REPORT

Tonkin+Taylor

Technical Air Quality Assessment for Baldwins Road Development Plan

Prepared for

Millar Merrigan Pty Ltd

Prepared by

Tonkin & Taylor Ltd

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1 Introduction

NBA Pty Group Limited (NBA Group) is preparing a proposed Development Plan (DP) for land adjacent to Traralgon-Maffra Road and Baldwin Road, Traralgon North. This land was rezoned from Farming Zone (Schedule 1) to General Residential (Schedule 3) in June 2023 and a subsequent DP overlay was issued setting out the requirements applicable to the development. The wording of the DP overlay is presented in Table 1.1 and sets out the relevant air quality requirements in the proposed DP.

Table 1.1: Air quality requirements for the project

Landuse	Wording from overlay
Sensitive land use	Preparation of an assessment on the potential for noise and air pollution impacts from the Traralgon Maffra Road considering the Environment Reference Standards for Ambient Sound and Guidelines for Minimising Air Pollution in Victoria (EPA Publication 1961).
	Any proposed mitigating measures that are required to be included as part of the noise and air pollution assessment.

Note: the assessment of noise effects is not included in this report.

Millar Merrigan Pty Ltd (Millar Merrigan) has engaged Tonkin & Taylor Pty Ltd (T+T) on behalf of NBA Group to complete a screening level 1 assessment of the air quality at the future subdivision to address the air quality requirements set out in the DP overlay. This assessment evaluates the traffic emissions from vehicles traveling on Traralgon-Maffra Road adjacent to the subject site focusing on their impact on residential areas along the road.

This assessment has been undertaken in accordance with our letter of engagement (reference 1093627.0000) dated 8 March 2024.

2 Proposed description

The proposed DP will facilitate the future subdivision of the subject site into approximately 350 lots with an anticipated average lot size of approximately 900 m^2. Vehicle access to the future subdivision will be from the adjacent land that is subject to the Traralgon North (TN) subdivision to the south of Baldwin Road (note – this subdivision is under construction). Figure 2.1 presents the location of the proposed DP in proximity to other planned development plans in the area.

A Traffic Impact Assessment has been prepared by O'Brien Traffic[1], (herein referred to as the Traffic Assessment) in relation to the future subdivision and notes the following in relation to Traralgon-Maffra Road:

- "*Traralgon-Maffra Road is an arterial road (Road Zone Category 1) under the control and management of Department of Transport. It runs in a north-south orientation".*
- *"The posted speed limit on Traralgon-Maffra Road changes along the site frontage. A posted speed limit of 80 km/h applies from the southern boundary of the site for a distance of approximately 250 metres. North of this point, the posted speed limit increases to 100 km/h.*"

[1] O'Brien Traffic, 2024. Traffic Impact Assessment – Proposed Rezoning, Traralgon-Maffra Road, Traralgon North.

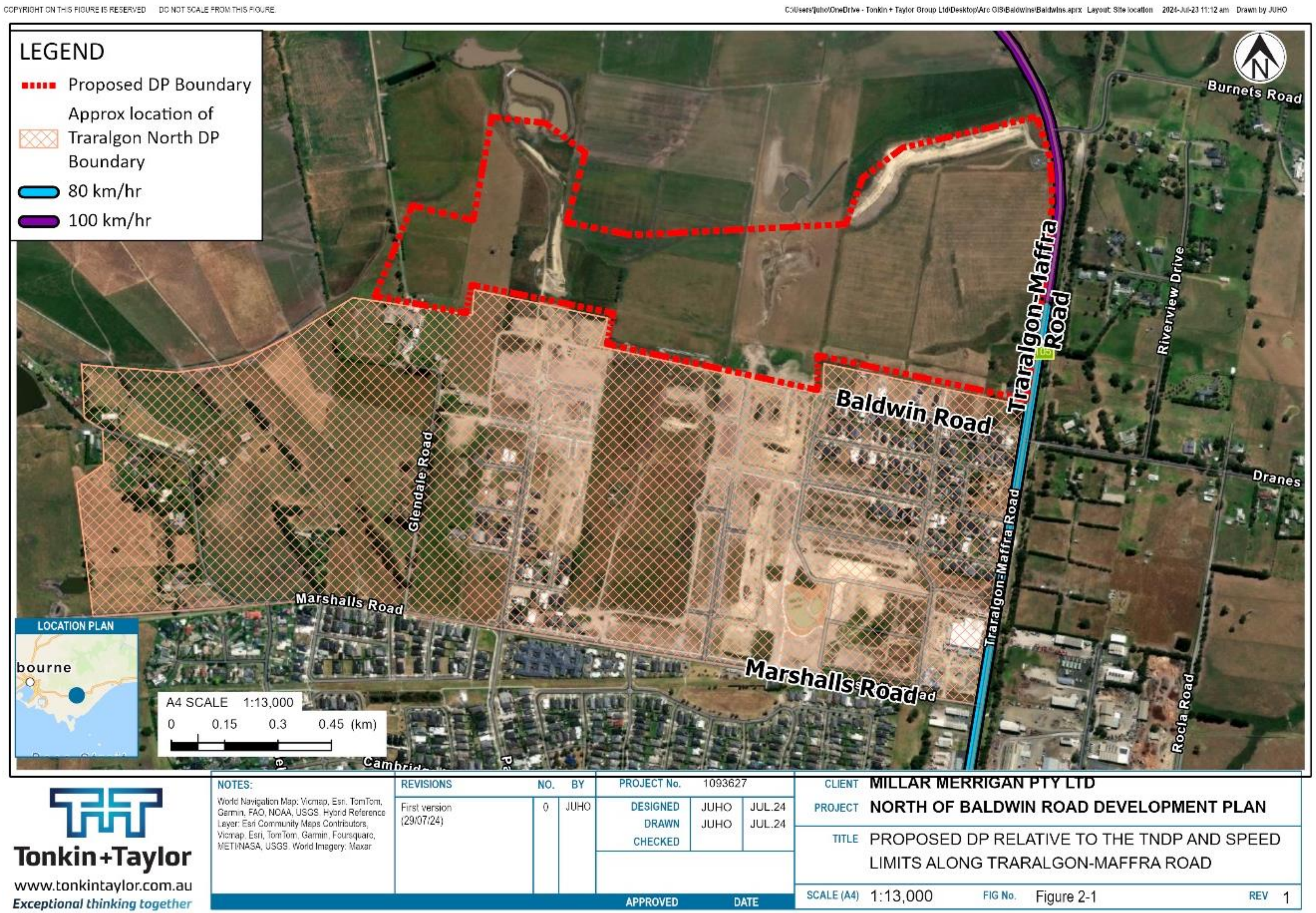

Figure 2.1 The proposed DP relative to the TNDP and speed limits along Traralgon-Maffra Road.

2.1 Road network

The TN subdivision will be developed before the subject site, so road connections to Baldwin Road from the TN subdivision will service the future development of the subject site.
The Traffic Assessment includes an assessment of traffic generated by development of the entire Traralgon North area (this includes consideration of the TN subdivision and future subdivision of the subject site) and looks at the impacts this will have on the surrounding road network. It notes:

- There are three road connections through the future subdivision to Marshalls Road that will function as collector roads.
- It is assumed that traffic generated by the future subdivision will use one of the three access routes assumed to be available. Figure 2.2 presents the approximate location of these north-south collector roads. The traffic assessment anticipates that at completion, "each of the three-connector road *[sic]* will carry one third of the total trips generated by the future subdivision".

There are no roads in the future subdivision area (including Baldwins Road) that are proposed to connect directly to Traralgon -Maffra Road.

The traffic assessment notes that movements from Marshalls Road are as follows:

- *"The main movements will be right turn out of Marshalls Road into Traralgon-Maffra Road, and left turn from Traralgon-Maffra Road".*
- *"The traffic movements anticipated to be generated by the proposal would be readily accommodated on the proposed road network without any significant adverse impacts*".

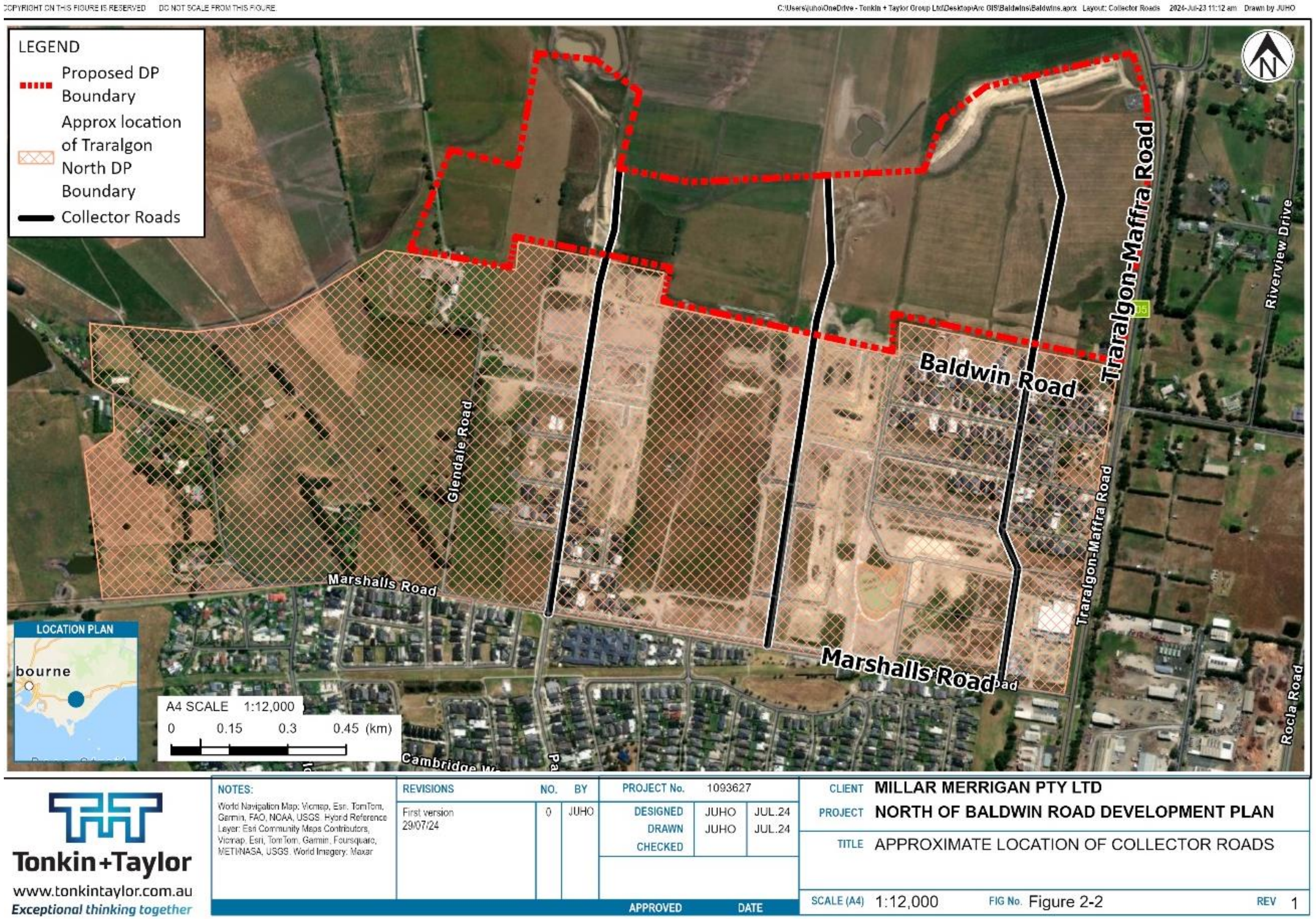

Figure 2.2 Approximate location of collector roads.

3 Relevant environmental legislation, policies and guidance

3.1 Environment Protection Act

The Environment Protection Act 2017 as amended by the Environment Protection Amendment Act 2018 (the Act) came into force on 1 July 2021. Central to the Act is the consideration of General Environmental Duty (GED), which applies in all of Victoria and is an ongoing obligation separate to any other permission. Under the GED, a person who is engaging in an activity that may give rise to risks of harm to human health or the environment from pollution or waste must eliminate or minimise those risks so far as reasonably practicable. This duty applies to those who introduce new forms of pollution to the environment as well as those who introduce population to additional risk due to existing ambient air quality concentrations.

The Act has a number of subordinate regulations and guidelines that need to be considered:

- The Environment Reference Standard (ERS).
- Recommended separation guidelines for industrial residual air emissions (Environment Protection Authority (EPA) Publication 1518).
- Guideline for assessing and minimising air pollution in Victoria (EPA Publication 1961).

3.2 Ability of the proposed development to meet the GED for atmospheric emissions

The General Environmental Duty (GED) require that the proposed Development Plan is designed to eliminate exposure of the residents in the future subdivision to traffic related air pollution or where this is not possible reduce exposure to the extent practicable.

The Traffic Assessment notes that "*The traffic movements anticipated to be generated by the proposal would be readily accommodated on the proposed road network without any significant adverse impacts*".

This is achieved through the design of the internal road network, which distributes traffic flows to and from the proposed subdivision area via three north-south collector roads. The traffic assessment states that "*at full build-out each of the three north-south connector roads would carry one third of the total trips generated by the site (i.e. approximately 1,520 trips per day)*". The collector roads are designed to carry between 2,500 and 6,000 trips per day.

As further discussed in Section 4.2, the proposed subdivision area includes a setback distance from Traralgon-Maffra Road to residential lots, incorporating an internal street that runs parallel to the arterial road. This additional setback helps reduce potential exposure to vehicle emissions from Traralgon-Maffra Road, thereby minimizing the impact of traffic-related air pollution on residents.

3.3 Exposure Reference Standards

The Exposure Reference Standard (ERS)[2] is a new tool made under the Act. The ERS:

- Identifies environmental values that the Victorian community want to achieve and maintain.
- Provides a way to assess those environmental values in locations across Victoria.

In terms of air quality impacts, the ERS provides ambient air quality objectives for commonly emitted species to the atmosphere. The ERS provides the basis of air quality levels that are considered acceptable by the EPA in locations of sensitive receptors such as residential receptors.

[2] Victoria Government Gazette, No. S 158 Tuesday 29 March 2022. Environment Protection Act 2017, Environment Reference Standard.

The ERS for air quality that are related to the identified vehicular sources of emissions to atmosphere are provided in Table 3.1.

Table 3.1: Ambient air quality ERS

Indicator	Objective (µg/m3)	Averaging period
Carbon monoxide (CO)	10,3001	8 hours
Nitrogen dioxide (NO_2)	1501	1 hour
	281	1 year
Sulphur dioxide (SO_2)	1961	1 hour
	521	24 hours
Particles as PM_{10}	50	1 day
	20	Annual
Particles as $PM_{2.5}$	25	1 day
	8	Annual
Lead	0.5	Annual
Odour	An air environment that is free from offensive odours from commercial, industrial, trade and domestic activities.	N/A

1 Converted at 25°C.

3.4 EPA Publication 1961

EPA Publication 1961 is the 'Guideline for assessing and minimising air pollution in Victoria' and provides a framework for the assessment and control of risks associated with air pollution. The guideline provides a three-level approach for undertaking an air quality assessment:

- Level 1 assessments are qualitative or semi-quantitative. They are used to assess risks from activities that either have intrinsically low risks, or have common, well-understood risks that can be controlled without extensive assessment.
- Level 2 assessments are the most common type of risk assessment. They usually involve the use of dispersion modelling or monitoring. Predicted or measured pollutant concentrations are benchmarked against pre-defined air pollution assessment criteria (APACs) to understand risks.
- Level 3 assessments are detailed risk assessments. These are only used when a simple comparison of a pollutant's concentration to an APAC cannot adequately assess risks.

This assessment has adopted a level 1 assessment as the number of vehicles on the surrounding road network are predicted to be low EPA Publication 1961 also provides 'Air Pollution Assessment Criteria' (APAC). Vehicles are known to emit the following compounds:

- NO_2
- SO_2
- PM_{10}
- $PM_{2.5}$
- CO
- Volatile organic compounds (VOCs)

- Ammonia
- Heavy metals (lead, cadmium, copper, chromium, nickel, selenium and zinc)

For NO_2, SO_2, PM_{10} $PM_{2.5}$ and CO, the APAC reference the standards in the ERS (as shown in Table 3.1). For the remainder of species, the APAC provides relevant standards (as listed in Table 3.2), with the exception of selenium. Consequently, the impact from selenium is not further assessed as it is not considered to be a hazard to air[3].

Chromium exists in a few valence or oxidation states, with the hexavalent form (Cr (VI)) being the most toxic and hence has been used as a proxy for the APAC as a conservative approach to the assessment. Typically, 18% of emitted chromium from vehicular emissions are in the Cr (VI) form.

VOCs are a variety of species which, in reference to the surrounding land use, are related to the combustion of fuel in vehicles. The typical VOCs considered are benzene, toluene, ethylbenzene and xylenes (collectively known as BTEX). Of these compounds, the one with the lowest numerical criteria is benzene (Table 3.2), and benzene has been used as a proxy for VOCs as a conservative approach to the assessment.

Table 3.2: APAC for non-ERS listed species from EPA Publication 1961

Species	Averaging Period	Criterion (ug/m^3)	Cumulative / incremental
Benzene	1 hour	580	Cumulative
	24 hours	29	Cumulative
	1 year	9.6	Cumulative
		1.7	Incremental
Toluene	1 hour	15,000	Cumulative
	7 days	260	Cumulative
Ethylbenzene	1 hour	86000	Cumulative
	24 hours	27,712	Cumulative
	1 year	261	Cumulative
Xylenes	1 hour	22,000	Cumulative
	24 hours	8,685	Cumulative
	1 year	100	Cumulative
Ammonia	1 hour	3200	Cumulative
	24 hours	1184	Cumulative
	1 year	70	Cumulative
Cadmium	1 year	0.005	Cumulative
Copper	1 hour	100	Cumulative
Chromium as Cr(VI)	1 hour	1.3	Cumulative
	1 year	0.005	Cumulative
Nickel	1 hour	0.2	Cumulative
	1 year	0.09	Cumulative
Zinc	1 hour	20	Cumulative
	1 year	2	Cumulative

[3] https://echa.europa.eu/registration-dossier/-/registered-dossier/15204/6/1

4 Assessment approach

4.1 Overview

Air quality impacts of the proposed PD have been evaluated for three scenarios:

- Base Year (2023).
- The opening year without the future subdivision (2030 without).
- The opening year with the future subdivision (2030 with).

To assess the impact of these sources on air quality, the following approach was adopted:

- Traffic volumes for Traralgon-Maffra Road sourced from the Traffic Assessment and Victoria department of Transport (VIC DoT). This is further detailed in Section 4.3.
- Emission factor generation for vehicle emissions for VOCs, CO, oxides of nitrogen (NO_X)[4], PM_{10} and $PM_{2.5}$ using COPERT Australia for Traralgon-Maffra Road. This is further detailed in Section 4.3.
- Estimation of contribution to ambient air quality using the dispersion curves contained in the Design Manual for Roads and Bridges (DMRB)[5]. This is further detailed in Section 4.5.
- Assessment against the relevant ERS and APAC from Sections 3.3 and 3.4 to determine vehicular contribution to air quality impacts at residential receptors. This is further detailed in Section 4.6.

4.2 Receptor distances from road sources

The screening level 1 assessment has considered the vehicle emissions at future residential properties along the eastern boundary of the site (i.e. closest to Traralgon -Maffra Road). As the building layouts have not yet been developed, distances have been based on indicative layout plans and the road description provided in the Traffic Assessment, which states that:

> "*Traralgon-Maffra Road has a road reserve of approximately 20 metres and a pavement width of approximately 12 metres providing one traffic lane (3.8 metres wide) and a sealed shoulder (between 2 and 2.5 metres wide) in each direction*".

Millar Merrigan have provided a layout plan of the future subdivision, which provides a high-level display of the residential sections – this is presented in Figure 4.1. Based on the layout of Figure 4.1, the eastern boundary of the future subdivision proposes to have a road and tree reserve between Traralgon-Maffra Road and the nearest residential lot. According to the Traffic Assessment, the road reserve within the proposed subdivision will be 16 m wide.

T+T has assumed the nearest distance from residential boundaries to the centre of Traralgon-Maffra Road as 26 m based on the above description of the road corridor in the Traffic Assessment and the layout of the future property boundaries relative to Traralgon-Maffra Road.

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[4] NO_X is a mixture of nitric oxide (NO) and NO_2.

[5] Design Manual for Roads and Bridges, Volume 11 Environmental Assessment, Section 3, Environmental Assessment Techniques, Highways Agency England (http://www.semmms.info/wp-content/uploads/2016/06/Design-Manual-for-Roads-and-Bridges-Volume-11-Section-3-Part-1.-PDF-981Kb.pdf)

Figure 4.1 Future subdivision masterplan Layout (image source Millar Merrigan Pty Ltd).

4.3 Traffic volumes

The traffic count data that was used were derived from a variety of data sources provided by Victoria Government Department of Transport (VIC DoT) and O'Brien Traffic for the project area. The following sources of traffic data was used in this assessment:

Table 4.1: Traffic volume data

Sceanario	All vehicles AADT	% HV	Source
Base year 2023	5,670	7	VIC DoT
Opening Year 2030 – Without	7,514	7	VIC DoT: Forecast year 2030 AADT was based on the annual growth rate of 2.5 %
Opening Year 2030 - With	8,289	7	O'Brien Traffic Assessment and VIC DoT Forecast year 2030 AADT was based on the annual growth rate of 2.5 % plus AADT of 775 vehicles from the combined developments[6].

Hourly traffic data was not available in the locality of the project site. However, Vic DoT has undertaken hourly traffic counts along Traralgon-Maffra Road approximately 4 km north of the subject site for 2023. Given the lack of road links onto Traralgon Maffra Road, the location of the traffic counts is considered to be appropriate to assess hourly volumes in the proximity of the subject site. Figure 4.2 presents the approximate location where hourly traffic count data was collected.

The Traffic Assessment anticipates that main movements will turn right out of Marshalls Road into Traralgon -Maffra Road and travel south i.e. away from the future subdivision. The hourly traffic flows on Traralgon Maffra Road in 2030 are expected to follow a similar pattern to the observed 2023 flows. The projection of 2030 hourly traffic counts, accounts for an annual growth rate of 2.5% (as reported by Vic Roads) and the additional AADT daily vehicle traffic anticipated from both the TN subdivision and future subdivision by 2030.

[6] Email from [redacted] of O'Brien Traffic, dated 5 June 2024.

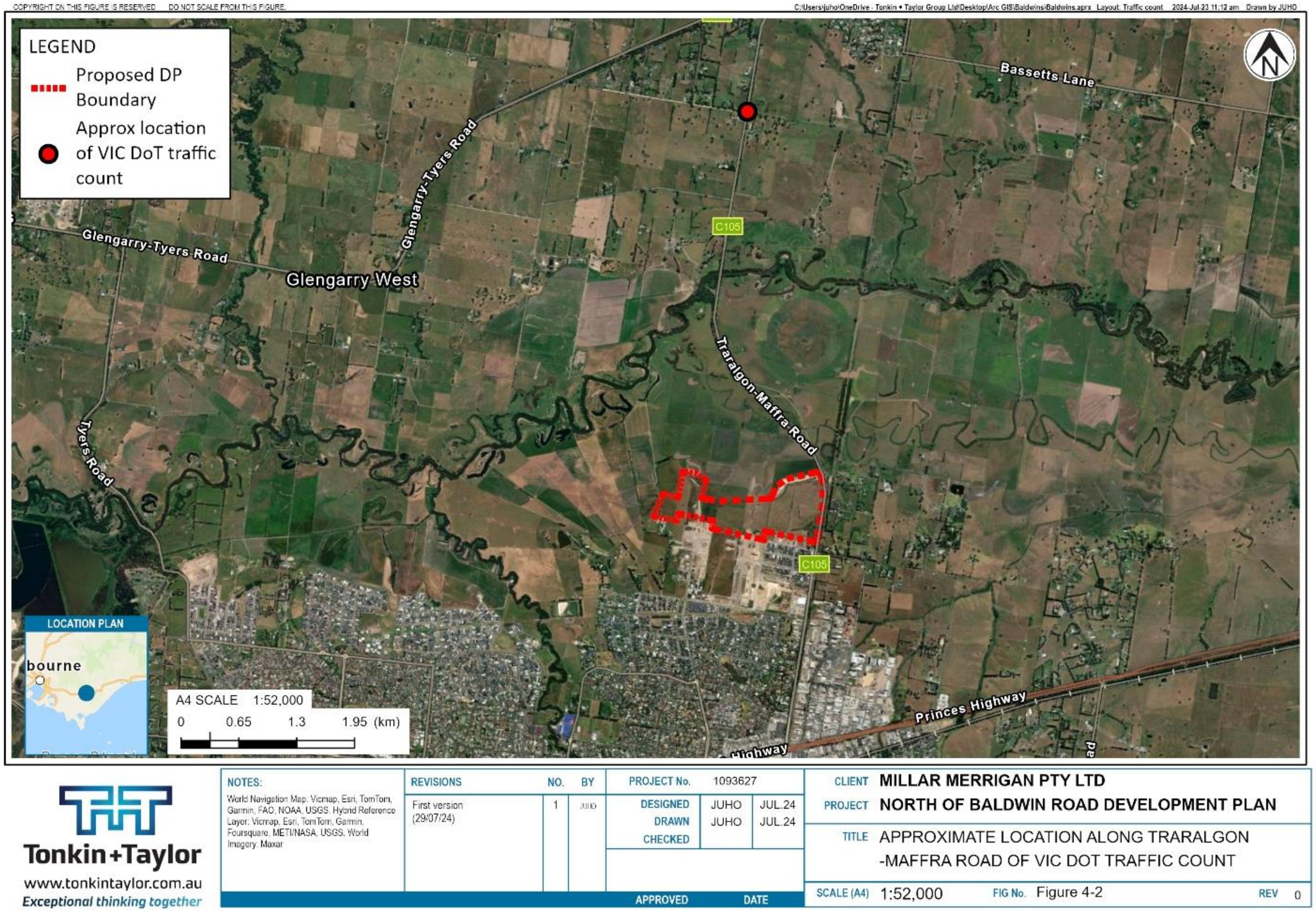

Figure 4.2 Approximate location along Traralgon -Maffra road of Vic DoT traffic count.

Table 4.2: 2023 and 2030 average hourly traffic count for Traralgon-Maffra Road (northbound and southbound combined)

Hour of the day	Number of vehicles per hour		
	2023	2030 Without future subdivision	2030 With future subdivision
0	13	18	20
1	19	25	28
2	42	55	61
3	92	122	135
4	170	226	249
5	260	345	381
6	329	436	481
7	367	486	536
8	394	522	576
9	396	525	579
10	400	531	585
11	401	530	586
12	417	553	610
13	449	595	657
14	471	624	688
15	431	571	630
16	333	441	486
17	244	323	357
18	168	222	245
19	112	149	164
20	74	99	109
21	45	59	66
22	26	35	38
23	17	22	25

4.4 Emission factor generation using COPERT

4.4.1 CO, NO_X, PM_{10}, $PM_{2.5}$ and heavy metals

COPERT calculates air pollutant and greenhouse gas emissions from road transport, covering all important vehicle classes and driving conditions in Australia.

The COPERT software includes algorithms that are developed from data collected in Australian test programs designed to reflect the Australian fleet and activity data. It is designed to be used for road transport emission inventories across Australia and potentially become a harmonized national prediction tool[7].

[7] https://www.emisia.com/utilities/copert-aust26.6ralia/

To calculate emissions, COPERT requires the following inputs:

- Region and fuel information.
- Fleet configuration.
- Activity data.

4.4.1.1 Region and fuel information

Traralgon is located on expansive flat land which covers much of the Traralgon Creek Valley catchment. The nearest meteorological monitoring station is located at Latrobe Valley Airport AWS approximately 8 km southwest of the subject site. Given the station's proximity to the subject site, and the relatively flat terrain, the meteorological station is considered to be representative of conditions at the subject site.

Table 4.3 provides region information from Latrobe Valley Airport AWS used in all COPERT software runs. Table 4.4 provide fuel information used in all COPERT Australia software runs. It should be noted that all the scenarios adopted default fuel information contained in COPERT database for 2009.

Table 4.3: Region information adopted in COPERT Australia software runs

Month	Minimum temperature (°C)[1]	Maximum temperature (°C)[2]	Relative humidity (%)[3]	Reid vapour pressure (kPa)[4]	Beta[5]
January	13	26.7	59.5	64	0.44
February	12.9	26.6	62.5	64	0.44
March	11.4	24.5	65	64	0.45
April	8.8	20.6	70	71	0.48
May	6.4	16.9	76.5	71	0.51
June	4.4	14.2	79	71	0.53
July	3.8	13.8	78	71	0.54
August	4.4	14.9	73	71	0.53
September	5.9	17.1	69.5	71	0.51
October	7.5	19.6	65	71	0.50
November	9.6	22	65	64	0.47
December	11.4	24.5	60.5	64	0.45

1 Mean minimum temperature, Latrobe Valley Airport AWS, Bureau of Meteorology (Climate statistics for Australian locations (bom.gov.au)).

2 Mean maximum temperature, Latrobe Valley Airport AWS, Bureau of Meteorology (Climate statistics for Australian locations (bom.gov.au)).

3 Averaged from 9am and 3pm mean relative humidities, Latrobe Valley Airport AWS, Bureau of Meteorology (Climate statistics for Australian locations (bom.gov.au)).

4 From Regulation 18, Environment Protection (Vehicle Emissions) Regulations 2013 (http://classic.austlii.edu.au/au/legis/vic/num_reg/eper2013n159o2013644/s18.html).

5 Calculated by COPERT Australia software.

Table 4.4: 2009 Fuel information adopted by COPERT Australia software

Fuel	Sulphur content (% weight)	Lead content (g/L)	H:C ratio	O:C ratio	Cadmium content (mg/kg)	Copper content (mg/kg)	Chromium content (mg/kg)	Nickel content (mg/kg)	Selenium content (mg/kg)	Zinc content (mg/kg)
ULP	0	0.000000	1.92	0	0.0108	0.0418	0.0159	0.013	0.0002	2.164
PULP	0	0.000025	1.85	0	0.0108	0.0418	0.0159	0.013	0.0002	2.164
Diesel	0	0.000044	1.86	0.005	0.0087	0.0212	0.03	0.0088	0.0001	1.738
Autogas	0	0.000026	2.53	0	0.0106	0.0373	0.0093	0.0107	0	2.13
Compressed natural gas	0	0.000025	3.9	0	0.0106	0.0373	0.0093	0.0107	0	2.13
Biodiesel	0	0.000045	1.94	0.11	0.0087	0.0212	0.03	0.0088	0.0001	1.738
Bioethanol	0	0.000025	3	0.5	0.0108	0.0418	0.0159	0.013	0.0002	2.164

4.4.1.2 Fleet configuration

COPERT contains a variety of engine technologies which can be used to make up the vehicle fleet. The average age of the vehicle fleet in Victoria is 10.6 years[8]. This means that when new technology is introduced it takes approximately 10.6 years to replace other technologies in the vehicle fleet.

The current minimum standard for new light vehicles in Australia is ADR 79/04, which is based on the Euro 5 standards. The current minimum standard for new heavy vehicles is ADR 80/03, which is based on the Euro V standards, with equivalent US or Japanese standards accepted as alternatives[9]. Given that the replacement of the Victorian fleet takes approximately 10 years as mentioned above and that these standards were introduced in 2016, this means that currently these standards or better make up almost entirely the fleet of vehicles in Victoria.

The development is estimated to be completed by 2030, after 1 July 2026 (when all light/heavy vehicles manufactured are proposed to be Euro 6/Euro VI). Therefore, ADR79/05 vehicle technology has been selected for the passenger vehicles, SUVs, and light commercial vehicles, whilst ADR 80/04 has been selected for trucks.

4.4.1.3 Activity data

Activity data inputs within COPERT Australia, require the following information for each vehicle technology and class:

- Input fleet data, including:
  - Population (number of vehicles in each category).
  - Mileage (km/year).
  - Mean fleet mileage (km).
- Input circulation data:
  - Speed (km/hr) for each type of road (urban, rural and highway).
  - Driving share (%) for each type of road (urban, rural and highway).
- Input evaporation data.

Table 4.5 presents the fleet breakdown and vehicle types used in this assessment. This has been based on statistics published by the Bureau of Infrastructure, Transport and Regional Economics (BITRE) [10].

[8] From Table 3 Estimated average age of motor vehicles, 2021 Motor Vehicle Census, Australian Bureau of Statistics. 10.6 years refer to total motor vehicles on a 2021 basis in Victoria (https://www.abs.gov.au/statistics/industry/tourism-and-transport/motor-vehicle-census-australia/latest-release#average-age).

[9] Vehicle emission standards. (https://www.infrastructure.gov.au/infrastructure-transport-vehicles/vehicles/vehicle-safety-environment/emission-standards).

[10] Bureau of Infrastructure, Transport and Regional Economics (BITRE) 2017, Fuel economy of Australian passenger vehicles — a regional perspective, Information Sheet 91, BITRE, Canberra (https://www.bitre.gov.au/sites/default/files/is_091.pdf)

Table 4.5: Percentage of vehicle types in the Australian fleet for 2023 and 2030

Sector	Subsector	% of fleet breakdown /day	Number of vehicles by type /day		
			2023	2030 without	2030 with
Passenger Cars	PC-S-petrol	1	26	35	39
Passenger Cars	PC-M-petrol	33	1,756	2,327	2,567
Passenger Cars	PC-L-petrol	1	70	93	103
Passenger Cars	PC-S-diesel	0	0	0	0
Passenger Cars	PC-ML-diesel	4	219	290	320
Passenger Cars	PC-S-E10	0	0	0	0
Passenger Cars	PC-M-E10	0	6	8	9
Passenger Cars	PC-L-E10	0	0	0	0
Passenger Cars	PC-LPG	1	78	103	114
SUV	SUV-C-petrol	33	1,756	2,327	2,567
SUV	SUV-L-petrol	1	70	93	103
SUV	SUV-diesel	4	219	290	320
SUV	SUV-C-E10	0	6	8	9
SUV	SUV-L-E10	0	0	0	0
Light Commercial Vehicles	LCV-petrol	6	295	391	432
Light Commercial Vehicles	LCV-diesel	15	771	1,022	1,127
Heavy Duty Trucks	MCV-petrol	3	10	13	15
Heavy Duty Trucks	MCV-diesel	27	107	142	157
Heavy Duty Trucks	HCV-diesel	53	212	281	310
Heavy Duty Trucks	AT-diesel	16	65	86	95
Heavy Duty Trucks	Autogas Trucks	1	2	3	3

COPERT is designed to estimate the total emissions per year form a road network, and to provide an emission rate the system must be configured to estimate emissions from nominal population (1,000,000 vehicles) and mileage (1 km/year). This provides a value which is equivalent in value to units expressed in terms g/km/vehicle which can be used with the DMRB dispersion curves to estimate emissions away from the road. All scenarios adopted default mean fleet mileage[11] contained in the COPERT Australia software.

The speed is based on the posted speed limit of 100 km/hr and 80 km/hr. The driving share has been assumed to be 100 % urban as the purpose of the assessment is to determine emissions from Traralgon-Maffra Road.

[11] The mean fleet mileage describes the number of kilometres that each vehicle class has typically travelled thus describing the age of the vehicle fleet, and any deterioration in engines and mitigation technology since introduction of the vehicle to the fleet.

4.4.2 BTEX

Emissions for volatile emissions from vehicles occurs both from the exhaust and from evaporative losses. No evaporative losses have been considered from the vehicles on Traralgon-Maffra Road as evaporative losses are related to:

- Diurnal emissions due to thermal expansion and emission of vapour from the fuel tank of a parked vehicle due to diurnal changes in ambient temperature.
- Hot soak losses – emissions from a warmed-up vehicle after the vehicle has been parked and the engine stopped.
- Evaporative emissions during idling.
- Refuelling losses.

Evaporative loses have not been considered to be significant from vehicles travelling down Traralgon-Maffra Road adjacent to the site, this is due to the following reasons:

- Low number of vehicles travelling on this segment of road.
- Absence of traffic controls such as stop signs or give ways.

4.4.3 Exhaust emissions

Unlike other air contaminants in COPERT, non-methane volatile organic compounds (NMVOCs) speciation in COPERT Australia output is provided per fleet instead of for each vehicle technology class. Therefore, additional runs were completed to derive emissions for benzene for cars and trucks separately.

As with the emission factor generation for CO, NO_X, PM_{10} and $PM_{2.5}$, these runs were based on a nominal number of 1,000,000 vehicles with traffic statistics from BITRE (Section 4.4.1.3).

4.4.4 Emission factors from COPERT outputs

The generated emission factors from COPERT, which is equivalent in value to units expressed in terms g/km/vehicle, are summarised in Appendix A. The two sets of emission factors for the base year and opening year are due to the difference in vehicle speed assumed, i.e. 80 km/hr and 100 km/hr.

The percentages of each vehicle type shown in Table 4.5 were then used with the traffic counts discussed in Table 4.1 to provide the vehicle numbers for each category shown in Table 4.2.

The vehicle counts for each vehicle type shown in Table 4.2were then multiplied by the emission factors shown in Appendix A to derive the total emission from the road in g/km.

4.5 Estimation of contribution to ambient air quality at the residential dwellings

Estimation of contribution to ambient air quality can be completed using atmospheric dispersion modelling. The regulatory atmospheric dispersion model in Victoria is the latest version of AERMOD. The AERMOD dispersion model is capable of determining impact to surrounding land use from a distance of approximately 50 m up to 50 km and is typically unreliable in the very near field until the emission forms a plume with a gaussian distribution on which the model algorithms are based.

The DMRB screening tool from the United Kingdom, which combines UK fleet emission data with decay curves of concentrations from roads which, is based on roadside measurements to provide concentrations at a distance between 2 m and 200 m from the road centreline[12]. The fleet emission factors contained in the model are not applicable to Australia, however the decay curves of contribution to ambient concentration follow dispersion theory which is applicable globally. The equations for the decay curves are provided in an earlier version of the DMRB air quality chapter[13]:

- 2m < d ≤ 5 m – traffic contribution = 0.063541 µg/m³ per g/km/hr.
- 5 m < d ≤ 168 m – $traffic\ contribution = 0.17887 + 0.00024d - \left(\frac{0.295776}{d}\right) + \left(\frac{0.2596}{d^2}\right) - \left(0.0421 \times ln(d)\right)$ µg/m³ per g/km/hr.
- D > 168 – $traffic\ contribution = 0.0017675 - \left(0.0000276173 \times (d - 168)\right)$.

The equations provide a traffic contribution to annual mean concentrations in µg/m³ per g/km.hr. The implication of an annual mean concentration is that the traffic count needs to be provided on an AADT basis. This means that using the hourly average traffic flow for the year (AADT divided by 24 hours) together with the emission factors derived from COPERT Australia and the above equations provides an annual mean contribution to air quality at a given distance from the road.

4.5.1 Conversion of annual mean concentrations to other averaging periods

As shown in Table 3.1 and Table 3.2 the air quality criteria specified in the ERS and EPA Publication 1961 are based on a variety of averaging periods. However, the DMRB screening approach only provides an annual average concentration.

AERSCREEN is the screening model promulgated by the USEPA and is based on AERMOD which is the regulatory dispersion model in Victoria. AERSCREEN uses fixed ratios to convert from 1 hour predictions to 3 hour, 8 hour, 24 hour and annual mean concentrations[14]. The inverse of these fixed ratios has been used to convert from annual mean to shorter averaging periods (Table 4.6).

Table 4.6: Conversion factors from annual mean to other averaging periods based on AERSCREEN conversion factors[14]

Averaging period	Conversion factor
1 hour	10
8 hours	9
24 hours	6
Annual	1

4.5.2 Conversion of NO to NO_2

The emitted NO_X from vehicle exhausts consists of nitric oxide (NO) and NO_2. NO, in the presence of an oxidant such as ozone, can oxidise into NO_2 (i.e. secondary formation of NO_2). To simplify the conversion rate of NO_X to NO_2, and in the absence of available local ozone information, a fixed-ratio approach has been used whereby 50% oxidation of NO_X to NO_2 is conservatively assumed to take place[15].

[12] https://www.standardsforhighways.co.uk/prod/attachments/10191621-07df-44a3-892e-c1d5c7a28d90?inline=true. Last accessed 1 April 2022

[13] http://www.semmms.info/wp-content/uploads/2016/06/Design-Manual-for-Roads-and-Bridges-Volume-11-Section-3-Part-1.-PDF-981Kb.pdf

[14] https://gaftp.epa.gov/Air/aqmg/SCRAM/models/screening/aerscreen/aerscreen_userguide.pdf last accessed 1 July 2024.

[15] Review of methods for NO to NO_2 conversion in plumes at short ranges. Environment Agency of England and Wales, November 2007

4.6 Assessment against the relevant ERS and APAC

To assess predicted GLCs against the criteria contained in the ERS (Table 3.1) and APAC (Table 3.2), the distances from the residential receptors to Traralgon-Maffra Road have been used with the emission factors presented in Appendix A, with the equations contained in Section 4.5 and converted to the relevant averaging period using the factors contained in Table 4.6.

Predicted concentrations of NO_X have been converted to NO_2 using the approach outlined in Section 4.5.2, whereas apportionment of total chromium to hexavalent chromium has been undertaken with the 18% factor in Section 3.4.

4.6.1 Test of insignificance

To assess whether any predicted incremental GLC from vehicular emissions is considered a significant addition to what naturally occurs in ambient air, a "test" of insignificance has been applied. This is based upon the guidance from EPA Publication 1961, whereby an increment of 4% or less of the relevant ERS/APAC is considered to indicate a contribution so small that it is unlikely to result in measurable impacts in the population.

If an incremental GLC exceeds 4%, it does not immediately follow that the incremental GLC is significant. Instead, the background concentration is then assessed cumulatively with the incremental GLC to assess whether an ERS/APAC has been exceeded. However, it is noted that a cumulative GLC that is below the ERS/APAC does not automatically mean the requirement of GED to eliminate or minimise air quality risks so far as reasonably practicable has been met, as that is a parallel but separate consideration.

(https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/290985/scho0907bnhi-e-e.pdf)

5 Environmental setting

5.1 Site locality

The subdivision falls under General Residential Zone as per the Latrobe City Planning Scheme. It fronts approximately 800 m along Traralgon-Maffra Road, covering an area of about 55 hectares. The subject site is located in an area that is generally farming to the north, east and west. There is some rural living on the eastern side of Traralgon-Maffra Road. The land to the south is currently being redeveloped into a residential area as part of the TN subdivision.

5.2 Meteorology and terrain

The terrain in Traralgon is relatively flat, characterised by the low-lying Gippsland Basin, which cover much of south-eastern Victoria. The nearest operating Bureau of Meteorology automatic weather station (AWS) to the Site is located at Latrobe Valley Airport, approximately 8.6 km southwest from the subject site. The hourly windspeed and wind direction frequency between 1 January 2019 and 31 December 2021 are presented as a wind rose in Figure 5.1. Figure 5.1 shows the following features:

- The predominant wind pattern is from the west.
- The distribution of light winds (winds less than 3 m/s) is less aligned with the predominant wind pattern, with light winds well distributed in all directions and no more than 4 % of light winds experienced at any one direction.
- Strong winds (winds greater than 5 m/s) are expected to occur approximately 33% of the time and are primarily (15% of the time) from the west.

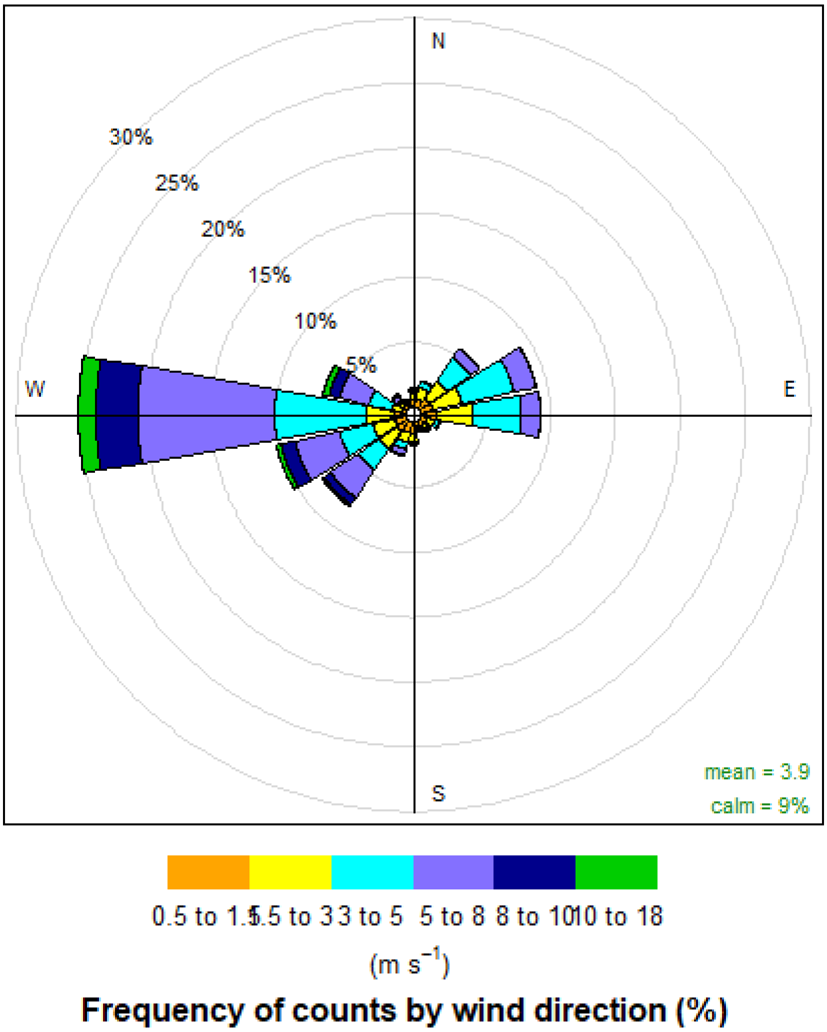

Figure 5.1 Wind speed and wind direction recorded at Latrobe Valley AWS between 1 January 2019 to 31 January 2021.

5.3 Background air quality

Vehicle emissions disperse such that concentrations at receptors typically revert to background concentrations at more than 200 m from a road source[16]. In other words, potential air quality impacts typically occur within 200 m from a road source in the absence of mitigation. Within 200 m from a road source, a cumulative assessment is undertaken by adding the incremental GLCs from traffic emissions to the background air quality.

No onsite background monitoring has been undertaken for the site. The nearest EPA-run continuous, real-time ambient air quality monitoring station to the site which collects data for NO_2, PM_{10} and $PM_{2.5}$ is located at Traralgon town. Air quality data between 1 January 2019 and 31 December 2021 has been reviewed, and background air quality data for 2021 has been selected as data from previous years appeared to have influence from bush fires or covid lockdowns. Table 5.1 presents a summary of background air quality used in this assessment.

[16] Design Manual for Roads and Bridges, Volume 11 Environmental Assessment, Section 3, Environmental Assessment Techniques, Highways Agency England (http://www.semmms.info/wp-content/uploads/2016/06/Design-Manual-for-Roads-and-Bridges-Volume-11-Section-3-Part-1.-PDF-981Kb.pdf).

Table 5.1: Summary of background air quality from Traralgon monitoring station (2021 basis)

Pollutant		NO_2 (µg/m³)	PM_{10} (µg/m³)	$PM_{2.5}$ (µg/m³)
1 hour	Maximum	37.1	-	-
	99th percentile	21.3		
	ERS	1501		
	Number of exceedances of ERS	0		
24 hours	Maximum	-	43.4	31.8
	99th percentile		20.1	9.6
	ERS		50	25
	Number of exceedances of ERS		0	13
1 year	Average	5.7	15.4	7.2
	ERS	281	20	8
	Number of exceedances of ERS	0	0	0

Overall, the NO_2 and PM_{10} ambient air quality levels as measured in Traralgon are considered to be good as there were no exceedances in 2021. Daily $PM_{2.5}$ ambient air quality levels were exceeded in 2021 (thirteen exceedances, respectively) and the annual $PM_{2.5}$ background level is elevated averaging 7.2 µg/m³ (or 90% of the ERS value of 8 µg/m³). Generally, exceedances/elevated concentrations of PM_{10} and $PM_{2.5}$ tend to occur due to regional events such as back burning or bush fires.

6 Assessment of air quality impacts

6.1 Pollutants that may cause potential incremental air quality impacts

Table 6.1 presents the predicted incremental GLCs using the DMRB equation for the vehicular emissions from Traralgon-Maffra Road at residential boundaries for the following scenarios:

- 2023 base year.
- 2030 opening year – without future subdivision.
- 2030 opening year – with future subdivision.

The comparison against the ERS/APAC value is presented in percentages in parentheses, any exceedance of the 4% threshold is presented in bold.

6.2 Results of assessment

From Table 6.1, the base year scenario has an exceedance of the 4% threshold for NO_2 1 hour and 1 year assessment criteria. However, these concentrations are predicted to fall below the screening criteria by the opening year. Despite an increase of vehicles on the road in the opening year, improvements in engine technology by 2026 is expected to have a reduced level of emissions for most contaminants when compared to the base year scenario. Even though there are some contaminants that are predicted to have a slight increase in the opening year when compared to the base year scenario there are no exceedances of the 4% threshold in the 2030 with or without scenarios.

The comparison between the 2030 with scenario and the 2030 without scenario shows a slight increase in vehicle emissions in the with scenario. Specifically, there is approximately a 9% increase in emissions when compared to the "without" scenario, regardless of this increase in emissions due to traffic from the combined subdivisions concentrations are predicted to remain within the 4% criteria.

Based on a Level 1 screening assessment and the available data, the incremental Ground Level Concentrations (GLCs) of pollutants in the opening year 2030 "with" scenario are considered insignificant, as the predicted contribution is less than 4% of the respective ERS. Accordingly, vehicle emissions from Traralgon – Maffra Road are expected to have an insignificant additional impact on air quality at residential receptors sites within the future subdivision. Since the 4% insignificance threshold has not been exceeded, further assessment of cumulative impacts is not warranted.

Based on the Level 1 screening assessment mitigation measures have not been considered further. The assessment is subject to limitations in Section 6.3 and the overall risk should be viewed in the context of such uncertainties.

Table 6.1: Predicted incremental GLCs (µg/m³) from traffic during 2030 with percentage of the criterion in brackets

Pollutant	Averaging period	Base year (2023) incremental GLC (ug/m³)		Opening year (2030) incremental GLC (ug/m³) without future development		Opening year (2030) incremental GLC (ug/m³) with future development		ERS/APAC criteria (ug/m³)
		80 km/hr	100 km/hr	80 km/hr	100 km/hr	80 km/hr	100 km/hr	
CO	8 hours	22.4 (0.22%)	33.0 (0.3%)	28.2 (0.3%)	41.6 (0.4%)	31.1 (0.3%)	45.9 (0.45%)	10,300
Benzene	1 hour	1.6 (0.3%)	1.8 (0.3%)	0.14 (0.03%)	1.5 (0.25%)	0.2 (0.03%)	1.6 (0.28%)	580
	24 hours	0.62 (2.2%)	0.7 (2.4%)	0.04 (0.15%)	0.9 (3.0%)	0.05 (0.18%)	0.9 (3.2%)	29
	1 year	0.10 (1.1%)	0.11 (1.2%)	0.007 (0.08%)	0.15 (1.5%)	0.009 (0.09%)	0.2 (1.7%)	9.6
NO_2	1 hour	**13.6 (9.0 %)**	**13.6 (9.0%)**	3.7 (2.5%)	4.0 (2.7%)	4.1 (2.7%)	4.5 (2.9%)	150
	1 year	**1.2 (4.2%)**	**1.4 (4.8%)**	0.37 (1.3%)	0.40 (1.5%)	0.41 (1.5%)	0.5 (1.6%)	28
NH_3	1 hour	0.2(0.005%)	0.1 (0.003%)	0.2 (0.005%)	0.2 (0.005%)	0.2 (0.005%)	0.2 (0.005%)	3200
	1 year	0.01 (0.02%)	0.01 (0.02%)	0.02 (0.02%)	0.02 (0.02%)	0.01 (0.02%)	0.01 (0.02%)	70
$PM_{2.5}$	24 hours	0.8 (3.0%)	0.64 (2.5%)	0.8 (3.4%)	0.1 (1.4%)	0.9 (3.7%)	0.7 (3.0 %)	25
	1 year	0.13 (1.6%)	0.11 (1.3%)	0.1 (1.8%)	0.7 (2.7%)	0.2 (1.9%)	0.1 (1.6%)	8
PM_{10}	24 hours	0.98 (1.9%)	0.70 (1.4%)	1.2 (2.4%)	0.8 (1.7%)	1.3 (2.7%)	0.9 (1.8%)	50
	1 year	0.16 (0.8%)	0.12 (0.6%)	0.2 (1.0%)	0.1 (0.7%)	0.2 (1.1%)	0.1 (0.8%)	20
SO_2	1 hour	0	0	0	0	0	0	196
	24 hours	0	0	0	0	0	0	52
Lead	1 year	0.0002 (0.04%)	0.00009 (0.02%)	0.0002 (0.04%)	0.0001 (0.02%)	0.0003 (0.05%)	0.0001 (0.02%)	0.5
Cadmium	1 year	7.4 (0.15%)	7.4 (0.15%)	0.00001 (0.2%)	0.00001 (0.2%)	0.00001 (0.2%)	0.00001 (0.2%)	0.005
Copper	1 hour	0.02 (0.02%)	0.007 (0.01%)	0.02 (0.02%)	0.0009 (0.1 %)	0.02 (0.02%)	0.01 (0.01%)	100
Cr (VI)	1 hour	0.0002 (0.02%)	0.00006 (0.005%)	0.0002 (0.01%)	0.0001 (0.01%)	0.0002 (0.01%)	0.0001 (0.01%)	1.3
	1 year	0.00001 (0.3%)	0.000006 (0.1%)	0.00002 (0.4%)	0.00008 (0.2%)	0.00002 (0.4%)	0.00009 (0.2%)	0.005
Nickel	1 hour	0.0003 (0.2%)	0.0001 (0.06%)	0.0002 (0.1%)	0.0003 (0.1%)	0.0002 (0.1%)	0.0003 (0.2%)	0.2
	1 year	0.00002 (0.02%)	0.0001 (0.01%)	0.00002 (0.03%)	0.00002 (0.02%)	0.00002 (0.03%)	0.00002 (0.03%)	0.09
Zinc	1 hour	0.02 (0.1%)	0.02 (0.1%	0.03 (0.1%)	0.04 (0.2%)	0.03 (0.1%)	0.05 (0.2%)	20

Pollutant	Averaging period	Base year (2023) incremental GLC (ug/m^3)		Opening year (2030) incremental GLC (ug/m^3) without future development		Opening year (2030) incremental GLC (ug/m^3) with future development		ERS/APAC criteria (ug/m^3)
		80 km/hr	100 km/hr	80 km/hr	100 km/hr	80 km/hr	100 km/hr	
	1 year	0.002 (0.1%)	0.002 (0.1%)	0.003 (0.1%)	0.003 (0.1%)	0.003 (0.1%)	0.003 (0.1%)	2

6.3 Limitations of the assessment

As this is a screening Level 1 assessment, the assessment has assumed free-field dispersion and has not taken into account barriers to dispersion (such as solid fencing).

The traffic counts are based on AADT, which is an average value. However, vehicle numbers are not constant throughout the day, and for short averaging time periods such as 1 hour, it is more accurate to account for peak hourly traffic (such as during morning and afternoon commute) to assess short-term air quality impacts. Opening year scenarios assume that the hourly traffic flows in 2030 will have a similar pattern to the observed hourly 2023 volumes.

As this is a screening Level 1 assessment, the assessment has not taken into account the effects of wind direction in affecting downwind exposure at residential receptors from vehicular emissions. For instance, Traralgon-Maffra Road is located to the east of the nearest subdivision residential dwellings, and the frequency of easterly winds is at a relatively low frequency of 9.5% (Figure 5.1). This means that the combination of elevated levels from vehicles has to coincide with either downwind conditions or calm conditions to become a reality.

7 Conclusions

NBA Group is preparing a DP for land adjacent to Traralgon-Maffra Road and Baldwin Road, Traralgon North. This land was rezoned from Farming Zone (Schedule 1) to General Residential (Schedule 3) in October 2023 and a subsequent Development Plan overlay was issued

An air quality assessment has been prepared to consider the potential effects of the development on traffic flows in the surrounding area and subsequent air quality effects of traffic emissions on sensitive activities that will be established within the proposed subdivision area.

A screening Level 1 assessment has been undertaken for the proposed development north of Baldwin Road, Traralgon. The potential air quality impacts from the traffic emissions of Traralgon-Maffra Road has been assessed using the following methodology:

- Estimation of traffic emission factors using COPERT Australia software, taking into account fleet technology and driving speed.
- Estimation of incremental GLCs using the DMRB dispersion curves using COPERT-generated emission factors and traffic counts.
- Comparison of incremental GLCs against relevant air quality criteria (ERS/APAC).
- Application of 4% test of insignificance.

The results of the screening assessment indicate that Traralgon-Maffra Road present insignificant additional air quality impacts to people located at the nearest likely residential dwelling locations of the proposed subdivision. All pollutants from Traralgon-Maffra Road have been predicted to have similar insignificant impacts on air quality at potential nearest residential dwellings. As such, based on the information provided by Millar Merrigan, additional mitigation options have not been proposed.

8 Applicability

This report has been prepared for the exclusive use of our client Millar Merrigan Pty Ltd, with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

Tonkin & Taylor Ltd
Environmental and Engineering Consultants

Report prepared by:

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Appendix A COPERT emission factors

- **Base year 2023 80 km/hr emission factors**
- **Base year 2023 100 km/hr emission factors**
- **Base year 2030 80 km/hr emission factors**
- **Base year 2030 100 km/hr emission factors**

Table Appendix A.1 : 2023 Emission factors from COPERT Australia outputs – 80 km/hour

Sector	Subsector	Technology	CO	NMVOC	NO_x	NH_3	$PM_{2.5}$	PM_{10}	SO_2	Lead	Cadmium	Copper	Chromium	Nickel	Zinc
			g/vehicle.km							kg/vehicle.km					
Passenger Cars	PC-S-petrol	ADR79-04	0.2962	0.004	0.0170	0.0008	0.0074	0.0119	0.0000	0.0128	0.0005	0.0909	0.005	0.0013	0.1457
Passenger Cars	PC-M-petrol	ADR79-04	0.2962	0.004	0.0170	0.0008	0.0074	0.0119	0.0000	0.0130	0.0006	0.0912	0.005	0.0014	0.1627
Passenger Cars	PC-L-petrol	ADR79-04	0.2962	0.004	0.0170	0.0008	0.0074	0.0119	0.0000	0.0135	0.0008	0.0917	0.005	0.0016	0.1909
Passenger Cars	PC-S-diesel	ADR79-04	0.0189	0.000	0.4809	0.0010	0.0079	0.0124	0.0000	0.0135	0.0004	0.0899	0.005	0.0011	0.1238
Passenger Cars	PC-ML-diesel	ADR79-04	0.0189	0.000	0.4809	0.0010	0.0079	0.0124	0.0000	0.0144	0.0006	0.0902	0.006	0.0012	0.1512
Passenger Cars	PC-S-E10	ADR79-04	0.3395	0.013	0.0190	0.0008	0.0075	0.0120	0.0000	0.0124	0.0006	0.0909	0.005	0.0013	0.1477
Passenger Cars	PC-M-E10	ADR79-04	0.3395	0.013	0.0190	0.0008	0.0075	0.0120	0.0000	0.0127	0.0007	0.0915	0.005	0.0015	0.1761
Passenger Cars	PC-L-E10	ADR79-04	0.3395	0.013	0.0190	0.0008	0.0075	0.0120	0.0000	0.0129	0.0008	0.0918	0.005	0.0016	0.1919
Passenger Cars	PC-LPG	ADR79-04	0.3395	0.014	0.0190	0.0008	0.0075	0.0120	0.0000	0.0130	0.0006	0.0910	0.005	0.0013	0.1647
SUV	SUV-C-petrol	ADR79-04	0.3395	0.013	0.0190	0.0008	0.0111	0.0182	0.0000	0.0198	0.0008	0.1417	0.007	0.0020	0.2266
SUV	SUV-L-petrol	ADR79-04	0.3395	0.013	0.0190	0.0008	0.0111	0.0182	0.0000	0.0201	0.0010	0.1422	0.008	0.0021	0.2501
SUV	SUV-diesel	ADR79-04	0.0350	0.008	0.2025	0.0010	0.0114	0.0185	0.0000	0.0217	0.0008	0.1405	0.009	0.0018	0.2116
SUV	SUV-C-E10	ADR79-04	0.3395	0.013	0.0190	0.0008	0.0111	0.0182	0.0000	0.0194	0.0009	0.1405	0.008	0.0020	0.2327
SUV	SUV-L-E10	ADR79-04	0.3395	0.013	0.0190	0.0008	0.0111	0.0182	0.0000	0.0194	0.0009	0.1405	0.008	0.0020	0.2327
Light Commercial Vehicles	LCV-petrol	ADR79-04	0.4846	0.005	0.0136	0.0020	0.0123	0.0194	0.0000	0.0194	0.0007	0.1412	0.007	0.0018	0.1968
Light Commercial Vehicles	LCV-diesel	ADR79-04	0.0002	0.000	0.7415	0.0019	0.0110	0.0181	0.0000	0.0214	0.0007	0.1404	0.009	0.0017	0.2020
Heavy Duty Trucks	MCV-petrol	ADR00-UNC	2.6307	1.699	4.2875	0.0020	0.0170	0.0324	0.0000	0.0474	0.0018	0.3929	0.020	0.0047	0.4534
Heavy Duty Trucks	MCV-diesel	ADR80-03	0.2657	0.015	1.0539	0.0030	0.0300	0.0455	0.0000	0.0558	0.0016	0.3902	0.022	0.0042	0.4145
Heavy Duty Trucks	HCV-diesel	ADR80-03	0.5498	0.025	1.8696	0.0030	0.0389	0.0543	0.0000	0.0573	0.0019	0.3908	0.023	0.0044	0.4645
Heavy Duty Trucks	AT-diesel	ADR80-03	0.6407	0.033	2.2602	0.0030	0.0434	0.0588	0.0000	0.0683	0.0037	0.3953	0.030	0.0063	0.8332
Heavy Duty Trucks	Autogas Trucks	ADR80-03	2.7956	1.800	4.6575	0.0020	0.0170	0.0324	0.0000	0.0521	0.0018	0.3923	0.019	0.0043	0.4484

Table Appendix A.2 : 2023 Emission factors from COPERT Australia outputs – 100 km/hour

Sector	Subsector	Technology	CO	NMVOC	NO_x	NH_3	$PM_{2.5}$	PM_{10}	SO_2	Lead	Cadmium	Copper	Chromium	Nickel	Zinc
			g/vehicle.km							kg/vehicle.km					
Passenger Cars	PC-S-petrol	ADR79-04	0.4391	0.0052	0.0136	0.0008	0.006	0.0084	0.0000	0.0056	0.0006	0.0304	0.0021	0.0009	0.1392
Passenger Cars	PC-M-petrol	ADR79-04	0.4391	0.0052	0.0136	0.0008	0.006	0.0084	0.0000	0.0058	0.0006	0.0307	0.0022	0.0010	0.1545
Passenger Cars	PC-L-petrol	ADR79-04	0.4391	0.0052	0.0136	0.0008	0.006	0.0084	0.0000	0.0062	0.0007	0.0311	0.0024	0.0012	0.1773
Passenger Cars	PC-S-diesel	ADR79-04	0.0091	0.0004	0.5422	0.0010	0.006	0.0087	0.0000	0.0064	0.0004	0.0293	0.0027	0.0007	0.1140
Passenger Cars	PC-ML-diesel	ADR79-04	0.0091	0.0004	0.5422	0.0010	0.006	0.0087	0.0000	0.0074	0.0006	0.0297	0.0033	0.0009	0.1467
Passenger Cars	PC-S-E10	ADR79-04	0.5297	0.0157	0.0145	0.0008	0.006	0.0084	0.0000	0.0051	0.0005	0.0302	0.0020	0.0009	0.1305
Passenger Cars	PC-M-E10	ADR79-04	0.5297	0.0157	0.0145	0.0008	0.006	0.0084	0.0000	0.0054	0.0006	0.0307	0.0022	0.0010	0.1571
Passenger Cars	PC-L-E10	ADR79-04	0.5297	0.0157	0.0145	0.0008	0.006	0.0084	0.0000	0.0057	0.0008	0.0313	0.0025	0.0012	0.1865
Passenger Cars	PC-LPG	ADR79-04	0.5297	0.0161	0.0145	0.0008	0.006	0.0084	0.0000	0.0060	0.0007	0.0307	0.0019	0.0010	0.1696
SUV	SUV-C-petrol	ADR79-04	0.5297	0.0157	0.0145	0.0008	0.009	0.0125	0.0000	0.0087	0.0009	0.0475	0.0033	0.0015	0.2212
SUV	SUV-L-petrol	ADR79-04	0.5297	0.0157	0.0145	0.0008	0.009	0.0125	0.0000	0.0087	0.0009	0.0476	0.0034	0.0015	0.2257
SUV	SUV-diesel	ADR79-04	0.0270	0.0076	0.2621	0.0010	0.009	0.0130	0.0000	0.0102	0.0007	0.0459	0.0044	0.0011	0.1861
SUV	SUV-C-E10	ADR79-04	0.5297	0.0157	0.0145	0.0008	0.009	0.0125	0.0000	0.0082	0.0009	0.0476	0.0034	0.0015	0.2279
SUV	SUV-L-E10	ADR79-04	0.5297	0.0157	0.1383	0.0009	0.007	0.0113	0.0000	0.0063	0.0009	0.0545	0.0024	0.0014	0.2697
Light Commercial Vehicles	LCV-petrol	ADR79-04	0.9183	0.0080	0.0121	0.0020	0.011	0.0149	0.0000	0.0082	0.0007	0.0469	0.0031	0.0013	0.1928
Light Commercial Vehicles	LCV-diesel	ADR79-04	0.0001	0.0002	1.0213	0.0019	0.008	0.0124	0.0000	0.0104	0.0007	0.0459	0.0045	0.0012	0.1930
Heavy Duty Trucks	MCV-petrol	ADR00-UNC	2.5780	1.5472	4.4469	0.0020	0.011	0.0181	0.0000	0.0158	0.0017	0.1285	0.0080	0.0030	0.4069
Heavy Duty Trucks	MCV-diesel	ADR80-03	0.2661	0.0151	1.0951	0.0030	0.024	0.0317	0.0000	0.0248	0.0016	0.1259	0.0108	0.0025	0.3816
Heavy Duty Trucks	HCV-diesel	ADR80-03	0.5301	0.0248	1.8402	0.0030	0.033	0.0401	0.0000	0.0264	0.0019	0.1266	0.0118	0.0028	0.4368
Heavy Duty Trucks	AT-diesel	ADR80-03	0.6226	0.0322	2.1938	0.0030	0.037	0.0439	0.0000	0.0347	0.0032	0.1299	0.0165	0.0042	0.7118
Heavy Duty Trucks	Autogas Trucks	ADR80-03	2.7396	1.6395	4.8306	0.0020	0.011	0.0181	0.0000	0.0206	0.0017	0.1278	0.0071	0.0026	0.4018

Table Appendix A.3 : 2030 Emission factors from COPERT Australia outputs – 80 km/hour

Sector	Subsector	Technology	CO	NMVOC	NO_x	NH_3	$PM_{2.5}$	PM_{10}	SO_2	Lead	Cadmium	Copper	Chromium	Nickel	Zinc
			g/vehicle.km							kg/vehicle.km					
Passenger Cars	PC-S-petrol	ADR79-05	0.2512	0.000013	0.019	0.0000	0.0076	0.0121	0.0000	0.0128	0.0005	0.0909	0.0048	0.0013	0.1457
Passenger Cars	PC-M-petrol	ADR79-05	0.2512	0.000891	0.019	0.0000	0.0076	0.0121	0.0000	0.0130	0.0006	0.0912	0.0049	0.0014	0.1627
Passenger Cars	PC-L-petrol	ADR79-05	0.2512	0.000036	0.019	0.0000	0.0076	0.0121	0.0000	0.0135	0.0008	0.0917	0.0051	0.0016	0.1909
Passenger Cars	PC-S-diesel	ADR79-05	0.0384	0.000000	0.147	0.0000	0.0073	0.0119	0.0000	0.0135	0.0004	0.0899	0.0054	0.0011	0.1238
Passenger Cars	PC-ML-diesel	ADR79-05	0.0384	0.000017	0.147	0.0000	0.0073	0.0119	0.0000	0.0144	0.0006	0.0902	0.0059	0.0012	0.1512
Passenger Cars	PC-S-E10	ADR79-05	0.3395	0.000000	0.019	0.0000	0.0075	0.0120	0.0000	0.0124	0.0006	0.0909	0.0048	0.0013	0.1477
Passenger Cars	PC-M-E10	ADR79-05	0.3395	0.000004	0.019	0.0000	0.0075	0.0120	0.0000	0.0127	0.0007	0.0915	0.0050	0.0015	0.1761
Passenger Cars	PC-L-E10	ADR79-05	0.3395	0.000000	0.019	0.0000	0.0075	0.0120	0.0000	0.0129	0.0008	0.0918	0.0051	0.0016	0.1919
Passenger Cars	PC-LPG	ADR79-05	0.3395	0.000053	0.019	0.0000	0.0075	0.0120	0.0000	0.0130	0.0006	0.0910	0.0046	0.0013	0.1647
SUV	SUV-C-petrol	ADR79-05	0.3395	0.001204	0.019	0.0000	0.0111	0.0182	0.0000	0.0198	0.0008	0.1417	0.0075	0.0020	0.2266
SUV	SUV-L-petrol	ADR79-05	0.3395	0.000048	0.019	0.0000	0.0111	0.0182	0.0000	0.0201	0.0010	0.1422	0.0077	0.0021	0.2501
SUV	SUV-diesel	ADR79-05	0.0349	0.000015	0.202	0.0000	0.0114	0.0185	0.0000	0.0217	0.0008	0.1405	0.0087	0.0018	0.2116
SUV	SUV-C-E10	ADR79-05	0.3395	0.000004	0.019	0.0000	0.0111	0.0182	0.0000	0.0194	0.0009	0.1419	0.0075	0.0020	0.2326
SUV	SUV-L-E10	ADR79-05	0.3395	0.000000	0.019	0.0000	0.0111	0.0182	0.0000	0.0197	0.0010	0.1423	0.0077	0.0022	0.2570
Light Commercial Vehicles	LCV-petrol	ADR79-05	0.4846	0.000289	0.014	0.0020	0.0123	0.0194	0.0000	0.0194	0.0007	0.1412	0.0073	0.0018	0.1968
Light Commercial Vehicles	LCV-diesel	ADR79-05	0.0002	0.000000	0.134	0.0070	0.0110	0.0181	0.0000	0.0214	0.0007	0.1404	0.0086	0.0017	0.2020
Heavy Duty Trucks	MCV-petrol	ADR00-UNC	2.6307	0.000054	4.288	0.0020	0.0170	0.0324	0.0000	0.0474	0.0018	0.3929	0.0200	0.0047	0.4534
Heavy Duty Trucks	MCV-diesel	ADR80-04	0.2666	0.000058	0.059	0.0030	0.0183	0.0337	0.0000	0.0558	0.0016	0.3902	0.0225	0.0042	0.4145
Heavy Duty Trucks	HCV-diesel	ADR80-04	0.5496	0.000236	0.134	0.0030	0.0192	0.0346	0.0000	0.0573	0.0019	0.3908	0.0233	0.0044	0.4645
Heavy Duty Trucks	AT-diesel	ADR80-04	0.6455	0.000085	0.166	0.0030	0.0196	0.0351	0.0000	0.0683	0.0037	0.3953	0.0297	0.0063	0.8332
Heavy Duty Trucks	Autogas Trucks	ADR80-04	2.7956	0.000011	4.658	0.0020	0.0170	0.0324	0.0000	0.0521	0.0018	0.3923	0.0190	0.0043	0.4484

Table Appendix A.4 : 2030 Emission factors from COPERT Australia outputs – 100 km/hour

Sector	Subsector	Technology	CO	NMVOC	NO_x	NH_3	$PM_{2.5}$	PM_{10}	SO_2	Lead	Cadmium	Copper	Chromium	Nickel	Zinc
			g/vehicle.km							kg/vehicle.km					
Passenger Cars	PC-S-petrol	ADR79-05	0.3741	0.0070	0.0144	0.0000	0.0061	0.0087	0.0000	0.006	0.0006	0.0304	0.0021	0.0009	0.1392
Passenger Cars	PC-M-petrol	ADR79-05	0.3741	0.0070	0.0144	0.0000	0.0061	0.0087	0.0000	0.006	0.0006	0.0307	0.0022	0.0010	0.1545
Passenger Cars	PC-L-petrol	ADR79-05	0.3741	0.0070	0.0144	0.0000	0.0061	0.0087	0.0000	0.006	0.0007	0.0311	0.0024	0.0012	0.1773
Passenger Cars	PC-S-diesel	ADR79-05	0.0450	0.0004	0.1657	0.0000	0.0056	0.0081	0.0000	0.006	0.0004	0.0293	0.0027	0.0007	0.1140
Passenger Cars	PC-ML-diesel	ADR79-05	0.0450	0.0004	0.1657	0.0000	0.0056	0.0081	0.0000	0.007	0.0006	0.0297	0.0033	0.0009	0.1467
Passenger Cars	PC-S-E10	ADR79-05	0.5297	0.0157	0.0145	0.0000	0.0059	0.0084	0.0000	0.005	0.0005	0.0302	0.0020	0.0009	0.1305
Passenger Cars	PC-M-E10	ADR79-05	0.5297	0.0157	0.0145	0.0000	0.0059	0.0084	0.0000	0.005	0.0006	0.0307	0.0022	0.0010	0.1571
Passenger Cars	PC-L-E10	ADR79-05	0.5297	0.0157	0.0145	0.0000	0.0059	0.0084	0.0000	0.006	0.0008	0.0313	0.0025	0.0012	0.1864
Passenger Cars	PC-LPG	ADR79-05	0.5297	0.0161	0.0145	0.0000	0.0059	0.0084	0.0000	0.006	0.0007	0.0307	0.0019	0.0010	0.1695
SUV	SUV-C-petrol	ADR79-05	0.5297	0.0157	0.0145	0.0000	0.0085	0.0125	0.0000	0.009	0.0009	0.0475	0.0033	0.0015	0.2212
SUV	SUV-L-petrol	ADR79-05	0.5297	0.0157	0.0145	0.0000	0.0085	0.0125	0.0000	0.009	0.0009	0.0476	0.0034	0.0015	0.2256
SUV	SUV-diesel	ADR79-05	0.0270	0.0076	0.2621	0.0000	0.0090	0.0130	0.0000	0.010	0.0007	0.0459	0.0044	0.0011	0.1861
SUV	SUV-C-E10	ADR79-05	0.5297	0.0157	0.0145	0.0000	0.0085	0.0125	0.0000	0.008	0.0009	0.0476	0.0034	0.0015	0.2279
SUV	SUV-L-E10	ADR79-05	0.5297	0.0157	0.0145	0.0000	0.0085	0.0125	0.0000	0.008	0.0009	0.0477	0.0034	0.0015	0.2325
Light Commercial Vehicles	LCV-petrol	ADR79-05	0.9183	0.0080	0.0121	0.0020	0.0109	0.0149	0.0000	0.008	0.0007	0.0469	0.0031	0.0013	0.1928
Light Commercial Vehicles	LCV-diesel	ADR79-05	0.0001	0.0002	0.1838	0.0070	0.0084	0.0124	0.0000	0.010	0.0007	0.0459	0.0045	0.0012	0.1930
Heavy Duty Trucks	MCV-petrol	ADR00-UNC	2.5780	1.5472	4.4469	0.0020	0.0109	0.0181	0.0000	0.016	0.0017	0.1285	0.0080	0.0030	0.4069
Heavy Duty Trucks	MCV-diesel	ADR80-04	0.2656	0.0048	0.0522	0.0030	0.0123	0.0195	0.0000	0.025	0.0016	0.1259	0.0108	0.0025	0.3816
Heavy Duty Trucks	HCV-diesel	ADR80-04	0.5297	0.0103	0.1116	0.0030	0.0131	0.0203	0.0000	0.026	0.0019	0.1266	0.0118	0.0028	0.4368
Heavy Duty Trucks	AT-diesel	ADR80-04	0.6214	0.0125	0.1511	0.0030	0.0135	0.0207	0.0000	0.035	0.0032	0.1299	0.0165	0.0042	0.7118
Heavy Duty Trucks	Autogas Trucks	ADR80-04	2.7396	1.6395	4.8306	0.0020	0.0109	0.0181	0.0000	0.021	0.0017	0.1278	0.0071	0.0026	0.4018

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