AIR QUALITY IMPACT ASSESSMENT

Mamre Road Upgrade - Stage 1

Prepared for:

Transport for NSW
PO Box 973
Parramatta NSW 2124

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BASIS OF REPORT

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

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DOCUMENT CONTROL

Reference	Date	Prepared	Checked	Authorised
610.30064-R01-v2.0	15 July 2021	K Lawrence	A Naghizadeh	K Lawrence
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1 Introduction

Transport for NSW (TfNSW) proposes to upgrade about 3.8 kilometres (km) of Mamre Road between the M4 Motorway, St Clair and Erskine Park Road, Erskine Park to a four-lane divided road (the proposal). The proposal forms Stage 1 of the larger Mamre Road Upgrade Project, which is proposed to be delivered by TfNSW in two stages. Overall, the Mamre Road Upgrade Project would involve upgrades to a 10 km long section of Mamre Road between the M4 Motorway, St Clair and Kerrs Road.

Mamre Road is a key transport corridor, providing connections to the Western Sydney Employment Area and the proposed Western Sydney Aerotropolis. The proposal is required to support future economic and residential growth in Western Sydney by increasing the capacity of Mamre Road and improving road safety and movement between the M4 Motorway and Erskine Park Road.

SLR has been commissioned by TfNSW to prepare an air quality impact assessment for the proposal. The aim of this report is to present an assessment of potential air quality impacts at nearby sensitive receptor locations as a result of traffic emissions from Mamre Road after the upgrade has been completed. Construction-related air quality impacts from the proposal will be addressed through the Construction Air Quality Management Plan (CAQMP) once construction information is confirmed by the contractor, and the assessment of these activities is beyond the scope of this study.

1.1 Approach to the Air Quality Impact Assessment

SLR has performed a high-level quantitative assessment of operational impacts associated with identified sources of air emissions from the proposal. The methodology applied in assessing the potential for air quality-related impacts included:

- Identification of key risks on future receptors of the proposal, as well as suitable criteria for the evaluation of these risks.
- Characterisation of key features of the surrounding environment including prevailing climate and meteorological conditions; and background air quality.
- Screening level quantitative assessment of the potential for impacts to occur during operations using NSW Roads and Maritime Services' Tool for Roadside Air Quality (TRAQ) prediction model.

Based on the outcomes of the above, mitigation measures have been recommended to effectively manage identified risks to air quality for future receptors.

2 Project Description

2.1 The Proposal

The proposal is located within the City of Penrith local government area (LGA) in Sydney, New South Wales (NSW). A map showing the location of the proposal is shown in **Figure 1**.

Key features of the proposal include:

- an upgrade of Mamre Road to a four-lane divided road with a wide central median that would allow for widening to six lanes in the future, if required
- changes to intersections with Mamre Road including:
  - an upgrade to the existing signalised intersection at Banks Drive, including a new western stub for access and a U-turn facility
  - a new signalised intersection at Solander Drive, including a new western stub for access and a Uturn facility
  - a new signalised intersection at Luddenham Road with new turning lanes
  - an upgrade to the existing signalised intersection at Erskine Park Road with new turning lanes
  - modified intersection arrangements (left in, left out only) at McIntyre Avenue and Mandalong Close
- a new shared path along the eastern side of Mamre Road and provision for a future shared path on the western side
- reinstatement of bus stops near Banks Drive with provision for additional bus infrastructure in the future
- changes to property access to Mamre House, Erskine Park Rural Fire Service and other private properties
- drainage and flooding infrastructure upgrades including culvert crossings, water quality basins, grass swales and channel tail-out work
- new traffic control facilities including new traffic signals and relocation of existing electronic variable message signage
- roadside furniture and street lighting
- noise walls along the eastern side of Mamre Road at St Clair
- utility relocations
- establishment of temporary ancillary facilities to support construction, including compound sites, stockpile and laydown locations, temporary access tracks, temporary waterway crossings and concrete batching plants.

Further details of the layout of the proposal are shown in **Figure 2**. Construction of the proposal is expected to start in 2022 and be completed in late 2025, subject to approval, funding and weather considerations. The construction works are planned to be carried out in two stages: early works and main construction work. Early works would involve utility relocations, site establishment activities, property adjustments and other low impact work required to facilitate the main construction works.

Figure 1 Proposal Location

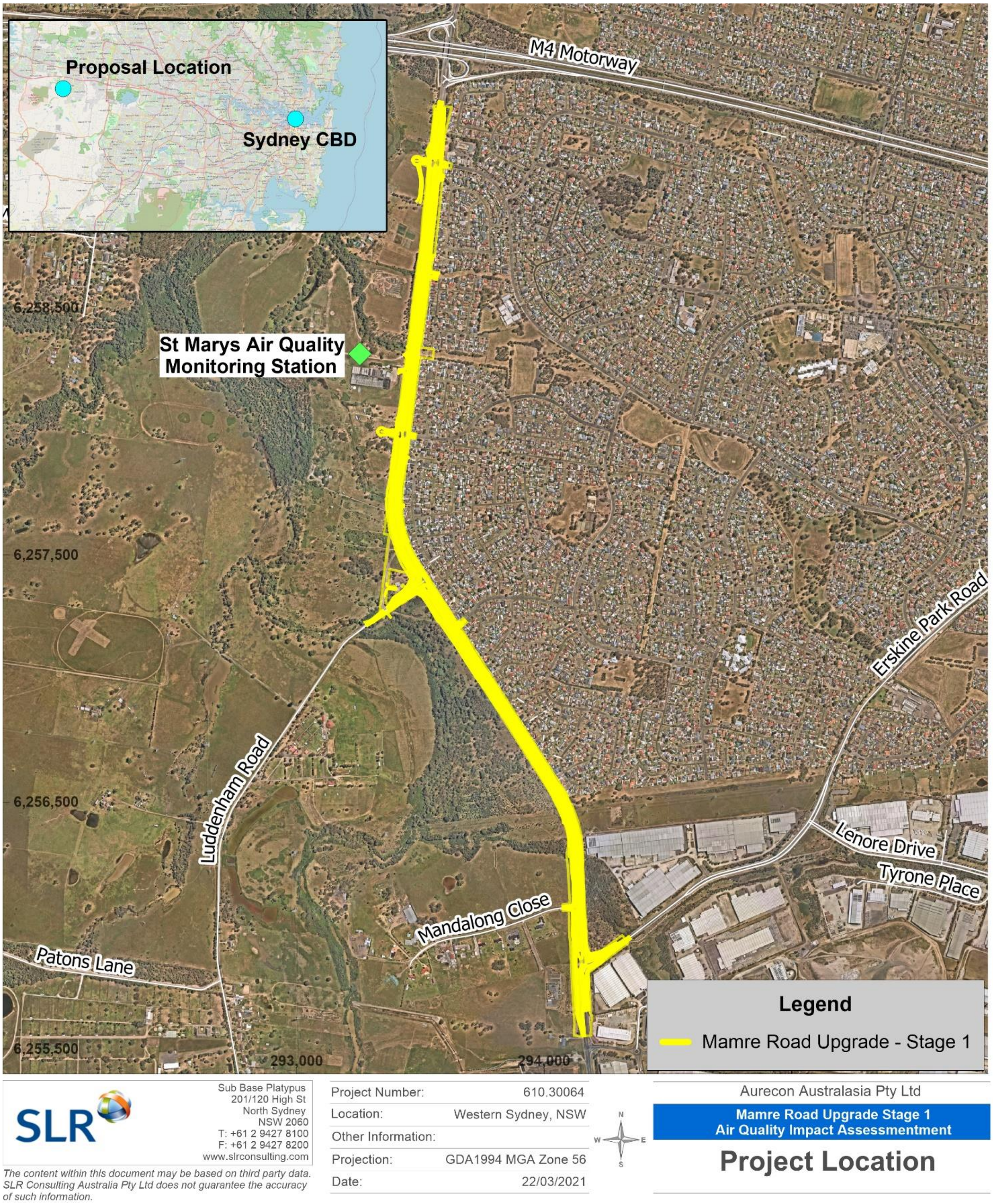
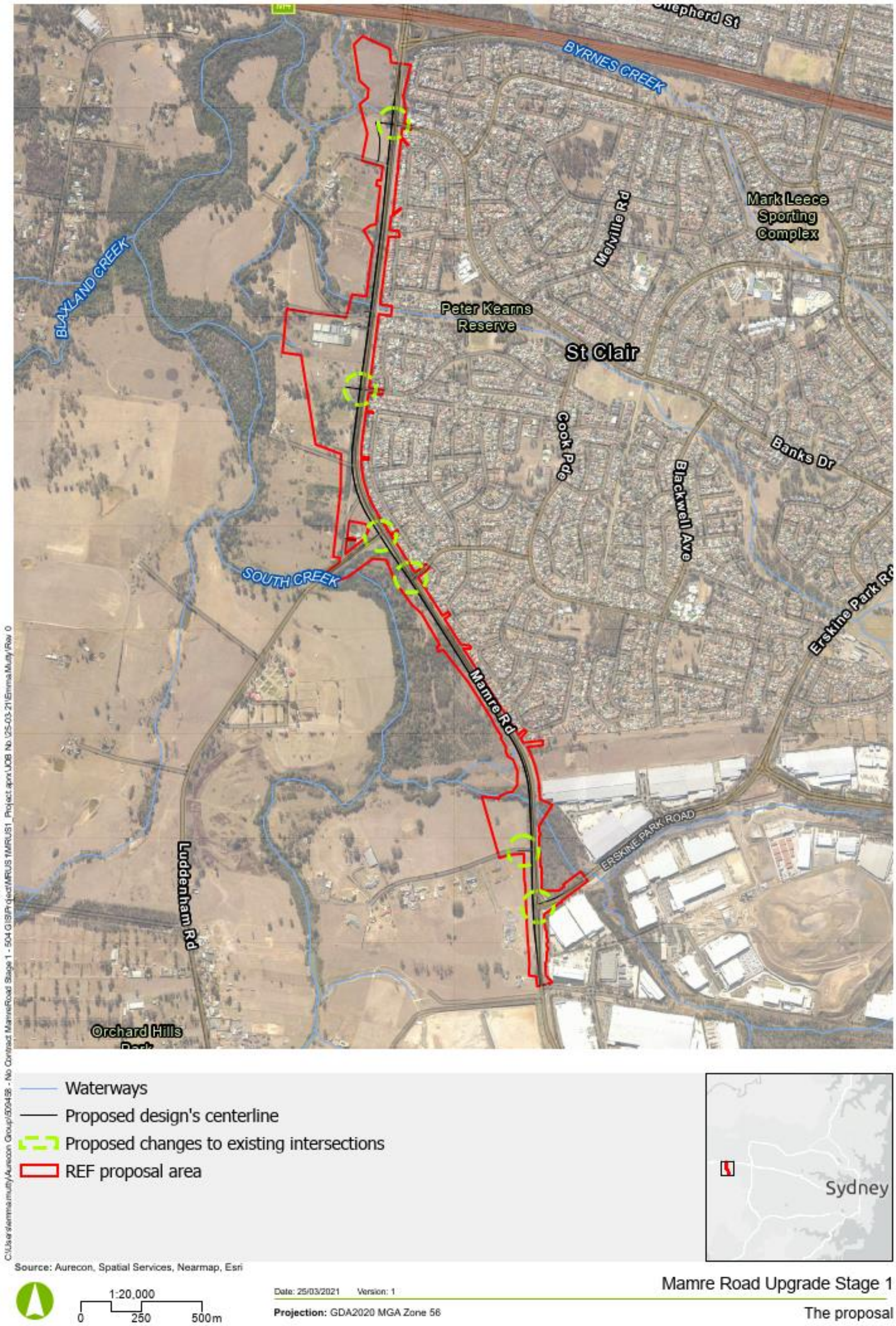


Figure 2 Layout of the Proposal

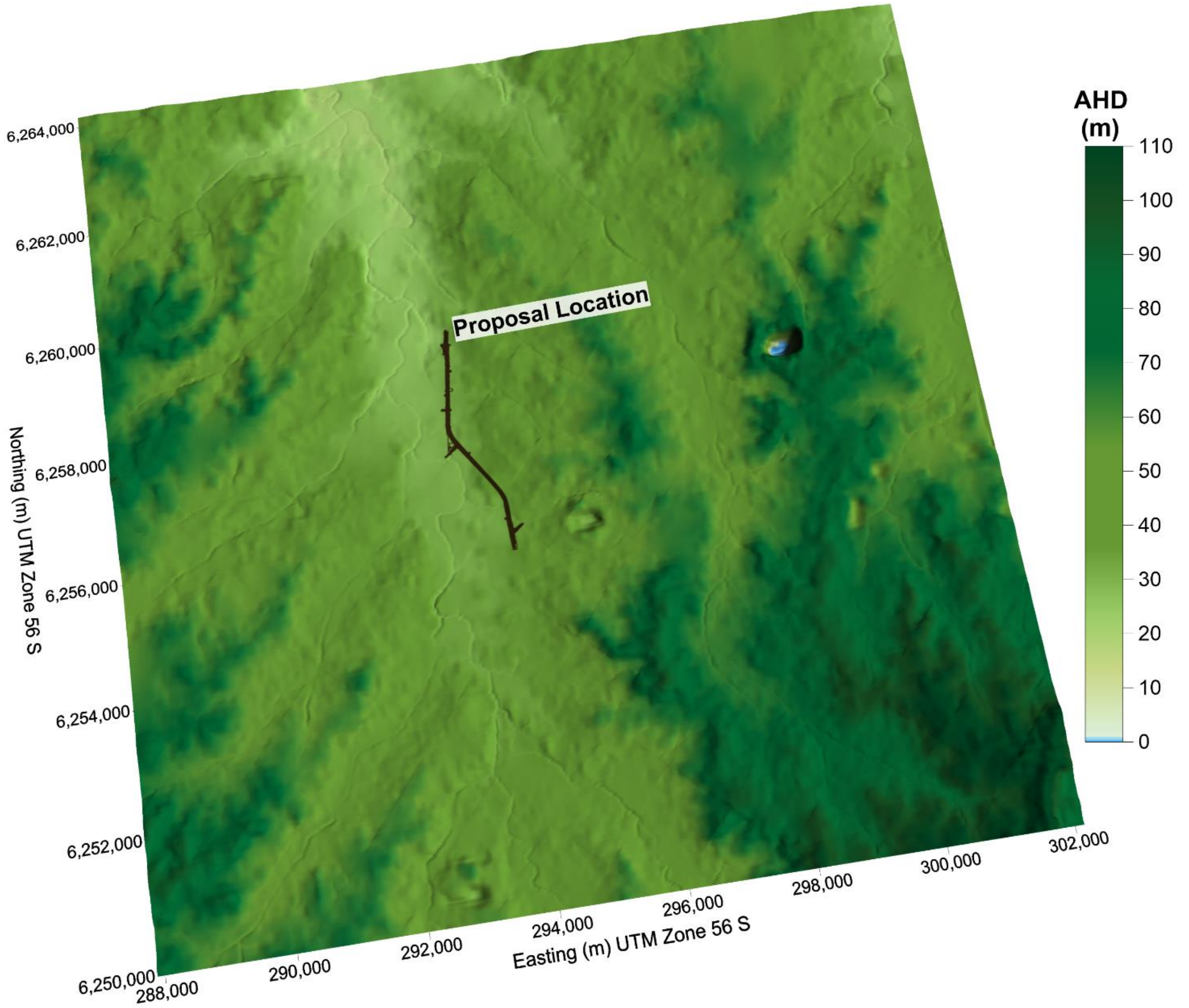


2.2 Local Topography

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 is shown in **Figure 3**. The topography of the local area within the illustrated area ranges from an approximate elevation of 0 m to 110 m Australian Height Datum (AHD). The proposal area is reasonably flat, with a slight decrease in elevation towards the south. The area immediately surrounding Mamre Road is relatively open, which will facilitate the dispersion of emissions to air and prevent accumulation of air pollutants.

Figure 3 Topography of Area Surrounding the Proposal



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Project Number:	610.30064
Location:	Western Sydney, NSW
Other Information:	
Projection:	UTM Zone 56S
Date:	22/03/2021

Aurecon Australasia Pty Ltd
Mamre Road Upgrade Stage 1
Air Quality Impact Assessment
Topography

2.3 Local Meteorology

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

The Bureau of Meteorology (BoM) maintains and publishes data from weather stations across Australia. The closest such stations recording hourly wind speed and wind direction data include the Penrith Lakes Automatic Weather Station (AWS) (located approximately 11 km northwest of the proposal), Badgerys Creek AWS (located approximately 9.5 km southwest of the proposal) and Horsley Park AWS (located approximately 8 km southeast of the proposal). Considering the distance between the proposal and the closest AWSs, data from these AWSs is not deemed to be a reliable representation of meteorological conditions in the vicinity of Mamre Road.

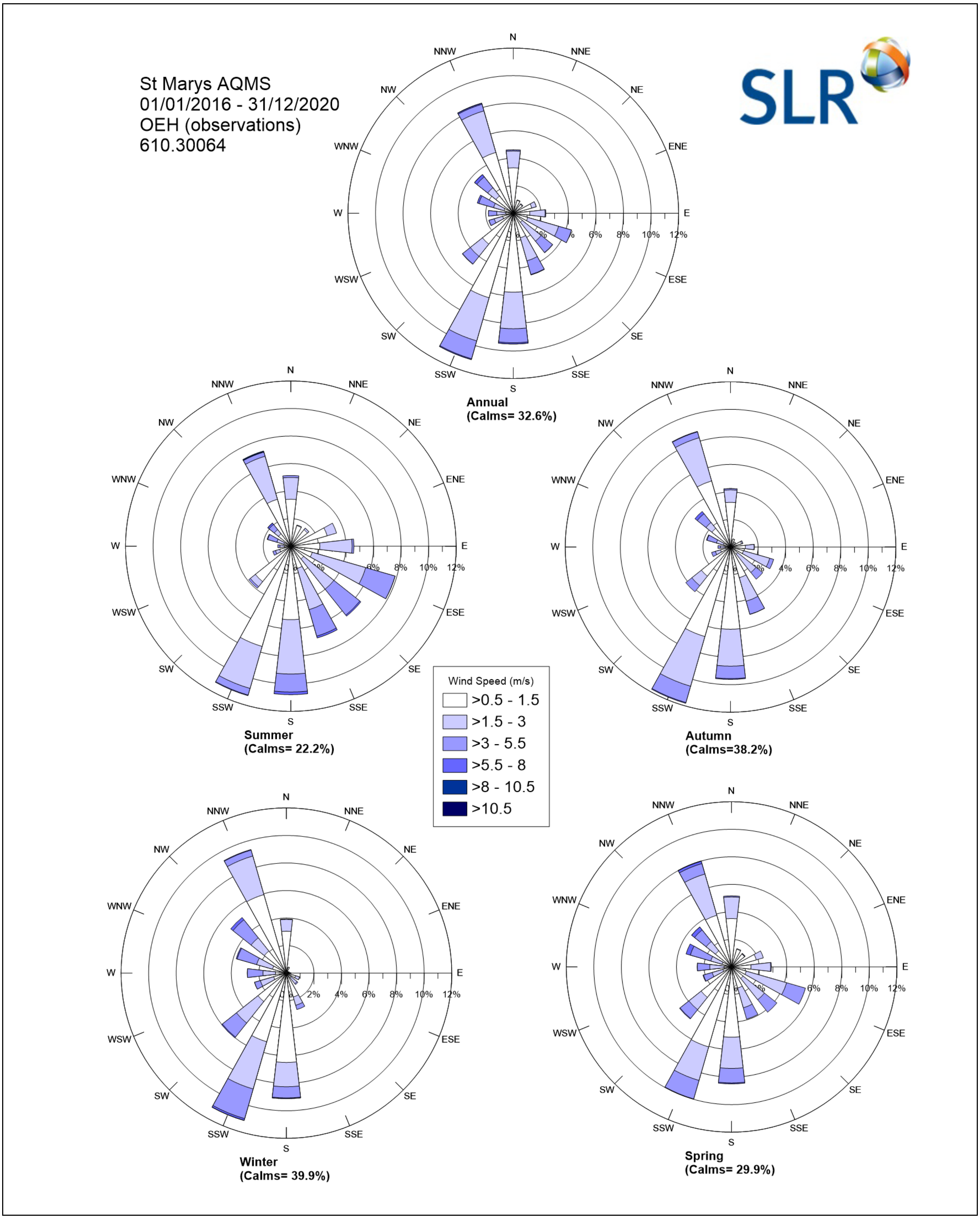
Air quality monitoring is performed by the NSW Department of Planning, Industry and Environment's Environment, Energy and Science (EES) group at a number of monitoring stations across NSW. Many of these stations monitor and record meteorological conditions as well as air quality data. The closest such station is the St Marys Air Quality Monitoring Station (AQMS), which is located 270 m west of Mamre Road (see **Figure 1**).

Annual and seasonal wind roses for the years 2016-2020 inclusive, compiled from data recorded by the St Marys AQMS, are presented in **Figure 4**. The 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.

The wind roses indicate that:

- On both an annual and seasonal basis, the predominant wind directions in the area are from the south-southwest, south and north-northwest. These winds have potential to blow vehicle emissions from Mamre Road towards the nearest residential areas.
- Moderately strong winds from the southeastern quadrant, which would blow vehicle emissions from Mamre Road away from the nearest residential areas, also feature during summer.
- Calm conditions (<0.5 m/s) were recorded to occur with a very high frequency, particularly during autumn and winter.

Figure 4 Annual and Seasonal Wind Roses - St Marys AQMS (2016-2020)

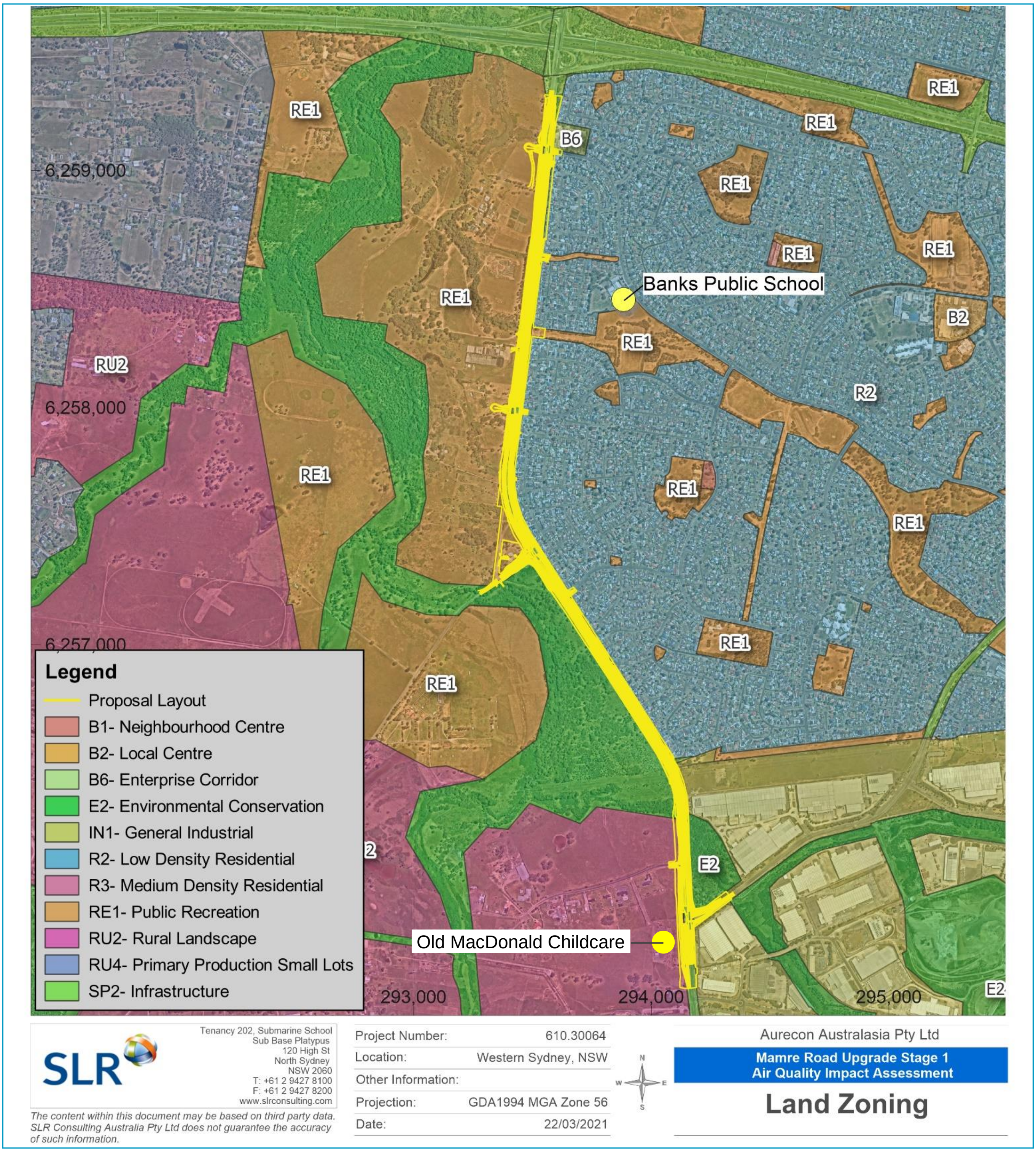


2.4 Surrounding Land Use

As illustrated in **Figure 5**, most of the land immediately to the west of the proposal is zoned Public Recreation (RE1) or Environmental Conservation (E2) in the *Penrith Local Environmental Plan 2010*. To the east, at the northern end of the proposal, the land is predominantly zoned Low Density Residential (R2), with small pockets of Public Recreation (RE1). At the southern end of the proposal, the land to the east is predominantly zoned General Industrial (IN1) in the *State Environmental Planning Policy (Western Sydney Employment Area) 2009*, with smaller areas of Environmental Conservation (E2).

The only school or childcare centre identified within 100 m of the proposal is the Old MacDonalds Childcare Centre located on Mandalong Close, about 90 m west of Mamre Road opposite the Erskine Park Industrial Estate. The next closest educational/childcare facility is Banks Public School at 220 m to the east of the proposal (see **Figure 5**).

Figure 5 Surrounding Land Use



2.5 Sensitive Receptors

To assess the potential impacts of the proposal on the nearest sensitive receptors, the closest residences to the kerbside of the proposal were identified based on the design drawings, and the reductions from the current separation distances due to the proposal were then estimated. A summary of these distances is provided in **Table 1**.

As noted in **Section 2.4**, the closest schools or childcare centres to the proposal were identified to be Old MacDonald Childcare Centre, located approximately 90 m west of the southern end of the proposal, and Banks Public School, located approximately 220 m to the east of the northern end of the proposal.

Table 1 Estimated Changes in Distance from Kerbside due to the Proposal for the Closest Residences

Rank	Street Name	Current Distance from Kerbside (m)	Proposed Distance from Kerbside (m)	Change (m)
1	Solander Drive	10	8	-2
2	Solander Drive	14	11	-3
3	McIntyre Avenue	15	11	-4
4	Banks Drive	14	12	-2
5	Olympus Drive	22	12	-10
6	McIntyre Avenue	12	12	-
7	Unnamed	19	13	-6
8	Madison Circuit	21	13	-8
9	Kiwi Close	20	13	-7
10	McIntyre Avenue	13	13	-
11	Madison Circuit	21	13	-8
12	Kiwi Close	19	15	-4
13	Unnamed	24	15	-9

3 Relevant Air Quality Policy and Guidance

A number of legislative instruments and guidelines apply to air pollution from road transport, including specific requirements for road tunnels (not relevant to the proposal). These include:

- National emission standards that apply to new vehicles
- Emission regulations, checks and policies that apply to in-service vehicles
- Fuel quality regulations
- In-tunnel limits on pollutant concentrations for tunnel ventilation design and operational control
- Ambient air quality standards and assessment criteria, which define levels of pollutants in the outside air that should not be exceeded during a specific time period to protect public health.

The focus of this assessment, which is limited to the assessment of potential operational phase impacts once the proposal is constructed, is on assessing the expected level of compliance with relevant ambient air quality standards based on the proposed road design and projected operational parameters.

An ambient air quality standard defines a metric relating to the concentration of an air pollutant in the ambient air. Standards are usually designed to protect human health, including sensitive populations such as children, the elderly, and individuals suffering from respiratory disease, but may relate to other adverse effects such as damage to buildings and vegetation. The form of an air quality standard is typically a concentration limit for a given averaging period (e.g. annual average, 24-hour average), which may be stated as a 'not-to-be-exceeded' value or with some exceedances permitted. Several different averaging periods may be used for the same pollutant to address long-term and short-term exposure.

3.1 Approved Methods

State air quality guidelines adopted by the NSW EPA are published in the *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (hereafter the Approved Methods). The Approved Methods lists the statutory methods for modelling and assessing air pollutants from stationary sources and specifies criteria which reflect the environmental outcomes adopted by the EPA. The Approved Methods are referred to in the *Protection of the Environment Operations (Clean Air) Regulation 2002* for assessment of impacts of air pollutants. The air quality criteria set out in the Approved Methods relevant to the proposal are reproduced and discussed in **Section 4.2**.

It is noted that the NSW Approved Methods are designed mainly for the assessment of industrial point sources, and do not contain specific information on the assessment of (for example), transport schemes and land use changes.

3.2 TfNSW Air Quality Management Guideline

TfNSW document DMS-SD-107 provides guidance with regard to managing air quality and emissions on Infrastructure and Place (IP) project sites, acknowledging that the inappropriate management of emissions has the potential to result in health impacts, loss of amenity and community dissatisfaction and environmental degradation. Such impacts are identified in the Guideline as primarily being associated with fugitive dust from construction activities and exhaust emissions from vehicles, plant and equipment used during construction. Construction-related air quality impacts from the proposal will be addressed through the Construction Air Quality Management Plan (CAQMP) once construction information is confirmed by the contractor and are outside the scope of this report.

4 Identification of Air Emissions and Relevant Criteria

4.1 Identification of Pollutants of Concern

The primary source of air pollutant emissions associated with the operational phase of the proposal will be vehicles travelling along Mamre Road. Mamre Road is classified as a "Main Road" (Gazetted Road Number: 536). A review of the National Pollutant Inventory Emission Estimation Technique Manual (NPI EET) for Combustion Engines (DEWHA , 2008) identifies the primary pollutants from combustion engines as:

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

Other substances that are also emitted from vehicle exhausts in trace amounts include products of incomplete combustion, such as metallic additives which contribute to the particulate content of the exhaust (DEWHA , 2008). In addition, ozone (O_3) is formed as a secondary pollutant from atmospheric reactions between VOCs and NO_X, and is used as a key indicator of smog in urban environments.

The rate and composition of air pollutant emissions from road vehicles is a function of a number of factors, including the type, size and age of vehicles within the fleet, the type of fuel combusted, number and speed of vehicles and the road gradient.

Information on the potential health impacts of the pollutants identified above is provided in the following sections.

Suspended Particulate Matter

Airborne contaminants that can be inhaled directly into the lungs can be classified on the basis of their physical properties as gases, vapours or particulate matter. In common usage, the terms "dust" and "particulates" are often used interchangeably. The term "particulate matter" refers to a category of airborne particles, typically less than 30 microns (µm) in diameter and ranging down to 0.1 µm and is termed total suspended particulate (TSP).

The annual criterion for TSP recommended by the NSW EPA is 90 micrograms per cubic metre of air (µg/m^3). The TSP criterion was developed before the more recent results of epidemiological studies which suggested a relationship between health impacts and exposure to concentrations of finer particulate matter.

Emissions of particulate matter less than 10 µm and 2.5 µm in diameter (referred to as PM_{10} and $PM_{2.5}$ respectively) are considered important pollutants due to their ability to penetrate into the respiratory system. In the case of the $PM_{2.5}$ category, recent health research has shown that this penetration can occur deep into the lungs. Potential adverse health impacts associated with exposure to PM_{10} and $PM_{2.5}$ include increased mortality from cardiovascular and respiratory diseases, chronic obstructive pulmonary disease and heart disease, and reduced lung capacity in asthmatic children.

Oxides of Nitrogen

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 will be converted to NO_2 in the atmosphere after leaving a car exhaust.

NO is a colourless and odourless gas that does not significantly affect human health. However, in the presence of oxygen, NO can be oxidised to form NO_2 which can have significant health effects including damage to the respiratory tract and increased susceptibility to respiratory infections and asthma. Long term exposure to NO_2 can lead to lung disease.

Carbon Monoxide

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

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.

Sulphur Dioxide

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

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

Volatile Organic Compounds

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

VOCs are emitted by a variety of sources, including motor vehicles, chemical plants, automobile repair services, painting/printing industries, and rubber/plastics industries. VOCs that are often typical of these sources include benzene, toluene, ethylbenzene and xylenes (often referred to as ‘BTEX’). Biogenic (natural) sources of VOC emissions (e.g. vegetation) are also significant.

Impacts due to emissions of VOCs can be health or nuisance (odour) related. Benzene is a known carcinogen and a key VOC linked with the combustion of motor vehicle fuels.

4.2 Relevant Air Quality Criteria

As discussed in **Section 3.1**, Section 7.1 of the Approved Methods set out impact assessment criteria for the air pollutants identified in **Section 4**. The criteria listed in the Approved Methods are derived from a range of sources (including NHMRC, NEPC, WHO, ANZEEC and DoE). The criteria specified in the Approved Methods are the defining ambient air quality criteria for NSW, and are considered to be appropriate for the setting. The following sections outline the potential health impacts of each of the identified pollutants, and the relevant criteria from the Approved Methods are summarised in **Table 2**.

Table 2 Air Quality Assessment Criteria

Pollutant	Averaging Period	Ambient Air Quality Criterion	
		µg/m³	pphm
Total suspended particulate (TSP)	Annual	90	-
Particulate matter less than 10 microns (PM_{10})	24-Hour	50	-
	Annual	25	-
Particulate matter less than 2.5 microns ($PM_{2.5}$)	24-Hour	25	-
	Annual	8	-
Nitrogen dioxide (NO_2)	1-hour	246	12
	Annual	62	3
Carbon monoxide (CO)	15-minutes	100,000	8,700
	1-hour	30,000	2,500
	8-hour	10,000	900
Sulfur dioxide (SO_2)	10-minutes	712	25
	1-hour	570	20
	24-hour	228	8
	Annual	60	2
Benzene	1-hour	29	0.9
Toluene	1-hour	360	9
Ethylbenzene	1-hour	8,000	180
Xylenes	1-hour	190	4

In relation to the air quality criteria shown in **Table 2**, it is noted that on 18 May 2021, the National Environment Protection Council (NEPC) varied the National Environment Protection (Ambient Air Quality) Measure (hereafter the Ambient Air NEPM) standards for ozone, NO_2 and SO_2 based on the latest scientific understanding of the health risks arising from these pollutants. In addition, the updated Ambient Air NEPM includes a reduced goal for $PM_{2.5}$ by 2025. As the ambient air quality criteria set out in the Approved Methods are based on the standards in the Ambient Air NEPM, and given that this assessment is based on traffic projections out to 2036, an assessment of the proposal's compliance with the new standards set out in the Ambient Air NEPM has also been performed. A summary of the updated standards for NO_2 and $PM_{2.5}$ is provided below in **Table 3**.

Table 3 Recent Changes to National Ambient Air Quality Criteria Relevant to this Assessment

Pollutant	Averaging Period	Previous NEPM Standard (µg/m^3)	New NEPM Standard (µg/m^3)
NO_2	1-Hour	246	165
	Annual	62	31
$PM_{2.5}$	24-Hour	25	20
	Annual	8	7

5 Background Air Quality

5.1 Regional Air Quality

Air quality is generally classified as good in Sydney, based on information from the 43 station Air Quality Monitoring Network operated by the NSW Department of Planning, Industry and Environment's (DPIE's) Environment, Energy and Science (EES) group. Between 2000 and2019, the air quality was 'very good', 'good' or 'fair' for 94% of days in the Sydney northwest region, within which the proposal is located. During this time, exceedances of the national air quality standards for particle pollution have usually been associated with regional dust storms and vegetation fires (NSW Government, 2017) (NSW OEH, 2017b) (NSW OEH, 2019).

The nearest DPIE-operated air quality monitoring stations to the proposal are located at St Marys and Prospect. The St Marys AQMS was commissioned in 1992, and is located on a residential property 270 m west of Mamre Road (see **Figure 1**), and is at an elevation of 29 m. The Prospect AQMS is located 13 km to the east of the proposal. It was commissioned in February 2007 and is located at William Lawson Park, Prospect, in a residential area and is at an elevation of 66 m. Both these stations are a part of the Sydney northwest air quality monitoring region.

The St Marys AQMS monitors the concentration levels of following air pollutants:

- Oxides of nitrogen (NO, NO_2 and NO_X)
- Fine particles ($PM_{2.5}$ and PM_{10})

Given the very close proximity of the proposal to the St Marys AQMS, this station is considered to be more representative of background pollutant concentrations than the Prospect AQMS, however this station does not monitor CO and SO_2. Therefore, CO and SO_2 data from the Prospect AQMS have been used to supplement the background data analysis for the purpose of this AQIA.

The available air monitoring data from the St Marys AQMS are summarised in **Table 4** (red font indicates an exceedance of the relevant criterion) and presented graphically in **Figure 6** to **Figure 8**. Air monitoring data from the Prospect AQMS are summarised in **Table 5** and presented graphically in **Figure 9** and **Figure 10**.

A review of the ambient air quality data presented in the following tables and graphs shows:

- Generally, the 24-hour average PM_{10} and $PM_{2.5}$ concentrations recorded by the St Marys AQMS are below the relevant 24-hour average guidelines, however isolated exceedances (normally on less than ten days per year) have been recorded in most years. The exception to this was the November 2019 to January 2020 period, when unprecedented and extensive bushfires within NSW resulted in an extended period of very elevated particulate concentrations across Sydney that were significantly above the 24-hour average PM_{10} and $PM_{2.5}$ guidelines. A review of the available compliance monitoring reports indicates that the intermittent exceedance days recorded during the other years were also primarily due to exceptional events such as bushfire emergencies, dust storms and hazard reduction burns.
- No exceedances of the annual average PM_{10} criterion were recorded at St Marys during the five years investigated, however the annual average $PM_{2.5}$ criterion was exceeded in 2019 due to the bushfire event that started in November 2019.
- Ambient concentrations of the gaseous pollutants NO_2, CO and SO_2 were all well below the relevant criteria for all years investigated.

Table 4 Summary of Ambient PM_{10}, $PM_{2.5}$ and NO_2 Data - St Marys AQMS (2016 – 2020)

Pollutant	PM_{10} (µg/m³)			$PM_{2.5}$ (µg/m³)			NO_2 (µg/m³)		
Averaging Period	24-Hours		Annual	24-Hours		Annual	1-hour		Annual
	Maximum	90th %ile		Maximum	90th %ile		Maximum	90th %ile	
2016	100.2 (3)	26.4	16.1	93.2 (7)	11.5	7.9	86	21	7.0
2017	49.8	26.1	16.2	38.2 (3)	10.7	7.0	76	21	8.1
2018	100.5 (2)	29.7	19.4	80.5 (3)	11.3	7.8	76	25	9.6
2019	159.8 (26)	41.9	24.7	88.3 (21)	16.3	9.8	68	21	7.6
2020	260.3 (11)	30.9	18.9	82.5 (9)	11.1	7.6	70	18	7.4
All Years	*260.3 (42)*	*30.8*	*19.1*	*93.2 (43)*	*12.4*	*8.1*	*86*	*21*	*7.9*
Criterion	**50**		**25**	**25**		**8**	**246**		**62**

Notes: %ile = Percentile; ND = No Data; Number in brackets is the number of exceedances

Figure 6 24-Hour Average PM_{10} Concentrations - St Marys AQMS

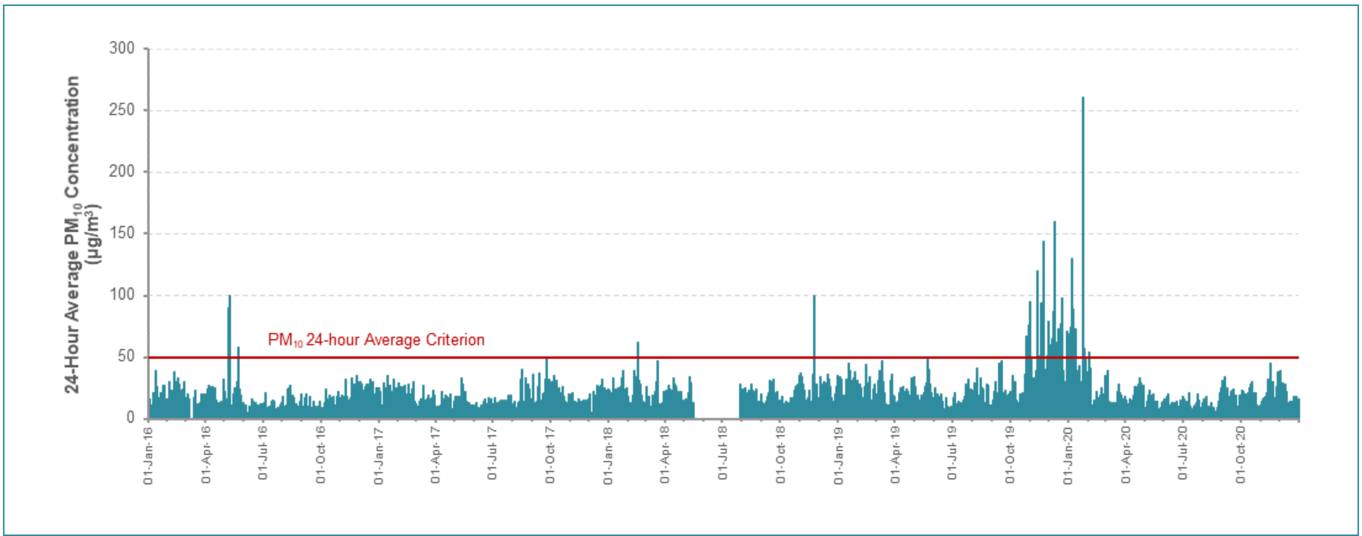


Figure 7 24-Hour Average $PM_{2.5}$ Concentrations - St Marys AQMS

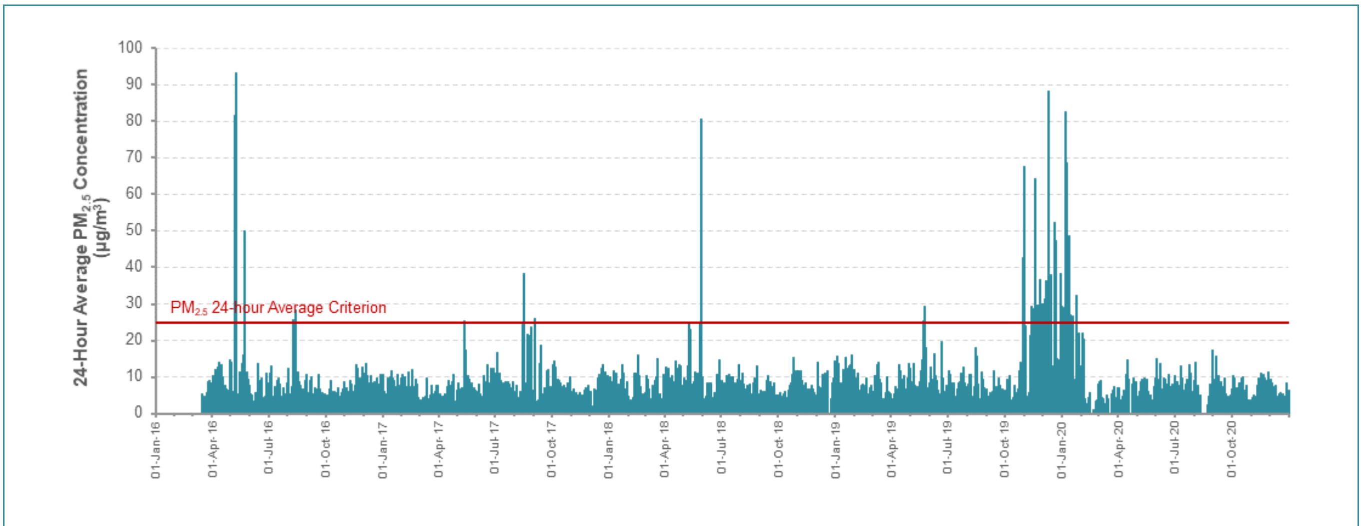


Figure 8 1-Hour Average NO_2 Concentrations - St Marys AQMS

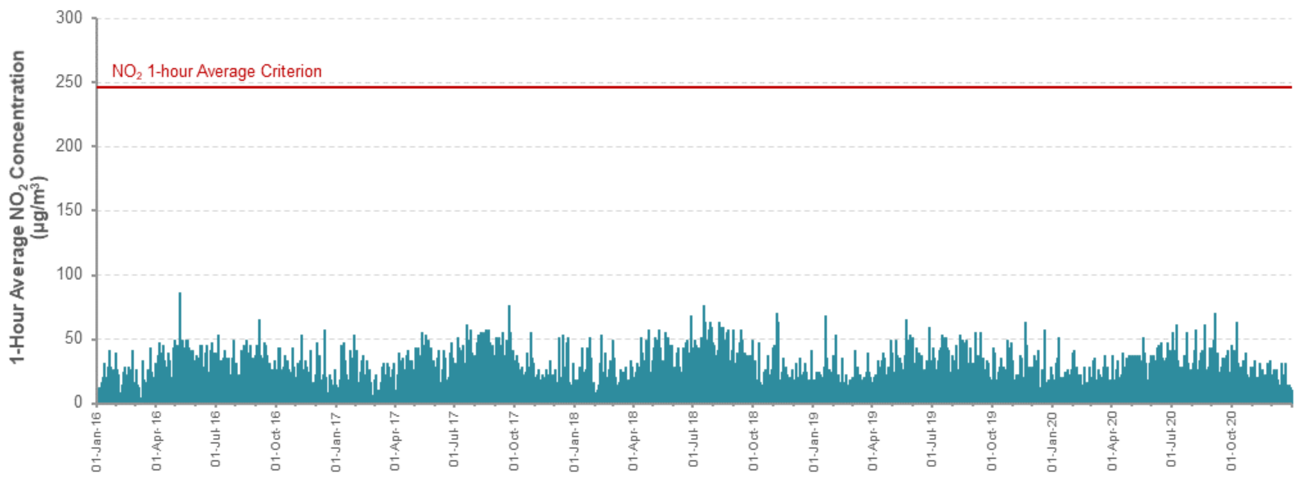


Table 5 Summary of Ambient CO and SO_2 Data - Prospect AQMS (2016 – 2020)

Pollutant	CO (mg/m³)				SO_2 (µg/m³)				
Averaging Period	1-Hour		8-Hours		1-Hour		24-Hours		Annual
	Maximum	90th %ile	Maximum	90th %ile	Maximum	90th %ile	Maximum	90th %ile	
2016	2.0	0.4	1.9	0.4	60.1	5.7	11.4	2.9	1.7
2017	2.0	0.4	1.4	0.4	65.8	5.7	11.4	4.6	1.9
2018	1.6	0.3	1.4	0.3	71.5	5.7	14.3	5.7	1.8
2019	6.9	0.4	3.5	0.4	60.1	5.7	11.4	5.7	2.0
2020	2.6	0.4	2.3	0.4	51.5	2.9	11.4	2.9	1.4
All Years	*6.9*	*0.4*	*3.5*	*0.4*	*71.5*	*5.7*	*14.3*	*5.7*	*1.8*
Criterion	**30**		**10**		**570**		**228**		**60**

Notes: %ile = Percentile

Figure 9 Rolling 8-Hour Average CO Concentrations - Prospect AQMS (2016 – 2020)

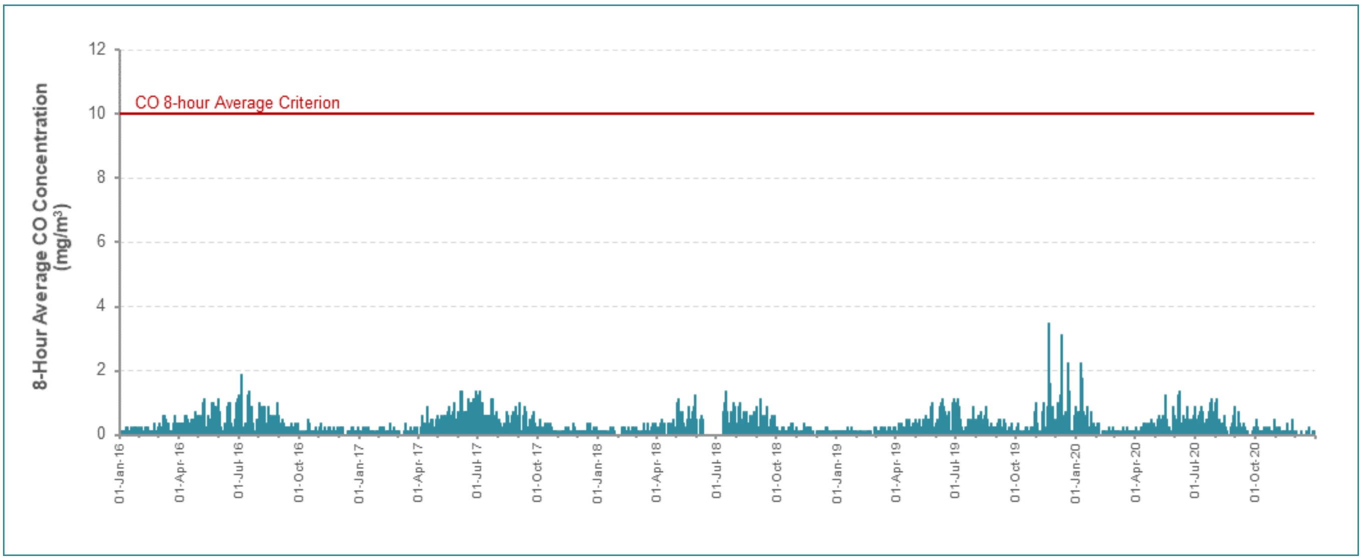
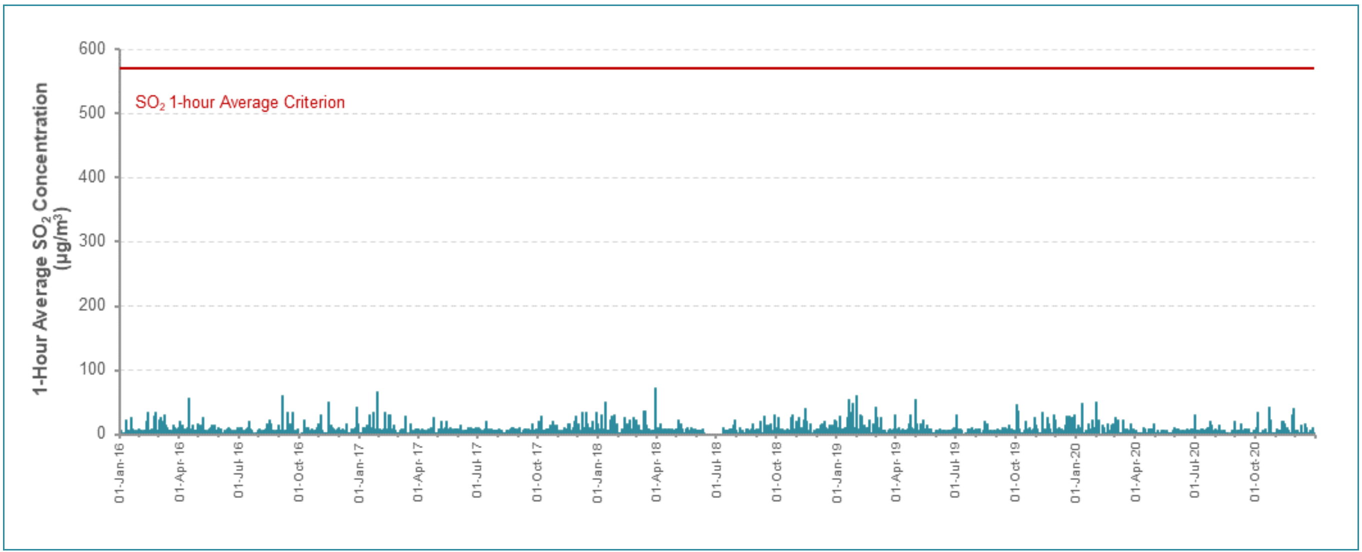


Figure 10 1-Hour Average SO_2 Concentrations - Prospect AQMS (2016 – 2020)



5.2 Local Air Emission Sources

Industrial sites surrounding the proposal with the potential to be significant emitters of air pollutants of interest in this assessment were identified through:

- Desktop mapping of industrial sites regulated by the EPA; and
- A review of facilities required to report to the National Pollutant Inventory (NPI).

Environment Protection Licences (EPLs) are issued under the POEO Act and are regulated by the NSW EPA. EPLs stipulate emission limits to water, land and/or air and provide operational protocols to ensure industrial emissions/operations comply with relevant standards.

General requirements of EPLs relating to air quality include:

- Plant and equipment to be maintained and operated in a proper and efficient manner.
- Emissions of dust and odour from the premises are to be minimised/prevented.

The NPI database provides details on industrial emissions of over 4,000 facilities across Australia. The requirement to return annual reports to the NPI quantifying a facility's emissions is determined by the activities/processes being undertaken at the facility, and also whether those processes exceed process-specific thresholds in terms of activity rates (i.e. throughput and/or consumption). It is not intended to make a statement that the emissions associated with those activities will be significant in terms of their potential for impact and/or generation of complaint, however it provides a tool to identify significant emission sources in a specific area that then may be investigated further to assess their potential to impact on local air quality.

A search of the NPI database identified the following sources of combustion-related air emissions within 2 km of the proposal:

- BlueScope Steel: Metal coating and finishing
- Enviroguard Erskine Park: Landfill operations
- Goodman Fielder Consumer Foods: Manufacturing of liquid groceries such as mayonnaise, vinegar and salad dressing
- Saputo Dairy Australia: Dairy processing plant

These sites are all located within the Erskine Park Industrial Estate, which is located on the eastern side on Mamre Road at the southern end of the proposal. Annual emissions from these facilities from the most recent available reporting year are shown in **Table 6**. The only potentially significant emission identified, considering the regional monitoring data presented above, are the PM_{10} emissions from the Enviroguard Erskine Park operations. There is potential for PM_{10} concentrations in the residential area immediately to the north of the Erskine Park Industrial Estate to be slightly higher than the levels recorded further north at the St Marys AQMS due to these localised emissions.

Table 6 Emissions to Air Reported to the NPI by Nearby Industries (2018/2019 Reporting Year)

Substance	Annual Emissions of Combustion Products (kg/year)			
	Supato Dairy Australia	Enviroguard Erskine Park*	BlueScope Steel #	Goodman Fielder
Carbon monoxide (CO)	840	22,000	10,000	2,000
Oxides of nitrogen (NO_2)	1,000	3,600	8,000	1,900
Particulate matter less than 10.0 µm (PM_{10})	74	22,000	3,400	140
Particulate matter less than 2.5 µm ($PM_{2.5}$)	74	340	410	140
Polycyclic aromatic hydrocarbons (B[a]Peq)	0.010	1.5	0.051	0.012
Sulfur dioxide	11	190	61	21
Total volatile organic compounds (VOCs)	79	2,300	8,800	150

* Emissions of metals also reported, not included here

Emissions of metals, acid gases and individual VOCs also reported, not included here

A search of the EPA public register for licences currently held by sites located within the 2748 and 2759 postal codes (with the proposal lying along the boundary between these two post codes) identified the following facilities in addition to those in **Table 6**:

- Cleanaway: Chemical & waste storage and non-thermal treatment of general waste
- CPB Contractors: Cement or lime works, road construction for The Northern Road Upgrade Stage 5 (between Littlefields Road and Glenmore Parkway) & Stage 6 (Littlefields Road to Eaton Road) [*note: both Stage 5 and Stage 6 construction works are expected to conclude in 2021* (CPB, 2019a) (CPB, 2019b))
- DHL Supply Chain: Chemical storage
- Retail Ready Operations: Meat retail products processing facility (Coles-owned)
- SRC Operations: Patons Lane Resource Recovery Centre
- Twentieth Super Pace: Transport logistics (licence relates to rolling stock operated on a licensed rail network)

None of these operations are considered likely to have a significant impact on local air quality that would not be captured by the regional monitoring data presented above.

There is potential for additional industrial and commercial activities to be present in the local area (beyond those listed on the NPI database) that operate below the activity threshold specified for the relevant industry type, and hence do not need to report under the NPI program and do not have an EPA licence. Sources that fall under this category could potentially impact on air quality within the vicinity of the proposal, but on a smaller scale than those that are licenced and/or are required to report under the NPI program.

One other activity identified from the desk top review with potential to impact on local air quality is a service station located on Banks Road, 90 m east of the intersection with Mamre Road. Operation of this service station has the potential to result in elevated concentrations of VOCs in the area immediately surrounding the facility. However, the concentrations of VOCs are expected to have returned to background levels within approximately 30 – 50 m of the facility.

6 Assessment of Air Quality Impacts

6.1 Assessment Methodology

The key potential air quality issue identified for the operational phase of the proposal is emissions of combustion products and particulate matter from vehicles travelling along the upgraded Mamre Road.

To assess the potential air quality impacts of the proposal from vehicular emissions on surrounding sensitive receptors, the Tool for Roadside Air Quality (TRAQ) assessment tool developed by Roads and Maritime Services (RMS) (now Transport for NSW) has been used.

TRAQ is a US-EPA CALINE 4 based modelling tool designed for the first-pass screening of air quality impacts associated with new or existing roads. TRAQ does not provide accurate air quality assessments but rather uses worst-case scenarios to determine whether or not a more detailed assessment is required. TRAQ is considered to provide conservative predictions of potential incremental impacts. The model has been used extensively in NSW and is currently accepted by regulatory agencies as an appropriate conservative screening-level model for predicting near field ground level pollutant concentrations from traffic.

6.1.1 Pollutants Assessed

TRAQ provides predictions of CO, NO_2 and PM_{10} concentrations at various distances from the road kerb. It does not provide predictions of the other traffic-related pollutants identified in **Section 4.1**, namely $PM_{2.5}$, SO_2 and VOCs.

Given the low level of SO_2 emissions from vehicles and the low ambient concentrations recorded in the region (see **Section 5**), it is reasonable to assume that SO_2 emissions from road traffic are unlikely to result in any exceedances of the relevant criteria at locations beyond the road kerb.

SLR's experience in modelling VOC emissions from roads has also shown that kerbside concentration of VOCs are typically well below the relevant air quality guidelines. Moreover, a review of the Air Quality Impact Assessment prepared for M4 East (Pacific Environment, 2015), which will have significantly higher traffic volumes than Mamre Road (as forecasted by the traffic modelling), showed that ground level VOC concentrations at the nearest receptors were predicted to be well below the relevant assessment criteria.

Given the above, SO_2 and VOC traffic emissions have not been considered further in this assessment. $PM_{2.5}$ emissions, however, have been assessed based on the PM_{10} concentrations given by TRAQ using a conservative $PM_{2.5}/PM_{10}$ ratio estimated from COPERT Australia derived emission factors (see **Section 6.1.3**).

6.1.2 Modelling Scenarios

Modelling was performed for two scenarios:

- Projected 2026 traffic flows with and without the proposal
- Projected 2036 traffic flows with and without the proposal

The predicted morning and afternoon peak traffic volumes on Mamre Road for 2026 and 2036 are presented in **Table 7** (without proposal) and **Table 8** (with proposal). A review of the data shows that the combined northbound and southbound traffic flows are greatest along the section between the M4 Westbound ramps and Banks Drive and are mostly associated with the morning peak hour period.

Table 7 Projected Peak Hourly Traffic Volumes – Mamre Road - Without Proposal

Road Sections		AM Peak (vehicles/hour)				PM Peak (vehicles/hour)				Posted Speed Limit (km/hr)
From	To	Northbound		Southbound		Northbound		Southbound		
		Total	Heavy Vehicles	Total	Heavy Vehicles	Total	Heavy Vehicles	Total	Heavy Vehicles	
Without Proposal - 2026										
M4 Westbound Ramps	Banks Drive	1,567	151	1,562	235	1,514	138	1,605	150	60
Banks Drive	Solander Drive	942	157	1,247	261	1,033	166	1,084	199	80
Solander Drive	Luddenham Road	960	144	1,292	245	1,057	168	1,031	176	
Luddenham Road	Esrkine Park Road	683	90	1,375	256	1,120	119	744	119	
Erskine Park Road	James Erskine Drive	1,155	134	1,766	316	1,213	128	989	183	
Without Proposal - 2036										
M4 Westbound Ramps	Banks Drive	2,231	242	1,879	253	1,961	221	2,113	175	60
Banks Drive	Solander Drive	1,504	257	1,460	278	1,402	272	1,493	229	80
Solander Drive	Luddenham Road	1,537	234	1,497	261	1,453	275	1,444	206	
Luddenham Road	Esrkine Park Road	814	103	1,622	274	1,337	149	828	125	
Erskine Park Road	James Erskine Drive	1,498	145	2,003	307	1,724	149	1,383	182	

Table 8 Projected Peak Hourly Traffic Volumes – Mamre Road - With Proposal

Road Sections		AM Peak (vehicles/hour)				PM Peak (vehicles/hour)				Posted Speed Limit (km/hr)
From	To	Northbound		Southbound		Northbound		Southbound		
		Total	Heavy Vehicles	Total	HV	Total	Heavy Vehicles	Total	Heavy Vehicles	
With Proposal - 2026										
M4 Westbound Ramps	Banks Drive	1,622	151	1,924	235	1,657	138	1,684	150	60
Banks Drive	Solander Drive	1,034	157	1,633	261	1,202	166	1,185	199	80
Solander Drive	Luddenham Road	1,030	140	1,671	241	1,202	163	1,076	169	
Luddenham Road	Esrkine Park Road	796	90	1,759	257	1,291	119	849	119	
Erskine Park Road	James Erskine Drive	1,255	137	1,853	321	1,320	131	1,093	186	
With Proposal – 2036										
M4 Westbound Ramps	Banks Drive	2,366	242	2,026	253	2,189	221	2,241	175	60
Banks Drive	Solander Drive	1,678	257	1,621	278	1,669	272	1,733	229	80
Solander Drive	Luddenham Road	1,709	231	1,668	257	1,700	270	1,655	200	
Luddenham Road	Esrkine Park Road	941	103	1,794	274	1,541	149	994	125	
Erskine Park Road	James Erskine Drive	1,636	148	2,246	312	1,887	151	1,547	184	

A summary of the change in projected peak hourly traffic numbers associated with the proposal is provided in **Table 9**. This table shows that the largest increases in vehicle numbers predicted as a result of the proposal occur on the section between Luddenham Road and Erskine Park Road, although this section has the lowest numbers of vehicles overall. **Table 9** also shows that the proposal is not anticipated to have a significant impact on the number of heavy vehicles travelling on Mamre Road, compared to the 'without proposal' scenario.

Table 9 Change in Projected Peak Hourly Traffic Volumes Due to the Proposal

Road Sections		Percentage Change with the Proposal Compared to Without [1]							
From	To	Northbound				Southbound			
		Total		Heavy Vehicles		Total		Heavy Vehicles	
		AM	PM	AM	PM	AM	PM	AM	PM
2026 Projections									
M4 Westbound Ramps	Banks Drive	3%	9%	0	0	19%	5%	0	0
Banks Drive	Solander Drive	9%	14%	0	0	24%	9%	0	0
Solander Drive	Luddenham Road	7%	12%	-3%	0	23%	4%	-1%	-4%
Luddenham Road	Esrkine Park Road	14%	13%	0	0	22%	12%	0	0
Erskine Park Road	James Erskine Drive	8%	8%	2%	3%	5%	10%	2%	2%
2036 Projections									
M4 Westbound Ramps	Banks Drive	6%	10%	0	0	7%	6%	0	0
Banks Drive	Solander Drive	10%	16%	0	0	10%	14%	0	0
Solander Drive	Luddenham Road	10%	15%	-2%	-2%	10%	13%	-1%	-3%
Luddenham Road	Esrkine Park Road	14%	13%	0	0	10%	17%	0	0
Erskine Park Road	James Erskine Drive	8%	9%	1%	2%	11%	11%	1	1%

[1] ('With build' -'Without build')/'With build'

6.1.3 Dispersion Model Configuration

TRAQ requires a number of inputs to describe the proposal environment and emissions to air, including:

- Background pollutant concentrations
- Peak hour traffic volumes and vehicle speeds
- Traffic mix (heavy vehicle percentage)
- Road type, number of lanes and gradient
- Year of assessment (vehicle fleet)
- Location land use
- Season

The sources of the required data and assumptions made for the purpose of this assessment are summarised in **Table 10**.

Table 10 TRAQ Input Data

Parameter	Value	Description
Background pollutant concentrations	PM_{10} 24-Hour: 30.8 µg/m^3 PM_{10} Annual: 17.6 µg/m^3 $PM_{2.5}$ 24-Hour: 12.4 µg/m^3 $PM_{2.5}$ Annual: 7.5 µg/m^3 NO_2 1-Hour: 21 µg/m^3 NO_2 Annual: 7.9 µg/m^3 CO 1-Hour: 0.4 mg/m^3 CO 8-Hour: 0.4 mg/m^3	The 1-, 8- and 24-hour average values are the 90th percentile background air quality concentrations recorded by the St Marys and Prospect AQMSs as per TRAQ guidance. The values are based on records from 2016-2020 inclusive, except for PM_{10} and $PM_{2.5}$ which exclude the elevated levels recorded during the major bushfire event in November and December 2019 (refer **Section 5**)
Road Grade	Mamre Road northbound: +2% Mamre Road southbound: -2%	Average gradient estimated from road design information
Peak hour speeds	35 km/hr	TRAQ default for peak periods on arterial roads
Peak hour traffic volumes	**2026: Without Proposal (AM peak)** Mamre Road northbound: 1,567 Mamre Road southbound: 1,562 **2036**: **Without Proposal (AM peak)** Mamre Road northbound: 2,231 Mamre Road southbound: 1,879 **2026: With Proposal (AM peak)** Mamre Road northbound: 1,622 Mamre Road southbound: 1,924 **2036**: **With Proposal (PM peak)** Mamre Road northbound: 2,189 Mamre Road southbound: 2,241	Projected peak hourly traffic volumes (either AM or PM, whichever is highest) for the segment of Mamre Road between the M4 Westbound Ramps and Banks Drive, with and without the proposal in place (see **Table 7** and **Table 8**)
Peak hour percentage of daily traffic	10%	TRAQ default
Traffic mix	The TRAQ default traffic mix was adjusted to contain 19% heavy vehicles as listed in **Table 11**.	Conservative assumption based on traffic modelling. On the section of Mamre Road with the highest traffic volume, heavy vehicles comprise 9%-12% of all vehicles, depending on the year and with/without the proposal.
Road type and number of lanes	Arterial Road, two lanes in each direction	-
Year of assessment (vehicle fleet)	**2026:** 2026 vehicle fleet **2036:** 2036 vehicle fleet	As per TRAQ default options
Location land use	Residential	-
Season	Worst-case	TRAQ default worst-case season
Cold start emissions	Included	-

The proportion of heavy vehicles along Mamre Road predicted by the traffic modelling on the highest volume section of the road ranges from 9 to12 per cent, depending on the year and with/without the proposal. For other sections of Mamre Road, the proportion ranges up to 19 per cent without the proposal and 16 per cent with the proposal. The TRAQ default traffic mix for arterial roads has a combined total of 8.8 per cent heavy vehicles. To better reflect the predicted proportion of heavy vehicles, this default traffic mix was adjusted as shown in **Table 11**. The proportions of individual heavy and light vehicle classes within each group remained the same but the overall split between the two groups was modified to have a conservative value of 19 per cent heavy vehicles.

Table 11 Adopted Traffic Mix Used in TRAQ

Vehicle Category		TRAQ Default Traffic Mix (%)*	Traffic Mix Used in this Assessment (%)
CP	Petrol passenger vehicles	75.6	67.2
CD	Diesel passenger vehicles	2.2	2.0
LDCP	Light-duty commercial petrol vehicles less than 3.5 tonnes	9.6	8.5
LDCD	Light-duty commercial diesel vehicles less than 3.5 tonnes	3.2	2.8
MC	Motorcycles	0.6	0.5
Percentage Light Vehicles		***91.2%***	***81.0%***
HDCP	Heavy-duty commercial petrol vehicles greater than 3.5	0.2	0.4
RT	Rigid trucks, 3.5-25 tonnes, diesel only	5.3	11.5
AT	Articulated trucks greater than 25 tonnes, diesel only	2.7	5.8
BusD	Heavy public transport buses, diesel only	0.6	1.3
Percentage Heavy Vehicles		***8.8%***	***19.0%***

Default TRAQ traffic mix for 'Arterial' road type

The TRAQ screening tool does not include emission factors for $PM_{2.5}$. For the purposes of this assessment therefore, an estimated $PM_{2.5}/PM_{10}$ ratio was derived from the COPERT Australia emission factor database tool (COPERT). Vehicle speeds of 10 km/hr and 65 km/hr were modelled using COPERT to derive PM_{10} and $PM_{2.5}$ emission factors for the 2010 NSW vehicle fleet. The $PM_{2.5}/PM_{10}$ ratio for each vehicle speed scenario was estimated and a ratio of 85% (calculated based on 10 km/hr vehicle speeds) was adopted as a conservative measure (accounts for both exhaust and non-exhaust emissions). This ratio was applied to the PM_{10} concentrations predicted by TRAQ to derive estimated $PM_{2.5}$ concentrations. It is noted that the ambient $PM_{2.5}$ and PM_{10} concentration ratio recorded by the St Marys AQMS is in the region of 45%.

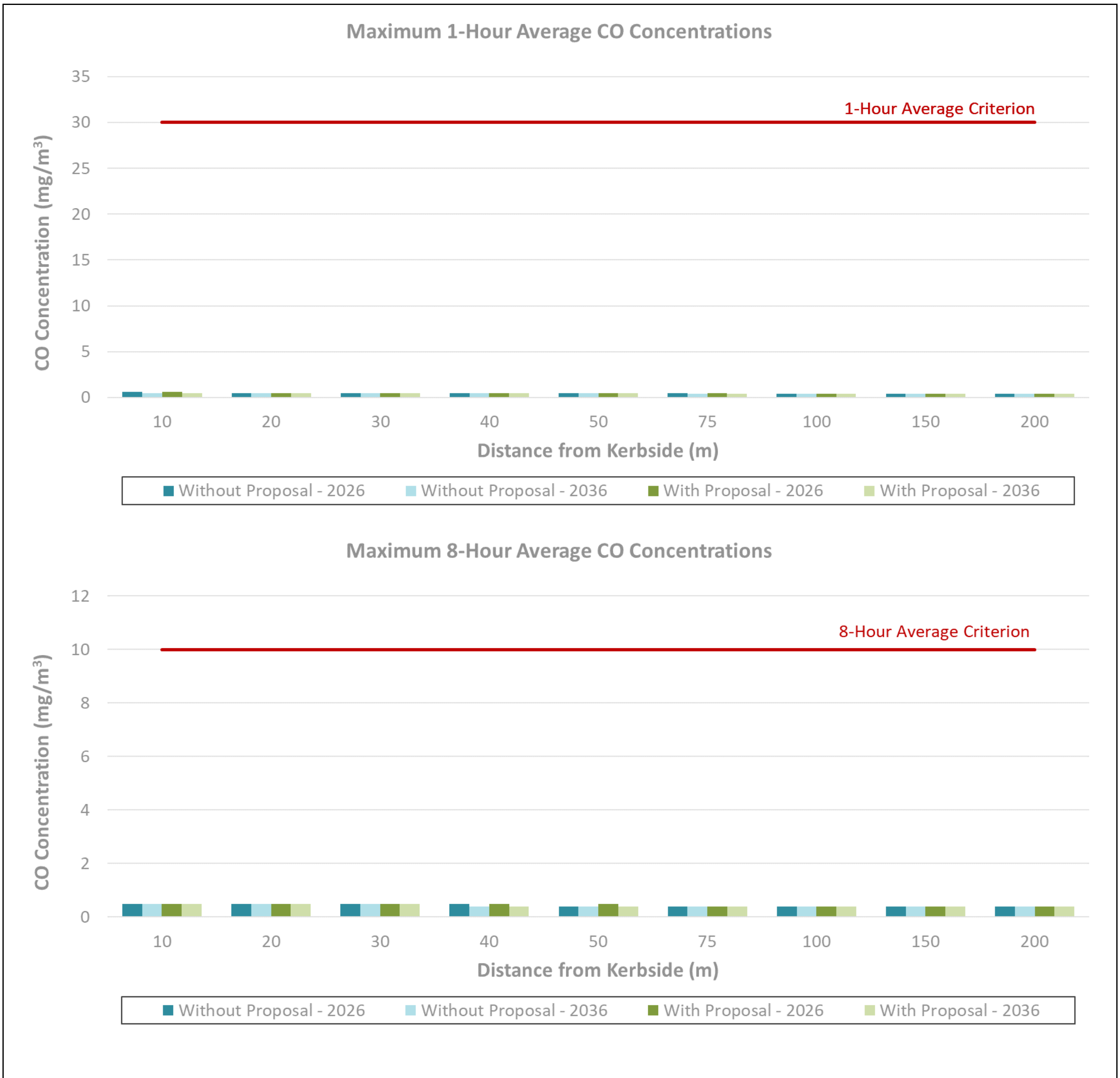
6.2 Modelling Results

The air quality impacts predicted by the conservative screening model TRAQ due to vehicle emissions from Mamre Road, based on the anticipated peak hour traffic volumes and default TRAQ settings, are presented below. As outlined in **Section 2.5**, after the upgrade the closest residential property boundaries will be set back approximately 5 m from the Mamre Road kerbside (including turnoff lanes). As shown in the results plots, pollutant concentrations decrease with increasing distance from the road, and pollutant concentrations at locations further than 5 m from the kerbside (e.g. at the houses themselves) are lower.

6.2.1 Carbon Monoxide

The CO concentrations predicted by TRAQ at varying distances for the Mamre Road are shown in **Figure 11**. These are cumulative concentrations, including the background levels listed in **Table 10**. As shown by the plots, the predicted concentrations are far below the relevant ambient air quality criteria. There is no significant difference in the downwind concentrations predicted for the with and without proposal scenarios, for both 2026 and 2036.

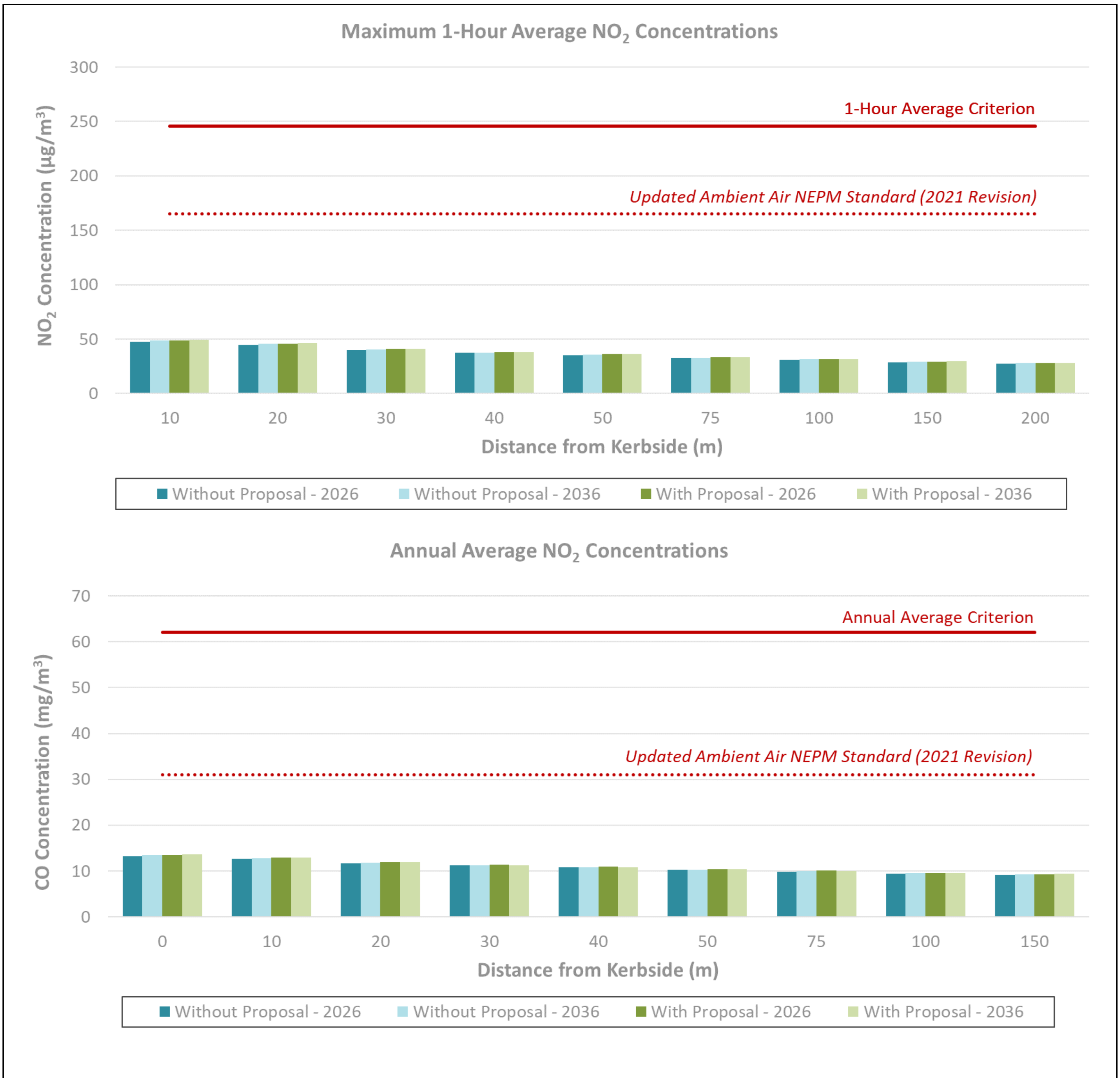
Figure 11 Maximum Predicted CO Concentrations Versus Distance from Mamre Rd (TRAQ)



6.2.2 Nitrogen Dioxide

The maximum cumulative 1-hour average and annual average NO_2 concentrations predicted by TRAQ at varying distances from Mamre Road are shown in **Figure 12**. As shown by the plots, the predicted concentrations are well below the current ambient air quality criteria for NO_2. They are also well below the reduced standards in the recently updated Ambient Air NEPM. As for CO, there is no significant difference in the downwind concentrations predicted for the with and without proposal scenarios, for both 2026 and 2036.

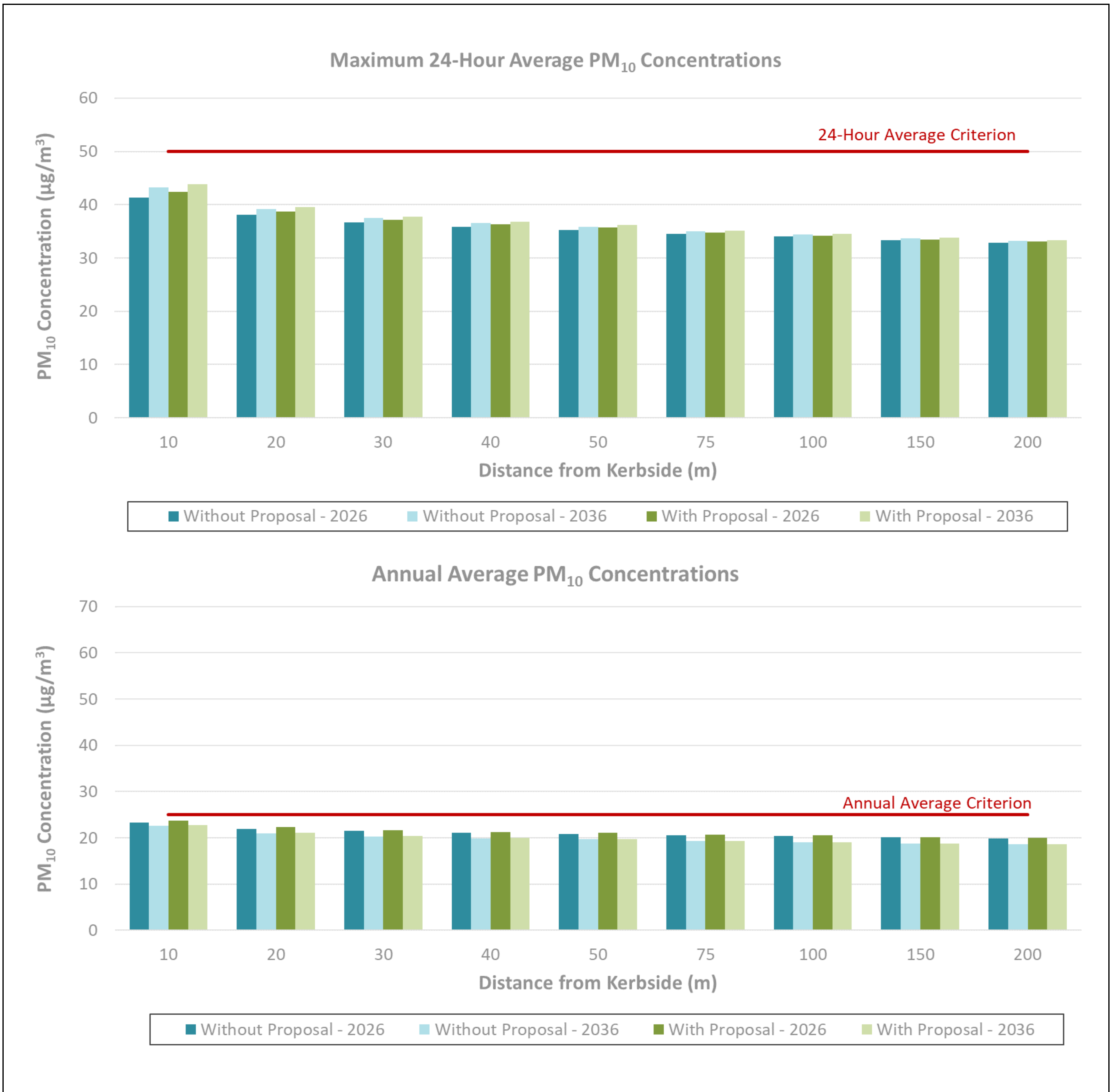
Figure 12 Maximum Predicted NO_2 Concentrations Versus Distance from Mamre Rd (TRAQ)



6.2.3 PM_{10}

The maximum cumulative 24-hour average and annual average PM_{10} concentrations predicted by TRAQ at varying distances from Mamre Road are shown in **Figure 13**. As shown by the plots, the predicted concentrations are below both the 24-hour average and annual average criteria at distances greater than 10 m from the kerbside. It is noted that the house on Solander Drive identified in **Table 1** as being within 8 m of the kerbside after the upgrade is located on a section of Mamre Road with lower traffic numbers than those used in the modelling. Therefore the incremental impacts from traffic on Mamre Road that would be predicted by TRAQ in the vicinity of Solander Drive would be lower than the predictions shown in **Figure 13**.

Figure 13 Maximum Predicted PM_{10} Concentrations Versus Distance from Mamre Rd (TRAQ)



Concentrations are predicted to be slightly higher in 2036 compared to 2026 due to the higher traffic numbers used for these scenarios. The predicted concentrations are also slightly higher (approximately 10 per cent higher in terms of incremental annual average concentrations but only up to one per cent higher in terms of cumulative annual average concentrations) for the with proposal scenarios, compared to without the proposal scenarios.

6.2.4 $PM_{2.5}$

$PM_{2.5}$ concentrations have been estimated from the PM_{10} concentrations given by TRAQ using a $PM_{2.5}/PM_{10}$ ratio of 84% (estimated from COPERT Australia derived emission factors). The maximum cumulative 24-hour average and annual average $PM_{2.5}$ concentrations derived using this approach are shown in **Figure 14**.

Figure 14 Estimated $PM_{2.5}$ Maximum Concentrations Versus Distance from Mamre Rd

As shown by **Figure 12**, the predicted 24-hour average concentrations are below the current 24-hour average ambient air quality criterion for $PM_{2.5}$ 10 m from the kerbside, however they are above the reduced $PM_{2.5}$ standard set out in the updated Ambient Air NEPM until approximately 20 m from the kerbside. As for PM_{10}, the predicted concentrations are slightly higher (approximately 10 per cent higher in terms of incremental 24-hour average concentrations but only up to four per cent higher in terms of cumulative annual average concentrations) for the with proposal scenarios, compared to without the proposal scenarios.

The annual average $PM_{2.5}$ concentrations are predicted by TRAQ to be above the current annual average guideline of 8 $\mu g/m^3$ up to 200 m downwind of the kerbside (and also above the reduced Ambient Air NEPM guideline of 7 $\mu g/m^3$). These cumulative impacts are driven mainly by the background concentration assumed in the calculations of 7.6 $\mu g/m^3$ (which is also already above the new Ambient Air NEPM standard).

6.2.5 Summary

The predicted concentrations at 10 m from the kerbside are summarised in **Table 12** for all pollutants and averaging periods assessed. As shown in the table and discussed above, only the annual average $PM_{2.5}$ concentrations are predicted to exceed the relevant current ambient air quality criteria. These predicted exceedances are driven mainly by the background concentration assumed in the calculations of 7.6 $\mu g/m^3$, which is close to the criterion of 8 $\mu g/m^3$.

As shown in **Figure 12** and discussed above, the predicted downwind air pollutant concentrations increase slightly for the ‘with proposal’ scenarios compared to the ‘without proposal’ scenarios, which is a result of the projected increase in traffic numbers for these scenarios. It is also noted that the road widening proposed as part of the upgrade would result in a number of houses being located closer to the Mamre Road kerbside compared to the current alignment. As indicated in **Table 1**, the number of houses identified as being located within 15 m of the kerbside increases from 6 to 13 residences with the proposal. The separation distance for the closest house to the new alignment is estimated to decrease by less than 2 m compared to the current alignment.

However, as shown in **Table 12**, the increases in the predicted cumulative annual average concentrations at 10 m from the kerbside as a result of the upgrade are minimal, and less than the change in the concentrations predicted for 2026 compared to 2036 even if the proposal was not to proceed. The predicted changes in cumulative impacts due to the proposal are also less for the 2036 scenarios compared to the 2026 scenarios. TRAQ is also a highly conservative screening model, which will overestimate actual impacts, and the modelling was performed using conservative assumptions in relation to the meteorological data and season options and the fleet mix.

In addition, the upgrade may improve traffic flows and minimise congestion levels that might otherwise be expected to occur without the proposal, which would assist in minimising air pollutant emissions from the associated stop/start and acceleration driving patterns. This has potential to reduce pollutant concentrations at the nearest receptors.

Table 12 TRAQ Model Results – Mamre Road – 10 m from the Kerbside

Pollutant and Averaging Period	Units	Incremental Impact		Background Concentration	Cumulative Impact *			Criteria
		Without Proposal	With Proposal		Without Proposal	With Proposal	Change Due to Proposal	
2026 Traffic Emissions Scenarios								
Maximum 1-hour CO concentrations	mg/m^3	0.2	0.2	0.4	0.6	0.6	no change	**30**
Maximum 8-hour CO concentrations	mg/m^3	0.1	0.1	0.4	0.5	0.5	no change	**10**
Maximum 1-hour NO_2 concentrations	$\mu g/m^3$	26.4	28.1	21	47.4	49.1	1.7 $\mu g/m^3$ increase	**246**
Annual NO_2 concentrations	$\mu g/m^3$	5.3	5.6	7.9	13.2	13.5	0.3 $\mu g/m^3$ increase	**62**
Maximum 24-hour PM_{10} concentrations	$\mu g/m^3$	10.6	11.6	30.8	41.4	42.4	1.0 $\mu g/m^3$ increase	**50**
Annual PM_{10} concentrations	$\mu g/m^3$	4.2	4.6	17.6	23.3	23.7	0.4 $\mu g/m^3$ increase	**25**
Maximum 24-hour $PM_{2.5}$ concentrations	$\mu g/m^3$	8.9	9.7	12.4	21.3	22.1	0.8 $\mu g/m^3$ increase	**25**
Annual $PM_{2.5}$ concentrations	$\mu g/m^3$	3.5	3.9	7.6	**11.1**	**11.5**	0.4 $\mu g/m^3$ increase	**8**
2036 Traffic Emissions Scenarios								
Maximum 1-hour CO concentrations	mg/m^3	0.1	0.1	0.4	0.5	0.5	no change	**30**
Maximum 8-hour CO concentrations	mg/m^3	0.1	0.1	0.4	0.5	0.5	no change	**10**
Maximum 1-hour NO_2 concentrations	$\mu g/m^3$	28.1	28.6	21	49.1	49.6	0.5 $\mu g/m^3$ increase	**246**
Annual NO_2 concentrations	$\mu g/m^3$	5.6	5.7	7.9	13.5	13.6	0.1 $\mu g/m^3$ increase	**62**
Maximum 24-hour PM_{10} concentrations	$\mu g/m^3$	12.5	13.0	30.8	43.3	43.8	0.5 $\mu g/m^3$ increase	**50**
Annual PM_{10} concentrations	$\mu g/m^3$	5.0	5.2	17.6	22.6	22.8	0.2 $\mu g/m^3$ increase	**25**
Maximum 24-hour $PM_{2.5}$ concentrations	$\mu g/m^3$	10.5	10.9	12.4	22.9	23.3	0.4 $\mu g/m^3$ increase	**25**
Annual $PM_{2.5}$ concentrations	$\mu g/m^3$	4.2	4.4	7.6	**11.8**	**12.0**	0.2 $\mu g/m^3$ increase	**8**

* Predicted incremental impact plus assumed background concentration.

7 Conclusions

SLR was commissioned by TfNSW to perform an Air Quality Impact Assessment (AQIA) for the proposed Mamre Road Upgrade – Stage 1.

The primary source of air pollutant emissions associated with the operational phase of the proposal will be vehicles travelling along Mamre Road. To assess the potential air quality impacts from these vehicular emissions on surrounding sensitive receptors, the Tool for Roadside Air Quality (TRAQ) assessment tool developed by Roads and Maritime Services (RMS) (now Transport for NSW) has been used. TRAQ is a US-EPA CALINE 4 based modelling tool designed for the first-pass screening of air quality impacts associated with new or existing roads, and is considered to provide conservative predictions of potential incremental impacts.

The results of the cumulative assessment indicated that the predicted cumulative PM_{10}, NO_2 and CO concentrations are below the relevant air quality criteria within 10 m of the kerbside. Based on a $PM_{2.5}/PM_{10}$ ratio of 84% for the downwind concentrations (based on emission factors from COPERT Australia), compliance with the current 24-hour average criterion for $PM_{2.5}$ is also predicted to be achieved within 10 m of the kerbside. However, exceedances of the annual average $PM_{2.5}$ criterion of 8.0 µg/m^3 are predicted up to 200 m downwind of the kerbside. These exceedances are primarily driven by the background concentrations of $PM_{2.5}$ within the local airshed, which in some years already exceed the annual average guideline.

Based on the results given by TRAQ, which is a conservative screening level assessment tool, SLR concludes that the proposal would not result in an unacceptable increase in incremental or cumulative air quality impacts at the nearest sensitive receptors, and air quality is not considered to be a constraint for the proposal. The elevated $PM_{2.5}$ concentrations predicted in this assessment are typical of many areas across Sydney, and the incremental impact predicted as a result of emissions from Mamre Road would be a minor contributor to total cumulative ambient concentrations. In addition, the downwind air pollutant concentrations predicted by TRAQ are only slightly increased as a result of the proposed upgrade, compared to the without proposal predictions. While the upgrade would result in a number of houses being located slightly closer to the Mamre Road kerbside compared to the current alignment, the upgrade may improve traffic flows and minimise congestion levels that may otherwise be expected to occur without the proposal, which would assist in minimising air pollutant emissions and downwind impacts, particularly at the nearest receptors.

8 References

CPB. (2019a). *Construction Environmental Management Plan - The Northern Road Upgrade between Littlefields Road and Glenmore Parkway, Revision 3.* Sydney: CPB Contractors.

CPB. (2019b, April 1). *CPB Contractors awarded $119M Northern Road Upgrade Stage 6*. Retrieved from CPB Contractors: https://www.cpbcon.com.au/en/news-and-media/2019/cpb-contractors-awarded-$119m-northern-road-upgrade-stage-6

DEWHA . (2008). *National Pollutant Inventory Emission Estimation Technique Manual for Combustion Engines.* Department of Environment, Water, Heritage and Arts.

DoP. (2008). *Development Near Rail Corridors and Busy Roads – Interim Guideline.* NSW Department of Planning.

National Environment Protection Council. (2003). *Variation to the National Environment Protection (Ambient Air Quality) Measure.* Canberra: National Environment Protection Council.

National Environment Protection Council. (2016). *National Environment Protection (Ambient Air Quality) Measure.* Canberra: Department of the Environment.

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

NSW DoP. (2008). *Development Near Rail Corridors and Busy Roads – Interim Guideline.* NSW Department of Planning.

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

NSW Government. (2007). *State Environmental Planning Policy (Infrastructure).*

NSW Government. (2017, June). *Air Quality in NSW.* Retrieved from https://www.epa.nsw.gov.au/~/media/EPA/Corporate%20Site/resources/air/Air-Quality-in-NSW.ashx

NSW OEH. (2016). *New South Wales Air Quality Statement 2015.*

NSW OEH. (2017). *New South Wales Annual Compliance Report 2015.*

NSW OEH. (2017b). *Air quality statement 2017.*

NSW OEH. (2017b). *NSW Annual Air Quality Statement 2017.*

NSW OEH. (2019). *NSW Annual Air Quality Statement 2018.*

NSW OEH. (n.d.). *Clearing the Air - New South Wales Air Quality Statement 2017.*

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

PIARC Technical Committee D.5. (2019). *Road Tunnels: Vehicle Emissions and Air Demand for Ventilation.* World Road Association (PIARC).

TfNSW. (2012). *Sydney Metro Northwest Environmental Impact Statement Stage 2 - Stations, Rail Infrastructure and Systems.*

Uniquest. (2014, August 02). Australian Motor Vehicle Emission Inventory for the National Pollutant inventory (NPI). Uniquest, Prepared for Department of Environment.

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