



# Cracow TSF2 Stage 3B to 5 Lift

## Air Quality Impact Assessment

### Aeris Resources (Lion Mining Pty Ltd)

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Cracow, QLD 4719

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SLR Project No.: 623.030484.00001

28 October 2025

Revision: v1.0

## Revision Record

Revision	Date	Prepared By	Checked By	Authorised By
V1.0	15 October 2025	F Rahaman	K Wiles	DRAFT to client
V1.1	28 October 2025	F Rahaman	K Wiles	F Rahaman

## Basis of Report

This report has been prepared by SLR Consulting Australia (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Aeris Resources (Lion Mining Pty Ltd) (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

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## Table of Contents

<b>Basis of Report</b> .....	<b>i</b>
<b>1.0 Introduction</b> .....	<b>1</b>
<b>2.0 Project Overview</b> .....	<b>1</b>
<b>3.0 Pollutants of Interest</b> .....	<b>4</b>
3.1 Particulate Matter .....	4
<b>4.0 Regulatory Framework -Air Quality</b> .....	<b>5</b>
4.1 National Environment Protection Measures .....	5
4.1.1 National Environment Protection Council Act 1994.....	5
4.1.2 National Environment Protection (Ambient Air Quality) Measure .....	5
4.2 Queensland Environmental Protection Act 1994.....	6
4.3 Environmental Protection (Air) Policy and Amendment.....	6
4.4 Existing Environmental Authority (EPML00770913) .....	7
4.5 Air Quality Criteria Adopted for this Assessment .....	8
<b>5.0 Existing Air Environment</b> .....	<b>9</b>
5.1 Topography and Land use.....	9
5.2 Sensitive Receptors .....	9
5.3 Existing Air Quality .....	11
5.3.1 Ambient Monitoring Program .....	11
5.3.2 Review of Available Regional Ambient Air Monitoring Data .....	12
5.3.3 Adopted Background Concentrations .....	14
<b>6.0 Emission Estimation</b> .....	<b>15</b>
6.1 Modelling Scenarios .....	15
<b>7.0 Dispersion Modelling Methodology</b> .....	<b>16</b>
7.1 Selection of Models .....	16
7.2 Meteorological Modelling.....	16
7.2.1 WRF.....	16
7.2.2 CALMET .....	17
7.3 Meteorological Data Used in the Dispersion Modelling .....	17
7.3.1 Wind Speed and Direction.....	17
7.3.2 Atmospheric Stability.....	19
7.3.3 Mixing Heights.....	20
7.4 Dispersion Model Configuration.....	21
<b>8.0 Modelling Results and Assessment</b> .....	<b>22</b>
<b>9.0 Recommendations</b> .....	<b>24</b>



9.1 Air Quality Control Measures.....	24
9.2 Proposed Monitoring Programs.....	24
<b>10.0 Conclusion.....</b>	<b>25</b>
<b>11.0 References.....</b>	<b>26</b>

## **Appendices**

<b>Appendix A</b>	<b>Activity Data</b>
<b>Appendix B</b>	<b>Emmision Factors</b>
<b>Appendix C</b>	<b>Emission Estimation</b>
<b>Appendix D</b>	<b>Variable Emmision Compilation</b>
<b>Appendix E</b>	<b>Contour Plots</b>



## Tables

Table 1	TSF2 Stage 3A and Stage 3B to 5 Facility Characteristics.....	3
Table 2	Air NEPM Ambient Air Quality Standards .....	5
Table 3	Ambient Air Quality Criteria Adopted for Use in this AQIA.....	8
Table 4:	Details of Identified Potential Sensitive Receptors .....	9
Table 5	Summary of Review of Available Monitoring Data – Toowoomba AQMS.....	12
Table 6	Background Levels Adopted for Assessing Cumulative Impacts .....	14
Table 7	Annual Average Emissions Rate.....	15
Table 8	Meteorological Parameters – WRF (2024 Calendar Year) .....	16
Table 9	Meteorological Modelling Parameters - CALMET .....	17
Table 10	Meteorological Conditions Defining PGT Stability Classes.....	20
Table 11	Predicted Incremental and Cumulative PM <sub>2.5</sub> Concentrations .....	22
Table 12	Predicted Incremental and Cumulative PM <sub>10</sub> Concentrations .....	22
Table 13	Predicted Incremental and Cumulative TSP Concentrations.....	23
Table 14:	Dust Mitigation Measures .....	24

## Figures

Figure 1	Site Location.....	2
Figure 2	Stages 3B to 5 Lift Design Footprints.....	3
Figure 3	Stages 3B to 5 Lift Design Typical Sections.....	3
Figure 4	Local Topography.....	10
Figure 5:	Sensitive Air Quality Receptors in relation to the TSF2 Emission Sources.....	11
Figure 6	Measured 24-Hour Average PM <sub>2.5</sub> – Toowoomba AQMS (2022-2024) .....	13
Figure 7	Measured 24-Hour Average PM <sub>10</sub> - Toowoomba AQMS (2022-2024).....	13
Figure 8	Wind Roses for the Site, as Predicted by CALMET (2024) .....	18
Figure 9	Annual Wind Speed Frequencies at the Site (CALMET Predictions, 2024).....	19
Figure 10	Stability Class Distribution Predicted by CALMET (2024) .....	20
Figure 11	Mixing Heights Predicted by CALMET (2024).....	21



## 1.0 Introduction

Cracow Gold Mine and Processing Operations (CRO) is owned by Lion Mining Limited a subsidiary of Aeris Resources Limited. CRO is proposing to undertake the Stage 3B, 4 and 5 lifts of the existing Tailings Storage Facility 2 (TSF2) to increase storage capacity, thereby supporting ongoing mining operations (The Project).

CRO intends to submit an application to amend their Environmental Authority (EA) EPML00770913 to facilitate the Project.

This Air Quality Impact Assessment (AQIA) has been prepared by SLR Consulting (Australia) Pty Ltd (SLR) to inform the EA amendment application.

## 2.0 Project Overview

CRO is located in Central Queensland, northwest of the township Cracow in the Banana Shire. The gold mine lies approximately 40 km southeast of Theodore and approximately 500 km northwest of Brisbane. The TSF2 occurs to the northwest of CRO within ML80144 and ML80089 (Refer to Figure 1).

The environmental value for air at CRO is an airshed that is typical of a rural nature impacted by agricultural, mining and transport infrastructure related activities. The environmental protection objective is to ensure emissions to air from CRO do not impact on sensitive receptors or surrounding environment.

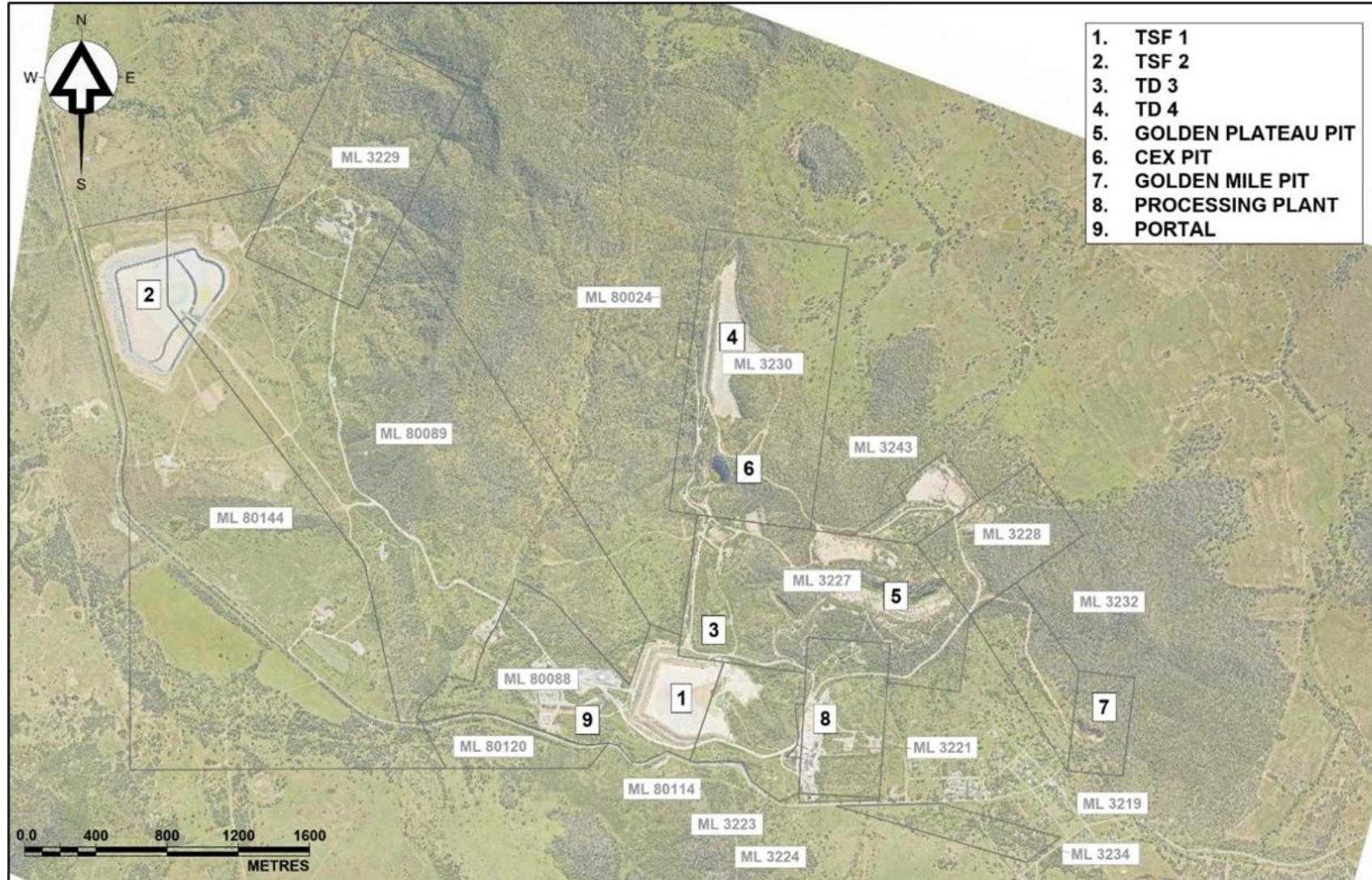
The conceptual design of the proposed Stages 3B, 4 and 5 lifts are as follows (and shown in **Figure 2** and **Figure 3**):

- Centre line raising of the main embankments of each of the three raises are proposed, per the original concept.
- Eastern embankment in the vicinity of the decant pond to be downstream raised and HDPE geomembrane lined.
- Embankments to be constructed using a combination of:
  - Local clay borrow pits
  - Existing excess soil stockpiles
  - Gabbro Hill hard rock – to be used only if necessary
  - NAF mine waste rock from various existing stockpiles
- Additional requirements:
  - Establishing topsoil stockpiles
  - Constructing ramps and perimeter roads
  - Relocating power supply and electrical components
  - Installing instrumentation
  - Relocating fence lines
  - Implementing minor stormwater management and sediment control infrastructure

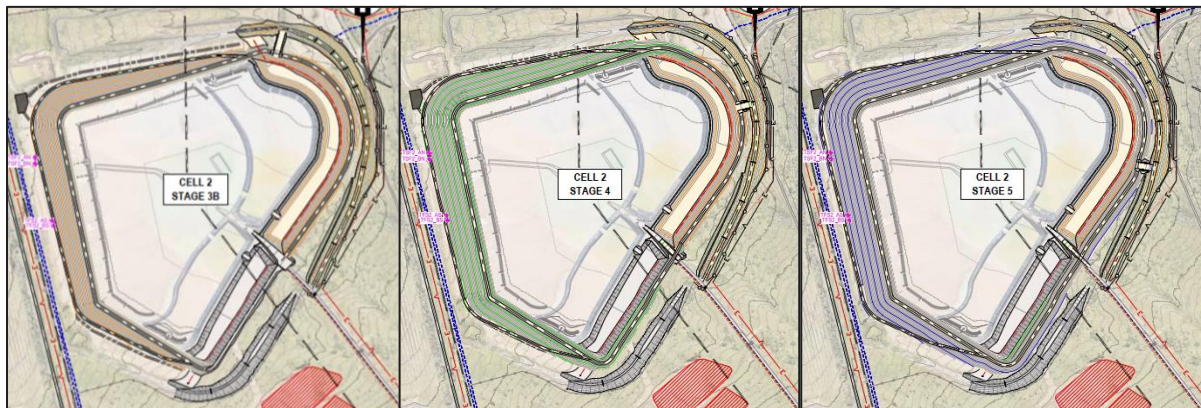
Key raise characteristics are summarised in **Table 1**.



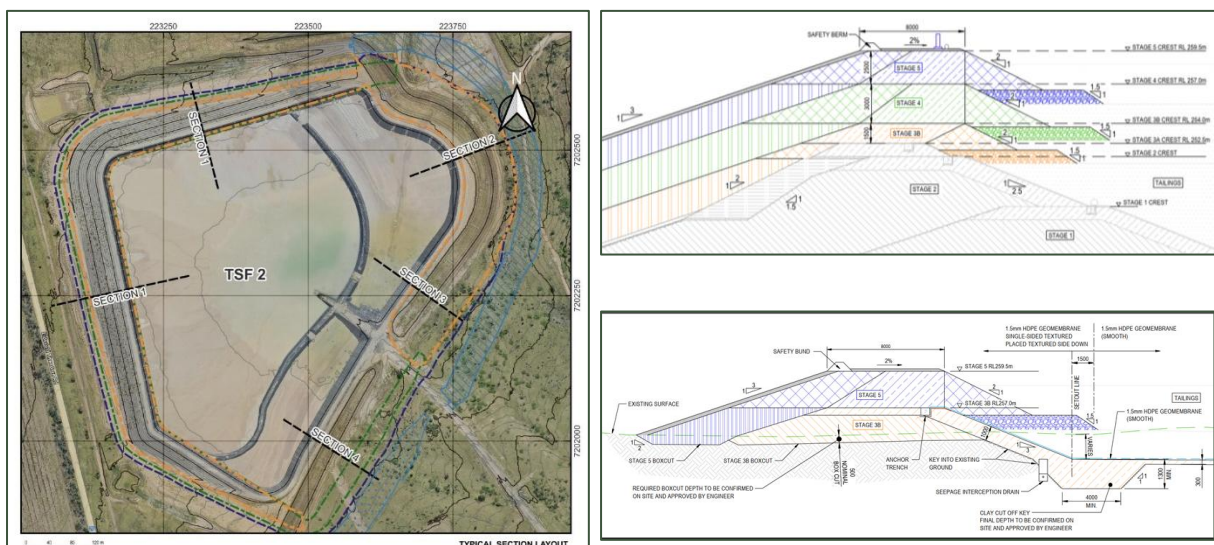
Figure 1 Site Location



**Figure 2 Stages 3B to 5 Lift Design Footprints**



**Figure 3 Stages 3B to 5 Lift Design Typical Sections**



**Table 1 TSF2 Stage 3A and Stage 3B to 5 Facility Characteristics**

Description	Approved	Proposed		
	Stage 3A	Stage 3B	Stage 4	Stage 5
Tailings production rate	620,000 tpa	650,000 tpa	650,000 tpa	650,000 tpa
Life of raise	~1 year	~1 year	~2 years	~2 years
Cumulative TSF storage Capacity	~3.1 Mt	~3.8 Mt	~5.1 Mt	~6.4 Mt
Embankment crest elevation	252.5 mRL	254.0 mRL	257.0 mRL	259.5 mRL
Maximum Embankment Height	19 m	20.5 m	23.5 m	26 m
TSF footprint area	37.8 ha	43.1 ha	44.7 ha	46.6 ha
Embankment fill volume (approximate)	~75,000 m <sup>3</sup>	271,000 m <sup>3</sup>	300,000 m <sup>3</sup>	345,000 m <sup>3</sup>



### 3.0 Pollutants of Interest

The key air emissions from the Project would be fugitive emissions of particulate matters associated with the earthwork activities, including drilling and blasting, bulldozer and compactor operation, wheel generated dust and handling and transport of construction materials. Wind erosion of stockpiles and active open areas also has the potential to generate dust emissions under dry and windy conditions.

Other air pollutants that have the potential to be generated as a result of the Project include products of fuel combustion from the on-site vehicles and mobile/fixed equipment, the most significant of these being:

- oxides of nitrogen (NO<sub>x</sub>)
- particulate matters
- sulphur oxides (SO<sub>x</sub>)
- carbon monoxide (CO) and
- volatile organic compounds (VOCs).

These emissions are primarily associated with the mobile sources and are dispersed over a large area (as opposed to a single point source emission). Given this, the Project is not expected to result in any significant change in ground level concentrations of these pollutants at surrounding sensitive receptors. Consequently, these emissions have not been assessed further in this report. It is noted that a separate greenhouse gas assessment report has been prepared to support the EA amendment application.

#### 3.1 Particulate Matter

To assess potential health and nuisance impacts of dust emissions, particles are classified primarily by size, as TSP (total suspended particulates), PM<sub>10</sub> (particulate matter with an aerodynamic diameter up to 10 µm) and PM<sub>2.5</sub> (particulate matter with an aerodynamic diameter up to 2.5 µm).

Human health effects of dust tend to be associated with particles with an aerodynamic diameter of 10 µm or less ( $\leq$  PM<sub>10</sub>). These smaller particles tend to remain suspended in the air for longer periods and can penetrate into the lungs. The PM<sub>10-2.5</sub> fraction (coarse fraction) is termed “thoracic particles”. These particles are inhaled into the upper part of the airways and lungs. PM<sub>2.5</sub> particles are fine particles that are inhaled more deeply and lodge in the gas exchange region (alveolar region) of the human lung and are termed “respirable dust”.

Emissions of TSP also have the potential to result in nuisance impacts due to increased rates of dust deposition in the surrounding area.

Based on the discussion above, this AQIA focusses on the following key pollutants of interest:

- PM<sub>2.5</sub>
- PM<sub>10</sub>
- TSP and
- dust deposition



## 4.0 Regulatory Framework -Air Quality

### 4.1 National Environment Protection Measures

#### 4.1.1 National Environment Protection Council Act 1994

The National Environment Protection Council (NEPC) was established under the *National Environment Protection Council Act 1994* (NEPC Act). The primary functions of the NEPC are to:

- prepare National Environment Protection Measures (NEPMs)
- assess and report on the implementation and effectiveness of NEPMs in each state and territory.

NEPMs are a set of national objectives designed to protect or manage aspects of the environment e.g. air quality.

The NEPM relevant to air quality for the Project is the *National Environment Protection (Ambient Air Quality) Measure 2021*.

#### 4.1.2 National Environment Protection (Ambient Air Quality) Measure

The *National Environment Protection (Ambient Air Quality) Measure* (Air NEPM) sets out ambient air quality standards to be achieved nationwide to protect human health and wellbeing (NEPC, 2021). The Air NEPM standards apply at performance monitoring locations that are to be located in areas that represent the air quality likely to be experienced by the general population in a region or sub-region of 25,000 people or more.

The Air NEPM includes air quality standards and performance monitoring goals for the following key air pollutants:

- carbon monoxide (CO)
- lead (Pb)
- nitrogen dioxide (NO<sub>2</sub>)
- PM<sub>10</sub>
- PM<sub>2.5</sub>
- photochemical oxidants, as ozone (O<sub>3</sub>)
- sulfur dioxide (SO<sub>2</sub>).

The Air NEPM air quality standards relevant to this AQIA are provided in **Table 2**.

**Table 2 Air NEPM Ambient Air Quality Standards**

Pollutant	Averaging Period	Maximum Concentration	Units
PM <sub>10</sub>	24 hours	50	µg/m <sup>3</sup>
	Annual	25	µg/m <sup>3</sup>
PM <sub>2.5</sub>	24 hours	25 (goal of 20 by 2025)	µg/m <sup>3</sup>
	Annual	8 (goal of 7 by 2025)	µg/m <sup>3</sup>



## 4.2 Queensland Environmental Protection Act 1994

The *Environmental Protection Act 1994* (hereafter the EP Act) enables the framework for environmental assessments to be developed in Queensland. The EP Act is applicable to all members and bodies in the community, including industry and government. It provides a method for government departments to incorporate environmental factors into their decision-making process.

A summary of the objective of the EP Act is as follows:

*... 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.* (EPP (Air) Explanatory Notes, General outline).

There is a general environmental duty to prevent and minimise environmental harm under section 319 of the EP Act. The EP Act specifically states:

A person must not carry out an activity that causes, or is likely to cause, environmental harm unless the person takes all reasonable and practicable measures to prevent or minimise the harm (the general environment duty).

To decide the measures required to meet the general environmental duty in accordance with the EP Act, regard must be had to the:

- Nature of the harm or potential harm
- Sensitivity of the receiving environment
- Current state of technical knowledge for the activity
- Current state of successful application of the different measures that might be taken
- Financial implications of the different measures as they would relate to the type of activity.

The EP Act allows the Environment Minister to produce Environmental Protection Policies, designed to protect environmental aspects in Queensland. The EPP (Air) was developed under this framework in 2008, with the most recent amendment being published in August 2024 and came into force as of 1 January 2025.

## 4.3 Environmental Protection (Air) Policy and Amendment

The *Environmental Protection (Air) Policy* provides for the management and regulation of commercial and industrial air emissions that could adversely impact on sensitive receptors.

The purpose of the EPP (Air) is summarised below:

*The purpose of the EPP (Air) is to achieve the object of the Act in relation to the air environment (EPP (Air) Part 2, Section 3). The purpose of this policy is achieved by:*

- a) Identifying environmental values to be enhanced or protected; and*
- b) Stating indicators and air quality objectives for enhancing or protecting the environmental values; and*
- c) Providing a framework for making consistent, equitable and informed decisions about the air environment.*



The environmental values listed in the EPP (Air) that are to be enhanced or protected under the policy are:

- a) *The qualities of the air environment that are conducive to protecting the health and biodiversity of ecosystems; and*
- b) *The qualities of the air environment that are conducive to human health and wellbeing; and*
- c) *The qualities of the air environment that are conducive to protecting the aesthetics of the environment, including the appearance of buildings, structures and other property; and*
- d) *The qualities of the air environment that are conducive to protecting agricultural use of the environment.*

Queensland air quality objectives are published in Schedule 1 of the EPP (Air) to protect the environmental values listed above. In late August 2024, the *Environmental Protection (Air) Amendment Policy 2024* (QLD Gov, 2024) was notified, which amended the air quality objectives listed in the EPP (Air) 2019 to make them consistent with the 2021 NEPM AAQ standards and goals.

#### 4.4 Existing Environmental Authority (EPML00770913)

Condition B2 of EPML00770913 (dated 8 May 2025) sets out the current air quality criteria for the Project, as follows:

**B2** The environmental authority holder 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, when monitored in accordance with the most recent version of *Australia Standard AS3580.10.1 Methods for sampling and analysis of ambient air – Determination of particulate matter – Deposited matter – Gravimetric method*; and
- b) A concentration of particulate matter with an aerodynamic diameter of less than 10 micrometre ( $\mu\text{m}$ ) ( $\text{PM}_{10}$ ) 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, when monitored in accordance with the most recent version of either:
  - 1. Australian Standard AS3580.9.6 Methods for sampling and analysis of ambient air—Determination of suspended particulate matter— $\text{PM}_{10}$  high volume sampler with size selective inlet – Gravimetric method, or
  - 2. Australian Standard AS3580.9.9 Methods for sampling and analysis of ambient air—Determination of suspended particulate matter— $\text{PM}_{10}$  low volume sampler—Gravimetric method.
- c) A concentration of particulate matter with an aerodynamic diameter of less than 2.5 micrometres ( $\text{PM}_{2.5}$ ) suspended in the atmosphere of 20 micrograms per cubic metre over a 24-hour averaging time, when monitored in accordance with the most recent version of AS/NZS3580.9.10 Methods for sampling and analysis of ambient air—Determination of suspended



particulate matter—PM (sub)2.5(/sub) low volume sampler—Gravimetric method.

- d) A concentration of particulate matter suspended in the atmosphere of 90 micrograms per cubic metre over a 1 year averaging time, when monitored in accordance with the most recent version of AS/NZS3580.9.3:2003 Methods for sampling and analysis of ambient air—Determination of suspended particulate matter—Total suspended particulate matter (TSP)—High volume sampler gravimetric method.

## 4.5 Air Quality Criteria Adopted for this Assessment

The air quality adopted for use in this AQIA are listed in **Table 3**. For TSP, PM<sub>10</sub> and PM<sub>2.5</sub>, the relevant EPP (Air) air quality objectives have been adopted.

**Table 3 Ambient Air Quality Criteria Adopted for Use in this AQIA**

Indicator	Environmental Value	Assessment Criterion	Averaging Period	Reference
TSP	Health and wellbeing	90 µg/m <sup>3</sup>	1 year	EPP (Air) 2024
PM <sub>10</sub>	Health and wellbeing	50 µg/m <sup>3</sup>	24 hours	EPP (Air) 2024 EPML00770913
		25 µg/m <sup>3</sup>	1 year	EPP (Air) 2024
PM <sub>2.5</sub>	Health and wellbeing	20 µg/m <sup>3</sup>	24 hours	EPP (Air) 2024 EPML00770913
		7 µg/m <sup>3</sup>	1 year	EPP (Air) 2024
Deposited dust	Nuisance	120 mg/m <sup>2</sup> /day	1 month	EPML00770913



## 5.0 Existing Air Environment

### 5.1 Topography and Land use

The land surrounding the Project Site is rural in nature. Nearby industry only includes operations of the related Cracow Underground Gold Mine located 1.6 km to the east. Dawson river is located approximately 5.5 km west.

There are a few scattered rural dwellings mainly to the south of the project, with Cracow being the closest township, which had a population of approximately 89 people based on the 2016 census.

The Project Site is located in a relatively flat valley, with the eastern ridgeline extending to the north and south directions. The western range is aligned with northwest and southeast directions and opens to form a large flat basin in the North and Northwest directions. The ridgelines are approximately 200 m higher than surrounding areas with a 450 m maximum height featured. The Project Site includes a small hill approximately 70 m higher than surrounding areas.

For this study, topographical data was sourced from the Shuttle Radar Topography Mission (SRTM) database, which obtained elevation data on a near-global scale to generate the most complete high-resolution digital topographic database of Earth. There are two resolution outputs available: 1 km and 90 m resolutions. SRTM data with 90 m resolution was used to characterise terrain heights in the local area, as presented in **Figure 4**.

### 5.2 Sensitive Receptors

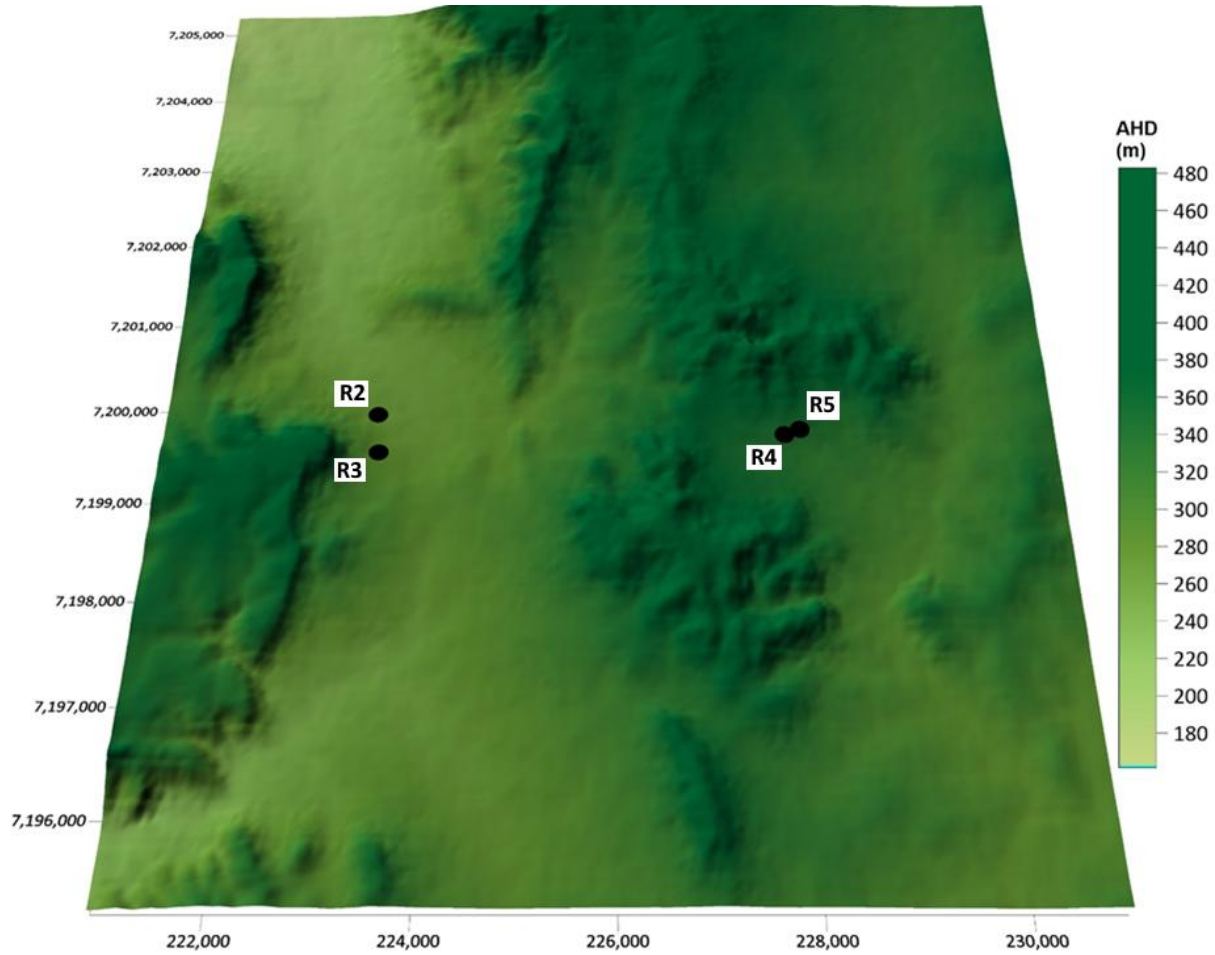
The nearest identified sensitive receptors are summarised in **Table 4** and **Figure 5**.



**Table 4: Details of Identified Potential Sensitive Receptors**

ID	Easting (m)	Northing (m)
R2	223,289	7,199,885
R3	223,334	7,199,460
R4	227,878	7,199,605
R5	228,055	7,199,664



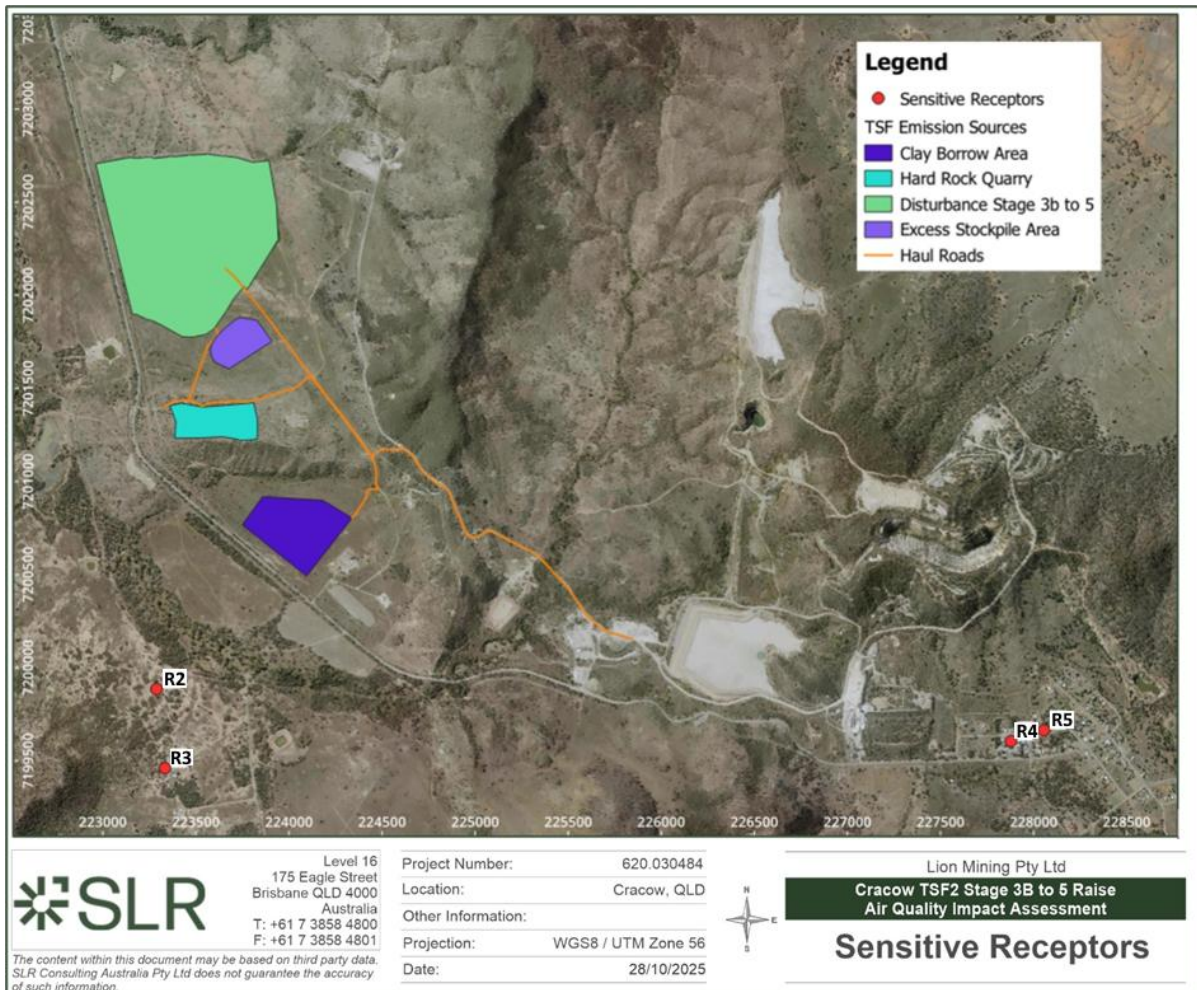
**Figure 4 Local Topography**



	Level 16 175 Eagle Street Brisbane QLD 4000 Australia T: +61 7 3858 4800 F: +61 7 3858 4801	Project Number: 620.030484 Location: Cracow, QLD Other Information: Projection: WGS84 / UTM Zone 56 Date: 28/10/2025		Lion Mining Pty Ltd <b>Cracow TSF2 Stage 3B to 5 Raise                  Air Quality Impact Assessment</b>
	<b>Topography</b>			
	<small>                     The content within this document may be based on third party data.                      SLR Consulting Australia Pty Ltd does not guarantee the accuracy                      of such information.                 </small>			



**Figure 5: Sensitive Air Quality Receptors in relation to the TSF2 Emission Sources**



### 5.3 Existing Air Quality

Ambient air quality criteria relate to the total cumulative pollutant concentration that the population may be exposed to. Air dispersion modelling assessments therefore require the background air quality to be characterised, so that background concentrations of key pollutants of interest can be added to the incremental impacts predicted as a result of the modelled emission sources to provide an assessment of cumulative impacts.

#### 5.3.1 Ambient Monitoring Program

Ambient air quality monitoring is not a requirement under CRO’s current Environmental Authority (EA). However, as part of its operational practices, CRO voluntarily installed particulate monitors and dust deposition gauges at the project site. Ambient concentrations of TSP, PM<sub>10</sub>, and PM<sub>2.5</sub> were measured using OSIRIS monitors, while dust deposition was monitored at six locations surrounding the project area.

It is noted that dust deposition monitoring has not been conducted in recent years, although a substantial archive of historical data is available if required. Additionally, OSIRIS monitors do not comply with Australian Standards and are therefore suitable only for indicative monitoring, not for compliance purposes. Given these limitations, the particulate concentration data collected at the site have not been considered further in this assessment.



### 5.3.2 Review of Available Regional Ambient Air Monitoring Data

The Queensland Department of the Environment, Tourism, Science and Innovation (DETSI) conducts air quality monitoring at various locations across the state to characterise ambient air quality and assess potential community exposure to dust and air contaminants. For this study, the DETSI-operated ambient air quality monitoring station (AQMS) in Toowoomba was selected to establish background air quality levels. Given the Project's remote location, it is acknowledged that using data from this station may overestimate background concentrations (consequently, the predicted cumulative impacts) at the site and surrounding areas.

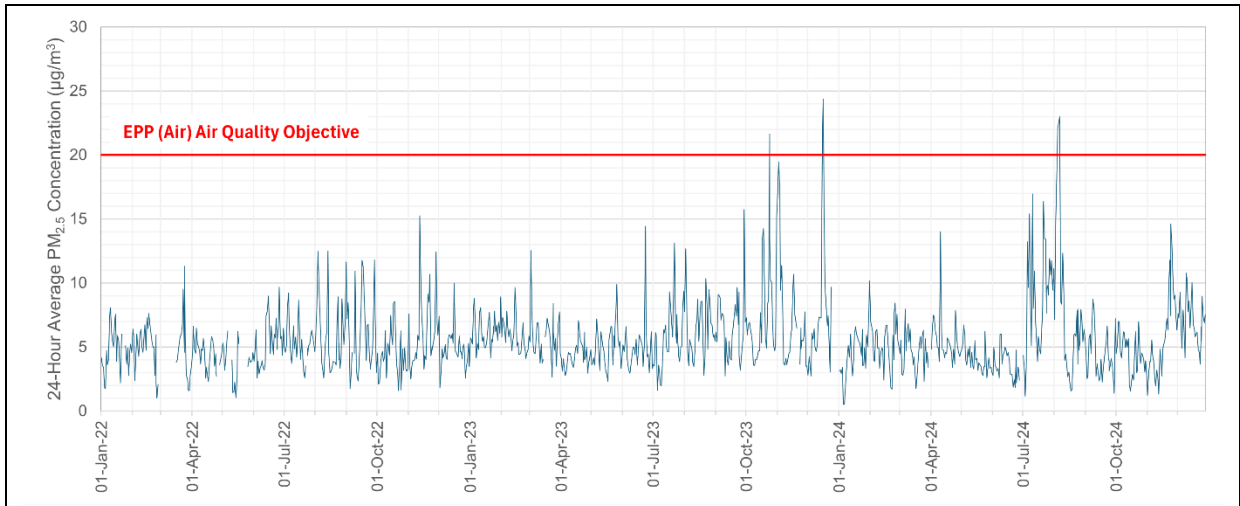
Available validated PM<sub>2.5</sub> and PM<sub>10</sub> concentration data (covering 2022-2024) recorded by the Toowoomba AQMS are summarised in **Table 5** and presented as time series plots in **Figure 6** and **Figure 7**. Recorded values above the adopted criteria are noted in red text, with the number of exceedances shown in brackets.

**Table 5 Summary of Review of Available Monitoring Data – Toowoomba AQMS**

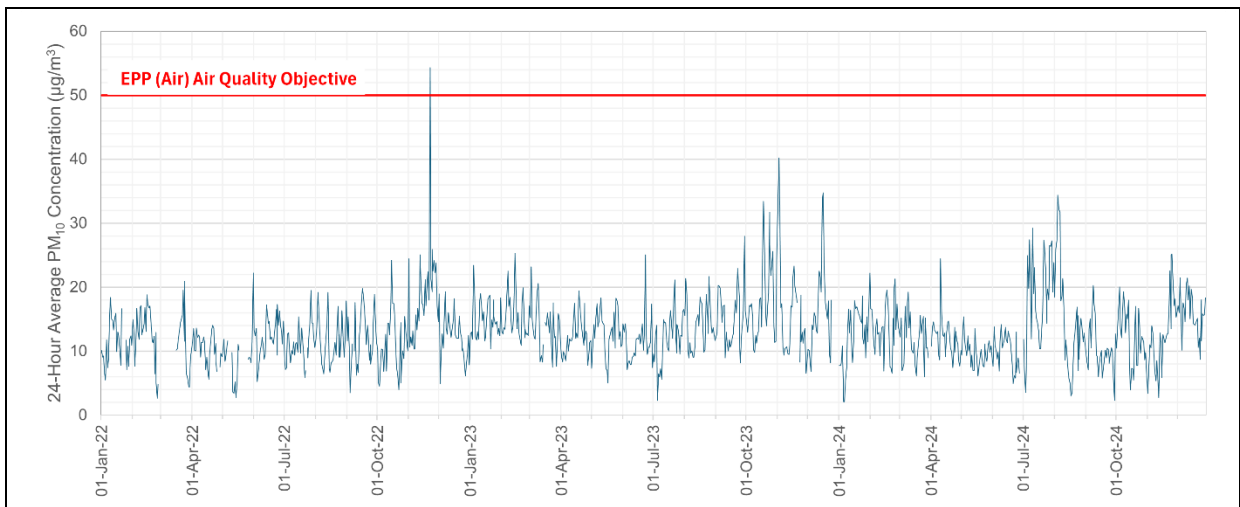
Statistic	Year			Adopted Criterion
	2022	2023	2024	
<b>24-Hour Average PM<sub>2.5</sub> (µg/m<sup>3</sup>)</b>				
Maximum	15.3	24.4 (2)	23 (2)	20
95 <sup>th</sup> Percentile	7.1	4.6	11.2	-
90 <sup>th</sup> Percentile	6.7	4.5	9	-
70 <sup>th</sup> Percentile	5.8	4.3	6.2	-
Average	5.1	6.1	5.5	7
<b>24-Hour Average PM<sub>10</sub> (µg/m<sup>3</sup>)</b>				
Maximum	54.3 (1)	40.2	34.4	50
95 <sup>th</sup> Percentile	17.1	11.6	22.6	-
90 <sup>th</sup> Percentile	17.0	11.4	19.3	-
70 <sup>th</sup> Percentile	12.8	10.9	15.1	-
Average	12.1	14.2	12.9	25
Note: Recorded values above the adopted criteria are noted in red text, with the number of exceedances shown in brackets				



**Figure 6 Measured 24-Hour Average PM<sub>2.5</sub> – Toowoomba AQMS (2022-2024)**



**Figure 7 Measured 24-Hour Average PM<sub>10</sub> - Toowoomba AQMS (2022-2024)**



### 5.3.3 Adopted Background Concentrations

The background particulate concentrations used to assess potential cumulative impacts, and their basis, are presented in **Table 6**. The use of the 70<sup>th</sup> percentile 24-hour concentration as an indication of typical background PM<sub>10</sub> and PM<sub>2.5</sub> concentrations is commonly adopted as a first-pass screening assessment methodology. Only if exceedances are predicted, would a more detailed analysis using daily varying background levels be warranted.

Ambient TSP monitoring data are not available for the region. Given this, a PM<sub>10</sub>/TSP ratio of 0.4, derived based on data collected in the vicinity of open cut coal mines (Richardson, 2000), was adopted to estimate a background annual average TSP level.

Background dust deposition data for recent years are also not available for the area. In the absence of any measured data, a conservatively high background level of 60 mg/m<sup>2</sup>/day was assumed (AECOM, 2016). This is also consistent with the NSW approach for regulating dust nuisance impacts, where the guidelines are 4 g/m<sup>2</sup>/month for cumulative impacts and 2 g/m<sup>2</sup>/month for incremental impacts (where 4 g/m<sup>2</sup>/month is approximately equivalent to 120 mg/m<sup>2</sup>/day).

**Table 6 Background Levels Adopted for Assessing Cumulative Impacts**

Pollutant	Averaging Period	Adopted Background Concentration	Basis
PM <sub>2.5</sub>	24-Hours	6.2 µg/m <sup>3</sup>	Highest 70 <sup>th</sup> percentile 24-hour average concentration - Toowoomba AQMS (2022-2024)
	Annual	6.1 µg/m <sup>3</sup>	Highest annual average concentration - Toowoomba AQMS (2022-2024)
PM <sub>10</sub>	24-Hours	15.1 µg/m <sup>3</sup>	Highest 70 <sup>th</sup> percentile 24-hour average concentration - Toowoomba AQMS (2022-2024)
	Annual	14.2 µg/m <sup>3</sup>	Highest annual average concentration - Toowoomba AQMS (2022-2024)
TSP	Annual	35.5 µg/m <sup>3</sup>	Scaled using a PM <sub>10</sub> /TSP ratio of 0.4
Deposited Dust	30-days	60 mg/m <sup>2</sup> /day	Conservative estimate



## 6.0 Emission Estimation

### 6.1 Modelling Scenarios

Based on a review of available Project information, including activities associated with the construction and operational activities, it is understood that potential dust emissions associated with the operational phase of the Project is likely to be minimal compared to that associated with the construction phase of the Project. Given this, only construction phase of the project has been assessed for this study.

Potential air emissions associated with each stage of the Project (Stage 3B, Stage 4, Stage 5) were estimated using the activity data and appropriate emission factors. The activity data used to estimate the potential particulate emissions for each scenario are presented in **Appendix A**. Fugitive dust emissions for each stage were estimated using relevant emission factors sourced from the USEPA's AP42 Emission Factor Handbook (US EPA, 2006) and updates) and the NPI Emission Estimation Technique Manual for Mining (DSEWPC, 2012).

The emission inventories were developed based on of the following assumptions/input data:

- Haul road lengths and areas of disturbance were estimated based on the location and footprint of the quarry and stockpile areas, and existing surface infrastructures.
- Construction was assumed to operate on 24/7 basis.
- Level 1 watering on haul roads and exposed areas during dry and dusty wind conditions.
- No drilling or blasting occurs in the clay pit and
- The excess stockpile is created from quarry stripped soil.

It is noted that drilling, blasting, and other material extraction activities at the hard rock quarry are considered unlikely and will only be undertaken if deemed necessary. Nonetheless, potential emissions from these activities have been included in this assessment as a precautionary measure to ensure a conservative approach.

Details of the emission Factors and estimated dust emissions for each activity are presented in **Appendix B** and **Appendix C**.

A summary of the total estimated annual average TSP, PM<sub>10</sub> and PM<sub>2.5</sub> emissions for each scenario is provided in **Table 7**. Based on the analysis of these emissions and considering the relative proximity of proposed activities to the nearest sensitive receptors, construction emissions associated with Stage 3B were identified as representative of a potential worst-case scenario. Accordingly, Stage 3B was selected for detailed dispersion modelling to predict potential worst-case air quality impacts on surrounding sensitive receptors.

**Table 7 Annual Average Emissions Rate**

Scenario	TSP (kg/y)	PM <sub>10</sub> (kg/y)	PM <sub>2.5</sub> (kg/y)
Stage 3B	1,140,589	315,732	68,573
Stage 4	995,382	275,863	64,466
Stage 5	1,033,600	287,291	65,619



## 7.0 Dispersion Modelling Methodology

### 7.1 Selection of Models

Potential dust emissions were modelled using a combination of the Weather Research and Forecast (WRF), CALMET and CALPUFF models. CALPUFF is a transport and dispersion model that ejects “puffs” of material emitted from modelled sources, simulating dispersion and transformation processes along the way. In doing so, it typically uses the fields generated by a meteorological pre-processor CALMET, discussed further below. Temporal and spatial variations in the meteorological fields selected are explicitly incorporated in the resulting distribution of puffs throughout a simulation period.

The primary output files from CALPUFF contain either hourly concentration or hourly deposition fluxes evaluated at selected receptor locations. The CALPOST post-processor is then used to process these files, producing tabulations that summarise results of the simulation for user-selected averaging periods.

### 7.2 Meteorological Modelling

Three-dimensional meteorological data for the site and surrounding areas were generated using a combination of the WRF and CALMET models. Brief details of these models are provided in the following sections.

#### 7.2.1 WRF

The WRF model is a next-generation mesoscale numerical weather prediction system designed for both atmospheric research and operational forecasting needs. The model serves a wide range of meteorological applications across scales from tens of meters to thousands of kilometres.

For this assessment, the WRF modelling system was used to produce the meteorological field required to provide the ‘initial guess’ field for the CALMET meteorological model. The WRF modelling was conducted for the 2024 calendar year using a nested approach, where the results from a coarser resolution grid run were used as the inputs into a finer resolution grid run. Parameters used in the WRF modelling are presented in **Table 8**.

**Table 8 Meteorological Parameters – WRF (2024 Calendar Year)**

Parameter	Domain 1	Domain 2	Domain 3	Domain 4
Modelling domain	837 km x 837 km	279 km x 279 km	93 km x 93 km	31 km x 31 km
Grid resolution	27 km	9 km	3 km	1 km
Number of vertical levels	30	30	30	30
Microphysics	WSM6	WSM6	WSM6	WSM6
Cumulus parametrization	Kain-Fritsch	Kain-Fritsch	Kain-Fritsch	Kain-Fritsch
Shortwave radiation physics	Dudhia	Dudhia	Dudhia	Dudhia
Longwave radiation physics	RRTM	RRTM	RRTM	RRTM
Planetary boundary layer	YSU	YSU	YSU	YSU



## 7.2.2 CALMET

In the simplest terms, CALMET is a meteorological model that develops hourly wind and other meteorological fields on a three-dimensional gridded modelling domain that are required as inputs to the CALPUFF dispersion model. Associated two dimensional fields such as mixing height, surface characteristics and dispersion properties are also included in the file produced by CALMET. The interpolated wind field is then modified within the model to account for the influences of topography, sea breeze (if relevant), as well as differential heating and surface roughness associated with different land uses across the modelling domain. These modifications are applied to the winds at each grid point to develop a final wind field. The final hourly varying wind field thus reflects the influences of local topography and land uses.

The CALMET model was run for a 10 km by 10 km domain with a 100 m grid resolution. WRF-generated three-dimensional meteorological data were used as the 'initial-guess' wind field, and local topography and land use information were used to refine the wind field predetermined by the WRF output.

**Table 9** details the parameters used in the meteorological modelling to drive the CALMET model.

**Table 9 Meteorological Modelling Parameters - CALMET**

Parameter	Data
Modelling period	1 January 2024 to 31 December 2024
Meteorological grid	10 km × 10 km
Meteorological grid resolution	100 m
Initial guess field	3D output from WRF model
Vertical resolution (cell heights)	9 (0 m, 20 m, 40 m, 80 m, 160 m, 320 m, 640 m, 1200 m, 2000 m, 3000 m)
Data assimilation	None

## 7.3 Meteorological Data Used in the Dispersion Modelling

To provide a summary of the meteorological conditions predicted for the Project area using the methodology described in **Section 7.2**, a single-point, ground-level meteorological dataset was extracted from the 3-dimensional dataset near the centre of the Project Site. Key features of the data set relevant to pollutant dispersion are presented and discussed below.

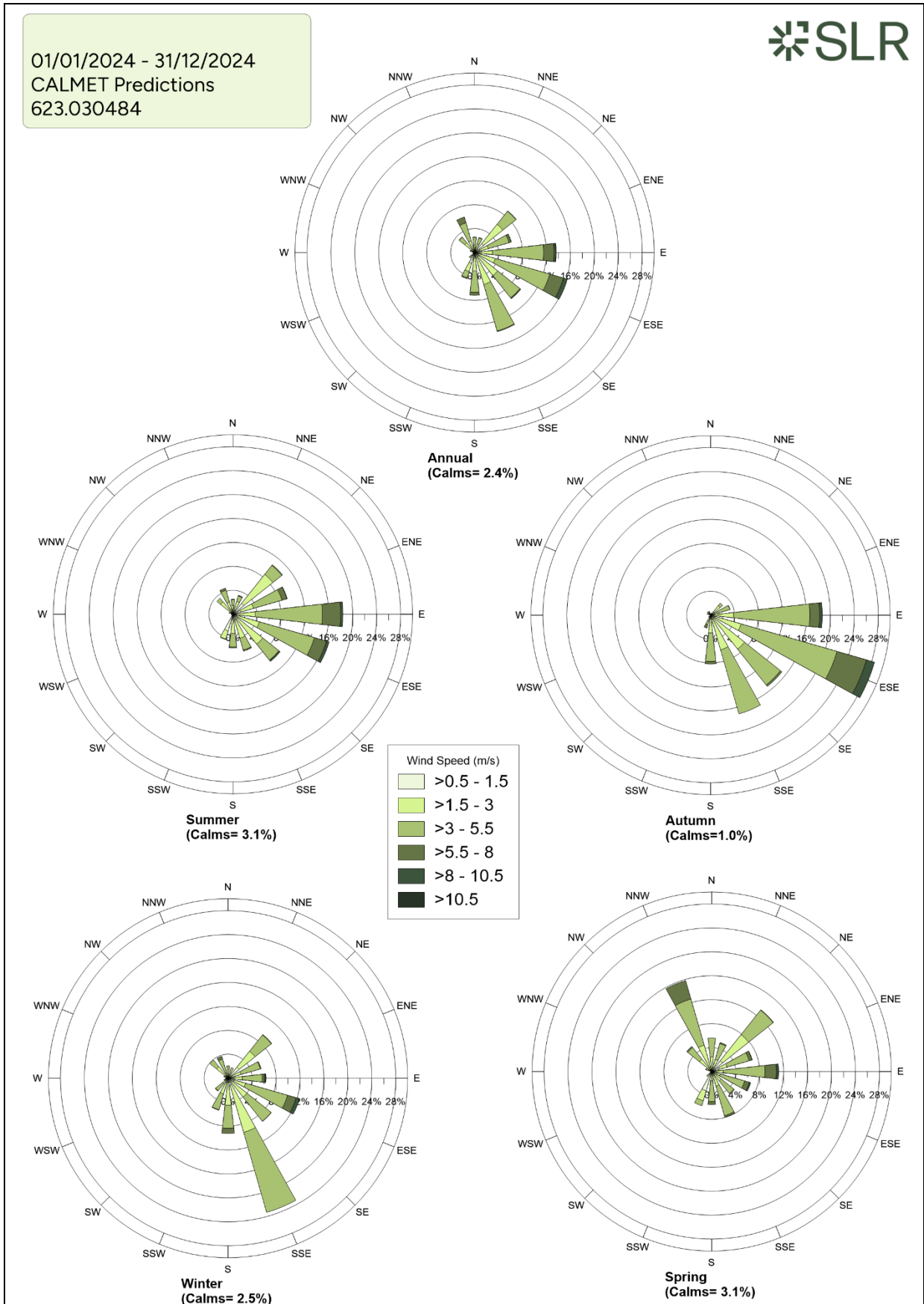
### 7.3.1 Wind Speed and Direction

A summary of the annual wind behaviour and distribution of wind speed frequencies predicted by CALMET for 2024 is presented in **Figure 8** and **Figure 9**. The predicted wind data indicates that in this year, the Site experienced light to moderate winds (between 1.5 m/s and 8 m/s), predominantly from the east and southeastern quadrants. Calm wind conditions (wind speeds less than 0.5 m/s) were predicted to occur approximately 2.4% of the time.

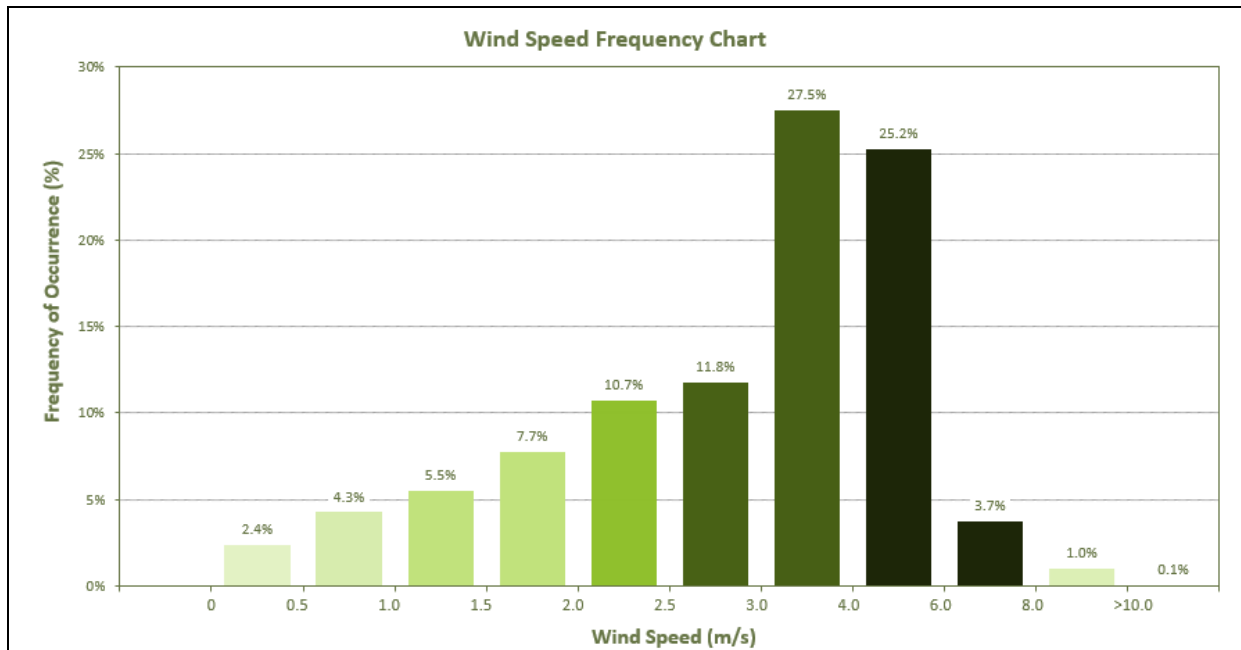
The seasonal wind roses indicate significant variation between the seasons. In summer, winds are light to moderate (1.5 to 8 m/s) and predominantly from the eastern quadrant. In autumn and winter, winds are light to moderate and predominantly from the southeastern quadrant. In spring, light to moderate winds blow predominantly from the eastern quadrant with a high frequency of winds from the north-northwest.



**Figure 8 Wind Roses for the Site, as Predicted by CALMET (2024)**



**Figure 9 Annual Wind Speed Frequencies at the Site (CALMET Predictions, 2024)**



### 7.3.2 Atmospheric Stability

Atmospheric stability refers to the tendency of the atmosphere to resist or enhance vertical motion. The Pasquill-Gifford-Turner (PGT) assignment scheme identifies six Stability Classes, A to F, to categorise the degree of atmospheric stability as follows:

- A = Extremely unstable conditions.
- B = Moderately unstable conditions.
- C = Slightly unstable conditions.
- D = Neutral conditions.
- E = Slightly stable conditions.
- F = Moderately stable conditions.

The meteorological conditions defining each PGT stability class are shown in **Table 10**.

**Figure 10** shows the frequency distribution of the atmospheric stability classes predicted for the Site. The results indicate a very high frequency of stable conditions (Stability Class E and F). Stable conditions occur during the night-time, under low wind speed conditions, which inhibit pollutant dispersion.



**Table 10 Meteorological Conditions Defining PGT Stability Classes**

Surface Wind Speed (m/s)	Daytime Insolation			Night-time Conditions	
	Strong	Moderate	Slight	Thin overcast or > 4/8 low cloud	≤ 4/8 Cloudiness
< 2	A	A - B	B	E	F
2 - 3	A - B	B	C	E	F
3 - 5	B	B - C	C	D	E
5 - 6	C	C - D	D	D	D
> 6	C	D	D	D	D

**Notes:**

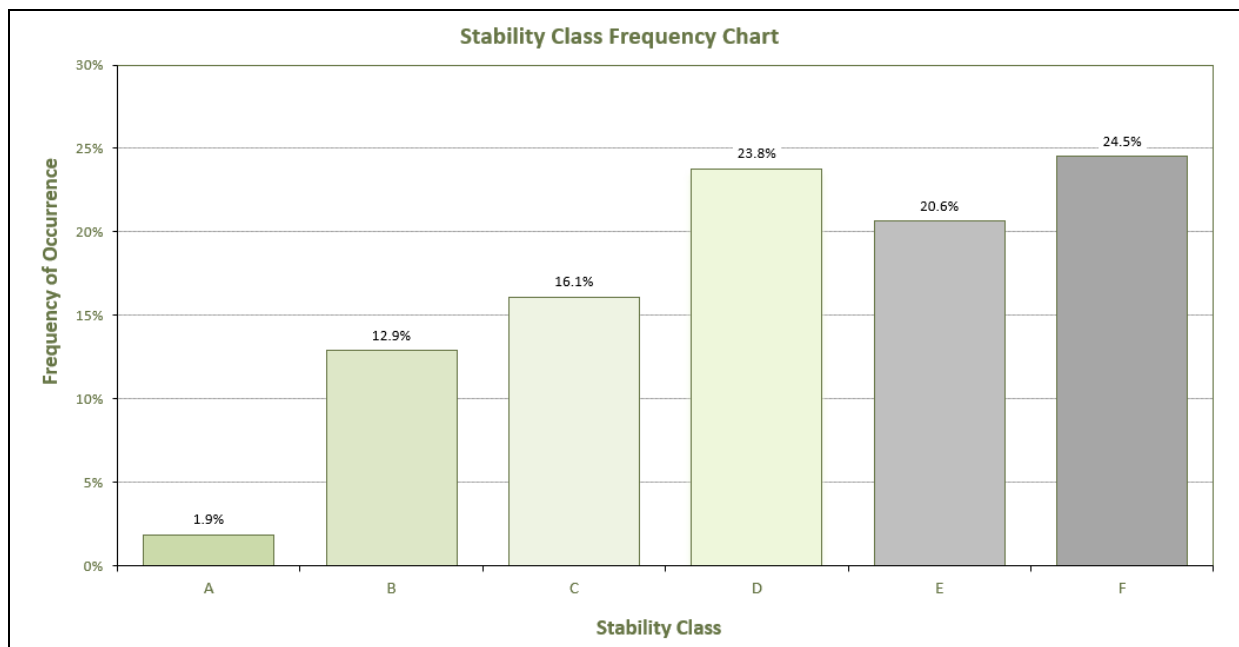
Strong insolation corresponds to sunny midday in midsummer in England; slight insolation to similar conditions in midwinter.

Night refers to the period from 1 hour before sunset to 1 hour after sunrise.

The neutral category D should also be used, regardless of wind speed, for overcast conditions during day or night and for any sky conditions during the hour preceding or following night as defined above.

Source: (NOAA, 2018).

**Figure 10 Stability Class Distribution Predicted by CALMET (2024)**



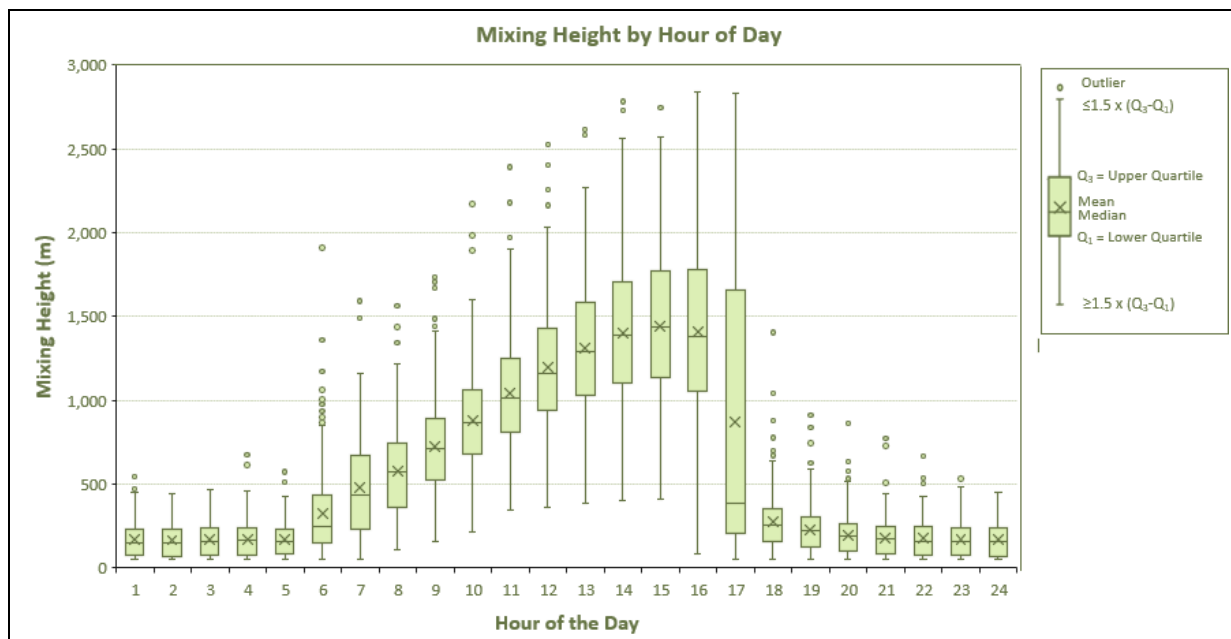
### 7.3.3 Mixing Heights

Diurnal variations in maximum and average mixing heights predicted by CALMET at the Site are illustrated in **Figure 11**. As would be expected, an increase in the mixing height 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 the convective mixing layer.



**Figure 11 Mixing Heights Predicted by CALMET (2024)**



## 7.4 Dispersion Model Configuration

Emissions from the dust generating activities were represented within CALPUFF by a series of volume sources, while wind erosion from exposed areas were represented by a number of area sources. The estimated particulate emissions were modelled as:

- Fine Particulates (FP < 2.5  $\mu\text{m}$ ).
- Course Matter (2.5  $\mu\text{m}$ <CM<10  $\mu\text{m}$ ).
- Remainder (RE>10  $\mu\text{m}$ ).

These parameters were then grouped within the CALPUFF model to predict PM<sub>2.5</sub>, PM<sub>10</sub> and TSP concentrations at surrounding receptor locations. This approach provides the most realistic treatment of the differing size fractions, with the lighter, finer particulate matter being dispersed further than the heavier size fraction that settles out of the air more rapidly.

Based on the sensitivity of each activity to wind speed, hourly varying emission files representing hourly FP, CM and RE emissions for each source were generated for each model scenario based on the annual average emission rates estimated for each activity. Details of the algorithm used to generate the variable emission files are presented in **Appendix D**.



## 8.0 Modelling Results and Assessment

The incremental and cumulative impacts predicted by the modelling at each identified receptor surrounding the Project for the modelled scenario are presented in **Table 11** (maximum 24-hour and annual average PM<sub>2.5</sub> concentrations), **Table 12** (maximum 24-hour and annual average PM<sub>10</sub> concentrations) and **Table 13** (annual average TSP concentrations and monthly dust deposition rates). The estimated background concentrations derived in **Section 5.3.3** were used to calculate the cumulative impacts at each identified surrounding receptor.

The modelling results showed that the predicted cumulative maximum 24-hour and annual average PM<sub>2.5</sub> and PM<sub>10</sub> concentrations and annual average TSP concentrations and monthly dust deposition rates are below and comply with the relevant criteria at each of the identified receptors.

Isopleths presenting the spatial distribution of cumulative impact levels for each pollutant and each averaging period are presented in **Appendix E**.

**Table 11 Predicted Incremental and Cumulative PM<sub>2.5</sub> Concentrations**

Receptor ID	Maximum 24-Hour Average Concentrations (µg/m <sup>3</sup> )		Annual Average Concentrations (µg/m <sup>3</sup> )	
	Increment	Cumulative	Increment	Cumulative
R2	1.9	8.1	0.2	6.3
R3	1.4	7.6	0.2	6.3
R4	0.2	6.4	<0.1	<6.2
R5	0.2	6.4	<0.1	<6.2
<b>Criterion (EPP Air 2025 Amendment)</b>	-	<b>20</b>	-	<b>7</b>

Refer to Figure 5 for Receptor ID locations

**Table 12 Predicted Incremental and Cumulative PM<sub>10</sub> Concentrations**

Receptor ID	Maximum 24-Hour Average Concentrations (µg/m <sup>3</sup> )		Annual Average Concentrations (µg/m <sup>3</sup> )	
	Increment	Cumulative	Increment	Cumulative
R2	8.0	23.1	1.2	15.4
R3	6.1	21.2	0.8	15.0
R4	1.1	16.2	<0.1	<14.3
R5	1.0	16.1	<0.1	<14.3
<b>Criterion (EPP Air 2025 Amendment)</b>	-	<b>50</b>	-	<b>25</b>

Refer to Figure 5 for Receptor ID locations



**Table 13 Predicted Incremental and Cumulative TSP Concentrations**

Receptor ID	Maximum 24-Hour Average Concentrations (µg/m <sup>3</sup> )		Maximum 1-Month Average Deposition (mg/m <sup>2</sup> /day)	
	Increment	Cumulative	Increment	Cumulative
R2	2.8	38.3	2.8	62.8
R3	1.9	37.4	2.2	62.2
R4	0.1	35.6	0.1	60.1
R5	0.1	35.6	0.1	60.1
<b>Criterion (EPP Air 2025 Amendment)</b>	-	<b>90</b>	-	<b>120</b>
Refer to Figure 5 for Receptor ID locations				



## 9.0 Recommendations

### 9.1 Air Quality Control Measures

Considering the findings outlined above, any exceedances of relevant criteria are unlikely, it is still recommended that a management strategy be adopted as a best practice mitigation measure.

It is recommended to adopt normal procedures for minimising dust generation from the construction operations. **Table 14** provides a summary of control procedures to be considered in mitigating dust emissions.

**Table 14: Dust Mitigation Measures**

Source	Mitigation Measure
Material Dumping	Disturb the minimum area necessary for construction and rehabilitate promptly.
Haul Roads	Keep to a minimum and maintain in good condition and regular use of water truck. Only drive on prepared/designated roads. Implement speed restrictions in case of any significant visible dust generation.
Management	The site Air Quality Management Plan is to include a reactive component. On site staff should be trained to be aware of dust emission potential and reporting procedures for reporting visible dust. Active management strategies such as reduction in extraction rates of operations or increasing watering activities can be undertaken if visible dust is seen leaving site. All visible dust observations should be recorded and management actions undertaken to mitigate these emissions.
Landholder consultation	Consultation with potentially impacted landowners and negotiation of relevant mitigation measures, if required. The implementation of simple mitigation measures at residences if appropriate, for example installing first flush systems on rainwater tanks.

### 9.2 Proposed Monitoring Programs

It is not recommended that the site conduct any real time monitoring. It is therefore more appropriate to focus on air quality management and mitigation rather than monitoring.

Therefore, monitoring should only occur in the instances of any complaints. SLR recommends continuing particulate monitoring using current OSIRIS monitors and restart dust deposition monitoring at (or near the boundary of the site) the vicinity of R2 receptor.



## 10.0 Conclusion

To predict the potential worst-case impact at each of the identified sensitive receptors surrounding the Project site, potential particulate emissions for one representative worst-case scenario were quantified, modelled and assessed against the relevant ambient air guidelines for sensitive uses. The worst-case scenario was selected based on the intensity of the dust generating activities associated with the proposed construction stages. This review identified that construction activities during Stage 3B are likely to produce the highest dust emissions compared to other construction stages or the operational phase of the Project.

The fugitive particulate emissions for this worst-case scenario (representing Stage 3B construction phase) were estimated using emission estimation techniques including the USEPA AP42 (USEPA 2006 and updates), National Pollutant Inventory (NPI) emission factors for coal mining (DSEWPC, 2012).

Air dispersion modelling was conducted for TSP, PM<sub>10</sub>, PM<sub>2.5</sub> and deposited dust, and incremental ground level concentrations and deposition rates were predicted at sensitive receptors identified in the surrounding area. Modelling was performed using the CALPUFF dispersion model, and a site-representative 3-dimensional meteorological file compiled for the 2024 calendar year using the WRF and CALMET meteorological models. Cumulative impacts were then calculated by including background TSP, PM<sub>10</sub> and PM<sub>2.5</sub> concentrations and dust deposition rates, estimated based on a review of ambient air quality monitoring data for the regional airshed.

Based on the modelling results, it is concluded that estimated emissions of TSP, PM<sub>10</sub>, and PM<sub>2.5</sub> from the construction stages of the Project are not expected to result in exceedances of the relevant ambient air quality guidelines at any identified sensitive receptors.

Furthermore, considering the substantial separation distance between key dust sources and sensitive receptors during the operational phase, the Project is unlikely to significantly contribute to elevated particulate concentrations or dust deposition levels that could lead to exceedances of relevant air quality standards.



## 11.0 References

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# Appendix A Activity Data

## **Cracow TSF2 Stage 3B to 5 Lift**

**Air Quality Impact Assessment**

**Aeris Resources (Lion Mining Pty Ltd)**

SLR Project No.: 623.030484.00001

28 October 2025

**Table B1 Activity Data Used in Estimation of Dust Emissions**

Activity	Operational Year Assessment Scenario			Unit
	Stage 3B Data	Stage 4 Data	Stage 5 Data	
Scraper	25,500	1,300	3,500	m <sup>3</sup>
General fill available – Local borrow	120,000	26,000	23,000	m <sup>3</sup>
General fill available – Local Stockpile	0	37,000	0	m <sup>3</sup>
Rockfill required – Main Rock Dump	123,000	0	0	m <sup>3</sup>
Rockfill required – Hard Rock Quarry	0	168,000	226,000	m <sup>3</sup>
Clay fill required – Local Borrow	9,000	10,000	10,000	m <sup>3</sup>
Clay fill required – Southern Borrow - Core Yard	49,000	19,000	24,000	m <sup>3</sup>
General fill density	1.8	1.8	1.8	t/m <sup>3</sup>
Rockfill density - Hard	3.0	3.0	3.0	t/m <sup>3</sup>
Clay fill density	1.6	1.6	1.6	t/m <sup>3</sup>
General fill throughput – Local Borrow	216,000	46,800	41,400	t
General fill throughput – Local Stockpile	-	66,600	-	t
Rockfill throughput – Main Rock Dump	369,000	-	-	t
Rockfill throughput – Hard Rock Quarry	-	504,000	678,000	t
Clay fill throughput – Local Borrow	14,400	16,000	16,000	t
Clay fill throughput – Southern Borrow - Core Yard	78,400	30,400	38,400	t
Moisture content - General Fill	2.0	2.0	2.0	%
Moisture content - Rockfill	2.0	2.0	2.0	%
Moisture content – Clay fill	10.0	10.0	10.0	%
Silt content – General Fill	10.0	10.0	10.0	%
Silt content - Rockfill	10.0	10.0	10.0	%
Silt content - Clay Fill	6.0	6.0	6.0	%
Silt content - Haul road	10.0	10.0	10.0	%
Drilling - Hardrock	-	16,380	16,380	holes/annum
Blasting - Hardrock	-	156	156	blasts/annum
Blast area - Hardrock	-	2,100	2,100	m <sup>2</sup>



Activity	Operational Year Assessment Scenario			
	Stage 3B Data	Stage 4 Data	Stage 5 Data	Unit
Dozer	8,760	8,760	8,760	hr/annum
Roller/Compactor	17,520	17,520	17,520	hr/annum
Average weight of haul truck	38	38	38	t
Haul truck loading capacity	28	28	28	t
Hauling distance – General Fill from Local borrow	2	2	2	km
Hauling distance – Local Stockpile	3.26	3.26	3.26	km
Hauling distance – Main Rock Dump to TSF	6.60	-	-	km
Hauling distance – Hardrock Quarry to TSF	4.02	4.02	4.02	km
Hauling distance – Clay Fill from Local borrow	2	2	2	km
Hauling distance – Clay Fill from Clay Pit	6.4	6.4	6.4	km
Speed of grader	15.0	15.0	15.0	km/h
Grading	13,140	13,140	13,140	hrs/annum
Wind erosion - Excess soil stockpile	5.5	5.5	5.5	ha
Wind erosion - Quarry Hard Rock Quarry)	4.0	4.0	4.0	ha
Wind erosion - Clay Pit	7.2	7.2	7.2	ha
Wind erosion - TSF	21.5	21.5	21.5	ha
Dust suppression on exposed area and haul routes	Level 1 watering			





# Appendix B    Emmision Factors

## **Cracow TSF2 Stage 3B to 5 Lift**

**Air Quality Impact Assessment**

**Aeris Resources (Lion Mining Pty Ltd)**

SLR Project No.: 623.030484.00001

28 October 2025

Activity	Emission Factor			Unit	Variables
	TSP	PM <sub>10</sub>	PM <sub>2.5</sub>		
Scraper Stripping Topsoil	0.029	0.007	0.001	kg/t	
Drilling - Hardrock	0.590	0.307	0.028	kg/hole	
Blasting - Hardrock	21.2	11.0	0.6	kg/blast	2,100 m <sup>2</sup> area of blast
Loading to trucks - General Fill – Local Borrow	0.00211	0.00100	0.00015		2% moisture content
Loading to trucks - General Fill – Local Stockpile	0.00211	0.00100	0.00015	kg/t	2% moisture content
Loading to trucks - Rockfill – Waste Rock Dump	0.00211	0.00100	0.00015		2% moisture content
Loading to trucks - Rockfill – Hardrock Quarry	0.00211	0.00100	0.00015	kg/t	2% moisture content
Loading to trucks – Clay Fill – Local Borrow	0.00022	0.00010	0.00002		10% moisture content
Loading to trucks – Clay Fill – Southern Borrow - Core Yard	0.00022	0.00010	0.00002	kg/t	10% moisture content
Hauling material - General Fill – Local Borrow	0.213	0.063	0.006		28 tonnes/load 38 Ave GMV (tonnes) 1.5 km/return trip 4 kg/VKT 10 % silt content
Hauling material - General Fill – Local Stockpile	0.463	0.137	0.014	kg/t	28 tonnes/load 38 Ave GMV (tonnes) 3.3 km/return trip 4 kg/VKT 10 % silt content
Hauling material - Rockfill – from Waste Rock Dump to Hard Rock Quarry	0.937	0.277	0.028		28 tonnes/load 38 Ave GMV (tonnes) 6.6 km/return trip 4 kg/VKT 10 % silt content
Hauling material - Rockfill – from Waste Rock Dump from Hard Rock Quarry to TSF	0.571	0.169	0.017		28 tonnes/load 38 Ave GMV (tonnes) 4.0 km/return trip 4 kg/VKT 10 % silt content
Hauling material - Rockfill – Hard Rock Quarry material to TSF	0.571	0.169	0.017	kg/t	28 tonnes/load 38 Ave GMV (tonnes) 4.0 km/return trip 4 kg/VKT 10 % silt content



Activity	Emission Factor			Unit	Variables
	TSP	PM <sub>10</sub>	PM <sub>2.5</sub>		
Hauling material - Clay Fill – Local Borrow	0.213	0.063	0.006		28 tonnes/load 38 Ave GMV (tonnes) 1.5 km/return trip 4 kg/VKT 10 % silt content
Hauling material - Clay Fill – Southern Borrow - Core Yard	0.909	0.268	0.027	kg/t	28 tonnes/load 38 Ave GMV (tonnes) 6.4 km/return trip 4 kg/VKT 10 % silt content
Unloading materials - General fill	0.00211	0.00100	0.00015	kg/t	2% moisture content
Unloading materials - Hardrock	0.00211	0.00100	0.00015	kg/t	2% moisture content
Unloading materials- Clay fill	0.00022	0.00010	0.00002	kg/t	10% moisture content
Dozers	16.7	4.0	1.8	kg/h	10 % Silt content 2% Moisture content
Rollers/Compactor	16.7	4.0	1.8	kg/h	10 % Silt content 2% Moisture content
Crushing - Hard Rock – at Main Rock Dump	0.0027	0.0012	0.0001	kg/t	
Crushing - Hard Rock – at Hard Rock Quarry	0.0027	0.0012	0.0001	kg/t	
Grading roads	2.96	0.76	0.09	kg/VKT	15 km/h grader speed
Wind erosion - Excess soil stockpile	0.40	0.20	0.02	kg/ha/hour	
Wind erosion - Quarry Rockfill (Hard Rock Quarry)	0.40	0.20	0.02	kg/ha/hour	
Wind erosion - Clay Pit	0.40	0.20	0.02	kg/ha/hour	
Wind erosion - TSF	0.40	0.20	0.02	kg/ha/hour	





# Appendix C Emission Estimation

## Cracow TSF2 Stage 3B to 5 Lift

Air Quality Impact Assessment

Aeris Resources (Lion Mining Pty Ltd)

SLR Project No.: 623.030484.00001

28 October 2025

**Table C1 Fugitive Dust Emissions**

Operation Year	Stage 3B Assessment Scenario			Stage 4 Assessment Scenario			Stage 5 Assessment Scenario		
	TSP (kg/y)	PM <sub>10</sub> (kg/y)	PM <sub>2.5</sub> (kg/y)	TSP (kg/y)	PM <sub>10</sub> (kg/y)	PM <sub>2.5</sub> (kg/y)	TSP (kg/y)	PM <sub>10</sub> (kg/y)	PM <sub>2.5</sub> (kg/y)
Scraper Stripping Topsoil	740	186	37	38	9	2	102	26	5
Drilling - Hardrock	0	0	0	9,664	5,025	452	9,664	5,025	452
Blasting - Hardrock	0	0	0	3,303	1,717	99	3,303	1,717	99
Loading to trucks - General Fill – Local Borrow	455	215	33	99	47	7	87	41	6
Loading to trucks - General Fill – Local Stockpile	0	0	0	140	66	10	0	0	0
Loading to trucks - Rockfill – Waste Rock Dump	778	368	56	0	0	0	0	0	0
Loading to trucks - Rockfill – Hardrock Quarry	0	0	0	1,062	502	76	1,429	676	102
Loading to trucks – Clay Fill – Local Borrow	3	2	0	4	2	0	4	2	0
Loading to trucks – Clay Fill – Southern Borrow - Core Yard	17	8	1	7	3	0	9	4	1
Hauling material - General Fill – Local Borrow	23,008	6,791	679	4,985	1,471	147	4,410	1,302	130
Hauling material - General Fill – Local Stockpile	0	0	0	15,418	4,551	455	0	0	0
Hauling material - Rockfill – from Waste Rock Dump to Hard Rock Quarry	172,944	51,046	5,105	0	0	0	0	0	0
Hauling material - Rockfill – from Waste Rock Dump from Hard Rock Quarry to TSF	105,339	31,092	3,109	0	0	0	0	0	0
Hauling material - Rockfill – Hard Rock Quarry material to TSF	0	0	0	143,877	42,467	4,247	193,549	57,128	5,713
Hauling material - Clay Fill – Local Borrow	1,534	453	45	1,704	503	50	1,704	503	50
Hauling material - Clay Fill – Southern Borrow - Core Yard	35,631	10,517	1,052	13,816	4,078	408	17,452	5,151	515



Operation Year	Stage 3B Assessment Scenario			Stage 4 Assessment Scenario			Stage 5 Assessment Scenario		
	TSP (kg/y)	PM <sub>10</sub> (kg/y)	PM <sub>2.5</sub> (kg/y)	TSP (kg/y)	PM <sub>10</sub> (kg/y)	PM <sub>2.5</sub> (kg/y)	TSP (kg/y)	PM <sub>10</sub> (kg/y)	PM <sub>2.5</sub> (kg/y)
Unloading materials - General fill	455	215	33	239	113	17	87	41	6
Unloading materials - Hardrock	778	368	56	1,062	502	76	1,429	676	102
Unloading materials- Clay fill	21	10	1	10	5	1	12	6	1
Dozers	146,602	35,427	15,393	146,602	35,427	15,393	146,602	35,427	15,393
Rollers/Compactor	293,203	70,854	30,786	293,203	70,854	30,786	293,203	70,854	30,786
Crushing - Hard Rock – at Main Rock Dump	996	443	44	0	0	0	0	0	0
Crushing - Hard Rock – at Hard Rock Quarry	0	0	0	1,361	605	60	1,831	814	81
Grading roads	291,987	74,504	9,052	291,987	74,504	9,052	291,987	74,504	9,052
Wind erosion - Excess soil stockpile	9,636	4,818	451	9,636	4,818	451	9,636	4,818	451
Wind erosion - Quarry Rockfill (Hard Rock Quarry)	7,008	3,504	328	7,008	3,504	328	7,008	3,504	328
Wind erosion - Clay Pit	12,614	6,307	590	12,614	6,307	590	12,614	6,307	590
Wind erosion - TSF	37,580	18,790	1,759	37,580	18,790	1,759	37,580	18,790	1,759
<b>Total</b>	<b>1,140,589</b>	<b>315,732</b>	<b>68,573</b>	<b>995,382</b>	<b>275,863</b>	<b>64,466</b>	<b>1,033,600</b>	<b>287,291</b>	<b>65,619</b>





# Appendix D Variable Emission Compilation

## **Cracow TSF2 Stage 3B to 5 Lift**

**Air Quality Impact Assessment**

**Aeris Resources (Lion Mining Pty Ltd)**

SLR Project No.: 623.030484.00001

28 October 2025

A brief summary of the steps used in calculating the hourly varying emission rates for each source are presented below.

**Step 1: Calculate annual average emission rate (kg/year) for FP, CM and RE**

$FP_{\text{annual}} = PM_{2.5, \text{annual}}$	(FP) Fine Particulate – particulate of size less than 2.5 µm
$CM_{\text{annual}} = PM_{10, \text{annual}} - PM_{2.5, \text{annual}}$	(CM) Coarse Particulate – particulate of size between 10 µm and 2.5 µm
$RE_{\text{annual}} = TSP_{\text{annual}} - PM_{10, \text{annual}}$	(RE) Remaining Particulate – particulate of size greater than 10 µm

**Step 2: Identify the operating hours for each activity**

**Step 3: Classify the sensitivity of each type of activity to wind speed**

Wind insensitive: Activities with emission factor that is independent of wind speed (e.g. blasting)

Wind sensitive: Activities with emission factor that is a function of (wind speed/2.2)<sup>1.3</sup> (e.g. loading)

Wind erosion: Emission from exposed areas/stockpiles

**Step 4: Identify the number of sources associated with each activity**

Note that each wind erosion source is modelled as an independent source.

**Step 5: Calculate the hourly average emission rate for each activity per source**

$FP_{AC,i,h} = \frac{FP_{\text{annual},i} \times 1000}{N_{\text{days}} \times OH_i \times 3600 \times N_{s,i} \times WSFactor_{i,h}}$ $CM_{AC,i,h} = \frac{CM_{\text{annual},i} \times 1000}{N_{\text{days}} \times OH_i \times 3600 \times N_{s,i} \times WSFactor_{i,h}}$ $RE_{AC,i,h} = \frac{RE_{\text{annual},i} \times 1000}{N_{\text{days}} \times OH_i \times 3600 \times N_{s,i}} \times WSFactor_{i,h}$ <p>For wind insensitive activities <math>WSFactor_{i,h} = 1</math></p> <p>For wind sensitive activities</p> $WSFactor_{i,h} = \frac{\left(\frac{WS_h}{2.2}\right)^{1.3}}{\frac{\sum_{j=1}^n \left(\frac{WS_j}{2.2}\right)^{1.3}}{n}}$ <p>For wind erosion activities</p> $WSFactor_{i,h} = \frac{(WS_h)^3}{\frac{\sum_{j=1}^n (WS_j)^3}{n}}$	<p>WHERE:</p> <p><math>FP_{AC,i,h}</math>- fine particulates emission rate for activity <math>i</math> (g/s) at hour <math>h</math></p> <p><math>CM_{AC,i,h}</math>- fine particulates emission rate for activity <math>i</math> (g/s) at hour <math>h</math></p> <p><math>RE_{AC,i,h}</math>- fine particulates emission rate for activity <math>i</math> (g/s) at hour <math>h</math></p> <p><math>OH_i</math>-daily operating hours (1- 24) for activity <math>i</math></p> <p><math>N_{\text{DAYS}}</math>-number of days in the meteorological data file</p> <p><math>N_{s,i}</math>-number of sources associated with activity <math>i</math></p> <p><math>WS_H</math>-wind speed at the hour</p> <p><math>N</math>-number of hours in the meteorological data file</p>
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Note: If the activity was modelled as area source, the equation on the left column of the table needs to be divided by the area of that activity

**Step 6: Calculate hourly average emission rate for each source**

To calculate the emission rate for a particular source for a particular hour, add up the calculated emission rate for each activity associated with that source.

For example, if Source 1 is associated with Activity 1, Activity 2 and Activity 3, then:

- $ER_{S1,h,FP} = FP_{AC,1,h} + FP_{AC,2,h} + FP_{AC,3,h}$
- $ER_{S1,h,CM} = CM_{AC,1,h} + CM_{AC,2,h} + CM_{AC,3,h}$
- $ER_{S1,h,RE} = RE_{AC,1,h} + RE_{AC,2,h} + RE_{AC,3,h}$





# Appendix E Contour Plots

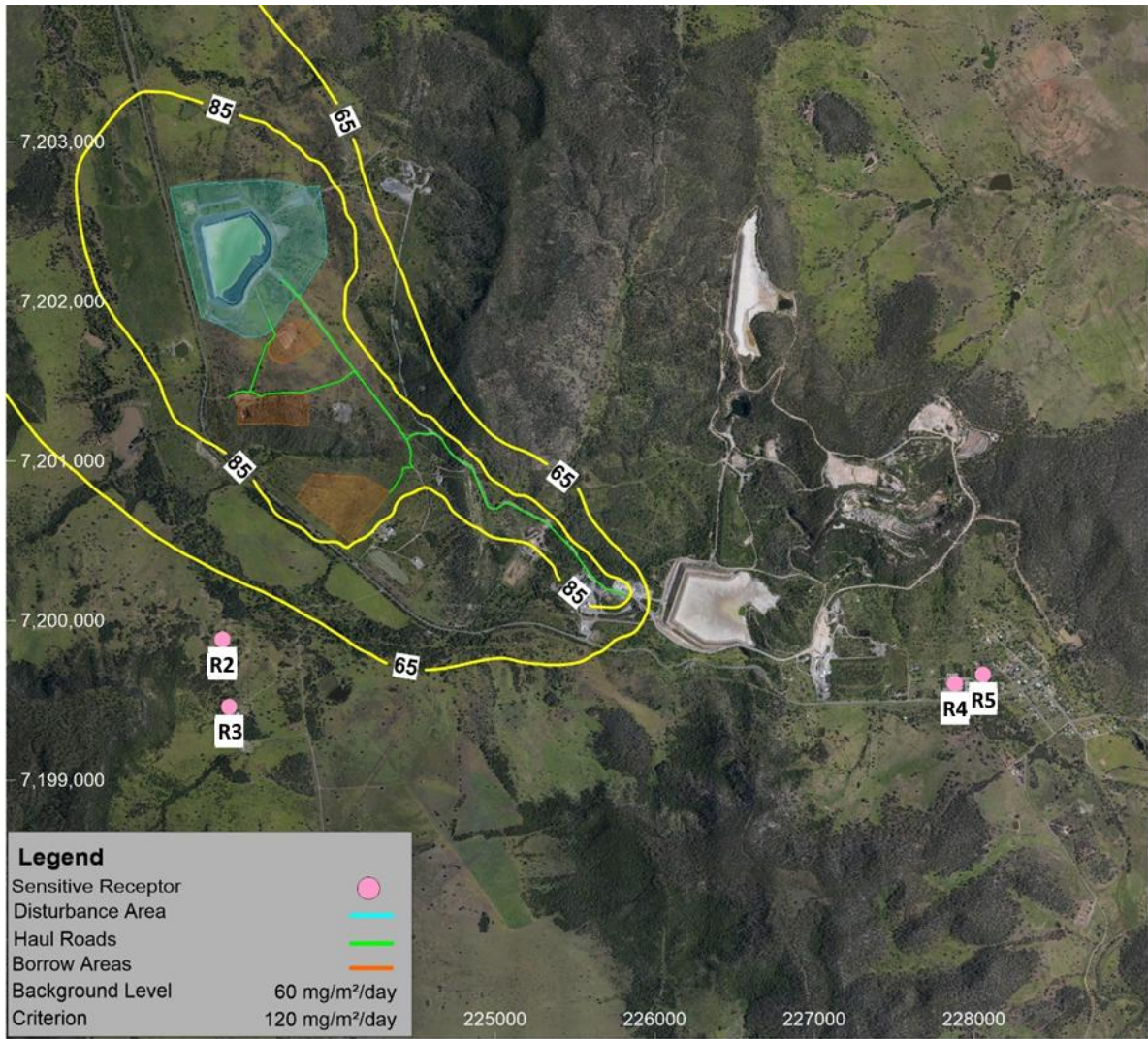
## **Cracow TSF2 Stage 3B to 5 Lift**

**Air Quality Impact Assessment**

**Aeris Resources (Lion Mining Pty Ltd)**

SLR Project No.: 623.030484.00001

28 October 2025



**Legend**

- Sensitive Receptor ●
- Disturbance Area —
- Haul Roads —
- Borrow Areas —
- Background Level — 60 mg/m<sup>2</sup>/day
- Criterion — 120 mg/m<sup>2</sup>/day

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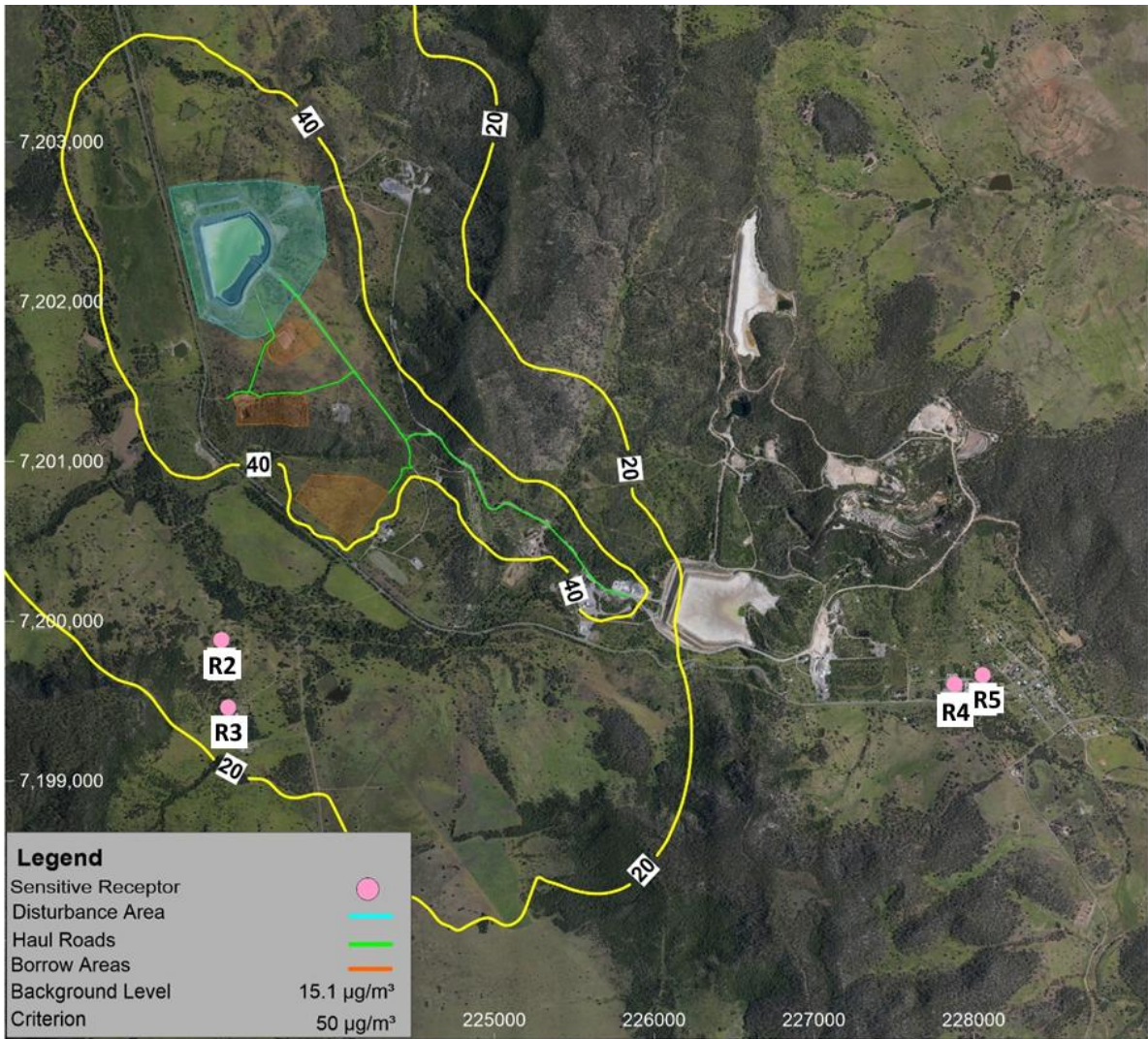
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Project Number:	620.030484
Dispersion Model:	CALPUFF
Modelling Period:	2024
Projection:	GDA 1994 MGA Zone 56
Date:	14/10/2025



Lion Mining Pty Ltd			
<b>Cracow TSF2 Stage 3B to 5 Raise Air Quality Impact Assessment</b>			
Cumulative Impact			
Pollutant	Dust Deposition	Averaging Period	1 Month Unit mg/m <sup>2</sup> /day





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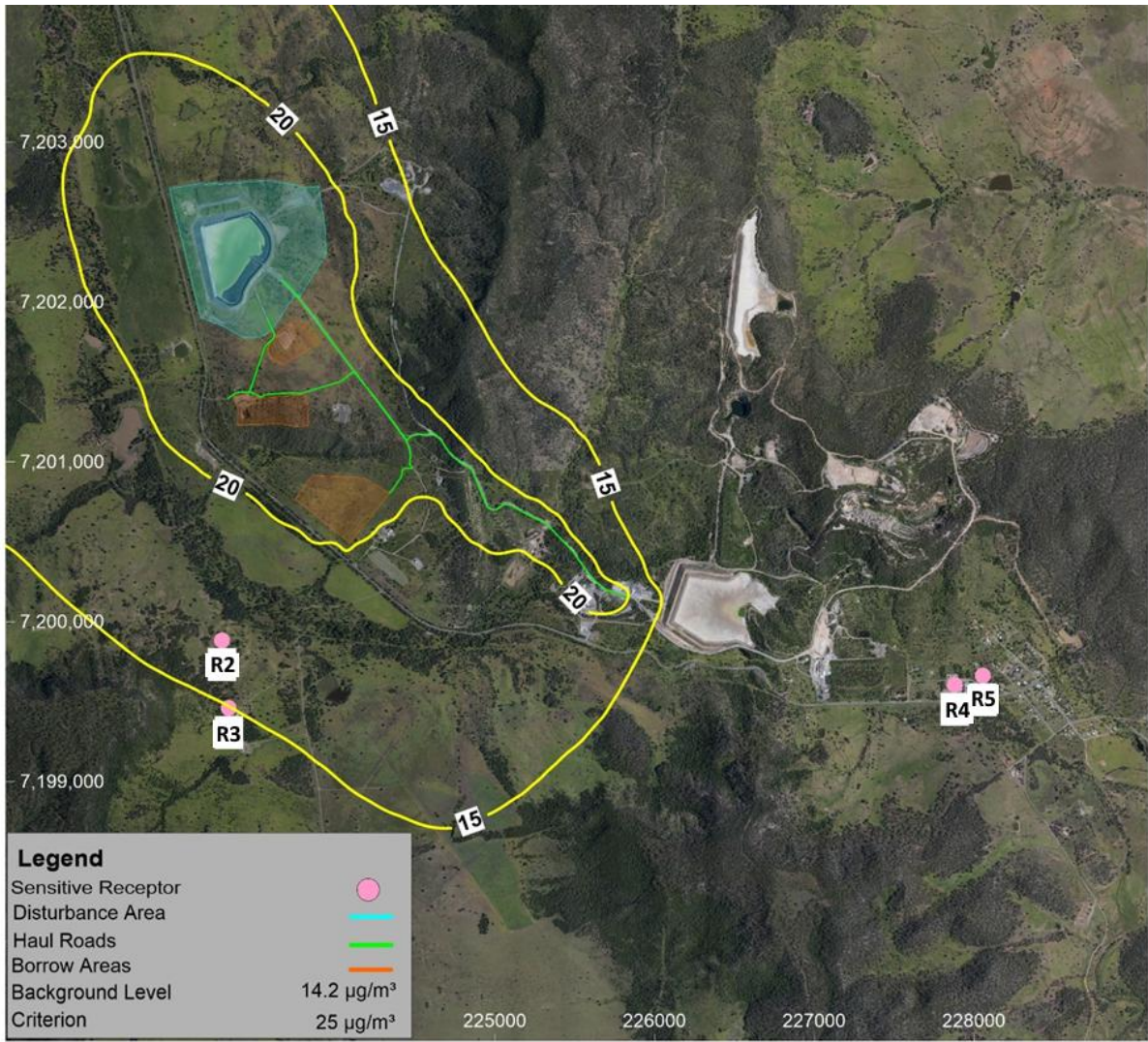
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**Cracow TSF2 Stage 3B to 5 Raise  
 Air Quality Impact Assessment**

Cumulative Impact

Pollutant	PM <sub>10</sub>	Averaging Period	24-Hour	Unit	$\mu\text{g}/\text{m}^3$
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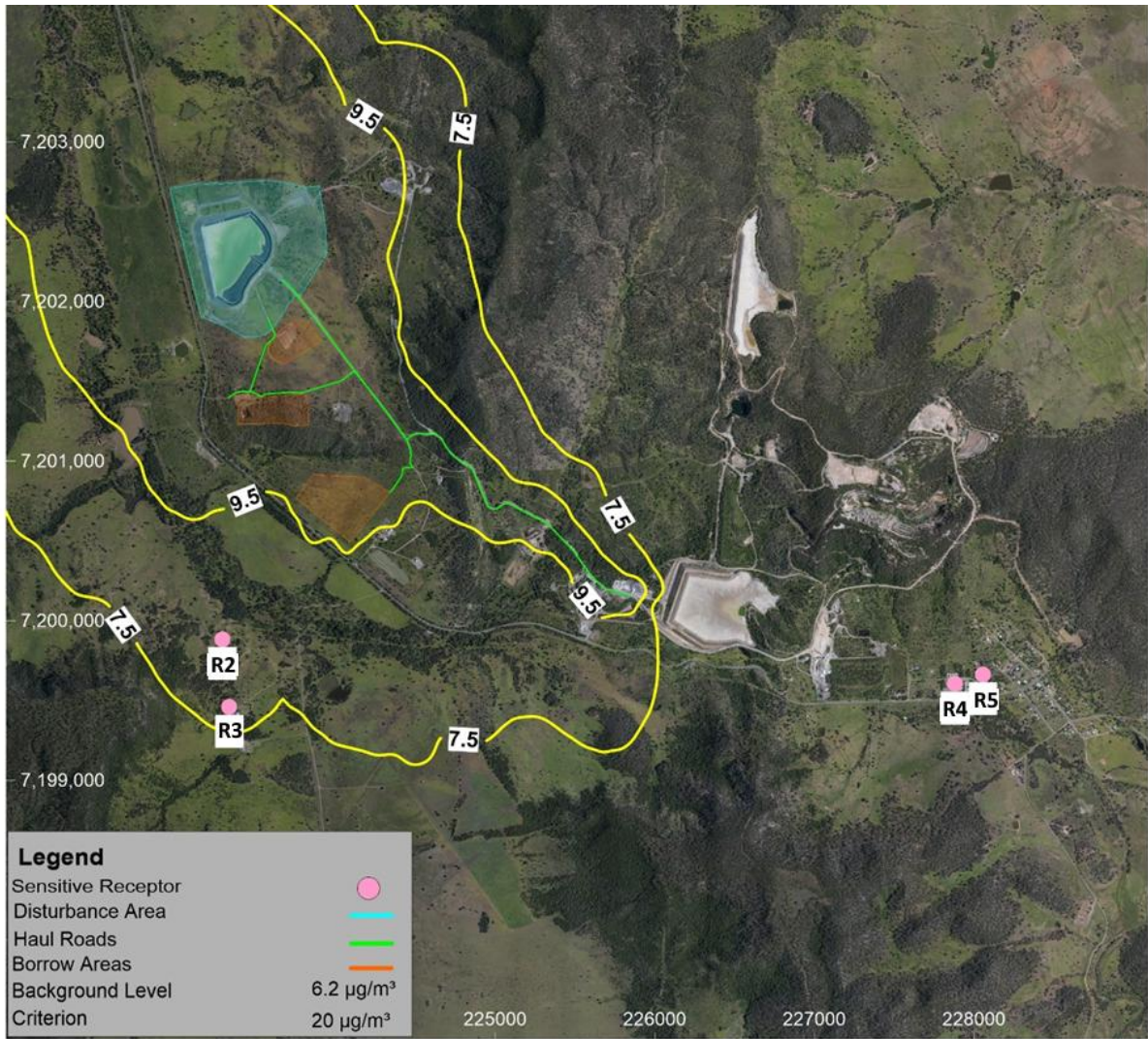
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Lion Mining Pty Ltd				
<b>Cracow TSF2 Stage 3B to 5 Raise Air Quality Impact Assessment</b>				
Cumulative Impact				
Pollutant	PM <sub>10</sub>	Averaging Period	Annual	Unit
				$\mu\text{g}/\text{m}^3$





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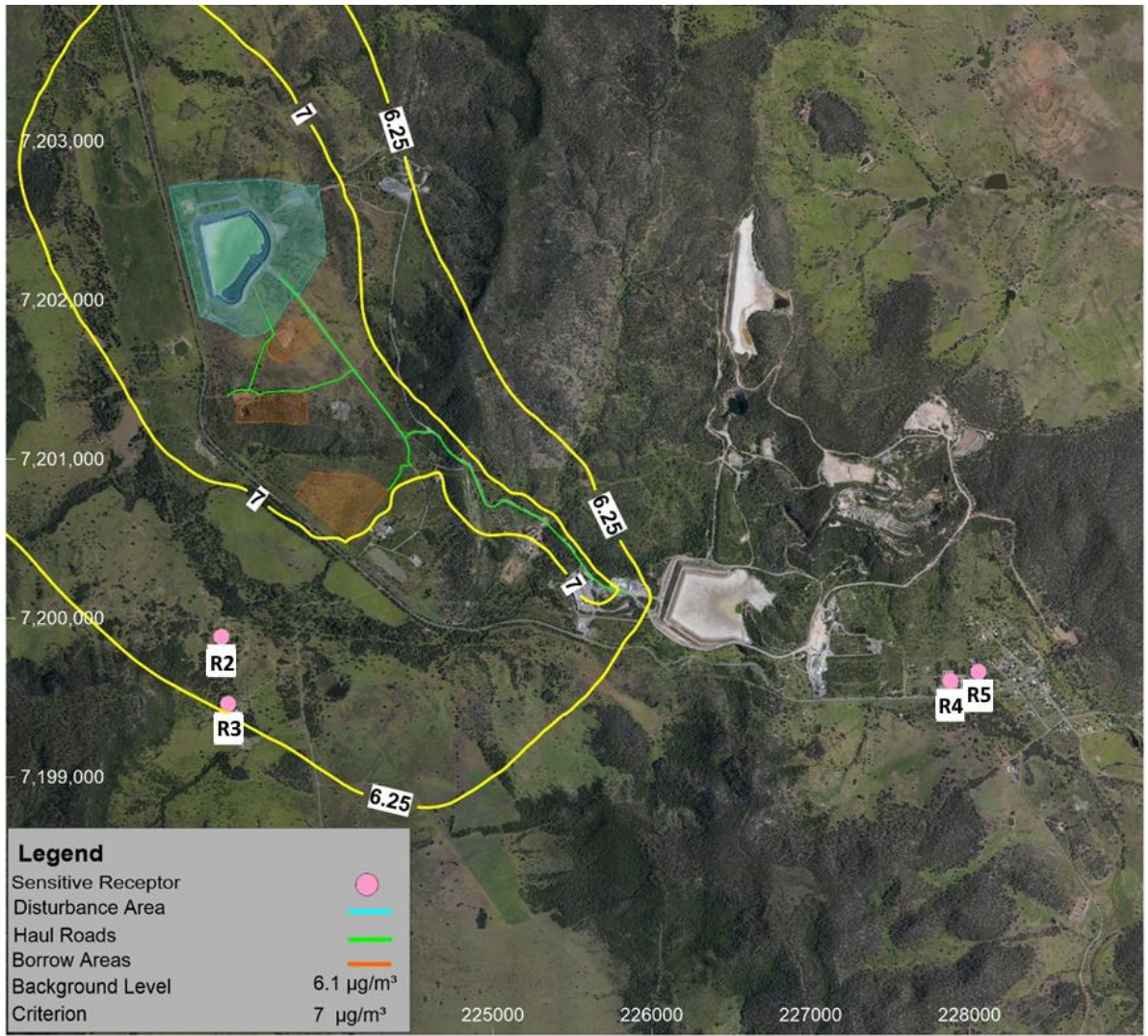
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Lion Mining Pty Ltd					
<b>Cracow TSF2 Stage 3B to 5 Raise Air Quality Impact Assessment</b>					
Cumulative Impact					
Pollutant	PM <sub>2.5</sub>	Averaging Period	24-Hour	Unit	µg/m <sup>3</sup>





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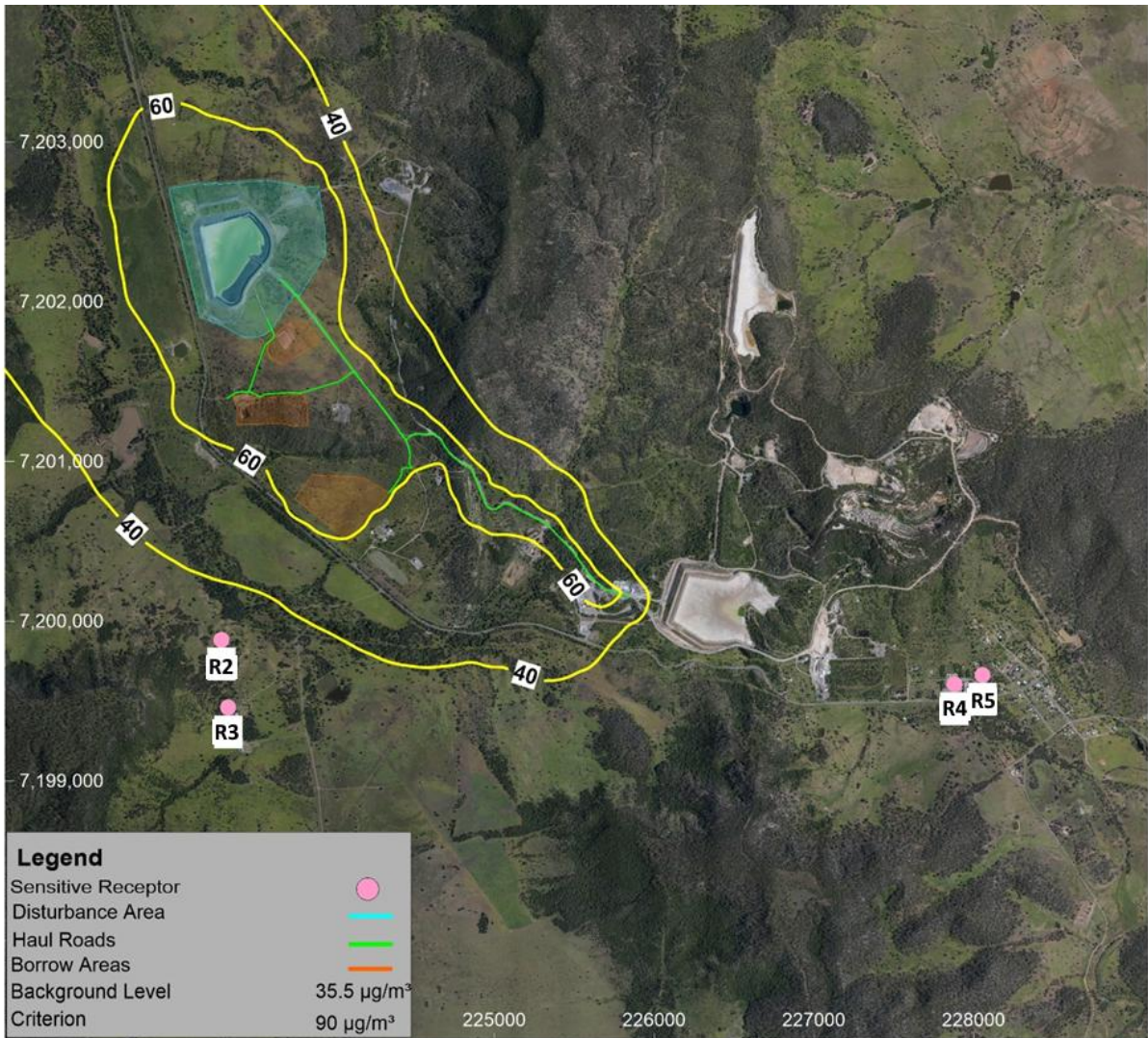
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Lion Mining Pty Ltd					
<b>Cracow TSF2 Stage 3B to 5 Raise Air Quality Impact Assessment</b>					
Cumulative Impact					
Pollutant	PM <sub>2.5</sub>	Averaging Period	Annual	Unit	µg/m <sup>3</sup>





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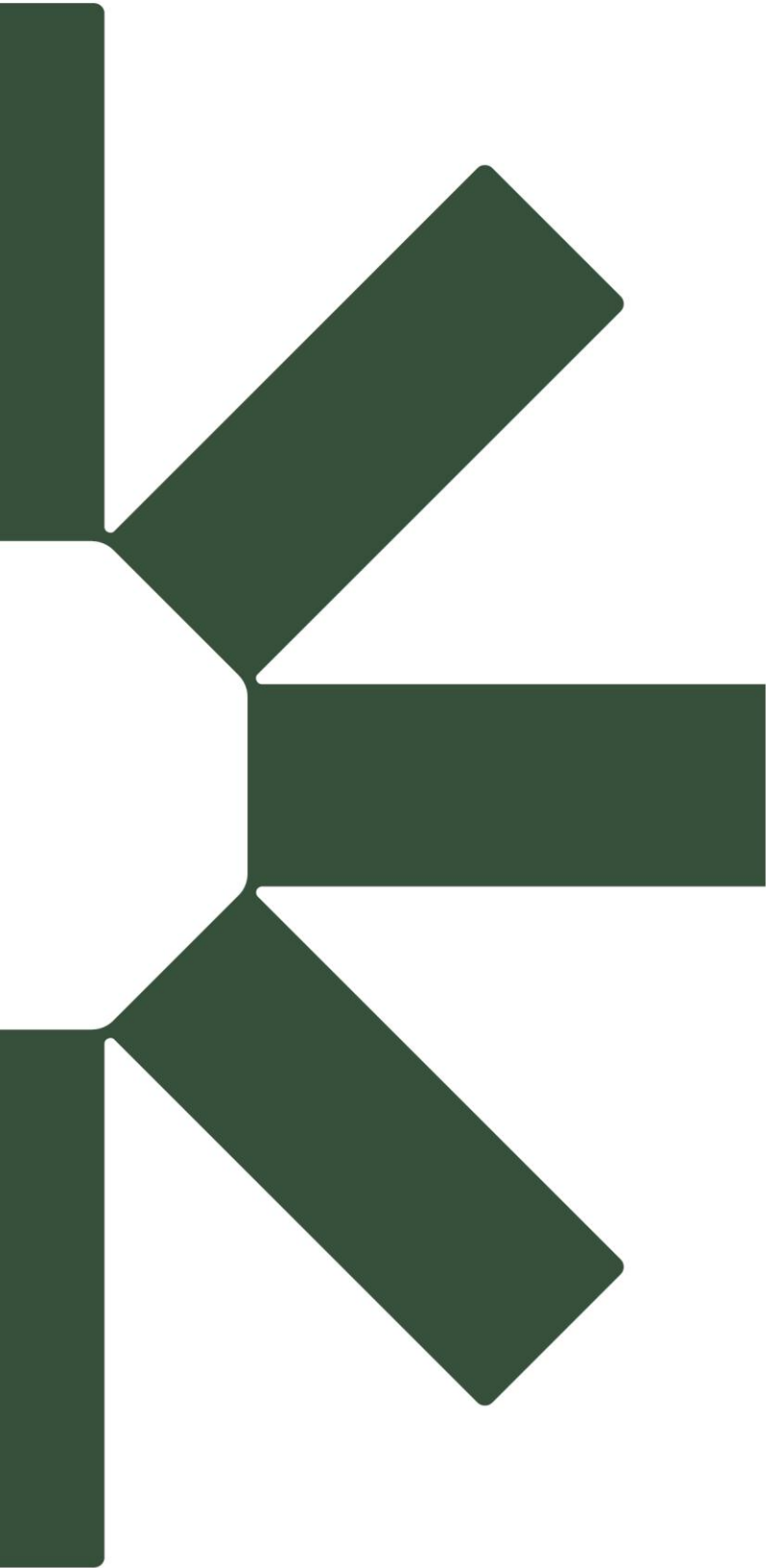
Lion Mining Pty Ltd

**Cracow TSF2 Stage 3B to 5 Raise  
 Air Quality Impact Assessment**

Cumulative Impact

Pollutant	TSP	Averaging Period	Annual	Unit	µg/m <sup>3</sup>
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