APPENDIX U - AIR QUALITY ASSESSMENT

Isaac Downs Extension: Air Quality Assessment

Prepared for:

Stanmore ID Extension Pty Ltd

January 2026

Final

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Contents

Tables

Figures

Glossary

Term	Definition
$\mu g/m^3$	micrograms per cubic metre
°	degrees
°C	degrees Celsius
g/s	grams per second
ha	hectare
km	kilometres
km/h	kilometres per hour
$L/m^2/h$	Litres per metre squared per hour
m	metres
m/s	metres per second
m^2	square metres
m^3	cubic metres
Mtpa	million tonnes per annum
tpa	tonnes per annum
Nomenclature	**Definition**
DDEP	dust deposition
PM_{10}	particulate matter with a diameter less than 10 micrometres
$PM_{2.5}$	particulate matter with a diameter less than 2.5 micrometres
TSP	Total suspended particulates
Abbreviation	**Definition**
AAQ NEPM	National Environment Protection (Ambient Air Quality) Measure
AEMP	Air Emissions Management Plan
Air EPP	Environmental Protection (Air) Policy 2019
Air NEPM	National Environmental Protection (Ambient Air Quality) Measure
AQA	Air quality assessment
ASL	Above sea level
AWS	automatic weather station
BG	ambient background
BoM	Bureau of Meteorology
CHPP	Coal handling and processing plant
CSIRO	The Commonwealth Scientific and Industrial Research Organisation
DEM	Digital Elevation Model
DES	Department of Environment and Science
DETSI	Department of Environment, Tourism, Science, and Innovation
EA	Environmental Authority
EF	Emission factor
EIS	Environmental impact statement
EP Act	*Environmental Protection Act 1994*
EPA	Environment Protection Authority
ERA	Environmentally Relevant Activity
IDE	Isaac Downs Extension Project
IDM	Isaac Downs Mine
IPM	Isaac Plains Mine
IOA	index of agreement
LOM	life of mine
MLA	Mine Lease Area
ML	Mine Lease
NEPC	National Environment Protection Council
NPI	National Pollutant Inventory database

Term	Definition
NSW	New South Wales
OB	Overburden waste rock
PRCP	Progressive rehabilitation and closure plan
QLD	Queensland
RMSE	root mean square error
ROM	Run-of-mine coal
TAPM	The Air Pollution Model
ToR	Terms of Reference
UTM	Universal Transverse Mercator
VKT	vehicle kilometres travelled

EXECUTIVE SUMMARY

Katestone Environmental Australia Pty Ltd (Katestone) was commissioned by Stanmore ID Extension Pty Ltd (ID Extension), a wholly owned subsidiary of Stanmore Resources Ltd (Stanmore), to complete an air quality assessment (AQA) of the proposed Isaac Downs Extension Project (IDE or the Project) located in the Bowen Basin approximately 15 km southeast of the Moranbah township and 150 km southwest of Mackay.

The Project will comprise an open cut coal mine pit and associated infrastructure, primarily mining metallurgical (steel making) coal. Approximately 46 million tonnes (Mt) of run of mine (ROM) coal will be mined over 15 years, with approximately 2 – 4.5 million tonnes per annum (Mtpa). The Project will extend the life of mining operations at Isaac Plains Complex (IPC) which comprises Isaac Downs Mine (IDM), Isaac Plains Mine (IPM) and the Project.

ID Extension was approved to prepare a voluntary environmental impact statement (EIS) for the Project under Chapter 3, Part 2 of the *Environmental Protection Act 1994* (EP Act). The EIS will be required to support an application for a new environmental authority (EA) and progressive rehabilitation and closure plan (PRCP) schedule. A final Terms of Reference (ToR) has been issued for the EIS.

This AQA report was prepared to support the EIS and EA application. The AQA report was conducted in accordance with the requirements of the final ToR and the Department of Environment, Tourism, Science, and Innovation (DETSI) *Guideline: Application requirements for activities with impacts to air* (DETSI, 2025). Dispersion modelling was undertaken to assess the potential impacts of mining operations at the Project on nearby sensitive receptors both in isolation and cumulatively including ambient background. Model predicted ground-level concentrations of emitted substances were assessed against air quality objectives detailed in *The Environmental Protection (Air) Policy* 2019 and the *Environmental Protection (Air) Amendment Policy 2024* (Air EPP).

The results of the dispersion modelling indicated:

- Predicted ground-level concentrations of all emissions ***comply*** with the relevant air quality objectives at all sensitive receptors for the Project operating in isolation.
- Predicted cumulative maximum monthly average dust deposition rates ***comply*** with the guideline of 120 mg/m^2/day at all sensitive receptors.
- Predicted cumulative annual average ground-level concentrations of TSP ***comply*** with the annual average objective of 90 µg/m^3 at all sensitive receptors.
- Predicted cumulative 24-hour maximum ground-level concentrations of PM_{10} ***can avoid any additional exceedances*** of the air quality objective of 50 µg/m^3 at any sensitive receptors when inclusive of additional mitigation measures.
- Predicted cumulative 24-hour maximum ground-level concentrations of $PM_{2.5}$ ***can avoid any additional exceedances*** of the air quality objective of 20 µg/m^3 at any sensitive receptors when inclusive of additional mitigation measures.
- Predicted cumulative annual average ground-level concentrations of PM_{10} can ***comply*** with the annual average objective of 25 µg/m^3 at all sensitive receptors when inclusive of additional mitigation measures.
- Predicted cumulative annual average ground-level concentrations of $PM_{2.5}$ can ***comply*** with the annual average objective of 7 µg/m^3 at all sensitive receptors when inclusive of additional mitigation measures.

The dispersion modelling results indicate that the Project can meet the Air EPP objectives at all nearby sensitive receptors in isolation and cumulatively when inclusive of additional mitigation measures. ID Extension will

develop a DMP for the Project, building on the existing DMP for IPC, to enable the effective implementation of additional mitigation measures.

1. INTRODUCTION

Katestone Environmental Australia Pty Ltd (Katestone) was commissioned by Stanmore ID Extension Pty Ltd (ID Extension), a wholly owned subsidiary of Stanmore Resources Ltd (Stanmore), to complete an air quality assessment (AQA) of the proposed Isaac Downs Extension (IDE) Project (the Project) located in the Bowen Basin approximately 9.1 km southeast of the Moranbah township and 150 km southwest of Mackay.

The Project is intended to extend the life of mining activities at the Isaac Downs Mine (IDM). The Project will extend the life of mining operations at Isaac Plains Complex (IPC), which comprises Isaac Downs Mine (IDM) and Isaac Plains Mine (IPM), operated by wholly owned subsidiaries of Stanmore.

The Project will be integrated with IPC, with run-of-mine (ROM) coal washed at the IPM coal handling and preparation plant (CHPP), shared mine infrastructure area (MIA) at IDM, and connecting infrastructure such as water management infrastructure and power supply.

Mining of run of mine (ROM) coal at IDM is expected to ramp down between 2026 and 2028, with Project construction commencing late 2027 / early 2028 and ROM coal extraction in 2029. The IPC workforce will transition to IDE as mining ramps down at IDM and IPM and ramps up at IDE. IDE is therefore important to ensure a near steady state workforce across IPC beyond 2027 and 2028.

The Project will comprise of an open cut coal mine pit and associated infrastructure, primarily mining metallurgical (steel making) coal. Approximately 46 million tonnes (Mt) of run of mine (ROM) coal will be mined over 15 years, with approximately 2 – 4.5 million tonnes per annum (Mtpa).

ID Extension was approved to prepare a voluntary environmental impact statement (EIS) for the Project under Chapter 3, Part 2 of the *Environmental Protection Act 1994* (EP Act). The EIS will be required to support an application for a new environmental authority (EA) and progressive rehabilitation and closure plan (PRCP) schedule. A final Terms of Reference (ToR) has been issued for the EIS, which has been referred to for the purposes of preparing this report.

This report presents an AQA in support of the EIS and EA application.

2. ISAAC DOWNS EXTENSION

Mining at the Project will utilise standard drill and blast techniques to clear overburden and expose coal seams. Material (waste overburden and ROM coal) extraction will be via dragline and a fleet of excavators, haul trucks and dozers. The Project will be integrated into the IPC with ROM coal to be washed at the existing IPM coal handling and preparation plant (CHPP). The IPM CHPP is an existing approved operation as are connecting haul routes within the IPM and IDM mining lease (ML) boundaries. ROM coal from the IDE pit will be stockpiled at a ROM pad within the IDE MLs before being hauled to the IPM CHPP. Other features of the IDE mine include:

- Topsoil stockpiles and in- and out-of-pit overburden dumps
- Internal haul routes for overburden (OB) and ROM transport
- The active pit areas
- Crib area
- Mine affected water dam.

The IDE mine pit will progress from west to east. ROM coal extraction is expected to commence in 2029. Four ML applications (MLAs) have been made for the Project (Figure 1). The area of MLAs is 2,707 hectare (ha) and the proposed disturbance area is 2,080 ha (Figure 2). Previously mined areas and unused dump areas will be progressively rehabilitated as mining progresses. Mining areas will be progressively rehabilitated as they become available for rehabilitation. Rehabilitation milestone criteria will be developed for each stage of rehabilitation. Post mining land uses will be developed for different rehabilitation areas. A satellite go line and crib area will be constructed at IDE, with the existing MIA at IDM continuing to service project activities.

IPC has access to external raw water supplied from SunWater and has excess storage capacity for water within existing mined voids and dams. As IDE's water management systems will be integrated with IPC, it is anticipated that water supply will be available during dry periods, and storage capacity will be able to receive any excess water during wet periods. Therefore, no new sources of water supply are required.

Power for the dragline will be supplied to IDE via powerline connections with existing power supply at IDM.

Key activities at the IDE which may give rise to emissions of dust and are of primary concern for this AQA, include:

- clearing of vegetation, stripping and stockpiling of topsoil
- drilling and blasting of pre-strip overburden
- removing the pre-strip overburden using a dragline and / or truck and shovel fleets and / or dozers
- drilling and blasting of overburden
- drilling and blasting of pit floor for geotechnical stability to allow for in-pit dumping
- overburden removal using dragline and / or truck and shovel fleets
- coal mining using excavators
- formation of out of pit and in-pit overburden dumps as mining progresses
- progressive rehabilitation of overburden dump areas.
- handling of mined materials
- wind erosion from exposed surfaces.

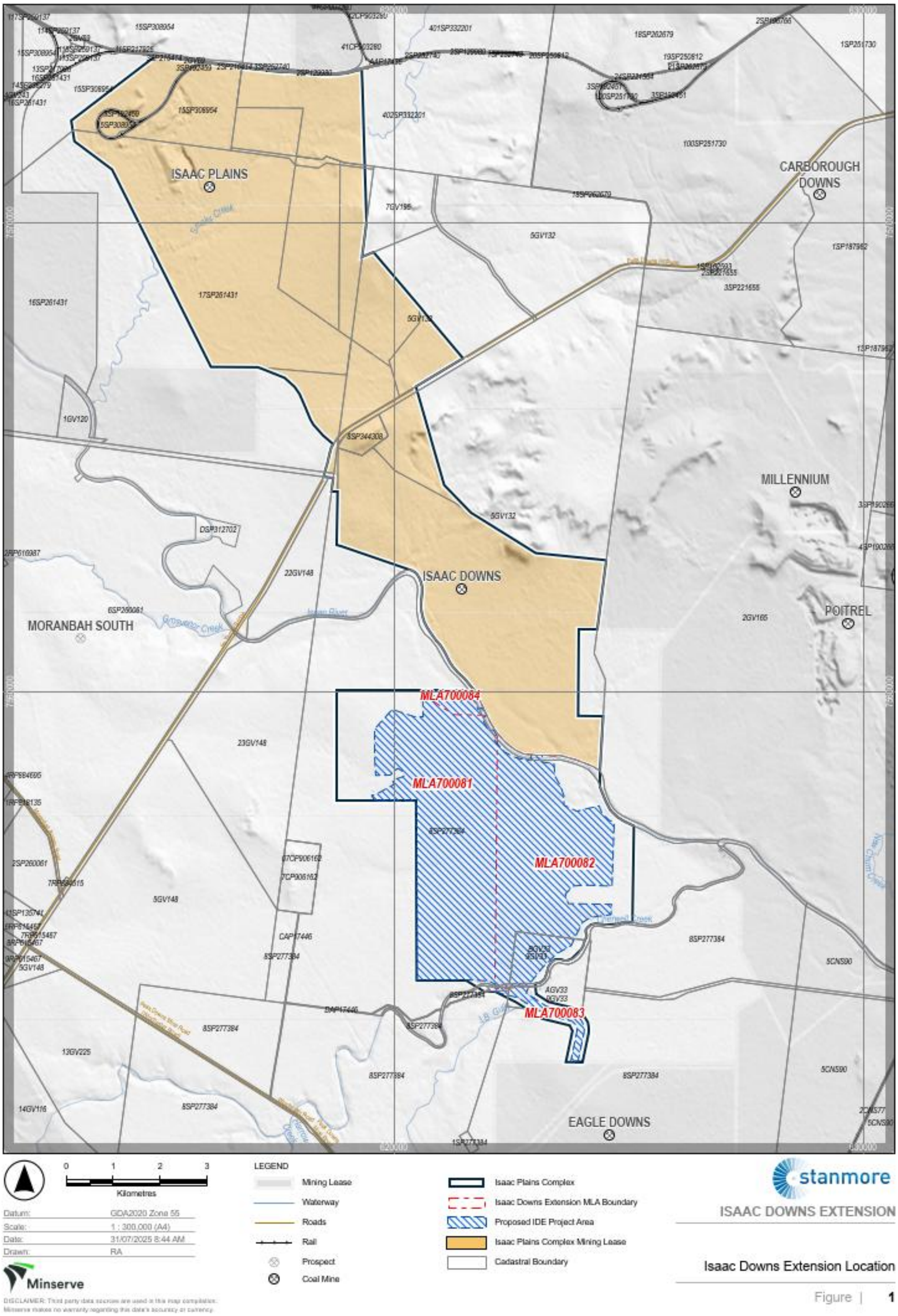

Figure 1 IDE location

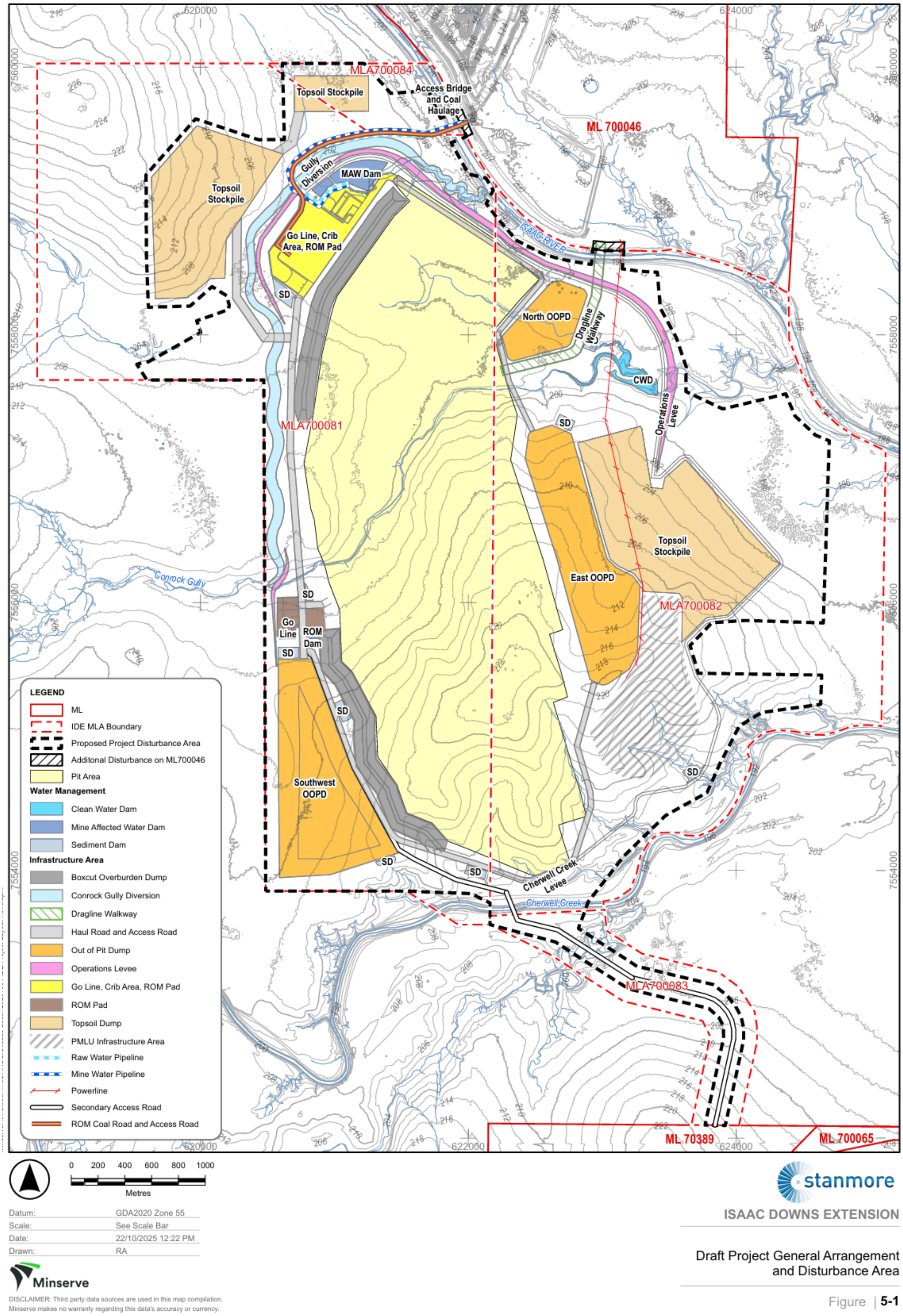

Figure 2 Project layout and disturbance areas

3. LEGISLATIVE FRAMEWORK FOR AIR QUALITY

3.1 EP Act and subordinate legislation

Management of the air environment in Queensland is addressed under two key pieces of legislation, the overarching *Environmental Protection Act 1994* (EP Act) which outlines fundamental principles, objectives, and powers related to environmental regulation, including air quality management; and the subordinate regulation to the EP Act, the *Environmental Protection Regulation 2019* (EP Regulation) which elaborates how the principles and objectives of the EP Act are to be implemented and enforced.

The EP Act gives the Department of Environment, Tourism, Science, and Innovation (DETSI) the power to create Environmental Protection Policies that identify and aim to protect, environmental values of the atmosphere that are conducive to the health and well-being of humans and biological integrity. The specific policies relating to air quality are *The Environmental Protection (Air) Policy* 2019 and the *Environmental Protection (Air) Amendment Policy 2024* (Air EPP).

The objective of the Air EPP is:

...to identify the environmental values of the air environment to be enhanced or protected and to achieve the objective of the Environmental Protection Act 1994, i.e. ecologically sustainable development.

The environmental values to be enhanced or protected under the Air EPP are the qualities of the environment that are conducive to:

- Protecting health and biodiversity of ecosystems
- Human health and wellbeing
- Protecting the aesthetics of the environment, including the appearance of building structures and other property
- Protecting agricultural use of the environment

The administering authority must consider the requirements of the Air EPP when it decides an application for an EA, amendment of a licence or approval of a draft environmental management plan. Schedule 1 of the Air EPP specifies air quality indicators and objectives for specific air emissions.

Further to the Air EPP, DETSI has published the *Guideline: Application requirements for activities with impacts to air, ESR/2015/1840* (DETSI 2025) (Impacts to Air Guideline). The Impacts to Air Guideline is relevant to the Project and outlines information to be provided to DETSI as part of an EA application and for assessing Environmentally Relevant Activities (ERA). In general, the Impacts to Air Guideline considers three key areas to be identified and addressed:

- Identifying the environmental values of the receiving air environment including the identification of any nearby sensitive places (Section 5.2)
- Identifying the possible impacts of the proposed activity and all associated risks to the environmental values (Section 7)
- Identifying the strategies to mitigate the identified risks to the environmental values (Sections 6.1, 6.2, 7.2, and Section 8)

The term 'environmental value' is generally used to describe the physical, aesthetic, social and cultural values of a location or proposed site. Specific environmental values relevant to air are defined in the Air EPP.

3.2 Terms of Reference

The final ToR provided for Project describes the scope and content of information required to adequately assess an EIS as part of an EA application as defined in the EP Act (EP Act section 40). Sections 8 and 9 of the ToR identifies matters to be addressed by impact assessments, such as this AQA. Impact assessments must identify and describe environmental values that must be protected. Of relevance to this air quality assessment, impact assessments will need to address the following:

- Assess the impacts of the project on environmental values. This includes demonstrating that the project meets the environmental objectives and outcomes for each matter in Section 9 of the ToR and the environmental objectives and performance outcomes for any matters listed in Schedule 8 of the EP Regulation. The impact assessment must address:
    - a) short-, medium- and long-term scenarios
    - b) the scale of an impact, including:
        - i. the impact's intensity and duration
        - ii. cumulative effects of the project in combination with other major projects or developments of which the proponent is reasonably aware
        - iii. the risk of environmental harm
        - iv. avoidance, mitigation and management strategies and if necessary, offsets (Queensland Government 2024b) provisions

Impact assessments must consider cumulative impacts from the Project inclusive of other sources contributing the same emissions to air. Avoidance, mitigation and management strategies must also be identified for the protection or enhancement of identified environmental values.

Section 9 of the ToR outlines specific matters to air quality which must be addressed. Specific matters to be addressed by this air quality assessment as defined in the ToR include the following:

- A detailed description of the existing air environment relevant to the Project including an analysis of available site-specific or State conducted monitoring data and NPI reporting data for nearby existing operations (Section 5.3 and Section 5.4)
- An emissions inventory identifying all substances to be released to air addressing construction, commissioning, operation, upset conditions, and closure of the Project (Section 6). By assessing worst-case operational years for compliance this AQA report indirectly supports compliance of pre- and post-operational year activities which will have significantly lower emission rates compared to the peak operational years.
- Demonstration of Project compliance with environmental objectives and performance outcomes in Schedule 8 of the EP Regulation (Section 7)
- Use industry established and accepted methods in accordance with the EP Regulation, Air EPP, *Air EIS information guideline ESR/2020/5294* (DETSI 2024) and Impacts to Air Guideline (DETSI 2025) to predict impacts from the Project considering (Sections 4 – 7.3):
    - a) the sensitivity and assimilative capacity of the receiving environment and the practices and procedures that would be used to avoid or minimise impacts
    - b) the cumulative impact of any release with other known releases of contaminants, materials or wastes associated with existing development and possible future development (as described by approved plans and existing project approvals)

c) the human health risk and amenity impacts associated with emissions from the Project for all contaminants whether or not they are covered by the *National Environment Protection (Ambient Air Quality) Measure* (AAQ NEPM) or the Air EPP or not

- Address the compatibility of the project's air emissions with existing or potential land uses in surrounding areas. Potential land uses might be gauged from the zonings of local planning schemes, State Development Areas or other relevant planning frameworks (Section 5.1).
- Describe the proposed mitigation measures to limit impacts from air emissions and how the proposed activity will be consistent with best practice environmental management. Describe how the project's air emission objectives would be achieved, monitored, audited and reported, and how corrective actions would be managed for the life of the project (Section 8).

This AQA has been prepared in accordance with the requirements of the ToR.

3.3 National Environment Protection Council

The National Environment Protection Council (NEPC) defines national ambient air quality standards and goals in consultation and with agreement from all Australian State and Territory governments. These were first published in 1998 in the National Environment Protection (Ambient Air Quality) Measure (AAQ NEPM) and varied in 2015 and 2021. The AAQ NEPM contains, amongst other parameters, standards for particulates and combustion products. Compliance with the AAQ NEPM standards is determined by ambient air quality monitoring undertaken at locations prescribed by the AAQ NEPM and that are representative of large urban populations. The goal of the AAQ NEPM is to monitor and improve ambient air quality.

With respect to $PM_{2.5}$, the AAQ NEPM identifies standards for 24-hour average and annual average $PM_{2.5}$ of 25 µg/m^3 and 8 µg/m^3, respectively. The AAQ NEPM also identifies goals (from 1 January 2025) for 24-hour average and annual average $PM_{2.5}$ of 20 µg/m^3 and 7 µg/m^3, respectively. The Air NEPM goal for $PM_{2.5}$ relates to desired environmental outcomes and guides the formulation of strategies for the management of human activities that may affect the environment. It provides a framework for continuous improvement to facilitate a review of the $PM_{2.5}$ standard.

The Air EPP has adopted these goals for $PM_{2.5}$ from January 2025.

3.4 Air quality objectives

The Air EPP objectives of key substances that may be emitted by Project are presented in Table 1.

Table 1 also shows the dust deposition guideline commonly used in QLD as a benchmark for avoiding amenity impacts due to dust. The dust deposition guideline is not defined in the Air EPP but is contained within DETSI's Guideline and is therefore adopted here.

Table 1 Air quality objectives

Substance	Environmental value	Averaging period	Air quality objective (µg/m³)	Basis
TSP	Health and wellbeing	1-year	90	Air EPP
PM_{10}	Health and wellbeing	24-hour	50	Air EPP
		1-year	25	Air EPP
$PM_{2.5}$	Health and wellbeing	24-hour	20	Air EPP
		1-year	7	Air EPP

Substance	Environmental value	Averaging period	Air quality objective (µg/m³)	Basis
Dust deposition rate for total insoluble solids	Amenity guideline	Monthly	120 $mg/m^2/day$	Impacts to Air Guideline

4. AIR QUALITY ASSESSMENT METHOD

4.1 Existing environment

The air quality impact assessment has included an analysis of the existing environment (Section 5) for the Project area. Aspects of the existing environment that are important for the dispersion of air emissions and that may influence the concentration of air emissions at sensitive receptors include terrain features, regional land uses, existing sources of emissions, existing ambient emissions concentrations and the locations of sensitive receptors relative to emission sources.

4.2 Meteorology

Site-specific meteorological data was generated by coupling the prognostic model TAPM (version 4.0.5) (The Air Pollution Model) with the diagnostic meteorological model CALMET (version 6.5.0). The coupled TAPM/CALMET modelling system enables high resolution modelling capabilities for regulatory and environmental assessments. The modelling system incorporates synoptic, mesoscale and local atmospheric conditions, and detailed topographic and land use categorisation schemes to simulate synoptic and regional scale meteorology for input into dispersion models, in this case CALPUFF.

The assessment was conducted using the most recent versions of TAPM and CALMET available at the time of undertaking the study.

The meteorological modelling methodology included the following steps:

- Evaluation of a representative year for wind speed and direction based on the most recent five years of meteorological data at the BoM Moranbah Airport automatic weather station (AWS)
- Selection of a suitably representative meteorological year for modelling based on the BoM AWS data.
- Available Stanmore meteorological monitoring data was additionally evaluated.
- TAPM modelling and validation of outputs against monitoring data. An observational hourly-varying meteorological data file was then prepared for inclusion into the TAPM model for the selected modelling year.
- CALMET modelling.
- The calendar year 2023 was ultimately adopted for modelling as it is judged to be the year with the least variation from the mean when averaged across all of the parameters considered in the BoM data, and this corresponded with suitable quality Stanmore monitoring data at the Poitrel Mine station (approximately 5 km east of the Project) with good data capture for 2023.

Technical details of the TAPM and CALMET model configurations are provided in Appendix A, including a validation of the generated data and a summary of the meteorological data generated for the study area.

4.3 Assessment scenarios

Annual extraction rates of OB and ROM, and mine progression layouts for each year of the Project, were reviewed to determine the two worst-case operational scenarios for adoption as modelling years. Worst-case years were considered to be those with peak extraction rates of OB and ROM and those with mine layouts which would situate operations near to sensitive receptors and represent significant areas of mining operations. Years with peak extraction amounts often require significant haul truck movements which are a dominant source of emissions from mining. Review of the supplied information identified the following two years as worst-case years for modelling:

- Mine year 2029: Although this year does not represent a significant quantity of material extraction it does represent the year when mining operations are closest to the nearest sensitive receptor (Winchester Downs Homestead) located approximately 0.8 km south of Project's ML application boundary and approximately 1.2 km south of proposed mining activities, and captures operations associated with the southwestern out-of-pit dump.
- Mine year 2034: This year represents peak total material extraction for the Project and maximum OB from any year. It also represents extensive mining areas covering the length of the proposed disturbance area from north to south with some operations near to the Winchester Downs Homestead sensitive receptor, particularly southern ROM and OB haul routes.

Table 2 presents the extraction totals for each Project year. Figure 3 and Figure 4 present the model scenario mine layouts for 2029 and 2034, respectively.

Emissions from these two selected worst-case operational years are expected to significantly exceed emissions associated with construction or closure of mine activities. Therefore, by modelling these conservative years and assessing compliance against the relevant air quality objectives, demonstration of compliance can be assumed to also demonstrate compliance for all mine years with less intensive operations and construction and closure activities. All other mine years either represent lesser material extraction rates or mining operations which are further from the nearest sensitive receptors.

Table 2 Annual extraction totals for ROM and OB

Year	Material/Process (Mtpa)					
	Cast	Dozer Push OB	Truck Shovel OB	Dragline OB	Total OB	ROM Coal
2029	2.25	4.45	18.62	28.72	54.04	2.18
2030	2.27	13.66	19.00	32.38	67.31	4.50
2031	2.48	21.56	12.63	29.77	66.44	4.50
2032	2.83	25.19	13.27	33.11	74.39	4.50
2033	3.36	33.20	10.62	32.09	79.28	4.50
2034	3.36	30.76	13.36	38.35	85.84	4.50
2035	2.64	24.27	13.44	33.54	73.89	3.47
2036	1.57	20.67	15.37	33.35	70.96	2.87
2037	1.89	18.54	13.79	31.79	66.01	2.59
2038	1.67	18.33	14.94	33.07	68.01	2.54
2039	1.18	17.50	11.54	31.86	62.08	2.25
2040	1.42	17.92	14.60	34.69	68.63	2.38
2041	1.73	16.11	10.16	33.37	61.38	2.46
2042	1.62	19.96	8.51	32.44	62.53	2.37
2043	0.22	5.64	0.05	1.93	7.84	0.47

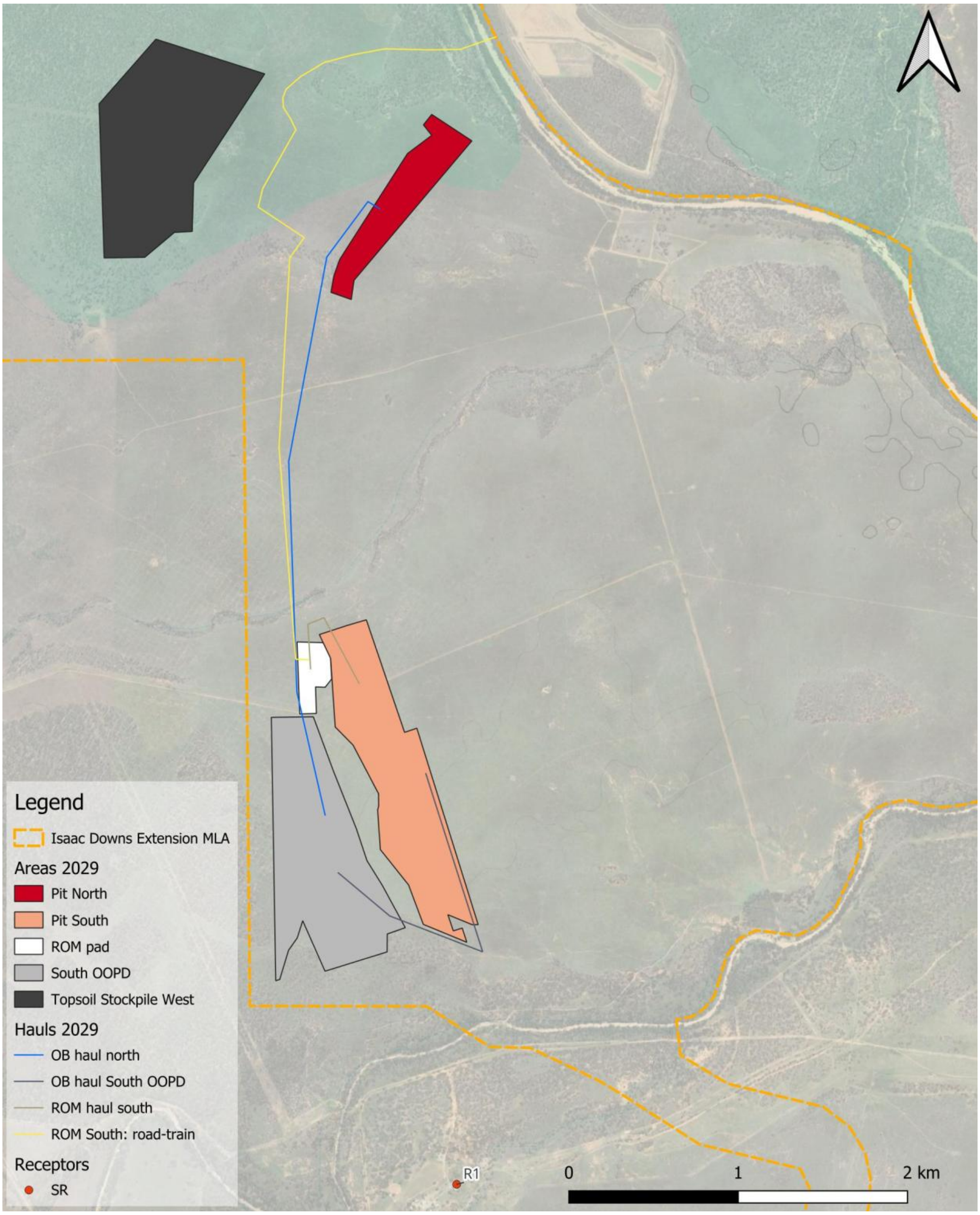

Figure 3 2029 model scenario mine layout

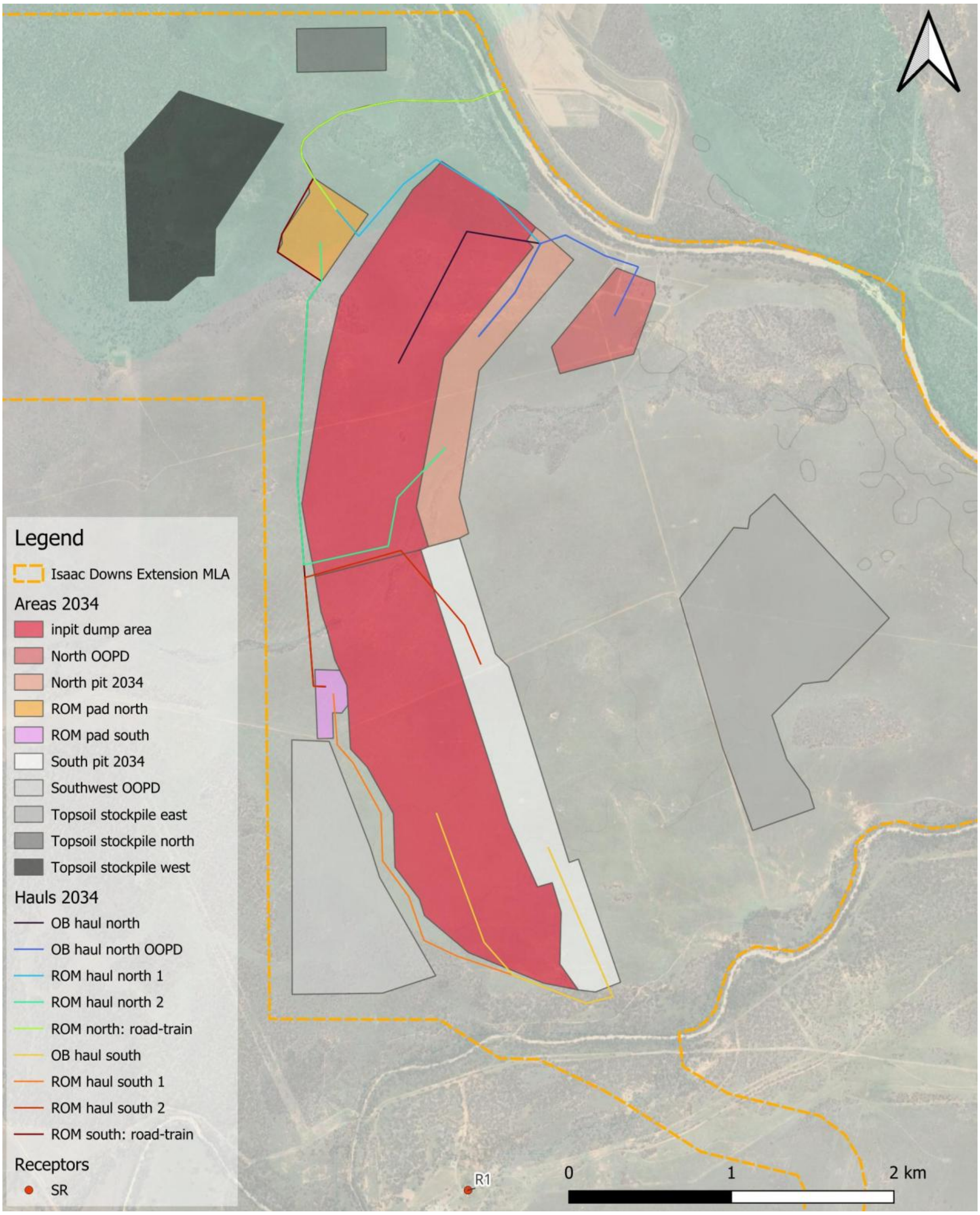

Figure 4 2034 model scenario mine layout

4.4 Emission rates

Emissions of dust and particulates constitute the primary substances of concern generated by the Project. Specifically, this will include total suspended particulates (TSP), particulate matter of an aerodynamic diameter of 10 microns or less (PM_{10}), particulate matter of an aerodynamic diameter of 2.5 microns or less ($PM_{2.5}$), and deposited dust. Small quantities of odour and combustion products (nitrogen dioxide (NO_2), carbon monoxide (CO), and sulphur dioxide (SO_2)) may also be emitted from Project vehicles and equipment. However, the emission rates of these substances are low compared to the emission rates of particulate matter and are likely to have negligible impacts. Therefore, these emissions have not been considered further.

The air quality impact assessment quantitatively assessed emissions associated with:

- Drilling and blasting
- Dozing of coal and waste materials (OB)
- Handling of extracted materials including loading and unloading from vehicles
- Haulage of ROM to onsite stockpiles and via road-train to the northern MLA boundary, including return trips
- Haulage of OB to waste dumps, including return trips
- Movement of material via dragline, specifically characterised as a function of drop height
- Grading of haul routes
- Wind erosion of exposed surfaces.

Emission rates were estimated using the base equation:

$$ER = A \times EF \times (1 - CF)$$

where:

ER	emission rate
A	activity / operations data
EF	emission factor
CF	reduction in emissions due to the implementation of control measures

Emissions of TSP, PM_{10} and $PM_{2.5}$ from mining activities were estimated using recognised and accepted methods of dust emissions estimation. This includes approximation of emission rates from the National Pollutant Inventory (NPI) emissions estimation technique (EET), and the United States Environmental Protection Agency (USEPA) AP-42 publications, specifically:

- NPI EET manual for mining – Version 3.1 (NPI, 2012)
- AP-42, Section 11.9 Western Surface Coal Mining (USEPA, 1998)
- AP-42, Section 11.19.2 Crushed Stone Processing and Pulverized Mineral Processing (USEPA, 2004)
- AP-42, Section 13.2.2 Unpaved Roads (USEPA, 2006)
- AP-42, Section 13.2.4 Aggregate Handling and Storage Piles (USEPA, 2006)
- AP42, Section 13.2.5 Industrial Wind Erosion (USEPA, 2006)

The emissions estimation techniques applied in this assessment are based on standard methods that are applied throughout Australia and in the United States. These methods are consistent with those adopted for air quality assessments conducted for other mines in Australia. The size distribution of dust particles was derived from the emission rates estimated for TSP, PM_{10}, and $PM_{2.5}$.

Emissions inventories for each modelling scenario are presented in Section 6.3. Activity data used to develop the emissions inventories are detailed in Appendix B.

4.5 Dispersion modelling

The industry standard and regulated model developed by Earth Tech, Inc., namely, the CALPUFF dispersion model (version 7.2.1) was utilised to model the scenarios discussed in Section 4.3.

CALPUFF is an advanced non-steady-state air quality modelling system. The meteorological data generated by TAPM/CALMET was used as input for CALPUFF in order to include all weather conditions likely to be experienced in the region during a typical year. This system was used to predict ground-level particulate concentrations and dust deposition rates at nearby sensitive receptor locations and across a cartesian grid representing the application region.

Emissions sources were modelled as occurring 24-hours per day and everyday day of the year to ensure dispersion under all possible meteorological conditions within a year have been represented. Air quality impacts for TSP, PM_{10}, $PM_{2.5}$ and dust deposition were predicted across the modelling domain and graphically presented as contour plots and as tabulated concentrations at discrete sensitive receptors. Emission concentrations were determined for short-term (24-hour) and long-term averaging periods (monthly and annual).

Details of the model configuration are provided in Section A2 of Appendix A.

4.6 Cumulative impacts

For all emitted substances, the contributions of all modelled sources were combined. Where available, ambient background concentrations were added to the modelled contributions to determine the total cumulative concentrations. Ambient background data was available at the Moranbah monitoring stations operated and maintained by DETSI. Real-time monitoring conducted by IDM for PM_{10} and $PM_{2.5}$ using beta-attenuation monitors (BAMs) was also reviewed.

Section 5.3.2 presents an analysis of available air quality monitoring data to determine suitable ambient backgrounds for use in the cumulative assessment of IDE. Selected background concentrations used in the cumulative assessment of IDE are presented in Section 5.4.

Monitored ambient background concentrations were included cumulatively with modelled predictions as follows:

- 24-hour concentrations: 24-hour ambient background concentrations were added contemporaneously to the model predicted 24-hour model concentrations for PM_{10} and $PM_{2.5}$ and the maximum cumulative 24-hour concentration at each sensitive receptor was determined
- Annual concentrations: annual average ambient background concentrations were added to the annual average predicted model concentrations for TSP, PM_{10}, $PM_{2.5}$
- Dust deposition: 12-month rolling average dust deposition rate data from the DETSI Moranbah deposition gauge was added to the maximum monthly annual average model deposition rate

The available ambient monitoring data covers an extended period of time and so can be considered to capture the variability of regional emissions activities. This includes years with significant mining operations and variations in natural dust sources such as fires, dry conditions, or dust storms. It is, therefore, reasonable to expect that the ambient monitoring data appropriately reflects regional impacts from both existing and future mining operations being representative of the fluctuating nature of mining operations between mines approaching closure and others commencing, variability in the intensity of mining within respective projects between ramping up or down depending on the stage of the mine-life, and changing locations of mining operations within an MLA between exposed active mine areas and rehabilitated areas.

Cumulative impacts from air emissions relating to other mining operations in the region are heavily dependent upon wind direction and proximity to mining operations. Mining related dust and particulates received at a sensitive receptor will be primarily attributable to the nearest mining operations during adverse meteorological conditions. Adverse meteorological conditions will typically be either when the receptor is downwind of the nearest mine or, if the sensitive receptor is particularly close to mining operations, during calm meteorological conditions (low wind speeds and reduced mixing heights typically during evening hours) which allows for the accumulation of emitted dust and particulates in air (conversely unstable meteorological conditions relate to increased mixing heights and higher wind speeds tend to dilute emissions). Therefore, for the purposes of establishing peak impacts at a sensitive receptor, emissions from the nearest mine will be most pertinent while regional mining further from the respective sensitive receptors will most accurately be reflected by ambient background monitoring. Explicit modelling of other existing projects that contribute emissions to air was not conducted. It is expected that the ambient background monitoring data will accurately reflect ambient background air quality conditions for the region including from existing mining activities other than the Project.

Results of predicted cumulative impacts using ambient background air quality monitoring data are presented in Section 7.

Qualitative discussion of potential cumulative impacts with other approved but not yet operational mines is provided in Section 7.3.

4.7 Limitations and uncertainty

This study relies on the accuracy of a number of data sets that feed into the dispersion model, all of which will have uncertainties associated with them. The input data sets include:

- Meteorological monitoring observations from the BoM
- Meteorological monitoring observations from the Poitrel AWS
- Air quality monitoring observations from DETSI
- Synoptic and surface information datasets from CSIRO.
- Operational data provided by ID Extension (which may be subject to change with each edition of the Life of Mine (LOM))
- Approximations of haul routes and lengths
- Accuracy and consistency of application of mitigation measures proposed by ID Extension.

It is also important to note that numerical models are based on an approximation of governing equations and will inherently be associated with some degree of uncertainty. The more complex the physical model, the greater the number of physical processes that must be included. There will be physical processes that are not explicitly accounted for in the model and, in general, these approximations tend to lead to an over prediction of emissions levels.

The dispersion model has been configured with conservative assumptions and, therefore, the assessment is likely to overpredict potential impacts of the Project. Conservative assumptions include the:

- Assumption that mining activities occur constantly for every hour of operation with constant emission rates (does not reflect fluctuations in emissions intensity, for instance, a section of haul road will be constantly generating dust and particulates in the model, in reality the same section of haul will only produce emissions for the few moments a truck is driving across it)
- Assumption that “snapshot” representations of mine layouts are constant over an entire year for the purposes of dispersion modelling which likely overestimate active mining areas
- Use of worst-case operational data to reflect conservative emissions scenarios
- Inability of dispersion modelling to account for the impacts of rainfall on the reduction of dust/particulate emissions
- Modelling of blasting emissions as occurring on every day of the year when only 150 blasts are projected to occur within any one year.

5. EXISTING ENVIRONMENT

5.1 Local terrain and land-use

Figure 5 displays a terrain and mining lease (ML) map within the study area (45 km by 45 km), including the Project MLAs. The nearest MLs to the Project include the adjoining IDM ML to the north (ML 700046), Poitrel and Daunia open cut coal mines to the east (ML 4749 and ML 1781, respectively), Winchester South open cut coal mine to the southeast (ML 700049) and Eagle Downs underground coal mine to the south (ML 70389). Daunia, Poitrel and IDM are existing mines with mining at IDM ramping down with the commencement of the Project. Winchester South and Eagle Downs mines are yet to commence operations.

Terrain within the study area is largely gently sloping plains approximating 200 m above sea level (asl) interspersed by some elevated areas, particularly to the north rising to approximately 500 m asl and southwest reaching approximately 320 m asl. The Project is located within a flat low area between 200 – 220 m asl. Land-use in the region is predominantly coal mining and low-intensity cattle grazing. The population of approximately 9,500 is concentrated in the Moranbah township.

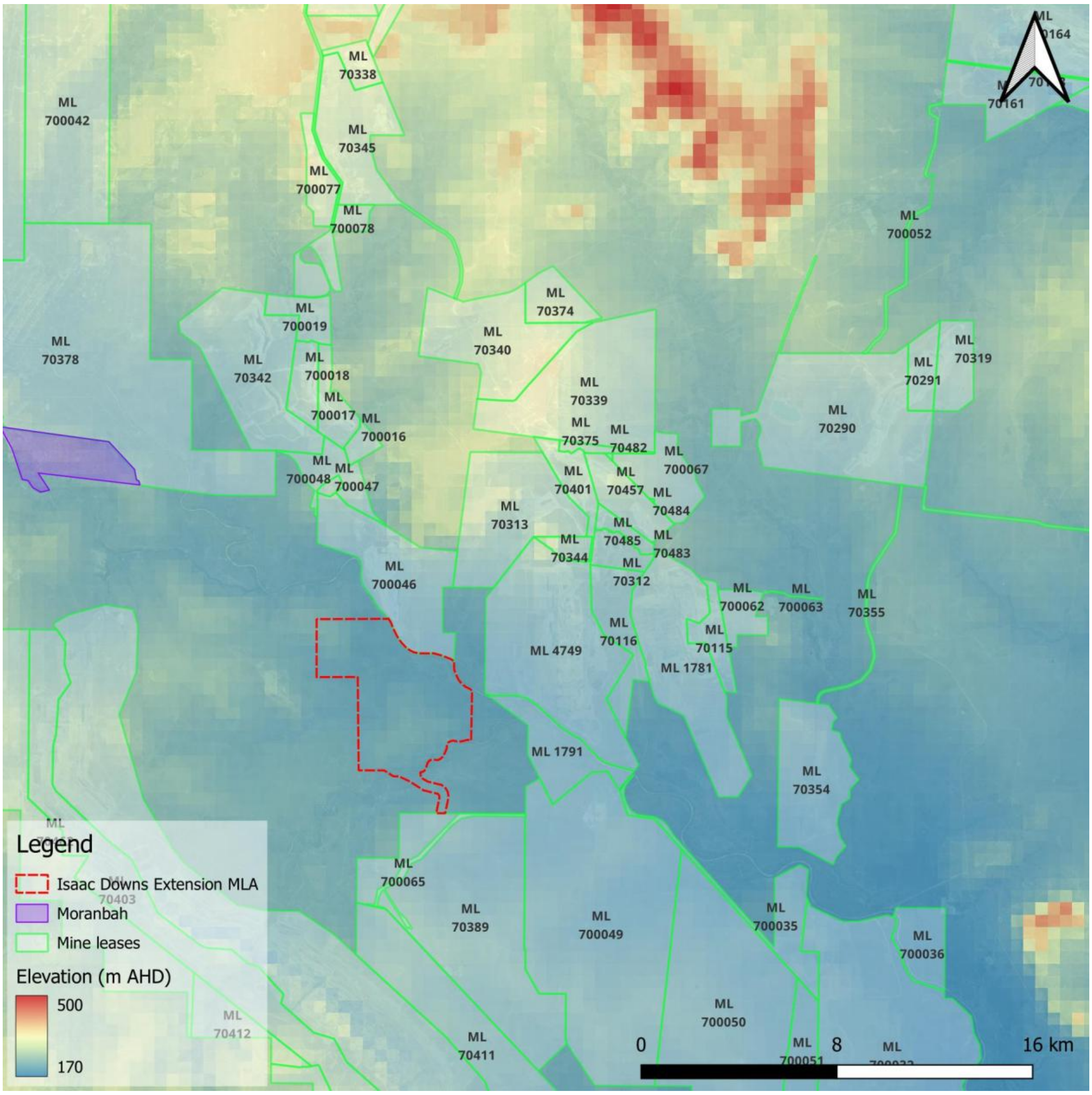

Figure 5 Terrain and mine leases within the study area (CALMET 45 x 45 km)

5.2 Sensitive receptors

The Project locality is sparsely populated with sixteen sensitive receptors (isolated homesteads) located within a 10 km radius. Three receptors are mine or other camps. The township of Moranbah is also located approximately 9.1 km northwest of the Project's MLA boundary, and approximately 10 km northwest of Project mining activities. Receptors are presented in Table 3 and Figure 6. The closest receptor is Winchester Downs Homestead, 0.8 km south of the Project's MLA boundary, and approximately 1.2 km south of proposed mining activities.

Table 3 Nearest sensitive receptors to the Project

Receptor ID	Description	Easting (km)	Northing (km)	Distance and direction from Project MLA boundary
R0	Moranbah	611.544	7565.526	9.1 km, NW
R1	Residential property	621.714	7552.798	0.8 km, S
R10	Mine camp	611.431	7562.793	7.6 km, NW
R11	Residential property	611.422	7562.992	7.9 km, NW
R12	Residential property	611.215	7562.754	8.0 km, NW
R13	Residential property	609.640	7561.130	9.2 km, W
R14	Residential property	613.688	7565.893	7.8 km, NW
R15	Residential property	633.907	7553.014	9.1 km, E
R2	Residential property	614.001	7555.363	5.3 km, W
R3	Residential property	620.229	7566.672	6.6 km, N
R4	Residential property	612.085	7557.528	6.7 km, W
R5	Residential property	611.915	7557.488	6.8 km, W
R6	Residential property	612.227	7555.014	7.1 km, W
R7	Residential property	611.505	7557.991	7.3 km, W
R8	Mine camp	611.001	7558.082	7.8 km, W
R9	Mine camp	611.266	7562.139	7.8 km, NW

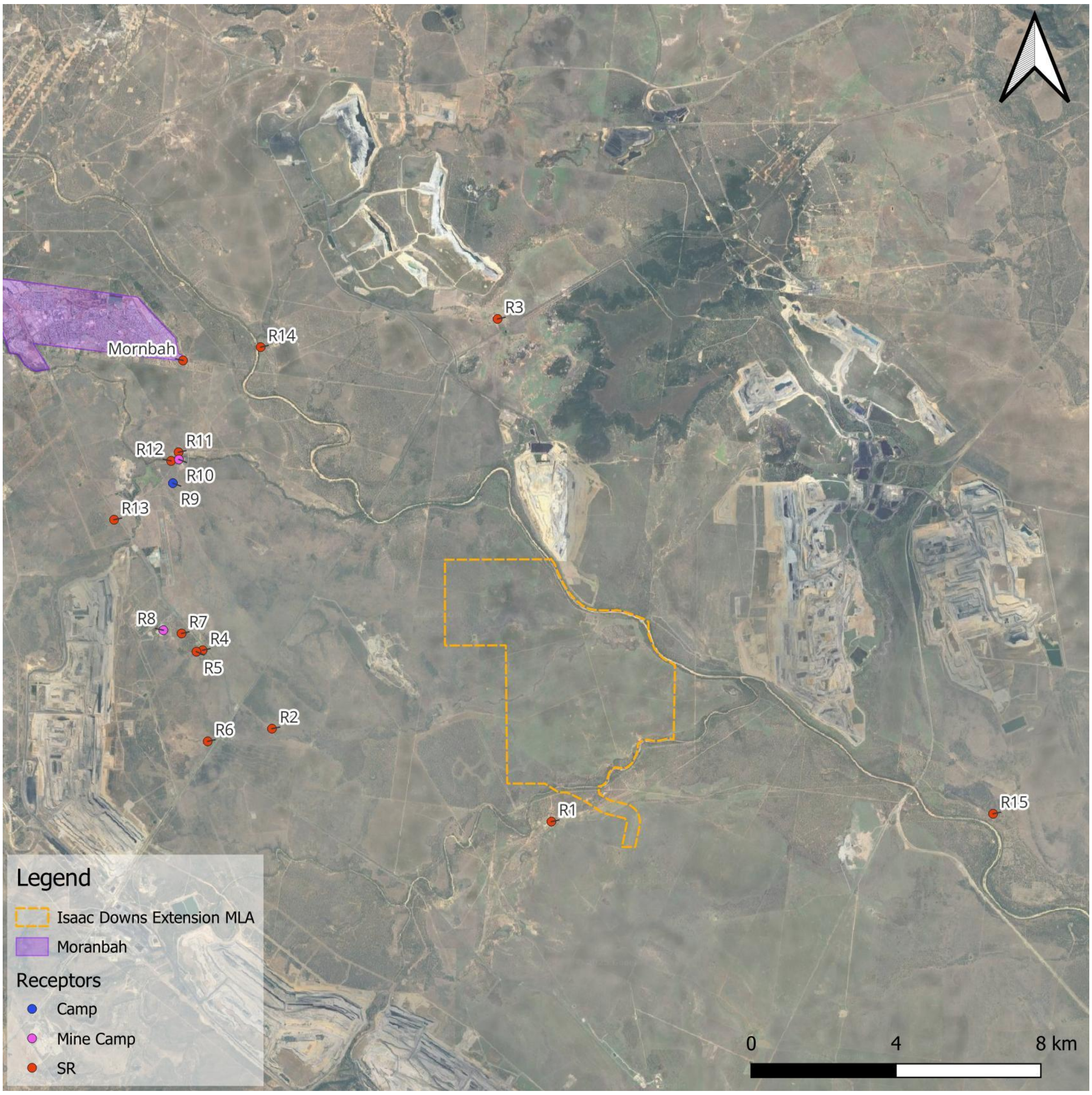

Figure 6 Sensitive receptors

5.3 Existing air quality

5.3.1 Existing sources of emissions

The National Pollution Inventory (NPI) is a public database of annual emissions of 93 substances reported by industries across Australia. Industries exceeding set emission limits for different substances are required to report their emissions to the NPI on an annual basis.

A review of the NPI annual emissions reporting database for the reporting period FY2023/2024 identified 15 industries reporting emissions of particulate matter to air within 25 km of the Project. A summary is presented in Table 4. Industries primarily include coal mining, alongside some energy and construction industry.

Distances between the Project and NPI reporting sites are based on the distances between the Project MLA and coordinates provided in the NPI data for reporting sites and may not reflect the true distance between operational site boundaries or locations of operations. The majority of NPI reporting sites are closer to the Project when considering mining footprints.

The large number of coal mines within the local region is likely to result in elevated ambient concentrations of dust alongside livestock grazing land which will be prone to wind erosion. Many of these facilities are close to the township of Moranbah where DETSI conducts ambient air quality monitoring. Air quality monitoring data from the Moranbah township stations are likely to suitably represent ambient conditions for the region while also representing the primary residential centre and main location of sensitive receptors. Ambient air quality monitoring data is discussed in the following Section 5.3.2.

Table 4 NPI reporting industries within 25 km of IDE (2023/2024 reporting period)

Business Name	Facility Name	Main Activities	NPI mapping coordinates (UTM km GDA2020, z55)		Distance and direction between Project ML and NPI site coordinates or nearest ML boundary	PM_{10} (tpa)	$PM_{2.5}$ (tpa)
			X	Y			
BHP COAL PTY LTD	Peak Downs Mine	Coal Mining	621.420	7537.970	6.6 km, SW	12,517	191
QPM ENERGY (MGP UPSTREAM) PTY LTD	Moranbah Operations	Oil and Gas Extraction	605.000	7568.000	15.9 km, NW	11	0.3
STANMORE SMC PTY LTD	Poitrel Coal Mine	Coal mining	627.873	7533.441	0.5 km, E	3,160	178
CARBOROUGH DOWNS COAL MANAGEMENT PTY LTD	Carborough Downs Coal Mine	Underground coal mine (development and longwall operations)	628.286	7570.004	8.5 km, NE	2,021	9
SUSTAINABLE ENERGY INFRASTRUCTURE PTY LTD	SEI Moranbah Power Station	Burning of coal seam methane to produce electricity	604.899	7568.454	16.2 km, NW	0.002	0.002
PEABODY ENERGY AUSTRALIA PCI (C&M MANAGEMENT) PTY LTD	Moorvale Coal Mine	Coal mining and coal preparation	640.114	7568.179	13.7 km, NE	4,277	64
DYNO NOBEL MORANBAH PTY LTD	Dyno - Moranbah	Gun cotton manufacturing	601.575	7569.897	19.8 km, NW	10	10
ANGLO COAL (MORANBAH NORTH MNGT) P/L	Grosvenor	Coal mining	604.483	7569.849	5.3 km, N	406	48
BM ALLIANCE COAL OPERATIONS PTY LTD	Daunia Mine	Coal	630.801	7561.864	7.3 km, E	2,686	84
ENERGY GENERATION PTY LTD	Grosvenor	Electricity Generation	603.978	7569.305	17.5 km, NW	0.1	0.1
BM ALLIANCE COAL OPERATIONS PTY LTD	Caval Ridge Mine	Coal Mining	630.801	7561.864	9.9 km, SW	8,357	142
QUARRIES OF QUEENSLAND PTY LTD	Skyville Quarry	Crushing & screening of gravel to make various quarry products.	599.379	7546.670	22 km, SW	123	2
PEMBROKE RESOURCES NOMINEE PTY LTD	Olive Downs Coking Coal Complex	Coal mining and processing	639.592	7546.159	16.7 km, SE	10,321	47
VITRINITE PTY LTD	Vulcan	Coal Mining	621.952	7535.241	16 km, S	1,390	17

Table note:

$PM_{2.5}$ tpa include combustion sources only, i.e. no bulk material handling

5.3.2 Existing ambient air quality

5.3.2.1 DETSI

DETSI is responsible for undertaking ambient air quality monitoring in Queensland. Each monitoring station is located for a specific purpose such as measuring air quality near industry, measuring air quality at roadside or to demonstrate compliance with the requirements of the Air NEPM. In the vicinity of the Project, DETSI conducts monitoring at Moranbah East and Moranbah West monitoring stations.

Data summaries for PM_{10} and $PM_{2.5}$ are provided in Table 5 to Table 8 for 2020 to 2024 and associated timeseries plots in Figure 7 and Figure 8. Due to exceptional conditions in Queensland in 2019, this year is not considered to be representative of normal ambient background conditions and therefore has not been included; elevated levels were attributed to bushfires or dust storms, regional and localised windblown dust, vegetation fires and domestic sources such as solid fuel heaters (DES, February 2019 Central Queensland Air Quality Bulletin).

The existing ambient air quality data show that at Moranbah East:

- The 24-hour average PM_{10} Air EPP objective was exceeded on five days in 2020, six days in 2023 and seven days in 2024 and on no occasions between 2021 - 2022
- The 24-hour average $PM_{2.5}$ Air EPP objective was exceeded on five days in 2020, five days in 2023, and five days in 2024 and on no occasions between 2021 - 2022
- Exceedances were largely due to wind-blown dust, bushfires, hazard reduction burns, local activities, and vegetation fires, according to DETSI monthly air quality bulletins for central QLD
- Annual average concentrations did not exceed the objective but were elevated, reaching a maximum of 23.8 µg/m³ of PM_{10} and 6.8 µg/m³ of $PM_{2.5}$ in 2023, constituting 95% and 85% of the relevant Air EPP objectives, at the time of monitoring, respectively
- Data capture was good for the Moranbah East monitor with all years achieving above 97% capture

Similarly, at Moranbah West:

- The 24-hour average PM_{10} Air EPP objective was exceeded on four days in 2020, six in 2021, two in 2022, ten days in 2023, and 24 days in 2024
- The 24-hour average $PM_{2.5}$ Air EPP objective was exceeded on two days in 2020, one day in 2022, six days in 2023, and nine days in 2024 and on no occasions between 2021
- Exceedances were largely due to wind-blown dust, local activities (particularly vehicle movements on nearby unsealed roads, bushfires, and vegetation fires according to DETSI monthly air quality bulletins
- The Moranbah West monitor is close to a major highway and exposed dirt fields with tyre tracks evident in aerial imagery, suggesting the site may be exposed to local dust sources which corresponds with the DETSI air quality bulletins for this monitoring site and likely explains the consistently higher concentrations compared to Moranbah East
- Annual average concentrations exceeded the PM_{10} Air EPP objective in 2020, 2023, and 2024 with 28.7 µg/m³, 26.9 µg/m³, and 27.9 µg/m³, respectively. The annual $PM_{2.5}$ Air EPP objective at the time of monitoring was not exceeded but annual average concentrations were elevated, reaching a maximum of 7.4 µg/m³ in 2020.
- Moranbah West data capture was generally good although less consistent compared to Moranbah East, with capture rates ranging from 88% to 100%. It should be noted that although the Moranbah West site shows 100% data capture for 2020, monitoring only commenced on 29 June of that year.

DETSI dust deposition data collected between February 2020 and November 2021 is presented in Figure 9. DETSI no longer collects or reports dust deposition data.

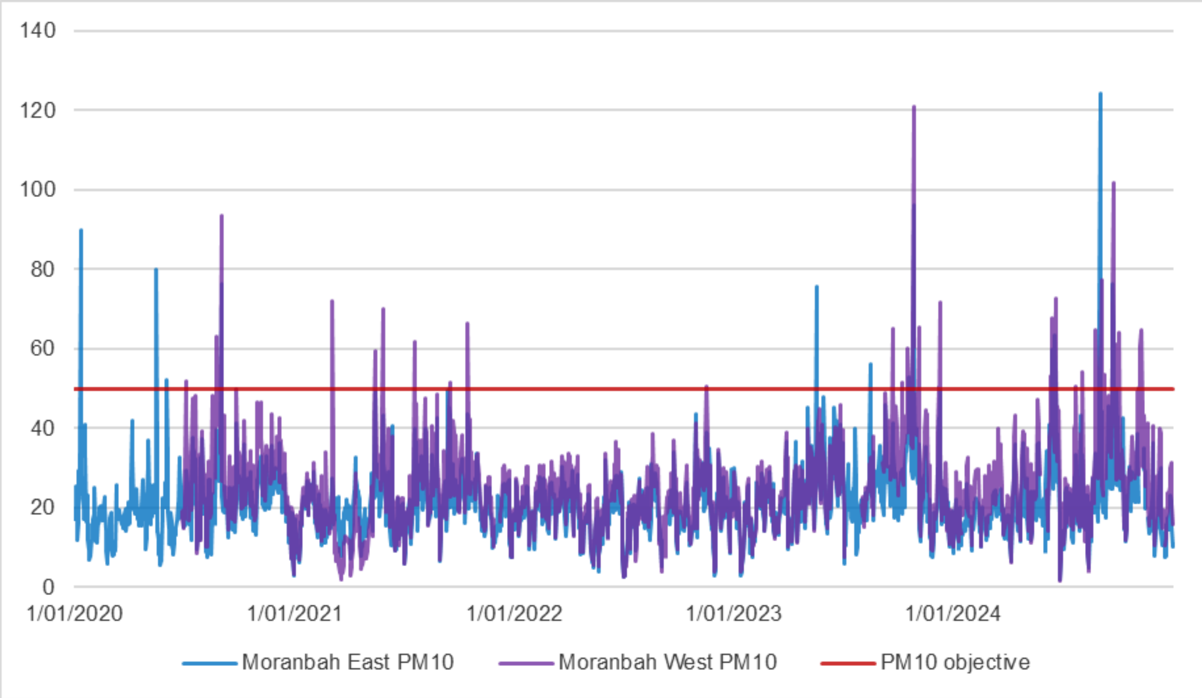

Figure 7 PM$_{10}$ 24-hour timeseries for Moranbah East and West (2020 – 2024)

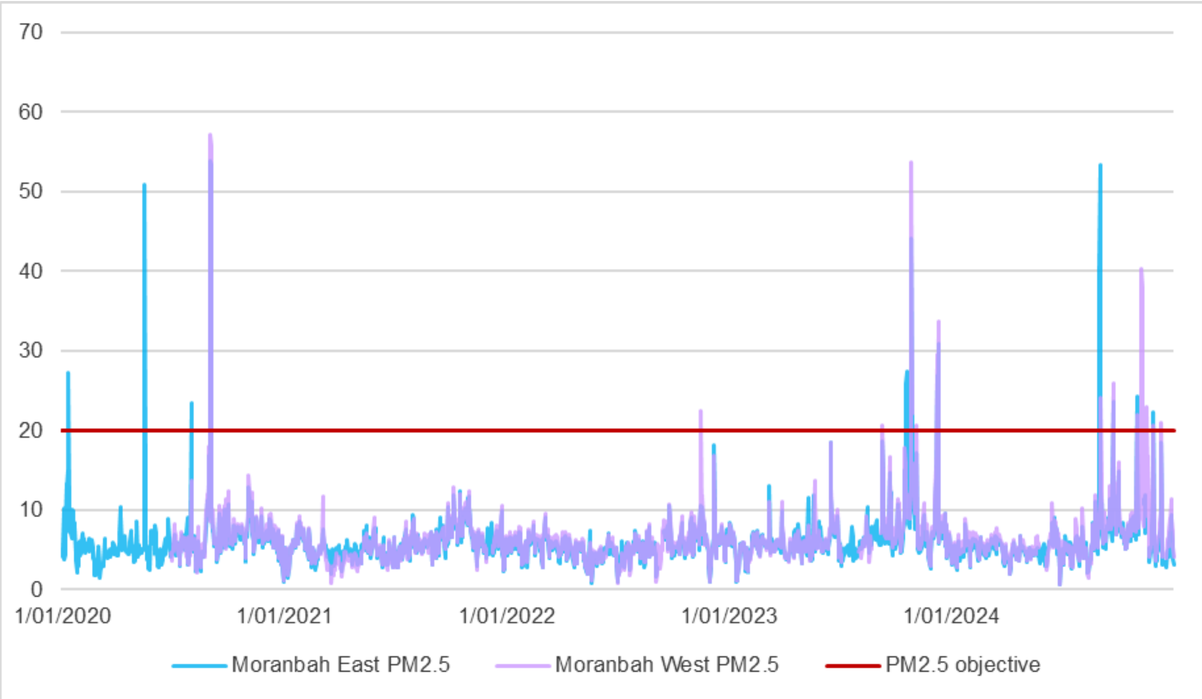

Figure 8 PM$_{2.5}$ 24-hour timeseries for Moranbah East and West (2020 – 2024)

Table 5 Background PM_{10} measured by DETSI at Moranbah East

Year	Maximum 24-hour average A,B ($\mu g/m^3$)	70th percentile 24-hour average A,B ($\mu g/m^3$)	Annual average A,B ($\mu g/m^3$)	Number of days above 50 $\mu g/m^3$	Data capture
2020	89.8	23.4	21.1	5	100%
2021	49.7	23.4	20.5	0	100%
2022	43.5	22.1	19.0	0	97%
2023	96.2	26.9	23.8	6	100%
2024	124.3	24.1	21.9	7	97%
Objective	**50**		**25**	**0**	**-**

Table notes:

[A] Averages require 75% data availability pursuant to AAQ NEPM standards (PRC, 2002).

[B] Data obtained from the Queensland Government Open Data Portal annual air quality monitoring records.

Table 6 Background PM_{10} measured by DETSI at Moranbah West

Year	Maximum 24-hour average A,B ($\mu g/m^3$)	70th percentile 24-hour average A,B ($\mu g/m^3$)	Annual average A,B ($\mu g/m^3$)	Number of days above 50 $\mu g/m^3$	Data capture
2020	93.6	32.9	28.7	4	100% C
2021	72.0	27.7	22.6	6	98%
2022	50.7	24.9	21.1	2	100%
2023	121.1	30.8	26.9	10	88%
2024	101.8	31.6	27.9	24	96%
Objective	**50**		**25**	**0**	**-**

Table notes:

[A] Averages require 75% data availability pursuant to AAQ NEPM standards (PRC, 2002).

[B] Data obtained from the Queensland Government Open Data Portal annual air quality monitoring records.

[C] Moranbah West monitoring commenced 29 June 2020.

Table 7 Background $PM_{2.5}$ measured by DETSI at Moranbah East

Year	Maximum 24-hour average A,B ($\mu g/m^3$)	70th percentile 24-hour average A,B ($\mu g/m^3$)	Annual average A,B ($\mu g/m^3$)	Number of days above 20 $\mu g/m^3$	Data capture
2020	53.9	6.6	6.4	5	100%
2021	12.4	6.2	5.6	0	100%
2022	18.1	6.0	5.4	0	97%
2023	44.2	6.8	6.8	5	100%
2024	53.3	6.2	6.1	5	97%
Objective	**25/20 C**		**8/7 C**	**0**	**-**

Table notes:

[A] Averages require 75% data availability pursuant to AAQ NEPM standards (PRC, 2002).

[B] Data obtained from the Queensland Government Open Data Portal annual air quality monitoring records.

[C] Air EPP prior to 2025 determined a 24-hour and annual average objective for $PM_{2.5}$ of 25 µg/m^3 and 8 µg/m^3, respectively, during the period of monitoring. The Air EPP Amendment revised the 24-hour and annual average objectives for $PM_{2.5}$ to 20 µg/m^3 and 7 µg/m^3, respectively, taking effect from January 2025.

Table 8 Background $PM_{2.5}$ measured by DETSI at Moranbah West

Year	Maximum 24-hour average [A,B] (µg/m³)	70th percentile 24-hour average [A,B] (µg/m³)	Annual average [A,B] (µg/m³)	Number of days above 20 µg/m³	Data capture
2020	57.2	7.7	7.4	2	100% [D]
2021	12.8	6.5	5.6	0	98%
2022	22.5	6.3	5.6	1	100%
2023	53.6	7.3	7.2	6	88%
2024	40.3	7.1	6.9	9	96%
Objective	**25/20[C]**		**8/7[C]**	**0**	**-**

Table notes:

[A] Averages require 75% data availability pursuant to AAQ NEPM standards (PRC, 2002).

[B] Data obtained from Annual and Monthly Queensland Monitoring Reports for 2020 to 2023 provided by DETSI.

[C] Air EPP prior to 2025 determined a 24-hour and annual average objective for $PM_{2.5}$ of 25 µg/m^3 and 8 µg/m^3, respectively, during the period of monitoring. The Air EPP Amendment revised the 24-hour and annual average objectives for $PM_{2.5}$ to 20 µg/m^3 and 7 µg/m^3, respectively, taking effect from January 2025.

[D] Moranbah West monitoring commenced 29 June 2020.

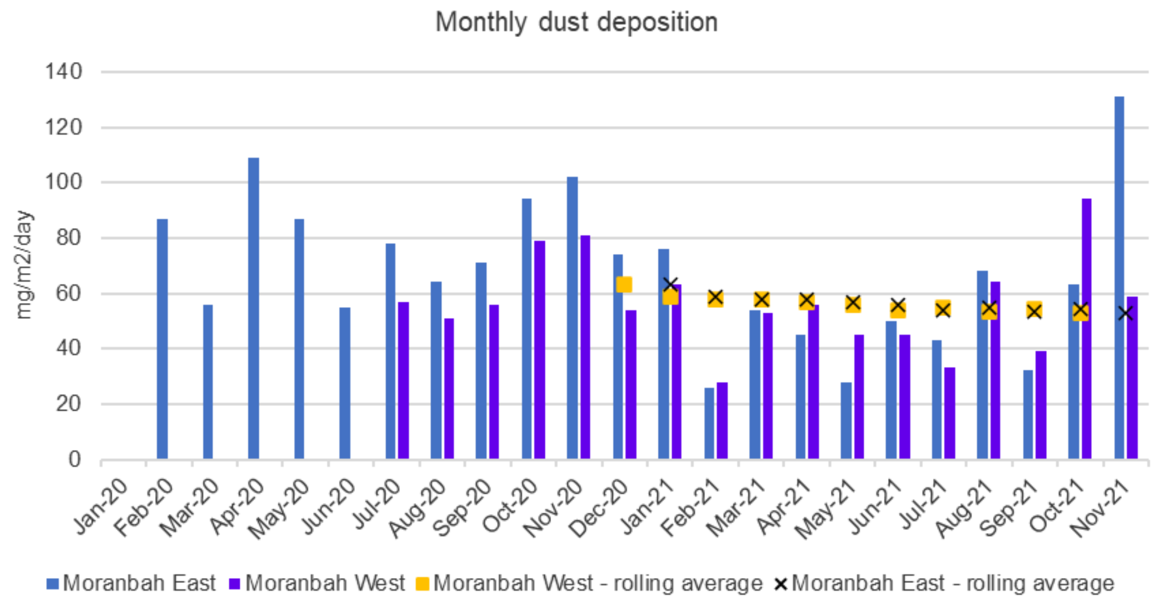

Figure 9 DETSI Moranbah monthly dust deposition monitoring

5.3.2.2 Other monitoring sites

Stanmore conducts monitoring of PM_{10} and $PM_{2.5}$ at two BAM monitors located approximately 1km east of the Moranbah East DETSI air quality monitoring station. These monitoring stations were installed as part of management plans for IDM and IPM mine operations. Data from the two BAM monitors have been analysed for the period 2020 – 2024 with data summarised in Table 9 and Table 10 and presented as 24-hour concentration timeseries for PM_{10} and $PM_{2.5}$ in Figure 10 and Figure 11, respectively.

Comparison against DETSI Moranbah East monitoring data for the period 2020 – 2024 indicates that:

- Data capture is generally higher at Moranbah East averaging 99% for PM_{10} and $PM_{2.5}$ compared to 89% at the Stanmore monitoring sites
- Annual average and 24-hour maximum and 70th percentile concentrations of PM_{10} are typically higher at Moranbah East compared to the Stanmore site with the exception of 2020 and the maximum 24-hour PM_{10} recorded by Stanmore for 2021. On average, 24-hour maximum PM_{10} concentrations were 7% higher at Moranbah East than Stanmore, 70th percentile PM_{10} was 12% higher at Moranbah East than Stanmore, and annual average PM_{10} was 16% higher at Moranbah East compared to Stanmore.
- $PM_{2.5}$ concentrations showed a similar trend with 24-hour maximum $PM_{2.5}$ concentrations 27% higher at Moranbah East than Stanmore, 70th percentile $PM_{2.5}$ 26% higher at Moranbah East than Stanmore, and annual average $PM_{2.5}$ 33% higher at Moranbah East compared to Stanmore.
- There were more exceedances (7) of the 24-hour objective for PM_{10} at the Stanmore monitor compared to Moranbah East for 2020 (5), and one exceedance recorded at Stanmore in 2021 not observed at Moranbah East. For all other years for both PM_{10} and $PM_{2.5}$ the number of recorded exceedances were greater at Moranbah East compared to Stanmore.
- The differences in concentrations may be a result of lower data capture at the Stanmore monitoring site or differences in the nature of local sources – the Stanmore site is further from residential areas and roads which may constitute local sources for the Moranbah East monitoring station.

Table 9 Stanmore PM_{10} ambient monitoring data

Year	Maximum 24-hour average (µg/m³)	70th percentile 24-hour average (µg/m³)	Annual average (µg/m³)	Number of days above 25 µg/m³	Data capture
2020	114.9	27.7	24.4	7	97%
2021	54.9	19.7	15.9	1	96%
2022	37.5	17.9	14.5	0	96%
2023	89.3	20.6	17.8	5	74%
2024	58.2	19.2	16.2	1	86%

Table 10 Stanmore $PM_{2.5}$ ambient monitoring data

Year	Maximum 24-hour average (µg/m³)	70th percentile 24-hour average (µg/m³)	Annual average (µg/m³)	Number of days above 25 µg/m³	Data capture
2020	40.8	6.3	5.8	3	97%
2021	10.4	5.6	4.7	0	98%
2022	14.6	3.8	3.0	0	98%
2023	30.3	4.2	3.5	3	87%
2024	30.0	3.7	3.3	2	60%

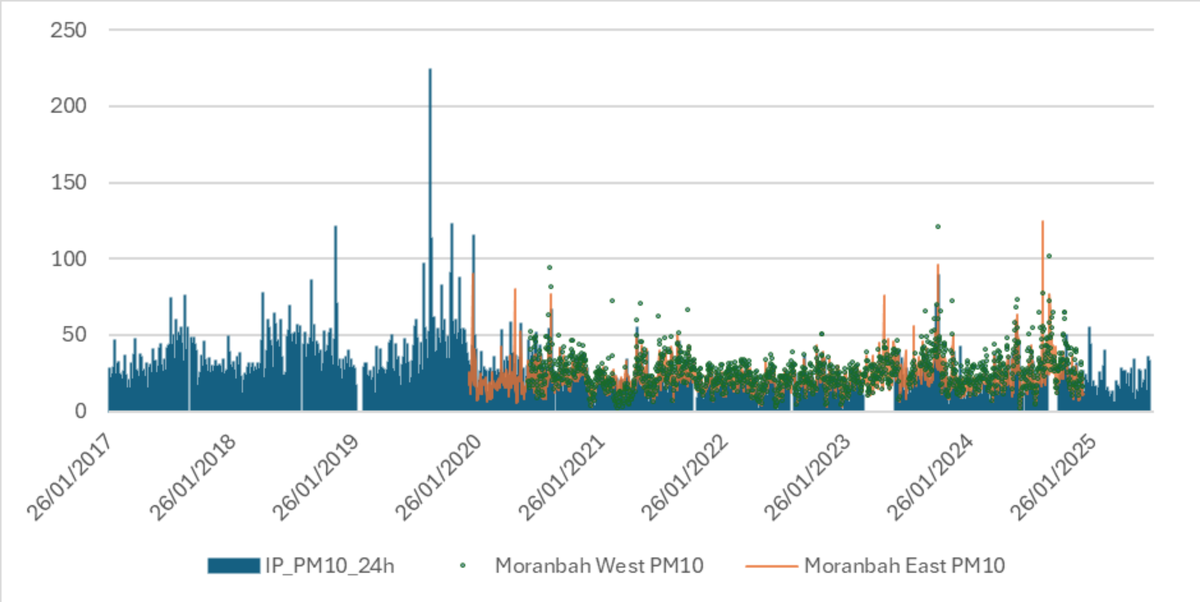

Figure 10 IPC BAM monitored concentrations of 24-hour PM_{10} and DETSI Moranbah monitored PM_{10}

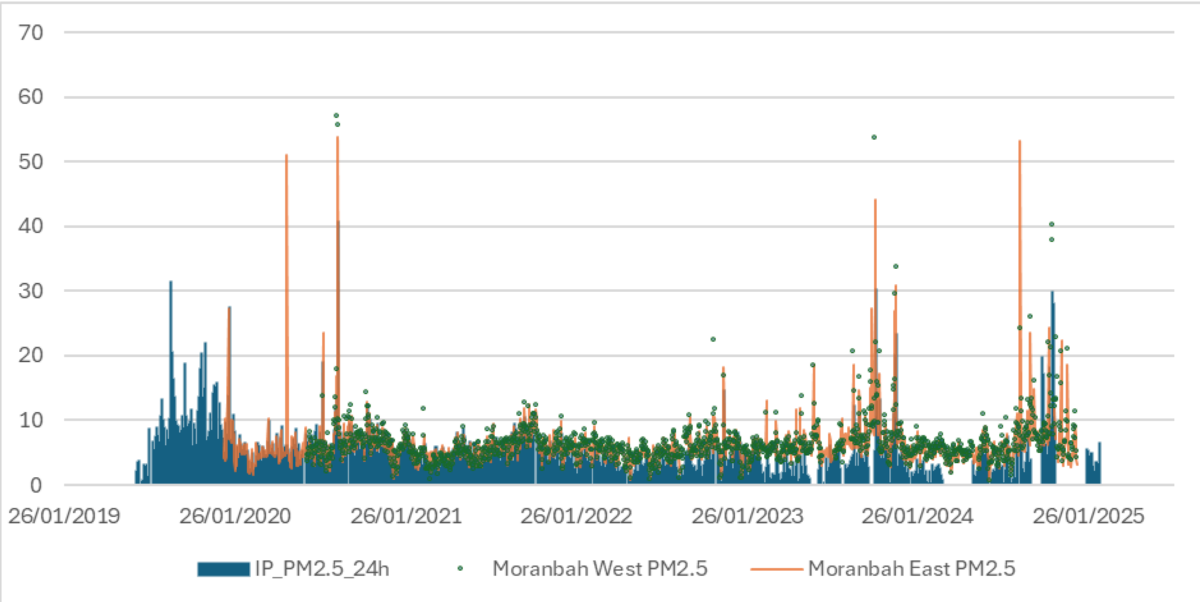

Figure 11 IPC BAM monitored concentrations of 24-hour $PM_{2.5}$ and DETSI Moranbah monitored $PM_{2.5}$

5.4 Ambient backgrounds

Data from the Moranbah East monitoring site has been used to represent background conditions in the study area for modelling. It was decided that DETSI data would be preferentially used over Stanmore data given the better data capture and generally higher concentrations provided by the DETSI monitors making the data more conservative.

A summary of the background air quality levels used in this assessment are presented in Table 11. The annual PM_{10} and $PM_{2.5}$ values are the maximum of annual averages for the years 2020 – 2024. The dust deposition value is the 12-month rolling average between December 2020 and November 2021 as measured by DETSI at Moranbah

East. A contemporaneous assessment has been undertaken for 24-hour cumulative impacts of PM_{10} and $PM_{2.5}$ using DETSI Moranbah East data covering the same 365 day period as the modelling (2023).

Table 11 Background particulates measured by DETSI at Moranbah East

Substance	Average Period	Background	Criterion	Percentage of criterion
TSP[1]	Annual	47.6 µg/m³	90 µg/m³	53%
PM_{10}	Annual	23.8 µg/m³	25 µg/m³	95%
$PM_{2.5}$	Annual	6.8 µg/m³	7 µg/m³	97%
Dust Dep	Annual	65.1 mg/m²/day	120 mg/m²/day	54%

Table note:

[1] TSP is not monitored by DETSI. Therefore background values have been derived by assuming TSP/PM_{10} of 2 using PM_{10} data from Moranbah East.

5.5 Meteorology

Local meteorology is of paramount importance for dispersion of air emissions generated by Project operations; key features are wind speed, wind direction, atmospheric stability and boundary layer mixing height. Conditions in the local area, as derived from the meteorological modelling carried out for the assessment, are discussed in detail in Section A1.5 of Appendix A, but can be summarised in simple terms based upon the wind rose presented in Figure 12, which summarises the wind speed and direction between 2020 to 2024.

Predicted annual average wind speed at the Project site in 2023 was 2.94 m/s, with winds predominantly coming from the east to southeast. In terms of annual average dispersion patterns emissions can be expected to follow the prevailing wind conditions, in this case, moving downwind from the Project in the west and northwest directions. The nearest sensitive receptor (R1) is located to the south of the Project site and therefore the majority of winds will transport any dust from the Project away from the receptor.

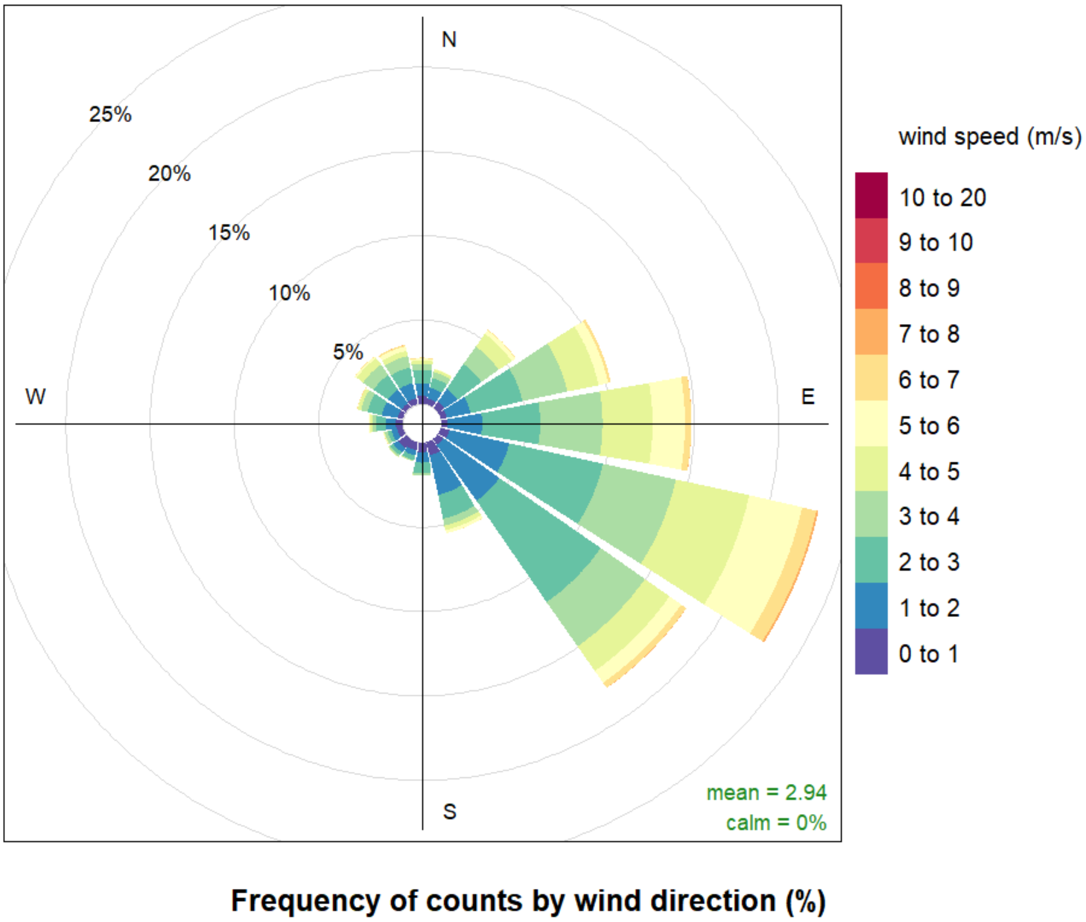

Figure 12 **Annual wind rose for the on-site monitoring location for 2023 (extracted from TAPM/CALMET)**

6. EMISSIONS TO THE ATMOSPHERE

6.1 Routine mitigation

The Project has reliable access to water supply and ample available water storage options. Water management systems will be integrated with the IPC. Routine mitigation will involve watercart use to wet down unpaved haul routes, additional watering and chemical suppressant application during dryer periods, and management of vehicle speeds. Mitigation control efficiencies are summarised in Table 12.

Previously mined and waste material dump areas will be progressively rehabilitated to minimise exposed surfaces to wind erosion. The assessment has not accounted for the impacts of rehabilitation actions on reducing dust emissions and therefore conservatively overestimates emissions.

Routine mitigation measures have been applied to all hours included within the dispersion modelling.

Table 12 Routine mitigation measures

Activity	Mitigation Measure	Control Efficiency	Reference
Wheel generated dust from OB hauling	level 2 watering (>2 L/m2/h) + chemical suppressants + vehicle speed limits	85%	NPI Mining v3.1 Table 4; NSW benchmarking study
Wheel generated dust from ROM hauling	level 2 watering (>2 L/m2/h) + chemical suppressants + vehicle speed limits	85%	NPI Mining v3.1 Table 4; NSW benchmarking study

6.2 Additional mitigation

Stanmore currently operates the IPC including IDM and IPM under the respective EAs EA0002817 (DETSI, 2025a) and EPML00932713 (DETSI, 2025b). In accordance with the respective EAs Stanmore implements a dust management plan (DMP). ID Extension will expand upon the existing IPC DMP to include the Project and will comprise of real-time monitoring of PM_{10} and $PM_{2.5}$, real-time meteorological monitoring of wind speed and direction, a trigger-action-response-plan (TARP) and complaints handling procedures. A DMP including real-time monitoring and a TARP will assist in managing air quality impacts resulting from Project operations. Further details on potential additional mitigation measures are provided in Section 7.2 and the DMP in Section 7.3. Further to the DMP and potential additional mitigation measures, ID Extension will seek to enter an alternative agreement with R1 for amenity impacts.

6.3 Emissions inventory

Table 13 and Table 14 present the calculated emission rates for Project mining operations occurring in 2029 and 2034. Emissions were calculated using NPI emission factor calculations as discussed in Section 4.4 in conjunction with operational data provided by ID Extension. Mine layout configurations are as presented in Figure 3 and Figure 4. Presented emission rates are inclusive of the routine mitigation control factors for OB and ROM haulage.

Emissions associated with construction and commissioning of any onsite equipment or worksites, and closure and rehabilitation activities will be insignificant compared to worst-case operational mining emissions. The quantification of dispersion modelling results for these operational years and the subsequent demonstration of compliance with relevant air quality objectives indirectly supports, with a high degree of confidence, the compliance of significantly less intensive construction and closure activities. Therefore, emissions for construction and closure have not been quantified.

Table 13 Emissions inventory - 2029

Operation	Control Factor	Emission rate (t/yr)		
		TSP	PM_{10}	$PM_{2.5}$
Drilling	0%	8.0	4.2	0.2
Blasting	0%	11.7	6.1	0.4
Dozing OB	0%	11.1	2.2	1.2
Excavators OB	0%	2.3	1.1	0.2
Truck loading OB	0%	2.3	1.1	0.2
Hauling OB	85%	379.3	108.1	10.8
Grading OB	0%	38.6	11.4	1.2
Dumping OB	0%	2.3	1.1	0.2
Dragline	0%	388.9	74.1	6.6
Dozing ROM	0%	17.7	5.5	0.4
Excavators ROM	0%	0.7	0.3	0.05
Truck loading ROM	0%	1.3	0.6	0.1
Hauling ROM	85%	107.3	28.2	2.8
Grading ROM	0%	37.9	11.2	1.2
Dumping ROM	0%	0.7	0.3	0.05
Wind erosion	0%	236.3	118.1	18.9
Total		**1,246.5**	**373.6**	**44.4**

Table 14 Emissions inventory - 2034

Operation	Control Factor	Emission rate (t/yr)		
		TSP	PM_{10}	$PM_{2.5}$
Drilling	0%	8.0	4.2	0.2
Blasting	0%	8.8	4.6	0.3
Dozing OB	0%	44.1	8.6	4.6
Excavators OB	0%	1.7	0.8	0.1
Truck loading OB	0%	1.7	0.8	0.1
Hauling OB	85%	363.8	103.7	10.4
Grading OB	0%	19.8	5.9	0.6
Dumping OB	0%	3.1	1.5	0.2
Dragline	0%	456.8	87.0	7.8
Dozing ROM	0%	333.8	102.6	7.3
Excavators ROM	0%	1.3	0.6	0.1
Truck loading ROM	0%	2.7	1.3	0.2
Hauling ROM	85%	263.7	71.8	7.2

Operation	Control Factor	Emission rate (t/yr)		
		TSP	PM_{10}	$PM_{2.5}$
Grading ROM	0%	56.7	16.8	1.8
Dumping ROM	0%	1.3	0.6	0.1
Wind erosion	0%	837.0	418.5	67.0
Total		**2,404.2**	**829.1**	**108.0**

7. RESULTS

7.1 Routine Mitigation

Table 15 and Table 16 show the predicted ground-level concentrations of TSP, PM_{10}, $PM_{2.5}$, and dust deposition rates at each sensitive receptor. These results show peak contributions resulting from the Project in isolation and cumulatively when inclusive of ambient background concentrations. Presented cumulative results in Table 15 and Table 16 do not show a constant predicted concentration occurring at all times but instead represent the single worst-case day, which in this case, is dominated by the peak day ambient background concentrations. Cumulative concentrations for the majority of the year are significantly lower than the presented single day peak concentrations. Additionally, contour plates showing predicted isolation ground-level concentrations for each substance and averaging period are present in Plate 1 to Plate 12.

The results show the following:

Routine mitigation – isolation (Project only) for model years 2029 and 2034:

- Predicted maximum monthly average dust deposition rates ***comply*** with the guideline of 120 mg/m^2/day at all sensitive receptors
- Predicted annual average ground-level concentrations of TSP ***comply*** with the annual average objective of 90 µg/m^3 at all sensitive receptors
- Predicted 24-hour and annual average ground-level concentrations of PM_{10} ***comply*** with the relevant air quality objectives at all sensitive receptors
- Predicted 24-hour and annual average ground-level concentrations of $PM_{2.5}$ ***comply*** with the relevant air quality objectives at all sensitive receptors

Routine mitigation – cumulative (Project including ambient background) for model years 2029 and 2034:

- **Year 2029**
    - Predicted cumulative maximum monthly average dust deposition rates ***comply*** with the guideline of 120 mg/m^2/day at all sensitive receptors
    - Predicted cumulative annual average ground-level concentrations of TSP ***comply*** with the annual average objective of 90 µg/m^3 at all sensitive receptors
    - Predicted cumulative 24-hour maximum ground-level concentrations of PM_{10} indicate (Table 15; Table 17):
        - Six exceedance days occur due to the ambient background PM_{10} (Table 5)
        - No additional exceedances occur due to IDE at sensitive receptors R3 and R15
        - One additional exceedance day is predicted due to IDE at sensitive receptors Moranbah, R9 – R14
        - Two additional exceedance days are predicted due to IDE at sensitive receptors R4 – R8
        - Three additional exceedance days are predicted due to IDE at sensitive receptor R2
        - Eight additional exceedance days are predicted due to IDE at sensitive receptor R1
        - Contributions from the Project to 24-hour maximum PM_{10} concentrations are at most 63.6% (31.78 µg/m^3) of the air quality objective of 50 µg/m^3 at R1. Beyond R1 the Project contribution reduces to a maximum of 17.1% of the objective.

- Predicted cumulative annual average ground-level concentrations of PM_{10} are predicted to exceed at four sensitive receptors (R1, R2, R10, R11) (Table 15). This is primarily due to the high ambient background concentration of 23.8 µg/m^3 or 95% of the annual average PM_{10} objective (25 µg/m^3). The Project does not contribute more than 8.3% of the objective at any sensitive receptor (2.07 µg/m^3).
- Predicted cumulative 24-hour maximum ground-level concentrations of $PM_{2.5}$ indicate (Table 15; Table 17):
  - Five exceedance days occur due to the ambient background $PM_{2.5}$ (Table 7)
  - No additional exceedance days are predicted due to IDE at any sensitive receptor except for one additional day at R13
  - Contributions from IDE to 24-hour maximum $PM_{2.5}$ concentrations are at most 20.8% (4.17 µg/m^3) of the air quality objective of 20 µg/m^3 at R1. Beyond R1 the Project contribution reduces to a maximum of 7.8% of the objective.
- Predicted cumulative annual average ground-level concentrations of $PM_{2.5}$ are predicted to exceed at eight sensitive receptors (R1, R2, R4, R10 – R12, R14) (Table 15). This is primarily due to the high ambient background concentration of 6.8 µg/m^3 or 98% of the annual average $PM_{2.5}$ objective (7 µg/m^3). The Project does not contribute more than 3.9% of the objective at any sensitive receptor (0.27 µg/m^3).

- **Year 2034**
  - Predicted cumulative maximum monthly average dust deposition rates ***comply*** with the guideline of 120 mg/m^2/day at all sensitive receptors
  - Predicted cumulative annual average ground-level concentrations of TSP ***comply*** with the annual average objective of 90 µg/m^3 at all sensitive receptors
  - Predicted cumulative 24-hour maximum ground-level concentrations of PM_{10} indicate (Table 16; Table 17):
    - Six exceedance days occur due to the ambient background PM_{10} (Table 5)
    - No additional exceedances occur due to IDE at sensitive receptors R3 and R15
    - One additional exceedance day is predicted due to IDE at sensitive receptors Moranbah, R9 – R12 and R14
    - Two additional exceedance days are predicted due to IDE at sensitive receptors R4 – R8, and R13
    - Three additional exceedance days are predicted due to IDE at sensitive receptor R2
    - Eleven additional exceedance days are predicted due to IDE at sensitive receptor R1
    - Contributions from IDE to 24-hour maximum PM_{10} concentrations are at most 68.3% (34.17 µg/m^3) of the air quality objective of 50 µg/m^3 at R1. Beyond R1 the Project contribution reduces to a maximum of 20.7% of the objective.
  - Predicted cumulative annual average ground-level concentrations of PM_{10} are predicted to exceed at ten sensitive receptors (Moranbah, R1, R2, R4, R6, R9 – R12, R14) (Table 16). This is primarily due to the high ambient background concentration of 23.8 µg/m^3 or 95% of the annual average PM_{10} objective (25 µg/m^3). The Project does not contribute more than 13.8% of the objective at any sensitive receptor (3.46 µg/m^3).
  - Predicted cumulative 24-hour maximum ground-level concentrations of $PM_{2.5}$ indicate (Table 16; Table 17):

    - Five exceedance days occur due to the ambient background $PM_{2.5}$ (Table 7)
    - No additional exceedance days are predicted due to IDE at sensitive receptors Moranbah, R1, R3 – R5, R7 - R8, and R14 - R15
    - One additional exceedance day is predicted due to IDE at sensitive receptors R2, R6, R9, and R10 – R13
    - Contributions from IDE to 24-hour maximum $PM_{2.5}$ concentrations are at most 23.0% (4.61 µg/m^3) of the air quality objective of 20 µg/m^3 at R1. Beyond R1 the Project contribution reduces to a maximum of 13.7% of the objective.
  - Predicted cumulative annual average ground-level concentrations of $PM_{2.5}$ are predicted to exceed at all sensitive receptors except R3 and R15 (Table 16). This is primarily due to the high ambient background concentration of 6.8 µg/m^3 or 98% of the annual average $PM_{2.5}$ objective (7 µg/m^3). The Project does not contribute more than 6.5% of the objective at any sensitive receptor (0.46 µg/m^3).

Table 15 Year 2029 - Model predicted ground-level dust and particulate concentrations

Report ID	PM$_{2.5}$ (µg/m^3)				PM$_{10}$ (µg/m^3)				TSP (µg/m^3)		Dust Deposition (mg/m^2/day)	
	Max 24h PM$_{2.5}$		Annual avg PM$_{2.5}$		Max 24h PM$_{10}$		Annual avg PM$_{10}$		Annual avg TSP		Max monthly avg Dust Dep	
	IDE	IDE + BG[1]	IDE	IDE + BG[2]	IDE	IDE + BG[1]	IDE	IDE + BG[2]	IDE	IDE + BG[2]	IDE	IDE + BG[3]
Moranbah	1.55	44.22	0.20	7.04	8.54	96.59	1.17	24.96	1.32	48.91	3.47	60.97
R1	4.17	44.15	0.27	7.12	31.78	96.22	2.07	25.87	3.95	51.54	22.97	80.47
R2	1.19	44.15	0.22	7.07	7.07	96.22	1.46	25.25	1.96	49.55	4.94	62.44
R3	0.50	44.15	0.01	6.86	3.13	96.23	0.06	23.85	0.08	47.66	0.21	57.71
R4	0.79	44.15	0.15	7.00	4.29	96.22	0.94	24.73	1.22	48.81	2.46	59.96
R5	0.75	44.15	0.15	6.99	4.05	96.22	0.91	24.70	1.18	48.77	2.37	59.87
R6	0.97	44.15	0.16	7.00	5.22	96.22	0.97	24.76	1.26	48.85	3.04	60.54
R7	0.72	44.15	0.13	6.98	4.02	96.22	0.82	24.61	1.07	48.66	2.16	59.66
R8	0.63	44.15	0.12	6.97	3.69	96.22	0.74	24.53	0.97	48.55	1.97	59.47
R9	1.06	44.15	0.18	7.03	6.23	96.22	1.12	24.91	1.39	48.98	2.85	60.35
R10	0.99	44.16	0.21	7.05	5.10	96.26	1.27	25.06	1.55	49.14	2.99	60.49
R11	0.96	44.16	0.21	7.06	5.68	96.28	1.30	25.10	1.58	49.17	3.02	60.52
R12	0.97	44.16	0.20	7.04	4.93	96.25	1.20	25.00	1.47	49.06	2.87	60.37
R13	0.62	44.15	0.12	6.97	2.85	96.22	0.73	24.52	0.94	48.52	2.22	59.72
R14	1.27	44.56	0.18	7.02	7.20	98.04	1.02	24.81	1.11	48.70	1.48	58.98
R15	0.88	44.15	0.03	6.87	4.81	96.22	0.14	23.93	0.16	47.74	0.33	57.83
Background	**44.15**		**6.85**		**96.22**		**23.79**		**47.6**		**57.50**	
Objective	**20**		**7**		**50**		**25**		**90**		**120**	

Table notes:
[1] Results represent the maximum 24-hour concentration from the contemporaneous addition of model predicted concentrations with ambient background concentrations from the Moranbah East DETSI monitoring station. Peak ambient background days and peak model predicted concentrations do not always occur on the same day. The IDE columns show peak contributions from IDE which demonstrate the majority of the peak cumulative result is attributable to the background.
[2] Results present the annual average model predicted concentration with the addition of the annual average monitored concentration at the Moranbah East DETSI monitoring station.
[3] Results present the annual maximum of monthly average dust deposition rates with addition of the 12-month rolling average dust deposition rate monitored between December 2020 and November 2021 as measured by DETSI at Moranbah East.

Table 16 Year 2034 - Model predicted ground-level dust and particulate concentrations

Report ID	$PM_{2.5}$ (µg/m³)				PM_{10} (µg/m³)				TSP (µg/m³)		Dust Deposition (mg/m²/day)	
	Max 24h $PM_{2.5}$		Annual avg $PM_{2.5}$		Max 24h PM_{10}		Annual avg PM_{10}		Annual avg TSP		Max monthly Dust Dep	
	IDE	IDE + BG[1]	IDE	IDE + BG[2]	IDE	IDE + BG[1]	IDE	IDE + BG[2]	IDE	IDE + BG[2]	IDE	IDE + BG
Moranbah	2.54	44.24	0.32	7.17	9.87	96.71	1.89	25.68	2.17	49.75	6.13	63.63
R1	4.61	44.15	0.46	7.30	34.17	96.22	3.46	27.25	6.53	54.12	30.12	87.62
R2	2.14	44.15	0.31	7.15	9.39	96.22	1.85	25.65	2.41	49.99	6.81	64.31
R3	0.72	44.16	0.02	6.86	4.33	96.25	0.10	23.90	0.13	47.72	0.33	57.83
R4	1.11	44.15	0.21	7.06	4.46	96.22	1.22	25.02	1.58	49.16	3.31	60.81
R5	1.08	44.15	0.21	7.05	4.60	96.22	1.18	24.98	1.52	49.11	3.19	60.69
R6	1.42	44.15	0.22	7.06	6.40	96.22	1.26	25.06	1.60	49.19	4.10	61.60
R7	1.02	44.15	0.19	7.04	4.10	96.22	1.08	24.88	1.40	48.99	3.07	60.57
R8	0.97	44.15	0.18	7.02	3.91	96.22	0.99	24.78	1.28	48.86	2.81	60.31
R9	1.62	44.15	0.26	7.11	6.79	96.22	1.50	25.30	1.89	49.48	4.22	61.72
R10	2.12	44.16	0.30	7.14	8.37	96.25	1.73	25.53	2.14	49.73	4.61	62.11
R11	2.24	44.16	0.31	7.15	8.88	96.26	1.79	25.58	2.20	49.78	4.73	62.23
R12	1.94	44.16	0.29	7.13	7.67	96.24	1.64	25.43	2.03	49.62	4.37	61.87
R13	1.15	44.15	0.18	7.03	4.53	96.22	1.00	24.79	1.27	48.86	2.94	60.44
R14	2.74	45.00	0.29	7.13	10.34	99.66	1.71	25.50	1.91	49.50	3.75	61.25
R15	1.64	44.15	0.05	6.89	9.10	96.22	0.24	24.03	0.27	47.86	0.55	58.05
Background	**44.15**		**6.85**		**96.22**		**23.79**		**47.6**		**57.50**	
Objective	**20**		**7**		**50**		**25**		**90**		**120**	

Table notes:
[1] Results represent the maximum 24-hour concentration from the contemporaneous addition of model predicted concentrations with ambient background concentrations from the Moranbah East DETSI monitoring station. Peak ambient background days and peak model predicted concentrations do not always occur on the same day. The IDE columns show peak contributions from IDE which demonstrate the majority of the peak cumulative result is attributable to the background.
[2] Results present the annual average model predicted concentration with the addition of the annual average monitored concentration at the Moranbah East DETSI monitoring station.
[3] Results present the annual maximum of monthly average dust deposition rates with addition of the 12-month rolling average dust deposition rate monitored between December 2020 and November 2021 as measured by DETSI at Moranbah East.

7.2 Additional Mitigation

To achieve compliance with 24-hour and annual average concentrations of PM_{10} and $PM_{2.5}$ at each sensitive receptor additional mitigation measures are required. Additional mitigation measures will be enacted incrementally and proactively as necessary based on real-time monitoring data as part of the DMP TARP. Additional mitigation measures are those in excess of the routine mitigation measures (watering, speed limits, and chemical suppressants on haul roads) and could variously include the following:

- Watering or use of chemical suppressants on exposed dump areas
- Reducing or relocating operations within certain mine areas
- Reducing hauling operations
- Ceasing certain operations in certain areas

Ground-level dispersion modelling results were investigated via a source-contribution approach to determine the level of additional mitigation required to avoid any predicted exceedances due to the Project above those attributable to the ambient background. In the case of 24-hour concentrations of PM_{10} the ambient background exceeds the Air EPP objective on six occasions, and for 24-hour concentrations of $PM_{2.5}$ the Air EPP is exceeded five times.

Additional mitigation is predicted to be necessary for up to:

- 8 days for the Year 2029 scenario
- 11 days for the Year 2034 scenario

Table 17 depicts additional exceedance days for the Year 2029 and Year 2034 modelling scenarios before and after application of the abovementioned additional mitigation measures. R1 is predicted to experience the greatest number of impacts. R13 is predicted to have an additional exceedance of $PM_{2.5}$ in both years. In all cases the additional mitigation measures can achieve zero additional exceedance days.

Source contribution plots in Figure 13 to Figure 16 show the top 50-days of ground-level concentrations of 24-hour PM_{10} at R1 and 24-hour $PM_{2.5}$ at R13 prior to additional mitigation. These source contribution figures demonstrate the dominant contribution of ambient background concentrations. The mostly smaller Project contributions result primarily from haul road emissions, and in the case of predicted impacts at R1, mining operations in the southern pit and dump areas. Controlling haul road emissions and managing southern pit operations, including progressive rehabilitation activities, are key factors for the purposes of mitigating additional impacts due to the Project at R1 and reducing wind-blown dust at more distant downwind receptors to the northwest, such as R13. Figure 17 and Figure 18 display a daily timeseries of ground-level predicted concentrations of 24-hour PM_{10} at R1 for Year 2029 and Year 2034 before and after additional mitigation.

The modelling represents predicted ground-level concentrations informed by assumptions described in Section 4.7. These assumptions include the accuracy and representativeness of ambient background data, meteorological modelling and monitoring data, and conservative assumptions concerning continuous emissions from all mining activities across the mine site for every hour of the year and the inability of modelling to account for rainfall. It may, in reality, be the case that the peak model predicted ground-level concentrations will never coincide with ambient background concentrations under the same meteorological conditions as represented by this dispersion modelling assessment. Therefore, the modelling is understood to represent worst-case hypothetical emissions scenarios that conservatively represent the broad range of possible operational, meteorological, and ambient background conditions.

In this context, the dispersion modelling results indicate that emissions will ***comply*** with all relevant Air EPP air quality objectives for the Project operating in isolation and that, with appropriate additional mitigation measures, the Project will result in no additional exceedances of the air quality objectives at any sensitive receptors.

Real-time monitoring and TARP triggers as part of the DMP will be integral to effectively identifying occasions when additional mitigation measures may be required.

Table 17 Predicted additional exceedance days for PM_{10} and $PM_{2.5}$ before and after additional mitigation measures

Sensitive Receptor	PM_{10}				$PM_{2.5}$			
	Predicted additional number of days above 50 µg/m^3				Predicted additional number of days above 20 µg/m^3			
	Year 2029		Year 2034		Year 2029		Year 2034	
	Pre-additional mit	Post-additional mit	Pre-additional mit	Post-additional mit	Pre-additional mit	Post-additional mit	Pre-additional mit	Post-additional mit
Moranbah	1	0	1	0	0	0	0	0
R1	8	0	11	0	0	0	0	0
R2	3	0	3	0	0	0	1	0
R3	0	0	0	0	0	0	0	0
R4	2	0	2	0	0	0	0	0
R5	2	0	2	0	0	0	0	0
R6	2	0	2	0	0	0	1	0
R7	2	0	2	0	0	0	0	0
R8	2	0	2	0	0	0	0	0
R9	1	0	1	0	0	0	1	0
R10	1	0	1	0	0	0	1	0
R11	1	0	1	0	0	0	1	0
R12	1	0	1	0	0	0	1	0
R13	1	0	2	0	1	0	1	0
R14	1	0	1	0	0	0	0	0
R15	0	0	0	0	0	0	0	0

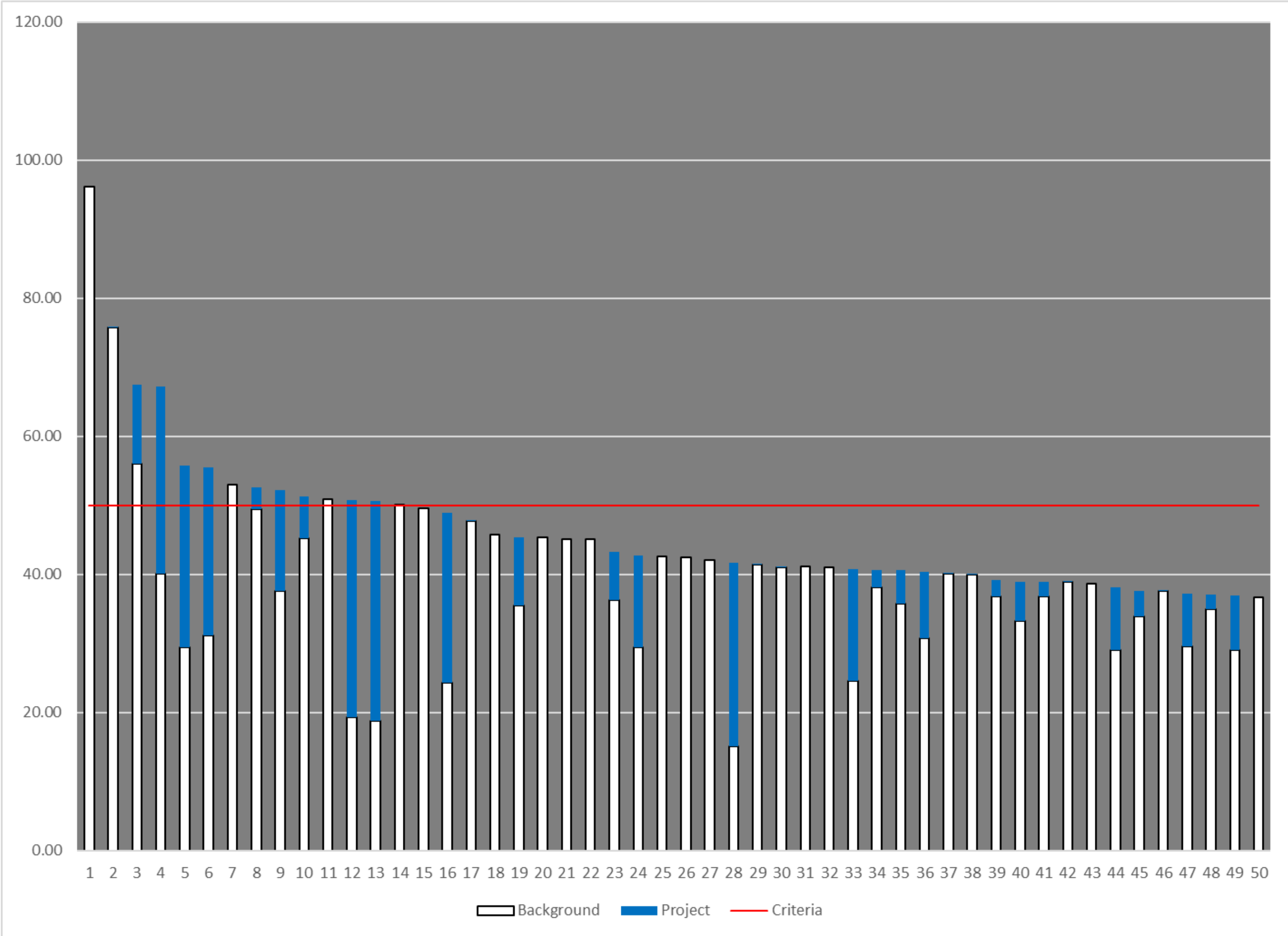

Figure 13 Year 2029 – R1 24-hour PM_{10} ground-level concentration source contribution plot for top 50 days

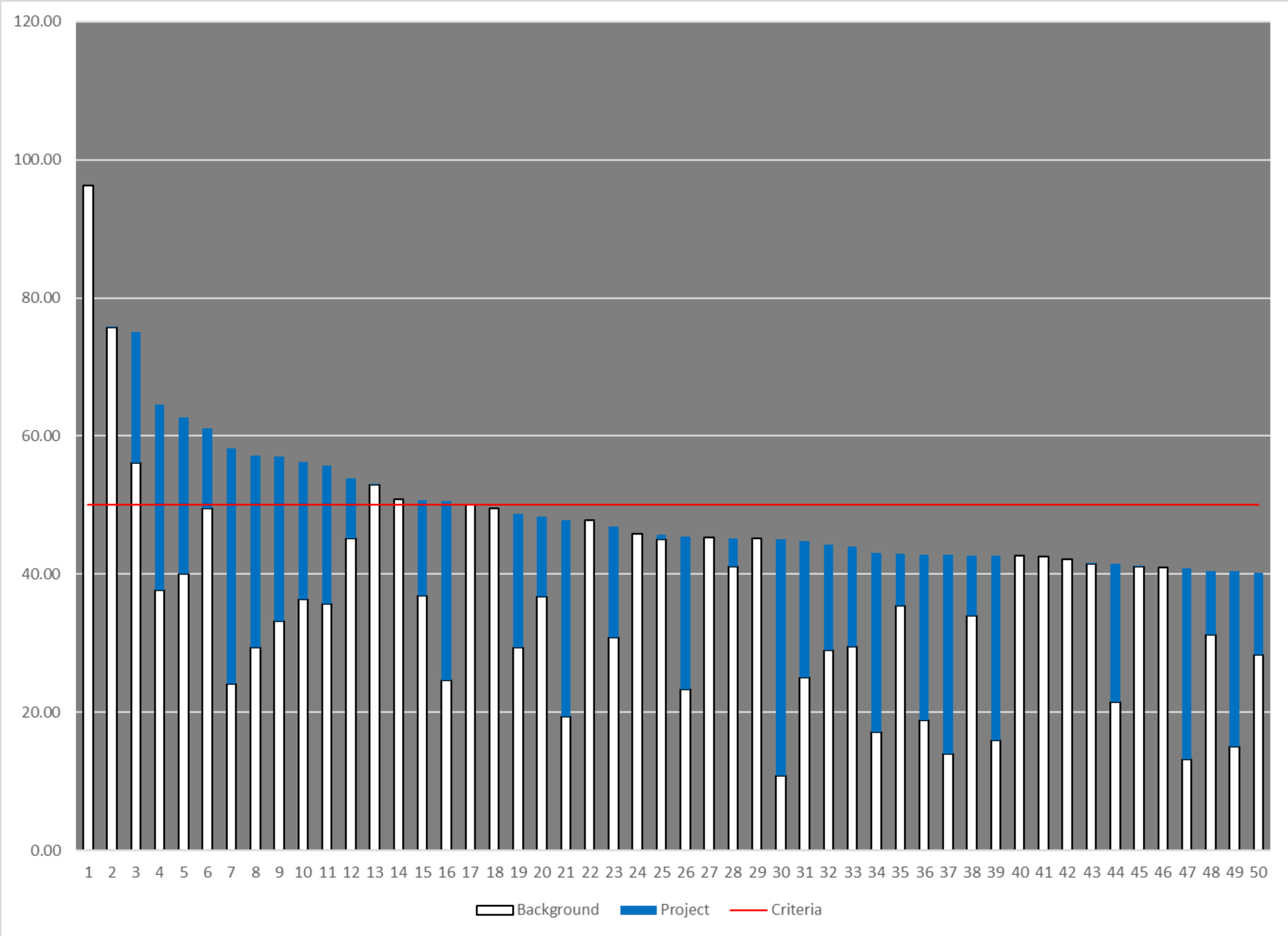

Figure 14 **Year 2034 – R1 24-hour PM_{10} ground-level concentration source contribution plot for top 50 days**

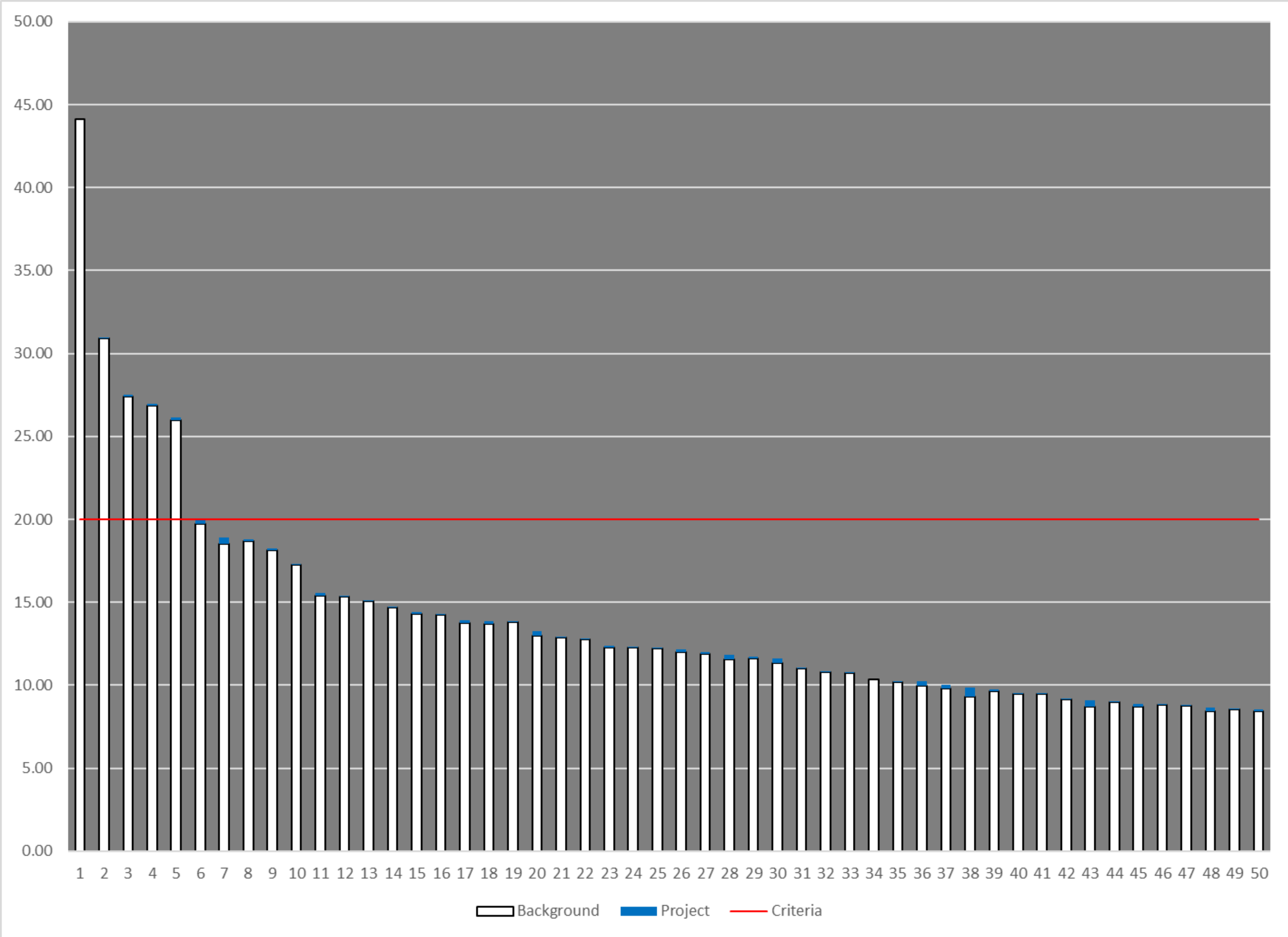

Figure 15 Year 2029 – R13 24-hour $PM_{2.5}$ ground-level concentration source contribution plot for top 50 days

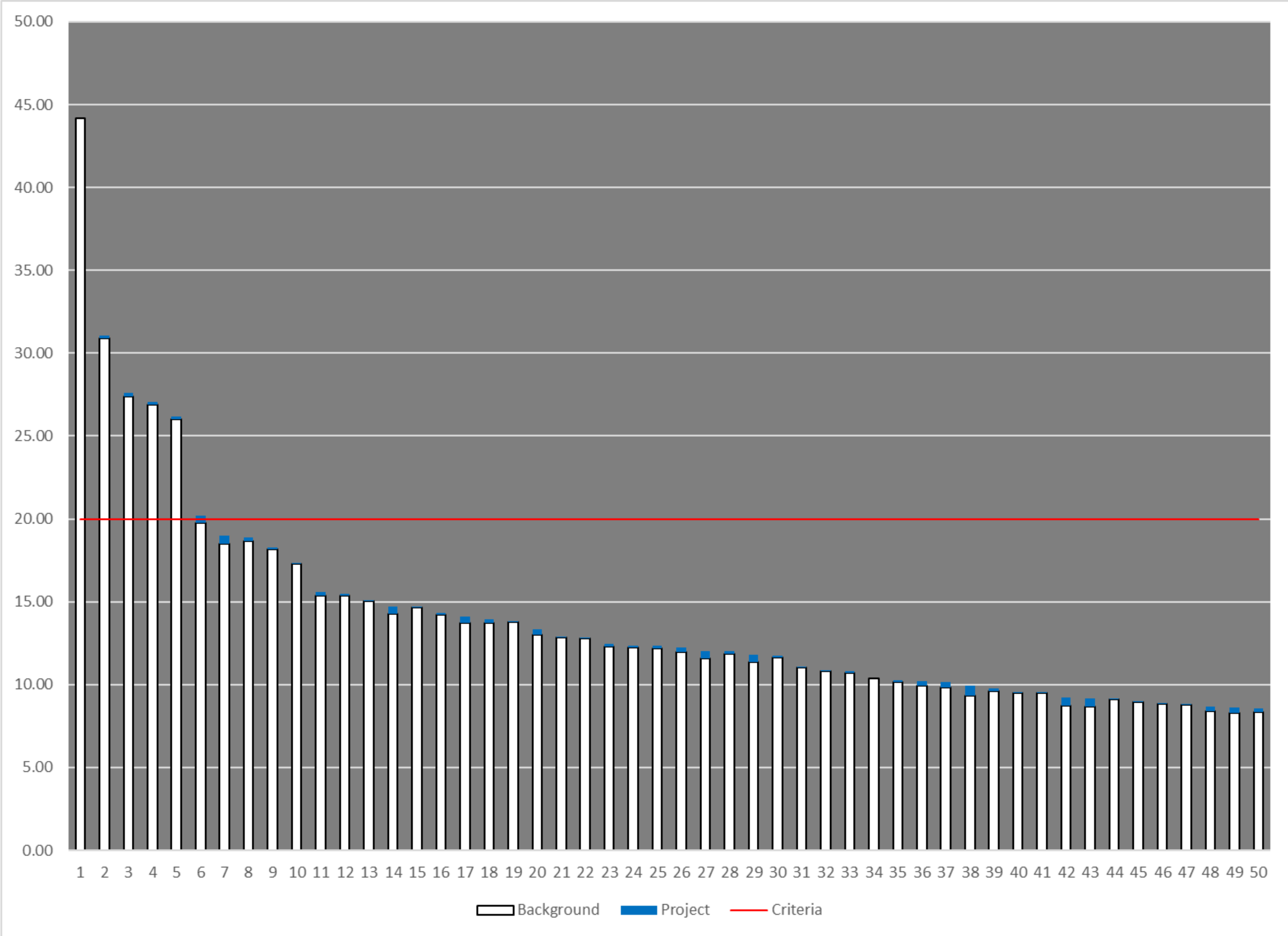

Figure 16 **Year 2034 – R13 24-hour $PM_{2.5}$ 24-hour ground-level concentration source contribution plot for top 50 days**

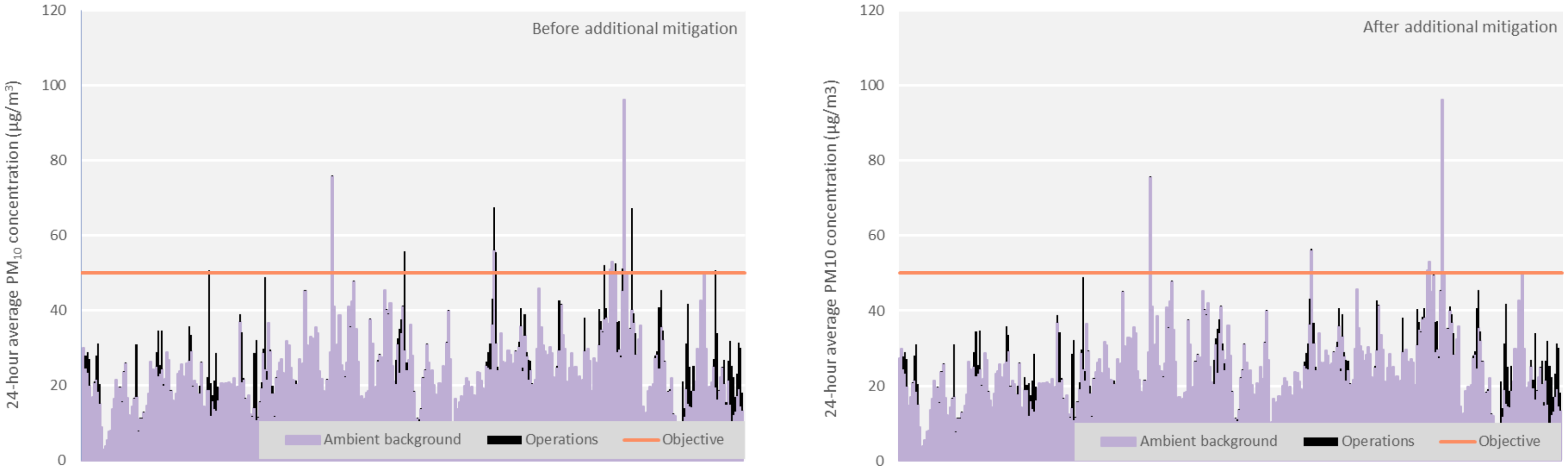

Figure 17 Year 2029 – R1 24-hour cumulative PM_{10} ($\mu g/m^3$) before and after additional mitigation

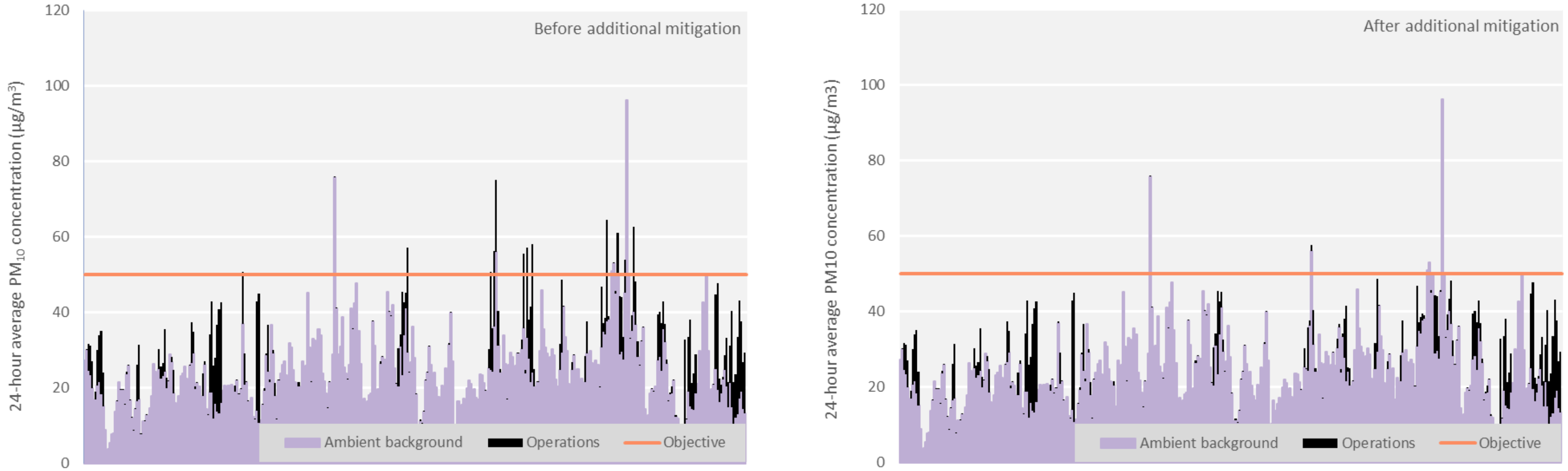

Figure 18 Year 2034 – R1 24-hour cumulative PM_{10} ($\mu g/m^3$) before and after additional mitigation

7.3 Cumulative assessment with future mines

There are a number of mines located near to the Project which are approved but are yet to commence, namely the Eagle Downs underground coal mine, Peak Downs Mine Continuation Project, and Winchester South open cut coal mine.

The potential for these approved future mining projects to cumulatively contribute to predicted air quality impacts from the Project are qualitatively discussed as follows:

- The Eagle Downs underground mine ML and underground mine portal are approximately 2 km south and 8 km south, respectively, of the Project's operational mining areas. Cumulative impacts from Eagle Downs and the Project at the nearest sensitive receptor (R1) are unlikely to occur at the same time as the Project. Dust from Eagle Downs will be transported to R1 under southerly winds, and from the Project to R1 under northerly winds. Eagle Downs is an underground coal mine and, therefore, will make minor contributions in emissions to air compared to open cut mining. Review of the publicly available Assessment Report (Department of Environment and Resource Management, 2010) indicates the Eagle Downs mine will be subject to a range of dust related mitigation measures, considered adequate to manage the air impacts of the mine.
- The Peak Downs Continuation Project represents a continuation of existing mining rather than new additional mining. The magnitude of emissions will remain largely consistent with current emissions due to the ceasing and rehabilitation of Peak Downs mine areas that are preceding the Continuation Project. Ambient background monitoring is representative of these existing emissions. The Peak Downs Continuation Project is located >6 km to the south of the Project's operational mining areas and any dust from the Peak Downs Continuation Project is unlikely to affect the nearest sensitive receptor (R1) under the same meteorological conditions as the Project. Review of the publicly available ToR (QLD Government, 2023) for the Peak Downs Mine Continuation Project requires that the mine EIS detail mitigation measures inclusive of a Dust Management Plan and a description on how air objectives would be monitored, audited, and reported and how corrective/preventive actions would be managed for the life of the mine. It is reasonable then to expect that the mine will incorporate monitoring and management measures necessary to mitigate impacts at R1.
- The Winchester South mine ML, similarly to the Eagle Downs mine and Peak Downs Continuation Project, is located >4.5 km southeast of the Project's operational mining areas and so is unlikely to affect the nearest sensitive receptor (R1) under the same meteorological conditions as the Project. Draft EA conditions for the mine indicate that real-time monitoring and a dust management plan will be implemented and this will include mitigation measures for dust to ensure compliance with relevant air quality objectives.

Most mines (existing and approved) within the region will implement monitoring and management procedures to proactively avoid dust impacts. As such, mines within the region are committed to achieving the same air quality outcomes. Cumulative modelling of regional mining operations without detailed operational information will not reflect this reality and will produce highly conservative results not represented by monitoring data conducted either at the DETSI monitoring sites or mine operated monitoring sites.

The DMP for the Project, discussed in Section 6.2 and Section 8, commit to regular review and improvement of the dust management practices and monitoring to ensure emissions and impacts from the Project are managed into the future.

8. DUST MANAGEMENT PLAN

The AQA's dispersion modelling for the Project has indicated that there is a potential for exceedances of the Air EPP objectives for PM_{10} and $PM_{2.5}$ when considered cumulatively with ambient background concentrations. As demonstrated, these potential exceedances can be managed through the staged implementation of additional mitigation measures. To identify when these additional measures should be implemented a DMP, strategic monitoring network, and TARP will be adopted for the Project's mining operations.

The requirement to monitor is consistent with existing EAs approved for currently operating Stanmore mines (e.g. IPC) and other mines within the region, and as a result, may be a conditioned requirement of the Project's EA.

ID Extension will develop a DMP for the Project, building on the existing DMP for IPC as mentioned in Section 6.2. The DMP for the Project will include:

- Information on potential dust sources
- Information on the compliance requirements of the relevant air quality conditions of the EA
- Dust management and mitigation methods
- Dust monitoring locations and methods for PM_{10}, $PM_{2.5}$ (real-time monitoring) and deposited particulate matter (monthly collected dust deposition gauges), noting that existing dust monitoring stations operated by Stanmore in the region, may be suitable
- Meteorological monitoring station capable of monitoring wind direction and speed, noting that existing meteorological monitoring stations operated by Stanmore in the region, may be suitable
- A TARP, with triggers and actions to include any additional Project relevant mitigation measures and the location of sensitive receptors with particular emphasis on R1.
- A complaints management procedure
- Reporting procedures including annual review of the DMP to ensure continuous improvement of the DMP as future conditions change with the progression of mining.

The combination of real-time monitoring for wind speed, wind direction, and PM_{10} and $PM_{2.5}$ concentrations with a TARP enables the Project to identify when adverse air quality conditions are happening and to proactively implement additional mitigation measures to avoid potential impacts. Additional mitigation measures may be implemented during adverse meteorological conditions such as high wind speeds from the Project towards sensitive receptors, calm evening conditions with poor dispersion, or during prolonged dry and hot conditions. Triggers will be incrementally set based on measured concentrations of PM_{10} and $PM_{2.5}$, wind speed and wind direction. Actions in response to triggers will likewise increase in scope as the severity of triggers increases. Additional mitigation measures could variously include the following:

- Watering or use of chemical suppressants on exposed dump areas
- Reducing or relocating operations within certain mine areas
- Reducing hauling operations
- Ceasing certain operations in certain areas

The Project DMP will include the following monitoring requirements:

- Real-time PM_{10} and $PM_{2.5}$ monitoring at or near R1 utilising compliance level monitoring equipment (Australian Standard compliant beta-attenuation monitors (BAMs), noting that an existing dust monitoring station operated by Stanmore at R1 may be suitable.

- Dust deposition gauges including near R1, noting that an existing dust deposition gauge deployed by Stanmore at R1 may be suitable.

ID Extension has existing data sharing agreements with other nearby mines which will enable coordination of dust monitoring data.

Stanmore will additionally seek to enter into an alternative agreement with R1 for amenity impacts.

9. AIR QUALITY CONCLUSIONS

Katestone was commissioned by ID Extension to complete an AQA of the proposed Project located in the Bowen Basin approximately 15 km southeast of the Moranbah township and 150 km southwest of Mackay.

The Project will comprise an open cut coal mine pit and associated infrastructure, primarily mining metallurgical (steel making) coal. Approximately 46 Mt of ROM coal will be mined over 15 years, with approximately 2 – 4.5 Mtpa.

ID Extension was approved to prepare a voluntary EIS for the Project under Chapter 3, Part 2 of the EP Act. The EIS will be required to support an application for a new EA and PRCP schedule. A final ToR has been issued the EIS.

This AQA report was prepared to support the EIS and EA application. The AQA report was conducted in accordance with the requirements of the ToR and the DETSI Impacts to Air Guideline (DETSI, 2025). Dispersion modelling was undertaken to assess the potential impacts of mining operations at the Project on nearby sensitive receptors both in isolation and cumulatively including ambient background. Model predicted ground-level concentrations of each emitted substance were assessed against air quality objectives detailed in Air EPP.

The results indicated that:

- Predicted ground-level concentrations of all emissions ***comply*** with the relevant air quality objectives at all sensitive receptors for the IDE operating in isolation.
- Predicted cumulative maximum monthly average dust deposition rates ***comply*** with the guideline of 120 mg/m^2/day at all sensitive receptors.
- Predicted cumulative annual average ground-level concentrations of TSP ***comply*** with the annual average objective of 90 µg/m^3 at all sensitive receptors.
- Predicted cumulative 24-hour maximum ground-level concentrations of PM_{10} ***can avoid any additional exceedances*** of the air quality objective of 50 µg/m^3 at any sensitive receptors when inclusive of additional mitigation measures.
- Predicted cumulative 24-hour maximum ground-level concentrations of $PM_{2.5}$ ***can avoid any additional exceedances*** of the air quality objective of 20 µg/m^3 at any sensitive receptors when inclusive of additional mitigation measures.
- Predicted cumulative annual average ground-level concentrations of PM_{10} can ***comply*** with the annual average objective of 25 µg/m^3 at all sensitive receptors when inclusive of additional mitigation measures.
- Predicted cumulative annual average ground-level concentrations of $PM_{2.5}$ can ***comply*** with the annual average objective of 7 µg/m^3 at all sensitive receptors when inclusive of additional mitigation measures.

The dispersion modelling results indicate that the Project can meet the Air EPP objectives at all nearby sensitive receptors in isolation and cumulatively when inclusive of additional mitigation measures. ID Extension will develop a DMP for the Project, building on the existing DMP for IPC, to enable the effective implementation of additional mitigation measures.

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11. CONTOUR PLATES

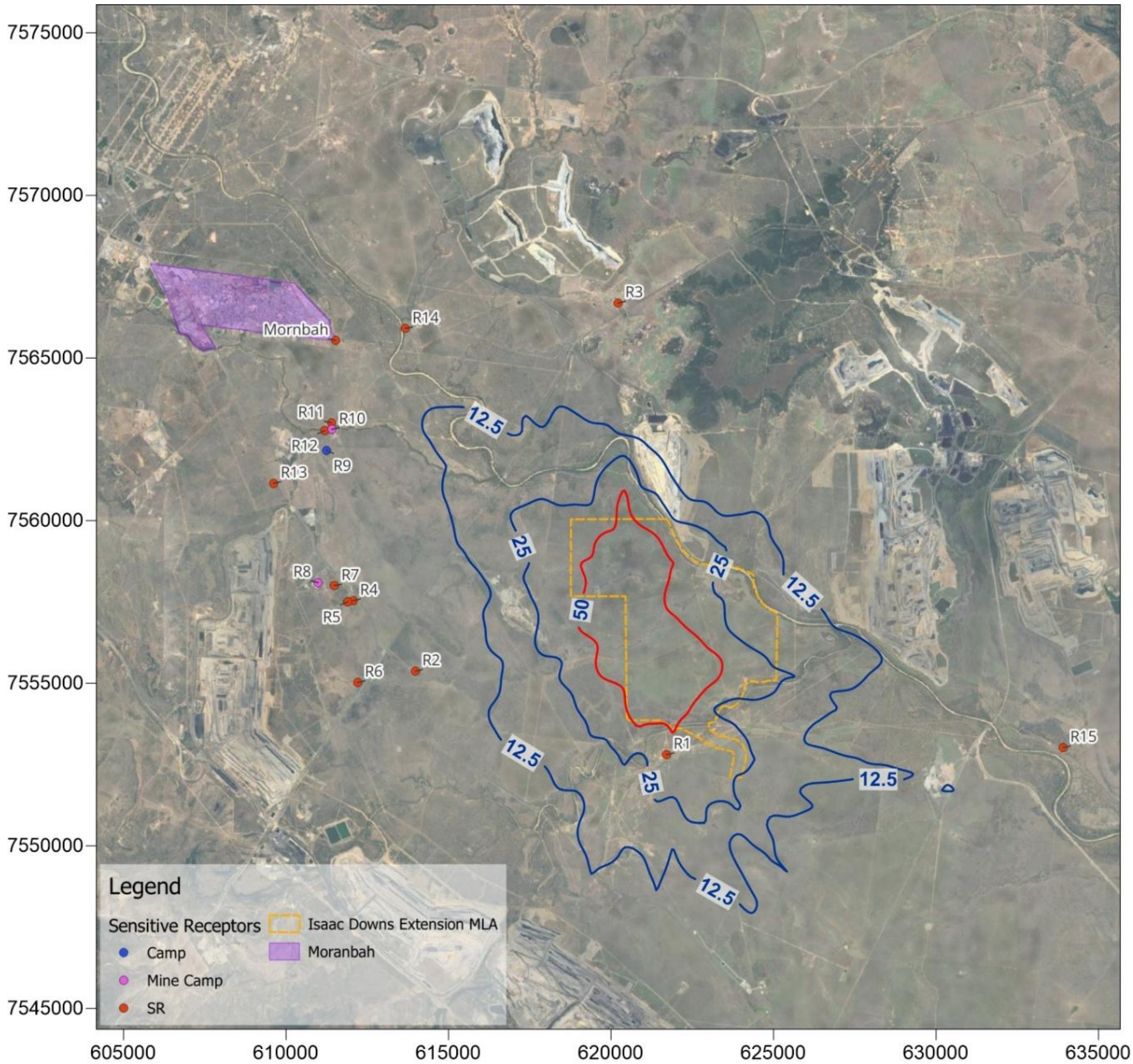

Plate 1	**Year 2029: Predicted 24-hour maximum ground-level concentrations of PM_{10} due to emissions from IDE in isolation**

Location:	**Averaging period:**	**Data source:**	**Units:**
Bowen Basin, QLD	24-hour	CALPUFF	µg/m^3
Type:	**Objective:**	**Prepared by:**	**Date:**
Contour plot	50 µg/m^3	Daniel Gallagher	November 2025

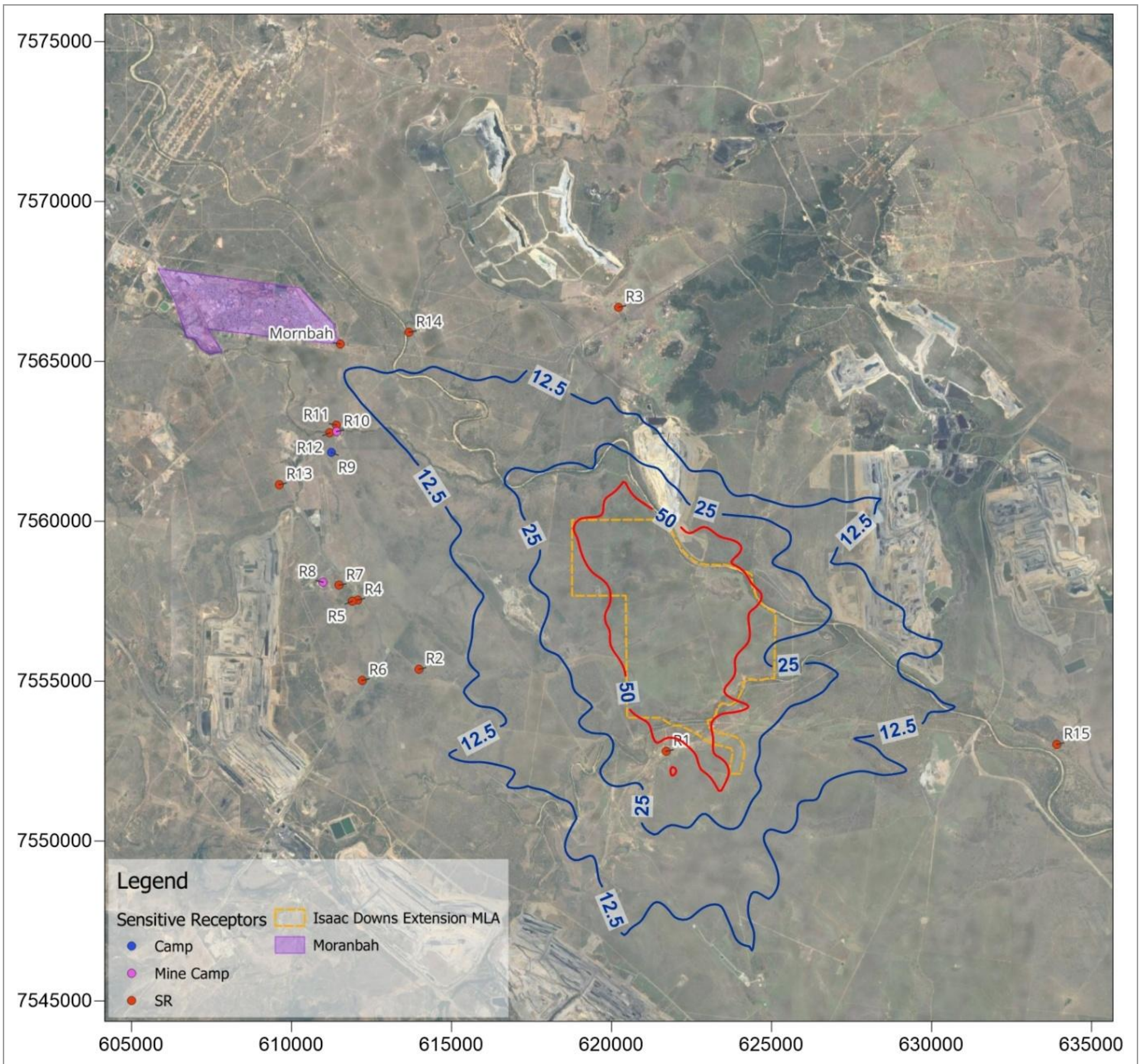

Plate 2	**Year 2034: Predicted 24-hour maximum ground-level concentrations of PM_{10} due to emissions from IDE in isolation**

Location:	**Averaging period:**	**Data source:**	**Units:**
Bowen Basin, QLD	24-hour	CALPUFF	µg/m^3
Type:	**Objective:**	**Prepared by:**	**Date:**
Contour plot	50 µg/m^3	Daniel Gallagher	November 2025

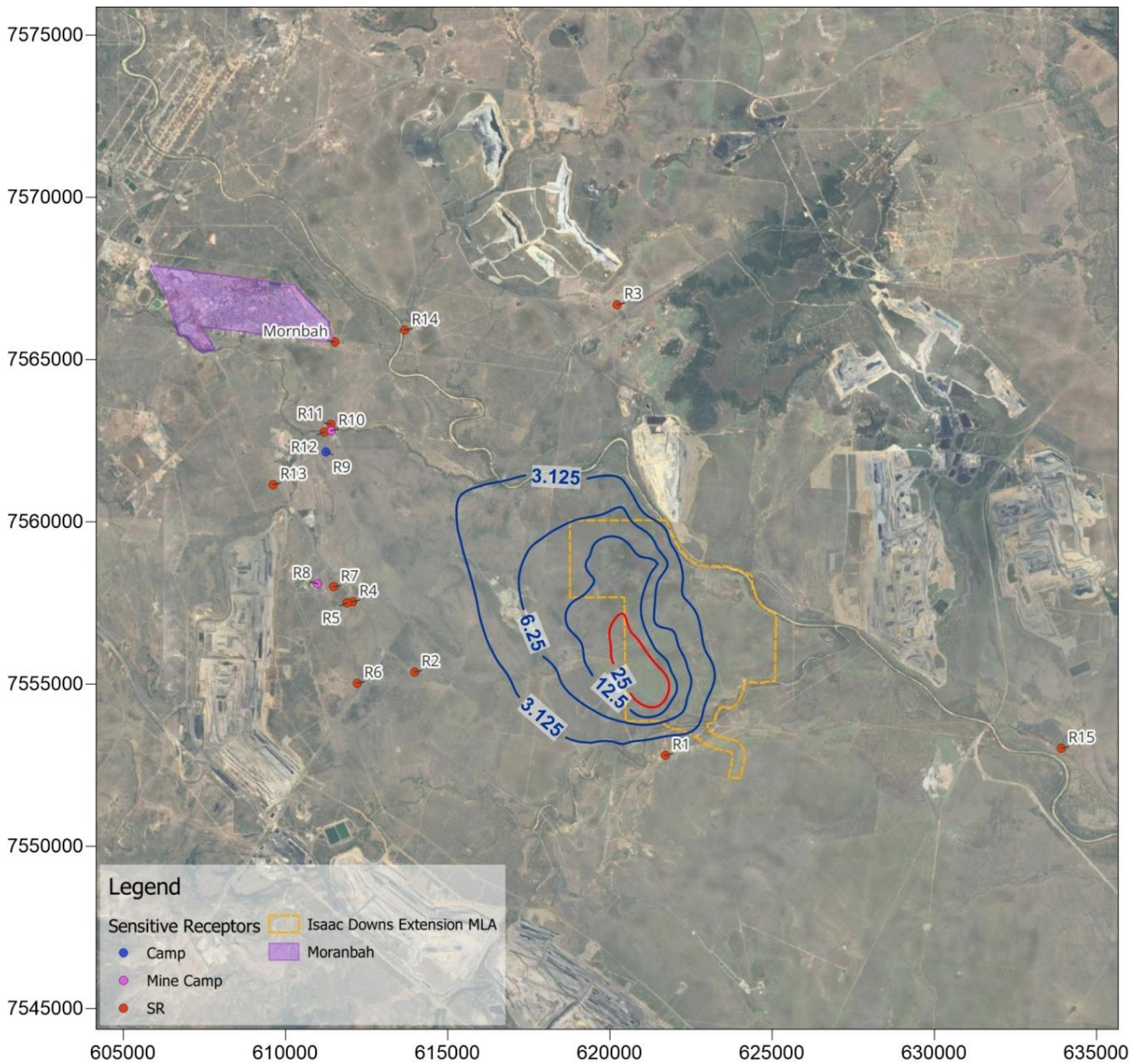

Plate 3	**Year 2029: Predicted annual average ground-level concentrations of PM_{10} due to emissions from IDE in isolation**

Location: Bowen Basin, QLD	**Averaging period:** 8760-hour	**Data source:** CALPUFF	**Units:** µg/m^3
Type: Contour plot	**Objective:** 25 µg/m^3	**Prepared by:** Daniel Gallagher	**Date:** November 2025

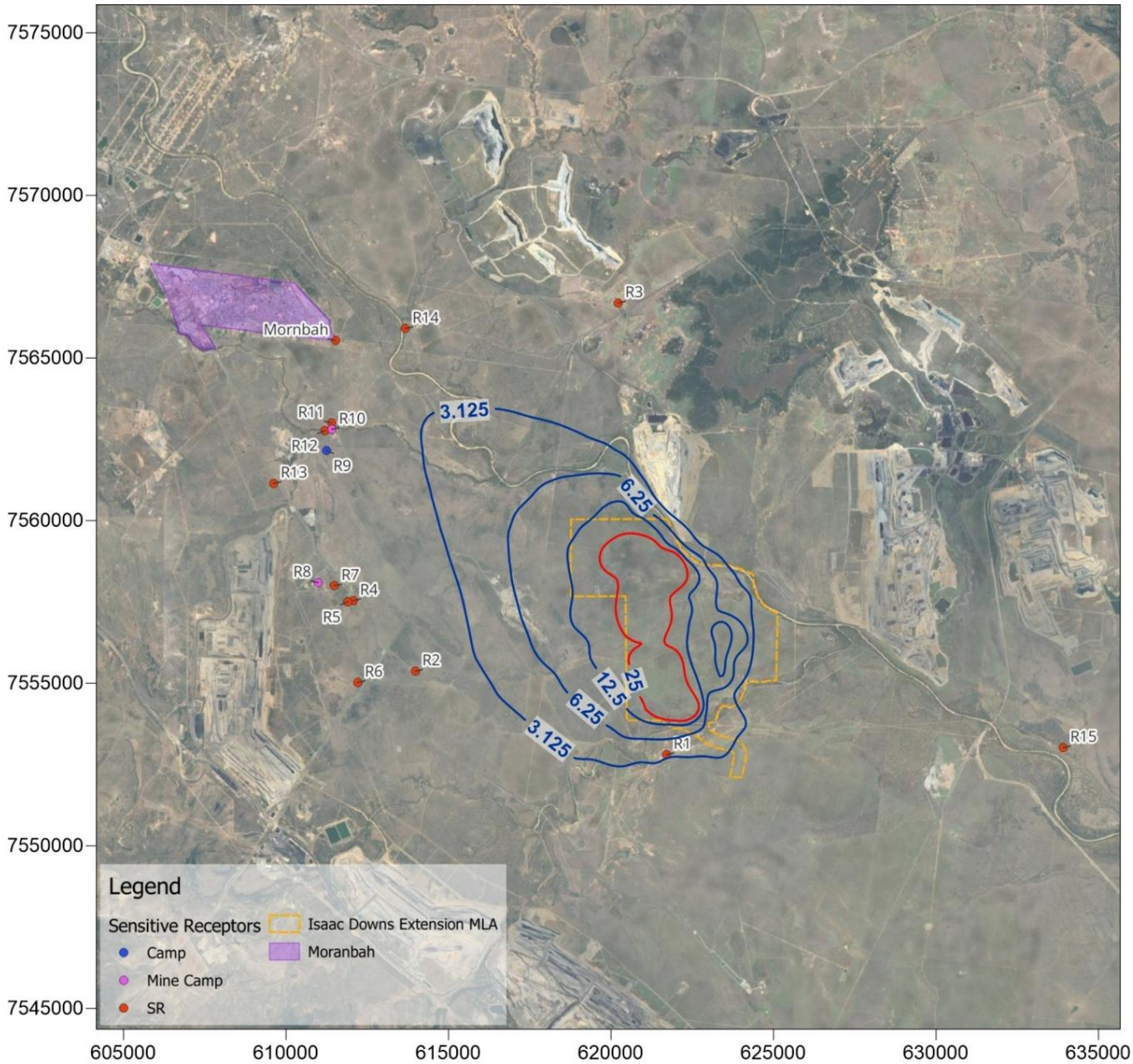

Plate 4	**Year 2034: Predicted annual average ground-level concentrations of PM_{10} due to emissions from IDE in isolation**		
Location: Bowen Basin, QLD	**Averaging period:** 8760-hour	**Data source:** CALPUFF	**Units:** µg/m³
Type: Contour plot	**Objective:** 25 µg/m³	**Prepared by:** Daniel Gallagher	**Date:** November 2025

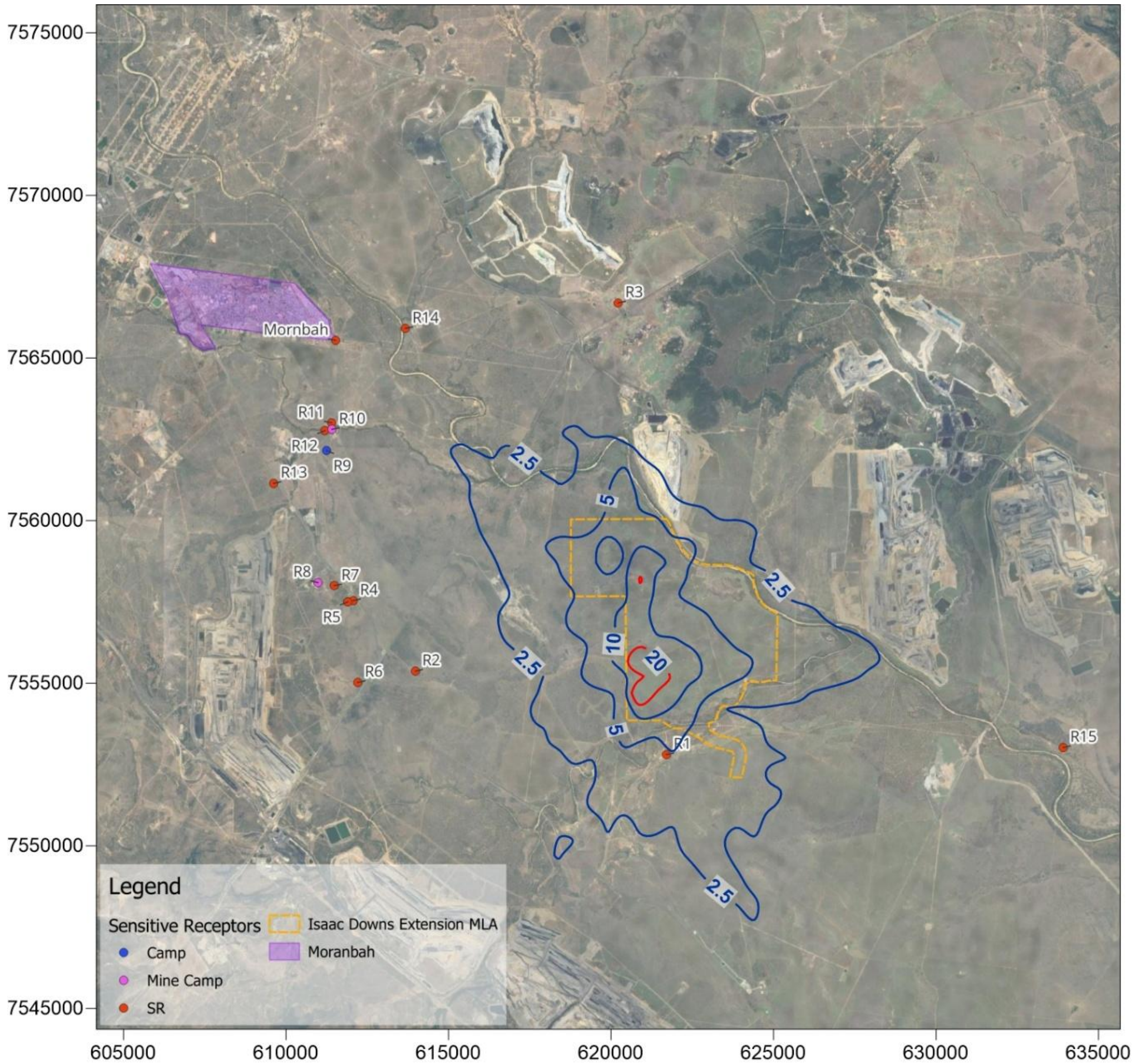

Plate 5	**Year 2029: Predicted 24-hour maximum ground-level concentrations of $PM_{2.5}$ due to emissions from IDE in isolation**

Location: Bowen Basin, QLD	**Averaging period:** 24-hour	**Data source:** CALPUFF	**Units:** µg/m^3
Type: Contour plot	**Objective:** 20 µg/m^3	**Prepared by:** Daniel Gallagher	**Date:** November 2025

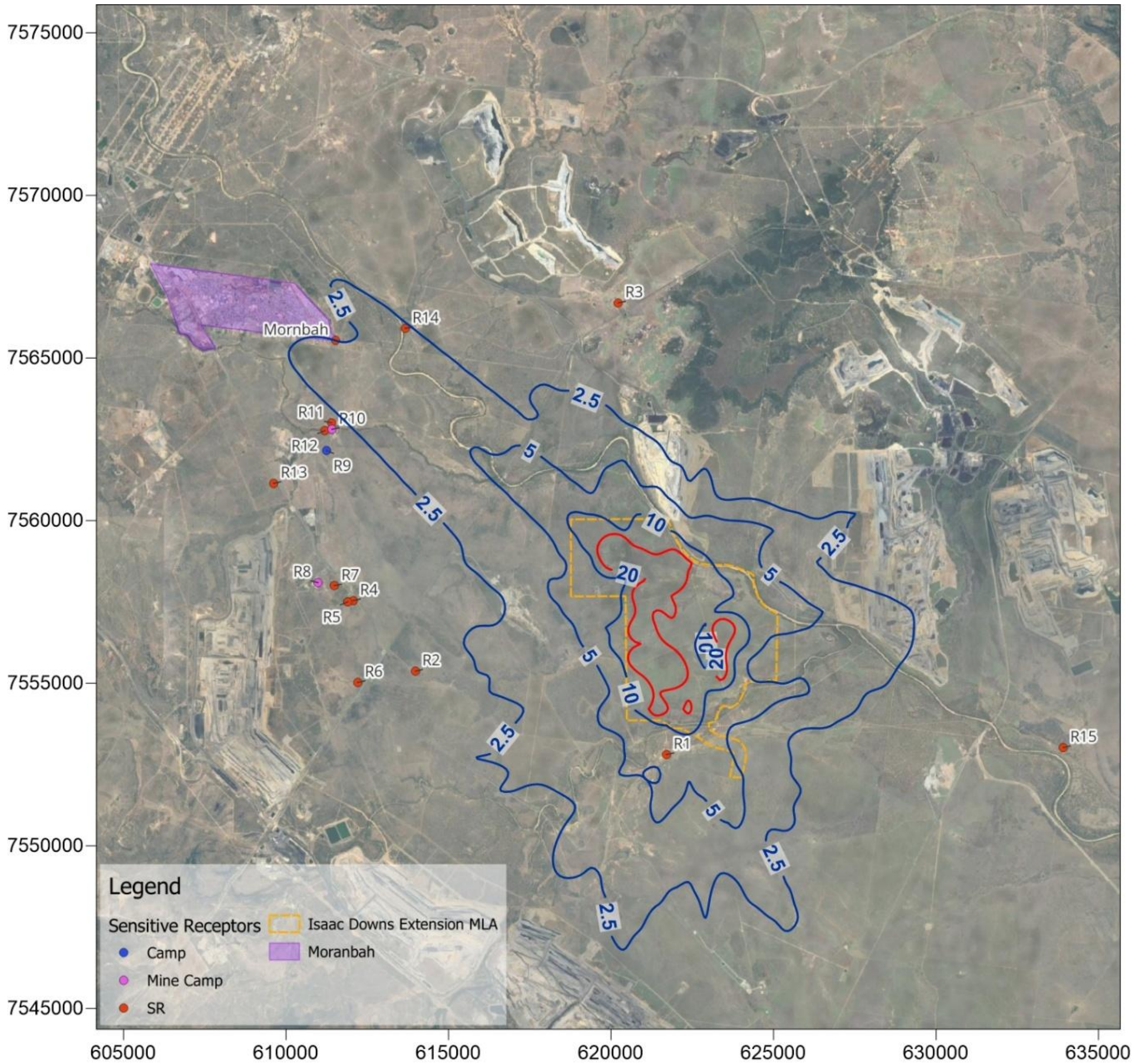

Plate 6	**Year 2034: Predicted 24-hour maximum ground-level concentrations of $PM_{2.5}$ due to emissions from IDE in isolation**

Location: Bowen Basin, QLD	**Averaging period:** 24-hour	**Data source:** CALPUFF	**Units:** µg/m^3
Type: Contour plot	**Objective:** 20 µg/m^3	**Prepared by:** Daniel Gallagher	**Date:** November 2025

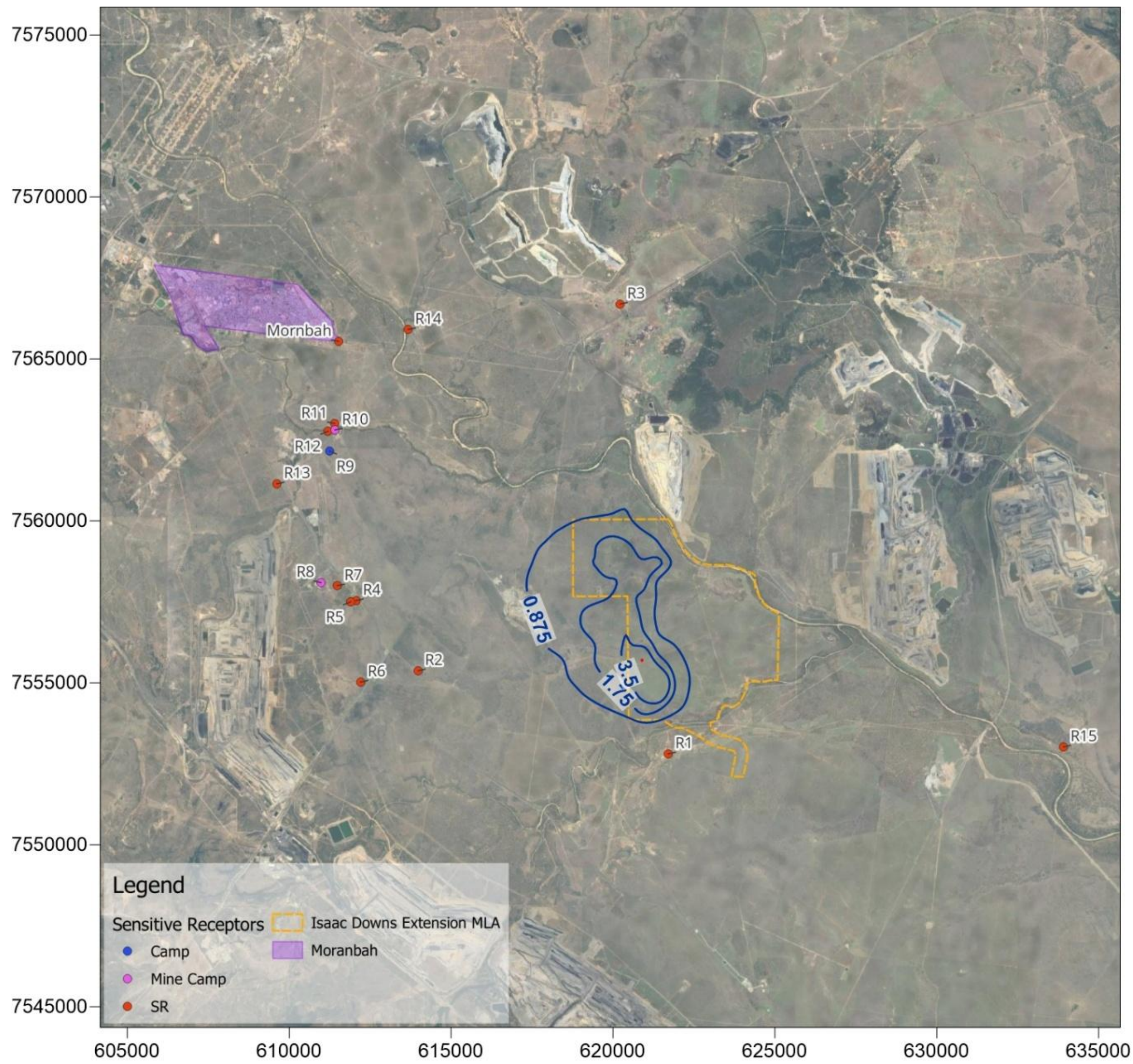

Plate 7 **Year 2029: Predicted annual average ground-level concentrations of $PM_{2.5}$ due to emissions from IDE in isolation**

Location:	Averaging period:	Data source:	Units:
Bowen Basin, QLD	8760-hour	CALPUFF	µg/m^3
Type:	**Objective:**	**Prepared by:**	**Date:**
Contour plot	7 µg/m^3	Daniel Gallagher	November 2025

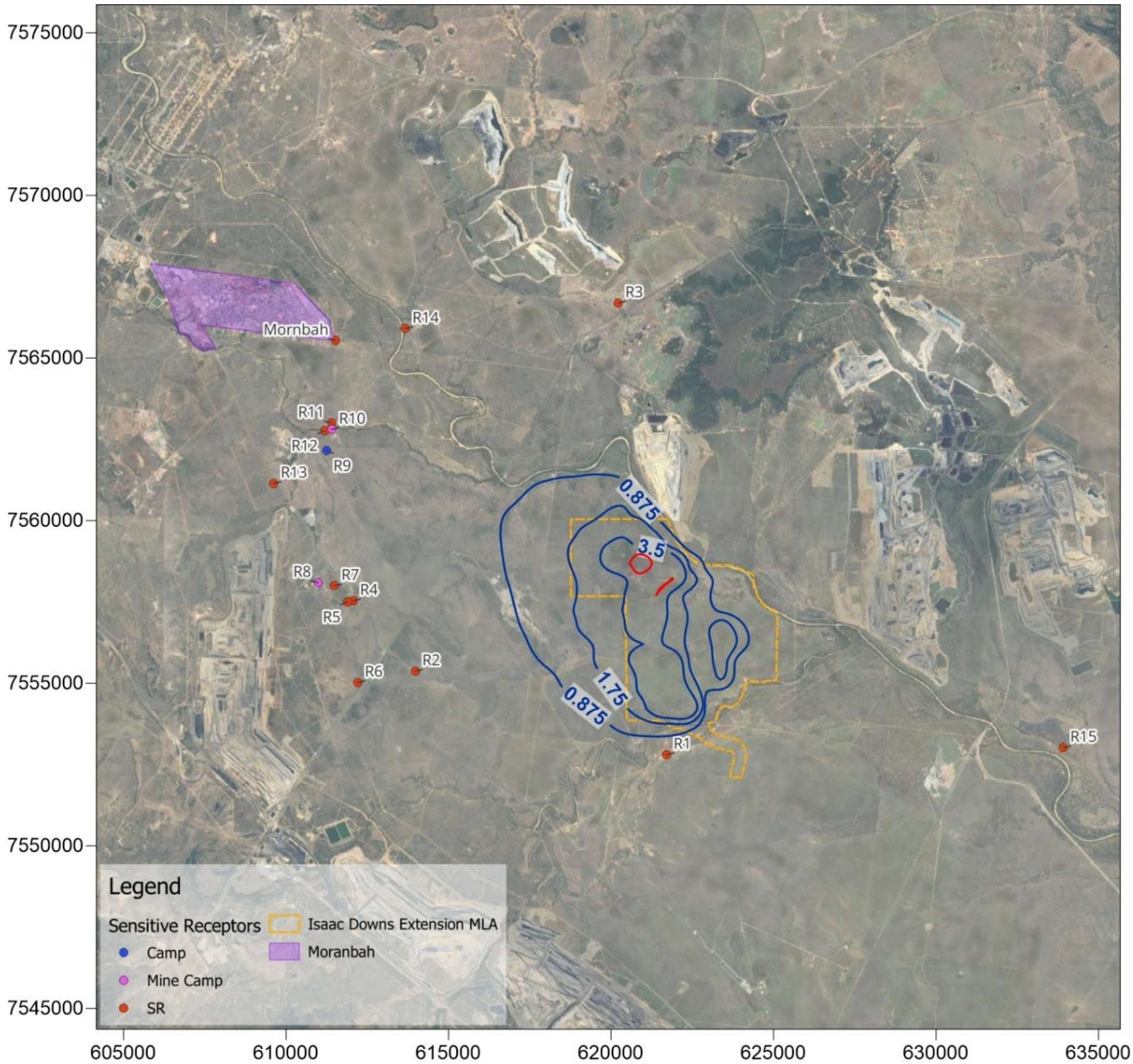

Plate 8	**Year 2034: Predicted annual average ground-level concentrations of $PM_{2.5}$ due to emissions from IDE in isolation**

Location:	**Averaging period:**	**Data source:**	**Units:**
Bowen Basin, QLD	8760-hour	CALPUFF	µg/m^3
Type:	**Objective:**	**Prepared by:**	**Date:**
Contour plot	7 µg/m^3	Daniel Gallagher	November 2025

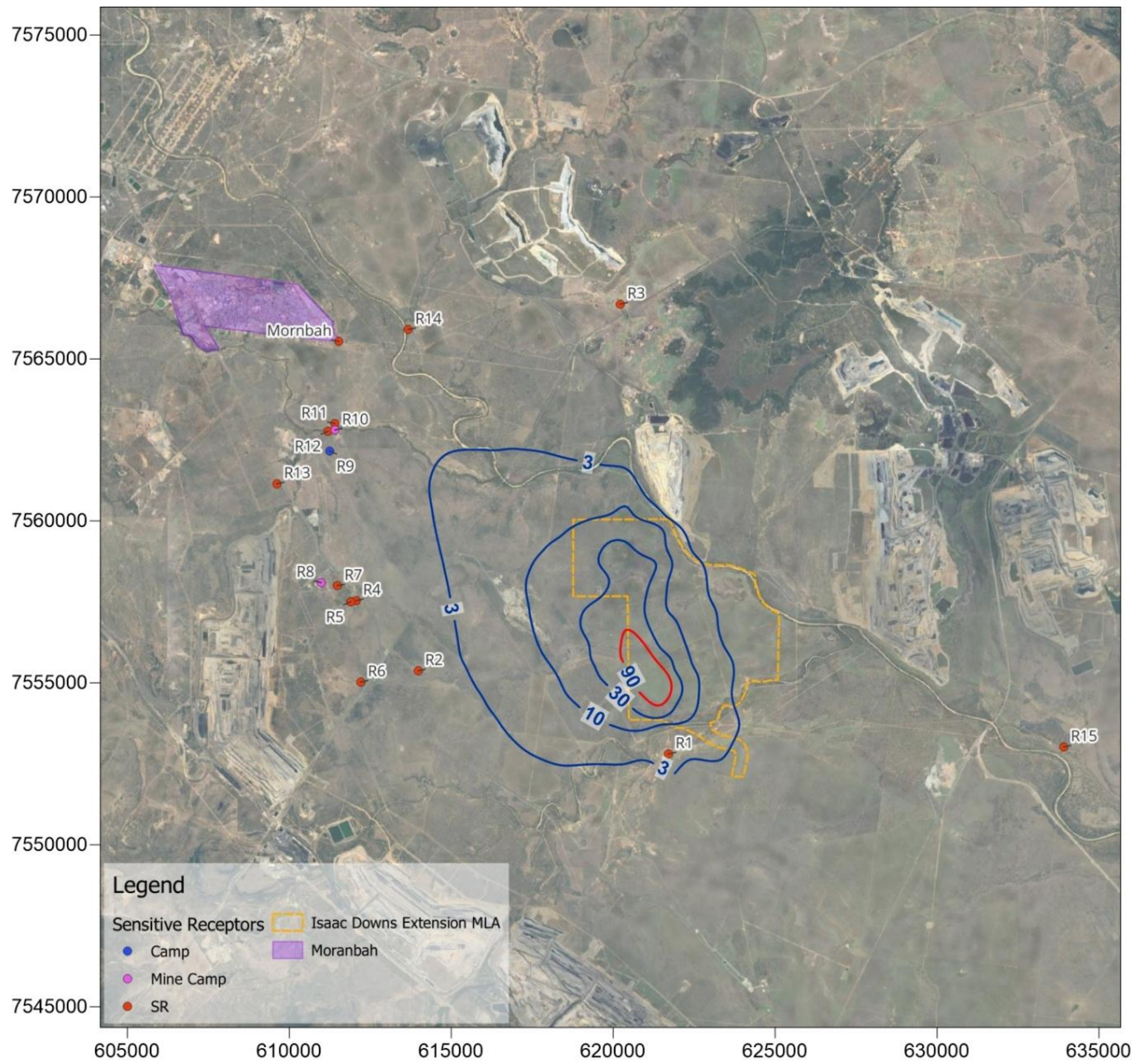

Plate 9 Year 2029: Predicted annual average ground-level concentrations of TSP due to emissions from IDE in isolation

Location:	Averaging period:	Data source:	Units:
Bowen Basin, QLD	8760-hour	CALPUFF	µg/m³
Type:	**Objective:**	**Prepared by:**	**Date:**
Contour plot	90 µg/m³	Daniel Gallagher	November 2025

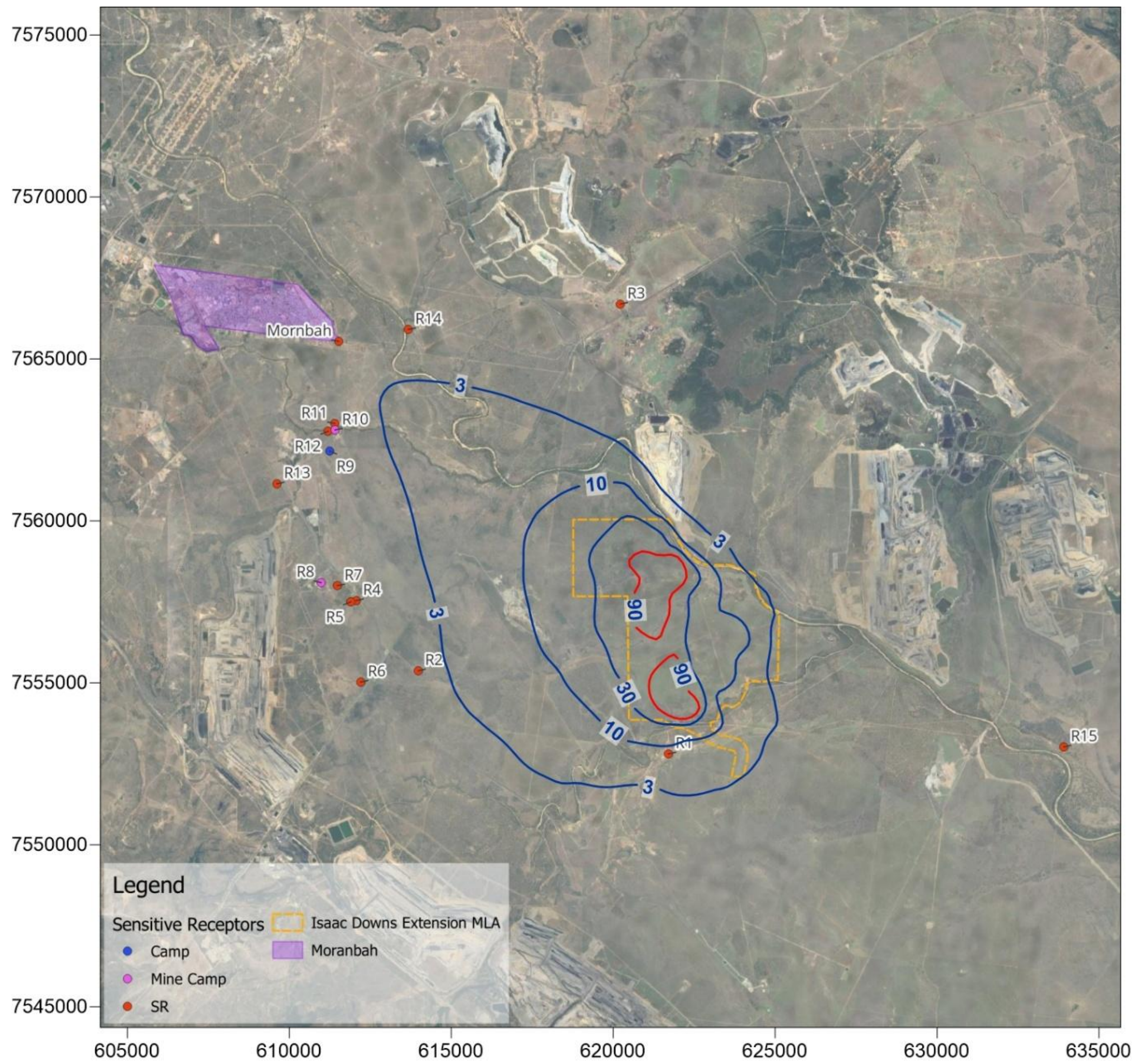

Plate 10	**Year 2034: Predicted annual average ground-level concentrations of TSP due to emissions from IDE in isolation**

Location:	**Averaging period:**	**Data source:**	**Units:**
Bowen Basin, QLD	8760-hour	CALPUFF	µg/m^3
Type:	**Objective:**	**Prepared by:**	**Date:**
Contour plot	90 µg/m^3	Daniel Gallagher	November 2025

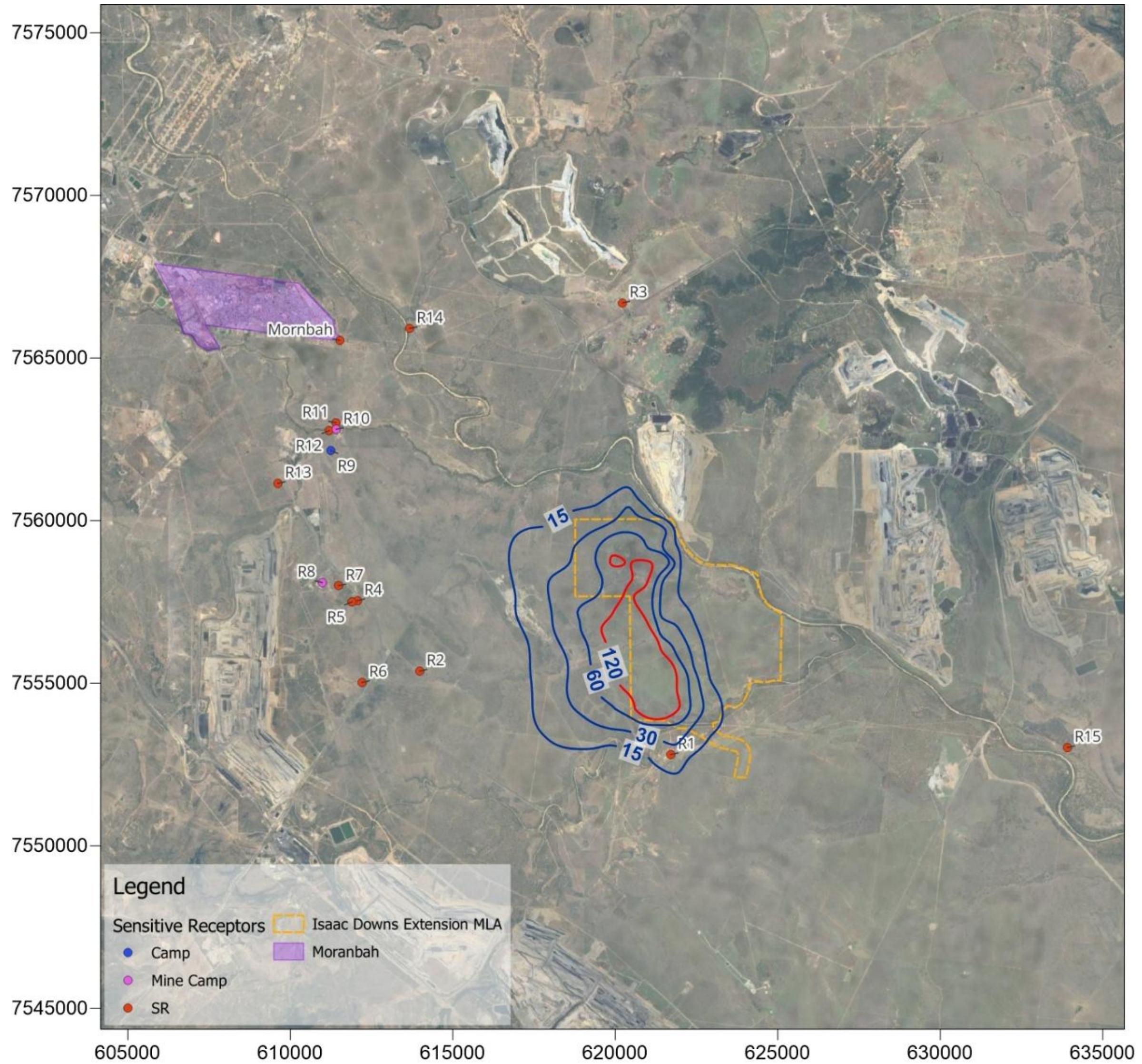

Plate 11	**Year 2029: Predicted maximum monthly average ground-level dust deposition rates due to emissions from IDE in isolation**		
Location: Bowen Basin, QLD	**Averaging period:** Monthly	**Data source:** CALPUFF	**Units:** mg/m²/day
Type: Contour plot	**Objective:** 120 mg/m²/day	**Prepared by:** Daniel Gallagher	**Date:** November 2025

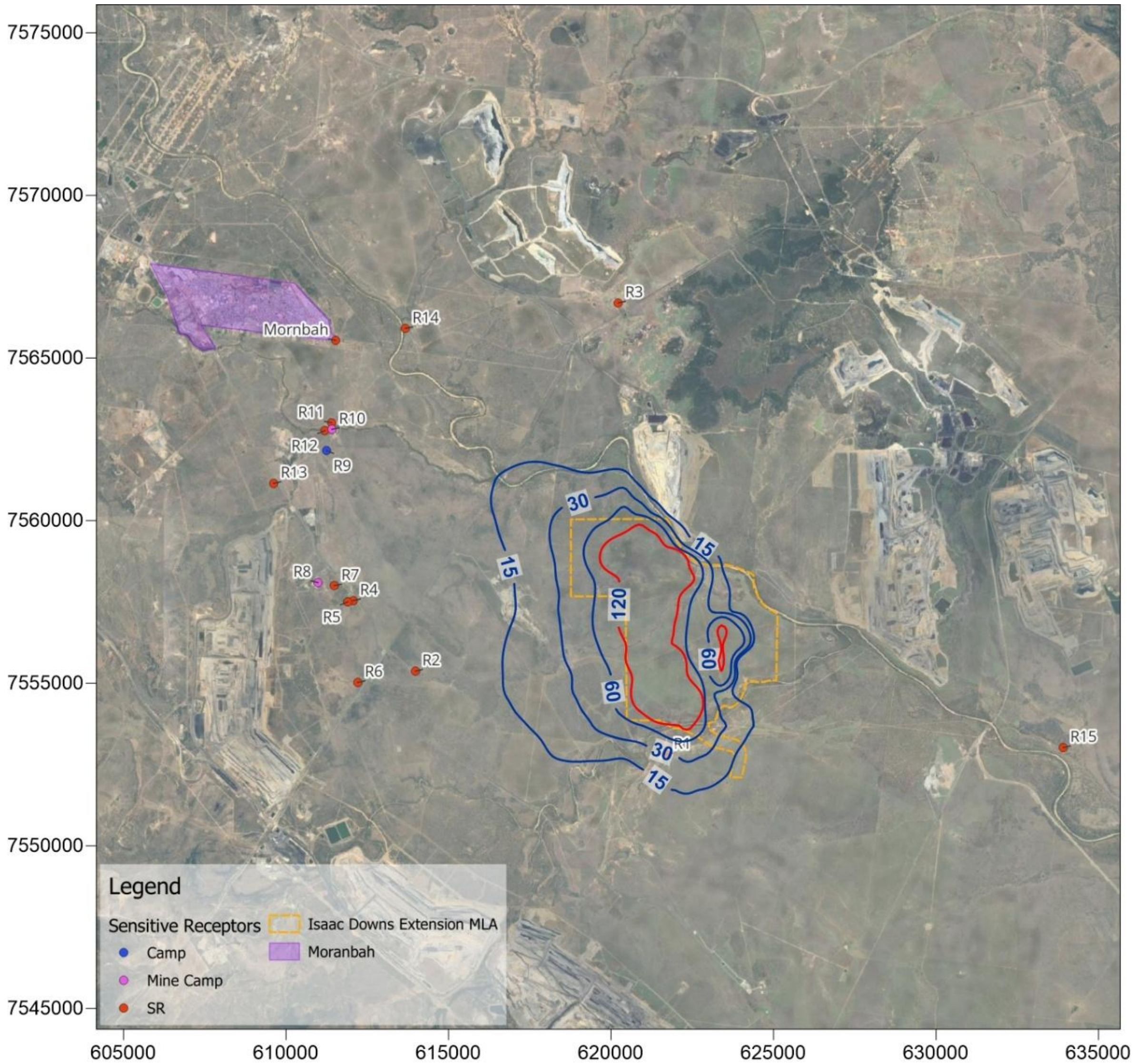

Plate 12	**Year 2034: Predicted maximum monthly average ground-level dust deposition rates due to emissions from IDE in isolation**		
Location: Bowen Basin, QLD	**Averaging period:** Monthly	**Data source:** CALPUFF	**Units:** mg/m^2/day
Type: Contour plot	**Objective:** 120 mg/m^2/day	**Prepared by:** Daniel Gallagher	**Date:** November 2025

APPENDIX A METEOROLOGICAL AND DISPERSION MODELLING METHODOLOGY

A1 Meteorology

The meteorological modelling methodology for the application included the following steps:

- Selection of a representative year
- TAPM modelling and validation
- CALMET modelling

The following sections describe each step of the meteorological modelling conducted for the application. A summary of the meteorological data generated is provided in Section A1.5.

A1.1 Selection of representative year

A representative year is required to be selected at the beginning of the meteorological modelling process. Using a representative year in the air quality assessment ensures that the typical conditions experienced at the application site are reflected in the model.

Selection of a representative year has been done through statistical analysis of historical meteorological observations at the BoM automatic weather station located at Moranbah Airport. Meteorological observations from the past five years (2020 to 2024) at Moranbah Airport were analysed to assess the inter-annual variability.

Figure A1 presents annual wind roses for the five years and shows that inter-annual conditions are typically very similar. Figure A2 presents frequency distribution plots for humidity, wind direction, wind speed and temperature, with the year 2023 highlighted, and demonstrates that there is relatively little variation in the distribution of these variables year-on-year. Figure A3 presents Z-Scores for each variable for each year, these being a measure of the variation of values in each individual year against the mean of values across all years.

Based on the BoM Moranbah Airport data 2021 and 2023 were considered suitably representative years for modelling.

Meteorological monitoring data conducted by Stanmore at the nearby Poitrel mine, IDM and IPM were also evaluated. Poitrel data covered the period 2022 – 2024. IDM data covered the period 7 May 2021 – 29 July 2025 and IPM data covered the period 15 August 2014 – 28 July 2025. The Poitrel monitoring site had good data capture (~100%) for 2023 and had a 10m wind mast. IDM monitoring station had poor data capture for 2021 and 2022 (<75%) and good capture (100%) for 2023 – 2025 however, the wind mast is only 3m and so the monitoring site is not compliant with Australian Standards and was considered not suitable for use in determining representative meteorological years. Similarly, at the IPM monitor, data capture was generally good but the 10m mast collapsed in 2022 and has since been replaced with a 5m mast. The impact on wind speeds was significant with an average speed of 3.2 m/s with the 10m mast compared to an average of 1.58 m/s with the 5m mast. This site, therefore, was not considered further for representative year purposes.

The calendar year 2023 was ultimately adopted for modelling as it is judged to be the year with the least variation from the mean when averaged across all of the parameters considered in the BoM data, and this corresponded with suitable quality Stanmore monitoring data at the Poitrel station with good data capture for 2023.

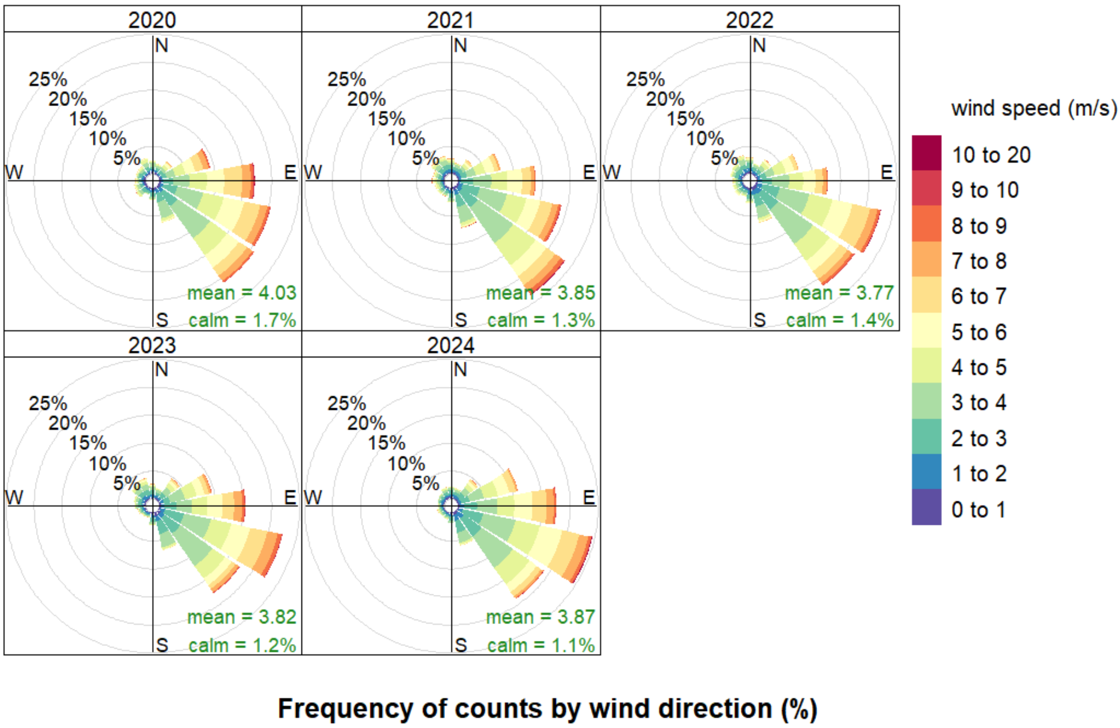

Figure A1 Annual wind roses for Moranbah Airport between 2020 and 2024

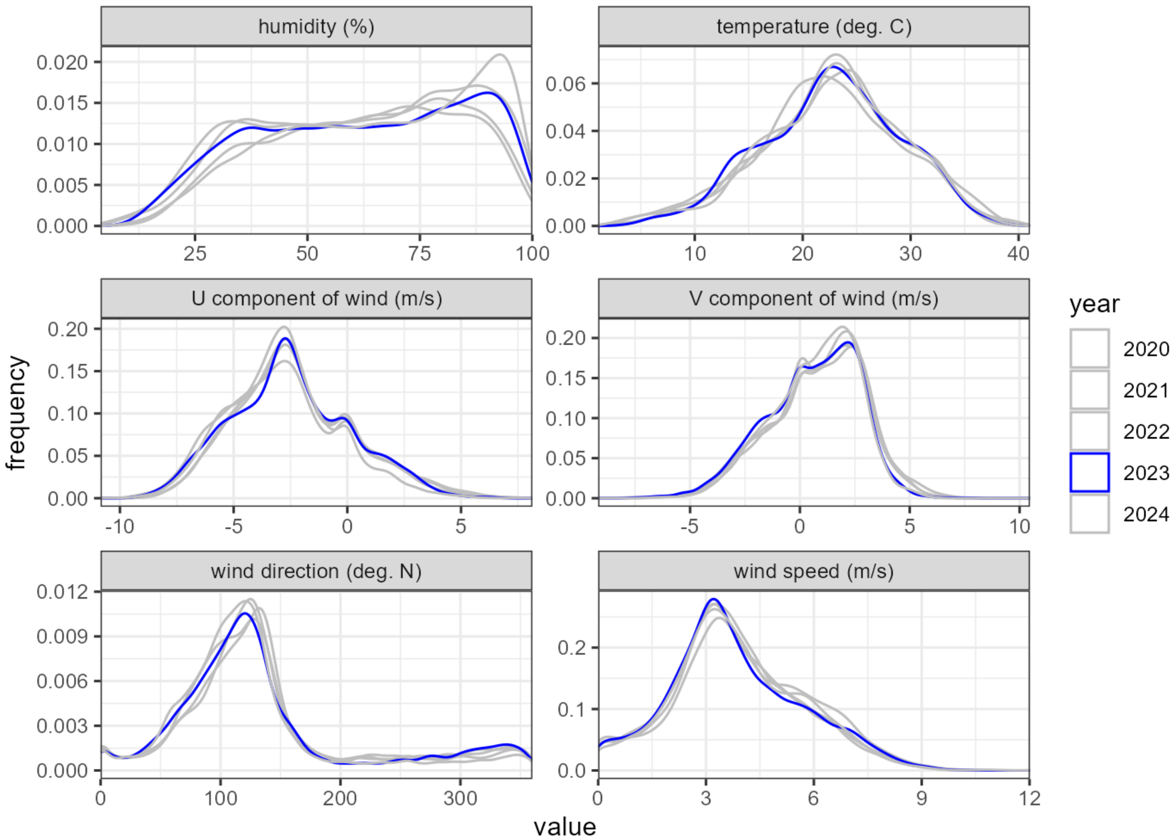

Figure A2 Annual frequency distributions plots for Moranbah Airport between 2020 and 2024 (2023 highlighted)

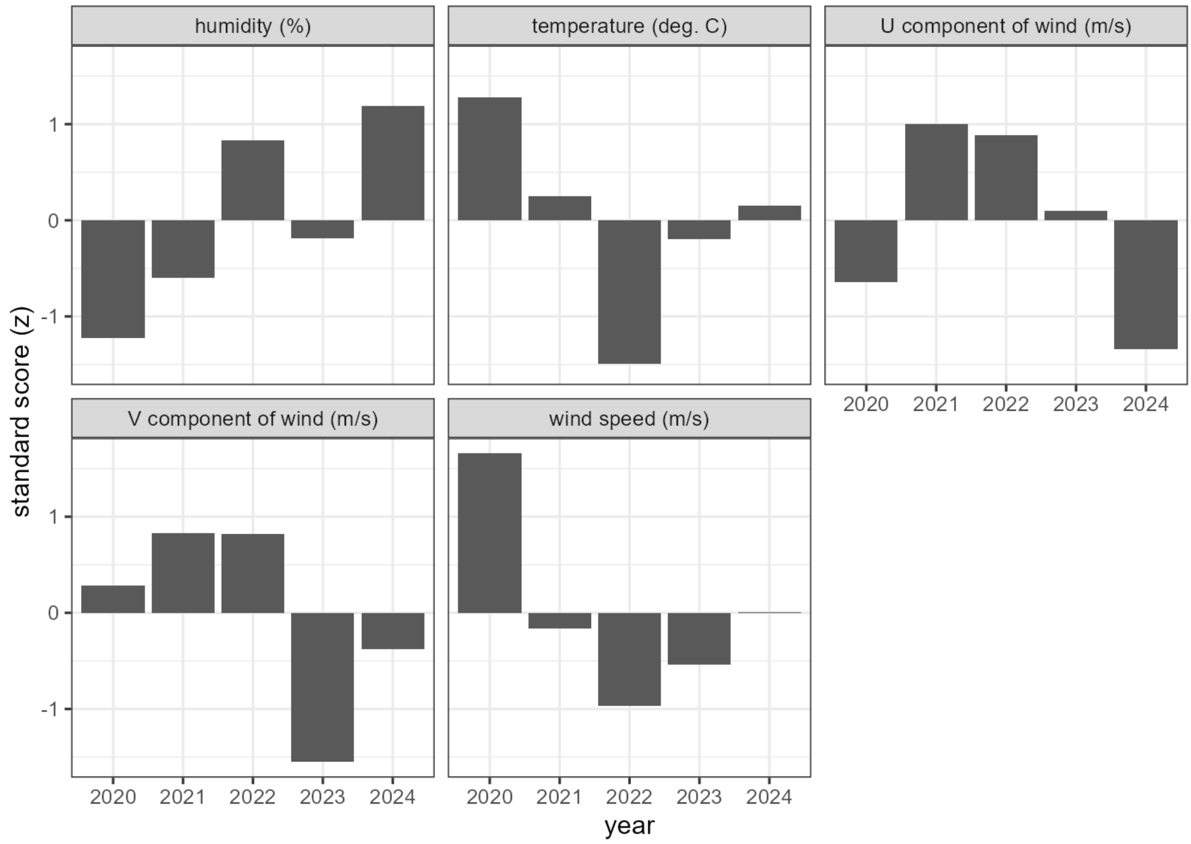

Figure A3 Z-Scores for Moranbah Airport between 2020 and 2024

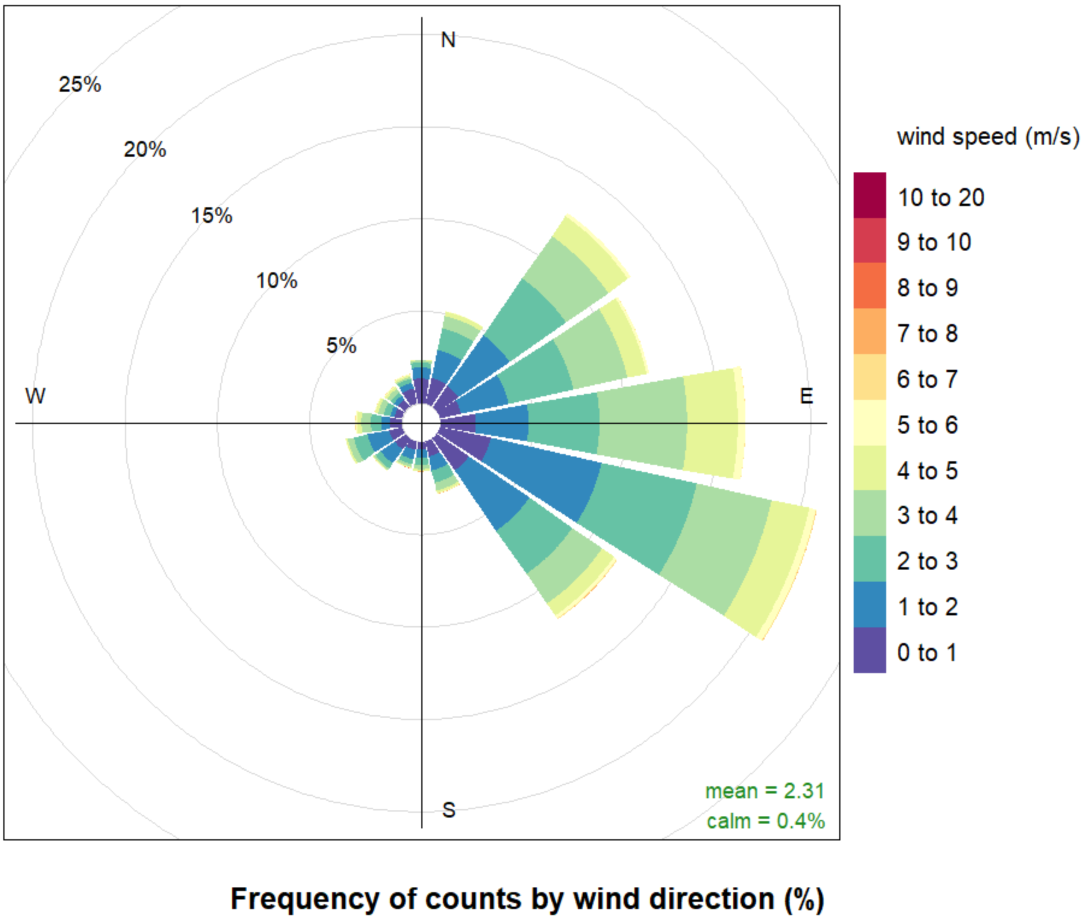

Figure A4 Annual wind rose for the Poitrel monitoring station (2023)

A1.2 TAPM meteorological modelling configuration

TAPM (The Air Pollution Model) was developed by the CSIRO and has been validated by the CSIRO, Katestone and others for many locations in Australia, in south-east Asia and in North America (CSIRO, 2008). Katestone has extensive experience with TAPM for sites throughout Australia and in parts of America, Bangladesh, New Caledonia and Vietnam. The model performs well in simulating regional wind patterns and has proven to be a useful tool for simulating meteorology in locations where monitoring data providing the vertical distribution of meteorological parameters are unavailable.

TAPM is a prognostic meteorological model which predicts the flows important to regional and local scale meteorology, such as sea breezes and terrain-induced flows from the larger-scale meteorology provided by the synoptic analyses. TAPM solves the fundamental fluid dynamics equations to predict meteorology at a mesoscale (20 km to 200 km) and at a local scale (down to a few hundred metres). TAPM includes parameterisations for cloud/rain micro-physical processes, urban/vegetation canopy, soil type and radiative fluxes.

TAPM requires synoptic meteorological information for the region. This information is generated by a global model similar to the large-scale models used to forecast the weather. The data were supplied on a grid resolution of approximately 75km, and at elevations of 100m to 5km above the ground. TAPM uses this synoptic information, along with specific details of the location such as surrounding terrain, land-use, soil moisture content and soil type to simulate the meteorology of a region as well as at a specific location.

TAPM version 4.0.5 was configured with the following parameters:

- Modelling period from 1 January to 31 December 2023
- 50 x 50 grid point domain with nesting resolutions of 30 km, 20 km, 10 km, 3 km, and 1 km
- 30 vertical levels
- Grid centred on latitude -22° 2.0’, longitude 148° 14.5’
- Geoscience Australia 9 second DEM terrain data
- TAPM default land cover data edited to be consistent with aerial imagery
- Default options selected for advanced meteorological inputs
- Data assimilation as follows:
  - Data from the BoM monitoring station at Moranbah Airport assimilated over two vertical levels with a radius of influence of 12km and a quality factor of 0.9.
  - Data from the Poitrel monitoring station assimilated over two vertical levels with a radius of influence of 5km and a quality factor of 0.9.

A1.3 Comparison of TAPM output with observational data

A1.3.1 Overview

The model validation in this section compares observational data with data derived from running TAPM after assimilating data from the BoM monitoring station at Moranbah Airport and from the Poitrel monitoring station. The observational data from these monitoring sites was then used to validate the output of the TAPM iteration. The model generally performed well at simulating the meteorology across the region.

A1.3.2 Validation of TAPM modelling

The following section presents the results of the validation of the final TAPM run that was used for the dispersion modelling assessment. The first model validation compares the Poitrel observational meteorological data with data extracted from TAPM at the location of the Poitrel monitor. The same validation was repeated for the BoM Moranbah Airport site.

Figure A5 shows probability density functions that graphically compare statistical distributions of meteorological parameters between the TAPM output and Poitrel observational data. Figure A6 presents the same for the BoM Moranbah Airport observational data. Table A1 presents statistical comparisons of TAPM output (wind speed and temperature) to meteorological data recorded at the Poitrel monitoring station. Table A2 presents the same for the BoM Moranbah Airport observational data. The TAPM output was extracted from the closest inner grid point to the locations of the weather stations.

The following statistical measures of model accuracy are presented in the tables:

- The mean bias, which is the mean model prediction minus the mean observed value. Values of the mean bias close to zero show good prediction accuracy.
- The root mean square error (RMSE), which is the standard deviation of the differences between predicted values and observed values. The RMSE is non-negative and values of the RMSE close to zero show good prediction accuracy. The RMSE is given by

$$\mathrm{RMSE} = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(P_i - O_i)^2}$$

where N is the number of observations, P_i are the hourly model predictions and O_i are the hourly observations

- The index of agreement (IOA), which takes a value between 0 and 1, with 1 indicating perfect agreement between predictions and observations. The IOA is calculated following a method described in Willmott (1982), using the equation

$$\mathrm{IOA} = 1 - \frac{\sum_{i=1}^{N}(P_i - O_i)^2}{\sum_{i=1}^{N}(|P_i - O_{mean}| + |O_i - O_{mean}|)^2}$$

where N is the number of observations, P_i are the hourly model predictions, O_i are the hourly observations and O_{mean} is the observed observation mean.

The wind speeds and temperatures generated by TAPM are within the benchmark ranges for RMSE and index of agreement for the BoM and Poitrel monitoring stations. Despite the mean biases being slightly beyond the benchmark range, the model generally performed well. The probability density functions illustrate good agreement between predicted and observed meteorological data, which is to be expected given the assimilation of data from the Moranbah Airport and Poitrel monitoring locations. Observational data from both sites were assimilated into the modelling. Annual wind roses for 2023 at IDE site and at the BoM monitoring station are presented in Figure A7.

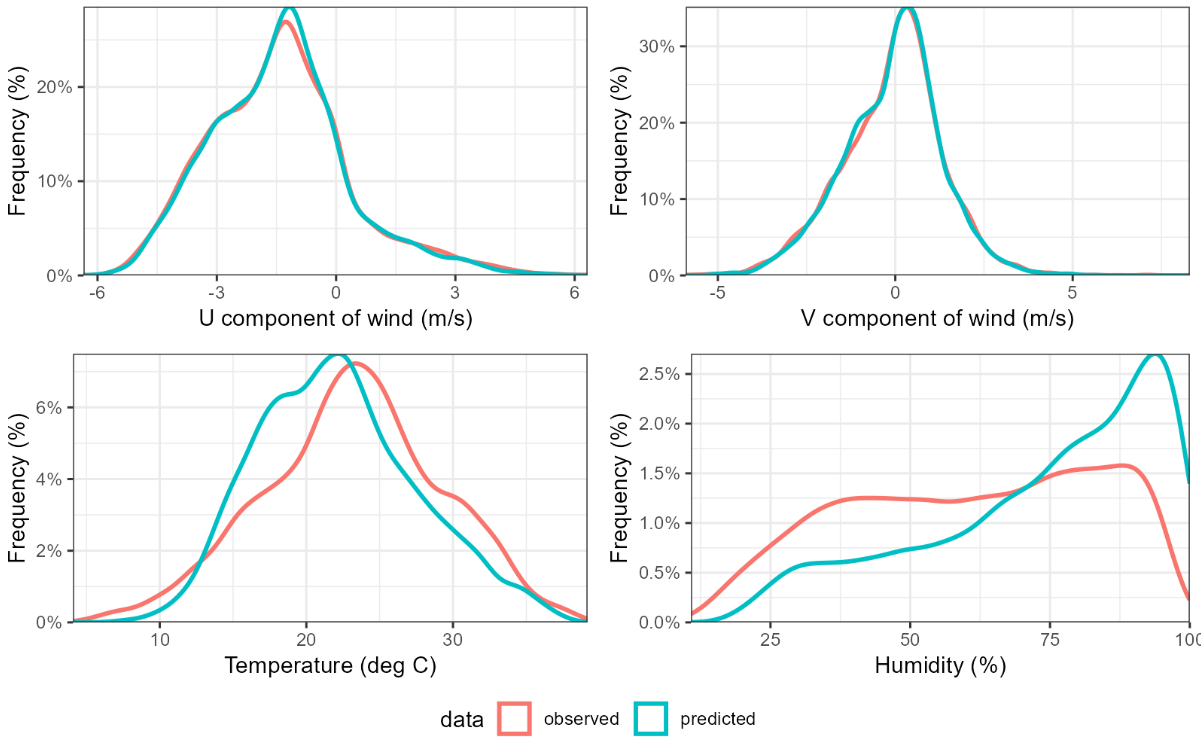

Figure A5 Probability density functions comparing 2023 observational data (red) with TAPM data (blue) at the location of the Poitrel monitoring station

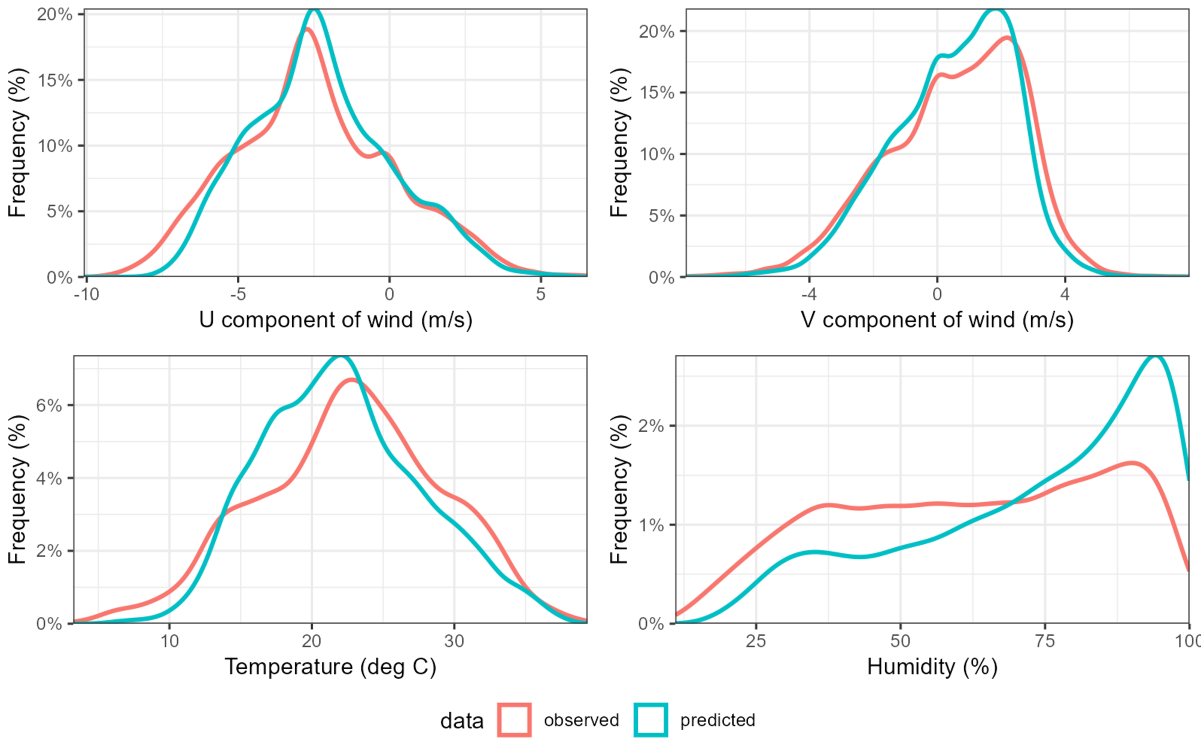

Figure A6 **Probability density functions comparing 2023 observational data (red) with TAPM data (blue) at the BoM Moranbah Airport monitoring station**

Table A1 **Comparison of the observed meteorological data with the TAPM output for 2023 at the location of the Poitrel monitoring station**

Statistic	"Good" value	Wind speed			Temperature		
		Benchmark	Observational data	TAPM	Benchmark	Observational data	TAPM
Mean	-	-	2.3	2.3	-	23.1	22.1
SD	-	-	1.3	1.3	-	6.1	5.5
Min	-	-	0.0	0.0	-	4.1	6.8
Max	-	-	8.7	6.5	-	39.2	37.9
Bias	0	<±0.5 m/s	-0.05		<±0.5 °C	-1.0	
RMSE	Close to 0	<2 m/s	0.4		-	2.9	
IoA	Close to 1	>0.6	1.0		≥0.8	0.9	

Table A2 Comparison of the observed meteorological data with the TAPM output for 2023 at the BoM Moranbah Airport monitoring station

Statistic	"Good" value	Wind speed			Temperature		
		Benchmark	Observational data	TAPM	Benchmark	Observational data	TAPM
Mean	-	-	3.8	3.4	-	22.7	22.1
SD	-	-	1.9	1.6	-	6.4	5.6
Min	-	-	0.0	0.0	-	3.3	5.6
Max	-	-	10.5	8.6	-	39.4	37.9
Bias	0	<±0.5 m/s	-0.4			-0.5	
RMSE	Close to 0	<2 m/s	0.6			3.1	
IoA	Close to 1	>0.6	1.0			0.9	

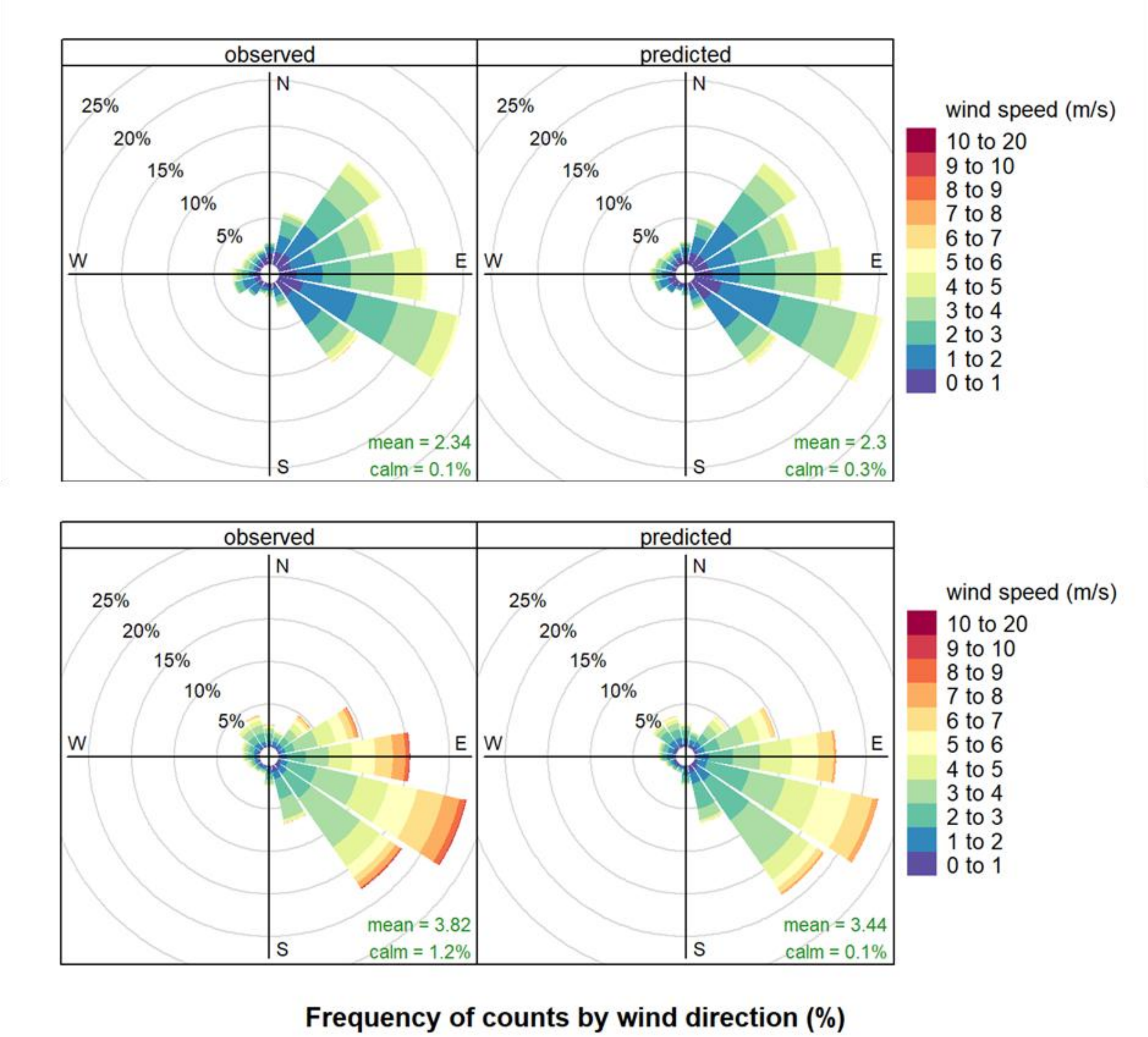

Figure A7 Wind roses comparing 2023 observational data with TAPM data at the Poitrel monitoring station (top image) and the BoM Moranbah Airport monitoring station (bottom image).

A1.4 CALMET meteorological modelling configuration

CALMET is an advanced non-steady-state diagnostic 3D meteorological model with micro-meteorological modules for overwater and overland boundary layers. The model is the meteorological pre-processor for the CALPUFF modelling system. CALMET is capable of reading hourly meteorological data as data assimilation from multiple sites within the modelling domain; it can also be initialised with the gridded three-dimensional prognostic output from other meteorological models such as TAPM. This can improve dispersion model output, particularly over complex terrain as the near surface meteorological conditions are calculated for each grid point.

CALMET version 6.5.0 was used to simulate meteorological conditions in the region. The CALMET simulation was initialised with the gridded TAPM 3D wind field data from the 1km grid. CALMET treats the prognostic model output as the initial guess field for the CALMET diagnostic model wind fields. The initial guess field is then adjusted for the kinematic effects of terrain, slope flows, blocking effects and 3D divergence minimisation.

CALMET was configured with the following parameters:

- Modelling period from 1 January to 31 December 2023
- 90 x 90 grid point domain with 500 m resolution, nested within the TAPM inner domain
- 12 vertical levels at heights of 20, 60, 100, 150, 200, 250, 350, 500, 800, 1600, 2600 and 4600 metres
- Prognostic wind fields generated by TAPM input as MM5/3D.DAT at surface and upper air for “initial guess” field (no-observations mode)
- Gridded cloud cover from prognostic relative humidity at all levels
- No extrapolation of surface wind observations.

A1.5 CALMET meteorological outputs

The following sections provide a description of the CALMET outputs as utilised in the CALPUFF dispersion modelling for critical meteorological parameters, namely wind speed, wind direction, atmospheric stability, mixing layer height, and temperature. These parameters have been extracted from the TAPM/CALMET dataset at the IDE site, specifically at the location of the Poitrel monitoring station.

A1.5.1 Wind speed and wind direction

The annual distribution of winds predicted by TAPM/CALMET at the IDE site for 2023 is presented in Figure A8. The seasonal and diurnal distribution of winds is presented in Figure A9 and Figure A10, respectively.

Winds across the study area are predominantly light to moderate (up to around 5 m/s) and from the northeast through to southeast. Winds from the northwest and southwest sectors are much less frequent.

The seasonal breakdown of winds shows that the predominant southeast winds present throughout the year although Spring sees a slight shift in direction to greater easterlies.

The diurnal breakdown of winds shows that the lightest winds are predicted between midnight and 6am, mostly from the southeast. Between 6am and midday, winds maintain a generally southeasterly direction and slightly increase in speed. The strongest winds, also from the east-southeast, occur between midday and 6pm. During the evening (6pm – midnight) winds begin to slow again and shift to a greater number of north-easterly winds.

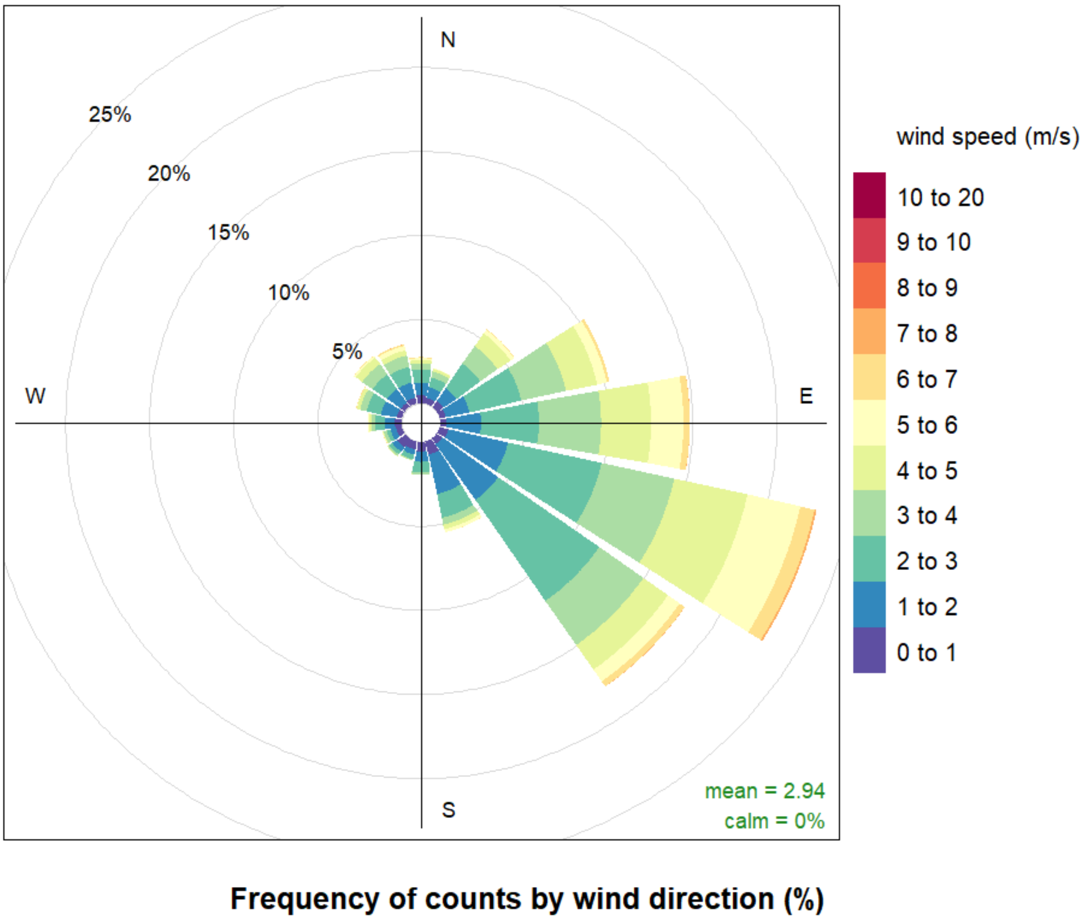

Figure A8 2023 Annual distribution of winds predicted by TAPM/CALMET at IDE

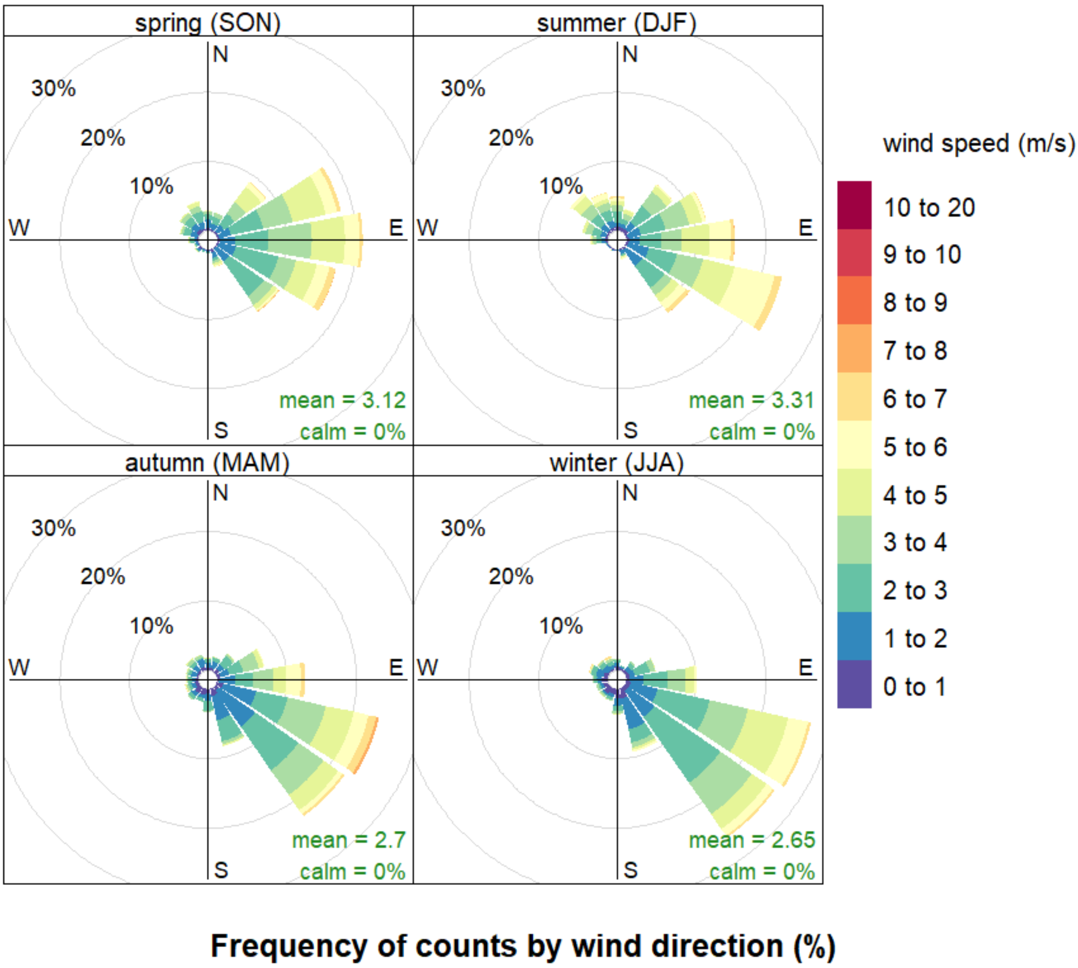

Figure A9 2023 Seasonal distribution of winds predicted by TAPM/CALMET at IDE

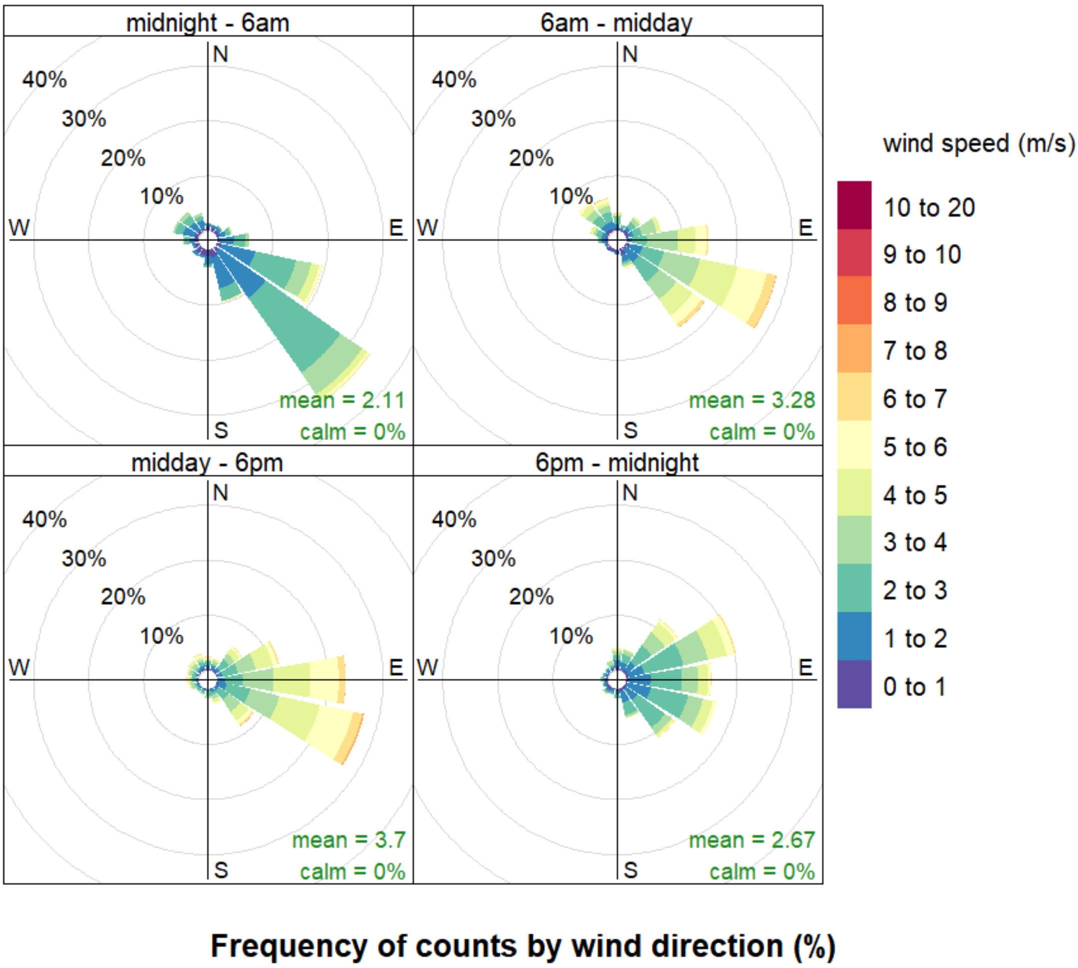

Figure A10 2023 Diurnal distribution of winds predicted by TAPM/CALMET at IDE

A1.5.2 Atmospheric stability

Stability classification is a measure of the stability of the atmosphere and can be determined from wind measurements and other atmospheric observations. The stability classes range from A Class, which represents very unstable atmospheric conditions that may typically occur on a sunny day, to F Class, which represents very stable atmospheric conditions that typically occur during light wind conditions at night. Unstable conditions (Classes A to C) are characterised by strong solar heating of the ground that induces turbulent mixing in the atmosphere close to the ground. This turbulent mixing is the main driver of dispersion during unstable conditions. Dispersion processes for Class D conditions are dominated by mechanical turbulence generated as the wind passes over irregularities in the local surface. During the night, the atmospheric conditions are generally stable (often Classes E and F).

Figure A11 shows the distribution of stability classes extracted from the TAPM/CALMET dataset at the IDE site, where Class A represents the most unstable conditions and Class F represents the most stable. Neutral (D class) conditions are the most common and are present throughout the day, comprising 42% of total time. Very stable (F class) conditions are the next most frequent, comprising 25% of total time, and only occur between 5 pm and 7 am.

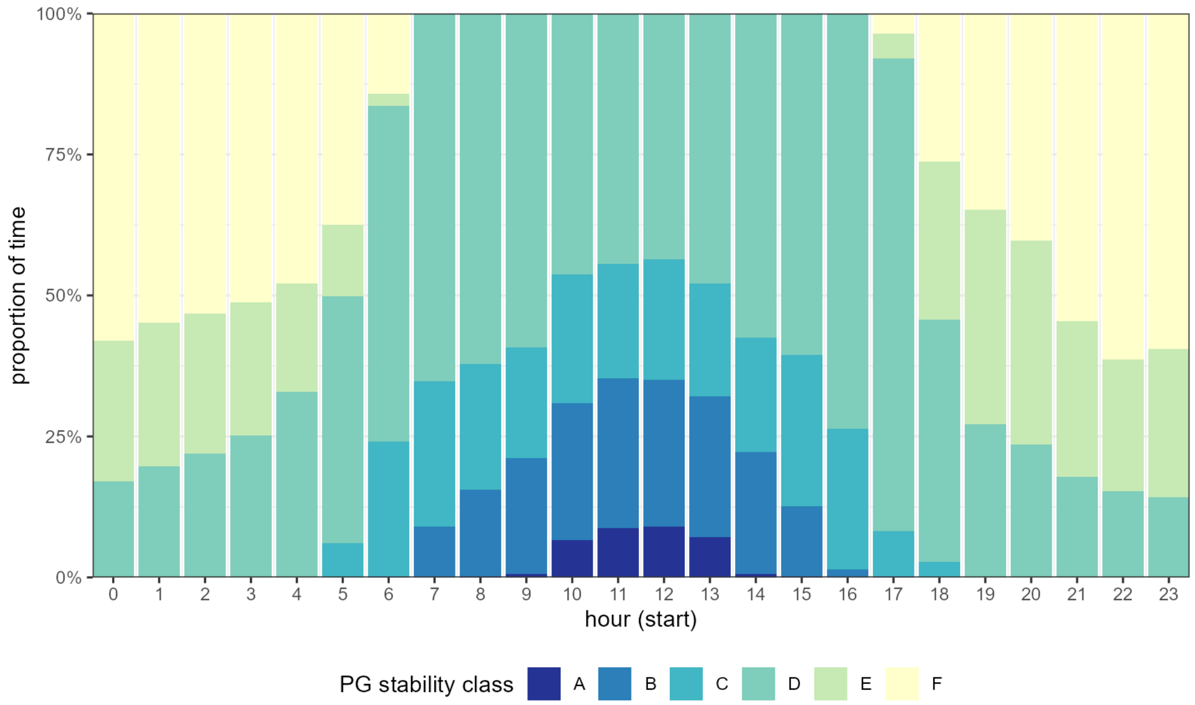

Figure A11 2023 Frequency distribution of atmospheric stability conditions predicted by TAPM/CALMET at IDE

A1.5.3 Mixing height

The mixing height defines the height of the mixed atmosphere above the ground (mixed layer), which varies diurnally. Air emissions released at or near the ground will become dispersed within the mixed layer. During stable atmospheric conditions, the mixing height is often quite low, and dispersion is limited to within this layer. During the day, solar radiation heats the ground and causes the air above it to warm, resulting in convection and an increase to the mixing height. The growth of the mixing height is dependent on how well the warmer air from the ground can mix with the cooler upper-level air and, therefore, depends on meteorological factors such as the intensity of solar radiation and wind speed. Strong winds cause the air to be well mixed, resulting in a high mixing height.

Mixing height information extracted from the TAPM/CALMET dataset at the IDE site are presented as a diurnal frequency (box and whisker) plot in Figure A12. The plot shows that, on average, the mixing height begins to increase around 6am and peaks around 4pm before descending rapidly into the evening.

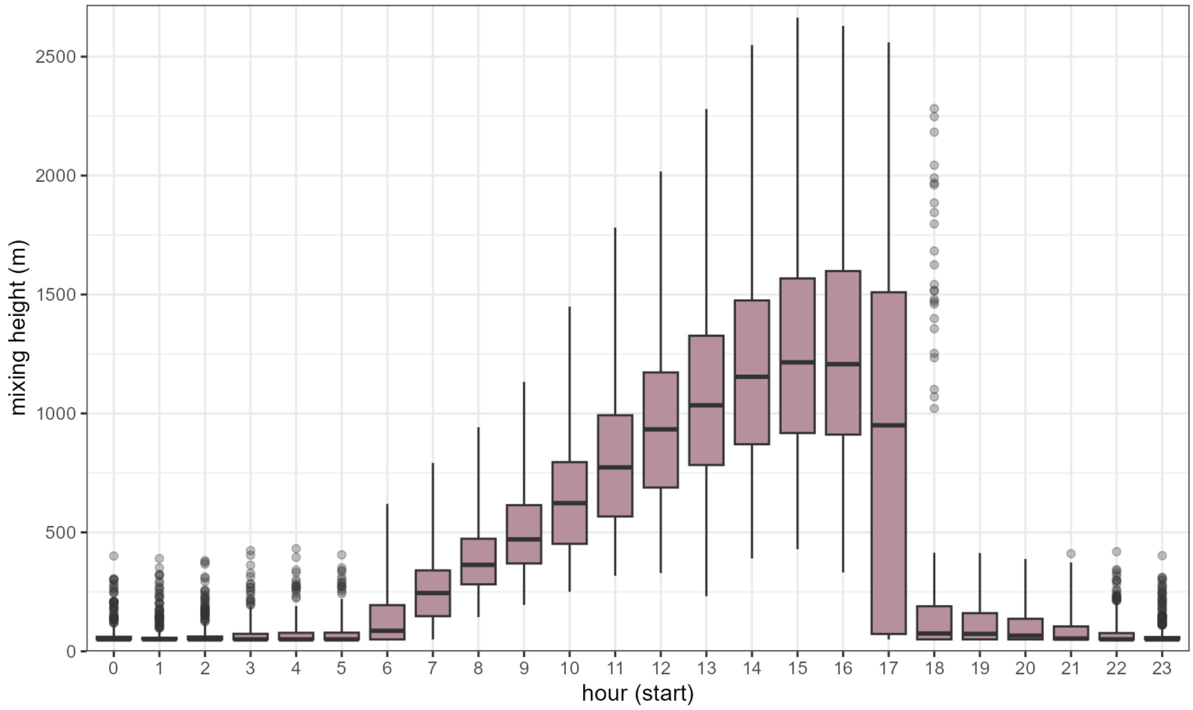

Figure A12 2023 Diurnal profile of mixing height predicted by TAPM/CALMET at IDE

A1.5.4 Temperature

The hourly distribution of TAPM/CALMET predicted temperature at the IDE site is provided in Figure A13 and the monthly distribution is provided in Figure A14. Over the twelve-month meteorological simulation, the temperature was predicted to range between 6.0°C and 37.9°C (average of 22.1°C).

During winter the temperature was predicted to range between 7.7°C and 28.6°C (average of 17.3°C). During summer the temperature was predicted to range between 19.1°C and 37.9°C (average of 26.8°C).

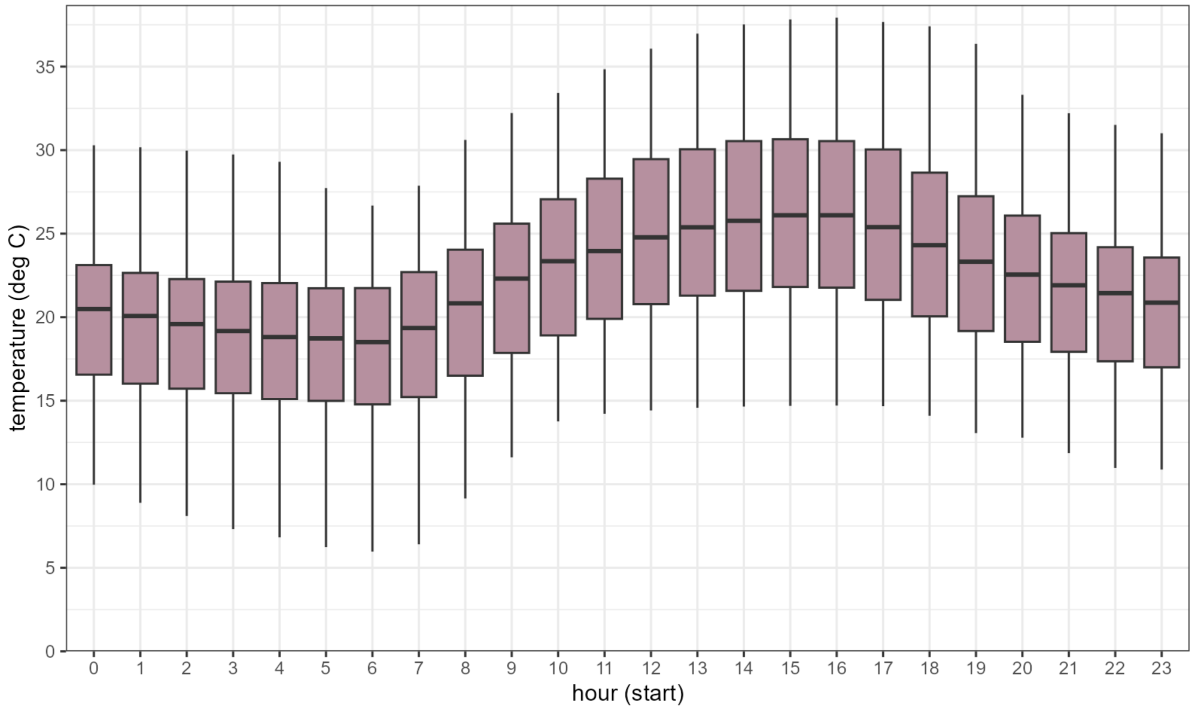

Figure A13 2023 Hourly distribution of TAPM/CALMET predicted temperature

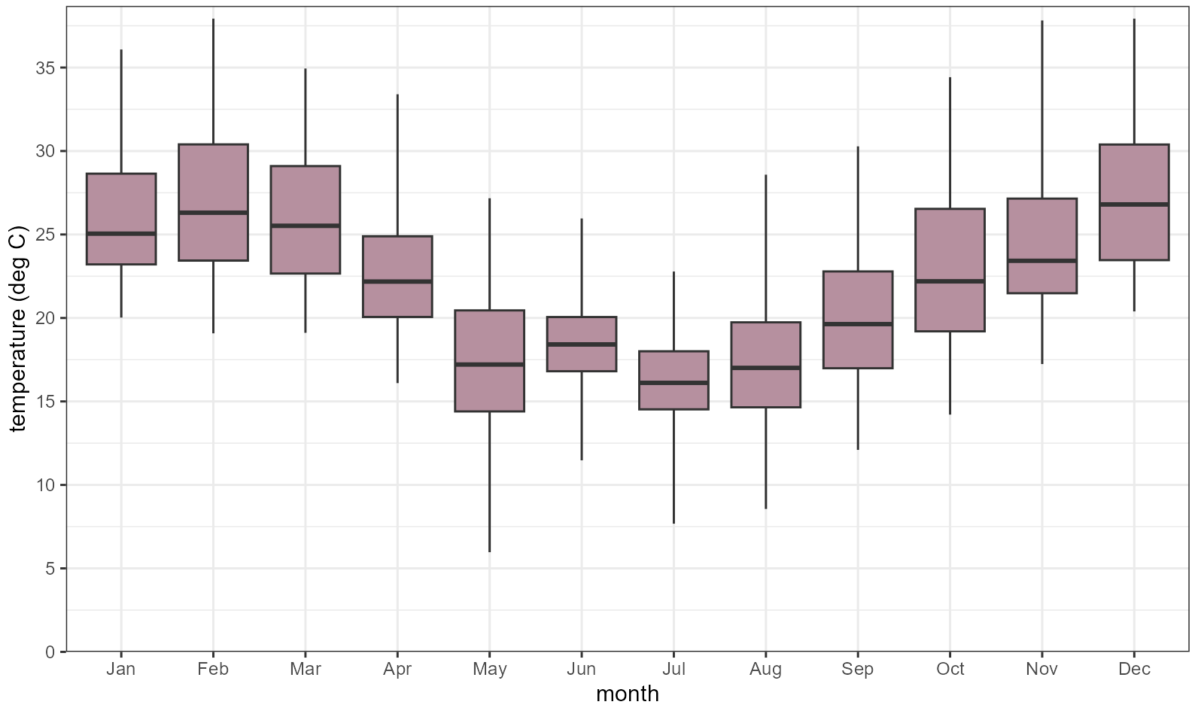

Figure A14 2023 Monthly distribution of TAPM/CALMET predicted temperature

A2 Dispersion modelling

CALPUFF simulates the dispersion of substances emitted to air to predict ground-level concentration and deposition rates across a network of receptors spaced at regular intervals, and at identified discrete locations. CALPUFF is a non-steady-state Lagrangian Gaussian puff model containing parameterisations for complex terrain effects, overwater transport, coastal interaction effects, building downwash, wet and dry removal, and simple chemical transformation. CALPUFF employs the 3D meteorological fields generated from the CALMET model by simulating the effects of time and space varying meteorological conditions on emissions transport, transformation, and removal.

CALPUFF takes into account the geophysical features of the study area that affect dispersion of emitted substances and ground-level concentrations of those substances in identified regions of interest. CALPUFF contains algorithms that can resolve near-source effects such as building downwash, transitional plume rise, partial plume penetration, sub-grid scale terrain interactions, as well as the long-range effects of removal, transformation, vertical wind shear, overwater transport and coastal interactions. Emission sources can be characterised as arbitrarily varying point, area, volume and lines or any combination of those sources within the modelling domain.

Key features of CALPUFF used to simulate dispersion:

- Domain area of 90 by 90 grids at 0.5 km spacing, equivalent to the domain defined in CALMET
- 365 days modelled (1 January 2023 to 31 December 2023)
- Gridded 3D hourly-varying meteorological conditions generated by CALMET
- Partial plume path adjustment for terrain modelled
- Dispersion coefficients calculated internally from sigma v and sigma w using micrometeorological variables
- Inclusion of external hourly-varying PTEMARB files for wind erosion sources

APPENDIX B ACTIVITY DATA AND RESULTS

B1.1 Activity Data

All activity data was supplied to Katestone by ID Extension.

Table B1 Activity data for all modelling scenarios

Activity	Units	2029	2034
Operations			
Standard hours of operation	hours/day	24	24
Blasting hours	hours/day	12	12
Throughputs			
Total waste - hauled	t	18,615,773	13,363,211
Total waste - handled	t	54,035,521	85,840,228
ROM coal	t	2,175,575	4,500,000
Material characteristics			
Overburden density	t/m3	2.30	2.30
Overburden moisture content	%	7.90	7.90
Overburden silt content	%	7.50	7.50
ROM coal moisture content	%	7.00	7.00
ROM coal silt content	%	6.20	6.20
Unpaved road surface silt content	%	8.40	8.40
Mine areas			
Total active pit area	ha	87.88	126.44
Total in-pit dump area	ha	-	369.27
Total out-pit dump area	ha	71.80	107.19
Total rehabilitation area	ha	-	-
Total topsoil dump area	ha	76.62	220.25
Total ROM stockpile area	ha	6.42	24.89
Drilling and blasting			
Forecast number of blasts	Blasts/year	150	150
Horizontal area of blast (average)	m2/blast	5,000	5,000
Holes drilled per blast (average)	holes/blast	90	90
Haulage			
Total waste haulage	VKT/year	441,769	290,830
Total ROM coal haulage	VKT/year	135,536	280,917
Mean grader speed	km/h	11.4	11.4
Total grader travel	VKT	51,300	51,300
Bulldozing			
Total dozer hours	hours/year	6,438	38,216