# Air Quality Impact Assessment

## Eulonga Quarry Proposed Extraction Area

### Eulonga Quarries Pty Limited


Prepared by:

**SLR Consulting Australia**



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## Revision Record

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# Basis of Report

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

This report is for the exclusive use of the Client. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR.

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# Table of Contents

## Tables in Text

## Figures in Text

# Appendices

# Executive Summary

Eulonga Quarries Pty Limited ('Eulonga Quarries') operates the Eulonga Quarry (EQ) in a rural area of Coolac NSW, on the Murrumbidgee River. The existing EQ includes quarrying (sand extraction) areas, a stockpiling area, internal access roads, and supporting infrastructure. Products include: fine sand, coarse sand, sand blend, river rock, and cement premix. The EQ is licensed by the NSW Environment Protection Authority (EPA) to extract 172 kilotonnes per annum (ktpa) of material.

Eulonga Quarries proposes to establish a new, extraction area approximately 2.0 km south-west of the existing operation ('the Site'). The existing EPA-licensed hours of operation and extraction rate covering both sites will remain unchanged.

Eulonga Quarries commissioned SLR Consulting Australia Pty Ltd (SLR) to prepare an Air Quality Impact Assessment (AQIA), to assess the potential air quality impacts associated with the proposed new area, and to support an Environmental Impact Statement.

As required, the AQIA was undertaken in accordance with the EPA's 'Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales'. The assessment methodology included air dispersion modelling of air emissions estimates for the existing sand extraction operation, and the Site, to predict the potential air quality impacts.

Key assumptions in the modelling assessment included no changes to the EPA-approved maximum production rate of 172 ktpa, and no changes to the existing processing equipment and methods. The results of the cumulative air quality impact assessment for airborne particulate matter and deposited dust from the proposed extraction area, which included the effects due to operations in the existing approved areas, did not lead to modelled exceedances of air quality impact assessment criteria at the sensitive receptor locations.

Based on the results of this assessment, it is concluded that air quality impact does not represent a constraint to Eulonga Quarries' proposed extraction area.

On-site air quality management measures assumed for the dust modelling are described in this report. From review of the model results, and a site visit by an SLR air quality specialist, some additional and practical management measures that don't require additional water include:

- Simply, maintain awareness of visible dust emissions – if a dust plume is heading in the direction of a sensitive receptor, modify or stop the relevant activity, which may include waiting until wind direction shifts.
- Use speed limits for parts of the site including the access roads to minimise wheel-generated dust. Practically, 60 km/h would be a reasonable speed limit for the access roads, with 40 km/h being desirable. A speed limit of 10-20 km/h would be more appropriate for the stockpile/truck loading areas.
- Dust emissions can be reduced by dropping loads carefully into trucks and sand-screeners, and minimising drop heights.
- Keep detailed records of any dust complaints and address complaints rapidly.

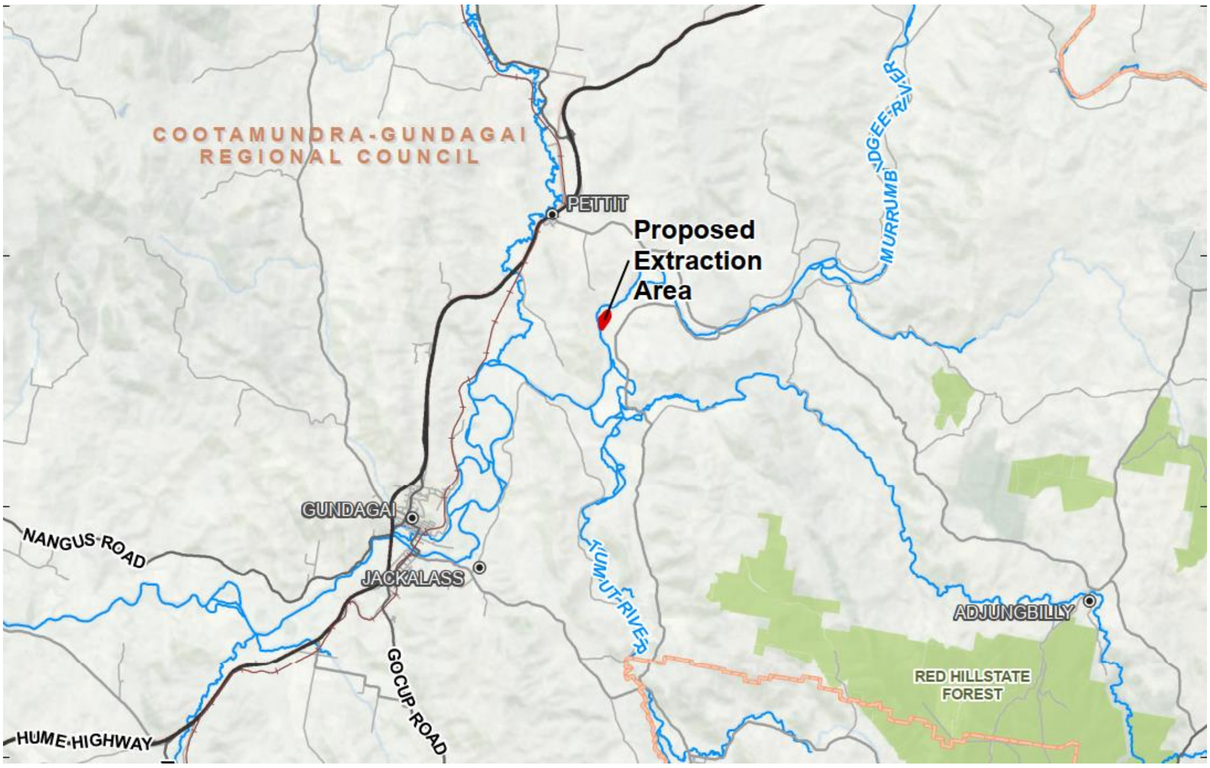
Some of these and other measures for consideration listed in this report would be typical considerations for a site-specific, Air Quality Management Plan, which would cover all sources of emissions.

# 1.0 Introduction

## 1.1 Eulonga Quarry

Eulonga Quarries Pty Limited ('Eulonga Quarries') operates the Eulonga Quarry (EQ) in a rural area of Coolac NSW, on the Murrumbidgee River. The EQ is located approximately 13 kilometres (km) north-east of the township of Gundagai, and 6.0 km south-east of Coolac on the Hume Highway. A regional map showing the location of the location of the proposed new extraction area is provided in **Figure 1-1** (extract from SLR Regional Locality Map, 10/12/2024).

**Figure 1-1: Regional Map: Eulonga Quarry Proposed Extraction Area**




The existing EQ includes quarrying areas, a stockpiling area, internal access roads, and supporting infrastructure. Products include: fine sand, coarse sand, sand blend, river rock, and cement premix (EQ 2024). The EQ is licensed by the NSW Environment Protection Authority (EPA) to extract 172,000 tonnes per annum (tpa) of material (NSW EPA 2023). Other conditions set out in the Environment Protection Licence (EPL) 12835, relevant to air quality impact assessment, are:

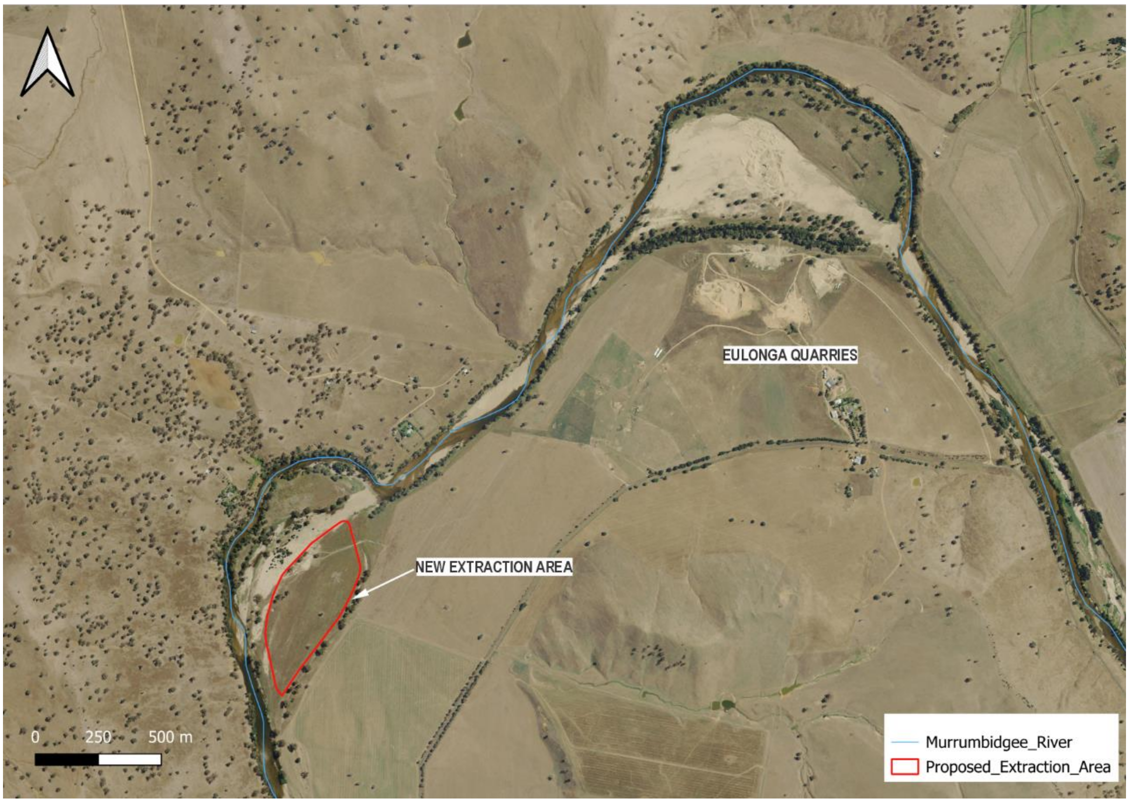
- **Hours of operation**
- L4.1 Standard construction hours:
  - Unless otherwise specified by any other condition of this licence, all construction activities are:
  - a) restricted to between the hours of 7:00am and 6:00pm Monday to Saturday; and
  - b) not to be undertaken on Sundays or Public Holidays.
- **O2 Maintenance of plant and equipment**

- O2.1 All plant and equipment installed at the premises or used in connection with the licensed activity:
- a) must be maintained in a proper and efficient condition; and
- b) must be operated in a proper and efficient manner.
- **O3 Dust**
- O3.1 All operations and activities occurring at the premises must be carried out in a manner that will minimise the emission of dust from the premises.
- O3.2 Trucks entering and leaving the premises that are carrying loads must be covered at all times, except during loading and unloading.
- **M2 Recording of pollution complaints**
- M2.1 The licensee must keep a legible record of all complaints made to the licensee or any employee or agent of the licensee in relation to pollution arising from any activity to which this licence applies.

## 1.2 Proposed Extension

Eulonga Quarries proposes to establish a new, 14-hectare (ha) extraction area approximately 2.0 km south-west of the existing operation. The existing EPA-licensed hours of operation and extraction rate of 172,000 tpa will remain unchanged. The proposed new extraction area in relation to the existing EQ operations is illustrated in **Figure 1-2**.

**Figure 1-2: Proposed Extension and Existing EQ Site**




SLR was commissioned by Eulonga Quarries with a scope of works including to provide an assessment of the proposal and addressing legislative requirements, potential impacts and mitigation measures, and preparation of an Environmental Impact Statement (EIS) with supporting plans and reports.

## 1.3 Air Quality Assessment

Eulonga Quarries commissioned SLR Consulting Australia Pty Ltd (SLR) to prepare an Air Quality Impact Assessment (AQIA), to assess the potential air quality impacts associated with the proposed extraction area at the Eulonga Quarry (the Site), and to support the EIS.

This AQIA has been performed in accordance with the NSW EPA document '*Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales*' (NSW EPA 2022), hereafter referred to as the 'EPA Approved Methods'. The assessment methodology included air dispersion modelling of air emissions estimates for the Site to predict the potential air quality impacts. The sections of this report where the requirements of the EPA Approved Methods are met are as follows:

- Description of Site Plan including layout of the Site clearly operational areas, boundaries, sensitive receptor locations and local topographic features (**Appendix A**, **Section 3.0**)., and **Section 4.0**.
- Establishment of air quality assessment criteria for the Site (**Section 2.0**).
- A detailed discussion of the methodology used to calculate the expected pollutant emission rates for each source, including detailed calculations (**Section 3.0**).
- A description of the techniques used to prepare the meteorological data into a format for use in the dispersion modelling (**Sections 6.2**).
- A detailed discussion of the prevailing dispersion meteorology at the Site, including wind rose diagrams, an analysis of wind speed, wind direction, stability class, ambient temperature and mixing height (**Sections 6.3**).
- A detailed discussion of the methodology used to calculate the background concentrations for each pollutant including tables summarising the ambient monitoring data (**Section 7.0**).
- A detailed discussion of air quality impacts for all relevant pollutants, based on predicted ground-level concentrations at all sensitive receptors, including risk isopleths and tables summarising the predicted concentrations of all relevant pollutants at sensitive receptors (**Section 8.0**).

## 1.4 Site Inspection

A site inspection of the existing operations and the proposed extraction area was undertaken on 22/12/2024 by an experienced air quality specialist (M. Pickett, 22/12/2024). The day was hot, with strong winds experienced at higher levels. Air quality conditions were poor due to smoke from distant fires to the north. The EQ site was found to be well protected from the strong winds due to surrounding high hills forming the river valley.

The site inspection revealed the EQ sands to be moist underneath drier surface layers with a tendency to crust over if not being used. For example, sand stockpiles were well crusted, and moist underneath. Other exposed areas had a high stony content with small river pebbles and clays contributing to stabilisation of surface layers. As such the areas identified as dust sources for this assessment were limited to unpaved roads and the working areas used by loaders and trucks. All other areas were thickly vegetated with grasses. Other dust sources identified were sand-screeners and excavators.

No existing or potential future sources of odours were identified.

# 2.0 Assessment Requirements

## 2.1 Overview

This section sets out the assessment requirements for the Project, describes the NSW policy and guidance for air quality impact assessment relevant for the Eulonga Quarries proposal.

## 2.2 Planning SEARs

The Planning Secretary's Environmental Assessment Requirements (SEARs) received 5 September 2024 outlined items to be addressed in an Environmental Impact Statement (EIS). The SEARs related to air quality assessment were:

- *The goals of the project in relation to air quality should be to ensure sensitive receptors are protected from adverse impacts from dust, odour and particulate emissions.*
- *The project must create an emissions inventory that identifies all potential air pollutants at their source and discharge point. Measures to prevent or control the emission of dust, odour and particulates must be detailed based on the outcome of an assessment of air pollutants undertaken in accordance with the Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in New South Wales (EPA, 2022). All potentially impacted residential or sensitive premises likely to be impacted by the development must be identified and included in the assessment.*
- *The EIS needs to identify any other existing impacts on air quality within the area, and if necessary provide an assessment and commentary on the predicted cumulative impacts that may arise.*
- *Emissions from any plant must meet the design criteria detailed in the Protection of the Environment Operations (Clean Air) Regulation 2022. Details need to be provided on the proposed air pollution control techniques from any air emission points, including proposed measures to manage and monitor efficiency and performance.*

The critical SEAR requirement was a (cumulative) air quality impact assessment to be undertaken in accordance with the EPA Approved Methods. A requirement of the EPA Approved Methods is cumulative air quality impact assessment, which is based on comparisons of model-predicted, total air pollutant concentrations, with prescribed ambient air quality standards, referred to as impact assessment criteria. The purpose of these criteria is the protection of human health and amenity, therefore they do not distinguish between predicted air emissions due to a proposal and emissions from other sources. As such this assessment of the proposed new sand extraction area included the effects of dust emissions from the existing sand extraction operation.

## 2.3 POEO

The *Protection of the Environment Operations (Clean Air) Regulation 2022* (NSW Government 2022), ('POEO'), is the key regulatory mechanism in NSW for reducing emissions of air pollutants. The POEO emissions limits, or standards of concentration, are not applicable to heavy vehicles and other mobile equipment such as the equipment used by EQ. This is related to the POEO exemptions for 'special purpose motor vehicles', which includes those used for construction and agriculture.

The POEO makes reference to the use of the EPA Approved Methods for an application to vary an environmental protection licence, which is the main undertaking of this assessment for EQ.

## 2.4 Air Pollutants and EPA Approved Methods

### 2.4.1 Overview

The NSW Environment Protection Authority (EPA) is the NSW regulatory authority for air quality regulation and associated activities. The EPA Approved Methods provides guidance on air quality impact assessment in NSW and prescribes air quality impact assessment criteria reflecting environmental outcomes adopted by the EPA.

### 2.4.2 Pollutants of Interest

The key air pollutants for assessment for the Eulonga Quarries proposal were determined by review of relevant National Pollutant Inventory (NPI) Emissions Estimation Technique Manuals (EETM). While the Eulonga Quarries operation is on a smaller scale than an open-cut mine, tthe activities described in the following manuals are relevant:

- NPI EETM for Mining (DSWPC 2012); and
- NPI EETM for Mining and Processing of Non-Metallic Minerals (DoE 2014).

The key air quality indicators from these types of operations are those associated with dust emissions (discussed in detail in the next section):

- Total Suspended Particulate (matter) (TSP)
- Particulate Matter 10 ($PM_{10}$); the mass concentration of small particles with aerodynamic diameters less than 10 microns ($10^{-6}$ m);
- Particulate Matter 2.5 ($PM_{2.5}$); the mass concentration of small particles with aerodynamic diameters less than 2.5 microns; and
- Dust deposition.

While emissions of pollutants associated with the combustion of diesel fuel such as carbon monoxide (CO) and nitrogen oxides ($NO_X$) will be generated by EQ's equipment, these are unlikely to compromise air quality goals at the closest receptors given the nature and small scale of EQ's operation. Therefore these air pollutants have not been considered further.

### 2.4.3 Airborne Particulate Matter

Airborne contaminants that can be inhaled directly into the lungs can be classified on the basis of their physical properties as gases, vapours or particulate matter. In common usage, the terms "dust" and "particulates" are often used interchangeably. The health effects of particulate matter are strongly influenced by the size of the airborne particles. Smaller particles can penetrate further into the respiratory tract, with the smallest particles having a greater impact on human health as they penetrate to the gas exchange areas of the lungs. Larger particles primarily cause nuisance associated with coarse particles settling on surfaces.

The term "particulate matter" refers to a category of airborne particles, typically less than 30 microns (µm) in diameter and ranging down to 0.1 µm and is termed total suspended particulate (TSP). Particulate matter with an aerodynamic diameter of 10 microns or less is referred to as $PM_{10}$. The $PM_{10}$ size fraction is sufficiently small to penetrate the large airways of the lungs, while $PM_{2.5}$ (2.5 microns or less) particulates are generally small enough to be drawn in and deposited into the deepest portions of the lungs. Potential adverse health impacts associated with exposure to $PM_{10}$ and $PM_{2.5}$ include increased mortality from cardiovascular and respiratory diseases, chronic obstructive pulmonary disease and heart disease, and reduced lung capacity in asthmatic children.

The ambient air quality impact assessment criteria set by NSW EPA for suspended (airborne) particulate matter are listed in **Table 1**, which correspond with national air quality (monitoring) standards established by the National Environment Protection (Ambient Air Quality) Measure (AAQM) (NEPC 2021).

**Table 1 NSW Impact Assessment Criteria for Airborne Particulate Matter**

| Pollutant | Averaging Time | Goal |
|---|---|---|
| TSP | Annual | 90 µg/m³ |
| $PM_{10}$ | 24-Hours | 50 µg/m³ |
| | Annual | 25 µg/m³ |
| $PM_{2.5}$ | 24-Hours | 25 µg/m³ |
| | Annual | 8 µg/m³ |
| Source: EPA Approved Methods | | |

### 2.4.4 Deposited Particulate Matter

Impacts on nuisance (amenity) can occur due to the deposition of dust. The EPA Approved Methods impact assessment criteria for dust deposition are listed in **Table 2**.

**Table 2 Goals for Allowable Dust Deposition**

| Averaging Period | Maximum Increase in Deposited Dust Level | Maximum Total Deposited Dust Level |
|---|---|---|
| Annual | 2 g/m²/month | 4 g/m²/month |
| Source: EPA Approved Methods | | |

# 3.0 Site Activity and Dust Emissions

## 3.1 Overview

This section analyses the existing and proposed sand extraction activities with the potential to create dust emissions, such as materials processing, and handling and storage. Particulate (dust) emissions estimates for these activities are determined using published emission factors with the purpose of providing input data for the dispersion modelling.

The EQ activities and identification of dust sources were determined by inspection of EQ site plans and discussions with EQ. A Site Plan showing the location of the existing operation and the proposed new area is provided in **Appendix A**. The emissions estimates were limited by the EPA-licensed maximum sand extraction rate of 172 kt p.a. The details used for the modelling assessment are set out in the following sub-sections.

## 3.2 Sources of Emissions

Sources of particulate emissions associated with the proposed activities at the quarry include:

- Topsoil removal;
- Raw material extraction activities;
- Loading of materials to transfer to processing area and stockpiles;
- Vehicle entrainment of particulate matter during the haulage of material along unsealed roads for internal movements;
- Unloading of material to processing plants;
- Screening of extracted material at processing plants;
- Transport of product from processing plant to product stockpile area;
- Loading of products to delivery trucks;
- Vehicle entrainment of particulate matter during the haulage of material along unsealed roads for trucks entering/exiting site; and
- Wind erosion associated with material stockpiles, open pit, processing area and topsoil stockpiles.

## 3.3 Emission Estimation Methodology

Particulate emissions from the above sources were estimated for various particle size fractions based on the relevant emission factors sourced from the following:

- National Pollutant Inventory (NPI) *Emission Estimation Technique Manual for Mining* (DSWPC 2012), hereafter the ‘NPI EETM for Mining’;
- National Pollutant Inventory (NPI) *Emission Estimation Technique Manual for Mining and Processing of Non-Metallic Minerals* (DoE 2014), hereafter the ‘NPI EETM for Mining and Processing’;
- USEPA’s AP-42 Emission Factor Handbook; and
- *The Proposed Revisions to Fine Fraction Rations Used for AP-42 Fugitive Emission Factors* by C. Cowherd et al. (Cowherd C Donaldson J.Jr & Hegarty R. 2006).

Meteorological data, particularly wind speed is a critical parameter used in the emission estimation calculations (specifically, for the estimation of emissions from wind erosion and material handling). For the estimation of these emissions, the 2023 meteorological data extracted from CALMET were used (refer to **Section 6.3**).

## 3.4 Activity Data

A summary of the adopted mitigation measures and activity data used to estimate the potential particulate emissions for each emission source is presented in **Table 3** and **Table 4** respectively.

**Table 3 Adopted Mitigation Measures**

| Area | Control | Unit | Assumption |
|---|---|---|---|
| Exposed areas -coarse sand pits | 100 | % | wet material - assumed no wind-blown dust |
| Exposed areas - processing plant area of fine sand quarry | 50 | % | Assumed Level 1 watering (<2 L/m$^2$/hr) |
| Main stockpiles | - | % | No water sprays |
| Haul roads - watering | 50 | % | Assumed Level 1 watering (<2 L/m$^2$/hr)<br>If a dust suppressant additive is used on haul roads the control may be greater than 50%. |

**Table 4 Activity Data used in Estimation of Peak Fugitive Dust Emissions**

| Parameter | Annual Estimation | Unit | Assumption/source |
|---|---|---|---|
| Operating hours -loader | 2,080 | hrs/annum | Assumed 7 am to 3 pm (Monday to Friday) - 8 hours per day, average 5 days per week, in new extraction area |
| Operating hours - haul trucks | 8 | hours/day | Assumed 7 am to 3 pm (Monday to Friday) - 8 hours per day, average 5 days per week, in new extraction area |
| Sand throughput | 172,000 | t/annum | No changes to the approved throughput |
| Pit area (proposed pit only) | 135,500 | $m^2$ | pit drawing |
| Loading screening plant - Coarse Sand | 130,000 | t/annum | - |
| screening - Coarse Sand | 130,000 | t/annum | - |
| Loading screening plant - fine Sand | 42,000 | t/annum | - |
| screening - fine Sand | 42,000 | t/annum | - |
| Moisture content of coarse sand (processing) | 15 | % | Assumed (conservative) |
| Moisture content of fine sand (processing) | 5 | % | Assumed (conservative) |
| Stockpile loading -coarse sand | 130,000 | t/annum | - |
| stockpile loading (product) - coarse sand | 130,000 | t/annum | - |
| Stockpile loading -fine sand | 42,000 | t/annum | - |
| Moisture content (processed material stockpiles) | 5.0 | % | Assumed (conservative) |
| Silt content - Haul road | 4.0 | % | Assumed |
| Raw sand - Average weight of haul truck | 44.9 | t | Volvo A35E Specifications -https://www.volvoce.com/global/en/products-and-services/past-products/articulated-haulers/volvo/a35e/ |
| Raw Sand - Haul truck payload | 33.5 | t | Volvo A35E Specifications -https://www.volvoce.com/global/en/products-and-services/past-products/articulated-haulers/volvo/a35e/ |

| Parameter | Annual Estimation | Unit | Assumption/source |
|---|---|---|---|
| Product Sand - Average weight of haul truck | 48.5 | t | Conservative assumption - 40t truck with CVM of 68.5t (https://www.vicroads.vic.gov.au/~/media/files/documents/business-and-industry/hpfv_mass_map_quad_tri_and_quad_quad_b_doubles.pdf?la=en#:~:text=B%2DDoubles%20are%20up%20to,in%20excess%20of%2068.5%20tonne.) |
| Product Sand - Haul truck payload | 40.0 | t | Conservative assumption - 40t truck with CVM of 68.5t (https://www.vicroads.vic.gov.au/~/media/files/documents/business-and-industry/hpfv_mass_map_quad_tri_and_quad_quad_b_doubles.pdf?la=en#:~:text=B%2DDoubles%20are%20up%20to,in%20excess%20of%2068.5%20tonne.) |
| Hauling distance - raw coarse sand to screening stockpile | 2.6 | km | Based on aerial imagery |
| Hauling distance - Product coarse sand to offsite | 1.4 | km | Based on aerial imagery |
| Hauling distance - raw fine sand | | | no hauling - FEL will be used for stockpiling onsite |
| Hauling distance - Product fine sand | 3.2 | km | Based on site layout - loop around stockpile area |
| Exposed area - fine sand processing plant area and stockpiles | 1.3 | ha | Based on aerial imagery |

## 3.5 Estimated Emissions

A summary of the fugitive dust emissions estimated for the modelled scenario based on the input data and assumptions outlined above is presented in **Table 5**.

**Table 5 Estimated Fugitive Particulate Emissions**

| Scenario | TSP (kg/annum) | $PM_{10}$ (kg/annum) | $PM_{2.5}$ (kg/annum) |
|---|---|---|---|
| **Proposed Pit Operation** | | | |
| Loading to trucks (coarse sand) | 7 | 3 | 1 |
| Hauling to processing plant (coarse sand) | 11,395 | 2,800 | 280 |
| unloading to screening plant (coarse sand) | 7 | 3 | 1 |
| Loading stockpile - from screening plant (coarse sand) | 33 | 15 | 2 |
| Hauling -transfer to product stockpile (coarse sand) | 1,753 | 431 | 43 |
| unloading to product stockpile (coarse sand) | 7 | 3 | 1 |
| Loading to trucks from product stockpile (coarse sand) | 7 | 3 | 1 |
| Hauling - taking product off-site (coarse sand) | 5,323 | 1,308 | 131 |
| **Current Coarse and Fine Sand Pit Operations** | | | |
| unloading to screening plant (coarse sand) | 7 | 3 | 1 |
| Loading stockpile - from screening plant (coarse sand) | 33 | 15 | 2 |
| Hauling -transfer to product stockpile (coarse sand) | 1,753 | 431 | 43 |
| unloading to product stockpile (coarse sand) | 7 | 3 | 1 |
| Hauling - taking product off-site (coarse sand) | 5,323 | 1,308 | 131 |
| unloading to screening plant (fine sand) | 21 | 10 | 2 |
| Loading stockpile - from screening plant (fine sand) | 21 | 10 | 2 |
| unloading to product stockpile (fine sand) | 21 | 10 | 2 |
| Loading to trucks from product stockpile (coarse sand) | 21 | 10 | 2 |
| Hauling - taking product off-site (fine sand) | 3,931 | 966 | 97 |
| Exposed area - fine sand processing plant and stockpiles | 2,278 | 1,139 | 107 |
| **Total TSP emissions (kg/yr)** | **31,947** | **8,473** | **845** |

# 4.0 Existing Environment

## 4.1 Sensitive Receptors

Sensitive receptors are locations where the general population can be adversely impacted by exposure to pollution from the atmospheric emissions. These locations include hospitals, schools, day care facilities and residential housing.

The Site is situated in a rural environment surrounded by several farming properties at varying distances from the Site operations, all but one well beyond one kilometre. A list of existing sensitive receptor points identified in the vicinity of the site is provided in **Table 6**, along with the respective distances of each of these receptor points to an approximate centre point on the Site. **Figure 3** illustrates the location of the surrounding receptors in relation to the Site.

**Table 6 Details of Identified Sensitive Receptors**

| Receptor ID | Receptor Type | Location (m, UTM) | | Indicative distance from Site operations (m) |
|---|---|---|---|---|
| | | Easting | Northing | |
| R1 | Residential | 608,064 | 6,127,920 | 2,450 |
| R2 | Residential | 608,454 | 6,128,361 | 2,030 |
| R3 | Residential | 608,779 | 6,128,168 | 1,710 |
| R4 | Residential | 608,998 | 6,128,407 | 1,490 |
| R5 | Residential | 611,613 | 6,129,684 | 1,810 |
| R6 | Residential | 611,811 | 6,128,551 | 1,360 |
| R7 | Residential | 611,884 | 6,128,109 | 1,420 |
| R8 | Residential (Eulonga Quarry landowner & operator) | 610,527 | 6,128,255 | 60 |

It is emphasised the distances listed in **Table 6** were identified as representative distances for use as input data for dust dispersion modelling. They are not intended for any other purpose.

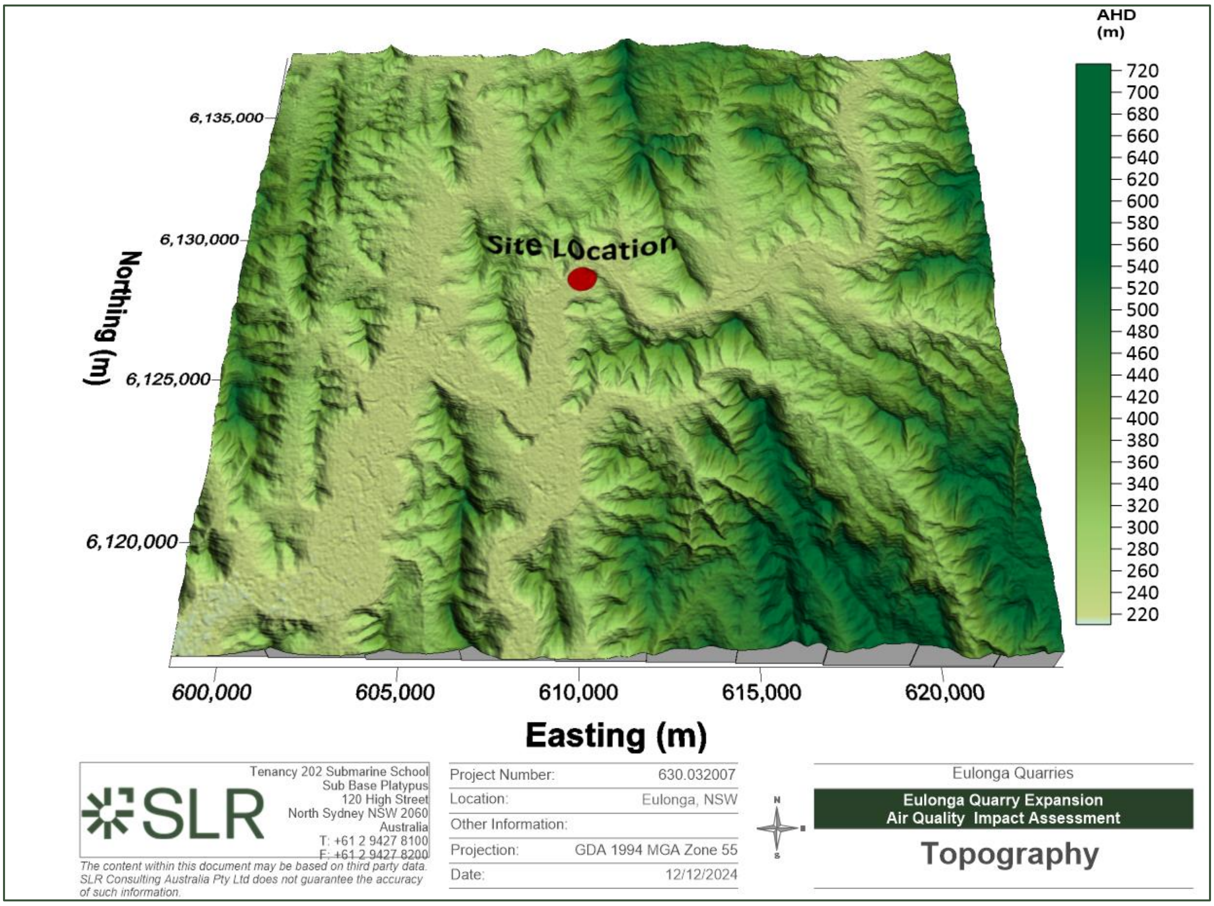
**Figure 4-1 Locations of Sensitive Receptors**


## 4.2 Surrounding Topography

Terrain can be important for the dispersion of air pollutants, such blocking effects by hills, and channelling effects in gullies. A three-dimensional representation of the EQ study area is provided in **Figure 4-2**.

The topography of the local area within a 20 km radius of the Site ranges from approximately 200 m to 700 m Australian Height Datum (AHD). There are a number of significant topographical features in the surrounding area that are expected to influence local wind patterns and affect the dispersion of air emissions from the site. This has been taken into consideration in the selection of the model and modelling grid resolution used for the study.

**Figure 4-2 Terrain Elevations: Eulonga Quarries Air Quality Study Area**



# 5.0 Local Meteorology

The nearby Bureau of Meteorology (BoM) Automatic Weather Stations (AWS) collecting data suitable for use in a quantitative air dispersion modelling study are listed in **Table 8**. These AWS have data available for the following parameters:

- Temperature (°C); Rainfall (mm); Relative humidity (%); Wind speed (m/s); and Wind direction.

**Table 7 Meteorological Monitoring Station Details**

| Station Name | Station ID | Location (m, MGA) | | Distance / Direction from Site |
|---|---|---|---|---|
| | | Easting | Northing | |
| Gundagai | 073141 | 587,835 | 6,118,592 | 24 km/south-west |
| Wagga Wagga AMO | 072150 | 541,667 | 6,109,306 | 72 km/south-west |
| Temora Airport | 073151 | 547,017 | 6,190,301 | 86 km/north-west |

A review of the long-term data collected by these stations is provided in the following sections; these summaries provide an indication of the climatology for Eulonga.

## 5.1 Temperature

Long-term temperature statistics for Gundagai AWS are summarised in **Figure 5-1**. Mean maximum temperatures range from 13.1°C in winter to 32.7°C in summer, while mean minimum temperatures range from 2.6°C in winter to around 16.9°C in summer. Maximum temperatures of 45.2°C and minimum temperatures less than -5.5°C have been recorded.

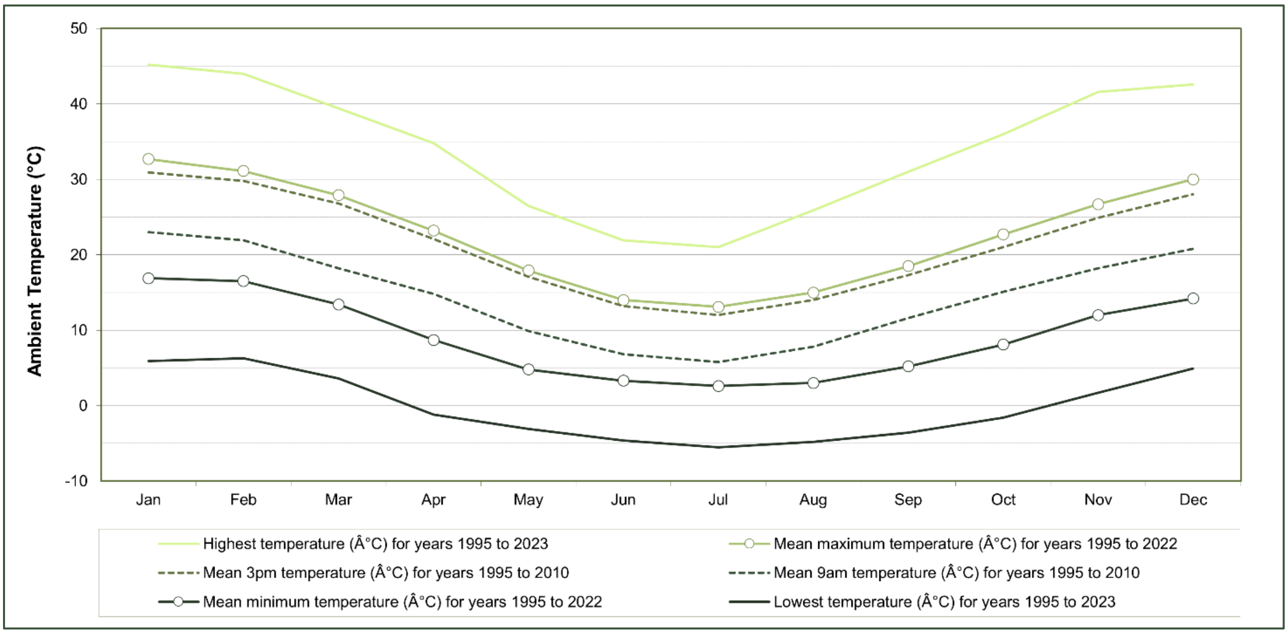
## 5.2 Rainfall

Long-term rainfall statistics for Gundagai AWS are summarised in **Figure 5-2.** The average monthly rainfall is relatively high between late spring and early autumn, generally reducing from mid-autumn to mid-spring with the lowest average of 32.1 mm/month recorded during April. On average, all months recorded an average of greater than six days of rain days per month except February. The highest average monthly rainfall of 202.6 mm/month occurs in February, with an average of 5.5 rain days recorded in this month. The highest daily rainfall recorded over the time period examined was 78.4 mm recorded on 4 March 2012.

## 5.3 Relative Humidity

Long-term humidity statistics (9 am and 3 pm monthly averages) for Gundagai AWS are summarised in **Figure 5-3**. Morning humidity levels range from an average of around 55% in mid-spring to around 91% in early autumn to mid-summer. Afternoon humidity levels are lower, at around 31% in late summer and 67% in winter.

## Figure 5-1 Long Term Temperature Data




## Figure 5-2 Long Term Monthly Rainfall Data

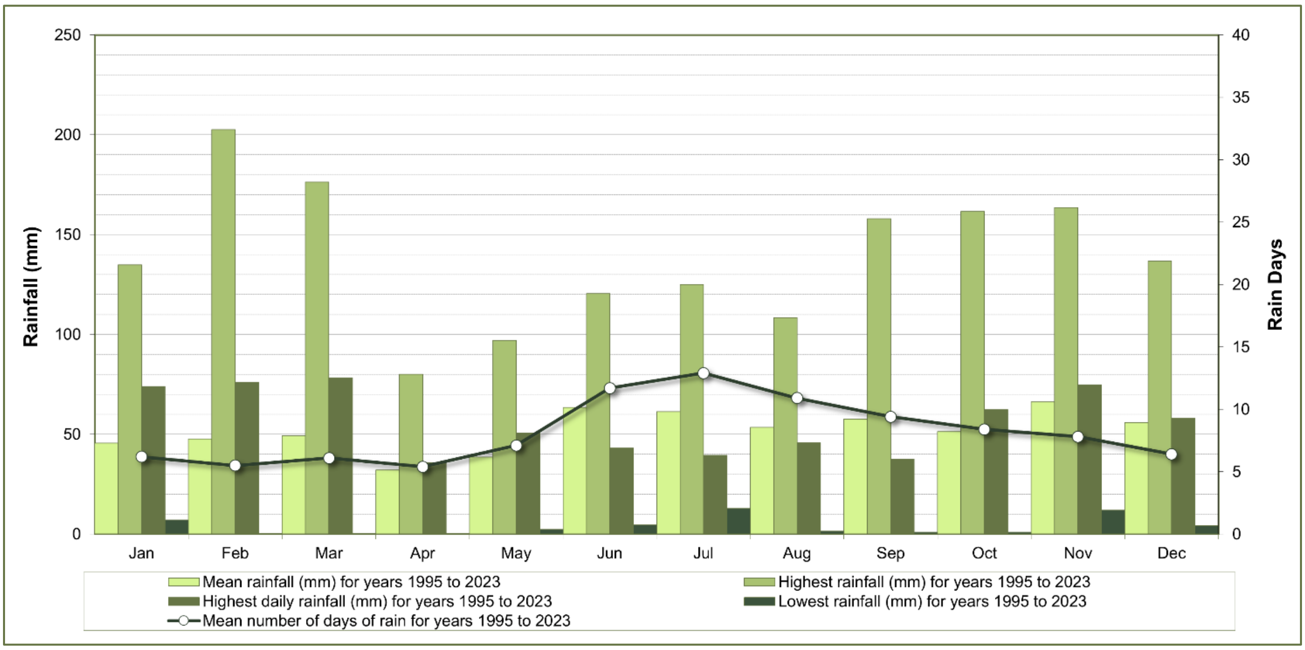
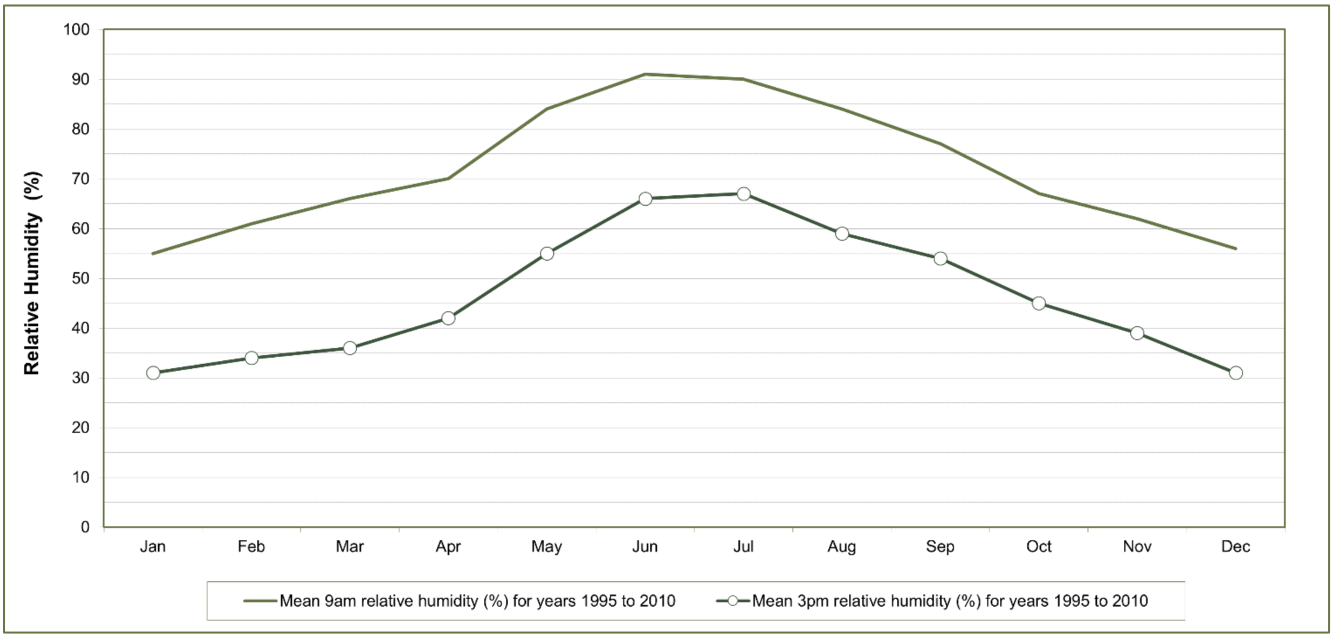


**Figure 5-3 Long Term Humidity Data**



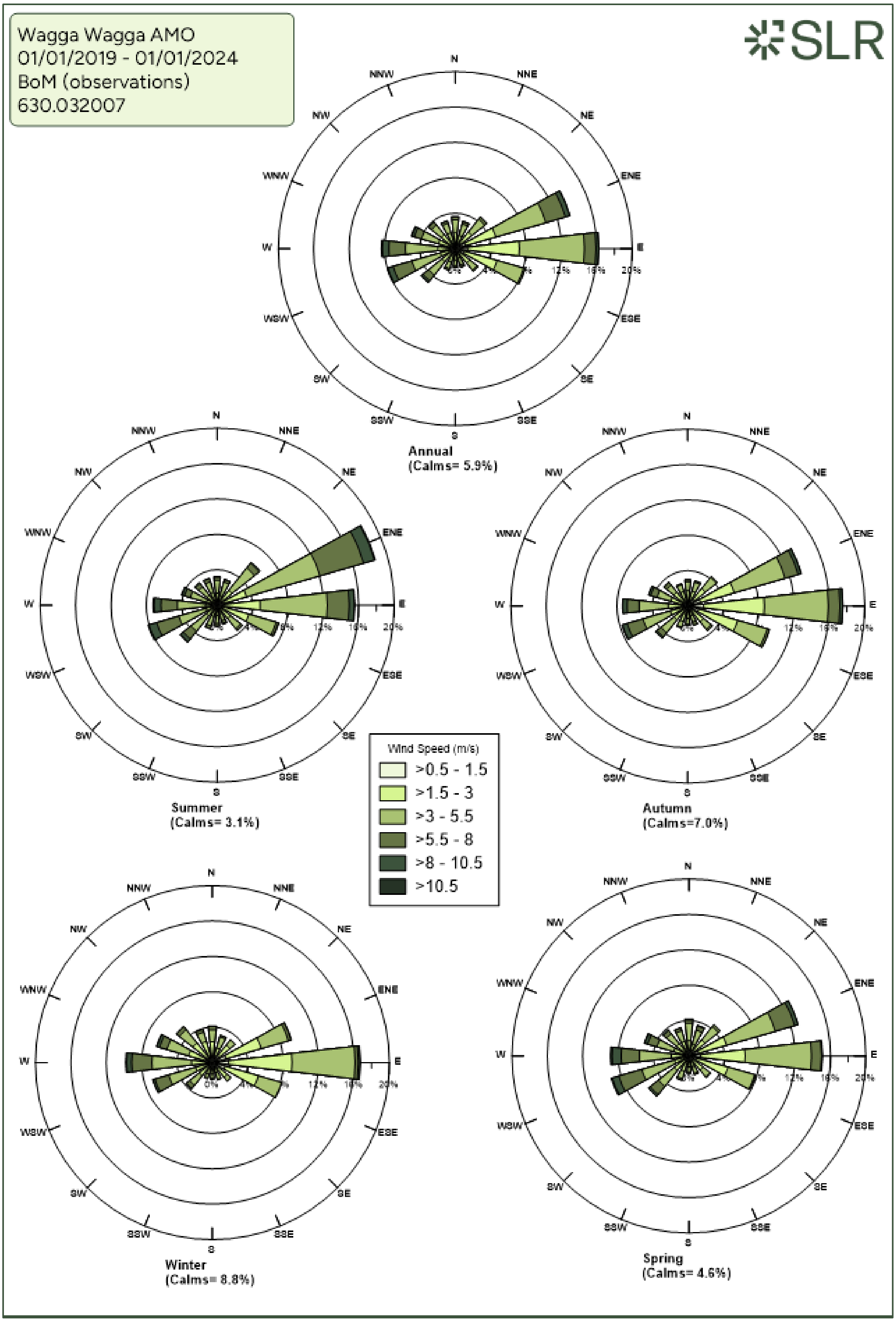

## 5.4 Wind Speed and Direction

Long term wind data (2019 – 2023) recorded by the Wagga Wagga AMO AWS are presented as wind roses in **Figure 5-4**. The wind roses show the frequency of occurrence of winds by direction and strength. The bars correspond to the 16 compass points (degrees from north). The direction of the bar shows the direction from which the wind is blowing. The length of the bar represents the frequency of occurrence of winds from that direction, and the widths of the bar sections correspond to wind speed categories, the narrowest representing the lightest winds. Thus, it is possible to visualise how often winds of a certain direction and strength occur over a long period, either for all hours of the day, or for particular periods during the day. There are times when the wind is calm [defined as being from zero to 0.5 metres/second (m/s)], and the percentage of the time that winds are calm is shown as a note on the wind rose.

**Figure 5-4** shows that winds at Wagga Wagga AMO AWS are predominantly of moderate strength (between 1.5 m/s and 5.5 m/s). Calm wind conditions were predicted to occur approximately 5.9% of the time over the 5-year period reviewed. The seasonal wind roses indicate that typically:

- In summer, winds predominantly blow from the east and northeast quadrants with a very low frequency of winds from the north and south quadrants. On average, calm winds are experienced 3.1% of the time during summer.
- In autumn, a similar wind pattern in summer. On average, calm winds are experienced 7.0% of the time during autumn.
- In winter, winds predominantly blow from the eastern and western quadrants, with the lowest frequency of winds from the northern and southern quadrants. On average, calm winds are experienced 8.8% of the time during winter.
- In spring, a similar wind pattern as in winter is experienced with the lowest frequency from the northern and southern quadrants. On average, calm winds were experienced 4.6% of the time during spring.

**Figure 5-4 Wind Direction Roses: Wagga Wagga AMO AWS 2019-2023**



# 6.0 Atmospheric Dispersion Modelling Methodology

## 6.1 Model Selection

Emissions from the Site have been modelled using a combination of the TAPM, CALMET and CALPUFF models. CALPUFF is a transport and dispersion model that ejects “puffs” of material emitted from modelled sources, simulating dispersion and transformation processes along the way. In doing so it typically uses the fields generated by a meteorological pre-processor CALMET, discussed further below. Temporal and spatial variations in the meteorological fields selected are explicitly incorporated in the resulting distribution of puffs throughout a simulation period. The primary output files from CALPUFF contain either hourly concentration or hourly deposition fluxes evaluated at selected receptor locations. The CALPOST post-processor is then used to process these files, producing tabulations that summarise results of the simulation for user-selected averaging periods.

## 6.2 Meteorological Modelling

### 6.2.1 Selection of Representative Year for Meteorological Modelling

In order to determine a representative meteorological year for use in dispersion modelling, five years of meteorological data (2019-2023) from the nearby meteorological monitoring station with similar terrain and elevation (i.e. Wagga Wagga AMO and Temora Airport AWS) were analysed against the five-year average meteorological conditions. Specifically, the following parameters were analysed:

- Frequency and distribution of the predominant wind directions;
- Hourly wind speeds observed;
- Hourly temperature; and
- Hourly relative humidity.

Based on this analysis, it was concluded that the year 2023 was representative of the last five years of meteorological conditions experienced at the Site and hence the 2023 calendar year was adopted for use in this assessment. A detailed analysis is presented in **Appendix** B**.**

### 6.2.2 Meteorological Data Availability

To adequately characterise the dispersion meteorology of the Site, information is needed on the prevailing wind regime, atmospheric stability, mixing depth and other meteorological parameters. Hourly meteorological data from the following Automatic Weather Stations (AWSs) (refer **Table 8**) operated by BoM were used in the meteorological modelling study for the study area:

**Table 8 Meteorological Monitoring Station Details**

| Station Name | Station ID | Location (m, MGA) | | Distance / Direction from Site |
|---|---|---|---|---|
| | | Easting | Northing | |
| Wagga Wagga AMO | 072150 | 541,667 | 6,109,306 | 72 km/south-west |
| Temora Airport | 073151 | 547,017 | 6,190,301 | 86 km/north-west |

### 6.2.3 TAPM

The TAPM prognostic model, developed by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) was used to generate the upper air data required for CALMET modelling.

TAPM predicts wind speed and direction, temperature, pressure, water vapour, cloud, rain water and turbulence. The program allows the user to generate synthetic observations by referencing databases (covering terrain, vegetation and soil type, sea surface temperature and synoptic scale meteorological analyses) which are subsequently used in the model input to generate one full year of hourly meteorological observations at user-defined levels within the atmosphere.

Additionally, the TAPM model may assimilate actual local wind observations so that they can optionally be included in a model solution. The wind speed and direction observations are used to realign the predicted solution towards the observation values. In this study, data from the BoM's AWS's listed in **Table 8** have been used to nudge (ie influence) the TAPM predictions. **Table 9** details the parameters used in the TAPM meteorological modelling for this assessment.

**Table 9 Meteorological Parameters Used for this Study - TAPM**

| TAPM (v 4.0) | |
|---|---|
| Number of grids (spacing) | 4 (30 km, 10 km, 3 km and 1 km) |
| Number of grid points | 25 x 25 x 35 |
| Year of analysis | 2023 |
| Centre of analysis | 610,300m E 6,129,060m S |

### 6.2.4 CALMET

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

The CALMET domain was modelled with a resolution of 0.1 km in no observation mode. The TAPM-generated 3-dimensional meteorological data was used as the 'initial guess' wind field and the local topography was used to refine the wind field predetermined by TAPM. **Table 10** details the parameters used in the meteorological modelling to drive the CALMET model.

**Table 10 Meteorological Parameters Used for this Study – CALMET (V 6.326)**

| CALMET Domain | |
|---|---|
| Meteorological grid | 10 km × 10 km |
| Meteorological grid resolution | 0.1 km |
| Mode | No-observation |

| CALMET Domain | |
|---|---|
| Initial guess filed | 3D output from TAPM modelling |

## 6.3 Meteorological Data Used in Modelling

To provide a summary of the meteorological conditions predicted at the Site using the methodology described in **Section 6.2**, a single-point, ground-level meteorological dataset was 'extracted' from the 3-dimensional dataset at the Site and is presented in this section.

### 6.3.1 Wind Speed and Direction

A summary of the annual wind behaviour predicted by CALMET for 2023 (extracted at the Site) is presented as a wind speed distribution plot in **Figure 6-1** and wind roses in **Figure 6-2**.

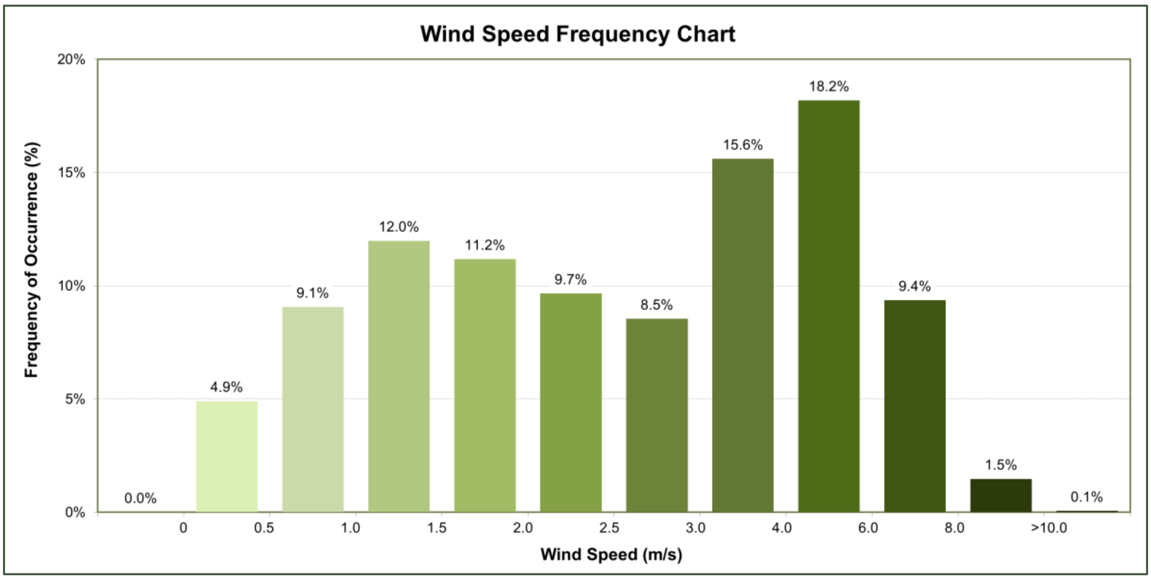
The wind roses show the frequency of occurrence of winds by direction and strength. The bars correspond to the 16 compass points (degrees from north). The direction of the bar shows the direction from which the wind is blowing. The length of the bar represents the frequency of occurrence of winds from that direction, and the widths of the bar sections correspond to wind speed categories, the narrowest representing the lightest winds. Thus, it is possible to visualise how often winds of a certain direction and strength occur over a long period, either for all hours of the day, or for particular periods during the day. There are times when the wind is calm (defined as being from zero to 0.5 metres/second), and the percentage of the time that winds are calm are shown as a note on the wind rose. **Table 11** outlines the wind scale used to describe the wind speed.

**Table 11 Wind Scale Descriptions**

| Description | m/s | Description on land |
|---|---|---|
| Calm | 0-0.5 | Smoke rises vertically |
| Light air | 0.5-1.5 | Smoke drift indicates wind direction |
| Light breeze | 1.5-3 | Wind felt on face, leaves rustle, light flags extended, ordinary vanes moved by wind |
| Gentle breeze | 3-5.5 | Leaves and small twigs in constant motion; light flags extended. |
| Moderate winds | 5.5-8.0 | Raises dust and loose paper, small branches are moved |
| Fresh winds | 8.0-10.5 | Small trees in leaf begin to sway, crested wavelets form on inland waters |
| Strong winds | >10.5 | Large branches in motion, whistling heard in telephone wires; umbrellas used with difficulty |

**Figure 6-1** indicates that annual winds experienced in the study area are predominantly light to moderate (between 1.5 m/s and 8. m/s). Calm wind conditions were predicted to occur approximately 5.0% of the time throughout the modelling period. It is noted that the high wind speeds and overall low percentage of calm wind conditions could increase dust emissions due to wind erosion. However, these factors will also assist pollutant dispersion resulting in lower pollutant concentrations at the surrounding receptors.

**Figure 6-1 Annual Wind Speed Frequencies at the Site (CALMET Predictions, 2023)**

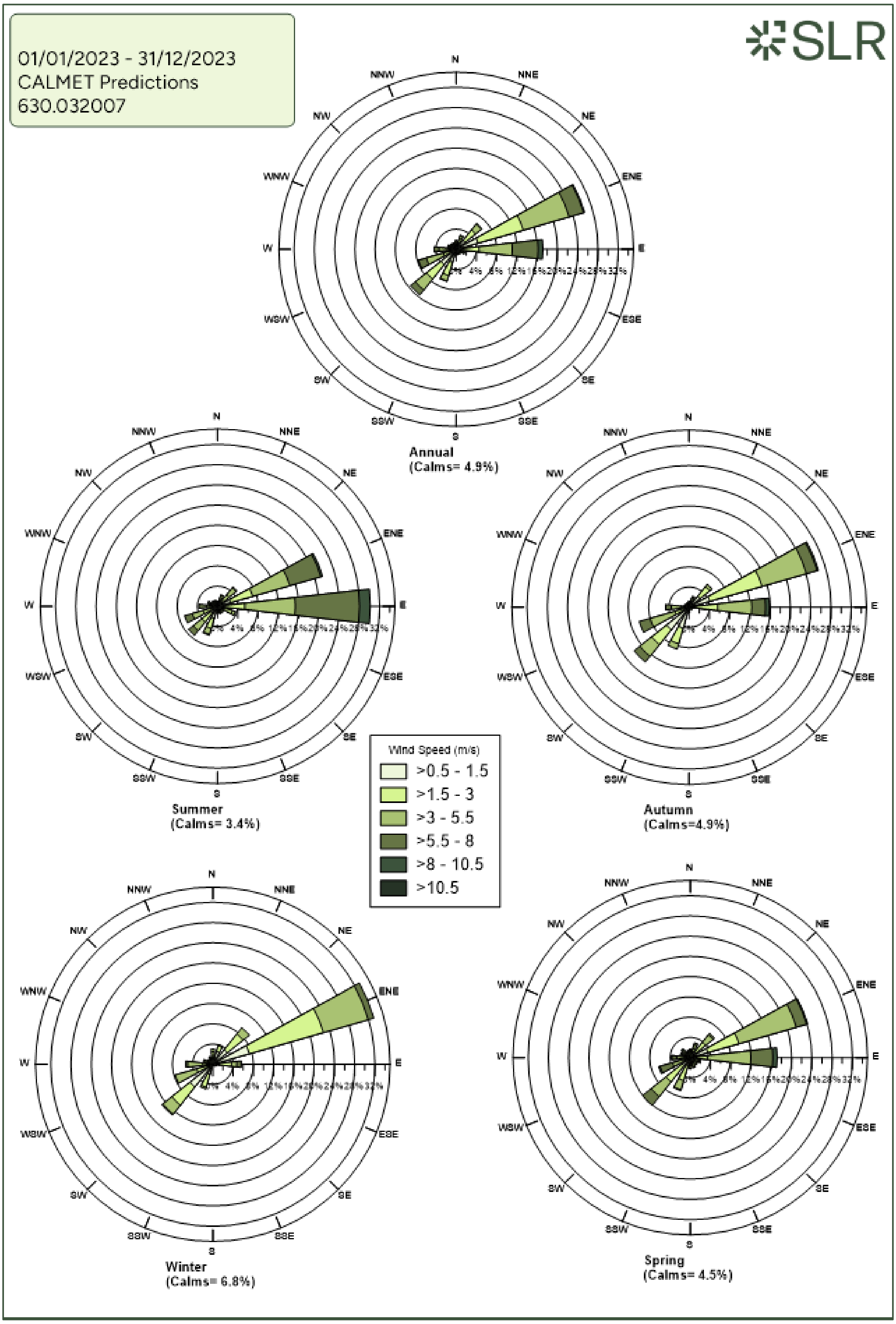



The annual wind rose in **Figure 6-2** indicated that the predicted prevailing wind direction is in the northeast and southwest therefore it is likely that receptors to the southwest and northeast would experience a higher frequency of potential impacts.

The seasonal wind roses in **Figure 6-2** indicate that typically:

- In summer, prevailing winds are predicted to blow from the eastern directions. There is a comparatively lower frequency of wind from the north, south and westerly directions. Winds from the prevailing summer wind direction range from light to fresh winds. Calm winds are predicted to occur approximately 3.4% of the time during winter.
- Autumn and spring show a pattern similar to the annual pattern. In these two seasons, the prevailing winds are predicted to blow from the east and northeast ranging from light to moderate winds. There is a lower frequency of wind from the north and south. Calm winds are predicted to occur 4.9% and 4.5% of the time in autumn and spring respectively.
- In winter, prevailing winds are predicted to blow from the northeasterly directions. There is a lower frequency of wind from the southwesterly directions. There are very few winds from all other directions. Winds from the prevailing winter wind direction range from light to fresh winds. Calm winds are predicted to occur approximately 6.8% of the time during winter.

**Figure 6-2 CALMET-Predicted Seasonal Wind Roses for the Site (2023)**



### 6.3.2 Atmospheric Stability

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

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

The meteorological conditions defining each PGT stability class are shown in **Table 12**.

**Table 12 Meteorological Conditions Defining PGT Stability Classes**

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

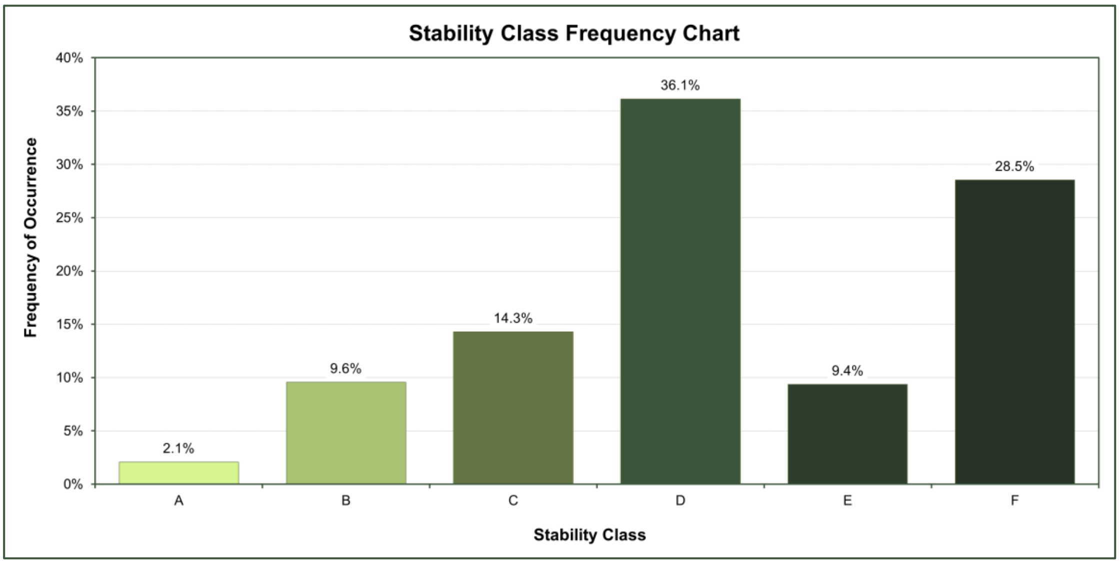
Source: (NOAA 2018)

Notes:

1. Strong insolation corresponds to sunny midday in midsummer in England; slight insolation to similar conditions in midwinter.
2. Night refers to the period from 1 hour before sunset to 1 hour after sunrise.
3. The neutral category D should also be used, regardless of wind speed, for overcast conditions during day or night and for any sky conditions during the hour preceding or following night as defined above.

The frequency of each stability class predicted by CALMET, extracted at the Site, during the modelling period, is presented in **Figure 6-3**. The results indicate a high frequency of conditions typical to Stability Class D. Stability Class D is associated with the relatively high frequency of high wind speed conditions, which limit the formation of very stable conditions.

**Figure 6-3 Predicted Stability Class Frequencies at the Site (CALMET predictions, 2023)**

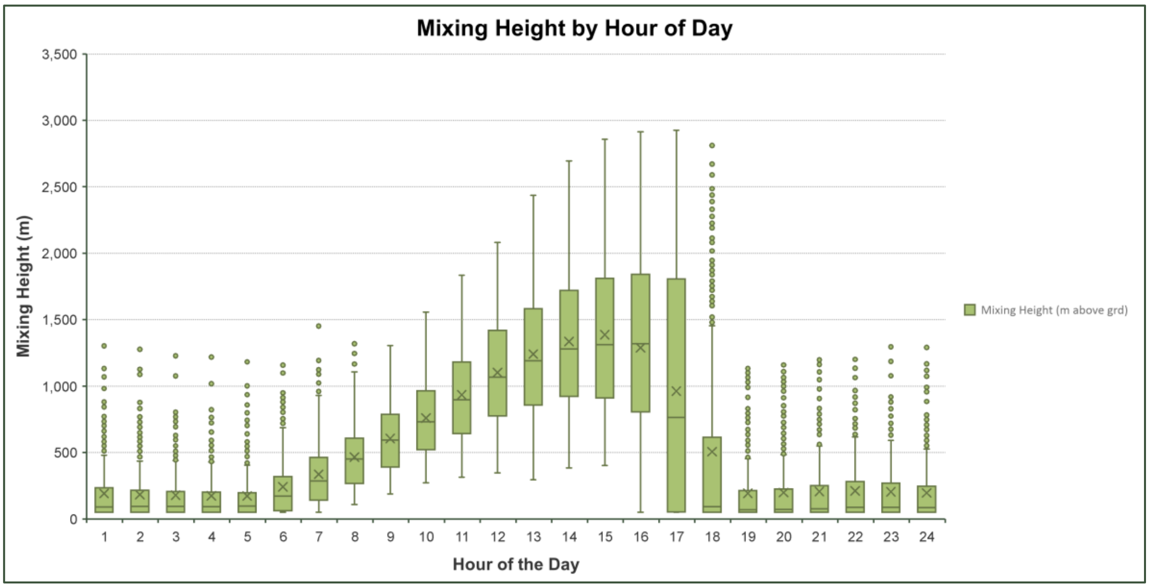



### 6.3.3 Mixing Heights

Diurnal variations in maximum and average mixing heights predicted by CALMET at the Site during the 2023 modelling period are illustrated in **Figure 6-4**.

As would be expected, an increase in mixing depth during the morning is apparent, arising due to the onset of vertical mixing following sunrise. Maximum mixing heights occur in the mid to late afternoon, due to the dissipation of ground-based temperature inversions and growth of the convective mixing layer.

**Figure 6-4 Predicted Mixing Heights at the Site (CALMET predictions, 2023)**




## 6.4 Dispersion Model Configuration

As discussed in **Section 6.1**, dispersion modelling was conducted using the CALPUFF dispersion model and three-dimensional meteorological data output from CALMET.

Emissions from the activities at the Site were represented by a series of volume sources, while wind erosion from exposed areas was represented by area sources. The estimated particulate emissions were modelled as TSP, $PM_{10}$ and $PM_{2.5}$. These parameters were grouped using CALPOST to predict $PM_{2.5}$, $PM_{10}$ and TSP concentrations at surrounding receptor locations. This approach provides the most realistic treatment of the differing size fractions, with the lighter, finer particulate matter being dispersed further than the heavier size fraction which settles out of the air more rapidly.

Based on the sensitivity of each activity to wind speed, an hourly varying emission file representing hourly FP, CM and RE emissions for each source was generated using the annual average emission rate estimated for each activity. Details of the algorithm used to generate the variable emission files are presented in **Appendix D.**

# 7.0 Existing Air Quality

The main focus of this report is the assessment of the potential impacts of dust emissions from the Site on the closest sensitive receptors **Section 4.1**. The purpose of assessing background air quality is to determine the concentrations of air pollutants currently experienced at these residences, with the predicted concentrations from the Site added to these background concentrations to identify the likely future cumulative air quality impacts. It is therefore important to gain an understanding of the current background air quality at these residential locations.

For the purposes of assessing potential cumulative off-site air quality impacts, an estimation of ambient air quality concentrations is required. In accordance with the EPA Approved Methods, the background data used in this assessment is based on the same year as the meteorological year used in the modelling (i.e. 2023). This section outlines the background pollutant concentrations representative of regional air quality.

## 7.1 Airborne Particulate Matter

The nearest Air Quality Monitoring Station (AQMS) operated by the Department of Planning and Environment (DPE) considered to best represent the Site is Goulburn, which measures continuous $PM_{10}$ and $PM_{2.5}$ concentrations, located approximately 140 km to the northeast of the Site. Other monitoring stations include Junee and Wagga Wagga located approximately 70 km west of the Site, however, considering the topography and surrounding land uses Goulburn is identified as the most representative AQMS for the Site.

### 7.1.1 $PM_{10}$

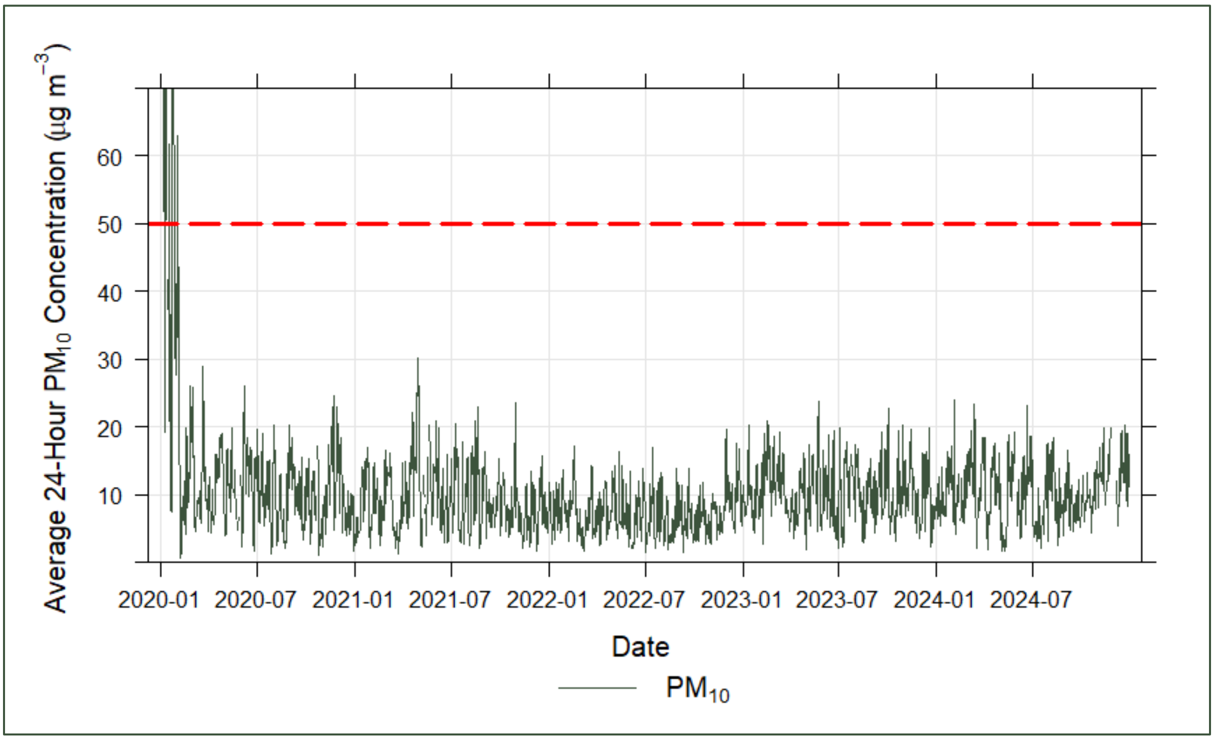
Summaries of the 24-hour average and annual average $PM_{10}$ concentrations measured by the Goulburn AQMS for the five most recent years are presented in **Table 13** and **Figure 7-1**.

**Table 13 Summary of $PM_{10}$ Monitoring Data at Goulburn AQMS for 2020-2024**

| Year | AQMS | Maximum 24-Hour $PM_{10}$ Concentration | Number of Exceedances of 24-Hour Criterion | Annual $PM_{10}$ Concentration |
|---|---|---|---|---|
| | | (µg/m³) | (days/year) | (µg/m³) |
| 2020 | Goulburn | 556.7 | 18 | 19.2 |
| 2021 | Goulburn | 30.1 | 0 | 9.1 |
| 2022 | Goulburn | 19.6 | 0 | 7.3 |
| 2023 | Goulburn | 23.8 | 0 | 10.4 |
| 2024 | Goulburn | 23.9 | 0 | 10.4 |
| **Criterion** | | **50** | | **25** |

The daily-varying $PM_{10}$ data for 2023 from Goulburn AQMS were used contemporaneously in the modelling to represent regional background levels to enable an assessment of potential cumulative $PM_{10}$ concentrations. There are no exceedances recorded by the Goulburn AQMS that would result in cumulative concentrations (i.e. Site increment + regional background) exceeding the respective criterion on those days, which is discussed further in **Section 8.0.**

**Figure 7-1 24-Hour Average $PM_{10}$ Data Monitored at Goulburn AQMS 2020-2024**



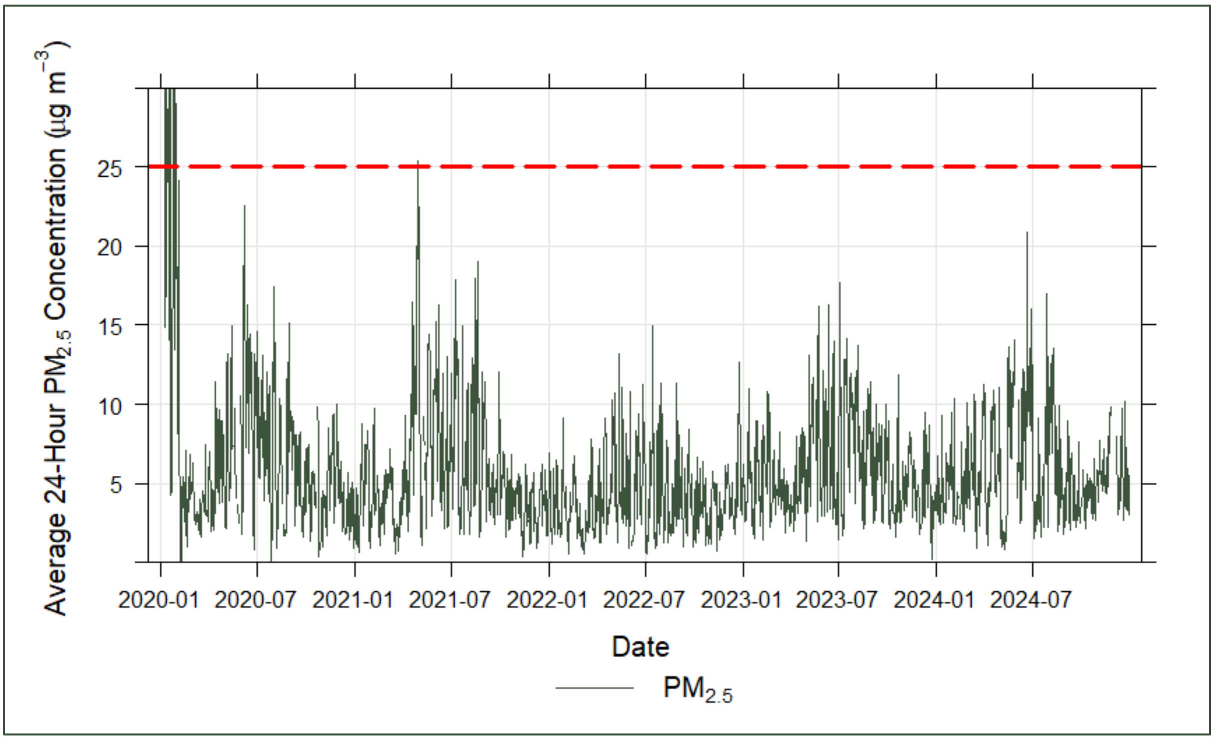

### 7.1.2 $PM_{2.5}$

A summary of the 24-hour average and annual average $PM_{2.5}$ concentrations measured by the Goulburn AQMS during 2020-2024 calendar years are presented in **Table 14** and **Figure 7-2**.

**Table 14 Summary of $PM_{2.5}$ Monitoring Data at Goulburn AQMS for 2020-2024**

| Year | AQMS | Maximum 24-Hour $PM_{2.5}$ Concentration (µg/m³) | Number of Exceedances of 24-Hour Criterion (days/year) | Annual $PM_{2.5}$ Concentration (µg/m³) |
|---|---|---|---|---|
| 2020 | Goulburn | 516.1 | 16.0 | 11.8 |
| 2021 | Goulburn | 25.4 | 0 | 5.6 |
| 2022 | Goulburn | 15.0 | 0 | 4.1 |
| 2023 | Goulburn | 17.7 | 0 | 5.9 |
| 2024 | Goulburn | 20.8 | 0 | 5.7 |
| **Criterion** | | **25** | | **8** |

**Figure 7-2 24-Hour Average $PM_{2.5}$ Data Monitored at Goulburn AQMS 2020-2024**




The daily-varying $PM_{2.5}$ data for 2023 from Goulburn AQMS were used contemporaneously in the modelling to represent regional background levels.

### 7.1.3 TSP

No TSP monitoring is conducted by the Goulburn AQMS or other nearby AQMS. In the absence of any monitoring data for TSP, daily varying ambient TSP concentrations have been estimated from the $PM_{10}$ concentrations recorded by the Merriwa AQMS using a $PM_{10}$/TSP ratio of 0.4, which is typical for industrial areas in Australia.

Therefore, for cumulative analysis purposes, the annual average background TSP concentration was estimated to be 26 µg/m$^3$.

## 7.2 Dust Deposition Rate

No dust deposition monitoring is conducted by the Goulburn AQMS or nearby AQMS. In the absence of any local dust deposition monitoring data, a conservative background dust deposition rate of 2 g/m$^2$/month has been assumed for this assessment, which is typical for residential/industrial areas in Australia. This results in the cumulative assessment criterion of 4 g/m$^2$/month being the defining criterion for the Site.

## 7.3 Adopted Background for Assessment

The site-representative background ambient air quality concentrations adopted for use in this assessment are summarised in **Table 15**.

Air quality data from the Goulburn AQMS has been analysed over the past five years. The year 2020 recorded unusually high values that do not accurately represent the region's typical background levels. Although air quality values in 2024 were higher than those in

2023, due to the unavailability of complete 2024 data, year 2023—representing the worst-case scenario among the previous years—has been adopted as the representative background for this assessment.

**Table 15 Adopted Background Data**

| Pollutant | Averaging Period | Regional Background | Notes |
|---|---|---|---|
| TSP | Annual | 26 µg/m$^3$ | Assumed to be 2.5 times the monitored $PM_{10}$ concentrations at Goulburn AQMS during 2023 |
| $PM_{10}$ | 24-hour | Daily varying | As monitored at Goulburn AQMS during 2023 |
| | Annual | 10.4 µg/m$^3$ | As monitored at Goulburn AQMS during 2023 |
| $PM_{2.5}$ | 24-hour | Daily varying | As monitored at Goulburn AQMS during 2023 |
| | Annual | 5.9 µg/m$^3$ | As monitored at Goulburn AQMS during 2023 |
| Deposited dust | Annual | 2 g/m$^2$/month | Estimated. Not monitored at Goulburn AQMS |

# 8.0 Dispersion Modelling Results

The sections below present a summary of the air quality impacts predicted by the modelling at the sensitive receptors identified in **Section 4.1**. Dispersion modelling was performed for the operations at the Site, representative of the worst case impacts associated with the peak operations of the proposed and existing activities.

Isopleth (contour) plots showing the incremental impact predicted due to the Site's emissions i.e. excluding background levels for each pollutant are presented in **Appendix C**. These plots do not represent the dispersion pattern for any individual time period, rather they illustrate the maximum concentration that was predicted to occur at each model calculation point given the range of meteorological conditions occurring over the 2023 modelling period.

## 8.1 Particles as $PM_{2.5}$

### 8.1.1 Maximum 24-Hour Average $PM_{2.5}$ Concentrations

To assess the maximum cumulative 24-hour average $PM_{2.5}$ concentrations at each of the identified sensitive receptors, a contemporaneous analysis was performed, with each daily incremental 24-hour average prediction for each receptor added to the corresponding day's background concentration measured by the Goulburn AQMS, to calculate the cumulative 24-hour average $PM_{2.5}$ impacts. **Table 16** presents a summary of the predicted incremental and cumulative $PM_{2.5}$ impacts at the identified sensitive receptors.

**Table 16 Summary of 24-Hour $PM_{2.5}$ Cumulative Impact Analysis**

| Receptor ID | Maximum 24-Hour Average $PM_{2.5}$ Concentrations (µg/m$^3$) | | |
|---|---|---|---|
| | Regional Background | Incremental Impact | Cumulative Impact |
| R1 | 17.7 | <0.1 | <17.8 |
| R2 | 17.7 | <0.1 | <17.8 |
| R3 | 17.7 | 0.1 | 17.8 |
| R4 | 17.7 | 0.1 | 17.8 |
| R5 | 17.7 | <0.1 | <17.8 |
| R6 | 17.7 | <0.1 | <17.8 |
| R7 | 17.7 | 0.1 | 17.8 |
| R8 | 17.7 | 0.1 | 17.8 |
| **Criterion** | **-** | **-** | **25** |

**Table 16** shows that there are no predicted exceedances of the criterion, and the effects are dominated by the background $PM_{2.5}$. When the maximum 24-hour background concentration occurs, the incremental impact of the Site on those days is negligible. The contribution of Site towards the maximum cumulative $PM_{2.5}$ 24-hour average concentrations is negligible.

### 8.1.2 Annual Average $PM_{2.5}$ Concentrations

**Table 17** presents the incremental and cumulative annual average $PM_{2.5}$ concentrations predicted at each of the identified receptors.

**Table 17 Predicted Incremental and Cumulative Annual Average $PM_{2.5}$ Concentrations**

| Receptor ID | Annual Average $PM_{2.5}$ Concentrations (µg/m$^3$) | | |
|---|---|---|---|
| | Regional Background | Incremental Impact | Cumulative Impact |
| R1 | 5.9 | <0.1 | <6.0 |
| R2 | 5.9 | <0.1 | <6.0 |
| R3 | 5.9 | <0.1 | <6.0 |
| R4 | 5.9 | <0.1 | <6.0 |
| R5 | 5.9 | <0.1 | <6.0 |
| R6 | 5.9 | <0.1 | <6.0 |
| R7 | 5.9 | <0.1 | <6.0 |
| R8 | 5.9 | <0.1 | <6.0 |
| **Criterion** | **-** | **-** | **8** |

**Table 17** present shows that the predicted cumulative concentrations at receptors are below the annual average $PM_{2.5}$ criterion of 8 µg/m$^3$.

## 8.2 Particles as $PM_{10}$

### 8.2.1 Maximum 24-Hour Average $PM_{10}$ Concentrations

To assess the maximum cumulative 24-hour average $PM_{10}$ concentrations at each of the identified sensitive receptors, a contemporaneous analysis was performed, as required by the EPA Approved Methods when the background concentration dataset contains exceedances of the criterion. At each receptor, each individual incremental 24-hour average prediction was added to the corresponding day's background concentration measured by the Goulburn AQMS, to calculate the cumulative 24-hour average $PM_{10}$ impacts. **Table 18** presents a summary of the predicted incremental and cumulative impacts at the sensitive receptors.

**Table 18 Summary of 24-Hour $PM_{10}$ Cumulative Impact Analysis**

| Receptor ID | Maximum 24-Hour Average $PM_{10}$ Concentrations (µg/m$^3$) | | |
|---|---|---|---|
| | Regional Background | Incremental Impact | Cumulative Impact |
| R1 | 23.8 | 0.4 | 24.2 |
| R2 | 23.8 | 0.3 | 24.1 |
| R3 | 23.8 | 0.8 | 24.6 |
| R4 | 23.8 | 0.9 | 24.7 |
| R5 | 23.8 | 0.3 | 24.1 |
| R6 | 23.8 | 0.4 | 24.2 |
| R7 | 23.8 | 0.6 | 24.4 |
| R8 | 23.8 | 0.7 | 24.5 |
| **Criterion** | **-** | **-** | **50** |

**Table 18** shows that there are no predicted exceedances of the criterion, and the results are dominated by background $PM_{10}$. When the maximum 24-hour background concentration occurs, the incremental impact of the Site on those days is negligible. The highest 24-hour average $PM_{10}$ increment; i.e., Site only, is predicted at receptor R4. The contribution of Site towards the maximum cumulative $PM_{10}$ 24-hour average concentrations is negligible. Therefore, no further analysis is required to verify the contribution of Site towards exceedances.

### 8.2.2 Annual Average $PM_{10}$ Concentrations

**Table 19** presents the incremental and cumulative annual average $PM_{10}$ concentrations predicted at each of the identified receptors.

**Table 19 Predicted Incremental and Cumulative Annual Average $PM_{10}$ Concentrations**

| Receptor ID | Annual Average $PM_{10}$ Concentrations (µg/m$^3$) | | |
|---|---|---|---|
| | Regional Background | Incremental Impact | Cumulative Impact |
| R1 | 10.4 | <0.1 | <10.5 |
| R2 | 10.4 | <0.1 | <10.5 |
| R3 | 10.4 | 0.2 | 10.6 |
| R4 | 10.4 | 0.2 | 10.6 |
| R5 | 10.4 | <0.1 | <10.5 |
| R6 | 10.4 | 0.1 | 10.5 |
| R7 | 10.4 | <0.1 | <10.5 |
| R8 | 10.4 | 0.2 | 10.6 |
| **Criterion** | **-** | **-** | **25** |

**Table 19** shows that the cumulative annual average $PM_{10}$ concentrations at both receptors are below the annual average $PM_{10}$ criterion of 25 µg/m$^3$.

## 8.3 Particles as TSP

### 8.3.1 Annual Average TSP Concentrations

**Table 20** presents the incremental and cumulative annual average TSP concentrations predicted at each of the identified receptors.

**Table 20 Predicted Incremental and Cumulative Annual Average TSP Concentrations**

| Receptor ID | Annual Average TSP Concentrations (µg/m$^3$) | | |
|---|---|---|---|
| | Regional Background | Incremental Impact | Cumulative Impact |
| R1 | 26.0 | 0.2 | 26.2 |
| R2 | 26.0 | 0.2 | 26.2 |
| R3 | 26.0 | 0.5 | 26.5 |
| R4 | 26.0 | 0.5 | 26.5 |

| Receptor ID | Annual Average TSP Concentrations (µg/m$^3$) | | |
|---|---|---|---|
| | Regional Background | Incremental Impact | Cumulative Impact |
| R5 | 26.0 | 0.1 | 26.1 |
| R6 | 26.0 | 0.2 | 26.2 |
| R7 | 26.0 | 0.2 | 26.2 |
| R8 | 26.0 | 0.6 | 26.6 |
| **Criterion** | **-** | **-** | **90** |

**Table 20** indicate that the predicted cumulative concentrations at both receptors are below the annual average TSP criterion of 90 µg/m$^3$.

## 8.4 Dust Deposition

**Table 21** shows the annual average dust deposition rates predicted at each of the identified receptors.

**Table 21 Predicted Annual Average Dust Deposition Rates**

| Receptor ID | Annual Average Dust Deposition Rate (g/m$^2$/month) | | |
|---|---|---|---|
| | Regional Background | Incremental Impact | Cumulative Impact |
| R1 | 2.0 | <0.1 | <2.1 |
| R2 | 2.0 | <0.1 | <2.1 |
| R3 | 2.0 | <0.1 | <2.1 |
| R4 | 2.0 | <0.1 | <2.1 |
| R5 | 2.0 | <0.1 | <2.1 |
| R6 | 2.0 | <0.1 | <2.1 |
| R7 | 2.0 | <0.1 | <2.1 |
| R8 | 2.0 | <0.1 | <2.1 |
| **Criterion** | **-** | **2** | **4** |

**Table 21** indicates that the predicted incremental and cumulative annual average dust deposition rates at receptors are well below the criterion of 2 g/m$^2$/month (incremental increase in dust deposition) and below 4 g/m$^2$/month (cumulative dust deposition). The incremental impacts predicted due to the estimated emissions from the Site are very low, and represent a negligible contribution to the total cumulative concentrations.

# 9.0 Dust Mitigation Measures

The results of the dispersion modelling demonstrate compliance with the EPA Approved Methods criteria for long term (annual average) particulate concentrations, and short term (24-hour) concentrations for $PM_{10}$ and $PM_{2.5}$.

The dust mitigation measures assumed for the dust modelling were described in **Section 3.4**. From the site visit, and a review of the model results, some additional and practical management measures that don't require additional water include:

- Simply, maintain awareness of visible dust emissions – if a dust plume is heading in the direction of a sensitive receptor, modify or stop the relevant activity, which may include waiting until the wind direction shifts.
- Use speed limits for parts of the site including the access roads to minimise wheel-generated dust. Practically, 60 km/h would be a reasonable speed limit for the access roads (40 km/h would be desirable). A speed limit of 10-20 km/h would be more appropriate for the stockpile/truck loading areas.
- Dust emissions can be reduced by dropping loads carefully into trucks and sand-screeners and minimising drop heights.
- Keep a detailed record of any dust complaints and address the complaints rapidly.

Some of these and other measures for consideration are listed in **Table 22**; these would be typical considerations for a site-specific, Air Quality Management Plan (AQMP). An AQMP would cover all sources of emissions, such as those identified in **Section 3.2** of this AQIA.

**Table 22 Potential Additional Dust Mitigation Measures**

| Potential Pollution Source | Control Measures |
|---|---|
| Wind generated dust from exposed areas and stockpiles. | Water cart and wet suppression (water sprays) as required.<br>A chemical dust suppressant could be used, noting crusting of EQ's stockpiles was observed due to clay content. |
| Wheel generated dust from road trucks, haul trucks and mobile equipment. | The speed limit on exposed, working areas could be limited to 10-20 km/hr |
| | Higher water cart rates as required |
| Loading product to haul and road trucks. | Cover loads leaving the site where practicable |
| Fixed materials handling activities:<br>- Crushing and screening<br>- Dumping of product to the primary crushing facility<br>- Loading product to rail carriages | Wet suppression (water sprays) |
| | Minimise dust-generating activities during times of high wind speeds |
| | Reduction of the intensity/rate of activities in response to excessive dust generation |
| Other quarrying activities:<br>- Dumping of material to stockpiles by front end loaders and conveyors<br>- Drilling and blasting of rock<br>- Stripping of overburden | Wet suppression (water sprays) |
| | Minimising dust-generating activities during times of high wind speeds |
| | Relocation of offending plant and equipment to less sensitive on-site areas |
| | Reduction of the intensity/rate of activities in response to excessive dust generation |

# 10.0 Conclusion

An air quality impact assessment was undertaken based on dust dispersion modelling in accordance with the EPA Approved Methods to test a proposed extension of the EQ quarry. Key assumptions included no changes to the EPA-approved maximum production rate of 172 kt per annum, and no changes to the existing processing equipment and methods.

The cumulative assessment results for $PM_{2.5}$, $PM_{10}$, TSP and deposited dust from the proposed extension, which included the effects due to operations in the existing approved areas, did not cause exceedances of air quality impact assessment criteria at the sensitive receptor locations.

Based on the results of this assessment, it is concluded that air quality impact does not represent a constraint to the proposed expansion of EQ's existing sand extraction activity.

# 11.0 References

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# Appendix A Site Plan

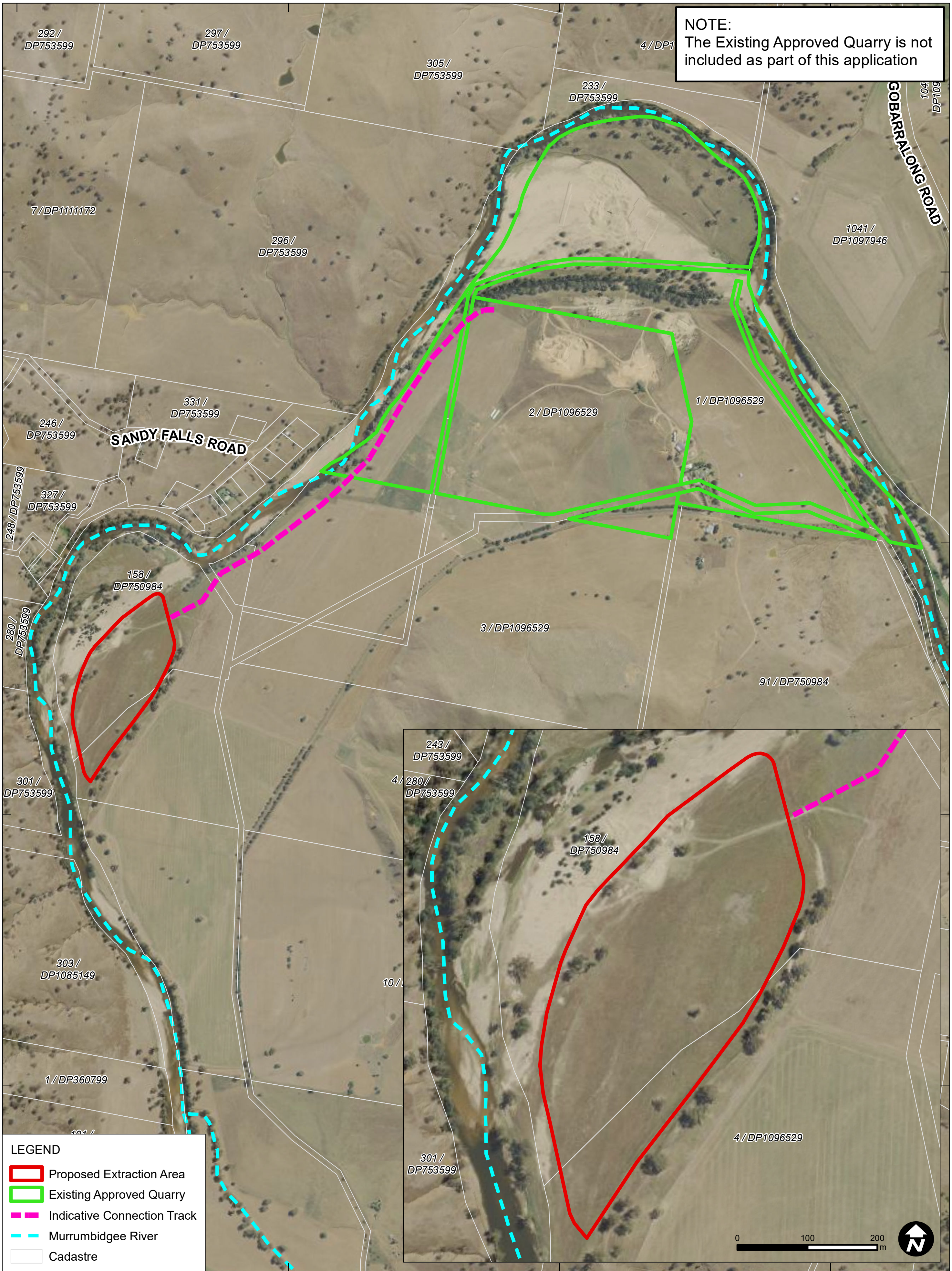
## Air Quality Impact Assessment

### Eulonga Quarry Proposed Extraction Area

Eulonga Quarries Pty Limited

SLR Project No.: 630.032007.00001

13 March 2025




0 375 750 m

Scale: 1:18,000 at A4
Coordinate System: GDA2020 MGA Zone 55

Date Drawn: 21-Feb-2025
Project Number: 630.032007

\\au.slr.local\Corporate\Projects-SLR\630-SrvNTL\630-NTL\630.032007.00001 Eulonga Quarry Expansion\06 SLR Data\01 GIS\GIS\SLR630032007_EIS_G13_ConceptualSiteLayout_001.mxd

SLR

Data Source: Basedata supplied by NSW SS (November, 2024)
Imagery © Department of Customer Service 2020

**CONCEPTUAL SITE LAYOUT PLAN**

**Appendix A**

# Appendix B Meteorological Data

## Air Quality Impact Assessment

### Eulonga Quarry Proposed Extraction Area

**Eulonga Quarries Pty Limited**

SLR Project No.: 630.032007.00001

13 March 2025

## B.1 SELECTION OF REPRESENTATIVE METEOROLOGICAL DATA

Once emitted to atmosphere, emissions will:

Rise according to the momentum and buoyancy of the emission at the discharge point relative to the prevailing atmospheric conditions;

Be adverted from the source according to the strength and direction of the wind at the height which the plume has risen in the atmosphere;

Be diluted due to mixing with the ambient air, according to the intensity of turbulence; and

(Potentially) be chemically transformed and/or depleted by deposition processes.

Dispersion is the combined effect of these processes.

Dispersion modelling is used as a tool to simulate the air quality effects of specific emission sources, given the meteorology typical for a local area together with the expected emissions. Selection of a year when the meteorological data is atypical means that the resultant predictions may not appropriately represent the most likely air quality impacts. Therefore, in dispersion modelling, one of the key considerations is the representative nature of the meteorological data used.

The year of meteorological data used for the dispersion modelling was selected by reviewing the most recent five years of historical surface observations at Wagga Wagga AMO AWS (2019 to 2023 inclusive) to determine the year that is most representative of average conditions. Wind direction, wind speed and ambient temperature were compared to averages for the region to determine the most representative year.

Data collected from 2019 to 2023 is summarised in **Figure B1** to **Figure B3**. Examination of the data indicates the following:

**Figure B1** indicates relatively similar wind roses for all years analysed with strong wind components blowing from the east. As the closest receptors are located at the west and southwest of the Site, winds from east and southeast directions are critical to cause impacts on these receptors.

**Figure B2** indicates that 2023 exhibits wind speeds that are closest to the long-term average; and

**Figure B3** shows that temperature in 2023 more closely reflects the long-term average.

Given the above considerations, the year 2023 was selected as the representative year of meteorology.

**Figure B1 Frequency of Winds at Wagga Wagga AMO AWS for 2019 – 2023**

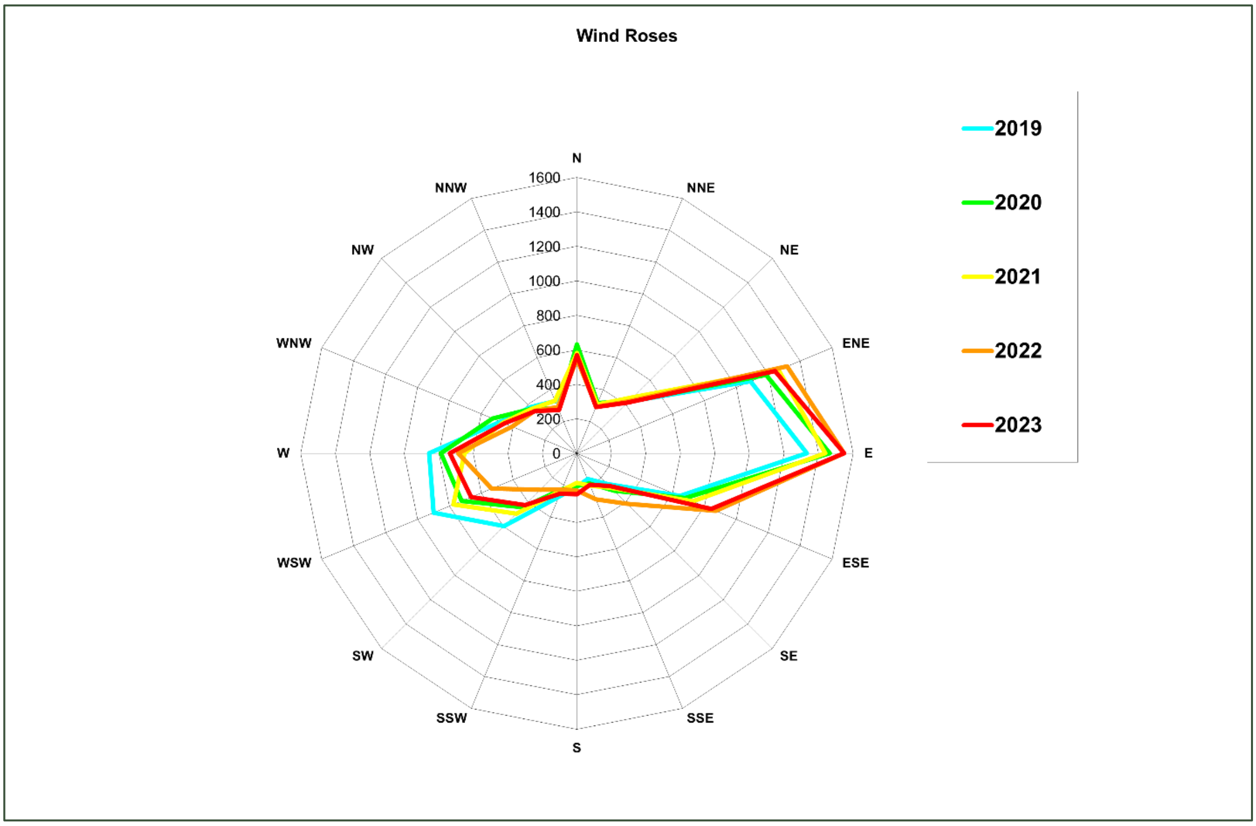


**Figure B2 Monthly Average Wind Speed at Wagga Wagga AMO AWS for 2019 – 2023**

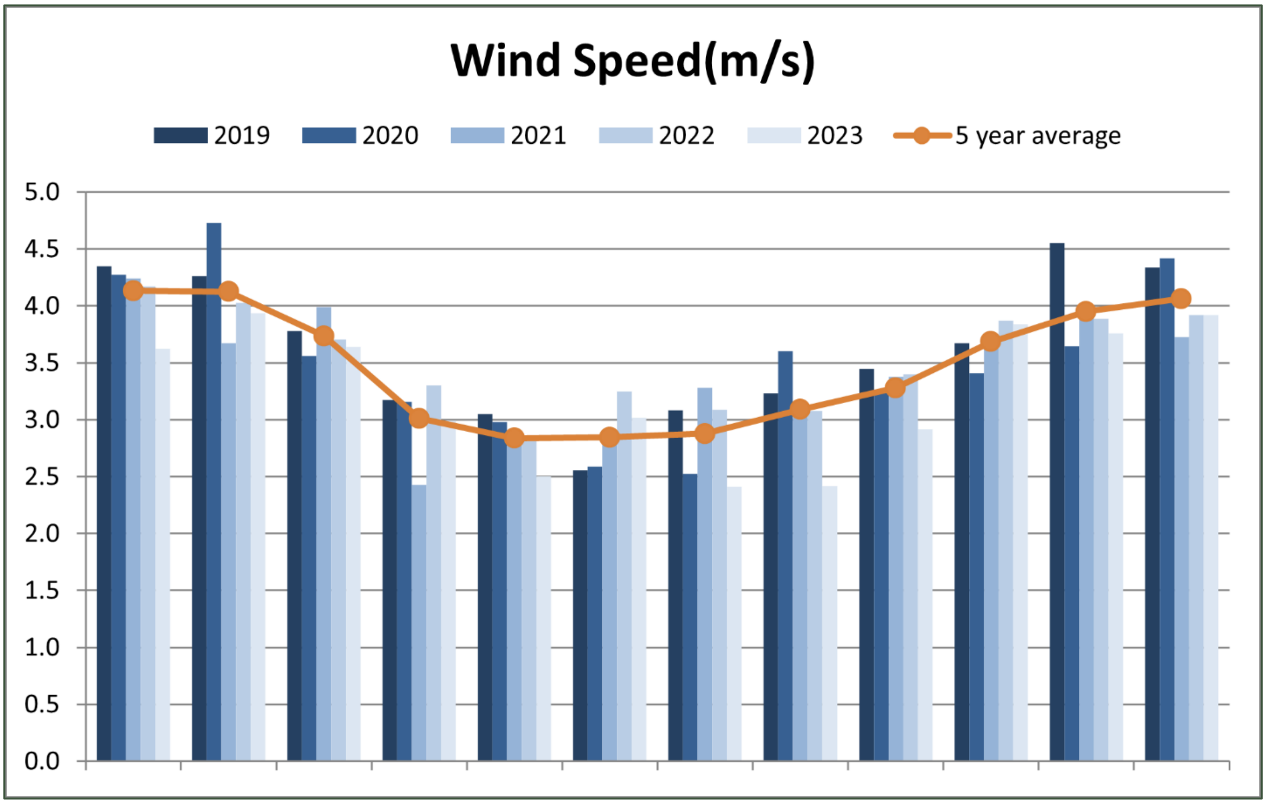
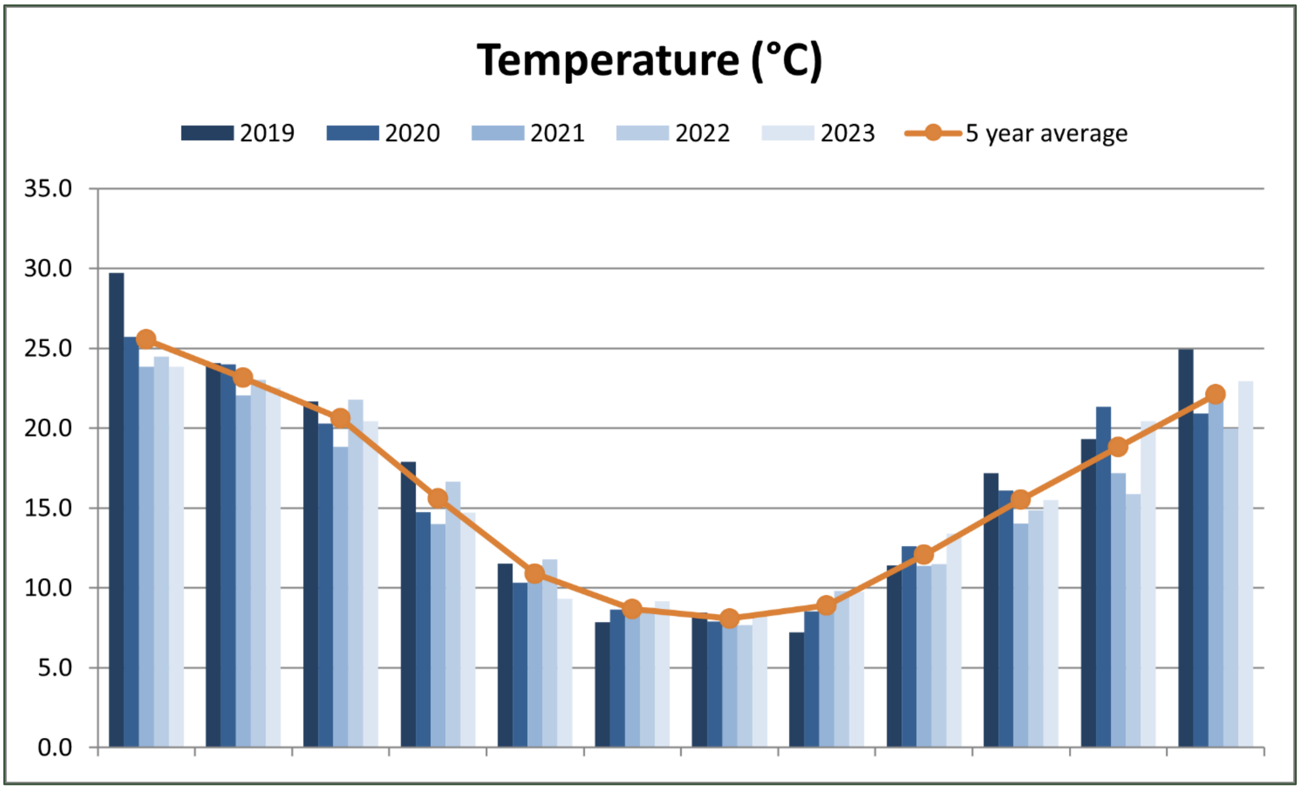


**Figure B3 Monthly Average Temperature at Wagga Wagga AMO AWS for 2019 – 2023**



# Appendix C Isopleth Results

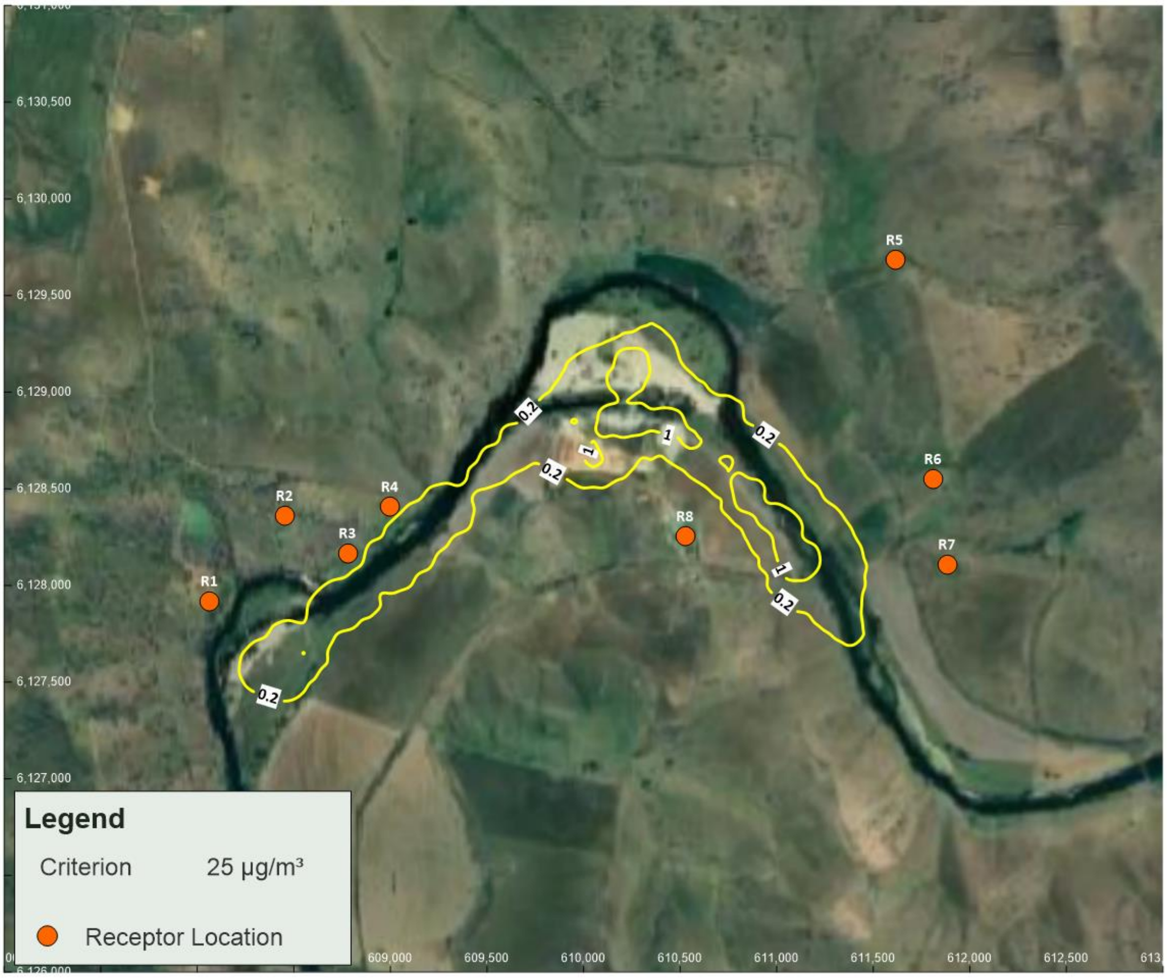
## Air Quality Impact Assessment

### Eulonga Quarry Proposed Extraction Area

### Eulonga Quarries Pty Limited

SLR Project No.: 630.032007.00001

13 March 2025

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| | |
|---|---|
| Project Number: | 630.032007 |
| Dispersion Model: | CALPUFF |
| Modelling Period: | 2023 |
| Projection: | GDA 1994 MGA Zone 55 |
| Date: | 17/01/2025 |

Eulonga Quarries Pty Limited

**Eulonga Quarry Expansion**
**Air Quality Impact Assessment**

Incremental Impact

| Pollutant | $PM_{2.5}$ | Avg Period | 24-Hour | Unit | µg/m³ |
|---|---|---|---|---|---|

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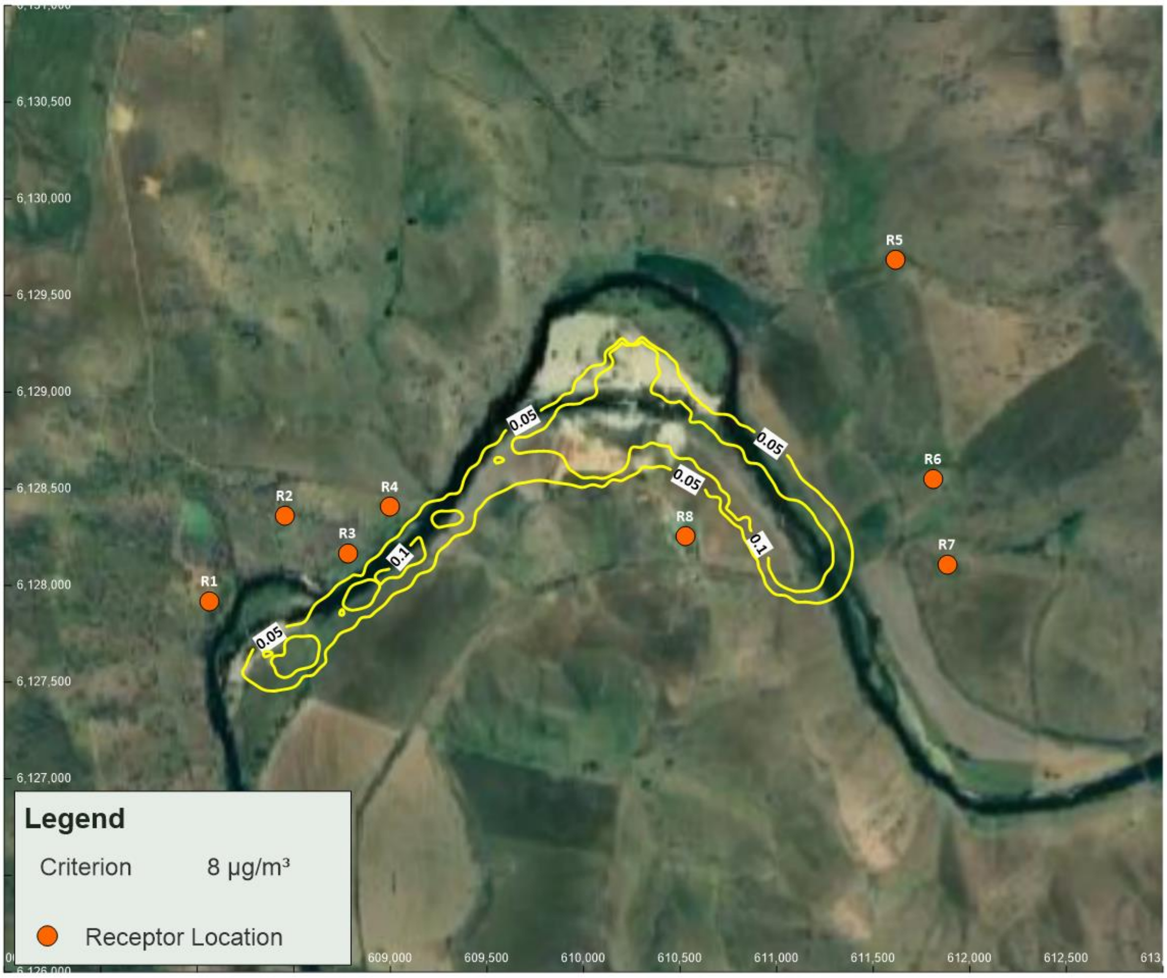


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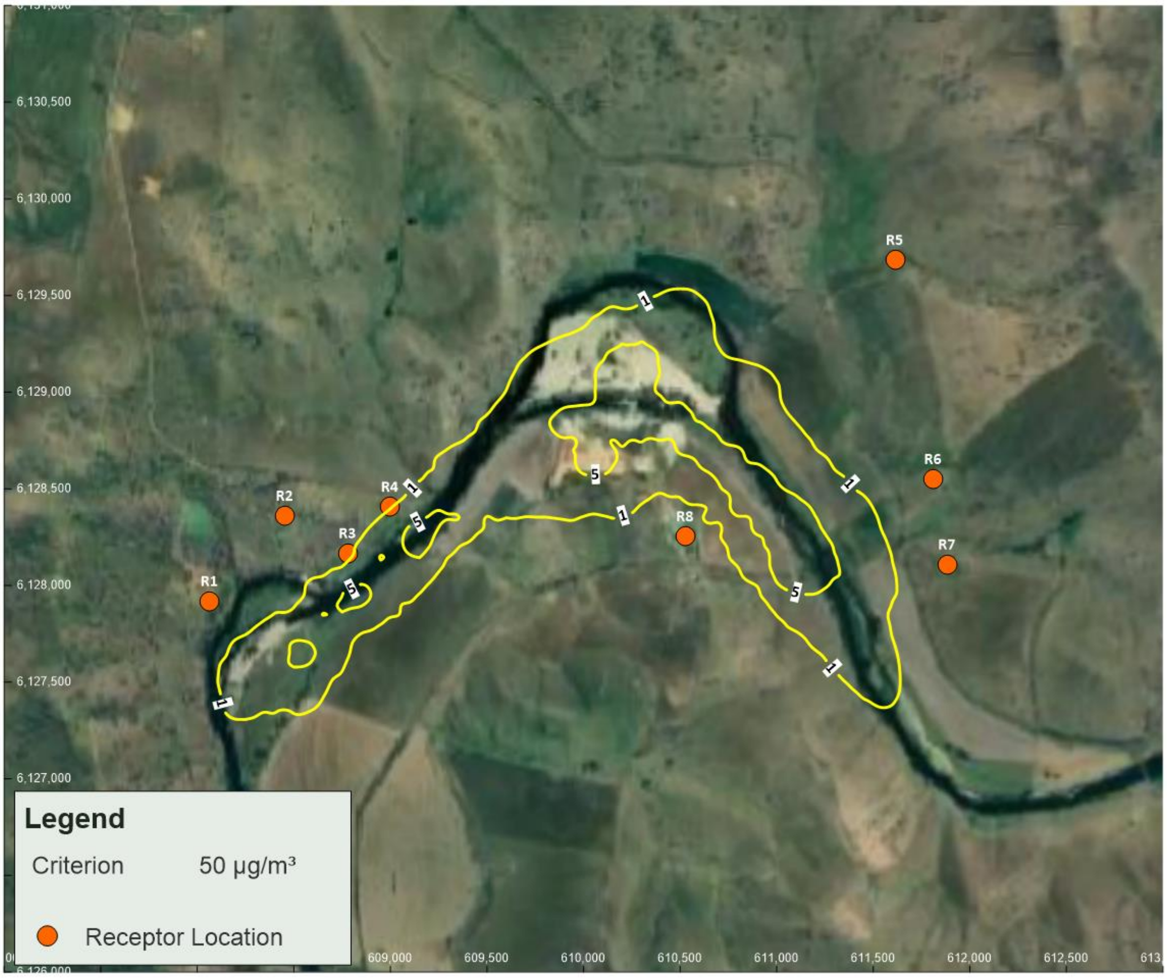
| Projection: | GDA 1994 MGA Zone 55 |
| Date: | 17/01/2025 |

Eulonga Quarries Pty Limited

**Eulonga Quarry Expansion**
**Air Quality Impact Assessment**

Incremental Impact

| Pollutant | $PM_{2.5}$ | Avg Period | Annual | Unit | $\mu g/m^3$ |
|---|---|---|---|---|---|

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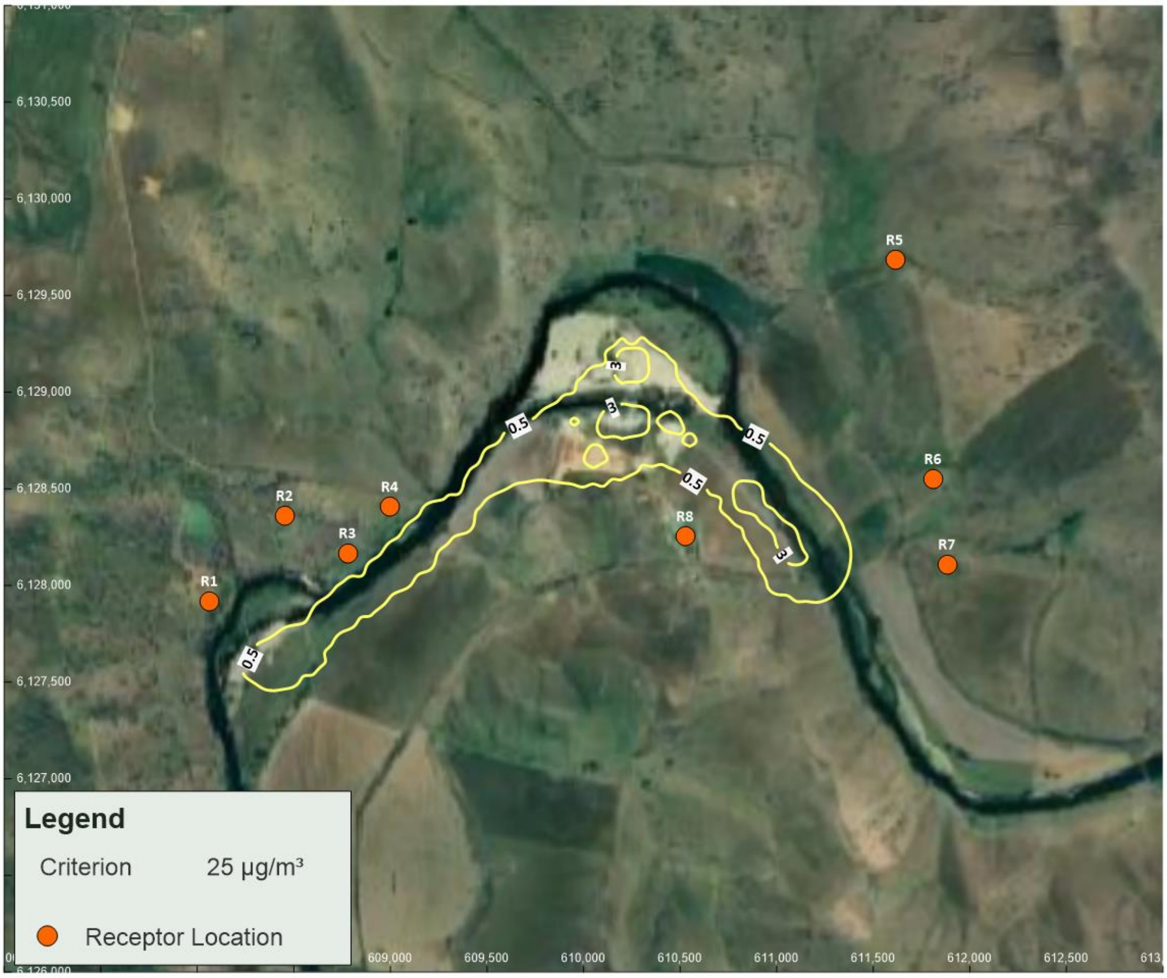
|---|---|
| Project Number: | 630.032007 |
| Dispersion Model: | CALPUFF |
| Modelling Period: | 2023 |
| Projection: | GDA 1994 MGA Zone 55 |
| Date: | 17/01/2025 |

Eulonga Quarries Pty Limited

**Eulonga Quarry Expansion**
**Air Quality Impact Assessment**

Incremental Impact

| Pollutant | $PM_{10}$ | Avg Period | 24-Hour | Unit | µg/m³ |
|---|---|---|---|---|---|

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|---|---|---|---|
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| | Dispersion Model: CALPUFF | | **Eulonga Quarry Expansion Air Quality Impact Assessment** |
| | Modelling Period: 2023 | | |
| | Projection: GDA 1994 MGA Zone 55 | | Incremental Impact |
| | Date: 17/01/2025 | Pollutant $PM_{10}$ | Avg Period Annual | Unit µg/m³ |

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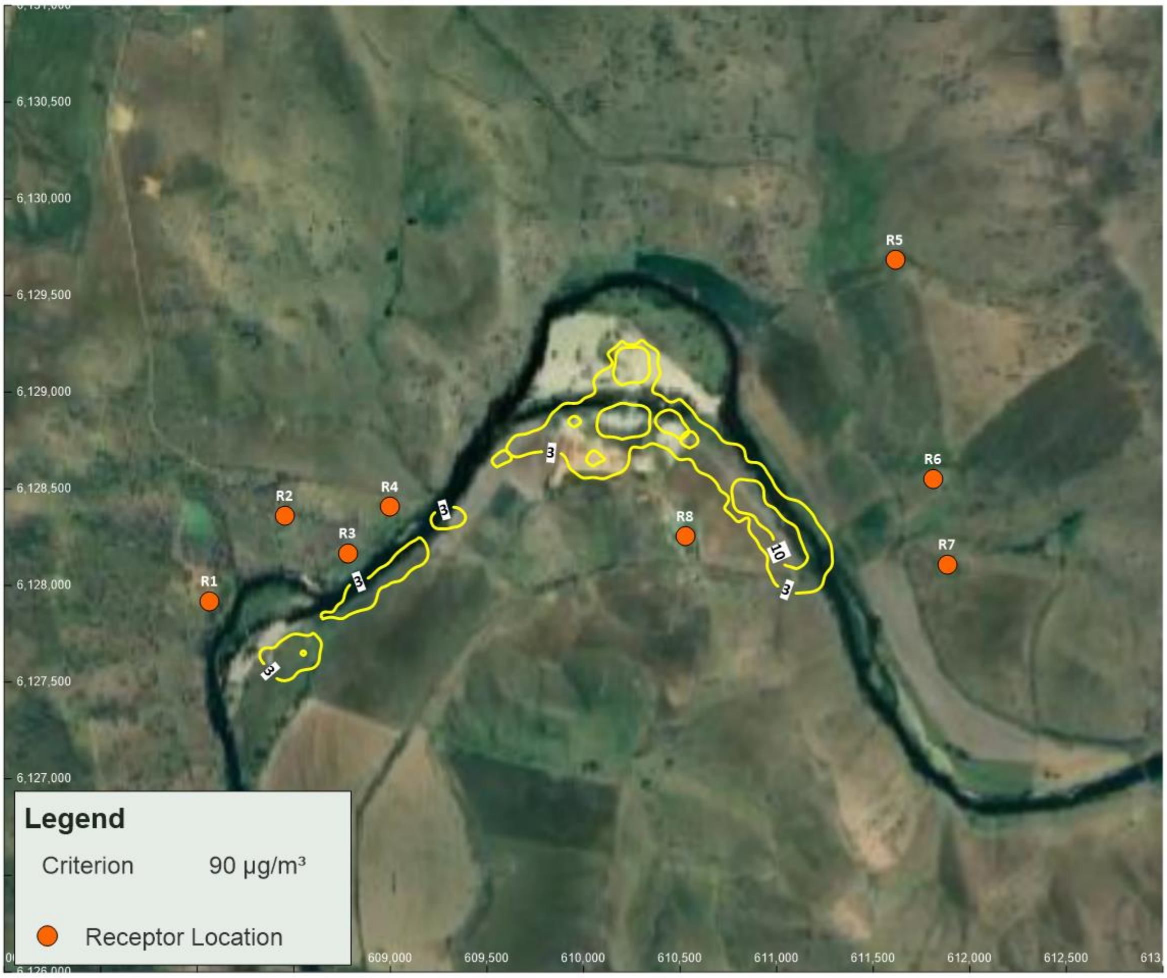


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| | |
|---|---|
| Project Number: | 630.032007 |
| Dispersion Model: | CALPUFF |
| Modelling Period: | 2023 |
| Projection: | GDA 1994 MGA Zone 55 |
| Date: | 17/01/2025 |

Eulonga Quarries Pty Limited

**Eulonga Quarry Expansion**
**Air Quality Impact Assessment**

Incremental Impact

| Pollutant | TSP | Avg Period | Annual | Unit | µg/m³ |
|---|---|---|---|---|---|

# Appendix D Variable Emission Rates

## Air Quality Impact Assessment

**Eulonga Quarry Proposed Extraction Area**

**Eulonga Quarries Pty Limited**

SLR Project No.: 630.032007.00001

13 March 2025

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

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

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

Step 2: Identify the operating hours for each activity

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

- Wind insensitive: Activities with emission factor that is independent of wind speed (e.g. blasting)
- Wind sensitive: Activities with emission factor that is a function of $(\text{wind speed}/2.2)^{1.3}$ (e.g. loading)
- Wind erosion: Emission from exposed areas/stockpiles

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

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

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

| | |
|---|---|
| $FP_{AC,i,h} = \frac{FP_{annual,i} \times 1000}{N_{days} \times OH_i \times 3600 \times N_{s,i}} \times WSFactor_{i,h}$ <br> $CM_{AC,i,h} = \frac{CM_{annual,i} \times 1000}{N_{days} \times OH_i \times 3600 \times N_{s,i}} \times WSFactor_{i,h}$ <br> $RE_{AC,i,h} = \frac{RE_{annual,i} \times 1000}{N_{days} \times OH_i \times 3600 \times N_{s,i}} \times WSFactor_{i,h}$ <br><br> For wind insensitive activities: <br> $WSFactor_{i,h} = 1$ <br><br> For wind sensitive activities: <br> $WSFactor_{i,h} = \frac{\left(\frac{WS_h}{2.2}\right)^{1.3}}{\frac{\sum_{j=1}^{n}\left(\frac{WS_j}{2.2}\right)^{1.3}}{n}}$ <br><br> For wind erosion activities: <br> $WSFactor_{i,h} = \frac{(WS_h)^3}{\frac{\sum_{j=1}^{n}(WS_j)^3}{n}}$ | Where: <br> $FP_{AC,i,h}$ = Fine particulates emission rate for activity i (g/s) at hour h <br> $CM_{AC,i,h}$ = Coarse particulates emission rate for activity i (g/s) at hour h <br> $RE_{AC,i,h}$ = Remaining particulates emission rate for activity i (g/s) at hour h <br> $OH_i$ = Daily operating hours (1- 24) for activity i <br> $N_{days}$ = Number of days in the meteorological data file <br> $N_{s,i}$ = Number of sources associated with activity i <br> $WS_h$ = Wind speed at the hour <br> n = number of hours in the meteorological data file |

*Note: If the activity was modelled as area source, the equation on the left column of the table needs to be divided by the area of that activity*

Step 6: Calculate hourly average emission rate for each source

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

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

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

Making Sustainability Happen