AIR QUALITY IMPACT ASSESSMENT

SSD-35962232: Burrows Road Multi-level Warehouse, St Peters

Prepared for:

Goodman Property Services (Aust) Pty Ltd

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BASIS OF REPORT

This report has been prepared by SLR Consulting Australia Pty Ltd (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Goodman Property Services (Aust) 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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DOCUMENT CONTROL

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1 Introduction

This air quality impact assessment report has been prepared by SLR Consulting (Australia) Pty Ltd (SLR) to accompany a State Significant Development Application (SSDA) for a proposed warehouse and distribution centre development located at 1-3 Burrows Road, St Peters (the Project).

This Air Quality Impact Assessment (AQIA) has been prepared to assess the potential short and long term air quality impacts at ground and elevated receptors of the proposed warehouse and office buildings. Potential air quality impacts associated with the construction and operation of the Project has also been addressed qualitatively in this report.

As summarised in **Table 1** below, this report has also been prepared to address the relevant Secretary's Environmental Assessment Requirements (SEARs) issued by the Department of Planning and Environment (DPE) for SSD-35962232 on 7 February 2022.

Table 1 SEARS Requirements – SSD 35962232

Item	Description of Requirement	Report Reference
10. Air Quality	Identify significant air emission sources at the proposed development (during construction and operation), assess their potential to cause adverse off-site impacts, and detail proposed management and mitigation measures that would be implemented.	Section 4
	Where air emissions during operation have the potential to cause adverse off-site impacts, provide a quantitative air quality impact assessment prepared in accordance with the relevant NSW Environment Protection Authority (EPA) guidelines.	Section 8

This report has been prepared to address potential air quality impacts on the Project site associated with the operation of key air emission sources in the surrounding area, as well as potential air quality impacts on the surrounding environment associated with the construction and operational phases of the Project. This report provides the following:

- An assessment of potential air quality risks associated with the construction activities and identification of appropriate mitigation measures for the construction phase of the Project.
- Assessment of potential air quality impacts on surrounding environment associated with the operational phase of the Project.
- Assessment of potential air quality impacts on the Project site associated with the significant air emission sources in the surrounding area.

2 Site Description

2.1 Site Location

The land to which this SSDA relates is located at 1-3 Burrows Road, St Peters (**the Site**). The site comprises two parcels of land (allotments) and is legally described as follows:

- Lot 1 DP 1227450; and
- Lot 11 DP 606737.

The site is an irregular shaped allotment with a total area of approximately 34,614 square metres (m^2). The site adjoins Burrows Road to the east with a primary curved frontage of approximately 528 metres (m), and adjoins Canal Road to the west with a secondary frontage of approximately 289 m.

The site is located in the City of Sydney Local Government Area (LGA), at the junction with the Inner West and Bayside LGA's.

The site is currently occupied by older low-rise industrial units that are largely consistent with development in the surrounding area, which is predominantly of an industrial nature. The industrial units comprise four large format, steel-framed warehouse / distribution facilities. These buildings no longer meet the requirements of contemporary industrial users in this market.

The site is situated within an established largely industrial area, immediately south of the St Peters WestConnex Interchange and is well connected to Sydney Airport. The locality surrounding the site is characterised by existing industrial and commercial developments, as well as new road and other major transport infrastructure. The Alexandra Canal is located approximately 100 m to the southeast and east. Stacks venting emissions from the M5 and M4-M5 motorway tunnels are located approximately 300 m to the northwest and 370 m to the north-northeast respectively.

The Project site layout is shown in **Figure 1**, while the relative locations of the Project site and the tunnel ventilation outlets are presented in **Figure 2**. **Figure 2** also shows the location of an Air Quality Monitoring Station (AQMS) currently operated by WestConnex adjacent to the Project site.

Figure 1 Location Plan

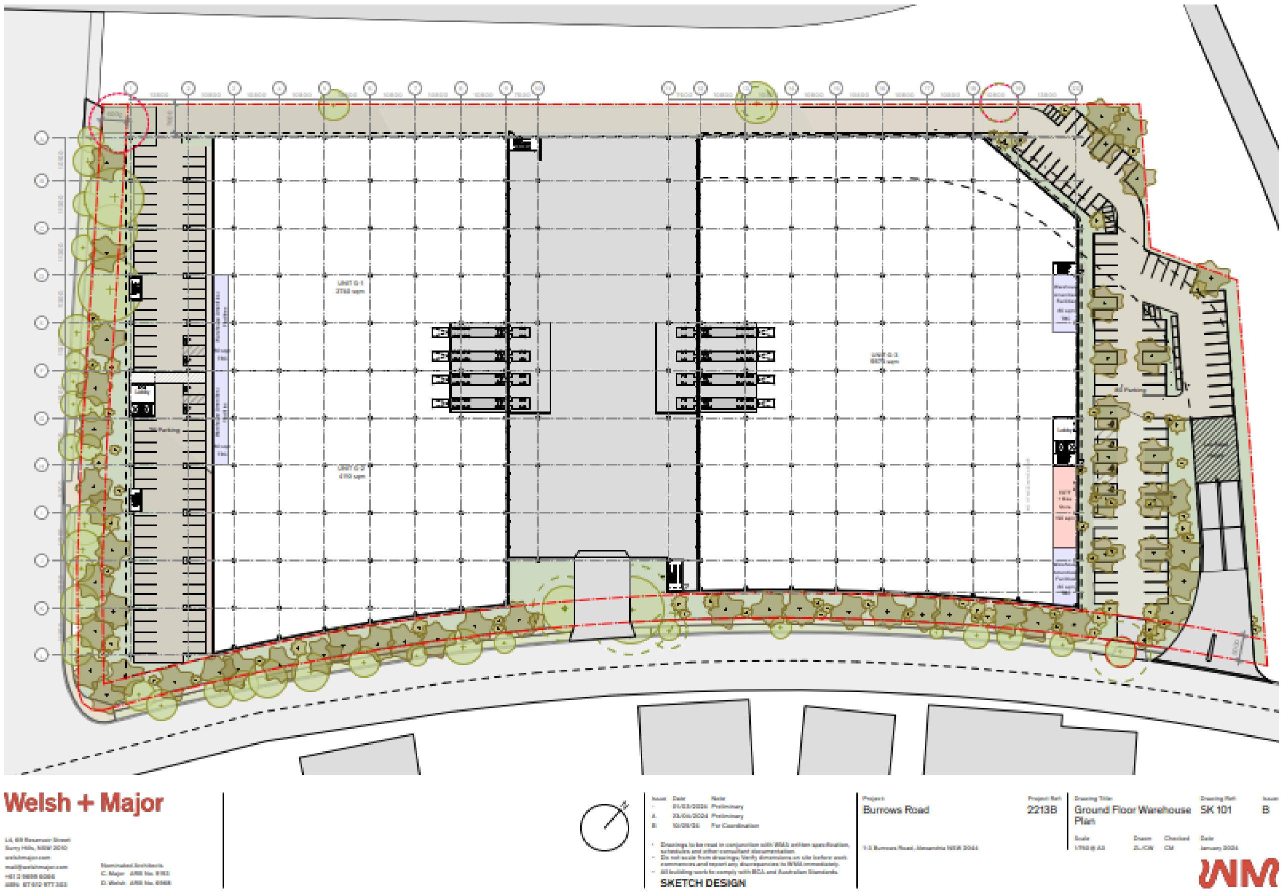


Figure 2 Relative Location - Project Site and M5 and M4-M5 Tunnel Ventilation Outlets

2.2 Surrounding Land Uses and Sensitive Receptors

As shown in **Figure 3**, the site and the adjacent areas to its east and northeast zoned as General Industrial (E4) and there are small areas zoned Infrastructure (SP2) to the north and northwest of the Site. There are several industrial/commercial receptors located approximately 50 m to the south of the site boundary, including office buildings and workshops (see **Figure 4**). Individuals in these areas could potentially experience air quality impacts due to the demolition and construction works at the Site. The nearest residential receptors are located approximately 500 m to the northwest of the site boundary.

Figure 3 Surrounding Land Use Zoning

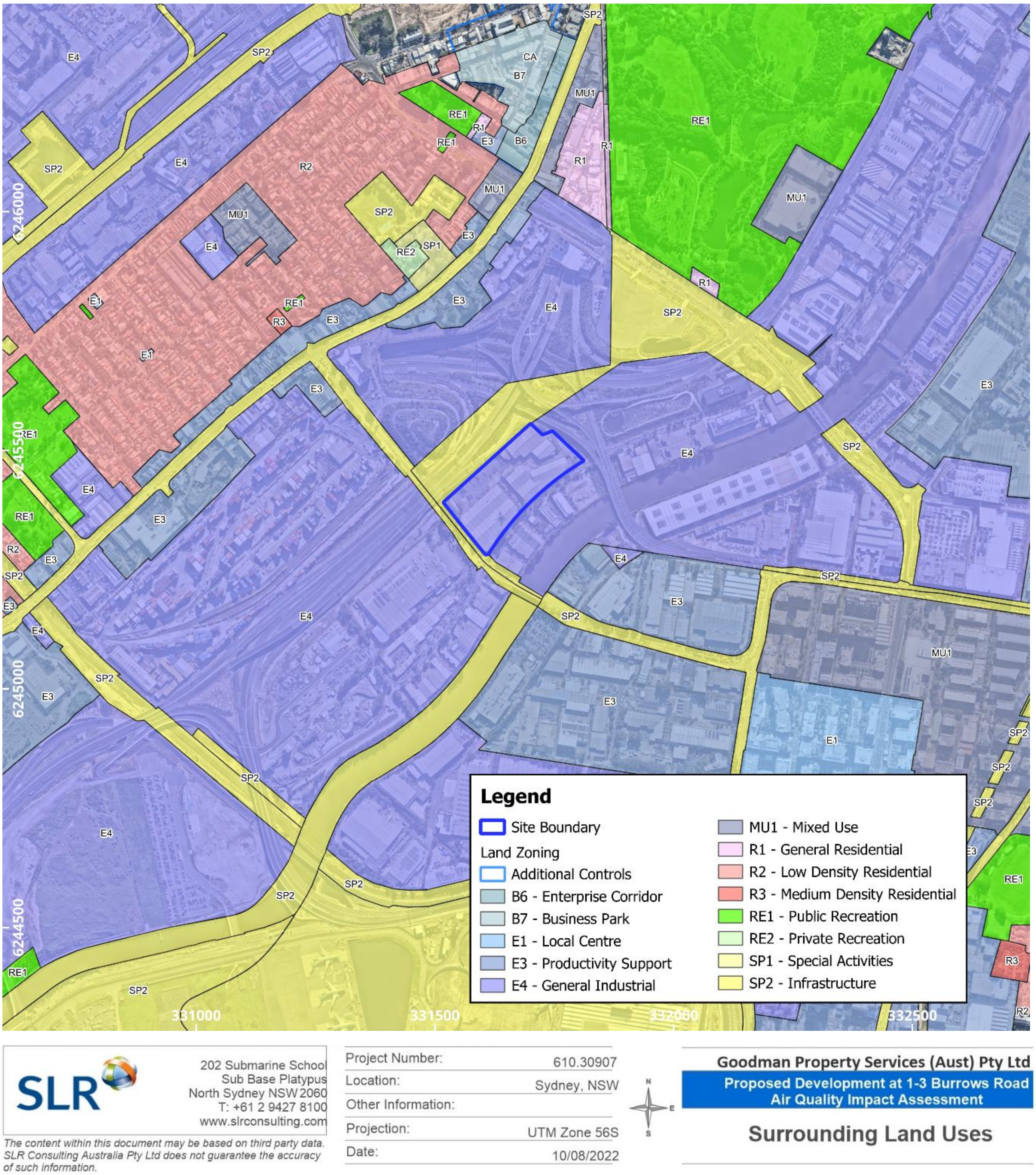
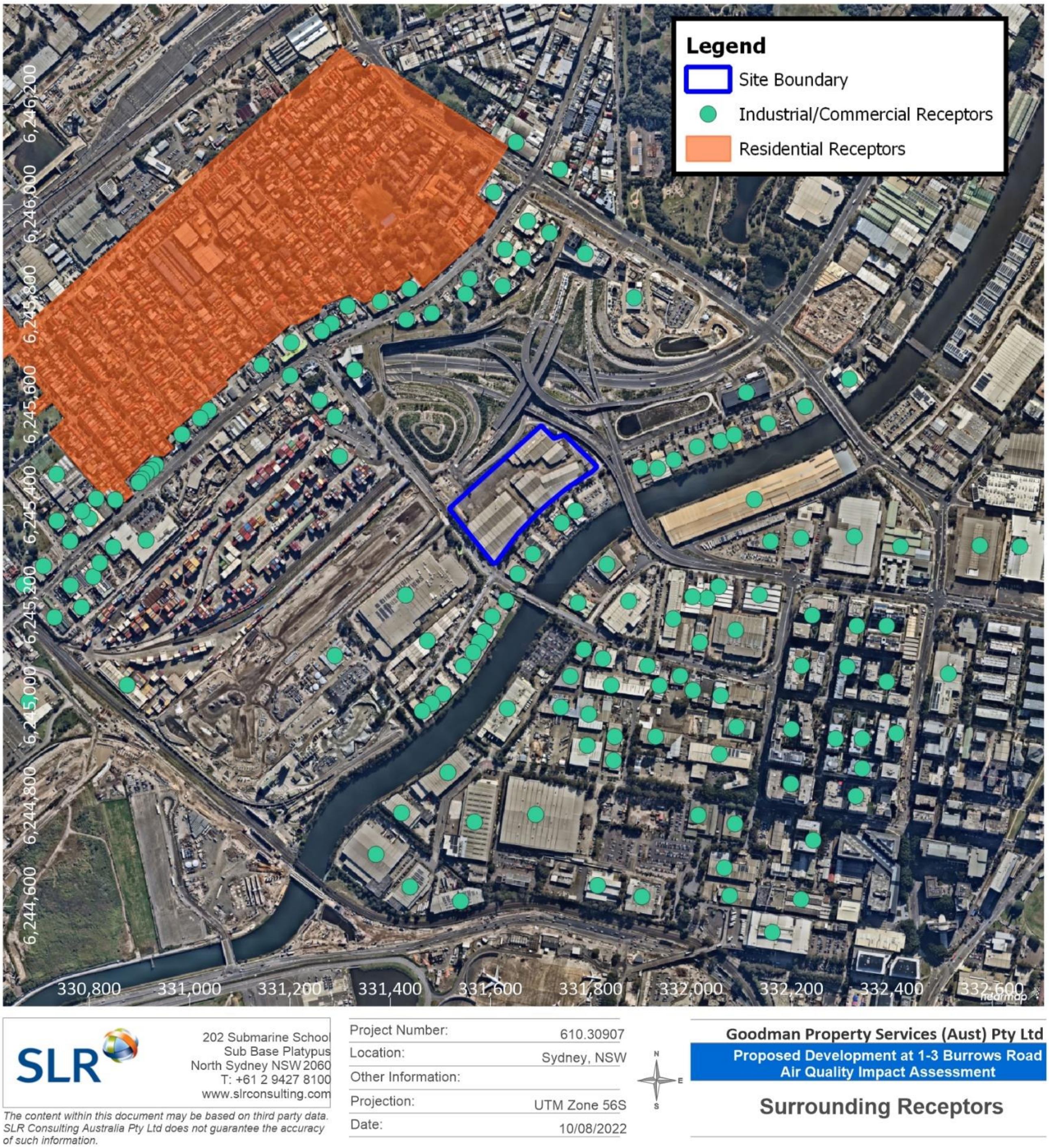


Figure 4 Surrounding Receptors

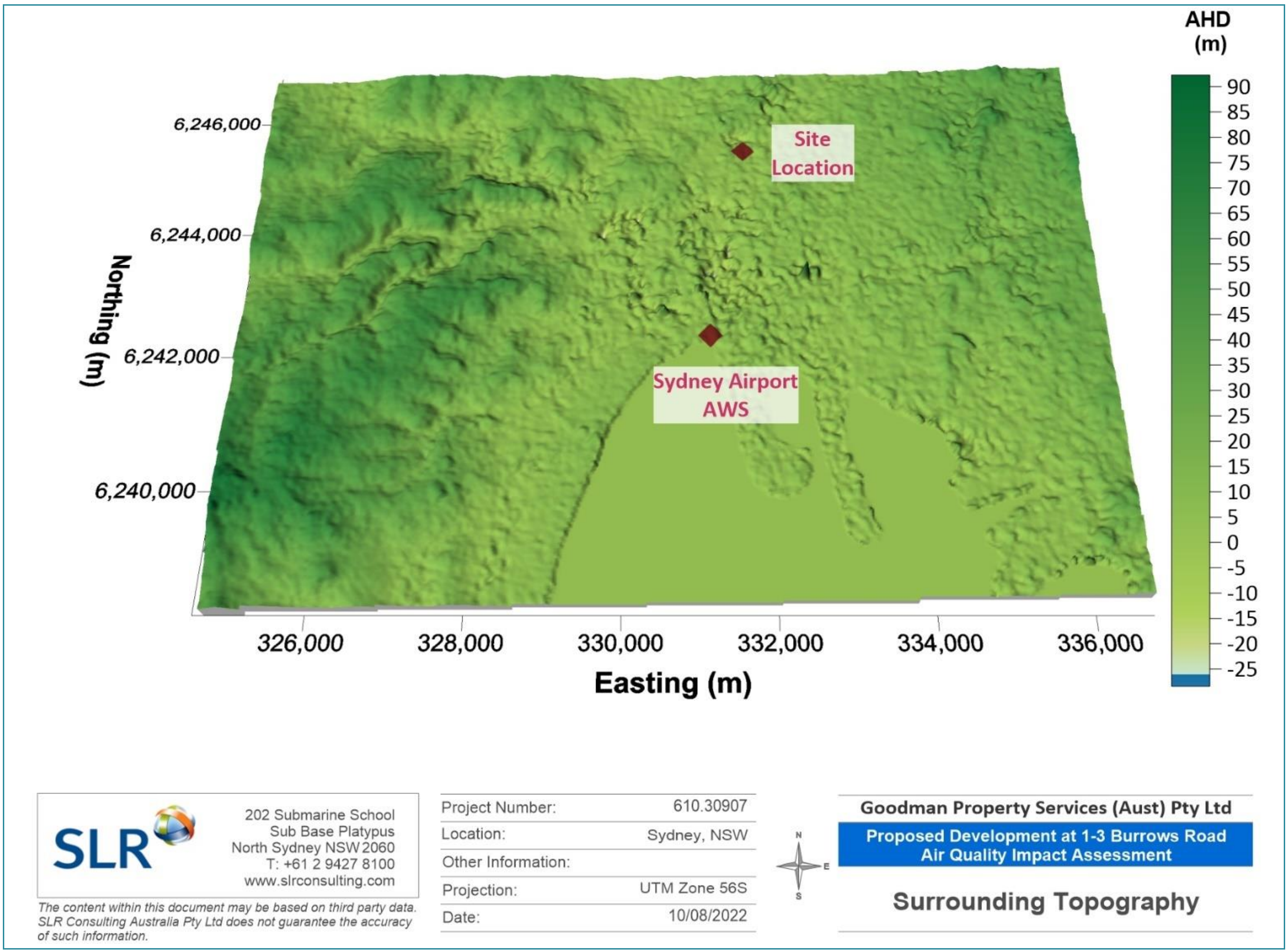


2.3 Topography

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 as well as position receptors at an elevated position in relation to emission sources.

The topography of the site and nearby surrounds are relatively flat with an elevation of the approximately 5 m Australian Height Datum (AHD). A three-dimensional representation of the area surrounding the site is presented in **Figure 5**.

Figure 5 Regional Topography



3 Project Background

3.1 Planning Proposal PP-2020-298

The applicant recently obtained approval on 16 September 2020 for a Planning Proposal (PP-2020-298) at the site. The approved Planning Proposal amended the Sydney Local Environmental Plan 2012 (SLEP 2012) by increasing the applicable maximum building height for the site from 18 metres to 30 metres. The Planning Proposal also introduced a set of site-specific controls for 1-3 Burrows Road, St Peters, in the SLEP 2012, including a 6-metre setback control to Burrows Road and Canal Road for landscaping purposes.

3.2 Competitive Design Alternatives Process

Goodman undertook a Competitive Design Alternatives Process (competitive design process) with three selected architectural firms following an expression of interest process.

The Jury resolved that the Welsh and Major scheme best demonstrated the ability to achieve design excellence as per Clause 6.21 of the Sydney LEP 2012 and the scheme which best met the design, planning and commercial objectives of the Competition Brief. The Welsh and Major scheme was subsequently awarded the winner of the Competitive Design Process.

SLR has been working in close collaboration with Goodman and the Welsh and Major throughout the preparation of this SSDA and generally as part of the ongoing detailed design phase of the project.

3.3 S37 AMENDMENT TO SSD-35962232

On behalf of Goodman Property Services (Australia) Pty Ltd (the applicant), formal amendment to SSD-35962232 is sought in accordance with s37 of the *Environmental Planning and Assessment Regulation 2021*. The amendments to the proposal have arisen following an ECI process and market testing which confirmed the previous three level scheme would not be viable to construct or operate. As such, Goodman seeks to amend the application to propose an alternative two-level scheme.

The changes requested to the development application are set out below. A thorough description and assessment of the amended proposal will be undertaken in the Amended Development Report (ADR) (including a response to submissions received doing the original notification period for the SSDA), which will be formally lodged with DPHI along with updated plans and technical reports.

3.4 Change to the Proposal

The proposed design has been amended in response to issues relating to site contamination, potential flood impacts, assessment of the local logistics market, and construction cost escalation. The intent of the proposal remains the same, however, there have been changes to the physical layout/ built form of the warehouse and distribution facility as outlined below:

- Reduction of the proposed warehouse from three storeys (30.14 m) to two storeys (25 m). Despite the reduction of one storey, the overall height is generally consistent due to increasing the heights of the two remaining storeys.
- Re-orientation of the layout from an east-west central hardstand with smaller warehouse tenancies on the north and south, to a north-south central hardstand with larger/deeper warehouse tenancies on the east and west. This provides for more efficient warehouse layouts and truck access.

- Previously, truck access to the warehouse tenancies was facilitated via north and south spiral ramps from Burrows Road, connecting to a north-south hardstand on each level. Under the amended proposal, truck access will be provided directly to the ground level from Burrows Road, and upper-level hardstand access will be provided via a northern ramp from Burrows Road.
- Previously, the offices associated with the warehouse tenancies were arranged over six levels in a separate block at the northern end of the site, featuring a shared rooftop garden terrace. The revised design situates the offices in a mezzanine layout above each warehouse tenancy, each having direct access to a garden terrace along the building's east and west facades.
- Previously, car parking was located in an undercroft basement below the warehouse, which was accessed from Burrows Road. The amended design situates car parking at ground level, either externally to the building's footprint or within a ground-level undercroft at the site's southern end.
- The facade has been redesigned to simplify the raked cladding panels, making them predominantly vertical while still maintaining a stepped appearance. The prominent corners of the development at the southeast and southwest extents of the building continue to feature expressive detailing.
- The proposal maintains a 6 m landscaped setback to Burrows Road with a curved façade and a minimum 6 m landscaped setback to Canal Road.
- The landscape design has been modified to reflect the revised site arrangement and orientation. However, the design concept retains native and endemic species as key aspects of Connecting with Country.

The numerical changes to the proposal are detailed below.

Element	Exhibited Proposal	Amended Proposal	Difference
Total site area	34,615 m^2	34,614 m^2	Nil
Total warehouse area	47,076 m^2	30,389 m^2	Decrease of 16,687 m^2
Total office area	5,014 m^2	3,353 m^2	Decrease of 1,661 m^2
Total café area	60 m^2	0 m^2	Decrease of 60 m^2
Total GFA	52,150 m^2	34,051 m^2	Decrease of 18,099 m^2
Carparking	241 car parking spaces (incl. 12 accessible bays)	145 car parking spaces (incl. 8 accessible bays)	Decrease of 96 car parking spaces
Maximum building height	30.14 m	25 m	Decrease of 5.14 m
Landscaped area	7,464 m^2 (or 21.6% of the site)	6,856 m^2 (or 19.8% of the site)	Decrease of 608 m^2

3.5 Proposed Development

The vision for the Project is to transform the site into a functional and adaptable multi-storey industrial warehouse building that will support industrial expansion in this highly accessible location, and build upon strong ecommerce drivers, close to Sydney Airport, Port Botany, Cooks River Intermodal Terminal and the Sydney CBD.

The detailed SSDA seeks approval for the following:

- Demolition of all existing structures and buildings on site
- Site remediation and establishment works
- Design, construction and operation of an industrial warehouse and distribution centre building with an ancillary office building, including:
- Maximum building height of 25 m
- Operation 24 hours per day seven days a week
- Provision of a single storey under croft basement car parking area accessed off Burrows Road
- Site landscaping works including two 6 m landscaped setback areas to both the Burrows and Canal Roads site frontages, and deep soil and tree canopy coverage provisions
- Provision of building / business identification signage

4 Potential Air Emission Sources

4.1 Project Construction

The main air quality issue associated with construction works relates 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:

- Demolition of the existing buildings
- Grading
- Loading and unloading of materials
- Wheel-generated dust from vehicles 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 prior to 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
- 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 being used, localised elevations in ambient concentrations of combustion-related pollutants may also occur, however any potential for the relevant impact assessment criteria for these pollutants to be exceeded at surrounding sensitive areas is typically minimal. Fugitive dust emissions are generally considered to have the greatest potential to give rise to downwind air quality impacts at construction sites. Given the above, combustion emissions during construction have not been considered further.

A qualitative, risk-based assessment of potential air quality impacts associated with the proposed construction activities, focussed on identifying appropriate mitigation measures, is presented in **Section 8.1**.

4.2 Warehousing and Distribution Operations

During the operational phase, the main source of air emissions would be emissions associated with fossil fuel combustion and particulate matter (associated with brake and tyre wear as well as re-entrainment of road dust) generated by the trucks and other vehicles entering and leaving the site or idling at the site during loading/unloading operations. At the time of writing this report, detailed information on the site-specific operations (eg, vehicle numbers and types) was not available. Therefore, a general risk assessment associated with warehousing operations is presented in **Section 8.2**.

4.3 External Sources - M5 and M4-M5 Tunnel Ventilation Outlets

Given the height of the proposed building, the New M5 and M4-M5 tunnel ventilation outlets located to the northwest and north-northeast of the Project site have the potential to give rise to elevated pollutant concentrations at the upper levels of the proposed building. Given this, a detailed air quality assessment has been carried out to quantify the potential impacts of the tunnel emissions at the upper levels of the proposed building.

No other significant sources of air emissions with potential to impact on air quality at the Project site have been identified.

4.3.1 Identification of Air Emissions

The key air emissions from the tunnel ventilation outlets would be:

- Particulate matter less than 10 µm in aerodynamic diameter (PM_{10})
- Particulate matter less than 2.5 µm in aerodynamic diameter ($PM_{2.5}$)
- Oxides of nitrogen (NO_x)
- Carbon monoxide (CO)
- Sulphur dioxide (SO_2)
- Total Volatile Organic Compounds (TVOCs)

Suspended Particulate Matter

Emissions of particulate matter less than 10 µm and 2.5 µm in diameter (referred to as PM_{10} and $PM_{2.5}$ respectively) are considered important pollutants due to their ability to penetrate into the respiratory system. In the case of the $PM_{2.5}$ category, recent health research has shown that this penetration can occur deep into 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.

Oxides of Nitrogen

Oxides of nitrogen (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 form NO_2 which can have significant health effects including damage to the respiratory tract and increased susceptibility to respiratory infections and asthma. Long term exposure to NO_2 can lead to lung disease. NO will be converted to NO_2 in the atmosphere after leaving a vehicle exhaust.

Carbon Monoxide

Carbon monoxide (CO) is an odourless, colourless gas formed from the incomplete burning of fuels in motor vehicles. CO bonds to the haemoglobin in the blood and reduces the oxygen carrying capacity of red blood cells, thus decreasing the oxygen supply to the tissues and organs, in particular the heart and the brain.

CO emissions in urban areas are almost entirely from vehicle emissions and its spatial distribution follows that of traffic flow. The highest concentrations are found at the kerbside, with concentrations decreasing rapidly with increasing distance from the road.

Sulphur Dioxide

Sulphur dioxide (SO_2) is a colourless, pungent gas with an irritating smell. When present in sufficiently high concentrations, exposure to SO_2 can lead to impacts on the upper airways in humans (i.e. the noise and throat irritation). SO_2 can also mix with water vapour to form sulphuric acid (acid rain) which can damage vegetation, soil quality and corrode materials.

Main sources of SO_2 in the air are industries that process materials containing sulphur (i.e. wood pulping, paper manufacturing, metal refining and smelting, textile bleaching, wineries etc.). SO_2 is also present in motor vehicle emissions, however since Australian fuels are relatively low in sulphur, high ambient concentrations are not common.

Volatile Organic Compounds

Volatile Organic Compounds (VOCs) are organic compounds (i.e. contain carbon) that have high vapour pressure at normal room-temperature conditions. Their high vapour pressure leads to evaporation from liquid or solid form and emission release to the atmosphere.

VOCs are emitted by a variety of sources, including motor vehicles, chemical plants, automobile repair services, painting/printing industries, and rubber/plastics industries. VOCs that are often typical of these sources include benzene, toluene, ethylbenzene and xylenes (often referred to as ‘BTEX’). Biogenic (natural) sources of VOC emissions are also significant (e.g. vegetation). Impacts due to emissions of VOCs can be health or nuisance (odour) related. Benzene is a known carcinogen and a key VOC linked with the combustion of motor vehicle fuels.

4.3.2 Pollutants Selected for Assessment

Given the relatively low ambient concentrations of CO and SO_2 typically recorded in urban areas in Australia, and based on the recent findings of detailed air quality impact assessments for major road developments in NSW and other states, it is reasonable to assume that CO and SO_2 emissions from the tunnel ventilation stacks are unlikely to result in any exceedances of the relevant ambient air quality criteria at the Project site.

SLR’s experience in modelling VOC emissions from roads has also shown that kerbside concentration of VOCs are typically well below the relevant air quality guidelines. Moreover, a review of the Air Quality Impact Assessment prepared for M4 East (Pacific Environment, 2015) showed that ground level VOC concentrations at the nearest receptors were predicted to be well below the relevant assessment criteria.

Given the above, CO, SO_2 and VOC emissions have not been considered further in this study, and only emissions of NO_X, PM_{10} and $PM_{2.5}$ have been assessed (see **Section 8.3**). Provided the assessment demonstrates compliance with ambient air quality criteria for these pollutants, compliance can also be assumed for the other gases emitted by the ventilation stacks.

5 Relevant Air Quality Assessment Criteria

Section 7.1 of the *Approved Methods for Modelling and Assessment of Air Pollutants in NSW* (NSW EPA, 2017) (hereafter the Approved Methods) outlines the impact assessment criteria for the pollutants identified for detailed assessment in **Section 4.3.2**. The criteria listed in the Approved Methods are derived from a range of sources, are the defining ambient air quality criteria for NSW, and are considered to be appropriate for the setting. The criteria adopted for use in the AQIA are summarised in **Table 2**.

Table 2 Air Quality Assessment Criteria Adopted for this Study

Pollutant	Averaging Period	Assessment Criteria
PM_{10}	24-Hours	50 µg/m^3
	Annual	25 µg/m^3
$PM_{2.5}$	24-Hours	25 µg/m^3
	Annual	8 µg/m^3
NO_2	1-hour	246 µg/m^3
	Annual	62 µg/m^3
Ozone	8-hours	139 µg/m^3

SOURCE: Approved Methods, (NSW EPA, 2017)

6 Review of Ambient Air Quality Monitoring Data

WestConnex is operating an ambient air quality monitoring station (AQMS) immediately adjacent to the eastern boundary of the Project site since June 2020 (St Peters 2). Data recorded by this station during the 2021 calendar year (consistent with the representative modelling year, refer **Section 7.3.4** for details) were analysed to establish background pollutant concentrations for use in this assessment where relevant.

It is noted that the New M5 and M4-M5 tunnel ventilation outlets were in operation during this period and that the ambient monitoring data recorded at this station would therefore include contributions from these emission sources. Given this, the use of this dataset for characterising background levels to be added to the results of the modelling study is conservative.

The hourly average NO_2 monitoring data recorded by the St Peters 2 AQMS in 2021 is missing data for a number of hours in December. To compile a complete 1-year, site-representative dataset for the 2021 calendar year, hourly average monitoring data recorded by the nearest DPE operated AQMS located at Earlwood (approximately 3.5 km to the west of the Project site) was used to substitute for the missing data. Additionally, background ozone (O_3) levels were also sourced from the Earlwood AQMS as the St Peters 2 AQMS does not record O_3 levels.

The ambient monitoring data recorded by these stations in 2021 are summarised in **Table 3** and presented graphically in **Figure 6** to **Figure 9.** An analysis of the measured ambient air quality data shows the following:

- No exceedances of the maximum 1-hour and annual average NO_2 criteria were recorded during 2021. The highest 1-hour average NO_2 concentration of 76 µg/m³ was recorded on at 11am on 1 September 2021.
- No exceedances of the maximum 8-hour average O_3 criterion were recorded during 2021. The highest rolling 8-hour average O_3 concentration of 114 µg/m³ was recorded at 3pm on 24 January 2021.
- Exceedances of the 24-hour average $PM_{2.5}$ criterion were recorded on five days in 2021. The $PM_{2.5}$ and PM_{10} concentrations recorded on these days are presented in **Table 4**, which shows that on 3rd May and 22nd August 2021, the recorded $PM_{2.5}$ concentrations were higher than the recorded PM_{10} concentrations. Given this, the high $PM_{2.5}$ concentrations recorded on these days may have been associated with instrumental/database error. Other exceedances were recorded on 27th April, 4th May and 21st August 2021. However, there were no exceedances recorded for the regional compliance monitoring at Randwick on these days, which is an indication that these exceedances were likely to be caused by some localised source(s).
- The annual average $PM_{2.5}$ concentration recorded by the St Peters 2 AQMS in 2021 of 6.7 µg/m³ was well below the criterion of 8 µg/m³.
- No exceedances of the maximum 24-hour or annual average PM_{10} criteria were recorded in 2021. The highest 24-hour average PM_{10} concentration of 41 µg/m³ was recorded on 29th October 2021.

Table 3 Summary of Ambient Monitoring Data

Parameter	NO_2 (µg/m³)	O_3 (µg/m³)	$PM_{2.5}$ (µg/m³)	PM_{10} (µg/m³)
Averaging Period	**1-Hour**	**8-hours**	**24-Hours**	**24-Hours**
Maximum	76	114	39	41
2nd Highest	74	114	33	37
3rd Highest	71	112	30	36
4th Highest	71	111	28	35
5th highest	70	110	28	34
6th Highest	70	107	23	34
90th percentile	43	54	11	27
70th percentile	19	30	5.7	17
Median	29	40	7.1	20
Average	22	30	6.7	18
Criteria	**246**	**139**	**25**	**50**
Number of exceedances	**0**	**0**	**5**	**0**

Table 4 Particulate Concentrations Recorded on $PM_{2.5}$ Exceedance Days

Date	24-Hour Average Concentrations (µg/m³)	
	$PM_{2.5}$ (µg/m³)	PM_{10} (µg/m³)
27-04-2021	27.9	33.6
03-05-2021	32.5	31.2
04-05-2021	27.8	30.6
21-08-2021	29.9	35.7
22-08-2021	39.0	35.2
Criteria	**25**	**50**

Figure 6 Measured 1-Hour Average NO_2 Concentrations at St Peters 2 AQMS and Earlwood AQMS

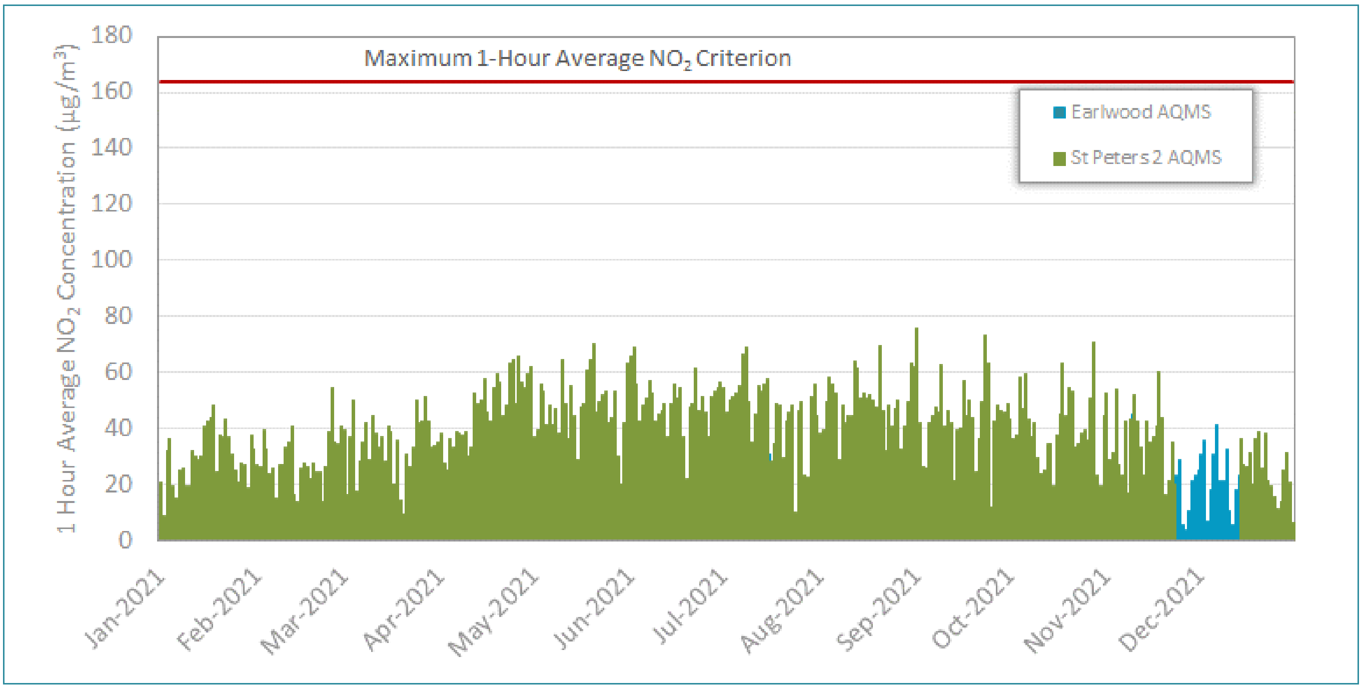


Figure 7 Measured 1-Hour Average O_3 Concentrations at Earlwood AQMS

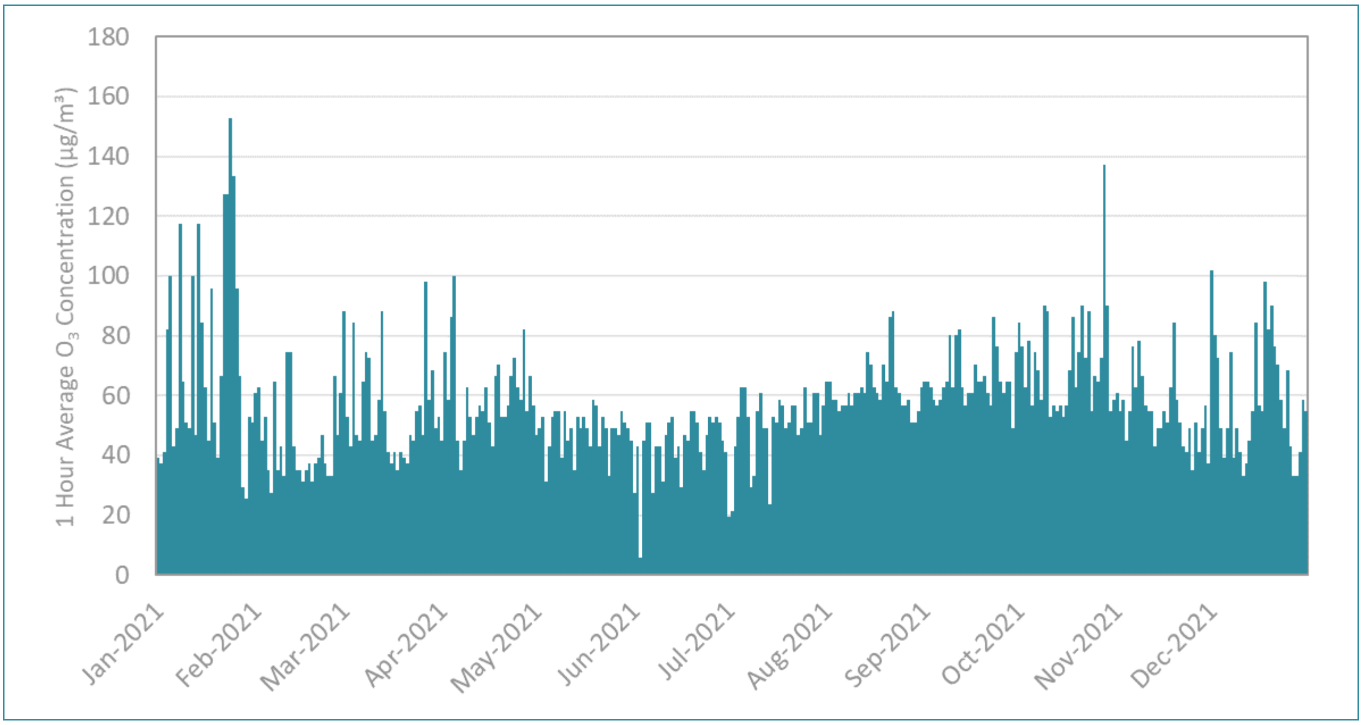


Figure 8 Measured 24-Hour Average $PM_{2.5}$ Concentrations at St Peters 2 AQMS

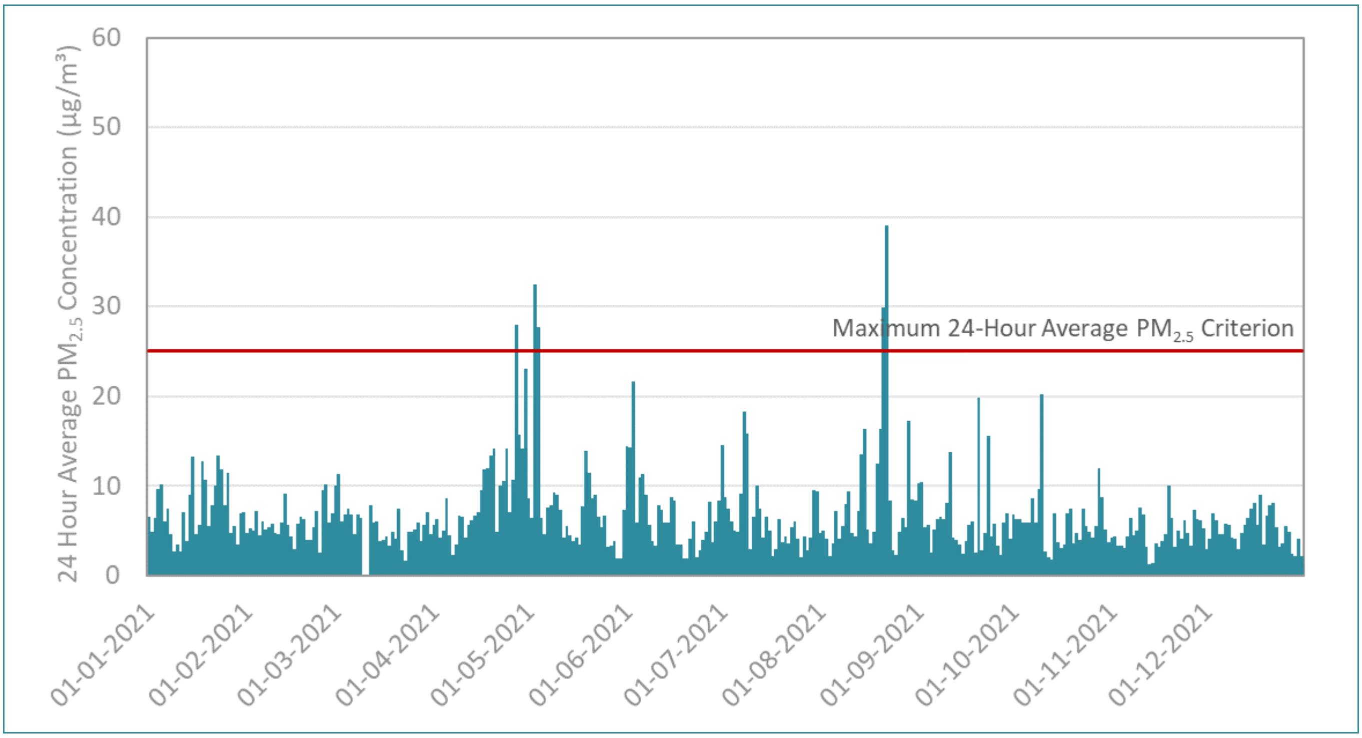
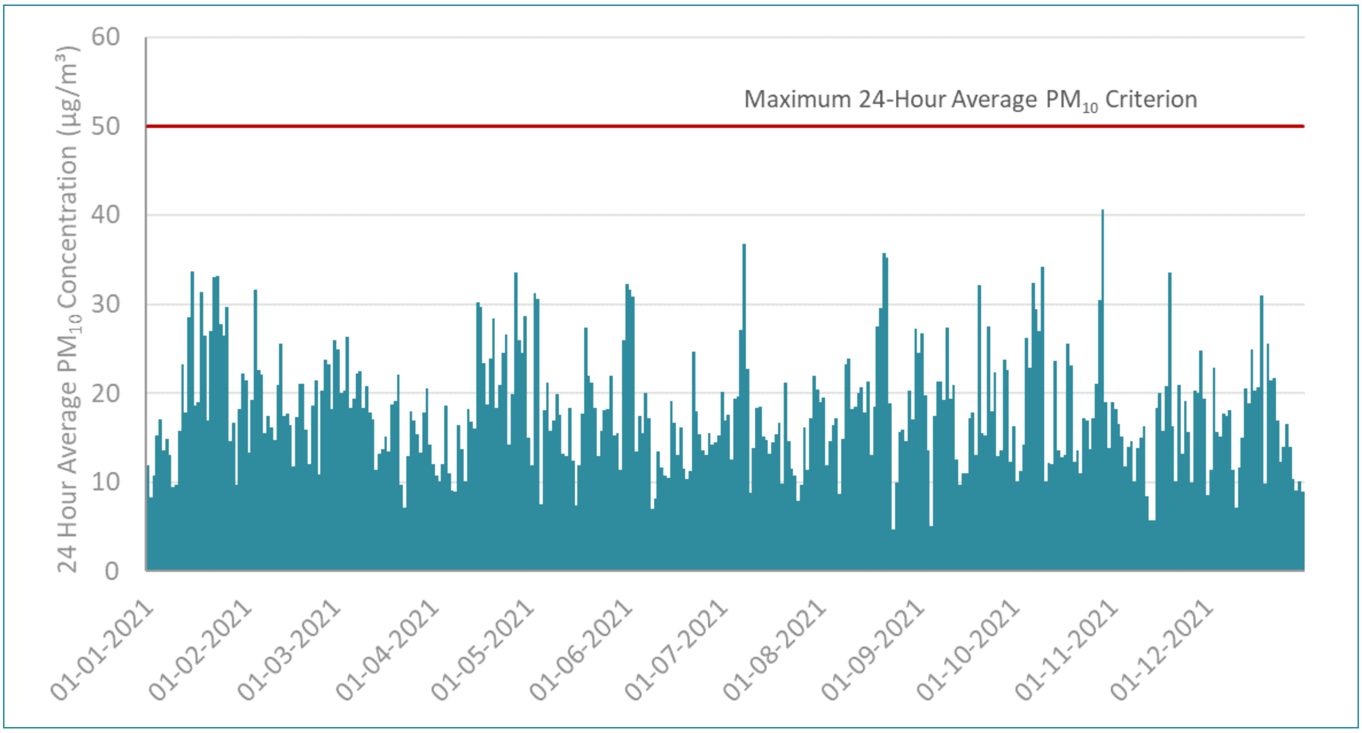


Figure 9 Measured 24-Hour Average PM_{10} Concentrations at St Peters 2 AQMS



7 Assessment Methodology

7.1 Construction Phase Qualitative Impact Assessment

Quantitatively assessing impacts of fugitive dust emissions from construction projects using predictive modelling is seldom considered appropriate, primarily due to the uncertainty in the details of the construction activities, including equipment type, number, location and scheduling, which are unlikely to be available at the time of the assessment. Furthermore, they are also likely to change as construction progresses.

Instead, it is considered appropriate to conduct a qualitative assessment of potential construction related air quality impacts. Fugitive dust was identified to be the key air emission associated with the proposed construction activities. To assess the potential impacts of fugitive dust emissions during construction, the *IAQM Guidance on the Assessment of Dust from Demolition and Construction* developed in the United Kingdom by the Institute of Air Quality Management (IAQM, 2024) was adopted to provide a qualitative impact assessment for the construction phase of the Proposal.
The IAQM method uses a four-step process (refer to **Appendix A**) for assessing dust impacts from construction activities:

- **Step 1**: Screening based on distance to the nearest sensitive receptor; whereby the sensitivity to dust deposition and human health impacts of the identified sensitive receptors is determined.
- **Step 2**: Assess risk of dust effects from activities based on:
  - the scale and nature of the works, which determines the potential dust emission magnitude; and
  - the sensitivity of the area surrounding dust-generating activities.
- **Step 3**: Determine site-specific mitigation for remaining activities with greater than negligible effects.
- **Step 4**: Assess significance of remaining activities after management measures have been considered.

It is important to note that the IAQM Guidance uses the term ‘impact’ to describe a change in PM_{10} concentrations or dust deposition due to the activities at a construction site, and ‘effect’ to describe the consequences of any impacts at sensitive receptors. The emphasis of the IAQM Guidance is on classifying the risk of adverse dust effects from a construction site based on the scale of the proposed works and sensitivity of the surrounding environment (with no mitigation measures applied), and identification of mitigation measures commensurate with the risk to reduce the risk to acceptable levels (i.e. negligible risk of adverse air quality effects at the sensitive receptors).

7.2 Operational Phase Qualitative Assessment

A risk-based qualitative assessment approach has also been adopted for the assessment of potential air quality impacts due to mobile plant and delivery vehicles during the operational phase (see **Appendix C** for full methodology).

The risk-based operational assessment methodology takes account of a range of impact descriptors, including the following:

- **Nature of Impact**: does the impact result in an adverse or beneficial environment?
- **Sensitivity**: how sensitive is the receiving environment to the anticipated impacts? This may be applied to the sensitivity of the environment in a regional context or specific receptor locations.
- **Magnitude**: what is the anticipated scale of the impact?

The integration of sensitivity with impact magnitude is used to derive the predicted significance of that change.

7.3 Potential Impacts of Existing Tunnel Ventilation Outlets on the Project

Two ventilation outlets from the New M5 and M4-M5 link tunnels are currently operating within 500 m of the Project site. Each ventilation outlet consists of four ventilation shafts. The location of these ventilation shafts and the physical parameters adopted for this assessment are presented in **Table 5**. Each ventilation shaft was modelled as a separate source.

Table 5 Stack Locations and Physical Parameters

Ventilation Outlet	Easting (m)	Northing (m)	Release Height (m)	Individual Vent Diameters (m)
New M5 Ventilation Outlet	331,345	6,245,655	20	4.8
	331,351	6,245,660		
	331,356	6,245,653		
	331,350	6,245,649		
M4-M5 Ventilation Outlet	331,754	6,245,925	20	4.8
	331,764	6,245,940		
	331,773	6,245,933		
	331,764	6,245,918		

7.3.1 Selection of Models

The downwind dispersion of air pollutants emitted from the tunnel ventilation stacks was modelled using a combination of the TAPM, CALMET and CALPUFF models.

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

7.3.2 Modelling Scenarios

Based on a review of available information on the operation of the tunnel ventilation systems, the following two scenarios were modelled to assess potential air quality impacts at the Project site due to the operation of the tunnel ventilation stacks:

- Scenario 1 – Current operation of ventilation stacks based on measured hourly-varying stack parameters (i.e. velocity, temperature) and emission data from the New M5 tunnel stack.
- Scenario 2 – Regulatory worst-case option based on the air quality emission limits described in *Section L2 of the Environmental Protection Licence (EPL) for the M4-M5 Tunnel* (EPL 21372, 2022) and flowrate and other parameters sourced from the environmental impact statement (EIS) for the New M5 project (WestConnex, 2015).

A comparison of the flowrate and emissions data used for Scenario 1 (based on measured dataset) and Scenario 2 (regulatory worst case) is presented in **Section 7.3.3.3**. It is noted that concurrent operation of ventilation stacks for both New M5 (M8) and M4-M5 ventilation outlets were assumed to predict the potential worst-case impacts.

7.3.3 Stack and Emission Data

7.3.3.1 Scenario 1 – Measured Emissions

Emissions data for the WestConnex New M5 tunnel ventilation outlet were sourced from hourly in-stack concentration and exhaust air flowrate data recorded by the Continuous Emission Monitoring System (CEMS) operated by WestConnex for the 2021 calendar year. A variable emission file that includes hourly varying velocity, temperature and emission rates of each pollutant was created and used as input to the CALPUFF model. A statistical summary of the hourly varying stack emission rates calculated based on the measured stack concentrations and flowrate data for each shaft of the New M5 tunnel ventilation stack (as recorded in 2021), and used in the modelling, is presented in **Table 6**.

In-stack monitoring data for the M4-M5 link tunnel, located approximately 400 m north-northeast of the Project site were not available at the time of preparing this assessment. Thus, it was assumed that emissions from the M4-M5 ventilation stacks would be similar to that reported for the New M5 tunnel ventilation stack.

Furthermore, as the New M5 CEMS does not record particle size distribution or in stack concentration of $PM_{2.5}$ and PM_{10} size fractions, a conservative approach was taken, with the recorded total particulate concentrations assumed to be representative of $PM_{2.5}$ concentrations.

Table 6 Statistical Summary of Measured Stack Emission Data – Scenario 1

Pollutant	Measured Pollutant Emission Rate (g/s)					
	Maximum	95th Percentile	90th Percentile	70th Percentile	Median	Average
NO_x	0.71	0.17	0.13	0.03	0.01	0.04
	0.81	0.17	0.12	0.03	0.01	0.04
	0.76	0.31	0.24	0.12	0.06	0.10
	0.63	0.33	0.26	0.12	0.06	0.10
CO	0.79	0.24	0.18	0.06	0.02	0.06
	0.74	0.21	0.15	0.04	0.01	0.05
	0.83	0.35	0.26	0.17	0.10	0.13
	0.97	0.37	0.29	0.17	0.10	0.13
Particulate Matter	0.118	0.010	0.007	0.002	0.001	0.002
	0.073	0.009	0.007	0.002	0.0004	0.002
	0.134	0.016	0.012	0.007	0.004	0.006
	0.145	0.017	0.013	0.007	0.004	0.006

7.3.3.2 Scenario 2 -Regulatory Worst-Case Scenario

Emission rates and stack parameters for this scenario were derived based on the air quality emission limits described in *Section L2 of the Environmental Protection Licence (EPL) for the M4-M5 Tunnel* (EPL 21372, 2022) and ventilation data used to represent the regulatory worst case scenario in the Appendix H of the *New M5 Environmental Impact Statement (EIS)* (WestConnex, 2015).

The adopted concentration limits and stack parameters for this scenario are presented in **Table 7** and **Table 8**. A summary of the stack parameters and emission rates modelled is presented in **Table 9.**

Table 7 Regulatory Concentration Limits Tunnel Ventilation Outlets

Pollutant	Limit Concentration (mg/m^3)
PM_{10}	1.1
$PM_{2.5}$	1.1
NO_X	20.0
NO_2	2.0
CO	40.0
VOC	4.0

Source - (EPL 21372, 2022)

Table 8 Ventilation Outlet Parameters for Regulatory Worst-Case Scenario Assessed in New M5 EIS

Ventilation Facility	Total Air Flow (m^3/s)	Air Flow Per Vent (m^3/s)	Outlet Diameter (m)	Exit Velocity (m/s)	Temperature (°C)
New M5 (4 vents)	400	100	4.8	5.7	25
M4-M5 Link (4 vents)	400	100	4.8	5.7	25

Source: Table 9-22 of New M5 EIS (WestConnex, 2015)

Table 9 Model Inputs – Scenario 2

Source ID	Vent Parameters				Emission Rates			
	Diameter (m)	Velocity (m/s)	Temperature (°C)	Height (m)	PM_{10} (kg/hour)	$PM_{2.5}$ (kg/hour)	NOx (kg/hour)	CO (kg/hour)
New M5 Tunnel Vents								
1	4.8	5.7	25	20	0.4	0.4	7.2	14.4
2	4.8	5.7	25	20	0.4	0.4	7.2	14.4
3	4.8	5.7	25	20	0.4	0.4	7.2	14.4
4	4.8	5.7	25	20	0.4	0.4	7.2	14.4
M4-M5 Link Tunnel Vents								
5	4.8	5.7	25	20	0.4	0.4	7.2	14.4
6	4.8	5.7	25	20	0.4	0.4	7.2	14.4
7	4.8	5.7	25	20	0.4	0.4	7.2	14.4
8	4.8	5.7	25	20	0.4	0.4	7.2	14.4

7.3.3.3 Validation of Regulatory Worst Case (Scenario 2) Emissions Based on Measured Data

This section presents comparisons of flowrate and emissions data used for Scenario 1 (based on the in-stack measured dataset) and Scenario 2 (hypothetical regulatory worst case) to validate the assumptions for the regulatory worst case stack parameters.

It is noted that detailed review of the measured in-stack CEMS data showed that only two of the four vents were operational at one time during the monitoring period, with the other two vents on standby with minimal flowrates. Given this and considering the co-location of the four vents within the ventilation outlet structure, the combined total measured flowrates and emission rates for the four vents were compared to the total adopted flowrate and emission rates modelled for Scenario 2 to validate the regulatory worst case model inputs.

Figure 10 and **Figure 11** present comparisons of the hourly-varying measured and regulatory limit NO_x and particulate matter (assumed to be $PM_{2.5}$) emission rates modelled for Scenario 1 and Scenario 2 respectively. The comparisons show that the measured NO_x and particulate matter emission rates were significantly lower during 2021 compared to that adopted for the regulatory worst case emission scenario.

Figure 10 Comparison of Measured Versus Regulatory Limit NO_x Emissions (Total from Four Vents)

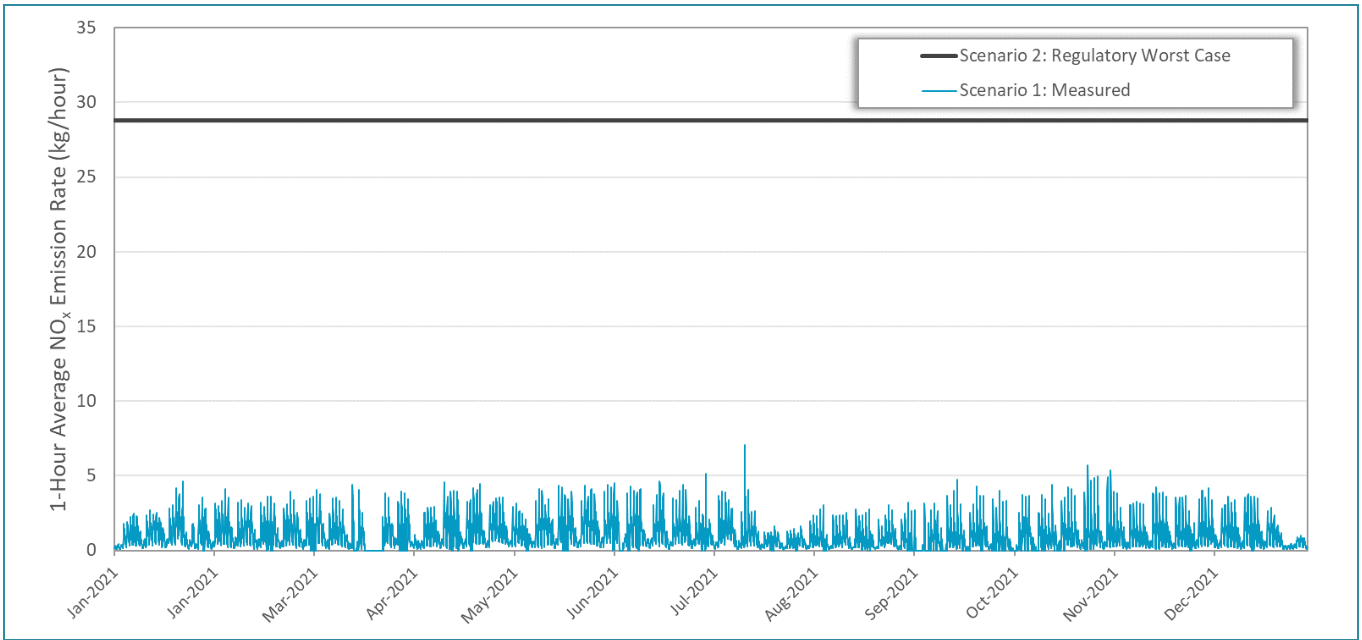


Figure 11 Comparison of Measured Versus Regulatory Limit Particulate Matter Emissions (Total from Four Vents)

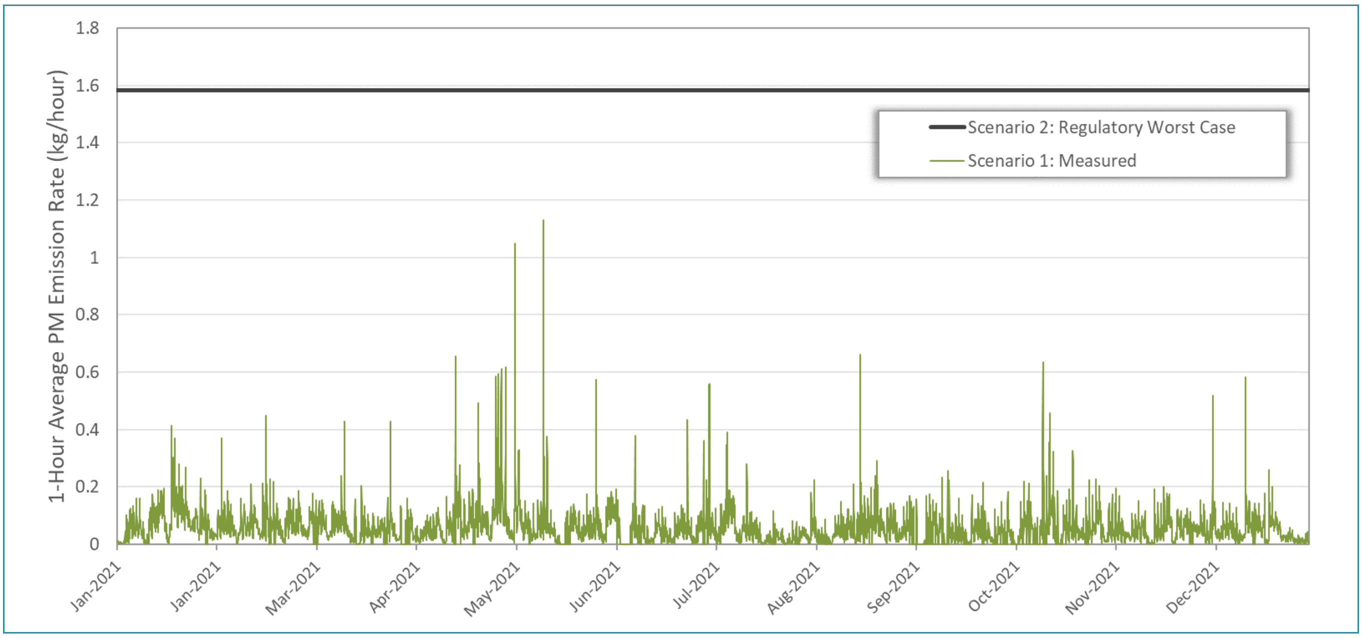
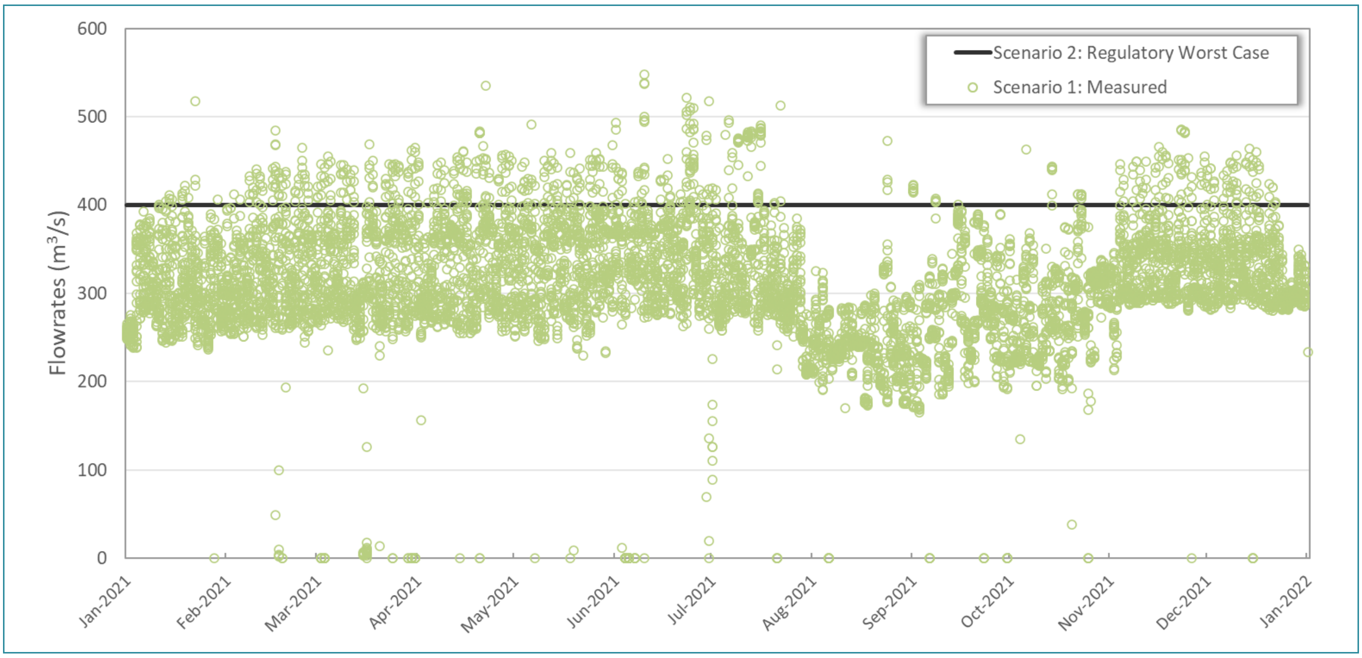


Figure 12 presents a comparison of the total combined flowrates used for each ventilation outlet for Scenario 1 and Scenario 2. The comparison shows that the combined measured hourly flowrates were higher at times (~7% of the time) compared to that adopted for the regulatory worst case scenario.

However, given that measured emission rates are well below those adopted for the regulatory worst case scenario throughout the monitoring/modelling period, it can be concluded that the adopted regulatory worst case scenario still represents a conservative, over estimate of the potential worst emissions, even though the measured flowrates are higher at times than the flowrate adopted for the regulatory worst case scenario.

Figure 12 Comparison of Measured Versus Assumed Regulatory Limit Flowrates (Total from Four Vents)



7.3.4 Meteorological Modelling Methodology

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, 2002).

For this study, a site-representative three-dimensional meteorological dataset was compiled using a combination of the TAPM and CALMET models, as discussed in the following sections.

Selection of Modelling Year

In order to determine a representative meteorological year for use in dispersion modelling, five years of meteorological data (2017-2021) from Sydney Airport AMO were analysed against the five-year average meteorological conditions. Specifically, the following parameters were analysed:

- frequency and distribution of the predominant wind directions
- hourly wind speeds observed
- hourly temperature

Based on this analysis, it was concluded that the years 2019, 2020 and 2021 were most representative of meteorological conditions experienced in the region. As background pollutant concentrations for 2019 and 2020 were significantly impacted by bush fires and dust storms, the use of these years was not deemed appropriate, therefore the 2021 calendar year was selected for use in the meteorological/ dispersion modelling study. Further details are presented in **Appendix D**.

TAPM

In order to calculate all required meteorological parameters required by the dispersion modelling process, meteorological modelling using The Air Pollution Model (TAPM, v 4.0.4) was performed. TAPM, developed by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) is a prognostic model that can be used to predict three-dimensional meteorological data and air pollution concentrations.

TAPM 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.

TAPM can assimilate actual local wind observations so that they can optionally be included in a model solution. TAPM parameters used for this study, including the observational data assimilated into the model run are presented in **Table 10**. The three-dimensional meteorological data from the TAPM output was used as input for the diagnostic meteorological model (CALMET).

Table 10 Meteorological Modelling Parameters - TAPM v 4.0.4

Modelling Period	1 January 2020 to 31 December 2020
Centre of analysis	331,290 mE 6,245,584 mS (UTM Coordinates)
Number of grid points	30 × 30 × 35
Number of grids (spacing)	4 (30 km, 10 km, 3 km, 1 km)
Data assimilation	Sydney Airport (BoM), Earlwood AQMS (NSW OEH)
Terrain	AUSLIG 9 second DEM

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.

Given the short distance between the tunnel ventilation outlets and the Project site, CALMET modelling was then conducted using a finer resolution of 50 m to ensure adequate resolution of modelling predictions between the source and receptors required for model accuracy. The TAPM-generated three-dimensional meteorological data was used as the initial guess wind field for the CALMET model. The local topographical data and available surface weather observations from Sydney Airport BoM station were then used to refine the initial guess wind field predetermined by TAPM.

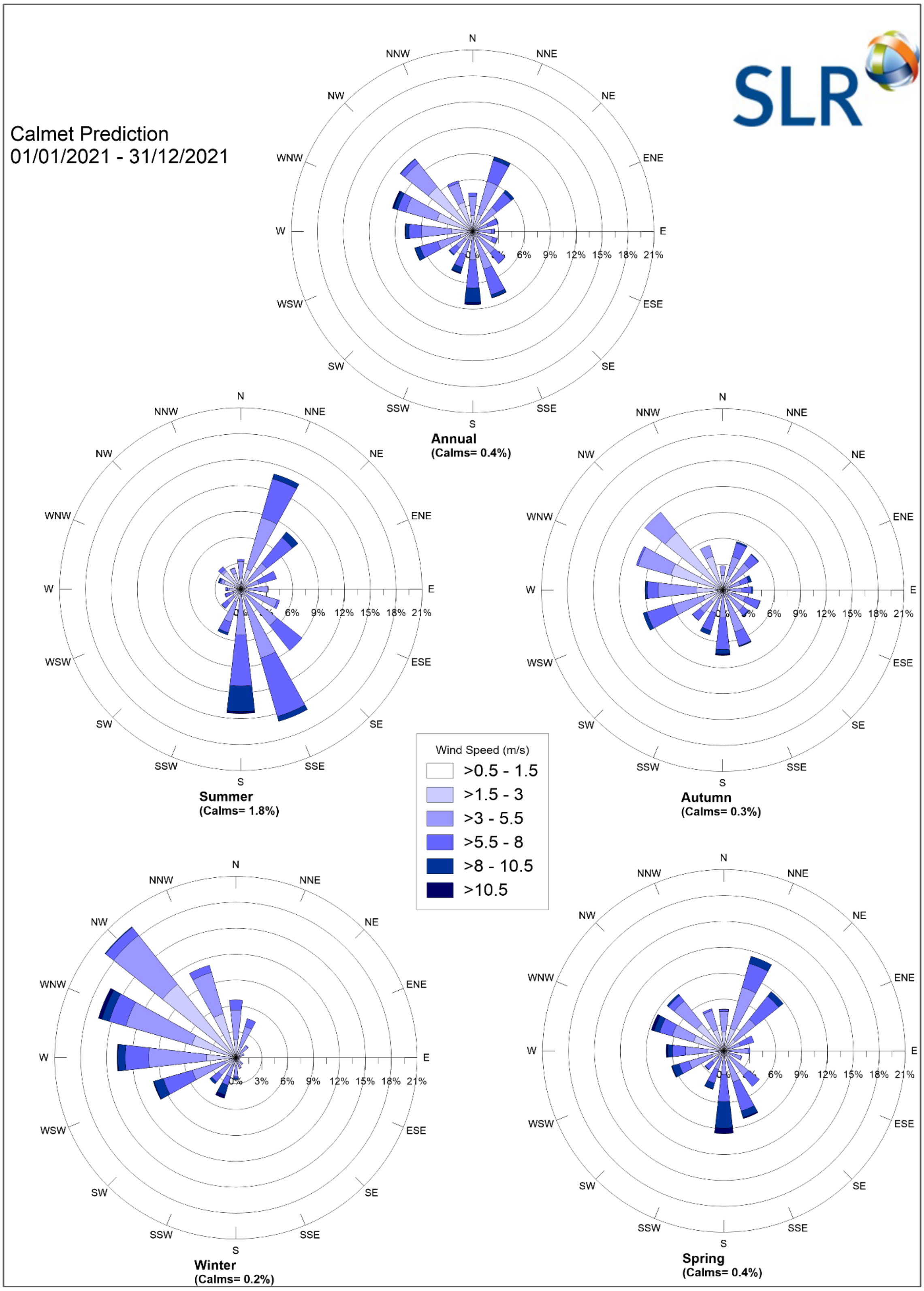
7.3.5 Site Representative Meteorological Data Used in the Modelling

This section presents a summary of the key meteorological conditions predicted by CALMET at the Project site.

Wind Speed and Direction

A summary of the seasonal wind behaviour predicted by CALMET at the Project site is presented as wind roses in **Figure 13**. The seasonal wind roses indicate that in autumn and winter, winds blow predominantly from the western quadrant, with minimal winds from the eastern quadrant. In spring and summer, winds from the west become less dominant and winds from the south and northeast quadrants increase in frequency. The predicted occurrence of calm conditions ranges from 0.2% in winter to 1.8% in summer.

Figure 13 Predicted Seasonal Wind Roses for the Project Site (CALMET, 2021)



Atmospheric Stability

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

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

The meteorological conditions defining each PGT stability class are shown in **Table 11**.

Table 11 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)

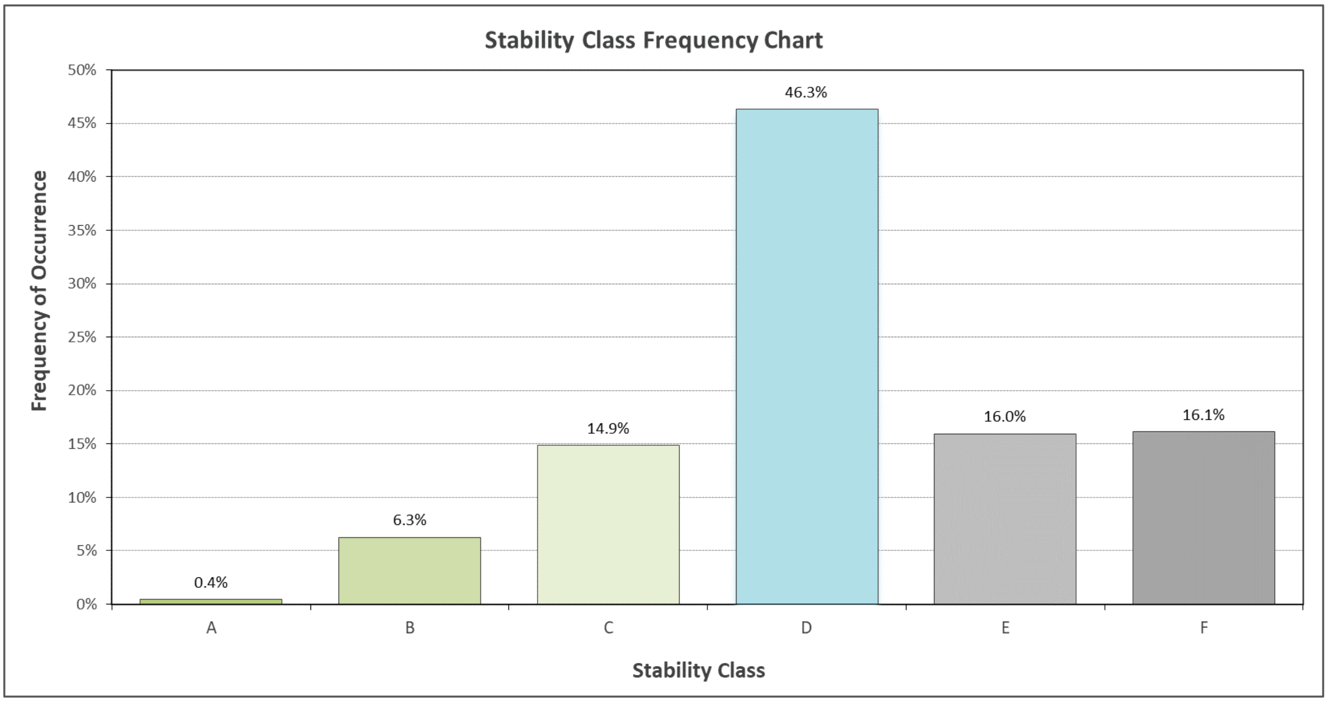
Notes:

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 over the modelling period is presented in **Figure 14**. The results indicate a high frequency of conditions typical to Stability Class D, with a low frequency of very unstable conditions (Stability Class A). Stability Class D refers to neutral conditions and typically occurs in the day time and under moderate to high wind speed conditions during the night time.

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

Figure 14 Predicted Stability Class Frequencies at the Site (CALMET, 2021)

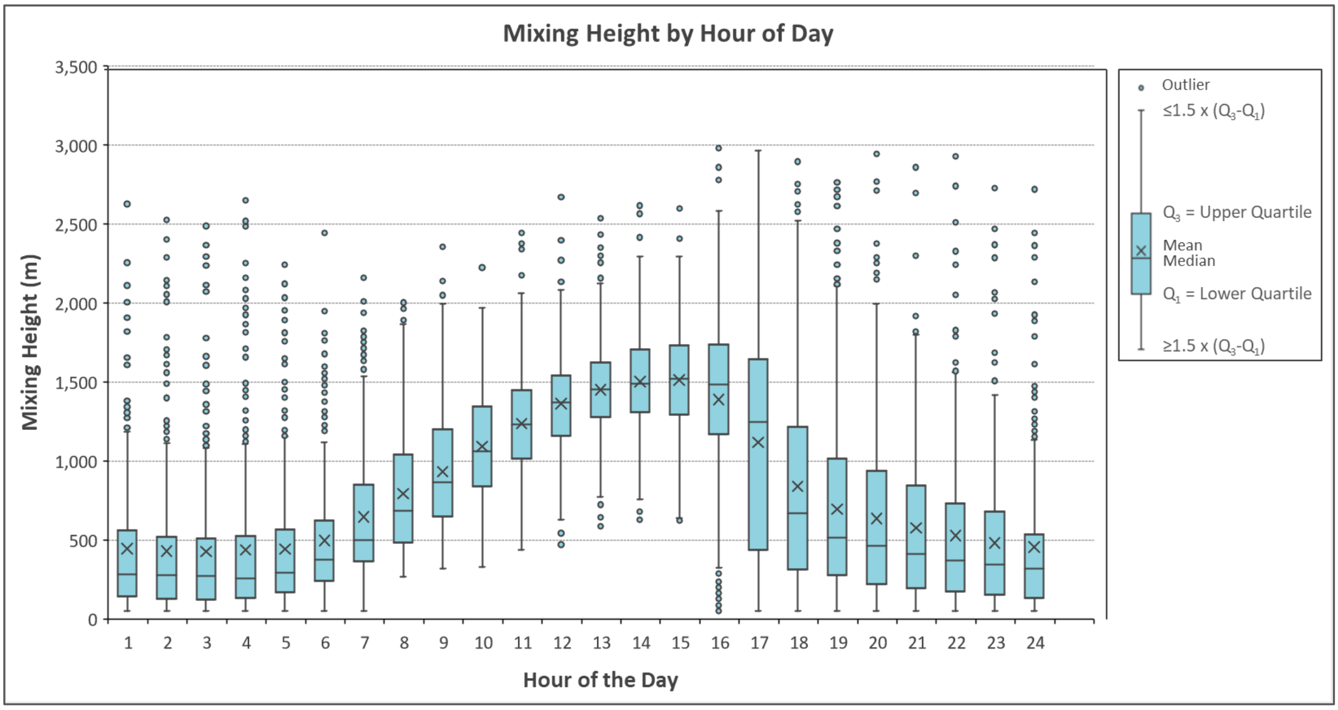


Mixing Heights

Diurnal variations in maximum and average mixing heights predicted by CALMET at the site for the 2021 modelling period are illustrated in **Figure 15**.

As would be expected, an increase in mixing height is apparent during the morning, 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 15 Predicted Mixing Heights at the Site (CALMET, 2021)



7.3.6 Building Downwash

Building downwash is a phenomenon caused by structures near air pollutant emission sources influencing atmospheric turbulence. Airflow is rapidly mixed to the ground in the wake of buildings downwind of elevated sources as frictional forces and pressure gradients cause stagnations and eddies to develop.

The USEPA has established a Good Engineering Practice (GEP) stack height which is defined as the '*height necessary to ensure that emissions from the stack do not result in excessive concentrations of any air pollutants in the immediate vicinity of the source as a result of atmospheric downwash, eddies or wakes which may be created by the source itself, nearby structures or nearby terrain obstacles*' (USEPA, 1985). The definition of GEP stack height is the building height plus 1.5 times the lesser of the building height or projected building width.

A stack is considered to be wake-affected when the stack and building are located less than five times the lesser of the building height or project building width apart.

For modelling purposes, existing buildings within 200 m of the ventilation outlets were included in the modelling to account for potential building wakes. The *Prime* building downwash algorithm was adopted to take account of building downwash effects.

7.3.7 NO_x to NO_2 conversion

NO_x emitted from combustion processes mainly consist of NO with a small portion (approximately 10%) of NO_2. In the atmosphere however, NO emitted from the source oxidises to NO_2 in the presence of O_3 and sunlight as it travels further from the source. The rate of oxidation depends on a number of parameters including the ambient O_3 concentration. The Approved Methods lists the following methods that can be applied to take account the oxidation of NO to NO_2 in estimating downwind NO_2 concentrations at receptor locations.

Method 1 – 100% Conversion

This method is usually used as a screening level assessment and assumes 100% conversion of NO to NO_2 before the plume arrives at the receptor location. Use of this method can significantly over-predict NO_2 concentrations at nearfield receptors. Given the proximity of sensitive receptors to the Project Site, the use of Method 1 (100% conversion) is not appropriate.

Method 2 – Ambient Ozone Limiting Method (OLM)

This method assumes that all the available ozone in the atmosphere will react with NO in the plume until either all the O_3 or all the NO is used up. NO_2 concentrations can be estimated by this method using the following equation:

$$[NO_2]_{total} = \{0.1 \times [NO_x]_{pred}\} + MIN\{(0.9) \times [NO_x]_{pred} \text{ or } (46/48) \times [O_3]_{bkgd}\} + [NO_2]_{bkgd}$$

Again, given the proximity of sensitive receptors, with relatively short transport durations from the Project Site, Method 2 could be deemed overly conservative as it assumes that the atmospheric reaction is instantaneous when in reality, the reaction takes place over a number of hours (NSW EPA, 2022).

Method 3 – NO to NO_2 Conversion using Empirical Relationship

This method uses an empirical equation for estimating the oxidation rate of NO in power plant plumes dependent on distance downwind from the source and the parameters A and α, which has the following form:

$$NO_2 = NO_x \times A(1 - e^{-\alpha x})$$

where *x* is the distance from the source and A and α are classified according to the O_3 concentration, wind speed and season (Janssen, van Wakeren, van Duuran, & Elshout, 1988) as provided in **Table 12.**

Table 12 Classification of Values for A and α by Season

Season	Ozone (ppb)	Wind Speed (m/s)		
		5	15	>15
Winter	40	A = 0.87 α = 0.07	A = 0.87 α = 0.07	A = 0.87 α = 0.15
	30	A = 0.82 α = 0.07	A = 0.83 α = 0.07	A = 0.83 α = 0.07
	20	A = 0.74 α = 0.07	A = 0.74 α = 0.07	A = 0.74 α = 0.07
	10	A = 0.49 α = 0.05	A = 0.49 α = 0.05	A = 0.49 α = 0.05
Spring/Autumn	60	A = 0.85 α = 0.10	A = 0.85 α = 0.15	A = 0.85 α = 0.30
	40	A = 0.80 α = 0.10	A = 0.80 α = 0.10	A = 0.80 α = 0.25
	30	A = 0.74 α = 0.10	A = 0.74 α = 0.10	A = 0.74 α = 0.15
	20	A = 0.635 α = 0.10	A = 0.635 α = 0.10	A = 0.635 α = 0.10
Summer	200	A = 0.93 α = 0.40	A = 0.93 α = 0.65	A = 0.93 α = 0.80
	120	A = 0.88 α = 0.20	A = 0.88 α = 0.35	A = 0.88 α = 0.45
	60	A = 0.81 α = 0.15	A = 0.81 α = 0.25	A = 0.81 α = 0.35
	40	A = 0.74 α = 0.10	A = 0.74 α = 0.15	A = 0.74 α = 0.25
	30	A = 0.67 α = 0.10	A = 0.67 α = 0.10	A = 0.67 α = 0.10

Method 2, conversion of NO_x to NO_2 using the OLM was adopted for this assessment. Given the short distance between the source and receptor, use of this method is likely to overestimate the predicted NO_2 concentrations at the Project site by a significant margin. Given this, the modelling predictions of NO_2 concentrations presented in this report can be expected to be conservative.

8 Air Quality Impact Assessment

8.1 Construction Impact Assessment

The key potential air pollution and amenity issues associated with fugitive dust emissions from the proposed construction activities includes:

- Annoyance due to dust deposition (soiling of surfaces) and visible dust plumes
- Elevated suspended particulate concentrations.

The following sections present a qualitative assessment of the potential risks to air quality associated with dust from construction activities at the Project site. Details of the IAQM methodology used to perform the risk assessment are provided in **Appendix A**.

8.1.1 Step 1 – Screening Based on Separation Distance

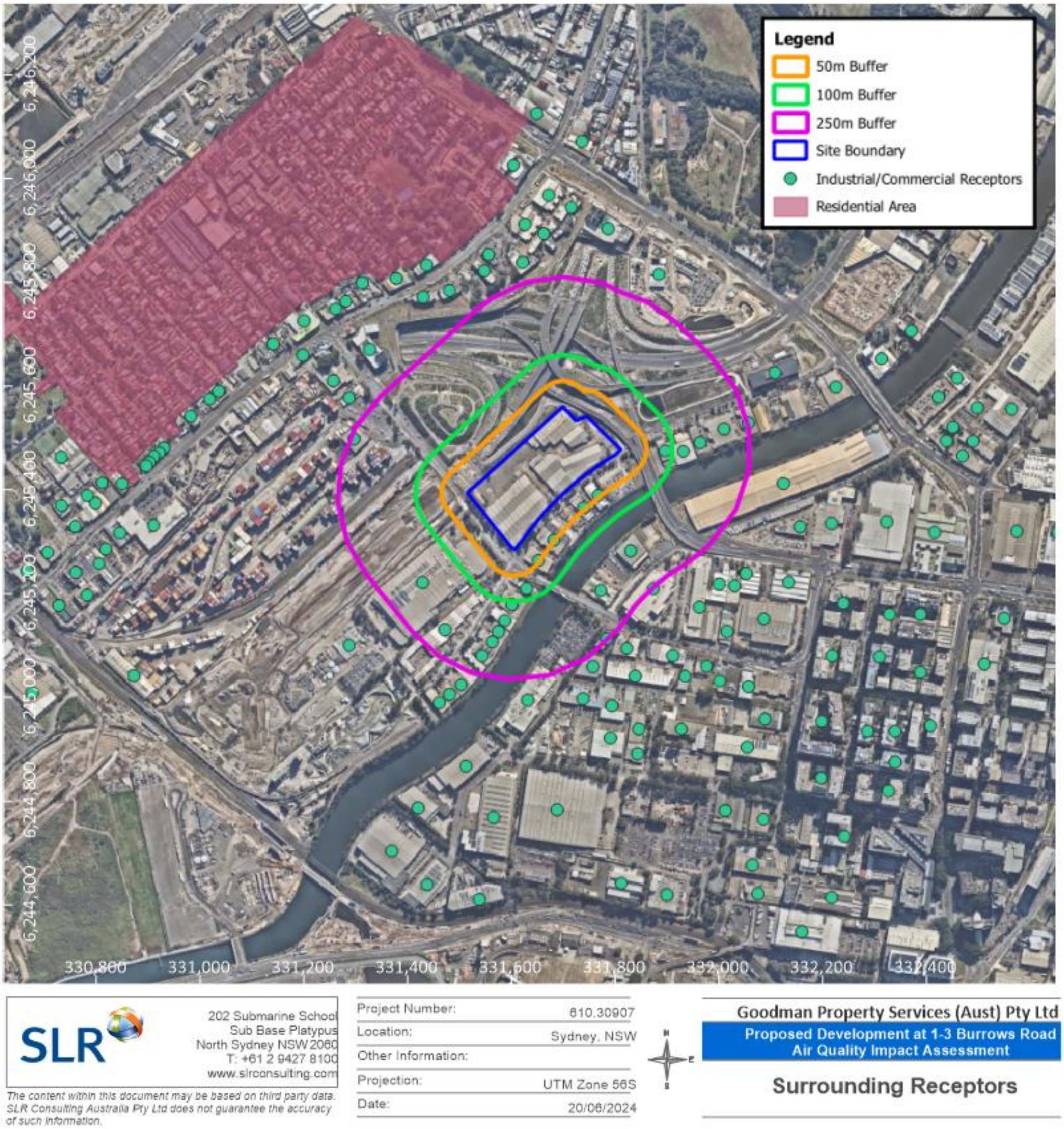
As noted in **Section 2.2**, a number of sensitive receptors are located within 50 m from the nearest Site boundary.

The IAQM screening criteria for further assessment is the presence of a 'human receptor' within:

- 250 m of the boundary of the Proposal; or
- 50 m of the route(s) used by construction vehicles, up to 250 m from the Proposal entrance(s).

As a 'human receptor' is located within 250 m of the boundary of the site, and within 250 m of the site entrance, further assessment is required. For the purpose of this assessment, the number of sensitive receptors is estimated to be more than 100 within 250 m of the site boundary (see **Figure 16**).

Figure 16 Density of Sensitive Receptors in the Vicinity of the Site



8.1.2 Step 2a – Assessment of Scale and Nature of the Works

Based upon the above assumptions and the IAQM definitions presented in **Appendix A**, the dust emission magnitudes for each phase of the construction works have been categorised as presented in **Table 13**.

Table 13 Categorisation of Dust Emission Magnitude

Activity	Dust Emission Magnitude	Basis
Demolition	Large	**IAQM Definition:** Total building volume greater than 75,000 m3, potentially dusty construction material (e.g. concrete), on-site crushing and screening, demolition activities higher than 12 m above ground level. **Relevance to this Project:** *The total area of the buildings to be demolished is estimated to be approximately 28,000 m^2 based on aerial imagery; considering an average height of 3.4 m, the total demolition volume is likely to be greater than 75,000 m^3.*
Earthworks	Medium	**IAQM Definition:** Total site area 18,000 m^2 to 110,000 m^2, moderately dusty soil type (e.g. silt), 5 to 10 heavy earth moving vehicles active at any one time, formation of bunds 3 m to 6 m in height. **Relevance to this Project:** *Total area of the site is estimated to be approximately 35,000 m^2 based on site layout.*
Construction	Large	**IAQM Definition:** Total building volume greater than 75,000 m^3, on site concrete batching; sandblasting. **Relevance to this Project:** *Based on site layout the total warehouse area is approximately 17,500 m^2 and the elevation of the building is 28 m. Therefore, the total building volume is estimated to be 490,000 m^3.*
Trackout	Large	**IAQM Definition:** More than 50 heavy vehicle (>3.5 t) outward movements in any one day, potentially dusty surface material (e.g. high clay content), greater than 100 m of unpaved road length. **Relevance to this Project:** *It is estimated that more than 50 heavy vehicles movements per day will occur during the peak construction period.*

8.1.3 Step 2b – Risk Assessment

Receptor Sensitivity

Based on the criteria listed in **Table A-1** in **Appendix A**, the sensitivity of the residential receptors in this study is concluded to be *high* for health impacts and *high* for dust soiling, as they are located where people may be reasonably expected to be present continuously as part of the normal pattern of land use. The sensitivity of the commercial receptors immediately surrounding the site is concluded to be *medium* for health impacts and *medium* for dust soiling, being places of work.

Sensitivity of an Area

Based on the classifications shown in **Table A-2** and **Table A-3** in **Appendix A**, the sensitivity of the residential area to the north of Project site to both dust soiling and health effects may be classified as ***low***. This categorisation has been made taking into account the individual receptor sensitivities derived above, the mean background PM_{10} concentration of 18 µg/m^3 recorded at Saint Peters 2 AQMS (see **Section 6**) and all high sensitivity (residential) receptors being located more than 250 m away from the Project site.

Risk Assessment

Given the sensitivity of the general area is classified as '***low'*** for dust soiling and for health effects, and the dust emission magnitudes for the various construction phase activities as shown in **Table 13**, the resulting risk of air quality impacts should no dust controls be applied is as presented in **Table 14**.

Table 14 Preliminary Risk of Air Quality Impacts from Construction Activities (Uncontrolled)

Impact	Sensitivity of Area	Dust Emission Magnitude				Preliminary Risk			
		Demolition	Earthworks	Construction	Trackout	Demolition	Earthworks	Construction	Trackout
Dust Soiling	Low	Large	Medium	Large	Large	Medium Risk	Low Risk	Low Risk	Low Risk
Human Health	Low					Medium Risk	Low Risk	Low Risk	Low Risk

The results indicate that there is a ***medium*** risk of adverse dust soiling and human health impacts during demolition phase and a ***low*** risk of adverse dust soiling and human health impacts occurring during the earthworks and construction phases, and due to trackout, if no mitigation measures were to be applied to control emissions.

8.1.4 Step 3 - Mitigation Measures

A reappraisal of the predicted mitigated air quality impacts on sensitive receptors has been performed to demonstrate the opportunity for minimising risks associated with the use of mitigation strategies. These are termed 'residual impacts'.

Mitigation measures targeting potential impacts from demolition are provided in **Table 15**. Implementing these measures should reduce the risk of these impacts to acceptable levels. These measures are designated as *highly recommended* (H) or *desirable* (D) by the dust IAQM method to control dust emissions associated with demolition for medium risk projects.

Table 15 Mitigation Measures Specific to Demolition

Activity	Highly recommended or Desirable
Soft strip inside buildings before demolition (retaining walls and windows in the rest of the building where possible, to provide a screen against dust).	D
Ensure effective water suppression is used during demolition operations. Handheld sprays are more effective than hoses attached to equipment as the water can be directed to where it is needed. In addition, high volume water suppression systems, manually controlled, can produce fine water droplets that effectively bring the dust particles to the ground.	H
Avoid explosive blasting, using appropriate manual or mechanical alternatives.	H
Bag and remove any biological debris or damp down such material before demolition.	H

H = Highly recommended; D = Desirable

Since the assessment identified earthworks to be of low risk (as per **Table 14**), no additional mitigation measures are recommended by the IAQM. However best practice mitigation measures to reduce potential for any dust generation from the construction works should be identified and adopted during the construction phase.

Table 16 and **Table 17** provide the mitigation measures targeting the potential impacts from construction, and trackout for low risk projects. Implementing these measures reduce the risk of these impacts to acceptable levels.

Table 16 Mitigation Measures Specific to Construction

Activity	Highly recommended or Desirable
Avoid scabbling (roughening of concrete surfaces) if possible.	D
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.	D

H = Highly recommended; D = Desirable

Table 17 Mitigation Measures Specific to Trackout

Activity	Highly recommended or Desirable
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.	D
Avoid dry sweeping of large areas.	D
Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport.	D
Record all inspections of haul routes and any subsequent action in a site log book.	D
Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable).	D

H = Highly recommended; D = Desirable

Appendix B lists the relevant general mitigation measures designated by the dust IAQM method for a development shown to have a medium risk of adverse impacts.

Not all the identified mitigation measures will be practical or relevant to the Project, therefore a detailed review of the recommendations should be performed, and the most appropriate measures be adopted as part of the Construction Environmental Management Plan (CEMP).

8.1.5 Step 4 – Determining Significant Effects

For almost all construction activity, the dust IAQM method notes that the aim should be to prevent significant effects on receptors through the use of effective mitigation, and experience shows that this is normally possible. Through the application of good practice dust control methods, it is therefore expected that any potential for nuisance or health impacts associated with the construction phase of the Project can be managed without any significant effects to the surrounding commercial land users.

8.2 Assessment of Impacts from Warehouse Operations

As discussed in **Section 4.2**, air quality issues associated with the proposed warehouse operations predominantly relate to emissions of products of combustion and particulate matter from trucks and other vehicles accessing and idling at the site.

These emissions will be of a similar nature to existing emissions from traffic on Burrows Road and Campbell Road. The magnitude of emissions from the Project is anticipated to be significantly lower compared to that currently emitted by traffic on Burrows Road. To assess the risk of traffic-related air emissions from the site impacting on surrounding sensitive receptors during the operational phase, the following risk based approach has been adopted.

The risk-based assessment takes account of a range of impact descriptors, including the following:

- Nature of Impact: does the impact result in an adverse, neutral or beneficial environment?

  The nature of impact is anticipated to be ***neutral*** to the environment.

- Receptor Sensitivity: how sensitive is the receiving environment to the anticipated impacts?

  The nearest sensitive receptors to the site include offices within 50 m of the boundary (see **Section 2.2**). In terms of the methodology in **Appendix C**, the sensitivity of the surrounding residential areas to emissions from the Site should be considered ***medium***.

- Magnitude: what is the anticipated scale of the impact?

  Based on the anticipated small amount of traffic movements on the site and its comparison to the existing traffic numbers on Burrows Road and Campbell Road, as well as the nearby interchange, the magnitude of these emissions considered to be ***negligible*** (ie the impact is predicted to cause no significant consequences).

Given the above, the potential impact of the Project operations on the nearest sensitive receptors is concluded to be ***neutral*** for all receptors (see **Table 18**).

Table 18 Impact Significance

Magnitude / Sensitivity	Substantial Magnitude	Moderate Magnitude	Slight Magnitude	Negligible Magnitude
Very High Sensitivity	Major Significance	Major/ Intermediate Significance	Intermediate Significance	Neutral Significance
High Sensitivity	Major/ Intermediate Significance	Intermediate Significance	Intermediate/Minor Significance	Neutral Significance
Medium Sensitivity	Intermediate Significance	Intermediate/Minor Significance	Minor Significance	Neutral Significance
Low Sensitivity	Intermediate/Minor Significance	Minor Significance	Minor/Neutral Significance	Neutral Significance

It is noted that this assessment is based on warehousing operations only (ie storage and receival/dispatch of goods). If at the development stage, other industrial uses are proposed with potential to generate air pollutant emissions, then an updated site specific air quality impact assessment may be required.

8.3 Assessment of Impacts – New M5 and M4-M5 Ventilation Outlets

8.3.1 Scenario 1 – Current Operation

This section presents the predicted incremental and cumulative air quality impacts associated with the operation of the New M5 and M4-M5 tunnel ventilation stacks at ground and elevated levels of the proposed Project building. For analysis purposes, given that the ventilation stacks are located to the northwest and northeast of the Development Site (refer to **Figure 2**), concentration predictions were extracted from the model output at two onsite locations located at the northwest and northeast corner of the Project site.

NO_2

The predicted incremental and cumulative maximum 1-hour and annual average NO_2 concentrations are presented in **Table 19** and **Table 20**. Hourly varying background data presented in **Section 6** were used in calculating the cumulative impacts at each level. The conversion of NO_x to NO_2 was performed using the OLM approach and hourly-varying O_3 data recorded by the Earlwood AQMS.

Table 19 and **Table 20** show that, as may be expected, the maximum 1-hour and annual average NO_2 concentrations associated with the operation of ventilation outlets at the Project site are predicted to be higher at elevated levels compared to that predicted for the ground level. The highest incremental and cumulative maximum 1-hour and annual average NO_2 concentrations are predicted at the top level of the proposed development.

The predicted cumulative NO_2 concentrations at all levels, however, are well below the relevant NO_2 assessment criteria outlined in **Section 5** of this report.

Table 19 Predicted Incremental and Cumulative Maximum 1-Hour Average NO_2 Concentrations

Building Level	Increment (µg/m³)		Cumulative (µg/m³)	
	Northeast Corner	Northwest Corner	Northeast Corner	Northwest Corner
Ground	18	16	76	76
Ground Mezzanine	18	16	76	76
Level 1	19	16	77	76
Level 1 Mezzanine	22	17	79	77
Parapet	26	21	83	78
Maximum	**26**	**21**	**83**	**78**
Criteria	-		**246**	

Note – incremental values refer to predicted NO_2 concentrations associated with the ventilation stacks, cumulative includes hourly varying background data, as presented in **Section 6**.

Table 20 Predicted Incremental and Cumulative Annual Average NO_2 Concentrations

Building Level	Increment (µg/m³)		Cumulative (µg/m³)	
	Northeast Corner	Northwest Corner	Northeast Corner	Northwest Corner
Ground	0.4	0.4	22.6	22.6
Ground Mezzanine	0.4	0.4	22.6	22.6
Level 1	0.4	0.4	22.6	22.6
Level 1 Mezzanine	0.5	0.4	22.6	22.6
Parapet	0.5	0.5	22.7	22.6
Maximum	**0.5**	**0.5**	**22.7**	**22.6**
Guideline	-		**62**	

Note – incremental values refer to predicted NO_2 concentrations associated with the ventilation stacks, cumulative includes hourly varying background data, as presented in **Section 6**.

PM_{10}

The predicted incremental and cumulative maximum 24-hour and annual average PM_{10} concentrations are presented in **Table 21** and **Table 22**. The daily varying background PM_{10} data presented in **Section 6** were used in calculating the cumulative impacts at each level.

Table 21 and **Table 22**show that the predicted cumulative PM_{10} concentrations at each level are well below the relevant PM_{10} guidelines outlined in **Section 5**. Similar to NO_2, the highest incremental and cumulative maximum 24-hour and annual average PM_{10} concentrations are predicted at the top level of the proposed development.

Table 21 Predicted Incremental and Cumulative Maximum 24-Hour Average PM_{10} Concentrations

Building Level	Increment (µg/m³)		Cumulative (µg/m³)	
	Northeast Corner	Northwest Corner	Northeast Corner	Northwest Corner
Ground	0.2	0.4	40.7	40.8
Ground Mezzanine	0.2	0.4	40.7	40.8
Level 1	0.2	0.5	40.7	40.8
Level 1 Mezzanine	0.2	0.5	40.7	40.8
Parapet	0.2	0.6	40.7	40.8
Maximum	**0.3**	**0.6**	**40.7**	**40.8**
Guideline	-		**50**	

Note – incremental values refer to predicted PM_{10} concentrations associated with the ventilation stacks, cumulative includes daily varying background data, as presented in **Section 6**.

Table 22 Predicted Incremental and Cumulative Annual Average PM_{10} Concentrations

Building Level	Increment (µg/m³)		Cumulative (µg/m³)	
	Northeast Corner	Northwest Corner	Northeast Corner	Northwest Corner
Ground	<0.1	<0.1	<17.9	<17.9
Ground Mezzanine	<0.1	<0.1	<17.9	<17.9
Level 1	<0.1	<0.1	<17.9	<17.9
Level 1 Mezzanine	<0.1	<0.1	<17.9	<17.9
Parapet	<0.1	<0.1	<17.9	<17.9
Maximum	**<0.1**	**<0.1**	**<17.9**	**<17.9**
Guideline	-		**25**	

Note – incremental values refer to predicted PM_{10} concentrations associated with the ventilation stacks, cumulative includes daily varying background data, as presented in **Section 6**.

$PM_{2.5}$

The predicted incremental and cumulative maximum 24-hour and annual average $PM_{2.5}$ concentrations are presented in **Table 23** and **Table 24**. The daily varying background $PM_{2.5}$ data presented in **Section 6** were used in calculating the cumulative impacts at each level.

Similar to NO_2 and PM_{10}, the incremental maximum 24-hour and annual average $PM_{2.5}$ concentrations associated with the operation of the tunnel ventilation outlets are predicted to be higher at elevated levels compared to that predicted at ground level.

The predicted incremental maximum 24-hour average $PM_{2.5}$ concentrations at each level are minimal, however exceedances of the cumulative 24-hour average guideline of 25 µg/m³ are predicted at all levels as a result of the background data file containing days that exceeded the criterion (see **Section 6**).

A contemporaneous analysis of the highest predicted incremental 24-hour average $PM_{2.5}$ concentrations and concurrent background data is presented in **Table 25** for the worst impacted level (Parapet, northwest corner). The analysis shows that the incremental $PM_{2.5}$ concentrations associated with the operation of the ventilation outlets are not predicted to cause any additional exceedances of the cumulative 24-hour average guideline of 25 µg/m³.

The predicted annual average $PM_{2.5}$ concentrations comply with the relevant guideline at all levels of the proposed building.

Table 23 Predicted Incremental and Cumulative Maximum 24-Hour Average $PM_{2.5}$ Concentrations

Building Level	Increment (µg/m³)		Cumulative (µg/m³)	
	Northeast Corner	Northwest Corner	Northeast Corner	Northwest Corner
Ground	0.2	0.4	39.1	39.1
Ground Mezzanine	0.2	0.4	39.1	39.2
Level 1	0.2	0.5	39.1	39.2
Level 1 Mezzanine	0.2	0.5	39.1	39.2
Parapet	0.2	0.6	39.1	39.3
Maximum	**0.3**	**0.6**	**39.1**	**39.3**
Guideline	-		**25**	

Note – incremental values refer to predicted $PM_{2.5}$ concentrations associated with the ventilation stacks, cumulative includes daily varying background data, as presented in **Section 6**.

Table 24 Predicted Incremental and Cumulative Annual Average $PM_{2.5}$ Concentrations

Building Level	Increment (µg/m³)		Cumulative (µg/m³)	
	Northeast Corner	Northwest Corner	Northeast Corner	Northwest Corner
Ground	<0.1	<0.1	<6.8	<6.8
Ground Mezzanine	<0.1	<0.1	<6.8	<6.8
Level 1	<0.1	<0.1	<6.8	<6.8
Level 1 Mezzanine	<0.1	<0.1	<6.8	<6.8
Parapet	<0.1	<0.1	<6.8	<6.8
Maximum	<0.1	<0.1	<6.8	<6.8
Guideline	-		**8**	

Note – incremental values refer to predicted $PM_{2.5}$ concentrations associated with the ventilation stacks, cumulative includes daily varying background data, as presented in **Section 6**.

Table 25 Contemporaneous $PM_{2.5}$ Analysis – Parapet, Northwest Corner

Date	$PM_{2.5}$ 24-Hour Average (µg/m³)			Date	$PM_{2.5}$ 24-Hour Average (µg/m³)		
	Highest Background	Predicted Increment	Cumulative		Background	Highest Increment	Cumulative
22-08-2021	**39.0**	0.3	**39.3**	21-08-2021	**29.9**	0.6	**30.5**
03-05-2021	**32.5**	0.3	**32.8**	30-04-2021	14.5	0.4	14.8
21-08-2021	**29.9**	0.6	**30.5**	19-08-2021	6.3	0.4	6.7
27-04-2021	**27.9**	<0.1	**<30**	30-08-2021	14.5	0.3	14.9
04-05-2021	**27.8**	<0.1	**<27.9**	21-01-2021	6.7	0.3	7.0
30-04-2021	23.0	0.3	23.3	29-04-2021	32.5	0.3	32.8
03-06-2021	21.7	0.2	21.8	31-05-2021	18.3	0.3	18.6
10-10-2021	20.2	0.0	20.2	14-01-2021	39.0	0.3	39.3

8.3.2 Scenario 2 – Regulatory Worst Case

This section presents the predicted incremental and cumulative air quality impacts associated with the operation of the New M5 and M4-M5 tunnel ventilation stacks at ground and elevated levels of the proposed Project building for a hypothetical regulatory worst-case scenario, when all ventilation outlets are emitting at the maximum allowable emission rates. Similar to Scenario 1, for analysis purposes,), concentration predictions were extracted from the model output at two onsite locations located at the northwest and northeast corner of the Project site.

NO_2

The predicted incremental and cumulative maximum 1-hour and annual average NO_2 concentrations are presented in **Table 26** and **Table 27**. Hourly varying background data presented in **Section 6** were used in calculating the cumulative impacts at each elevated level. The conversion of NO_x to NO_2 was performed using the OLM approach and hourly-varying O_3 data recorded by the Earlwood AQMS.

Table 26 and **Table 27** show that similar to Scenario 1, the maximum 1-hour and annual average NO_2 concentrations associated with the operation of ventilation outlets at the Project site are predicted to be higher at elevated levels compared to that predicted for the ground level.

The predicted cumulative NO_2 concentrations at all levels are well below (approximately 55% of) the relevant NO_2 guidelines outlined in **Section 5** of this report.

Table 26 Predicted Incremental and Cumulative Maximum 1-Hour Average NO_2 Concentrations

Building Level	Increment (µg/m³)		Cumulative (µg/m³)	
	Northeast Corner	Northwest Corner	Northeast Corner	Northwest Corner
Ground	86	90	139	133
Ground Mezzanine	86	89	138	132
Level 1	86	89	138	132
Level 1 Mezzanine	86	92	138	130
Parapet	82	107	132	129
Maximum	**86**	**107**	**139**	**133**
Criteria	-		**246**	

Note – incremental values refer to predicted NO_2 concentrations associated with the ventilation stacks, cumulative includes hourly varying background data, as presented in **Section 6**.

Table 27 Predicted Incremental and Cumulative Annual Average NO_2 Concentrations

Building Level	Increment (µg/m³)		Cumulative (µg/m³)	
	Northeast Corner	Northwest Corner	Northeast Corner	Northwest Corner
Ground	5.9	5.3	28.1	27.5
Ground Mezzanine	5.9	5.4	28.1	27.5
Level 1	5.9	5.4	28.1	27.6
Level 1 Mezzanine	6.0	5.5	28.2	27.7
Parapet	6.1	5.7	28.3	27.9
Maximum	**6.1**	**5.7**	**28.3**	**27.9**
Guideline	-		**62**	

Note – incremental values refer to predicted NO_2 concentrations associated with the ventilation stacks, cumulative includes hourly varying background data, as presented in **Section 6**.

PM_{10}

The predicted incremental and cumulative maximum 24-hour and annual average PM_{10} concentrations are presented in **Table 28** and **Table 29**. The daily varying background PM_{10} data presented in **Section 6** were used in calculating the cumulative impacts at each level.

The predicted cumulative PM_{10} concentrations at all levels are below the relevant PM_{10} guidelines outlined in **Section 5**.

Table 28 Predicted Incremental and Cumulative Maximum 24-Hour Average PM_{10} Concentrations

Building Level	Increment (µg/m³)		Cumulative (µg/m³)	
	Northeast Corner	Northwest Corner	Northeast Corner	Northwest Corner
Ground	2.3	3.2	41.4	41.9
Ground Mezzanine	2.3	3.2	41.4	41.9
Level 1	2.3	3.3	41.4	42.0
Level 1 Mezzanine	2.3	3.5	41.4	42.3
Parapet	2.3	4.0	41.3	42.6
Maximum	**2.3**	**4.0**	**41.4**	**42.6**
Guideline	-		**50**	

Note – incremental values refer to predicted PM_{10} concentrations associated with the ventilation stacks, cumulative includes daily varying background data, as presented in **Section 6**.

Table 29 Predicted Incremental and Cumulative Annual Average PM_{10} Concentrations

Building Level	Increment (µg/m³)		Cumulative (µg/m³)	
	Northeast Corner	Northwest Corner	Northeast Corner	Northwest Corner
Ground	0.5	0.5	18.4	18.3
Ground Mezzanine	0.5	0.5	18.4	18.3
Level 1	0.5	0.5	18.4	18.3
Level 1 Mezzanine	0.5	0.5	18.4	18.4
Parapet	0.6	0.55	18.4	18.4
Maximum	**0.6**	**0.6**	**18.4**	**18.4**
Guideline	-		**25**	

Note – incremental values refer to predicted PM_{10} concentrations associated with the ventilation stacks, cumulative includes daily varying background data, as presented in **Section 6**.

$PM_{2.5}$

The predicted incremental and cumulative maximum 24-hour and annual average $PM_{2.5}$ concentrations are presented in **Table 30** and **Table 31**. The daily varying background $PM_{2.5}$ data presented in **Section 6** were used in calculating the cumulative impacts at each level.

Table 30 and **Table 31** show that the incremental 24-hour average $PM_{2.5}$ concentrations predicted at each level are minimal, however exceedances of the cumulative 24-hour average guideline of 25 µg/m³ are predicted all levels as a result of the background data file containing days that exceeded the criterion (see **Section 6**), similar to Scenario 1.

A contemporaneous analysis of the highest predicted incremental 24-hour average $PM_{2.5}$ concentrations and concurrent background data is presented in **Table 32** for the worst impacted level (Parapet, northwest corner). The analysis shows that the incremental $PM_{2.5}$ concentrations associated with the operation of the ventilation outlets are not predicted to cause any additional exceedances of the cumulative 24-hour average guideline of 25 µg/m³.

The predicted annual average $PM_{2.5}$ concentrations comply with the relevant guideline at all levels of the proposed building.

Table 30 Predicted Incremental and Cumulative Maximum 24-Hour Average $PM_{2.5}$ Concentrations

Building Level	Increment (µg/m³)		Cumulative (µg/m³)	
	Northeast Corner	Northwest Corner	Northeast Corner	Northwest Corner
Ground	2.3	3.2	39.9	40.6
Ground Mezzanine	2.3	3.2	39.9	40.6
Level 1	2.3	3.3	39.9	40.6
Level 1 Mezzanine	2.3	3.5	39.9	40.6
Parapet	2.3	4.0	40.0	40.7
Maximum	**2.3**	**4.0**	**40.0**	**40.7**
Guideline	-		**25**	

Note – incremental values refer to predicted $PM_{2.5}$ concentrations associated with the ventilation stacks, cumulative includes daily varying background data, as presented in **Section 6**.

Table 31 Predicted Incremental and Cumulative Annual Average $PM_{2.5}$ Concentrations

Building Level	Increment (µg/m³)		Cumulative (µg/m³)	
	Northeast Corner	Northwest Corner	Northeast Corner	Northwest Corner
Ground	0.5	0.5	7.2	7.1
Ground Mezzanine	0.5	0.5	7.2	7.2
Level 1	0.5	0.5	7.2	7.2
Level 1 Mezzanine	0.5	0.5	7.2	7.2
Parapet	0.6	0.6	7.2	7.2
Maximum	**0.6**	**0.6**	**7.2**	**7.2**
Guideline	-		**8**	

Note – incremental values refer to predicted $PM_{2.5}$ concentrations associated with the ventilation stacks, cumulative includes daily varying background data, as presented in **Section 6**.

Table 32 Contemporaneous $PM_{2.5}$ Analysis – Parapet, Northwest Corner

Date	$PM_{2.5}$ 24-Hour Average (µg/m³)			Date	$PM_{2.5}$ 24-Hour Average (µg/m³)		
	Highest Background	Predicted Increment	Cumulative		Background	Highest Increment	Cumulative
22-08-2021	**39.0**	1.7	**40.7**	11-09-2021	13.8	4.0	17.8
03-05-2021	**32.5**	2.3	**34.8**	26-01-2021	11.4	2.4	13.8
21-08-2021	**29.9**	1.3	**31.1**	04-04-2021	5.0	2.3	7.3
27-04-2021	**27.9**	0.1	**28.0**	10-08-2021	9.3	2.3	11.6
04-05-2021	**27.8**	<0.1	**27.8**	19-12-2021	3.4	2.3	5.7
30-04-2021	23.0	0.6	23.6	03-05-2021	32.5	2.3	34.8
03-06-2021	21.7	0.9	22.6	25-01-2021	7.8	2.2	10.1
10-10-2021	20.2	0.5	20.7	12-09-2021	4.2	2.2	6.4

9 Conclusions

Goodman engaged SLR to conduct an air quality impact assessment for the proposed warehousing and logistics development at 1-3 Burrows Road, St Peters, NSW.

Potential air quality impacts on neighbouring land users associated with the construction and operation of the proposed development were assessed qualitatively using structured risk-based assessment methodologies. The findings of the assessments showed the following:

- With the implementation of appropriate site specific mitigation measures (refer to **Section 8.1.4**) during the construction phase of the project, the risk of potential dust soiling and human health impacts associated with the demolition of the existing building and construction activities (including earthwork and track out) would be negligible
- Potential risks associated with the proposed operation of the warehouse are expected to have neutral significance.

Potential air quality impacts at the ground floor and at elevated levels of the proposed building associated with the emissions released from the ventilation outlets of the New M5 and M4-M5 link tunnels were assessed using a combination of the CALMET/ CALPUFF models. Two modelling scenarios were assessed, as follows:

- Scenario 1 – Current operation of the ventilation stacks based on measured hourly-varying stack parameters (ie. velocity, temperature) and emission data from the New M5 tunnel stack
- Scenario 2 - Regulatory worst-case scenario based on the air quality emission licence limits for the M4-M5 tunnel

The following inputs and assumptions were considered:

- Scenario 1:
  - Hourly varying air emission data (NO_x and particulate matter, as well as exit velocities) recorded at the New M5 ventilation outlet during 2021 was used as input to the dispersion model for Scenario 1.
  - In the absence of CEMS data for M4-M5 link tunnel emissions, it was assumed that the emission rates for the M4-M5 link tunnel ventilation outlet are similar to that recorded in the New M5 ventilation outlet .
  - Recorded CEMS data for 'particulate matter' were assumed to be representative of the $PM_{2.5}$ size fraction (particle size <2.5 µm).
- Scenario 2:
  - Air quality emission limits listed in *Section L2 of the EPL for the M4-M5 Tunnel* (EPL 21372, 2022) and ventilation data used for the regulatory worst case scenario in the *New M5 EIS* (Pacific Environment, 2015) were adopted for both tunnel ventilation outlets.
- Hourly varying ambient background data recorded during 2021 at the WestConnex St Peters 2 monitoring site, located adjacent to the Project site was used as the background pollutant level for calculating cumulative impacts for both ground and elevated level receptors. Monitoring data recorded by the Department of Environment and Heritage (DEH)-operated Earlwood AQMS was used to fill in any missing data where relevant.
- Conversion of NO_x to NO_2 was performed using the OLM approach based on hourly varying O_3 concentrations recorded by the DEH-operated monitoring station at Earlwood.

Based on the modelling results, it is concluded that:

- No exceedances of the relevant ambient air quality criteria for NO_2 were predicted at ground level or at any of the upper levels of the proposed building.
- No exceedances of the relevant ambient air quality criteria for PM_{10} were predicted at ground level or at any of the upper levels of the proposed building.
- A small number of exceedances of the 24-hour average $PM_{2.5}$ guideline were predicted at the ground floor and elevated levels of the proposed building. Further investigation showed that these exceedances are driven by high background levels that already exceed the criterion (refer to **Section 6**. The incremental concentrations from the ventilation outlets are negligible on these days compared to the background $PM_{2.5}$ level recorded at the Saint Peters 2 AQMS. The modelling results also showed that the emissions from the ventilation outlets are not predicted to cause any additional exceedances of the 24-hour $PM_{2.5}$ criterion at any levels of the proposed building compared to measured background levels.
- The predicted incremental annual average $PM_{2.5}$ concentrations showed compliance with the relevant criterion at all levels of the proposed building.

Given the minor incremental impacts predicted at the Project site for the tunnel ventilation emissions, and the conservative assumptions adopted for this assessment, changes to the above conclusion are considered unlikely as a result of potential future increases in annual average daily traffic flows (eg. 10 year horizon) through the tunnels or on the surrounding road network. The expected increase in electric and hybrid vehicle within the Australian fleet, and ongoing improvements in emission controls for petrol and diesel vehicles and fuel quality in Australia, will also assist in reducing impacts from traffic emissions in the Sydney urban area.

10 References

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Appendix A

CONSTRUCTION PHASE RISK ASSESSMENT METHODOLOGY

Step 1 – Screening Based on Separation Distance

The Step 1 screening criteria provided by the IAQM Guidance (IAQM, 2024) suggests an assessment may be required where:

- a 'human receptor' is located within:
  - 250 m of the boundary of the site; or
  - 50 m of the route(s) used by construction vehicles on public roads, up to 250 m from the site entrance.
- an 'ecological receptor' is located within:
  - 50 m of the boundary of the site; or
  - 50 m of the route(s) used by construction vehicles on public roads, up to 250 m from the site entrance.

This step is noted as having deliberately been chosen to be conservative and will require assessments for most projects.

Step 2a – Assessment of Scale and Nature of the Works

Step 2a of the assessment provides "dust emissions magnitudes" for each of four dust generating activities; demolition, earthworks, construction, and track-out (the movement of site material onto public roads by vehicles). The magnitudes are: Large; Medium; or Small, with suggested definitions for each category. The definitions given in the IAQM guidance for demolition, earthworks, construction activities and track-out, are as follows:

- Demolition (Any activity involved with the removal of an existing structure [or structures]. This may also be referred to as de-construction, specifically when a building is to be removed a small part at a time):
  - **Large**: Total building volume greater than 75,000 m^3, potentially dusty construction material (e.g. concrete), on-site crushing and screening, demolition activities higher than 12 m above ground level.
  - **Medium**: Total building volume 12,000 m^3 – 75,000 m^3, potentially dusty construction material, demolition activities 6-12 m above ground level.
  - **Small**: Total building volume less than12,000 m^3, construction material with low potential for dust release (e.g. metal cladding or timber), demolition activities less than 6 m above ground, demolition during wetter months.
- Earthworks (Covers the processes of soil-stripping, ground-levelling, excavation and landscaping):
  - **Large**: Total site area greater than 110,000 m^2, potentially dusty soil type (e.g. clay, which will be prone to suspension when dry due to small particle size), more than 10 heavy earth moving vehicles active at any one time, formation of bunds greater than 6 m in height.
  - **Medium**: Total site area 18,000 m^2 to 110,000 m^2, moderately dusty soil type (e.g. silt), 5 to 10 heavy earth moving vehicles active at any one time, formation of bunds 3 m to 6 m in height.

- **Small**: Total site area less than 18,000 m^2, soil type with large grain size (e.g. sand), less than 5 heavy earth moving vehicles active at any one time, formation of bunds less than 4 m in height.

- Construction (Any activity involved with the provision of a new structure (or structures), its modification or refurbishment. A structure will include a residential dwelling, office building, retail outlet, road, etc.):
  - **Large**: Total building volume greater than 75,000 m^3, on site concrete batching; sandblasting.
  - **Medium**: Total building volume 12,000 m^3 to 75,000 m^3, potentially dusty construction material (e.g. concrete), on site concrete batching.
  - **Small**: Total building volume less than 12,000 m^3, construction material with low potential for dust release (e.g. metal cladding or timber).
- Track-out (The transport of dust and dirt from the construction / demolition site onto the public road network, where it may be deposited and then re-suspended by vehicles using the network):
  - **Large**: More than 50 heavy vehicle (>3.5 t) outward movements in any one day, potentially dusty surface material (e.g. high clay content), greater than 100 m of unpaved road length.
  - **Medium**: Between 20 and 50 heavy vehicle (>3.5 t) outward movements in any one day, moderately dusty surface materials (e.g. high clay content), between 50 m and 100 m of unpaved road length.
  - **Small**: Less than 20 heavy vehicle (>3.5 t) outward movements in any one day, surface materials with a low potential for dust release, less than 50 m of unpaved road length.

In order to provide a conservative assessment of potential impacts, it has been assumed that if at least one of the parameters specified in the 'large' definition is satisfied, the works are classified as large, and so on.

Step 2b – Risk Assessment

Assessing Sensitivity of the Area

Step 2b of the assessment process requires the sensitivity of the area to be defined. The sensitivity of the area takes into account:

- The specific sensitivities that identified sensitive receptors have to dust deposition and human health impacts
- The proximity and number of those receptors
- In the case of PM_{10}, the local background concentration
- Other site-specific factors, such as whether there are natural shelters such as trees to reduce the risk of wind-blown dust.

Individual human receptors are classified as having high, medium or low sensitivity to either dust deposition or human health impacts. The IAQM method provides guidance on the sensitivity of different human receptor types to dust soiling and health effects as summarised in **Table A-1**. The definitions and examples given in the IAQM Guidance for ecological receptors have been modified in **Table A-1** to be relevant to the Australian context based on advice from SLR's ecological specialist team.

It is noted in the IAQM Guidance that people's expectations of amenity levels (dust soiling) is also dependent on existing deposition levels.

Table A1 IAQM Guidance for Categorising Receptor Sensitivity

Value	High Sensitivity Receptor	Medium Sensitivity Receptor	Low Sensitivity Receptor
Dust soiling	Users can reasonably expect a high level of amenity; or The appearance, aesthetics or value of their property would be diminished by soiling, and the people or property would reasonably be expected to be present continuously, or at least regularly for extended periods as part of the normal pattern of use of the land.	Users would expect to enjoy a reasonable level of amenity, but would not reasonably expect to enjoy the same level of amenity as in their home; or The appearance, aesthetics or value of their property could be diminished by soiling; or The people or property wouldn't reasonably be expected to be present here continuously or regularly for extended periods as part of the normal pattern of use of the land.	The enjoyment of amenity would not reasonably be expected; or Property would not reasonably be expected to be diminished in appearance, aesthetics or value by soiling; or There is transient exposure, where the people or property would reasonably be expected to be present only for limited periods of time as part of the normal pattern of use of the land.
	Examples: Dwellings, museums, medium and long term car parks and car showrooms.	*Examples: Parks and places of work.*	*Examples: Playing fields, farmland (unless commercially-sensitive horticultural), footpaths, short term car parks and roads.*
Health effects	Locations where the public are exposed over a time period relevant to the air quality objective for PM_{10} (in the case of the 24-hour objectives, a relevant location would be one where individuals may be exposed for eight hours or more in a day).	Locations where the people exposed are workers, and exposure is over a time period relevant to the air quality objective for PM_{10} (in the case of the 24-hour objectives, a relevant location would be one where individuals may be exposed for eight hours or more in a day).	Locations where human exposure is transient.
	Examples: Residential properties, hospitals, schools and residential care homes.	*Examples: Office and shop workers, but will generally not include workers occupationally exposed to PM_{10}.*	*Examples: Public footpaths, playing fields, parks and shopping street.*

According to the IAQM methods, the sensitivity of the identified individual receptors (as described above) is then used to assess the *sensitivity of the area* surrounding the active construction area, taking into account the proximity and number of those receptors, and the local background PM_{10} concentration (in the case of potential health impacts) and other site-specific factors. Additional factors to consider when determining the sensitivity of the area include:

- Any history of dust generating activities in the area;

- The likelihood of concurrent dust generating activity on nearby sites;
- Any pre-existing screening between the source and the receptors;
- Any conclusions drawn from analysing local meteorological data which accurately represent the area and if relevant, the season during which the works will take place;
- Any conclusions drawn from local topography;
- The duration of the potential impact (as a receptor may be willing to accept elevated dust levels for a known short duration, or may become more sensitive or less sensitive (acclimatised) over time for long-term impacts); and
- any known specific receptor sensitivities which go beyond the classifications given in the IAQM document.

The IAQM guidance for assessing the sensitivity of an area to dust soiling is shown in **Table A2**. The sensitivity of the area should be derived for each of activity relevant to the project (i.e. construction and earthworks).

Table A2 IAQM Guidance for Categorising the Sensitivity of an Area to Dust Soiling Effects

Receptor sensitivity	Number of receptors	Distance from the source (m)			
		<20	<50	<100	<250
High	>100	High	High	Medium	Low
	10-100	High	Medium	Low	Low
	1-10	Medium	Low	Low	Low
Medium	>1	Medium	Low	Low	Low
Low	>1	Low	Low	Low	Low

Note: Estimate the total number of receptors within the stated distance. Only the *highest level* of area sensitivity from the table needs to be considered. For example, if there are 7 high sensitivity receptors < 20m of the source and 95 high sensitivity receptors between 20 and 50 m, then the total of number of receptors < 50 m is 102. The sensitivity of the area in this case would be high.

A modified version of the IAQM guidance for assessing the *sensitivity of an area* to health impacts is shown in **Table A-3**. For high sensitivity receptors, the IAQM methods takes the existing background concentrations of PM_{10} (as an annual average) experienced in the area of interest into account and is based on the air quality objectives for PM_{10} in the UK. As these objectives differ from the ambient air quality criteria adopted for use in this assessment (i.e. an annual average of 25 µg/m^3 for PM_{10}) the IAQM method has been modified slightly.

- This approach is consistent with the IAQM guidance, which notes that in using the tables to define the *sensitivity of an area*, professional judgement may be used to determine alternative sensitivity categories, taking into account the following factors:
- any history of dust generating activities in the area;
- the likelihood of concurrent dust generating activity on nearby sites;
- any pre-existing screening between the source and the receptors;
- any conclusions drawn from analysing local meteorological data which accurately represent the area, and if relevant the season during which the works will take place;
- any conclusions drawn from local topography;
- duration of the potential impact; and
- any known specific receptor sensitivities which go beyond the classifications given in this document.

Table A-3 IAQM Guidance for Categorising the Sensitivity of an Area to Dust Health Effects

Receptor sensitivity	Annual mean PM_{10} conc.	Number of receptors [a,b]	Distance from the source (m)				
			<20	<50	<100	<200	<250
High	>25 µg/m³	>100	High	High	High	Medium	Low
		10-100	High	High	Medium	Low	Low
		1-10	High	Medium	Low	Low	Low
	21-25 µg/m³	>100	High	High	Medium	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	High	Medium	Low	Low	Low
	17-21 µg/m³	>100	High	Medium	Low	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	<17 µg/m³	>100	Medium	Low	Low	Low	Low
		10-100	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Medium	>25 µg/m³	>10	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	21-25 µg/m³	>10	Medium	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
	17-21 µg/m³	>10	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
	<17 µg/m³	>10	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Low	-	>1	Low	Low	Low	Low	Low

Notes: (a) Estimate the total within the stated distance (e.g. the total within 350 m and not the number between 200 and 350 m); noting that only the highest level of area sensitivity from the table needs to be considered.

(b) In the case of high sensitivity receptors with high occupancy (such as schools or hospitals) approximate the number of people likely to be present. In the case of residential dwellings, just include the number of properties.

Risk Assessment

The dust emission magnitude from Step 2a and the receptor sensitivity from Step 2b are then used in the matrices shown in **Table A4** (demolition), **Table A5** (earthworks and construction) and **Table A6** (track-out) to determine the risk category with no mitigation applied.

Table A4 Risk Category from Demolition Activities

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Medium Risk

Medium	High Risk	Medium Risk	Low Risk
Low	Medium Risk	Low Risk	Negligible

Table A5 Risk Category from Earthworks and Construction Activities

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible

Table A6 Risk Category from Track-out Activities

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Low Risk	Negligible
Low	Low Risk	Low Risk	Negligible

Step 3 - Site-Specific Mitigation

Once the risk categories are determined for each of the relevant activities, site-specific management measures can be identified based on whether the Site is a low, medium or high risk site.

Step 4 – Residual Impacts

Following Step 3, the residual impact is then determined after management measures have been considered.

Appendix B

GENERAL MITIGATION MEASURES

Table B-1 lists the relevant general mitigation measures designated as *highly recommended* (H) or *desirable* (D) by the dust IAQM method for a development shown to have a high risk of adverse impacts. Not all these measures would be practical or relevant to the Project therefore a detailed review of the recommendations should be performed, and the most appropriate measures be adopted as part of the Construction Environmental Management Plan (CEMP). For almost all construction activity, the dust IAQM method notes that the aim should be to prevent significant effects on receptors through the use of effective mitigation and experience shows that this is normally possible.

Table B-1 Site-Specific Management Measures Recommended by the IAQM

	Activity	Highly recommended or Desirable
1	Develop and implement a stakeholder communications plan that includes community engagement before work commences on site.	H
2	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.	H
3	Display the head or regional office contact information.	H
4	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.	H
Site Management		
5	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.	H
6	Make the complaints log available to the local authority when asked.	H
7	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.	H
Monitoring		
8	Undertake daily 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. This should include regular dust soiling checks of surfaces such as street furniture, cars and window sills within 100 m of site boundary, with cleaning to be provided if necessary.	D
9	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.	H
10	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.	H
11	Agree dust deposition, dust flux, or real-time PM continuous monitoring locations 10 with the Local Authority. Where possible commence baseline monitoring at least three months before work commences on site or, if it a large site, before work on a phase commences. Further guidance is provided by IAQM on monitoring during demolition, earthworks and construction.	H
Preparing and Maintaining the Site		

	Activity	Highly recommended or Desirable
12	Plan site layout so that machinery and dust causing activities are located away from receptors, as far as is possible.	H
13	Erect solid screens or barriers around dusty activities or the site boundary that are at least as high as any stockpiles on site.	H
14	Fully enclose site or specific operations where there is a high potential for dust production and the site is actives for an extensive period	H
15	Avoid site runoff of water or mud.	H
16	Keep site fencing, barriers and scaffolding clean using wet methods.	H
17	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.	H
18	Cover, seed, or fence stockpiles to prevent wind whipping.	H
Operating Vehicle/Machinery and Sustainable Travel		
19	Ensure all vehicles switch off engines when stationary - no idling vehicles.	H
20	Avoid the use of diesel or petrol powered generators and use mains electricity or battery powered equipment where practicable.	H
21	Impose and signpost a maximum-speed-limit of 15 mph on surfaced and 10 mph 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).	D
22	Produce a Construction Logistics Plan to manage the sustainable delivery of goods and materials.	H
23	Implement a Travel Plan that supports and encourages sustainable travel (public transport, cycling, walking, and car-sharing).	D
Operations		
24	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.	H
25	Ensure an adequate water supply on the site for effective dust/particulate matter suppression/mitigation, using non-potable water where possible and appropriate.	H
26	Use enclosed chutes and conveyors and covered skips.	H
27	Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on such equipment wherever appropriate.	H
28	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.	H
Waste Management		
29	Avoid bonfires and burning of waste materials.	H

Appendix C

OPERATIONAL PHASE RISK ASSESSMENT METHODOLOGY

Nature of Impact

Predicted impacts may be described in terms of the overall effect upon the environment:

- **Beneficial**: the predicted impact will cause a beneficial effect on the receiving environment.
- **Neutral**: the predicted impact will cause neither a beneficial nor adverse effect.
- **Adverse**: the predicted impact will cause an adverse effect on the receiving environment.

Receptor Sensitivity

Sensitivity may vary with the anticipated impact or effect. A receptor may be determined to have varying sensitivity to different environmental changes, for example, a high sensitivity to changes in air quality, but low sensitivity to noise impacts. Sensitivity may also be derived from statutory designation which is designed to protect the receptor from such impacts.

Sensitivity terminology may vary depending upon the environmental effect, but generally this may be described in accordance with the following broad categories - Very high, High, Medium and Low.

Table C-1 outlines the methodology used in this study to define the sensitivity of receptors to air quality impacts.

Table C-1 Methodology for Assessing Sensitivity of a Receptor

Sensitivity	Criteria
Very High	Receptors of very high sensitivity to air pollution (e.g. dust or odour) such as: hospitals and clinics, and retirement homes.
High	Receptors of high sensitivity to air pollution, such as: schools, residential areas, food retailers, glasshouses and nurseries.
Medium	Receptors of medium sensitivity to air pollution, such as: farms / horticultural land, offices/recreational areas, painting and furnishing, hi-tech industries and food processing, and outdoor storage (ie new cars).
Low	All other air quality sensitive receptors not identified above, such as light and heavy industry.

Magnitude

Magnitude describes the anticipated scale of the anticipated environmental change in terms of how that impact may cause a change to baseline conditions. Magnitude may be described quantitatively or qualitatively. Where an impact is defined by qualitative assessment, suitable justification is provided in the text.

Table C-2 Magnitude of Impacts

Magnitude	Description
Substantial	Impact is predicted to cause significant consequences on the receiving environment (may be adverse or beneficial)

Magnitude	Description
Moderate	Impact is predicted to possibly cause statutory objectives/standards to be exceeded (may be adverse)
Slight	Predicted impact may be tolerated.
Negligible	Impact is predicted to cause no significant consequences.

Significance

The risk-based matrix provided below illustrates how the definition of the sensitivity and magnitude interact to produce impact significance.

Table C-3 Impact Significance Matrix

Magnitude / Sensitivity		[Defined by Table B2]			
		Substantial Magnitude	Moderate Magnitude	Slight Magnitude	Negligible Magnitude
[Defined by TableB1]	**Very High Sensitivity**	Major Significance	Major/ Intermediate Significance	Intermediate Significance	Neutral Significance
	High Sensitivity	Major/ Intermediate Significance	Intermediate Significance	Intermediate/Minor Significance	Neutral Significance
	Medium Sensitivity	Intermediate Significance	Intermediate/Minor Significance	Minor Significance	Neutral Significance
	Low Sensitivity	Intermediate/Minor Significance	Minor Significance	Minor/Neutral Significance	Neutral Significance

Appendix D

Long Term Meteorological Data Analysis

D.1 SELECTION OF REPRESENTATIVE METEOROLOGICAL DATA

Once emitted to atmosphere, emissions will:

- Rise according to the momentum and buoyancy of the emission at the discharge point relative to the prevailing atmospheric conditions;
- Be adverted from the source according to the strength and direction of the wind at the height which the plume has risen in the atmosphere;
- Be diluted due to mixing with the ambient air, according to the intensity of turbulence; and
- (Potentially) be chemically transformed and/or depleted by deposition processes.

Dispersion is the combined effect of these processes.

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

The year of meteorological data used for the dispersion modelling was selected by reviewing the most recent six years of historical surface observations from the Sydney Airport AMO (2018 to 2022 inclusive) to select the most appropriate year representative of average conditions. Annual wind direction, wind speed and ambient temperature statistics were compared to the five year averages to identify the most representative year.

Data reported from the Sydney Airport AWS from 2017 to 2021 is summarised in **Figure D-1** to **Figure D-4**. Examination of the data indicates the following:

- **Figure D-1** shows very similar wind roses for all years analysed;
-
- Figure **D-2** indicates that from 2017-2021, 2021 was closest to average;
-
- Figure **D-3** indicates that 2019 and 2020 exhibited higher than average frequencies of calm conditions across the year, with 2021 and 2022 closest to average; and
- **Figure D-4** shows relatively similar temperatures for all years analysed, with 2019 closest to the average

It is noted that background air quality data recorded in 2020 is potentially not representative of typical conditions for the region due impacts of the COVID pandemic. In addition, the Black Summer bushfire emergency in late 2019 and early 2020 had significant impacts on ambient air pollutant concentrations across the east coast of Australia (refer **Section 7.3.4**).

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

Figure D-1 Wind Roses for Sydney Airport AMO: 2018 – 2022

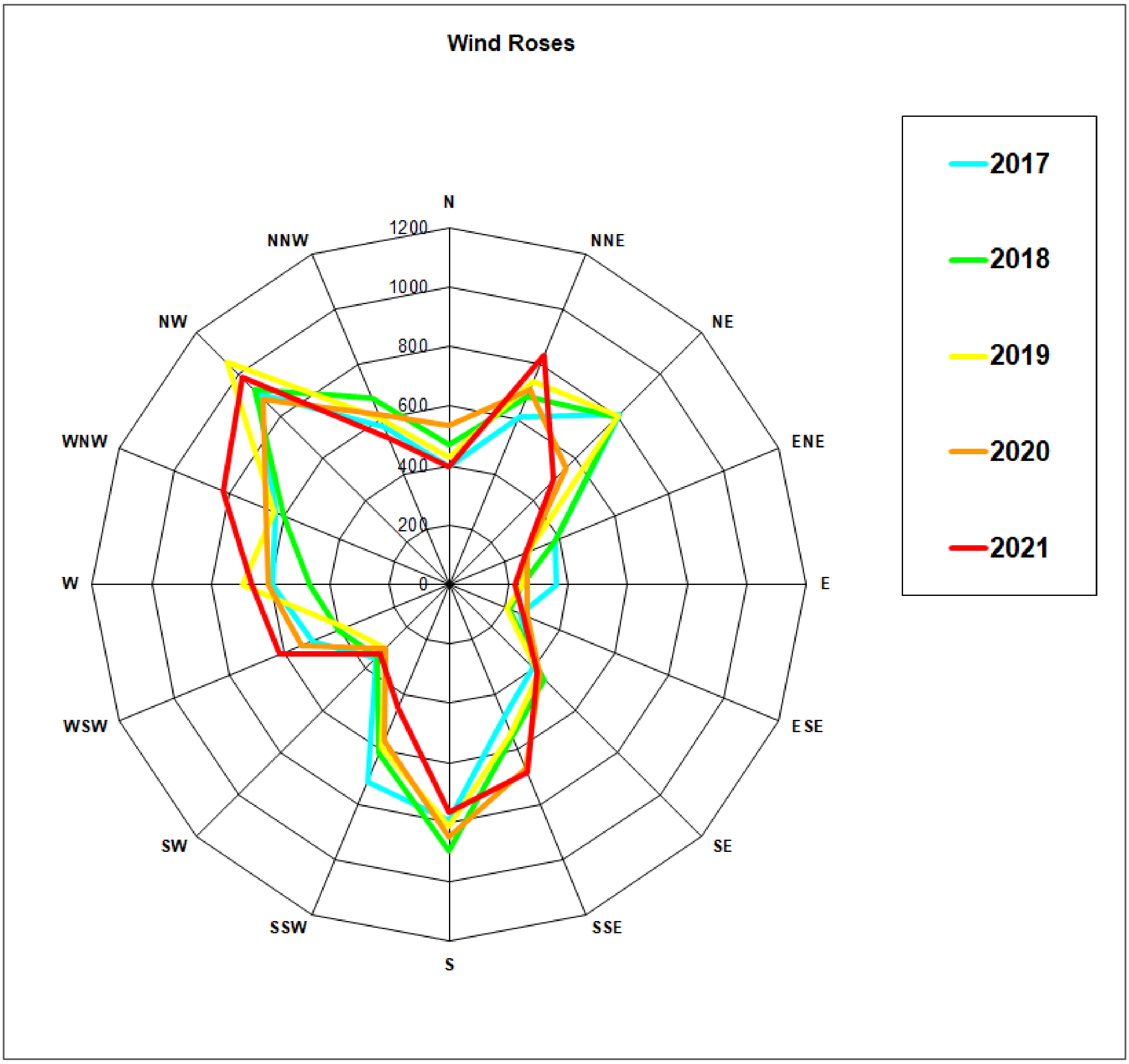


Figure D-2 Monthly Average Wind Speed for Sydney Airport AMO: 2018 – 2022

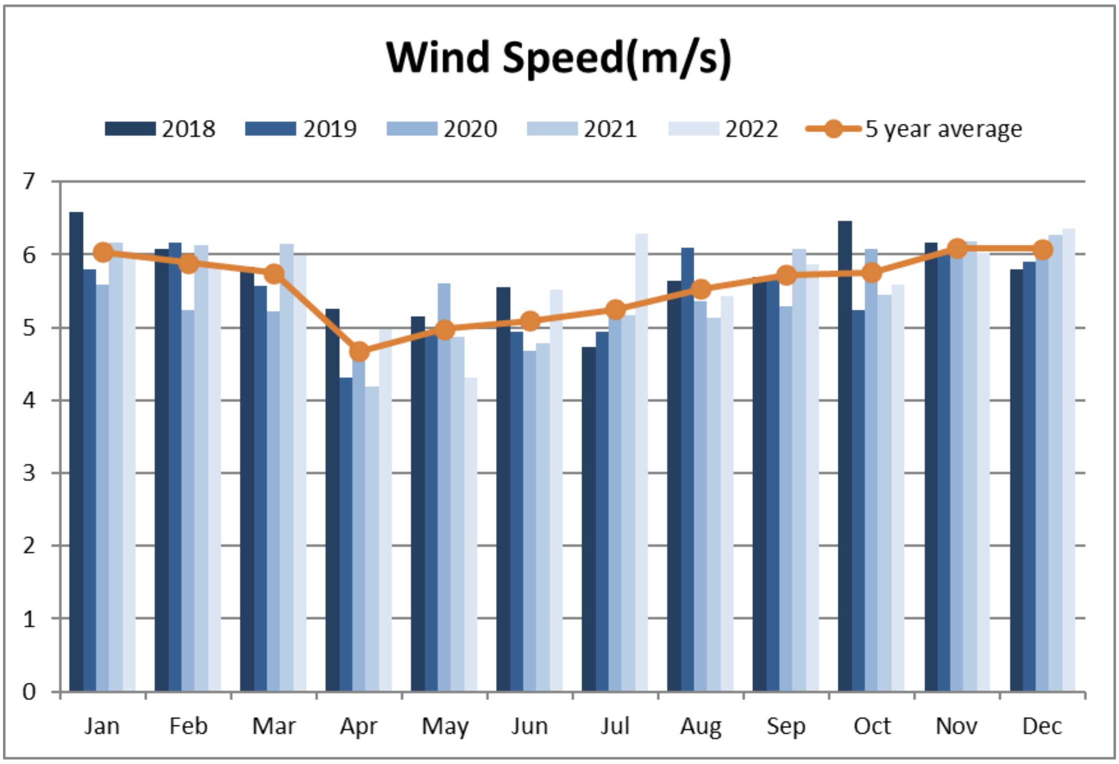


Figure D-3 Monthly Average Calm Wind Frequency for Sydney Airport AMO: 2018 – 2022

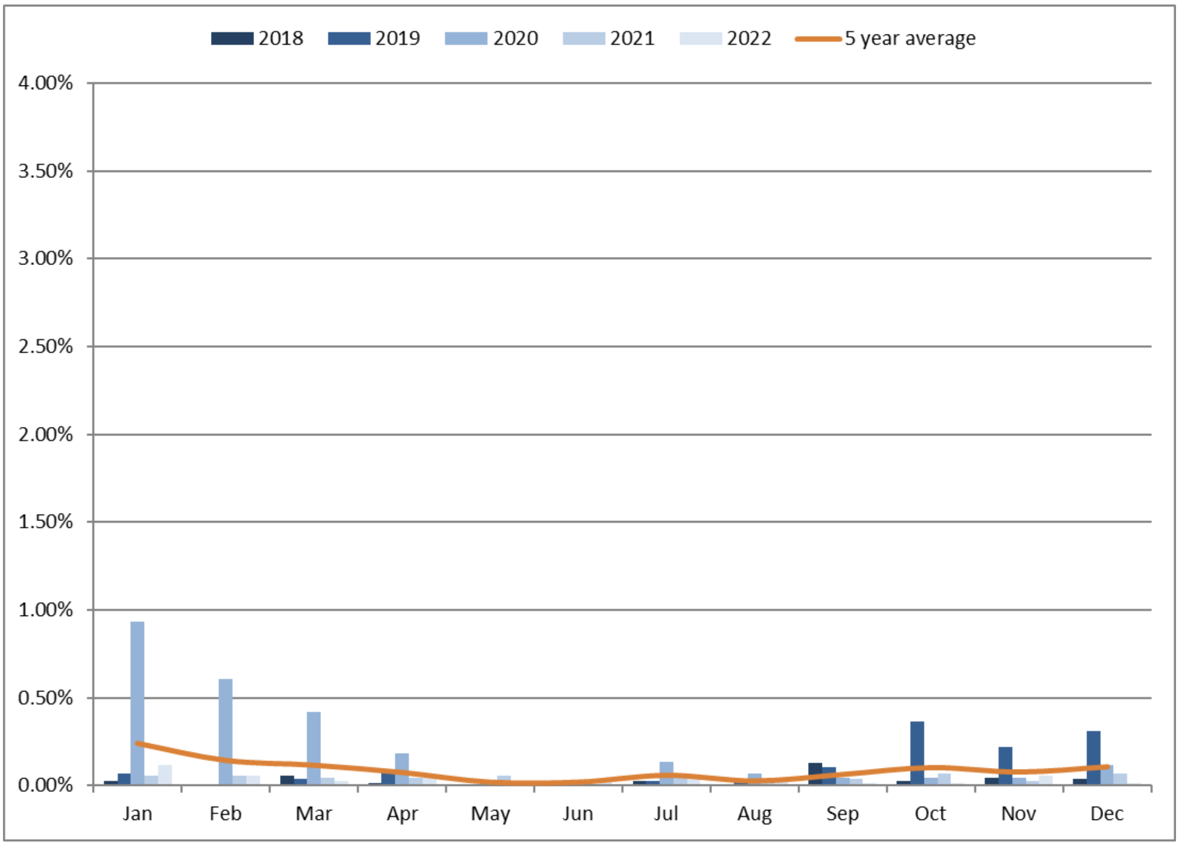
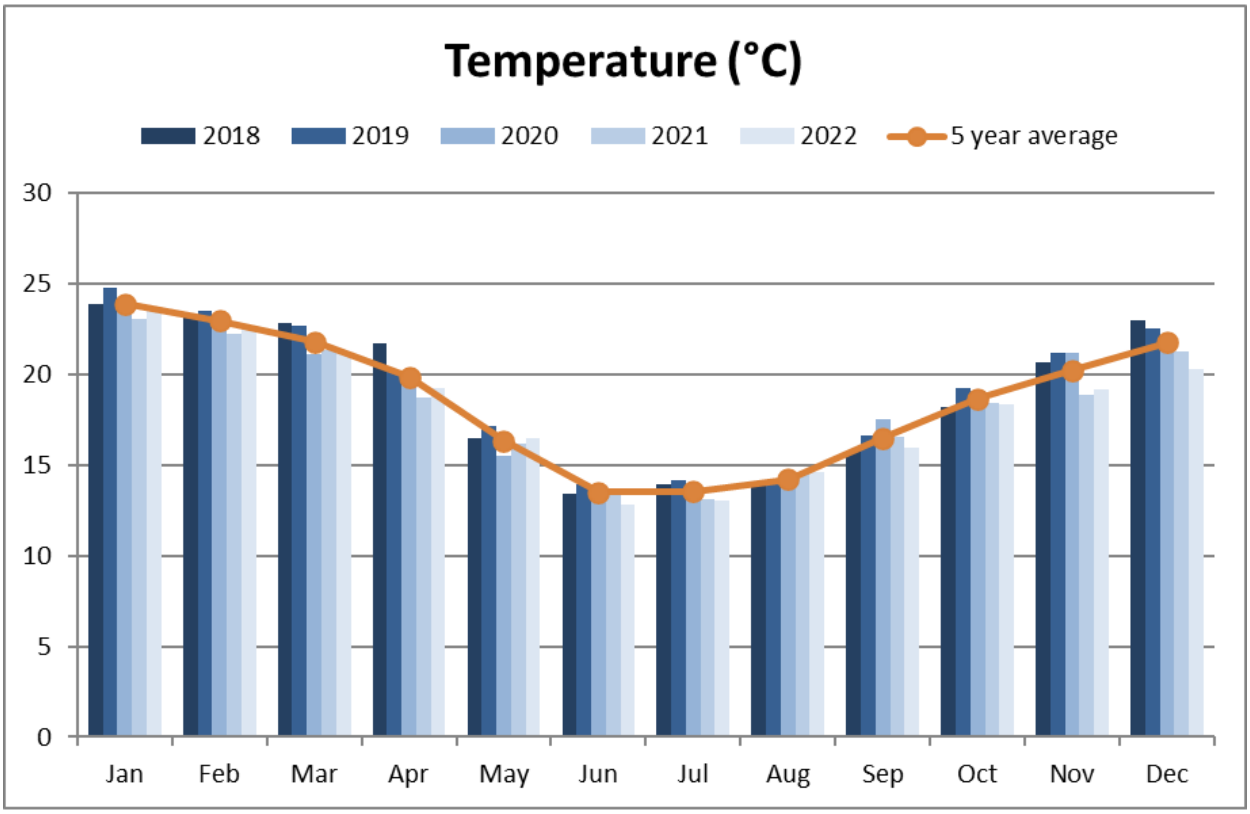


Figure D-4 Monthly Average Temperature for Sydney Airport AMO: 2018 – 2022



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