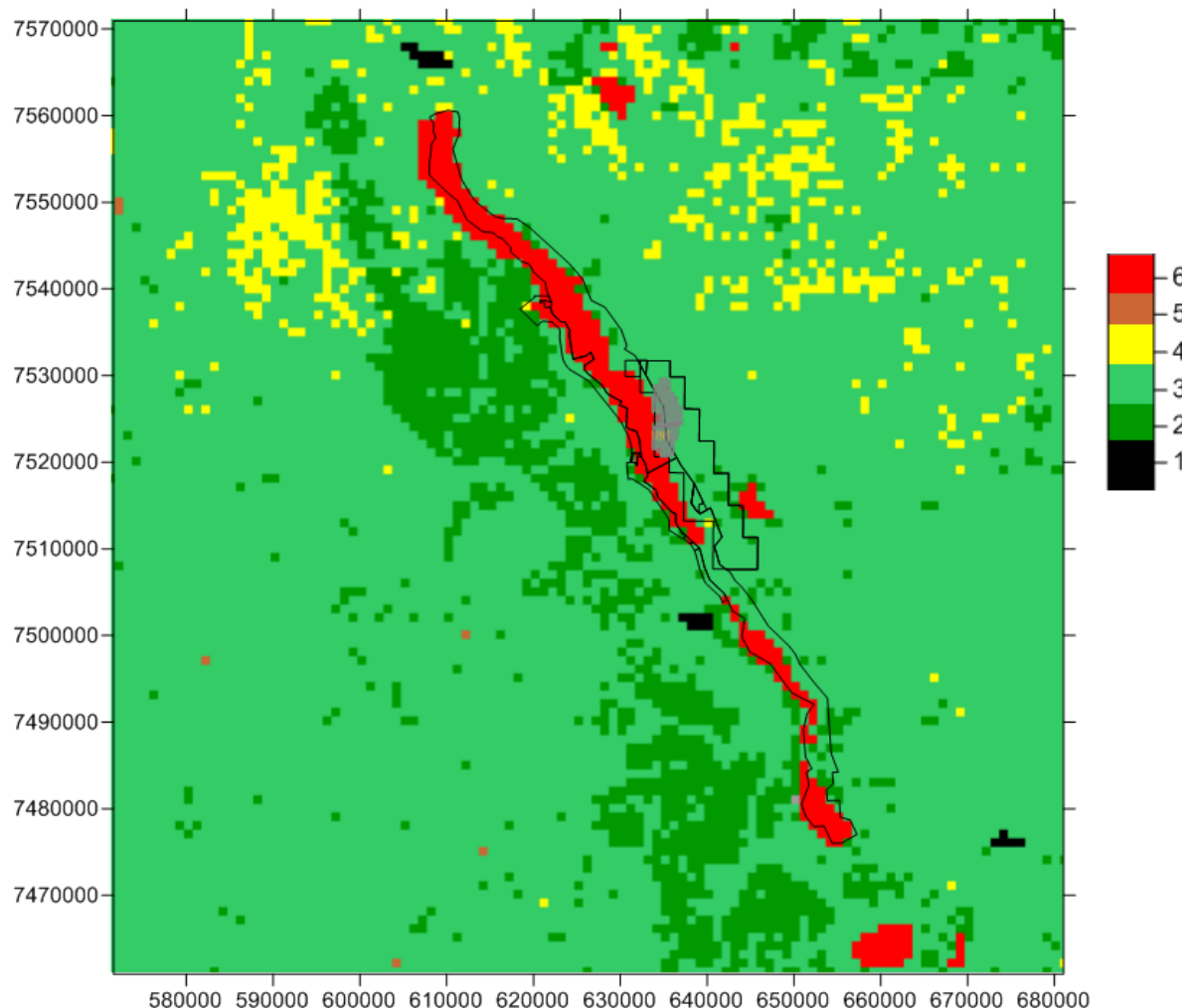


Table 22: CALMET Land use categories included in the assessment

CALMET User defined Category	ESA Category	AERMET Category
1	17 Artificial surfaces and associated areas (Urban areas >50%)	Low intensity residential
2	3 Closed to open (>15%) broadleaved evergreen or semi-deciduous forest (>5m)	Mixed Forest
	5 Open (15-40%) broadleaved deciduous forest/woodland (>5m)	
3	9 Mosaic forest or shrub land (50-70%) / grassland (20-50%)	Shrub land (Non-arid)
	10 Mosaic grassland (50-70%) / forest or shrub land (20-50%)	
	11 Closed to open (>15%) (broadleaved or needle leaved,	

CALMET User defined Category	ESA Category	AERMET Category
	evergreen or deciduous) shrub land (<5m)	
	12 Closed to open (>15%) herbaceous vegetation (Grassland, savannas or lichens/mosses)	
	2 Mosaic vegetation (grassland/shrub land/forest) (50-70%)/cropland (20-50%)	
4	13 Sparse (<15%) vegetation	Grassland/Herbaceous
5	1 Mosaic cropland (50-70%) / vegetation (grassland/shrub land/forest) (20-50%)	Small grains
	0 Rain fed croplands	
6	-	Quarries/strip mine/gravel

Details of the CALMET configuration are presented in Table 23.

Table 23: CALMET Configuration

Parameter	Units	Value
CALMET version	-	V6.326
Years modelled	-	2019
No. X grid cells (NX)	-	121
No. Y grid cells (NY)	-	121
Grid spacing (DGRIDKM)	km	1
X coordinate (XORIGKM)	km	570.000
Y coordinate (YORIGKM)	km	7460.000
No. of vertical layers (NZ)	-	10
Number of surface stations	-	0
Number of upper air stations	-	0
Maximum radius of influence over land in the surface layer (RMAX1)	km	3
Maximum radius of influence over land aloft (RMAX2)	km	30
Maximum radius of influence over water (RMAX3)	km	10
Radius of influence of terrain features (TERRAD)	km	1
Land use database	-	Manually edited 300 m resolution Globcover land cover map (© ESA)

Parameter	Units	Value
		2010 and UCLouvain, published by European Space science, Dec 2010).
Terrain database	-	Manually edited 3-arc second (90m) spaced elevation data obtained via NASA's Shuttle Radar Topography Mission (SRTM) in 2000
Minimum overland mixing height (ZIMIN)	m	50
Maximum overland mixing height (ZIMAX)	m	3000
UTC time zone (ABTZ)	Hours	UTC+1000

CALPUFF

Dust dispersion modelling was undertaken using the US EPA approved CALPUFF model for 2019 meteorological conditions at 100 m resolution using wind fields developed by CALMET. General run control parameters and technical options that were selected are presented in Table 24. Defaults were used for all other options.

Table 24: CALPUFF Configuration

Parameter	Units	Value
CALPUFF version	-	V6.263
Years modelled	-	2019
No. of vertical layers (NZ)	-	10
UTC time zone (XBTZ)	Hours	UTC+1000
Method used to compute dispersion coefficient (MDISP)	-	2 (internally calculated sigma v, sigma w using micrometeorology)
Computational grid size and resolution	-	Identical to CALMET grid
Sampling grid size and resolution	-	Identical to CALMET grid
Discrete receptors height above ground	m	1.5
Wet deposition		False
Dry deposition		True

Appendix B. Meteorological Environment

B.1. Climate

This section describes rainfall patterns, humidity, air temperature, wind speed and direction, as well as stability class characteristics in the region.

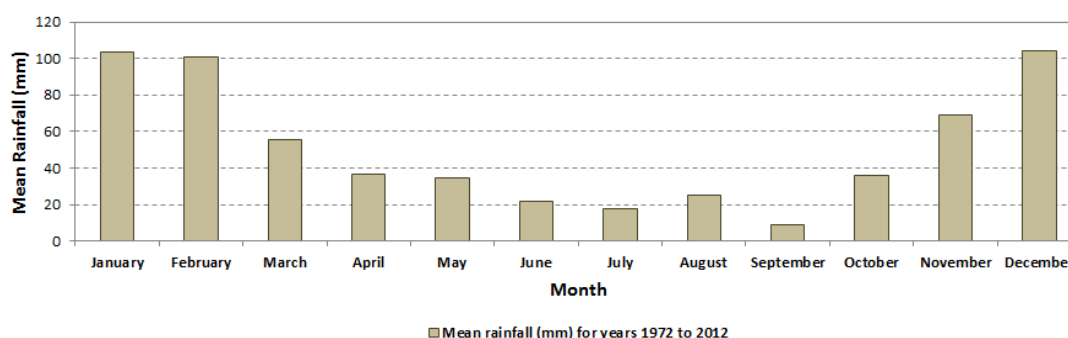
Data for long term climate statistics have been sourced from the Bureau of Meteorology (BoM) climate statistics for the Moranbah Water Treatment Plant. Monitoring commenced at this site in 1972 and ended in April 2012.

BoM data was supplemented by numerically simulated data developed using CALMET. The modelled data were used to generate hourly records of wind speed, wind direction and air temperature, because the BoM data from the Moranbah Water Treatment Plant has only recorded these parameters twice daily: 9.00am and 3.00pm. Additionally, the numerically simulated data provide site-specific parameters that cannot be directly measured, such as stability class.

B.2. Rainfall Patterns

The mean annual rainfall at Moranbah is approximately 600 mm of which c. 50% is received between the months of November through to March. Monthly mean rainfall values for the period January 1972 through to March 2012 are presented in Figure 23.

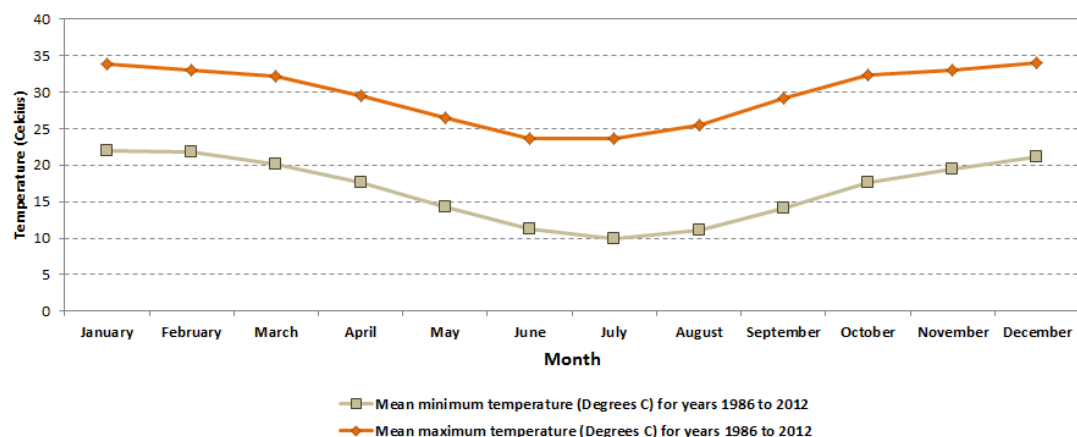
Figure 23: Mean Rainfall Statistics, Moranbah Water Treatment Plant (1972-2012)



B.3. Air Temperature

Long term ambient air temperature statistics for the mean maximum and mean minimum from Moranbah Water Treatment Plant suggest that the maximum daily temperatures in summer average between 33.1°C and 34°C, with overnight minimums averaging between 21.1°C and 21.9°C. During winter, the maximum daily temperatures average between 23.7°C and 25.5°C, with overnight minimums averaging between 9.9°C and 11.2°C (Figure 21).

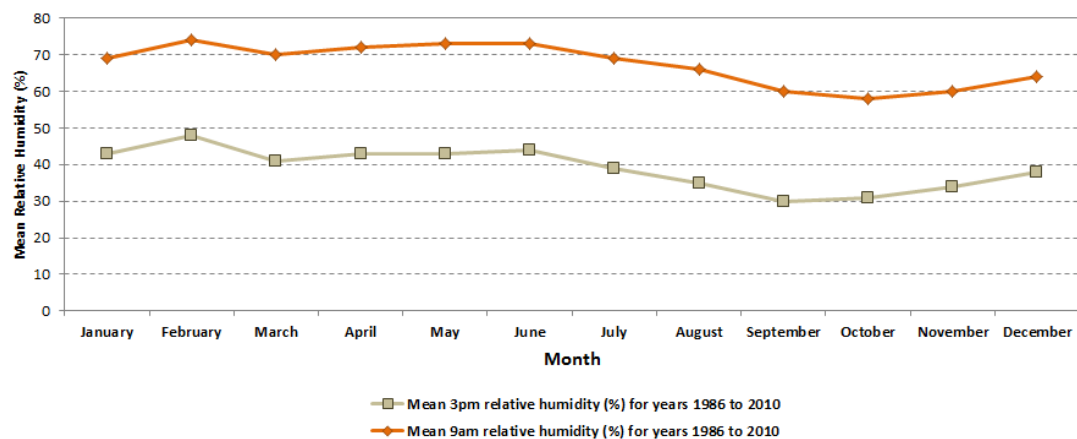
Figure 24: Mean Air Temperature Statistics, Moranbah Water Treatment Plant (1986-2012)



B.4. Humidity

The mean relative humidity measured at 9am and 3pm at the Moranbah Water Treatment Plant are presented in Figure 25. The mean monthly relative humidity at 9am ranges from 58% (in October) to 74% (in February). Records of mean relative humidity at 3pm indicate that humidity is lowest in September (30%) and highest in February (48%).

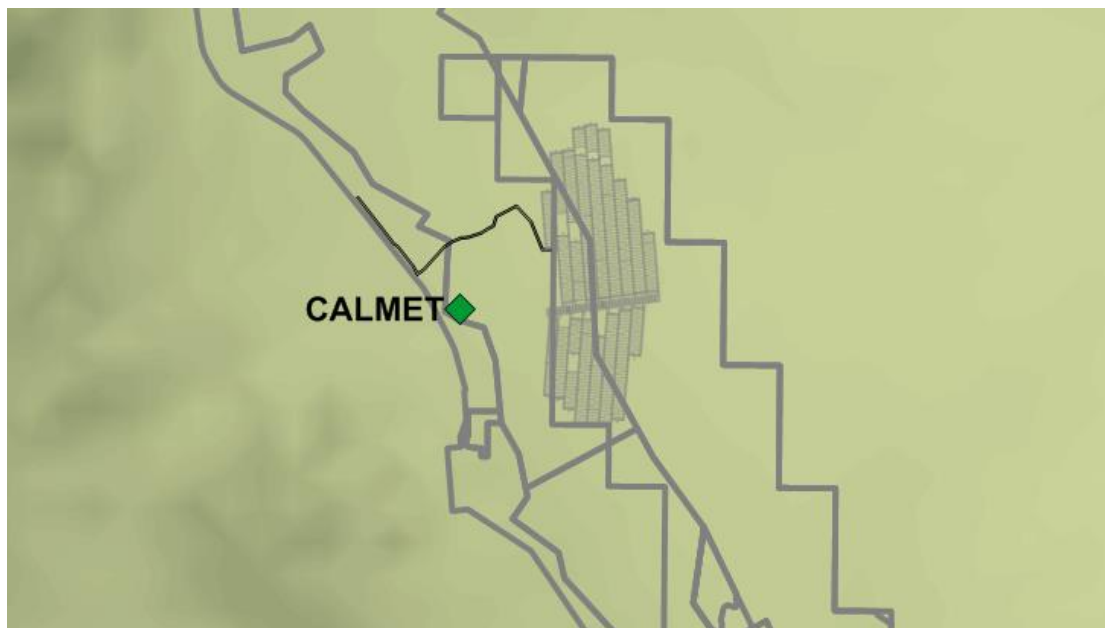
Figure 25: Mean Relative Humidity Statistics, Moranbah Water Treatment Plant (1986-2010)



B.5. Wind Speed and Direction

Numerically simulated wind fields (CALMET) for 2019 were developed. The location of the extracted numerically simulated wind data developed using CALMET is shown in Figure 26.

Figure 26 Location of CALMET Extracted Data



The wind rose for 2019 presented in Figure 27. The wind directions in the vicinity of the Project are predominantly from the east through southeast. Seasonal variations and variations as a function of the time of day are highlighted in Figure 28.

Figure 27: Annual Wind Rose (CALMET 2019)

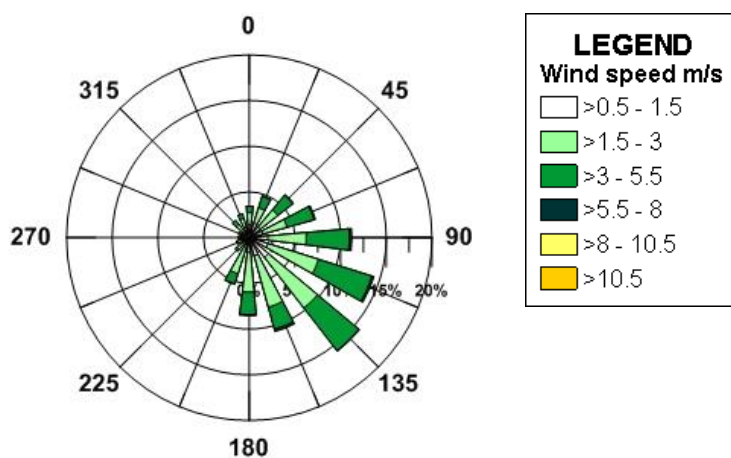
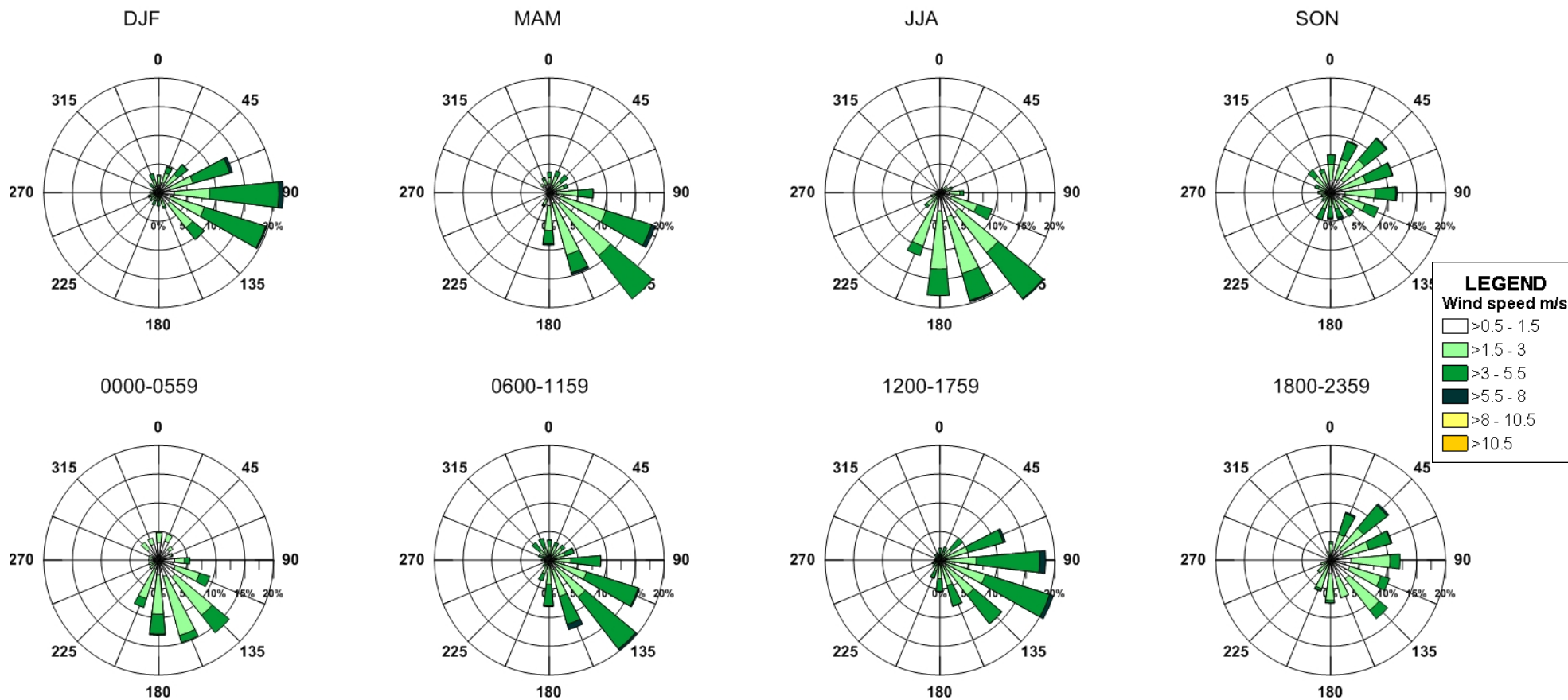


Figure 28: Wind Roses as a Function of the Season (upper) and Time of Day (lower). (CALMET 2019)



B.6. Atmospheric Stability Class

Stability of the atmosphere is determined by a combination of horizontal turbulence caused by the wind and vertical turbulence caused by the solar heating of the ground surface. Stability cannot be measured directly; instead it must be inferred from available data, either measured or numerically simulated.

The Pasquill-Gifford scale defines stability on a scale from A to G, with stability class A being the least stable, occurring during strong daytime sun and stability class G being the most stable condition, occurring during low wind speeds at night. For any given wind speed the stability category may be characterised by two or three categories depending on the time of day and the amount of cloud present. In meteorological models such as CALMET, the stability classes F and G are combined.

A summary of the numerically simulated hourly stability class data for 2019 is presented in Figure 29 and Figure 30. Stability class F is predicted to occur most frequently, indicating that the dominant conditions are moderately to very stable, with very little lateral and vertical diffusion.

The frequency of strongly convective (unstable) conditions at the study area, represented by stability class A, is relatively low.

Figure 29: Variability in the Frequency of Stability Classes (CALMET 2019)

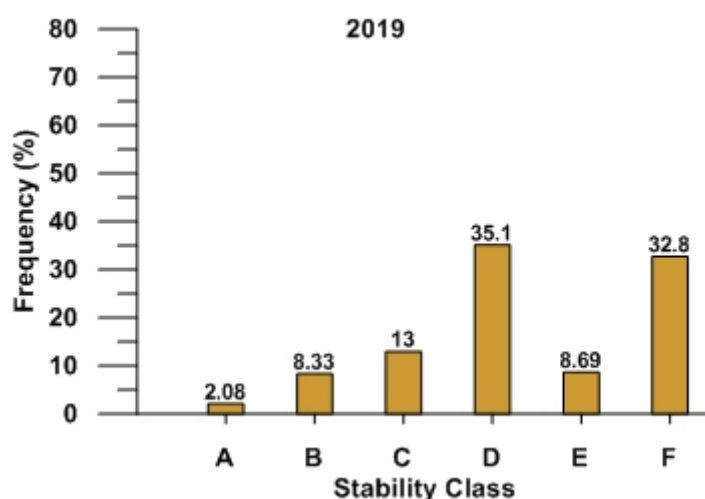
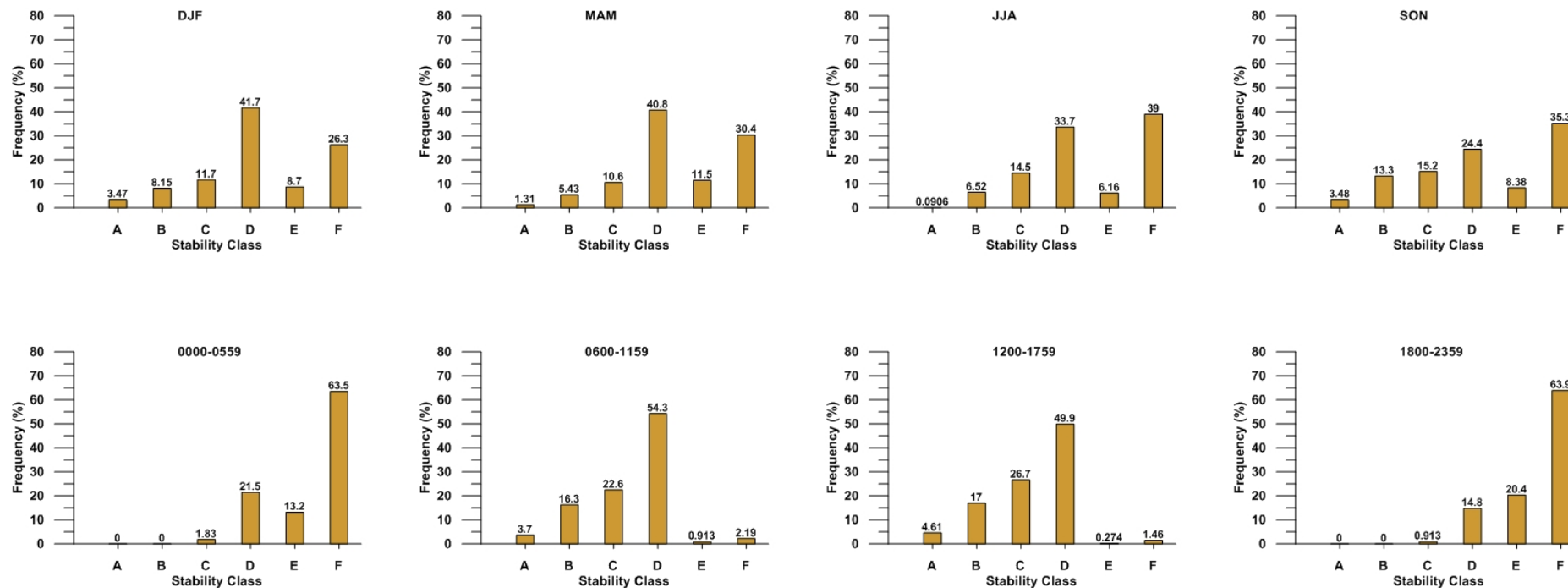


Figure 30: Seasonal Variation in the Stability Class Frequency (upper) and Variation as a Function of the Time of Day (lower) (CALMET 2019)



Appendix C. Development of Dust Emissions Inventory

C.1. Material Parameters

Presented in Table 25 is a summary of the values for the material parameters that have been used in the development of emission factors for the Project.

Table 25: Material Parameters

Material	units	Value	Reference
Moisture Content			
Coal – ROM	%	4	BMA
Coal - Raw	%	6	BMA
Coal - Product	%	9	BMA
Silt Content			
Road	%	4.3	Assumed based on US EPA AP42 table 11.9.3
Coal	%	5	BMA

C.2. Emission Factors

The National Pollutant Inventory (NPI) has a series of Emission Estimation Technique Manuals that are intended to provide data on emissions of air pollutants during peak operations. The NPI Emission Estimation Technique Manual (EETM) for Mining V3.1 (NPI, 2012) has been used to provide data to estimate the amount of TSP and PM₁₀ emitted from the various activities on a mine site, based on the amount of coal and overburden material mined as provided by the Proponent. Emission factors from the NPI EETM for Mining were supplemented with those from the US EPA's AP42 (USEPA, 1995) as required and/or when considered appropriate.

Bulldozers

The TSP and PM₁₀ emission factors for dozers on coal were sourced from the US EPA AP42 which is in agreement with that recommended by NPI (2012):

- $EF_{TSP} = 35.6 \times (S^{1.2}) \times (M^{-1.4})$ (kg/hr)
- $EF_{PM_{10}} = 0.75 \times 8.44 \times (S^{1.5}) \times (M^{-1.4})$ (kg/hr)

Truck Unloading

The default TSP and PM₁₀ emission factor for truck unloading of coal has been sourced from NPI (2012):

- $EF_{TSP} = 0.01$ (kg/tonne)

-
- $EF_{PM10} = 0.0042$ (kg/tonne)

Wheel Generated Dust

The emission factors for wheel generated dust were taken from NPI (2012):

- $EF_{TSP} = 1.38 \times (s/12)^{0.7} \times (W/3)^{0.45}$ (kg/vkt)
- $EF_{PM10} = 0.42 \times (s/12)^{0.9} \times (W/3)^{0.45}$ (kg/vkt)

where 's' is the haul road silt content (%) and 'W' is the vehicle mass (t).

Loading and Unloading Stockpiles

Note that for the unloading of stockpiles by reclaimer the emission factors for miscellaneous transfer points have been used. Also note that reclaiming using dozers has been explicitly accounted for based on dozer hours allocated to CHPP related activities.

Miscellaneous Transfer and Conveying Points

Emission factors for miscellaneous transfer points have been sourced from NPI (2012) as:

- $EF_{TSP} = 0.74 \times 0.0016 \times (U/2.2)^{1.3} \times (M/2)^{-1.4}$ (kg/tonne)
- $EF_{PM10} = 0.35 \times 0.0016 \times (U/2.2)^{1.3} \times (M/2)^{-1.4}$ (kg/tonne)

where 'U' is the mean wind speed (m/s) and 'M' is the material moisture content (%).

Wind Speed Dependent Wind Erosion

Following the recommendations of SKM (2005), for the purposes of estimating wind erosion from stockpiles and exposed areas, the US EPA AP42 formula has been used. In contrast to the default emission factor of 0.4 kg/ha/hr for TSP recommended in NPI (2012), Equation 1 has been used in order to account for the climate variations across Australia while it is recognised that there is uncertainty in the representativeness of the equation.

$$E = 1.9 \left(\frac{s}{1.5} \right) 365 \left(\frac{365-p}{235} \right) \left(\frac{f}{15} \right) \quad (\text{Equation 1})$$

Where: 's' is the silt content (%), 'f' is the percentage of time that wind speed is greater than 5.4 m/s at the mean height of the stockpile, and 'p' is the number of days when rainfall is greater than 0.25 mm.

Equation 1 is used to provide an estimate for the annual total emissions of dust (TSP) associated with wind erosion. The local meteorological data was then used to distribute the total annual emissions equally to those hours for which the wind speed is greater than a critical wind speed using the methodology outlined in the following sections.

Wind Erosion for Stockpiles

The annual total emissions of TSP calculated using Equation 1 was distributed on an hourly basis in accordance with Equation 2 (SKM, 2005)

$$F = ku^3 \left(1 - \frac{u_o^2}{u^2}\right) \text{ when } u > u_o, \text{ otherwise } F = 0 \quad (\text{Equation 2})$$

Where 'k' is a constant, 'u' is hourly average wind speed at root mean square height of the stockpile (m), 'u_o' is a wind speed threshold velocity.

The critical wind speed 'u_o' is calculated based on a critical wind speed of 5.4 m/s at the root mean square height of the stockpile, corrected to 10 m based on logarithmic wind speed profile as shown in Equation 3.

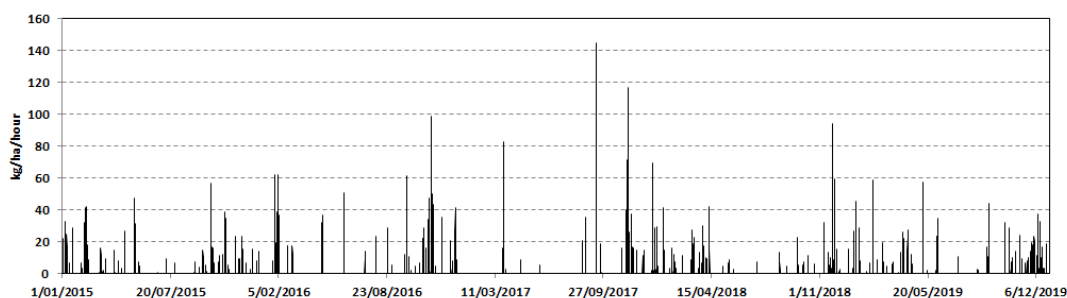
$$u_o = 5.4 \ln \left(\frac{10 - z_o}{z - z_o} \right) \quad (\text{Equation 3})$$

Where 'z' is the root mean square height of a stockpile (m), 'z_o' is the surface roughness (0.3 m).

The constant 'k' in Equation 2 is obtained based on the relationship that the cumulative hourly emissions calculated from Equation 2 are equal to the total annual emissions calculated from Equation 1.

Presented in Figure 31 is an example of wind speed dependent wind erosion emission factors for a 5 year period 2015 through 2019.

Figure 31: Example of Wind Speed Dependent Emission Factor



C.2.1. Summary of Emission Factors

Presented in Table 26 is a summary of the adopted emission factors for TSP and PM₁₀. TSP and PM₁₀ control factors specified in the table have been sourced from the NPI EETM for Mining V3.1.

For this assessment a conservative approach has been adopted where it has been assumed that 20% of PM₁₀ is in the form of PM_{2.5}.

Table 26: Emission Factors

Emission Source	Units	TSP	PM ₁₀	Peak BAU		Peak Upset	Nature of Control
				TSP Control (%)	PM ₁₀ Control (%)	PM ₁₀ Control (%)	
Activities at Project CHPP							
Conveying of coal	Kg/ha/year	4197	2098	50%	50%	50%	u-shaped conveyor
Coal processing	Kg/tonne	0.03	0.011	50%	50%	0%	Water sprays
Stacking coal	Kg/tonne	0.004	0.002	50%	50%	0%	Water sprays
Reclaiming coal	Kg/tonne	0.0006	0.003	50%	50%	0%	Water sprays
Dozers on coal	Kg/hour	19.9	5.76	0%	0%	0%	-
Wind erosion of stockpiles	Kg/ha/year	1807	904	-	-	-	-
Transport of excess ROM coal to Saraji CHPP	Kg/VKT	4.8	1.3	75%	75%	50%	Level 2 watering
Activities at Saraji CHPP							
Dumping of coal	Kg/tonne	0.01	0.004	50%	50%	50%	Water sprays
Coal processing	Kg/tonne	0.015	0.006	50%	50%	50%	Water sprays
Stacking/reclaiming coal	Kg/tonne	0.005	0.002	50%	50%	50%	Water sprays
Ventilation Outlets							
Ventilation Outlets	kg/year/Mtpa	4520	2260	0%	0%	0%	-