# Hawkesbury-Nepean Valley Flood Evacuation Road Resilience Program. Improvements on The Northern Road and Londonderry Road Flood Evacuation Routes

## Air Quality and Greenhouse Gas Assessment


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# Basis of Report

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

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

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

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# 1.0 Introduction

SLR Consulting Australia Pty Ltd (SLR) was commissioned by SMEC Australia (SMEC) to prepare an air quality impact assessment (AQIA) report for the proposed construction of a widened southbound shoulder that will operate as an additional flood evacuation lane along Londonderry Road and The Northern Road (the Proposal) located in Hawkesbury City and Penrith City local government areas (LGAs) and a greenhouse gas (GHG) assessment for the construction phase of the Proposal.

The study has been conducted in accordance with the following guidelines:

- *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales*, New South Wales Environment Protection Authority (NSW EPA 2022)
- *Local Government Air Quality Toolkit – Visual guide: Dust from urban construction sites* (NSW EPA 2007)
- Institute of Air Quality Management (IAQM – UK) *Guidance on the assessment of dust from demolition and construction* (IAQM 2024)
- Roadside Air Quality Screening Tool (RAQST)[1] developed by Transport for NSW (TfNSW)
- *National Greenhouse and Energy Reporting Act* 2009 (NGER Act)

[1] RAQST replaces the previous *Tool for Roadside Air Quality* (TRAQ).

# 2.0 Proposal Description

## 2.1 Program Overview

The NSW and Australian Governments have committed $33 million towards planning for more than 100 improvements that will make the Hawkesbury-Nepean Valley flood evacuation road network more resilient to flooding. Road infrastructure improvements have been identified across four Western Sydney Local Government Areas: Penrith, Hawkesbury, Blacktown, and The Hills. The proposed improvements include road shoulder widening, culvert upgrades, new bridge structure, road raising, pinch point upgrades and drainage improvements. These improvements will make evacuation routes better able to withstand local flash flooding which can cause early closure of evacuation routes.

The Hawkesbury-Nepean Valley has the highest flood risk in NSW due to its unique landscape and large existing population. Floods in the Hawkesbury-Nepean Valley can and have had a significant impact on people's lives, livelihoods, and homes.

The key objective of Hawkesbury-Nepean Valley Flood Evacuation Road Resilience Program is to improve drainage on the road network to better withstand local flash flooding and to increase capacity to evacuate by road during major flood events.

The Hawkesbury-Nepean Valley Flood Evacuation Road Resilience Program has two components – State Road Improvements (on the Transport for NSW managed roads of The Northern Road and Londonderry Road) and Regional/Local Road Improvements (on the mostly local council managed road network), this proposal refers to the State Road Improvements only, being The Northern Road and Londonderry Road flood evacuation routes.

## 2.2 Proposal Location

The Proposal comprises construction works for widening of the southbound shoulder of the existing Londonderry Road and The Northern Road for an approximately 20 km stretch to provide an additional southbound evacuation lane to be used only in the event of a major flood. The location of the Proposal is presented in **Figure 1**.

It is noted that the proposed evacuation lane will not form part of normal operation of these roads and is only designed for use of the widened shoulder as an additional lane during the flood evacuation period.

**Figure 2** illustrates the proposed layout for the main construction activities of the Proposal.

The proposal area generally includes the road corridors of The Northern Road, Londonderry Road, Andrews Road and Vincent Road as follows:

- The Northern Road between the intersection with Richmond Road/Blacktown Road, Bligh Park in the north, and Borrowdale Way, Cranebrook in the south
- Londonderry Road from 270 m south of Southee Road, Hobartville to the intersection with The Northern Road, Llandilo excluding approximately 270 m north and 300 m south of the existing intersection at The Driftway, Londonderry
- Route A9 (The Northern Road/Richmond Road) from 130 m north of Andrews Road, Cranebrook to Boomerang Place, Cambridge Gardens in the south
- Andrews Road, Cranebrook from The Northern Road to the Andrews Road Baseball Complex west of Greygums Road, Cranebrook

- Vincent Road, Cranebrook, for approximately 70 m west from The Northern Road
- Identified isolated areas along Route A9 (Richmond Road/Parker Street) between Gascoigne Street and Great Western Highway, Kingswood for the installation of flood evacuation signage.

The Proposal area includes a buffer from the outer edge of the designed works to facilitate construction work. The buffer is generally 10 m in width but is reduced to 6 m or less in specific areas, to minimise impacts on sensitive areas.

## 2.3 Key Features

The key features of the Proposal include:

- Widening of the southbound shoulder pavement on the following roads, a total of approximately 20 km, to provide a second outbound lane reserved for drivers to use during emergency flood evacuations. This will include culvert and drainage extensions to accommodate a wider road corridor, and connecting drainage along:
    - Londonderry Road between 270 m south of Southee Road and The Northern Road, Londonderry
    - The Northern Road between Richmond Road and Borrowdale Way, in Londonderry, Berkshire Park, Cranebrook, Llandilo, and Jordan Springs
- Drainage improvements including upgrades to culvert crossings, drainage channels, and pit and pipe networks at identified locations to improve resilience in localised flooding events. Work would include:
    - Culvert upgrades, and associated drainage channel work:
        - Along sections of The Northern Road associated with raising of low points as outlined below
        - On Carrington Road at the intersection with The Northern Road, Londonderry
        - At two locations on The Northern Road approximately 50 m and 130 m north of the intersection of Carrington Road, Londonderry
        - On The Northern Road approximately 250 m north of Toorah Road, Londonderry
        - On Vincent Road at the intersection with The Northern Road, Cranebrook
        - On Fifth Avenue at the intersection with The Northern Road, Llandilo
    - New roadside drainage channels (including vegetated and concrete of various widths):
        - Along Londonderry Road (adjacent to the southbound shoulder), from 270 m south of Southee Road, Hobartville to the intersection with The Northern Road, Llandilo
        - Along The Northern Road (adjacent to the southbound shoulder), from the intersection with Blacktown Road/Richmond Road, Bligh Park to Ninth Avenue, Llandilo

        - Along The Northern Road (adjacent to the northbound shoulder) at road raising areas (described in further detail below)
    - Underground drainage network upgrades:
        - Along The Northern Road (southbound), Cleeve Place and Star Crescent, Cambridge Gardens from Trinity Drive to Boomerang Place, including approximately 60m along Trinity Drive, Cambridge Gardens
        - Along The Northern Road, Cranebrook (northbound) from approximately 115m north of Andrews Road, Cranebrook to Trinity Drive, Cambridge Gardens including new drainage crossings underneath The Northern Road
        - Along Andrews Road from The Northern Road up to the Andrews Road Baseball Complex in Cranebrook
- Raising of low points along sections of The Northern Road, affecting all road lanes located:
    - Starting from around 120 m north of Whitegates Road, Londonderry heading northwards (about 345 m length)
    - Starting from around 200 m north of Spinks Road, Llandilo heading northwards (about 920 m length)
    - Starting from around 270 m north of Fifth Avenue to around 435 m south of Fifth Avenue, Llandilo
    - Starting from around 185 m north of Vincent Road to around 105 m south of Vincent Road, Cranebrook
    - Starting from around 50 m south of Ninth Avenue to about 365 m south of Ninth Avenue, Cranebrook
- Extend, replace or add new culverts at selected locations along Londonderry Road and The Northern Road to maintain property access (eg driveways) as required.
- Realignment of The Northern Road, Cranebrook (within the road corridor), between around 330 m north of Seventh Avenue, Llandilo to around 280 m south of Vincent Road, Cranebrook to reduce Proposal impacts on adjacent sensitive receivers and improve road safety.
- Adjustments to the following intersections to facilitate a secondary outbound lane for drivers to use during a flood evacuation event. These may include changes to existing median, traffic islands, kerbs and line marking at:
    - The Northern Road and Richmond Road and Blacktown Road, Bligh Park
    - Londonderry Road and The Northern Road and Cranebrook Road, Cranebrook
    - The Northern Road and Vincent Road, Cranebrook
    - The Northern Road and Ninth Avenue, Jordan Springs
- Installation of new signage to be displayed during emergency flood evacuations to facilitate a second left turn at the existing Parker Street/Great Western Highway intersection in Penrith under traffic control.
- Adjustments as required to connect Londonderry Road and The Northern Road to local roadways, side roads and access roads.

- Relocation and/or adjustments of various road furniture (such as signage, road safety barriers, street lighting, kerb and island adjustment etc) throughout the proposal area.
- Relocation of bus stops at:
    - The Northern Road (northbound) approximately 30 m south of Vincent Road. To relocate this bus stop approximately 130 m to the south
    - The Northern Road (southbound) approximately 210 m south of Ninth Avenue. To relocate this bus stop approximately 20 m to the north
- Utility and driveway adjustments as required within the proposal area.
- Landscaping as required.
- Provision of temporary ancillary facilities to support the construction works, including office and staff amenities, site compound and laydown areas:
    - Road reserve adjacent to the Francis Greenway Correctional Complex, Berkshire Park
    - Road reserve adjacent to 245 The Northern Road, Berkshire Park
    - 557 The Northern Road, Berkshire Park
    - Road reserve adjacent to 107 Fifth Avenue, Llandilo
    - Road reserve adjacent to 902 The Northern Road, Llandilo
    - 1042 The Northern Road, Llandilo
    - Council reserve, Greenwood Parkway, Jordan Springs
    - Part of the Richmond Race Club, Londonderry Road, Londonderry
    - Council reserve, Andrews Road, Penrith
    - Council reserve, Parker Street, Penrith

The final construction staging of the Proposal would be determined by Transport and the construction contractor. However, it is anticipated that the main works would be carried out in stages, with an early works component. Subject to funding availability, the construction is expected to commence in 2026 and completed in 2030.

### 2.3.1 Construction Equipment

It is assumed that the following equipment will primarily be utilised during the construction phase.

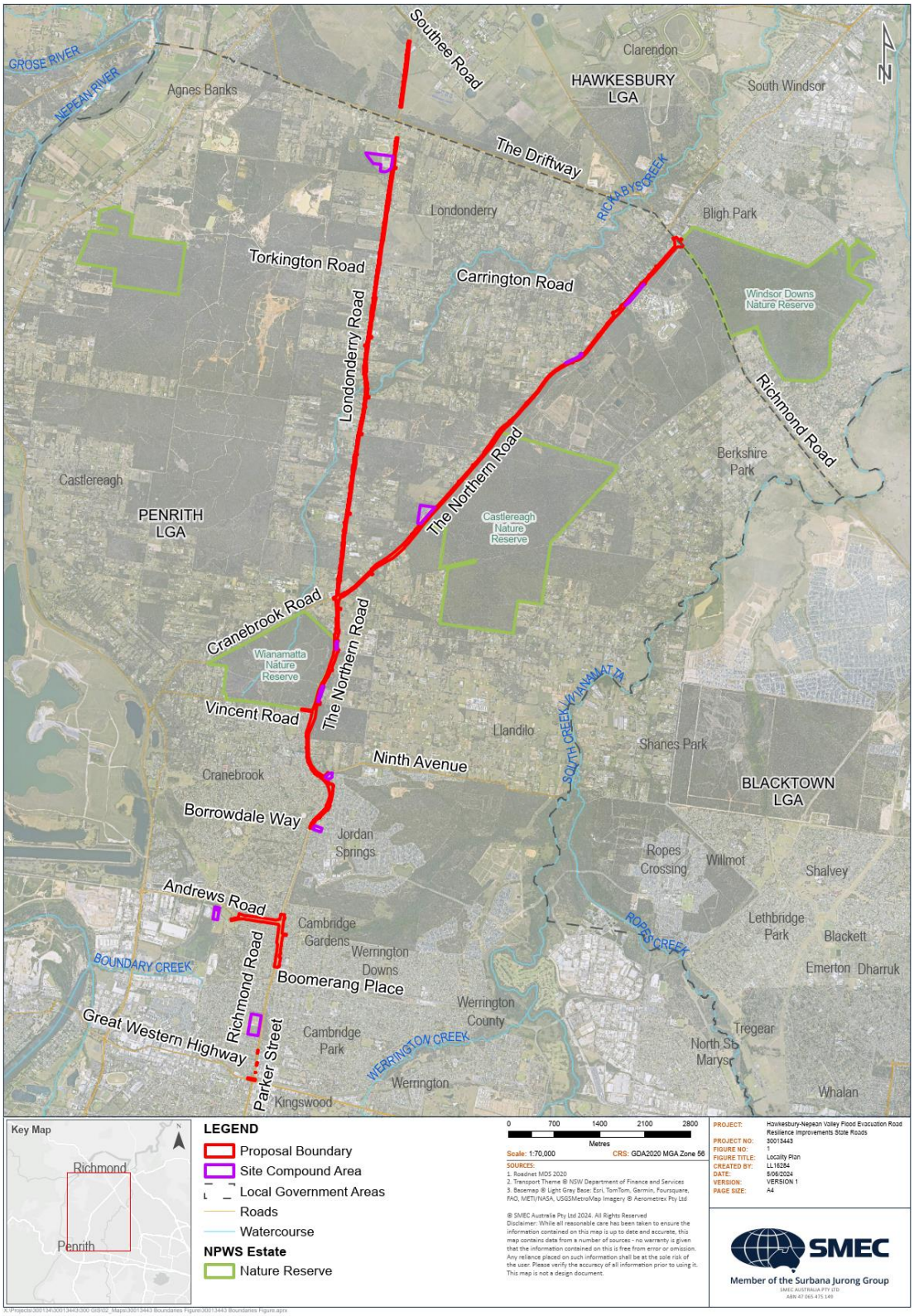
- Five lighting towers (diesel-powered) – five hours/night,
- Five portable 5kvA generators (diesel) - five hours/day,
- Three portable trailer-mounted 14 kVA generators (diesel) – five hours/day
- 14 light vehicles (LV, diesel) - 20 km/day/vehicle
- 10 heavy vehicles (HV, diesel) – 50 km/day/vehicle

It is noted that for the purposes of this assessment, it is assumed that construction activities will be executed simultaneously, which will result in a conservative assessment.

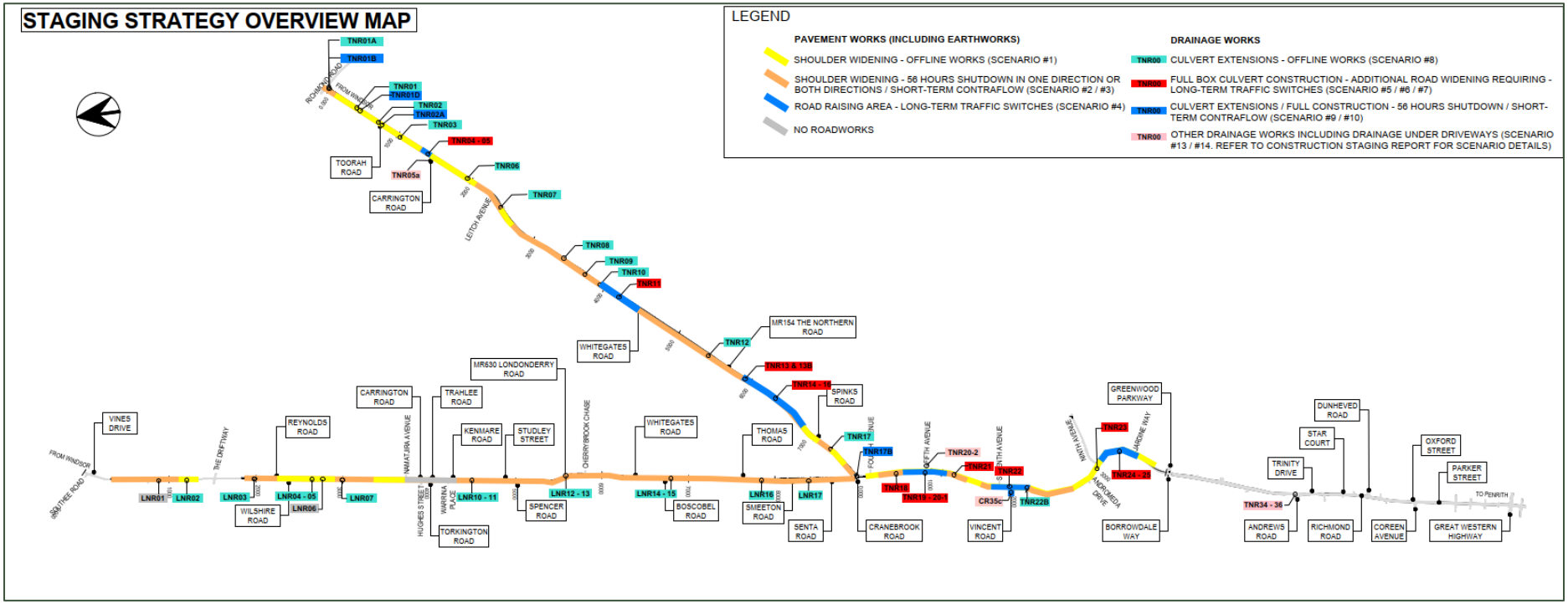
Furthermore, considering that the Proposal is at Concept Design stage, details of electrical demand and power sources are limited. Therefore, it is assumed that all power will be

provided by onsite generators as a conservative approach, in the absence of detailed information.

**Figure 1 Proposal Location**



## Figure 2 Key Construction Activities and Layout



# 3.0 Pollutants of Concern

## 3.1 Particulate Matter

Particulate matter refers to the many types and sizes of particles that can be suspended in the air environment. Particulate matter is unique among atmospheric pollutants in that it is not defined on the basis of its chemical composition; as it includes a broad range of chemical species, but upon its aerodynamic size. Particle size fractions are commonly described as follows:

- Particles with an aerodynamic diameter of less than or equal to 50 micrometres (µm) are classified as total suspended particulate matter (TSP)
- Particles with an aerodynamic diameter less than or equal to 10 µm are classified as $PM_{10}$
- Particles with an aerodynamic diameter less than or equal to 2.5 µm are classified as $PM_{2.5}$.

Particulate matter can be emitted from natural sources (bushfires, dust storms and pollens) or as a result of human activities, such as from internal combustion sources (e.g., motor vehicle emissions, power generation, incineration, etc) or from mechanical processes (e.g. excavation works, bulk material handling, crushing operations, vehicles on unpaved roads, etc).

TSP is primarily associated with nuisance impacts associated with coarse particles settling on surfaces, referred to as dust deposition. Dust deposition is a common cause of complaints, particularly due to staining of clothes (hanging on washing lines) and deposition on vehicles and windowsills. TSP, which includes the coarser size particulate matter fraction, is generated primarily from fugitive emissions sources such as vehicle travel on unsealed roads, wind erosion from exposed areas or earthen material stockpiles and handling of earthen material.

$PM_{10}$ particles tend to remain suspended in the air for longer periods than larger particles (e.g., TSP) and can penetrate into human lungs. $PM_{10}$ can be created in high quantities through crushing and grinding of rocks and soil. $PM_{10}$ is also emitted from vehicle exhausts (combustion engine emissions), but in significantly lower quantities as compared with construction activities and fugitive emission sources.

Due to its smaller aerodynamic size, $PM_{2.5}$ can travel further into human lungs than the larger particulates and can be made up of heavy metals and carcinogens. Therefore, fine particulates ($PM_{2.5}$) are considered to pose a greater risk to human health than larger particle sizes (e.g., $PM_{10}$ and TSP). However, $PM_{2.5}$ is emitted in minor quantities from mechanical sources such as construction activity and is more commonly emitted from combustion sources (e.g., vehicles and diesel generators).

## 3.2 Nuisance Dust

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



## 3.3 Products of Combustion

Emissions associated with road traffic and the combustion of fossil fuels (diesel, petrol, AVGAS etc.) will include carbon monoxide (CO), oxides of nitrogen ($NO_x$), particulate matter ($PM_{10}$ and $PM_{2.5}$), sulfur dioxide ($SO_2$) and volatile organic compounds (VOCs).

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

CO is an odourless, colourless gas formed from the incomplete burning of fuels in motor vehicles. It can be a common pollutant at the roadside and highest concentrations are found at the kerbside with concentrations decreasing rapidly with increasing distance from the road. CO in urban areas results almost entirely from vehicle emissions and its spatial distribution follows that of traffic flow. However, based on the findings of other air quality impact assessments prepared for similar projects in Australia, and a review of ambient air quality monitoring data for urban areas in Sydney, there would be no significant potential for exceedances of the relevant CO ambient air quality criteria. Hence, CO emissions from the Proposal have not been considered further in this study.

Engine exhausts can contain emissions of $SO_2$ due to impurities in the fuel. The sulfur content in diesel fuel has significantly reduced over the years and ambient $SO_2$ concentrations in Australian cities are typically well below regulatory criteria. Hence, $SO_2$ impacts have not been considered further in this study.

VOCs may be emitted as a result of the incomplete combustion of fuel. VOC emissions are reducing significantly due to the improved combustion processes offered by modern engines and hence have not been considered further in this study.

## 3.4 Greenhouse Gases

GHGs in the atmosphere trap incoming radiation from the sun, which in turn increases temperature. This process is known as the greenhouse effect. The six GHGs that are reported under the *National Greenhouse and Energy Reporting (NGER) Act 2007* (see **Section 5.2**) are:

- Carbon dioxide ($CO_2$)
- Methane ($CH_4$)
- Nitrous oxide ($N_2O$)
- Specified hydrofluorocarbons (HFCs)
- Specified perfluorocarbons (PFCs)
- Sulfur hexafluoride ($SF_6$).

### 3.4.1 Scope 1, 2 and Scope 3 Emissions

The internationally accepted method of reporting GHG emissions is to separate the emission sources into three categories, referred to as ‘Scopes’. The three Scopes of GHG emissions as per the *NGER (Measurement) Determination 2008*, are described below.

### Scope 1 emissions

Direct emissions where the point of emission release is owned/controlled by the organisation or project owner, such as:

- Emissions resulting from fuel combustion, e.g. from petrol fuelled vehicles, gas-fired boilers or diesel generators
- Fugitive emissions during the extraction, production, processing and distribution of fossil fuels (e.g. methane emissions from coal mines, leakage from coal seam gas or natural gas extraction and processing)
- Industrial process emissions, e.g. the use of fuels as feedstocks, leakage of insulating or refrigerant GHGs from switchgear and cooling systems
- Waste emissions, which result from the decomposition of organic material in an on-site landfill or on-site wastewater treatment plant.

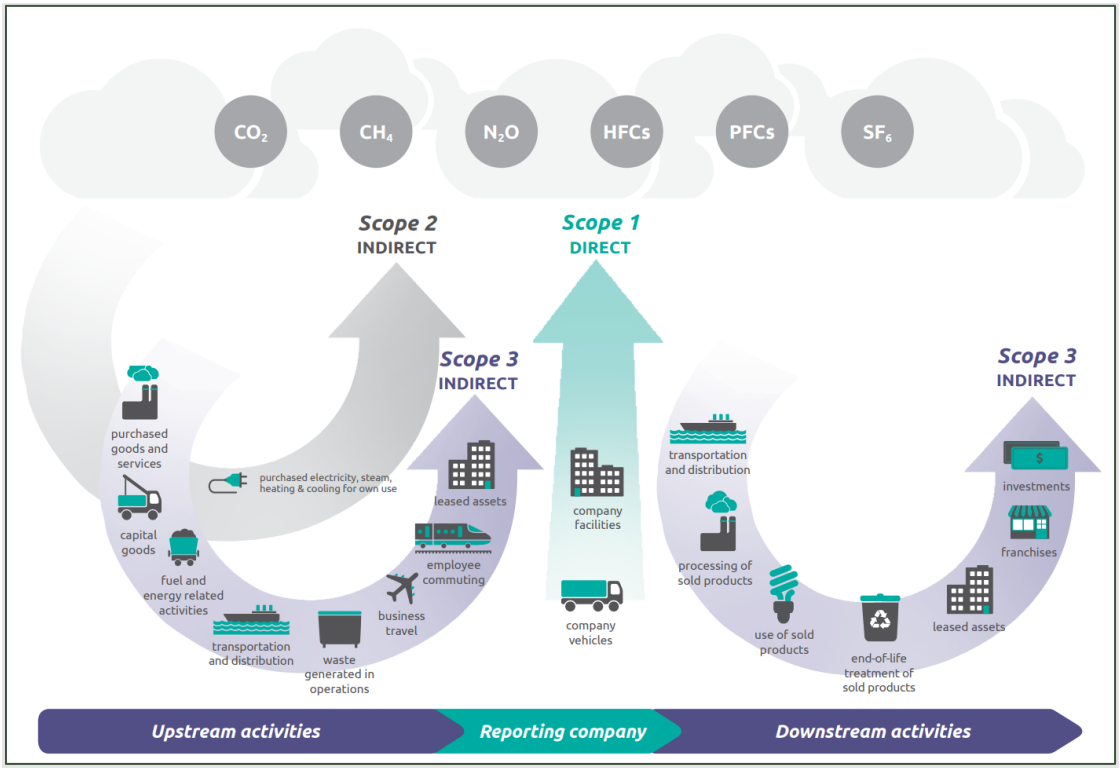
### Scope 2 emissions

Indirect GHG emissions that occur inside the reporting facility footprint or within the control of the reporting organisation. The main Scope 2 emission relates to electricity usage, where the emissions arise principally at an electricity generator, or through the loss of electricity from the electricity transmission network or distribution network.

### Scope 3 emissions

Scope 3 emissions are optional to report, because these emissions are under another entity's control and should be accounted for as Scope 1 emissions by those relevant entities. Scope 3 GHG emissions are not reported under the NGER scheme and have not been included in this assessment.

**Figure 3 Overview of GHG Protocol Scopes and Emissions**




SOURCE: (WRI 2011)

The purpose of differentiating between the scopes of emissions is to avoid the potential for 'double counting', which is where two or more organisations assume responsibility for the same emissions.

Reporting under the NGER Act requires that organisations report Scope 1 and Scope 2 emissions, but not Scope 3 emissions. Scope 3 emissions may be reported voluntarily.

Given the above and considering that electricity demand for the construction works is assumed to be met by onsite generators (as mentioned in **Section 2.3.1**), for the purpose of this assessment Scope 2 and Scope 3 emissions have been excluded from the inventory.

### 3.4.2 Global Warming Potentials

GHG emissions are generally reported in terms of carbon dioxide equivalent ($CO_2$-e). This is to provide a standardised unit for reporting due to different gases having varying effects of global warming impacts or global warming potential (GWP). The GWP refers to the GHG potential to trap heat in the atmosphere for a certain period (generally 100 years), relative to carbon dioxide (with a GWP of one).

At the time of writing, the most recent available *National Greenhouse Accounts Factors* (DCCEEW 2023) equates methane with a GWP of 28, which means for every tonne of methane emitted, it has the same global warming effect of 28 tonnes of carbon dioxide.

**Table 1** presents the GWPs of the GHGs relevant to the Proposal.

**Table 1 GHG Global Warming Potentials**

| Gas | Chemical Formula | Global Warming Potential (GWP) |
|---|---|---|
| Carbon dioxide | $CO_2$ | 1 |
| Methane | $CH_4$ | 28 |
| Nitrous oxide | $N_2O$ | 265 |

# 4.0 Potential Sources of Emissions to Air

## 4.1 Construction Phase

### 4.1.1 Air Toxics

The main air quality concern associated with demolition and construction works relates to emissions of fugitive dust. The potential for dust to be emitted during the demolition and construction works will vary 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
- Earthworks
- Backfilling operations
- Grading
- Loading and unloading of materials
- Wheel-generated dust and combustion emissions from construction equipment
- Wheel-generated dust from trucks travelling on unpaved surfaces
- Wind erosion of exposed surfaces.

Temporary elevations in local dust levels are most likely to occur when demolition and 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 nearby 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.
- Other external factors such as current works being undertaken by others outside of the defined Proposal boundaries and current climatic (dry) weather conditions.
- 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. Given the scale of operation, potential for any significant elevation of existing levels of these pollutants at surrounding areas would be minimal.

Given above, fugitive dust emissions were considered to have the greatest potential to give rise to downwind air quality impacts at construction sites. Combustion emissions associated with construction activities have not been assessed further in this report.

### 4.1.2 Greenhouse Gas Emissions

The primary GHG species of concern for the construction phase of the Proposal is $CO_2$ released from diesel combustion in mobile and stationary equipment.

## 4.2 Operational Phase

The key sources of air emissions would be product of combustion and particulate matter (from brake and tyre wear as well as re-entrainment of road dust) associated with the traffic movement.

# 5.0 Relevant Legislation, Policy and Guidance

## 5.1 Air Quality

The following Air Quality Policy and Guidance documents have been referenced within this assessment and have been used to identify the relevant air quality criteria.

### 5.1.1 Protection of the Environment Operations Act 1997

The *Protection of the Environment Operations Act 1997* (POEO Act) is a key piece of environment protection legislation administered by the EPA, which enables and establishes instruments for setting environmental standards, goals, protocols and guidelines.

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

- Section 126 of the POEO Act requires that materials (e.g. raw ingredients and waste storage/disposal at the Proposal) are managed in a proper and efficient manner to prevent air pollution (e.g. odour).
- Section 128 of the POEO Act states:
  1 The occupier of a premises must not carry out any activity or operate any plant in or on the premises in such a manner to cause or permit the emission at any point specified in or determined in accordance with the regulation of air impurities in excess of [the standard of concentration and/or the rate] prescribed by the regulations in respect of any such activity or any such plant.
  2 Where neither such a standard nor rate has been so prescribed, the occupier of any premises must carry on activity, or operate any plant, in or on the premises by such practicable means as may be necessary to prevent or minimise air pollution.

### 5.1.2 Protection of the Environment Operations (Clean Air) Regulation 2022

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

- Sets maximum limits on emissions from activities and plant for a number of substances; and
- Restricts the use of high sulphur liquid fuel.

### 5.1.3 NSW EPA Air Quality Policy and Guidance

The *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (the Approved Methods) (NSW EPA 2022), lists the statutory methods for modelling and assessing air pollutants from stationary sources, and specifies criteria that reflect the environmental outcomes adopted by the EPA. The air quality criteria set out in the Approved Methods for air pollutants associated with the Proposal have been reproduced and discussed in **Section 5.1.5.**

### 5.1.4 Local Air Quality Toolkit

The Local Government Air Quality Toolkit (AQ Toolkit) has been developed by the EPA to assist local government in their management of air quality issues and provides guidelines for air quality management and for the use of air pollution control techniques. The AQ Toolkit

document, *Dust from urban construction sites* (NSW EPA 2007) is relevant for the proposed construction activities.

### 5.1.5 Ambient Air Quality Criteria

NSW air quality guidelines specified by the EPA for the pollutants identified in **Section 3.0** are published in the Approved Methods. The ground level air quality impact assessment criteria listed in Section 7 of the Approved Methods have been established by NSW EPA to achieve appropriate environmental outcomes and to minimise risks to human health. They have been derived from a range of sources and are the defining ambient air quality criteria for NSW appropriate for use in this assessment.

The impact assessment criteria listed in the Approved Methods for relevant pollutants are presented in **Table 2**.

**Table 2 NSW EPA Impact Assessment Criteria for Air Quality Assessment**

| Pollutant | Averaging Period | Ambient Air Quality Criterion | |
|---|---|---|---|
| | | µg/m$^3$ | pphm |
| TSP | Annual | 90 | - |
| $PM_{10}$ | 24-Hour | 50 | - |
| | Annual | 25 | - |
| $PM_{2.5}$ | 24-Hour | 25 | - |
| | Annual | 8 | - |
| $NO_2$ | 1-hour | 226 | 8 |
| | Annual | 56 | 1.5 |
| Deposited dust | Annual | 2 g/m$^2$/month (maximum increase in deposited dust level)<br>4 g/m$^2$/month (maximum total deposited dust level) | |

a. This impact assessment criterion applies to assessments prepared before 1 January 2025.
b. pphm = parts per hundred million.

## 5.2 Greenhouse Gases

Australia ratified the Paris Agreement in November 2016 and committed to reducing its GHG emissions by 26-28% below 2005 levels by the year 2030. On 16 June 2022, the Australian Government lodged an updated Nationally Determined Contribution (NDC) with the United Nations Framework Convention on Climate Change as part of Australia's obligations under the Paris Agreement, which commits Australia to a more ambitious target of reducing GHG emissions by 43% below 2005 levels by 2030. It also reaffirmed Australia's commitment to net zero emissions by 2050.

The Australian Government has a range of programs, policies, and tools in place to act on climate change. The key aspects of the federal action on climate change are summarised below.

### 5.2.1 National Greenhouse and Energy Reporting Act 2007

The Commonwealth *National Greenhouse and Energy Reporting Act 2007* (NGER Act) introduces a single national framework for reporting and disseminating company information about GHG emissions, energy production, and energy consumption. Under the NGER Act, companies that meet threshold levels for GHG emissions, energy consumption or energy production are required to report their GHG emissions annually. The six GHGs that are reported under the NGER Act include the following compounds and groups of compounds:

- Carbon dioxide ($CO_2$)
- Methane ($CH_4$)
- Nitrous oxide ($N_2O$)
- Specified hydrofluorocarbons (HFCs)
- Specified perfluorocarbons (PFCs)
- Sulfur hexafluoride ($SF_6$).

The current GHG reporting thresholds for corporations are as follows:

- Emission of more than 50,000 tonnes (t) of carbon dioxide equivalent ($CO_2$-e)
- Production of 200 terajoules (TJ) or more of energy, or
- Consumption of more than 200 TJ of energy per year.

### 5.2.2 Emissions Reduction Fund

To meet its targets set under the Kyoto Protocol and Paris Agreement, the Australian Department of Climate Change, Energy, the Environment and Water (DCCEEW) commissioned the Emissions Reduction Fund (ERF). The ERF was developed to provide incentives for Australian businesses, farmers, land holders and citizens to reduce their GHG emissions by adoption of more efficient practices and technologies.

Key elements of the ERF were as follows:

- Crediting emissions reductions that go beyond business as usual standards
- Selling emission reductions in the form of Australian Carbon Credit Units (ACCU)
- A Safeguard Mechanism that provides a framework for Australia's largest emitters to measure, report and manage emissions.

The Safeguard Mechanism commenced in 2016. It was reformed in 2023 to ensure that covered facilities contribute to meeting Australia's reduction targets, while strengthening their competitiveness as the world moves to net zero. The reforms apply a decline rate to facilities' baselines so that they are reduced predictably and gradually over time on a trajectory consistent with achieving Australia's emission reduction targets of 43% below 2005 levels by 2030 and net zero by 2050.

As part of the Safeguard Mechanism Reforms, ERF projects that solely reduce covered emissions at Safeguard facilities are no longer be able to be registered. Projects that are already registered will continue to generate and sell credits for their existing crediting period, however, are not able to enter into new contracts for Government purchase of ACCUs or extend their crediting period.



# 6.0 Receiving Environment

## 6.1 Surrounding Land Use and Sensitive Receptors

The following land use and development control provisions apply to the site of the Proposal:

- Hawkesbury Local Environmental Plan 2012
- Penrith Local Environmental Plan 2010
- State Environmental Planning Policy (Industry and Employment) 2021.

**Figure 4** illustrates the surrounding land zoning in these provisions. The Proposal is located within areas zoned as SP2 (Infrastructure) and areas around the site are zoned as RU4 (Primary Production Small Lots) and SP1 (Special Activities) along Londonderry Road, while areas along The Northern Road are zoned as RU4 (Primary Production Small Lots), C1 (National Parks and Nature Reserve) and C2 (Environmental Conservation).

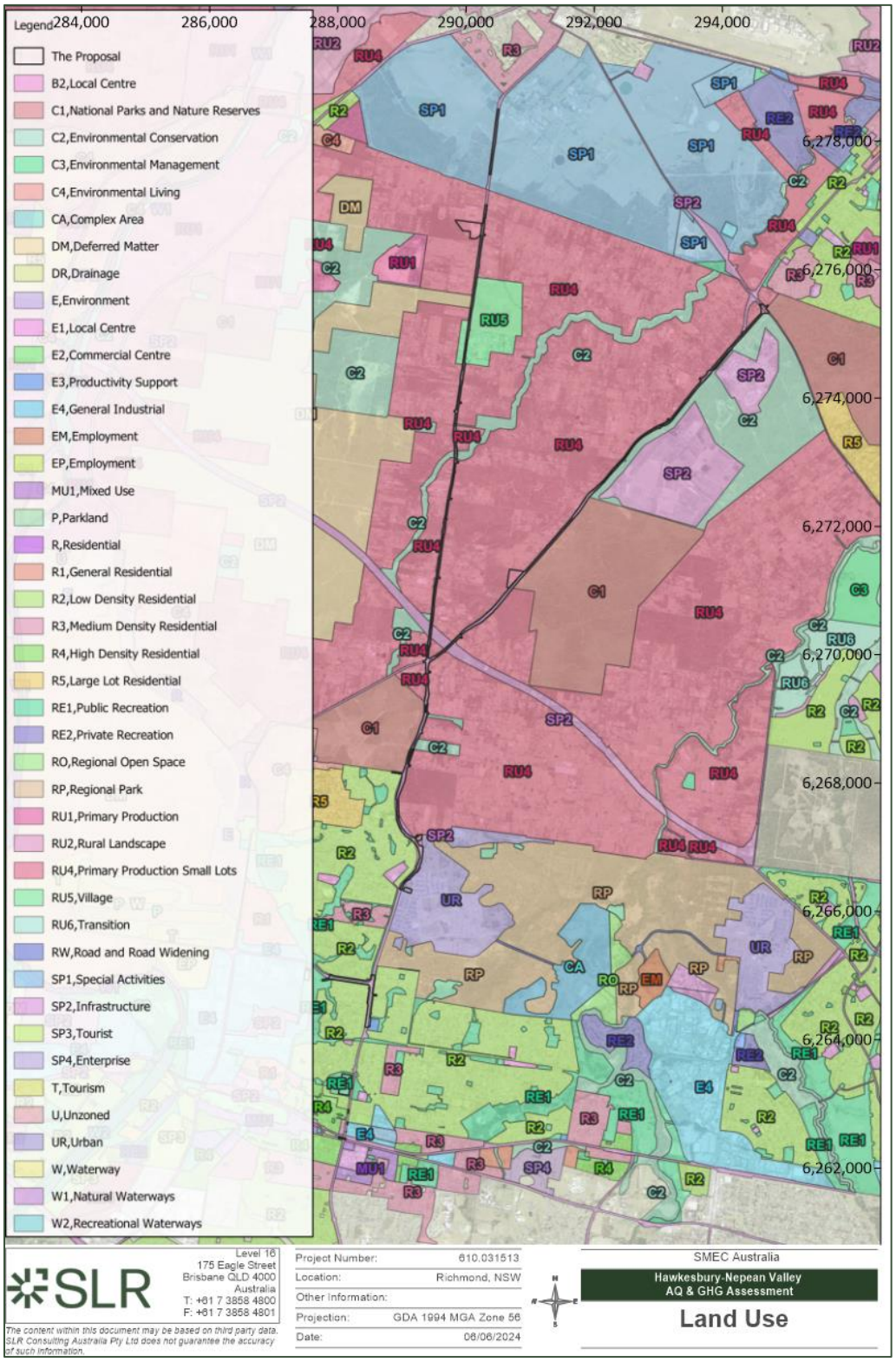
The nearest residential areas are located within 10 m from the proposed construction areas along Londonderry Road and The Northern Road (as shown in **Table 3**) shown in **Figure 4** as RU4 (Primary Production Small Lots), R2 (Low Density Residential) and RU5 (Village) zones. Additionally, the nearest ecological receptors are located east and west of The Northern Road as well as near the northern end of the proposed upgrades on The Northern Road, shown in **Figure 4** as C1 (National Parks and Nature Reserve). Some areas zoned as C2 (Environmental Conservation) along The Northern Road are also present.

**Table 3 Number of Sensitive Receptors around the Site**

| Distance from The Proposal | Number of Residential Receptors |
|---|---|
| 10 m | 141 |
| 20 m | 316 |
| 50 m | 902 |
| 100 m | 2,100 |

It is noted that no sensitive receptors are identified in construction areas shown within the Proposal in **Figure 4**. Given this, all receptors considered for this study are located outside the proposed Proposal footprint.

## Figure 4 Zoning of Surrounding Land

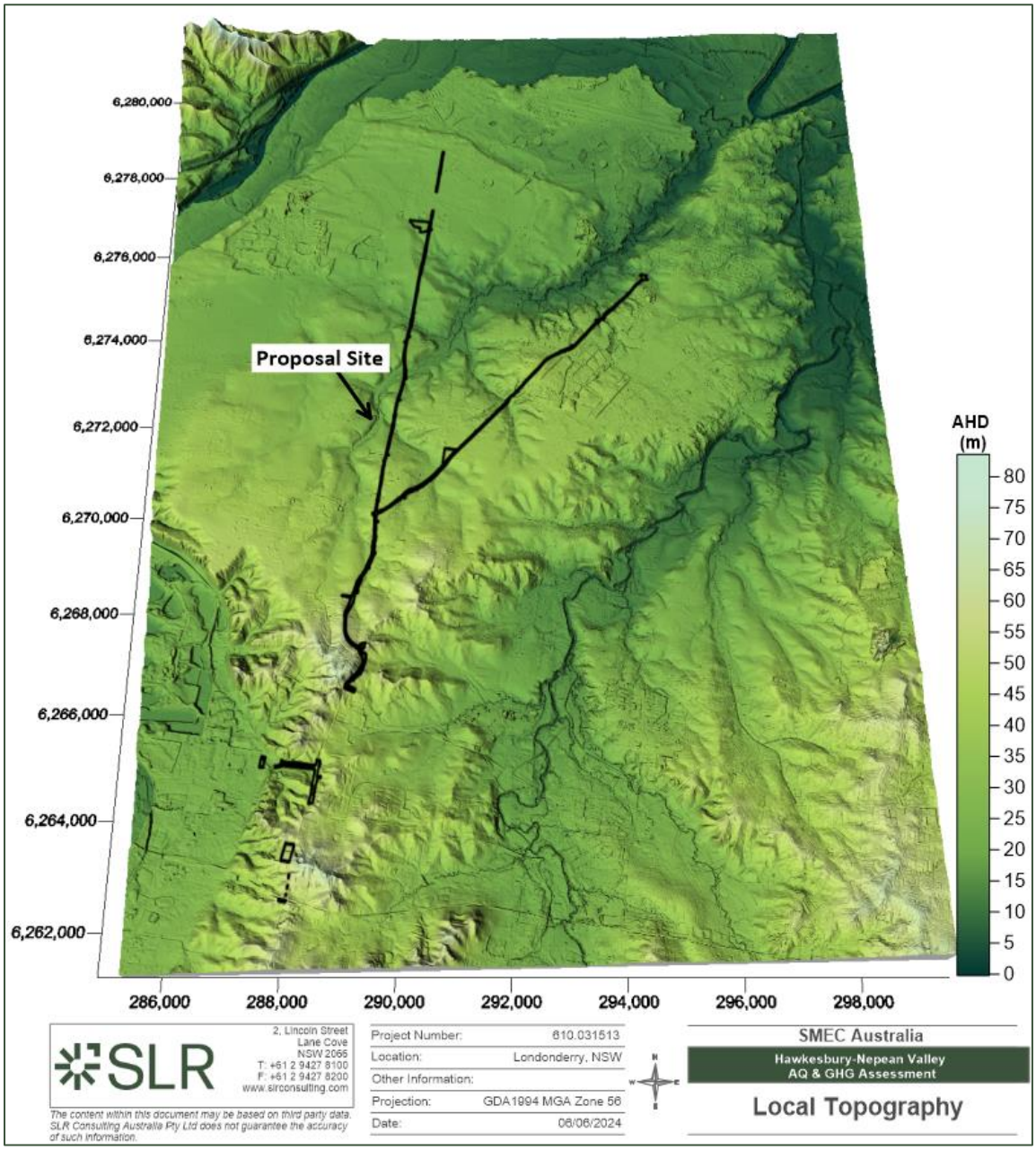


## 6.2 Local Topography

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.

A three-dimensional representation of the region surrounding the Proposal is shown in **Figure 5**. The topography of the local area ranges from an approximate elevation of 5 m to 70 m Australian Height Datum (AHD).

**Figure 5 Local Topographical Features**



## 6.3 Climate and Meteorology

Local climatic conditions can impact the dispersion of pollutant plumes. Parameters such as temperature, rainfall for its ability to scrub pollutants, wind speed and direction, solar radiation for its heating properties and relative humidity are of particular interest to air quality assessments.

The nearest meteorological monitoring station to the Proposal with long-term climate statistics available operated by the Bureau of Meteorology (BoM) is the automatic weather station (AWS) located at Richmond RAAF (ID 067105), approximately 7.5 km north-northeast. This AWS was commissioned in 1993 and has long-term meteorological data up to 2023 for the following parameters:

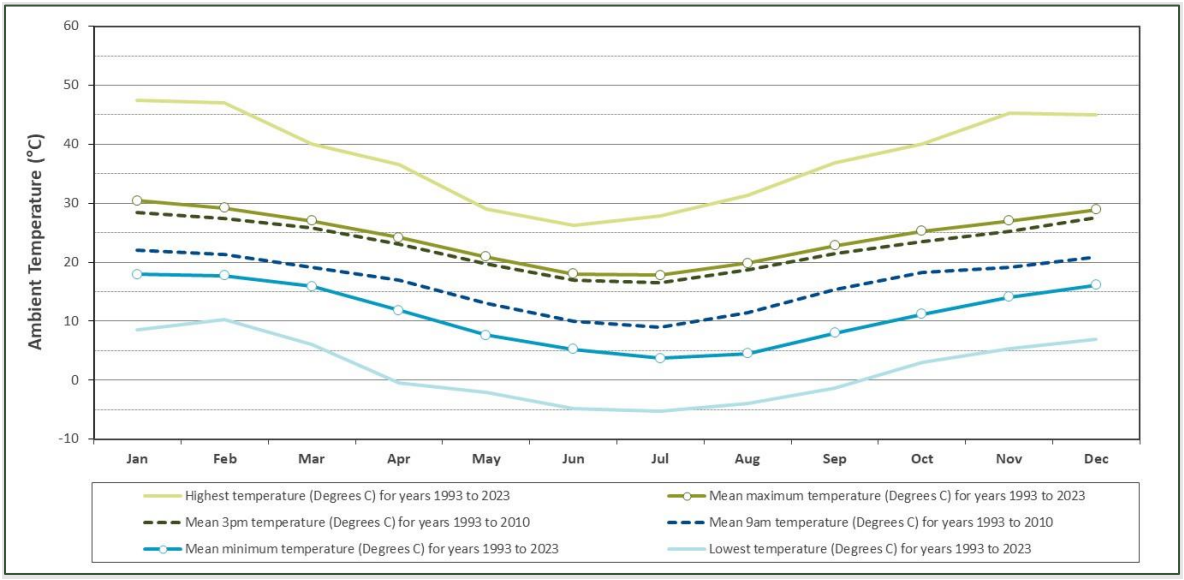
- Temperature (°C)
- Rainfall (mm)
- Solar radiation (MJ/m$^2$)
- Relative humidity (%)
- Wind speed (m/s) and wind direction (degrees)

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

### 6.3.1 Temperature

Long-term temperature statistics for the Richmond RAAF AWS are summarised in **Figure 6**. Mean maximum temperatures show seasonal variation throughout the year, ranging from 17.8°C in winter to 30.4°C in summer. The mean minimum temperatures show more of a seasonal variation, ranging from 3.7°C in winter to 17.9°C in summer.

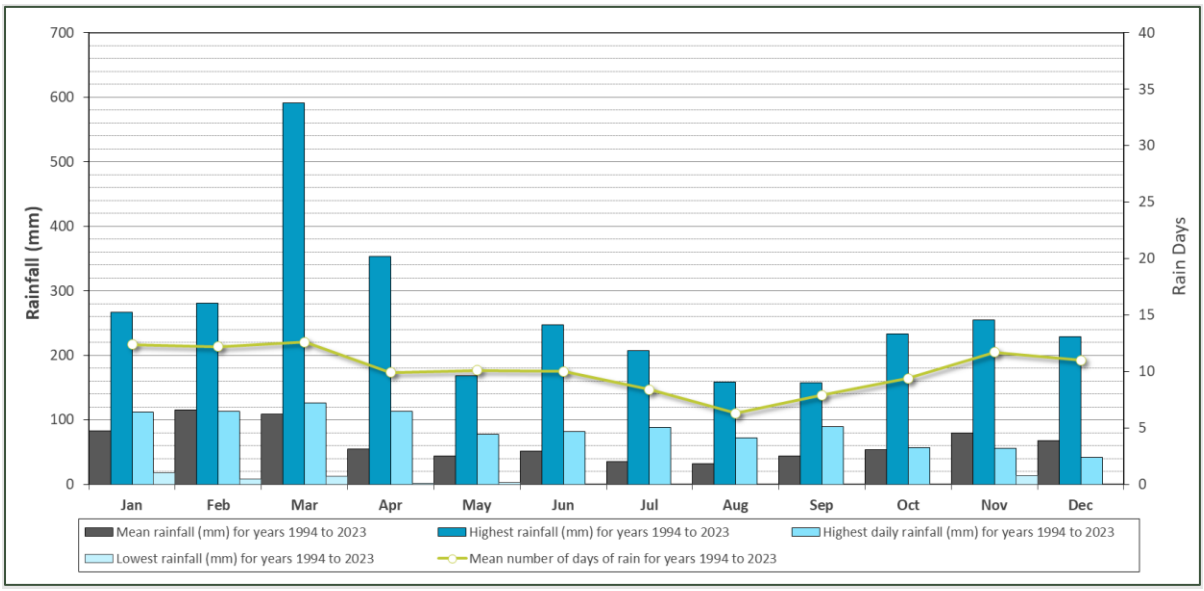
**Figure 6 Long-Term Temperature Data – Richmond RAAF AWS**



### 6.3.2 Rainfall

Long-term rainfall statistics reported for the Richmond RAAF AWS are summarised in **Figure 7**. Rainfall is relatively high in autumn, reducing over winter into spring, with the lowest average rainfall recorded in August and December.

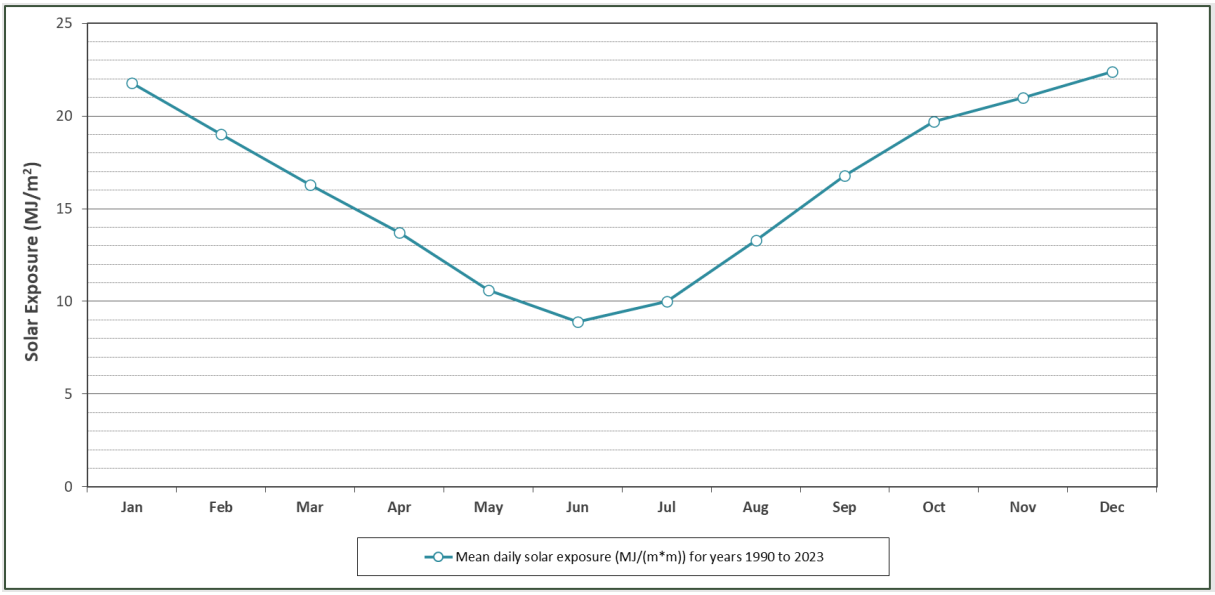
**Figure 7 Long-Term Rainfall Data – Richmond RAAF AWS**




### 6.3.3 Solar Radiation

The mean daily solar radiation levels (see **Figure 8**) peak in early summer (up to 22.4 MJ/m$^2$ in December) and are lowest in winter (down to 8.9 MJ/m$^2$ in June).

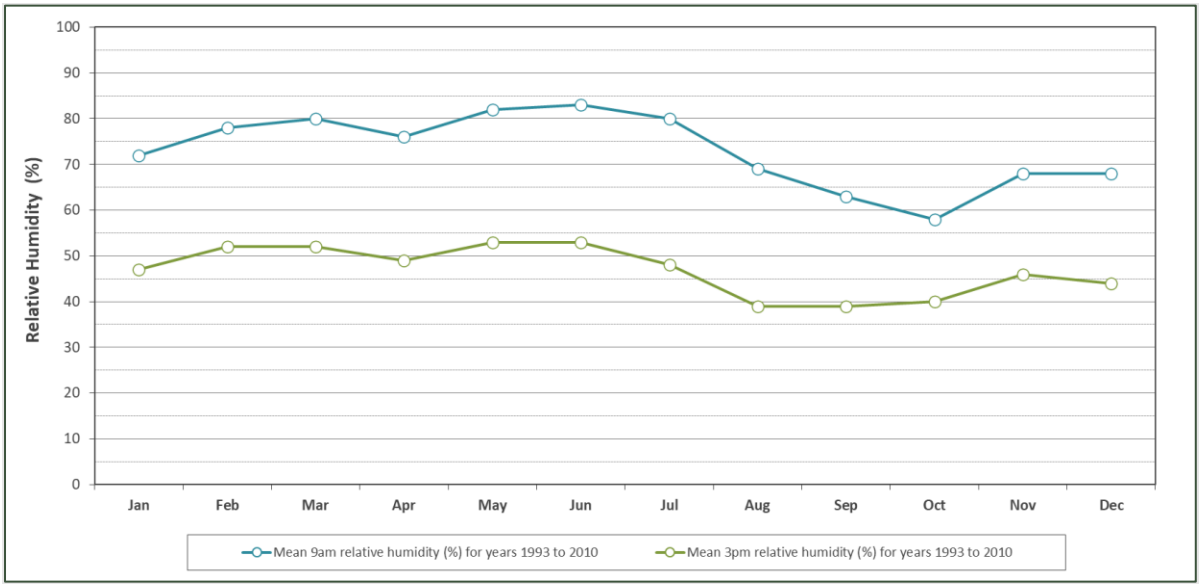
**Figure 8 Long-Term Solar Radiation Data – Richmond RAAF AWS**



### 6.3.4 Relative Humidity

Long-term humidity statistics (9 am and 3 pm monthly averages) are summarised in **Figure 9**. Morning humidity levels range from an average of around 58% in late spring to around 83% in late summer. Afternoon humidity levels are lower, at around 39% in mid spring and 53% in late summer.

**Figure 9 Long-Term Relative Humidity Data – Richmond RAAF AWS**



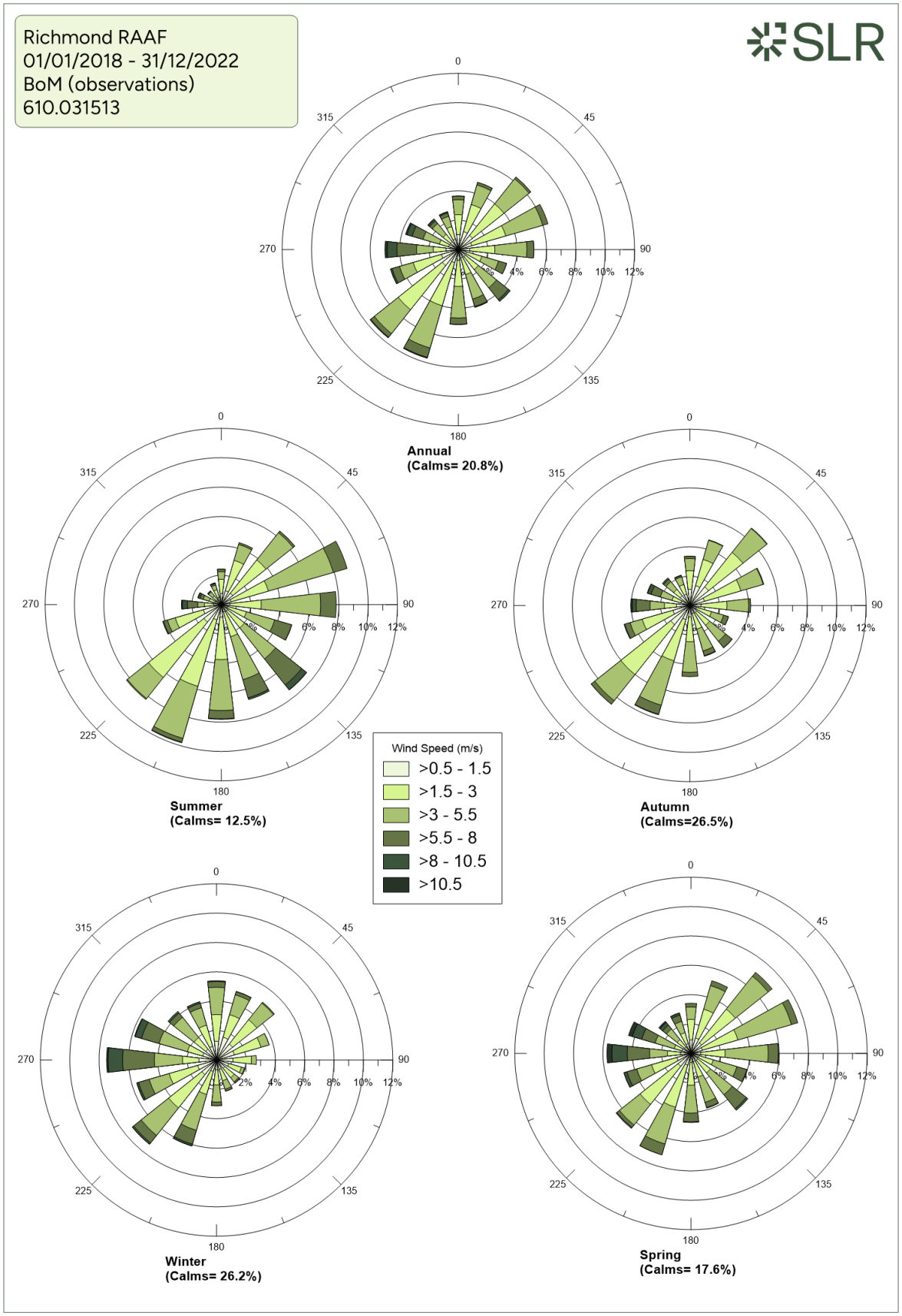

### 6.3.5 Wind Speed and Direction

Hourly average wind data recorded over the five-year period 2018-2022 by the Richmond RAAF AWS are presented as wind roses in **Figure 10**.

Wind roses show the frequency of occurrence of winds by direction and strength. The bars correspond to the 16 compass points (degrees from north). The bar at the top of each wind rose diagram represents winds blowing from the north (i.e., northerly winds), and so on. The length of the bar represents the frequency of occurrence of winds from that direction, and the widths of the bar sections correspond to wind speed categories, the narrowest representing the lightest winds. Thus, it is possible to visualise how often winds of a certain direction and strength occur over a long period, either for all hours of the day, or for particular periods during the day.

On an annual basis, winds emanate from all directions, with predominant winds from southwest quadrant. During summer, winds occur most frequently from the eastern and southern quadrants, with minimal winds from northern and western quadrant. During autumn, winds are predominately from the northeast and southwest quadrants. During winter, winds from the western quadrants dominate, while during spring, the predominant winds emanate from all directions, with stronger winds from northeastern quadrant.

**Figure 10 Wind Roses – Richmond RAAF AWS (2018 – 2022)**



## 6.4 Review of Ambient Air Quality Monitoring Data

Air quality monitoring is performed by the NSW Department of Environment and Heritage (DEH) at a number of monitoring stations across NSW. The closest station to the Proposal is the Richmond Air Quality Monitoring Station (AQMS), located approximately 4.2 km to the north of the Proposal. Due to the proximity of the Richmond AQMS from the Proposal and similar land use around this AQMS, it is considered sufficiently representative to use for describing background air quality. The following air pollutants are monitored by the Richmond AQMS and are presented in this section:

- Fine particles as $PM_{10}$ and $PM_{2.5}$
- $NO_2$

A summary of the monitored pollutant concentrations for the last five years (2018-2022) is presented in **Table 4** to **Table 6** and the data are presented graphically in **Figure 11** to **Figure 13**.

A review of the data shows that exceedances of 24-hour average $PM_{10}$ and 24-hour average $PM_{2.5}$ criteria were recorded in 2018 to 2022 (inclusive).

Measured ambient $NO_2$ concentrations were below the relevant criteria for all of these years.

It is noted for the semi-quantitative assessment of operational impacts using RAQST, the latest available (i.e. calendar year of 2021) background concentrations included in the tool's database were used for the Richmond AQMS.

**Table 4 Measured Ambient $PM_{10}$ Concentrations at Richmond AQMS**

| Averaging Period | | Criterion ($\mu g/m^3$) | Measured $PM_{10}$ Concentration ($\mu g/m^3$) | | | | |
|---|---|---|---|---|---|---|---|
| | | | 2018 | 2019 | 2020 | 2021 | 2022 |
| 24-hours | maximum | 50 | 116.3 (8) | 193.4 (28) | 237.7 (9) | 54.0 (1) | 24.5 |
| | 70th percentile | | 21.7 | 25.1 | 17.0 | 16.2 | 11.6 |
| | 90th percentile | | 28.9 | 43.7 | 26.8 | 21.4 | 15.4 |
| Annual | | 25 | 18.8 | 24.3 | 16.9 | 13.5 | 10.3 |
| Note – Numbers in red brackets signify number of exceedances for each year | | | | | | | |

**Table 5 Measured Ambient $PM_{2.5}$ Concentrations at Richmond AQMS**

| Averaging Period | | Criterion ($\mu g/m^3$) | Measured $PM_{2.5}$ Concentration ($\mu g/m^3$) | | | | |
|---|---|---|---|---|---|---|---|
| | | | 2018 | 2019 | 2020 | 2021 | 2022 |
| 24-hours | maximum | 25 | 123.9 (4) | 141.2 (32) | 93.0 (9) | 44.1 (4) | 15.7 |
| | 70th percentile | | 8.8 | 12.0 | 9.1 | 7.6 | 5.6 |
| | 90th percentile | | 12.5 | 25.5 | 13.8 | 12.1 | 7.8 |
| Annual | | 8 | 8.1 | 12.9 | 8.2 | 6.7 | 4.8 |
| Note – Numbers in red brackets signify number of exceedances for each year | | | | | | | |

**Table 6 Measured $NO_2$ Concentrations at Richmond AQMS**

| Averaging Period | | Criterion (µg/m³) | Measured $NO_2$ Concentration (µg/m³) | | | | |
|---|---|---|---|---|---|---|---|
| | | | 2018 | 2019 | 2020 | 2021 | 2022 |
| 1-hour | maximum | **226** | 61.5 | 61.5 | 71.8 | 59.5 | 36.9 |
| | 70th percentile | | 12.3 | 12.3 | 8.2 | 6.2 | 4.1 |
| | 90th percentile | | 22.6 | 20.5 | 14.4 | 12.3 | 10.3 |
| Annual | | **56** | 10.5 | 9.5 | 5.6 | 3.9 | 3.0 |

**Figure 11 Measured 24-Hour Average $PM_{10}$ Concentrations (2018-2022)**

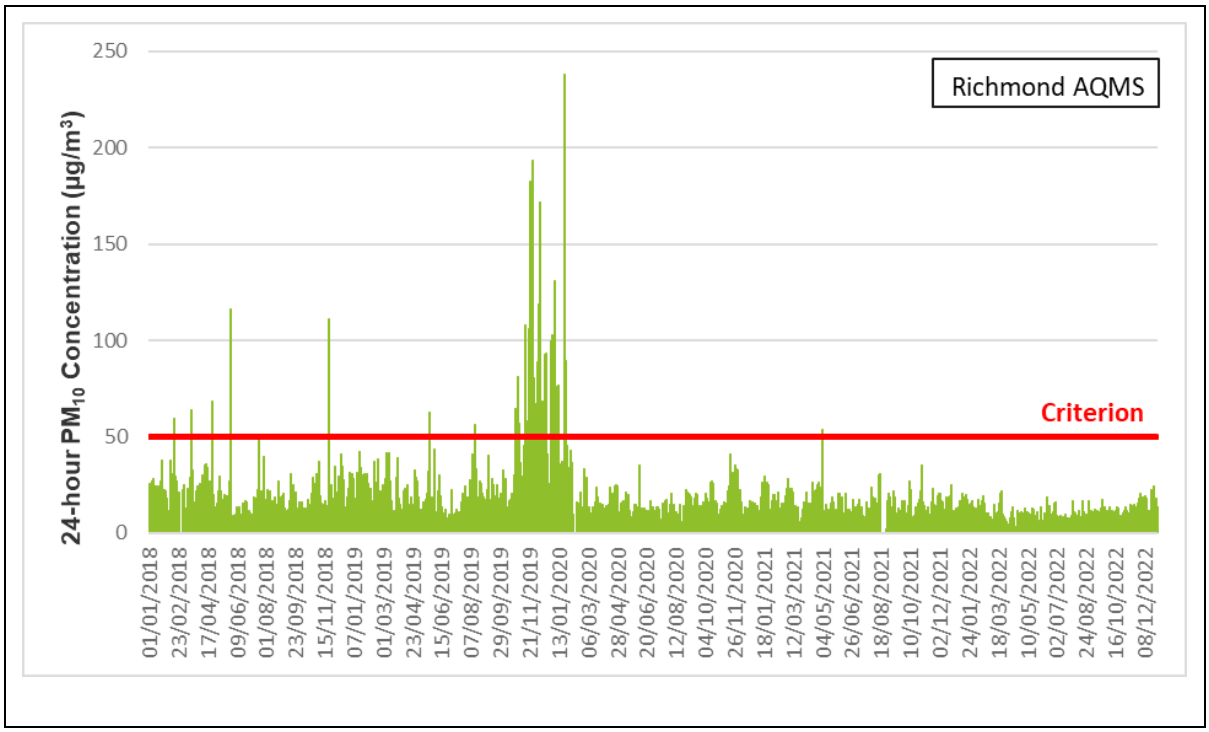


**Figure 12 Measured 24-Hour Average $PM_{2.5}$ Concentrations (2018-2022)**

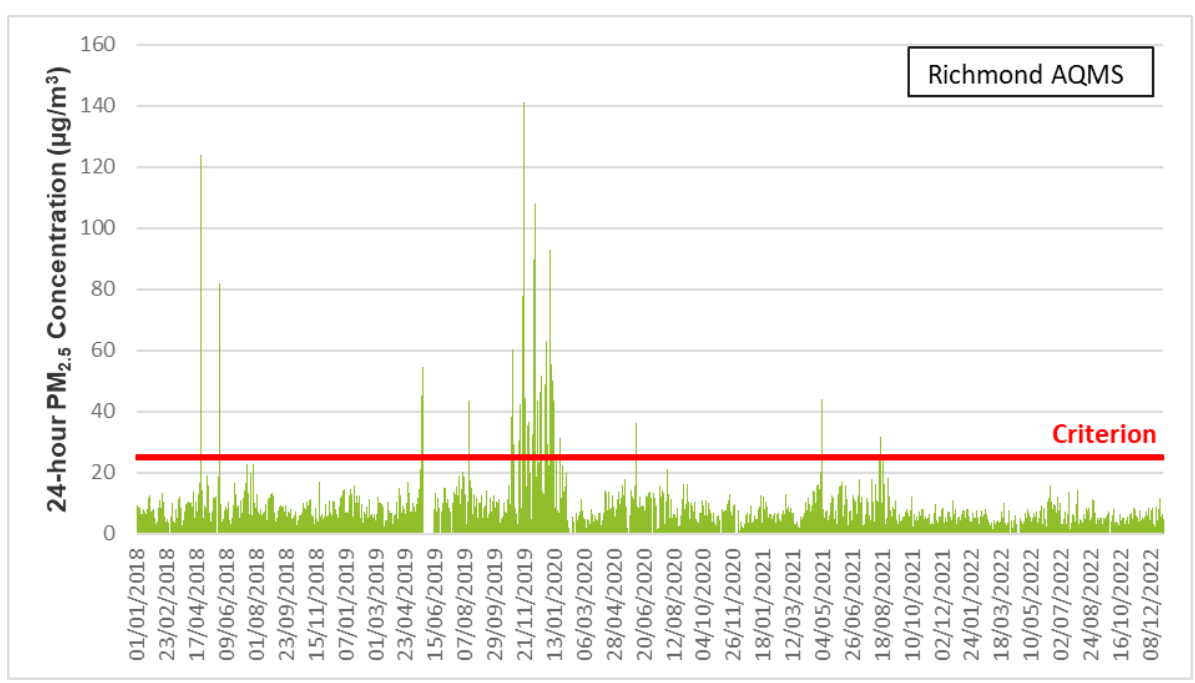
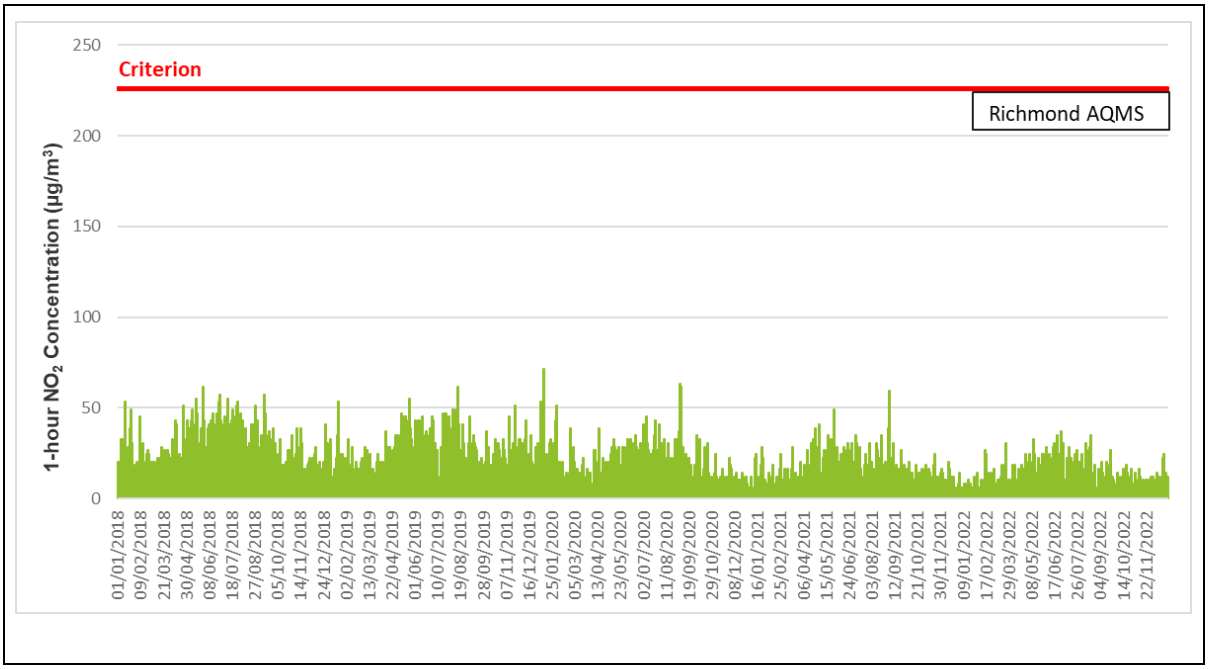



**Figure 13 Measured Daily Maximum 1-Hour Average $NO_2$ Concentrations (2018-2022)**



# 7.0 Assessment Methodology

## 7.1 Construction Phase

As mentioned in **Section 4.1**, fugitive dust was identified to be the key air emission associated with the proposed construction activities. To assess the potential impacts of fugitive dust emissions during construction, the *IAQM Guidance on the Assessment of Dust from Demolition and Construction* developed in the United Kingdom by the Institute of Air Quality Management (IAQM 2024) was adopted to provide a qualitative impact assessment for the construction phase of the Proposal.

The IAQM method uses a four-step process (refer to **Appendix A**) for assessing dust impacts from construction activities:

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

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

### 7.1.1 Greenhouse Gas

The following equation presents the calculation methodology for estimating Scope 1 GHG emissions from the combustion of diesel fuel.

$$E_{ij} = \frac{Q_i \times EC_i \times EF_{ij}}{1000}$$

Where,

$E_{ij}$, is the emissions of each gas type ($CO_2$, $CH_4$, or $N_2O$ in tonnes (t) $CO_2$-e)

$Q_i$, is the quantity of diesel fuel used annually (kilolitre (kL))

$EC_i$, is the energy content factor for diesel (gigajoule (GJ) per kL)

$EF_{ij}$, is the emission factor for diesel for each gas type (kilogram (kg) $CO_2$-e per GJ)

As noted in **Section 2.3.1**, the proposed construction activities are assumed to not use electricity from the national grid. Given this, no Scope 2 GHG emissions will be associated with the Proposal.

## 7.2 Operational Phase

Following construction, the widened shoulder provided by the Proposal would not be used as a travel lane by general traffic during normal operations. This assessment has considered the potential for additional air quality impacts in the event of a flood evacuation during which the widened shoulder would be used as additional evacuation lane.

A semi-quantitative risk-based assessment approach has been adopted for the proposed operational activities (refer to **Appendix B)** to determine if emissions during operation have the potential to cause adverse air quality impacts requiring a detailed quantitative air quality impact assessment.

This 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, neutral or beneficial environment?
- **Receptor Sensitivity**: how sensitive is the receiving environment to the anticipated impacts?
- **Magnitude**: what is the anticipated scale of the impact?

The key potential air quality issue identified for the operational phase of the Proposal is emissions of combustion products and particulate matter associated with the traffic travelling along Londonderry Road and The Northern Road. As mentioned previously, to assess the potential air quality impacts of the Proposal, the RAQST developed by TfNSW has been used as part of this risk-based approach.

RAQST is a simplified version of the road vehicle emission model designed for a first-pass screening of air quality impacts associated with new or existing roads. RAQST uses worst-case scenarios to determine whether a more detailed assessment is required. It is considered to provide conservative predictions of potential incremental impacts. The model is relatively simple and its use been recommended by TfNSW as a conservative screening-level model for predicting near field ground level pollutant concentrations from traffic.



# 8.0 Air Quality Impact Assessment

## 8.1 Construction Dust Assessment

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

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

Modelling of dust from construction activities is generally not considered appropriate, as emission rates can vary significantly depending on a combination of the activity and prevailing meteorological conditions (i.e., rainfall and wind speed), which cannot be reliably predicted. The following sections therefore present a qualitative assessment of the potential risks to air quality associated with dust from construction activities at the Proposal.

It is noted that, as stated in **Section 2.2**, construction activities are proposed to be executed in stages, while this assessment assumes simultaneous execution of construction works. This is likely to provide a conservative assessment of risks associated with the Proposal.

Details of the IAQM methodology used to perform the risk assessment are provided in **Appendix A**.

### 8.1.1 Step 1 – Screening Based on Separation Distance

As noted in **Section 6.1**, the nearest sensitive receptors (residential) are located within 10 m from the proposed construction areas. The IAQM screening criteria for further assessment is the presence of a ‘human receptor’ within:

- 250 m of the boundary of the Proposal; or
- 50 m of the route(s) used by construction vehicles, up to 500 m from the Proposal entrance(s).

In addition, as mentioned in **Section 6.1**, the Castlereagh Nature Reserve, Wianamatta Nature Reserve and Windsor Downs Nature Reserve immediately adjoining the Proposal are locations reserved under the *National Parks and Wildlife Act 1974*. These areas were considered as ‘ecological receptors’ for this assessment.

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

Based upon the available Proposal information 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 7**.

**Table 7 Categorisation of Dust Emission Magnitude**

| Activity | Dust Emission Magnitude | Basis |
|---|---|---|
| Demolition | Medium | **IAQM Definition:**<br>Total building volume 12,000 $m^3$ – 75,000 $m^3$, potentially dusty construction material, demolition activities 6-12 m above ground level.<br>**Relevance to this Proposal:**<br>*Dust will be generated from saw cutting activities of stormwater structures and profiling/milling of existing asphalt pavement. Demolition activities will be across the Proposal with a focus on drainage upgrade areas and road raising areas, accounting for approximately 34,000 $m^3$.* |
| Earthworks | Large | **IAQM Definition:**<br>Total site area greater than 110,000 $m^2$, potentially dusty soil type (e.g. clay, which will be prone to suspension when dry due to small particle size), more than 10 heavy earth moving vehicles active at any one time, formation of bunds greater than 6 m in height.<br>**Relevance to this Proposal:**<br>*Total area of the Proposal requiring earthworks covers an area over 100,000 $m^2$ to prepare foundations for shoulder widening, table drains, road raising areas and verges. At least 10 heavy earth moving vehicles will be expected to be working on site during the peak period.* |
| Construction | Medium | **IAQM Definition:**<br>Total building volume 12,000 $m^3$ to 75,000 $m^3$, potentially dusty construction material (e.g. concrete), on site concrete batching.<br>**Relevance to this Proposal:**<br>*The Proposal does not involve the construction of large buildings or other significant above-ground structures. Construction activities are limited to road construction for the shoulder widening, drainage works and road raising areas will require over 60,000 $m^3$ of materials in terms of volume. Concrete will be required for culvert base slab and headwall construction..* |
| Trackout | Large | **IAQM Definition:**<br>More than 50 heavy vehicle (3.5 t) movements in any one day, surface materials with a high potential for dust generation (e.g. high clay content), greater than 100 m of unpaved road length.<br>**Relevance to this Proposal:**<br>*It is estimated that more than 50 heavy vehicle movements per day will occur during the peak works period, and it is expected that vehicles will travel on unpaved roads longer than 100 m.* |

Definitions of activities provided by IAQM (IAQM 2024) -

**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.

**Earthworks** - Covers the processes of soil-stripping, ground-levelling, excavation and landscaping.

**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.

**Trackout** - 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. This arises when heavy duty vehicles (HDVs) leave the construction/demolition site with dusty materials, which may then spill onto the road, and/or when HDVs transfer dust and dirt onto the road having travelled over muddy ground on site.

### 8.1.3 Step 2b – Assessment of Area Sensitivity

#### Types of Receptors and Receptor Sensitivity

As the nearest residential receptors are located approximately 10 m from the Proposal (along the road alignment), this assessment focusses on the residential receptors that could be adversely impacted by dust emissions from the construction works if they are poorly controlled. Based on the criteria listed in **Table A-1** in **Appendix A**, the sensitivity of the residential receptors has been classified as *high* for dust soiling[2], and *high* for health effects[3].

#### Sensitivity of the Area

The sensitivity of the area surrounding the Site has been classified as shown in **Table 8**.

This categorisation has been made taking into account the individual receptor sensitivities derived above, the peak annual average background $PM_{10}$ concentration of 24.3 µg/m$^3$ recorded by the Richmond AQMS in 2019 (see **Table 4**) and the number of sensitive receptors present in the vicinity of the Site.

**Table 8 Sensitivity of the Area to Effects using IAQM Guidance**

| Impact | Receptors Considered | Receptor Sensitivity | Area Sensitivity | Basis |
|---|---|---|---|---|
| Dust soiling | Surrounding residential sites | High | High | >100 high sensitivity receptors within 20 m (**Table A-2**) |
| Health | Surrounding residential sites | High | High | Peak annual mean background of 24.3 µg/m$^3$ recorded at Richmond with >100 high sensitivity receptors within 20 m of Site (**Table A-3**) |
| Ecological | Castlereagh Nature Reserve and Windsor Downs Nature Reserve | Low | Low | Low sensitivity receptor area within 20 m of Site (**Table A-4**) |
| Note- 20m separation from sources is considered for assessing sensitivity of the area based on IAQM guidance provided in **Table A-2** | | | | |

### 8.1.4 Step 2c – Risk Assessment

Given the area sensitivity classifications in **Table 8** as *high* for dust soiling and for health effects, and *low* for ecological effects, and the dust emission magnitudes for the various construction phase activities shown in **Table 7**, the resulting risk of air quality effects is as presented in **Table 9**.

[2] As Users can reasonably expect a high level of amenity and appearance, aesthetics or value of properties would be diminished by soiling.

[3] As there is potential for some nearby commercial sites to be locations where workers may not be expected to be occupationally exposed to $PM_{10}$.

**Table 9 Preliminary Risk of Dust Effects from Construction (Uncontrolled)**

| Impact | Sensitivity of Area | Dust Emission Magnitude | | | | Preliminary Risk | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Demolition | Earthworks | Construction | Track-out | Demolition | Earthworks | Construction | Track-out |
| Dust Soiling | High | Medium | Large | Medium | Large | Medium Risk | High Risk | Medium Risk | High Risk |
| Human Health | High | | | | | Medium Risk | High Risk | Medium Risk | High Risk |
| Ecological | Low | | | | | Low Risk | Low Risk | Low Risk | Low Risk |

The results indicate that if dust mitigation measures were not to be implemented, there is:

- A *low* risk of ecological effects
- A *medium* risk of human health or dust soiling effects as a result of the proposed demolition and construction activities, and
- A *high* risk of human health or dust soiling effects at the residential receptor locations as a result of earthworks and trackout.

### 8.1.5 Step 3 – Recommended Mitigation Measures

**Table 10** lists the general site-wide mitigation measures recommended by the IAQM Guidance for a construction project shown to have a *high* risk of adverse impacts. These measures are designated as *highly recommended* (H) or *desirable* (D) by the dust IAQM method. Additional mitigation measures targeting potential impacts from earthworks, construction and trackout recommended by the IAQM based on the level of risk of adverse effects for these activities derived for the proposal in **Table 9** are provided in **Table 11** to **Table 14**.

Not all mitigation measures recommended by the IAQM Guidance will be suitable or relevant for all construction sites, therefore the mitigation measures listed below should be reviewed by the construction contractor and documented in the Construction Environmental Management Plan developed for the proposal. Effective implementation of the adopted measures should reduce the risk of adverse effects to negligible or low levels.

**Table 10 General Site Wide Mitigation Measures for High Risk Projects**

| Mitigation Measure | High Risk Site Recommendation |
|---|---|
| **Communications** | |
| Develop and implement a stakeholder communications plan that includes community engagement before work commences on site. | H |
| Display the name and contact details of person(s) accountable for air quality and dust issues on the site boundary. This may be the environment manager/engineer or the site manager. | H |
| Display the head or regional office contact information. | H |

| Mitigation Measure | High Risk Site Recommendation |
|---|---|
| Develop and implement a Dust Management Plan (DMP), which may include measures to control other emissions, approved by the relevant regulatory authority. The level of detail will depend on the risk and should include as a minimum the highly recommended measures in the IAQM Guidance. The desirable measures should be included as appropriate for the site. The DMP may include monitoring of dust deposition, real-time $PM_{10}$ continuous monitoring and/or visual inspections. | H |
| **Site Management** | |
| 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 |
| Make the complaints log available to the relevant regulatory authority when asked. | H |
| 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 log book. | H |
| Hold regular liaison meetings with other high risk construction sites within 500 m of the site boundary, to ensure plans are co-ordinated and dust and particulate matter emissions are minimised. It is important to understand the interactions of the off-site transport/deliveries which might be using the same strategic road network routes. | H |
| **Monitoring** | |
| Undertake daily on-site and off-site inspections, where receptors (including roads) are nearby, to monitor dust, record inspection results, and make the log available to the relevant regulatory authority when asked. This should include regular dust soiling checks of surfaces such as street furniture, cars and windowsills within 100 m of the site boundary, with cleaning to be provided if necessary. | H |
| Carry out regular site inspections to monitor compliance with the DMP, record inspection results, and make an inspection log available to the relevant regulatory authority when asked. | H |
| 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 |
| Agree dust deposition or real-time $PM_{10}$ continuous monitoring locations with the relevant regulatory authority. Where possible, commence baseline monitoring at least three months before work commences on site or, if it is a large site, before work on a phase commences. | H |
| **Preparing and Maintaining the Site** | |
| Plan site layout so that machinery and dust causing activities are located away from receptors, as far as is possible. | H |
| Erect solid screens or barriers around dusty activities or the site boundary that are at least as high as any stockpiles on site. | H |
| Fully enclose site or specific operations where there is a high potential for dust production and the site is active for an extensive period. | H |
| Avoid site runoff of water or mud. | H |



| Mitigation Measure | High Risk Site Recommendation |
|---|---|
| Keep site fencing, barriers and scaffolding clean using wet methods. | H |
| 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 |
| Cover, seed or fence stockpiles to prevent wind whipping. | H |
| **Operating vehicle/machinery and sustainable travel** | |
| Ensure all vehicles switch off engines when stationary - no idling vehicles. | H |
| Avoid the use of diesel or petrol powered generators and use mains electricity or battery powered equipment where practicable. * | H |
| Impose and signpost a maximum-speed-limit of approximately 20 km/hr on surfaced and 15km/hr on unsurfaced 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 relevant regulatory authority, where appropriate). | H |
| Implement a Travel Plan that supports and encourages sustainable travel (public transport, cycling, walking, and car-sharing) | H |
| **Operations** | |
| 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 |
| Ensure an adequate water supply on the site for effective dust/particulate matter suppression/ mitigation, using non-potable water where possible and appropriate | H |
| Use enclosed chutes and conveyors and covered skips. | H |
| 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 |
| 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** | |
| Avoid bonfires and burning of waste materials. | H |

H = Highly recommended

* It is noted that this report conservatively assumes the proposed construction works are to be powered using onsite diesel generators for the estimation of worst case impacts. However, in order to assist with reduction of emissions from the site this mitigation measure is recommended where practicable.

### Table 11 Mitigation Measures Specific to Medium-Risk Demolition

| Mitigation Measure | 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. Hand held 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 12 Mitigation Measures Specific to High-Risk Earthworks

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

### Table 13 Mitigation Measures Specific to Medium-Risk Construction

| Mitigation Measure | 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 powder materials ensure bags are sealed after use and stored appropriately to prevent dust. | D |
| H = Highly recommended; D = Desirable | |



**Table 14 Mitigation Measures Specific to High-Risk Trackout**

| Mitigation Measure | 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 release 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 | |

### 8.1.6 Step 4 - Residual Impacts

For almost all construction activities, the IAQM Guidance 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. Hence the residual effects will normally be *negligible*, providing the appropriate level of dust control is effectively implemented.

## 8.2 Operational Impacts

To assess the risk of operational impacts from the Proposal impacting on surrounding sensitive receptors, a risk based qualitative assessment approach outlined in **Appendix B** has been adopted, as outlined below.

- **Nature of Impact**: *does the impact result in an adverse, neutral or beneficial environment?*
    - The nature of impacts associated with emissions of products of combustion into the atmosphere are *adverse* to the environment.
- **Receptor Sensitivity**: *how sensitive is the receiving environment to the anticipated impacts*?
    - The distance to the nearest sensitive receptors (school and residential) are 20 m from the road alignment which have the potential to be impacted by combustion emissions from the Proposal, during either construction or operation. The sensitivity of these receptors is classified as *very high* as per the descriptors in **Table D-1**.

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

In order to predict air quality impacts associated with the Proposal, a first-pass screening of the potential air quality impacts associated with the proposed operations was done using RAQST.

One scenario representing peak southbound traffic associated with flood evacuation was modelled to predict potential worst case impacts at nearfield receptors (10 m from kerb). It is noted that the evacuation lane would only be used in the event of a major flood. The widened shoulder would not be open to general traffic as a additional travel lane during normal operations.

**Table 15** presents the input parameters used in the RAQST model.

**Table 15 RAQST Model Inputs**

| Parameter | Value | Description |
|---|---|---|
| Assessment Year | 2036 | Assumed |
| Electric vehicle projections | Included | - |
| Number of Lanes | 2 | Based on proposed design |
| Road type | Residential | Based on land use of the area |
| Road gradient | 5% | Average road gradients calculated based on terrain elevations. |
| Lane width (m) | 3.5 m | Assumed |
| Level for traffic composition | Level 1 – all vehicles | No detailed traffic composition available |
| Traffic speed | 25 km/hr | Default for residential road type |
| Traffic volume | 1,200 vehicles/hr<br>(600 vehicles/hr/lane) | Based on proposed design |
| **Background Concentrations** | | |
| Background site | Richmond AQMS | Nearest air quality monitoring station |
| Background year | 2021 | Included databased contains 2021 data only |
| 1-hour metric for $NO_x$ | 90$^{th}$ Percentile | - |
| 24-hour metric for $PM_{10}$ and $PM_{2.5}$ | 90$^{th}$ Percentile | - |

### 8.2.1 Modelling Results

Predicted cumulative $NO_2$, $PM_{10}$ and $PM_{2.5}$ concentrations at nearfield receptors are presented in **Figure 14**. The predicted concentrations are well below the relevant ambient air quality criteria for short term (1-hour and 24-hour) averaging periods. Annual average criteria have not been assessed in this study as flood evacuation events occur infrequently**.**

Given above, a detailed assessment is not warranted.

**Figure 14 Predicted Pollutant Concentrations 10m from the Kerb (RAQST)**

## Results - concentrations at receptor

| Pollutant | Averaging period | Air quality criterion (µg/m³) | Predicted concentration (µg/m³) | | | Predicted concentration as % of criterion | | | Compliance of total with criterion | Total <90% of criterion | Impact assessment result |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Background | Road | Total | Background | Road | Total | | | |
| $NO_X$ | 1-hour | - | 18.5 | 38.2 | 56.7 | Not applicable | | | Not applicable | | |
| | Annual | - | 6.2 | 7.6 | 13.8 | | | | | | |
| $NO_2$ | 1-hour | **164** | Not applicable | | **56.7** | Not applicable | | *35%* | Yes | Yes | Not applicable |
| | Annual | **31** | 6.2 | 4.2 | **10.4** | *20%* | *14%* | *34%* | Yes | Yes | Slight |
| $PM_{10}$ | 24-hour | **50** | 21.4 | 2.0 | **23.5** | *43%* | *4%* | *47%* | Yes | Yes | Not applicable |
| | Annual | **25** | 13.6 | 0.8 | **14.4** | *54%* | *3%* | *58%* | Yes | Yes | Negligible |
| $PM_{2.5}$ | 24-hour | **25** | 12.1 | 1.3 | **13.4** | *49%* | *5%* | *54%* | Yes | Yes | Not applicable |
| | Annual | **8** | 6.8 | 0.5 | **7.3** | *85%* | *6%* | *91%* | Yes | No | Moderate |

| **Summary** |
|---|
| Complies with air quality criteria, but marginal. |
| Potential impact is moderate. |
| **Recommendation** |
| Seek advice on whether a detailed assessment should be conducted. |

Note – annual average criteria have not been assessed in this study as flood evacuation events are infrequent.

Based on the modelling results, the magnitude of any air quality impact associated with flood evacuation traffic is considered to be ***negligible*** at the nearfield receptors.

Given the very high sensitivity of the potentially affected receptors and the negligible magnitude of the potential air quality impacts, the potential impact significance for the local receptors is concluded to be of neutral significance (see **Table 16**).

**Table 16 Impact Significance– Operational Phase**

| Sensitivity \ Magnitude | | [Defined by Table C-2] | | | |
|---|---|---|---|---|---|
| | | **Substantial Magnitude** | **Moderate Magnitude** | **Slight Magnitude** | **Negligible Magnitude** |
| **[Defined by Table C-1]** | **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 |

## 8.3 Mitigation Measures

In addition to dust and air emission mitigation measures for the construction phase provided in **Section** 8.1.3, key air quality management measures implemented at the site may include:

- Development an Air Quality Management Plan as part of the Construction Environmental Management Plan that evaluates the details of the construction site and addresses site specific dust and air quality management measures for each proposed activity and details a monitoring program if deemed necessary.
- Mobile heavy lift equipment and other vehicles operated on site are maintained and operated as per manufacturer specifications or best practice requirements.
- Mobile heavy lift equipment and other vehicles are turned off when not in use, where safe to do so. All unnecessary engine idling is avoided.
- Any spillages are cleaned up in a timely manner.
- Consider positioning ancillary sites and stockpiles away from nearby sensitive receptors where possible.
- Consider activity planning around ceasing in high wind conditions.
- Where possible sealed access roads and hardstand areas are maintained and the surface kept free of significant dust-generating materials.
- To confirm that the controls adequately minimise dust emissions from the proposal, it is recommended that visual inspections of dust levels be performed on a daily basis, particularly during the peak earthworks phases.
- In the event of a dust complaint being received, a targeted dust monitoring campaign should be implemented to verify the issues raised and to assist in managing the effectiveness of dust controls being applied.
- Monitoring of dust impacts on the adjacent nature reserves should be performed on a weekly basis by inspecting foliage conditions. Should significant dust buildup be

observed, water sprays should be used to wash down the foliage and minimise any impacts.

Given the negligible risk of off-site air quality impacts identified for the operational phase, no additional mitigation measures are considered to be necessary.

# 9.0 GHG Assessment

## 9.1 Construction GHG Emissions

The main sources of GHG emissions associated with the construction phase of the Proposal are as follows:

- Diesel combustion in power generators and other stationary equipment (Scope 1), and
- Diesel combustion in light and heavy vehicles (Scope 1)

### 9.1.1 Emission factors and activity data

Greenhouse gas emission factors sourced from the NGA Factors workbook (DCCEEW 2022) have been used to estimate emissions associated with fuel combustion during construction.

The emission factors used to estimate emissions from the construction works are summarised in **Table 17**. The associated activity data required by the emission factors to estimate emissions are outlined in **Table 18.**

**Table 17 Emission Factors Used to Estimate GHG Emissions**

| GHG Source | Emission Factor (kg $CO_2$-e / GJ) | Energy Content Factor (GJ/kL) | Source |
|---|---|---|---|
| Diesel usage in stationary/off-road equipment | 70.2 | 38.6 | (DCCEEW 2023) |
| Diesel usage in mobile plant/trucks | 70.4 | 38.6 | (DCCEEW 2023) |

**Table 18 Activity Data used to Estimate Construction-Related GHG Emissions**

| Parameter | Estimated Usage |
|---|---|
| Diesel consumption – On road vehicles | 41 kL/month for 36 months |
| Diesel consumption – Off-road and stationary plant, generators etc | 48 kL/month for 36 months |

### 9.1.2 Estimated Greenhouse Gas Emissions

The estimated Scope 1 GHG emissions associated with the construction phase of proposal are presented in **Table 19.**

**Table 19 Estimated GHG Emissions for Construction Activities**

| Emission Scope | Emission Source/Activity | Total Estimated Emissions ($tCO_2$-e) | Equivalent Annual Emissions ($tCO_2$-e/annum) |
|---|---|---|---|
| Scope 1 | Diesel consumption – On road vehicles | 332 | 111 |
| | Diesel consumption – Off-road and stationary plant, generators etc | 390 | 130 |
| **TOTAL** | | **722** | **241** |
| Note - as mentioned in **Section 7.1.1**, no Scope 2 emissions are estimated as it is assumed that electricity will be provided by onsite diesel generators (refer **Section 2.3.1**) | | | |

To provide context for these emissions, the most recently reported National Greenhouse Accounts data was reviewed to assess the contribution of the estimated Scope 1 emissions from the Proposal to the reported state/territory and federal emissions. This comparison is provided in **Table 20**, which shows that the proposal is not expected to make any significant contribution to either the state or nationwide GHG emissions totals.

**Table 20 Comparison of Proposal to NSW and Australia Reported GHG Emissions**

| Inventory | The Proposal Scope 1 and 2 Emissions | Australia GHG Emissions | NSW GHG Emissions |
|---|---|---|---|
| | | ($t CO_2$-e) | ($t CO_2$-e) |
| 2021 Paris Emission Inventory (DCCEEW 2023) | | 464,770,700 | 132,049,300 |
| **Proposal Emissions** | **Annual Emissions ($t CO_2$-e)** | **Proposal Contribution (%)** | **Proposal Contribution (%)** |
| Estimate Emissions | 240.8 | 0.00005% | 0.00018% |

## 9.2 Mitigation Measures

The following energy efficiency opportunities have been identified to minimise GHG emissions from the Proposal:

- As far as reasonably possible, construction materials will be sourced from within or close to the Proposal area to reduce fuel use from transport of materials,
- Construction equipment will be maintained in good working to maximise fuel efficiency of equipment,
- Appropriately sized equipment will be used for construction activities,
- Waste from construction will be minimised,
- Greenhouse reduction initiatives (use of solar power, energy efficient lighting, etc) will be implemented at construction sites.

# 10.0 Conclusions

SLR was commissioned by SMEC to prepare an air quality and GHG assessment report for the proposed widened southbound shoulder that will operate as an additional flood evacuation lane along Londonderry Road and The Northern Road located in Londonderry NSW, being the State Roads component of the flood evacuation improvements for the Hawkesbury-Nepean Valley Road Resilience Program.

### Air Quality Assessment

The key sources of air emissions associated with the Proposal were identified as particulate matter for the construction phase and products of combustion for the operational phase in the infrequent event of a major flood evacuation.

The potential for dust impacts during the construction phase was assessed using a qualitative risk-based approach. The results of this assessment indicate that dust impacts due to construction works should be able to be adequately managed with the implementation of recommended mitigation measures.

It is noted that not all mitigation measures recommended by the IAQM Guidance will be suitable or relevant for all construction sites, therefore the mitigation measures provided in this report should be reviewed by the construction contractor and documented in a relevant Construction Environmental Management Plan. Effective implementation of the adopted measures should reduce the risk of adverse effects to negligible or low levels.

For the operational phase, a semi qualitative approach was adopted to determine the risk of adverse air quality impacts and requirement for a detailed assessment. Findings from a quantitative assessment using the TfNSW's tool RAQST was used to inform the semi-qualitative risk assessment. The results given by RAQST showed that potential cumulative air quality impacts at nearfield receptors would be below the relevant air quality criteria and a detailed assessment is not warranted. It is also noted that since major flood evacuation events are infrequent, assessment against annual average criteria was not considered relevant for this study. The evacuation lane would not be used during normal traffic operation.

### Greenhouse Gas Assessment

Scope 1 GHG emissions were conservatively estimated based on anticipated diesel usage in stationary and mobile equipment for the construction phase of the Proposal. Since the Proposal is at Concept Design stage, details of electrical demand and power sources are limited. Therefore, it was conservatively assumed that all power will be provided by onsite generators. Thus, given that the proposed construction activities are assumed to not use electricity from national grid, Scope 2 GHG emissions were not relevant for this study.

The estimated GHG emissions for the construction phase of the Proposal is 240.8 $tCO_2$-e/annum over the 3-year construction period which represents a very slight increment to the state and national GHG emissions.

# 11.0 References

CBRK. 2023. "Transport and Accessibility Impact Assessment for Proposed Warehouse and Distribution Centre at Augusta Street, Huntingwood." Colston Budd Rogers & Kafes Pty Ltd, July.

DCCEEW. 2022. *Australian National Greenhouse Accounts Factors.* Canberra: Australian Government Department of Climate Change, Energy, the Environment and Water.

DCCEEW. 2023. *Australian National Greenhouse Accounts Factors.* Canberra: Australian Government Department of Climate Change, Energy, the Environment and Water.

DCCEEW. 2023a. *Consultation paper: International best practice benchmarks.* Australian Government. Department of Climate Change, Energy, the Environment and Water.

DCCEEW. 2023b. *Draft guidelines - setting international best practice benchmarks.* Australian Government. Department of Climate Change, Energy, the Environment and Water.

DCCEEW. 2023. "Paris Agreement Inventory." Accessed September 20, 2023. https://ageis.climatechange.gov.au/.

IAQM. 2023. *Guidance on the assessment of dust from demolition and construction.* London: Institute of Air Quality Management.

IAQM. 2024. *Guidance on the assessment of dust from demolition and construction.* London: Institutre of Air Quality Management.

IAQM. 2014. *Guidance on the Assessment of Dust from Demolition and Construction.* London: Institute of Air Quality Management.

NGER Act. 2007. *National Greenhouse and Energy Reporting Act. Inc Amendments to Safeguard Mechanism (Crediting) Amendment Act 2023.* Australian Government.

NGER Measurement Determination. 2008. *National Greenhouse and Energy Reporting (Measurement) Determination 2008. Inc. Amendments to National Greenhouse and Energy Reporting (Measurement) Amendment (2023 Update) Determination 2023.* Australian Government.

NGER Regulations. 2008. *National Greenhouse and Energy Reporting Regulations 2008. Inc Amendments to National Greenhouse and Energy Reporting Amendment (2023 Measures No. 1) Regulations 2023.* Australian Government.

NGER Safeguard Rules. 2015. *National Greenhouse and Energy Reporting (Safeguard Mechanism) Rule 2015. Inc Amendments to National Greenhouse and Energy Reporting (Safeguard Mechanism) Amendment (Reforms) Rules 2023.* Australian Government.

NSW Department of Planning. 2008. *Development Near Rail Corridors and Busy Roads - .* Sydney: NSW Department of Planning.

NSW EPA. 2022. *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales.* New South Wales Environment Protection Authority.

NSW EPA. 2007. "Local Government Air Quality Toolkit - Visual guide: Dust from urban construction sites."

WRI. 2011. *The GHG Protocol Corporate Value Chain (Scope 3) Standard.* WRI/WBCSD.



# Appendix A Construction Dust Risk Assessment Methodolgy

## Hawkesbury-Nepean Valley Flood Evacuation Road Resilience Program. Improvements on The Northern Road and Londonderry Road Flood Evacuation Routes

### Air Quality and Greenhouse Gas Assessment

**SMEC Australia**

SLR Project No.: 610.031513.00001

18 June 2024

# Construction Phase Risk Assessment Methodology

## Step 1 – Screening Based on Separation Distance

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

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

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

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

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

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

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

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

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

## Step 2b – 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
- Other site-specific factors, such as whether there are natural shelters such as trees to reduce the risk of wind-blown dust.

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

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

**Table A-1 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<br>• 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<br>• The appearance, aesthetics or value of their property could be diminished by soiling; or<br>• The people or property would not 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<br>• Property would not reasonably be expected to be diminished in appearance, aesthetics or value by soiling; or<br>• 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 other culturally important collections, 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 streets.* |
| Ecological | • Locations that support International or National (EPBC) level species or ecological communities | • Locations that support National or State level species or ecological communities of conservation | • Locations that support State or Local Government level species of |

| Value | High Sensitivity Receptor | Medium Sensitivity Receptor | Low Sensitivity Receptor |
|---|---|---|---|
| | of conservation significance that may be affected by dust soiling; or<br>• Locations that are protected under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act), that will require approval from the Commonwealth Government Minister for the Environment (the minister) if the action has, will have, or is likely to have, a significant impact on Matters of National Environmental Significance (MNES). | significance, where its dust sensitivity is uncertain or unknown; or<br>• Locations that are protected under the EPBC Act or State legislation (e.g. Biodiversity Conservation Act), that will require approval from the Commonwealth or State Government Minister for the Environment (the minister) if the action has, will have, or is likely to have, a significant impact on MNES or State listed conservation significant species or communities. | conservational significance where the features may be affected by dust deposition.<br>• Locations that are protected under State legislation (e.g. Biodiversity Conservation Act) or Local Government Environmental Management Plans, that will require approval from the State Government Minister for the Environment (the minister) if the action has, will have, or is likely to have, a significant impact on State listed conservation significant species or communities. |
| | *Examples: Threatened avifauna that are impacted from air pollution through the ingestion of fine dust particles into the liver and lungs due to their high metabolic rate and special respiratory systems.* | *Examples: Threatened or Priority Ecological Communities that are sensitive to dust by inhibiting photosynthesis and respiration of species.* | *Examples: a local Nature Reserve with dust sensitive vegetation communities.* |

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 become more sensitive over time)
- 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 A-2**. The sensitivity of the area should be derived for each of activity relevant to the Proposal (i.e. construction and earthworks).

**Table A-2 IAQM - Categorising the Sensitivity of an Area to Dust Soiling Impacts**

| 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
- any known specific receptor sensitivities which go beyond the classifications given in the IAQM document.

**Table A-3 IAQM - Categorising the Sensitivity of an Area to Dust Health Impacts**

| Receptor sensitivity | Annual Mean $PM_{10}$ | 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.

The IAQM Guidance matrix used to categorise the sensitivity of the area to ecological impacts from dust is presented in **Table A-4**.

**Table A-4 IAQM - Categorising the Sensitivity of an Area to Ecological Impacts**

| Receptor Sensitivity | Distance from the Source (m) | |
|---|---|---|
| | <20 | <50 |
| High | High | Medium |
| Medium | Medium | Low |
| Low | Low | Low |

Notes: (a) The sensitivity of the area should be derived for each of the four activities: demolition, construction, earthworks and trackout and for each designated site.

(b) Only the highest level of area sensitivity from the table needs to be considered.

(c) For trackout, the distances should be measured from the side of the roads used by construction traffic. Without site-specific mitigation, trackout may occur from roads up to 500 m from large sites, 200 m from medium sites and 50 m from small sites, as measured from the site exit. The impact declines with distance from the site.

## Step 2c - 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 A-5** (demolition), **Table A-6** (earthworks and construction) and **Table A-7** (track-out) to determine the risk category with no mitigation applied.

**Table A-5 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 A-6 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 A-7 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 |

| Sensitivity of Area | Dust Emission Magnitude | | |
|---|---|---|---|
| | Large | Medium | Small |
| 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 Operational Phase Risk Assessment Methodology

## Hawkesbury-Nepean Valley Flood Evacuation Road Resilience Program. Improvements on The Northern Road and Londonderry Road Flood Evacuation Routes

### Air Quality and Greenhouse Gas Assessment

**SMEC Australia**

SLR Project No.: 610.031513.00001

18 June 2024

### 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 D-1** outlines the methodology used in this study to define the sensitivity of receptors to air quality impacts.

**Table D-1 Methodology for Assessing Sensitivity of a Receptor**

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

### Magnitude

Magnitude describes the anticipated scale of the anticipated environmental change in terms of how that impact may cause a change to baseline conditions (refer to **Table C-2**). Magnitude may be described quantitatively or qualitatively. Where an impact is defined by qualitative assessment, suitable justification is provided in the text.

**Table D-2 Magnitude of Impacts**

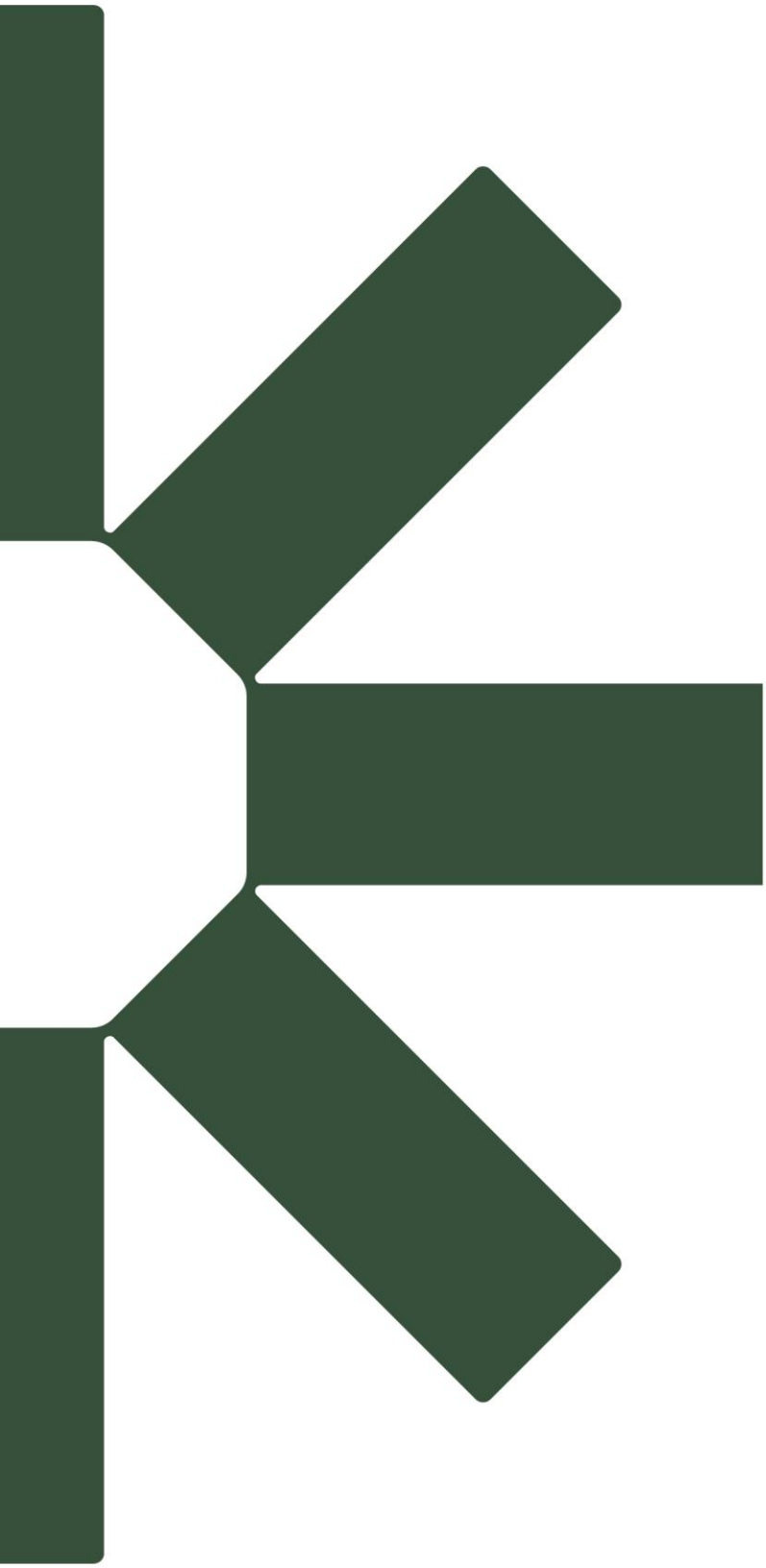
| Magnitude | Description |
|---|---|
| Substantial | Impact is predicted to cause significant consequences on the receiving environment (may be adverse or beneficial) |
| Moderate | Impact is predicted to possibly cause statutory objectives/standards to be exceeded (may be adverse) |
| Slight | Predicted impact may be tolerated. |
| Negligible | Impact is predicted to cause no significant consequences. |

## Significance

The risk-based matrix provided in **Table C-3** illustrates how the definition of the sensitivity and magnitude interact to produce impact significance.

**Table D-3 Impact Significance Matrix**

| Sensitivity / Magnitude | | [Defined by Table C-2] | | | |
|---|---|---|---|---|---|
| | | **Substantial Magnitude** | **Moderate Magnitude** | **Slight Magnitude** | **Negligible Magnitude** |
| **[Defined by Table C-1]** | **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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