SEED- Stage 1B

Air Quality Impact Assessment

Mirvac Projects Pty Ltd

Level 28, 200 George Street
Sydney NSW 2000

Prepared by:

SLR Consulting Australia

SLR Project No.: 610.032539.00004

5 March 2026

Revision: V2.0

Making Sustainability Happen

Revision Record

Revision	Date	Prepared By	Checked By	Authorised By
V2.0	5 March 2026	F Jafarigol (PhD, CAQP) K Barker (BSc)	A Naghizadeh (CAQP)	A Naghizadeh (CAQP)
V1.0	18 February 2026	F Jafarigol (PhD, CAQP) K Barker (BSc)	J A Cox(CAQP)	J A Cox(CAQP)

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 Mirvac Projects Pty Ltd (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

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SLR disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.

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Executive Summary

This Air Quality Impact Assessment (AQIA) has been prepared by SLR Consulting Australia Pty Ltd (SLR) to accompany a State Significant Development Application (SSDA) SSD-99079487 which supports the staged development of SEED Stage 1.

The SEED Stage 1 Concept Proposal (SSD-19618251) and detailed stage development identified as the Stage 1A Development has been approved on 4 February 2026. SEED Stage 1 (SSD-19618251) establishes a Concept Masterplan for seven (7) industrial buildings and a cafe, subdivision at 1669-1723 and 1669A Elizabeth Drive Badgerys Creek. SEED Stage 1A includes site preparation works the bulk earthworks, road construction, construction and operation of two (2) warehouse buildings (Warehouses 2 and 6).

Mirvac is seeking approval for a new DA for the construction and operation of Warehouses 1, 4, 5, 7 and 8, a café and regional stormwater basin at 1669-1723 and 1669A Elizabeth Drive Badgerys Creek. This forms the second stage of development works envisaged under the SEED Stage 1 Concept Proposal (SSD-19618251) and is referred to as the "SEED Stage 1B".

A concurrent modification application to SEED Stage 1 Concept Proposal and SEED Stage 1A (SSD-19618251) is proposed to update civil design elements and to align with proposed design for SEED Stage 1B.

The legal description of the site as it pertains to SEED Stage 1B is outlined in **Table 1** below.

Table 1 Legal Description

Property Address	Title Description
1669-1732 Elizabeth Drive, Badgerys Creek	Lot 100 in DP 1283398
1669A Elizabeth Drive, Badgerys Creek	Lot 741 in DP810111

This report has been prepared to address the Secretary’s Environmental Assessment Requirements (SEARs) issued (dated 8 December 2025) for the project (SSD-99079487).

This report concludes that the proposed development is suitable and warrants approval subject to the implementation of the following mitigation measures:

- Adopted recommended mitigation measures in a site-specific Construction Air Quality Management Plan. This plan will cover all sources of emissions, such as those identified in this AQIA, including wind erosion, wheel generated dust, extraction, material handling and processing of extracted material.
- Utilisation of Trigger Action Response Plan supported by PM_{10} real-time air quality monitors to manage impacts at receptors.

Following the implementation of the above mitigation measures, the remaining impacts are appropriate.

1.0 Introduction

Mirvac is seeking approval for a new DA for the construction and operation of Warehouses 1, 4, 5, 7 and 8, a café and regional stormwater basin at 1669-1723 and 1669A Elizabeth Drive, Badgerys Creek (the Site). This forms the second stage of development works envisaged under the SEED Stage 1 Concept Proposal (SSD-19618251) and is referred to as the "SEED Stage 1B".

The SEED Stage 1B Development seeks approval for the following:

- Construction of the following warehouse buildings for the purpose of warehouse and distribution centres (including warehouse building, ancillary office, hardstand areas for loading/unloading/vehicular manoeuvring and on-lot car parking):
    - Warehouse 1 (Lot 1) comprising 4,130 m^2 of Gross Floor Area (GFA) and 31 car parking spaces;
    - Warehouse 4 (Lot 4) comprising 8,990 m^2 of GFA and 55 car parking spaces;
    - Warehouse 5 (Lot 5) comprising 6,840 m^2 of GFA and 42 car parking spaces;
    - Warehouse 7 (Lot 7) comprising 40,410 m^2 of GFA and 183 car parking spaces;
    - Warehouse 8 (Lot 8) comprising 21,370 m^2 of GFA and 98 car parking spaces; and
    - Operating hours for Warehouse Buildings 1, 4, 5, 7 and 8 for 24 hours, 7 days a week.
- Estate café comprising 300 m^2 of GFA, 24 car supporting parking spaces as part of the Edge Amenity node. Operating hours for the Estate café from 5am to 5pm, 7 days a week;
- Construction of Sydney Water Regional Stormwater Basin SC09 (through a Developer Works Agreement with Sydney Water Corporation (SWC) which will eventually be acquired by SWC);
- Landscaping, including on-lot landscaping and amenity areas, street reserve landscaping and estate amenity nodes;
- Construction of some new on-lot retaining walls to manage level differences between development lots; and
- Estate wayfinding signage.

This proposal concerns the construction and operation of remaining warehouse buildings established under the SEED Stage 1 Concept Masterplan and further to the site preparation works approved under the Stage 1A Development approval.

Modifications to SEED Stage 1

- Re-distribution of warehouse and ancillary office GFA across Warehouse Buildings 1, 4, 5, 7 and 8 to align with the proposed SEED Stage 1B designs (net-zero change to the total GFA across these warehouse buildings);
- Minor increase to the café GFA by 150sqm for consistency with SEED Stage 1B requirements;
- Refinement to the approved levels and retaining walls for consistency with SEED Stage 1B requirements. This includes adjustment to Lot 8s FFL as well as refinements to the design of some approved retaining walls;

- Update to the cumulative stormwater management strategy for SEED to reflect changes to the intended development outcome at the Aspect Industrial Estate (AIE) site that is being progressed under a separate application; and
- An optional contingency to modify the interim evaporation basin within the SEED Stage 2 land.

The development sought as part of this proposal and the development under SSD-19618251 will deliver a unified, staged development of the overall Precinct.

Purpose of this Report

This report has been prepared in response to the requirements contained within the Secretary's Environmental Assessment Requirements (SEARs) dated 8 December 2025 and issued for the SSDA (SSD-99079487). Specifically, this report has been prepared to respond to the SEARs requirement and government agency comments issued below (**Table 2**).

Table 2 SEARs Requirements & Government Agency Comments

Item	Description of Requirement	Section Reference (this report)
Air Quality and Odour	*a quantitative assessment of the potential air quality, dust and odour impacts of the development (construction and operation) on surrounding landowners, businesses and sensitive receptors, in accordance with relevant Environment Protection Authority guidelines, which includes:* - *details of a proposed trigger action response plan (TARP) to be implemented during construction, using mitigation, management and monitoring measures supported by the cumulative quantitative assessment, that are part of an integrated and coordinated plan to manage cumulative dust impacts* - *details of proposed mitigation, management and monitoring measures.*	Construction stage assessment - **Section 5.0** Operational stage assessment **Section 7.0** Mitigation measures (including TARP) - **Section 8.0** The proposal does not seek consent for any use (such as an odour emitting use), therefore this report does not include an odour assessment.

In addition, Condition B16 of the development consent conditions under SSD-19618251, issued 4 February 2026, must be met but all future DAs. The relevant conditions are outlined in **Table 3**.

Table 3 SSD-19618251 Consent Conditions

Item	Description of Requirement	Section Reference (this report)
Air Quality B16	Future DAs must be accompanied by an Air Quality and Odour Impact Assessment. The assessment must: a) be prepared in accordance with the Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales (EPA 2016) and Assessment and Management of Odour from Stationary Sources in NSW (DEC 2006); b) identify the air quality and odour impacts during construction and operation, including potential impacts on sensitive receivers; c) update the air quality impact assessment for the relevant stage to incorporate any findings from the air quality monitoring conducted under condition D43 and the air quality independent audit under D45; d) compare the air quality predictions for the relevant stage with the Air Quality Impact Assessment included in the Submissions Report; e) assess any potential cumulative impacts from concurrent construction and operational activities on the site and from surrounding developments; and f) recommend mitigation, management and monitoring measures to be implemented to minimise air quality and odour impacts during construction and operation.	Item A – This report considers the relevant legislation and guidance in **Section 3.0** and been appropriately prepared in general accordance with these, Item B – Sources of emissions are identified in **Section 2.2**. Item C –SSD-19618251 was approved on 4 February 2026 during preparation of report. Air quality monitoring is not available at this stage. Item D – A comparison of impacts is provided in **Section 9.0**. Item E – Cumulative Impacts from surrounding developments are considered in **Sections 6.0** and **0**. Item F – Mitigation Measures are outlined in **Section 8.0**.

1.1 Approach to Assessment

This assessment has been prepared with consideration of the following documents:

- *Protection of the Environment Operations (Clean Air) Regulation 2022* (NSW Parliament 2022)
- *Approved Methods for the Sampling and Analysis of Air Pollutants in NSW* (NSW EPA 2022b)
- *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (NSW EPA 2022)(the Approved Methods)

1.1.1 Construction Impact Assessment Methodology

The key potential air quality issue identified for the construction phase of the Site is particulate matter emissions associated with bulk earthworks.

To assess potential peak impacts associated with construction stage emissions from the Site, a quantitative assessment in general accordance with the NSW EPA's *Approved Methods for Modelling and Assessment of Air Pollutants in NSW* publication (NSW EPA 2022)(hereafter referred to as the Approved Methods), has been prepared.

Section 2.1 of the Approved Methods outlines a two-tiered approach to Air Quality Impact Assessments (AQIA):

- Level 1, which is a basic screening using worst-case assumptions, and
- Level 2, a more detailed assessment with refined techniques and site-specific data.

If a Level 1 assessment shows that adverse impacts are unlikely, there is no need to proceed to Level 2. For this assessment, considering the type of emissions associated with bulk earthworks, a Level 2 assessment using the TAMP/CALMET/CALPUFF modelling systems has been completed.

1.1.2 Operational Impact Assessment Methodology

The key potential air quality issue identified for the operational phase of the Site is emissions of combustion products associated with vehicle movements at the Site.

To estimate potential peak impacts associated with operational stage emissions from the Site, a quantitative assessment in general accordance with the Approved Methods has been prepared.

For this assessment, the Roadside Air Quality Screening Tool (RAQST) is employed. RAQST, developed by Transport for NSW (TfNSW), is a simplified version of a road vehicle emission model used for initial air quality impact screening. It employs worst-case scenarios to determine if a detailed Level 2 assessment is necessary, providing conservative predictions of incremental impacts. TfNSW recommends its use as a Level 1 equivalent for near-field ground-level pollutant concentration prediction from traffic.

2.0 Project Overview

2.1 Site Description

The Site is located at 1669-1732 Elizabeth Drive (Lot 100 in DP1283398) Badgerys Creek within the Penrith Local Government Area (LGA). The legal description of the Site as it pertains to SEED Stage 1B, is outlined in **Table 4** below.

Table 4 Legal Description

Property Address	Title Description
1669-1732 Elizabeth Drive, Badgerys Creek	Lot 100 in DP 1283398
1669A Elizabeth Drive, Badgerys Creek	Lot 741 in DP810111

The Site is located at in Badgerys Creek, within the Penrith Local Government Area (LGA) (refer to **Figure 1)**. The proposed site layout is shown in **Figure 2**.

Figure 1 Site Location

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www.slrconsulting.com

The content within this document may be based on third party data. SLR Consulting Australia Pty Ltd does not guarantee the accuracy of such information.

Project Number:	610.032539
Location:	Kemps Creek, NSW
Source:	Nearmap
Projection:	GDA 2020 MGA Zone 56
Date:	16/01/2026

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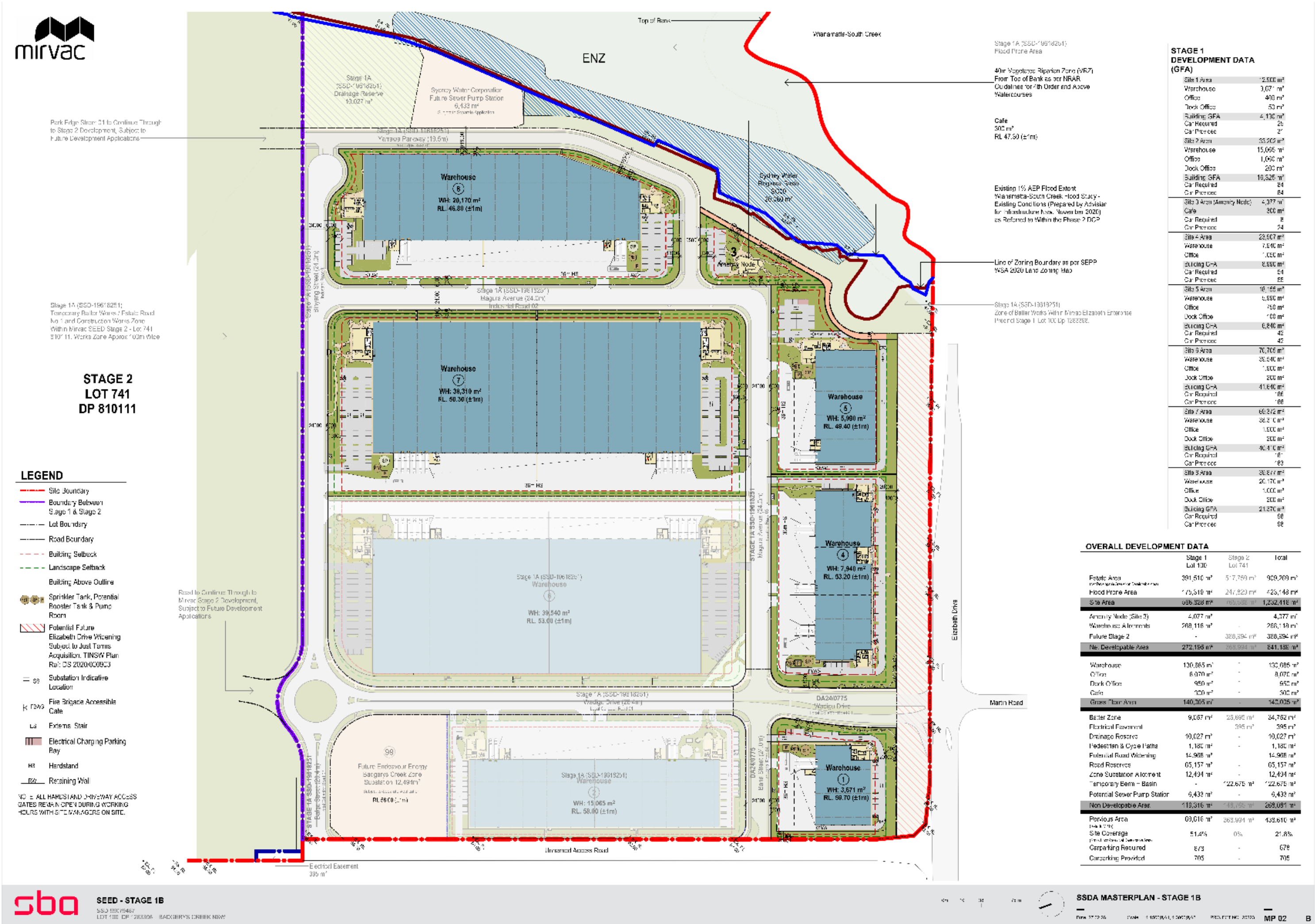
SEED Stage 1B
Air Quality Impact Assessment

Site Location

Figure 2 Site Layout (Stage 1B SSDA Masterplan)



2.2 Potential Sources of Emissions to Air

2.2.1 Construction Phase

The main air quality issues associated with construction works relate to emissions of fugitive dust. The potential for dust to be emitted during the construction works will be directly influenced by the nature of the activities being performed at any given time. Generally, the activities that are most likely to lead to short-term emissions of dust, include:

- Loading and unloading of materials.
- Crushing of materials
- Wheel-generated dust and combustion emissions from construction equipment.
- Wheel-generated dust from trucks travelling on unpaved surfaces.
- Wind erosion of exposed surfaces.

Temporary elevations in local dust levels are most likely to occur when construction activities are undertaken during periods of low rainfall and/or windy conditions. The impact of elevated dust emissions is dependent upon the potential for particulates to become and remain airborne before being deposited as dust or experienced as an ambient particulate concentration.

A number of environmental factors may affect the generation and dispersion of dust emissions, including:

- Wind direction - determines whether dust and suspended particles are transported in the direction of the sensitive receptors.
- Wind speed - determines the potential suspension and drift resistance of particles.
- Surface type - more erodible surface material types have an increased soil or dust erosion potential.
- Surface material moisture - increased surface material moisture reduces soil or dust erosion potential; and
- Rainfall or dew - rainfall or heavy dew that wets the surface of the soil reduces the risk of dust generation.

Where diesel-powered mobile machinery and vehicles are used, localised elevations in ambient concentrations of combustion-related pollutants may also occur, however, the potential risk of the relevant impact assessment criteria for these pollutants to be exceeded in surrounding sensitive areas is considered to be low. Fugitive dust emissions are generally considered to have the greatest potential to give rise to downwind air quality impacts at construction sites.

2.2.2 Operational Phase

During the operational phase, the main source of air emissions would be emissions of products of fuel combustion and particulate matter (from brake and tyre wear as well as re-entrainment of road dust) associated with the trucks and other vehicles entering and leaving or idling at the Site during loading/unloading operations. It is assumed that no refuelling or power generation will occur on site and that the site would be used for general warehousing, and distribution only.

Emissions associated with the combustion of fuel (diesel, petrol, etc.) in road vehicles will include carbon monoxide (CO), oxides of nitrogen (NO_x), particulate matter (PM_{10} and

$PM_{2.5}$), sulfur dioxide (SO_2) and volatile organic compounds (VOC_s). The exact rate and composition of air pollutant emissions from road vehicles is a function of several factors, including the type, size and age of the vehicles, the type of fuel combusted, the number and speed of vehicles and the road gradient

2.2.2.1 Project Traffic

Project traffic data provided by the Project's traffic consultants (Ason 2024) indicates that operational traffic volumes on Elizabeth Drive would generate 4,065 vehicles per day (two-way) and 297 and 331 vehicles per hour (two-way) during the weekday morning and afternoon peaks, respectively. **Table 5** provides an indicative distribution of traffic generation over a typical day.

Table 5 Operational 24-Hour Traffic Profile of the Site

Time	All Vehicle	Light Vehicle	Heavy Vehicle
0:00	34	24	10
1:00	30	20	10
2:00	32	22	11
3:00	36	28	9
4:00	115	95	20
5:00	219	176	44
6:00	297	235	61
7:00	294	221	73
8:00	272	188	84
9:00	236	144	92
10:00	221	132	89
11:00	232	141	91
12:00	253	171	82
13:00	304	221	83
14:00	331	257	74
15:00	283	218	65
16:00	235	183	52
17:00	194	150	44
18:00	116	85	31
19:00	69	50	19
20:00	51	36	15
21:00	66	55	11
22:00	85	71	13
23:00	60	48	12
Total	**4,065**	**2,972**	**1,094**

Note 1: There may be some discrepancies between movements for individual hours and the total movements per day due to rounding.

Source: (Ason 2024)

2.3 Pollutants of Interest

As identified above, the key air pollutants of interest are considered to be particulate matter from construction works, and wheel-generated dust and products of fuel combustion from operations. The following sections outline the potential health and amenity issues associated with particulate matter and products of fuel combustion, while **Section 3.4** identifies the relevant air quality assessment criteria.

2.3.1 Particulate Matter

Airborne contaminants that can be inhaled directly into the lungs can be classified based on 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 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 called 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.

2.3.2 Nuisance Dust

In addition, nuisance impacts need also to be considered, mainly in relation to deposited dust. Dust can cause nuisance by settling on surfaces and possessions, affecting visibility and contaminating tank water supplies. High rates of dust deposition can also adversely affect vegetation by blanketing leaf surfaces.

2.3.3 Products of Combustion

Emissions associated with road traffic and the combustion of fossil fuels (diesel, petrol, AVGAS etc.) will include CO, NO_x, PM_{10}, $PM_{2.5}$, SO_2 and VOCs.

CO is an odourless, colourless gas formed from the incomplete burning of fuels in motor vehicles. It can be a common pollutant at the roadside and the highest concentrations are found at the kerbside with concentrations decreasing rapidly with increasing distance from the road. CO in urban areas results almost entirely from vehicle emissions and its spatial distribution follows that of traffic flow. The incomplete combustion of fuel in diesel powered vehicles can generate particulate in the form of black soot.

NO_x is a general term used to describe any mixture of nitrogen oxides formed during combustion. In atmospheric chemistry, NO_x generally refers to the total concentration of nitric oxide (NO) and nitrogen dioxide (NO_2). NO is a colourless and odourless gas that does not significantly affect human health. However, in the presence of oxygen, NO can be oxidised to NO_2 which can have significant health effects including damage to the respiratory tract and increased susceptibility to respiratory infections and asthma. NO will be converted to NO_2 soon after leaving the engine exhaust.

Engine exhausts can contain emissions of SO_2 due to impurities in the fuel. The sulfur content in diesel fuel has significantly reduced over the years ambient SO_2 concentrations in Australian cities are typically well below regulatory criteria. Volatile organic compounds (VOCs) may be emitted as a result of the incomplete combustion of fuel. VOCs emissions are reducing significantly due to the improved combustion processes offered by modern engines.

3.0 Relevant Legislation, Policy and Guidance

The following air quality policy and guidance documents have been referenced within this assessment and have been used to identify the relevant air quality criteria.

3.1 Protection of the Environment Operations (POEO) Act 1997 & Amendment Act 2011

The POEO Act (and Amendment Act 2011) is a key piece of environment protection legislation administered by the EPA group which enables and establishes instruments for setting environmental standards, goals, protocols and guidelines.

The following sections of the POEO Act are of general relevance to the Project:

- Section 126 of the POEO Act requires that materials (e.g. raw ingredients and waste storage/disposal at the Site) are managed in a proper and efficient manner to prevent air pollution (e.g. odour).
- Section 128 of the POEO Act states:

2 The occupier of premises must not carry out any activity or operate any plant in or on the premises in such a manner to cause or permit the emission at any point specified in or determined in accordance with the regulation of air impurities in excess of [the standard of concentration and/or the rate] prescribed by the regulations in respect of any such activity or any such plant.

3 Where neither such a standard nor rate has been so prescribed, the occupier of any premises must carry on activity, or operate any plant, in or on the premises by such practicable means as may be necessary to prevent or minimise air pollution.

3.2 Protection of the Environment Operations (Clean Air) Regulation 2022

The POEO (Clean Air) Regulation 2022 (the Regulation) is the core regulatory instrument for air quality issues in NSW. In relation to industry, the Regulation:

- sets maximum limits on emissions from activities and plants for a number of substances; and
- restricts the use of high sulphur liquid fuel.

3.3 NSW Environment Protection Authority Air Quality Policy and Guidance

The NSW Environmental Protection Agency (EPA) is the NSW regulatory authority responsible for air quality regulation and associated activities.

The NSW EPA Approved Methods (NSW EPA 2022) lists the statutory methods for modelling and assessing air pollutants from stationary sources and specifies criteria that reflect the environmental outcomes adopted by the EPA.

The Approved Methods are referred to in the POEO (Clean Air) Regulation 2022 for assessment of impacts of air pollutants. The air quality criteria set out in the Approved Methods have been reproduced and discussed in **Section 3.4.**

3.4 Ambient Air Quality Criteria

State air quality guidelines specified by the NSW EPA for the pollutants identified in **Section 2.2** are published in the Approved Methods. The air quality impact assessment criteria listed in **Section 3.4** of the Approved Methods have been established by NSW EPA to achieve appropriate environmental outcomes and to minimise risks to human health. They have been derived from a range of sources and are the defining ambient air quality criteria for NSW and are considered to be appropriate for use in this assessment.

The impact assessment criteria listed in the Approved Methods for relevant pollutants are shown in **Table 6**.

Table 6 NSW EPA Impact Assessment Criteria for Air Quality Assessment

Pollutant	Averaging Period	Ambient Air Quality Criterion	
		µg/m^3	pphm
Total suspended particulate (TSP)	Annual	90	-
Particulate matter less than 10 microns (PM_{10})	24-Hour	50	-
	Annual	25	-
Particulate matter less than 2.5 microns ($PM_{2.5}$)	24-Hour	25	-
	Annual	8	-
Nitrogen dioxide (NO_2)	1-hour	164	8
	Annual	31	1.5
Carbon monoxide (CO)	15-minutes	100,000 mg/m^3	8,700 (ppm)
	1-hour	30,000 mg/m^3	2,500 (ppm)
	8-hour	10,000 mg/m^3	900 (ppm)
Sulfur dioxide (SO_2)	1-hour	215	7.5
	24-hour	57	2
Benzene	1-hour	29	0.9
Toluene	1-hour	360	9
Ethylbenzene	1-hour	8,000	180
Xylenes	1-hour	190	4

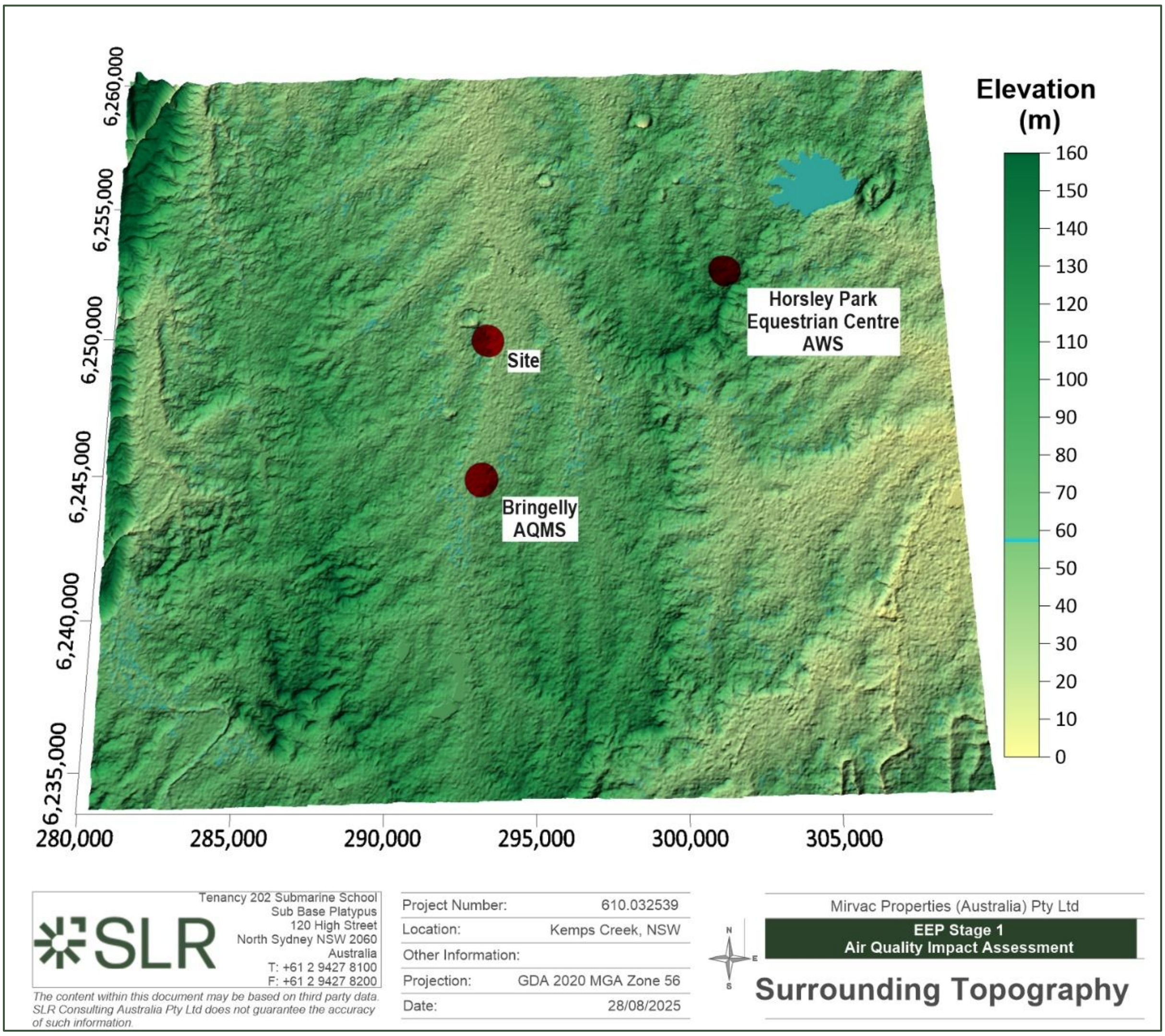
4.0 Existing Air Environment

4.1 Surrounding Topography

Local topography is important in air quality studies as local atmospheric dispersion can be influenced by night-time katabatic (downhill) drainage flows from elevated terrain or channelling effects in valleys or gullies.

The topography of the Site and near surrounds is relatively flat, with an elevation of the approximately 45 m Australian Height Datum (AHD). A pseudo-three-dimensional representation of the region surrounding the Site is presented in **Figure 3**. The locations of Horsley Park Equestrian Centre automatic weather station (AWS) and Bringelly air quality monitoring station (AQMS) are also indicated.

Figure 3 Regional Topography

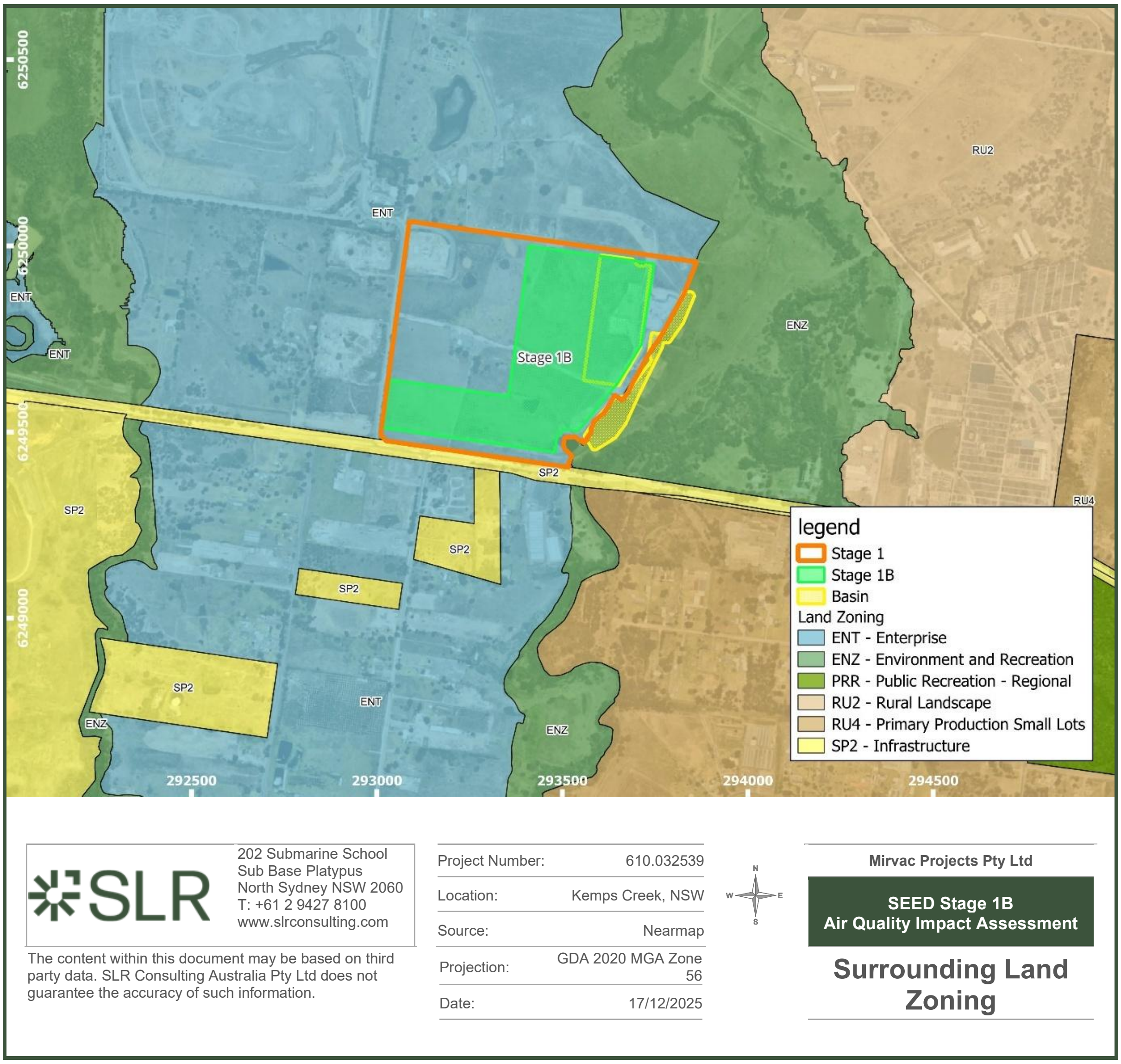


4.2 Surrounding Land Uses

As shown in **Figure 4**, the area surrounding the Site is predominantly zoned Enterprise (ENT), with Infrastructure (SP2) along the southern transport corridor, Environment and Recreation (ENZ) to the east and north, and Rural Landscape (RU2) further east.

This zoning context indicates a transition between enterprise, infrastructure, and environmentally sensitive land uses. While the ENT zoning supports employment and industrial type uses, the proximity of ENZ land suggests that environmental considerations may constrain the scale, layout, and operational characteristics of any future development

Figure 4 Surrounding Land Zoning



4.3 Sensitive Receptors

As shown in **Figure 5**, there are several residential and commercial receptors located in all directions from the Site, with the closest sensitive receptor located approximately 30 m to the south.

Table 7 outlines the location of the sensitive receptors included in the assessment and their approximate distance to the nearest Site boundary.

The sensitive receptor locations are intended to be representative of all sensitive receptor locations, whether discretely identified or not.

It is noted that some surrounding locations have not been included as sensitive receptors due to current and proposed developmental activities contributing to dust generation in the area. Where a development has been considered as a source of emissions contributing to cumulative impacts (See **Section 5.4.4)**, that location has been excluded from the incremental impact assessment a sensitive receptor.

Figure 5 Surrounding Receptors

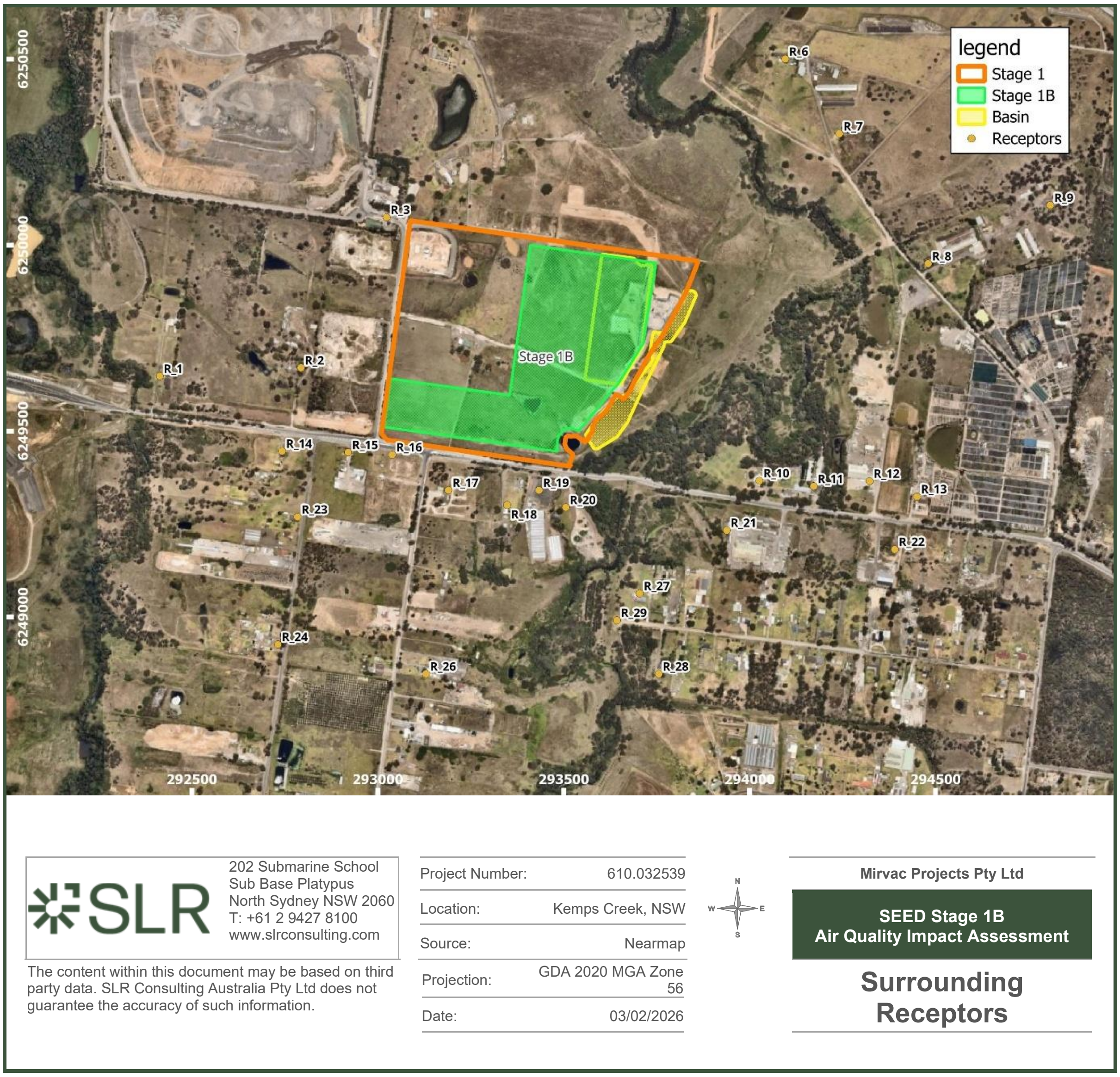


Table 7 Sensitive Receptor Locations

Map ID	Easting (m)	Northing (m)	Base Elevation (m)	Approximate Distance from Closest Site Boundary (m)
R1	292,414	6,249,648	51	580
R2	292,793	6,249,670	63	220
R3	293,024	6,250,075	58	60
R6	294,096	6,250,501	42	640
R7	294,241	6,250,300	43	530
R8	294,480	6,249,950	46	620
R9	294,808	6,250,107	57	970
R10	294,026	6,249,366	42	430
R11	294,172	6,249,352	46	570
R12	294,323	6,249,365	41	720
R13	294,450	6,249,324	41	820
R14	292,743	6,249,446	64	240
R15	292,920	6,249,443	63	70
R16	293,039	6,249,436	61	30
R17	293,190	6,249,341	62	100
R18	293,348	6,249,301	56	110
R19	293,434	6,249,341	50	60
R20	293,506	6,249,295	46	110
R21	293,938	6,249,233	43	460
R22	294,390	6,249,182	45	870
R23	292,784	6,249,269	64	290
R24	292,731	6,248,926	53	620
R26	293,130	6,248,847	63	590
R27	293,704	6,249,063	45	390
R28	293,756	6,248,847	47	680
R29	293,643	6,248,991	45	450

4.4 Local Meteorological Conditions

The Bureau of Meteorology (BoM) maintains and publishes data from weather stations across Australia. A description of the wider climate for a site assists in the interpretation of the air quality impacts by describing existing conditions. The closest such station recording long term wind speed and wind direction data is the Badgerys Creek AWS (Station 67108, elevation 81 m AHD) located approximately 4 km south-west of the Site (see location shown on **Figure 3**).

Badgerys Creek AWS, has data available from 1995 to the present for the following parameters:

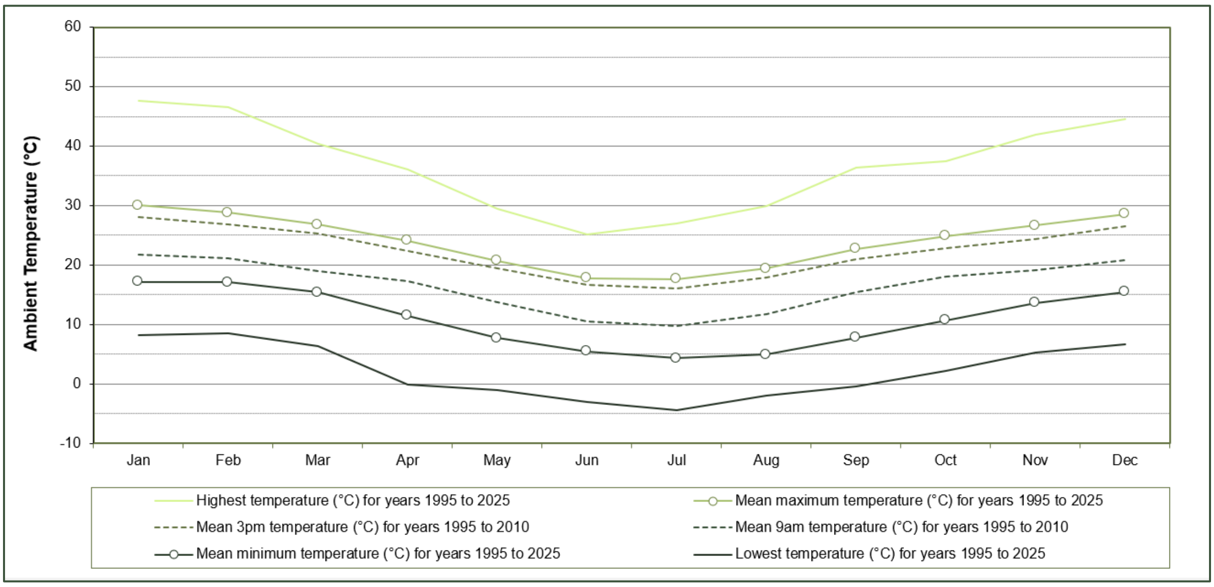
- temperature (°C)
- rainfall (mm)
- relative humidity (%)
- wind speed (m/s) and wind direction (degrees).

A review of the long-term data collected at this AWS is provided in the following sections.

4.4.1 Temperature

Temperature statistics for Badgerys Creek AWS between 1995 and 2025 are summarised in **Figure 6.** Mean maximum temperatures range from 17.6°C in winter to 30°C in summer, while mean minimum temperatures range from 4.3°C in winter to 17.2°C in summer.

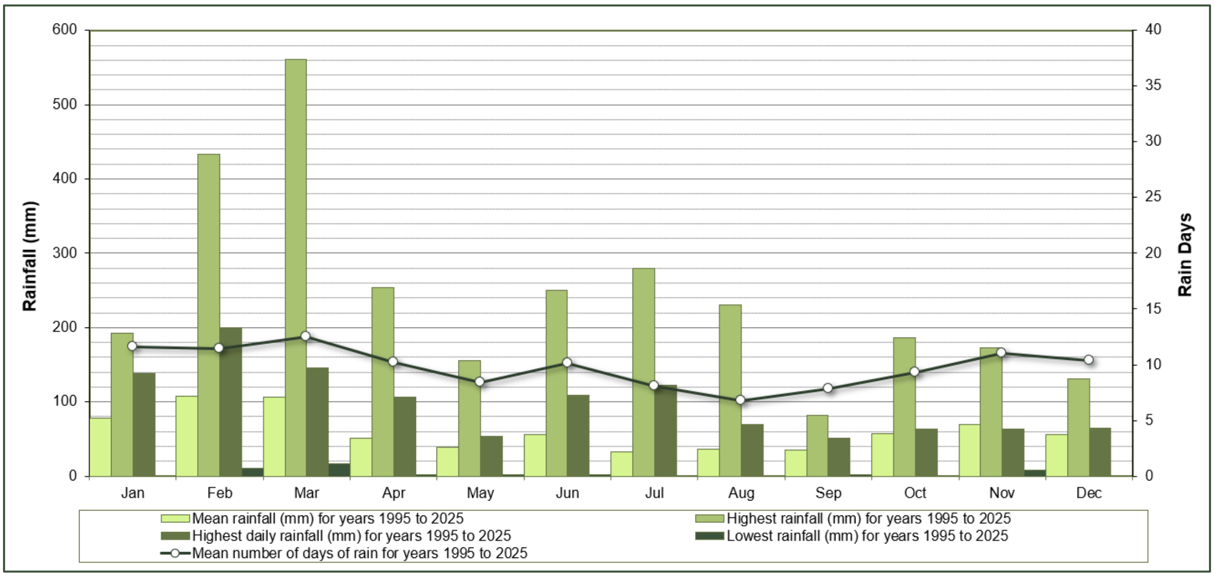
Figure 6 Temperature trends for Badgerys Creek AWS (1995 - 2025)



4.4.2 Rainfall

Rainfall statistics for Badgerys Creek AWS for the years 1995 to 2025 are summarised in **Figure 7**. The mean annual rainfall is 727.9 millimetres (mm). The average monthly rainfall is highest in summer with the highest average daily rainfall of 107 mm in February and an average of 11.4 rain days. The lowest monthly rainfall is 0 mm in December. The highest monthly rainfall recorded over the period examined was 561.4 mm recorded in March 2022. The maximum daily rainfall of 200 mm was recorded on 10th February 2020.

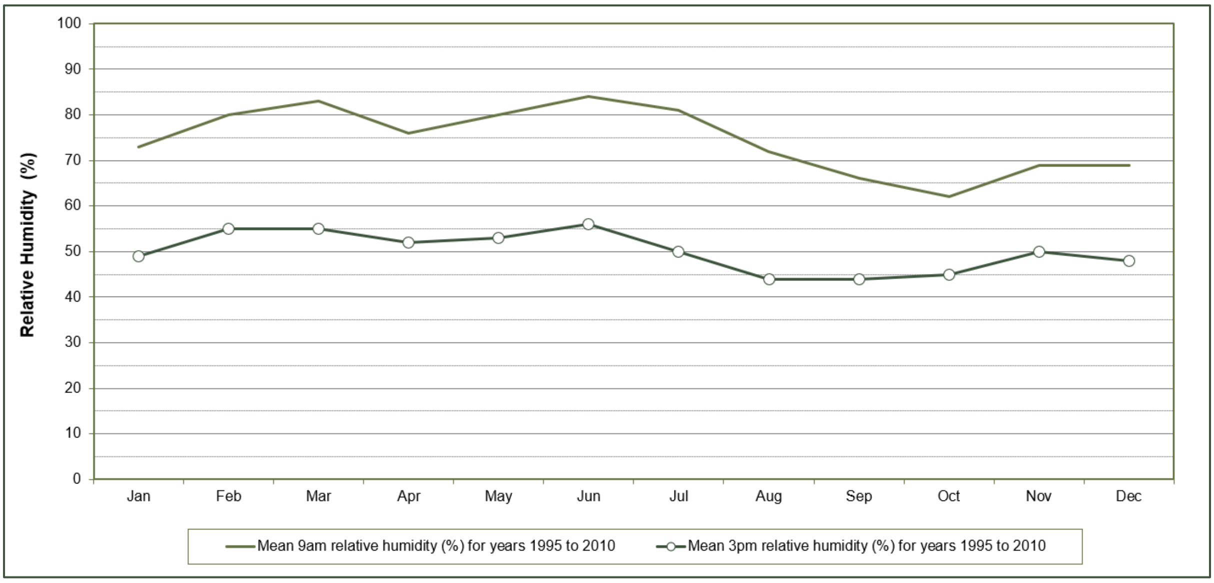
Figure 7 Monthly Rainfall Data for Badgerys Creek AWS (1995 – 2025)



4.4.3 Humidity

Available humidity statistics (9 am and 3 pm monthly averages) for Badgerys Creek AWS for the years 1995 to 2010 are summarised in **Figure 8**. Morning humidity levels range from an average of around 84% in June to around 62% in October. Afternoon humidity levels are lower, at around 56% in June and dropping to around 44% in August.

Figure 8 Humidity Data for Badgerys Creek AWS (1995 – 2010)



4.4.4 Wind

Local wind speed and direction influence the dispersion of air pollutants. Wind speed determines both the distance of downwind transport and the rate of dilution as a result of ‘plume’ stretching. Wind direction, and the variability in wind direction, determine the general path pollutants will follow and the extent of crosswind spreading. Surface roughness (characterised by features such as the topography of the land and the presence of buildings, structures and trees) will also influence dispersion.

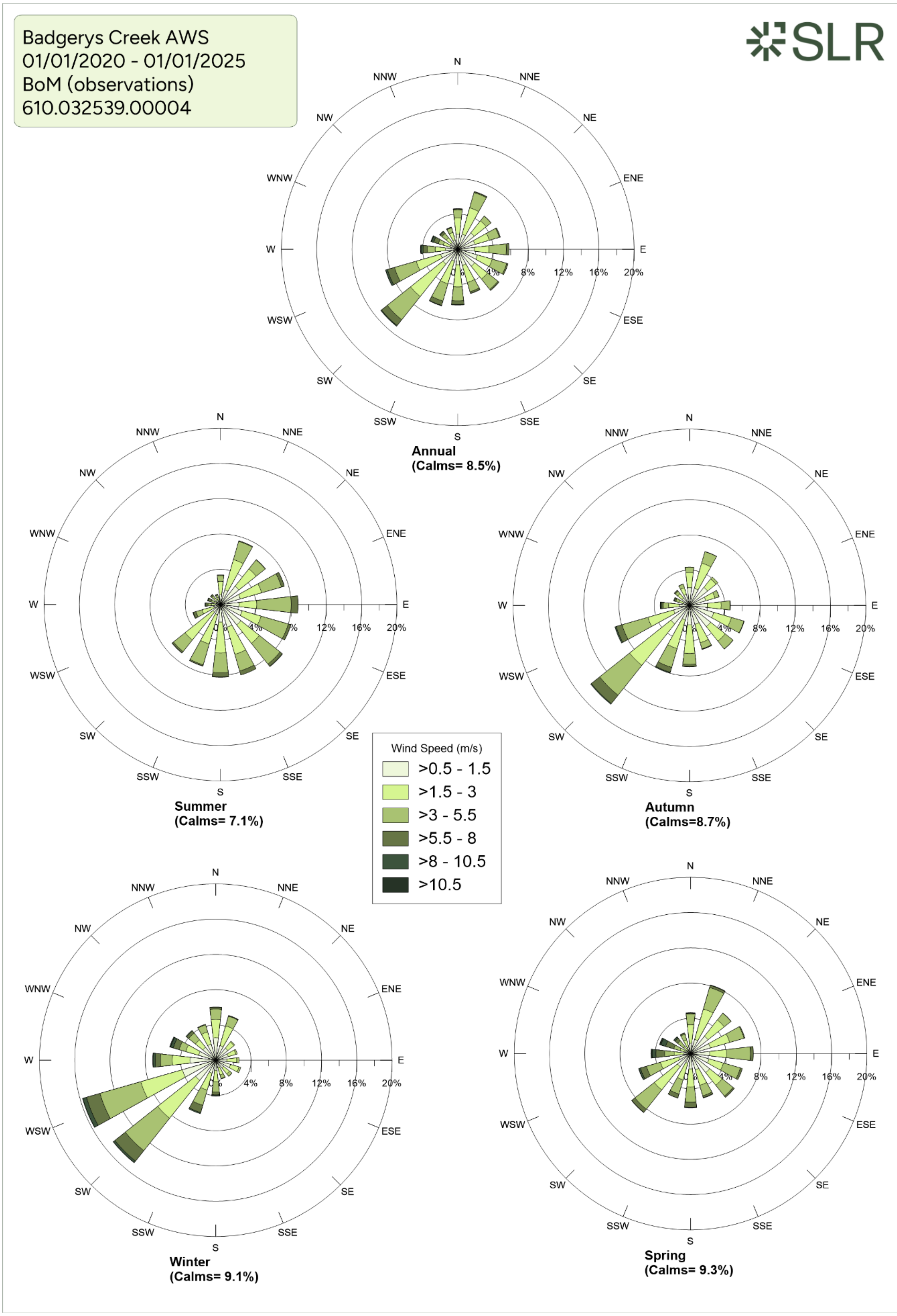
Annual and seasonal wind roses for years 2020-2024, compiled from data recorded by the Badgerys Creek AWS are presented in **Figure 9**. Wind roses show the frequency of occurrence of winds by direction and strength. The bars correspond to the 16 compass points (degrees from North). The bar at the top of each wind rose diagram represents winds blowing from the north (i.e., northerly winds), and so on. 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 periods during the day.

The annual wind rose for the years 2020-2024 shows that winds predominantly blow from the southwest quadrant. Wind speeds are mostly moderate (1.5 – 5.5 m/s), with occasional stronger winds, though speeds exceeding 8 m/s are relatively uncommon. Calm conditions occur 8.5% of the time, suggesting that while wind movement is generally steady, there are still periods of low air circulation.

The seasonal wind roses for the years 2020-2024 indicate that:

- In spring and summer, there are winds present from each direction with less frequent winds from the north-western quadrant but a higher frequency of wind from the southeastern quadrant in summer and northeastern quadrant in spring. On average, calm winds are experienced 9.3% of the time during spring and 7.1% of the time during summer.
- In autumn and winter, winds predominantly blow from the south-western quadrant, with the lowest frequency of winds from the northwest quadrant in autumn and the southeast quadrant in winter. On average, calm winds are experienced approximately 9% of the time during autumn and winter.

Figure 9 Badgerys Creek Annual and Seasonal Wind Roses 2020-2024



4.5 Background Air Quality

Air quality monitoring is performed by the NSW Department of Climate Change, Energy, the Environment and Water (DCCEEW) at a number of monitoring stations across NSW. The closest station to the Site is the Bringelly Air Quality Monitoring Station (AQMS), located approximately 5 km to the south of the Site (see **Figure 3**).

The following air pollutants are monitored at this station:

- NO, NO_2 & NO_X
- PM_{10}
- $PM_{2.5}$
- SO_2
- Ozone (O_3).

A summary of the monitored pollutant concentrations for the last five years (2020-2024) is presented in **Table 8** and the data are presented graphically in **Figure 10** to **Figure 16**.

No TSP monitoring is conducted by the Bringelly 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 Bringelly AQMS using a PM_{10}/TSP ratio of 0.4[1], which is typical for industrial areas in Australia. Therefore, for cumulative analysis purposes, the annual average background TSP concentration was estimated to be 37.5 µg/m^3.

No background dust deposition monitoring is conducted at the Bringelly AQMS. In the absence of suitably representative dust deposition monitoring data, a 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.

Table 8 Summary of Air Quality Monitoring Data at Bringelly AQMS (2020-2024)

Pollutant	PM_{10}		$PM_{2.5}$		NO_2		SO_2	
Averaging Period	Maximum 24-hour	Annual	Maximum 24-hour	Annual	Maximum 1-hour	Annual	Maximum 1-hour	Maximum 24-hour
Units	µg/m^3	µg/m^3	µg/m^3	µg/m^3	µg/m^3	µg/m^3	µg/m^3	µg/m^3
2020	241.8 (11)	18.3	78.1 (12)	8.5	61.5	6.3	62.9	8.6
2021	69.0 (1)	15.3	57.4 (3)	7.2	49.2	7.1	25.7	5.7
2022	28.7	12.1	17.8	5.1	45.1	5.9	28.6	5.7
2023	53.2 (1)	16.2	45.4 (3)	7.0	51.3	6.2	25.7	8.6
2024	58.1 (1)	16.4	17.2	6.9	65.6	7.7	34.3	5.7
Criteria	**50**	**25**	**25**	**8**	**164**	**31**	**215**	**57**
# numbers in brackets represent number of exceedances of relevant criteria recorded each year.								

[1] This is conservative as when this ratio is determined from the total PM_{10} and TSP emissions to area in Sydney as detailed in the 2013 Calendar Year Air Emissions Inventory for the Greater Metropolitan Region in NSW, the ratio is 0.6, which would result in a concentration was estimated to be 25.0 µg/m^3. This includes the following sources of emissions: natural, commercial, domestic-commercial, industrial, off-road mobile, on-road mobile.

Exceedances of the 24-hour average PM_{10} criteria were recorded by the Bringelly AQMS each year over the period analysed except for 2022. $PM_{2.5}$ criteria exceedances were recorded in the years 2020, 2021, and 2023. Exceedances of the annual average $PM_{2.5}$ criterion were also recorded for 2020.

A review of the available compliance monitoring reports indicates that the PM_{10} and $PM_{2.5}$ exceedances during these years were primarily due to exceptional events such as bushfire emergencies, dust storms and hazard reduction burns (NSW DPIE 2020) (NSW DPE 2021). The high number of exceedances recorded in 2020 were due to bushfire smoke that affected Sydney and the surrounding areas for a significant number of days in early 2020 (the 'Black Summer' bushfire event). The NEPM compliance report for 2023 shows that the single PM_{10} exceedance in 2023 was a non-exceptional exceedance due to local dust (DCCEEW 2025). The NEPM compliance report for 2024 has not been published at the time of this assessment and the cause of the single PM_{10} exceedance in 2024 is unknown.

Figure 10 Measured 24-Hour Average PM_{10} Concentrations at Bringelly AQMS (2020-2024)

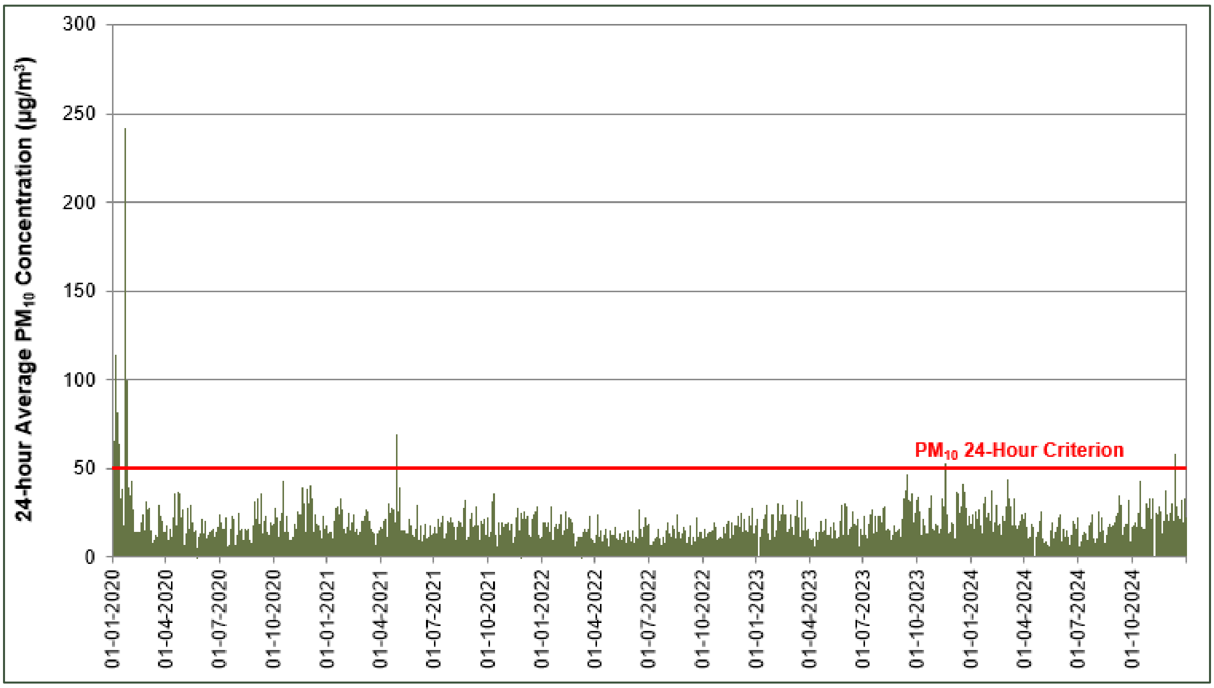


Figure 11 Measured 24-Hour Average $PM_{2.5}$ Concentrations at Bringelly AQMS (2020-2024)

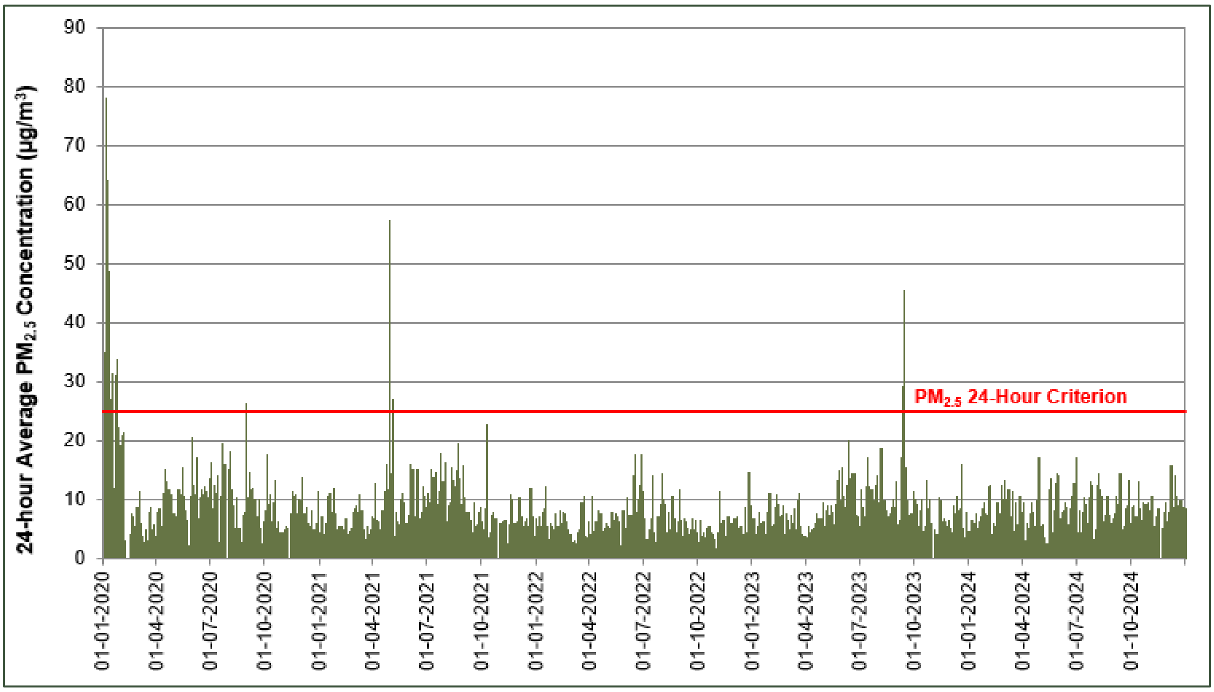


Figure 12 Measured 1-Hour Average NO_2 Concentrations at Bringelly AQMS (2020-2024)

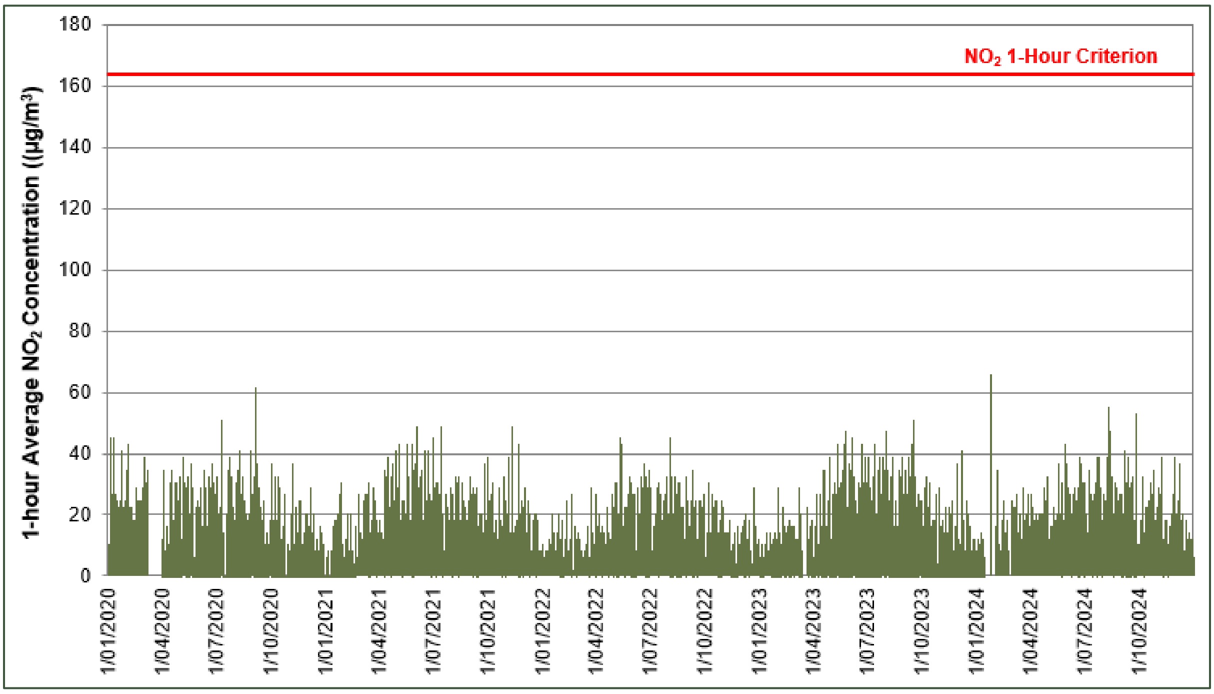


Figure 13 Measured 1-Hour Average CO Concentrations at Bringelly AQMS (2020-2024)

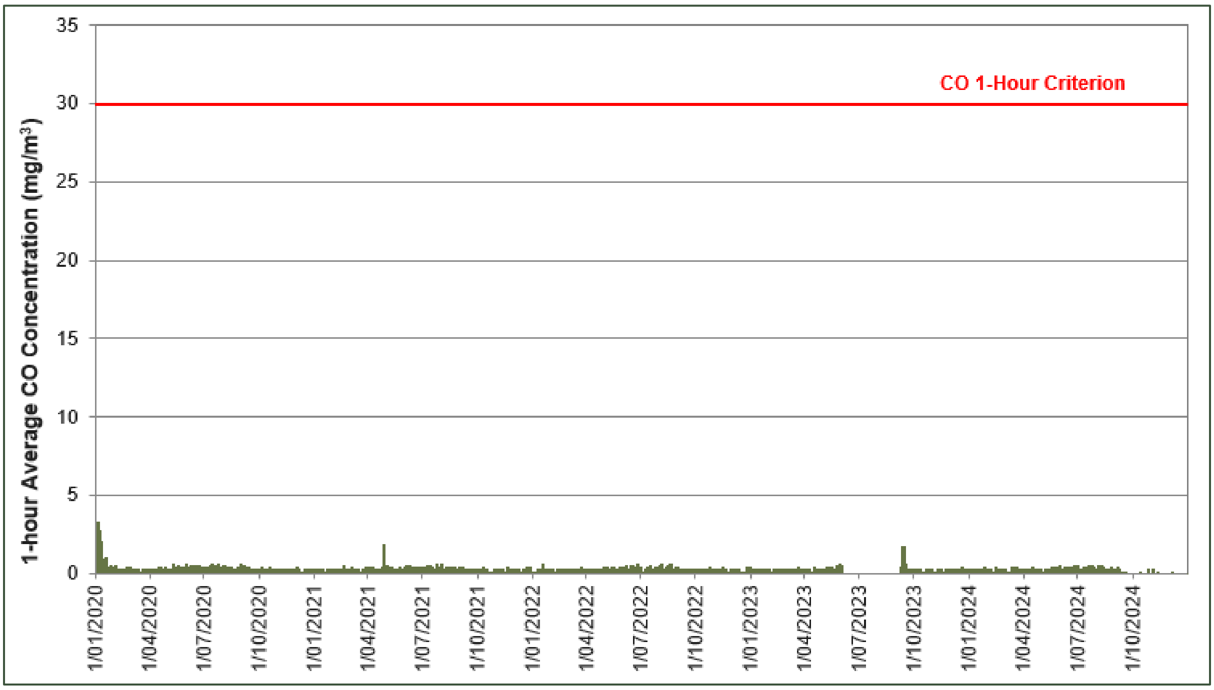


Figure 14 Measured 8-Hour Average CO Concentrations at Bringelly AQMS (2020-2024)

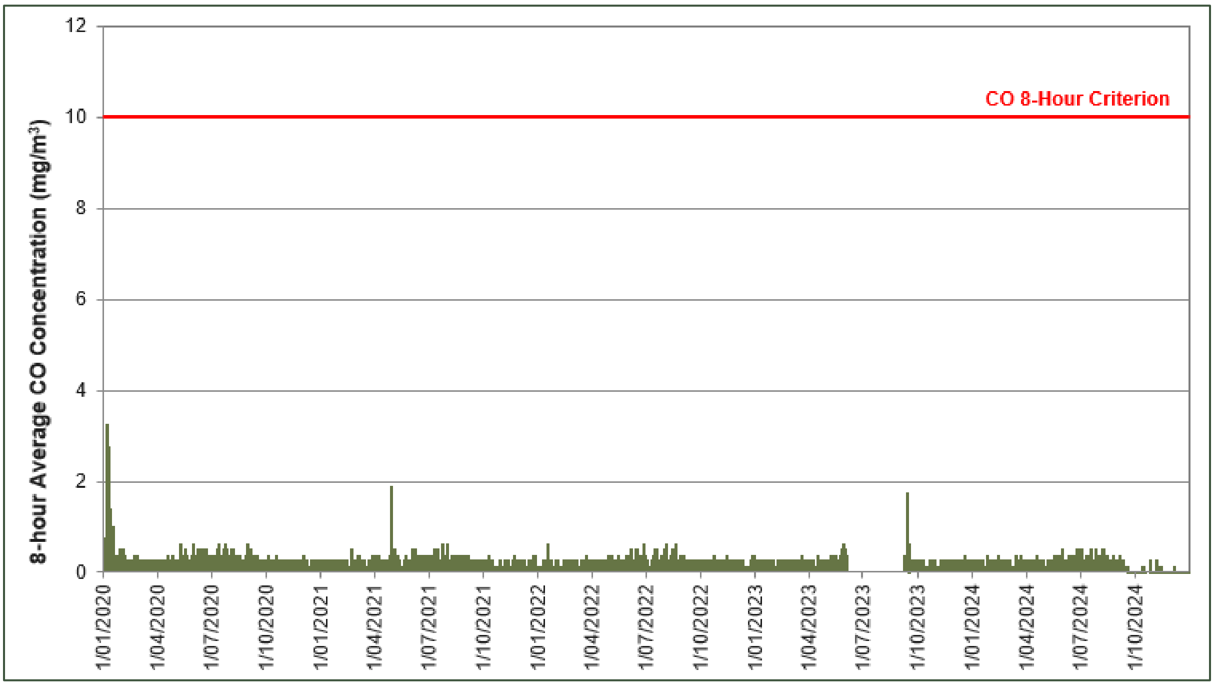


Figure 15 Measured 1-Hour Average SO_2 Concentrations at Bringelly AQMS (2020-2024)

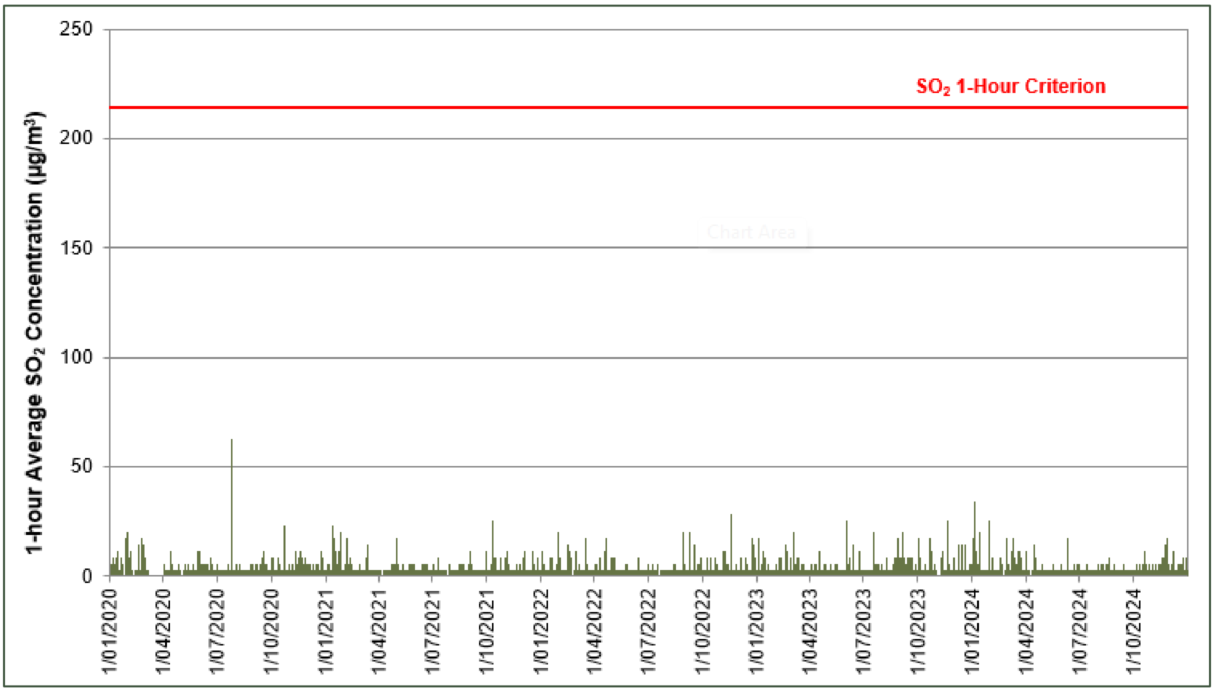
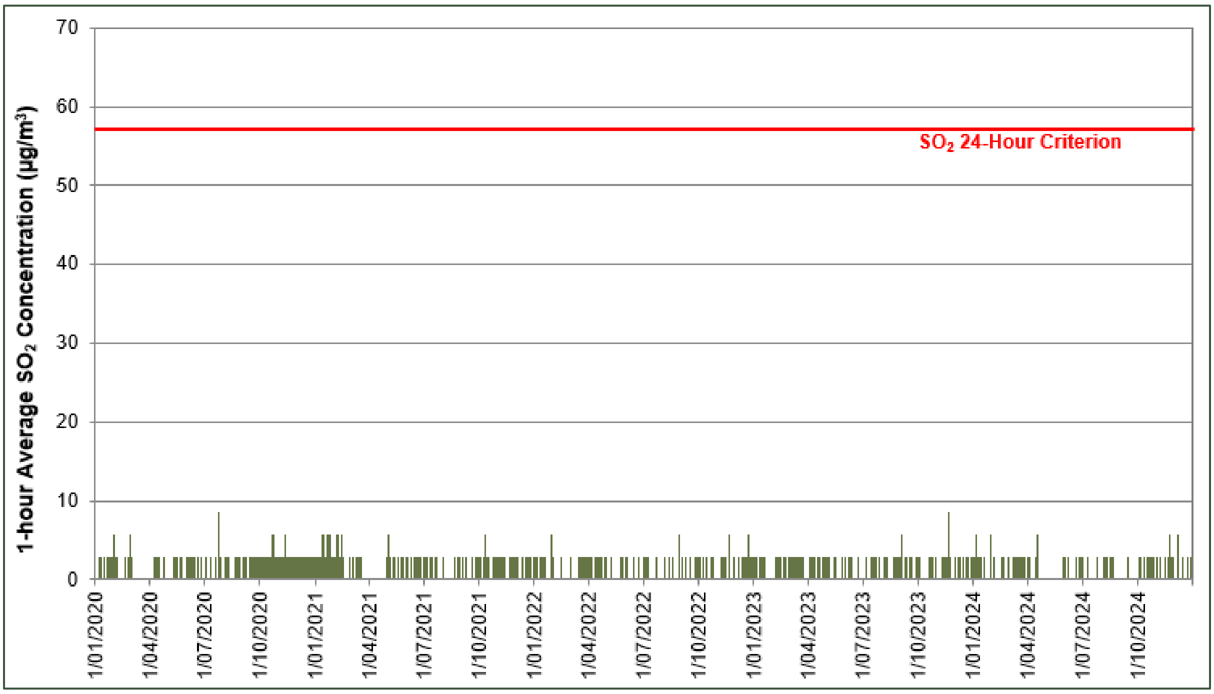


Figure 16 Measured 24-Hour Average SO_2 Concentrations at Bringelly AQMS (2020-2024)



5.0 Construction Air Quality Assessment

5.1 Assessment Methodology

The assessment of air emissions from the proposed construction has been performed quantitatively using dispersion modelling techniques.

The dispersion modelling was performed using the CALPUFF dispersion model (Version 6). The CALPUFF dispersion model is approved by NSW EPA for the modelling of air quality impacts in NSW and it has been used in numerous air quality impact assessments in NSW and across Australia.

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. Topographical, 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 hourly concentrations or deposition values 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.

5.1.1 Meteorological Modelling

Meteorological mechanisms govern the dispersion, transformation and eventual removal of pollutants from the atmosphere. The extent to which pollution will accumulate or disperse in the atmosphere is dependent on the degree of thermal and mechanical turbulence within the earth’s boundary layer. Dispersion comprises vertical and horizontal components of motion. The stability of the atmosphere and the depth of the surface-mixing layer define the vertical component. The horizontal dispersion of pollution in the boundary layer is primarily a function of the wind field. The wind speed determines both the distance of downwind transport and the rate of dilution as a result of plume ‘stretching’. The generation of mechanical turbulence is similarly a function of the wind speed, in combination with the surface roughness. The wind direction, and the variability in wind direction, determines the general path pollutants will follow, and the extent of crosswind spreading.

Pollution concentration levels therefore fluctuate in response to changes in atmospheric stability, to concurrent variations in the mixing depth, and to shifts in the wind field (Oke 1988).

To adequately characterise the dispersion meteorology of the Site, information is needed on the prevailing wind regime, mixing height and atmospheric stability and other parameters such as ambient temperature, rainfall and relative humidity.

In order to determine a representative meteorological year for use in dispersion modelling, five years of meteorological data (2020-2024) from the closest meteorological monitoring station (i.e. Badgerys Creek AWS) were analysed against the five-year average meteorological conditions. Specifically, the following parameters were analysed:

- frequency and distribution of the predominant wind directions
- monthly average wind speeds observed
- monthly average temperatures.

Based on this analysis, it was concluded that the year 2021 was representative of the last five years of meteorological conditions experienced at the Site and hence the 2021 calendar year was adopted for use in this assessment. A summary of the analysis is presented in **Appendix A.**

Details of the meteorological modelling completed are provided below. A summary of the meteorological model domain details is provided in **Table 9.** Evaluation of the processed meteorological data is provided **Appendix B**.

5.1.2 TAPM

In order to calculate all required meteorological parameters required by the dispersion modelling process, meteorological modelling using The Air Pollution Model (TAPM v4.0.4) has been performed. TAPM, developed by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) is a prognostic model which may be used to predict three-dimensional meteorological data and air pollution concentrations.

TAPM model predicts wind speed and direction, temperature, pressure, water vapour, cloud, rainwater 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 site-specific hourly meteorological observations at user-defined levels within the atmosphere. A full description of TAPM is available in the model user manual (CSIRO 2008)

TAPM model may assimilate actual local wind observations so that they can optionally be included in a model solution. However, given that TAPM is known to under-predict calm wind conditions, the wind speed and direction observations obtained from the nearest BoM and stations have also been used in the subsequent CALMET component of the modelling as described in **Section 5.0**.

The dispersion modelling requires twelve months of hourly timestep meteorological data. The Air Pollution Model (TAPM) was used to generate site-representative data for input into CALMET for further processing of the fine scale three-dimensional wind field data required for the CALPUFF dispersion model.

5.1.3 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.

A full description of the CALMET/CALPUFF model is available in the CALPUFF manual (SRC 2011).

The CALMET domain was modelled with a resolution of 0.05 km. The TAPM-generated 3-dimensional meteorological data (1 km resolution) was used as the ‘initial guess’ wind field and the local topography and available surface weather observations in the area were used to refine the wind field predetermined by TAPM.

Table 9 TAPM and CALMET Modelling Domain Details

Model and Domain Settings	Details	Model and Domain Settings	Details
TAPM		**CALMET**	
5 nested grids	25 x 25 x 35 grid points	Domain size	12.5 km x 12.5 km
Grid point resolutions	30 km, 10 km, 3 km, 1 km	Receptor grid	50 m resolution
Domain origin centre point	E: 295,164 N: 6,253,975 Zone: 56H	Domain origin southwest corner	E: 286,250 N: 6,241,750 Zone: 56H
Period	31/12/2020 to 01/01/2022	Period	31/12/2020 to 01/01/2022
Modelled with wind assimilation data for Badgerys Creek AWS and Horsley Park Equestrian Centre AWS. Further details on model settings can be provided as required.		Initial guess field	3D output from TAPM

5.2 Dispersion Modelling

CALPUFF was used for the dispersion modelling and is widely used in Australia as a suitable model for a range of applications and conditions including odour modelling assessments.

As with any air dispersion model, CALPUFF requires inputs in three major areas:

- emission rates and source details
- meteorology
- terrain and surface details, as well as specification of specific receptor locations.

A summary of the model details is provided in **Table 10**.

Table 10 CALPUFF Domain Details and Model Settings

Item	Details
Domain details	50 m resolution for 12.5 km by 12.5 km domain
Receptor details	50 m resolution gridded receptors and 27 discrete receptors
Emissions data	Varys by emission source. Refer to **Section 5.4** for details.
Further details on model settings can be provided as required.	

5.2.1 Model Configuration

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:

- Fine Particulates (FP < 2.5 µm);
- Course Matter (2.5 µm<CM<10 µm); and
- the Rest (RE>10 µm).

These parameters were then 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 C.**

5.3 Accuracy of Modelling

All atmospheric dispersion models, including CALPUFF, represent a simplification of the many complex processes involved in the dispersion of pollutants in the atmosphere. To obtain good quality results it is important that the most appropriate model is used and the quality of the input data (meteorological, terrain, source characteristics) is adequate.

The main sources of uncertainty in dispersion models, and their effects, are discussed below:

- Oversimplification of physics: This can lead to both under-prediction and over-prediction of ground level pollutant concentrations. Uncertainties are greater in Gaussian plume models as they do not include the effects of non-steady-state meteorology (i.e., spatially- and temporally varying meteorology).
- Uncertainties in emission rates: Ground level concentrations are proportional to the pollutant emission rate. In addition, most modelling studies assume constant worst-case emission levels or are based on the results of a small number of stack tests, however operations (and thus emissions) are often quite variable. Accurate measurement of emission rates and source parameters requires continuous monitoring.
- Uncertainties in wind direction and wind speed: Wind direction affects the direction of plume travel, while wind speed affects plume rise and dilution of plume. Uncertainties in these parameters can result in errors in the predicted distance from the source of the plume impact, and magnitude of that impact. In addition, aloft wind directions commonly differ from surface wind directions. The preference to use rugged meteorological instruments to reduce maintenance requirements also means that light winds are often not well characterised.
- Uncertainties in mixing height: If the plume elevation reaches 80% or more of the mixing height, more interaction will occur, and it becomes increasingly important to properly characterise the depth of the mixed layer as well as the strength of the upper air inversion.

- Uncertainties in temperature: Ambient temperature affects plume buoyancy, so inaccuracies in the temperature data can result in potential errors in the predicted distance from the source of the plume impact, and magnitude of that impact.
- Uncertainties in stability estimates: Gaussian plume models use estimates of stability class, and 3D models use explicit vertical profiles of temperature and wind (which are used directly or indirectly to estimate stability class for Gaussian models). In either case, uncertainties in these parameters can cause either under-prediction or over-prediction of ground level concentrations. For example, if an error is made of one stability class, then the computed concentrations can be off by 50% or more.

The US EPA makes the following statement in its Modelling Guideline (US EPA 2005) on the relative accuracy of models:

"*Models are more reliable for estimating longer time-averaged concentrations than for estimating short-term concentrations at specific locations; and the models are reasonably reliable in estimating the magnitude of highest concentrations occurring sometime, somewhere within an area. For example, errors in highest estimated concentrations of ±10 to 40% are found to be typical, i.e., certainly well within the often-quoted factor-of-two accuracy that has long been recognised for these models. However, estimates of concentrations that occur at a specific time and site are poorly correlated with actually observed concentrations and are much less reliable.*"

5.4 Emission Estimation

This section describes the scenarios assessed (**Section 5.4.1**), the methodology used to estimate emissions (**Section 5.4**) and the emissions inventory for the Project (**Section 5.4.3**).

5.4.1 Scenarios Assessed

Only one scenario is quantified to assess the pollutant emissions due to the construction activities of the Project. The construction activities for the proposed Project would be conducted in phases. It is understood by SLR that construction works for Warehouse 7 and 8 and basin SC09 will be overlapping phases. As Warehouse 7 and 8 are the largest lots (outlined in **Section 1.0**) and earthworks (associated with the basin) is generally the highest dust generating phase of construction, assessment of this phase of construction of SEED Stage 1B is considered to be the most conservative scenario, as compared to the remaining proposed development of smaller warehouse lots and cafe. A summary of the emission sources assessed in is shown in **Table 11**.

Table 11 Summary of the Scenarios Assessed

Scenario	Emission Sources	Pollutants
Construction	Material handling, wheel generated dust, wind erosion	TSP, PM_{10}, $PM_{2.5}$ and deposited dust

This scenario assesses the emissions due to construction activities within the Project Application Area from construction activities related to Warehouse 7, Warehouse 8, and basin SC09. A summary of the proposed activities within the respective phases is shown in **Table 12**. The timelines for the construction are indicative and will be refined during contract negotiations.

Table 12 Summary of the Assessed Project Construction Activities

Phase	Estimated Duration (weeks)
Basin SC09 excavation & civil works	20
Warehouse 7 excavation & civil works	44
Warehouse 8 excavation & civil works	36
Building construction	52

It is noted that the total duration of all works is anticipated to be 14 months due to staggered commencement dates, however the dispersion assessment is limited to a 12 months assessment period.

5.4.2 Methodology

Particulate emissions from the construction activities have been calculated using default or calculated emission factors for the relevant emission sources. Emission factors were primarily sourced from the National Pollutant Inventory (NPI) *EETM for Mining* version 3.1 (DSEWPC 2012).

The NPI *EETM for Mining* (DSEWPC 2012)and US EPA AP 42 Emission Factor Handbook (USEPA 2006) contain emission factors for TSP and PM_{10}. No emission factors for $PM_{2.5}$ are provided within the NPI *EETM for Mining* and only limited emission factors for $PM_{2.5}$ are provided in US EPA AP 42. Limited research has been undertaken to assess the fraction of PM_{10} from the wide range of sources which would be emitted as $PM_{2.5}$. Research has been conducted by the Midwest Research Institute (MRI) on behalf of the Western Regional Air Partnership (WRAP) with findings published within the document entitled *'Background Document for Revisions to Fine Fraction Ratios Used for AP-42 Fugitive Dust Emission Factors'* (MRI 2006) . This document provides three proposed $PM_{2.5}/PM_{10}$ ratios for fugitive dust source categories as presented in **Table 13**.

Table 13 Proposed Particle Size Ratios for AP-42

Fugitive Dust Source	AP-42 Section	Proposed $PM_{2.5}/PM_{10}$ Ratio
Unpaved roads (public & industrial)	13.2.2	0.1
Aggregate handling and storage piles	13.2.4	0.1
Industrial wind erosion	13.2.5	0.15

The $PM_{2.5}$ / PM_{10} ratios presented in **Table 13** have been used within this assessment to calculate the emissions of $PM_{2.5}$ attributable to this Project. The most appropriate ratio has been applied to each of the sources. Water sprays and additional controls will be applied to the key emission sources.

The emission factors used for the estimation of TSP, PM_{10} and $PM_{2.5}$ emissions from the construction activities and controls applied at the Project are presented in **Table 14**.

Table 14 Summary of Emission Factors Used to Estimate Emissions

Activity	Emission Factor Equation	Units	Source of Emission Factor	Controls Applied
Excavator/FEL on overburden	$EF_{TSP} = 0.025$ $EF_{PM10} = 0.012$ $EF_{PM2.5} = 0.1 \times EF_{PM10}$	kg/t	DSEWPC 2012 MRI 2006	50% control
Bobcat & Backhoe (In the absence of specific emission factors for 'Bobcat & Backhoe', emission factors for 'Excavator/FEL on overburden' have been adopted)	$EF_{TSP} = 0.025$ $EF_{PM10} = 0.012$ $EF_{PM2.5} = 0.1 \times EF_{PM10}$	kg/t	DSEWPC 2012 MRI 2006	50% control
Scraper (removing topsoil)	$EF_{TSP} = 0.029$ $EF_{PM10} = 0.0073$ $EF_{PM2.5} = 0.1 \times EF_{PM10}$	kg/t	DSEWPC 2012 MRI 2006	50% control
Wind erosion	$EF_{TSP} = 0.4$ $EF_{PM10} = 0.2$ $EF_{PM2.5} = 0.15 \times EF_{PM10}$	kg/ha/h	DSEWPC 2012 MRI 2006	50% control
Wheel generated dust from unpaved roads	$EF_{TSP} = 4.23$ $EF_{PM10} = 1.25$ $EF_{PM2.5} = 0.1 \times EF_{PM10}$	kg/t	DSEWPC 2012 MRI 2006	75% control
Wheel generated dust from unpaved roads (used by light duty vehicles)	$EF_{TSP} = 0.94$ $EF_{PM10} = 0.33$ $EF_{PM2.5} = 0.1 \times EF_{PM10}$	kg/t	DSEWPC 2012 MRI 2006	75% control

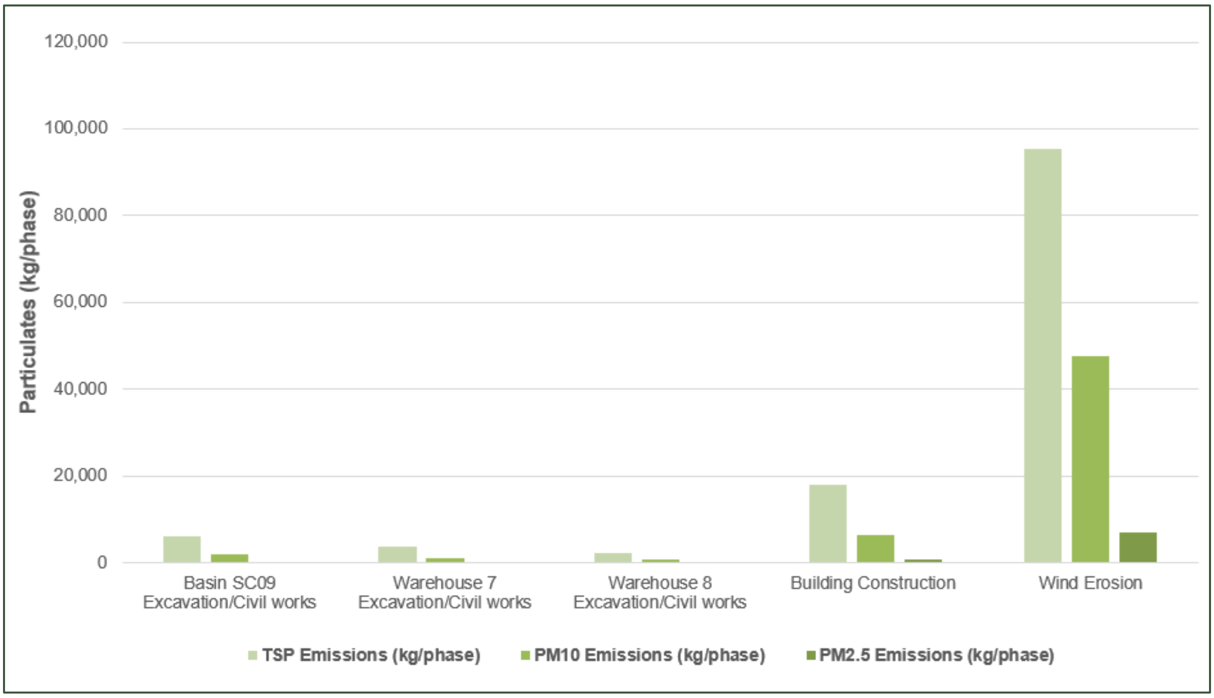
5.4.3 Emissions Inventory

Based on the emission factors and the activity data presented in the above section, the emissions for the various construction phases with controls have been calculated, and a summary of these is shown in **Table 15** and **Figure 17**.

Table 15 Controlled Emissions per Source(kg/phase)

Emission Source	TSP (kg/phase)	PM_{10} (kg/phase)	$PM_{2.5}$ (kg/phase)
Basin SC09 Excavation & Civil Works	6,206	1,929	193
Warehouse 7 Excavation & Civil Works	3,598	1,143	114
Warehouse 8 Excavation & Civil works	2,278	722	72
Building construction	18,038	6,298	630
Wind Erosion	95,249	47,624	7,144
TOTAL	125,368	57,717	8,153

Figure 17 Emissions per Source(kg/phase)



In order to ensure the worst-case 24-hour average concentrations were predicted, this assessment assumes that all activities occur equally and simultaneously each day.

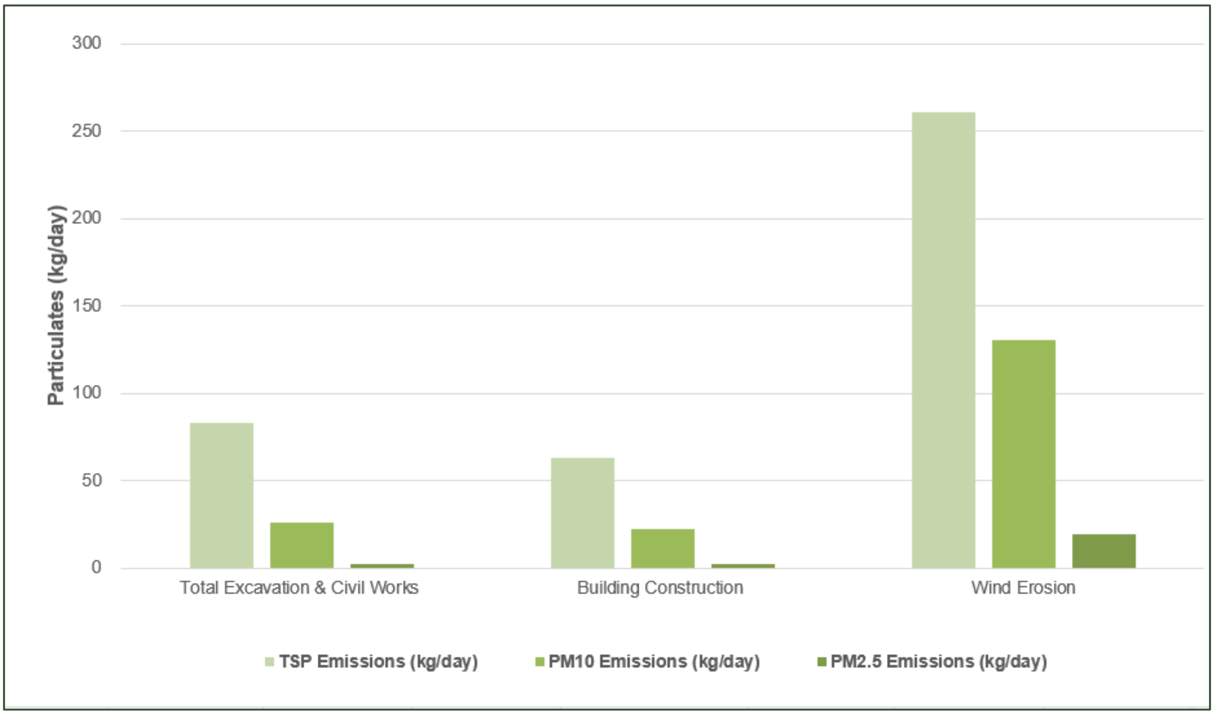
Construction hours are 7:00 am to 6:00 pm (11 hours per day) from Monday to Friday, with half days on Saturdays and no work on Sundays or public holidays. These operational hours were used to estimate the peak day scenario. However for dispersion modelling, peak day emissions are modelled for 11 hours per day (7:00 am to 6:00 pm) and 365 days a year. This is except for wind erosion which is modelled 24 hours per day and 365 days a year.

The estimated particulate emissions by activity on a daily basis are shown in **Table 16** and **Figure 18**.

Table 16 A Summary of the Controlled Emissions Inventory for each Activity (per day)

Activity	TSP (kg/day)	PM_{10} (kg/day)	$PM_{2.5}$ (kg/day)
Total Excavation & Civil Works (Basin SC09, Warehouse 7, Warehouse 8)	83	26	2.6
Building construction	63	22	2.2
Wind Erosion	261	130	20
Total	**407**	**178**	**24**

Figure 18 Daily Emissions by Activity (kg/day)



It is noted that on a per day basis, the particulate emissions are likely to be highest during the ‘Excavation & Civil Works’ and due to ‘Wind Erosion’.

As the two highest contributing sources (‘Excavation & Civil Works’ and ‘Wind Erosion’) will occur in conjunction, it is considered appropriate to assess the potential air quality impacts of these two emission sources. This ensures that the highest dust emitted construction phase is considered.

Particulate emissions generated during the phases are assumed to occur at the maximum potential intensity for all days of the modelled year. In this way, all potential combinations of worst case emissions and meteorology have been examined. This is considered to be a highly conservative approach. A summary of the modelled particulate emissions is shown in **Table 17**.

Table 17 A Summary of the Modelled Emissions Inventory (per year)

Phase	TSP (kg/year)	PM_{10} (kg/year)	$PM_{2.5}$ (kg/year)
Excavation & Civil Works	30,217	9,457	946
Wind Erosion	95,249	47,624	7,144
Total	**125,465**	**57,081**	**8,089**

5.4.4 Surrounding Sources

This assessment has considered potential cumulative impacts on surrounding sensitive receptors from the Site and likely future development outlined in **Table 18**.

A two-tiered approach to emission estimation was adopted for the surrounding sources included in the modelling:

1. Where a publicly available Environmental Impact Statement (EIS) containing a detailed construction air quality assessment existed, TSP, PM_{10}, and $PM_{2.5}$ emission rates were adopted directly from those studies.
2. Where no detailed assessment was available, the TSP emission factor for heavy construction was sourced from 'US EPA AP42 Section 13.2.3 Heavy Construction Operation' (USEPA 1995). Emission rates for finer particulate fractions were then estimated using scaling factors published in the *NPI Emissions Estimation Technique Manual for Mining v3.1* (DSEWPC 2012) and Proposed Revisions to Fine Fraction Ratios (Cowherd, Donaldson and Hegarty 2010).

In addition, where no detailed assessment was available, control measures were applied in accordance with the experience of SLR for similar projects. The following reduction rates on emissions on uncontrolled emissions from the Surrounding Sources:

- 67% reduction in TSP emissions
- 64% reduction in PM_{10} emissions
- 56% reduction in $PM_{2.5}$ emissions

A summary of the adopted emission factors for Tier-2 sources is presented in **Table 19** and the resulting estimated emissions are detailed in **Table 20.** To ensure a conservative assessment, the modelling assumed that for all surrounding sources:

- All proposed developments would be under construction simultaneous.
- 75% of the developable land is actively under construction at any given time.
- Construction occurs 365 days a year, for 11 hours per day (7:00 am to 6:00 pm) (unless specified otherwise).
- Mitigation controls achieve a similar reduction efficiency to those applied at similar projects in the experience of SLR.

It is noted that the modelling assumes that dust emissions from surrounding sources are limited to the construction hours of 7:00 am to 6:00 pm (unless specified otherwise). This assumption is justified by the mechanics of wind erosion, which typically requires wind speeds to exceed a threshold of approximately 5 m/s (USEPA 2006) to initiate dust lift-off from exposed surfaces. As illustrated in **Figure 19**, wind speeds exceeding 5 m/s are uncommon outside of construction hours. Furthermore, **Figure 20** indicates that such wind speeds occur less than 4.5% of the time during the night (6:00 pm to 7:00 am). Therefore, potential dust generation from exposed surfaces outside of active work hours is considered insignificant for the purpose of this assessment.

All sources were modelled as area sources in CALPUFF. While the absence of detailed information for many of these surrounding sources leads to high uncertainty in emission estimation, this approach is considered conservative for the following reasons:

- Assumes all activities occur simultaneously across all modelled areas during the operational hours.

- Excludes benefits from some proposed mitigation measures such as low vehicle speeds, and reduced activities during adverse weather or air quality impacts from other outside sources.
- Potentially underestimates the quenching effect of rainfall on dust emissions.

Considering the conservatism of the above assumptions and methodology, the cumulative assessment is deemed to overestimate potential cumulative impacts. It is noted that potential impacts of likely future development/uses on the proposal has been excluded from this assessment.

Table 18 Surrounding Likely Future Developments

Development	Status	Consideration	Included in Cumulative Assessment?	Construction Details
SSD 97688711, Project Maverick – Internal works, (225-245 Martin Road, Bradfield)	SSD-97688711 - Prepare EIS	This development is located within 3km from the Site, cumulative impacts are considered possible.	Yes	The site area is approximately 1,900,000 m^2 [a]. An assessment of air quality impacts was not publicly available at the time of preparing this report.
SSD-74191717 Badgerys Creek Industry Park (85 Martin Road, Badgerys Creek)	Response to Submissions.	This development is located within 3km from the Site, cumulative impacts are considered possible.	Yes	The total project area is approximately 170,000 m^2 [b]. The air quality assessment report submitted with the EIS did not quantify potential dust emissions associated with the proposed construction works.
SSD-65529236 EMKC3 Industrial Development (230 Martin Road, Badgerys Creek NSW 2555)	Prepare EIS	This development is located within 3km from the Site, cumulative impacts are considered possible.	Yes	The site area is approximately 245,000 m^2, however the total project area is approximately 79,000 m^2 [c]. An assessment of air quality impacts was not publicly available at the time of preparing this report.

Development	Status	Consideration	Included in Cumulative Assessment?	Construction Details
SSD-81662708 Cross Link Industrial Estate (125; 145-175 Lawson Road, Badgerys Creek)	Prepare EIS.	This development is located within 3km from the Site, cumulative impacts are considered possible.	Yes	The total project area is approximately 80,500 m^2 [d]. An assessment of air quality impacts was not publicly available at the time of preparing this report.
SSD-TBC – SEED - Stage 2A (1669-1723 Elizabeth Drive, Badgerys Creek)	Pending Application.	SEED Stage 2A is anticipated to occur simultaneously to SEED Stage 1B. This development is located within 3km from the Site, cumulative impacts are considered possible.	Yes	The total project area is approximately 525,000 m^2, with 50% of this to be active at any time. Concurrent to this development, SLR is preparing a quantitative AQIA which will be submitted under a separate SSDA. [e]..
SSD-76913969 Aldi Automated Distribution Centre (475 Badgerys Creek Road, Bradfield)	Under Assessment.	This development is located over 1km from the Site, cumulative impacts are considered unlikely.	No	-
SSD-48438209 Barings Industrial Park (2289-2309, 2311 Elizabeth Drive, Luddenham)	Approved 15 April 2025.	This development is located over 3km from the Site, cumulative impacts are considered unlikely.	No	-
SSD-70316465 Burrah Park, (953-2109 Elizabeth Drive, Badgerys Creek)	Under Assessment.	This development is located within 3km from the Site, cumulative impacts are considered possible.	Yes	The total project area is approximately 170,000 m^2 [f]. A quantitative AQIA was completed by EMM in October 2024[f].

Development	Status	Consideration	Included in Cumulative Assessment?	Construction Details
				The construction hours for Burrah Park are 7:00 am to 8:00 pm
SSD-82437463 30-40 Martin Road, Badgerys Creek Waste Transfer Station, Badgerys Creek	Prepare EIS	This development is located within 3km from the Site, cumulative impacts are considered possible.	Yes	The site area is approximately 44,500 m^2 however the total project area is approximately 25,000 m^2 [g]. An assessment of air quality impacts is not publicly available at this stage.

Notes:

a – Source: https://majorprojects.planningportal.nsw.gov.au/prweb/PRRestService/mp/01/getContent?AttachRef=PDA-96625708%2120251015T062725.781%20GMT

b – Source: https://majorprojects.planningportal.nsw.gov.au/prweb/PRRestService/mp/01/getContent?AttachRef=SSD-74191717%2120250520T055155.401%20GMT Accessed 3 December 2025.

c – Source: https://majorprojects.planningportal.nsw.gov.au/prweb/PRRestService/mp/01/getContent?AttachRef=SSD-65529236%2120231206T221219.036%20GMT Accessed 3 December 2025.

d – Source: https://majorprojects.planningportal.nsw.gov.au/prweb/PRRestService/mp/01/getContent?AttachRef=PDA-81613458%2120250327T235757.337%20GMT Accessed 3 December 2025.

e – Source: SLR is currently preparing this assessment, assumption adopted are consistent,

f – Source: https://majorprojects.planningportal.nsw.gov.au/prweb/PRRestService/mp/01/getContent?AttachRef=SSD-70316465%2120241101T040611.828%20GMT

g – Measured from plans included in request for SEARS, source: https://majorprojects.planningportal.nsw.gov.au/prweb/PRRestService/mp/01/getContent?AttachRef=SSD-82437463%2120250411T065901.441%20GMT Accessed 3 December 2025.

Table 19 Emission Factor/ Equations Used to Estimate Emissions

Activity	Emission Factor			Units	Source
	TSP	PM_{10}	$PM_{2.5}$		
Construction operations	EF_{TSP} = 2.69	EF_{PM10} = EF_{TSP} x 0.47	$EF_{PM2.5}$ = EF_{PM10} x 0.1	tonne/hectare/ month of activity	EF_{TSP}: (USEPA 1995), PM_{10}/TSP particle size ratio: (DSEWPC 2012) $PM_{2.5}$/PM_{10} particle size ratio: (Cowherd, Donaldson and Hegarty 2010)

Table 20 Emission Rates Used to Assess Cumulative Impacts

Address of Construction	Area Modelled (m^2)	TSP emissions (g/s)	PM_{10} emissions (g/s)	$PM_{2.5}$ emissions (g/s)
225-245 Martin Road, Bradfield	1,421,972	48.19	18.63	2.31
85 Martin Road, Badgerys Creek	127,476	4.32	1.67	0.21
230 Martin Road, Badgerys Creek NSW 2555	59,137	2.00	0.77	0.10
125; 145-175 Lawson Road, Badgerys Creek	60,365	2.05	0.79	0.10
1669-1723 Elizabeth Drive, Badgerys Creek – Stage 2A	262,516	23.35	8.44	1.00
953-2109 Elizabeth Drive, Badgerys Creek	496,500	13.54	3.60	1.00
475 Badgerys Creek Road, Bradfield	286,500	9.71	3.75	0.46
30-40 Martin Road, Badgerys Creek	18,719	0.63	0.25	0.03

Figure 19 Average Construction (7am to 6pm) and Non-Construction (6pm to 7am) Wind Roses for Badgerys Creek AWS – 2020-2024

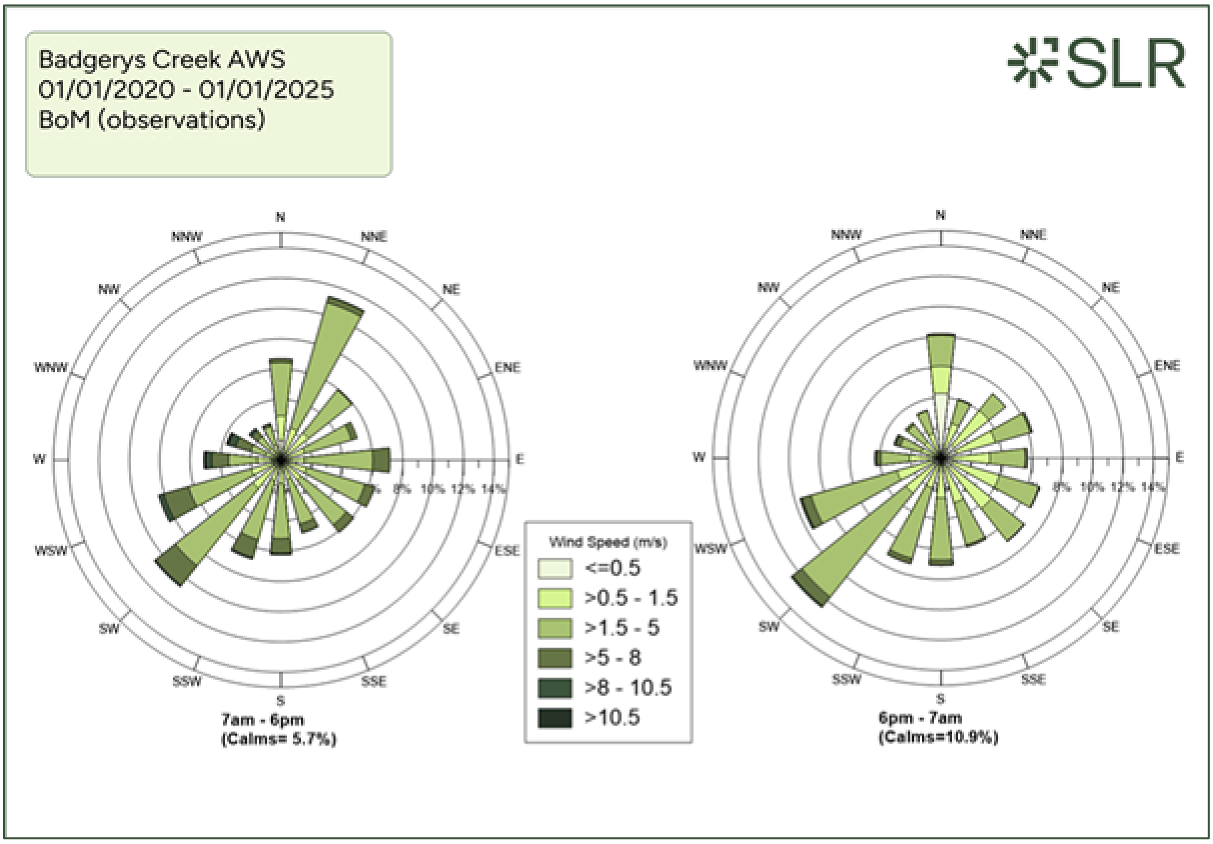
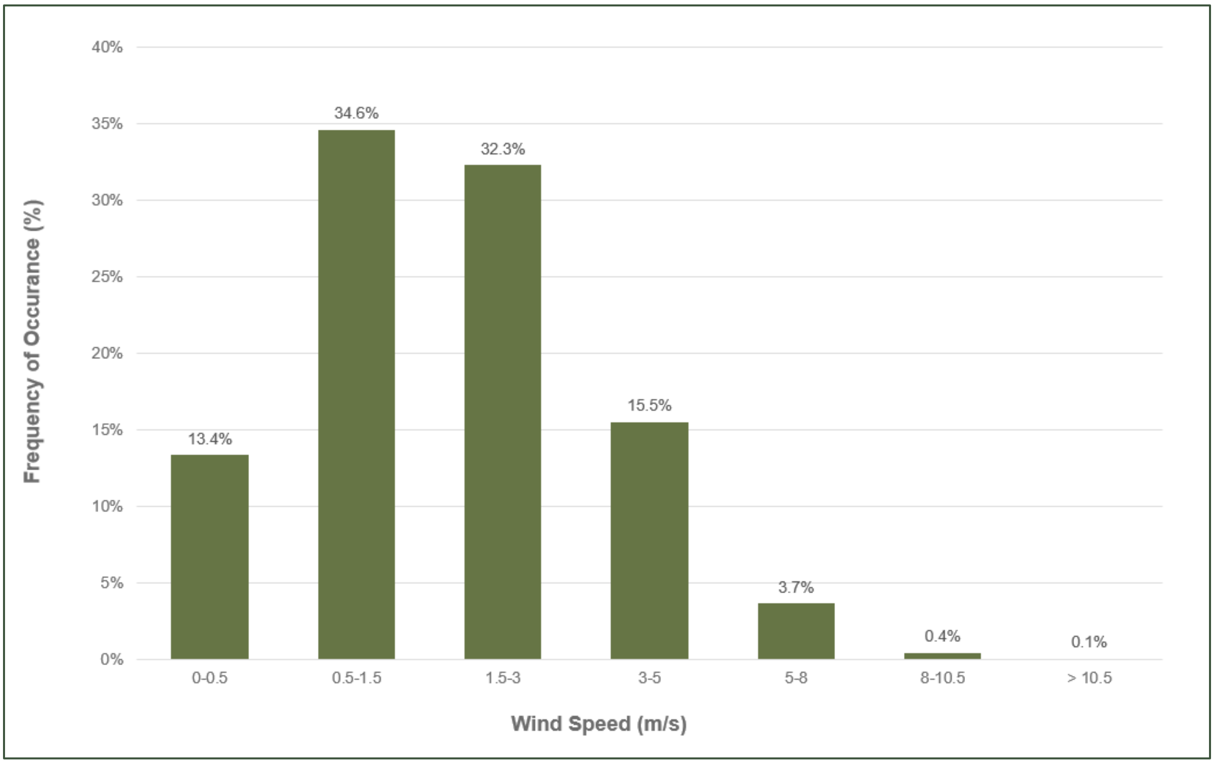


Figure 20 Average Night (6pm to 7am) Wind Frequency for Badgerys Creek AWS – 2020-2024



5.5 Adopted Background for this Assessment

The purpose of assessing background air quality is to determine the concentrations of air pollutants currently experienced at surrounding receptors, with the predicted concentrations from the Site and any other cumulative sources modelled added to these background concentrations to identify the likely future cumulative air quality impacts.

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 Approved Methods, the background data used in this AQIA is based on the same year as the meteorological year used in the modelling (ie 2021).

The representative background ambient air quality concentrations adopted for use in this assessment are summarised in **Table 21**.

Table 21 Adopted Background Data

Pollutant	Averaging Period	Concentration	Notes
TSP	Annual	37.5 µg/ m^3	Calculated from PM_{10} concentrations at Bringelly AQMS during 2021 during a PM_{10}/TSP ratio of 0.4
PM_{10}	24-hour	Daily varying	As monitored at Bringelly AQMS during 2021
	Annual	15.3 µg/ m^3	As monitored at Bringelly AQMS during 2021
$PM_{2.5}$	24-hour	Daily varying	As monitored at Bringelly AQMS during 2021
	Annual	7.2 µg/ m^3	As monitored at Bringelly AQMS during 2021
Deposited dust	Annual	2 g/m^2/month	Estimated. Not monitored at Bringelly AQMS

6.0 Predicted Construction Air Quality Impacts

The sections below present a summary of the air quality impacts predicted by the modelling at the worst impacted sensitive receptors modelled.

Isopleth plots showing the incremental impact predicted due to the Site emissions (ie excluding background levels) for each pollutant are presented in **Appendix D**. These plots do not represent the dispersion pattern for any individual time period, but rather illustrate the maximum concentration that was predicted to occur at each model calculation point given the range of meteorological conditions occurring over the 2021 modelling period.

6.1 Particles as $PM_{2.5}$

6.1.1 Maximum Predicted 24-Hour Average $PM_{2.5}$ Concentrations

Table 22 summarises the predicted incremental and cumulative 24-hour average $PM_{2.5}$ concentrations for the ten most affected discrete receptor locations modelled. These locations were selected based on the maximum 24-hour $PM_{2.5}$ increments predicted by the modelling due to the proposed activities at the Site.

A contemporaneous analysis was conducted to assess cumulative concentrations against the relevant impact assessment criteria. This involved combining the predicted incremental 24-hour $PM_{2.5}$ concentrations due to Site activities with the developments identified in **Section 5.4.4** (Surrounding Sources) and the daily varying background concentrations recorded at the Bringelly AQMS.

While cumulative 24-hour average $PM_{2.5}$ concentrations are predicted to exceed the 25 µg/m³ criterion at all 26 modelled receptors, these results are heavily influenced by elevated background levels. It is noted that the background data for the 2021 meteorological year already included three exceedances of the criterion, independent of the Site’s activities (See **Section 3.4**).

Receptor R7, identified as having the highest incremental impact, is predicted to experience no additional exceedances above the background levels.

A detailed daily contemporaneous analysis of Receptor R7 is presented **Figure 21** and **Figure 22**. **Figure 21** illustrates that predicted incremental concentrations from the Site are highest during the winter months. **Figure 22** illustrates that for the vast majority of days, throughout the year cumulative concentrations are well below the relevant criterion at the most impacted receptor.

It is noted that cumulative concentrations would decrease if emissions from surrounding construction sites are adequately controlled, if all Surrounding Sources are not simultaneously under construction, or if the recommended TARP and monitoring outlined in **Section 8.0** is implemented**.**

Isopleths showing dispersion patterns across the modelling domain are provided in **Appendix D.**

Table 22 Top 10 Highest Predicted 24-Hour Average $PM_{2.5}$ Concentrations

Receptor ID	Maximum 24-Hour Average $PM_{2.5}$ Concentrations (µg/m^3)		Additional Exceedances[2] due to Site Activities & Surrounding Sources	Additional Exceedances [2] due to Site Activities only
	Incremental	Cumulative[1]		
R7	5.4	57.6	0	0
R10	4.6	57.6	0	0
R11	4.5	57.6	0	0
R12	4.5	57.6	0	0
R6	4.3	57.6	0	0
R20	4.3	57.8	0	0
R8	3.7	57.6	0	0
R19	3.7	57.9	0	0
R13	3.5	57.6	0	0
R21	2.4	57.7	0	0
Criterion		**25**	-	-

1 – Cumulative impact includes: Site activities, Surrounding Sources, background concentrations.
2 – Additional exceedances above and over Bringelly AQMS

Figure 21 Contemporaneous Analysis of 24-Hour Average $PM_{2.5}$ Concentrations (R7)

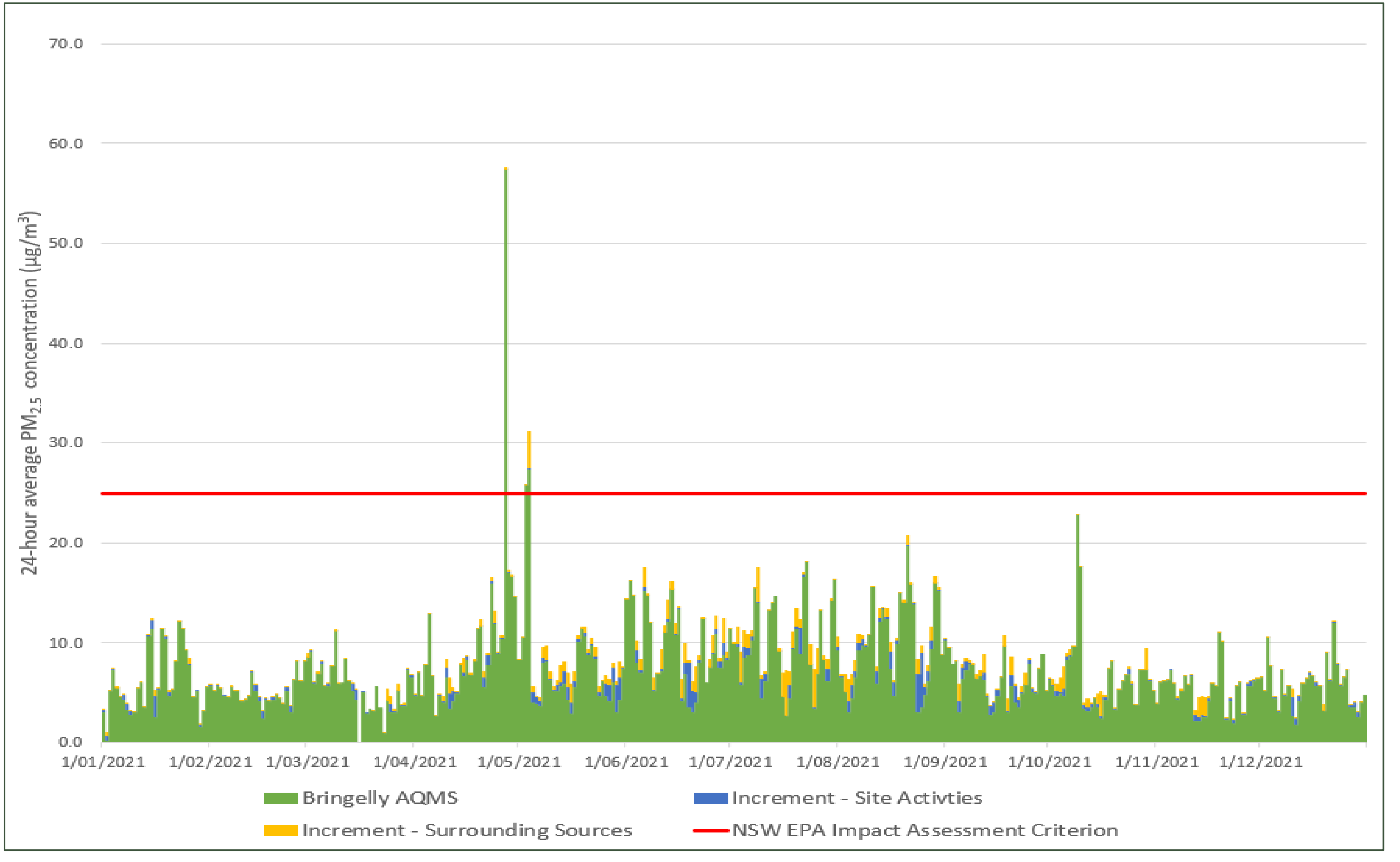
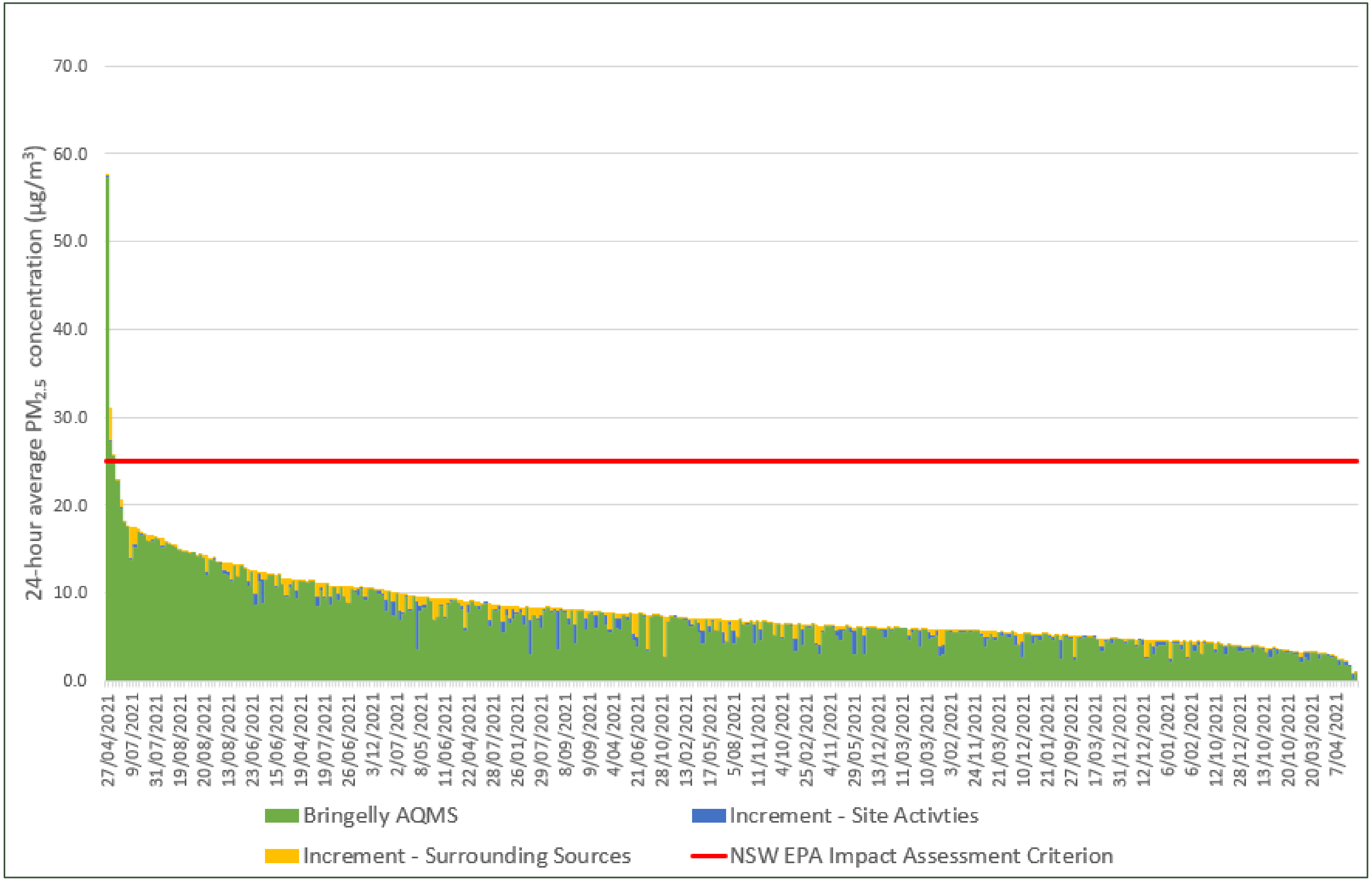


Figure 22 Ranked Contemporaneous Analysis of 24-Hour Average $PM_{2.5}$ Concentrations (R7)



6.1.2 Annual Average $PM_{2.5}$ Concentrations

Table 23 summarises the predicted incremental and cumulative annual average $PM_{2.5}$ concentrations for the ten most affected discrete receptor locations modelled. These locations were selected based on the annual average $PM_{2.5}$ increments predicted by the modelling due to the proposed activities at the Site.

Cumulative concentrations against the criterion have been considered by including the annual average concentrations from Site activities, Surrounding Sources, and background concentrations adopted from the Bringelly AQMS.

The cumulative annual average $PM_{2.5}$ concentrations are predicted to exceed the annual average $PM_{2.5}$ criterion of 8 µg/m³ at seven of the 26 receptors modelled. However, these predictions overestimate the concentrations as the conservative assumptions used in the emission estimation to ensure short-term concentrations were not underestimated resulted in an overestimation of annual averages(See **Section 5.4.2)**.

Receptor R19, identified as the most impacted location with respect to contribution from the Site, is predicted exceed the annual average $PM_{2.5}$ criterion of 8.0 µg/m³.

It is noted that cumulative concentrations would decrease if emissions from surrounding construction sites are adequately controlled, if all Surrounding Sources are not simultaneously under construction or if the recommended TARP and monitoring outlined in **Section 8.0** is implemented**.**

Isopleths showing dispersion patterns across the modelling domain are provided in **Appendix D.**

Table 23 Top 10 Highest Predicted Annual Average $PM_{2.5}$ Concentrations

Receptor ID	Annual Average $PM_{2.5}$ Concentrations (µg/m³)		Additional Exceedances[2] due to Site Activities & Surrounding Sources
	Incremental	Cumulative[1]	
R19	0.3	8.04	Yes
R20	0.3	8.00	No
R7	0.3	8.04	Yes
R18	0.3	8.02	Yes
R6	0.2	8.15	Yes
R10	0.2	7.77	No
R8	0.2	7.76	No
R11	0.2	7.73	No
R3	0.2	8.41	Yes
R17	0.2	7.98	No
Criterion		**8.0**	

1 – Cumulative impact includes: Site activities, Surrounding Sources, background concentrations.
2 – Additional exceedances above and over Bringelly AQMS

6.2 Particles as PM_{10}

6.2.1 Maximum Predicted 24-Hour Average PM_{10} Concentrations

Table 24 summarises the maximum predicted incremental and cumulative 24-hour average PM_{10} concentrations for the ten most affected discrete receptor locations modelled. These locations were selected based on the maximum 24-hour PM_{10} average predictions from by the modelling.

A contemporaneous analysis was conducted to assess predicted cumulative concentrations against the relevant air quality criteria. This involved combining the predicted incremental 24-hour PM_{10} concentrations from Site activities with those from Surrounding Sources and the daily varying background concentrations recorded at the Bringelly AQMS.

While the cumulative 24-hour average PM_{10} concentrations are predicted to exceed the 50 µg/m^3 criterion at all the 26 receptors modelled, these results are influenced by elevated background levels. It is noted that the background PM_{10} concentrations for the contemporaneous 2021 meteorological year already included one exceedance of the criterion recorded during that year, independent of the Site's activities.

Receptors R7, identified as having the highest incremental impact, is predicted to experience one additional exceedances above the background levels.

A detailed daily contemporaneous analysis of Receptor R7 is presented in **Figure 23** and **Figure 24**. **Figure 23** illustrating that incremental concentrations associated with the Site are higher in the winter months. **Figure 24** illustrates that for the vast majority of days, throughout the year cumulative concentrations are well below the relevant criterion at the most impacted receptor.

It is noted that cumulative concentrations would decrease if emissions from surrounding construction sites are adequately controlled, if all Surrounding Sources are not simultaneously under construction or if the recommended TARP and monitoring outlined in **Section 8.0** is implemented**.**

Isopleths showing dispersion patterns across the modelling domain are provided in **Appendix D**

Table 24 Top 10 Highest Predicted 24-Hour Average PM_{10} Concentrations

Receptor ID	Maximum 24-Hour Average PM_{10} Concentrations (µg/m³)		Additional Exceedances[2] due to Site Activities & Surrounding Sources	Additional Exceedances[2] due to Site Activities only
	Incremental	Cumulative[1]		
R7	30.9	70.6	1	0
R20	29.8	72.7	3	0
R10	28.3	70.9	0	0
R11	27.1	70.6	0	0
R12	26.2	70.5	0	0
R6	25.5	70.8	1	0
R19	25.5	72.9	1	0
R8	21.4	70.3	1	0
R13	20.1	70.4	0	0
R18	15.6	72.7	1	0
Criterion		**50**		

1 – Cumulative impact includes: Site activities, Surrounding Sources, background concentrations.
2 – Additional exceedances above and over Bringelly AQMS

Figure 23 Contemporaneous Analysis of 24-Hour Average PM_{10} Concentrations (R7)

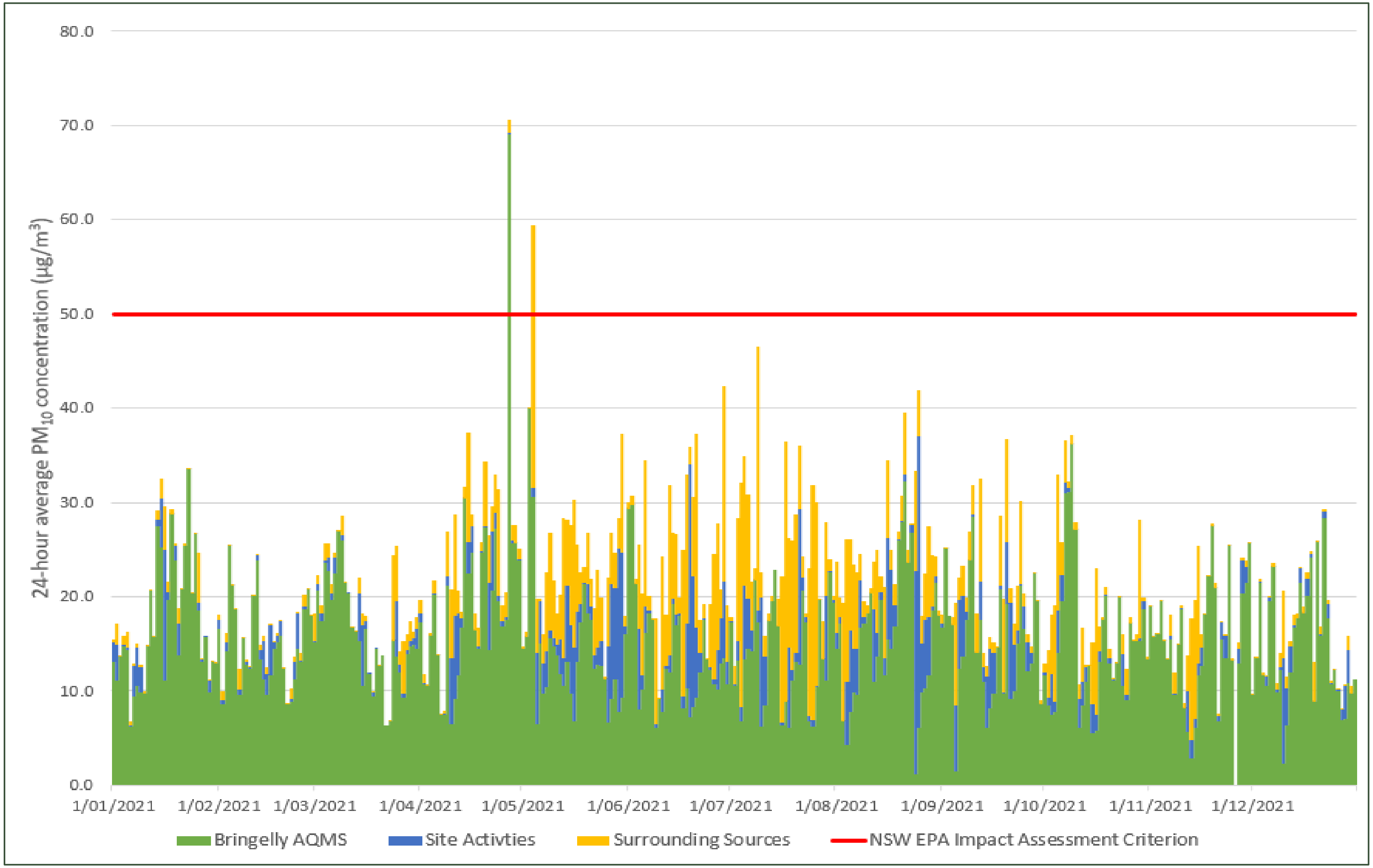
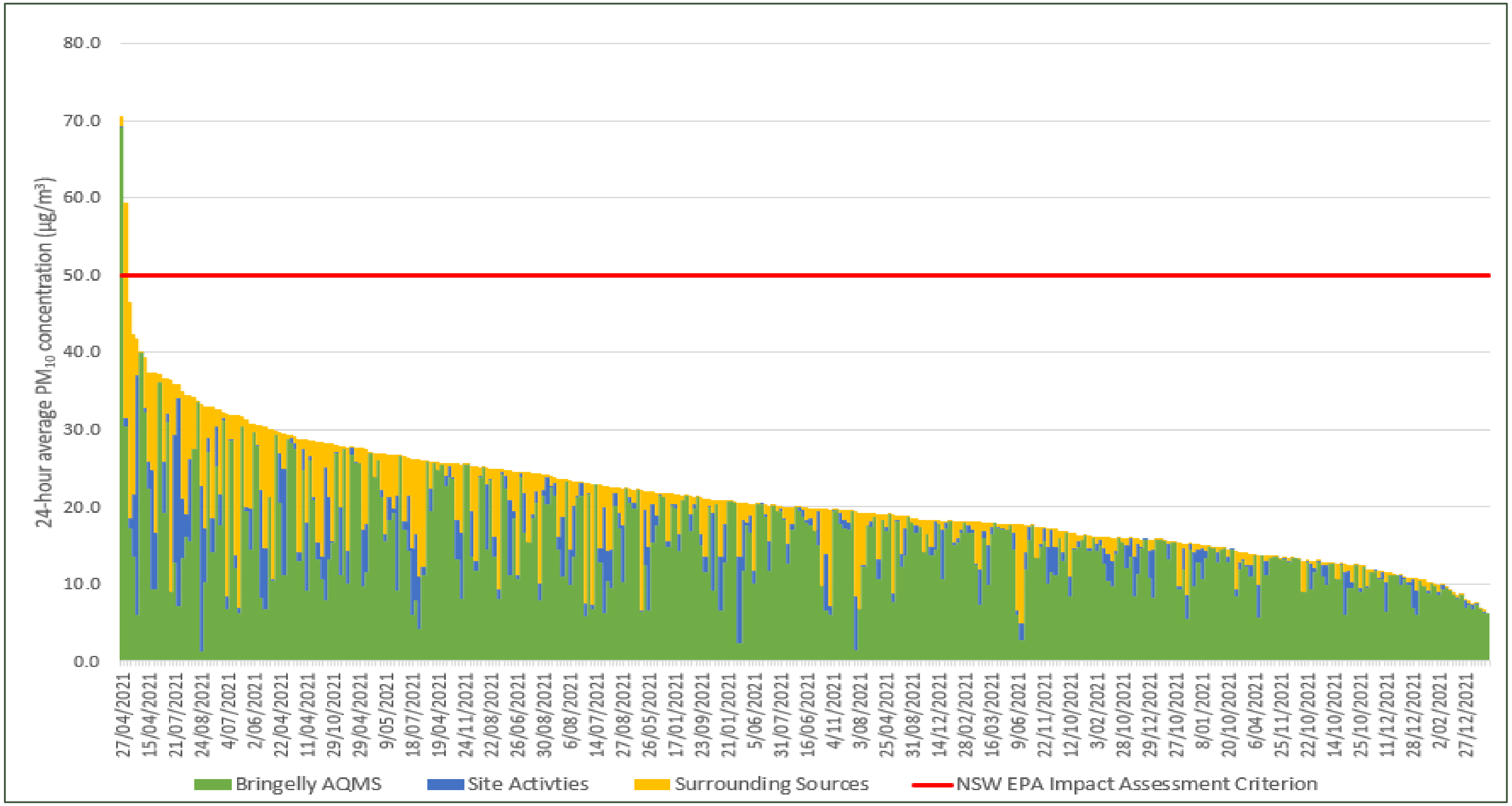


Figure 24 Ranked Contemporaneous Analysis of 24-Hour Average PM_{10} Concentrations (R7)



6.2.2 Meteorological Conditions Contributing to Exceedances

In order to determine the meteorological conditions that result in the highest predicted contributions from the Site at the worst impacted receptors, timeseries of predicted 1-hour average PM_{10} contributions were extracted at the six most affected discrete receptor locations modelled, and combined with the contemporaneous windspeed and wind direction data to create the polar plots presented in **Figure 25.**

Polar plots show how the predicted contribution at each receptor varies with both wind speed and direction. All figures are plotted on the same arbitrary scale to allow for direct comparison between them.

A review of the polar plots indicates that the predicted 1-hour average PM_{10} concentration at receptors R10, R11, R12, R20, R6, R7 is greater at wind speeds over 6 m/s. This suggests that higher winds are picking up and transporting dust from the site to these locations. As expected, there is no single predominant wind direction that causes impacts across all receptors. This is because the sensitive receptors are located in various directions around the Site, so different wind directions affect different receptors.

Figure 26 presents annual and seasonal windroses at the Site based on the meteorological data used in the dispersion modelling for the proposed operating hours (7am to 6pm). A review of these windroses show that high windspeeds occur most frequently in winter and spring, and most frequently from the southwest.

Figure 25 Polar Plots of Predicted 1-hour Average PM_{10} Contribution at Selected Worst Impacted Receptors

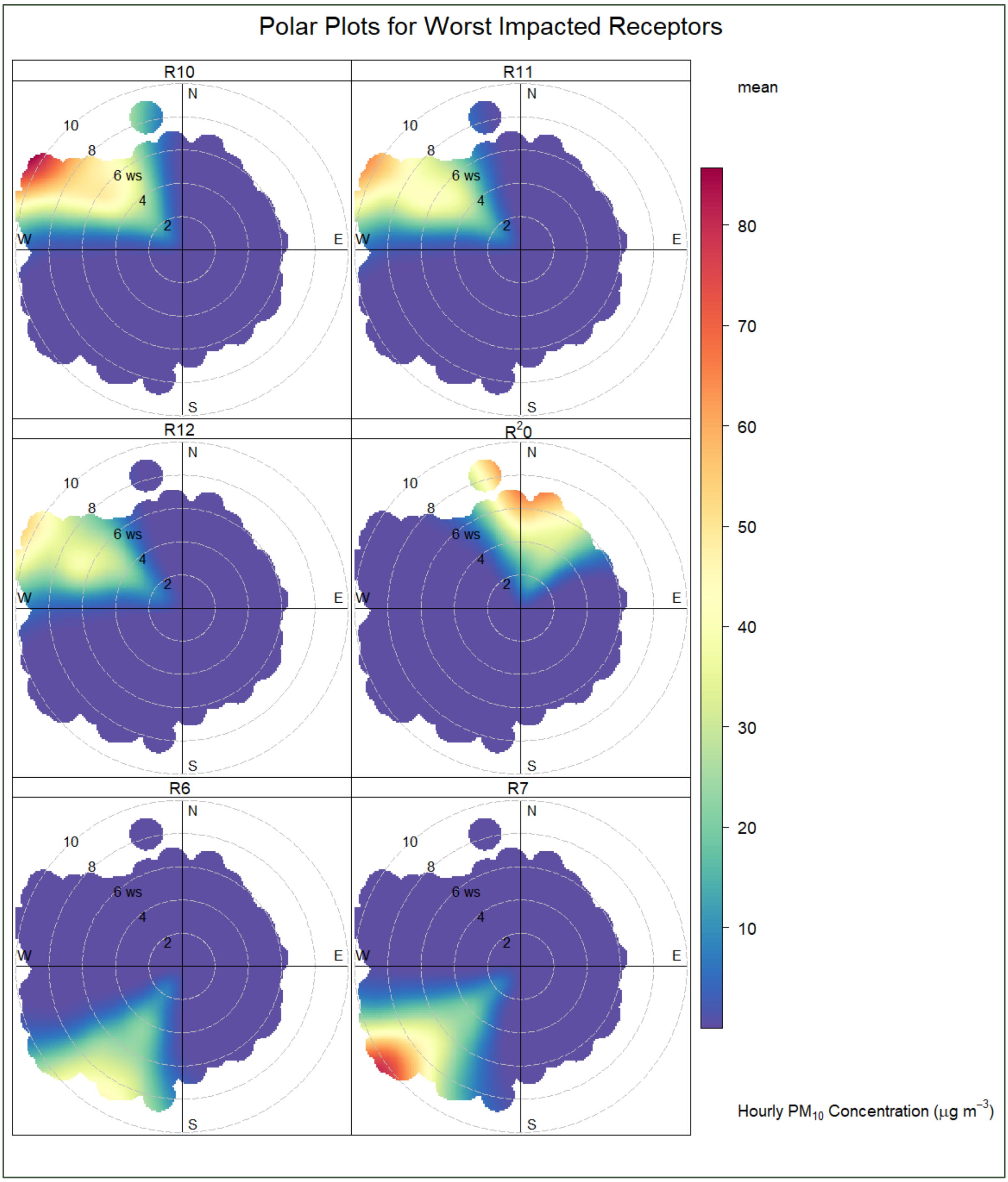
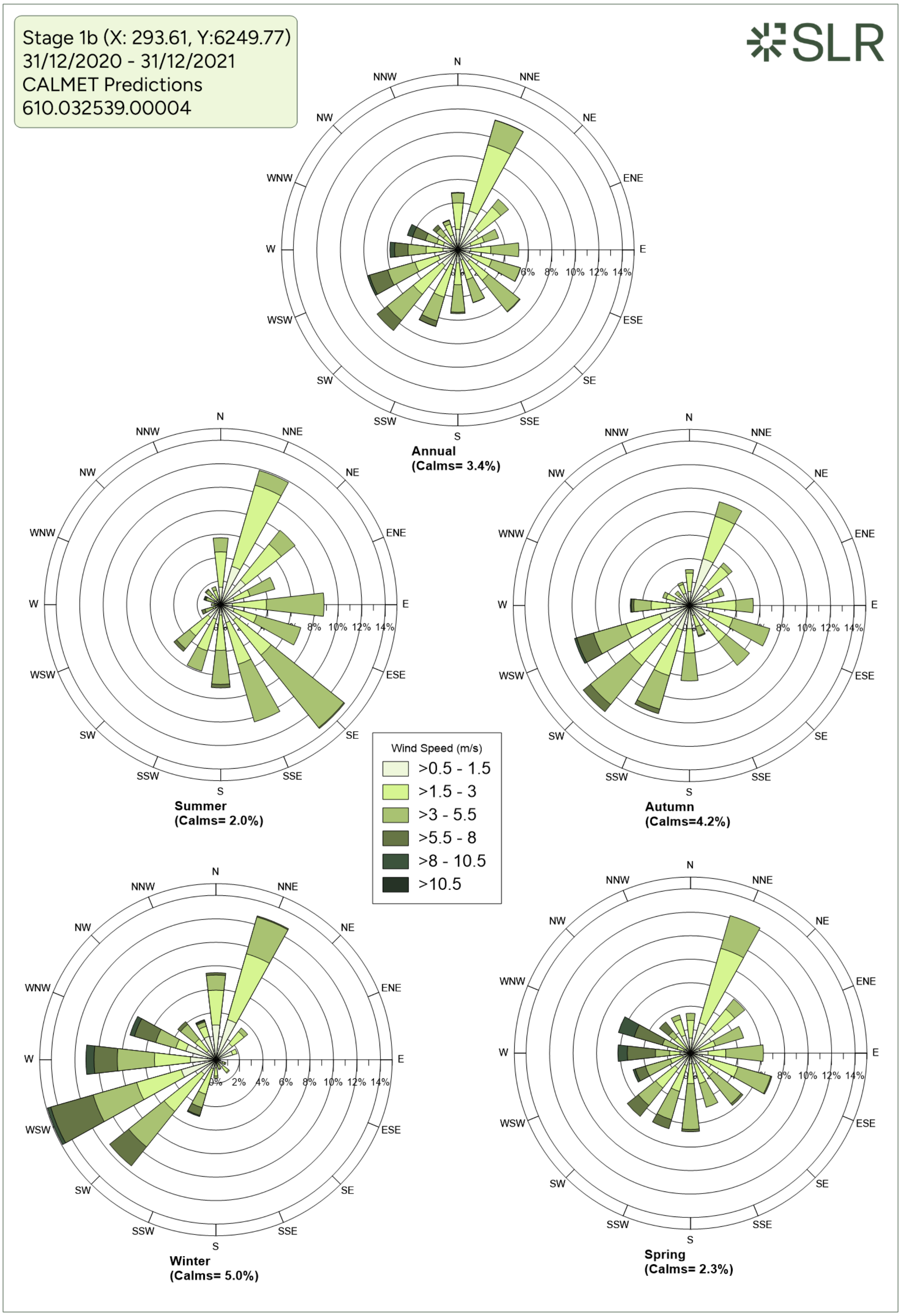


Figure 26 Annual and Seasonal Windroses at the Site: 7am – 6pm



6.2.3 Annual Average PM_{10} Concentrations

Table 25 summarises the predicted incremental and cumulative annual average PM_{10} concentrations for the ten most affected discrete receptor locations modelled. These locations were selected based on the annual average PM_{10} increments predicted by the modelling due to the proposed activities at the Site.

Cumulative concentrations against the criterion have been considered by including the annual average concentrations from Site activities, Surrounding Sources, and background concentrations adopted from the Bringelly AQMS.

The cumulative annual average PM_{10} concentrations are predicted to comply with the annual average PM_{10} criterion of 25 µg/m^3 at all 26 receptors modelled. It is noted that these predictions overestimate the concentrations as the conservative assumptions used in the emission estimation to ensure short-term concentrations were not underestimated lead to an overestimation of annual averages (See **Section 5.4.2)**.

Receptor R19, identified as the most impacted location, is predicted to comply with the annual criterion of 25 µg/m^3. It is noted that cumulative concentrations would decrease if emissions from surrounding construction sites are adequately controlled, if all Surrounding Sources are not simultaneously under construction or if the recommended TARP and monitoring outlined in **Section 8.0** is implemented**.**

Isopleths showing dispersion patterns across the modelling domain are provided in **Appendix D.**

Table 25 Top 10 Highest PM_{10} Incremental Impact Receptors - Annual PM_{10} Impact

Receptor ID	Annual Average PM_{10} Concentrations (µg/m^3)		Additional Exceedances [2] due to Site Activities & Surrounding Sources
	Incremental Impact	Cumulative Impact[1]	
R19	2.5	21.4	No
R20	2.5	21.1	No
R7	2.1	21.0	No
R18	1.9	21.2	No
R6	1.7	22.0	No
R10	1.6	19.1	No
R17	1.4	20.9	No
R8	1.4	18.9	No
R3	1.4	24.8	No
R11	1.3	18.7	No
Criterion		25	
1 – Cumulative impact includes: Site activities, Surrounding Sources, background concentrations. 2 – Additional exceedances above and over Bringelly AQMS			

6.3 Particles as TSP

Table 26 summarises the predicted incremental and cumulative annual average TSP concentrations for the ten most affected discrete receptor locations modelled. These locations were selected based on the annual average TSP increments predicted by the modelling due to the proposed activities at the Site.

Cumulative concentrations against the criterion have been considered by including the annual average concentrations from Site activities, surrounding sources, and estimated background concentrations. Background TSP concentrations have been calculated from PM_{10} concentrations at Bringelly AQMS during 2021 assuming a PM_{10}/TSP ratio of 0.4

The cumulative annual average TSP concentrations are predicted to comply with the annual average TSP criterion of 90 µg/m^3 at all 26 receptors modelled. As outlined in **Section 5.4.2**, annual average predictions overestimate the concentrations as the conservative assumptions used in the emission estimation to ensure short-term concentrations were not underestimated lead to an overestimation of annual averages.

It is noted that cumulative concentrations would decrease if emissions from surrounding construction sites are adequately controlled, if all Surrounding Sources are not simultaneously under construction or if the recommended TARP and monitoring outlined in **Section 8.0** is implemented**.**

Isopleths showing dispersion patterns across the modelling domain are provided in **Appendix D.**

Table 26 Predicted Incremental and Cumulative Annual Average TSP Concentrations

Receptor ID	Annual Average TSP Concentrations (µg/m^3)	
	Incremental	Cumulative[1]
R19	5.5	51.1
R20	5.5	50.5
R7	4.0	50.1
R18	3.9	50.5
R10	3.3	45.9
R6	3.1	52.5
R17	2.7	49.8
R8	2.7	45.4
R3	2.6	60.1
R11	2.6	45.0
Criterion	-	90
1 – Cumulative impact includes: Site activities, Surrounding Sources, background concentrations.		

6.4 Dust Deposition

Table 27 summarises the predicted incremental and cumulative dust deposition rates for the ten most affected discrete receptor locations modelled. These locations were selected based on the annual average dust deposition increments predicted by the modelling due to the proposed activities at the Site.

Cumulative concentrations against the criterion have been considered by including the annual average concentrations from Site activities, surrounding sources, and an assumed background dust deposition rate of 2 g/m^2/month.

The worst incremental impacted receptor is identified as R7. **Table 27** indicates that the predicted incremental annual average dust deposition rates are at or below the criterion of 2 g/m^2/month. Cumulative annual average dust deposition rates are below the 4 g/m^2/month criterion at all receptors.

As outlined in **Section 5.4.2**, annual average predictions overestimate the concentrations as the conservative assumptions used in the emission estimation to ensure short-term concentrations were not underestimated lead to an overestimation of annual averages.

It is noted that cumulative concentrations would decrease if emissions from surrounding construction sites are adequately controlled, if all Surrounding Sources are not simultaneously under construction or if the recommended TARP and monitoring outlined in **Section 8.0** is implemented**.**

Table 27 Predicted Annual Average Dust Deposition Rates

Receptor ID	Annual Average Dust Deposition Rate (g/m^2/month)	
	Incremental	Cumulative[1]
R7	0.2	2.7
R19	0.2	2.5
R20	0.2	2.5
R10	0.2	2.4
R8	0.2	2.4
R11	0.2	2.3
R12	0.2	2.3
R18	0.2	2.5
R6	0.2	2.8
R13	0.1	2.3
Criterion	2 g/m^2/month	4 g/m^2/month

1 – Cumulative impact includes: Site activities, Surrounding Sources, background concentrations.

6.5 Cumulative Impact Summary

A contemporaneous analysis was conducted to assess predicted cumulative concentrations against the relevant air quality criteria. This involved combining the predicted incremental 24-hour PM_{10} concentrations from Site activities with those from Surrounding Sources and the daily varying background concentrations recorded at the Bringelly AQMS.

The results of the contemporaneous assessment including the cumulative impacts from the surrounding sources and background concentrations indicate potential additional exceedances of the short-term (24-hour average) for PM_{10} and exceedances of the long term (annual average) impact assessment criterion for $PM_{2.5}$.

As described in **Sections 6.1** to **6.4** cumulative concentrations would decrease if emissions from surrounding construction sites are adequately controlled, if all Surrounding Sources are not simultaneously under construction or if the recommended TARP and monitoring outlined in **Section 8.0** is implemented**.**

7.0 Operational Air Quality Assessment

7.1 Pollutants Assessed

RAQST provides predictions of NO_2, PM_{10} and $PM_{2.5}$ concentrations at various distances from the road kerb. It does not provide predictions of the other traffic-related pollutants identified in **Section 2.2**, namely CO, SO_2 and VOCs. Given the low level of CO and SO_2 emissions from vehicles and the low ambient concentrations recorded in the region (see **Section 4.5**), it is reasonable to assume that CO and SO_2 emissions from road traffic are unlikely to result in any exceedances of the relevant criteria at locations beyond the road kerb. SLR's experience in modelling VOC emissions from roads has also shown that the kerbside concentration of VOCs is typically well below the relevant air quality guidelines.

Given the above, CO, SO_2 and VOC traffic emissions have not been considered further in this assessment.

7.2 Dispersion Model Configuration

RAQST requires a number of inputs to describe the Site environment and emissions to air, including:

- Background pollutant concentrations
- Daily or peak hour traffic volumes and vehicle speeds
- Traffic mix (heavy vehicle percentage)
- Road type, number of lanes and gradient
- Year of assessment (vehicle fleet).

The sources of the required data and assumptions made for this assessment are summarised in **Table 28**.

Table 28 RAQST Input Data

Parameter	Value	Description
Assessment Year	2027	Assumed project completion
Electric vehicle projections	Included	-
Number of Lanes	1 in each direction	-
Road type	Commercial Arterial	-
Road gradient	3.5%	Average road gradient calculated based on terrain elevations.
Lane width (m)	3.5 m	Assumed
Level for traffic composition	Level 2	No detailed information on traffic composition is available.
Traffic speed	10 km/hr	Conservative assumption representative of emissions during high congestion periods
Traffic volume	4,065 vpd (2,032 vpd per lane)	Peak incremental change
Peak hour traffic as a percentage of AADT	10%	Calculated based on data presented in **Table 5**.
Heavy vehicle percentage	27%	Calculated average daily based on the data presented in **Table 5**.
Background Concentrations		
Background site	Bringelly AQMS	Nearest air quality monitoring station
Background year	2021	Default RAQST year
1-hour metric for NO_x	Maximum	Per the Approved Methods, if the existing ambient air pollutant concentrations exceed the impact assessment criteria, the assessment demonstrates that no additional exceedances of the impact assessment criteria will occur.
24-hour metric for PM_{10} and $PM_{2.5}$	Maximum below the criterion	

7.3 Modelling Results

The nearest receptors to the Elizabeth Drive kerbside, which is the main access point for the Site are located approximately 20 m from the kerb. Therefore, predicted air pollutant concentrations at 20 m from the kerbside have been quantified.

As shown in **Table 29**, the incremental predicted concentrations due to Site generated traffic vehicles travelling along Elizabeth Drive are insignificant, and none of the predicted concentrations are predicted to contribute significantly to the potential for exceedances of the relevant criteria.

Furthermore, all cumulative concentrations comply with the relevant criteria at the nearest sensitive receptor location (approximately 20 m from the Elizabeth Drive kerb), therefore the potential impact of the development is considered negligible. It is noted that for the receptors located further away from the Site and unlikely to be impacted by the peak traffic generation rates (as vehicles will be using a variety of routes to access the Site), the incremental impact would be less than that presented in **Table 29**.

Table 29 RAQST Model Results – Peak Hour

Pollutant and Averaging Period	Background Concentration ($\mu g/m^3$)	Incremental Concentration ($\mu g/m^3$)	Cumulative Concentration ($\mu g/m^3$)	Criteria
Maximum 1-hour NO_2	Not Applicable	Not applicable	141.7	**164**
Annual NO_2	16.2	2.6	18.8	**31**
Maximum 24-hour PM_{10}	40.7	0.9	41.6	**50**
Annual PM_{10}	15.9	0.4	16.3	**25**
Maximum 24-hour $PM_{2.5}$	23.6	0.7	24.3	**25**
Annual $PM_{2.5}$	7.1	0.3	7.4	**8**

7.4 Cumulative Impacts Summary

Cumulative concentrations from the proposed development and background are comply with the relevant criteria at the nearest sensitive receptor as described in **Section 7.3**. While the Project's predicted impact due to vehicle emissions is considered negligible, there is the potential for cumulative impacts to arise if there are proposed changes to the use of the warehouses or changes to traffic assumptions due to future developments. The potential cumulative impact due to future development changes at the Site or surrounds would need to be assessed as part of their individual development applications.

8.0 Mitigation Measures

8.1 Construction Stage

The results of the dispersion modelling indicate potential exceedances of the short-term (24-hour average) for both PM_{10} and exceedances of the long term (annual average) impact assessment criterion for $PM_{2.5}$. It is noted that conservative assumptions made to ensure short term concentrations are not underpredicted are expected to have resulted in a potentially significant over estimation of long-term concentrations. Therefore, if appropriate measures are put in place to ensure compliance with the relevant short-term criteria, exceedances of long-term criteria are unlikely.

Control measures proposed to be adopted for the Project, including those already quantified for the purpose of this AQIA in Section **5.4.2**, are listed below in **Table 30**.

Additional dust mitigation and management measures recommended are listed in **Table 31** to **Table 33**. It is noted that the benefits gained from all mitigation measures outlined in these tables could not be quantified via dispersion modelling.

These mitigation measures may be adopted in a site-specific Construction Air Quality Management Plan (CAQMP). CAQMPs cover all sources of emissions, such as those identified in **Section 5.4** of this AQIA, including wind erosion, wheel generated dust, extraction, material handling and processing of extracted material.

In addition, it is recommended that the Site utilises a Trigger Action Response Plan (TARP) supported by PM_{10} real-time air quality monitors to manage impacts at receptors.

Table 30 Recommended Dust Mitigation Measures for the Project

	Activity
1	Display the name and contact details of person(s) account-able for air quality and dust issues on the site boundary. This may be the environment manager/engineer or the site manager.
2	Display the head or regional office contact information.
3	Develop and implement a Dust Management Plan (DMP), which may include measures to control other emissions, approved by the Local Authority. The level of detail will depend on the risk and should include as a minimum the highly recommended measures in this document. The desirable measures should be included as appropriate for the site.
Site Management	
4	Record all dust and air quality complaints, identify cause(s), take appropriate measures to reduce emissions in a timely manner, and record the measures taken.
5	Make the complaints log available to the local authority when asked.
6	Record any exceptional incidents that cause dust and/or air emissions, either on- or off-site, and the action taken to resolve the situation in the logbook.
Monitoring	
7	Undertake periodic on-site and off-site inspection, where receptors (including roads) are nearby, to monitor dust, record inspection results, and make the log available to the local authority when asked.
8	Carry out regular site inspections to monitor compliance with the DMP, record inspection results, and make an inspection log available to the local authority when asked.

	Activity
9	Increase the frequency of site inspections by the person accountable for air quality and dust issues on site when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions.
Preparing and Maintaining the Site	
10	Plan site layout so that machinery and dust causing activities are located away from receptors, as far as is possible.
11	Fully enclose site or specific operations where there is a high potential for dust production and the site is actives for an extensive period
12	Where possible, avoid site runoff of water or mud.
13	Keep site fencing, barriers and scaffolding clean using wet methods.
14	Remove materials that have a potential to produce dust from site as soon as possible, unless being re-used on site. If they are being re-used on-site cover as described below.
15	Cover, seed, or fence stockpiles to prevent wind whipping.
Operating Vehicle/Machinery and Sustainable Travel	
16	Ensure all vehicles switch off engines when stationary - no idling vehicles.
17	Avoid the use of diesel- or petrol-powered generators and use mains electricity or battery powered equipment where practicable.
18	Impose and signpost a maximum-speed-limit of 15 kph on surfaced and 10 kph on un-surfaced haul roads and work areas (if long haul routes are required these speeds may be increased with suitable additional control measures provided, subject to the approval of the nominated undertaker and with the agreement of the local authority, where appropriate).
Operations	
19	Only use cutting, grinding or sawing equipment fitted or in conjunction with suitable dust suppression techniques such as water sprays or local extraction, e.g. suitable local exhaust ventilation systems.
20	Ensure an adequate water supply on the site for effective dust/particulate matter suppression/mitigation, using non-potable water where possible and appropriate.
21	Use enclosed chutes and conveyors and covered skips.
22	Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on such equipment wherever appropriate.
23	Ensure equipment is readily available on site to clean any dry spillages and clean up spillages as soon as reasonably practicable after the event using wet cleaning methods.
Waste Management	
24	Avoid bonfires and burning of waste materials.

Table 31 Mitigation Measures Specific to Earthworks

Activity
Re-vegetate earthworks and exposed areas/soil stockpiles to stabilise surfaces as soon as practicable.
Use Hessian, mulches or trackifiers where it is not possible to re-vegetate or cover with topsoil, as soon as practicable.
Only remove the cover in small areas during work and not all at once.

Table 32 Mitigation Measures Specific to Construction

Activity
Avoid scabbling (roughening of concrete surfaces) if possible.
Ensure sand and other aggregates are stored in bunded areas and are not allowed to dry out, unless this is required for a particular process, in which case ensure that appropriate additional control measures are in place.
Ensure bulk cement and other fine powder materials are delivered in enclosed tankers and stored in silos with suitable emission control systems to prevent escape of material and overfilling during delivery.
For smaller supplies of fine power materials ensure bags are sealed after use and stored appropriately to prevent dust.

Table 33 Mitigation Measures Specific to Trackout

Activity
Use water-assisted dust sweeper(s) on the access and local roads, to remove, as necessary, any material tracked out of the site. This may require the sweeper being continuously in use.
Avoid dry sweeping of large areas.
Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport.
Inspect on-site haul routes for integrity and instigate necessary repairs to the surface as soon as reasonably practicable.
Record all inspections of haul routes and any subsequent action in a site log book.
Install hard surfaced haul routes, which are regularly damped down with fixed or mobile sprinkler systems, or mobile water bowsers and regularly cleaned.
Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable).
Ensure there is an adequate area of hard surfaced road between the wheel wash facility and the site exit, wherever site size and layout permit.
Access gates to be located at least 10 m from receptors where possible.

8.1.1.1 Recommended Ambient Air Quality Monitoring

Ambient air quality monitoring is proposed to assist in mitigating potential impacts at sensitive receptors. An example monitoring program is provided in **Table 34**.

It is recommended that at least four continuous air quality monitors with an alert system are to be employed and each paired with dust deposition gauges at the same location for assessing nuisance dust risk. The type of monitor and locations will be finalised for inclusion in the Construction Air Quality Management Plan.

As discussed in **Section 6.2.2**, as there are receptors in all directions from Site, there is not a predominate wind direction causing impacts at receptors, therefore it is recommended that monitors are located in each direction near the most impacted receptors.

The location of these will allow for effective project management and assist in minimising the potential for adverse air quality impacts at the sensitive receptors.

It is recommended that these locations are reviewed periodically to ensure representative of current construction activities and the seasonal variation in wind directions presented in **Section 4.4**.

Table 34 Air Quality and Meteorological Monitoring Program

Actions	Frequency
Conduct real-time continuous PM_{10} monitoring and monthly DDG sampling at locations representative of nearest sensitive receptors & prevailing wind directions.	Continuously one month prior to commencement and continuously during construction.
Continuous meteorological data will be recorded from an on-site station including wind speed and wind direction as a minimum.	Continuously during construction.
Undertake regular on-site inspections to check compliance with dust controls and maintain a log of results.	Daily during construction.

8.1.1.2 Recommended Trigger Action Response Plan

Trigger action response plans (TARPs) define the minimum set of actions required by workers in response to a deviation from normal working conditions.

A 1-hour average time period has been selected as a practical time-step for identifying sustained elevated dust concentrations that could potentially result in an exceedance of the NSW EPA 24-hour average PM_{10} criterion, while providing sufficient time for additional mitigation measures to be implemented at the Site to reduce dust emissions before such an exceedance occurs.

Table 35 presents recommended 1-hour average PM_{10} concentrations and actions. In the absence of local guidance, these values are adapted from the recommendation in the UK Institute of Air Quality Management (IAQM) Guidance on Monitoring in the Vicinity of Demolition and Construction Sites (IAQM 2018) that was developed based on extensive monitoring in the vicinity of construction sites and recommended a 1-hour average PM_{10} concentration of 190 µg/m^3 as the trigger upon which action must immediately be taken to minimise dust emissions. The upper trigger has been conservatively lowered to 150 µg/ m^3.

Table 35 TARP PM_{10} Trigger Levels and Responses

Level	1-hour Average PM_{10} Trigger Level	Action
Normal Operations	Daily inspections show that there is no visible dust leaving the site. There are no complaints received during the construction	Continue operations and mitigation measures as normal. Continue monitoring program as normal.
Alert	≥100 µg/m^3 but < 125 µg/ m^3 OR Wind speed > 2m/s OR Visible dust leaving the Site	• Review operations via a visual inspection of dust emissions from current activities to ensure all standard dust mitigation measures are being appropriately implemented. Where appropriate, implement additional remedial measures (refer to Section 7 (mitigation measures). • Determine if background concentrations may be the key contributor to high concentrations being recorded (e.g., based on wind direction, information on regional events such as bush fires or dust storms, etc). • Continue to closely monitor PM_{10} concentrations being recorded. • Record details of trigger event and actions taken in a log.
Action I	≥125 µg/ m^3 but < 150 µg/ m^3 AND Wind speed > 2m/s OR Visible dust leaving the Site	Project Manager to review and investigate construction activities and respective control measures. Where appropriate, implement additional remedial measures, such as: • Deployment of additional water sprays, water trucks etc • Relocation or modification of dust-generating sources • Record findings of investigations and actions taken to reduce dust levels

Level	1-hour Average PM_{10} Trigger Level	Action
		• Continue to closely monitor dust levels to ensure they are decreasing • If elevated dust levels are due to regional dust event (fire, dust storm etc) – still take action to minimise dust from the Project site to minimise cumulative impacts, but also record details of the cause of the elevated background levels. • Increase watering rates on haul roads where appropriate. • Reduce speed of equipment / vehicles. • Continue to closely monitor PM_{10} concentrations being recorded. • Undertake an investigation of the dust generating activities, and if necessary, temporarily halt the dust generating activities. • Record details of trigger event and actions taken in a log.
Action II	≥ 150 µg/ m^3 AND Wind speed > 2m/s OR Visible dust leaving the Site	• Review planned operations considering exposed areas. • Cease any non-critical dust-producing activities or relocate relevant activities where possible away from sensitive receptors, or to less exposed locations. • Continue to closely monitor PM_{10} concentrations being recorded. • Review real-time monitoring data at the existing continuous monitors and dust deposition monitor to investigate the likelihood of onsite activities contributing to dust impacts. • Project Managers to review and investigate construction activities and respective control measures for the monitoring period, in an air pollution incident report. • If it is concluded that construction activities at Project site were directly responsible for the elevated PM_{10} concentrations, Kane Constructions to engage specialist air quality consultants to audit site activities and operator to implement additional mitigation measures (and possibly Australian Standard monitoring) based on audit findings. • Record details of trigger event and actions taken in a log.

8.2 Operational Stage

In addition to dust and air emission mitigation measures provided for the construction phase, recommended air quality management measures for the operational phase of the Project include:

- Minimising vehicle idling times around the Site using best management practices, including:
  - Requiring vehicle engines to be turned off when loading/unloading; when drivers are on a break, or waiting to get administrative clearances, etc.; and
  - Installation of appropriate signage at relevant locations encouraging drivers to switch off engines when not in use.
- Mobile heavy lift equipment and other vehicles operated on site are maintained and operated as per manufacturer specifications or best practice requirements.
- Any spillages are cleaned up in a timely manner.
- Where possible sealed access roads and hardstand areas are maintained and the surface kept free of significant dust-generating materials.

9.0 Comparison of Impacts

This report assesses potential impacts from SEED Stage 1B which forms the second stage of development works envisaged under the SEED Stage 1 Concept Proposal (SSD-19618251).

It is noted that the SSD-19618251 AQIA did not consider surrounding sources of construction emissions and did not consider operational impacts.

The following comparison in impacts can be made between this AQIA and the AQIA submitted for SSD-19618251:

- $PM_{2.5}$ (24 hour): Both reports predict no additional exceedances due to the project.
- $PM_{2.5}$ (Annual): The SSD-19618251 AQIA predicts no exceedances due to the project. This AQIA predicts exceedances at some sensitive receptors.
- PM_{10} (24 hour): The SSD-19618251 AQIA predicts additional exceedance days due to the project when combining project increments with background. This report predicts additional exceedance days at some receptors when combining project increments with background and surrounding sources, but no additional exceedances due to the project contribution alone.
- PM_{10} (Annual): Both reports predict no additional exceedances due to the project.
- TSP (Annual): Both reports predict no additional exceedances due to the project.
- Dust Deposition (Month): Both reports predict no additional exceedances due to the project.

All impacts should be adequately controlled by adoption and adherence to recommended mitigation measures recommended in the report relevant to the stage.

10.0 Conclusions

This Air Quality Impact Assessment (AQIA) has been prepared by SLR Consulting Australia Pty Ltd (SLR) to accompany a State Significant Development Application (SSDA) SSD-99079487, which supports the staged development of SEED Stage 1.

The main potential sources of air emissions from Stage 1B were identified as fugitive particulate matter during the construction phase and products of combustion from traffic during the operational phase of the Site.

The potential for off-site dust impacts during the construction phase was assessed using modelling methods in general accordance with the NSW EPA Approved Methods. The results of this assessment - based on a conservative peak day scenario - indicate that exceedances of short term and long term PM_{10} criteria, and long term $PM_{2.5}$ criteria, could potentially occur if sufficient mitigation measures are not adopted by the Project. It is noted that considering the following factors, overestimation of predicted concentrations by the model is likely:

- Inability to quantify benefits gained from some of the proposed mitigation measures (e.g. speed reduction, reducing the intensity of dust generating activities on days with elevated background pollutant concentrations or weather conditions conducive to dust impacts, etc.)
- Assessment of all bulk earthworks and road works activities operating simultaneously at all times.
- Limitation of the CALPUFF model in predicting nearfield pollutant concentrations.
- Limitation of dispersion modelling to representatively predict reduced pollutant dispersion due to rainfall.

Regardless, it is recommended that real-time monitoring of ambient air quality be performed throughout the construction period to allow for effective site management and assist in minimising the potential for adverse air quality impacts at the sensitive receptors.

The screening-level assessment of operational stage emissions found that the incremental impact associated with the vehicles travelling along the surrounding roads was negligible at the closest receptors, such that Project vehicles are unlikely to result in any significant measurable increase in cumulative air quality impacts at these locations. Given this, a detailed assessment was not deemed to be required.

It is concluded that with an appropriate ambient air quality monitoring plan in place, the proposed construction activities can be completed without any significant impact on the surrounding receptors. Given the negligible impacts predicted by the screening operational stage assessment, air quality at the surrounding receptors should not be considered as a constraint due to the operation of the Site.

11.0 References

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Appendix A Selection of Representative Meteorological Data

SEED- Stage 1B

Air Quality Impact Assessment

Mirvac Projects Pty Ltd

SLR Project No.: 610.032539.00004

5 March 2026

Meteorological Year Selection

Once emitted to atmosphere, the emissions will:

- Rise according to the momentum and buoyancy of the emission at the discharge point relative to the prevailing atmospheric conditions.
- Be advected 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.
- (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 (2020 to 2024 inclusive) to determine the year that is most representative of average conditions. Wind direction and wind speed were compared to averages for the region to determine the most representative year.

Data collected from 2020 to 2024 is summarised in **Figures A-1** to **A-2**. Examination of the data indicates the following:

- **Figure A-1** indicates relatively similar wind roses for all years analysed, with a higher frequency of winds from the west-southwest in 2024 .
- **Figure A-2** indicates that 2020 and 2021 exhibit wind speeds that are lower than the 5-year average which will result in a conservative assessment due to reduced dispersion.
- **Figure A-3** indicates that 2020, 2021 and 2022 are most similar to the 5-year average of calms conditions, however 2020 has a much higher frequency of calms than the 5-year average, which may be overly conservative if selected.
- **Figure A-3** indicates relatively similar monthly temperatures for all years analysed, with some above average temperatures in 2024, 2023 and 2024.

Given the above, the year 2021 was selected as the representative year of meteorology.

Figure A-1 Frequency of Winds at Badgerys Creek AWS for 2020 – 2024

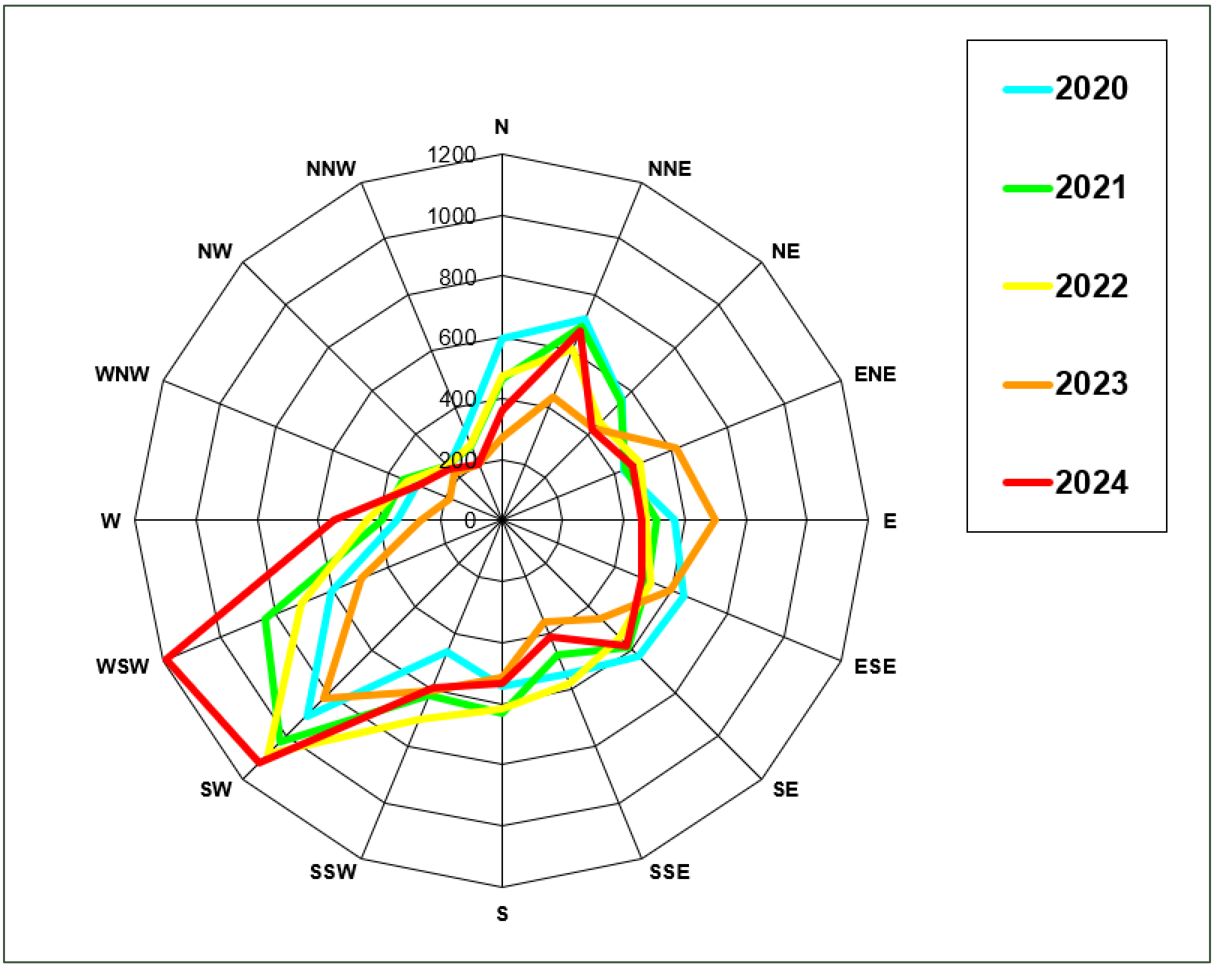


Figure A-2 Monthly Average Wind Speed at Badgerys Creek AWS for 2020 – 2024

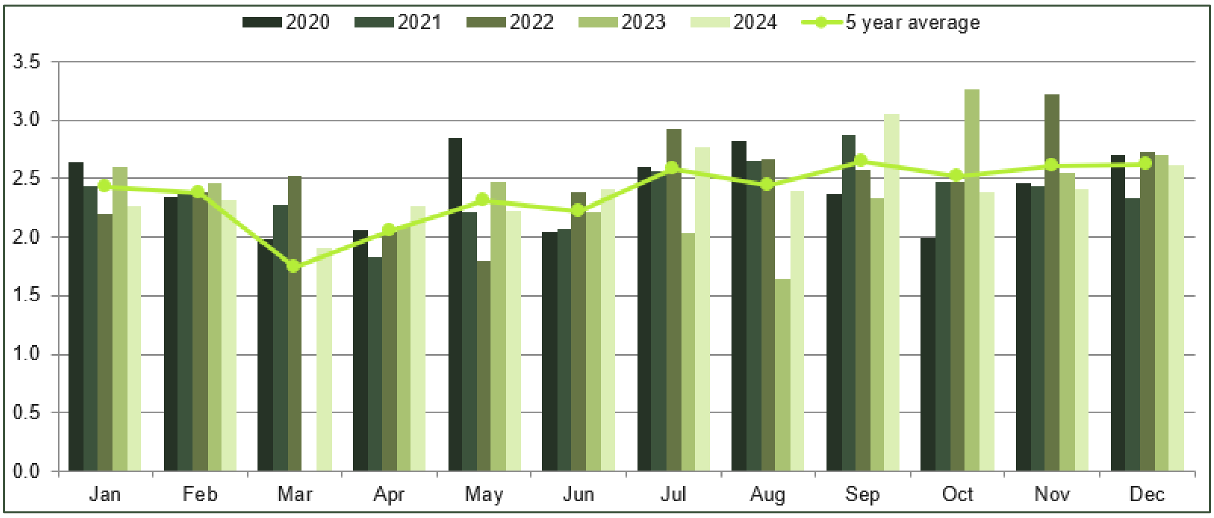


Figure A-3 Monthly Average Occurrence of Calms at Badgerys Creek AWS for 2020 – 2024

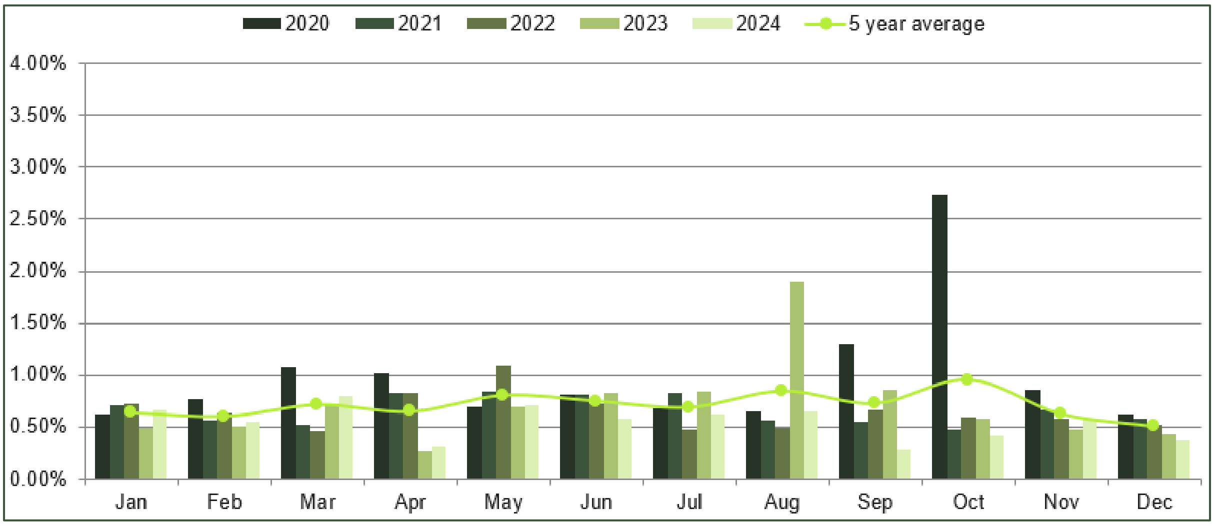
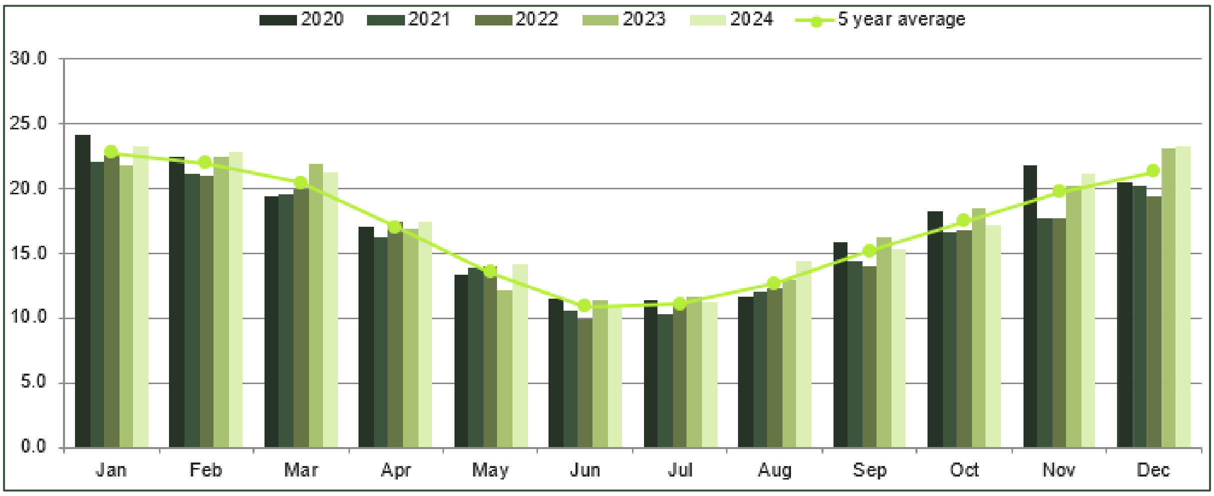


Figure A-4 Monthly Average Temperature at Badgerys Creek AWS for 2020 – 2024



Appendix B Evaluation of Meteorological Data

SEED- Stage 1B

Air Quality Impact Assessment

Mirvac Projects Pty Ltd

SLR Project No.: 610.032539.00004

5 March 2026

The primary meteorological data parameters relevant for dispersion modelling are typically:

- wind (wind speed and direction)
- turbulence (atmospheric stability)
- mixing height (depth of turbulent layer)

A review of the meteorological data used in the dispersion modelling for the above parameters is provided below.

Wind Speed and Wind Direction

A summary of the annual wind behaviour predicted by CALMET for 2021 (extracted at the Site) is presented as wind roses in **Figure B-1** and as a wind speed distribution plot in **Figure B-2**. These plots show that winds in the study area were predicted to be predominantly light to moderate during 2021. Calm wind conditions were predicted to occur 8.5% of the time throughout the modelling period.

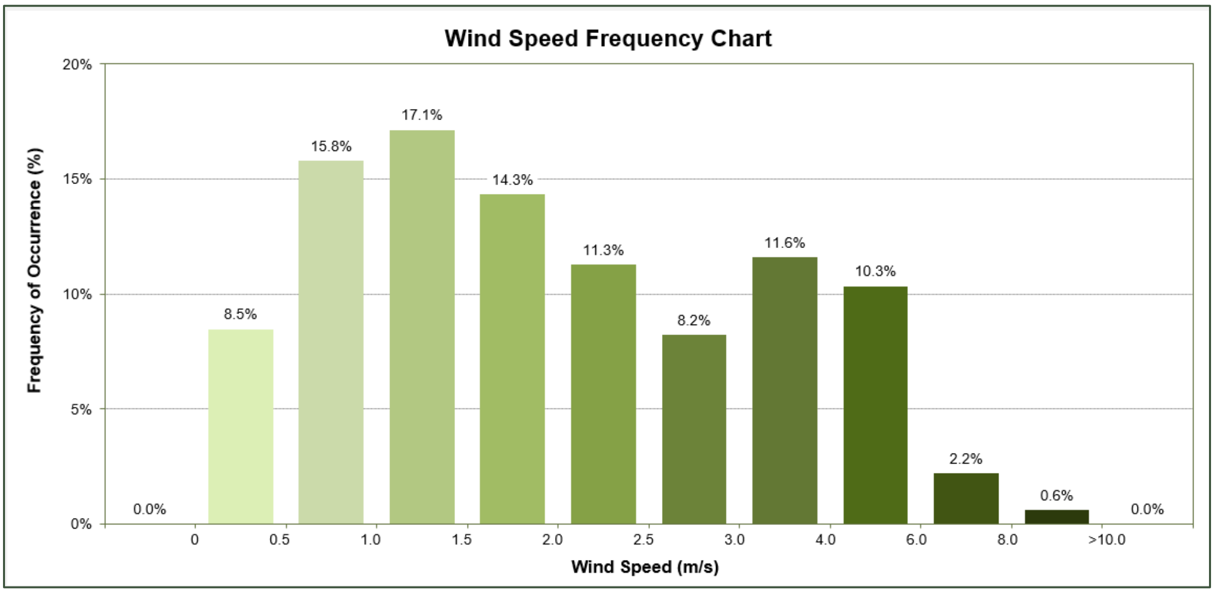
The seasonal wind roses indicate that typically:

- In summer, winds blow from all directions except the northwestern quadrant, where winds occur infrequently. Calms were predicted 5.9% of the time during the summer months.
- In autumn, winds predominantly blow from the southwestern quadrant, with the least frequent winds originating from the northeastern quadrant. Calms were predicted 8.7% of the time during the autumn months.
- In winter, winds predominantly blow from the southwestern and northwestern quadrants, with the least frequent winds originating from the southeastern quadrant. Calms were predicted 12.6% of the time.
- In spring, winds blow almost evenly from all directions, with fewer winds from the northwestern quadrant. Calms were predicted 6.6% of the time.

A comparison of the wind roses presented in **Figure B-1** with the Badgerys Creek AWS wind roses presented in **Figure 9** shows that the frequency distribution of wind speed and direction for both is very similar throughout the year, with the CALMET predictions having slightly lower calm frequency.

Figure B-1 CALMET-Predicted Seasonal Wind Roses for the Site – 2021

Figure B-2 Annual Wind Speed Frequencies at the Site (CALMET Predictions, 2021)



Atmospheric Stability

Atmospheric stability refers to atmospheric turbulence and the tendency of the atmosphere to resist or enhance vertical motion. Depending on conditions, the atmospheric stability can either inhibit or promote pollutant dispersion. The Pasquill-Gifford scheme provides 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 B-1**.

Unstable conditions are favourable for dispersion, while stable conditions are unfavourable for dispersion.

The dispersion modelling in CALPUFF used a more advanced atmospheric stability scheme (based on micro meteorology). Stability class data were extracted from the meteorological dispersion modelling data set for the meteorological data evaluation.

Table B-1 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

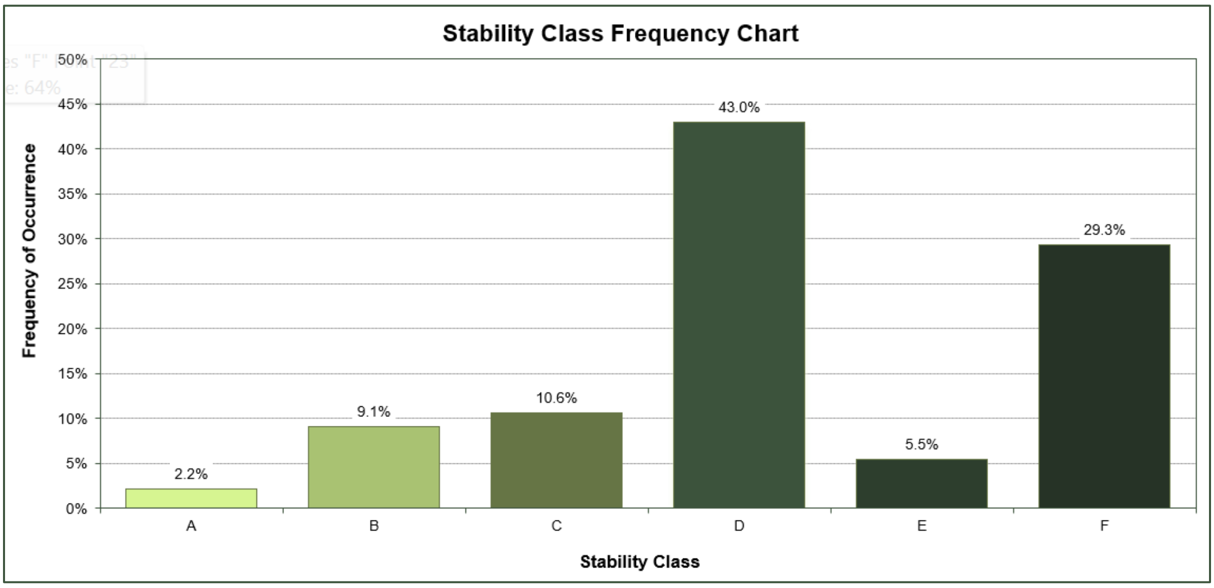
Source: (NOAA 2018)

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 at the Site during the modelling period is presented in **Figure B-3**. The results indicate a high frequency of conditions typical of Stability Class D and F. Stability Class D is indicative of neutral conditions, conducive to a moderate level of pollutant dispersion due to mechanical mixing. Stability Class F is indicative of calm conditions, which typically indicates poorer dispersion of pollutants.

Figure B-3 Predicted Stability Class Frequencies at the Site (CALMET predictions, 2021)



Mixing Heights

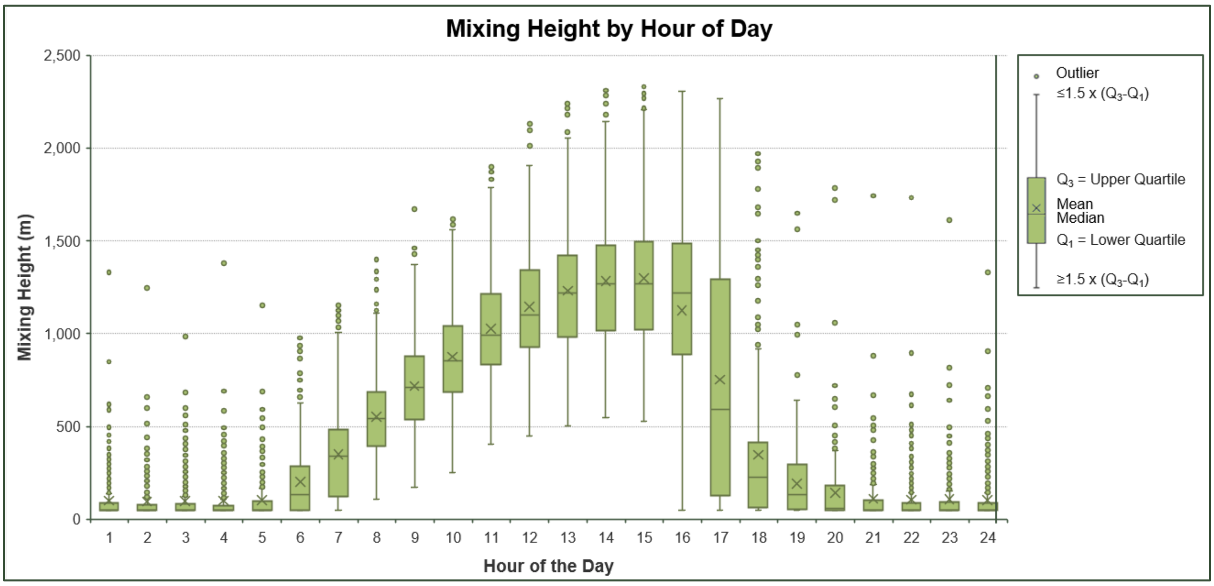
The mixing height is the depth of the atmospheric mixing layer between ground level and an elevated temperature inversion. Depending on conditions, vertical dispersion is typically limited by the mixing height. This is an important parameter in dispersion modelling since the mixing height largely sets the vertical profile the dispersion can take place in.

Mixing heights have a diurnal variation in response to mixing from convection due to insolation and grow from sunrise to around midday. Followed by a decline until sunset when there is typically a rapid decline. If a plume penetrates through, or is released above, the mixing height the pollutants will be trapped aloft with no mixing to ground level (unless in specific conditions such as fumigation). Similarly, if a plume is trapped below a low mixing height (inversion layer) the vertical dispersion will be limited, and higher ground-level concentrations are likely to occur.

Diurnal variations in maximum and average mixing heights predicted by CALMET at the Site during the 2021 modelling period are illustrated in **Figure B-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 B-4 Predicted Mixing Heights at the Site (CALMET predictions, 2021)



Appendix C Variable Emission file

SEED- Stage 1B

Air Quality Impact Assessment

Mirvac Projects Pty Ltd

SLR Project No.: 610.032539.00004

5 March 2026

Variable Emission File – Calculation Steps

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

FPannual = $PM_{2.5}$, annual	(FP) Fine Particulate – particulate of size less than 2.5 µm
CMannual = PM_{10}, annual – $PM_{2.5}$, annual	(CM) Coarse Particulate – particulate of size between 10 µm and 2.5 µm
REannual = TSPannual - PM10, annual	(RE) Rest Particulate – particulate of size greater than 10 µm

Step 2: Identify the operating hours for each activity

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

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

Wind sensitive: activities with emission factor that is a function of (wind speed/2.2)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

<table>
<tr>
<td>
$$FP_{AC,i,h} = \frac{FP_{annual,i} \times 1000}{N_{days} \times OH_i \times 3600 \times N_{s,i}} \times WSFactor_{i,h}$$
$$CM_{AC,i,h} = \frac{CM_{annual,i} \times 1000}{N_{days} \times OH_i \times 3600 \times N_{s,i}} \times WSFactor_{i,h}$$
$$RE_{AC,i,h} = \frac{RE_{annual,i} \times 1000}{N_{days} \times OH_i \times 3600 \times N_{s,i}} \times WSFactor_{i,h}$$
FOR WIND INSENSITIVE ACTIVITIES
$$WSFactor_{i,h} = 1$$
FOR WIND SENSITIVE ACTIVITIES
$$WSFactor_{i,h} = \frac{\left(\frac{WS_h}{2.2}\right)^{1.3}}{\frac{\sum_{j=1}^{n}\left(\frac{WS_j}{2.2}\right)^{1.3}}{n}}$$
FOR WIND EROSION ACTIVITIES
$$WSFactor_{i,h} = \frac{(WS_h)^3}{\frac{\sum_{j=1}^{n}\left(WS_j\right)^3}{n}}$$
</td>
<td>
Where:
$F_{PAC,i,h}$- Fine Particulates Emission Rate For Activity i (g/s) At Hour h
CMAC,i,h- Fine Particulates Emission Rate For Activity I (g/s) At Hour H
CMAC,i,h- Fine Particulates Emission Rate For Activity i (g/s) At Hour h
OHi-Daily Operating Hours (1- 24) For Activity i
Ndays -Number Of Days In The Meteorological Data File
Ns,i -Number Of Sources Associated With Activity i
WSFactori,h - Wind Speed At The Hour
N -Number Of Hours In The Meteorological Data File
</td>
</tr>
<tr>
<td colspan="2">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.</td>
</tr>
</table>

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 source.

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

ERS1,h,FP = FPAC,1,h+ FPAC,2,h+ FPAC,3,h

ERS1,h,CM = CMAC,1,h+ CMAC,2,h+ CMAC,3,h

ERS1,h,RE = REAC,1,h+ REAC,2,h+ REAC,3,h

Appendix D Isopleths

SEED- Stage 1B

Air Quality Impact Assessment

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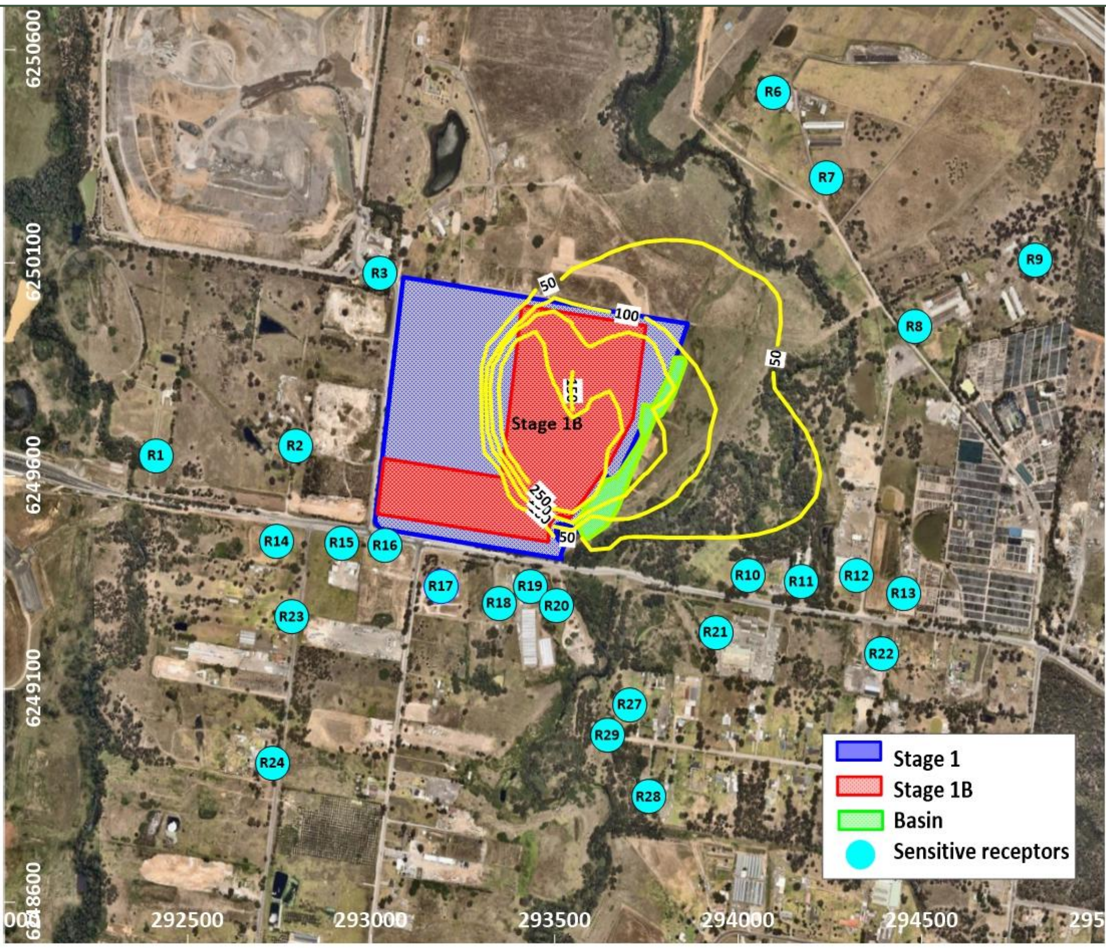
SLR Project No.: 610.032539.00004

5 March 2026

Figure D 1 Maximum Predicted 24-hour Average Incremental PM_{10} Concentrations ($\mu g/m^3$)



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Project Number:	610.032539
Dispersion Model:	CALPUFF
Modelling Period:	2021
Projection:	WGS84 UTM Zone 56S
Date:	02/02/2026

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SEED Stage 1B
Air Quality Impact Assessment

Pollutant	PM_{10}	Avg Period	24-Hour	Unit	$\mu g/m^3$

Figure D 2 Predicted Annual Average Incremental PM_{10} Concentrations ($\mu g/m^3$)

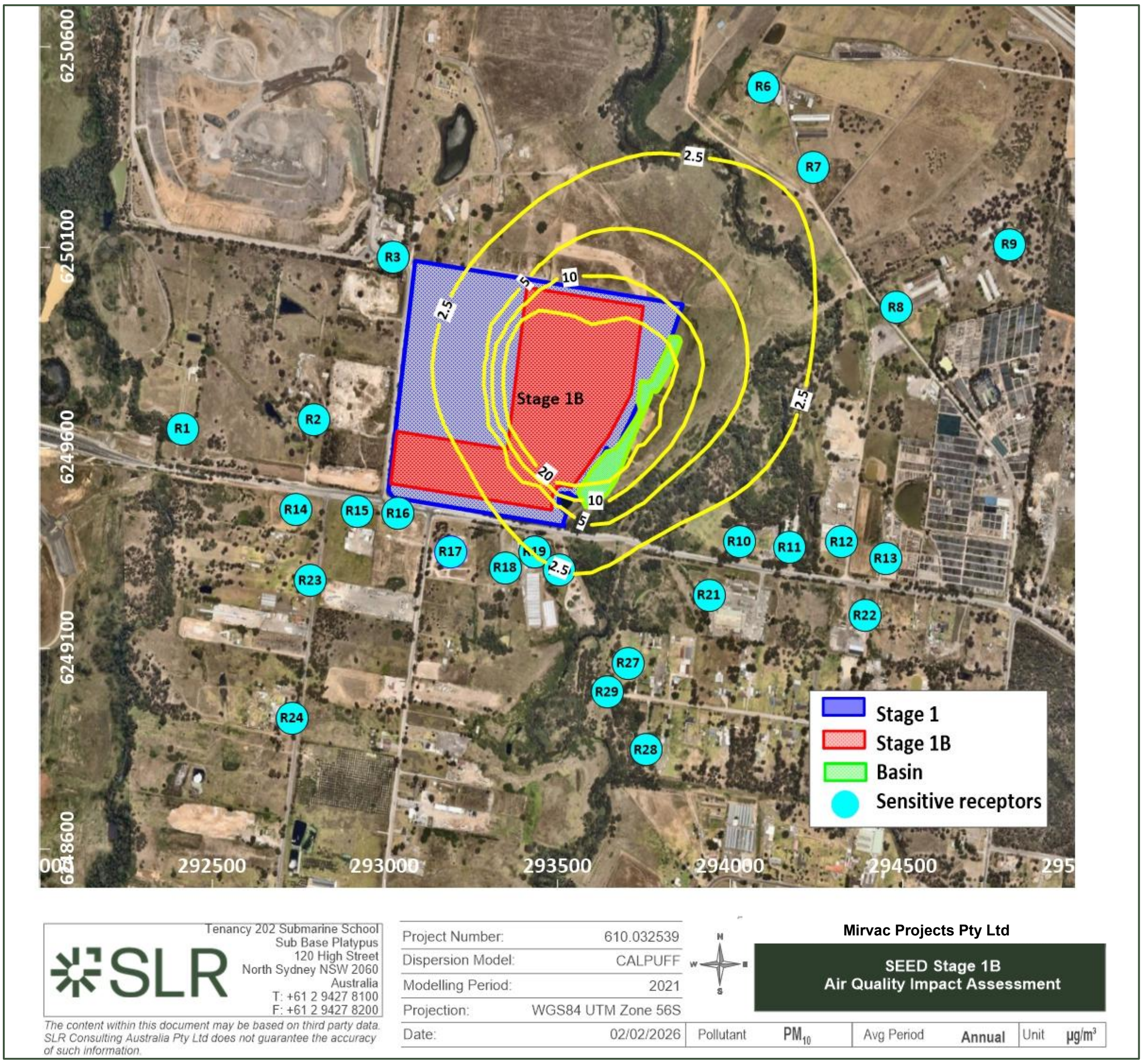


Figure D 3 Maximum Predicted 24-hour Average Incremental $PM_{2.5}$ Concentrations ($\mu g/m^3$)

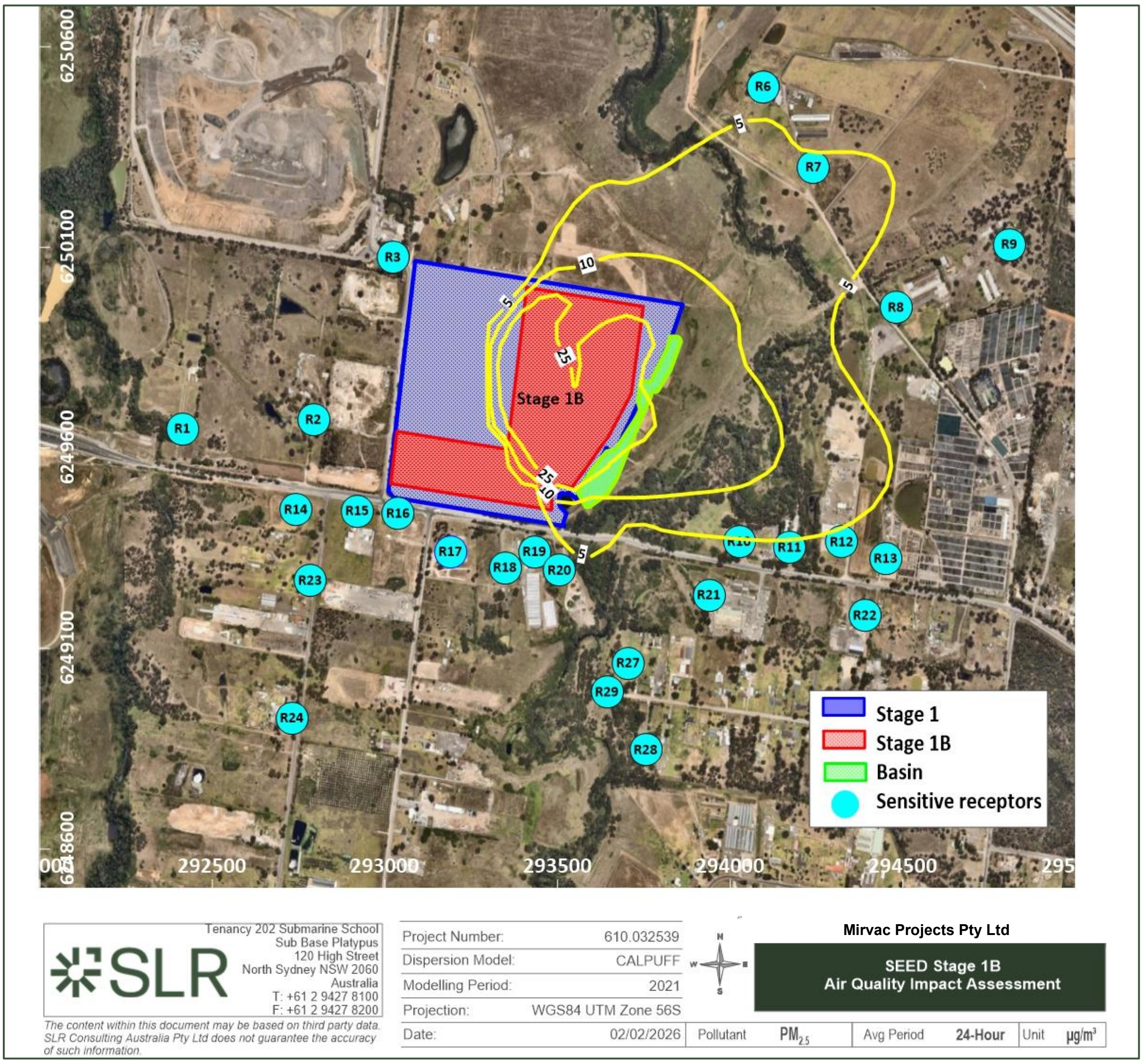
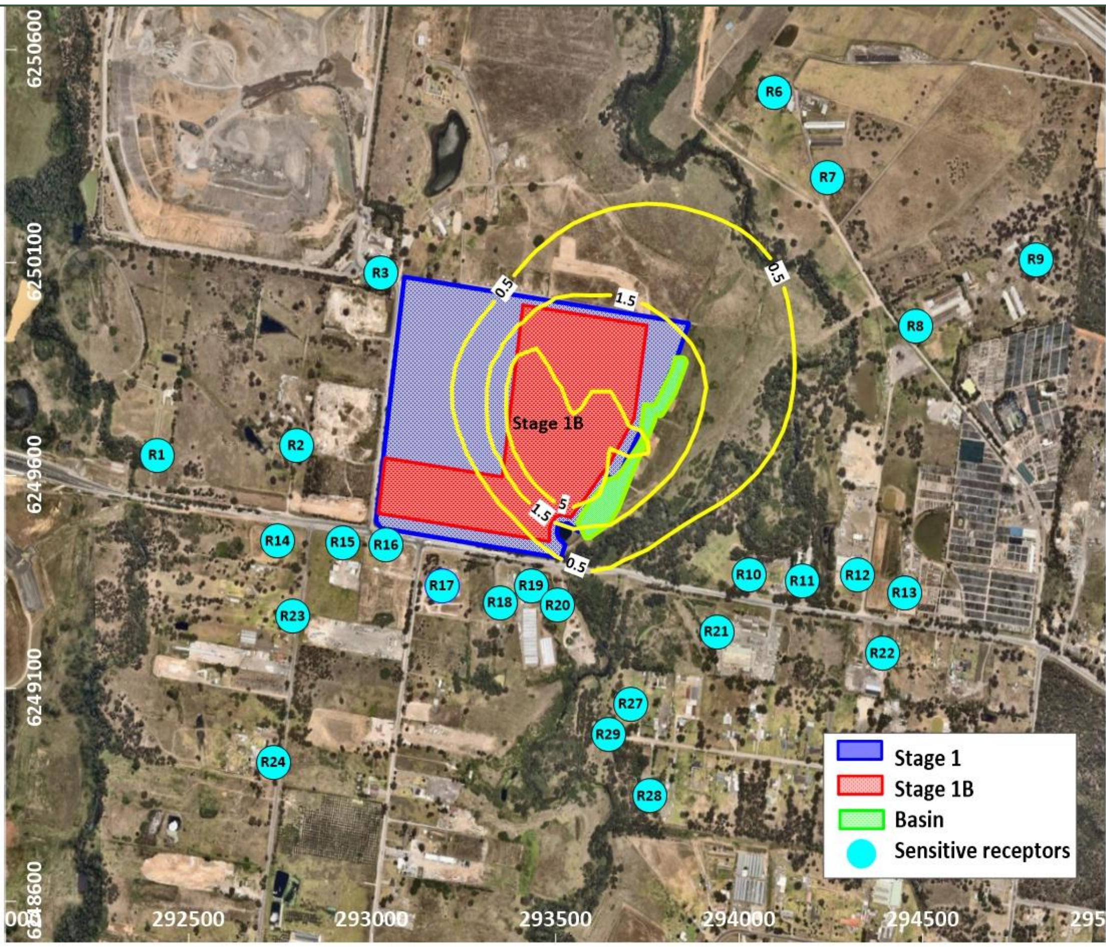


Figure D 4 Predicted Annual Average Incremental $PM_{2.5}$ Concentrations ($\mu g/m^3$)



Project Number:	610.032539
Dispersion Model:	CALPUFF
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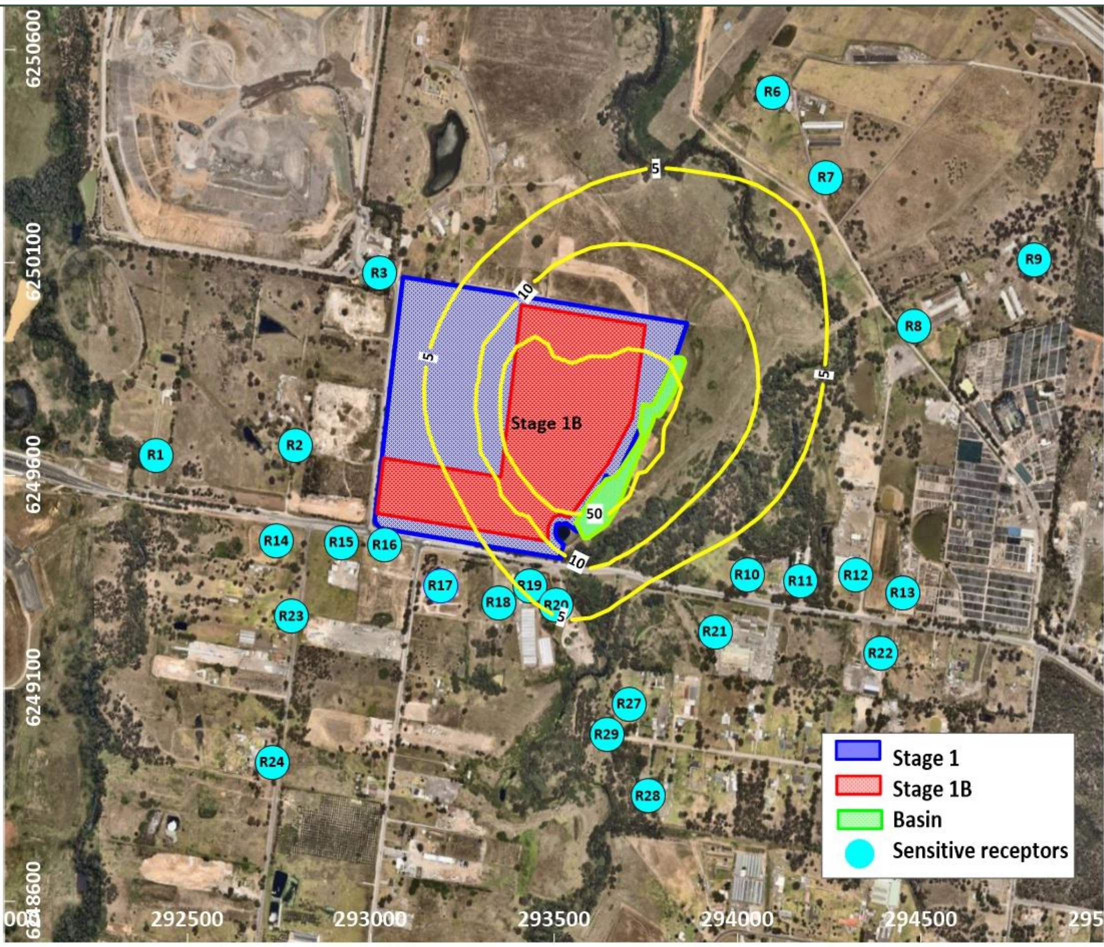
Pollutant: $PM_{2.5}$ | Avg Period: Annual | Unit: $\mu g/m^3$

Figure D 5 Predicted Annual Average Incremental TSP Concentrations ($\mu g/m^3$)



Project Number:	610.032539
Dispersion Model:	CALPUFF
Modelling Period:	2021
Projection:	WGS84 UTM Zone 56S
Date:	02/02/2026

Pollutant TSP | Avg Period Annual | Unit $\mu g/m^3$

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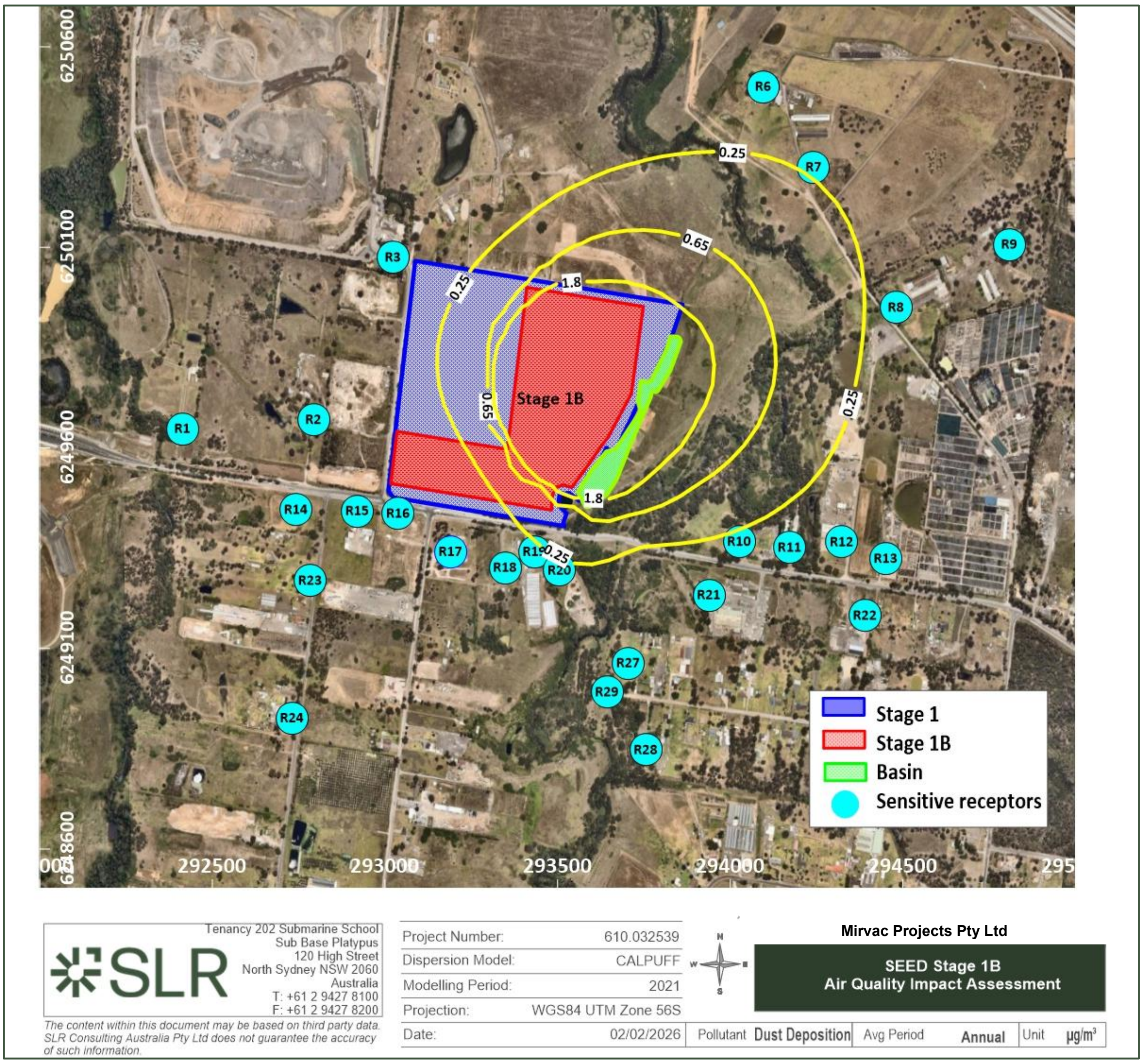
Figure D 6 Predicted Annual Average Incremental Deposited Dust Levels (g/m²/month)



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