**Avonbank Mineral Sands Project**

**Environment Effects Statement**

**Chapter 13 – Graphical user interface, website

Description automatically generatedAir Quality**

**TABLE OF CONTENTS**

[13 Air Quality 13-1](#_Toc126509061)

[13.1 Introduction 13-1](#_Toc126509062)

[13.2 Scope and Methods 13-1](#_Toc126509063)

[13.2.1 Scope 13-1](#_Toc126509064)

[13.2.2 Study Area 13-1](#_Toc126509065)

[13.2.3 Methodology 13-1](#_Toc126509066)

[13.3 Operational Context 13-5](#_Toc126509067)

[13.4 Existing Conditions 13-7](#_Toc126509068)

[13.4.1 Climate 13-7](#_Toc126509069)

[13.4.2 Observed Wind 13-7](#_Toc126509070)

[13.4.3 Ambient Air Quality 13-9](#_Toc126509071)

[13.5 Potential Impacts 13-11](#_Toc126509072)

[13.5.1 Identified Potential Impacts 13-11](#_Toc126509073)

[13.5.2 Sensitive Receptors 13-12](#_Toc126509074)

[13.5.3 Characterisation of Impacts 13-14](#_Toc126509075)

[13.6 Avoidance and Mitigation Measures 13-15](#_Toc126509076)

[13.6.1 Avoidance 13-15](#_Toc126509077)

[13.6.2 Minimisation 13-15](#_Toc126509078)

[13.6.3 Rehabilitation 13-18](#_Toc126509079)

[13.7 Residual Impacts 13-18](#_Toc126509080)

[13.7.1 Construction 13-18](#_Toc126509081)

[13.7.2 Operations 13-23](#_Toc126509082)

[13.7.3 Rehabilitation 13-32](#_Toc126509083)

[13.8 Management Framework 13-36](#_Toc126509084)

[13.8.1 Environmental Objectives 13-36](#_Toc126509085)

[13.8.2 Monitoring and Management 13-37](#_Toc126509086)

[13.8.3 Audits 13-37](#_Toc126509087)

[13.9 Cumulative Impacts 13-38](#_Toc126509088)

[13.10 Conclusions 13-38](#_Toc126509089)

**TABLES**

[Table 13‑1: Operational scenarios modelled 13-5](#_Toc126322119)

[Table 13‑2: Annual mean climatic conditions at Longerenong (079028) 13-7](#_Toc126322120)

[Table 13‑3: Summary of PM10 and PM2.5 measurements 13-10](#_Toc126322121)

[Table 13‑4: Summary of background metals measurements 13-11](#_Toc126322122)

[Table 13‑5: Potential Impacts 13-12](#_Toc126322123)

[Table 13‑6: Assessment criteria 13-14](#_Toc126322124)

[Table 13‑7: Significance ratings 13-14](#_Toc126322125)

[Table 13‑8: Maximum 24-hour average PM10 Project contribution and cumulative concentration (year 1) 13-19](#_Toc126322126)

[Table 13‑9: Maximum 24-hour average PM2.5 Project contribution and cumulative contribution (year 1) 13-22](#_Toc126322127)

[Table 13‑10: Annual average PM2.5 as RCS concentrations during construction (year 1) 13-22](#_Toc126322128)

[Table 13‑11: Maximum 24-hour average PM10 Project contribution and cumulative concentration (year 2, 7, 22) 13-24](#_Toc126322129)

[Table 13‑12: Maximum 24-hour average PM2.5 Project contribution and cumulative concentration (year 2, 7, 22) 13-30](#_Toc126322130)

[Table 13‑13: Annual average PM2.5 as RCS concentrations during operations (years 2, 7, 22) 13-31](#_Toc126322131)

[Table 13‑14: Maximum 24-hour average PM10 Project contribution and cumulative concentration (year 30) 13-32](#_Toc126322132)

[Table 13‑15: Maximum 24-hour average PM2.5 Project contribution and cumulative concentration 13-35](#_Toc126322133)

[Table 13‑16: Annual average PM2.5 as RCS concentrations during (year 30) 13-35](#_Toc126322134)

**FIGURES**

[Figure 13‑1: Study area 13-4](#_Toc126514914)

[Figure 13‑2: Modelled scenarios 13-6](#_Toc126514915)

[Figure 13‑3: Project annual wind rose 13-8](#_Toc126514916)

[Figure 13‑4: Project daily wind rose 13-8](#_Toc126514917)

[Figure 13‑5: Project seasonal wind rose 13-9](#_Toc126514918)

[Figure 13‑6: Measured 24-hour average PM10 and PM2.5 concentrations from 1 August 2018 to 31 July 2019 13-10](#_Toc126514919)

[Figure 13‑7: Sensitive receptor locations 13-13](#_Toc126514920)

[Figure 13‑8: Ranked Project contribution (year 1) at Receptor 37 and corresponding background concentration for 24-hour average PM10 (2018–2019 modelling period) 13-19](#_Toc126514921)

[Figure 13‑9: Max 24-hour average PM10 Project contribution 2018–2019 (year 1-Construction) 13-21](#_Toc126514922)

[Figure 13‑10: Annual average cumulative PM10 (year 1-Construction) 13-21](#_Toc126514923)

[Figure 13‑11: Ranked Project contribution (year 2) at Receptor 31 and corresponding background concentration for 24-hour average PM10 (2018–2019 modelling period) 13-25](#_Toc126514924)

[Figure 13‑12: Ranked project contribution (year 7) at Receptor 36 and corresponding background concentration for 24-hour average PM10 (2018–2019 modelling period) 13-25](#_Toc126514925)

[Figure 13‑13: Ranked project contribution (year 22) at Receptor 43 and corresponding background concentration for 24-hour average PM10 (2018–2019 modelling period) 13-26](#_Toc126514926)

[Figure 13‑14: Max 24-hour average PM10 Project contribution 2018–2019 (year 2) 13-27](#_Toc126514927)

[Figure 13‑15: Annual average cumulative PM10 (year 2) 13-27](#_Toc126514928)

[Figure 13‑16: Max 24-hour average PM10 Project contribution 2018–2019 (year 7) 13-28](#_Toc126514929)

[Figure 13‑17: Annual average cumulative PM10 (year 7) 13-28](#_Toc126514930)

[Figure 13‑18: Max 24-hour average PM10 Project contribution 2018–2019 (year 22) 13-29](#_Toc126514931)

[Figure 13‑19: Annual average cumulative PM10 (year 22) 13-29](#_Toc126514932)

[Figure 13‑20: Ranked project contribution (year 30) at Receptor 89 and corresponding background concentration for 24-hour average PM10 (2018–2019 modelling period) 13-33](#_Toc126514933)

[Figure 13‑21: Max 24-hour average PM10 Project contribution 2018–2019 (year 30) 13-34](#_Toc126514934)

[Figure 13‑22: Annual average cumulative PM10 (year 30) 13-34](#_Toc126514935)

# Air Quality

## Introduction

This Chapter provides an overview of the air quality effects for the Avonbank Mineral Sands Project (the Project). It has been prepared to address the Environment Effects Statement (EES) Scoping Requirements and is supported by a detailed impact assessment conducted by Tonkin and Taylor Pty Ltd (Appendix H).

The key evaluation objective relevant to this Chapter, as defined in the Scoping Requirements, is to ‘Protect the health and wellbeing of the community and minimise effects on air quality’ (DELWP, 2020). The associated issues and Project Scoping Requirements are detailed in Appendix A of this EES.

This Chapter describes the existing air quality environment, the potential impacts associated with the Project and details the avoidance and mitigation measures to minimise the residual impacts so far as reasonably practicable.

## Scope and Methods

### Scope

The scope of this Chapter covers the potential impacts identified in the Air Quality Impact Assessment (AQIA) (Appendix H) and addresses the relevant Scoping Requirements listed in Appendix A. The impact assessment focused on mining and mineral processing activities that may result in air quality impacts over the life of the Project. Project related aspects that are well understood and considered to be relatively low risk with standard controls in place are addressed in the Aspects and Risk Register (Attachment 5).

### Study Area

The AQIA focused on activities within the proposed mining licence area (MIN), WIM Base Area (WBA) and included areas that may be impacted by air emissions for representative worst-case scenarios. The study area extended around 4 km from the proposed mining licence, as shown in Figure 13‑1. Sensitive receptors that fall within the study area are described in Section 13.5.2.

### Methodology

The AQIA characterised the existing conditions, identified potential impacts and assessed the residual impacts with avoidance and mitigation measures in place. The tasks undertaken are summarised below and detailed in Appendix H, Section 6.

Existing conditions:

* Local meteorological data was collected from the Longerenong Bureau of Meteorology Station for the period 2015 to 2019.
* Air quality monitoring equipment was established during April 2018 in an area representative of the land use within the Project area.
* Real-time continuous PM10 and PM2.5 measurements were taken for a 12-month period between August 2018 and July 2019.
* PM10 samples were collected every 1 in 6 days between August 2018 and July 2019 using a high-volume air sampler.
  + - Heavy metals were analysed from the PM10 samples.
* PM2.5 samples were collected between June 2019 and June 2020 using a high-volume air sampler.
  + - Respirable Crystalline Silica (RCS) was analysed from the PM2.5.
* Depositional dust monitoring was conducted at five sites within and around the Project area between March 2019 and April 2021.

Potential impacts:

* Dust generating activities associated with the Project were identified and characterised.
* Representative sensitive receptors that may be impacted by the Project activities were identified within an area extending approximately 4 km from the source emissions.
* Hazards and risks were characterised for all phases of the Project as described in Appendix H, Section 7:
* Project hazards and emission sources were identified.
* Emission estimates were developed for particulate emissions and heavy metals, with RCS considered conservatively to be 100% of PM2.5 (refer Appendix H, Section 6.1).
* An analysis of the overburden, subsoil, ore, Heavy Mineral Concentrate (HMC) and topsoil was undertaken to inform the emissions estimates.
* The uncontrolled emissions estimates for the worst-case Project scenarios were assessed.
* Project design and controls were investigated and applied to avoid or minimise the residual risk so far as reasonably practicable.
* The potential impacts for the Project were identified with consideration to the outcomes of the above risk characterisation.

Residual impacts:

* Avoidance and mitigation measures were detailed based on the proposed controls identified in the risk assessment (refer Appendix H, Section 9).
* Atmospheric dispersion modelling was undertaken to predict emissions for each of the assessment scenarios with avoidance and mitigation measures in place (refer Appendix H, Section 6.3).
* Contemporaneous dispersion modelling was undertaken for PM10 and PM2.5 Project contribution and background covering the period from 1 August 2018 to 31 July 2019.
* Dispersion modelling was undertaken for:
  + - PM10, PM2.5, heavy metals and RCS with background concentrations for the period 1 August 2018 to 31 July 2019 to provide a cumulative impact assessment and to demonstrate the likely maximum concentrations associated with the Project in addition to existing background; and
    - PM10, PM2.5, heavy metals and RCS Project contributions covering a period from 1 January 2015 to 31 December 2018, to demonstrate the variability of predicted contributions.
* Residual air quality impacts were assessed and characterised.
* Concentrations of PM10, PM2.5, RCS and heavy metals identified at sensitive receptors were compared to the relevant Air Pollution Assessment Criteria (APAC).
* The contemporaneous 2018–2019 modelling period was used to interpret the residual impacts associated with the cumulative Project contribution and background air quality.
* The 2015–2018 modelling period was considered to determine whether variability in meteorology had the potential to cause an increase in Project contribution that was likely to result in the APAC being exceeded.
* A qualitative assessment of potential cumulative impacts associated with other activities or projects throughout the region was undertaken.

Key assumptions relating to the air quality modelling and impact assessment are detailed in Appendix H, Sections 6 and 10.

Map

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Figure 13‑1: Study area

## Operational Context

As described in Chapter 2, construction of the Wet Concentrator Plant (WCP) and preparation for the Block A starter pit will be undertaken in year 1, followed by progressive mining in the southern areas of the mine footprint in year 2. Mining operations will move to Block B north of the Wimmera Highway in year 7 (refer Figure 13‑2).

In years 2 and 7, overburden will be stockpiled to create a starter pit with sufficient room for the progressive placement of tails and overburden. Typically, overburden will be used to progressively backfill the mine void, along with tailings from the WCP. After the void is backfilled and tails have dried sufficiently, subsoil and topsoil will be placed.

It is expected that rehabilitation will be complete within 4 years after the initial topsoil disturbance in each mining cell. At any given time over the life of mine, the extent of Project disturbance will be less than 400 ha and will typically (on average) be less than 300 ha as areas are progressively mined and rehabilitated.

For the purposes of the AQIA, representative construction and mining scenarios were developed to characterise the activities, equipment used and proximity to sensitive receptors. Scenarios with the worst-case potential air emissions, with avoidance and mitigation measures in place, were modelled as summarised in Table 13‑1 and Figure 13‑2.

The year 1 construction scenario includes site preparation for the WCP and earthworks to establish the starter pit and overburden stockpile. The operational scenarios include progressive mining and rehabilitation through years 2, 7 and 22. The year 30 scenario includes rehabilitation with no mining activity.

Further detail is provided in Appendix H, Section 2.2 and Section 10.2.

Table 13‑1: Operational scenarios modelled

| Scenario | Activities |
| --- | --- |
| Site preparation of the starter pit during year 1 (construction). | Preparation of the starter pit in Block A. Topsoil, subsoil and overburden stripping. Overburden hauled by truck to the stockpile located in the south-west. |
| Mining and progressive rehabilitation during year 2 (operations). | Mining within Block A. Topsoil, subsoil and overburden stripping and placement. Dozers pushing ore to the mining unit. |
| Mining and progressive rehabilitation during year 7 (operations). | Mining within Block B. Topsoil, subsoil and overburden stripping and placement. Overburden hauled by truck to the stockpile located in Block B. Dozers pushing ore to the mining unit. Block A mining void backfilled. |
| Mining and progressive rehabilitation during year 22 (operations). | Mining within Block C. Topsoil, subsoil and overburden stripping and placement. Dozers pushing ore to the mining unit. |
| Rehabilitation during year 30 (decommissioning). | Rehabilitation in Block D. Topsoil, subsoil and overburden placement. |

It is noted in the AQIA that the overburden stockpile location for Block A (OB-A Rev 1) was relocated to an area around 600 m to the north-east following completion of the first modelling iteration (OB-A Rev 2). The construction scenario (Year 1) was remodelled to capture this change. The Year 7 scenario was not remodelled as it was determined that the movement of the stockpile would not result in a significant change to the modelling outcomes, as further explained in Appendix H (Appendix F).

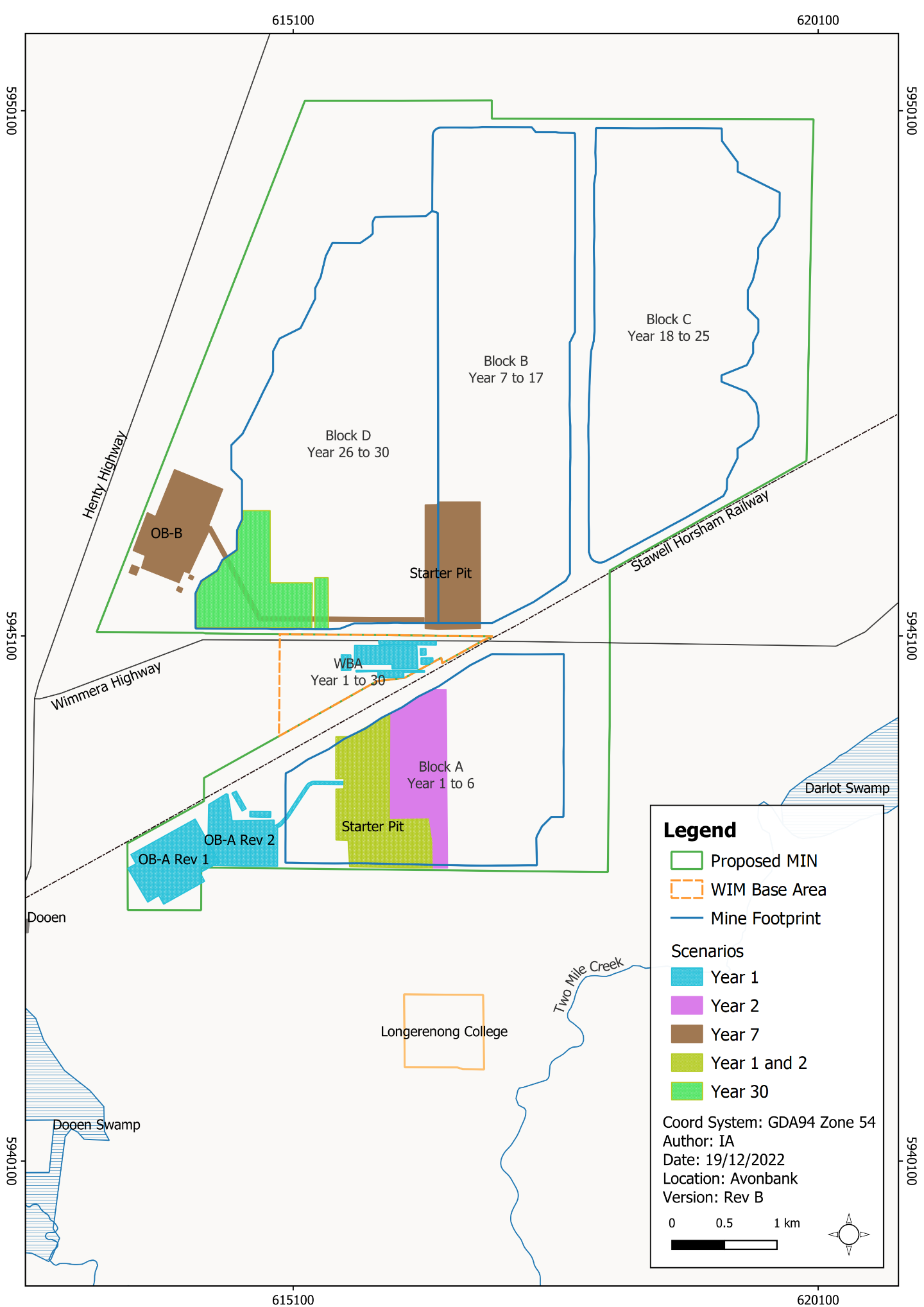


Figure 13‑2: Modelled scenarios

## Existing Conditions

### Climate

The Project area is in a temperate environment with cool wet winters and hot dry summers. Climatic conditions have been recorded between the years 1860 to 2021 at the Bureau of Meteorology (BOM) Longerenong meteorological station (0790280), around 2 km south of the Project area. Table 13‑2 shows the climatic conditions for a range of parameters collected at the Longerenong station.

Table 13‑2: Annual mean climatic conditions at Longerenong (079028)

|  |  |
| --- | --- |
| Statistic Element | Annual |
| Mean maximum temperature (°C) | 21.5 |
| Mean minimum temperature (°C) | 7.9 |
| Mean rainfall (mm) | 414.8 |
| Decile (median) rainfall (mm) | 410.1 |
| Mean number of days of rain ≥1 mm | 52.2 |
| Mean number of clear days | 75.8 |
| Mean number of cloudy days | 114.4 |
| Mean 9 am temperature (°C) | 13.5 |
| Mean 9 am relative humidity (%) | 73 |
| Mean 9 am wind speed (km/h) | 15.7 |
| Mean 3 pm temperature (°C) | 20.0 |
| Mean 3 pm relative humidity (%) | 49 |
| Mean 3 pm wind speed (km/h) | 20.5 |

Meteorological data from the Longerenong station was used in the dispersion modelling as described in Section 6.2 of the impact assessment (Appendix H).

### Observed Wind

A series of wind rose were developed using the data from the Longerenong station to characterise the local prevailing wind conditions over the 12-month period between 1 August 2018 and 31 July 2019. During the period, prevailing winds were from the south-westerly and south-easterly direction, with a moderate frequency of winds also from the north and north-west, as shown in Figure 13‑3.

The overnight and early morning (12 am to 6 am) wind speeds were low from the south-east and south-west directions (Figure 13‑4). Morning (6 am to 12 pm) wind speeds were higher and maintained the same direction with a stronger northerly vector. There was an increase in wind speed in the afternoon (12 pm to 6 pm), predominantly from the south-west and northerly directions. By the evening (6 pm to 12 am), the wind speeds generally dropped, but the predominant wind directions were maintained.

The seasonal variation of wind speeds and directions indicate strong winds from the south and the south-westerly and south-easterly quadrant in summer (Figure 13‑5). Autumn showed prevailing winds from the south-westerly quadrant, and winter showed prevailing winds between the north and west directions. Spring experienced a strong south-westerly wind direction increasing in frequency and wind speeds intensifying across the spectrum.

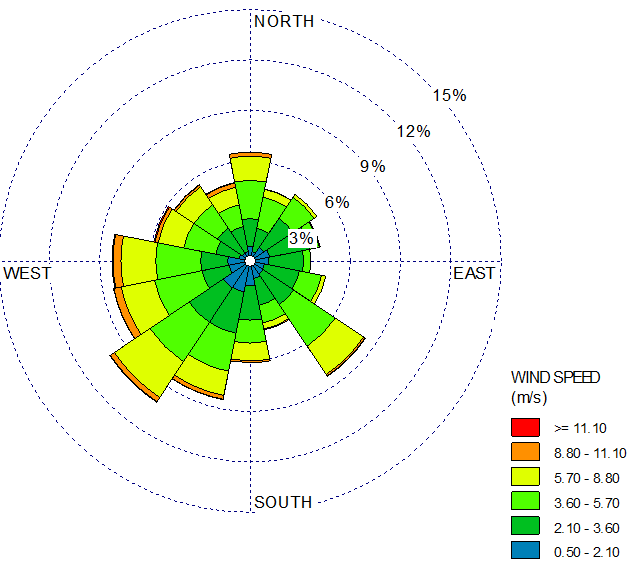


Figure 13‑3: Project annual wind rose

|  |  |
| --- | --- |
| 12 PM to 6 PM | 6 PM to 12 AM |
|
|
|
|

Figure 13‑4: Project daily wind rose

|  |  |
| --- | --- |
| **Summer** | **Autumn** |
|
|
|
|
| **Winter** | **Spring** |
|
|
|
|

Figure 13‑5: Project seasonal wind rose

### Ambient Air Quality

In accordance with the ‘Guideline for Assessing and Minimising Air Pollution in Victoria Publication 1961’ (EPA 2022), the Project was considered to require a Level 3 assessment which required 12-months of site-specific baseline data. The data requirements for a Level 3 assessment are:

* Real-time continuous 24-hour PM10 and PM2.5 monitoring for a 12-month period.
* Analysis of RCS (PM2.5 fraction).
* Heavy metal content (PM10) (where applicable).

The following sections present the on-site monitoring results for the specified measured data. The equipment was installed by Ecotech in April 2018. Ecotech provided ERM with 24-hour average validated PM10 and PM2.5 data from 29 April 2018 to 31 August 2019.

#### Particulate matter

There were five occasions on which the PM10 measurements exceeded the Environment Reference Standard (ERS) 24-hour average APAC of 50 µg/m3. When the measured PM10 concentrations increased above the ERS, measured PM2.5 concentrations did not rise concurrently. This indicates that the particulate matter was not from a combustion source (such as bushfires), rather it is suggestive of either:

* windblown dust from the more arid regions of Australia located to the north and north-west of the Project;
* harvesting of grain crops in the surrounding land use; or
* sowing of seed for grain crops in the surrounding land use.

There were no occasions on which the PM2.5 24-hour average measurements exceeded the current ERS criterion of 25 µg/m3. Measured values were below the annual average assessment criterion for both PM10 and PM2.5.

Table 13‑3 and Figure 13‑6 show the maximum 24-hour average and annual average PM10 and PM2.5 concentrations during the 2018–2019 period. Data capture rates for both PM10 and PM2.5 were above the minimum requirement of 75%, as per Australian Standard AS 3580.19.

Table 13‑3: Summary of PM10 and PM2.5 measurements

|  |  |  |  |
| --- | --- | --- | --- |
| Indicator | Data Capture rate | Maximum 24-hour Average (µg/m3) | Annual Average (µg/m3) |
| PM10 | 89% | 77.8 | 12.5 |
| PM2.5 | 95% | 17.4 | 4.0 |



Figure 13‑6: Measured 24-hour average PM10 and PM2.5 concentrations from 1 August 2018 to 31 July 2019

#### Respirable Crystalline Silica

Respirable Crystalline Silica (RCS) was initially measured using a low-volume air sampler (LVS), running for periods of up to 7 days. There was however insufficient capture of PM2.5 mass (limit of detection of 14 µg/m3) and the laboratory analysis identified no concentrations of RCS above the limit of detection (10 µg/m3) on any of the samples.

Further studies were undertaken using a PM2.5 size selective inlet on a high-volume sampler. Sufficient PM2.5 sample was collected to analyse RCS (quartz and cristobalite) and the values were confirmed to be very low, less than or equal to 0.95 µg/m3 from June 2019–June 2020. Of the 94 valid RCS samples collected over 12-months, the background value was calculated to be 0.134 µg/m3, well below the RCS criterion of 3 µg/m3.

#### Heavy metals

Ambient heavy metal concentrations from PM10 samples were taken from the high-volume air sampler (HVAS). Table 13‑4 summarises the maximum 24-hour and annual average measurements for 18 different metals over the 12-month period (57 sampling days). These values were used to determine the existing background levels for the air quality assessment. Of the 18 metals analysed, four were not detected and five were detected on a small number of occasions. For samples below the limit of detection, 50% of this level was assumed for the 24-hour average and incorporated into the annual average calculation. There were no exceedances of the annual mean standards for any of the measured metals.

Table 13‑4: Summary of background metals measurements

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Metal | Maximum 24-hour Average Over the Year (µg/m3) | 1-hour or 24-hour Criteria  (µg/m3) | Annual Average  (µg/m3) | Annual Criteria  (µg/m3) |
| Antimony | 0.0003 | 1 (24-hour) | 0.0002 | 0.3 |
| Arsenic  - cumulative  - incremental | 0.0006 | 9.9 (1-hour) | 0.0002 | 0.015  0.007 |
| Cadmium\* | 0.0002 | 18 (1-hour)  0.03 (24-hour) | 0.0002 | 0.005 |
| Chromium | 0.0092 | 1.3 (1-hour) | 0.0032 | 0.005 |
| Cobalt | 0.0004 | 0.7 (1-hour) | 0.0002 | 0.002 |
| Copper | 0.0045 | 100 (1-hour) | 0.0030 |  |
| Lead | 0.0098 |  | 0.0012 | 0.5 |
| Manganese | 0.0140 | 9.1 (1-hour) | 0.0034 | 0.15 |
| Molybdenum | 0.0014 | 30 (1-hour) | 0.0003 | 0.4 |
| Nickel | 0.0065 | 0.2 (1-hour) | 0.0013 | 0.09 |
| Selenium\* | 0.0002 | 2 (1-hour) | 0.0002 | 0.2 |
| Tin | 0.0028 | 20 (1-hour) | 0.0009 | 2 |
| Uranium\* | 0.0002 |  | 0.0002 | 0.04 |
| Vanadium\* | 0.0002 | 0.8 (24-hour) | 0.0002 | 0.1 |
| Zinc | 0.0280 | 20 (1-hour) | 0.0100 | 2 |

\* no data collected above the limit of detection (0.0003 µg/m3) so all readings were taken to be half the detection limit, that is, 0.00015 µg/m3, and the annual mean concentration was also assumed to be half the detection limit.

## Potential Impacts

### Identified Potential Impacts

Potential impacts were identified in the AQIA with consideration to the proposed Project activities, the baseline studies, stakeholder concerns and the issues identified in the referral document and Scoping requirements. Where a source-pathway-receptor relationship was considered plausible, further investigation was undertaken to assess the residual impacts with avoidance and mitigation measures in place (refer Section 13.7).

The potential impacts associated with air emissions are grouped broadly by Project phase, as shown in Table 13‑5. Each potential impact was subject to a detailed impact assessment that considered particulate matter (PM10 and PM2.5), RCS, heavy metals and depositional dust.

Table 13‑5: Potential Impacts

|  |  |  |
| --- | --- | --- |
| Item | Potential Impacts | Project Phase[[1]](#footnote-2) |
| IP-01 | Construction and site preparation resulting in short-term/temporary air emissions that impact sensitive receptors. | C |
| IP-02 | Operational mining activity and associated works resulting in air emissions that impact sensitive receptors. | O |
| IP-03 | Rehabilitation activity and associated works resulting in air emissions that impact sensitive receptors. | D |

### Sensitive Receptors

The AQIA identified 97 sensitive receptors within the study area surrounding the Avonbank mining licence and WBA (refer Figure 13‑7). For the purposes of this study the potential area of impact was conservatively determined to extend approximately 4 km from the source activities.

Sensitive receptors were selected within this area to represent locations where the general public may be exposed to resultant ground-level air emissions for extended periods, including residential dwellings in the townships of Jung and Dooen, dispersed farm dwellings, and the Longerenong College. Dispersion modelling was conducted for all identified sensitive receptors listed in Appendix H, Section 5.1.

Dispersion modelling was also conducted for the commercial buildings, community venues, rainwater tanks, Darlot swamp and representative agricultural areas. The risks associated with these receptors are addressed in the Human Health Risk Assessment (Chapter 18).

Several sensitive residential receptors will be vacated and/or removed over the life of the Project. These receptors a not shown or assessed in Section 13.7 for the periods that the dwellings are vacated (refer Appendix H, Section 5.1).

Map

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Figure 13‑7: Sensitive receptor locations

### Characterisation of Impacts

The AQIA considered the magnitude, spatial extent and duration of the air emissions and the sensitivity of the receptor. The residual impacts were characterised with regard to the relevant reference material listed in Table 13‑6.

The APAC, detailed in the EPA Publication 1961 (EPA, 2022), have been applied throughout this Chapter to provide a benchmark against which the residual impacts were compared.

The APAC do not represent compliance limits, nor do they imply acceptable pollution levels. In line with the EP Act 2017, General Environmental Duty (GED), the risk of harm to human health or the environment from air pollution must be minimised so far as reasonably practicable.

Section 13.6 of this Chapter describes how the GED could be met during operations, noting that additional measures may be required over the life of the Project in addition to those stated in this EES.

Table 13‑6: Assessment criteria

| Reference | Commentary |
| --- | --- |
| Environment Reference Standard (ERS, 2021) | Sets out the environmental values, indicators and objectives relevant to ambient air quality. The objectives and indicators are the same for all environmental values listed. In situations where background conditions are above the quantified ERS objectives for ambient air quality, the approach is to prevent additional risk to the environmental values by implementing appropriate avoidance and mitigation measures. |
| Guideline for Assessing and Minimising Air Pollution in Victoria, Publication 1961 (EPA, 2022) | The guideline provides a framework to assess and control risks associated with air pollution. This guideline presents APAC for the assessment and management of air emissions. The criteria are designed to be used within a broader air pollution management framework so that risks can be minimised so far as reasonably practicable. The AQPC are derived from a range of source documents including but not limited to the ERS and the World Health Organisation air quality guidelines. |
| Protocol for Environmental Management: Mining and extractive industries (EPA, 2007) | This guideline has been superseded by EPA Publication 1961, however, the criteria for depositional dust has been used as a point of reference in this report as there are no depositional dust criteria in current Victorian guidelines. The risks associated with depositional dust are further explored in Chapter 18 (Human Health Risk Assessment). |

In addition to the detailed characterisation of the impacts described above, the relative significance of each residual impact was summarised on a scale ranging from negligible through to severe (refer Table 13‑7).

Table 13‑7: Significance ratings

| **Rating** | **Description** |
| --- | --- |
| Negligible | No additional exceedances of the ERS beyond the Project Area at any location relevant to the averaging period for long-term and short-term averaging periods caused by the Project; and  For all averaging periods:   * + the percentage change in predicted Project contribution relative to APACs is less than 4% (EPA, 2021); and   + cumulative concentrations are less than 75% of the APACs (IAQM, 2017) at any location relevant to the averaging period for at least 99% of the year. |
| Minor | No additional exceedances of the ERS beyond the Project Area at any location relevant to the averaging period for long-term and short-term averaging periods caused by the Project; and  For all averaging periods:   * + the percentage change in predicted Project contribution relative to APACs is greater than 4% of the APACs (EPA, 2021); and   + cumulative concentrations are less than 75% of the APACs (IAQM, 2017) at any location relevant to the averaging period for at least 99% of the year. |
| Moderate | No additional exceedances of the ERS beyond the Project Area at any location relevant to the averaging period for long-term and short-term averaging periods caused by the Project; and  For all averaging periods:   * + the percentage change in predicted Project contribution relative to APACs is greater than 4% of the APACs (EPA, 2021); and   + cumulative concentrations are greater than 75% of the APACs (IAQM, 2017) at any location relevant to the averaging period for more than 1% of the year. |
| Major | Additional exceedances of the ERS beyond the Project Area at any location relevant to the averaging period for either long-term or short-term averaging periods caused by the Project; and  For all averaging periods the percentage change in predicted Project contribution relative to APACs is less than 75% of the APACs (IAQM, 2017) for at least 99% of the year. |
| Severe | Additional exceedances of the ERS beyond the Project Area at any location relevant to the averaging period for either long-term or short-term averaging periods caused by the Project; and  For all averaging periods the percentage change in predicted Project contribution relative to APACs is greater than 75% of the APACs (IAQM, 2017) for more than 1% of the year. |

## Avoidance and Mitigation Measures

This Section outlines the measures identified to avoid and minimise residual impacts. It is noted that in line with the requirements of the proposed environment management system (EMS) and relevant legislation, additional measures may be required during implementation to ensure risks and potential impacts have been minimised so far as reasonably practicable.

### Avoidance

#### AQ-01: HMC Transport

Transport of HMC from the Project area to the Port of Portland will be undertaken on sealed roads in covered B-double articulated vehicles. Trucks will utilise the sealed Arterial Road Network as described in Chapter 9 and no material dust emissions are expected.

HMC will be temporarily stored in a closed shed at the Port of Portland and will be loaded to the ship in a contained conveyor with water sprays to avoid dust lift-off during ship loading. There are expected to be no material dust emissions associated with the storage and loading of the HMC, as further detailed in the risk assessment provided in Attachment 5 (Aspects and Risks).

### Minimisation

#### AQ-02: Minimise disturbed area

The active disturbed area will be maintained to less than around 400 ha, comprising the active mining area, tails cells, overburden/soil removal and areas being land formed and rehabilitated. The area subject to topsoil stripping will be minimised so far as reasonably practicable.

The nature of the mining operation is such that mined areas can be rehabilitated and stabilised with a cover crop within around 1.5 to 4 years after disturbance. Areas within the mining licence will be cropped in line with surrounding farming areas upon completion of rehabilitation. It is expected that once rehabilitation is established dust emissions will be commensurate with surrounding unmined areas.

#### AQ-03: Road surface material

Roads for light and heavy vehicles will be constructed with appropriate materials comprising low silt content to minimise dust emissions. It is expected gravels mined from the Karoonda sandstone geological unit will be preferentially used as they are less susceptible to surface erosion due to the relatively large particle or aggregate size. Permanent and semi-permanent roads will be topped with gravel excavated during mining to optimise road conditions and minimise surface erosion and dust so far as reasonably practicable.

Sealing roads with bitumen was not considered feasible as internal Project haulage routes and light vehicle roads will progressively move over the life of mine. Haulage routes will typically change on a monthly basis depending on the location of stockpiles and the operational area. Sealing roads around the HMC stockpile circuit was not considered feasible due to geotechnical issues associated with the swelling characteristics of the underlying clay material.

#### AQ-04: Road and open area watering

Road watering will be undertaken on light vehicle roads and heavy vehicle routes to keep the surface moist and to minimise wheel generated dust. It will be undertaken as required in areas that have been disturbed and not yet stabilised.

Road watering will be scheduled such that the rate is commensurate with the ambient conditions and can be adapted to provide a preventative response to forecast weather events. This is a highly effective mitigation measure that is standard practice across the mineral sands industry to minimise dust emissions.

It is expected that during the summer months, there will be at least two water trucks to service all at risk areas. The water trucks will be able to complete a load of water every 50 minutes. Water trucks may be dosed with polymer stabilising agents to improve efficiency of the program during high-risk periods.

#### AQ-05: HMC stockpile management

Heavy Mineral Concentrate will be stockpiled wet when pumped from the concentrator plant. The HMC stockpile will retain moisture and will be loaded to the haulage trucks moist with around 4-6% water content.

In some circumstances during extreme conditions the surface may dry and be subject to some surface creep. Sprinklers will be established as a contingency to maintain moisture content across the stockpile and minimise surface creep. A sediment fence will be established around the stockpile area to prevent HMC surface creep outside the stockpile domain.

#### AQ-06: Operational scheduling

Topsoil stripping and placement will be avoided during extreme wind events to avoid excessive dust emissions. Watering topsoil during stripping and placement is not considered appropriate as it can adversely affect the resource making it more susceptible to compaction during rehabilitation.

Subsoil, overburden and ore extraction will continue during all weather conditions as the materials have a higher moisture content and are less susceptible to erosion. Water carts may be used as described in Section 13.6.2.3 to increase soil moisture during overburden and subsoil removal, however, this is not expected to be required due to the inherent moisture content of the material.

#### AQ-07: Vehicle types and operation

Appropriately sized vehicles will be used to maximise the efficiency of material carting (topsoil, subsoil, overburden) and minimise the number of circuits. Drop heights from the excavator to truck will be minimised so far as reasonably practicable without impacting safety.

#### AQ-08: Air Quality Management Plan

An Air Quality Management Plan (AQMP) will be prepared prior to Project commencement. It will provide a management framework to mitigate residual impacts from the Project so far as reasonably practicable, in line with the Project EMS and relevant legislative requirements.

The AQMP will be developed in consultation with stakeholders and will be subject to approval by the relevant Authority. It will be reviewed and updated at an appropriate frequency as established in the overarching EMS, with consideration to the level of risk, statutory requirements, monitoring results, community complaints and in response to audit findings.

The AQMP will:

* Summarise the baseline data and existing environment.
* Explain the relevant statutory requirements and context (including any relevant approvals).
* Describe the avoidance and mitigation measures to be implemented to minimise air emissions so far as reasonably practicable.
* Identify specific environmental objectives and performance standards to be achieved with avoidance and mitigation measures in place.
* Detail monitoring to be undertaken to verify the modelling and the effectiveness of the avoidance and mitigation measures (refer Section 13.8).
* Describe mechanisms to determine when/if corrective actions and contingency measures are required.
* Detail a program to investigate and implement ways to improve the environmental performance of the Project over time.
* Detail appropriate review periods and/or triggers to ensure the plan remains fit for purpose.
* Establish procedures to manage:
* incidents and any non-compliance.
* stakeholder and community complaints.
* failure to comply with statutory requirements and/or performance standards.
* roles and responsibilities for implementing the plan.
* a protocol for periodic review of the plan.
* Include a community engagement strategy which will include a complaints handling system.

In addition to the above requirements, the AQMP will include the avoidance and mitigation measures detailed in this Chapter. The AQMP will also include good management practices to:

* Train employees to record and report excessive dust emissions if they occur so that mitigation measures can be adjusted or applied.
* Require employees and contractors to drive to conditions to minimise emissions during extreme wind events.
* Encourage work teams to consider weather conditions at the commencement of each shift to ensure that all appropriate mitigation and contingency measures have been considered.
* Plan daily work programs with consideration to the forecast weather conditions to minimise dust emissions.

#### AQ-09: Community Engagement

A Community Engagement Plan (CEP) will be developed to identify interested and affected stakeholders and will outline the level of engagement required with each stakeholder or group of stakeholders. It will identify a range of consultation measures to inform and seek feedback from stakeholders. The CEP will be integrated into the overarching EMS to ensure feedback and complaints are addressed appropriately (refer Chapter 5). There will also be specific stakeholder engagement strategies embedded within the AQMP.

### Rehabilitation

#### AQ-10: Progressive Rehabilitation

A Rehabilitation Plan will be established for the Project that will address matters relating to progressive rehabilitation and closure. It will cover all work areas within the proposed mining licence and within the broader development extent and the Port of Portland.

The Rehabilitation Plan will include a schedule of progressive rehabilitation and will describe the strategy to establish a safe, stable, sustainable landform capable of supporting the proposed end land use. It is expected that land will be stabilised as soon as reasonably practicable after mining, typically within 4 years.

The Rehabilitation Plan will define the end land use with consideration to the views of the landholders and the broader community where appropriate.

A preliminary Rehabilitation Plan for the Project has been developed to meet the intent of the Scoping Requirements and is included with this EES as Attachment 3. This plan will be refined prior to commencement with consideration to the detailed operating plans, stakeholder and community feedback and the Minister’s assessment of the EES.

## Residual Impacts

This Section describes the likely residual impacts with avoidance and mitigation measures in place. The residual impacts have been characterised, as described in Section 13.5.3 and Chapter 6 (Impact Assessment Framework).

The modelling outputs used to describe the residual impacts in this Section include:

* Maximum Project contribution and modelled cumulative concentration (24-hour average PM10 and PM2.5) tabulated for the most affected sensitive receptors over the 2018-2019 modelling period.
* Ranked cumulative concentration (24-hour average PM10) graphs depicting the worst affected sensitive receptors over the 2018-2019 modelling period (background and Project contribution).
* Maximum Project contribution (24-hour average PM10) contour plots for the 2018-2019 modelling period.
* Cumulative background and Project contribution (annual average PM10) contour plots for the 2018-2019 modelling period.
* Maximum Project contribution and background annual average PM2.5 concentration as RCS, tabulated for the most affected sensitive receptors during the 2018-2019 modelling periods.
* Maximum 24-hour average and annual average metal concentrations at the most affected sensitive receptors (background and Project contribution).
* Average 1-hour 99.9th percentile metal concentrations outside the Project area.

The relevant APAC are referred to throughout this Section as a point of reference. The avoidance and mitigation measures have been applied to reduce the residual impacts so far as reasonably practicable, as described in Section 13.6.

### Construction

There is one potential impact (IP-01) identified in Section 13.5.1 relating to the generation of air emissions that may impact sensitive receptors during construction.

To assess the residual impacts, Project emissions were modelled during year 1 within Block A and the WBA as described in Section 13.3. Activities associated with this scenario include the stripping of topsoil/subsoil in preparation for construction of the WBA and the excavation/stockpiling of overburden for the Block A starter pit. Construction activities are expected to be complete within the first 2 years of the Project.

#### Particulate Matter PM10

The receptors with the highest Project contribution (24-hour average PM10) during the 2018–2019 period are listed in Table 13‑8. During the modelling period, days with the highest Project contribution did not exceed the APAC (50 µg/m3) when considered cumulatively with the background. The highest Project contribution was 13 µg/m3 at Receptor 37 (2.8 km east of WBA) and the associated cumulative 24-hour maximum PM10 concentration was 24 µg/m3.

Table 13‑8: Maximum 24-hour average PM10 Project contribution and cumulative concentration (year 1)

|  |  |  |
| --- | --- | --- |
| Receptor | Max 24-hour Average PM10 Project Contribution (2018–2019) (µg/m3) | Cumulative 24-hour PM10 on the Day of Maximum Project Contribution (2018–2019) (µg/m3) |
| R37 | 13 | 24 |
| R38 | 11 | 29 |
| R100 | 9 | 21 |
| R97 | 9 | 21 |
| R98 | 8 | 20 |

The background air quality (24-hour average PM10) exceeded the APAC over the 2018–2019 modelling period on several occasions. Figure 13‑8 shows the background concentration (orange) ranked from highest to lowest at the most affected sensitive receptors. For each background exceedance of the APAC, the Project contribution (green) was very low, between 0.1 µg/m3 and 0.9 µg/m3. This Project contribution, on the day of the maximum background was less than 4% of the APAC which was considered a non-significant contribution in line with EPA Publication 1961 (EPA 2022). The cumulative concentration at sensitive receptors was less than 75% of the APAC for at least 99% of the year.

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Figure 13‑8: Ranked Project contribution (year 1) at Receptor 37 and corresponding background concentration for 24-hour average PM10 (2018–2019 modelling period)

For the 24-hour period with the highest Project contribution, an analysis of the background conditions was conducted with consideration to the 5-year modelling period (2015–2018) to assess the likelihood that the APAC may be exceeded (refer Appendix H, Section 11.1). The likelihood of exceeding the criteria due to the Project contribution, with consideration to a range of meteorological conditions was low.

The maximum Project contribution (24-hour average PM10) during the 2018–2019 modelling period for the construction scenario (year 1) is shown in Figure 13‑9. This figure shows the spatial extent and magnitude of the PM10 concentration in relation to the identified sensitive receptors.

Figure 13‑10 shows the annual average PM10 cumulative concentrations for the 2018–2019 modelling period. There were no exceedances of the APAC (20 µg/m3) at any of the receptors identified. The maximum distance from the source at which the annual average PM10 cumulative concentration exceeds the APAC is shown in this figure.

The residual impacts of the Project PM10 emissions for the construction scenarios were considered to be minor and will be experienced temporarily at sensitive receptors over the first 2 years of the Project. Further discussion of the residual impacts is provided in Section 13.7.1.6.

|  |  |
| --- | --- |
| **Figure 13‑9: Max 24-hour average PM10 Project contribution 2018–2019 (year 1-Construction)** | **Figure 13‑10: Annual average cumulative PM10 (year 1-Construction)** |

#### Particulate Matter PM2.5

The receptors with the highest Project contribution (24-hour average PM2.5) during the 2018-2019 period are shown in Table 13‑9. During the modelling period, days with the highest Project contribution did not exceed the APAC (25 µg/m3) when considered cumulatively with the background.

The highest Project contribution was 1.9 µg/m3 at Receptor 37 (2.8 km east of WBA) and the associated cumulative 24-hour maximum PM2.5 concentration was 17 ug/m3.

Table 13‑9: Maximum 24-hour average PM2.5 Project contribution and cumulative contribution (year 1)

|  |  |  |
| --- | --- | --- |
| Receptor | Maximum 24-hour Average PM2.5 Project Contribution  (2018–2019) (µg/m3) | Cumulative 24-hour PM2.5 on the Day of Maximum Project Contribution (2018–2019) (µg/m3) |
| R37 | 1.9 | 17 |
| R38 | 1.5 | 17 |
| R100 | 1.5 | 17 |
| R97 | 1.2 | 17 |
| R98 | 1.2 | 17 |

Similarly, there were no exceedances of the annual average PM2.5 APAC (8 µg/m3) at any of the receptors identified. The highest annual average Project contribution was 0.12 µg/m3 and the highest cumulative annual average concentration was 4.6 µg/m3 at Receptor 38 (800 m north WBA). The percentage change in predicted Project concentration relative to the APACs was less than 4%. The Project contributions over the longer modelling period between 2015–2018 were shown to be similar to the 2018–2019 modelling period (refer Appendix H, Section 11.1).

The residual impacts of the Project PM2.5 emissions for the construction scenario were considered to be negligible during the first 2 years of the Project. Further discussion of the residual impacts is provided in Section 13.7.1.6.

#### Respirable Crystalline Silica

The receptors with the highest Project contribution (annual average PM2.5 as RCS) during the 2018–2019 modelling period are shown in Table 13‑10. It was assumed that 100% of PM2.5 was RCS as a conservative assumption. During the modelling period, days with the highest Project contribution did not exceed the APAC (3 µg/m3). The highest Project contribution during the 2018–2019 modelling period was 0.12 µg/m3 at Receptor 38 (~1 km north WBA) and the associated cumulativeconcentration was 0.26 µg/m3.

The Project contributions over the longer modelling period between 2015–2018 were slightly higher but similar to the 2018-2019 modelling period (Appendix H, Section 11.1).

Table 13‑10: Annual average PM2.5 as RCS concentrations during construction (year 1)

|  |  |  |
| --- | --- | --- |
| Receptor | Annual Average PM2.5 as RCS Project Contribution  (2018–2019) (µg/m3) | Annual Average PM2.5 as RCS Cumulative on the Day of Maximum Project Contribution  (2018–2019) (µg/m3) |
| R38 | 0.12 | 0.26 |
| R87 | 0.08 | 0.21 |
| R32 | 0.07 | 0.21 |
| R31 | 0.07 | 0.20 |
| R7 | 0.07 | 0.20 |

The residual impacts of the Project RCS emissions for the construction scenario were considered to be minor. Further discussion of the residual impacts is provided in Section 13.7.1.6.

#### Metals

Metal emissions were scaled from PM10 predictions for the maximum concentrations at the Project boundary for 1-hour average periods and individual sensitive receptors for 24-hour and annual mean average periods.

All metal concentrations were predicted to be below their respective criteria for annual average, maximum 24-hour average and maximum 1-hour average periods (refer Appendix H, Section 11.1.4).

The residual impacts of the Project metal emissions for the construction scenario were considered to be negligible to minor. Further discussion of the residual impacts is provided in Section 13.7.1.6.

#### Depositional dust

The highest predicted project contribution at a sensitive receptor was 0.24 g/m2/month for the 2018–2019 modelling period. While there are no current air quality assessment criteria for depositional dust in Victoria, the criteria in the ‘Protocol for Environmental Management: Mining and extractive industries’ (EPA, 2007) has been applied as a point of reference. This guideline states that monitoring should not exceed 4 g/m2/month (no more than 2 g/m2/month above background) as a monthly average. The depositional Project contribution was greater than 4% of the relevant criteria and the residual impact was considered to be minor.

#### Summary of Residual Impacts

The residual impacts at sensitive receptors due to air emissions for the construction scenario were considered to be negligible to minor, as described in Sections 13.7.1.1 to 13.7.1.5. The worst-case impacts at each sensitive receptor will be temporary. Construction activities including the WBA site preparation, starter pit construction and stockpiling of overburden will be completed within the first 2 years of the Project.

It is expected that the adaptive management strategy to mitigate dust lift-off using water carts on roads and disturbed areas will effectively minimise residual impacts. The adaptive management strategy outlined in the AQMP will be established to ensure the avoidance and mitigation measures described in Section 13.6 can be applied in response to forecast weather conditions, monitoring results and community complaints.

The potential effects and risks associated with dust emissions are further described in Chapter 18 (Human Health Risk Assessment).

### Operations

There is one potential impact (IP-02) identified in Section 13.5.1 relating to the generation of air emissions that may impact sensitive receptors during mine operations.

To assess the residual impacts, Project emissions were modelled for mining scenarios in years 2, 7 and 22, as described in Section 13.3. Mining activity will occur progressively through each Block for a maximum of 10 years (refer Figure 13‑2). For the scenarios modelled, the duration of dust emitting activities associated with mining and rehabilitation at each mining cell (~20 ha) will be between 1.5 and 4 years. Impacts are likely to be greatest when mining activities are closest to the sensitive receptor and will decrease as activities progress through the mining Blocks.

It is expected that air emissions from completed rehabilitation areas will be commensurate with surrounding agricultural areas.

#### Particulate Matter PM10

The receptors with the highest Project contribution (24-hour average PM10) for each scenario during the 2018-2019 modelling period are listed in Table 13‑11. During the modelling period, days with the highest Project contribution did not exceed the cumulative APAC (50 µg/m3) when considered cumulatively with the background. The highest Project contribution across all scenarios was 39 µg/m3 at Receptor 43 (1.5 km north-west of Jung) during year 22 and the associated cumulative 24-hour maximum PM10 concentration was 47 µg/m3, which was just below the APAC.

Table 13‑11: Maximum 24-hour average PM10 Project contribution and cumulative concentration (year 2, 7, 22)

|  |  |  |
| --- | --- | --- |
| Receptor | Maximum 24-hour Average PM10 Project Contribution (2018–2019) (µg/m3) | Cumulative 24-hour PM10 on the Day of Maximum Project Contribution (2018–2019) (µg/m3) |
| Year 2 | | |
| R31 | 25 | 36 |
| R32 | 19 | 27 |
| R37 | 19 | 30 |
| R38 | 18 | 32 |
| R97 | 17 | 28 |
| Year 7 | | |
| R36 | 19 | 27 |
| R40 | 15 | 27 |
| R41 | 14 | 26 |
| R102 | 13 | 25 |
| R7 | 12 | 25 |
| Year 22 | | |
| R43 | 39 | 47 |
| R44 | 32 | 39 |
| R40 | 22 | 30 |
| R39 | 19 | 27 |
| R41 | 19 | 31 |

The background air quality concentration (24-hour average PM10) exceeded the APAC over the 2018–2019 modelling period on several occasions for each modelling scenario. Figure 13‑11, Figure 13‑12 and Figure 13‑13 show the background contribution (orange) ranked from highest to lowest for each operating scenario at the most affected sensitive receptors. For each background exceedance of the APAC, the Project contribution (green) was low between 0.1 µg/m3 and 1.4 µg/m3. This Project contribution, on the day of the maximum background was less than 4% of the APAC which was considered a non-significant contribution in line with EPA Publication 1961 (EPA 2022). The cumulative concentrations at sensitive receptors were less than 75% of the APAC for at least 99% of the year.

Chart

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Figure 13‑11: Ranked Project contribution (year 2) at Receptor 31 and corresponding background concentration for 24-hour average PM10 (2018–2019 modelling period)

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Figure 13‑12: Ranked project contribution (year 7) at Receptor 36 and corresponding background concentration for 24-hour average PM10 (2018–2019 modelling period)



Figure 13‑13: Ranked project contribution (year 22) at Receptor 43 and corresponding background concentration for 24-hour average PM10 (2018–2019 modelling period)

For each of the highest Project contributions (24-hour average) in each scenario, an analysis of the background conditions was conducted with consideration to the 5 year modelling (2015–2018) to assess the likelihood that the APAC may be exceeded (refer Appendix H, Section 11.2 to 11.4). The likelihood of exceeding the criteria due to the Project contribution, with consideration to a range of meteorological conditions was low.

The maximum Project contribution (24-hour average PM10) during the 2018–2019 modelling period for each operational scenario (years 2, 7, 22) are shown in Figure 13‑14, Figure 13‑16 and Figure 13‑18. These figures show the spatial extent and magnitude of the PM10 concentration in relation to the identified sensitive receptors.

Figure 13‑15, Figure 13‑17 and Figure 13‑19 show the annual average PM10 cumulative concentrations for each scenario during the 2018–2019 modelling period. There were no exceedances of the APAC (20 µg/m3) at any of the receptors identified. The maximum distance from the source at which the annual average PM10 cumulative concentration exceeds the APAC is shown in these figures.

The residual impacts of the Project PM10 emissions for all scenarios were considered to be minor and will be experienced temporarily at sensitive receptors over the life of the Project. Further discussion of the operational residual impacts is provided in Section 13.7.2.6.

|  |  |
| --- | --- |
| Diagram, map  Description automatically generated  **Figure 13‑14: Max 24-hour average PM10 Project contribution 2018–2019 (year 2)** | Map  Description automatically generated  **Figure 13‑15: Annual average cumulative PM10 (year 2)** |
| Diagram, map  Description automatically generated  Figure 13‑16: Max 24-hour average PM10 Project contribution 2018–2019 (year 7) | A picture containing map  Description automatically generated  Figure 13‑17: Annual average cumulative PM10 (year 7) |

|  |  |
| --- | --- |
| Map  Description automatically generated  **Figure 13‑18: Max 24-hour average PM10 Project contribution 2018–2019 (year 22)** | A picture containing diagram  Description automatically generated  **Figure 13‑19: Annual average cumulative PM10 (year 22)** |

#### Particulate Matter PM2.5

The receptors with the highest Project contribution (24-hour average PM2.5) for each scenario during the 2018-2019 period are shown in Table 13‑12. During the modelling period, days with the highest Project contribution did not exceed the APAC (25 µg/m3) when considered cumulatively with the background.

The highest Project contribution across all scenarios was 7.9 µg/m3 at Receptor 43 (1.5 km north-west of Jung) during year 22, and the associated cumulative 24-hour maximum PM2.5 concentration was 17 µg/m3.

Table 13‑12: Maximum 24-hour average PM2.5 Project contribution and cumulative concentration (year 2, 7, 22)

|  |  |  |
| --- | --- | --- |
| Receptor | Maximum 24-hour Average PM2.5 Project Contribution  (2018–2019) (µg/m3) | Cumulative 24-hour PM2.5 on the Day of Maximum Project Contribution (2018–2019) (µg/m3) |
| Year 2 | | |
| R31 | 4.0 | 17 |
| R38 | 3.9 | 19 |
| R37 | 3.9 | 17 |
| R32 | 3.8 | 17 |
| R97 | 3.6 | 17 |
| Year 7 | | |
| R40 | 2.5 | 17 |
| R39 | 2.2 | 17 |
| R43 | 2.1 | 17 |
| R36 | 2.1 | 17 |
| R44 | 2.0 | 17 |
| Year 22 | | |
| R43 | 7.9 | 17 |
| R44 | 6.1 | 17 |
| R40 | 5.0 | 17 |
| R39 | 4.4 | 17 |
| R41 | 3.3 | 17 |

Similarly, there were no exceedances of the annual average APAC (8 µg/m3) at any of the receptors identified. The highest annual average Project contribution was 0.42 µg/m3 and the highest cumulative annual average concentration was 4.9 µg/m3 at Receptor 43 (1.5 km north-west of Jung). The percentage change in predicted Project concentration relative to the APACs was more than 4%, but the cumulative concentrations were less than 75% of the APACs at any location relevant to the averaging period for at least 99% of the year.

The Project contributions over the longer modelling period between 2015–2018 were shown to be similar to the 2018–2019 modelling period (refer Appendix H, Sections 11.2 to 11.4).

The residual impacts of the Project PM2.5 emissions for the operational scenario were considered to be minor and will be experienced temporarily at sensitive receptors over the life of the Project. Further discussions of the operational residual impacts are provided in Section 13.7.2.6.

#### Respirable Crystalline Silica

The receptors with the highest Project contribution (annual average PM2.5 as RCS) during the 2018–2019 modelling period are shown in Table 13‑13. It was assumed that 100% of PM2.5 was RCS as a conservative assumption. During the modelling period, days with the highest Project contribution did not exceed the APAC (3 µg/m3). The highest Project contribution during the 2018–2019 modelling period was 0.42 µg/m3 at Receptor 43 (1.5 km north-west of Jung) during year 22 and the associated cumulativeconcentration was 0.55 µg/m3.

The Project contributions over the longer modelling period between 2015–2018 were slightly higher but similar to the 2018–2019 modelling period (refer Appendix H, Section 11.2 to 11.4).

Table 13‑13: Annual average PM2.5 as RCS concentrations during operations (years 2, 7, 22)

|  |  |  |
| --- | --- | --- |
| Receptor | Annual Average PM2.5 as RCS Project Contribution  (2018–2019) (µg/m3) | Annual Average PM2.5 as RCS Cumulative Concentration on the Day of Maximum Project Contribution (2018–2019) (µg/m3) |
| Year 2 | | |
| R38 | 0.22 | 0.35 |
| R32 | 0.16 | 0.29 |
| R31 | 0.14 | 0.27 |
| R37 | 0.12 | 0.25 |
| R97 | 0.11 | 0.24 |
| Year 7 | | |
| R7 | 0.13 | 0.26 |
| R12 | 0.11 | 0.24 |
| R37 | 0.11 | 0.24 |
| R14 | 0.11 | 0.24 |
| R15 | 0.11 | 0.24 |
| Year 22 | | |
| R43 | 0.42 | 0.55 |
| R44 | 0.24 | 0.37 |
| R41 | 0.23 | 0.36 |
| R42 | 0.21 | 0.34 |
| R40 | 0.20 | 0.33 |

The residual impacts of the Project RCS emissions for the operational scenarios were considered to be negligible. Further discussion of the residual impacts is provided in Section 13.7.2.6.

#### Metals

Metal emissions were scaled from PM10 predictions for the maximum concentrations at the Project boundary for 1-hour average periods and individual sensitive receptors for 24-hour and annual mean averaging periods.

All metal concentrations were predicted to be below their respective criteria for annual average, maximum 24-hour average and maximum 1-hour average periods (refer Appendix H, Section 11.2 to 11.4)

The residual impacts of the metal emissions across all scenarios were considered to be negligible. Further discussion of the residual impacts is provided in Section 13.7.2.6.

#### Depositional dust

The highest predicted Project contribution at a sensitive receptor was 0.39 g/m2/month during year 22 for the 2018–2019 modelling period. While there are no current air quality assessment criteria for depositional dust in Victoria, the criteria in the ‘Protocol for Environmental Management: Mining and extractive industries’ (EPA, 2007) has been applied as a point of reference. These criteria state that monitoring should not exceed 4 g/m2/month (no more than 2 g/m2/month above background) as a monthly average. The depositional Project contribution was greater than 4% of the relevant criteria and the residual impact was considered to be minor.

#### Summary Residual Impacts

The residual impacts at sensitive receptors due to air emissions for all scenarios were considered to be negligible to minor, as described in Sections 13.7.2.1 to 13.7.2.5. The progressive mining and rehabilitation strategy means the worst-case impacts at each sensitive receptor will be temporary. Mining cells are expected to be disturbed and a potential source of Project related dust for a period of 1.5 to 4 years from initial disturbance through to mining and rehabilitation.

It is expected that mitigation measures to minimise area disturbed over the life of the Project in combination with an adaptive management strategy to mitigate dust lift-off using water carts on roads and disturbed areas will effectively minimise residual impacts. The adaptive management strategy outlined in the AQMP will be established to ensure the avoidance and mitigation measures described in Section 13.6 can be applied in response to forecast weather conditions, monitoring results and community complaints to minimise residual impacts so far as reasonably practicable.

The potential effects and risks associated with dust emissions are further described in Chapter 18 (Human Health Risk Assessment).

### Rehabilitation

There is one potential impact identified in Section 13.5.1 relating to the generation of air emissions that may impact sensitive receptors during rehabilitation (IP-03).

To assess the residual impacts, Project emissions were modelled during year 30 within Block D as described in Section 13.3. Activities associated with this scenario include the loading and placement of overburden, subsoil and topsoil. This scenario has been modelled to represent rehabilitation activities at the end of mine life and does not include mining related emissions. Section 13.7.2 considers both rehabilitation and mining activities. Rehabilitation of the final void and overburden stockpile is expected to be complete by year 36. It is expected that air emissions from completed rehabilitation areas will be commensurate with surrounding agricultural areas.

#### Particulate Matter PM10

The receptors with the highest Project contribution (24-hour average PM10) during the 2018–2019 period are shown in Table 13‑14. During the modelling period, days with the highest Project contribution did not exceed the APAC (50 µg/m3) when considered cumulatively with the background. The highest Project contribution across all scenarios was 7 µg/m3 at Receptor 89 (1.5 km south-west of WBA) and the associated cumulative 24-hour maximum PM10 concentration was 18 µg/m3.

Table 13‑14: Maximum 24-hour average PM10 Project contribution and cumulative concentration (year 30)

|  |  |  |
| --- | --- | --- |
| Receptor | Max 24-hour Average PM10 Project Contribution  (2018–2019) (µg/m3) | Cumulative 24-hour PM10 on the Day of Maximum Project Contribution  (2018–2019) (µg/m3) |
| R89 | 7 | 18 |
| R4 | 7 | 12 |
| R7 | 7 | 21 |
| R5 | 6 | 25 |
| R37 | 6 | 14 |

The background air quality (24-hour average PM10) exceeded the APAC over the 2018–2019 modelling period on several occasions. Figure 13‑20 shows the background contributions ranked from highest to lowest at the most affected sensitive receptor. For each background exceedance of the APAC, the Project contribution was between 0.2 µg/m3 and 0.4 µg/m3. This Project contribution, on the day of the maximum background was less than 4% of the APAC which was considered a non-significant contribution in line with EPA Publication 1961 (EPA, 2022). The cumulative concentrations at sensitive receptors were less than 75% of the APAC for at least 99% of the year.

Chart, bar chart

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Figure 13‑20: Ranked project contribution (year 30) at Receptor 89 and corresponding background concentration for 24-hour average PM10 (2018–2019 modelling period)

For each of the highest Project contributions (24-hour average), an analysis of the background conditions was conducted with consideration to the 5 year modelling period (2015–2018) to assess the likelihood that the APAC may be exceeded (refer Appendix H, Section 11.5). The likelihood of exceeding the criteria due to Project contributions, with consideration to a range of meteorological conditions was considered to be low.

The maximum Project contribution (24-hour average PM10) during the 2018–2019 modelling period for the rehabilitation scenario (year 30) is shown in Figure 13‑21.This figure shows the spatial extent and magnitude of the PM10 concentration in relation to the identified sensitive receptors.

Figure 13‑22 shows the annual average PM10 cumulative concentrations for each scenario during the 2018 - 2019 modelling period. There were no exceedances of the APAC (20 µg/m3) at any of the receptors identified. The maximum distance from the source at which the annual average PM10 cumulative concentration exceeds is shown in this figure.

The residual impacts of the Project PM10 emissions for the rehabilitation scenario were considered to be minor and will be experienced temporarily at sensitive receptors toward the end of the Project once mining is complete. Further discussion on the residual impacts is provided in Section 13.7.3.6.

|  |  |
| --- | --- |
| Diagram  Description automatically generated  **Figure 13‑21: Max 24-hour average PM10 Project contribution 2018–2019 (year 30)** | A picture containing diagram  Description automatically generated  **Figure 13‑22: Annual average cumulative PM10 (year 30)** |

#### Particulate Matter PM2.5

The receptors with the highest Project contribution (24-hour average PM2.5) during the 2018–2019 period are shown in Table 13‑15. During the modelling period, days with the highest Project contribution did not exceed the APAC (25 µg/m3) when considered cumulatively with the background.

The highest Project contribution was 1.1 µg/m3 at Receptor 5 (2 km west for the Project area) and the associated cumulative 24-hour maximum PM2.5 concentration was 18 µg/m3.

Table 13‑15: Maximum 24-hour average PM2.5 Project contribution and cumulative concentration

|  |  |  |
| --- | --- | --- |
| Receptor | Maximum 24-hour Average PM2.5 Project Contribution  (2018–2019) (µg/m3) | PM2.5 Cumulative on the Day of Maximum Project Contribution  (2018–2019) (µg/m3) |
| R5 | 1.1 | 18 |
| R7 | 1.1 | 17 |
| R89 | 1.0 | 17 |
| R36 | 0.9 | 17 |
| R37 | 0.8 | 17 |

Similarly, there were no exceedances of the annual average APAC (8 µg/m3) at any of the receptors identified. The highest annual average Project contribution was 0.08 µg/m3 at Receptors 89 and 7 (1.5 km south of Block D), and the highest cumulative annual average concentration was 4.5 µg/m3 at each location. The percentage change in predicted Project concentration relative to the APACs was less than 4%.

The Project contributions over the longer modelling period between 2015–2018 were shown to be similar to the 2018-2019 modelling period (refer Appendix H, Section 11.5).

The residual impacts of the Project PM2.5 emissions for the rehabilitation scenario were considered to be negligible at sensitive receptors over the life of the Project. Further discussion of the residual impacts is provided in Section 13.7.3.6.

#### Respirable Crystalline Silica

The receptors with the highest Project contribution (annual average PM2.5 as RCS) during the 2018–2019 modelling period are shown in Table 13‑16. It was assumed that 100% of PM2.5 was RCS as a conservative assumption. During the modelling period, days with the highest Project contribution did not exceed the APAC (3 µg/m3). The highest Project contribution during the 2018–2019 modelling period was 0.08 µg/m3 at Receptor 89 (1.5 km south-west of WBA) and the associated cumulativeconcentration was 0.22 µg/m3.

The Project contributions over the longer modelling period between 2015–2018 were slightly higher but similar to the 2018-2019 modelling period (refer Appendix H, Section 11.5).

Table 13‑16: Annual average PM2.5 as RCS concentrations during (year 30)

|  |  |  |
| --- | --- | --- |
| Receptor | Annual Average PM2.5 as RCS Project Contribution  (2018–2019) (µg/m3) | Annual Average PM2.5 as RCS Cumulative Concentration on the Day of Maximum Project Contribution (2018–2019) (µg/m3) |
| R89 | 0.08 | 0.22 |
| R7 | 0.08 | 0.20 |
| R52 | 0.05 | 0.18 |
| R51 | 0.05 | 0.18 |
| R5 | 0.05 | 0.18 |

The residual impacts of the Project RCS emissions for the rehabilitation scenario were considered to be negligible. Further discussion of the residual impacts is provided in Section 13.7.3.6.

#### Metals

Metal emissions were scaled from PM10 predictions for the maximum concentrations at the Project boundary for 1-hour average periods and individual sensitive receptors for the 24-hour and annual mean averaging periods.

All metal concentrations were predicted to be below their respective criteria for annual average, maximum 24-hour average and maximum 1-hour average periods (refer Appendix H, Section 11.5.4).

The residual impacts of the Project RCS emissions for the rehabilitation scenario were considered to be negligible. Further discussions of the residual impacts are provided in Section 13.7.3.6.

#### Depositional dust

The highest predicted project contribution at a sensitive receptor was 0.06 g/m2/month for the 2018–2019 modelling period. While there are no current air quality assessment criteria for depositional dust in Victoria, the criteria in the ‘Protocol for Environmental Management: Mining and extractive industries’ (EPA, 2007) has been applied as a point of reference. These criteria state that monitoring should not exceed 4 g/m2/month (no more than 2 g/m2/month above background) as a monthly average. The depositional Project contribution was less than 4% of the relevant criteria and the residual impact was considered to be negligible.

#### Summary of Residual Impacts

The residual impacts at sensitive receptors due to air emissions for the rehabilitation scenario were considered to be negligible to minor, as described in Sections 13.7.3.1 to 13.7.3.5. As explained in this Chapter, the progressive mining and rehabilitation strategy means the worst-case impacts at each sensitive receptor will be temporary. This scenario has been modelled to show the rehabilitation emissions at the end of mine life when mining has ceased.

Over the life of the Project, mining cells are expected to be disturbed and a potential source of Project related dust for a period of 1.5-4 years from initial disturbance through to mining and rehabilitation. These emissions are considered in the operational scenarios listed in Section 13.3.

It is expected that mitigation measures to minimise area disturbed over the life of the Project in combination with an adaptive management strategy to mitigate dust lift-off using water carts on roads and disturbed areas, will effectively minimise residual impacts (refer Section 13.6). The adaptive management strategy outlined in the AQMP will be established to ensure the avoidance and mitigation measures described in Section 13.6 can be applied in response to forecast weather conditions, monitoring results and community complaints.

The potential effects and risks associated with dust emissions are further described in the Chapter 18 (Human Health Risk Assessment).

## Management Framework

An AS/NZS ISO 14001:2016 EMS will be established for the Project, as detailed in Chapter 24. The EMS will address matters relating to planning, risk management, operational control, monitoring and continuous improvement over the life of the Project. Relevant matters relating to air quality monitoring, auditing and corrective actions/contingencies are summarised below.

### Environmental Objectives

Environmental objectives will be established as part of the EMS to articulate the outcomes to be achieved during Project implementation. These will reflect the expected and achievable outcomes based on the studies undertaken as part of this EES.

The key environmental objective is to ensure that air emissions from the Project will result in no material change to the environmental values or land use at sensitive receptors.

Performance standards will be established to measure/assess if the objective has been achieved during operation, as further discussed below in Section 13.8.2.

### Monitoring and Management

An air quality monitoring program will be incorporated into the EMS and associated AQMP to measure, analyse and evaluate the effectiveness of the avoidance and mitigation measures and overall environmental performance. The AQMP will be developed in consultation with stakeholders and will be subject to approval by the relevant Authority.

Air quality monitoring will be undertaken over the life of the Project at sensitive receptors to confirm the avoidance and mitigation measures are effective. In line with the requirements of the EMS described in Chapter 24 and relevant legislation, additional measures may be required during implementation to ensure risks and potential impacts have been minimised so far as reasonably practicable.

Monitoring locations will be established by a suitably qualified person, with consideration to the source/activity, established/proposed mitigation measures and sensitive receptors. Real-time continuous air quality monitoring of particulate matter (PM10 and PM2.5), with periodic analysis of RCS and metals, will be undertaken at representative sensitive receptors and compared to the predicted/modelled air emissions, project specific objectives/performance standards and the air quality criteria listed in Section 13.5.3.

Visual inspection and reporting of nuisance dust will be expected of all workers on-site. Immediate corrective actions will be applied when excessive dust is observed, and an incident will be reported in line with the overarching requirements of the EMS.

If nuisance dust is reported or air emissions are recorded trending toward predicted/modelled levels, internal performance standards or established regulatory criteria, a root cause investigation will be undertaken, and corrective actions identified and implemented where appropriate. Similarly, if community complaints are made, these will be investigated in the same manner.

Corrective actions may be applied as an immediate response to an observed issue or in response to a root cause investigation. These may include:

* Amending the open area/road watering schedule to increase the frequency of watering during particular periods as required.
* Soil stabilisers may be applied to open areas or topsoil/subsoil stockpiles if they do not naturally crust or if vegetation cover is not effectively established.
* Sediment fences may be established to protect sensitive receptors from surface creep where required.
* Sprinklers may be activated on the HMC stockpile if the inherent water content drops and surface creep is observed.
* Vehicle speeds may be periodically reduced during extreme weather conditions.

The air quality monitoring requirements will be established in the AQMP and will be subject to approval by the relevant Authority prior to commencement.

### Audits

Periodic internal and independent audits will be undertaken to assess the effectiveness of the EMS. An internal audit program will be maintained, which details the frequency, methods, responsibilities, and reporting requirements.

Audits will be undertaken by a suitably qualified person to assess the effectiveness of the EMS and associated management plans, including the AQMP to minimise or avoid air quality impacts so far as reasonably practicable. Any non-conformity identified in the audit will be investigated and corrective actions identified.

The outcomes of audits will be communicated to the Project Management team and records of the audit findings will be retained in the record management system. Significant findings will be reported to the relevant Regulator/s and stakeholders where appropriate to do so.

## Cumulative Impacts

The Avonbank EES has considered various proposed projects within the region that may have the potential to contribute to the cumulative effects within the study area. These projects are described in Chapter 7 (Regional Setting) and include:

* Western Highway Duplication project.
* Western Renewables Link project.
* Wimmera Mineral Sands project.
* WIM150 Mineral Sands project.
* Donald Minerals Sands project.
* Murra Warra Wind Farm project.
* Wimmera Plains Energy Facility.

Despite multiple projects operating and proposed in the region, it is considered that none of the projects listed above would result in any cumulative impacts, either because they are too distant for the zones of impact to overlap or because emissions would not occur concurrently.

## Conclusions

This Chapter provides an overview of the Air Quality Impact Assessment prepared to address the EES Scoping Requirements for the Avonbank Mineral Sands Project.

The potential impacts associated with the Project activities were assessed as part of the Tonkin and Taylor impact assessment. Consideration was given to potential impacts associated with particulate matter, respirable crystalline silica, heavy metals and depositional dust for all phases of the Project.

Avoidance and mitigation measures were identified to reduce the residual impacts so far as reasonably practicable. Listed below are the key measures identified:

* Transport of HMC will be undertaken on sealed roads to avoid wheel generated dust and will be stored and loaded onto the ship via a closed system.
* The active operational area disturbed will be minimised so far as reasonably practicable.
* Gravel and low silt content material will be used for internal haulage routes.
* Open areas and unsealed roads will be routinely watered, and schedules will be adapted as required in response to forecast weather conditions, monitoring and community feedback.
* HMC will be stockpiled wet, and sprinklers will be established to maintain moisture content and minimise surface creep during extremely dry conditions.
* Topsoil stripping and placement will be avoided during extreme weather conditions.
* Appropriately sized vehicles will be used to maximise the efficiency of material carting and minimise the number of haulage circuits.
* Topsoil stripping and placement will be avoided during extreme weather conditions.
* An AQMP will be established to provide a framework for the management of residual impacts and risks.
* A Community Engagement Plan will be implemented to provide a framework for consultation over the life of the Project.
* Mined areas will be progressively rehabilitated and stabilised with a crop cover 1.5 to 4 years after disturbance.

The progressive mining and rehabilitation strategy means the worst-case impacts at each sensitive receptor will be temporary. Mining cells are expected to be disturbed and a potential source of Project related dust for a period of 1.5 to 4 years from initial disturbance through to mining and rehabilitation.

It is expected that mitigation measures to minimise area disturbed over the life of the Project in combination with an adaptive management strategy to mitigate dust lift-off using water carts on roads and disturbed areas will effectively minimise residual impacts.

The adaptive management strategy outlined in the AQMP will be established to ensure the avoidance and mitigation measures described in Section 13.6 can be applied in response to forecast weather conditions, monitoring results and community complaints to minimise residual impacts so far as reasonably practicable.

The residual impacts associated with all phases of the Project were below the APAC for all indicators except for the 24-hour average PM10 cumulative concentration which exceeded the associated APAC due to the elevated background conditions on several days for each scenario during the 2018–2019 modelling period. The Project contribution in these instances was very low.

Air emissions from nearby Projects (existing and proposed) are unlikely to materially add to those generated by the Avonbank Project impacts to those described in this Chapter.

The above residual impacts were all considered to be minor or negligible. Overall, the proposed Project work/activity is unlikely to result in significant air quality environmental effects and the associated impacts can be managed with avoidance and mitigation measures in place to achieve the evaluation objectives.

1. Operations and rehabilitation (O); Decommissioning and closure (D) [↑](#footnote-ref-2)