AIR QUALITY IMPACT ASSESSMENT

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

Prepared for:

Goodman Property Services (Aust) Pty Ltd

SLR Ref: 610.30907-R01
Version No: -v1.2
November 2022

EXECUTIVE SUMMARY

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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

Reference	Date	Prepared	Checked	Authorised
610.30907-R01-v1.2	2 November 2022	S Bagheri	V Marwaha	V Marwaha
610.30907-R01-v1.2	2 November 2022	S Bagheri	V Marwaha	V Marwaha
610.30907-R01-v1.1	7 October 2022	F Rahaman	J Meline	J Meline
610.30907-R01-v1.0	8 September 2022	F Rahaman	J Meline	J Meline

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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 for key pollutants 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. 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 3 and Section 7

2 Site Description

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 34,614sqm. The site adjoins Burrows Road to the east with a primary curved frontage of approximately 528 metres and adjoins Canal Road to the west with a secondary frontage of approximately 289 metres.

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 to the immediate south of the St Peters WestConnex Interchange and well-connected to the 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 metres to the south-east and east.

The Project site is shown in **Figure 1** and relative location of the Project site and ventilation outlets are presented in **Figure 2**.

Figure 1 Location Plan

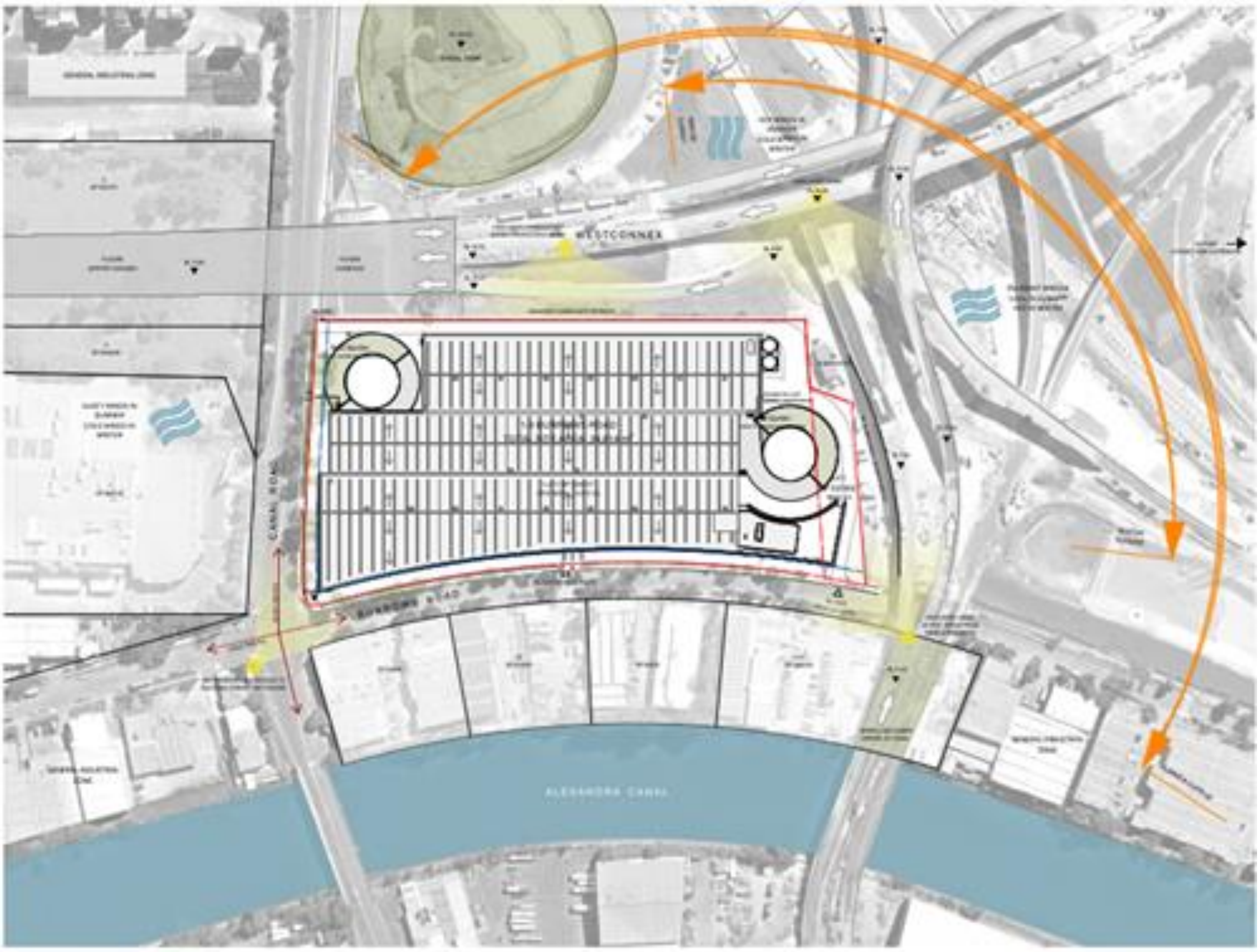


Figure 2 Relative Location - Project and Ventilation Outlets

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 Welsh and Major throughout the preparation of this SSDA and generally as part of the ongoing detailed design phase of the project.

3.3 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.

This detailed SSDA follows on from the Competitive Design Alternatives Process (competitive design process) undertaken between January and April 2022, whereby, the winning project architects Welsh and Major (W&M) were announced by the Selection Jury (Jury).

This proposed 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 a three-storey industrial warehouse and distribution centre building with an ancillary office building, including:
  - Approximately ~~51,920~~52,150 sqm of total GFA, comprising:
  - ~~46,798~~47,076 sqm of warehouse and distribution centre GFA; and
  - ~~5,122~~5,014 sqm of GFA for ancillary office space and retail (café).
- Maximum building height of RL 33.18 (~~30.14~~31.98 height in metres).
- Operation 24 hours per day seven days a week.

- Provision of a single storey under croft basement car parking area accessed off Burrows Road which provides 224 car parking spaces (including 12 accessible bays and carshare spaces), 19 motorcycle spaces and end-of-trip facilities (including ~~72~~ 73 bicycle parking spaces, showers, lockers and change rooms).
- Site landscaping works including two 6-metre 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.

This report has been prepared to address potential air quality issues 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 phase of the Project. This report provides the following:

- 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 associated with the significant air emission sources in surrounding areas.

4 Potential Sources of Emissions

4.1 Construction

The main air quality issue associated with construction works (including remediation 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;
- Combustion emissions from fixed and mobile equipment/machinery;
- Wheel-generated dust from vehicles travelling on unpaved surfaces; and
- 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; and
- Rainfall or dew - rainfall or heavy dew that wets the surface of the soil reduces the risk of dust generation.

Where diesel-powered mobile machinery and vehicles are 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 will be 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.

4.2 Warehousing 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) associated with 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, 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 - Ventilation Outlets

Based on a desktop review and considering the height of the proposed building, ventilation outlets associated with the operation of M8 and M4-M5 tunnels located to the north and northeast of the Project site have the potential to give rise in the pollutant levels at elevated levels of the proposed buildings. Given this, a detailed air quality assessment has been carried out to quantify the potential impacts at elevated levels of the proposed building.

4.3.1 Identification of Air Emissions

The key air emissions from the operation of these ventilation outlets would be emissions of products of combustion, these includes:

- 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)
- Sulfur 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 low level of CO and SO_2 emissions from vehicles and the low ambient concentrations typically recorded in urban areas in Australia, it is reasonable to assume that CO and SO_2 emissions from road traffic are unlikely to result in any exceedances of the relevant criteria at the Development 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), which will have significantly higher traffic volumes than the roads surrounding the Development Site, 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 traffic emissions have not been considered further in this study, and only emissions of NO_X, PM_{10} and $PM_{2.5}$ have been assessed.

4.4 Relevant Air Quality Assessment Criteria

Section 7.1 of the Approved Methods (NSW EPA, 2017) outlines the impact assessment criteria for the pollutants identified 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 the AQA are summarised in **Table 2**.

Table 2 Air Quality Assessment Criteria Adopted for this Study

Pollutant	Averaging Period	Assessment Criteria	Source
PM_{10}	24-Hour	50 µg/m³	Approved Methods, 2017
	Annual	25 µg/m³	Approved Methods, 2017
$PM_{2.5}$	24-Hour	25 µg/m³	Approved Methods, 2017
	Annual	8 µg/m³	Approved Methods, 2017
NO_2	1-hour	246 µg/m³	Approved Methods, 2017
	Annual	62 µg/m³	Approved Methods, 2017

5 Receiving Environment

5.1 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 (IN1) 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 amenities (such as office buildings or 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 Uses

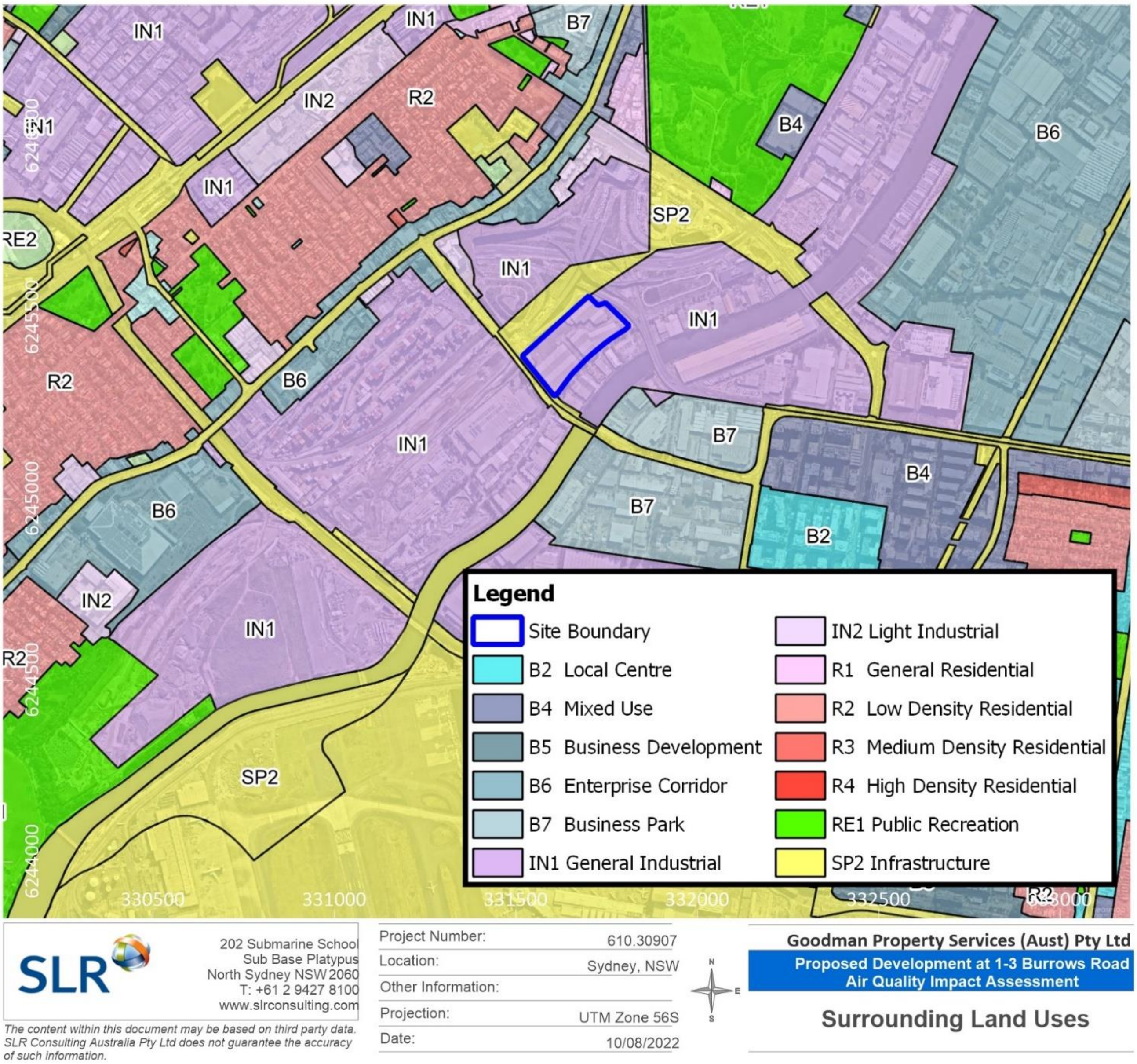
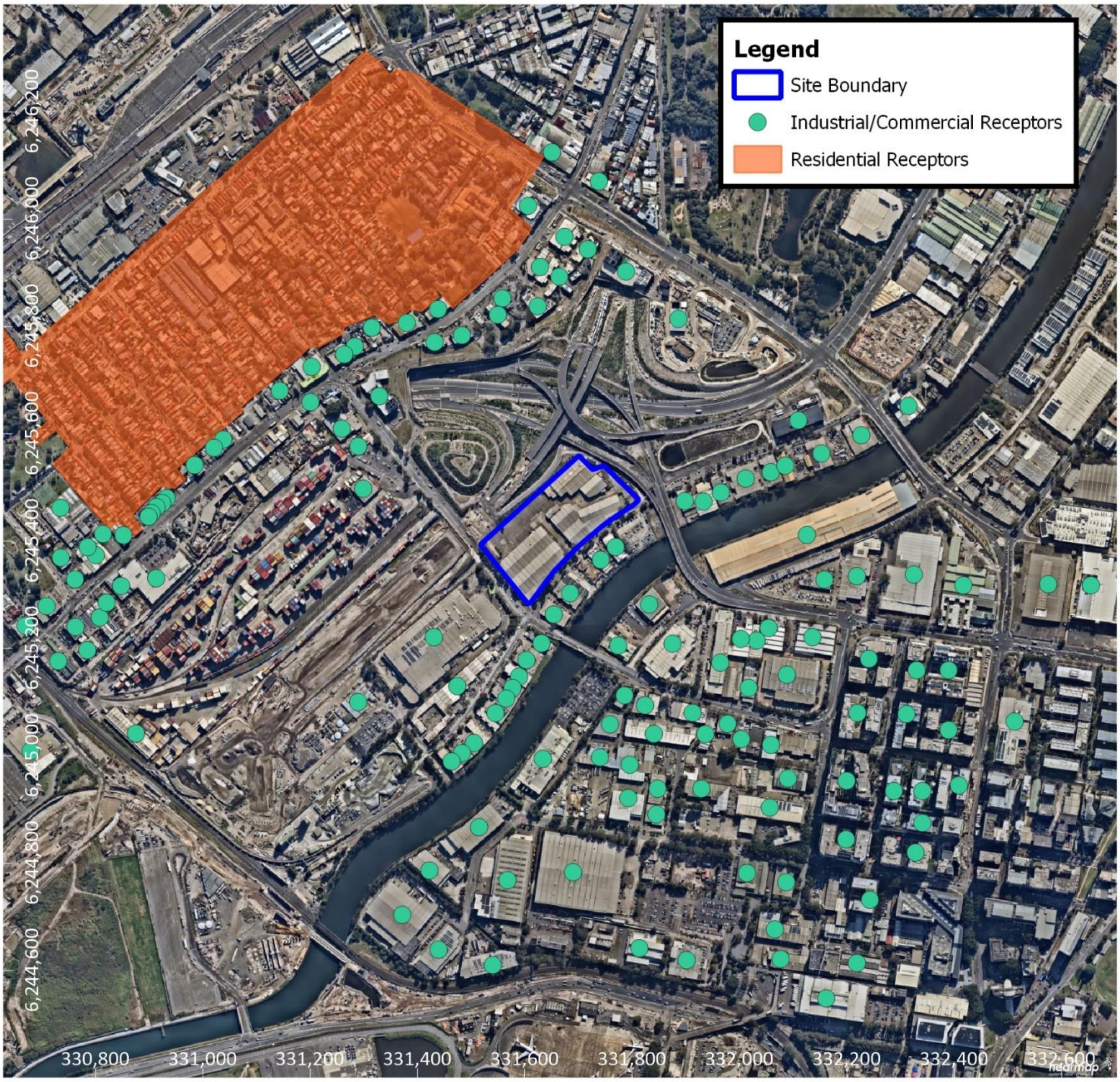


Figure 4 Surrounding Receptors



SLR 202 Submarine School Sub Base Platypus North Sydney NSW 2060 T: +61 2 9427 8100 www.slrconsulting.com	Project Number:	610.30907
	Location:	Sydney, NSW
	Other Information:	
	Projection:	UTM Zone 56S
	Date:	10/08/2022

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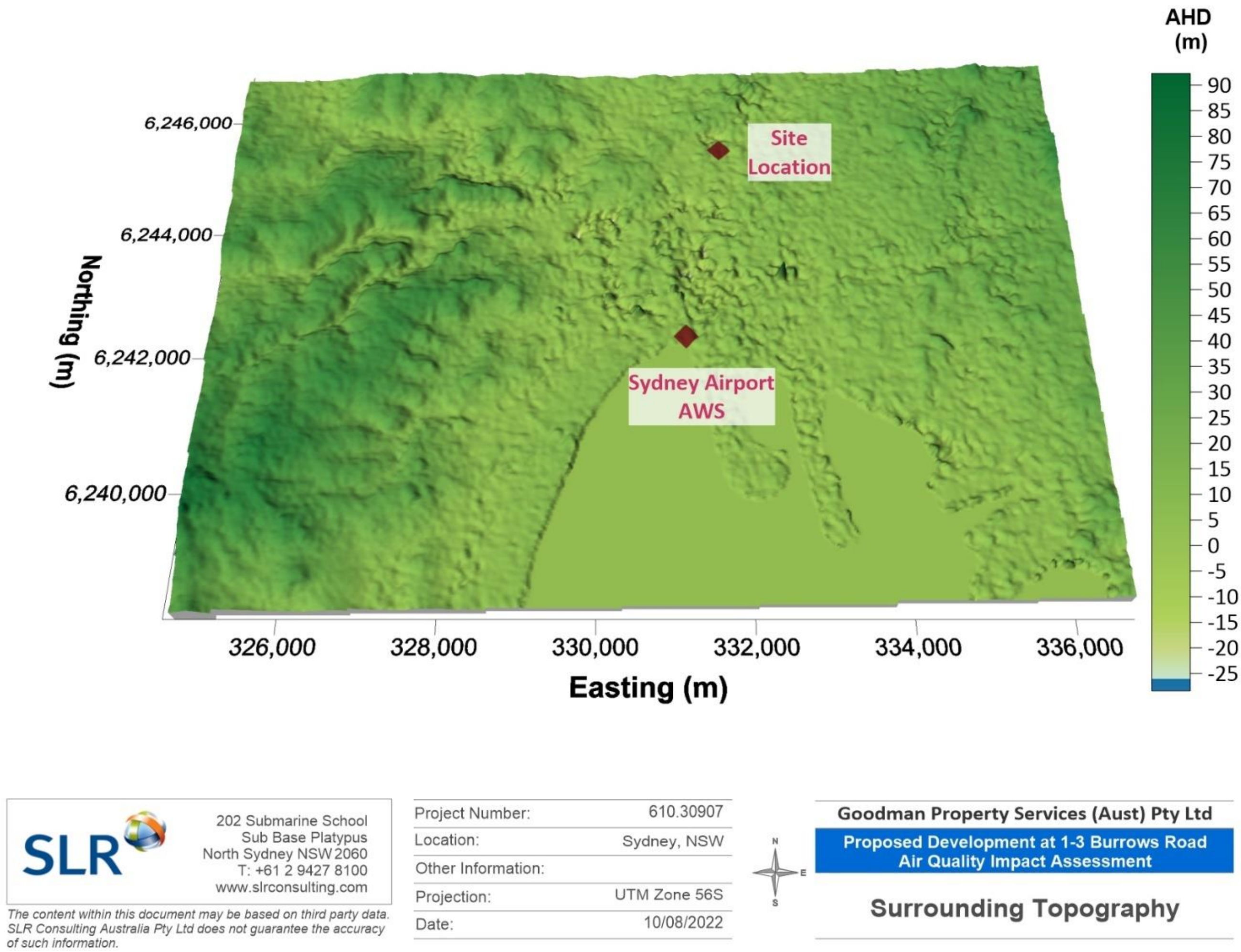
Goodman Property Services (Aust) Pty Ltd
Proposed Development at 1-3 Burrows Road
Air Quality Impact Assessment
Surrounding Receptors

5.2 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



6 Existing Environment

WestConnex operate an ambient air quality monitoring station (AQMS) located adjacent to the east of the Development site since June 2020 (St Peters 2). Data recorded at this station in 2021 (calendar year) were analysed to establish the background level for this assessment. It is noted that the M8 and M4-M5 tunnel ventilation outlets were in operation in this period and that the ambient monitoring data recorded at this station would include contribution from these ventilation outlets. Given this, the use of this dataset as the existing background level is conservative.

Ambient monitoring data recorded at this station are summarised in **Table 3** and presented graphically in **Figure 6** to **Figure 8**. Analysis of measured ambient air quality data showed the following:

- No exceedances of the relevant maximum 1-hour and annual average NO_2 criteria were recorded in the 2021 calendar year. The highest 1-hour average NO_2 concentration of 76 µg/m³ was recorded on hour 11 of 1 September 2021.
- Exceedances of the relevant 24-hour average $PM_{2.5}$ criterion were recorded on five days in 2021. Data recorded on these days are presented in **Table 4**. Analysis of data presented in **Table 4** showed that recorded $PM_{2.5}$ concentrations were higher than recorded PM_{10} concentrations on 3rd May and 22nd August 2021. Given this, the recorded high $PM_{2.5}$ concentrations on these days were likely 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). Recorded annual average $PM_{2.5}$ concentration at the Saint Peters 2 AQMS was well below the relevant criterion.
- 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 – St Peters 2 AQMS

Parameter	NO_2 (µg/m³)	$PM_{2.5}$ (µg/m³)	PM_{10} (µg/m³)
Averaging Period	1-Hour	24-Hour	24-Hour
Maximum	76	39	41
2nd Highest	74	33	37
3rd Highest	71	30	36
4th Highest	71	28	35
5th highest	70	28	34
6th Highest	70	23	34
90th percentile	42	11	27
70th percentile	28	7	20
Median	17	6	17
Average	20	6.7	18
Criteria	**246**	**25**	**50**
Number of exceedances	**0**	**2**	**0**

Table 4 Data Recorded on Days of Exceedances

Date	24-Hour Average Concentrations (µg/m³)	
	$PM_{2.5}$	PM_{10}
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

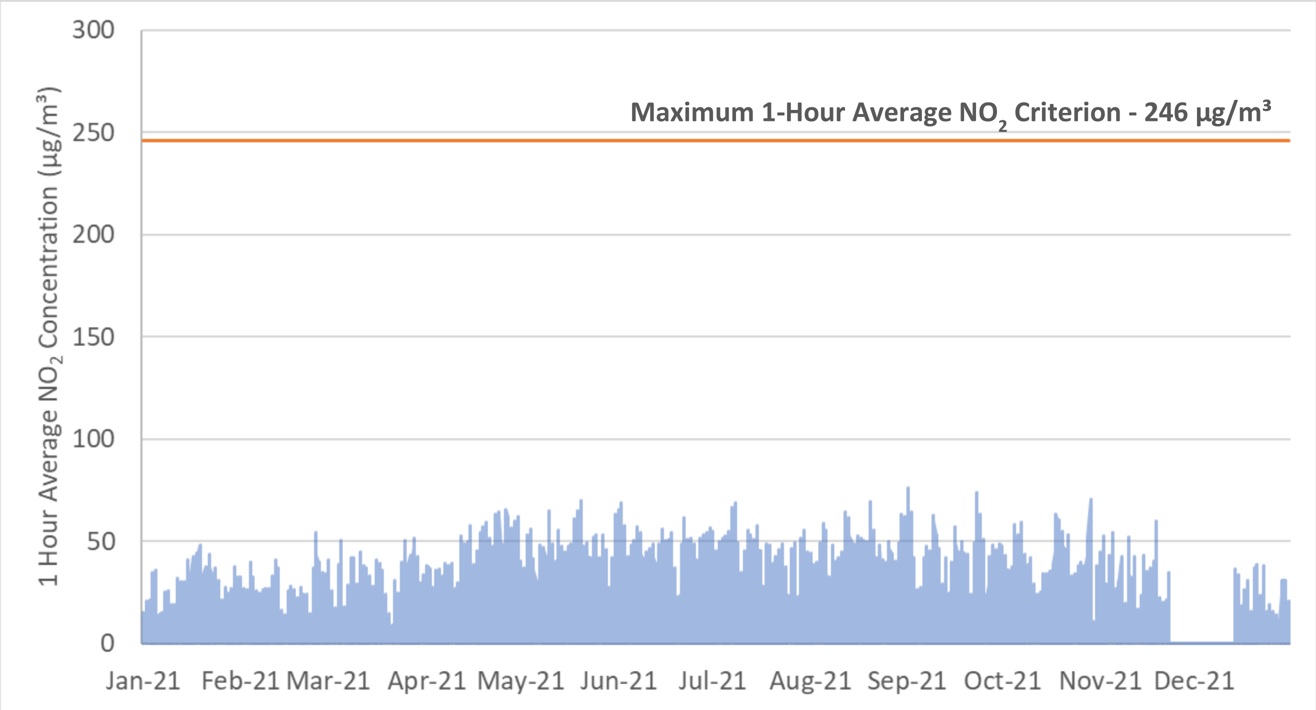


Figure 7 Measured 24-Hour Average $PM_{2.5}$ Concentrations at St Peters 2 AQMS

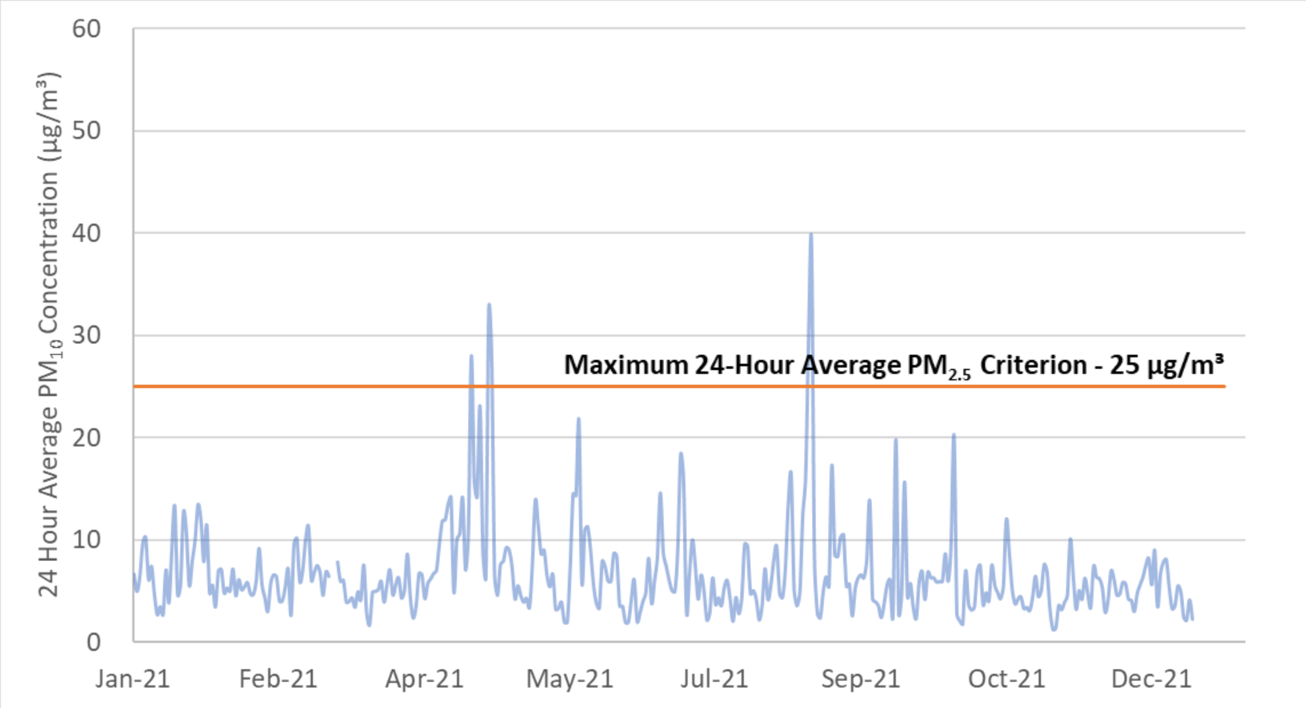
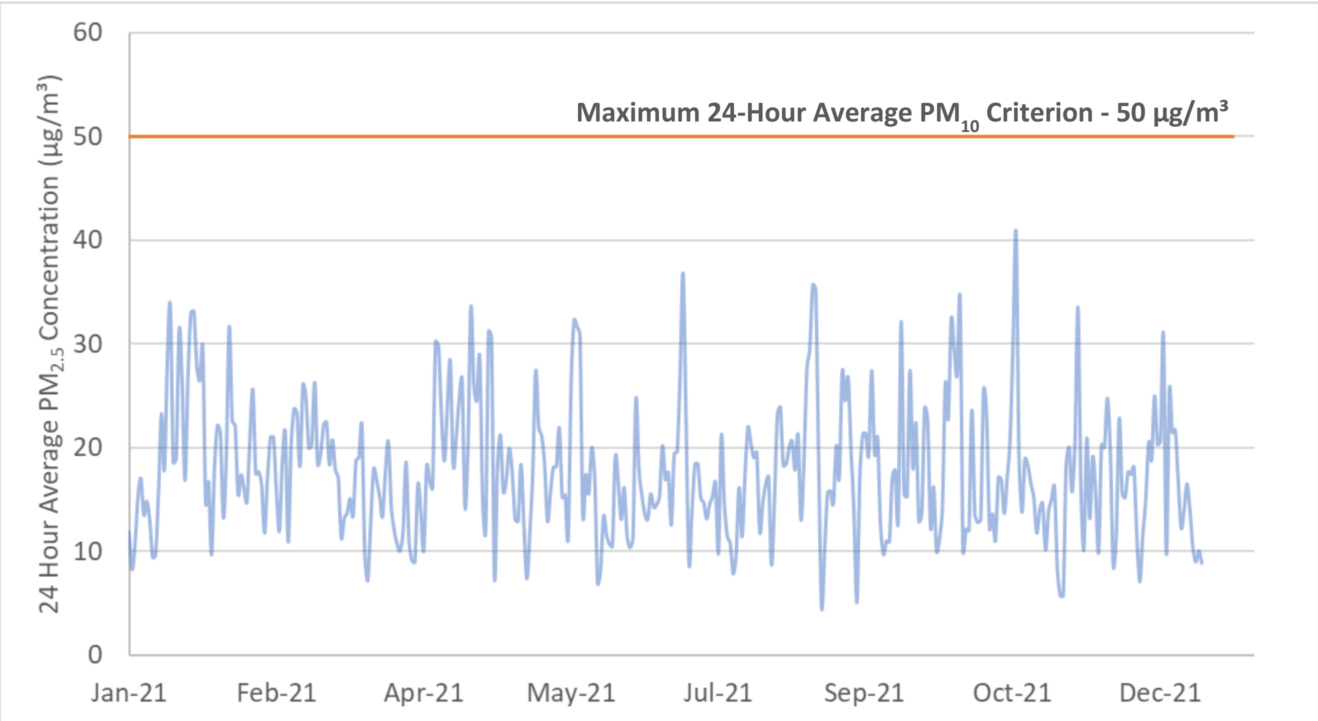


Figure 8 Measured 24-Hour Average PM_{10} Concentrations at St Peters 2 AQMS



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. Potential impacts of dust emissions associated with proposed demolition and construction activities at the Site has been performed based on the methodology outlined in the Institute of Air Quality Management (UK) (IAQM) document, "*Assessment of dust from demolition and construction*" (Holman et al 2014). This guidance document provides a structured approach for classifying construction sites according to the risk of air quality impacts, to identify relevant mitigation measures appropriate to the risk (see **Appendix A** for full methodology).

The IAQM approach has been used widely in Australia for the assessment of air quality impacts from construction projects and the identification of appropriate mitigation measures and has been accepted by regulators across all states and territories for a variety of construction projects.

The IAQM method uses a four-step process 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 noted that that detailed information regarding construction activities and equipment were not available at the time of preparing this report, hence SLR has made conservative assumptions where necessary to assess impacts from construction activities. If these parameters were to be significantly modified, re-assessment of construction impacts may be recommended.

7.2 Operational Phase Qualitative Assessment

A risk-based qualitative assessment approach has also been adopted for odour emissions due to the proposed operational activities at the Site as well as air quality impacts due to mobile plant and delivery vehicles (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 Assessment of Impacts – M8 and M4-M5 Ventilation Outlets on the Project

7.3.1 Emission Estimation

7.3.1.1 Emission Sources

Two ventilation outlets from the M8 and M4-M5 link tunnels are currently operating within 500 m of the proposed Development site. Each ventilation outlet consists of four ventilation shafts. The location of these ventilation shaft and physical parameters adopted for this assessment are presented in **Table 5**.

Table 5 Stack location and Parameters

Ventilation Outlet	Easting (m)	Northing (m)	Height (m)	Diameter (m)
M8 Ventilation Stack	331,345	6,245,655	20	5.4
	331,351	6,245,660		
	331,356	6,245,653		
	331,350	6,245,649		
M4-M5 Ventilation Stack	331,754	6,245,925		
	331,764	6,245,940		
	331,773	6,245,933		
	331,764	6,245,918		

7.3.1.2 Stack Emission

Emissions from the WestConnex M8 tunnel ventilation outlet were sourced from hourly varying stack concentration and exhaust air flowrate data recorded by the Continuous Emission Monitoring System (CEMS) operated by WestConnex for the 2021 calendar year. Stack monitoring data for the M4-M5 link tunnel, located approximately 400 m northeast of the Development site were not available at the time of preparing this assessment. It was assumed that air emissions for the M4-M5 ventilation stacks would be similar to that recorded for M8 tunnel ventilation stack.

A statistical summary of hourly varying stack emission rates calculated based on measured stack concentrations and flowrate data for each shaft of the M8 tunnel ventilation stack recorded for the calendar year of 2021 is presented in **Table 6**.

It is noted that CEMS data do not record particle size distribution or in stack concentration of $PM_{2.5}$ and PM_{10} pollutants. Given this, as a conservative approach, recorded total particulate concentrations were assumed to be representative of $PM_{2.5}$ concentrations.

Table 6 Statistical Summary of Calculated Stack Emission Rates

Percentile	Shaft 1			Shaft 2			Shaft 3			Shaft 4		
	NO_x (g/s)	CO (g/s)	Particulate (g/s)	NO_x (g/s)	CO (g/s)	Particulate (g/s)	NOx (g/s)	CO (g/s)	Particulate (g/s)	NO_x (g/s)	CO (g/s)	Particulate (g/s)
Maximum	0.71	0.79	0.118	0.81	0.74	0.073	0.76	0.83	0.134	0.63	0.97	0.145
95th	0.17	0.24	0.010	0.17	0.21	0.009	0.31	0.35	0.016	0.33	0.37	0.017
90th	0.13	0.18	0.007	0.12	0.15	0.007	0.24	0.26	0.012	0.26	0.29	0.013
70th	0.03	0.06	0.002	0.03	0.04	0.002	0.12	0.17	0.007	0.12	0.17	0.007
Median	0.01	0.02	0.001	0.01	0.01	0.0004	0.06	0.10	0.004	0.06	0.10	0.004
Average	0.04	0.06	0.002	0.04	0.05	0.002	0.10	0.13	0.006	0.10	0.13	0.006

7.3.2 Selection of Models

Air Emissions associated with the operation of ventilation stacks were 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.

7.3.3 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

Meteorological data recorded over the five-year period 2017-2021 by the Sydney Airport Automatic Weather Station operated by Bureau of Meteorology (BoM)was analysed to select a worst-case meteorological year in order to provide a conservative air quality impact assessment. An analysis of the wind speed, wind direction, temperature and relative humidity recorded in each of the calendar years aligned well with the five-year average data, Given this, and considering that background air quality data are available for 2021 calendar year, 2021 was chosen for the AQIA.

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, rain water and turbulence. The program allows the user to generate synthetic observations by referencing databases (covering terrain, vegetation and soil type, sea surface temperature and synoptic scale meteorological analyses) which are subsequently used in the model input to generate 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 7**. The three-dimensional meteorological data from the TAPM output was used as input for the diagnostic meteorological model (CALMET).

Table 7 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 ventilation outlets and proposed development site, CALMET modelling was conducted with a finer resolution of 50 m to ensure adequate resolution of modelling predictions in between source and receptors required for model accuracy. TAPM-generated three dimensional meteorological data was used as the initial guess wind field for 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.

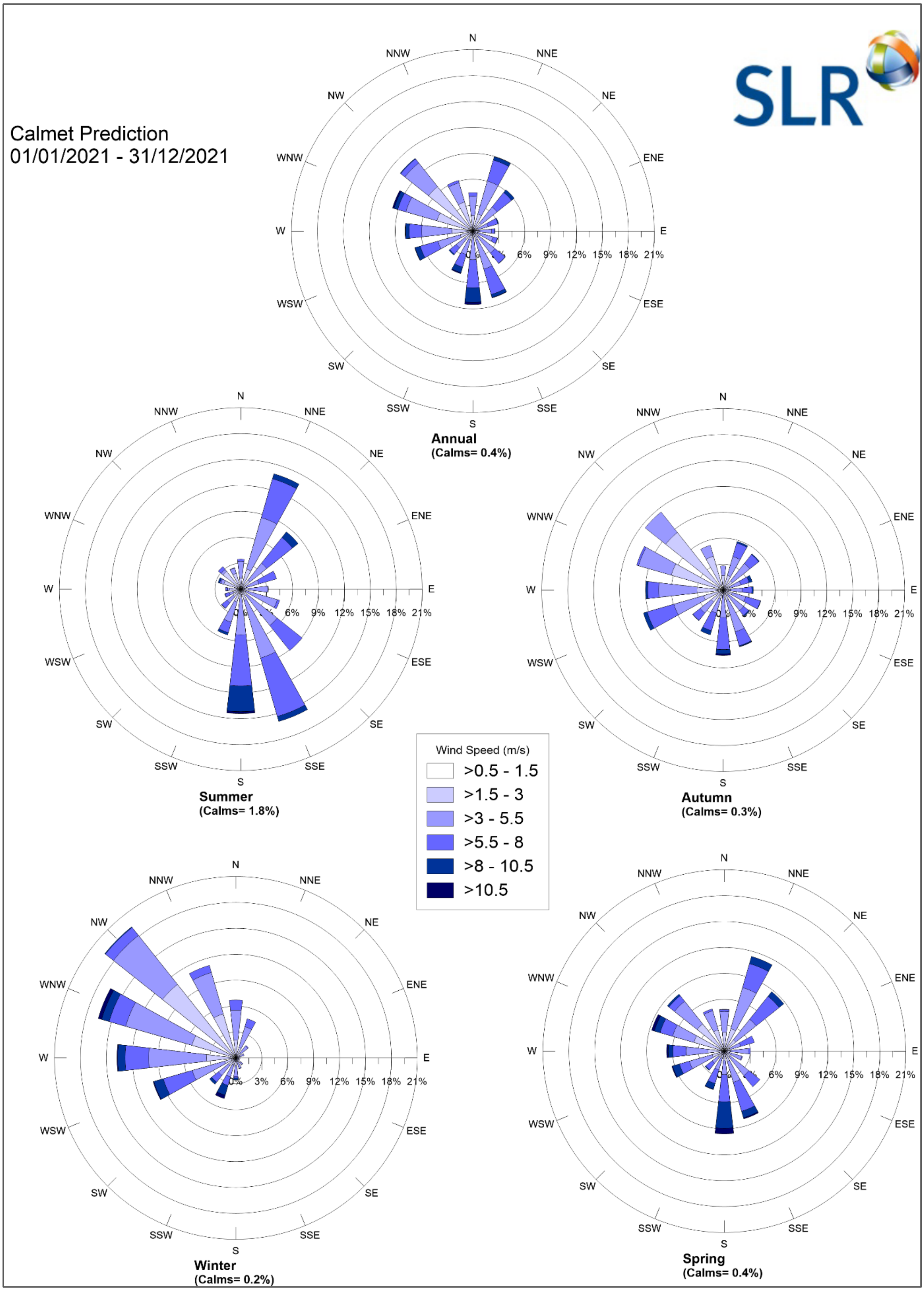
7.3.4 Site Representative Meteorological Data Used in the Modelling

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 Development site is presented as wind roses in **Figure 9**. 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 9 Predicted Seasonal Wind Roses for the 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 8**.

Table 8 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 10**. 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 day time and moderate to high wind speed conditions during 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.

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 11**.

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

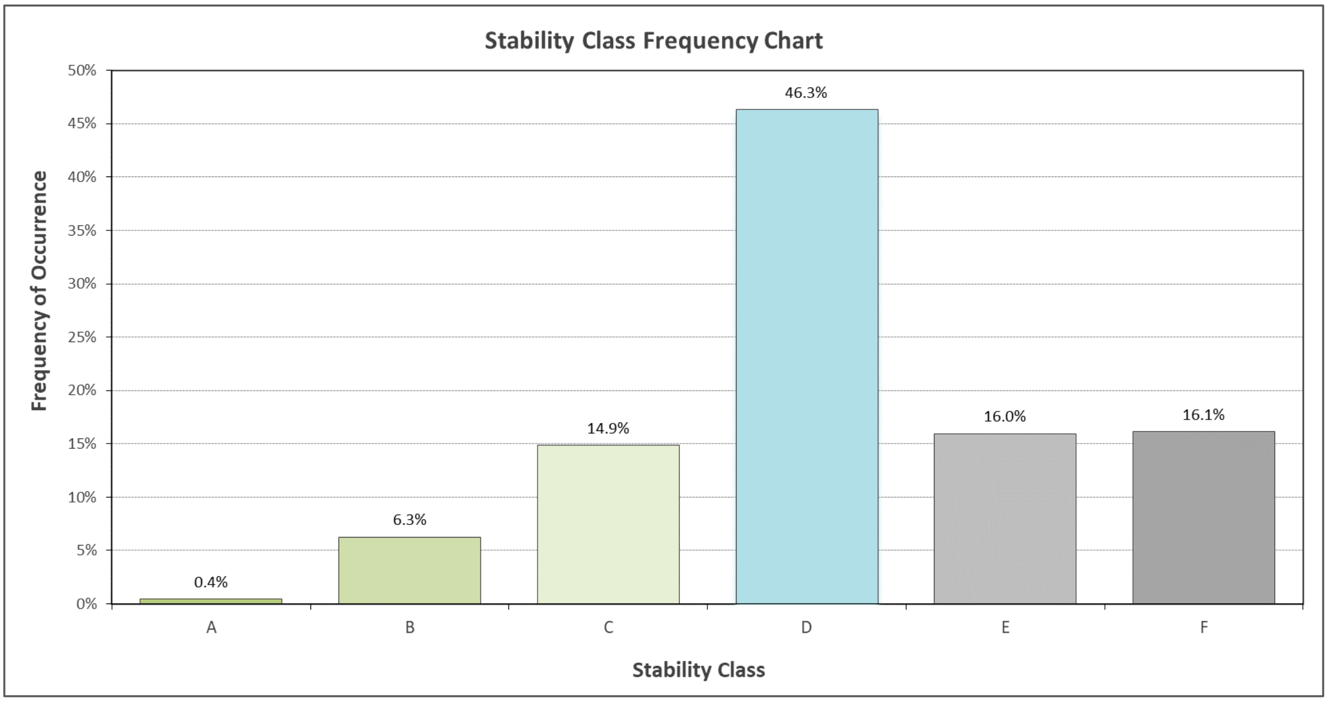
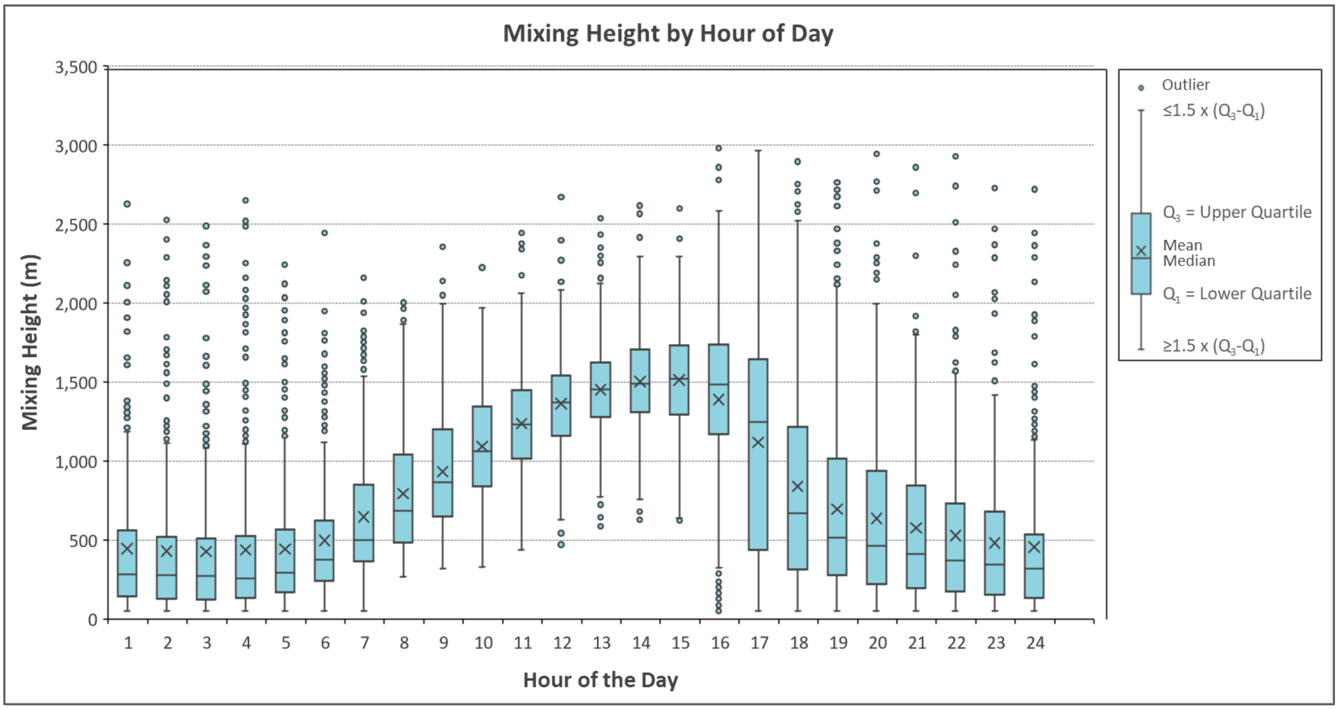


Figure 11 Predicted Mixing Heights at the Site (CALMET, 2021)



7.3.5 Building Downwash

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

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.

7.3.6 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 ozone (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, 2017).

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 9.**

Table 9 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 1, 100% conversion of NO_x to NO_2 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 Development site by a significant margin. Modelling results of NO_2 concentrations presented in this report would be conservative.

8 Air Quality Impact Assessment

8.1 Construction Impact Assessment

For this assessment, 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], Holman *et al* 2014) has been used to provide a qualitative assessment method (refer to **Appendix A** for full methodology). The IAQM method uses a four-step process 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.

8.1.1 Step 1 – Screening Based on Separation Distance

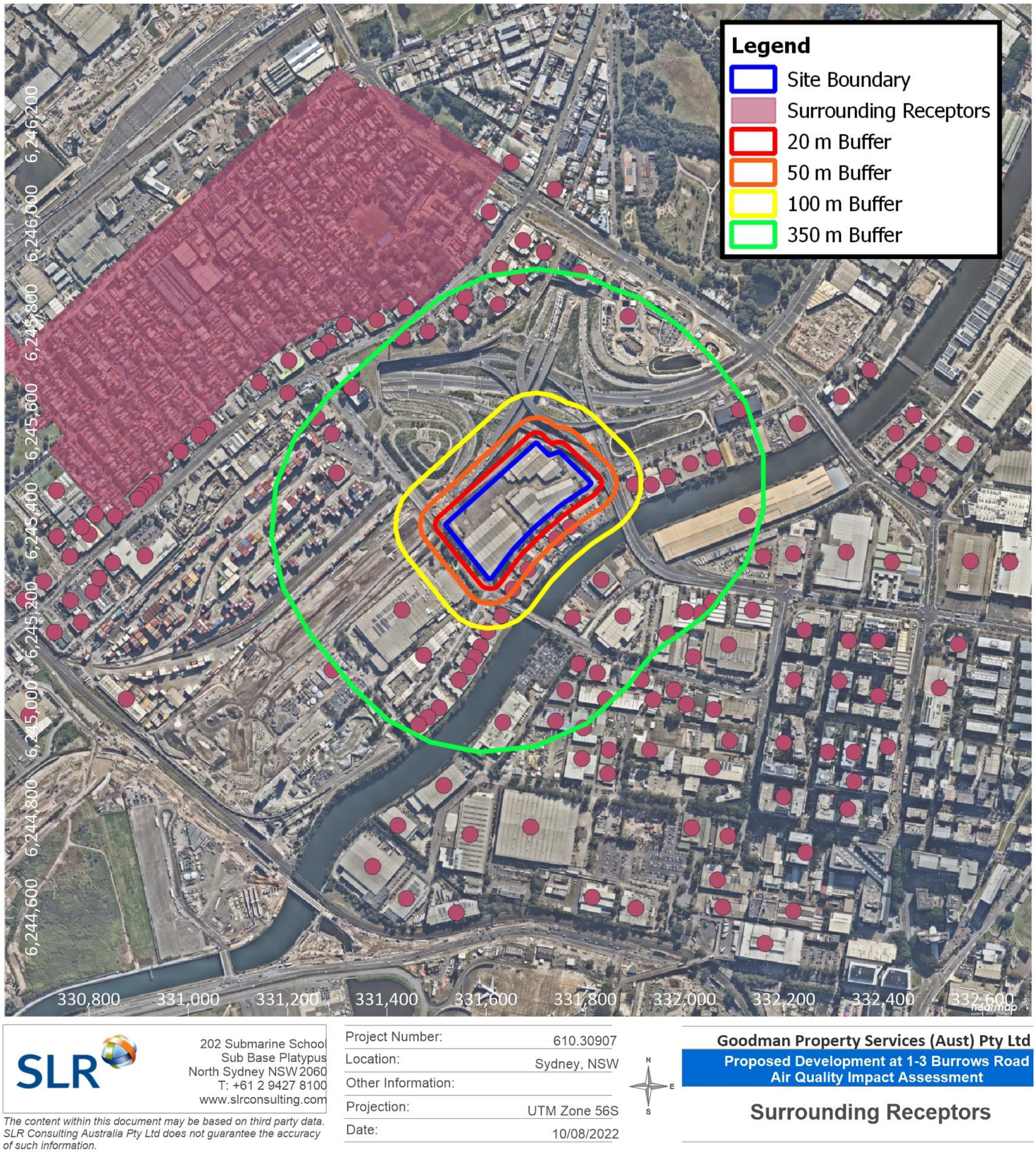
As noted in **Section 5.1**, a number of sensitive receptors are located within 50 m from the nearest Site boundary.

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

- 350 m of the boundary of the site; or
- 50 m of the route(s) used by construction vehicles on the public highway, up to 500 m from the site entrance(s).

As a 'human receptor' is located within 350 m of the boundary of the site, and within 500 m of the site entrance, further assessment is required. For the purpose of this assessment, the number of sensitive receptors is estimated to be between more than 100 within 350 m of the Site boundary (see **Figure 12**).

Figure 12 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 10**.

Table 10 Categorisation of Dust Emission Magnitude

Activity	Dust Emission Magnitude	Basis
Demolition	Large	**IAQM Definition:** Total building volume >50,000 m3, potentially dusty construction material (e.g. concrete), on-site crushing and screening, demolition activities >20 m above ground level. **Relevance to this Project:** *The total area of the buildings to be demolished is approximately 20,600 $m^{2;}$ considering an average height of 3.4 m, the total demolition volume is approximately 70,000 m^3.*
Earthworks	Large	**IAQM Definition:** Total site area greater than 10,000 m^2, potentially dusty soil type (eg 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 8 m in height, total material moved more than 100,000 t. **Relevance to this Project:** *Total area of the Site is estimated to be approximately 35,000 m^2.*
Construction	Large	**IAQM Definition:** Total building volume greater than 100,000 m^3, piling, on site concrete batching; sandblasting. **Relevance to this Project:** *The total warehouse area is 16,000 m^2 and the elevation of the building is 31.6 m. Therefore, the total building volume will be 340,000 m^3.*
Trackout	Large	**IAQM Definition:** More than 50 heavy vehicle movements per day, surface materials with a high potential for dust generation, 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 A1** in **Appendix A**, the sensitivity of the identified 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.

Sensitivity of an Area

Based on the classifications shown in **Table A2** and **Table A3** in **Appendix A**, the sensitivity of the area 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 the existing number of sensitive receptors present in the vicinity of the Site (ie more than 100 within 350 m).

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 10**, the resulting risk of air quality impacts is as presented in **Table 11**.

Table 11 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	Large	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 during earthworks, construction, and trackout phases occurring at the off-site sensitive receptor locations if no mitigation measures were to be applied to control emissions during the construction works.

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 12**. Implementing these measures should reduce the risk of these impacts from ***medium*** to ***low***. These measures are designated as *highly recommended* (H) or *desirable* (D) by the dust IAQM method.

Table 12 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

Table 13 to **Table 15** provide the mitigation measures targeting the potential impacts from earthworks, construction, and trackout. Implementing these measures reduce the risk of these impacts from ***low*** to ***negligible***.

Table 13 Mitigation Measures Specific to Earthworks

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

H = Highly recommended; D = Desirable

Table 14 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.	H
Ensure bulk cement and other fine powder materials are delivered in enclosed tankers and stored in silos with suitable emission control systems to prevent escape of material and overfilling during delivery.	D
For smaller supplies of fine power materials ensure bags are sealed after use and stored appropriately to prevent dust.	D

H = Highly recommended; D = Desirable

Table 15 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.	H
Avoid dry sweeping of large areas.	H
Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport.	H
Inspect on-site haul routes for integrity and instigate necessary repairs to the surface as soon as reasonably practicable.	H
Record all inspections of haul routes and any subsequent action in a site log book.	H
Install hard surfaced haul routes, which are regularly damped down with fixed or mobile sprinkler systems, or mobile water bowsers and regularly cleaned.	H
Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable).	H
Ensure there is an adequate area of hard surfaced road between the wheel wash facility and the site exit, wherever site size and layout permits.	H
Access gates to be located at least 10 m from receptors where possible.	H

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.

8.1.5 Step 4 - Residual Impacts

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'. The results of the reappraisal are presented below in **Table 16**.

Table 16 Residual Risk of Air Quality Impacts from Construction

Impact	Sensitivity of Area	Residual Risk			
		Demolition	Earthworks	Construction	Trackout
Dust Soiling	Low	Low Risk	Negligible Risk	Negligible Risk	Negligible Risk
Human Health	Low	Low Risk	Negligible Risk	Negligible Risk	Negligible Risk

The mitigated dust deposition and human health impacts for demolition phase are anticipated to be ***low*** and the mitigated dust deposition and human health impacts for earthworks, construction, and trackout phases are anticipated to be ***negligible***.

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 and 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 scale and magnitude of emissions from the Project is anticipated to be significantly lower compared to the estimated annual average daily traffic on Canal Road. To assess the risk of 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 5.1**). In terms of the methodology in **Appendix C**, the sensitivity of the surrounding residential areas to emissions from the Site should be considered ***high***.

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

  Based on the anticipated small amount of traffic movements on and its comparison to the traffic numbers on Burrows Road and Campbell Road, the magnitude of these emissions considered to be ***negligible***.

Given the above considerations, and the scale of operations, the potential impact of the Project on the local sensitive receptors is concluded to be ***neutral*** for all receptors (see **Table 17**).

Table 17 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 quality emissions, then site specific air quality impact assessment should be prepared.

8.3 Assessment of Impacts – M8 and M4-M5 Ventilation Outlets

This section presents analysis of predicted incremental and cumulative air quality impacts associated with the operation of the ventilation stacks at ground and elevated levels of the proposed building. For analysis purpose, given that the ventilation stacks are located to the northwest and northeast of the Development Site (refer to **Figure 2**), model predictions were investigated at two onsite locations located at the northwest and northeast corner of the development site.

8.3.1 NO_2

Predicted incremental and cumulative maximum 1-hour and annual average NO_2 concentrations are presented in **Table 18** and **Table 19**. Hourly varying background data presented in **Section 6** were used in calculating the cumulative impacts at each elevated level.

Model predictions shows that the predicted maximum 1-hour and annual average NO_2 concentrations associated with the operation of ventilation outlets at the development site are higher at elevated levels compared to that predicted for the ground level. Predicted cumulative NO_2 concentrations at each elevated levels are well below the relevant NO_2 guidelines outlined in **Section 4.4** of this report. The highest incremental and cumulative maximum 1-hour and annual average NO_2 concentrations are predicted at the top level of the proposed development.

Table 18 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
LO	19.9	16.7	80.5	81.3
L0.5	20.3	16.8	80.5	81.5
L1	21.1	17.1	80.6	81.9
L1.5	22.2	17.4	80.8	82.5
L2	23.5	21.2	81.5	83.3
L2.5	24.8	25.3	82.9	84.3
L3	26.6	29.5	84.4	85.3
Pavilion Roof	29.9	32.8	86.0	86.4
Top of Lift	31.5	33.7	87.6	87.4
Maximum	**31.5**	**33.7**	**87.6**	**87.4**
Criteria	-		**246**	

Table 19 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
LO	0.5	0.6	23.5	23.6
L0.5	0.5	0.6	23.5	23.6
L1	0.5	0.6	23.5	23.6
L1.5	0.6	0.6	23.6	23.6
L2	0.6	0.6	23.6	23.6
L2.5	0.6	0.7	23.6	23.7
L3	0.6	0.7	23.6	23.7
Pavilion Roof	0.7	0.8	23.7	23.8
Top of Lift	0.7	0.9	23.7	23.9
Maximum	**0.7**	**0.9**	**23.7**	**23.9**
Guideline	-		**62**	

8.3.2 PM_{10}

Predicted incremental and cumulative maximum 24-hour and annual average PM_{10} concentrations are presented in **Table 20** and **Table 21**. Daily varying background data presented in **Section 6** were used in calculating the cumulative impacts at each elevated level.

Model predictions shows the predicted incremental maximum 24-hour and annual average PM_{10} concentrations associated with the operation of ventilation outlets at the development site are higher at elevated levels compared to that predicted for the ground level. Predicted cumulative PM_{10} concentrations at each elevated levels are well below the relevant PM_{10} guidelines outlined in **Section 4.4**. Similar to NO_2, highest incremental and cumulative maximum 24-hour and annual average PM_{10} concentrations are predicted at the top level of the proposed development.

Table 20 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
LO	0.2	0.4	40.7	40.8
L0.5	0.2	0.4	40.7	40.8
L1	0.2	0.4	40.7	40.8
L1.5	0.2	0.5	40.7	40.8
L2	0.2	0.5	40.7	40.8
L2.5	0.2	0.6	40.7	40.8
L3	0.3	0.6	40.7	40.8
Pavilion Roof	0.3	0.6	40.7	40.8

Building Level	Increment (µg/m³)		Cumulative (µg/m³)	
	Northeast Corner	Northwest Corner	Northeast Corner	Northwest Corner
Top of Lift	0.3	0.6	40.7	40.8
Maximum	**0.3**	**0.6**	**40.7**	**40.8**
Guideline	-		**50**	

Table 21 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
LO	<0.1	<0.1	<17.9	<17.9
L0.5	<0.1	<0.1	<17.9	<17.9
L1	<0.1	<0.1	<17.9	<17.9
L1.5	<0.1	<0.1	<17.9	<17.9
L2	<0.1	<0.1	<17.9	<17.9
L2.5	<0.1	<0.1	<17.9	<17.9
L3	<0.1	<0.1	<17.9	<17.9
Pavilion Roof	<0.1	<0.1	<17.9	<17.9
Top of Lift	<0.1	<0.1	<17.9	<17.9
Maximum	**<0.1**	**<0.1**	**<17.9**	**<17.9**
Guideline	-		**25**	

8.3.3 $PM_{2.5}$

Predicted incremental and cumulative maximum 24-hour and annual average $PM_{2.5}$ concentrations are presented in **Table 22** and **Table 23**. Daily varying background data presented in **Section 6** were used in calculating the cumulative impacts at each elevated level.

Similar to PM_{10}, model predictions show that predicted incremental maximum 24-hour and annual average $PM_{2.5}$ concentrations associated with the operation of ventilation outlets are higher at elevated levels compared to that predicted for ground level. Predicted incremental 24-hour average $PM_{2.5}$ concentrations at each elevated levels are minimal, however exceedances of cumulative 24-hour average guideline of 25 µg/m³ was predicted at each level. Further analysis of the results shows that these exceedances are entirely driven by the background data used for this assessment.

A contemporaneous analysis of predicted $PM_{2.5}$ concentration data at worst impacted level (Top of Lift) is presented in **Table 24**. The analysis shows that the incremental $PM_{2.5}$ concentrations associated with the operation of the ventilation outlets are unlikely to cause any additional exceedances.

Predicted annual average $PM_{2.5}$ concentrations complies with the relevant guideline at all elevated levels of the proposed development.

Table 22 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
LO	0.2	0.4	39.1	39.1
L0.5	0.2	0.4	39.1	39.2
L1	0.2	0.4	39.1	39.2
L1.5	0.2	0.5	39.1	39.2
L2	0.2	0.5	39.1	39.2
L2.5	0.2	0.6	39.1	39.3
L3	0.3	0.6	39.1	39.3
Pavilion Roof	0.3	0.6	39.1	39.4
Top of Lift	0.3	0.6	39.1	39.4
Maximum	**0.3**	**0.6**	**39.1**	**39.4**
Guideline	-		**25**	

Table 23 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
LO	<0.1	<0.1	<6.8	<6.8
L0.5	<0.1	<0.1	<6.8	<6.8
L1	<0.1	<0.1	<6.8	<6.8
L1.5	<0.1	<0.1	<6.8	<6.8
L2	<0.1	<0.1	<6.8	<6.8
L2.5	<0.1	<0.1	<6.8	<6.8
L3	<0.1	<0.1	<6.8	<6.8
Pavilion Roof	<0.1	<0.1	<6.8	<6.8
Top of Lift	<0.1	<0.1	<6.8	<6.8
Maximum	**<0.1**	**<0.1**	**<6.8**	**<6.8**
Guideline	-		**8**	

Table 24 Contemporaneous $PM_{2.5}$ Analysis – Top of the Lift

Date	$PM_{2.5}$ 24-Hour Average (µg/m³)			Date	$PM_{2.5}$ 24-Hour Average (µg/m³)		
	Background	Increment	Total		Background	Highest Predicted Increment	Total
22-08-2021	39.0	0.1	39.1	21-08-2021	29.9	0.3	30.1
03-05-2021	32.5	0.2	32.7	30-04-2021	23.0	0.3	23.3
21-08-2021	29.9	0.3	30.1	19-08-2021	12.4	0.2	12.6
27-04-2021	27.9	0.0	28.0	30-08-2021	8.5	0.2	8.7
04-05-2021	27.8	0.1	27.9	21-01-2021	7.9	0.2	8.1
30-04-2021	23.0	0.3	23.3	29-04-2021	14.2	0.2	14.4
03-06-2021	21.7	0.1	21.7	31-05-2021	7.3	0.2	7.4
10-10-2021	20.2	0.0	20.2	14-01-2021	9.0	0.2	9.2

9 Conclusions

Goodman engaged SLR to conduct an air quality impact assessment for the proposed development at 1-3 Burrows Road, St Peters, NSW. Potential air quality impacts associated with the construction and operation of the proposed development were assessed qualitatively using IAQM methodology. The findings of the assessment showed the following:

- With the implementation of recommended site specific mitigation measures (refer to **Section 8.1.4**) during the construction phase of the project:
    - Potential risks 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 can be considered as of neutral significance

Potential air quality impacts on the ground and elevated levels of the proposed development associated with the emissions released from the ventilation outlets of the M8 and M4-M5 link tunnels were assessed using a combination of CALMET/ CALPUFF models and following inputs and assumptions:

- Hourly varying air emission data (NO_x and particulates) recorded for M8 ventilation outlet in 2021 calendar year was used as input to the dispersion model.
- In absence of CEMS data for M4-M5 link tunnel, it was assumed that the emission rates for M4-M5 link tunnel ventilation outlet will be similar to that recorded for the M8 ventilation outlet.
- Recorded CEMS data for particulates were assumed to be representative of $PM_{2.5}$ (particle size <2.5 µm).
- Hourly varying ambient background data recorded in 2021 calendar year at St Peters 2 monitoring site, located adjacent to the proposed development site was used as the background pollutant level for calculating cumulative impacts for both ground and elevated level receptors.
- 100% conversion of NO_x to NO_2 was adopted for this assessment as a conservative approach

Based on the modelling results, it is concluded that:

- No exceedances of the relevant ambient air quality criteria for NO_2 would be expected at the ground and elevated levels of the proposed building.
- No exceedances of the relevant ambient air quality criteria for PM_{10} would be expected at the ground and elevated levels of the proposed building.
- Few exceedances of 24-hour average $PM_{2.5}$ guideline were predicted at the ground and elevated levels of the proposed building. Further investigation showed that these exceedances are driven by high background levels (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 predicted results also showed that the contribution from the ventilation outlets is unlikely to cause any additional exceedances at any levels of the proposed building. Predicted incremental annual average $PM_{2.5}$ concentrations showed compliance with the relevant criterion at all levels of the proposed building.
- Given the predicted minimal incremental impact associated with the operation of the ventilation outlets and conservative assumptions adopted for this assessment, any changes to the above conclusion is unlikely with the increase in annual average daily traffic in future (eg. 10 year horizon).

10 References

Ason Group. (2022). *41 Roberts Road, Greenacre - Transport Impact Statement .*

EPAV. (2013, October). *EPA Publication 1550 Construction of input meteorological data files for EPA Victoria's regulatory air pollution model (AERMOD).* Retrieved 04 03, 2017, from EPA Victoria: http://www.epa.vic.gov.au/~/media/Publications/1550.pdf

IAQM. (2014). *Guidance on the assessment of dust from demolition and construction.* London: Institute of Air Quality Management.

Janssen, L. H., van Wakeren, J. H., van Duuran, H., & Elshout, A. J. (1988). A classification of NO oxidation rates in power plant plumes based on atmospheric conditions. *Atmospheric Environment, 22(1)*, 43-53.

NOAA. (2018, February 14). *Air Resources Laboratory*. Retrieved February 20, 2018, from National Oceannic and Atmospheric Association: https://www.ready.noaa.gov/READYpgclass.php

NSW EPA. (2017, January). *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales.* Prepared by NSW Environment Protection Authority, which is part of the NSW Office of Environment and Heritage (OEH). Retrieved from http://www.environment.nsw.gov.au/resources/air/ammodelling05361.pdf

Oke, T. R. (2002). *Boundary Layer Climates.* Routledge.

Pacific Environment. (2015). *WestConnex M4 East Air Quality Assessment Report.*

USEPA. (1985, June). Guideline for Determination of Good Engineering Practice Stack Height (Technical Support Document for the Stack Height Regulations) . *EPA-450/4-80-023R*. USEPA.

Appendix A

CONSTRUCTION PHASE RISK ASSESSMENT METHODOLOGY

Step 1 – Screening Based on Separation Distance

The Step 1 screening criteria provided by the IAQM guidance suggests screening out any assessment of impacts from construction activities where sensitive receptors are located more than 350 m from the boundary of the Site, more than 50 m from the route used by construction vehicles on public roads and more than 500 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 earthworks, construction activities and track-out, which are most relevant to this Development, 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 >50,000 m^3, potentially dusty construction material (e.g. concrete), on-site crushing and screening, demolition activities >20 m above ground level;
- ***Medium***: Total building volume 20,000 m^3 – 50,000 m^3, potentially dusty construction material, demolition activities 10-20 m above ground level; and
- ***Small***: Total building volume <20,000 m^3, construction material with low potential for dust release (e.g. metal cladding or timber), demolition activities <10m above ground, demolition during wetter months.

Earthworks *(Covers the processes of soil-stripping, ground-levelling, excavation and landscaping)*:

- ***Large***: Total site area greater than 10,000 m^2, potentially dusty soil type (eg 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 8 m in height, total material moved more than 100,000 t.
- ***Medium***: Total site area 2,500 m^2 to 10,000 m^2, moderately dusty soil type (eg silt), 5 to 10 heavy earth moving vehicles active at any one time, formation of bunds 4 m to 8 m in height, total material moved 20,000 t to 100,000 t.
- ***Small***: Total site area less than 2,500 m^2, soil type with large grain size (eg sand), less than five heavy earth moving vehicles active at any one time, formation of bunds less than 4 m in height, total material moved less than 20,000 t, earthworks during wetter months.

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 100,000 m^3, piling, on site concrete batching; sandblasting.
- ***Medium***: Total building volume 25,000 m^3 to 100,000 m^3, potentially dusty construction material (eg concrete), piling, on site concrete batching.

- ***Small***: Total building volume less than 25,000 m^3, construction material with low potential for dust release (eg 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 movements per day, surface materials with a high potential for dust generation, greater than 100 m of unpaved road length.
- ***Medium***: Between 10 and 50 heavy vehicle movements per day, surface materials with a moderate potential for dust generation, between 50 m and 100 m of unpaved road length.
- ***Small***: Less than 10 heavy vehicle movements per day, surface materials with a low potential for dust generation, 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

Assessment of the 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; and
- Other site-specific factors, such as whether there are natural shelters such as trees to reduce the risk of wind-blown dust.
- Individual receptors are classified as having *high*, *medium* or *low* sensitivity to dust deposition and human health impacts (ecological receptors are not addressed using this approach). The IAQM method provides guidance on the sensitivity of different receptor types to dust soiling and health effects as summarised in **Table A1**. It is noted that user expectations of amenity levels (dust soiling) is 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	<350
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	<350
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 C 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 C 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		
12	Plan site layout so that machinery and dust causing activities are located away from receptors, as far as is possible.	H

	Activity	Highly recommended or Desirable
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 B1 outlines the methodology used in this study to define the sensitivity of receptors to air quality impacts.

Table B1 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 B2 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 B3 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

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