Environment
Effects Statement

Chapter 10
Air quality

Chapter 10

Air quality

This chapter provides an assessment of the air quality impacts associated with the construction and operation of North East Link. This chapter is based on the impact assessment presented in Technical report B – Air quality.

Air quality is an important environmental issue in urban Australia. Emissions to air from industry, transport, domestic wood burning and other sources have the potential to affect human health and public amenity. During the construction of North East Link, existing air quality could be impacted by dust, odour and emissions from vehicles and machinery. Vehicle exhaust emissions during operation could also affect air quality.

The EES scoping requirements set out the following evaluation objective:

- **Health, amenity and environmental quality** – To minimise adverse air quality, noise and vibration effects on the health and amenity of nearby residents, local communities and road users during both construction and operation of the project.

An air quality assessment was undertaken to evaluate potential air quality impacts during the project's construction and operation.

For construction, this entailed a qualitative assessment of potential impacts from dust due to earthmoving activities, odours from asphalt production and laying and the exposure of contaminated soil and emissions from diesel and petrol fuelled construction vehicles and machinery.

For operation, modelling was undertaken to predict air quality changes, informed by an evaluation of existing air quality in the vicinity of the project. The modelling predicted the exhaust emissions from vehicles using North East Link surface roads and other nearby impacted roads and from vehicle exhaust emissions discharged from the tunnel ventilation system. This modelling was used to inform an assessment of the combined air quality impact from vehicles using the tunnels and surface roads.

Other aspects covered in the above evaluation objective are surface noise and vibration, tunnel vibration and regenerated noise, and human health. These are addressed in the following EES chapters and technical reports:

- Technical report C and Chapter 11 – Surface noise and vibration
- Technical report D and Chapter 12 – Tunnel vibration and regenerated noise
- Technical report J and Chapter 18 – Human health.

10.1 Method

Informed by the risk assessment described in Chapter 4 – EES assessment framework, the air quality impact assessment involved the following key tasks:

- A review of relevant national, state and local legislation and policies

- A study area was established for assessing air quality impacts. This was defined as the full project alignment (including the road tunnel ventilation structures) and selected existing surface roads where traffic volumes are significantly impacted (either increased or reduced due to North East Link), together with areas in the vicinity of the project potentially impacted by emissions from these sources

> **What are the risk categories?**
>
> Risk levels were categorised as very low, low, medium, high or very high. When an impact is a known consequence of the project, the rating is indicated as 'planned'. The results of the initial risk assessment were used to prioritise the focus of the impact assessments.

- A desktop assessment and baseline data review was undertaken to establish existing air quality and identify sensitive receptors

- EPA Victoria was consulted about the assessment methodology, modelling approach and air quality monitoring

- The potential air quality impacts of the project's construction and operation of the project were assessed. The methodology for the assessment of potential air quality impacts during the project's operation is outlined in more detail in Section 10.5.1 of this chapter. The assessment involved:

  - Use of an air dispersion model to assess air quality impacts for the 'with project' and 'no project' scenarios at sensitive receptors adjacent to major surface roads, where the project is expected to cause significant changes in traffic volumes or fleet mix

  - Use of an air dispersion model to assess the impacts of air emissions from tunnel ventilation structures

  - Evaluation of the combined impact of emissions from the tunnel ventilation structures and surface roads at nearby sensitive receptors

- Environmental Performance Requirements (EPRs) were developed in response to the impact assessment. The residual risk ratings and the assessment of impacts presented in this chapter assume implementation of the EPRs. Refer to Chapter 27 – Environmental management framework for the full list of EPRs.

10.2 Air quality regulatory framework and criteria

Air quality is protected in Australia under Commonwealth and State legislation.

At the national level, the *National Environment Protection (Ambient Air Quality) Measure* (Air NEPM) sets out standards, goals and monitoring and reporting protocols for six common air pollutants: carbon monoxide (CO), nitrogen dioxide (NO_2), lead and particles (as PM_{10}, $PM_{2.5}$), photochemical oxidants (as ozone) and sulphur dioxide (SO_2). The *National Environment Protection (Air Toxics) Measure* (Air Toxics NEPM) sets out monitoring and reporting protocols for benzo(a)pyrene [B(a)P, as a marker for polycyclic aromatic hydrocarbons (PAH)], benzene, toluene, formaldehyde and xylenes.

Air NEPM standards apply at air quality performance monitoring stations. These monitoring stations are carefully located so they can obtain measurements of the air quality conditions that would be experienced by the general population.

Importantly, the Air NEPM standards are not applied as modelling criteria for assessing air emissions from individual sources, specific industries or roadside locations.

In Victoria, the *Environment Protection Act 1970* is the primary legislative instrument that governs protection of the environment. As outlined in Chapter 3 – Legislative framework (Section 3.3.2), State Environment Protection Policies (SEPPs) prepared under this Act set standards, guidelines and environmental quality objectives and indicators to protect beneficial uses of the environment. Beneficial uses of the air quality environment are protected by SEPP (Ambient Air Quality) and SEPP (Air Quality Management), as described below.

Chapter 3 – Legislative framework (Section 3.3.2) also identifies the need for a works approval and licence from EPA Victoria for the installation and operation of the North East Link tunnel ventilation system, in accordance with the Environment Protection (Scheduled Premises) Regulations 2017.

There are currently no Victorian regulations or policies that specifically govern air quality during construction, although guidelines on good construction practices do exist, such as EPA Victoria Publication 480 Environmental Guidelines for Major Construction Sites. The legislation and guidelines applicable to managing air quality during construction are discussed in Section 10.4.

State Environment Protection Policy (Ambient Air Quality) – (SEPP AAQ)

The SEPP AAQ sets air quality objectives and goals for Victoria. In general, the SEPP AAQ adopts the standards within the Air NEPM, with environmental quality objectives for CO, NO_2, lead and particles (as PM_{10}, $PM_{2.5}$), photochemical oxidants (as ozone) and sulphur dioxide (SO_2), together with an additional objective for visibility reducing particles and more stringent requirements for PM_{10}.

The SEPP (AAQ) environmental quality objectives are shown in Table 10-1. The 'averaging' period shown in this table is the period of time over which the average pollutant concentration must not exceed the objective. For example, the average value of the 24-hourly PM_{10} readings on any particular day must not exceed 50 µg/m³.

The revised environmental quality objective listed for $PM_{2.5}$ is to be implemented by 2025, by which time it is expected there would be improved vehicle emission control technologies.

Table 10-1   SEPP (AAQ) environmental quality objectives

Pollutant	Objective	Units	Averaging period
PM_{10}	50	µg/m³	24 hour
	20		Annual
$PM_{2.5}$ (2025)	20	µg/m³	24 hour
	7		Annual
NO_2	0.12	ppm	1 hour
	0.03		Annual

State Environment Protection Policy (Air Quality Management) – (SEPP AQM)

The SEPP (AQM) sets out legislative requirements for managing and assessing air emissions in Victoria to meet the environment quality objectives outlined in the SEPP (AAQ).

Ambient air quality assessment criteria applicable to the emissions from the tunnel ventilation structures are specified in SEPP (AQM) Schedule A and listed in Table 10-2.

Table 10-2   SEPP (AQM) Schedule A design criteria

Pollutant	Criterion (mg/m³)	Averaging period
PM_{10}	0.08	1 hour
$PM_{2.5}$	0.05	1 hour
NO_2	0.19	1 hour
CO	29	1 hour
Benzene	0.053	3 minute
Toluene	0.65 (odour)	3 minute
Ethylbenzene	14.5	3 minute
Xylenes	0.35 (odour)	3 minute
Formaldehyde	0.04	3 minute
1,3 Butadiene	0.073	3 minute
PAH [as B(a)P toxic equivalent]	0.00073	3 minute

10.3   Existing conditions

This section outlines the existing conditions of the North East Link study area that relate to air quality.

North East Link would travel through the municipalities of Banyule, Boroondara, Manningham, Whitehorse, Yarra and Nillumbik. The project alignment traverses a highly urbanised area of Melbourne that includes long-established residential areas, shopping and commercial centres, industrial precincts, parks and reserves and community and recreational facilities.

Existing air quality in the vicinity of North East Link is typical of urban Melbourne. It is primarily influenced by emissions from industry, transport, domestic fuel burning and residential activities.

The air pollutants relevant to the assessment of North East Link during its construction and operation are largely the components of vehicle exhaust, emissions from mobile plant and the use of earthmoving machinery, as follows:

- Carbon monoxide (CO)

- Oxides of nitrogen (NOx), particularly nitrogen dioxide (NO_2) and nitric oxide (NO)

- Particulate matter, measured as PM_{10} and as $PM_{2.5}$

- Polycyclic aromatic hydrocarbons (PAHs)

- Volatile organic compounds (VOCs), including benzene, ethylbenzene, toluene, xylenes, formaldehyde and 1,3-butadiene.

Particulate matter

Particulate matter (PM) results from all types of combustion. Particles are emitted from industrial processes, motor vehicles, domestic fuel burning, planned burns and industrial and domestic incineration. Quarrying and mining activities as well as agricultural practices also release particles into the air. Dust particles can be lifted into the air, for example, as cars and trucks travel on roads or as dry soil is exposed to the wind. Natural sources of particles include bushfires, windblown dust, pollens and salt spray from the oceans. Particles can also form in the air as a result of chemical reactions.

PM_{10} refers to particles that have an aerodynamic diameter less than 10 micrometres (0.01 mm).

$PM_{2.5}$ refers to particles that have an aerodynamic diameter less than 2.5 micrometres (0.0025 mm), which is about three per cent of the diameter of a human hair. $PM_{2.5}$ can also be described as 'fine particles'. These fine particles cannot be seen directly by the human eye. Since they are so small and light, fine particles tend to remain in the air longer than larger, heavier particles.

The term ultrafine particles (UFPs) typically refers to particles with a diameter less than 0.1 micrometres. UFP formation has been observed in relatively unpolluted marine and land environments, as well as in polluted urban areas. In urban areas a large percentage of UFPs come from combustion-related sources such as motor vehicles. There is currently no standardised measurement method or ambient air quality criteria for UFPs, and therefore they have not been considered as part of the North East Link air quality impact assessment.

Public submissions on impact assessments undertaken for other major road projects have raised concerns regarding the potential impact of UFPs on human health. This is discussed further in Chapter 18 – Human health.

10.3.1   Sources of air pollution

Urban air pollution comes from a wide variety of sources. The main sources of air pollution in the study area are:

- Traffic using the road network, including the M80 Ring Road (otherwise known as the Metropolitan Ring Road) and Eastern Freeway

- Industrial and food manufacturing facilities

- Domestic fuel burning (gas, liquid and solid)

- Residential activities (such as lawn mowers and barbecues).

A review of 2016–17 data from the National Pollutant Inventory was undertaken to better understand air pollutant sources within the study area. The National Pollutant Inventory is a public online database that provides emissions estimates for 93 substances in Australia, together with the source and location of these emissions. Only facilities for which a National Pollutant Inventory pollutant reporting threshold has been exceeded are required to report to the National Pollutant Inventory.

National Pollutant Inventory data was examined for the municipalities of Banyule, Boroondara, Manningham, Whitehorse, Yarra and Nillumbik. Motor vehicle emissions accounted for the majority of air pollutant emissions reported to the National Pollutant Inventory across these local government areas, with industrial facilities also making a significant contribution in some areas.

Of the six municipalities, the highest motor vehicle emissions were reported for the City of Boroondara, which includes a section of the Eastern Freeway from the Yarra River in Fairfield near Yarra Boulevard to around Greythorn Road in Balwyn North.

The highest emissions from industry were reported for the City of Whitehorse, which has the highest number of industrial premises reporting emissions of the six municipalities. Reported air pollutant emissions from industry across the other local government areas for which data was reviewed were either relatively low, or there were no emissions from industrial facilities.

10.3.2   Existing air quality

Historical air quality data

EPA Victoria conducts long-term ambient air quality monitoring at monitoring stations to meet its obligations under the Air NEPM (as described in Section 10.2).

The EPA Victoria monitoring station closest to North East Link is the Alphington Ambient Air Quality Monitoring Station (AAQMS), located approximately 1.5 kilometres from the Eastern Freeway. This AAQMS was used to evaluate existing air quality, as it provides the most comprehensive dataset for CO, NO_2, PM_{10} and $PM_{2.5}$ in the vicinity of the project.

Data from the Alphington AAQMS were compared with the environmental quality objectives in the SEPP (AAQ) (as outlined in Table 10-1 of Section 10.2 above) to determine the level of compliance, and to provide an appreciation of existing air quality in the region.

The five most recent calendar years of data (2013 to 2017) were analysed and compared with long-term results dating back to 2005. A summary of Alphington AAQMS data from 2005 to 2017 against SEPP (AAQ) objectives is provided in Table 10-3 below.

This analysis found that air quality measured at the Alphington AAQMS is generally good. Key findings were:

- CO and NO_2 results complied with the SEPP (AAQ) environmental quality objective across all years

- Compliance with the environmental quality objectives for particulate matter was variable, with most exceedances attributed to bushfires, planned burns, dust storms in rural Victoria and urban sources, including smoke from wood heaters

- PM_{10} annual average results for 2013 to 2017 complied with the SEPP (AAQ) environmental quality objective, but 24-hour average results exceeded the environmental quality objective on several occasions

- The current $PM_{2.5}$ SEPP (AAQ) annual average environmental quality objective was exceeded on several occasions. $PM_{2.5}$ 24-hour average results also showed days of non-compliance with the SEPP (AAQ) environmental quality objective.

Table 10-3   Number of exceedances of SEPP (AAQ) at Alphington AAQMS, 2005–2017

Year	CO (8-hour)	NO_2 (1-hour)	PM_{10} (24-hour)*	$PM_{2.5}$ (24-hour)*
2005	0	0	0	3 (3)
2006	0	0	8 (0)	6 (3)
2007	0	0	2 (0)	3 (1)
2008	0	0	3 (0)	4 (0)
2009	0	0	6 (0)	2 (0)
2010	0	0	0	3 (0)
2011	0	0	0	0
2012	0	0	0	0
2013	0	0	0	1 (0)
2014	0	0	4 (4)	3 (3)
2015	0	0	0	0
2016	0	0	0	2 (2)
2017	0	0	0	8 (7)

* Values in parentheses represent the number of exceedances once exceptional events are excluded (such as bushfires, planned burns, dust storms).

The Alphington AAQMS does not monitor PAHs and VOCs (collectively known as 'air toxics'). Instead, existing levels of these pollutants were estimated based on air toxics concentrations measured by EPA Victoria at various locations across Melbourne, as shown in Table 10-4. This data is considered by EPA Victoria to provide the closest available approximation of air toxics levels within the study area.

Table 10-4   Existing air quality for PAH and VOCs

| Pollutant | Average concentration | | Units | Source |
	Maximum 24-hour	Annual		
PAH (Benzo(a)pyrene)	0.55	0.14	ng/m³	Yarraville, Francis Street, May 2012 to May 2013 (EPA Victoria, 2013)
Benzene	2.3	0.8	ppb	West Gate Freeway (Brooklyn) 2004 (EPA Victoria, 2004)
Toluene	11.5	6.0	ppb	West Gate Freeway (Brooklyn) 2004 (EPA Victoria, 2004)
Ethylbenzene	1.1	0.5	ppb	West Gate Freeway (Brooklyn) 2004 (EPA Victoria, 2004)
m&p Xylenes	3.5	1.1	ppb	West Gate Freeway (Brooklyn) 2004 (EPA Victoria, 2004)
o-Xylene	1.2	0.5	ppb	West Gate Freeway (Brooklyn) 2004 (EPA Victoria, 2004)
Formaldehyde	4.0	2.2	ppb	Carlton 2006 (EPA Victoria, 2014)
1,3-Butadiene	0.2	0.1	ppb	West Gate Freeway (Brooklyn) 2004 (EPA Victoria, 2004)

Further details relating to the ambient air quality of the North East Link receiving environment is provided in Section 6.6 Ambient air quality and Section 6.7 Overview of Technical Report B – Air quality.

Collecting additional air quality data

Five temporary ambient air quality monitoring stations have been established in the vicinity of North East Link to support the project's development. These are located:

- Just north of Grimshaw Street in Greensborough, next to the Hurstbridge rail line

- In Borlase Reserve, near the intersection of Greensborough Road and Lower Plenty Road in Yallambie

- Within the Trinity Grammar School Sporting Complex off Bulleen Road, in Bulleen

- At Belle Vue Primary School in Balwyn North, south of the off-ramp from the Eastern Freeway to Bulleen Road

- In Koonung Creek Reserve, near the off-ramp from the Eastern Freeway to Middleborough Road.

Air quality data collected at these stations will be presented to the EES Inquiry and Assessment Committee to enable comparison with the historical EPA Victoria Alphington AAQMS data.

10.3.3   Sensitive receptors

Sensitive receptors are locations where the land use requires 'a particular focus on protecting the beneficial uses of the air environment relating to human health and wellbeing, local amenity and aesthetic enjoyment' (EPA Victoria Publication No. 1518, *Recommended Separation Distances for Industrial Residual Air Emissions* (March 2013)).

North East Link would be located within an urban environment containing many locations where the land use is of a sensitive nature, principally residential receptors. However, a range of other sensitive receptors were identified as part of the social impact assessment (Technical Report I), including:

- **Educational facilities** –childcare centres, kindergartens and primary and secondary schools

- **Health and community facilities** –hospitals, aged care facilities and disability services

- **Other public facilities and services** –libraries, youth and community spaces and justice and emergency services

- **Recreational areas** –facilities for active indoor and outdoor sport and recreation, and passive open space such as parks and gardens.

The assessment of impacts associated with surface roads focused on sensitive receptors closest to the roads (as this is where the maximum impacts would occur) whereas the assessment of emissions from ventilation structures considered receptors in close proximity and remote from the sources, as emissions are dispersed widely.

10.4 Construction impact assessment

This section discusses the construction impacts associated with North East Link that relate to air quality.

The construction of North East Link may cause changes in air quality. The assessment of emissions to air during construction of a large road and tunnel project is complex. Emissions vary based on the range, type and number of construction activities, the geographical extent over which these activities occur and the intensity and duration of these activities.

As such, the air quality impacts associated with the construction of North East Link were assessed qualitatively. This section describes the nature of the proposed construction works, possible emission sources, the potential impacts and how these would be managed.

The potential impacts identified for the construction of North East Link that relate to air quality are grouped according to three main themes, being:

- Airborne particulate matter (dust) – including dust caused by vehicle movements on paved and unpaved surfaces, wind-generated particulate matter from disturbed soil or stockpiles, and emissions to air from concrete batching plants and asphalt plants

- Odours – due to asphalt plants and the sealing of constructed roads and from exposure of contaminated soils during excavation and spoil management

- Other emissions – from diesel and petrol-fuelled construction vehicles and earth moving machinery.

The potential for impacts associated with these main themes are discussed in the following sections.

10.4.1 Airborne particulate matter (dust)

Airborne particulate matter, or dust, has the greatest potential to impact air quality during the project's construction. Dust can be caused by earthworks, site clearance and establishment, and vehicle movements. Particulate matter impacts depend on the quantity and drift potential of the particles in the atmosphere. Larger dust particles settle close to their source due to their larger mass, while smaller particles can be dispersed at greater distances due to their greater drift potential. The handling and transfer of spoil and other building materials can also cause dust.

The risk pathways associated with dust and particulate matter generated during construction are described in Table 10-5, together with the residual risk rating assigned following additional or modified EPRs or design changes.

Table 10-5 Risk table: Construction – airborne particulate matter (dust)

Risk ID	Risk pathway	Risk rating
Risk AQ01	North East Link surface roads: site clearance & construction site establishment. Deposition of larger dust particles causing aesthetic impacts on buildings and vehicles at sensitive receptor locations.	Low
Risk AQ02	North East Link surface roads: earthworks. Deposition of larger dust particles causing aesthetic impacts on buildings and vehicles at sensitive receptor locations.	Medium
Risk AQ03	North East Link surface roads: earthworks. Generation of PM_{10} and $PM_{2.5}$ from soil disturbance causing health impacts at sensitive receptor locations.	Low
Risk AQ06	North East Link surface roads: construction of surface roads and other civil infrastructure. Deposition of larger dust particles causing aesthetic impacts on buildings and vehicles at sensitive receptor locations.	Medium
Risk AQ07	North East Link surface roads: construction of surface roads and other civil infrastructure. Generation of PM_{10} and $PM_{2.5}$ from soil and rock handling causing health impacts at sensitive receptor locations.	Medium
Risk AQ10	Tunnels: site clearance & construction site establishment. Deposition of larger dust particles causing aesthetic impacts on buildings and vehicles at sensitive receptor locations.	Low
Risk AQ11	Tunnels: Dive structure/portal and tunnel construction. Generation of odour and dust from tunnel ventilation during tunnel boring operations.	Medium

Construction activities associated with North East Link would generate airborne particulate matter of various sizes, including larger dust deposits, total suspended particulate matter (TSP), PM_{10} and $PM_{2.5}$.

Larger dust particles could cause nuisance impacts to the community and aesthetic impacts on buildings and vehicles at sensitive receptor locations. Smaller particles, defined as PM_{10} and $PM_{2.5}$, have the potential to impact upon health if emissions are not controlled (discussed further in Chapter 18 – Human health).

Dust generation during construction

Construction site clearance, site establishment and the construction of surface roads and other civil infrastructure could affect air quality through generation of both larger dust particles (risks AQ01, AQ06 and AQ10) and smaller particles (risk AQ07).

Potential dust-generating activities during construction include:

- The demolition of existing roadways and removal of existing asphalt pavement

- Vehicle movements on paved and unpaved roads (including vehicles transporting spoil)

- The construction of surface roads, bridges, pavements and viaducts

- Installation of above-ground infrastructure such as substations and ventilation structures

- Relocation of utility services.

The temporary ventilation system installed for the protection of people working in the tunnels also has the potential to generate some dust (risk AQ11).

Larger dust particles would be generated during earthworks required for the project's surface roads and tunnel sections, and these have the potential to cause aesthetic and nuisance impacts for sensitive receptors (risk AQ02). Earthworks may also release smaller particulate matter as PM_{10} and $PM_{2.5}$ (risk AQ03).

The tunnelling and surface road earthworks would involve excavation which would produce large amounts of spoil, as outlined in Chapter 8 – Project description (Section 8.8.1).

Spoil would typically be removed from the excavation sites and transported to stockpiles for storage using conveyors or off-road trucks (depending on the equipment used for excavation). The spoil would be trucked off-site for treatment and/or disposal. Spoil from tunnelling would primarily be stored south-west of the proposed Manningham Road interchange, between the Yarra River and the proposed northbound tunnel exit. The surrounding area is largely open space. Additional spoil management is proposed at the northern portal site in the vicinity of Lower Plenty Road, Yallambie.

There is the potential for the storage, handling and transportation of spoil material to generate airborne dust.

Dust management

A Dust and Air Quality Management and Monitoring Plan (DAQMMP) (EPR AQ1) would be developed and implemented by the contractors to minimise potential dust impacts. The DAQMMP would identify the main sources of dust and airborne pollutants, as well as the location of sensitive land uses and air quality monitoring equipment used to assess the effectiveness of mitigation measures. It would need to set out how the project would control dust emissions in accordance with SEPP (AQM) and EPA Victoria Publication 480 *Environmental Guidelines for Major Construction Sites*.

Specific mitigation measures outlined within the DAQMMP may include:

- Incorporating methods for management of emissions into project inductions, training and onsite 'toolbox' talks

- Locating dust-generating activities as far away from sensitive receptors as practical

- Scheduling known dust-generating activities to avoid adverse meteorological conditions (such as high winds during extended dry periods)

- Minimising land clearing and the duration that soil is exposed, including revegetating soil surfaces as soon as possible

- Fitting hardstand material to construction site access points to reduce the amount of soil being tracked offsite

- Erecting screens or wind breaks at construction sites

- Requirements relating to construction vehicles, including: enforcing construction site speed limits; covering vehicle loads; and securely fixing tailgates on trucks transporting spoil and other sources of dust

- Limiting vehicle movements to designated entries and exits, haulage routes and parking areas

- Washing away or sweeping mud and dirt tracked onto sealed roads

- Watering unpaved roads

- Daily inspections to assess the effectiveness of dust control measures.

Depending on the type of tunnelling equipment used, some form of dust extraction may also be required for the temporary tunnel ventilation system.

The contractors would be required to monitor air quality to determine the effectiveness of mitigation measures. The monitoring system, including monitoring requirements for key sensitive receptors, would form part of the DAQMMP.

A Spoil Management Plan (SMP) (EPR CL1) would be prepared and implemented by the contractors. This would include requirements for storage, handling, transport and disposal of spoil that consider the need to minimise dust generation during these activities. Specific worksite environmental management plans would also be developed for temporary stockpile areas.

Management measures may include minimising stockpiles and locating these away from sensitive receptors where practical, enclosing stockpiles in sheds, and enclosing the conveyors that would be used to transfer excavated material to the stockpiles. Stockpiles (and other exposed areas of soil) may also be dampened or covered to minimise dust generation.

10.4.2   Odours

Construction activities could generate odours that may impact sensitive receptors. Sources of odour may include:

- Exposure and management of contaminated soil

- Temporary tunnel ventilation during tunnel construction

- Producing and laying asphalt for surface roads and other civil infrastructure.

The risk pathways associated with odours generated during construction are described in Table 10-6, together with the residual risk rating assigned following additional or modified EPRs or design changes.

Table 10-6   Risk table: Construction – odours

Risk ID	Risk pathway	Risk rating
Risk AQ04	North East Link surface roads: earthworks. Generation of odour due to exposure, stockpiling and transportation of contaminated or anaerobic soil, with resultant aesthetic impacts on sensitive receptor locations.	Low
Risk AQ08	North East Link surface roads: construction of surface roads and other civil infrastructure. Generation of odour due to laying of asphalt with resultant aesthetic impacts on sensitive receptor locations.	Medium
Risk AQ11	Tunnels: Dive structure/portal and tunnel construction. Generation of odour and dust from tunnel ventilation during tunnel boring operations.	Medium
Risk AQ13	Tunnels: Tunnelling activities. Generation of odour from tunnel ventilation during tunnel boring operations and exposure, stockpiling and transportation of contaminated or anaerobic soil, with resultant aesthetic impacts on sensitive receptor locations.	Low

Odour from contaminated soils

Relatively small amounts of soil contamination are known to exist in the vicinity of the proposed North East Link alignment, as outlined in Chapter 23 – Contamination and soil. Nevertheless, construction of North East Link would involve excavation works that could expose contaminated, anaerobic or acid sulphate soils. When these contaminated soils are exposed to ambient air there is the potential for odour, which may be detectable close to the emission source. This is mostly due to the presence of VOCs and semi-volatile organic compounds (SVOCs). These compounds are also emitted to air from activities such as combustion processes, manufacturing industries and other industries using organic based solvents.

Odour may affect sensitive receptors during excavation, stockpiling or transportation of contaminated materials. This could occur when earthworks are undertaken for the surface roads (risks AQ04) and during tunnelling (risk AQ13).

Odours from contaminated, anaerobic or acid sulphate soils are expected to be localised and only detectable close to the source.

Odour from other sources during construction

Odour may also be generated during other construction activities, including:

- Temporary tunnel ventilation during tunnel construction – A temporary ventilation system would be employed on the tunnelled sections of the project. There is the potential for these systems to generate some odour during tunnelling (risks AQ11 and AQ13) that could be detected by sensitive receptors close to the source.

- Production and laying asphalt – The production and laying of asphalt for North East Link surface road works and for other civil infrastructure is expected to generate some odour, which has the potential to impact nearby sensitive receptors (risk AQ08). The odour from asphalt laying is due to the release of VOCs and sulphur compounds within the asphalt mix. It is expected that odour released during asphalt laying would only be detectable close to the construction sites, and would typically dissipate completely after the asphalt has been in place for a short period of time.

Odour management

The contractors would be required to develop and implement a Spoil Management Plan (SMP) containing measures for spoil management during the excavation, stockpiling and transportation of contaminated material (EPR CL1). This would require identification of areas of contamination that may pose an odour risk, monitoring of excavated material for possible odour risk, and management measures to minimise odour (EPR CL3).

Stockpile odour management measures may include minimising stockpiles and locating these away from sensitive receptors, where practical. Stockpiles may also be covered or enclosed within a shed to minimise odour.

As outlined in Section 10.4.1 above, the contractors would develop and implement a DAQMMP (EPR AQ1) which would set out how odour would be controlled during construction.

All construction sites and stockpile areas would be inspected daily and as required in the CEMP and DAQMMP to assess the effectiveness of odour control measures.

10.4.3 Other emissions

There is the potential for diesel and petrol-fuelled construction vehicles and the operation of construction machinery to produce emissions of CO, NOx, SO_2, VOCs, SVOCs (including PAH) and trace levels of heavy metals.

The risk pathways associated with air emissions from these products of combustion during construction are described in Table 10-7, together with the residual risk rating assigned following additional or modified EPRs or design changes.

Table 10-7   Risk table: Construction – other emissions

Risk ID	Risk pathway	Risk rating
Risk AQ05	North East Link surface roads: earthworks. Products of combustion (including PM_{10}, $PM_{2.5}$, CO, NOx, SO_2, VOC and SVOC) resulting from operation of diesel fuelled heavy equipment impacting on sensitive receptor locations.	Low
Risk AQ09	North East Link surface roads: construction of surface roads and other civil infrastructure. Products of combustion (including PM_{10}, $PM_{2.5}$, CO, NOx, SO_2, VOC and SVOC) resulting from operation of diesel fuelled heavy equipment impacting on sensitive receptor locations.	Low

The products of combustion from the operation of diesel-fuelled heavy equipment may cause air quality impacts for sensitive receptors while earthworks and other construction activities are being undertaken to build the North East Link surface roads (risks AQ05 and AQ09). There may also be emissions from construction vehicles (including trucks carrying spoil) that could impact sensitive receptors, although these risks are considered low.

Actual emission rates and impacts would depend on the number and power outputs of the combustion engines, the quality of the fuel and engine maintenance. It is expected that impacts associated with emissions from these sources would be minor, particularly as the operation of heavy machinery that is mostly likely to produce these emissions would largely be intermittent and of limited duration.

As outlined in Section 10.4.1 above, the contractors would develop and implement a DAQMMP which would set out how airborne pollutants would be controlled during construction.

Management measures that would be implemented to minimise these emissions or reduce their potential impact include, but are not limited to:

- Effectively maintaining vehicles and plant machinery in good working order

- Limiting vehicle movements to designated entries and exits, haulage routes and parking areas

- Switching off idling engines or throttling these down to a minimum when not in use for more than 15 minutes.

Emissions from trucks during construction would be regulated in accordance with the requirements of the National Environment Protection (Diesel Vehicle Emissions) Measure (2001).

10.5   Operation impact assessment

This section discusses the operational impacts associated with North East Link that relate to air quality.

The potential air quality impacts associated with operation of North East Link primarily relate to:

- Exhaust emissions from vehicles using North East Link and other roads, and how these may vary based on changes to traffic volumes and types of traffic in surrounding areas (both positive and negative impacts)

- Vehicle exhaust emissions discharged from the road tunnel ventilation system.

The assessment of air quality impacts associated with the operation of North East Link involved analysis of the following three aspects:

- Surface road vehicle emissions – modelling was undertaken to quantify the potential changes in air quality due to vehicle emissions along surface roads associated with or impacted by North East Link, as a result of predicted changes to traffic volumes and types of traffic

- Tunnel ventilation and emissions – modelling was undertaken to quantify the potential changes in air quality due to emissions from the North East Link tunnel ventilation system, which would disperse emissions from vehicles travelling through the tunnels

- Combined air quality impacts from tunnel and vehicle emissions – the combined impacts of the surface road vehicle emissions and emissions from the tunnel ventilation system were modelled.

The potential for impacts associated with these aspects are discussed in the following sections.

10.5.1   Air quality modelling and assessment approach

This section describes the application of a dispersion model to predict changes in air emissions and air quality during operation of North East Link.

A dispersion model estimates the concentrations of air pollutants by using mathematical algorithms to predict how the pollutants disperse through the air.

Air quality dispersion modelling for North East Link was undertaken in accordance with the SEPP (AQM) using EPA Victoria's regulatory air pollution model, AERMOD (Version 15181), which was developed by the American Meteorological Society and the United States Environmental Protection Agency.

The modelling was used to predict changes in air quality along and around surface roads where traffic volumes would likely change, or where the types of traffic would be different during operation of North East Link (for example, along roads where the number of trucks is predicted to decrease or increase significantly). Modelling of surface road vehicle emissions predicted ground level concentrations of particulate matter (PM_{10} and $PM_{2.5}$) and NO_2.

The modelling was also used to predict the changes in air quality associated with emissions from vehicles travelling through the North East Link tunnels. These emissions would be discharged through the ventilation structures and dispersed into the atmosphere. Modelling of tunnel ventilation structure emissions predicted ground level concentrations of all pollutants listed in Section 10.3.

To inform the impact assessment, air quality modelling was undertaken for the years 2026 and 2036 (based on predicted traffic volumes on North East Link and nearby arterial roads for these years) and compared with a 'no-project' scenario.

Predicted traffic volumes for the years 2026 and 2036 are understood to be generally representative of the 'expected year of opening' and '10 years following project opening'.

For each modelled pollutant and each modelling scenario (2026 and 2036), the most affected receptor location was identified and assessed. The most affected receptor is the sensitive receptor predicted to experience the highest concentration of pollutants. As air dispersion results in a rapid decrease in concentrations with greater distance from the emission source, the most affected receptor represents a worst case scenario, with all other receptors affected by lower concentrations.

As there are no regulatory criteria for assessing surface road vehicle emissions, the assessment of surface road vehicle emissions focused on evaluating incremental change in air quality with North East Link due to vehicle emissions when compared with the 'no project' scenario.

The assessment of tunnel ventilation structure emissions was based on the SEPP (AQM) Schedule A design criteria shown in Table 10-2 of Section 10.2.

The surface road vehicle emissions and emissions from the tunnel ventilation system were modelled together with the background pollutant concentrations to assess the combined impacts of the project. The predicted ground level concentrations of PM_{10}, $PM_{2.5}$ and NO_2 were compared against the SEPP (AAQ) objectives shown in Table 10-1 of Section 10.2. This was done for comparative rather than compliance purposes in the absence of regulatory criteria relevant to roadside locations.

Modelling inputs and assumptions

The modelling was based on a set of conservative inputs and assumptions that are summarised below.

Meteorology and topography

Air quality and the dispersal and transport of pollutants is influenced by topography. At the northern end of the project, land surrounding the M80 Ring Road and around the Plenty River in Greensborough is undulating, with the lowest elevations occurring along the river. Further south, Watsonia North, Watsonia and Yallambie are approximately 80 metres above sea level, and then the land gently slopes further south toward the Warringal Parklands and Banyule Flats, where the elevation can be as low as 10 metres. Much of the Eastern Freeway is also located at low elevation, increasing to 80 metres at the intersection with Springvale Road. The land adjoining the Eastern Freeway generally increases in elevation on either side, except at Yarra Bend Park and in the area to the north of the freeway between Chandler Highway and Burke Road, which is low lying land occupied by golf courses and river flats.

Air quality is also influenced by regional meteorological conditions, primarily wind speed and direction. EPA Victoria requires that modelling be conducted using five years of meteorological data, with the results of the worst-case year being used as the basis for the assessment. Meteorological data collected at the Bureau of Meteorology Automatic Weather Station at Viewbank from 2013- 2017 was used. The worst-case year for the modelling of the surface road vehicle emissions was found to be 2016, and for modelling of the tunnel ventilation emissions the worst-case year was 2017. The meteorological year chosen to assess the combined impacts was the same as for the surface road vehicle emissions (2016), as the sensitive receptors considered in this assessment would primarily be impacted by vehicle emissions from surface roads rather than vehicle emissions from the tunnel ventilation system.

Background pollutant concentrations

As described in Section 10.3.2, the Alphington AAQMS results are a good indicator of existing air quality in the study area. This dataset for the years 2013-2017 was therefore adopted to represent background air quality for PM_{10}, $PM_{2.5}$, CO and NO_2. Adopting these background pollutant concentrations from 2013 to 2017 when modelling air quality in the years 2026 and 2036 is conservative, as:

- EPA Victoria predicts a significant reduction in CO and NO_2 concentrations over the next 20 years through cleaner exhaust emissions from petrol, diesel and LPG engines and improvements in national motor vehicle emission standards. Similarly, a significant reduction in particle emissions ($PM_{2.5}$) from diesel vehicle engines is expected by 2030. Concentrations of these pollutants in 2026 and, in particular for 2036, are expected to be lower than those used as background levels in the air quality impact assessment.

- The adopted background concentrations for PM_{10}, $PM_{2.5}$, CO and NO_2 include exceptional events such as bushfires, controlled burns and dust storms. During these periods, concentrations of particulate matter (PM_{10} and $PM_{2.5}$) can reach extremely high levels. Including data from these events as representative of background concentrations for the project is highly conservative.

The background air quality values for PAHs and VOCs were determined in consultation with EPA Victoria. These are presented in Table 10-4 of Section 10.3.2.

Vehicle emissions

The traffic volumes and vehicle types (or 'fleet composition') that informed the air quality modelling were based on data from the traffic modelling undertaken for North East Link. AERMOD requires hourly pollutant emission rates for each modelled road. Emission rates for each hour of the day were calculated based on predicted traffic data and vehicle speeds for the selected roads and tunnels within the study area.

Emissions from vehicles in the tunnels and on selected surface roads were calculated using adjusted COPERT (Computer Programme to calculate Emissions from Road Transport) Australia vehicle emission factors for the 2010 Victorian fleet and projected diurnal weekday traffic conditions. Scenarios were initially modelled based on the 2010 COPERT factors adjusted by World Road Association (PIARC) factors that account for the future year 2020 and road gradient.

The approach to calculating vehicle emissions is considered to be conservative because:

- The upper limit of the predicted traffic volume range provided for all roads was selected

- Vehicle emission factors for 2026 and 2036 were assumed to remain at levels predicted for 2020 – these levels are considered to be conservatively high, as expected improvements in vehicle technology beyond 2020 are not accounted for

- Hybrid and electric vehicles were not considered in the fleet composition – the proportion of lower emission and zero emission vehicles in the Victorian vehicle fleet is expected to increase significantly in future years

- Acoustic barriers were assumed to have no effect on pollutant concentrations downwind even though there is a significant body of evidence to suggest that acoustic barriers reduce pollutant concentrations immediately downwind of roadways at the most impacted sensitive receptors.

Vehicle emissions factors for 2025 were also used to provide a realistic indicator of future vehicle emissions for:

- Surface roads in 2036

- Tunnel ventilation structure emissions in 2026 and 2036

- The combined air quality impacts associated with emissions from vehicles and from the tunnel ventilation system in 2026 and 2036.

Emission factors in this instance were still based on the 2010 COPERT factors. However, they were adjusted by the relative factors for the Brisbane vehicle fleet in 2010 and 2025 and PIARC road gradient factors. Further details on the modelling approach regarding emissions factors are provided in Section 9.4.3 of Technical Report B – Air quality.

10.5.2   Surface road vehicle emissions

Changes to traffic volumes and patterns on North East Link surface (non-tunnel) roads and other surface roads within the study area have the potential to affect air quality during its operation through increased or decreased vehicle emissions.

The risk pathways associated with air quality changes due to surface road vehicle emissions during the operation of North East Link are described in Table 10-8, together with the residual risk rating assigned following additional or modified EPRs or design changes.

Table 10-8   Risk table: Operation – surface road vehicle emissions

Risk ID	Risk pathway	Risk rating
Risk AQ14	Eastern Freeway and North East Link operations: Adverse impact on sensitive receptors from air quality changes associated with operation and maintenance of project (taking into account ventilation system and surface road emissions) and compared to no project situation, based on traffic volume projections	Low
Risk AQ15	Eastern Freeway and North East Link operations: Underestimation of traffic volumes resulting in higher than anticipated ambient air quality impacts on sensitive receptors.	Medium

The potential impacts associated with each of the risk pathways above are discussed in the following sections.

Vehicle emissions – modelled impacts

Air dispersion modelling was undertaken to quantify the potential changes in air quality due to vehicle emissions along surface roads associated with or impacted by North East Link, as a result of predicted changes to traffic volumes and types of traffic (risk AQ14). The analysis focuses on changes to the maximum concentrations of pollutants of interest at the most affected receptors.

Road traffic data was provided for passenger cars, light commercial vehicles and heavy commercial vehicles over three time periods: morning peak (7 am to 9 am); afternoon peak (4 pm to 6 pm); and total daily traffic over 24 hours. To minimise any possibility of underestimating the traffic volumes (risk AQ15), the maximum predicted traffic volume for each of the morning peak, afternoon peak and daily traffic periods was selected for modelling.

As described in Section 10.5.1 above, air quality was modelled at sensitive receptor locations (such as residential property boundaries) to predict maximum pollutant concentrations in 2026 and 2036, using meteorological data from 2016. The 25 roads included in the model are listed in Table 10-9 below. These roads were selected based on the predicted changes in traffic volumes or traffic types that would occur with North East Link (discussed further in Chapter 9 – Traffic and transport). Roads were selected to be modelled if:

- The number of vehicles predicted in either the 'no project' or 'with project' scenarios is greater than 30,000 vehicles per day, with the change in total vehicles under the 'with project' scenario greater than an increase or decrease of 25 per cent

- The volume of trucks predicted in either the 'no project' or 'with project' scenarios is greater than 1,000 vehicles per day, with the change in the volume of trucks under the 'with project' scenario greater than an increase or decrease of 25 per cent.

Maximum pollutant concentrations along each road were generally predicted to occur near intersections, where contributions from several pollutant sources would impact a single receptor. The maximum pollutant concentrations predicted to occur with North East Link were anticipated to arise on only two days in the modelled year for PM_{10} and $PM_{2.5}$, and during a period of only nine hours in the modelled year for NO_2, depending on the road under consideration.

Table 10-9   Surface roads included in North East Link air quality dispersion modelling

Modelled surface roads and location of modelled section	
Albert Street – from Bell Street to Plenty Road	Grimshaw Street – from Watsonia Road to Greensborough Road
Banksia Street – from Bulleen Road to Bell Street	High Street – from Settlement Road to M80 Ring Road
Bell Street – from High Street to Plenty Road	Keon Parade – from High Street to Dalton Road
Bolton Street – from Bridge Street to Main Road	Lower Plenty Road – from Rosanna Road to Greensborough Road
Broadway – from High Street to Bolderwood Parade	M80 Ring Road – from M80 Ring Road interchange to Hume Freeway
Bulleen Road – from Eastern Freeway to Manningham Road	Main Road – from Para Road to Bolton Street
Chandler Highway – from Eastern Freeway to Heidelberg Road	Manningham Road – from Thompsons Road to Williamsons Road
Dalton Road – from Childs Road to McKimmies Road	Middleborough Road – from Whitehorse Road to Eastern Freeway
Darebin Road – from Station Street to Grange Road	Plenty Road – from Albert Street to M80 Ring Road
Eastern Freeway – from Springvale Road to Bulleen Rd, and from Bulleen Road to Hoddle Street	Reynolds Road – from Blackburn Road to Williamsons Road

Modelled surface roads and location of modelled section	
Fitzsimons Lane – from Reynolds Road to Main Road	Rosanna Road – from Lower Heidelberg Road to Lower Plenty Road
Grange Road – from Darebin Road to Heidelberg Road	Station Street – from Bell Street to Darebin Road
Greensborough Road (North East Link) – from Lower Plenty Road to M80 Ring Road*	Williamsons Road – from Foote Street to Warrandyte Road

* The modelling results present combined impacts for Greensborough Road and North East Link between Lower Plenty Road and the M80 Ring Road, given the close proximity of these roads in this location.

As described in the air quality modelling and assessment approach in Section 10.5.1 above, the modelling results presented in this section represent the incremental change in air quality due to vehicle emissions on selected surface roads with North East Link when compared with the 'no project' scenario. These results do not consider the background concentration of pollutants from other sources.

North East Link is predicted to reduce the volume of traffic travelling along most of the roads that were assessed for changes in air quality. Accordingly, the modelling indicates that with North East Link operating in 2026 and 2036, air quality would improve along most of the roads that were assessed compared against the 'no project' scenario. The predicted reduction in air pollutants is directly related to the forecast reduction in traffic volumes along these roads.

For example, the diversion of a significant proportion of heavy commercial vehicle traffic off Rosanna Road and onto North East Link is modelled to reduce the surface road contribution to the maximum concentrations of PM_{10}, $PM_{2.5}$ and NO_2 along this road in 2026 and 2036. Compared with the 'no project' scenario, modelling with North East Link indicates that:

- The 24-hour average maximum concentrations of PM_{10} and $PM_{2.5}$ are predicted to decrease 26 to 30 per cent across both modelled years

- Annual average PM_{10} and $PM_{2.5}$ concentrations are predicted to decrease 31 to 36 per cent across both years

- One-hour average NO_2 is predicted to decrease 46 to 47 per cent across both years and annual average NO_2 is predicted to decrease 39 to 40 per cent across both years.

For Manningham Road there would be a mix of changes with PM_{10}, $PM_{2.5}$ and annual average NO_2 concentrations decreasing 24 to 30 per cent in 2026 and 2036. However, one-hour average NO_2 concentrations show an increase of 3 per cent with the project in 2026 and a decrease of 5 per cent in 2036.

The decreases in maximum PM_{10}, $PM_{2.5}$ and annual average NO_2 concentrations on Manningham Road are due to an approximate 70 per cent decrease in average daily heavy commercial vehicles and a 25 per cent decrease in average daily total vehicles under the 'with project' scenario. The slight changes in one-hour average NO_2 concentrations are due to increased traffic volumes on parts of the Eastern Freeway and Eastern Freeway – North East Link interchange, resulting in the maximum concentrations with and without the project varying by location, time and meteorological conditions.

The modelling indicates that air quality would be impacted along some roads when compared with the 'no project' scenario, due to predicted increases in traffic volumes along these roads when North East Link is operating. The largest increases in maximum pollutant concentration were predicted to occur along the North East Link alignment between Yallambie Road and the M80 Ring Road interchange. The changes in air quality along these roads are discussed in this section.

Bulleen Road

The number of trucks travelling along Bulleen Road is expected to decrease significantly with North East Link (refer to Chapter 9 – Traffic and transport). However, the close proximity of the North East Link Manningham Road interchange is anticipated to impact air quality along Bulleen Road.

The modelling predicts the maximum concentrations of PM_{10}, $PM_{2.5}$ and NO_2 would increase with North East Link compared with the 'no project' scenario. The maximum concentrations for these pollutants are predicted to occur on the eastern side of Bulleen Road close to Avon Street, which is a residential neighbourhood approximately 350 metres from the intersection with Manningham Road.

When comparing the project to the 'no project' scenario for Bulleen Road in 2026 and 2036, increases in the maximum concentrations of all modelled pollutants are predicted. The 24-hour average PM_{10}, and $PM_{2.5}$ concentrations from traffic sources are predicted to increase 29 to 33 per cent across the modelled years of 2026 and 2036, with annual average concentrations increasing 21 to 23 per cent across both years. One-hour average NO_2 concentrations from traffic sources are predicted to increase 5 to 7 per cent across both modelled years, with annual averages predicted to increase 19 to 21 per cent across both years.

Dalton Road

Dalton Road is a north-south arterial road adjoining the M80 Ring Road in Thomastown. The number of trucks travelling along Dalton Road is expected to increase with North East Link in operation. By 2036, there would be predicted increases in heavy commercial vehicles between Childs Road and McKimmies Road and between McKimmies Road and the M80 Ring Road with North East Link (when compared with the 'no project' scenario).

As a result, the maximum concentrations of PM_{10}, $PM_{2.5}$ and NO_2 are predicted to increase by around 6 to 9 per cent with North East Link compared with the 'no project' scenario in 2026, and to increase 5 to 10 per cent with North East Link in 2036.

These maximum pollutant concentrations would occur along Dalton Road approximately 270 metres from the intersection with the M80 Ring Road, near the start of the residential area.

Eastern Freeway

Total traffic volumes as well as the number of trucks travelling along the Eastern Freeway are expected to increase significantly with North East Link by 2036. The predicted volumes are included in Chapter 9 – Traffic and transport.

The increase is traffic volumes is anticipated to affect air quality in the vicinity of the freeway. Increases in the maximum concentrations of all modelled pollutants are predicted to occur along the Eastern Freeway with North East Link in both 2026 and 2036 compared with the 'no project' scenario. The changes in air quality would vary depending on the traffic volumes expected along each section of the freeway.

The smallest increases in pollutant concentrations are anticipated along the section of the freeway between Bulleen Road and Hoddle Street. The maximum concentrations of PM_{10}, $PM_{2.5}$ and NO_2 are predicted to increase 25 to 33 per cent with North East Link compared with the 'no project' scenario in 2026, and to increase 27 to 36 per cent with North East Link in 2036.

The largest increases in pollutant concentrations are anticipated along the section of the freeway between Elgar Road and Bulleen Road. Increases in maximum pollutant concentrations are predicted to range from 87 per cent (one-hour average NO_2) to 130 to 136 per cent (24-hour average PM_{10} and $PM_{2.5}$) with North East Link compared with the 'no project' scenario in 2026, and from 96 per cent (one-hour average NO_2) to 145 to 152 per cent (24-hour average PM_{10} and $PM_{2.5}$) with North East Link in 2036.

The maximum pollutant concentrations for 24-hour average and annual average PM_{10} and $PM_{2.5}$ were predicted to occur:

- Between Springvale Road and Middleborough Road – on the southern side of Eastern Freeway, west of Blackburn Road adjacent the west bound entry ramp

- Between Middleborough Road to Elgar Road – on the northern side of Eastern Freeway at the intersection with Tram Road

- Between Elgar Road and Bulleen Road – 24-hour average PM_{10} and $PM_{2.5}$ maximum concentrations on the southern side of the Eastern Freeway approximately half way between Elgar Road and Doncaster Road, annual average PM_{10} and $PM_{2.5}$ maximum concentration on the northern side of the Eastern Freeway close to the Elgar Road west bound exit ramp

- Between Bulleen Road and Hoddle Street – 24-hour average PM_{10} and $PM_{2.5}$ maximum concentrations on the southern side of the Eastern Freeway approximately close to Meldrum Street, annual average PM_{10} and $PM_{2.5}$ maximum concentration on the northern side of the Eastern Freeway close to Belford Road.

The maximum pollutant concentrations for one-hour average and annual average NO_2 were predicted to occur:

- Between Springvale Road and Middleborough Road – on the southern side of the Eastern Freeway at the intersection with Blackburn Road

- Between Middleborough Road to Elgar Road – on the northern side of the Eastern Freeway at the intersection with Tram Road

- Between Elgar Road and Bulleen Road – on the northern side of the Eastern Freeway close to the Elgar Road westbound exit ramp

- Between Bulleen Road and Hoddle Street – on the northern side of the Eastern Freeway close to Belford Road.

Grimshaw Street

The number of trucks travelling along Grimshaw Street between Watsonia Road and Greensborough Road is expected to increase with North East Link.

As a result, the maximum concentrations of PM_{10}, $PM_{2.5}$ and NO_2 are predicted to increase with North East Link in both 2026 and 2036. PM_{10} concentrations are predicted to increase 7 to 11 per cent across both years, while $PM_{2.5}$ concentrations are predicted to increase 18 to 23 per cent across both years. One-hour average NO_2 concentrations are predicted to increase 30 per cent in 2026 and 27 per cent in 2036. Annual average NO_2 concentrations are predicted to increase 36 to 37 per cent across both years.

These maximum pollutant concentrations are predicted to occur along Grimshaw Street close to Fyre Street, approximately 200 metres west of the intersection with Greensborough Road.

Keon Parade

Keon Parade is an east-west arterial road that runs just south of the M80 Ring Road in Reservoir. An increase in heavy commercial vehicle traffic is predicted by 2036 with North East Link when compared with the 'no project' scenario.

The increase in truck traffic with North East Link is predicted to result in an increase in PM_{10}, $PM_{2.5}$ and NO_2 are predicted to increase in 2026 and 2036. PM_{10} and $PM_{2.5}$ concentrations are predicted to increase 8 per cent in 2026 and 2036. NO_2 concentrations are predicted to increase 8 to 12 per cent across both years.

These maximum concentrations are predicted to occur on the southern side of Keon Parade at the intersection with High Street.

M80 Ring Road

As for the Eastern Freeway, total traffic volumes as well as the number of trucks travelling along the M80 Ring Road are expected to increase significantly with North East Link by the year 2036. The predicted volumes are included in Chapter 9 – Traffic and transport.

As a result of the increase traffic volumes, increases in the maximum concentrations of all modelled pollutants are predicted to occur along the M80 Ring Road with North East Link in 2026 and 2036 compared with the 'no project' scenario. The changes in air quality would vary depending on the traffic volumes expected along each section of the freeway.

The largest increases in pollutant concentrations are anticipated to occur on the northern side of the M80 Ring Road, approximately 500 metres from the interchange, along Eastgate Drive. The maximum concentrations of 24-hour average PM_{10} and $PM_{2.5}$ concentrations are predicted to increase by 162 to 177 per cent across 2026 and 2036 with North East Link when compared with the 'no project' scenario. Annual average PM_{10} and $PM_{2.5}$ concentrations are predicted to increase by 189 to 205 per cent across both years with North East Link when compared with the 'no project' scenario. One-hour average NO_2 is predicted to increase by 172 to 177 per cent across both years, and annual average NO_2 is predicted to increase by 214 to 225 per cent across both years when compared with the 'no project' scenario.

During operation, maximum pollutant concentrations are also anticipated to increase along the section of the freeway between the M80 Ring Road interchange and Plenty Road, but the increases would not be as large as those described above. Maximum concentrations for 24-hour average PM_{10} and $PM_{2.5}$ and one-hour average NO_2 are predicted to occur on the southern side of the M80 Ring Road at the intersection with Plenty Road. Maximum concentrations for annual average PM_{10} and $PM_{2.5}$ and NO_2 are predicted to occur on the northern side of the M80 Ring Road approximately one kilometre from the Plenty Road intersection at Killarney Ridge.

Small increases in pollutant concentrations would be expected along the M80 Ring Road between Plenty Road and the Hume Freeway during operation. The 24-hour and annual average PM_{10} and $PM_{2.5}$ concentrations are predicted to increase 11 to 13 per cent across 2026 and 2036 with North East Link compared with the 'no project' scenario. One-hour and annual average NO_2 concentrations are predicted to increase 10 to 14 per cent in 2026 and 11 to 14 per cent in 2036 with North East Link.

Maximum concentrations for 24-hour average PM_{10} and $PM_{2.5}$ and annual average PM_{10}, $PM_{2.5}$ and NO_2 with North East Link are predicted to occur on the northern side of the M80 Ring Road at the intersection with the Hume Freeway interchange. Maximum concentrations for one-hour average NO_2 are predicted to occur on the northern side of the M80 Ring Road, approximately 200 metres west of High Street.

Middleborough Road

Middleborough Road is a north-south arterial road adjoining the southern side of the Eastern Freeway in Blackburn. With North East Link, an increase in heavy commercial vehicle traffic is predicted between Whitehorse Road and the Eastern Freeway by 2036 when compared with the 'no project' scenario.

The increase in truck traffic with North East Link is predicted to increase PM_{10}, $PM_{2.5}$ and NO_2 in 2026 and 2036 compared with the 'no project' scenario. PM_{10} and $PM_{2.5}$ concentrations are predicted to increase 19 to 24 per cent across 2026 and 2036. One-hour average NO_2 is predicted to increase 26 to 28 per cent across both years and annual average NO_2 is predicted to increase 23 to 28 per cent across both years with North East Link.

These maximum concentrations are predicted to occur along Middleborough Road approximately 200 metres from the intersection with the Eastern Freeway.

Greensborough Road (North East Link)

The addition of North East Link alongside Greensborough Road is anticipated to increase the maximum concentrations of PM_{10}, $PM_{2.5}$ and NO_2 in the modelled years of 2026 and 2036 compared with the 'no project' scenario.

Near the Lower Plenty Road interchange, the maximum concentrations of all pollutants during operation are predicted to occur on the western side of Greensborough Road, opposite Blamey Road. The 24-hour average PM_{10} and $PM_{2.5}$ are predicted to increase 18 to 21 per cent in 2026 and 21 to 24 per cent in 2036 with North East Link. Annual average PM_{10} and $PM_{2.5}$ are predicted to increase 6 to 9 per cent in 2026 and by 9 to 12 per cent in 2036. One-hour and annual average NO_2 concentrations are predicted to increase 41 to 42 per cent in 2026 and 47 per cent in 2036.

Between Lower Plenty Road and Grimshaw Street, the maximum concentrations of pollutants are predicted to occur on the eastern side of the Greensborough Road between the Yallambie Road and Watsonia Road intersection, approximately 50 to 100 metres north of Yallambie Road. The 24-hour average PM_{10} and $PM_{2.5}$ are predicted to increase 85 to 100 per cent in 2026 and 93 to 110 per cent in 2036 with North East Link compared with the 'no project' scenario. Annual average PM_{10} and $PM_{2.5}$ are predicted to increase 104 per cent to 129 per cent across both years. One-hour and annual average NO_2 concentrations are predicted to increase 244 to 253 per cent in 2026 and 264 to 272 per cent in 2036 with North East Link.

Linear concentration plots for 2036 along North East Link from Lower Plenty Road to the M80 Ring Road interchange for PM_{10}, $PM_{2.5}$ and NO_2 are shown in Figure 10-1. The blue area represents the maximum predicted concentration at each receptor over the entire year for the 'no project' scenario, and the orange area represents the maximum predicted concentration at each receptor over the entire year during operation. These plots are a visual representation of the changes in air quality that are anticipated at this location as a result of North East Link.

Additional modelling was subsequently conducted for 2036 utilising the vehicle emission factors for 2025 described in Section 10.5.1. A comparison of modelling predictions using the 2020 and 2025 emission factors at the most impacted sensitive receptor adjacent to North East Link/Greensborough Road showed the maximum ground level concentrations (without background) would decrease by 28 per cent for PM_{10}, 47 per cent for $PM_{2.5}$ and 57 to 62 per cent for NO_2 with the 2025 factors.

For all modelled surface roads, application of 2025 emission factors reduces the average predicted PM_{10} concentration project contribution (without background) by 7 per cent compared to that predicted using the 2020 emission factors, with a maximum decrease of 29 per cent predicted to occur on North East Link.

For $PM_{2.5}$, the average reduction using 2025 emission factors compared to 2020 emission factors across all modelled roads is 30 per cent, with a maximum decrease of 46 per cent occurring on North East Link. For NO_2, the average reduction across all modelled roads is 70 per cent with a maximum decrease of 76 per cent occurring on the Eastern Freeway.
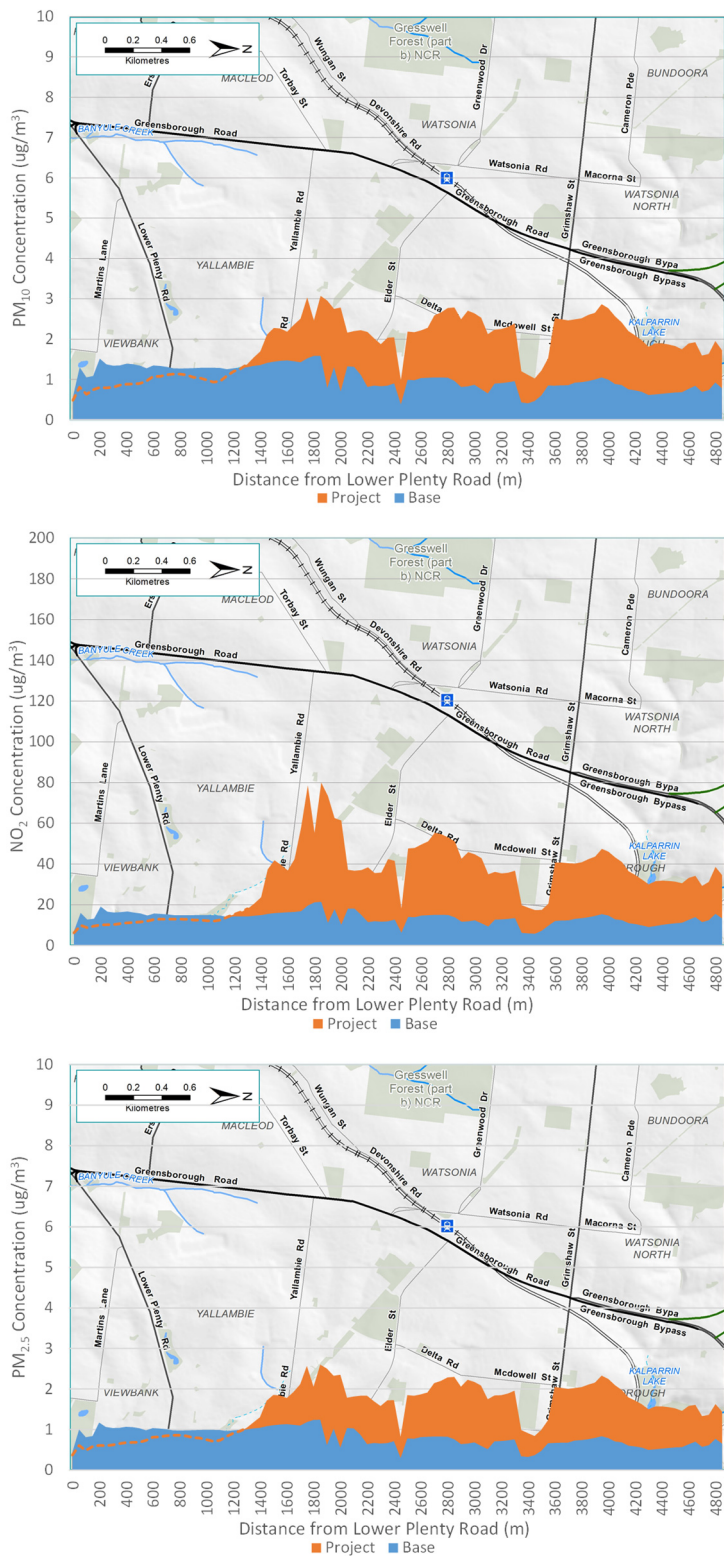
Figure 10-1   North East Link maximum 24-hour PM$_{10}$ and PM$_{2.5}$ concentrations and one hour NO$_2$ concentrations – 2036

Management of surface road vehicle emissions

The most effective means of reducing the impact of pollutant emissions from vehicles on surface roads is developments in low emission vehicle technology (such as electric vehicles) and emissions regulation.

However, at a project level, the best practice options for managing air quality associated with vehicle emissions principally relate to the effectiveness of vegetative and acoustic barriers installed between the road and adjoining residential properties or other sensitive receptors.

Pollutant concentrations behind a barrier located downwind of a roadway are typically lower than concentrations in the absence of the barrier. Vegetative barriers have major disadvantages in an urban environment because of the minimum thickness required and the time taken for the barrier to become established. However, acoustic barriers or noise walls constructed as part of the project could mitigate the effects of surface road vehicle emissions on air quality. The effectiveness of acoustic barriers at mitigating near-road pollutant exposure depends on roadway configuration, local meteorology and barrier height, design and endpoint location.

North East Link Project (NELP) would be required to undertake an ambient air quality monitoring program in consultation with EPA Victoria. The ambient air quality monitoring program must include at least one year of monitoring before operation (EPR AQ4). This monitoring would inform the implementation of any mitigation measures.

10.5.3   Tunnel ventilation and emissions

The tunnels would be a key feature of North East Link. The reference project includes twin tunnels of approximately six kilometres in length with ventilation structures at the exits of each tunnel.

North East Link has the potential to affect air quality with the operation of the tunnel ventilation system, which would disperse emissions from vehicles travelling through the tunnels.

The risk pathways associated with emissions from the tunnel ventilation system are described in Table 10-10, together with the residual risk rating assigned following additional or modified EPRs or design changes.

Table 10-10 Risk table: Operation – tunnel emissions

Risk ID	Risk pathway	Risk rating
Risk AQ16	Tunnel operations: Impact on sensitive receptors due to NO_2, PM_{10} and $PM_{2.5}$ emissions to air from the tunnel portals and ventilation system.	Low
Risk AQ17	Tunnel operations: Impact on sensitive receptors due to emissions to air of pollutants other than NO_2, PM_{10} and $PM_{2.5}$ from the tunnel portals and ventilation system.	Low
Risk AQ18	Tunnel operations: Potential impact on road users due to in-tunnel air quality.	Low
Risk AQ19	Tunnel operations: Underestimation of traffic volumes resulting in higher than anticipated ambient air quality impacts on road tunnel users and sensitive receptors.	Low

The potential impacts associated with each of the risk pathways above are discussed in the following sections.

Ventilation structures and ventilation system design

The tunnel ventilation system would include two ventilation structures, each approximately 40 metres high and located in the vicinity of the northern tunnel portal near Blamey Road (within Simpson Barracks) and near the southern tunnel portal at Bulleen Oval (west of Bulleen Road).

As described in Chapter 8 – Project description (Section 8.4.6), fresh air entering the tunnels through the entry portals would be drawn through the tunnels from the movement of vehicles (creating what is known as the 'piston' effect) combined with the action of jet fans installed along the length of the tunnels. Before the tunnel exit portals, air would be withdrawn from the tunnels into ventilation structures and discharged to the atmosphere. Additional jet fans would be installed immediately before the exit portals in both tunnels to reverse the airflow and prevent the emission of pollutants from the portals.

The North East Link tunnel ventilation system design would prevent any emissions from the tunnel portals. All vehicle emissions in the tunnels would be discharged via the ventilation structures.

The tunnel ventilation systems would be designed to provide adequate in-tunnel air quality during normal operation, in addition to supporting evacuation and rescue efforts during emergency incidents. The capacity of the ventilation system for normal operation is defined by the air demand required to maintain acceptable in-tunnel visibility and air quality.

The ventilation systems for the tunnels would be designed taking into account the location and individual characteristics of each tunnel. The gradual rise in elevation toward the north means that traffic emissions from the northbound tunnel are predicted to be greater than emissions from traffic travelling through the southbound tunnel. As such, the northern tunnel ventilation structure would be designed to have a larger diameter than the southern tunnel ventilation structure, which would allow it to operate at a higher ventilation rate.

The required volume of fresh air for a given tunnel traffic condition would vary between the northern (Blamey Road to Manningham Road) and southern (Manningham Road to Bulleen Oval) sections of the tunnels. It would depend on:

- The number of vehicles in the tunnel and types of vehicles

- The average pollutant emission per vehicle

- The allowable pollutant in-tunnel concentrations

- The ambient concentrations for each pollutant.

Each ventilation structure would consist of a primary and secondary vent. The primary vent of each ventilation structure would operate at all times, with use of the secondary vent dependent on the time of day, vehicle volumes, in-tunnel air quality and maintenance schedules.

Using the primary and secondary vents in combination would enable the exhaust air velocity to be maintained between approximately 18 to 22 metres per second, with combined ventilation rates of approximately 590 to 970 cubic metres per second in the southern ventilation structure, and approximately 740 to 1,290 cubic metres per second in the northern ventilation structure.

Tunnel emissions – modelled impacts

Air dispersion modelling was undertaken to predict the potential impacts of emissions from the proposed tunnel ventilation system on ground level concentrations of the following pollutants:

- PM_{10} and $PM_{2.5}$

- NO_2

- CO

- Air toxics – benzene, toluene, ethylbenzene and xylenes (BTEX), 1,3 butadiene, formaldehyde and PAHs as B(a)P toxic equivalents.

The modelling was undertaken in accordance with the requirements of Schedule C of the SEPP (AQM), using the Victorian regulatory model AERMOD. As described in Section 10.5.1, modelling results are presented for the following scenarios:

- 2026 – using conservative (2020) vehicle emissions factors and more realistic (2025) vehicle emissions factors

- 2036 – using conservative (2020) vehicle emissions factors and more realistic (2025) vehicle emissions factors.

The 99.9[th] percentile maximum predicted ground level concentration of each of the pollutants was added to background levels and assessed against the SEPP (AQM) design criteria outlined in Section 10.2.

Modelled data predicting the impacts of the ventilation structure emissions at discrete sensitive receptors (as described in Section 10.3.3) is provided in Appendix C of Technical Report B – Air quality. This section of the chapter describes the most affected receptor location that is predicted to experience the highest concentration of pollutants.

In summary, the assessment found the total predicted ground level concentrations of CO, NO_2 and air toxics would comply with the SEPP (AQM) criteria for all modelled scenarios. Overall, the risk that sensitive receptors would be impacted by emissions of these pollutants from the ventilation system is low (risk AQ17). The discrete receptor predicted to be most impacted is the Carey Grammar Sports Complex. This receptor had maximum project contributions to NO_2 levels ranging from 6.4 micrograms per cubic metre (in the 2026 realistic scenario) to 22 micrograms per cubic metre (in the 2036 conservative scenario), equivalent to 3.4 to 12 per cent of the criterion.

Particulate matter concentrations would exceed SEPP (AQM) design criteria, because the background concentrations of these pollutants are already high. Elevated levels of PM_{10} and $PM_{2.5}$ would apply at all the assessed sensitive receptors due to the elevated background concentration.

Figure 10-2 and Figure 10-3 show the background levels of PM_{10} and $PM_{2.5}$ recorded at the Alphington AAQMS, which were found to have already exceeded the one-hour SEPP (AQM) design criteria on multiple occasions in 2017, without any contribution from North East Link.
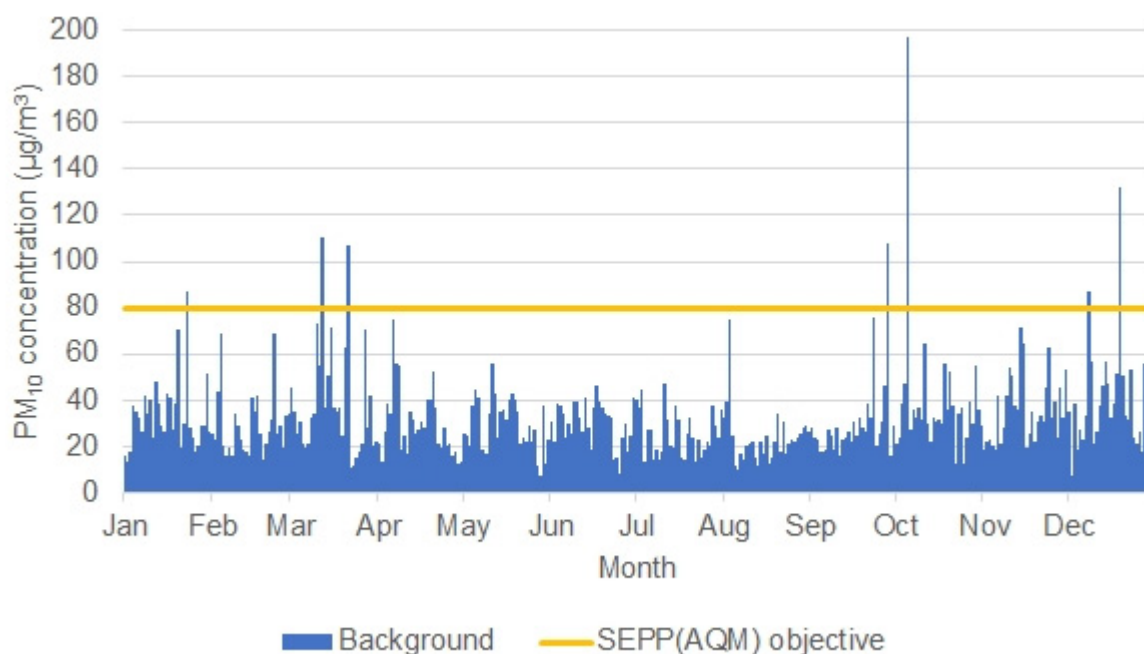

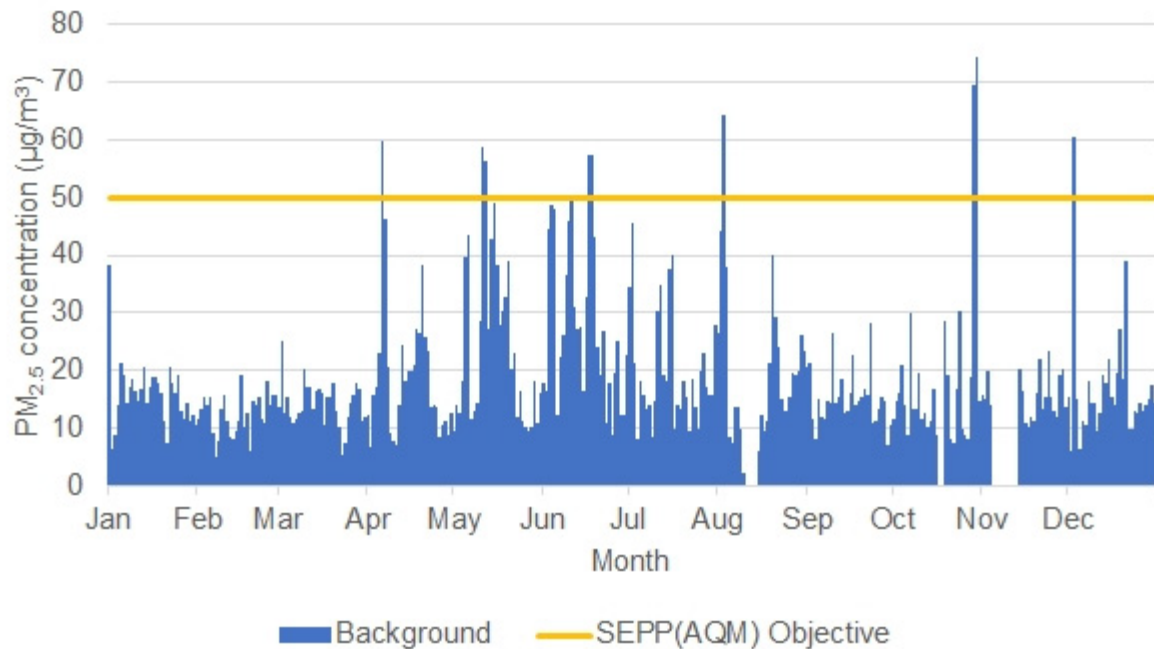Figure 10-2   2017 hourly background PM_{10} concentration

Figure 10-3 2017 hourly background $PM_{2.5}$ concentration

Modelling of PM_{10} levels for 2026 (conservative and realistic scenarios) and 2036 (conservative and realistic scenarios) found that:

- The ventilation structure emissions are not predicted to result in any additional exceedances of the one-hour average SEPP (AQM) design criterion for PM_{10}

- The maximum predicted ground level concentration of PM_{10} (including background) across all modelled scenarios would occur around 600 metres east-north-east of the northern ventilation structure within Simpson Barracks

- Tunnel ventilation structure emissions were modelled as having low contributions to the predicted 99.9th percentile PM_{10} ground level concentration, as follows:

    – 2026 (conservative scenario) – 0.087 per cent of predicted 99.9th percentile PM_{10} ground level concentration, equivalent to 0.22 per cent of the SEPP (AQM) design criterion

    – 2026 (realistic scenario) – 0.065 per cent of predicted 99.9th percentile PM_{10} ground level concentration, equivalent to 0.16 per cent of the SEPP (AQM) design criterion

    – 2036 (conservative scenario) – 0.11 per cent of predicted 99.9th percentile PM_{10} ground level concentration, equivalent to 0.27 per cent of the SEPP (AQM) design criterion

    – 2036 (realistic scenario) – 0.081 per cent of predicted 99.9th percentile PM_{10} ground level concentration, equivalent to 0.20 per cent of the SEPP (AQM) design criterion

- The maximum predicted project contribution to the ground level concentration of PM_{10} (not taking into account the background level) would occur approximately 140–145 metres south of the northern ventilation structure within Simpson Barracks. This value ranges from:
    - 2026 (conservative scenario) – 4.2 micrograms per cubic metre, equivalent to 5.3 per cent of the SEPP (AQM) design criterion
    - 2026 (realistic scenario) – 3.2 micrograms per cubic metre, equivalent to 4 per cent of the SEPP (AQM) design criterion
    - 2036 (conservative scenario) – 4.8 micrograms per cubic metre, equivalent to 6 per cent of the SEPP (AQM) design criterion
    - 2036 (realistic scenario) – 3.4 micrograms per cubic metre, equivalent to 4.2 per cent of the SEPP (AQM) design criterion.

Modelling of $PM_{2.5}$ levels for 2036 (conservative and realistic scenarios) and 2036 (conservative and realistic scenarios) found that:

- The ventilation structure emissions are predicted to result in one additional exceedance of the $PM_{2.5}$ SEPP (AQM) design criterion, with predictions of the project contribution ranging from less than 0.3 to 0.7 micrograms per cubic metre, against a corresponding background concentration of 49.8 micrograms per cubic metre

- The maximum predicted ground level concentration of $PM_{2.5}$ (including background) across all modelled scenarios would occur around 990 metres north-east of the southern ventilation structure within a residential area of Bulleen

- Tunnel ventilation structure emissions were modelled as having low contributions to the predicted 99.9[th] percentile $PM_{2.5}$ ground level concentration, as follows:
    - 2026 (conservative scenario) – 0.084 per cent of predicted 99.9[th] percentile $PM_{2.5}$ ground level concentration, equivalent to 0.13 per cent of the SEPP (AQM) design criterion
    - 2026 (realistic scenario) – 0.037 per cent of predicted 99.9[th] percentile $PM_{2.5}$ ground level concentration, equivalent to 0.055 per cent of the SEPP (AQM) design criterion
    - 2036 (conservative scenario) – 0.11 per cent of predicted 99.9[th] percentile $PM_{2.5}$ ground level concentration, equivalent to 0.17 per cent of the SEPP (AQM) design criterion
    - 2036 (realistic scenario) – 0.049 per cent of predicted 99.9[th] percentile $PM_{2.5}$ ground level concentration, equivalent to 0.073 per cent of the SEPP (AQM) design criterion

- Modelling of the year 2026 (conservative scenario) indicates the maximum project contribution to the ground level concentration of $PM_{2.5}$ (not taking into account the background level) would occur approximately 145 metres south of the northern ventilation structure, within Simpson Barracks. In the 2026 conservative scenario, this is predicted to be 3.6 micrograms per cubic metre, or 7.2 per cent of the SEPP (AQM) design criterion. In the 2026 realistic scenario, this is predicted to be 2.0 micrograms per cubic metre, or 4 per cent of the design criterion

- In the 2036 conservative scenario, the maximum project contribution to the ground level concentration of $PM_{2.5}$ is predicted to occur approximately 140 metres west of the northern ventilation structure within the residential area of Macleod. This is predicted to be 4.1 micrograms per cubic metre, or 8.2 per cent of the SEPP (AQM) design criterion

- In the 2036 realistic scenario, the maximum project contribution to the ground level concentration of $PM_{2.5}$ is predicted to occur approximately 145 metres south of the northern ventilation structure, within Simpson Barracks. This is predicted to be 2.2 micrograms per cubic metre, or 4.4 per cent of the SEPP (AQM) design criterion.

The predicted exceedances are not considered to conflict with the intent of the SEPP (AQM), given the small contribution that emissions from the tunnel ventilation system would make when compared with the background concentrations of particulate matter. Figure 10-4 and Figure 10-5 show the 1,000 highest modelled PM_{10} and $PM_{2.5}$ contributions from the project (for the conservative scenarios), starting from the maximum predicted project contribution at rank eight. This illustrates the predicted levels of PM_{10} and $PM_{2.5}$ from the project would be significantly below the maximum predicted ground level concentrations most of the time. As such, the risk that sensitive receptors would be impacted by emission of particulate matter from the ventilation system is low (risk AQ16). Consideration of the potential for health effects associated with these impacts is presented in Chapter 18 – Human health.
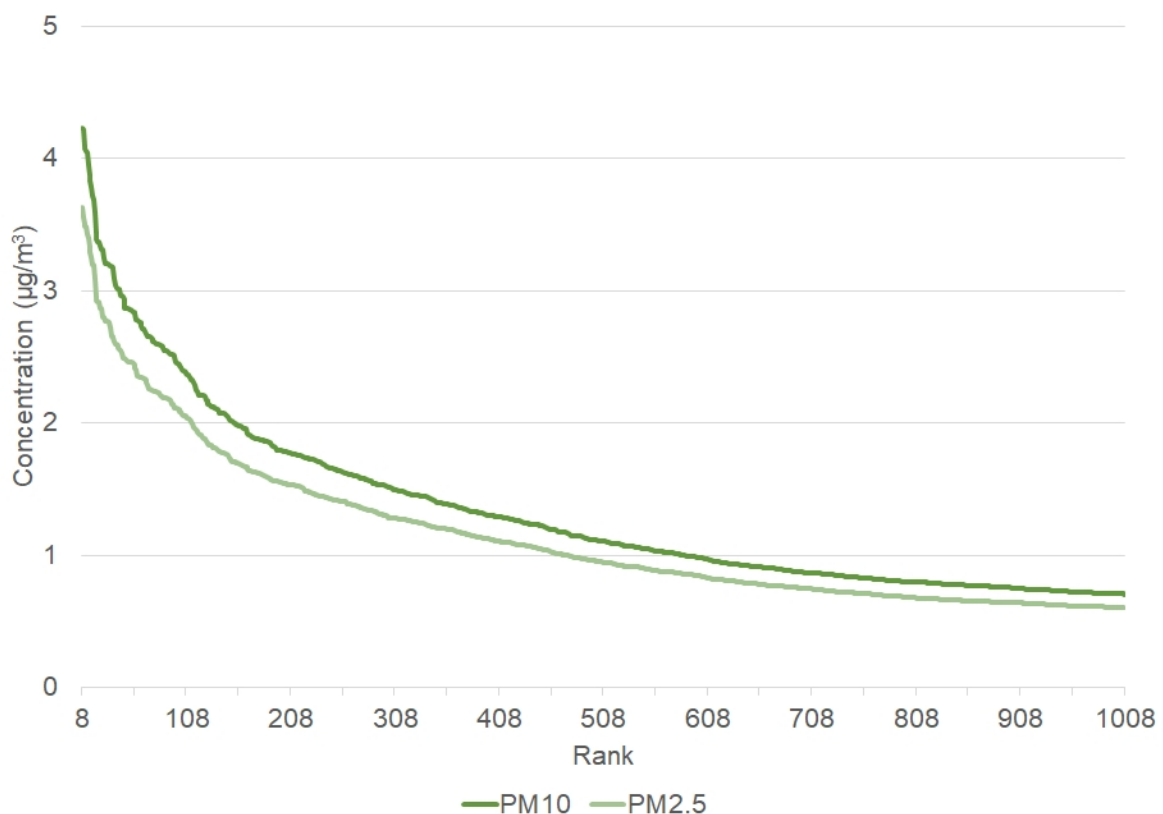

Figure 10-4   2026 conservative scenario – PM_{10} and $PM_{2.5}$ 1,000 highest results
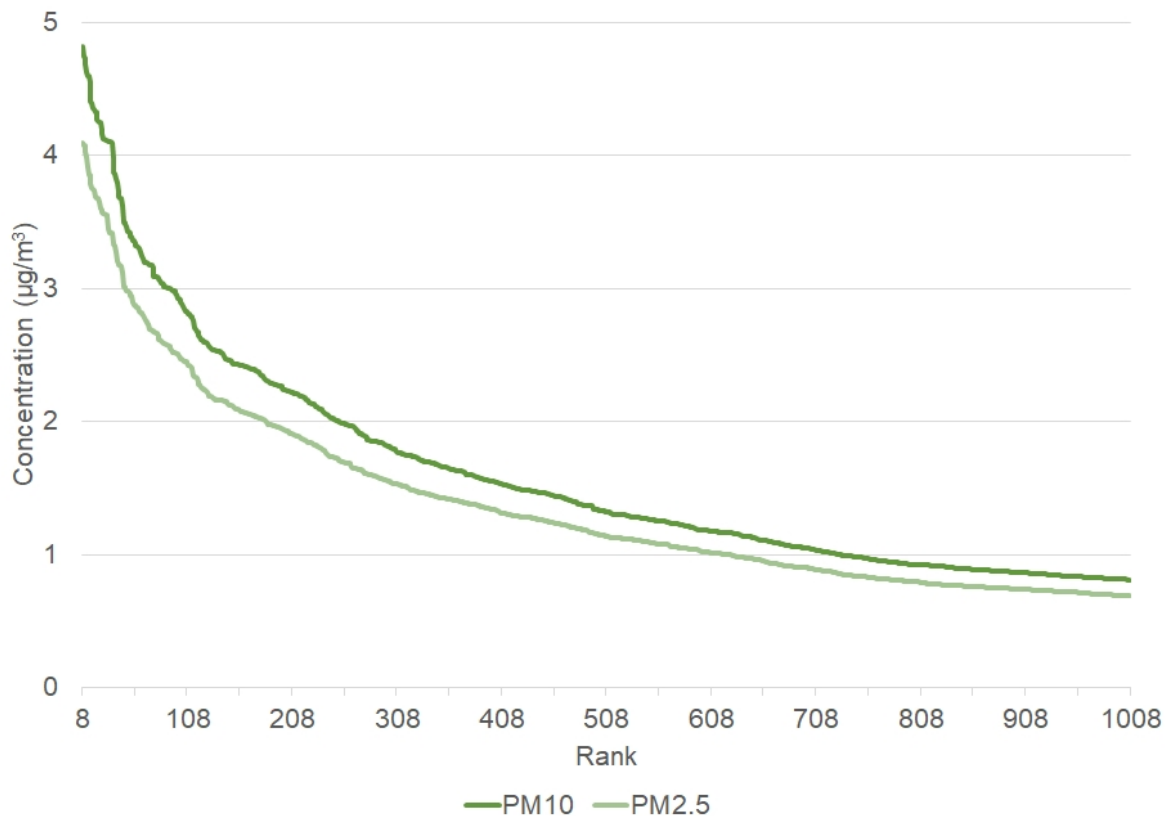
Figure 10-5   2036 conservative scenario – PM$_{10}$ and PM$_{2.5}$ 1,000 highest results

Tunnel emissions – sensitivity analyses

Sensitivity analyses were undertaken to understand how the impacts of emissions from the tunnel ventilation system would vary with changes to traffic conditions, or to the location of the ventilation structures. Modelling of the following scenarios was undertaken:

- Tunnels constantly operating at maximum lane capacity for 24 hours per day, 365 days a year – with maximum lane capacity defined as the maximum traffic density that the tunnels can support before traffic flow breaks down

- A theoretical worst-case traffic scenario, with tunnel ventilation structure emission rates based on pollutant concentrations equal to in-tunnel air quality limits – AQ18

- An increase in the predicted diesel to petrol fuelled car ratio, assuming the proportion of diesel cars would double from 15 per cent of all cars to 30 per cent of all cars – AQ19

- Four alternative locations for the northern and southern ventilation structures for the purpose of the air quality sensitivity analysis, as shown in Figure 10-6 and Figure 10-7.

The sensitivity analyses found that North East Link's contribution to the maximum predicted ground level concentrations of pollutants could increase significantly if traffic conditions were substantially different. However, this increase would result in relatively little change in the overall maximum predicted ground level concentrations, as these are largely determined by high background concentrations. This indicates that sensitive receptors are at a low risk of being impacted by higher than anticipated traffic volumes in the tunnels (risk AQ19).

As described above, modelling of the proposed locations of the ventilation structures predicts one additional exceedance of the $PM_{2.5}$ SEPP (AQM) criterion, over and above exceedances due to background concentrations. The sensitivity analysis indicated that changing the location of the ventilation structures would change the location of the maximum predicted $PM_{2.5}$ level, but would result in negligible change to the predicted ground level concentrations of $PM_{2.5}$. The future year adjusted emission factors (2020 and 2025) analysis predicts that project contributions to ground level concentrations of pollutants would decrease if vehicle emission rates were reduced. However, even with a predicted increase in the diesel to petrol fuelled car ratio, because the background concentrations are more significant, the increase in the predicted maximum ground level concentration would be minimal, given that background concentrations have been conservatively assumed to remain unchanged.

Figure 10-6   Northern ventilation structure – reference project and sensitivity testing locations

Figure 10-7   Southern ventilation structure – reference project and sensitivity testing locations

Management of tunnel ventilation system emissions

The tunnel ventilation system would be designed in accordance with the requirements of the EPA Victoria Works Approval to:

- Meet the requirements of the SEPP (AQM) (EPR AQ2)

- Meet project-specific requirements for in-tunnel air quality (EPR AQ3):

  - Maximum peak CO value of 150ppm

  - 15-minute average CO value of 50ppm

  - 2-hour average CO value of 25ppm

  - Tunnel average NO_2 concentration less than 0.5 ppm as a rolling 15-minute average.

In accordance with the requirements of EPR AQ3 and SEPP (AQM), best practice management techniques would be applied to minimise in-tunnel and sensitive receptor exposure to PM_{10} and $PM_{2.5}$ due to tunnel operation (see text box on next page).

The contractors would be required to monitor and report on in-tunnel air quality and ventilation structure emissions during operation (EPR AQ5). This monitoring would need to demonstrate compliance with EPRs AQ2 and AQ3 and the EPA Victoria licence. If these requirements were not being met, remedial action would be undertaken and this would need to be done to the satisfaction of EPA Victoria.

Best practice management of tunnel ventilation system emissions

Consistent with the requirements of SEPP(AQM) Clause 19, the North East Link ventilation structures would require the application of best practice in managing emissions to air.

Best practice is defined as '*the best combination of eco-efficient techniques, methods, processes or technology used in an industry sector or activity that demonstrably minimises the environmental impact of a generator of emissions in that industry sector or activity*'. Eco-efficient is defined as '*producing more goods with less energy and fewer natural resources, resulting in less waste and pollution*'.

Additionally, SEPP(AQM) Policy Principles under 7(1)(c) states that '*the measures adopted should be cost-effective and in proportion to the significance of the environmental problems being addressed*'.

Best practice for air quality management of emissions from the tunnel ventilation system principally relates to whether or not air pollution control technology should be installed on the North East Link ventilation structures.

The outcomes of the tunnel ventilation structure air dispersion modelling assessment suggest that pollution control technology would not be required. The design of the tunnel ventilation structures, including their location, discharge height and efflux velocities are aimed at minimising the impact of pollutant emissions. As outlined above, the tunnel ventilation systems would be designed to meet EPA Victoria's requirements for air quality and to achieve specific in-tunnel air quality performance standards.

10.5.4 Combined air quality impacts from tunnel and vehicle emissions

The maximum predicted ground level concentrations of PM_{10}, $PM_{2.5}$ and NO_2 resulting from surface roads and tunnel ventilation structure emissions were added to background concentrations to estimate the combined impact.

The combined predicted pollutant concentrations from these two sources were then compared against the SEPP (AAQ) objectives shown in Table 10-1 of Section 10.2. This was done for comparative rather than compliance purposes in the absence of regulatory criteria relevant to roadside locations.

Consistent with the modelling approach undertaken for emissions from the surface roads and ventilation system (as described in Section 10.5.1 above), the combined impacts were modelled based on predicted traffic volumes during 2026 and 2036 using 2020 and 2025 emissions factors.

The combined impacts were assessed at two receptors that would likely be impacted by surface roads and ventilation structure emissions:

- The receptor that would potentially be impacted by emissions from the northern ventilation structure corresponds to a surface road assessment receptor located on Watson Street in Macleod, approximately 450 metres north of the northern ventilation structure, as it is shown in the reference design

- The receptor that would potentially be impacted by emissions from the southern ventilation structure and from surface roads is located near the boundary of a residence on Ben Nevis Grove approximately 280 metres south-east of the southern ventilation structure.

Time-series plots of PM_{10}, $PM_{2.5}$ and NO_2 concentrations at the selected receptors confirm that surface road emissions contribute significantly more than the ventilation system to pollutant levels at the two assessed sensitive receptors. For example, this pattern is clear in Figure 10-8, which shows the predicted 24-hour average $PM_{2.5}$ concentrations at the selected receptor in the southern part of the project area, for the 2036 scenario using 2020 emissions factors.
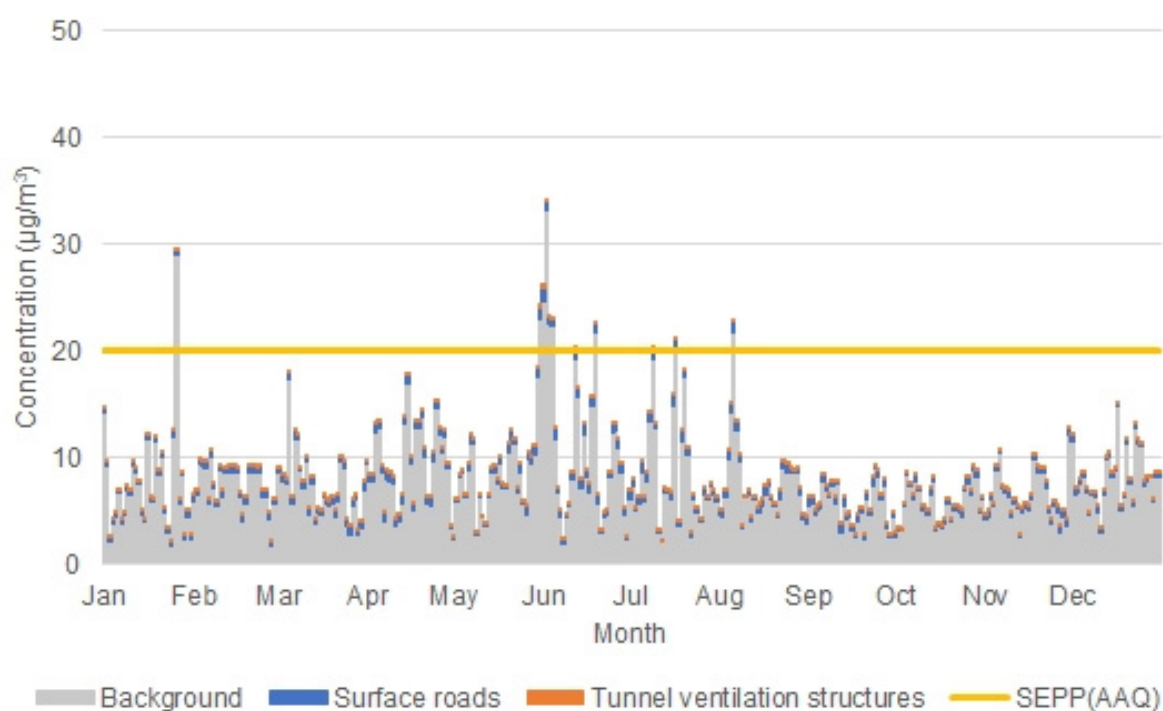

Figure 10-8   2036 predicted 24-hour average $PM_{2.5}$ concentrations at the selected receptor in the southern part of the project area

Individual contributions from the surface roads, tunnel ventilation system and background concentrations to the maximum predicted ground level concentrations (GLCs) of PM_{10}, $PM_{2.5}$ and NO_2 are provided in Table 10-11 and Table 10-12 for the 2026 and 2036 scenarios (2020 emission factors). Predictions of concentrations that would exceed SEPP (AAQ) environmental quality objectives (EQOs) are shown in **bold**.

It is noted that these ground level concentrations were calculated over 24-hour and annual averaging periods, whereas the background concentrations of PM_{10} and $PM_{2.5}$ shown in Figure 10-2 and Figure 10-3 (in Section 10.5.3 above) were calculated over a one-hour period, in accordance with the SEPP (AQM) modelling requirements.

Table 10-11   Combined air quality impacts – 2026 (2020 emission factors)

Project area	Pollutant	Units	Averaging period	Maximum predicted GLC[1]	SEPP (AAQ) objective[2]	Contribution to maximum predicted GLC		
						Tunnel ventilation	Surface roads	Background
North	PM_{10}	µg/m³	24-hour	39	50	0.042	1.0	38
			Annual	16	20	0.052	1.2	15
	$PM_{2.5}$	µg/m³	24-hour	**35**	20	0.039	1.5	33
			Annual	**8.5**	7	0.044	1.0	7.5
	NO_2	µg/m³	One-hour	130	225	6.2	53	70
			Annual	26	56	0.34	7.7	18
South	PM_{10}	µg/m³	24-hour	39	50	0.092	0.44	38
			Annual	15	20	0.043	0.54	15
	$PM_{2.5}$	µg/m³	24-hour	**34**	20	0.075	0.77	33
			Annual	**8.0**	7	0.037	0.44	7.5
	NO_2	µg/m³	One-hour	97	225	5.0	12	80
			Annual	21	56	0.26	2.2	18

Note: Concentrations are rounded to two significant figures
1. 100th percentile
2. For comparison only.

Table 10-12 Combined air quality impacts – 2036 (2020 emission factors)

Project area	Pollutant	Units	Averaging period	Maximum predicted GLC[1]	SEPP (AAQ) objective[2]	Contribution to maximum predicted GLC		
						Tunnel ventilation	Surface roads	Background
North	PM_{10}	µg/m³	24-hour	39	50	0.051	1.2	38
			Annual	16	20	0.061	1.4	15
	$PM_{2.5}$	µg/m³	24-hour	**35**	20	0.046	1.8	33
			Annual	**8.7**	7	0.052	1.2	7.5
	NO_2	µg/m³	One-hour	140	225	6.3	61	70
			Annual	28	56	0.40	8.9	18
South	PM_{10}	µg/m³	24-hour	39	50	0.11	0.49	38
			Annual	15	20	0.0451	0.60	15
	$PM_{2.5}$	µg/m³	24-hour	**34**	20	0.085	0.869	33
			Annual	**8.0**	7	0.044	0.49	7.5
	NO_2	µg/m³	One-hour	99	225	5.7	14	80
			Annual	21	56	0.31	2.5	18

Note: Concentrations are rounded to two significant figures
1. 100th percentile
2. For comparison only.

The above modelling results indicate that across the 24-hour and annual averaging periods:

- The combined impacts of surface road and ventilation structure emissions and background air quality are less than the PM_{10} and NO_2 SEPP (AAQ) EQOs at the receptors chosen to represent locations likely to be significantly impacted by both emissions sources

- The $PM_{2.5}$ SEPP (AAQ) EQO would not be met at either receptor due to the background concentration exceeding the objective.

The revised (2025) SEPP (AAQ) objective for $PM_{2.5}$ is based on the assumption that improvements in technology will drive a future reduction in vehicle emissions, which would improve air quality. While a projected reduction in background concentrations (as would be expected when vehicle emissions are reduced across the metropolitan area) has not been accounted for in any of the modelling undertaken for North East Link, it is expected that pollutant concentrations would be lower in future years.

The emission rates developed for the assessment of the ventilation structure emissions against SEPP (AQM) criteria include a number of conservative elements in order to thoroughly test the design. The 2025 vehicle emission factors that were tested for the combined impact assessment in 2026 and 2036 could potentially more realistically represent the predicted improvements in vehicle engine technology by 2026 and beyond. It is noted that the 2025 factors do not allow for the predicted increase in electric vehicles in the future traffic fleet mix, and therefore retain some conservatism.

Combined air quality impacts from surface roads and the ventilation structure emissions were modelled using the 2025 emission factors to account for the general trend in improvements in vehicle emission technology. The modelling predicted the combined impacts of the surface road and ventilation structure emissions would be significantly reduced under this scenario.

Using the 2025 emissions factors would result in the project contribution to the maximum 24 hour average PM_{10} concentration in the north of the project area (at the modelled location on Watson Street in Macleod) reducing from approximately 3 to 2 per cent of the combined project and background predicted concentration across both modelled years. In the south of the project area (at the modelled location near the boundary of a residence approximately 280 metres south-east of the southern ventilation structure) there would be a corresponding reduction from 2 per cent or 1.4 per cent to 1 per cent, depending on the modelled year. Annual average PM_{10} concentrations at the modelled locations reduced from 9 to 7 per cent of the combined project and background predicted concentration in the north and from 4 to 3 per cent in the south in both modelled years.

Using the 2025 emissions factors would result in the project contribution to the maximum 24 hour average $PM_{2.5}$ concentration in the north of the project area (at the modelled location described above) reducing from approximately 5 to 3 per cent of the combined project and background predicted concentration across both modelled years. In the south of the project area (at the modelled location described above) the project contribution reduces from 3 or 2 per cent to 2 or 1per cent, depending on the modelled year. The project contribution to the annual average $PM_{2.5}$ concentrations at the modelled locations reduces from 14 or 12 per cent in the north and 6 or 7 per cent to 4 per cent in the south, depending on the modelled year.

The maximum predicted 24-hour average and annual average $PM_{2.5}$ concentrations based on 2025 emission factors in the north and south of the project area would still be greater than the SEPP (AAQ) EQO, although this is primarily due to the background concentrations exceeding the objective on several occasions.

10.6   Conclusion

This chapter has identified and assessed existing conditions, impacts and associated risks to air quality from North East Link.

During construction, dust and other emissions from construction vehicles and machinery would be generated, together with odour from asphalt production and laying and potentially from contaminated soil. The activities that produce these types of emissions during construction and ways in which they can be managed to reduce potential impacts are well understood.

The construction impact assessment found that:

• Dust from earthworks and spoil management and other construction activities could cause nuisance impacts to the community and aesthetic impacts on buildings and vehicles at sensitive receptor locations. Particulate matter generated during these activities has the potential to impact upon health if emissions were not mitigated.

• Sensitive receptors may be impacted by odour from North East Link surface works, such as during the production and laying of asphalt. Other sources of odour could include temporary tunnel ventilation during construction of the tunnels. Odour from contaminated or anaerobic soils is also possible (if areas of soil contamination are disturbed). For the most part, these odours are expected to be localised and only detectable close to the source.

• Products of combustion from the operation of diesel-fuelled heavy equipment may cause air quality impacts for sensitive receptors while earthworks and other construction activities are being undertaken. It is expected the impacts associated with emissions from these sources would be minor, particularly as the operation of heavy machinery that would mostly likely produce these emissions would largely be intermittent and of limited duration.

During the project's operation, there would be changes to air quality due to the changed traffic conditions on North East Link and surrounding surface roads. North East Link also has the potential to affect air quality with the operation of the tunnel ventilation system, which would disperse emissions from vehicles travelling through the tunnels.

The key findings of the operation impact assessment are summarised below.

• Based on modelling undertaken for 2026 and 2036, air quality is predicted to improve along most surface roads that were assessed when compared with the 'no project' scenario. The predicted reduction in air pollutants is directly related to the forecast reduction in heavy commercial vehicles and total traffic volumes along these roads.

• Air quality would be impacted along some roads compared with the 'no project' scenario due to predicted increases in traffic volumes along these roads when North East Link was operating. The largest increases in maximum pollutant concentration were predicted to occur along the North East Link alignment between Yallambie Road and the M80 Ring Road interchange.

- The tunnel ventilation system would include two ventilation structures, each approximately 40 metres high and located in the vicinity of the northern tunnel portal near Blamey Road (within Simpson Barracks) and near the southern tunnel portal at Bulleen Oval (west of Bulleen Road). The tunnel ventilation system would be designed to prevent emissions from the tunnel portals, with all vehicle emissions in the tunnels being discharged via the ventilation structures.

- Ground level concentrations of CO, NO_2 and air toxics from the tunnel ventilation structure emissions were predicted to comply with the SEPP (AQM) criteria across both modelled years (2026 and 2036). The particulate matter levels would exceed SEPP (AQM) design criteria, because background concentrations of these pollutants are already high. The predicted exceedances are not considered to conflict with the intent of the SEPP (AQM), given the small contribution that emissions from the tunnel ventilation systems would make compared with the background concentrations of particulate matter.

- Using more realistic 2025 emission factors for modelling tunnel ventilation structure emissions during 2036 demonstrated that while the project contribution to the maximum predicted ground level concentrations of PM_{10} and $PM_{2.5}$ could decrease significantly, there would be relatively little change in the maximum predicted ground level concentrations (including background) due to the relatively low project contribution.

- The combined impacts of surface road and ventilation structure emissions are less than the PM_{10} and NO_2 SEPP (AAQ) EQOs at receptors chosen to represent locations likely to be significantly impacted by each emissions source.

- The $PM_{2.5}$ SEPP (AAQ) EQO would not be met at either receptor, because the background concentration (without the project contribution) exceeds the objective.

- The combined impacts of the surface road and ventilation structure emissions would be significantly reduced if more realistic 2025 emission factors were used to account for the general trend in improvements in vehicle emission technology.

Impacts to air quality from North East Link would be managed to protect the environment and human health. Application of the project EPRs (described in full in Chapter 27 – Environmental management framework) would minimise impacts associated with construction by management and monitoring dust emissions in accordance with a DAQMMP (EPR AQ1) and requiring implementation of a Spoil Management Plan (EPR CL3).

Application of the project EPRs would also minimise impacts associated with operation. The tunnel ventilation system would be designed in accordance with the EPA Victoria Works Approval to meet the requirements of the SEPP (AQM) (EPR AQ2), and to meet project-specific requirements for in-tunnel air quality (EPR AQ3).

The tunnel operator would also be required to monitor and report on in-tunnel air quality and ventilation structure emissions in accordance with EPA Victoria licence requirements (EPR AQ5) and to monitor ambient air quality for at least for at least one year before operation of North East Link (or as agreed with EPA Victoria) (EPR AQ4).

In response to the EES evaluation objective described at the beginning of this chapter, effects of the project on air quality have been assessed and EPRs as described above have been identified to reduce the anticipated impacts to air quality to acceptable levels.