Transport for NSW

Richmond Road Upgrade between M7 Motorway and Townson Road, Marsden Park

Air Quality Assessment Report

November 2024

NSW GOVERNMENT

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Acknowledgement of Country

Transport for NSW acknowledges the traditional custodians of the land on which the Richmond Road Upgrade between M7 Motorway and Townson Road, Marsden Park project is proposed.

We pay our respects to their Elders past and present and celebrate the diversity of Aboriginal people and their ongoing cultures and connections to the lands and waters of NSW.

Many of the transport routes we use today – from rail lines, to roads, to water crossings – follow the traditional Songlines, trade routes and ceremonial paths in Country that our nation's First Peoples followed for tens of thousands of years.

Transport for NSW is committed to honouring Aboriginal peoples' cultural and spiritual connections to the land, waters and seas and their rich contribution to society.

Approval and authorisation

Title	Richmond Road Upgrade between M7 Motorway and Townson Road: Air quality assessment report
Accepted on behalf of Transport for NSW by:	Maddy Mukerjee, Project Development Manager
Signed	Maddy Mukerjee
Date:	20/11/2024

Document review tracking

Draft No.	Date	Comments
00	18 November 2024	Issued to TfNSW

Executive summary

Background

The North West Growth Area (NWGA) has been identified by the New South Wales (NSW) Government as a key component to support urban growth in the greater Sydney region. When developed (2056 forecasts), the NWGA will provide approximately 90,000 homes accommodating 250,000 people. A key part of the identification of the NWGA was its proximity and connection to transport nodes including the M7 Motorway and ease of connection to the M4 Motorway, Sydney Metro northwest and the new Western Sydney Airport.

To unlock the potential of the NWGA, upgrades to transport infrastructure must align with current and forecasted needs, while considering forecasted population and economic growth. Richmond Road already experiences significant congestion, impacting travel times and hindering the potential for economic growth in the area. As the NWGA continues to grow there will be increasing pressure on Richmond Road and the transport network.

This air quality assessment supports the environmental assessment for the Richmond Road Widening Project between M7 Motorway and Townson Road (the proposal). The proposal is subject to assessment by a review of environmental factors (REF) under Division 5.1 of *Environmental Planning and Assessment Act 1979* (EP&A Act).

Purpose

The purpose of this air quality assessment report is to describe the existing environment with respect to air quality, document the potential impacts of the proposal on the air quality of the study area, and to detail measures to avoid, mitigate or manage the identified impacts.

Existing environment

A detailed review of the existing environment was carried out including an analysis of historically measured concentrations of key quality indicators (NO_2, PM_{10} and $PM_{2.5}$) from a representative monitoring station. The following conclusions were made in relation to the existing air quality and meteorological conditions:

- The existing climatic conditions are warm and temperate with generally consistent periods of rainfall but higher rainfall in January through March.
- PM_{10} annual averages for the years 2017 through 2021 are below the maximum concentration standard except for 2019, which exceeded the standard as a result of a major bushfire.
- The annual $PM_{2.5}$ averages for 2017 and 2021 are below the standard, while those for 2018, 2019, and 2020, exceed the maximum concentration standard.
- The NO_2 maximum 1-hour average and annual average for the years 2017 to 2021 are below the maximum concentration standard.

Outcomes of the air quality assessment

Potential air quality impacts of the proposal during construction were assessed using the semi-quantitative method recommended by CASANZ for transport projects. Operation stage air quality impact is assessed using Transport for NSW's Roadside Air Quality Screening Tool (RAQST) for "Do Nothing" and "The proposal" scenarios.

The key outcomes of the air quality assessment are:

- Construction of the proposal was determined to represent a 'high' risk of dust impacts primarily due to the large volumes of proposed earthworks; however, the application of the recommended mitigation measures would manage any adverse residual impacts.
- During the operation stage, the proposal resulted in lower predictions for PM_{10}, $PM_{2.5}$ and NO_2 . This slight reduction in concentrations could be attributed to the increase in lane numbers as well as road width leading to better traffic flow for the peak traffic volume (vehicles/hour).
- The cumulative predicted pollutant concentrations for both the proposal and existing scenarios are below the maximum concentration standards except for $PM_{2.5}$. The annual average $PM_{2.5}$ concentration exceeds the

maximum standard, but the contribution from Richmond Road is minimal. The background concentration is driving the higher predicted cumulative concentrations.

- The result plot from the RAQST model data for various receptor distances from the road infers that at a distance of 350 metres, the concentration of PM_{10} is expected to be 0.9 µg/m^3, and the concentration of $PM_{2.5}$ is expected to be 0.6 µg/m^3.

Outcome of the GHG assessment

Scope 1 emissions for the construction stage were estimated. Scope 2 emissions were considered negligible. The Scope 1 emission during construction stage is 11,930 t CO_2 e. During the operations phase, Scope 1 emissions (e.g., from maintenance vehicles) were deemed negligible. The operation stage GHG Scope 2 emissions calculated for street lighting over a period of 50 years is 32 t CO_2 e, also negligible. Total GHG emission estimated from the proposal is estimated to be a combined 14,347 t CO_2 e.

The GHG emission from the proposal is maximum during the construction phase, which is limited to 36 months. The potential GHG impact of the proposal over its lifecycle when compared with the total annual Australia emission of 498,112,400 t CO_2e is only 0.002%, and when compared with total annual NSW emissions of 132,407,600 t CO_2e is about 0.008%. This provides a context of the magnitude of the Proposal emission, which is insignificant in the context of Australia and NSW’s GHG emissions profiles and reduction targets.

Overview of the potential air quality impacts in the REF area

The key potential air quality impacts to the human and ecological sensitive receivers located in the study area was identified as dust during construction of the proposal. Adverse residual impacts to sensitive receivers are not anticipated, provided the recommended mitigation measures are implemented.

As per the RAQST model results, there is no negative impact on air quality to sensitive receivers located in the study area during operation stage. The ‘Do Nothing’ and the ‘The Proposal’ scenarios predicted similar results, with minor variations due to the increased lane number and lane width due to the road upgrade modelled in the ‘The Proposal’ scenario. ‘The Proposal’ scenario resulted in lower predictions for PM_{10}, $PM_{2.5}$ and NO_2 due to the proposals operation. This reduction in predicted concentrations could be attributed to the increase in the number of lanes lane as well as road width leading to ease in urban congestion and better traffic flow for the peak traffic volume (vehicles/hour). The reduction in the overall emission from the proposal will have a positive impact on air quality by a slight improvement in the existing poor air quality.

Mitigation measures

Mitigation measures are required to manage impacts during construction, and these would include measures detailed in the CASANZ guidance, including appropriate work practices and scheduling, equipment selection, monitoring and preventative controls. These measures would be incorporated into a relevant Air Quality Management Plan that would form part of the Construction Environment Management Plan. Adverse residual impacts from construction are not anticipated following the implementation of the recommended mitigation measures.

Conclusion

Based on this assessment, during construction, any adverse residual impacts on air quality are not anticipated following the application of the recommended mitigation measures. The proposal would slightly improve the existing poor air quality in the study area during the operations phase. As a result, air quality values would be maintained as part of the proposal.

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Terms and acronyms used in this assessment

Term / Acronym	Description
AADT	Annual Average Daily Traffic
AQAT	Air Quality Appraisal Tool
AQMP	Air Quality Management Plan
AQMS	Air Quality Monitoring Stations
AR	Assessment Report
BC Act	*Biodiversity Conservation Act 2016*
BEV	Battery Electric Vehicle
CASANZ	Clean Air Society of Australian & New Zealand
CO	Carbon monoxide
Construction boundary	Where all construction activities would be undertaken, allowing space to construct the road formation, fencing, ancillary facilities and temporary and permanent sediment basins.
DPE	Department of Planning and Environment
DPIE	Department of Planning Industry and Environment
EP&A Act	*Environmental Planning and Assessment Act 1979*
EPA	Environmental Protection Agency
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
GHG	Greenhouse Gas
GMR	Greater Metropolitan Region
GWP	Global Warming Potential
IAQM	Institute of Air Quality Management
LGA	Local Government Area
NEPC	National Environment Protection Measure for Ambient Air Quality
NEPM	National Environment Protection Measure
NGA	National Greenhouse Accounts
NO	Nitric oxide
NO_2	Nitrogen dioxide
NO_x	Oxides of nitrogen
NSW	New South Wales
NWGA	North West Growth Area
PCT	Plant Community Type
PM_{10}	Particulate matter less than 10 microns diameter
$PM_{2.5}$	Particulate matter less than 2.5 microns diameter
RAQST	Roadside Air Quality Screening Tool
REF	Review of Environmental Factors
SO_2	Sulphur Dioxide
Study area	The geographic boundary which defines the extent of the investigations supporting the proposal. Refer Figures 1-1 and 1-2.

Term / Acronym	Description
TAGG	Transport Authorities Greenhouse Group
The proposal	Richmond Road Widening between M7 and Townson Road
Transport	Transport for NSW
TRAQ	Tool for Roadside Air Quality
TSP	Total Suspended Particulate
UK IAQM	United Kingdom Institute of Air Quality Management
VOC	Volatile Organic Compound
$\mu g/m^3$	Micrograms per cubic metre

1. Introduction

1.1 Proposal identification

1.1.1 Proposal background

The North-West Growth Area (NWGA) has been identified by the New South Wales (NSW) Government as a key area to support urban growth in the greater Sydney region. When developed (2056 forecasts), the NWGA will provide approximately 90,000 homes accommodating 250,000 people. A key part of the identification of the NWGA was its proximity and connection to transport nodes including the M7 Motorway and ease of connection to the M4 Motorway, Sydney Metro and the new Western Sydney Airport.

To unlock the potential of the NWGA, upgrades to transport infrastructure must align with current and forecasted needs, while considering forecasted population and economic growth. Richmond Road already experiences significant congestion, impacting travel times and hindering the potential for economic growth in the area. As the NWGA continues to grow there will be increasing pressure on Richmond Road and the transport network.

As part of the NWGA Transport Strategy, Transport for NSW (Transport) is proposing to upgrade Richmond Road between the M7 Motorway and Townson Road (the proposal). The proposal has the ultimate objectives of relieving the current corridor congestion and providing road capacity that supports growth.

This Air Quality Assessment working paper supports the environmental assessment for the Richmond Road Upgrade between M7 Motorway and Townson Road (the proposal). The proposal is subject to assessment by a review of environmental factors (REF) under Division 5.1 of *Environmental Planning and Assessment Act 1979* (EP&A Act).

1.1.2 Proposal location

The section of Richmond Road to be upgraded is located in the Blacktown City Council Local Government Area (LGA) and traverses the suburbs of Marsden Park, Colebee, Hassall Grove, Oakhurst, Dean Park and Glendenning. The main feature of the study area is the intersection of Richmond Road with Rooty Hill Road North and the M7 Motorway on and off ramps.

1.1.3 Key features of the proposal

Key features of the proposal are shown in Figures 1-1a to 1-1e and would include:

- Upgrade of Richmond Road between the M7 Motorway and Townson Road to six lanes (three lanes in each direction). This would include:
    - road widening between the M7 Motorway and the Alderton Drive / Langford Drive intersection including a new bridge structure over Bells Creek
    - widening into the median from the Alderton Drive / Langford Drive intersection to 250 metres north of the Hollinsworth Road / Townson Road intersection.
- Building a new flyover bridge from the M7 Motorway Rooty Hill Road North off-ramp landing on Richmond Road around 300 metres prior to Bells Creek. This would include:
    - a single lane bridge structure around 250 metres long and 8.4 metres wide for traffic heading northbound on Richmond Road
    - 170 metre embankment at the southern end of the bridge beginning at the M7 Motorway Rooty Hill Road North off-ramp, roughly five metres above the existing ground level
    - 150 metre long retaining wall located at the northern end of the bridge within the median of Richmond Road. At its highest point the retaining wall would be 8.4 metres high
    - minor re-surfacing of the existing M7 Motorway Rooty Hill Road North off-ramp where the ramp ties into the new flyover
    - no changes to existing gantry, exit lanes or lane functions on the M7 Motorway.

- Upgrades to the intersection of Richmond Road, Hollinsworth Road and Townson Road including:
    - an additional northbound through lane along Richmond Road (providing three through lanes towards Richmond)
    - an additional dedicated right turn lane from Richmond Road southbound onto Hollinsworth Road
    - a new left turn slip lane from Hollinsworth Road onto Richmond Road including a pedestrian island and crossing
    - staged pedestrian crossings across Richmond Road on the north and south sides of the intersection, with a pedestrian refuge in the median.
- Upgrades to the intersection of Richmond Road, Langford Drive and Alderton Drive including:
    - additional northbound and southbound through lanes along Richmond Road (providing three through lanes in both directions)
    - staged pedestrian crossings across Richmond Road on the north and south sides of the intersection, with a pedestrian refuge in the median.
- Upgrades to the intersection of Richmond Road, Rooty Hill Road North and the M7 Motorway ramps including:
    - two dedicated lanes on Richmond Road heading onto the M7 Motorway (southbound on-ramp)
    - two dedicated southbound through lanes on Richmond Road (towards Blacktown)
    - an additional right turn lane from Richmond Road southbound onto Rooty Hill Road North (providing two dedicated right turn lanes onto Rooty Hill Road North)
    - extension of 10 metres for the left turn lane from Richmond Road southbound onto M7 Motorway northbound on-ramp
    - relocation of the existing pedestrian crossing on Richmond Road approximately 160 metres south. This would be a new staged pedestrian crossing across Richmond Road, with a pedestrian refuge in the median at the intersection of Richmond Road and the M7 Motorway southbound on-ramp.
- Active transport provisions throughout the proposal area including:
    - moving the existing shared pedestrian and bike path on the western side of Richmond Road to be further west. This would be a four metre wide shared pedestrian and bike path on the western side of Richmond Road (between the M7 Motorway to approximately 150 metres south of the Richmond Road / Langford Drive / Alderton Drive intersection) where it would connect to the existing shared path.
- Building a new concrete bridge structure over Bells Creek for the northbound carriageway located approximately 14 metres west of the existing Bells Creek bridge. This would include:
    - a bridge structure around 29 metres long and 18 metres wide
    - three northbound travel lanes
    - a shared pedestrian and bike path on the western side, which replaces the existing boardwalk bridge next to the northbound Richmond Road carriageway.
- Retention of the five bus stops on Richmond Road between Yarramundi Drive and the Richmond Road / Hollinsworth Road / Townson Road intersection. The dedicated bus lanes at the intersection of Richmond Road with Langford Drive / Alderton Drive and Hollinsworth Road / Townson Road are also retained.
- Drainage and water quality structures along the proposal including:
    - adjustments to the pits and pipes of the existing stormwater network
    - two gross pollutant traps to the north and south of Bells Creek
    - open flooding channel on the eastern side of Richmond Road roughly between the M7 Motorway northbound on-ramp and Bells Creek for flood mitigation purposes. The channel would be around 425 metres long and 10 metres wide and would discharge into Bells Creek.
- Roadside furniture including safety barriers, signage, line marking, lighting and fencing.
- Earthwork cutting, embankments and retaining walls to accommodate the widened road alignment, flyover bridge and open flooding channel.

- Modified formal access to four properties along the upgraded sections of Richmond Road.
- Installation of a formal driveway access to the Blacktown Native Institution property within the Rooty Hill Road North road corridor, and removal of the informal access track to the property from Richmond Road.
- Property acquisition including full acquisition of one property and partial acquisition of two properties.
- Rehabilitation of disturbed areas and landscaping.
- Establishment and use of three temporary ancillary facilities during construction.

1.1.4 Proposal objectives

The objectives of the proposal are to:

- Reduce transport cost by improving travel times and reducing congestion.
- Support economic growth and productivity by providing road capacity for projected freight and general traffic volumes.
- Improve road safety in line with the NSW Road Safety Strategy 2012-2021, Safe System Directions and Safer Roads Key Focus.
- Improve quality of service, sustainability and liveability.
- Minimise impacts on the environment.

1.2 Purpose of the report

Transport requires preparation of a REF for the proposed widening works that takes into account all matters affecting, or likely to affect, the environment as a result of the proposal. This air quality assessment working paper has been prepared by Stantec on behalf of Transport and will form part of the REF.

The purpose of this air quality assessment report is to describe the existing environment with respect to air quality, document the potential impacts of the proposal on the air quality of the study area, and to detail measures to avoid, mitigate or manage the identified impacts.

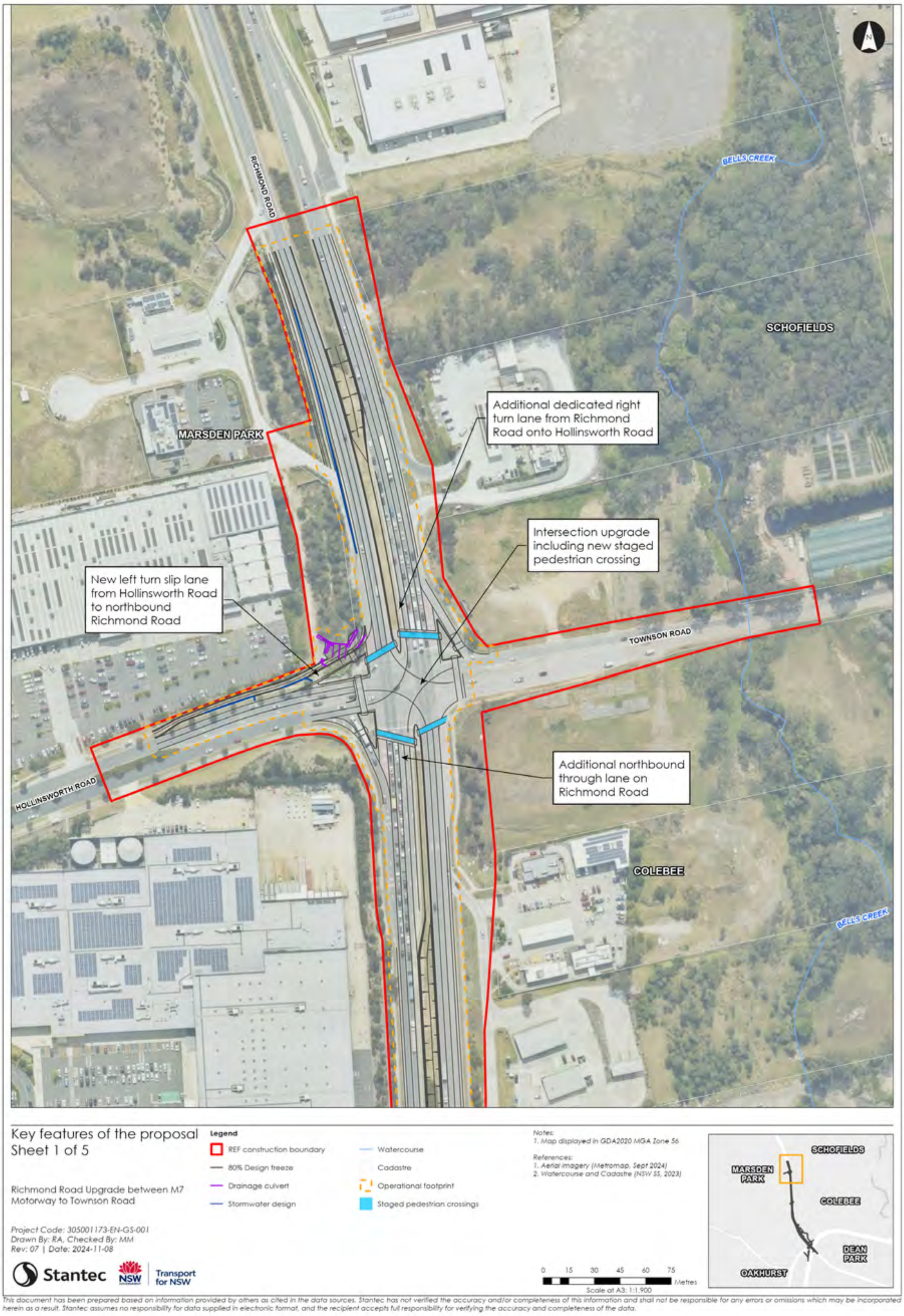

Figure 1-1a: Key features of the proposal

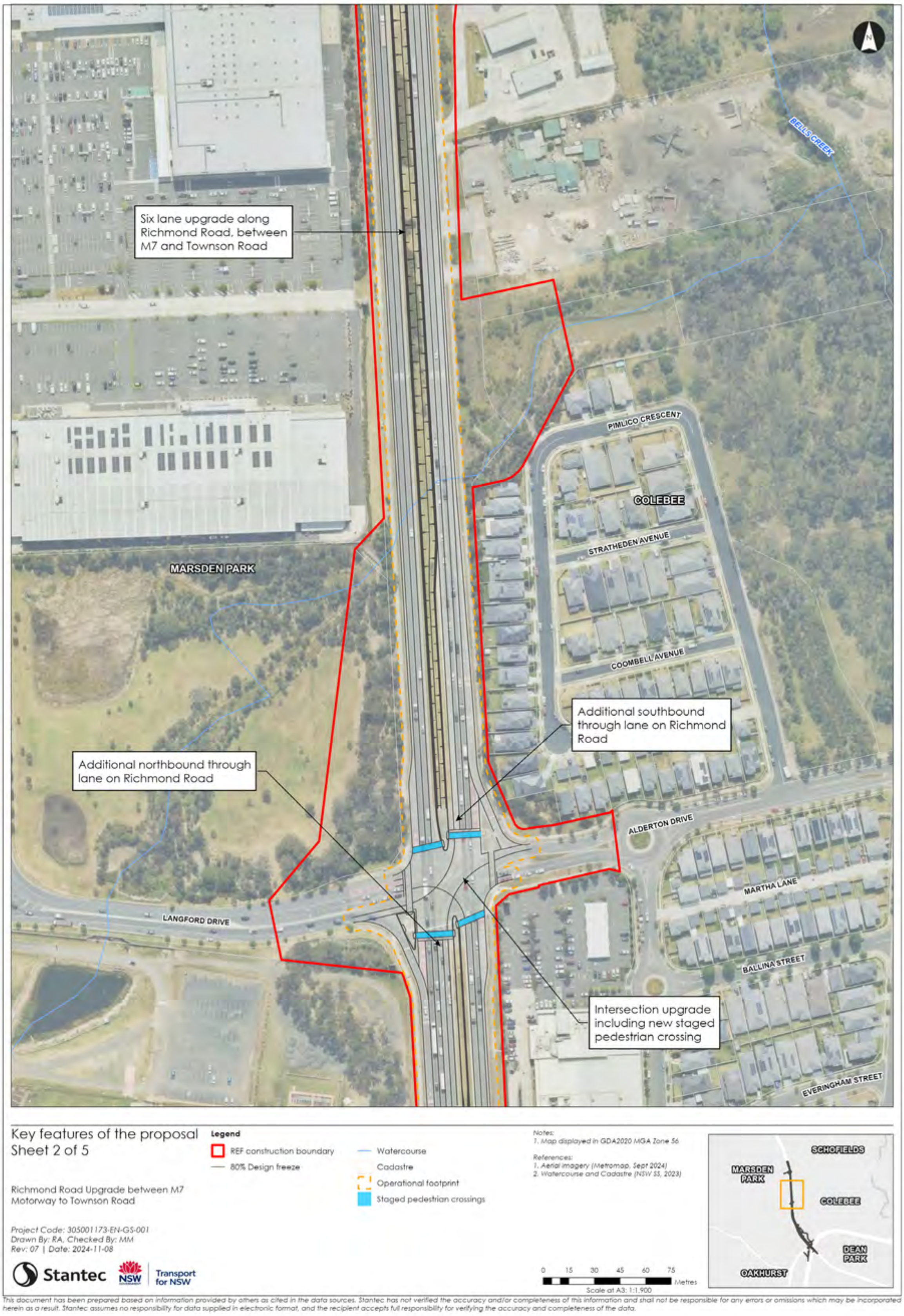

Figure 1-1b: Key features of the proposal

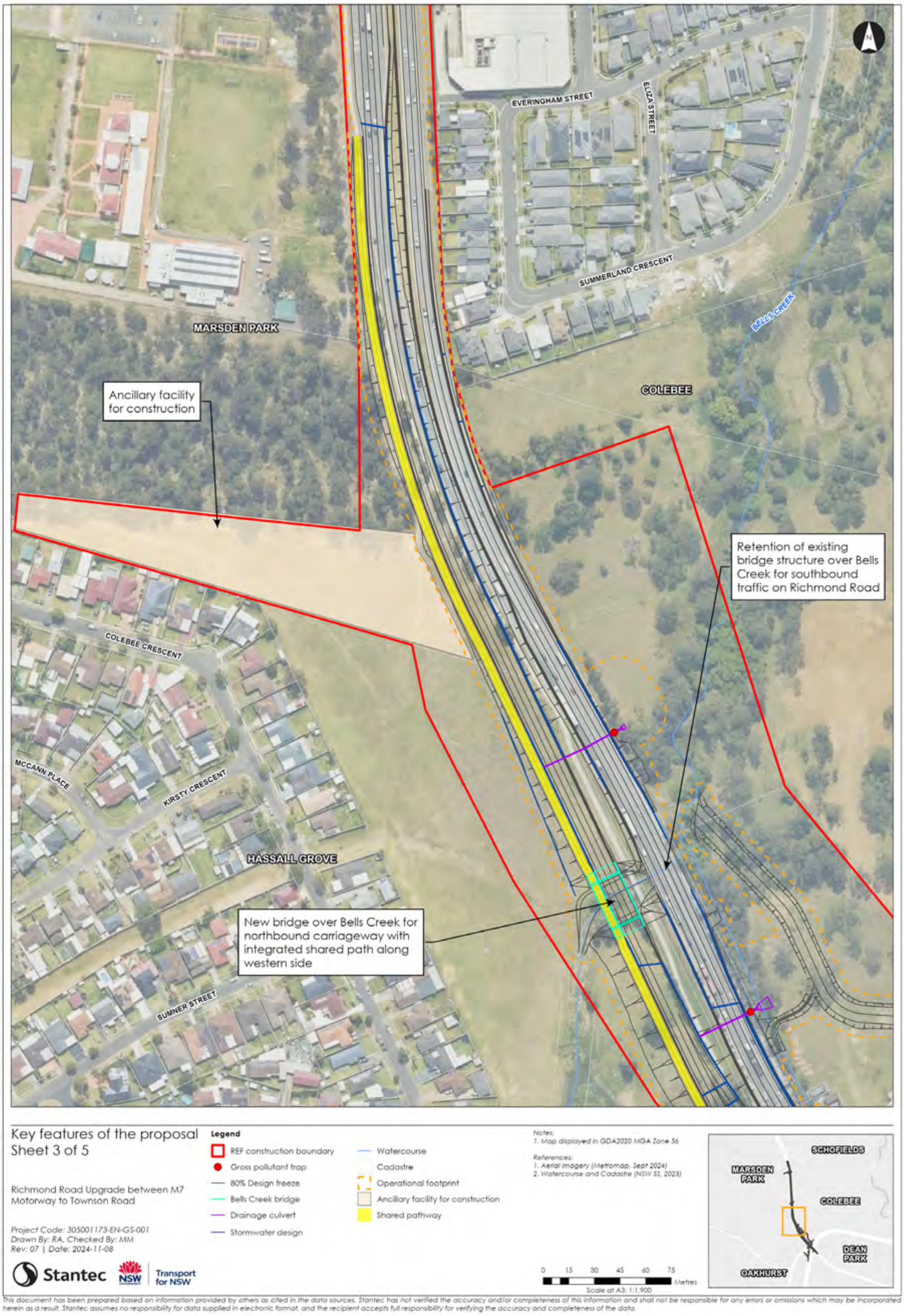

Figure 1-1c: Key features of the proposal

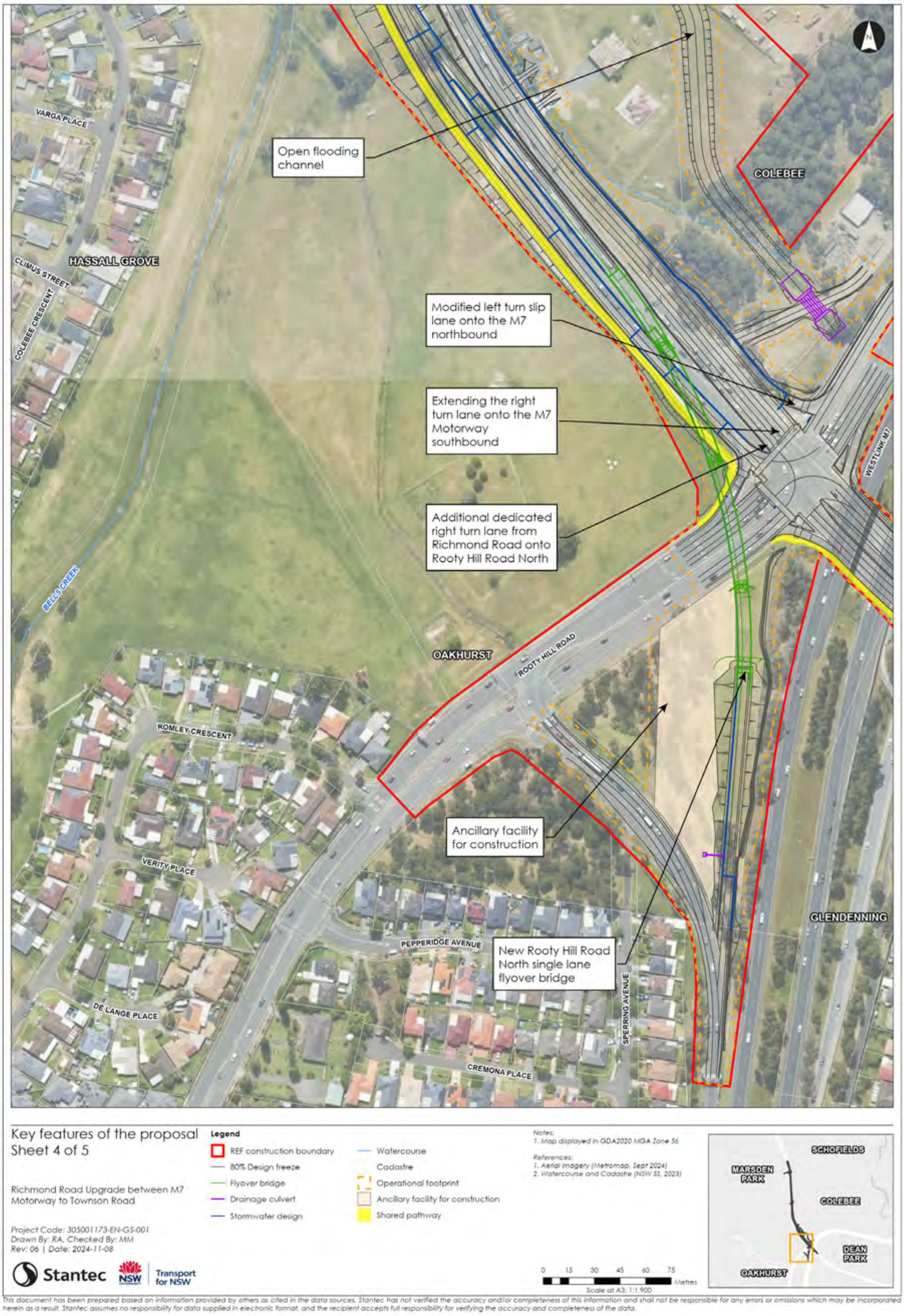

Figure 1-1d: Key features of the proposal

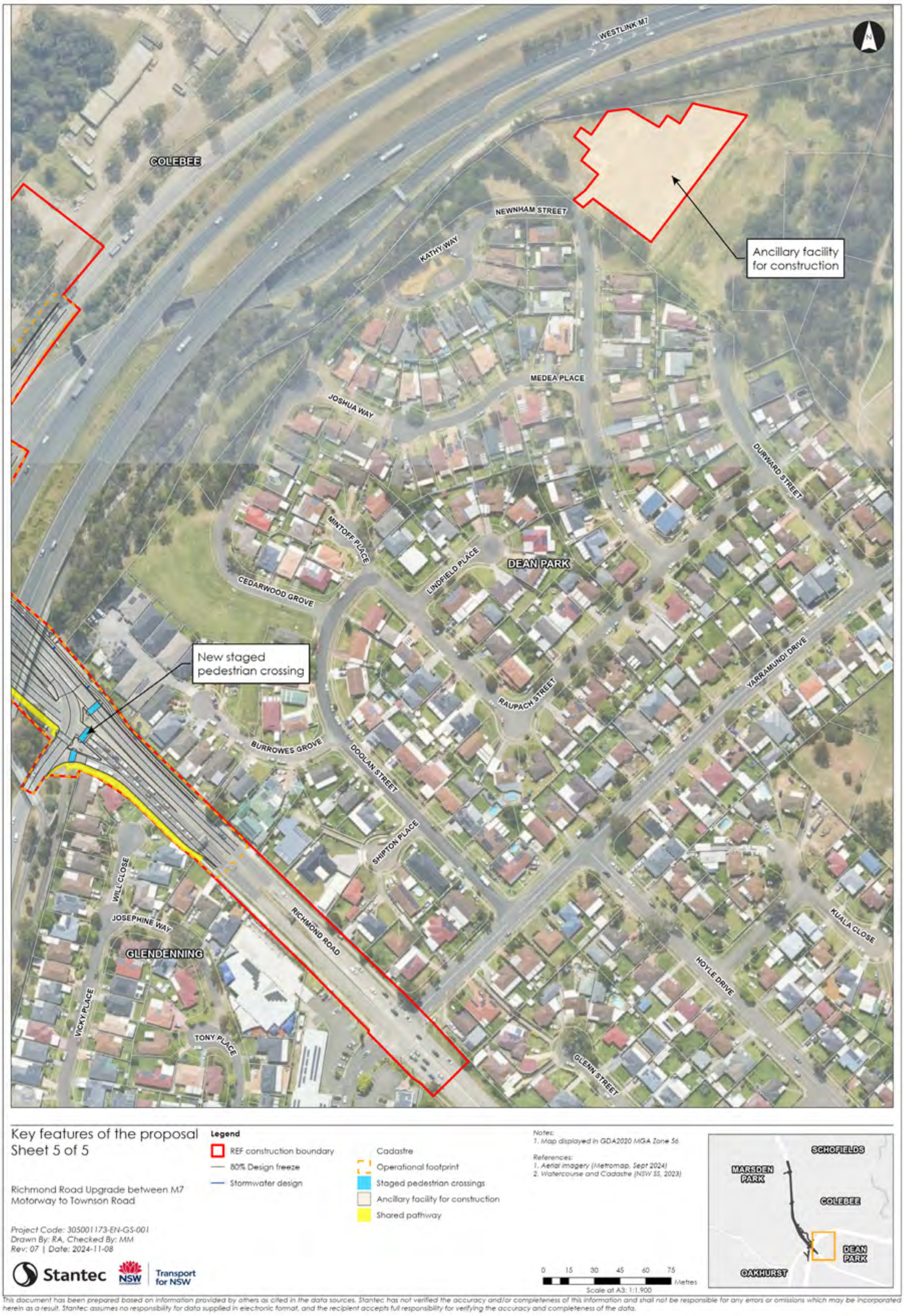

Figure 1-1e: Key features of the proposal

2. Legislative and policy context

2.1 Relevant legislations, plans and policies

The assessment has been prepared in consideration of the following legislations:

- *Protection of the Environment Operations Act 1997.*
- *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (EPA, 2017).
- *National Environment Protection Measure for Ambient Air Quality* (NEPC, 2021).
- *Good Practice Guide for the Assessment and Management of Air Pollution* from Road Transport Projects Version 1 (Clean Air Society of Australia & New Zealand, CASANZ, 2023).
- *Guidance on the assessment of dust from demolition and construction* (United Kingdom Institute of Air Quality Management (UK IAQM).
- Greenhouse Gas Assessment Workbook for Road Projects (Transport Authorities *Greenhouse* Group ,2013).
- *Australian National Greenhouse Accounts Factors* (Department of Climate Change, Energy, the Environment and Water, DCCEEW, 2023).

2.2 Air quality criteria

Air quality standards are contained within the *National Environment Protection Measure for Ambient Air Quality* (NEPC, 2021) and the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (NSW EPA, 2022). In the absence of criteria limits for total suspended particles (TSP), the particulate matter less than 10 microns diameter (PM_{10}) criteria limit has been adopted. Criteria relevant to the proposal are summarised in Table 2-1.

Table 2-1: Criteria for relevant air pollutants (NEPC, 2021)

Pollutant	Averaging period	Maximum concentration standard
Nitrogen dioxide (NO_2)	1 hour	164 micrograms per cubic metre (µg/m^3)
	1 year	30.75 µg/m^3
Particulate matter (PM_{10})	1 day	50 µg/m^3
	1 year	25 µg/m^3
Particulate matter ($PM_{2.5}$)	1 day	25 µg/m^3
	1 year	8 µg/m^3
Total Suspended Particulates (TSP)	1 year	25 µg/m^3

3. Methods

3.1 Scope

The purpose of the air quality assessment is to undertake a desktop analysis of air quality impacts the proposal may have during construction and operation, considering construction staging, proposed plant and equipment and operational conditions of the proposal. The air quality impact assessment will identify appropriate management measures and safeguards to reduce environmental impacts and provide positive environmental outcomes.

The primary tasks for the air quality assessment are listed below:

- Identification of air quality criteria in accordance with the Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales (NSW EPA, 2022) and the National Environment Protection Measure for Ambient Air Quality (NEPC, 2021).
- Review air quality monitoring data from nearby or representative air quality monitoring stations and pollutant concentration in line with their respective air quality criteria averaging periods:
  - Total suspended particulate (TSP)
  - Particulate matter less than 10 microns diameter (PM_{10})
  - Particulate matter less than 2.5 microns diameter ($PM_{2.5}$)
  - Nitrogen dioxide (NO_2)
- Summary of relevant climate data (temperature, rainfall, wind direction and speed).
- Characterisation of the existing environment in terms of land use and location of sensitive receptors.
- Assessment of potential impacts during the operation of the proposal, using Transport's Roadside Air Quality Screening Tool (RAQST).
- Assessment of potential impacts on air quality during the construction of the proposal, in accordance with the Institute of Air Quality Management (IAQM) Guidance on the assessment of dust from demolition and construction (Holman et al, 2014).
- A high-level review of potential GHG emissions and relative impacts to state and national GHG emission inventories and reduction targets.
- Detail safeguards and management measures to mitigate impacts.

3.2 Study area

The study area for the air quality assessment is a buffer spanning up to 350 metres from the proposal boundary as shown in Figure 3-1. This is the recommended study area from the IAQM Guidance for the construction-phase impact assessment. The operations-phase impact assessment, as per the RAQST Guidance, assesses up to 200 metres from the road. Potential sensitive receptors have been identified within this study area.

Figure 3-1: Study area map

3.3 Assessment methodology

3.3.1 Air pollutants considered

The assessment of the potential construction and operation stage impact of the proposal has considered the impact related to the emission of the following pollutants:

- TSP
- PM_{10}
- $PM_{2.5}$
- NO_2
- GHG emissions (construction phase only).

These are considered the main air emissions from the proposed activities, which primarily entails combustion emissions from vehicles and plant as well as dust from construction and demolition. They are also the air pollutants used in the Transport's RAQST.

Assessment of other typical vehicle fuel combustion products, including carbon monoxide (CO), sulphur dioxide (SO_2) and volatile organic compounds (VOCs), have been excluded from the assessment. SO_2 and VOC emissions factors are one to two orders of magnitude lower than PM and NO_2 (as per NPI Emission Estimation Technique Manual for Combustion Engines Version 3.0) with SO_2 emissions linked to the trace amounts of sulphur in fuel as opposed to combustion performance. CO, while of similar order of magnitude to the NO_2 emission factor, has a larger ambient air quality standard (under the National Environment Protection Measure for Ambient Air, NEPM). NO_2 is therefore considered the key indicator.

VOCs are not regulated with an ambient air quality standard under the Environment Protection Authority's (EPA) Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales or the National Environment Protection (Ambient Air Quality) Measure (NEPM) and are not expected to be a pollutant of concern. While there is no ambient air quality data available at the nearby monitoring stations, previous studies such as the 2004 study by the former NSW Department of Environment and Conservation (NSW DEC) concluded that concentrations of all measured VOCs in the nearby St Marys area were less than 1.0 part per billion by volume (ppb_v) for fuel-based VOCs like benzene, toluene and chloromethane. This is less than 10% of the ambient air quality goals in other regions such as the United Kingdom.

The proposed methodology to assess potential impact of these pollutants is provided in the below sections.

3.3.2 Construction impact assessment

A risk-based approach was used for the assessment of construction air quality impacts. This methodology, as recommended by the Clean Air Society of Australia and New Zealand (CASANZ) *Good Practice Guide for the Assessment and Management of Air Pollution from Road Transport Projects Version 1* (CASANZ, 2023), is based on that in the Institute of Air Quality Management (IAQM) Guidance on the assessment of dust from demolition and construction Version 1.1 (Holman et al, 2014). The steps to perform dust assessment as per IAQM guidance is shown in Figure 3-2:.

The methodology focuses on four aspects: demolition, earthworks, construction, and track-out. For each of these aspects, the scale and nature of the emissions are defined and assessed against the sensitivity of the area.

The main air pollution and amenity matters considered were the potential for:

- Annoyance due to dust deposition (e.g., settlement of surfaces at sensitive receivers) and visible dust plumes.
- Elevated PM10 concentrations due to on-site dust-generating activities.
- Visible dust plumes due to on-site dust-generating activities.
- High levels of soiling due to dust deposition, which can damage vegetation and affect the health and diversity of ecosystems.

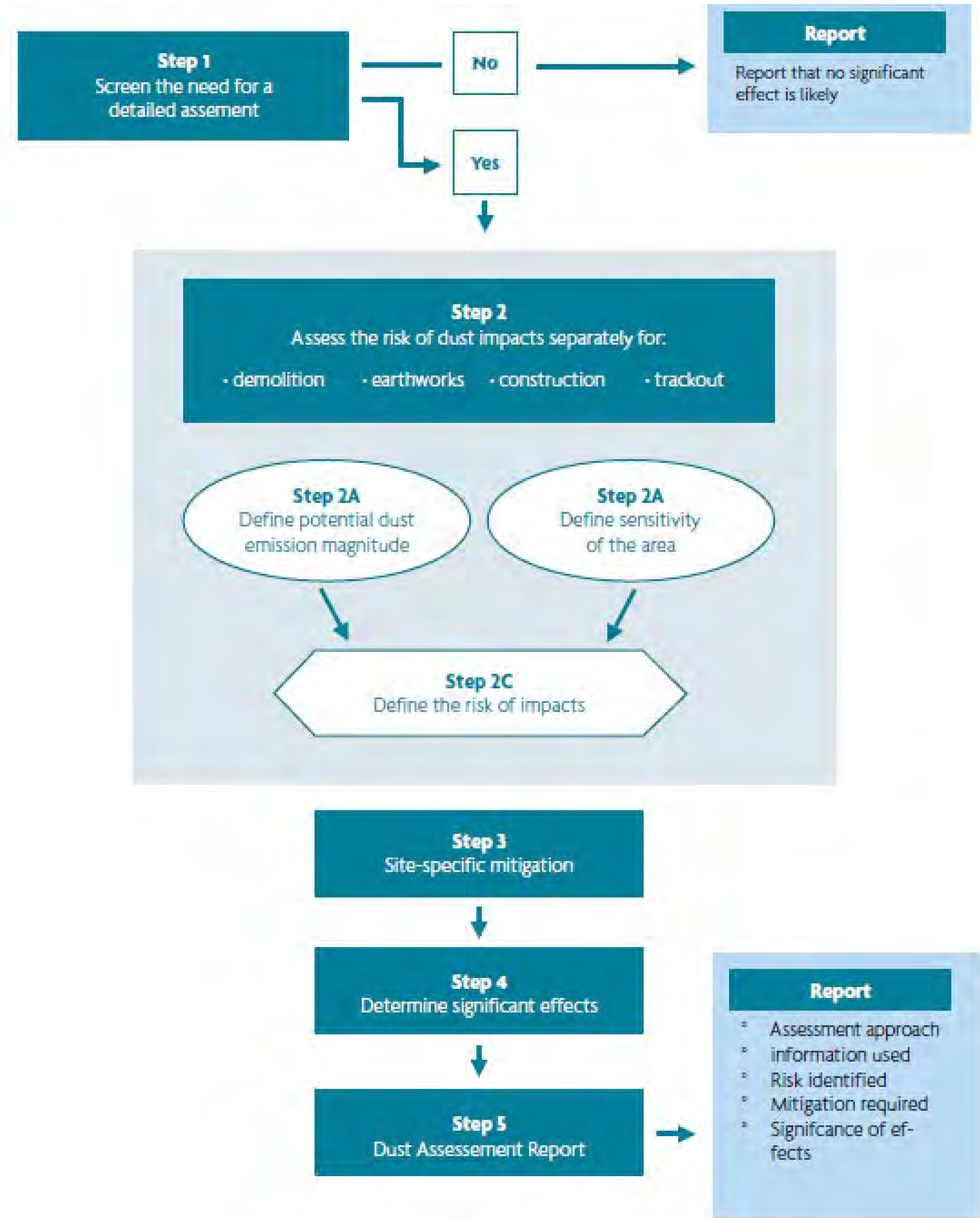

Figure 3-2: Construction air quality dust assessment procedure

The IAQM Guidance has been used to classify the risk of the construction activities according to the potential impacts. Appropriate mitigation measures are recommended consistent with the assessed risk level.

3.3.3 Operation impact assessment

The Transport RAQST was used to calculate operation-phase vehicle emissions. To calculate emissions, RAQST relies upon the algorithms and default data that were initially incorporated into Tool for Roadside Air Quality (TRAQ), and subsequently into the NSW Air Quality Appraisal Tool (PAE, Holmes, 2013). All these tools use a simplified version of the road vehicle emission model from the emission inventory for the NSW greater metropolitan region (GMR).

The Link Emissions Calculator and the RAQST also incorporate projections for the proportion of Battery Electric Vehicles (BEVs) in the fleet, based on the current Net Zero Plan Policy settings (NSW DPE 2022).

The RAQST uses a single dispersion function to represent all meteorological conditions. The function was derived using the CALINE 4 model (Benson 1984), based on conservative assumptions. An empirical approach is used to calculate NO_2 concentrations.

The predicted pollutant concentrations of the existing road and traffic conditions (i.e., do-nothing case) are compared against those predicted with the proposed project. The cumulative impact is assessed by adding the background ambient air quality concentrations and compared against the respective air quality criteria.

3.3.4 Greenhouse gas assessment

The methodologies used to estimate the GHG emissions attributable to the construction of the proposal are in alignment with *Greenhouse Gas Assessment Workbook for Road Projects 2013* Transport Authorities Greenhouse Group (TAGG). Estimated emissions are represented in CO_2-e using current global warming potential (GWP). The GWPs from the IPCC Fifth Assessment Report (AR5) have been used in this assessment and are listed in Table 3-1.

Table 3-1: Greenhouse gases and 100-year global warming potentials

Greenhouse gas	Global warming potential
Carbon Dioxide (CO_2)	1
Methane (CH^4)	28
Nitrous Oxide (N_2O)	265

The emission factors used in the estimation of GHG emissions have been taken from the TAGG workbook and National Greenhouse Accounts (NGA) Factors 2023, as appropriate.

4. Existing environment

4.1 Site topography

The Richmond Road widening project is situated in the Hawkesbury- Nepean catchment, which flows through areas of Sydney, supplying the city and surrounding regions with food, water, and other resources. This is one of the largest coastal basins in NSW covering more than 22,000 square kilometres. This catchment consists of more than 70 percent of mountainous terrain providing habitat for numerous native plants and animal species.

The northern section of the Richmond Road widening project is in the North West Growth Area. This is a low-lying area of the catchment. The contour map of NSW (refer Figure 4-1) shows the elevation ranging from 34 mAHD to 42 mAHD along the road upgradation works. There is declining elevation towards the eastern side of the project area in the Eastern Creek region. Elevation rises of up to 78 mAHD is observed in the Glenwood area.

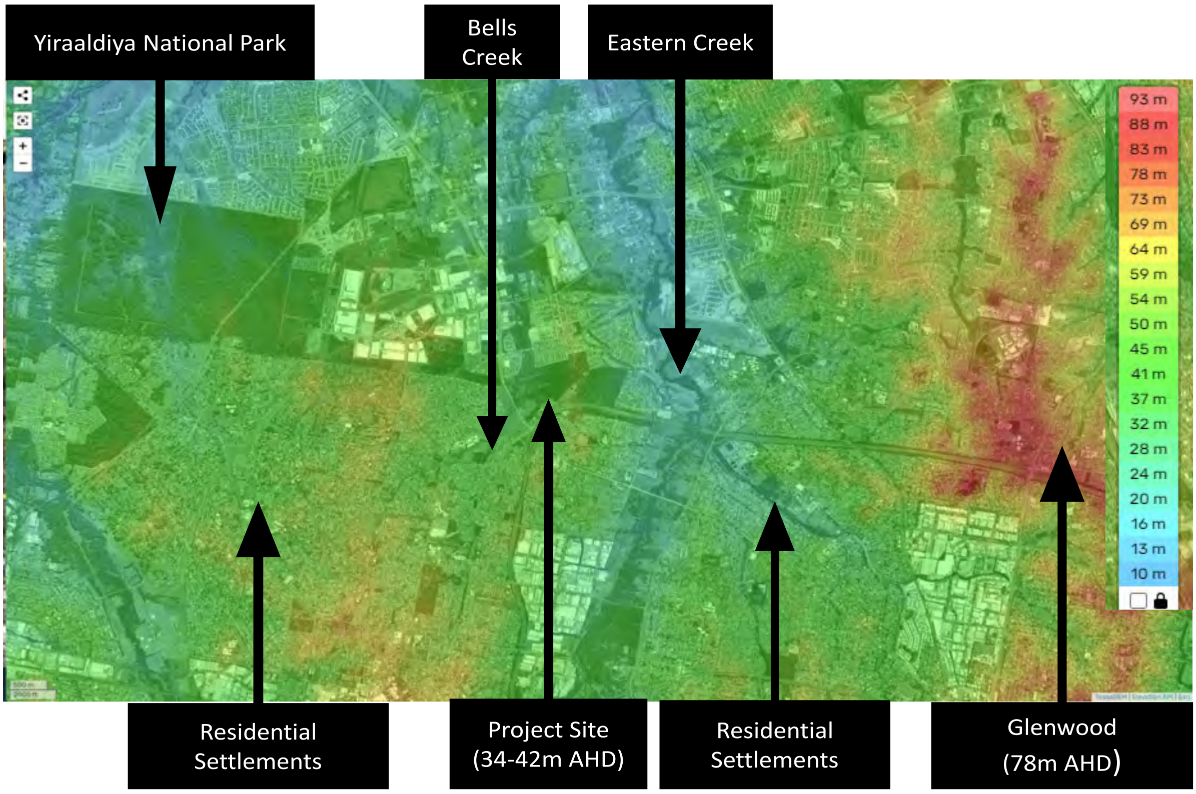

Figure 4-1: Landscape features and contours (local context) (source: topographic map.com)

Elevation rises of up to 207 mAHD in the western side of the site at the Blue Mountains National Park and around 172 mAHD in the east near the Marramarra and Berowra Valley National Park. These mountain and plateau regions in three directions and sea in one side of the of the area affects the wind pattern and air dispersion in regional context as shown in Figure 4-2.

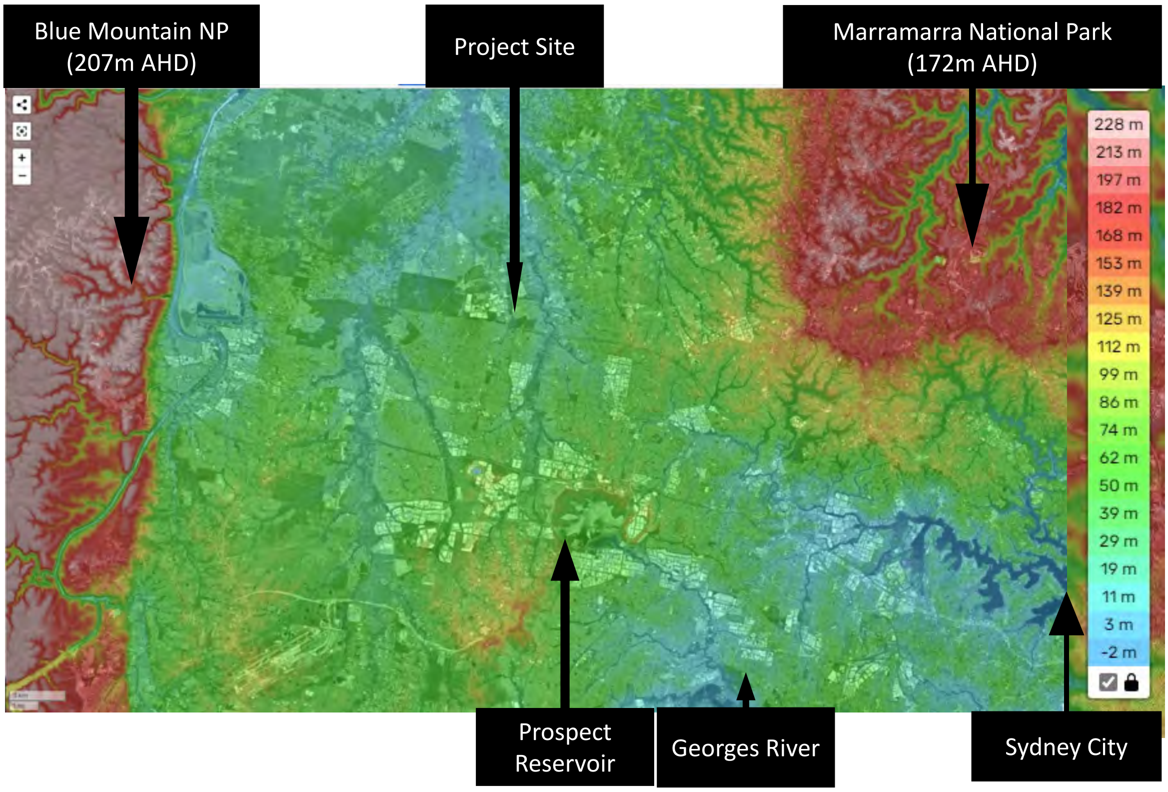

Figure 4-2: Landscape features and contours (regional context) (source: topographic map.com)

4.2 Meteorological conditions

The existing climatic conditions for the proposal were identified using data published by the Bureau of Meteorology (2024) collected from the Seven Hills (Collins Street) Weather Station (station number 067026), located about 8 kilometres southeast of the proposal. The existing climatic conditions are summarised in Table 4-1 and Table 4-2.

The existing climatic conditions are warm and temperate with generally consistent periods of rainfall but higher rainfall in January through March. It is unlikely that extended dry periods would have a considerable impact on dust generation on-site. Regardless the likely rainfall, wind speed and direction at the time of construction should be considered when developing the Construction Air Quality Management Plan (AQMP).

Table 4-1: Existing climatic conditions (Seven Hills (Collins Street) weather station, BOM, 2024)

Statistic	Existing conditions	Recorded period (start year-end year)
Annual mean maximum temperature (°C)	23.4	1950-1975
Annual mean minimum temperature (°C)	11.2	1950-1975
Hottest month on average	December (28.4°C)	1950-1975
Coldest month on average	July (4.5°C)	1950-1975
Mean annual rainfall (mm)	934.1	1950-1975
Wettest month on average	February (117.9 mm)	1950-1975
Mean 9am wind speed (km/h)	5.3	1965-1975
General wind direction am	Southwest	1965-1975

Table 4-2: Median monthly rainfall

Month	Median rainfall (mm)	Recorded period (start year-end year)
January	104.6	1950-2024
February	117.9	1950-2024
March	115.6	1950-2024
April	76.4	1950-2024
May	64.9	1950-2024
June	78.9	1950-2024
July	46.7	1950-2024
August	53.8	1950-2024
September	47	1950-2024
October	71.1	1950-2024
November	81.3	1950-2024
December	72.3	1950-2024

4.3 Existing air quality

The Prospect monitoring station is the nearest NSW government funded and operated air quality monitoring station (AQMS) from the proposal boundary. The location of the AQMS is shown on Figure 4-3. It is located approximately 9.4 kilometres southeast from the construction boundary.

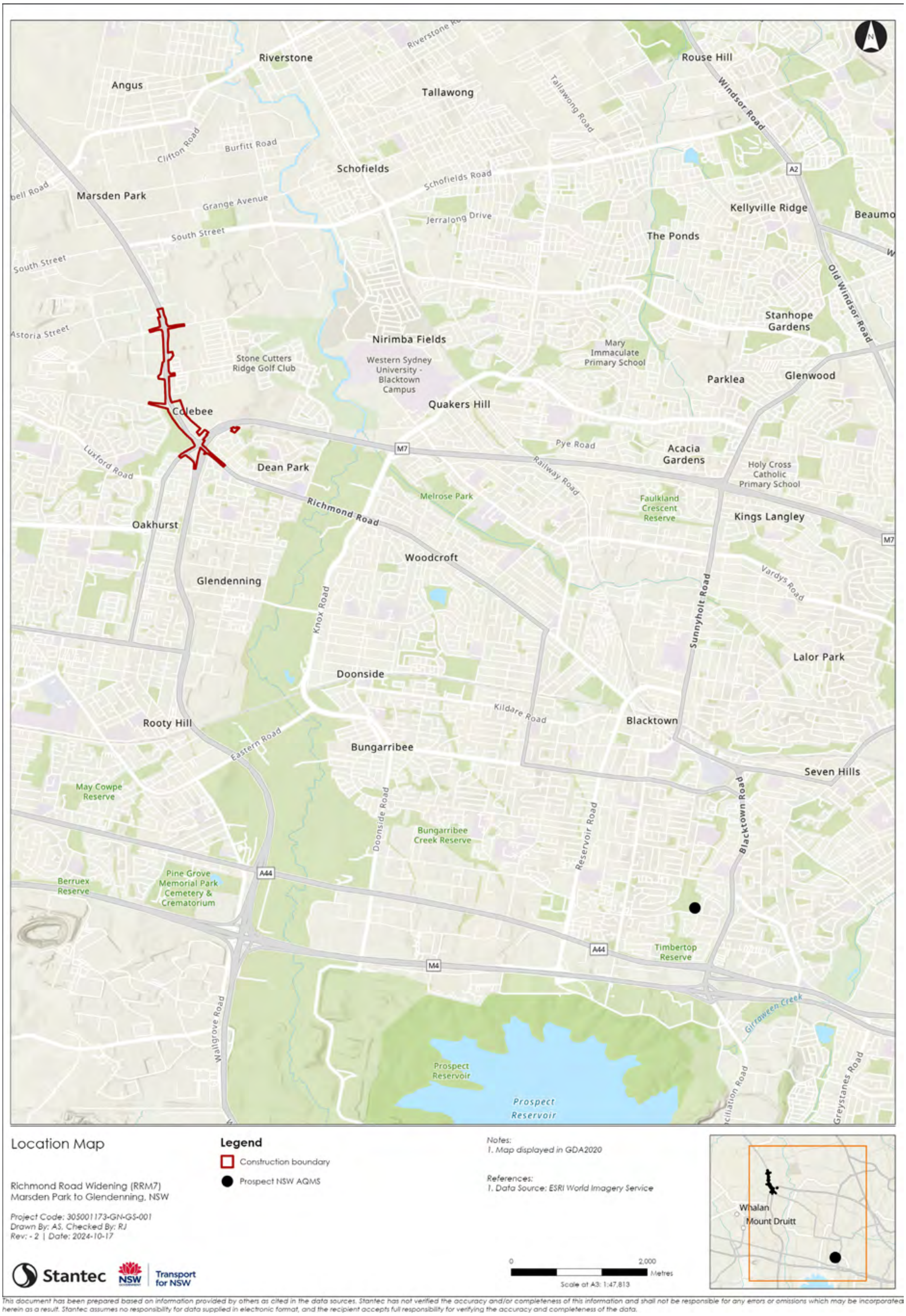

Figure 4-3: AQMS Location

Data from the Prospect NSW AQMS was used to define existing concentrations of NO_2, PM_{10}, and $PM_{2.5}$. The data from the AQMS was validated up to 30 June 2022, and therefore only data between 2017 and 2021 are used for this assessment. The existing maximum and average concentration for each relevant air quality pollutant over their respective averaging periods is summarised in Table 4-3.

Based on the past air quality data for the nearby monitoring station the 5-year average concentration of annual averages for years 2017 to 2021 for PM_{10} and NO_2 are below the maximum concentration standards, while that for $PM_{2.5}$ is above the criteria limit.

The existing air quality is mainly influenced by local road traffic and seasonal bushfires. The effects of agriculture and commercial activities surrounding the study area on air quality are considered to be relatively small and localised. The air quality is expected to be similar to that near the proposal and generally comprised of typical urban air quality.

Table 4-3: Existing air quality monitoring data (Prospect AQMS)

Year	NO_2 (µg/m³)		PM_{10} (µg/m³)		$PM_{2.5}$ (µg/m³)	
	Maximum 1-hour average	Annual average	Maximum 24-hour average	Annual average	Maximum 24-hour average	Annual average
2017	113	19	**61**	19	**30**	7.7
2018	96	17	**113**	22	**48**	**8.5**
2019	92	17	**183**	**26**	**134**	**12**
2020	81	13	**246**	20	**71**	**8.6**
2021	81	13	45	17	**37**	6.9
Average	93	16	130	21	64	8.7
Maximum concentration standard	164	30	50	25	25	8

Note: Bolded concentrations are above the NEPM standards

Annual and 1-hour average NO_2 are below the maximum concentration standards in all cases (approximately 505 of the criteria).

Annual PM_{10} averages for all years but 2019, as well as the 5-year average is below the maximum concentration standard. Annual PM2.5 averages are above the criteria in all years but 2021. For PM_{10} and $PM_{2.5}$ 24-hour averages, the maximum concentration standard was surpassed in almost all years, except for PM_{10} in 2021. These exceedances were likely due to specific events like seasonal bushfires, which do not reflect typical background levels of these pollutants.

The NO_2 maximum 1 hour average and annual average for years 2017 to 2021 and the average of these values are below the maximum concentration standard.

As per the NSW government air quality website, the air quality for terms of criteria pollutants is categorised into five classes as described in Table 4-4. The existing air quality in the study area is generally considered to be fair or poor due to elevated PM10 and PM2.5.

Table 4-4: Air quality category by NSW Government Air Quality website

Criteria Pollutant	Good	Fair	Poor	Very Poor	Extremely Poor
NO_2 (µg/m³)	0 to 151	151 to 226	226 to 339	339 to 452	452 to 565
PM_{10} (µg/m³)	0 to 50	50 to 100	100 to 200	200 to 600	600 to 2000+
$PM_{2.5}$ (µg/m³)	0 to 25	25 to 50	50 to 100	100 to 300	300 to 1000+

To assess the higher PM10 and PM2.5 concentrations, trends were taken over the 5-year period. The graphs in Figure 4-4 and Figure 4-5, which were sourced from the air quality data download facility on the NSW Government's air quality website, demonstrate the typical concentrations and the peaks that are driving the reported maximum 24-hour averages and annual averages.

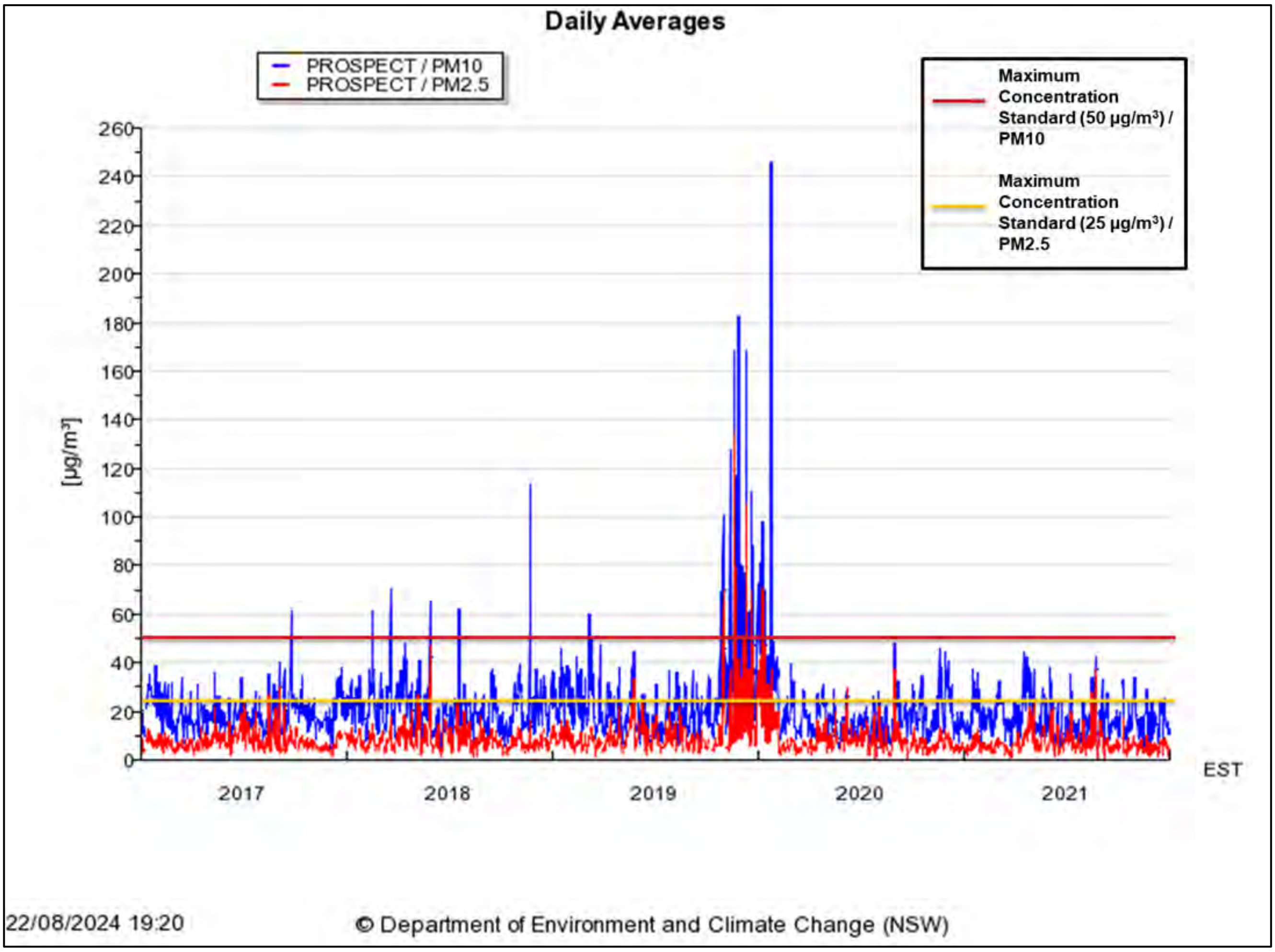

Figure 4-4: 24 Hour Averages for years 2017 to 2021 for PM10 and PM2.5

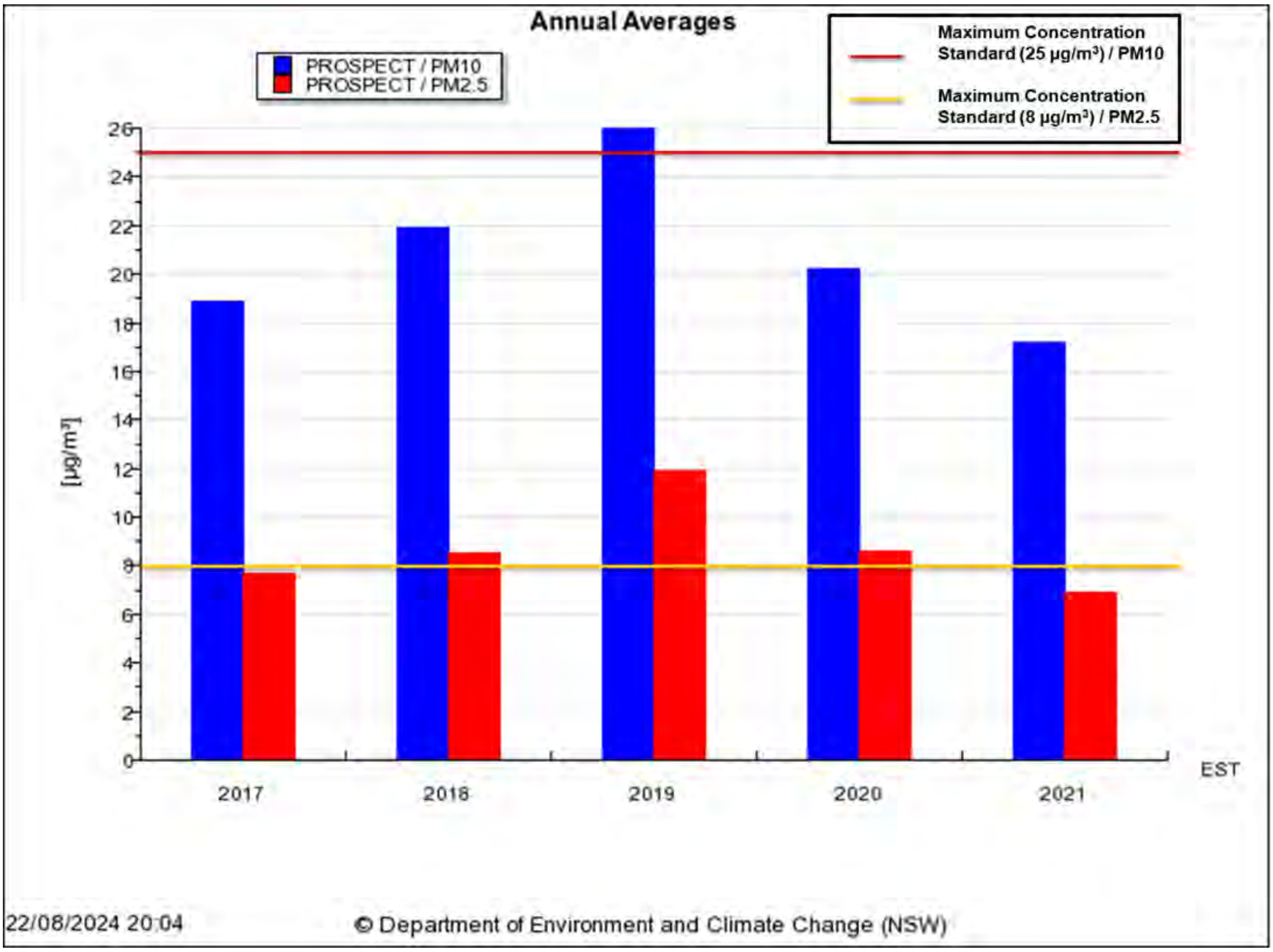

Figure 4-5: Annual Averages for years 2017 to 2021 for PM_{10} and $PM_{2.5}$

The graphs demonstrate that the PM_{10} concentration is below the air quality criteria for 97.6% of the time. There are approximately seven spikes in air quality over the five-year period as well as the significant event that occurred between October 2019 and February 2020. This can largely be attributed to the 2019–20 Australian bushfire season, known as Black Summer, which was one of the most severe and catastrophic fire seasons on record in Australia. The most intense fires occurred between December 2019 and January 2020, impacting various regions of New South Wales. Starting from late July to early September 2019, extensive fire ravaged areas including the North Coast, Mid North Coast, Hunter Region, Hawkesbury, Wollondilly, Blue Mountains, Illawarra, South Coast, Riverina, and Snowy Mountains, with over 100 fires across the state. By March 4, 2020, all fires in New South Wales had been fully extinguished.

Based on the analysis, it is evident that ambient air quality significantly deteriorated in 2019 and 2020. The impact to PM_{10} and $PM_{2.5}$ concentrations is significant and does not represent typical maximum background ambient air quality. This period has therefore been removed from the analyses.

The Proposal locale is expected to have typical urban air quality with air emissions primarily from transport. To check for industrial or other potential emission sources, a search of the National Pollutant Inventory for the Blacktown LGA carried out on 8 August 2024 identified twenty-five pollution sources during the 2022 to 2023 period (NPI, 2024). The closest identified source of air pollution is a ceramic product manufacturer in Schofields, NSW, about 740 metres east of the construction boundary. As the general wind direction does not trend directly west, the air pollution from the identified source is unlikely to influence air quality within a 350-metre buffer of the construction boundary. All other pollution sources in proximity of the proposal have negligible pollutant concentration that will influence the air quality of the study area.

5. Potential impacts

5.1 Construction stage

5.1.1 Air quality impacts

This air quality assessment has followed the IAQM Guidance, which includes four steps, to assess the potential impacts of the proposal construction phase and identify appropriate mitigation measures. This section summarises each of these steps.

Step 1 Screen the need for a detailed assessment

The screening criteria for the need for a detailed assessment as per the IAQM Guidance is as follows:

A 'human receptor' within:

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

An 'ecological receptor' within:

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

There are plant community types (PCTs) within 50 metres of the construction boundary that have been considered ecological receptors and there are sensitive human receptors within 350 metres of the construction boundary, therefore a detailed assessment is required as per the IAQM Guidance.

Human receptors

A human receptor, as defined in the CASANZ Guidance, is a discrete, fixed location where a person (or persons) can be exposed to air pollution from the project, with their health potentially suffering as a consequence. Sensitive receptors are typically those at locations where people spend long periods of time (e.g., residences) or are used by people with higher susceptivity to air pollution (e.g., hospitals, schools). The IAQM Guidance refers to receptors at any location where a person or property may experience the adverse effects of airborne dust or dust settlement, or exposure to PM_{10} over the averaging time period as per the Criteria limits.

Residential and commercial properties within 350 metres of the proposal boundary are shown in Figure 5-1 and Figure 5-2. There are 92 residential and commercial properties within 20 metres, 149 within 50 metres, 345 within 100 metres and 1,452 within 350 metres of the construction boundary that are considered to be sensitive human receptors.

Figure 5-1: Sensitive human receptors

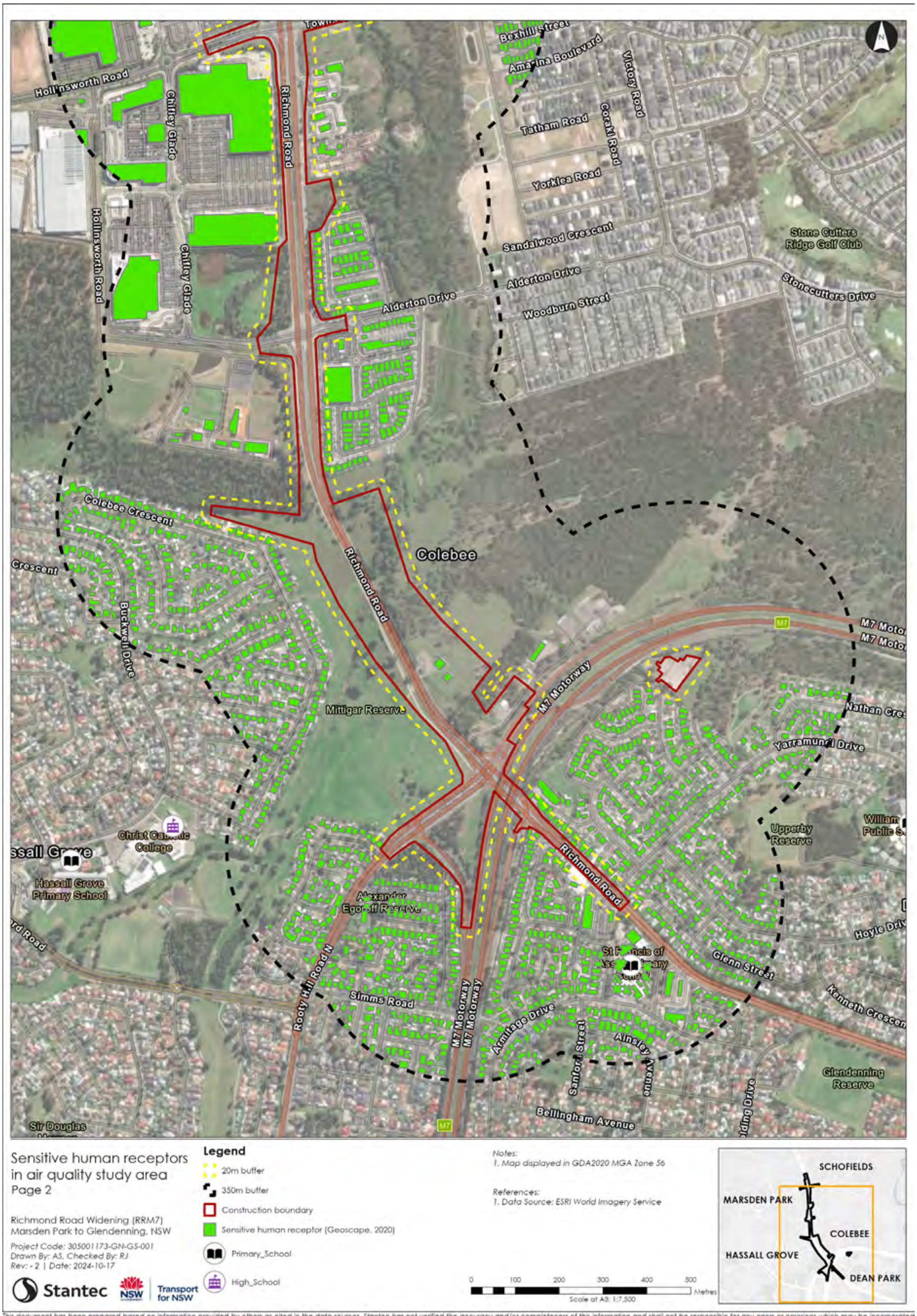

Figure 5-2: Sensitive human receptors

Ecological receptors

An 'ecological receptor' refers to any sensitive habitat affected by dust settlement. This includes the direct impacts on vegetation or aquatic ecosystems of dust deposition and the indirect impacts on fauna.

The IAQM guidance requires identification of ecological receptors within 50 metres of the proposal boundary.

The sensitivities of ecological receptors have been defined and are shown in Figure 5-4. The sensitivity of ecological receptors were determined based on Section 7.3 of the IAQM Guidance. PCTs that are listed as endangered under the *Biodiversity Conservation Act 2016* (BC Act) or the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) namely Cumberland Red Gum Riverflat Forest (PCT 4025), Cumberland Shale Plains Woodland (PCT 3320) were considered to have a medium sensitivity, as they are important plant species but their dust sensitivity is uncertain. All other PCTs such as exotic, landscaped natives and typha were considered to have a low sensitivity on the basis that they are not listed species which may be affected by dust deposition.

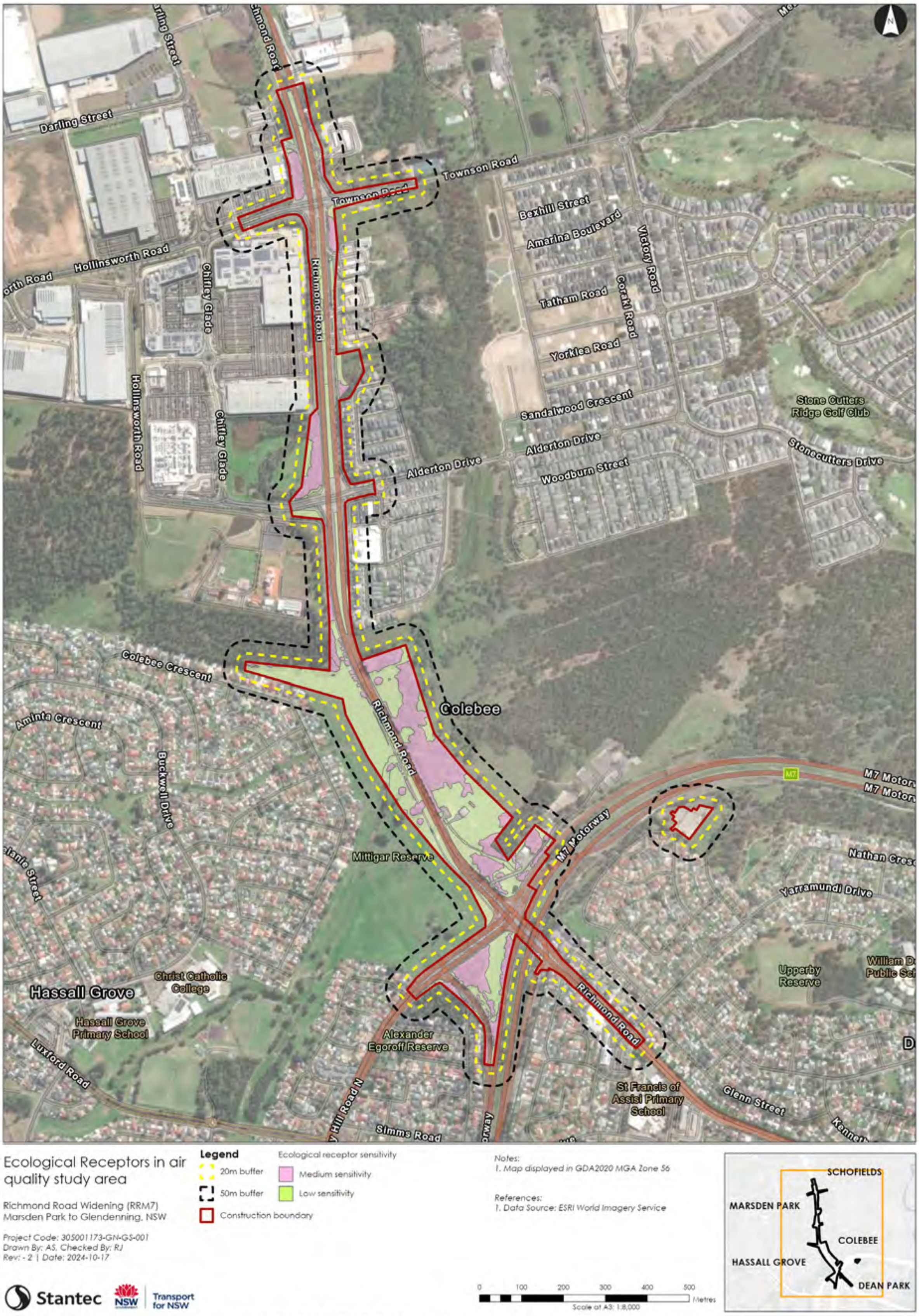

Figure 5-3: Ecological receptors

Step 2 Assess the risk of dust impacts

Step 2 Assess the risk of dust impact

Step 2 of the IAQM is to assess the risk of dust impacts separately for demolition, earthworks, construction and track-out (material tracking). This step requires the potential dust emission magnitude and the sensitivity of the area to be defined.

The potential dust emission magnitude for each activity type has been categorised for the proposal as shown in Table 5-1. The dust emission magnitude has been calculated as per section 7.2 of the "Guidance on the assessment of dust from demolition and construction" by IAQM.

Table 5-1: Dust emission magnitude for the proposal assuming no mitigation

Activity	Dust emission magnitude	IAQM criteria considered	Proposal justification
Demolition	Medium	Total building volume 20,000 m^3 – 50,000 m^3, potentially dusty construction material, demolition activities 10-20 metres above ground level.	Total demolition volume is approximately 40,000 m^3. Demolition activity at ground level.
Earthworks	Large	Total site area greater than 10,000 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 over 8 metres in height, total material moved over 100,000 t.	Total site area is 188,620 m^2. Soil type mostly silty clay. Total volume of material moved 113,998 t. Average 5-10 heavy earth moving vehicles at a time.
Construction	Medium	Total building volume 25,000 m^3 – 100,000 m^3, potentially dusty construction material (e.g., concrete), on-site concrete batching.	36,500 m^3 of construction works. Potentially dusty construction materials including earthworks materials, cement, bitumen and aggregates.
Track-out	Small	<10 Heavy Duty Vehicle (HDV, >3.5 t) outward movements in any one day, surface material with low potential for dust release, unpaved road length <50 metres.	5 HDV per day and unpaved road length < 1 km.

Material tracking (track-out) is likely to result in minimal dust emissions, while demolition and construction activities associated with the proposal are expected to produce medium dust emissions. Earthworks, however, have the potential for a large magnitude of dust emissions; however, this assumes no mitigation measures are in place. The sensitivity of the area is assessed below to evaluate the potential risk of dust impacts on nearby receptors.

The receptor sensitivity for dust settlement is determined based on whether 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'. The human receptors identified in Figure 5-1 and Figure 5-2, have all been considered to be of a high sensitivity, given that they are mostly residential properties. There are 92 receptors located within 20 metres.

The sensitivity of the area is calculated separately for its sensitivities to potential dust settlement, human health and ecological impacts. The sensitivity of the area to dust soiling effects is shown in Table 5-2. The sensitivity is considered high based on a high receptor sensitivity and between 10-100 receptors within 20 metres of the construction area.

Table 5-2: Dust soiling sensitivity matrix (IAQM, 2014)

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

The sensitivity of the area to human health impacts is determined based on the matrix shown in Table 5-3. NSW has a maximum annual concentration standard objective of 25 (µg/m3) for PM_{10}, which is lower than the annual mean concentration used by the IAQM Guidance. Table 4-3 shows an average of annual mean PM_{10} concentration of 20.84 µg/m3 for years 2017 to 2021, this is 83.4% of the maximum concentration standard (refer Table 2-1). This value was taken as the annual mean PM_{10} concentration. The matrix shown in Table 5-3 was used to calculate the sensitivity of the area within a 350 metres buffer of the proposal boundary. The area's sensitivity to health impact is considered low based on high receptor sensitivity, <24 µg/m3 annual mean concentration, and between 10-100 receptors within 20 metres of the construction area.

Table 5-3: Human health sensitivity matrix (IAQM, 2014)

Receptor sensitivity	Annual mean PM_{10} concentration	Number of receptors	Distance from the source (m)				
			<20	<50	<100	<200	<350
High	>32µg/m^3	>100	High	High	High	Medium	Low
		10-100	High	High	Medium	Low	Low
		1-10	High	Medium	Low	Low	Low
	28-32µg/m^3	>100	High	High	Medium	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	High	Medium	Low	Low	Low
	24-28µg/m^3	>100	High	Medium	Low	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	<24µg/m^3	>100	Medium	Low	Low	Low	Low
		10-100	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low

The section of the matrix detailing 'High Receptor Sensitivity' is displayed above in Table 5-3. The sections on 'Medium Receptor Sensitivity' and 'Low Receptor Sensitivity' are not applicable to the previous determination of "High Sensitivity" and have therefore been omitted from the table. For further details, please refer to the IAQM guidelines.

The sensitivity of the area to ecological impacts is determined based on the matrix in Table 5-4. There are ecological receptors with a medium sensitivity located within 20 metres of the construction boundary, therefore the sensitivity of the study area to ecological impact is considered medium.

Table 5-4: Ecological impact sensitivity matrix (IAQM, 2014)

Receptor sensitivity	Distance from source (m)	
	<20	<50
High	High	Medium
Medium	Medium	Low
Low	Low	Low

A summary of the sensitivity of the study area to dust soiling, human health and ecological impacts is presented in Table 5-5. The sensitivity related to demolition, earthworks, construction, and track-out are all considered the same due to respective activities occurring within similar distances to the receptors.

Table 5-5: Sensitivity of the study area to dust settlement, human health and ecological impacts

Activity	Sensitivity of the study area			
	Demolition	Earthworks	Construction	Track-out
Dust soiling	High	High	High	High
Human health	Low	Low	Low	Low
Ecological	Medium	Medium	Medium	Medium

The risk assessment ratings for each of the dust generating activities is presented in Table 5-6. This has been calculated based on the IAQM risk impact tables, the respective sensitivities of the area from Table 5-5, and the potential dust emission magnitudes from Table 5-1.

Table 5-6: Summary of risk assessment ratings assuming no mitigation

Potential impact	Risk rating			
	Demolition	Earthworks	Construction	Track-out
Dust soiling	Medium risk	High risk	Medium risk	Low risk
Human health	Low risk	Low risk	Low risk	Negligible
Ecological	Medium risk	Medium risk	Medium risk	Negligible

Table 5-6 shows that potential dust soiling impacts for most construction activities have a medium risk rating, except for earthwork with high risk rating and track-out which has a low risk rating. Potential human health and ecological impact have a low and medium risk rating respectively for most construction activities, except track-out activities which has a negligible rating for potential human health and ecological impact. The risk ratings shown in Table 5-6 assume no mitigation measures are adopted during construction activities. The risk ratings calculated in this step are used to inform the mitigation measures to be recommended in Step 3 of the IAQM Guidance.

Step 3 Site-specific mitigation

Step 3 of the IAQM guidance is to use the risk ratings calculated in Step 2 to inform the dust and air emissions mitigation measures to be adopted during the construction phase. The recommended and desirable mitigation measures provided in Section 8.2 of the IAQM Guidance were used to develop the mitigation measures listed in Section 6.

Step 4 Determine significant effects

The risk of dust impacts was determined in Step 2, and appropriate mitigation measures for the specific risk of the dust impact were recommended in Step 3 and would be implemented through the site's Construction Environmental Management Plan (CEMP). It is considered likely that mitigation measures would reduce the potential impacts to acceptable levels during the construction phase.

5.1.2 GHG assessment

The greenhouse gas (GHG) emissions assessment includes estimates for Scope 1 and Scope 2 emissions attributed to the construction and operation of the proposal. The scope categories are defined as:

- Scope 1 emissions are direct GHG emissions that are produced by activities that are controlled by the proponent.
- Scope 2 emissions are indirect GHG emissions from the consumption of electricity, heating, cooling or steam that is produced offsite.

The GHG emission assessment for the proposal is based on the guidelines provided in the Greenhouse Gas Assessment workbook for Road Projects by Transport Authorities Greenhouse Group (TAGG) Australia and New Zealand. In estimating GHG emissions for the proposal, the assessment boundary has been considered to include all the emission sources that were deemed to potentially be impacted by decisions made during the design and construction of the proposal. For the purposes of this GHG assessment all activities and project elements where data was available have been estimated. The activities and projects elements captured, likely represent the most emissions intensive over the construction and operation phases. Table 5-7 summarises the GHG scopes for relevant construction and operational activities by source and scope. Table 5-8 lists the assumptions used in the GHG assessment and the GHG emission inventory of the proposal for the construction (spread over 36 months) and operation stage (GHG emission from streetlight is estimated for 50 years) is shown in Table 5-9.

Table 5-7: Greenhouse gas emission scopes for relevant construction and operational activities by source and scope

Emission source category	Emission source	Emission scope	
		Scope 1	Scope 2
Construction stage			
Fuel use	Construction plant and equipment	✓	-
	Site vehicles	✓	-
	Operation of site offices	✓	-
Operation stage			
Electricity consumption	Electrical systems- street lighting	-	✓

- Not Applicable

Table 5-8: Assumptions used in GHG emission assessment

Activity	Assumption
Site office operations	• Operational for 36 months • 500 m^2 of office space, equivalent of 2 star NABERS rating, operating 12 hours a day, Monday to Friday
Mobilisation and site establishment	• Duration: 2 months • Equipment used (300hr/month): Franna crane 20t (1no), Excavator tracked 8-30t (2nos), Front End loader 5-23t (1no)

Activity	Assumption
	• Vehicles: Road truck (2nos), Light vehicle (4nos) • Generator (4nos)
Installation of erosion and sediment controls	• Duration- 1 month • Equipment used (300hr/month): Excavator tracked 8-30t (2nos), Bulldozer D10 (2nos), Grader (1no), Front End loader 5-23t (1no), Scraper earthmoving 30cm (1no) • Vehicles: Road truck (2nos), Light vehicle (4nos), Fuel tank (1no), Water cart (1no), Dump truck (4nos).
Relocation and protection of existing services	• Duration- 5 months • Equipment used (300hr/month): Excavator tracked 8-30t (2nos), Bulldozer (2nos), Grader (2nos), Vibratory roller (2nos), Front End loader 5-23t (1no), Scraper earthmoving (1no) • Vehicles: Water cart (1no), Road truck (2nos), Light vehicle (8nos), Fuel truck (1no), Dump truck (4nos)
Bulk earthworks and materials haulage	• Duration- 9 months • Equipment used (300hr/month): Excavator tracked 8-30t (2nos), Backhoe loader (1no), Front End loader 5-23t (1no) • Vehicles: Road truck (1no), Light vehicle (4nos), Concrete truck (1no), Dump truck (2nos)
Road pavement construction	• Duration- 11 months • Equipment used (300hr/month): Grader (1no), Profiler (1no), Roller- large pad foot (1no), vibratory roller (1no), Excavator tracked 8-30t (1no), Bulldozer (1no), Front End loader 5-23t (1no), Compactor (1no), Road broom (1no), Rubber tyre roller (1no), Line marking machine (1no) • Vehicles: Asphalt truck (1no), Water cart (1no), Road truck (1no), Light vehicle (1no), Fuel truck (1no)
Bridge construction	• Duration- 8 months • Equipment used (300hr/month): Franna crane (2nos), Piling rig (1no), Concrete pump (1no), vibratory roller (1no), Excavator tracked 8-30t (2nos) • Vehicles: Concrete truck (2nos), Road truck (2nos), Light vehicle (4nos)
Signposting, lighting and roadside furniture installation	• Duration- 2 months • Equipment used (300hr/month): Franna crane (1no), Excavator tracked 8-30t (2nos), Piling Rig bored (1no), Wacket/ Plate compactor (1no) • Vehicles: Concrete truck (1no), Road truck (1no), Light vehicle (4nos)

Table 5-9: GHG Emission during construction and operation stage

Activity	Quantity		Emission Factor		Emission	
Scope 1						
Site office	111.6	Kl	2.68	t CO_2e per KL	299	t CO2e
Mobilisation and site establishment	105.48	Kl	2.68	t CO_2e per KL	283	t CO2e
Installation of erosion and sediment control	127.24	Kl	2.68	t CO_2e per KL	341	t CO2e
Relocation and protection of existing services	292.7	Kl	2.68	t CO_2e per KL	784	t CO2e
Bulk earthworks and materials haulage	1324	Kl	2.68	t CO_2e per KL	3548	t CO2e
Road pavement construction	1143	Kl	2.68	t CO_2e per KL	3063	t CO2e
Bridge construction	766.72	Kl	2.68	t CO_2e per KL	2055	t CO2e
Signposting, lighting and roadside furniture installation	100.68	Kl	2.68	t CO_2e per KL	270	t CO2e
Vegetation removal - Moderately sensitive	2.1	ha	307	t CO_2e per ha	645	t CO2e
Vegetation removal - Low sensitive	5.84	ha	110	t CO_2e per ha	642	t CO2e
Total Scope 1					*11930*	*t CO2e*
Scope 2						
Street lighting electricity consumption	2746260	kWh	0.00088	t CO2-e per kWh	2417	t CO2e
Total Scope 2 Emission					*2417*	*t CO2e*
Total Emission					**14347**	**t CO2e**

The Scope 1 emission during construction stage is 11,930 t CO_2 e. The operation stage GHG emission calculated for street lighting calculated for a period of 50 years is 2417 t CO_2 e Scope 2 emission. Total GHG emission estimated from the proposal is about 14,347 t CO_2 e.

The GHG emission from the project is maximum during the construction phase, which is limited to 36 months, when compared with the operation phase duration. The potential impact of the Proposal in terms of GHG emission for the entire project lifecycle when compared with the total annual Australia emissions of 498,112,400 t CO_2 e is only 0.0028%, and when compared with total annual NSW emissions of 132,407,600 t CO_2 e is about 0.01%. This provides a context of the magnitude of the proposal emission, which is insignificant in larger context. (Total Australia emissions and NSW emissions sourced from Australia's 2020 National Greenhouse Accounts as reported under UNFCC with GWP to AR5).

To demonstrate its commitment to the project and to reduce GHG impact, the proposal utilises energy-efficient LED streetlights.

5.2 Operation

The RAQST was used to simulate a 'Do Nothing' and a 'The Proposal' scenario to estimate the operational-phase impact of the proposal on air quality.

Road and traffic details were input into the model to estimate vehicle emissions. The RAQST module utilises various road characteristics, including the number of lanes per direction, road type, gradient, median strip width, and lane width. Additionally, the RAQST module requires traffic data that encompasses traffic composition level, traffic periods, traffic speed, peak hour traffic as a percentage of Annual Average Daily Traffic (AADT), and lane-specific details such as lane direction, lane numbers and associated traffic volumes during peak hours, with traffic composition percentages.

The RAQST module automatically retrieves the background pollutant concentrations from the selected NSW Department of Planning and Environment (DPE) monitoring station for the year 2021 (as this data for 2021 has been validated) for PM_{10}, $PM_{2.5}$ and NOX. The module allows for the selection of either the maximum value, the 90th percentile, or the highest value below 50 µg/m^3 for background pollutant concentrations. If necessary, these values provided by NSW DPE can be modified or replaced. The module also uses the distance from the lane's kerb to the nearest receptor to determine the specific location along the kerb of the road where pollutant concentrations will be predicted.

For the air quality assessment during the operational phase for year 2033 of the Richmond Road, traffic data from node 7 located on Richmond Road south of Alderton Drive (both southbound and northbound) was used. This location was selected because it provides representative traffic data for air quality evaluation due to its strategic position for traffic monitoring, where multiple roads converge, and it represents the longest stretch of road in the area with highest traffic density depicting the worst-case scenario. Both scenarios were modelled as an arterial road type. Further road and traffic details provided in RAQST module user inputs, are shown below (Figure 5-4 and Figure 5-5).

User input

1. General set-up

† Changing parameters in bold will reset traffic data.

Assessment year†	**2033**
Electric vehicle projections	YES

2. Road characteristics

Lanes per direction†	**2**
Road type†	**Arterial**
Road gradient in direction A	4.0%
Median strip width (m)	1.2
Lane width (m)	3.5

3. Traffic data - general

Level for traffic composition†	**Level 4**
Fill with default composition†	**NO**
Traffic period†	**Peak hour**
Traffic speed (km/h)	48.45
Peak hour traffic as % of AADT‡	10%

‡ Used to calculate peak-hour traffic if only AADT is known.

5. Background concentrations

(a) Values from DPE monitoring stations (2021 only)

Background site for NO_X	PROSPECT
Background site for PM_{10}	PROSPECT
Background site for $PM_{2.5}$	PROSPECT
1-hour metric for NO_X	90th percentile
24-hour metric for PM_{10}	90th percentile
24-hour metric for $PM_{2.5}$	90th percentile

(b) User-defined values (overrides DPE data)

Apply user-defined values	NO

6. Closest receptor

Distance from kerb of lane A1 (m)	10

4. Traffic data - by lane

Direction	Lane	Road gradient	Traffic volume (peak hour - vph)	Traffic composition (%) - L4 Car	LCV	HGV (rigid)	HGV (artic.)	Bus	MC
A	Lane A1 ►	4.0%	2,106	85.9	8.6	1.0	4.5	0.0	0.0
A	Lane A2 ►	4.0%	2,106	85.9	8.6	1.0	4.5	0.0	0.0
B	◄ Lane B2	-4.0%	1,969	83.8	10.7	0.9	4.7	0.0	0.0
B	◄ Lane B1	-4.0%	1,970	83.8	10.7	0.9	4.7	0.0	0.0

Figure 5-4: User inputs in RAQST module for "Do Nothing Scenario"

User input

1. General set-up

† Changing parameters in bold will reset traffic data.

Assessment year†	**2033**
Electric vehicle projections	YES

2. Road characteristics

Lanes per direction†	**3**
Road type†	**Arterial**
Road gradient in direction A	4.0%
Median strip width (m)	3
Lane width (m)	3.875

3. Traffic data - general

Level for traffic composition†	**Level 4**
Fill with default composition†	**NO**
Traffic period†	**Peak hour**
Traffic speed (km/h)	48.45
Peak hour traffic as % of AADT‡	10%

‡ Used to calculate peak-hour traffic if only AADT is known.

5. Background concentrations

(a) Values from DPE monitoring stations (2021 only)

Background site for NO_X	PROSPECT
Background site for PM_{10}	PROSPECT
Background site for $PM_{2.5}$	PROSPECT
1-hour metric for NO_X	90th percentile
24-hour metric for PM_{10}	90th percentile
24-hour metric for $PM_{2.5}$	90th percentile

(b) User-defined values (overrides DPE data)

Apply user-defined values	NO

6. Closest receptor

Distance from kerb of lane A1 (m)	10

4. Traffic data - by lane

Direction	Lane	Road gradient	Traffic volume (peak hour - vph)	Traffic composition (%) - L4 Car	LCV	HGV (rigid)	HGV (artic.)	Bus	MC
A	Lane A1 ►	4.0%	1,404	85.9	8.6	1.0	4.5	0.0	0.0
A	Lane A2 ►	4.0%	1,404	85.9	8.6	1.0	4.5	0.0	0.0
A	Lane A3 ►	4.0%	1,404	85.9	8.6	1.0	4.5	0.0	0.0
B	◄ Lane B3	-4.0%	1,323	83.8	10.7	0.9	4.7	0.0	0.0
B	◄ Lane B2	-4.0%	1,323	83.8	10.7	0.9	4.7	0.0	0.0
B	◄ Lane B1	-4.0%	1,323	83.8	10.7	0.9	4.7	0.0	0.0

Figure 5-5: User inputs in RAQST module for "The Proposal Scenario"

The results of the RAQST simulation are presented in Figure 5-10. The results present the concentration of pollutants at 10 metres from the kerb being the nearest location with sensitive receptors.

Table 5-10: Predicted pollutions concentrations 10metres from the kerb in 2033

Scenario (Year 2033)	NO_2 ($\mu g/m^3$)		PM_{10} ($\mu g/m^3$)		$PM_{2.5}$ ($\mu g/m^3$)	
	Maximum 1-hour average	Annual average	Maximum 24-hour average	Annual average	Maximum 24-hour average	Annual average
'Do Nothing' alone	-	13	10.5	4.2	6.5	2.6
'Do Nothing' cumulative (including background)	141.5	29.3	38.4	21.4	18.3	9.5
'The Proposal' alone	-	11.7	9	3.6	5.5	2.2
'The Proposal' cumulative (including background)	139.3	28	36.8	20.8	17.3	9.1
Maximum concentration standard	164	30.75	50	25	25	8

The 'Do Nothing' and 'The Proposal' scenarios predicted similar results, with minor variations due to the increased lane number and lane width due to the road upgrade modelled in 'The Proposal' scenario. 'The Proposal' scenario resulted in lower predictions for PM_{10}, $PM_{2.5}$ and NO_2 due to the proposal operation. This reduction in predicted concentrations could be attributed to the increase in the number of lanes as well as road width leading to ease in urban congestion and better traffic flow for the peak traffic volume (vehicles/hour).

In addition, the cumulative predicted pollutants for both scenarios are below the maximum concentration standards except for $PM_{2.5}$. The annual average $PM_{2.5}$ concentration exceeds the maximum standard, but the contribution from traffic on the road is minimal. The results of $PM_{2.5}$ shows 15 percent decrease in predicted annual average concentration due to the road upgrade. The background pollutant concentrations are likely overly conservative, possibly influenced by natural events such as bushfires and dust storms. The reduction in the overall emission from the Proposal would have a positive impact on air quality by a slight improvement in the existing poor air quality.

The results for 'The Proposal' alone are simulated in the RAQST module for various receptor locations at distances from the lane kerb, ranging from 10 to 100 metres (including 10, 20, 40, 60, 80, and 100 metres) to analyse the dispersion trends of pollutants of PM_{10} and $PM_{2.5}$. These results were also overlaid on the aerial images to provide a visual context to the predicted concentrations relative to the geographic locations and receptors (refer Figure 5-6 to Figure 5-9).

The graph for the values mentioned above has been plotted to analyse the dispersion trend of the pollutants. Additionally, the trendline has been extended to estimate the likely concentration at 350 metres from the lane's kerb (Figure 5-10).

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Figure 5-6: Isopleths for PM_{10} concentrations along the proposed widened section of Richmond Road south of Alderton Drive based on RAQST results

Figure 5-7: Isopleths for PM_{10} concentrations along the proposed widened section of Richmond Road south of Alderton Drive based on RAQST results

Figure 5-8: Isopleths for $PM_{2.5}$ concentrations along the proposed widened section of Richmond Road south of Alderton Drive based on RAQST results

This document has been prepared based on information provided by others as cited in the data sources. Stantec has not verified the accuracy and/or completeness of this information and shall not be responsible for any errors or omissions which may be incorporated herein as a result. Stantec assumes no responsibility for data supplied in electronic format, and the recipient accepts full responsibility for verifying the accuracy and completeness of the data.

Figure 5-9: Isopleths for $PM_{2.5}$ concentrations along the proposed widened section of Richmond Road south of Alderton Drive based on RAQST results

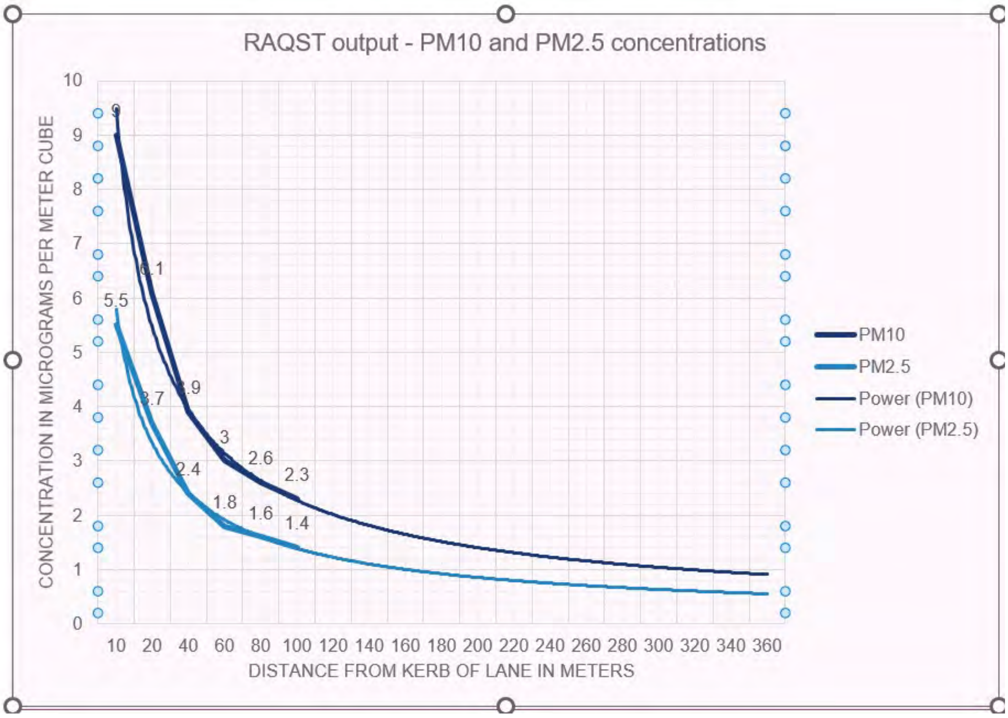

Figure 5-10: RAQST output - PM_{10} and $PM_{2.5}$ concentrations

Based on Figure 5-10 it can be inferred that at a distance of 350 metres from the lane's kerb, the concentration of PM_{10} is expected to be 0.9 µg/m^3, and the concentration of $PM_{2.5}$ is expected to be 0.6 µg/m^3.

6. Safeguards and management measures

Mitigation measures for the construction phase have been recommended in line with the IAQM guidance according to the assessed risk profile as outlined in Table 6-1.

Table 6-1: Mitigation measures

Impact	Environmental safeguards	Responsibility	Timing
AQ1 Construction air quality management	A Construction Air Quality Management Plan (AQMP) would be prepared and implemented as part of the CEMP. The AQMP would include, but not be limited to: • Potential sources of air pollution. • Air quality management objectives consistent with any relevant published EPA guidelines. • Roles and responsibilities for carrying out the AQMP. • A stakeholder communications plan that includes community engagement before work commences on site. • 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. • A process for recording all dust and air quality complaints, identify cause(s), take appropriate measures to reduce emissions in a timely manner, and record the measures taken. • Regular liaison meetings with other high risk construction sites within 500 metres of the construction boundary, to ensure plans are co-ordinated and dust and particulate matter emissions are minimised. • Dust monitoring and inspection plan with different levels of monitoring/inspection in response to the potential impact of the planned activity, dry/windy conditions, or in response to community complaints. This may include visual assessments of dust plumes, dust deposition measurement, and/or continuous PM_{10} ambient air monitoring. • Specific mitigation measures (in addition to those listed as baseline measures in AQ2, AQ3, and AQ4) with proposed action trigger levels for implementation of the mitigation measures. • A process for altering management measures as required and reprogramming construction activities if the safeguards and management measures do not adequately restrict dust generation. • A progressive rehabilitation strategy for exposed surfaces.	Contractor	Pre-construction, Construction

Impact	Environmental safeguards	Responsibility	Timing
AQ2 Construction and demolition mitigation measures	• Ensure all vehicles switch off engines when stationary - no idling vehicles. • Only use cutting, grinding or sawing equipment fitted with or used in conjunction with suitable dust suppression techniques. • Ensure an adequate water supply on the site for effective dust/particulate matter suppression/ mitigation, using non-potable water where possible and appropriate. • No bonfires and burning of waste materials. • Ensure effective water suppression is used during demolition operations. • Erect barriers that are higher than the activity or stockpiles where dusty activities are planned near receptors. • Employ sediment and erosion management measures.	Contractor	Construction
AQ3 Earthworks mitigation measures	• Cover, seed or fence stockpiles to prevent wind whipping. • Re-vegetate earthworks and exposed areas/soil stockpiles to stabilise surfaces as soon as practicable. • Use hessian, mulches or tackifiers where it is not possible to re-vegetate or cover with topsoil, as soon as practicable. • Only remove the cover in small areas during the work and not all at once.	Contractor	Construction
AQ4 Track-out mitigation measures	• Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport. • Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable).	Contractor	Construction

7. Conclusion

This report has presented an assessment of the potential air quality impacts of the proposal to widen a three-kilometre section of Richmond Road between M7 Motorway and Townson Road. The upgrade area is between Yarramundi Drive, Glendenning in the south and Townson Road, Marsden Park in the north. The key potential air quality issues were identified as dust during construction and changes in emissions from vehicles using the existing and modified roads affected by the proposal during operation.

A detailed review of the existing environment was carried out including an analysis of historically measured concentrations of key quality indicators (NO_2, PM_{10} and $PM_{2.5}$) from representative monitoring station. The following conclusions were made in relation to the existing air quality and meteorological conditions:

- The existing climatic conditions are warm and temperate with generally consistent periods of rainfall but higher rainfall in January through March.
- The NO_2 maximum 1 hour average and annual average for years 2017 to 2021 are below the maximum concentration standard.
- PM_{10} averages for the years 2017, 2018, 2020, and 2021, as well as the 5-year average of the annual PM_{10} concentrations, are below the maximum concentration standard. However, the annual average PM_{10} for 2019 exceeds this standard.
- The annual $PM_{2.5}$ averages for 2017 and 2021 are below the standard, while those for 2018, 2019, and 2020, as well as the 5-year average of the annual $PM_{2.5}$ concentrations, exceed the maximum concentration standard.
- All PM_{10} and $PM_{2.5}$ maximum 24-hour concentrations, but 2021 for PM_{10}, exceed the maximum concentration standard.
- Despite the reported elevated concentrations, both PM_{10} and $PM_{2.5}$ concentrations are below the criteria for 97% of the time with the peaks and annual averages likely a result of bushfires.

Potential air quality impacts of the proposal during construction were assessed using the semi-quantitative method developed by the IAQM. Operation stage air quality impact is assessed using Transport for NSW's Roadside Air Quality Screening Tool (RAQST) for "Do Nothing" and "The proposal" scenarios.

The key outcomes of the air quality assessment are:

- Construction of the proposal was determined to represent a 'high' risk of dust impacts according to the IAQM method. However, the application of the recommended mitigation measures would mean that adverse residual impacts from construction would not be anticipated.
- During the operation stage the proposal scenario after the road upgrade resulted in lower predictions for $PM_{10,}$ $PM_{2.5}$ and NO_2 due to the proposals operation. This slight reduction in concentrations could be attributed to the increase in lane numbers as well as road width leading to better traffic flow for the peak traffic volume (vehicles/hour).
- The cumulative predicted pollutants for both scenarios are below the maximum concentration standards except for $PM_{2.5}$. The annual average $PM_{2.5}$ concentration exceeds the maximum standard, but the contribution from traffic on the road is minimal.
- The result plot of RAQST model for various receptor distances when analysed for trend analysis, infers that at a distance of 350 metres from the lane's kerb, the concentration of PM_{10} is expected to be 0.9µg/m^3, and the concentration of $PM_{2.5}$ is expected to be 0.6µg/m^3.

Total GHG emissions estimated from the proposal is about 11,213 t CO2 e, nearly completely attributable to the construction phase. The potential impact of the Proposal for the entire project lifecycle when compared with the total annual Australia emissions of 498,112,400 t CO2e is only 0.002%, and when compared with total annual NSW emissions of 132,407,600 t CO2e is about 0.008%. This provides a context of the magnitude of the Proposal emission, which is insignificant in larger context.

Based on this assessment, the following three overall conclusions can be made:

- Highest air quality impacts will occur during construction, but residual impacts can be managed with the application of the recommended mitigation measures.
- The proposal will slightly improve the existing poor air quality in the study area.
- The Scope 1 and Scope 2 GHG emissions from the proposal are minor and only temporary as part of construction.

The proposal, therefore, is assessed to not result in adverse changes to air quality at local or regional scales.

8. References

Department of Environment and Conservation (DECC) (2004) *Ambient concentrations of toxic organic compounds in NSW 2004*. Ambient Air Quality Research Project. organics04120.pdf (nsw.gov.au)

NSW Environment Protection Authority (NSW EPA) (2022) *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales*. 22p3963-approved-methods-for-modelling-and-assessment-of-air-pollutants.pdf (nsw.gov.au)

Benson P E (1984) *CALINE 4: A Dispersion Model for Predicting Air Pollutant Concentrations Near Roadways*, FHWA-CA-TL-84-15, California Department of Transportation, Sacramento, California, United States.

NSW Rural Fire Service (2019) *Bush Fire Bulletin, The journal of the NSW Rural Fire Services, 2019 and 2020.* *Bush-Fire-Bulletin-Vol41-No2.pdf (nsw.gov.au)*

Department of Planning Industry and Environment (DPIE) (2021). *Air quality data services*. https://www.dpie.nsw.gov.au/air-quality/air-quality-data-services/data-download-facility

Department of Agriculture, Water and the Environment (DAWE) (2021). *National Pollutant Inventory*. http://www.npi.gov.au/

Department of Climate Change, Energy, the Environment and Water (DCCEEW) (2023). *Australian National Greenhouse Accounts Factors*. https://www.dcceew.gov.au/sites/default/files/documents/national-greenhouse-account-factors-2023.pdf

The Clean Air Society of Australia and New Zealand Inc (CASANZ)(2023). *Good practice guide for the assessment and management of air pollution from road transport projects 2023*. CASANZ GPG Assessment & Mgmt of Air Pollution from Road Transport Project_V1_Feb 23.pdf

Institute of Air Quality Management (IAQM) (2014). *Guidance on the assessment of dust from demolition and construction*. UK Institute of Air Quality Management, London. http://iaqm.co.uk/text/guidance/construction-dust-2014.pdf.

National Environment Protection Council (NEPC) (2021) *National Environment Protection (Ambient Air Quality) Measure 2021.* The Office of Parliamentary Counsel, Canberra. F2021C00475.pdf

PAE Holmes (2013) *Air Quality Appraisal Tool (AQAT), Report 6620*, 4 April 2013, PAE Holmes, Epping. https://www.epa.nsw.gov.au/-/media/epa/corporate-site/resources/air/aqatrpt.pdf?la=en&hash=F64C2E3530897C65690A769EDA17B379E893EFA2

Transport Authorities Greenhouse Group (TAGG) (2013). *Greenhouse Gas Assessment Workbook for Road Projects*. https://www.mainroads.wa.gov.au/globalassets/technical-commercial/technical-library/road-and-traffic-engineering/climate-change/carbon-gauge-workbook-2013.pdf

Transport for NSW (2023). *Roadside air quality screening tool guideline*. EMF-AQ-GD-0064 Roadside air quality screening tool guideline.pdf (nsw.gov.au)

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