

Environment
Effects Statement

Chapter 11

Surface noise and vibration



Chapter 11

Surface noise and vibration

This chapter provides an assessment of surface noise and vibration impacts associated with the construction and operation of North East Link. This chapter is based on the impact assessment presented in Technical Report C – Surface noise and vibration.

Noise and vibration from the construction and operation of North East Link has the potential to impact sensitive receivers. Examples of sensitive receivers include residences, kindergartens, schools and aged care facilities. Predicting the extent of noise exposure for people who live along the North East Link corridor allows for mitigation measures to be identified and tailored for individual areas. The management of noise and vibration is important to minimise amenity impacts on affected sensitive receivers and to prevent vibration-induced damage to property assets and other infrastructure.

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.

To assess the potential effects of surface noise and vibration from the construction and operation of North East Link, a surface noise and vibration impact assessment was undertaken.

The assessment included use of models to predict impacts, informed by baseline monitoring of existing noise and vibration levels. Project specific noise and vibration guideline targets were developed to minimise adverse impacts as far as practicable.

What is surface noise and vibration?

Noise and vibration caused by above-ground construction and operation activities for North East Link has been referred to as 'surface' noise and vibration.

Surface noise can emanate from sources such as construction plant and equipment, traffic and infrastructure such as ventilation systems. Where surface noise exceeds background levels this can impact on amenity for sensitive receivers.

Surface vibration is vibration generated by surface activities such as demolition, excavation, piling, and road construction. Vibration can be impulsive, as typical for demolition, or continuous, as in the case of compaction. At high levels, vibration can impact on amenity and result in damage to buildings, structures and services.

What is a sensitive receiver?

A place, location or point at which exposure to particular effects (such as noise, vibration, visual or airborne pollutants) are measured.

'Sensitive receivers' are those identified as likely to be more susceptible to adverse effects, such as schools, hospitals, day care facilities and residences.

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

- Chapter 10 and Technical report B – Air quality
- Chapter 12 and Technical report D – Tunnel vibration and regenerated noise
- Chapter 18 and Technical report J – Human health.

11.1 Method

The surface noise and vibration assessment was informed by the risk assessment described in Chapter 4 – EES assessment framework and involved the following key tasks:

- Review of relevant legislation and policy at a national, state and local level
- Establishment of a study area for surface noise and vibration. This was defined as a corridor of up to 400 metres each side of the road centre line. At distances greater than this, acoustic conditions would be less influenced by impacts from North East Link compared with other environmental sources such as local traffic. Figure 11-1 shows the study area for operational noise
- Desktop review and classification of sensitive receivers
- Baseline noise monitoring to establish the existing noise environment
- Developing project-specific guideline targets and project noise objectives for surface noise and vibration
- Building and validating an acoustic model using the environmental noise modelling software package SoundPLAN version 8.1. The construction noise modelling was undertaken using the prediction method outlined in ISO 9613-2:1996 *Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation*. Operational noise modelling was undertaken using the Calculation of Road Traffic Noise (CoRTN) algorithm
- Consultation with EPA Victoria, VicRoads, Transport for Victoria and the local community
- Risk assessment to prioritise the impact assessment
- Assessment of the potential surface noise and vibration impacts during construction, operation and maintenance of the project, including:
 - Identifying typical construction scenarios
 - Modelling to predict construction noise levels
 - Identifying construction activities that may generate vibration impacts

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.

- Modelling operational noise including for road traffic, portal noise emissions and fixed infrastructure
- Considering the potential for road traffic to generate perceptible vibration during operation
- Development of Environmental Performance Requirements (EPRs) 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.

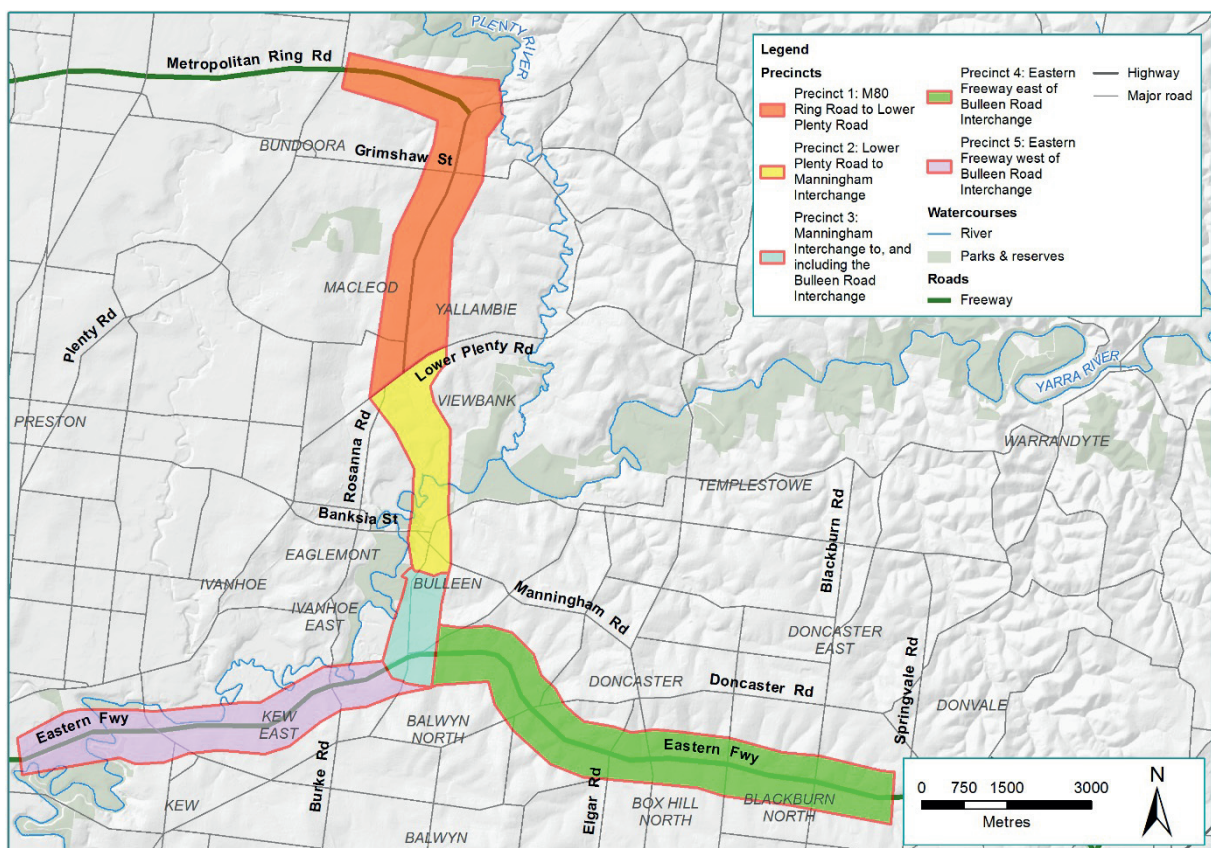


Figure 11-1 Surface noise and vibration study area

11.2 Existing conditions

This section outlines the existing conditions of the North East Link study area that relate to surface noise and vibration.

Baseline noise and vibration monitoring undertaken along the project corridor formed the basis of the existing conditions assessment. This was used to establish the study area and provide a baseline assessment of the current noise and vibration environment.

For the purposes of the surface noise and vibration assessment, the study area has been divided into five project noise precincts as shown in Figure 11-1:

- Noise Precinct 1 – M80 Ring Road (otherwise known as the Metropolitan Ring Road) to Lower Plenty Road
- Noise Precinct 2 – Lower Plenty Road to the Manningham Road interchange
- Noise Precinct 3 – Manningham Road interchange to and including the Eastern Freeway interchange
- Noise Precinct 4 – Eastern Freeway east of the Eastern Freeway interchange
- Noise Precinct 5 – Eastern Freeway west of the Eastern Freeway interchange.

Noise sensitive buildings

The assessment of surface noise and vibration undertaken for North East Link defined noise sensitive buildings in accordance with the VicRoads Traffic Noise Reduction Policy (2005) as:

- Category A – Dwellings, aged persons homes, hospitals, motels, caravan parks and other buildings with residential uses.
- Category B – Schools, kindergartens, libraries, places of worship and other noise-sensitive community uses.

The existing conditions assessment identified sensitive receivers in each precinct including the locations of noise sensitive buildings, recreational facilities and public open spaces. Additionally, other receivers such as commercial land and industrial land were identified.

Noise monitoring sites were informed by feedback received during community sessions and door knocks in representative areas close to the proposed alignment. The monitoring program included:

- 59 unattended noise measurement sites at locations adjacent the project boundary that the project would potentially impact
- 20 short-term attended noise measurement sites at recreation and public open spaces, one measurement site at a community recreation centre and three sites at Simpson Barracks (Commonwealth land).

Units of measurement

L_{Aeq} – the average noise level. It is defined as the equivalent sound level that has the same sound energy as the actual fluctuating sound measured over a specified period of time.

L_{A10(18 hour)} – the arithmetic average of the noise levels that are exceeded for 10 per cent of the time (six minutes) in each hour between 6 am and midnight.

L_{A10(12 hour)} – the arithmetic average of the noise levels that are exceeded for 10 per cent of the time (six minutes) in each hour between 6 am and 6 pm.

L_{A90} – The noise level exceeded for 90 per cent of the sample period. This noise level is described as the average minimum background sound level (in the absence of the source under consideration), or simply the background level.

All noise levels referred to in this chapter are 'A weighted'. This means they have been adjusted to emphasise the frequencies to which the human ear is most sensitive. Unless otherwise stated, all noise levels referred to are defined at locations one metre outside the most affected windows of the lowest habitable floors of noise-affected buildings, and include sound reflected back from the windows. Noise levels may be determined by computer modelling or by measurement with a calibrated Class 1 or Class 2 Sound Levels Meter.

Peak particle velocity – a measure of vibration representing the maximum instantaneous particle velocity.

Existing background noise levels were monitored and reported using:

- L_{A10(18 hour)} noise levels and L_{Aeq(8 hour)} (night) noise levels to inform the assessment of traffic noise impacts
- L_{A90} (day), (evening) and (night) noise levels to inform the construction noise impact assessment and set criteria to assess noise from fixed plant and infrastructure against the State Environment Protection Policy N-1 Control of Noise from Commerce, Industry and Trade (SEPP N-1).

Noise monitoring locations and results are shown in Figure 11-2 to Figure 11-5. Sections 11.2.1 to 11.2.5 present information on the types of receivers, dominant noise sources and a summary of measured noise levels within each of these precincts.

Vibration monitoring was carried out as part of the tunnel vibration and regenerated noise assessment and is therefore presented in Chapter 12. The average measured Peak Particle Velocity (PPV, mm/s) for each monitored site was below the threshold for human annoyance.

Time periods

EPA Victoria Publication 1254 defines time periods as:

Daytime/normal working hours:

- Monday to Friday 7 am to 6 pm
- Saturday 7 am to 1 pm

Weekend and evening:

- Monday to Friday 6 pm to 10 pm
- Saturdays 1 pm to 10 pm
- Sundays all day
- Public holidays all day

Night time:

- 10 pm to 7 am any day

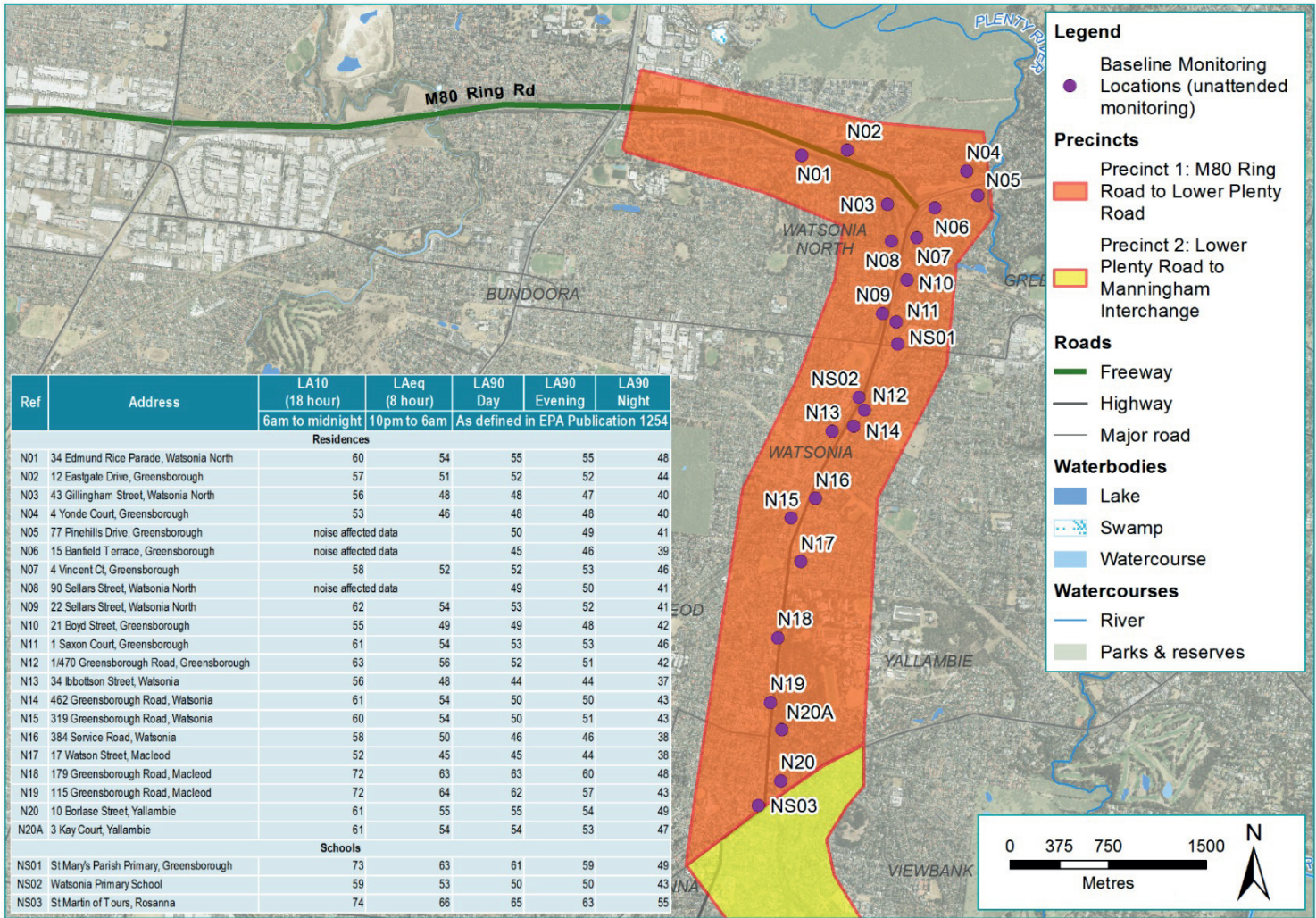


Figure 11-2 Baseline Noise Monitoring locations and measured noise levels for Noise Precinct 1

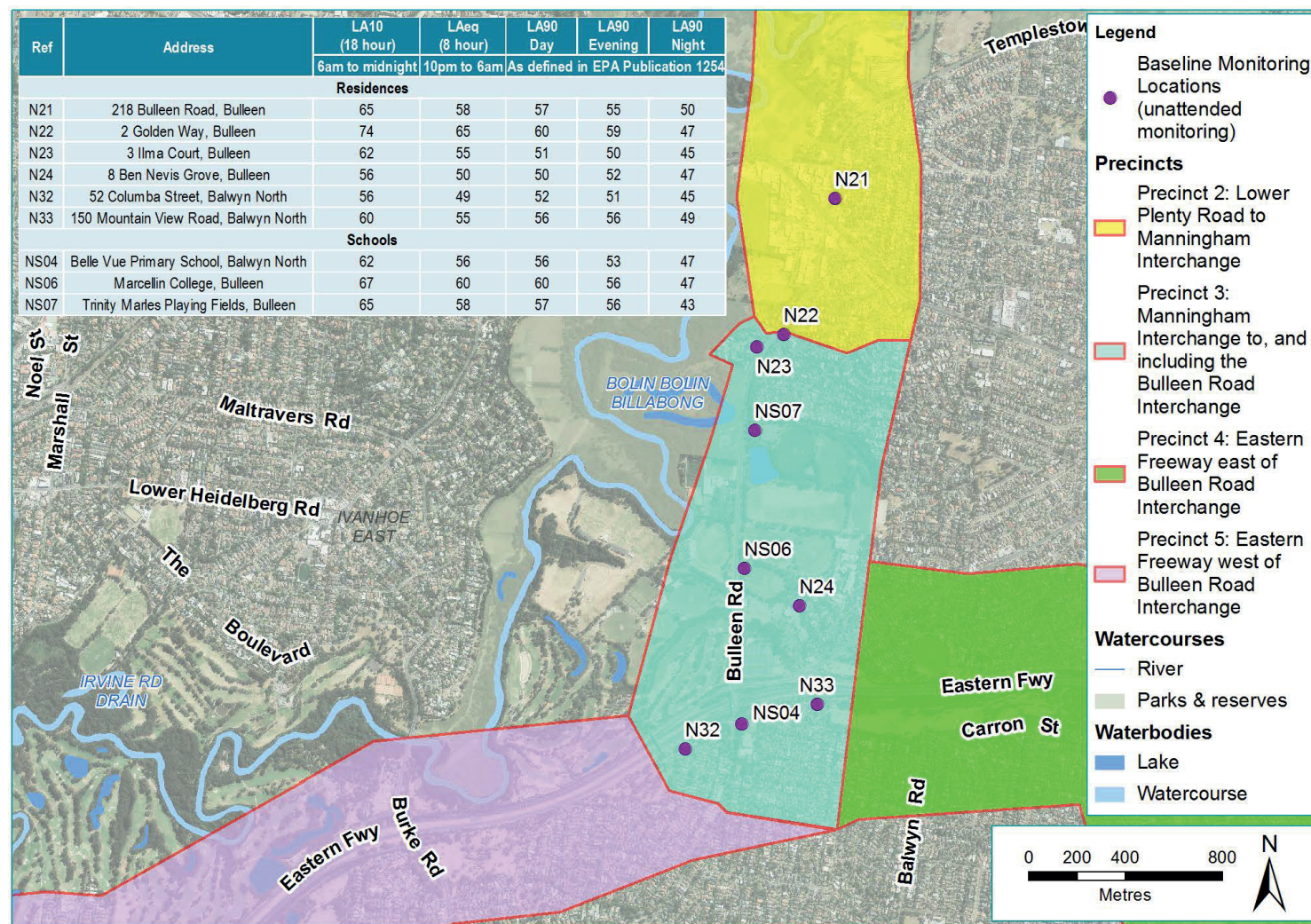


Figure 11-3 Baseline Noise Monitoring locations and measured noise levels for Noise Precinct 2 and Noise Precinct 3

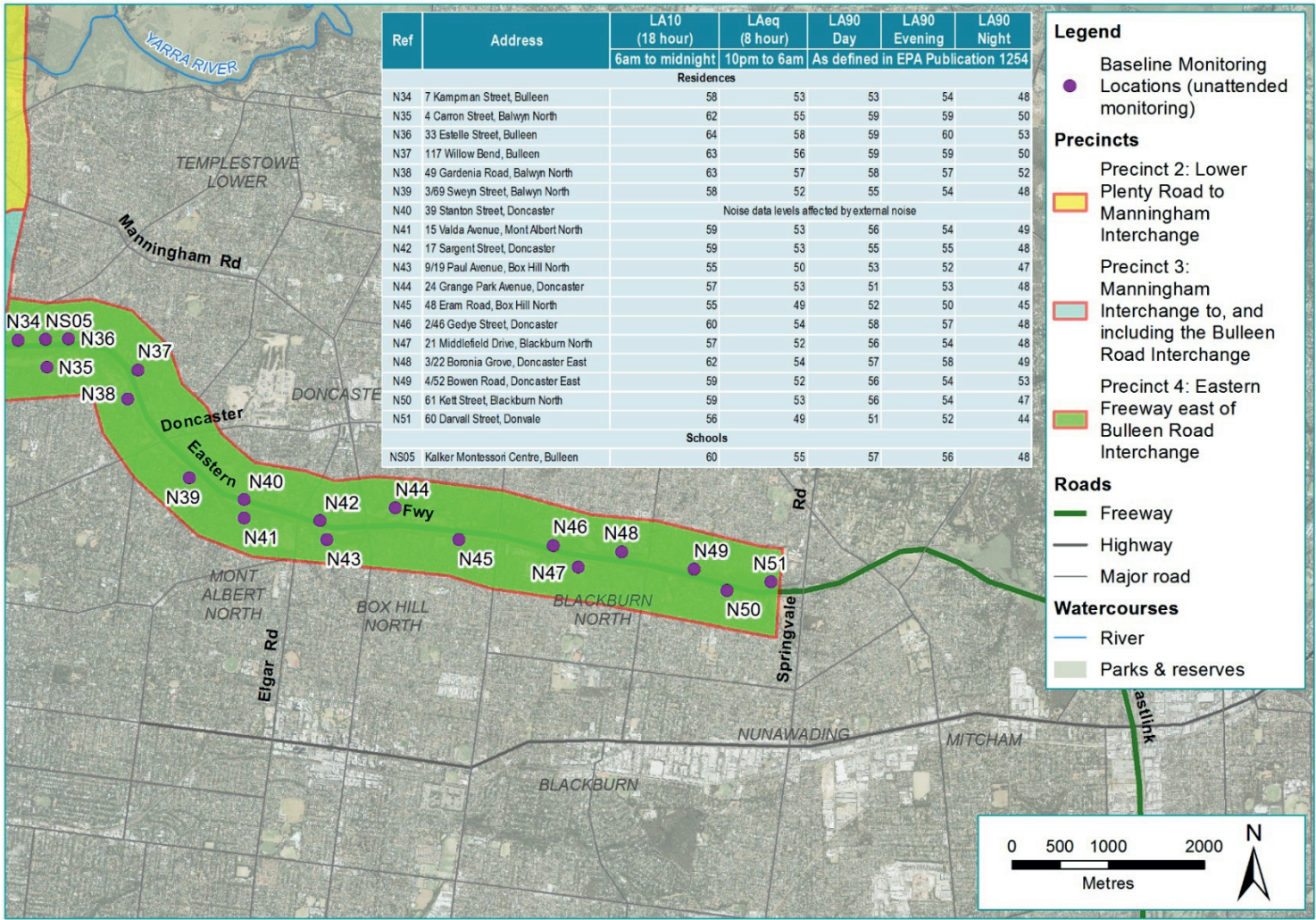


Figure 11-4 Baseline Noise Monitoring locations and measured noise levels for Noise Precinct 4

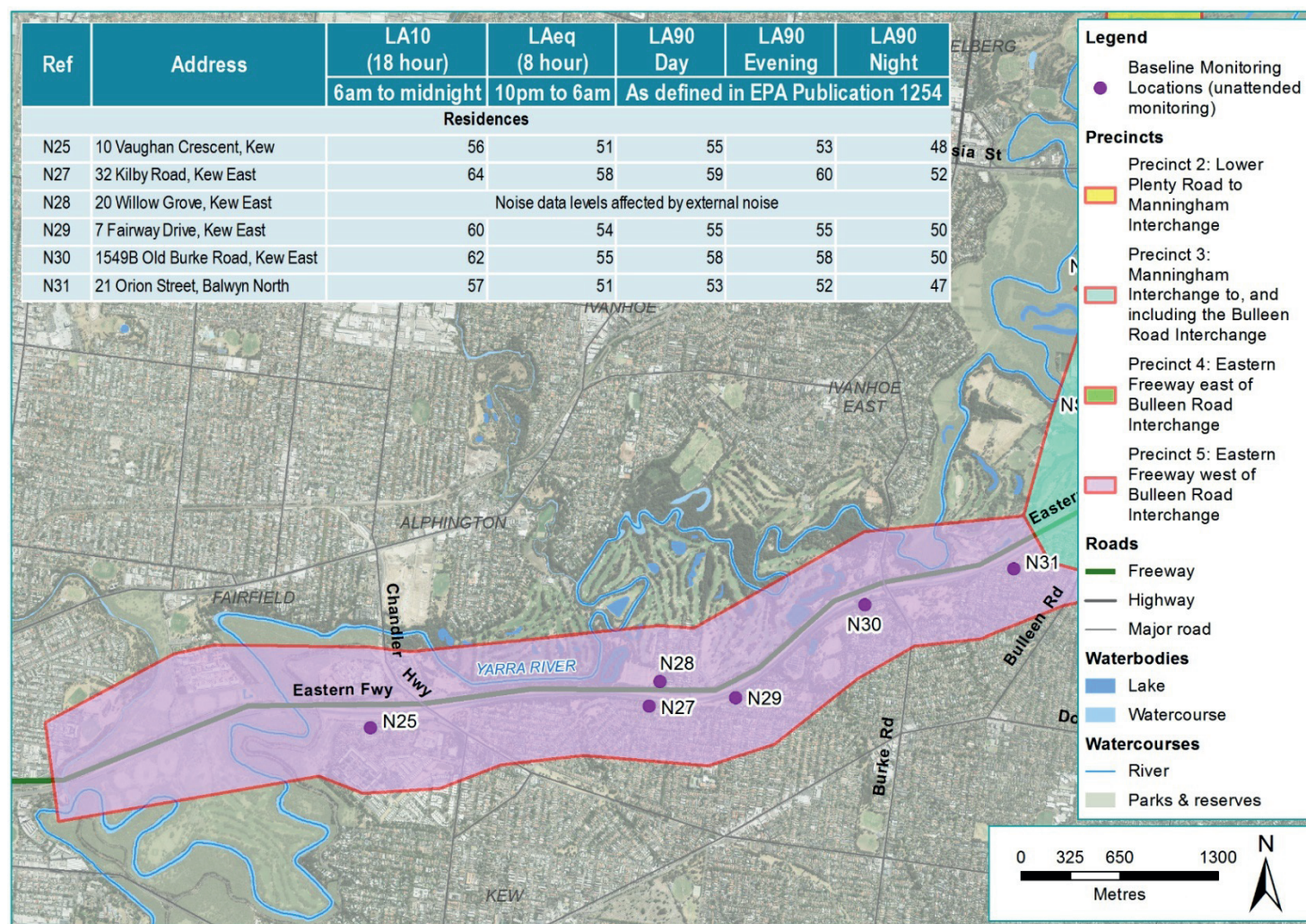


Figure 11-5 Baseline Noise Monitoring locations and measured noise levels for Noise Precinct 5

11.2.1 Noise Precinct 1

Noise Precinct 1 passes through the suburbs of Greensborough, Watsonia North, Watsonia, Macleod, Yallambie and Rosanna and Bundoora.

Sensitive receivers

Land use in Noise Precinct 1 is categorised as residential, community, commercial, industrial, Commonwealth land, and public open space. Most sensitive receivers within Noise Precinct 1 are residential.

The types of sensitive and other receivers within Noise Precinct 1 are listed in Table 11-1.

Table 11-1 Sensitive and other receivers – Noise Precinct 1

| Category | Description |
|--|--|
| Sensitive receivers | |
| Category A – Noise Sensitive Residential Buildings | <p>The areas surrounding the M80 Ring Road into Greensborough Road and along Greensborough Road from Grimshaw Street to Lower Plenty Road are predominantly residential. Dwellings are generally detached houses. Along Greensborough Road, these generally face onto the road or are separated from the main road by recreation or public open space.</p> <p>This area also includes the retirement villages of:</p> <ul style="list-style-type: none"> MS Respite Services, 303-311 Greensborough Road Baptcare Strathalan Macleod, 50 Braidhill Road, Macleod. |
| Category B – Noise Sensitive Community Buildings | <p>Noise Precinct 1 contains a range of noise sensitive community buildings. These include churches, schools, early learning and child care centres and Watsonia Library.</p> <p>A sample of Category B receptors were specifically considered in the assessment. These included:</p> <ul style="list-style-type: none"> St Mary's Church and Parish Primary School, 210 Grimshaw Street, Greensborough Watsonia Primary School, 240 Nell Street, Watsonia Concord School, 16 Meagher Street, Watsonia Grace Baptist Church, 240 Nell Street, Watsonia Watsonia Library, 4/6 Ibbottson Street, Watsonia Watsonia Uniting Church, 71 Devonshire Road, Watsonia Holy Spirit Anglican Church, corner of Watsonia Road and Ibbotson Street, Watsonia St Martin of Tours Primary School, 2-12 Silk Street, Rosanna. |
| Commonwealth land | <p>Simpson Barracks is an Australian Army facility located on Commonwealth land along Greensborough Road and includes residential accommodation.</p> |

| Category | Description |
|---|--|
| Outdoor recreation and public open spaces | <p>Noise Precinct 1 contains numerous outdoor recreation and public open spaces. These include reserves and gardens, ovals and shared use paths.</p> <p>A sample of key outdoor recreation and public open spaces were specifically considered in the assessment. These included:</p> <ul style="list-style-type: none"> • AK Lines Reserve, Grimshaw Street, Watsonia • Plenty River Linear Reserve, Plenty River Drive, Greensborough • Winsor Reserve, Somers Avenue, Macleod. |
| Other receivers | |
| Commercial land | <p>Watsonia Village Neighbourhood Centre contains commercial land including a mixture of retail, food and small independent local stores and a post office clustered around Watsonia Railway Station.</p> <p>Commercial land uses off Grimshaw Street along Greensborough Road and the Hurstbridge rail line include fast food outlets and accommodation.</p> |
| Industrial land | <p>There are limited industrial land uses within Noise Precinct 1. Several industrial land uses are located in the City of Whittlesea north of the M80 Ring Road and outside the study area. These industrial land uses are predominantly within the Janefield Technology Estate.</p> |

Noise conditions

The ambient noise environment in Noise Precinct 1 is dominated by noise from Greensborough Road and the M80 Ring Road. Non-traffic noise sources include occasional high-level aircraft, domestic activities and rail movements on the Hurstbridge rail line.

Measured background levels are considered typical for urban environments near freeways and major arterial roads. Background noise levels (L_{A90}) at residential receivers in Noise Precinct 1 were measured between 44 dBA and 63 dBA during the day, 44 dBA and 60 dBA during the evening and 37 dBA and 49 dBA during the night-time. Background noise levels at schools in Noise Precinct 1 were measured between 50 dBA and 65 dBA during the day, 50 dBA and 63 dBA during the evening and 43 dBA and 55 dBA during the night-time. Figure 11-2 presents the baseline noise monitoring locations and noise measurements for Noise Precinct 1.

Sensitive receivers near Grimshaw Street are exposed to significant noise from this major road as well as from Greensborough Road. Noise from trains also contribute to the noise environment in this area. The intersections of Greensborough Road and Grimshaw Street, and Greensborough Road and Lower Plenty Road correspond to higher levels of road traffic noise.

High maximum night-time noise levels were typically measured near major intersections along Greensborough Road. This is expected, due to the stop-start nature of traffic at intersections. Discrete maximum noise events are typically caused by heavy vehicle movements, the use of vehicle engine brakes and motorbikes.

Noise mitigation measures currently in place include noise walls and roadside mounds along the M80 Ring Road and Greensborough Highway into Greensborough Road. There is only a limited section of low-height roadside noise mitigation controls along Greensborough Road beyond the Grimshaw Street intersection. Dwellings along this section of Greensborough Road tend to experience higher traffic noise levels the closer they are located to the intersection of Greensborough Road and Lower Plenty Road.

11.2.2 Noise Precinct 2

Noise Precinct 2 extends south from Lower Plenty Road to the Manningham Road interchange, within the residential areas of Rosanna and Heidelberg.

Sensitive receivers

Land use in Noise Precinct 2 mostly includes residential and public open spaces with some industrial and community land use also present. The type of sensitive and other receivers within Noise Precinct 2 are listed in Table 11-2.

Table 11-2 Sensitive and other receivers – Noise Precinct 2

| Category | Location/description |
|--|--|
| Sensitive receivers | |
| Category A – Noise Sensitive Residential Buildings | The areas adjacent to and surrounding the project boundary between the northern and southern portals are characterised by low density, detached houses. There is increased residential density along Templestowe Road and Manningham Road towards Bulleen Plaza Neighbourhood Centre. Houses in this area are typically separated from the main road by high wooden or brick fences. |
| Outdoor recreation and public open spaces | Noise Precinct 2 passes underneath the Yarra River, Banyule Flats and Warringal Parklands. |
| Other receivers | |
| Commercial land | Commercial land uses within Noise Precinct 2 are located along Templestowe Road, Bulleen Road and within the Bulleen Industrial Estate which is located adjacent to the Yarra River off Manningham Road. |
| Industrial land | Industrial land uses within Noise Precinct 2 are generally limited to the Bulleen Industrial Estate. The estate contains a number of light industrial businesses including auto repair premises. These businesses are housed within single or two-storey warehouses. |

Noise conditions

The ambient noise environment along Bulleen Road and near the intersection of Manningham Road is dominated by road traffic noise. Sensitive receivers near the intersection of Manningham Road tend to experience high levels of road traffic noise. Congestion occurs in these areas during peak traffic times, and so the prevalence of stop-start traffic and the use of truck brakes would be high.

Background noise levels (L_{A90}) were measured at one residential receiver in Noise Precinct 2 as 57 dBA during the day, 55 dBA during the evening and 50 dBA during the night-time. Figure 11-3 presents the baseline noise monitoring locations and noise measurements for Noise Precinct 2.

There are generally no specific noise mitigation controls in place for residences in Noise Precinct 2.

11.2.3 Noise Precinct 3

Noise Precinct 3 extends from Bridge Street to south of the Bulleen Road interchange with the Eastern Freeway.

Noise Precinct 3 spans the suburbs of Heidelberg East, Bulleen and Balwyn North.

Sensitive receivers

Land use in Noise Precinct 3 is predominantly residential and open space. The type of sensitive and other receivers within Noise Precinct 3 are listed in Table 11-3.

Table 11-3 Sensitive and other receivers – Noise Precinct 3

| Category | Location/description |
|--|---|
| Sensitive receivers | |
| Category A – Noise Sensitive Residential Buildings | Residential land uses are generally one and two storey detached dwellings. Residences in this area have differing exposure to road traffic noise. Around the Manningham Road interchange, there is limited exposure to freeway noise. However, residents to the south have some exposure to noise from the Eastern Freeway. |
| Category B – Noise Sensitive Community Buildings | There are a range of noise sensitive buildings within Noise Precinct 3. These include schools and community facilities. A sample of Category B receptors were specifically considered in the assessment. These included: <ul style="list-style-type: none"> Belle Vue Primary School, 20 Highview Road, Balwyn North Veneto Club, 191 Bulleen Road, Bulleen Marcellin College, 160 Bulleen Road, Bulleen. |

| Category | Location/description |
|---|--|
| Outdoor recreation and public open spaces | <p>There are a range of outdoor recreation and public open spaces within Noise Precinct 3. A sample of outdoor recreation and public open spaces was specifically considered in the assessment, as follows:</p> <ul style="list-style-type: none"> Trinity Grammar School Sporting Complex, Bulleen Road, Bulleen, Carey Grammar Sports Complex, Bulleen Road, Bulleen. |
| Other receivers | |
| Commercial land | There is only isolated commercial activity along Bulleen Road, south of the Manningham Road interchange. |
| Industrial land | There is no industrial land use in Noise Precinct 3. |

Noise conditions

The ambient noise environment in Noise Precinct 3 is dominated by road traffic noise. Residents close to the Eastern Freeway tend to experience high levels of road traffic noise above the project noise objectives (described in Section 11.4.1). Other sources contributing to the local noise environment include noise from occasional passing aircraft, surrounding local roads, and local activities.

Discrete maximum noise events are typically caused by heavy vehicle movements, the use of vehicle engine brakes and motorbikes. This is typical of major road corridors with inclines or declines of the road gradient.

Noise-sensitive receivers located near ramps tend to experience higher maximum noise levels, due to the stop-start nature of the traffic flow.

Background noise levels (L_{A90}) at residential receivers in Noise Precinct 3 were measured between 50 dBA and 56 dBA during the day, 50 dBA and 56 dBA during the evening and 45 dBA and 49 dBA during the night-time. Background noise levels at schools in Noise Precinct 3 were measured between 56 dBA and 60 dBA during the day, 53 dBA and 56 dBA during the evening and 43 dBA and 47 dBA during the night-time. Figure 11-3 presents the baseline noise monitoring locations and noise measurements for Noise Precinct 3.

Noise walls and open graded asphalt are the typical noise mitigation controls in Noise Precinct 3.

11.2.4 Noise Precinct 4

Noise Precinct 4 extends along the Eastern Freeway east of Hoddle Street through to Springvale Road.

The suburbs of Balwyn North, Bulleen, Balwyn North, Doncaster, Doncaster East, Donvale, Box Hill North, Blackburn North and Nunawading border Noise Precinct 4.

Sensitive receivers

Land use in Noise Precinct 4 is predominantly residential and open space. The type of sensitive and other receivers within Noise Precinct 4 are listed in Table 11-4.

Table 11-4 Sensitive and other receivers – Noise Precinct 4

| Category | Location/description |
|--|--|
| Sensitive receivers | |
| Category A – Noise Sensitive Residential Buildings | <p>Residential land uses are generally one and two-storey detached dwellings built on land above the line of the freeway on the northern boundary of the Eastern Freeway, and in line with the freeway on its southern boundary. Medium density townhouses are also located in these precincts.</p> <p>The area between Burke Road and Doncaster Road, covering the suburbs of Balwyn North and Bulleen, is predominantly residential interspersed with parks and reserves along the boundary of the Eastern Freeway.</p> <p>The areas between Doncaster Road and Springvale Road along the Eastern Freeway are predominantly residential, interspersed with community parkland and reserves. The Koonung Creek Trail follows the line of the Eastern Freeway on its southern boundary.</p> |
| Category B – Noise Sensitive Community Buildings | <p>There a range of noise sensitive buildings within Noise Precinct 4. A sample of Category B receptors were specifically considered in the assessment. These included:</p> <ul style="list-style-type: none"> • Kalker Montessori Centre, 1-3 Estelle Street, Bulleen • Birrale Primary School, 8-26 Heyington Avenue, Doncaster • Wonderland Childcare and Kinder, 6 High Street, Doncaster • Applewood Retirement Village, 5 Grand Blvd, Doncaster • North Eastern Jewish Centre (Yeshurun Congregation), 6 High Street, Doncaster • Japara Sydney Williams Apartments/Japara Millward Nursing home, 31 Blackburn Road, Doncaster East • Heatherwood School, 370 Springvale Road, Donvale • Presbyterian Theological College, 684 Elgar Road, Box Hill North • Warekila Preschool, 38 Kett Street, Nunawading. |

| Category | Location/description |
|---|---|
| Outdoor recreation and public open spaces | <p>There are a range of outdoor recreation and public open spaces within Noise Precinct 4. These include parks and reserves typically following the Eastern Freeway and Koonung Creek or associated with the Yarra River, as well as a range of sporting clubs and golf courses.</p> <p>A sample of outdoor recreation and public open spaces were specifically considered in the assessment. These included:</p> <ul style="list-style-type: none"> • Musca Street Reserve, Musca Street, Balwyn North • Koonung Creek Reserve, Balwyn North • Manningham Park Reserve, Park Avenue, Doncaster • Freeway Golf Course, Columba Street, Balwyn North • Boroondara Tennis Centre, Bulleen Road, Balwyn North • Bulleen Cricket Club, Furneaux Grove, Bulleen • Winfield Road Reserve, Winfield Road, Balwyn North • Katrina Street Reserve Playground, Katrina Street, Doncaster • Elgar Park, Belmore Road, Mont Albert North • Tram Road Reserve, Tram Road, Doncaster • Koonung Creek Linear Park, Windella Quadrant, Doncaster • Boronia Grove Reserve, Leeds Street, Doncaster East • Slater Reserve, Grosvenor Street, Blackburn North • Eastern Freeway Linear Reserve, Kett Street, Nunawading • North Box Hill Tennis Club, Elizabeth Street, Box Hill North • Frank Sedgman Reserve, Paul Avenue, Box Hill North. |
| Other receivers | |
| Commercial land | <p>There is only isolated commercial activity along the line of the Eastern Freeway between Hoddle Street and Doncaster Road.</p> <p>A small number of commercial premises operate within the Joseph Street light industrial cluster, located south of the freeway in Blackburn North, within the City of Whitehorse. This precinct is separated from the freeway by the reserves associated with the Koonung Creek trail and noise walls or mounds.</p> |
| Industrial land | <p>Industrial land use is generally limited to the Joseph Street Industrial Estate and a power substation located adjacent to the Eastern Freeway. The industrial precinct is separated from the freeway by the reserves associated with the Koonung Creek trail and includes noise walls or mounds.</p> |



Noise conditions

The ambient noise environment in Noise Precinct 4 is dominated by road traffic noise from the Eastern Freeway. Residents close to the Eastern Freeway tend to experience high levels of road traffic noise above the project noise objectives. Non-traffic noise sources include occasional passing aircraft, surrounding local roads, and local activities.

Background noise levels (L_{A90}) at residential receivers in Noise Precinct 4 were measured between 51 dBA and 61 dBA during the day, 50 dBA and 61 dBA during the evening and 44 dBA and 56 dBA during the night-time. Background noise levels at the Kalker Montessori Centre were measured as 57 dBA during the day, 56 dBA during the evening and 48 dBA during the night-time. Figure 11-4 presents the baseline noise monitoring locations and noise measurements for Noise Precinct 4.

Sensitive receivers located near ramps tend to experience higher maximum noise levels, due to the stop-start nature of the traffic flow. Discrete maximum noise events are typically caused by heavy vehicle movements, the use of vehicle engine brakes and motorbikes. This is typical of major road corridors with inclines or declines of the road gradient.

Noise mitigation measures currently in place for residential areas along the Eastern Freeway include noise walls and the occasional roadside mound. Residences near parks and reserves which do not have noise mitigation controls tend to experience higher levels of road traffic noise. Most open spaces are separated from the road by acoustic noise walls, except for along the Koonung Creek Reserve.

11.2.5 Noise Precinct 5

Noise Precinct 5 extends along the Eastern Freeway from Hoddle Street to Bulleen Road.

The suburbs of Clifton Hill, Fairfield, Alphington, Kew, Kew East and Balwyn North border Noise Precinct 5.

Sensitive receivers

Land use in Noise Precinct 5 is predominantly residential and open space. The sensitive and other receivers within Noise Precinct 5 are listed in Table 11-5.

Table 11-5 Sensitive and other receivers – Noise Precinct 5

| Category | Location/description |
|--|--|
| Sensitive receivers | |
| Category A – Noise Sensitive Residential Buildings | <p>Residential land uses are generally one and two-storey detached dwellings built on land above the line of the freeway on the northern boundary of the Eastern Freeway, and in line with the freeway on its southern boundary. Medium density townhouses are also located in these precincts.</p> <p>The area between Burke Road and Bulleen Road, covering the suburb of Balwyn North, is predominantly residential interspersed with parks and reserves along the boundary of the Eastern Freeway.</p> <p>The area west of Burke Road is a mix of low rise residential and open parkland. Residences in this area are generally exposed to high levels of road traffic noise from the Eastern Freeway.</p> <p>The interface between dwellings and the adjacent freeway commonly includes a park or reserve, as well as an acoustic noise wall.</p> |
| Category B – Noise Sensitive Community Buildings | <p>There a range of noise sensitive buildings within Noise Precinct 5. A sample of Category B receptors were specifically considered in the assessment. These included:</p> <ul style="list-style-type: none"> Royal Talbot Rehabilitation Centre, 1 Yarra Boulevard, Kew Melbourne Polytechnic and Thomas Embling Hospital, Yarra Bend Road, Fairfield. |
| Outdoor recreation and public open spaces | <p>There are a range of outdoor recreation and public open spaces within Noise Precinct 5. A sample of outdoor recreation and public open spaces were specifically considered in the assessment. These included:</p> <ul style="list-style-type: none"> Musca Street Reserve, Musca Street, Balwyn North Jack O'Toole Reserve, Kilby Road, Kew East Hays Paddock, Leason Street, Kew East Latrobe Golf Club, Farm Road, Alphington Yarra Flats Park, The Boulevard, Ivanhoe East. |
| Other receivers | |
| Commercial land | <p>There is only isolated commercial activity along the line of the Eastern Freeway near Hoddle Street.</p> <p>Kew Golf Club is located on the north boundary of the freeway between Belford Road and Burke Road.</p> |
| Industrial land | <p>Industrial land use is generally limited to the Joseph Street Industrial Estate and a power substation located adjacent to the Eastern Freeway. The industrial estate is separated from the freeway by the reserves associated with the Koonung Creek trail and includes noise walls or mounds.</p> |

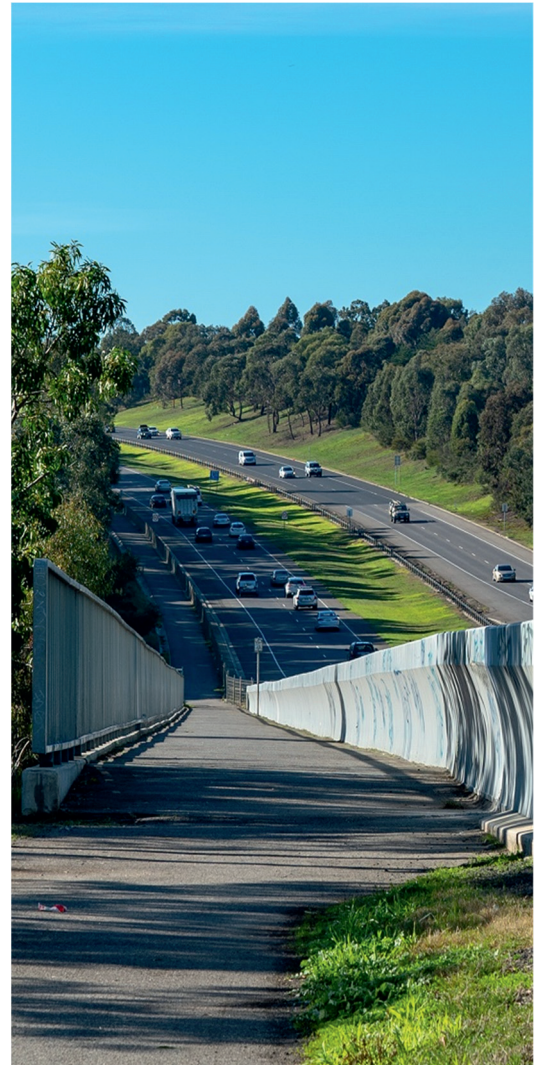
Noise conditions

The ambient noise environment in Noise Precinct 5 is dominated by road traffic noise from the Eastern Freeway. Residents close to the Eastern Freeway tend to experience high levels of road traffic noise above the project's noise objectives. Non-traffic noise sources include occasional passing aircraft, surrounding local roads, and local activities.

Background noise levels (L_{A90}) at residential receivers in Noise Precinct 5 were measured between 53 dBA and 59 dBA during the day, 52 dBA and 60 dBA during the evening and 47 dBA and 52 dBA during the night-time. Figure 11-5 presents the baseline noise monitoring locations and noise measurements for Noise Precinct 5.

Sensitive receivers located near ramps tend to experience higher maximum noise levels, due to the stop-start nature of the traffic flow. Discrete maximum noise events are typically caused by heavy vehicle movements, the use of vehicle engine brakes and motorbikes. This is typical of major road corridors with inclines or declines of the road gradient.

Noise mitigation measures currently in place for residential areas along the Eastern Freeway include noise walls and, occasionally, roadside mounds. Residences near parks and reserves which do not have noise mitigation controls tend to experience higher levels of road traffic noise.



11.3 Construction impact assessment

This section discusses the construction impacts associated with North East Link that relate to surface noise and vibration.

The surface noise and vibration impacts identified for the construction phase of North East Link are grouped according to two main themes:

- Construction noise –the potential for noise generated by construction works to impact amenity at sensitive receivers
- Construction vibration –the potential for vibration generated by construction works to impact amenity at sensitive receivers, interfere with scientific equipment or damage buildings and underground services.

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

11.3.1 Construction noise

Noise generated by construction has the potential to adversely impact amenity at sensitive receivers. Increased noise levels can occur due to construction activities, spoil haulage and temporary removal of noise walls.

The risk pathway associated with construction noise is described in Table 11-6 and discussed below.

Table 11-6 Risk table: Construction – noise

| Risk ID | Risk pathway | Risk rating |
|------------|---|-------------|
| Risk SNV01 | Noise generated by surface works during construction (including transport of spoil) causes an increase in noise or vibration affecting amenity at sensitive receivers | Medium |

Construction activities

Construction activities for North East Link are planned to start in early 2020 and be complete by the end of 2027. Early works are planned to start from late 2019. While the entire construction program is expected to extend over eight years, the duration of works in individual locations would vary considerably.

The activities likely required to construct the above-ground aspects of the project would involve conventional road construction equipment such as rock-breakers, earth moving equipment, piling equipment, paving plant, concreting equipment and cranes.

A number of scenarios have been developed to enable potential impacts associated with the project's construction to be assessed. The scenarios represent potential construction activities, their locations, anticipated durations and the likely hours of work.

Consistent with the EPA Victoria Noise Control Guidelines (EPA Victoria Publication 1254) the normal working hours for construction works would be:

- 7 am to 6 pm Monday to Friday
- 7 am to 1 pm on Saturdays.

Construction works would be undertaken outside these normal working hours where:

- They are inherently quiet and so would meet the applicable noise target at the nearest sensitive receiver
- They are unavoidable for reasons of public and construction worker safety, to maintain minimum performance levels on the transport network, or because of the continuous nature of the activities
- They involve tunnelling and tunnelling support sites which would operate 24-hours per day, seven days per week.

Some anticipated works outside normal working hours have been included in the assessment to inform the scheduling of construction activities and management of noise during the project's detailed design phase. Where construction activities are proposed to occur outside normal working hours, these would be managed in accordance with the Construction Noise Vibration Management Plan (CNVMP) required under EPR NV4.

Construction noise guidelines

Victoria does not have statutory limits for noise. Rather, EPA Victoria provides two guidance documents which have been used as the basis for establishing construction noise guideline targets and management levels for North East Link:

- *Noise Control Guidelines*, Publication 1254, 2008 (EPA Victoria Publication 1254)
- *Environmental Guidelines for major construction sites*, Publication 480 Best Practice Environmental Management, 1996 (EPA Victoria Publication 480).

These guidelines do not set daytime noise guidance. Accordingly, the New South Wales *Interim Construction Noise Guideline* (ICNG) and *Roads and Maritime Services' Construction Noise and Vibration Guideline* (CNVG) have been adopted to set guideline targets for daytime works during normal working hours. This approach is consistent with the approach adopted on other recent Victorian major transport projects.

The ICNG provides a method to assess construction noise impacts, including setting noise management levels and to consider the need for mitigation. The CNVG complements the ICNG, providing a framework for management of impacts and application of additional mitigation.

Table 11-7 summarises the construction noise guideline targets adopted for North East Link, which form the basis of EPR NV3.

For residential dwellings, management actions must be implemented as per EPR NV4 if noise from construction works during normal working hours is predicted to or does exceed the noise management levels for normal working hours below.

Noise from construction works during weekend/evening work hours and the night period must meet the weekend/evening and night period noise guideline targets in the table below unless they are Unavoidable Works.

Table 11-7 Construction noise guideline targets for residences

| Time of day | Construction noise guideline targets |
|---|--|
| Normal working hours: <ul style="list-style-type: none"> 7am – 6pm Monday to Friday 7am – 1pm Saturday | Noise affected: Background $L_{A90} + 10$ dB Highly noise affected: 75 dB(A) Source: NSW Interim Construction Noise Guideline (ICNG) Chapter 4.1.1 Table 2 The noise affected level represents the point above which there may be some community reaction to noise. The highly noise affected level represents the point above which there may be strong community reaction to noise. |
| Weekend/evening work hours: <ul style="list-style-type: none"> 6pm – 10pm Monday to Friday 1pm – 10pm Saturday 7am – 10pm Sunday and public holidays | Noise level at any residential premises not to exceed background noise (L_{A90}) by: <ul style="list-style-type: none"> 10 dB(A) or more for up to 18 months 5 dB(A) or more after 18 months Source: EPA Publication 1254 Section 2 |
| Night period: <ul style="list-style-type: none"> 10pm – 7am Monday to Sunday | Noise inaudible within a habitable room of any residential premises Source: EPA Publication 1254 Section 2 and EPA Publication 480 Section 5 |

Note: Where any reference is made to the rating background level (RBL) or background L_{A90} ; the 'average background' over the assessment period as per Victorian noise policy practices is to be used. This applies to all receptors and all time periods.

For sensitive land uses (based on AS/NZS 2107:2016) management actions would be implemented as per EPR NV4 if construction noise is predicted to or does exceed the internal and external noise levels in Table 11-8, and a noise sensitive receptor is adversely impacted. If construction exceeds the noise levels in Table 11-8, the following would be undertaken to determine whether a noise sensitive receptor is adversely impacted:

- Consider the duration of construction noise
- Consider the existing ambient noise levels
- Consult with the owner or operator of the noise sensitive receptor
- Consider any specific acoustic requirements of land uses listed below

Table 11-8 Construction noise management level guidelines for sensitive receptors

| Land use | Construction noise management level $L_{Aeq}(15 \text{ min})$ applies when properties are in use |
|---|---|
| Classrooms in schools and other educational institutions | Internal noise level 45 dB(A) |
| Hospital wards and operating theatres | Internal noise level 45 dB(A) |
| Places of worship | Internal noise level 45 dB(A) |
| Active recreation areas characterised by sporting activities and activities which generate their own noise, making them less sensitive to external noise intrusion | External noise level 65 dB(A) |
| Passive recreation areas characterised by contemplative activities that generate little noise and where benefits are compromised by external noise intrusion, for example reading, meditation | External noise level 60 dB(A) |
| Community centres | Depends on the intended use of the centre. Refer to the recommended maximum internal levels in AS/NZS 2107:2016 for specific uses |
| Industrial premises | External noise level 75 dB(A) |
| Offices, retail outlets | External noise level 70 dB(A) |
| Other noise sensitive land uses as identified in AS/NZS 2107:2016 | Refer to the noise levels in AS/NZS 2107:2016 |

Project-specific Noise Management Levels (NMLs) have been established based on these noise guideline targets. The NMLs are noise levels from construction works which trigger a particular action to manage impacts. These NMLs are to be used to guide the need for, and selection of, work practices to minimise noise impacts. Depending on the construction activity, extent of impact and scale of works it may not be possible to meet these guideline targets in all circumstances. Managing impacts may involve implementing additional mitigation measures such as time restrictions or alternative construction methodologies, and engaging with or notifying the community.

EPR NV4 requires a Construction Noise and Vibration Management Plan (CNVMP) to be prepared to address the specific activities being undertaken, the level of impact anticipated and appropriate management and mitigation. Management, notification and mitigation measures are to be implemented in accordance with the CNVG.

Predicted noise levels

Modelling was undertaken to predict worst case noise and vibration levels that may be experienced at sensitive receivers. Predicted noise levels were evaluated against the NMLs.

The number of receivers predicted to experience exceedances of the NMLs have been summarised in bands of 10 dBA and separated into daytime, evening and night-time periods. Table 11-9 describes the subjective perception of typical impacts for each NML exceedance band.

Table 11-9 Noise management level exceedance bands

| Noise level | Impact description |
|------------------------|--|
| 1 to 10 dBA above NML | Typically noticeable to clearly audible |
| 11 to 20 dBA above NML | Typically clearly audible to moderately intrusive |
| >20 dBA above NML | Typically moderately intrusive to highly intrusive |

Residential receivers with predicted noise levels of 75 dBA L_{Aeq} or greater during the day are considered 'Highly Noise Affected' (HNA). The HNA level is defined in the New South Wales ICNG as the point above which there may be strong community reaction to noise. Where noise is above this level, time restrictions may be applied to the very noisy activities in addition to other mitigation measures and notification of affected residents.

Exceedances have been defined as the potential for the construction activities to result in the NMLs being exceeded at a point in time for a sensitive receiver based on the modelled construction activities. During most activities, it is expected the construction noise levels are likely to frequently be lower than the worst-case levels predicted for periods of time. For example, when the works move around the site and are more distant from receivers, and when less noisy activities are being undertaken.

Overall, the modelling of construction scenarios identified potential noise and vibration impacts that would require additional mitigation or time restrictions. In localised areas noise at receivers would exceed the nominated NML for varying periods of time, especially during works outside normal working hours. For a small number of discrete operations, high noise impacts could be expected for a considerable period of time and as a result, risk SNV01 has been assessed as medium.

Construction works would be managed through a Construction Noise and Vibration Management Plan (EPR NV4) to minimise these impacts. Mitigation measures would be adopted in accordance with the New South Wales Roads and Maritime Services' Construction Noise and Vibration Guideline 2016 (CNVG). This approach is standard for major infrastructure projects currently occurring in Victoria.

The following sections provide a summary of potential impacts for each precinct. In reviewing these results it should be noted that:

- Durations are only indicative – the duration of the impacts at each specific location are likely to be less than the overall duration and would depend on the rate of progress
- Results are based on worst-case predicted noise levels
- Works outside normal working hours includes daytime periods on Saturday from 1 pm to 6 pm and on Sunday and public holidays from 8 am to 6 pm.

Noise Precinct 1

Works in Noise Precinct 1 include the widening of the M80 Ring Road and Greensborough Bypass, construction of grade-separated interchanges at Greensborough Bypass, Grimshaw Street and Lower Plenty Road, the trench section, land bridges and cut and cover tunnel and the northern tunnel portal, and the temporary relocation of the Watsonia railway station car park.

Table 11-10 shows the number of receivers predicted to potentially experience NML exceedances in Noise Precinct 1. These results are based on worst-case predicted noise levels. These noise levels and their duration would depend on the specific equipment used and activities carried out at each location. The duration of works and associated impacts at each specific location are likely to be less than the overall indicative activity durations shown in the table.

Table 11-10 Number of noise sensitive receivers predicted to experience NML exceedances – Noise Precinct 1

| Scenario | Indicative activity duration (months) | HNA | Normal | | | Works outside normal working hours | | | | | |
|-------------------------------------|---------------------------------------|-----|-------------------------------------|-----------|---------|------------------------------------|-----------|---------|------------|-----------|---------|
| | | | Daytime | | | Evening | | | Night-time | | |
| | | | NML exceedance (L _{Aeq}): | | | | | | | | |
| | | | 1-10 dBA | 11-20 dBA | >20 dBA | 1-10 dBA | 11-20 dBA | >20 dBA | 1-10 dBA | 11-20 dBA | >20 dBA |
| Compound construction | 3–6 | - | - | - | - | | | | | | |
| Compound operation | > 24 | - | - | - | - | - | - | - | - | - | - |
| Demolition – Kempston Street bridge | 3–6 | 13 | 50 | 11 | 5 | 131 | 29 | 8 | 325 | 99 | 26 |
| Demolition – Grimshaw Street bridge | 3–6 | - | 47 | 6 | - | 164 | 18 | - | 736 | 95 | 9 |
| Piling of trench | 12–18 | - | 11 | - | - | | | | | | |

| Scenario | Indicative activity duration (months) | HNA | Normal | | | Works outside normal working hours | | | | | |
|---|---------------------------------------|-----|-------------------------------------|-----------|---------|------------------------------------|-----------|---------|------------|-----------|---------|
| | | | Daytime | | | Evening | | | Night-time | | |
| | | | NML exceedance (L _{Aeq}): | | | | | | | | |
| | | | 1-10 dBA | 11-20 dBA | >20 dBA | 1-10 dBA | 11-20 dBA | >20 dBA | 1-10 dBA | 11-20 dBA | >20 dBA |
| Excavation of surface of trench | 12–18 | - | 11 | - | - | | | | | | |
| Excavation at 5m depth trench | 12–18 | - | 72 | 1 | - | | | | | | |
| Land bridge/ overpass construction | 9 | - | 2 | - | - | | | | | | |
| Crushing, screening and vegetation clearing M80 | 3–6 | 56 | 320 | 74 | - | | | | | | |
| Earthworks (with rock-breakers) | 6–12 | 4 | 154 | 12 | - | | | | | | |
| Road tie-in works (major road) | > 24 | 39 | 245 | 50 | - | | | | | | |
| Tunnel launch preparation (north option) | 6–12 | 3 | 9 | - | - | | | | | | |
| Tunnel boring machine tunnelling (north option) | > 24 | - | - | - | - | - | - | - | 3 | - | - |
| Viaduct construction | 12–18 | - | 15 | 1 | - | 64 | 9 | - | 307 | 27 | 6 |
| Viaduct earthworks | 12–18 | - | 10 | 1 | - | 40 | 5 | - | 283 | 17 | 3 |
| Watsonia Station clearing & civils | < 3 | - | 4 | - | - | | | | | | |
| Watsonia Station Pavement and road tie-ins | 3–6 | - | 1 | - | - | | | | | | |

Legend

1 - 10 dB above NML (noticeable to clearly audible)
 11 dB - 20 dB above NML (clearly audible to moderately intrusive)
 > 20 dB above NML (moderately intrusive to highly intrusive)

During normal construction hours moderately intrusive noise impacts (11 to 20 dBA above NML) may occur at receivers adjacent to the road corridor in Watsonia North and Greensborough from the clearing and widening works along the M80 Ring Road and Greensborough Road. These impacts are primarily due to activities such as mulching, which would likely occur for a relatively short period (several days) before progressing to a different area. Noise mitigation options would include the placement of equipment such as mulchers away from residences, temporary acoustic shielding and other management measures to minimise noise from equipment and work sites, such as turning equipment off when not in use.

Similarly, a single receiver adjacent to the excavation works for the trench in Watsonia and Macleod may experience moderately intrusive impacts while intensive works are nearby, particularly during rock breaking. Rock breaking would not be required for surface works, but may be required for excavations below a depth of 5 metres. As the trench was excavated deeper the works would become progressively more shielded. The duration of this total activity is 12 to 18 months with gradual progress along the project alignment. Accordingly, the worst case predicted impacts at any one receiver would be for a shorter duration. When the rock breakers were not in use, the noise levels and corresponding NML exceedances for the trench excavation works are predicted to reduce by around 9 dBA which eliminates the NML exceedance for the majority of identified receivers. Noise mitigation options include the use of alternative excavation methods, hoarding, temporary acoustic shielding and time restrictions.

Construction activities anticipated to occur into the evening and night-time period due primarily to site occupation and safety considerations may impact a significant number of receivers. These activities include the demolition of the Kempston and Grimshaw Street bridges as well as aspects of the construction of elevated viaduct for the northern interchange. These works may impact surrounding residential areas adjacent to the road corridor in Watsonia North and Greensborough.

The night-time noise impacts would primarily result from the use of large rock-breakers in bridge demolition. Noise mitigation options include the use of alternative demolition methods to rock breaking with a large rock-breaker, hoarding, temporary acoustic shielding and completing noisy operations during the daytime where possible.

No exceedances of the daytime NML for other sensitive receivers, such as educational facilities, hospitals and childcare centres are predicted.

The modelling for Noise Precinct 1 also considered potential noise impacts associated with a northern TBM launch site option. The northern TBM launch site option is located between Blamey Road and Lower Plenty Road, with the nearest residential receivers located approximately 30 to 50 metres away, along Greensborough Road and Borlase Street. The noise impacts associated with this option would be greater than for the southern TBM launch site option (discussed in subsection 'Noise Precinct 2'). This site option is within a truck curfew zone and so spoil haulage would potentially not occur during the night-time period. As a result, no increases in night-time noise levels or noise events along the proposed haulage route of Greensborough Road are predicted.

Noise Precinct 2

Noise Precinct 2 includes construction works for the North East Link tunnels, Manningham Road interchange and Manningham cut and cover tunnel section. Piling and excavation of the trench in Noise Precinct 1 and the Manningham cut and cover, which extends into Precinct 3, may also impact sensitive receivers in Precinct 2.

Table 11-11 shows the number of receivers predicted to potentially experience NML exceedances in Noise Precinct 2. These noise levels and their duration would depend on the specific equipment used and activities carried out at each location. The duration of works and associated impacts at each specific location are likely to be less than the overall indicative activity durations shown in the table.

Table 11-11 Number of sensitive receivers predicted to experience NML exceedances – Noise Precinct 2

| Scenario | Indicative activity duration (months) | HNA | Normal | | | Works outside normal working hours | | | | | |
|--|---------------------------------------|-----|-------------------------------------|-----------|---------|------------------------------------|-----------|---------|------------|-----------|---------|
| | | | Daytime | | | Evening | | | Night-time | | |
| | | | NML exceedance (L _{Aeq}): | | | | | | | | |
| | | | 1-10 dBA | 11-20 dBA | >20 dBA | 1-10 dBA | 11-20 dBA | >20 dBA | 1-10 dBA | 11-20 dBA | >20 dBA |
| Compound construction | 3–6 | - | - | - | - | | | | | | |
| Compound operation | > 24 | - | - | - | - | - | - | - | - | - | - |
| Piling of trench | 12–18 | - | - | - | - | | | | | | |
| Excavation of surface of trench | 12–24 | - | - | - | - | | | | | | |
| Excavation at 5m depth trench | >24 | - | 7 | - | - | | | | | | |
| Tunnel launch preparation (south option) | 12–18 | - | - | - | - | | | | | | |
| TBM tunnelling (south option) | > 24 | - | - | - | - | - | - | - | - | - | - |
| Piling of Manningham cut and cover | 12–18 | 1 | 1 | - | - | | | | | | |
| Excavation of surface of Manningham cut and cover | 12–18 | 1 | 1 | - | - | | | | | | |
| Excavation at 5m depth Manningham cut and cover | 6–12 | - | 5 | 1 | - | | | | | | |
| TBM retrieval Ground preparation (north option) | 3–6 | - | - | - | - | | | | | | |
| TBM retrieval Piling (north option) | 3–6 | - | - | - | - | | | | | | |
| TBM retrieval Excavation (north option) | 6–9 | - | - | - | - | | | | | | |
| TBM retrieval Equipment removal (north option) | <3 | - | - | - | - | | | | | | |

Legend

1 - 10 dB above NML (noticeable to clearly audible)
 11 dB - 20 dB above NML (clearly audible to moderately intrusive)
 > 20 dB above NML (moderately intrusive to highly intrusive)

Construction noise levels that are clearly audible are predicted at a relatively small number of receivers in Rosanna during the excavation of the trench near Lower Plenty Road in the north of the precinct and at a relatively small number of receivers in Bulleen during the excavation of the Manningham cut and cover tunnel in the south of the precinct. These impacts would primarily result from the use of a rock breaker to excavate the trench. As the trench was excavated deeper into harder ground which may necessitate the use of rock-breakers the works would become progressively more shielded. When the rock-breakers were not in use, the noise levels and corresponding NML exceedances are predicted to reduce by around 9 dBA which eliminates the NML exceedances.

No exceedances of the daytime NML for other sensitive receivers are predicted.

As described in Chapter 8 – Project description (Section 8.4.1), there is an alternative design for the Manningham Road interchange. The reference project and the alternative design for the interchange would likely result in very similar noise impacts.

The modelling for Noise Precinct 2 considered potential noise impacts associated with the proposed southern TBM launch site option. The proposed southern TBM launch site option is located within a commercial and industrial area near Greenaway Street and Kim Close, with the nearest residential receivers located approximately 150 to 250 metres away. Spoil haulage associated with this option would result in small increases in noise levels and noise events during the night-time period along the proposed haulage routes of Banksia Street, Bell Street (to the west), Rosanna Road and Greensborough Road (to the north) and three alternative routes of Sydney Road, High Street and Plenty Road. When tunnelling is finished, the TBM would be retrieved at the northern end of the tunnels, from within the trench excavation north of Lower Plenty Road.

For the northern TBM launch site option (discussed in subsection 'Noise Precinct 1'), a TBM retrieval site would be required north of Banksia Street in Banksia Park, within Noise Precinct 2. Noise modelling considered the construction of the TBM retrieval shafts at this site. The highest noise-generating construction activity is anticipated to be associated with the use of several large rock-breakers during excavation of the two retrieval shafts. High noise activities such as the use of rock-breakers are not expected to be required outside normal working hours, and so noise impacts are not anticipated.

Noise Precinct 3

Noise Precinct 3 involves construction works for the Manningham Road cut and cover tunnel, the southern tunnel portal and the Eastern Freeway interchange.

Table 11-12 shows the number of receivers predicted to potentially experience NML exceedances in Noise Precinct 3. These results are based on worst-case predicted noise levels. These noise levels and their duration would depend on the specific equipment used and activities carried out at each location. The duration of works and associated impacts at each specific location are likely to be less than the overall indicative activity durations shown in the table.

Table 11-12 Number of sensitive receivers to experience NML exceedances – Noise Precinct 3

| Scenario | Indicative activity duration (months) | HNA | Normal | | | Works outside normal working hours | | | | | |
|---|---------------------------------------|-----|-------------------------------------|-----------|---------|------------------------------------|-----------|---------|------------|-----------|---------|
| | | | Daytime | | | Evening | | | Night-time | | |
| | | | NML exceedance (L _{Aeq}): | | | | | | | | |
| | | | 1-10 dBA | 11-20 dBA | >20 dBA | 1-10 dBA | 11-20 dBA | >20 dBA | 1-10 dBA | 11-20 dBA | >20 dBA |
| Compound construction | 3–6 | - | - | - | - | | | | | | |
| Compound operation | > 24 | - | - | - | - | - | - | - | - | - | - |
| Crushing, screening and vegetation clearing Eastern Freeway | 3–6 | - | 3 | - | - | | | | | | |
| Earthworks (no rock-breakers) | 6–12 | - | - | - | - | | | | | | |
| Road tie-in works (major road) | > 24 | - | 1 | - | - | | | | | | |
| Piling of Manningham cut/cover | 6–12 | - | 3 | - | - | | | | | | |
| Excavation of surface of Manningham cut and cover | 6–12 | - | 3 | - | - | | | | | | |
| Excavation at 5m depth Manningham cut and cover | 12–18 | - | 7 | 1 | - | | | | | | |
| Viaduct construction | 12–18 | - | - | - | - | 1 | - | - | 34 | - | - |
| Viaduct earthworks | 6–12 | - | - | - | - | - | - | - | 13 | - | - |

Legend

1 - 10 dB above NML (noticeable to clearly audible)
 11 dB - 20 dB above NML (clearly audible to moderately intrusive)
 > 20 dB above NML (moderately intrusive to highly intrusive)

Clearly audible construction noise levels are predicted at a relatively small number of receivers in Bulleen during the excavation of the Manningham Road cut and cover tunnel in the north of Noise Precinct 3 during normal construction hours. Similar to Noise Precinct 1 and Noise Precinct 2, this impact would be due to the use of rock-breakers.

Construction activities anticipated to occur in the evening and night-time period due primarily to site occupation and safety considerations include some aspects of the construction of the elevated viaducts for the interchange. These may potentially cause clearly audible construction noise levels at a number of receivers in Balwyn North.

These excavation and viaduct construction activities would progress gradually along the project alignment. Accordingly the worst-case predicted impact at any one receiver would be for a shorter duration.

No exceedances of the daytime NML for other sensitive receivers are predicted.

Noise Precinct 4

Construction works within Noise Precinct 4 include widening of the Eastern Freeway, demolition and rebuilding of Doncaster Road Bridge over the Eastern Freeway, building of the Doncaster Busway and temporary relocation of the Doncaster Park and Ride facility to the south-western corner of the interchange. Table 11-13 shows the number of receivers predicted to potentially experience NML exceedances in Noise Precinct 4. These results are based on worst-case predicted noise levels. These noise levels and their duration would depend on the specific equipment used and activities carried out at each location. The duration of works and associated impacts at each specific location are likely to be less than the overall indicative activity durations shown in the table.

Table 11-13 Number of sensitive receivers predicted to experience NML exceedances – Noise Precinct 4

| Scenario | Indicative activity duration (months) | HNA | Normal | | | Works outside normal working hours | | | | | |
|---|---------------------------------------|-----|-------------------------------------|-----------|---------|------------------------------------|-----------|---------|------------|-----------|---------|
| | | | Daytime | | | Evening | | | Night-time | | |
| | | | NML exceedance (L _{Aeq}): | | | | | | | | |
| | | | 1-10 dBA | 11-20 dBA | >20 dBA | 1-10 dBA | 11-20 dBA | >20 dBA | 1-10 dBA | 11-20 dBA | >20 dBA |
| Compound construction | 3–6 | - | 2 | - | - | | | | | | |
| Compound operation | > 24 | - | - | - | - | 1 | - | - | 2 | - | - |
| Demolition – Doncaster Road Bridge | 1–3 | 1 | 26 | 1 | - | 154 | 9 | - | 410 | 40 | 4 |
| Crushing, screening and vegetation clearing | 3–6 | 1 | 110 | 2 | - | | | | | | |
| Earthworks (no rock-breakers) | > 24 | - | 14 | - | - | | | | | | |
| Road tie-in works (major road) | > 24 | - | 60 | - | - | | | | | | |
| Viaduct construction | 12–18 | - | - | - | - | - | - | - | 17 | - | - |
| Viaduct earthworks | 12–18 | 4 | - | - | - | - | - | - | 29 | - | - |
| Doncaster Park & Ride Clearing and site preparation | < 3 | - | 1 | - | - | | | | | | |
| Doncaster Park & Ride Pavement and road tie ins | 3–6 | - | 1 | - | - | | | | | | |

Legend

1 - 10 dB above NML (noticeable to clearly audible)
 11 dB - 20 dB above NML (clearly audible to moderately intrusive)
 > 20 dB above NML (moderately intrusive to highly intrusive)

During normal construction hours moderately intrusive noise impacts (11 to 20 dBA above NML) may occur in pockets of residential receivers adjacent to the road corridor in Bulleen, Balwyn North, Mont Albert North, Doncaster, Box Hill North and Doncaster East and at the Birrallee Primary School from the clearing and widening works along the Eastern Freeway. These impacts would be primarily due to activities such as mulching, which would likely occur for a relatively short period (several days) before progressing to a different area. Noise mitigation options would include the placement of equipment such as mulchers away from residences, temporary acoustic shielding and other management measures to minimise noise from equipment and work sites, such as turning equipment off when not in use.

During works outside of normal working hours, moderate noise impacts are predicted for a more significant number of localised receivers in Balwyn North and Doncaster which are close to the Doncaster Road Bridge demolition works. Similar to the Kempston and Grimshaw Street bridges in Noise Precinct 1, these impacts primarily would be due to the use of rock-breakers, and similar mitigation options could be applied. Any planned works outside normal working hours would require prior approval from the Independent Environmental Auditor and prior discussion with or notification of local residents and businesses in accordance with the Construction Noise and Vibration Management Plan (EPR NV4).

Noise Precinct 5

Construction works within Noise Precinct 5 include widening of the Eastern Freeway, strengthening of the bridges over the Yarra River and building of the Doncaster Busway.

Table 11-14 shows the number of receivers predicted to potentially experience NML exceedances in Noise Precinct 5. These results are based on worst-case predicted noise levels. These noise levels and their duration would depend on the specific equipment used and activities carried out at each location. The duration of works and associated impacts at each specific location are likely to be less than the overall indicative activity durations shown in the table.

Table 11-14 Number of sensitive receivers predicted to experience NML exceedances – Noise Precinct 5

| Scenario | Indicative activity duration (months) | HNA | Normal | | | Works outside normal working hours | | | | | |
|---|---------------------------------------|-----|-------------------------------------|-----------|---------|------------------------------------|-----------|---------|------------|-----------|---------|
| | | | Daytime | | | Evening | | | Night-time | | |
| | | | NML exceedance (L _{Aeq}): | | | | | | | | |
| | | | 1-10 dBA | 11-20 dBA | >20 dBA | 1-10 dBA | 11-20 dBA | >20 dBA | 1-10 dBA | 11-20 dBA | >20 dBA |
| Compound construction | 3–6 | - | - | - | - | | | | | | |
| Compound operation | > 24 | - | - | - | - | - | - | - | - | - | - |
| Crushing, screening and vegetation clearing | 3–6 | - | 33 | - | - | | | | | | |
| Earthworks (no rock-breakers) | 12–18 | - | 4 | - | - | | | | | | |
| Road tie-in works (major road) | > 24 | - | 13 | - | - | | | | | | |
| Viaduct construction | 12–18 | - | - | - | - | - | - | - | - | - | - |
| Viaduct earthworks | 6–12 | - | - | - | - | - | - | - | 1 | - | - |

Legend

1 - 10 dB above NML (noticeable to clearly audible)
 11 dB - 20 dB above NML (clearly audible to moderately intrusive)
 > 20 dB above NML (moderately intrusive to highly intrusive)

During normal construction hours clearly audible construction noise levels (1 to 10 dBA above NML) may occur in pockets of receivers adjacent to the road corridor in Balwyn North, Kew East and Kew from the clearing and widening works along the Eastern Freeway. This includes a predicted 5 dBA to 8 dBA exceedance of the daytime NML at the Royal Talbot Rehabilitation Centre. These impacts are primarily due to activities such as mulching, which would only occur for short periods of time in any one location.

For works outside normal working hours, noticeable construction noise levels are predicted for one localised receivers in Balwyn North which is close to the viaduct construction works at the eastern end of the precinct. The impacts of this activity are expected to be limited, with noise levels 1 to 5 dBA above the NML.

Spoil haulage

Significant spoil would be generated from the tunnelling process (using TBMs, road headers, cut and cover excavation equipment). Additionally, other construction areas along the project would generate surplus spoil during construction. Spoil that is unable to be reused would be transported to landfill by truck via designated haulage routes.

Figure 11-6 shows the indicative construction haulage routes for hauling spoil away from the construction areas. Return truck movements would also occur along these routes.

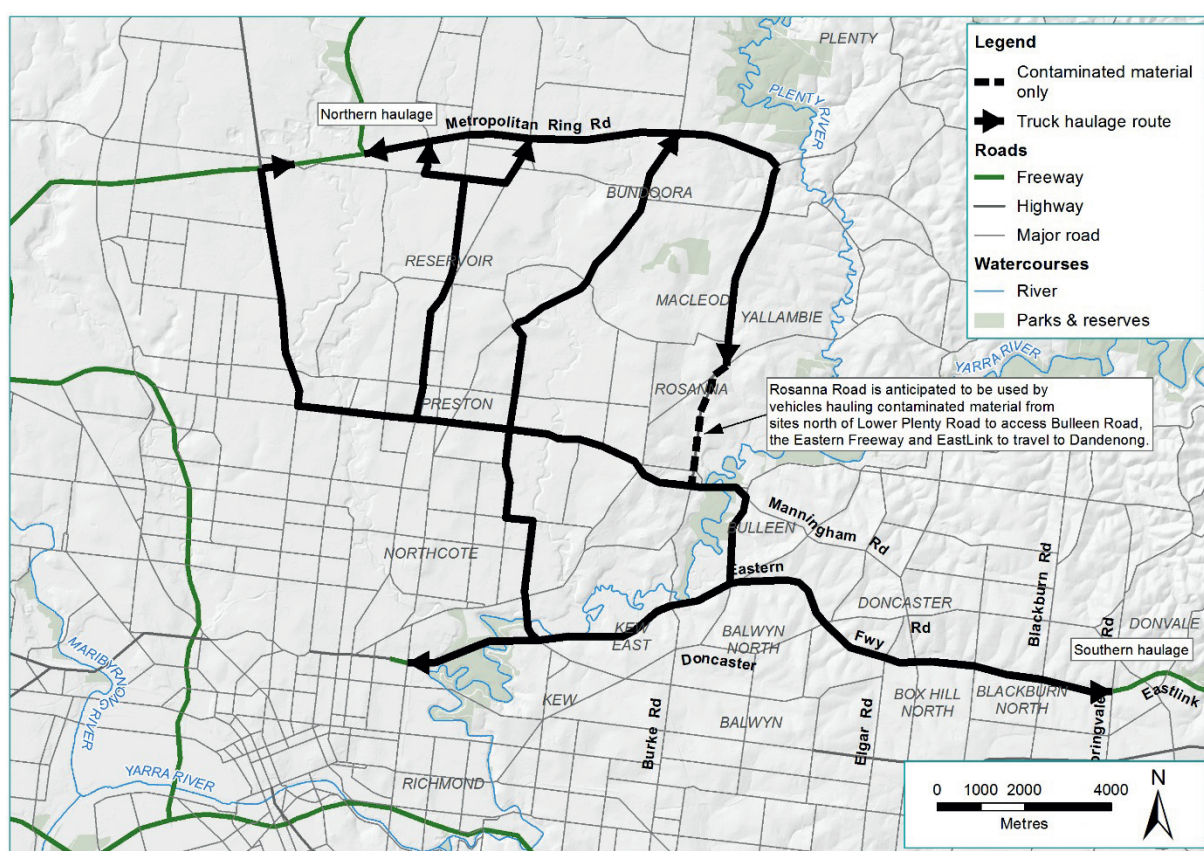


Figure 11-6 Indicative outbound construction spoil haulage routes

The potential noise level increases in the vicinity of spoil haulage routes have been assessed based on the peak truck numbers predicted for an individual month during project construction. Due to the high existing volume of vehicles on haulage routes, the addition of the spoil trucks results in a negligible increase in daytime traffic noise levels. The highest average noise level increase is predicted to be 0.9 dBA along the M80 Ring Road during the day and 0.6 dBA along Bell Street during the night-time.

Nevertheless, potential noise impacts associated with spoil haulage would be considered and managed through the Construction Noise and Vibration Management Plan required by EPR NV4.

Temporary removal of noise walls

Construction of North East Link would necessitate new or re-constructed noise walls along the project to achieve the project's noise objectives. New noise walls would be installed ahead of the demolition of the existing walls where feasible as required by EPR NV13. However, in a number of locations along the Eastern Freeway, it would not be feasible to erect the new noise walls before the existing noise walls were demolished, due to engineering limitations and space restrictions.

Where this occurs, there would be no noise wall between the Eastern Freeway and residences during this time. This time has been estimated as:

- Four to six weeks for concrete wall sections
- Two to three weeks for timber wall sections.

When the existing noise wall was removed, there would be a noticeable increase in traffic noise at those residences. The extent of impacts would depend on the height of the wall removed, and the noise reduction provided by the wall. This would vary along the corridor. The temporary increase in road traffic noise is anticipated to be typically in the range of 5 dBA to 15 dBA.

Measures such as the installation of temporary noise walls may be used by the construction contractor to minimise traffic and construction noise during these periods. These measures would be considered as part of the Construction Noise and Vibration Management Plan required by EPR NV4.

Temporary relocation of car parks

Watsonia railway station

A portion of the existing Watsonia railway station car park would be required for construction of North East Link and a number of existing car park spaces would be temporarily relocated to an alternative parking facility within the high voltage easement to the east of the station (as described in Section 9.4.3 of Chapter 9 – Traffic and transport).

Use of the temporary car park is anticipated to result in:

- An increase in traffic noise along Elder Street and Frensham Road due to traffic accessing the car park – this would likely be less than 1 dBA during the worst-case morning peak hour
- An increase in ambient noise at adjacent residences due to the normal use of the temporary car park – this would likely be between 1 dBA to 3 dBA during the worst-case morning peak hour.

It is possible that short-term noise events such as car starts and door slams could occur near residences. The need for a temporary noise screen at the boundary between residences and the temporary car park would be considered during detailed design.

Doncaster Park and Ride

The existing Doncaster Park and Ride facility would be impacted during the project's construction and would most likely be temporarily relocated to an area within Koonung Creek Reserve (as described in Section 9.4.3 of Chapter 9 – Traffic and transport). It is also expected the existing westbound on-ramp to the Eastern Freeway would need to be temporarily relocated closer to residents to accommodate the Doncaster Road Bridge upgrade works.

The relocation of the Doncaster Park and Ride and the Eastern Freeway on-ramp is anticipated to result in:

- An increase in traffic noise to residential receptors in Koonung Street, Gardenia Road and Doncaster Road due to the relocated on-ramp and buses accessing the Park and Ride facility – this would likely be less than 1 dBA
- An increase in ambient noise at adjacent residences due to the normal use of the temporary Park and Ride facility – this would likely be less than 1 dBA during the worst-case morning peak hour.

While these predicted noise increases are not significant, it is possible that short-term noise events such as car starts and door slams could occur near residences. The need for a temporary noise screen at the boundary between residences and the relocated Doncaster Park and Ride would be considered during detailed design.

11.3.2 Construction vibration

Construction activities such as vibratory rollers, rock-breakers and piling have potential to increase the level of vibration at sensitive receivers. Vibration can adversely affect residential amenity such as human comfort, and damage structures and buildings and interfere with sensitive scientific equipment.

The risk pathways associated with construction vibration are described in Table 11-15 and discussed below.

Table 11-15 Risk table: Construction – vibration

| Risk ID | Risk pathway | Risk rating |
|------------|---|-------------|
| Risk SNV03 | Human impact vibration (Vibration Dose Value) resulting by surface works during construction (including transport of spoil) causes loss of amenity at sensitive receivers | Low |
| Risk SNV04 | Structural damage to buildings resulting by surface works during construction (including transport of spoil) causes damage to structures | Low |
| Risk SNV05 | Vibration to sensitive scientific equipment from construction works | Low |
| Risk SNV06 | Vibration damage to underground services from construction vibration works | Low |

Construction activities

North East Link surface construction activities with the potential for vibration impacts include use of vibratory rollers, rock-breakers and driven piling. Vibratory rolling is a potential activity within the earthworks and roadworks' asphalt surfacing and road tie-ins construction scenarios. Rock-breaking is a potential activity within the demolition of existing structures and piling and excavation of trench scenarios.

Vibration guideline targets

There is no Australian government legislation or policy that specifies acceptable amenity or structural damage levels for vibration associated with construction, and no Victorian legislation or guidance limits exist for construction vibration. Vibration guideline targets have therefore been developed based on review of Australian and international standards and guidelines.

Vibration impacts can vary depending on the particular item of plant and local geotechnical conditions. The Transport for New South Wales Construction Noise Strategy (CNS) provides a guide to 'safe working distances' for 'cosmetic' damage and human comfort for typical items of vibration intensive plant. The safe working distances apply to addressing the risk of cosmetic (minor – easily reparable) damage of typical buildings under typical geotechnical conditions. The distances are indicative and vary depending on the particular item of plant and local geotechnical conditions.

In relation to human comfort, the safe working distances relate to continuous vibration. For most construction activities, vibration is intermittent in nature and for this reason, higher vibration levels, occurring over shorter periods are allowed.

The safe working distances have been used to assess the potential risk of construction vibration impacts to buildings and amenity based on the reference project. This is a common and generally conservative approach where site specific data on vibration levels from specific activities for specific ground conditions are not known. Where vibration intensive construction activities are required to be undertaken closer to sensitive receivers than the specified safe working distances, preliminary vibration testing would be undertaken. This testing would require the use of the actual construction equipment to validate the vibration modelling. Vibration monitoring would be undertaken to assess the site-specific vibration levels and inform the need for remodelling or any required mitigation measures.

More specific vibration guideline targets have also been established for different types of potential impact and form the basis of the EPRs. These guideline targets are summarised in Table 11-16 and would be used to guide the management of vibration impacts during the project's construction.

Depending on the construction activity and the extent of impact and scale of works, it may not be possible to meet the guideline targets at all times. EPR NV4 requires a Construction Noise and Vibration Management Plan to be prepared for all works addressing the specific activities being undertaken, the level of impact anticipated and the appropriate management and additional mitigations to be employed.

Table 11-16 Source for vibration guideline targets

| EPR ID | Aspect | Basis for guideline target levels |
|----------|-------------------------------------|--|
| EPR NV5 | Utility asset protection | Guideline target levels for vibration would be established in consultation with infrastructure and utility asset owners or applied in accordance with German Standard DIN 4150-3 Structural Vibration Part 3: Effects of vibration on structures |
| EPR NV8 | Construction vibration (amenity) | British Standard BS6472-1:2008 Guide to evaluation of human exposure to vibration in buildings, vibration sources other than blasting |
| EPR NV9 | Construction vibration (structures) | German Standard DIN4150 – Part 3 Structural Vibration in Buildings – Effects on Structures (2016) |
| EPR NV10 | Ground-borne (internal) noise) | New South Wales Interim Construction Noise Guideline 2009 |
| EPR NV11 | Amenity – blasting vibration | Australian Standard AS2187.2-2006, Explosives – Storage and use, Part 2: Use of explosives |
| EPR NV12 | Amenity – blasting overpressure | Australian Standard AS2187.2-2006, Explosives – Storage and use, Part 2: Use of explosives |

Vibration impacts

Construction scenarios have been reviewed to identify where vibration intensive activities such as the use of rock-breakers and vibratory rollers would occur and the potential for sensitive receivers (buildings) to be located closer to these activities than the safe working distances.

Table 11-17 summarises the number of buildings within each precinct that are potentially located closer to activities using a large or medium rock breaker than the cosmetic damage and human comfort safe working distances.

Table 11-17 Number of buildings potentially located closer than the safe working distance for rock breaker activities

| Noise Precinct | Works | Large hydraulic hammer 1600 kg – 18 to 34t | | Medium hydraulic hammer 900 kg – 12 to 18t | |
|----------------|--|---|--|---|--|
| | | Cosmetic damage (7.5 mm/s) | Human comfort (0.26mm/s ^{1.75}) | Cosmetic damage (7.5 mm/s) | Human comfort (0.26mm/s ^{1.75}) |
| 1 | Demolition of bridges and excavation of trench | 35 | 270 | 1 | 35 |
| 2 | Excavation of trench | 13 | 98 | 4 | 13 |
| 3 | Manningham cut and cover construction | 2 | 15 | - | 2 |
| 4 | Demolition of bridge | 1 | 10 | - | 1 |
| Total | | 51 | 393 | 5 | 51 |

Table 11-18 summarises the number of buildings that are potentially located closer to activities using a large or medium vibratory roller than the cosmetic damage and human comfort safe working distances.

Table 11-18 Number of buildings potentially located closer than the safe working distance for vibratory rollers

| Noise Precinct | Works | Large vibratory roller > 300 kN (typically > 18t) | | Medium vibratory roller < 300 kN (typically 7–13t) | |
|----------------|--------------------------|--|--|---|--|
| | | Cosmetic damage (7.5 mm/s) | Human comfort (0.26mm/s ^{1.75}) | Cosmetic damage (7.5 mm/s) | Human comfort (0.26mm/s ^{1.75}) |
| 1 | M80 Ring Road widening | 101 | 594 | 50 | 594 |
| 2 | N/A | - | - | - | - |
| 3 | Eastern Freeway widening | - | 11 | - | 11 |
| 4 | Eastern Freeway widening | 37 | 882 | 5 | 882 |
| 4 | Eastern Freeway widening | 2 | 263 | 1 | 263 |
| Total | | 140 | 1750 | 56 | 1750 |

The separation distances between the construction activities and the nearest sensitive receivers would generally be sufficient so that nearby buildings would unlikely suffer cosmetic damage from most construction equipment. However, based on the arrangement of the work zones, some items of construction equipment may be operated closer to sensitive receivers than the recommended minimum safe working distances. This situation would likely require management because the operation of large rock-breakers and vibratory rollers has the potential to generate high levels of vibration impacts due to the high vibration characteristics of the plant.

While the assessment identified that many buildings may be closer than the safe working distances for large rock-breakers and large vibratory rollers, it is anticipated that vibration impacts would be able to be controlled to avoid cosmetic damage to structures. This could be achieved through measures such as restricting hours of operation, use of lower vibration plant and equipment such as smaller capacity rock breakers or concrete crushers in place of rock breakers, the review of the location of plant and equipment within the site, and vibration monitoring and trials to assess the level of vibration and inform management. Based on this risk SNV04 has been assessed as low.

Receivers adjacent to the construction areas have been identified as likely to perceive vibration impacts at times during construction works. This is expected to be primarily due to works associated with rock-breakers, vibratory rollers and other high vibration plant items.

In practice vibration impacts from most construction activities would be intermittent within the overall duration of the project and would be managed in accordance with a Construction Noise and Vibration Management Plan (EPR NV4). Risk SNV03 has therefore been assessed as low. The required locations for vibration intensive equipment would be reviewed during the project's detailed design when finalised information relating to the works is available.

No building has yet been identified as containing vibration sensitive scientific equipment, this would be confirmed during the project's detailed design phase. Risk SNV05 has therefore been assessed as low.

All works would be required to occur in accordance with a Construction Noise and Vibration Management Plan (EPR NV4) that addresses the noise and vibration targets outlined in the EPRs and addresses the specific activities being undertaken, the level of impact anticipated and the appropriate management and additional mitigations to be employed. This approach is consistent with the approach adopted on other major projects currently underway in Victoria.

11.4 Operation impact assessment

This section discusses the operational impacts associated with North East Link that relate to surface noise and vibration.

The impacts identified for the operation of North East Link that relate to surface noise and vibration are grouped according to three main themes, being:

- Traffic noise – the potential for noise from traffic using North East Link or redistributed on the wider road network due to North East Link to impact amenity at sensitive receivers
- Fixed infrastructure noise – the potential for noise from fixed infrastructure such as the tunnel ventilation systems and substations to impact amenity at sensitive receivers
- Surface vibration – the potential for vibration generated by traffic using North East Link or redistributed on the wider road network to impact amenity at sensitive receivers, or damage buildings.

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

11.4.1 Traffic noise

Changes in traffic movements have the potential to change noise levels at sensitive receivers. An increase in noise level at a sensitive receiver may adversely affect amenity, or in instances where noise levels decrease, improve amenity.

Noise walls are a common form of noise mitigation along road corridors. However, the noise reduction achieved by walls needs to be balanced with other considerations such as visual amenity, overshadowing and connectivity. Other forms of mitigation include open graded asphalt, which provides a quieter road surface than dense graded asphalt and at property treatments.

The risk pathways associated with traffic noise are described in Table 11-19 and discussed below.

Table 11-19 Risk table: Operation – traffic noise

| Risk ID | Risk pathway | Risk rating |
|------------|---|-------------|
| Risk SNV08 | Traffic noise generated by the redistribution of traffic on the wider road network causes an increase in noise affecting amenity at sensitive receivers | Low |
| Risk SNV09 | Traffic noise mitigation measures required to reduce road traffic noise levels are not feasible, reasonable or practical | Low |
| Risk SNV10 | Additional post-opening mitigation required | Low |
| Risk SNV11 | The traffic noise along North East Link causes an increase in noise affecting amenity at sensitive receivers | Low |
| Risk SNV15 | Reverberant noise in the depressed roadway is not adequately addressed in the noise model | Low |
| Risk SNV16 | Risk of increased engine brake noise along corridor | Medium |

Traffic noise changes

Once operational North East Link would comprise a new freeway-standard connection between the M80 Ring Road and the Eastern Freeway. North East Link would include a tunnelled section between a northern portal at Blamey Road and a southern portal to the south of the Veneto Club. In addition, the Eastern Freeway would be widened to accommodate future traffic volumes and provide dedicated bus lanes.

As a result of North East Link, traffic movements in the study area would change. North East Link is a new road, but would remove vehicles, particularly heavy vehicles, off local roads. Traffic on the wider road network would be redistributed as a result of the new road. These changes in traffic movements would change the level of traffic noise at sensitive receivers.

Project noise objectives

VicRoads sets objectives for traffic noise from roads in Victoria at sensitive receivers based on the $L_{A10(18 \text{ hour})}$ noise index for Category A buildings, and the $L_{A10(12 \text{ hour})}$ index for Category B buildings.

Project-specific traffic noise objectives have been developed for North East Link by conservatively applying the VicRoads Traffic Noise Reduction Policy and Road Design Note 06-01, categorising all roads as new (rather than upgraded for the M80 Ring Road and Eastern Freeway).

These project noise objectives form the basis for EPR NV1 and require:

- External traffic noise from North East Link project roads must be no greater than 63 dBA measured from 6 am to midnight for Category A buildings or no greater than 63 dBA measured from 6am to 6pm for Category B buildings

- For buildings on non-project roads which directly intersect with North East Link project roads and where total traffic noise for the design year and 'with project' exceeds the thresholds listed above, the combined noise from North East Link project roads and the non-project roads must not be more than 2 dBA higher than the predicted traffic noise level under the design year no project scenario. Non-project roads would be modelled for a distance of 100 metres from the interface with North East Link project roads or to the first traffic intersection (whichever is the lesser).

These objectives apply to the year of opening and the design year. For the purpose of the project noise objectives, 'project roads' are defined as the M80 Ring Road (east of Plenty Road), the Greensborough Bypass (west of the Plenty River bridge and up to the M80 Ring Road interchange with North East Link), the upgrade of the Eastern Freeway (between Hoddle Street and Springvale Road) and the new North East Link Freeway (connecting the M80 Ring Road to the Eastern Freeway), including all access ramps.

Traffic noise monitoring is required by EPR NV2 to confirm baseline noise conditions before construction of the project starts, and then again to assess compliance with EPR NV1 within six months of the project opening and 10 years after project opening. Monitoring would be undertaken in accordance with the *VicRoads Traffic Noise Measurement Requirements for Acoustic Consultants* (September 2011), which require at least three days of valid data from which to assess compliance.

The risk of additional post-opening mitigation being required (risk SNV10) is assessed as low. Remedial action would be required if the objectives of EPR NV1 were not met.

Noise modelling

Operational traffic noise has been modelled to assess compliance with the project noise objectives. Traffic noise levels were calculated using SoundPLAN v8.1 software, which implements the CoRTN algorithm. Traffic noise from the tunnel portals has also been modelled using the SoundPLAN calculation NORD 2000 algorithm for portal noise emissions.

Where a road occurs in a cutting or between two parallel noise walls there is potential for noise to bounce off the walls. This can cause a reverberate build-up of noise in the road depression. The CoRTN prediction algorithms allow for this as well as for barrier effects, such as from noise walls, where the top of a barrier intercepts the line of sight to a receiver. As a result, reverberate noise from the trench section of North East Link has been predicted and reported as part of the operational traffic noise modelling and risk SNV15 has been assessed as low.

Four scenarios were modelled:

- 2018 existing conditions. This represents road traffic noise levels with existing (2018) road traffic volumes. This model was used for validation against the baseline noise measurements and road traffic surveys
- 2026 with project. This represents the traffic flows for 2026 and includes the proposed North East Link road alignment and noise wall design, and major arterial road traffic flows based on Technical report A – Traffic and transport

- 2036 with project. This includes the proposed North East Link road alignment and noise wall design, and major arterial road traffic flows in 2036 based on Technical report A – Traffic and transport
- 2036 no project. This predicted the future noise emissions based on the existing noise wall design and road alignment and the 2036 traffic flows based on the Technical report A – Traffic and transport.

The modelling has informed assessment of traffic noise impacts at sensitive receivers. The upper limits of the predicted traffic volume ranges for 2026 and 2036 were conservatively used for noise modelling and impact assessment purposes. Noise mitigation has been applied to the reference project where noise levels were predicted to exceed the noise objectives in EPR NV1.

Noise mitigation has included new or improved noise walls up to a maximum height of 10 metres. Quieter open graded asphalt has also been used on the main carriageways. At-property treatments may be required if the objectives in EPR NV1 are not met through the combination of road design, noise walls and open graded asphalt. These types of mitigation are typical for major road projects and would be assessed further during the project's detailed design, resulting in risk SNV09 being assessed as low.

Traffic noise modelling results

Overall, the traffic noise levels for the 'no project' 2036 scenario were predicted to be approximately 1 dBA higher than the current levels of traffic noise, due to the projected growth in traffic. This level of increase is generally considered not to be significant.

The introduction of North East Link (and associated noise mitigation) tends to reduce traffic noise levels from local roads and North East Link project roads by approximately 1 dBA across the study area, and so risk SNV011 has been assessed as low. It is noted that:

- 35 residential and other noise sensitive buildings along the corridor would experience very significant noise reductions of 10 dBA or more

What does a change in noise level mean?

A change of 1 dB or 2 dB in the level of a sound is difficult for most people to detect, while a 3 dB to 5 dB change corresponds to a small but noticeable change in loudness. A 10 dB change corresponds to an approximate doubling or halving in loudness. The table below lists examples of typical noise levels.

| Sound pressure level (dBA) | Typical source | Subjective evaluation |
|----------------------------|--|-----------------------|
| 130 | Threshold of pain | Intolerable |
| 120 | Heavy rock concert | Extremely noisy |
| 110 | Grinding on steel | |
| 100 | Loud car horn at 3 m | Very noisy |
| 90 | Construction site with pneumatic hammering | |
| 80 | Kerbside of busy street | Loud |
| 70 | Loud radio or television | |
| 60 | Department store | Moderate to quiet |
| 50 | General Office | |
| 40 | Inside private office | Quiet to very quiet |
| 30 | Inside bedroom | |
| 20 | Recording studio | Almost silent |

- 382 residential and other noise sensitive buildings along the corridor would experience significant noise reductions of 5 dBA to 10 dBA
- 1,883 residential and other noise sensitive buildings along the corridor would experience noise reductions of 2 dBA to 5 dBA
- 8,287 residential and other noise sensitive buildings along the corridor would experience no noticeable change in their noise environment (reductions or increases of 2 dBA or less)
- 889 residential and other noise sensitive buildings would experience a noise increase of more than 2 dBA.

Noise was modelled for traffic flows in 2036 under the 'with project' and 'no project' scenarios and the predictions compared. This assessment found the project would reduce traffic noise on many local roads. A slight increase in noise of up to 1.4 dBA was predicted in the southern portion of roads intersecting the Eastern Freeway and to the west of North East Link. This level of noise increase would be generally unnoticeable and so risk SNV08 has been assessed as low.

A summary of the noise modelling results corresponding to the 2036 'with project' scenario are presented in the sections below. Table 11-20 to Table 11-23 present the existing, 'no project' and 'with project' scenarios and indicate the typical range in traffic noise levels along a selection of streets and at community buildings close to North East Link project roads. These calculations include noise from North East Link and from nearby arterial roads in the immediate vicinity.

These tables are intended to provide a representative, high-level assessment and so not all residential streets or community buildings such as schools have been listed in the tables within this chapter. As the noise environment can vary substantially within a single street or even for different buildings or building facades within a single property, based on the roadway and influence of intervening structures, they should not be considered definitive for all properties in the identified street.

Some locations may indicate high levels of noise as the values presented are the combined influence of noise from North East Link and any arterial road in the immediate area. The design of noise mitigation is based on the need to reduce noise from North East Link to achieve compliance with the 63 dBA (EPR NV1) criterion (where it is feasible and reasonable to do so). Where traffic noise is dominated by a nearby non-project road, noise mitigation has not been proposed.

Noise Precinct 1

Noise Precinct 1 comprises an approximately seven kilometre section of North East Link between Plenty Road, Plenty River Bridge and Lower Plenty Road. North East Link would begin as a surface road in the north before entering an open trench and then a cut and cover tunnel section at Blamey Road.

Mitigation measures in this area include:

- Low-noise, open graded asphalt on the main carriageway
- New noise walls and replacement of the existing walls along the main carriageway, of heights three metres to 10 metres
- Upgrades to the roads at the interchange incorporating four metre noise walls on two viaducts.

Table 11-20 presents existing and calculated traffic noise for an indicative sample of sensitive noise receiver locations in Noise Precinct 1.

Table 11-20 Existing and calculated traffic noise for an indicative sample of sensitive noise receiver locations – Noise Precinct 1

| Receiver type | L _{A10(18hour)} road traffic noise level (dBA) | | | Difference (dB) | |
|---|---|-------------------|---------------------|---------------------------------------|------------------------------------|
| | Existing (2018) | No project (2036) | With project (2036) | With and no project comparison (2036) | Change from current (with project) |
| Category A – Noise Sensitive Residential Buildings | | | | | |
| Hughes Circuit, Bundoora | 57 to 63 | 58 to 64 | 57 to 60 | -4 to 0 | -3 to 0 |
| Edmund Rice Parade, Watsonia North | 53 to 57 | 54 to 59 | 58 to 61 | 2 to 4 | 3 to 5 |
| Eastgate Drive, Greensborough | 55 to 60 | 56 to 62 | 58 to 61 | -2 to 2 | 0 to 4 |
| Banfield Terrace, Greensborough | 55 to 61 | 56 to 62 | 58 to 60 | -4 to 2 | -3 to 3 |
| Sellars Street, Watsonia North | 56 to 70 | 58 to 71 | 57 to 64 | -9 to 0 | -8 to 1 |
| Hamlet Street, Greensborough | 65 to 71 | 66 to 71 | 59 to 66 | -9 to -3 | -8 to -1 |
| Ibbottson Street, Watsonia | 59 to 66 | 60 to 67 | 57 to 62 | -7 to -1 | -6 to 0 |
| Service Road (between Elder Street and Sarong Road), Watsonia | 61 to 66 | 63 to 67 | 57 to 59 | -8 to -5 | -7 to -3 |
| Greensborough Road (south of Watsonia Road), McLeod | 72 to 77 | 72 to 77 | 70 to 75 | -5 to -1 | -5 to -1 |
| Borlase Street, Yallambie | 65 to 67 | 66 to 68 | 58 to 64 | -8 to -3 | -8 to -3 |

| Receiver type | LA10(18hour) road traffic noise level (dBA) | | | Difference (dB) | |
|---|---|-------------------|---------------------|---------------------------------------|------------------------------------|
| | Existing (2018) | No project (2036) | With project (2036) | With and no project comparison (2036) | Change from current (with project) |
| Category B – Noise Sensitive Community Buildings | | | | | |
| Watsonia Primary School/Concord School/Grace Baptist Church, Watsonia | 61 to 67 | 61 to 66 | 60 to 61 | -5 to -1 | -5 to -1 |
| Baptcare Strathalan, McLeod | 74 to 76 | 73 to 75 | 71 to 73 | -2 | -2 |
| Watsonia Library, Watsonia | 68 | 69 | 60 | -9 | -8 |

The existing noise levels for residences in Noise Precinct 1 can vary by 12 dBA or more depending on their distance from the roadway and exposure to traffic. At some properties the total traffic noise currently exceeds and would continue to exceed the 63 dBA (EPR NV1) project noise objectives. This particularly applies to residences that experience noise from roads such as Greensborough Road, Grimshaw Street or other similar arterial roads. Noise levels greater than 63dBA $L_{A10(18\text{ hour})}$ are typical for busy arterial roads.

In these locations, the noise environment is dominated by traffic noise on non-project roads. As these roads do not have a significant noise influence from the project roads, and the cumulative increase of traffic noise from North East Link and the existing roads is not predicted to increase by more than 2dBA, these properties would not be further considered for noise mitigation.

There are approximately 11 properties in Noise Precinct 1 where the project's noise objectives would not be met: one property between Grimshaw Street and Watsonia Road and 10 properties between the M80 Ring Road interchange and Grimshaw Street. These properties may qualify for at-property noise mitigation. This would be assessed further during the project's detailed design.

Some residences in Noise Precinct 1 would experience decreases in traffic noise. These range from negligible decreases of around 2 dBA in locations throughout the precinct to more significant decreases of over 10 dBA in some locations between the M80 Ring Road interchange and Grimshaw Street and between Grimshaw Street and Watsonia Road.

Key community buildings in Noise Precinct 1 including schools, churches and the Watsonia Library are generally predicted to experience reduced noise, ranging from a decrease of between 1 dBA and 5 dBA (and up to 10 dBA at one façade) at Watsonia Primary School, Concord School and the Grace Baptist Church to a decrease of up to 9 dBA at Watsonia Library. As noted above, despite these reductions, in some instances noise levels would continue to exceed the 63 dBA objective due to traffic noise on non-project roads.

An increase in noise levels of approximately 1 dBA is predicted at St Mary's Parish Primary School. As traffic noise at the school is controlled by local traffic on Grimshaw Street and would remain high, and as the total noise with the project does not increase by more than 2 dB, noise mitigation would not be considered at this location.

Key outdoor recreation and public open spaces include AK Lines Reserve, Winsor Reserve and Plenty River Linear Reserve. Negligible to slight decreases in noise levels are expected at each of these locations of between 2 dBA and 3 dBA.

Noise Precinct 2

Noise Precinct 2 is the area between the Lower Plenty Road and the Manningham Road interchange, where the road would be in tunnel. The only project roads within Noise Precinct 2 are the entry and exit ramps at the Manningham interchange. Traffic noise from these ramps would comply with the project noise objectives.

Currently the most common current access route between the Eastern Freeway and the M80 Ring Road is between Greensborough Road, Lower Plenty Road, Rosanna Road, Banksia Street and Bulleen Road. Once operational, North East Link would provide an underground connection for the length of Noise Precinct 2 and the traffic noise on these intervening surface roads is predicted to reduce 1.5 dBA to 2.5 dBA, representing a negligible to slight reduction in traffic noise levels.

As described in Chapter 8 – Project description (Section 8.4.1), there is an alternative design for the Manningham Road interchange. This alternative design would result in minor changes to the noise environment when compared with the reference project, and would not introduce the need for any additional mitigation compared to the reference project or changes to the identified risks or EPRs.

Noise Precinct 3

Noise Precinct 3 includes the Bulleen Road and Manningham Road interchanges, the widened Eastern Freeway, the Doncaster Busway and Doncaster Park and Ride facility. Mitigation measures in Noise Precinct 3 include:

- Low-noise, open graded asphalt on the main carriageway and two of the viaducts at the southern portal
- Noise walls on the main carriageway, typically eight metres to 10 metres high
- Four metre high noise walls on selected flyovers.

Table 11-21 presents existing and calculated traffic noise for an indicative sample of sensitive noise receiver locations in Noise Precinct 3.

Table 11-21 Existing and calculated traffic noise for an indicative sample of sensitive noise receiver locations – Noise Precinct 3

| Receiver type | L _{A10(18hour)} road traffic noise level (dBA) | | | Difference (dB) | |
|---|---|-------------------|---------------------|---------------------------------------|------------------------------------|
| | Existing (2018) | No project (2036) | With project (2036) | With and no project comparison (2036) | Change from current (with project) |
| Category A – Noise Sensitive Residential Buildings | | | | | |
| Ursa Street, Balwyn North | 53 to 63 | 54 to 64 | 53 to 61 | -4 to -1 | -2 to 0 |
| Viewpoint Road, Balwyn North | 62 to 65 | 63 to 66 | 59 to 60 | -6 to -3 | -5 to -2 |
| Furneaux Grove, Bulleen | 57 to 63 | 57 to 64 | 58 to 64 | 0 to 2 | 1 to 2 |
| Category B – Noise Sensitive Community Buildings | | | | | |
| Marcellin College | 56 to 59 | 59 to 62 | 56 to 60 | -3 to -2 | 0 to 1 |
| Belle Vue Primary School | 60 to 69 | 62 to 70 | 59 to 70 | -3 to 0 | -2 to 1 |

It is predicted the new noise walls would reduce traffic noise at some residences in Bulleen and Balwyn North compared with the 'no project' scenario. Noise modelling has predicted a precinct wide change in noise of between an insignificant 1 dBA increase to a noticeable 4 dBA decrease.

Thirteen properties in Noise Precinct 3 in the Bulleen area were identified where the project noise objectives would not be met. These would be reviewed during the project's detailed design and would be considered for at-property treatments.

There are two schools in Noise Precinct 3: Marcellin College and Belle Vue Primary School. Traffic noise at Marcellin College is predicted to decrease compared with the 'no project' scenario by up to 3 dBA. Noise from the Eastern Freeway at Belle Vue Primary School is also predicted to reduce up to 3 dBA (as shown in Table 11-21) although the western facades on Bulleen Road would experience slight increases of less than 1 dBA and exceed 63 dBA. This is due to combined traffic noise from project and non-project roads and as it is less than a 2 dBA increase, would still comply with the project's noise objectives.

There are three main parks and open space areas in the precinct: Carey Grammar Sports Complex, Marcellin College ovals and Trinity Grammar School Sporting Complex. Increases in noise levels of up to 5 dBA are predicted at these locations. It is anticipated this impact may be mitigated through the project's detailed design, noting flood walls are to be explored in this location and these may provide acoustic shielding.

Noise Precinct 4

Noise Precinct 4 includes the widened Eastern Freeway and Doncaster Busway to the east of the Eastern Freeway interchange. Mitigation measures in this area include:

- Low-noise, open graded asphalt on the main carriageway
- Noise walls on the main carriageway, typically between five metres to 10 metres high.

Table 11-22 presents existing and calculated traffic noise for an indicative sample of sensitive noise receiver locations in Noise Precinct 4.

Table 11-22 Existing and calculated traffic noise for an indicative sample of sensitive noise receiver locations – Noise Precinct 4

| Receiver type | LA10(18hour) road traffic noise level (dBA) | | | Difference (dB) | |
|---|---|-------------------|---------------------|---------------------------------------|------------------------------------|
| | Existing (2018) | No project (2036) | With project (2036) | With and no project comparison (2036) | Change from current (with project) |
| Category A – Noise Sensitive Residential Buildings | | | | | |
| Estelle Street, Bulleen | 61 to 64 | 62 to 65 | 59 to 60 | -5 to -3 | -5 to -2 |
| Carron Street, Balwyn North | 63 to 66 | 64 to 66 | 58 to 60 | -7 to -5 | -6 to -4 |
| Koonung Street, Balwyn North | 59 to 64 | 60 to 65 | 59 to 62 | -3 to -1 | -2 to 0 |
| Paul Street, Doncaster | 60 to 65 | 61 to 66 | 61 to 63 | -4 to 0 | -3 to 0 |
| Hender Street, Doncaster | 63 to 66 | 64 to 67 | 65 to 67 | 0 to 2 | 0 to 3 |
| Jocelyn Avenue, Balwyn North | 57 to 61 | 57 to 62 | 60 to 67 | 0 to 5 | 1 to 5 |
| Stanton Street, Doncaster | 56 to 66 | 56 to 66 | 62 to 69 | 2 to 7 | 2 to 7 |
| Valda Street, Mont Albert North (Lincoln Street to Morris Street) | 59 to 62 | 60 to 62 | 58 to 60 | -3 to -1 | -3 to -1 |
| Paul Avenue, Box Hill North | 60 to 65 | 61 to 66 | 61 to 67 | 0 to 1 | 1 to 2 |
| Applewood Retirement Village, Doncaster | 62 to 64 | 62 to 65 | 65 to 66 | 1 to 2 | 2 to 3 |
| Norfolk Circuit, Doncaster | 58 to 60 | 58 to 61 | 59 to 62 | 0 to 2 | 1 to 2 |
| Lyndhurst Crescent, Box Hill North | 57 to 61 | 57 to 61 | 59 to 63 | 0 to 2 | 1 to 2 |
| Eram Road, Box Hill | 59 to 64 | 60 to 64 | 60 to 66 | -1 to 2 | 0 to 2 |
| Douglas Street, Blackburn North | 60 to 63 | 60 to 63 | 59 to 60 | -4 to -2 | -3 to -1 |
| Boronia Grove, Doncaster East | 55 to 61 | 56 to 61 | 57 to 62 | 0 to 1 | 1 to 2 |
| Kett Street, Blackburn North/Nunawading | 58 to 61 | 59 to 61 | 58 to 62 | -2 to 1 | -1 to 1 |
| Darvall Street, Doncaster East | 57 to 65 | 58 to 65 | 58 to 64 | -2 to 1 | -2 to 1 |

| Receiver type | LA _{10(18hour)} road traffic noise level (dBA) | | | Difference (dB) | |
|--|---|-------------------|---------------------|---------------------------------------|------------------------------------|
| | Existing (2018) | No project (2036) | With project (2036) | With and no project comparison (2036) | Change from current (with project) |
| Category B – Noise Sensitive Community Buildings | | | | | |
| Donvale Primary School | 54 to 55 | 55 to 56 | 56 | 0 to 1 | 1 |
| Birralee Primary School | 58 | 58 | 59 | 1 | 1 |
| Kalker Montessori Centre | 61 | 62 | 60 | -2 | -1 |

The assessment predicted that noticeable noise reductions may be experienced in some residential locations in Noise Precinct 4. Locations experiencing reduced noise include residences between Noise Precinct 3 and Doncaster Road which would experience typical reductions of around 4 dBA to 5 dBA and some areas between Doncaster Road and Springvale Road. Other areas between Doncaster Road and Springvale Road would experience increases in noise.

There are approximately 128 properties in Noise Precinct 4 where the project's noise objectives would not be met: 100 properties between Doncaster Road and Station Street/Tram Road; eight properties between Station Street/Tram Road and Middleborough Road; and 20 properties between Middleborough Road and Springvale Road.

These properties may qualify for at-property noise mitigation. This would be further considered during the project's detailed design and may be influenced by changes to the road and noise wall designs and proximity to gaps between noise walls for shared use paths.

The change in traffic noise levels at key community buildings in Noise Precinct 4 is varied, ranging from noise reductions of up to 2 dBA at the Kalker Montessori Centre to an increase at Birralee Primary School of up to 1 dBA. Noise levels at Applewood Retirement Village are predicted to marginally increase and exceed the project's noise objectives on the southern facades of the building. This would be further reviewed during the project's detailed design and at-property treatments may be considered.

Key outdoor recreation and public open spaces include a range of parks and reserves, typically following the Eastern Freeway, as well as the Bulleen Cricket Club. Noticeable decreases in noise levels are expected at some of these locations of up to 6 dBA. An increase of up to 2 dBA may be experienced at Winfield Road Reserve and Katrina Street Reserve Playground and an increase of up to 4 dBA may be experienced in some areas of Koonung Creek Linear Park. These changes would unlikely result in a loss of amenity to users of these parks.

Noise Precinct 5

Noise Precinct 5 includes the widened Eastern Freeway and Doncaster Busway to the west of the Eastern Freeway interchange. Mitigation measures in this area include:

- Low-noise, open graded asphalt on the main carriageway
- Noise walls ranging from three to 10 metres in height along the main carriageway
- Noise walls of typically four metres in height on the elevated viaducts for the busway and lanes from the tunnel heading west along the Eastern Freeway, and lanes heading west along the Eastern Freeway leading north into the tunnel
- Three metre noise walls south of the freeway on the bus lane approach and flyover (across the freeway).

Table 11-23 presents existing and calculated traffic noise for an indicative sample of sensitive noise receiver locations in Noise Precinct 5.

Table 11-23 Existing and calculated traffic noise for an indicative sample of sensitive noise receiver locations – Noise Precinct 5

| Receiver type | LA10(18hour) road traffic noise level (dBA) | | | Difference (dB) | |
|--|---|-------------------|---------------------|---------------------------------------|------------------------------------|
| | Existing (2018) | No project (2036) | With project (2036) | With and no project comparison (2036) | Change from current (with project) |
| Category A – Noise Sensitive Residential Buildings | | | | | |
| Obrien Court, Kew | 56 to 63 | 57 to 63 | 56 to 61 | -2 to 0 | -2 to 0 |
| Kellett Grove, Kew | 59 to 61 | 59 to 61 | 59 to 60 | -1 to 1 | 0 to 1 |
| Kilby Road, Kew East (west of Windella Avenue) | 60 to 64 | 60 to 65 | 57 to 61 | -7 to -1 | -6 to -1 |
| Willow Grove, Kew East | 57 to 65 | 58 to 65 | 58 to 64 | -2 to 0 | -1 to 0 |
| Fairway Drive, Kew East | 59 to 61 | 60 to 62 | 57 to 61 | -3 to 0 | -2 to 1 |
| Keystone Crescent, Kew East | 60 to 61 | 62 to 66 | 61 to 65 | -2 to -1 | 1 to 5 |
| Category B – Noise Sensitive Community Buildings | | | | | |
| Royal Talbot Rehabilitation Centre | 54 to 69 | 54 to 69 | 54 to 62 | -7 to 0 | -7 to 1 |

The assessment predicted the replaced and new noise walls would reduce noise in the range of 1 dBA to 7 dBA at residential properties in Noise Precinct 5.

There are approximately 7 properties in Noise Precinct 5 where the project's noise objectives would not be met: one property between Merri Creek bridge and Earl Street and six properties between Earl Street and Bulleen Road due to a break in the noise walls for the shared user path. For these six properties it is possible this exceedance could be mitigated through the detailed design of the noise walls and path. The need for at-property noise mitigation would be further considered during the project's detailed design.

Total traffic noise at some properties exceeds the 63 dBA (EPR NV1) project noise objective. However at these locations the noise environment is dominated by traffic noise on local (non-project) roads. The cumulative increase of traffic noise from North East Link and the existing roads is not predicted to increase by more than 2 dBA and so meets the project's noise objectives.

Key community buildings in Noise Precinct 5 include the Royal Talbot Rehabilitation Centre, Thomas Embling Hospital and Melbourne Polytechnic. The change in noise levels at the Royal Talbot Rehabilitation Centre is predicted to vary from a 7 dBA reduction in noise to an increase that exceeds the project's noise objectives on the eastern face of the building. This property would be reviewed further during the project's detailed design and may need to be considered for at-property treatments. Noise levels at Thomas Embling Hospital and Melbourne Polytechnic are predicted to marginally increase by less than 1 dBA and would comply with the project's noise objectives.

Key outdoor recreation and public open spaces include Musca Street Reserve, Freeway Public Golf Course and Jack O'Toole Reserve. Noise levels at the Freeway Public Golf Course and Jack O'Toole reserve are predicted to increase by 2 dBA and 3 dBA respectively due to natural future increases in traffic levels. These increases are considered to be low and would not result in the loss of acoustic amenity. A decrease in traffic noise of up to 4 dBA is predicted for Musca Street Reserve due to new noise walls.

Engine brake noise

Engine brakes are one type of secondary braking device fitted to a heavy vehicle. These are intended to assist in slowing rather than stopping the vehicle. They are predominantly used on downhill sections of road to slow down but could occasionally be used on flat or up-hill sections. Engine brakes are frequently reported as being a source of noise complaint, due to the character of the noise rather than the absolute level of the noise.

The variation in noise levels from engine brakes varies dramatically from vehicle to vehicle and this makes it difficult to predict the future number of events and maximum noise level associated with the use of engine brakes. An increase in heavy vehicles along the freeway sections of North East Link would increase the number of trucks potentially using engine brakes at these locations. However, trucks would be less likely to use their engine brakes in more free-flowing traffic conditions. These conditions are expected along the Eastern Freeway, and where North East Link would result in the removal of existing traffic lights (such as at the intersections of Greensborough Bypass and the M80 Ring Road, and Greensborough Bypass and Grimshaw Street).

Trucks may need to use engine brakes to slow down along sections of downhill gradient, such as when entering the northern tunnel portal. At this location, noise from the use of truck exhausts is likely to be sufficiently mitigated by the position of the roadway beneath the land bridges and noise walls so that significant impacts are minimised.

Overall, the risk of increased engine brake noise along the project corridor (risk SNV16) is assessed as medium. It is not possible to eliminate the noise from engine brakes, as it is not possible to mandate that trucks do not use engine brakes on project roads. To assist in minimising the use of truck engine brakes, appropriate signage would be considered during the project's detailed design to encourage drivers not to engage their secondary braking system. It is considered this measure may help reduce engine brake usage.

As described in Chapter 9 – Traffic and transport, the number of trucks travelling on arterial roads is generally forecast to decrease. This is also expected to reduce the number of engine brake noise events.

In the future, further reductions in engine brake noise are anticipated with improvements in heavy vehicle technology, and with greater use of electric-powered trucks.

11.4.2 Fixed infrastructure noise

Fixed plant and infrastructure such as ventilation structures and substations generate noise. This has the potential to increase noise levels at sensitive receivers, potentially adversely affecting residential amenity and other sensitive land uses.

The risk pathways associated with noise from fixed infrastructure are described in Table 11-24 and discussed below.

Table 11-24 Risk table: Operation – fixed infrastructure

| Risk ID | Risk pathway | Risk rating |
|------------|---|-------------|
| Risk SNV14 | Noise emissions from fixed plant exceed project noise objectives and affects amenity at sensitive receivers | Low |

Noise sources

Sources of fixed infrastructure noise for North East Link include ventilation structures and electrical substations. There are two primary ventilation structures located at:

- Northern portal
- Southern portal.

In addition, the Manningham Road interchange emergency smoke discharge has a ventilation system.

There would also be a number of electrical substations located along the tunnelled sections of the project. All except two of these would be below ground. The below ground substations would include space for acoustically treated ventilation systems and would have negligible acoustical influence on the noise environment. The above ground substations would be located at:

- Northern portal, above ground comprising four 2MVA transformers and one 20MVA transformer
- Manningham Road interchange comprising one 20MVA transformer.

The ventilation structures and substations are assumed to operate 24-hours per day.

Noise limits

The Victorian *Environment Protection Act 1970* and State Environment Protection Policy (Control of Noise from Commerce, Industry and Trade No 1 (SEPP N1) apply statutory requirements and limits for noise from fixed infrastructure. Noise from the tunnel ventilation systems requires assessment as part of the EPA Works Approval for North East Link.

SEPP N-1 balances the needs of industry with the protection of sensitive uses, and applies different noise levels depending on the planning scheme land use zoning, time of day and the amount of background noise in the area.

These requirements are embedded in EPR NV6, which requires the permanent tunnel ventilation system to be designed to comply with SEPP N1 and the Works Approval. Noise monitoring is required by EPR NV7 to assess compliance with EPR NV6 and implement contingency measures if targets are not met.

Modelling results

Noise from the ventilation structures and electrical substations has been modelled to assess compliance with SEPP N1.

Indicative noise limits were established based on the measured background noise levels and land use zoning. As the ventilation structures and electrical substations would operate 24-hours per day the most stringent night-time limit was adopted for assessing potential impacts.

Noise levels were assessed at a number of locations that were selected based on: the proximity of the receiver to the ventilation facility; the locations where baseline monitoring was undertaken; and where the results of noise modelling showed predicted noise emissions to be highest. The residential receivers selected for assessment were located:

- On Greensborough Road approximately opposite Blamey Road and near 5 Hester Walk in Macleod for the northern portal ventilation structure and substation
- At the north-western end of Ben Nevis Grove for the southern portal ventilation structure
- Near 218 Bulleen Road, 1a Elizabeth Street and 40-42 Bridge Street in Bulleen for the Manningham Road interchange ventilation structure and substation.

Based on the modelled results, noise from the ventilation structures and substations is predicted to comply with the SEPP N-1 noise limits at nearby residences during the night period. This assumes use of mitigation such as acoustic attenuators for the ventilation structures. The design of the ventilation structures and substations and required mitigation would be refined through detailed design and required to comply with the SEPP N1. Risk SNV14 has therefore been assessed as low.

11.4.3 Operation surface vibration

Traffic movements on surface roads have potential to cause an increased level of vibration at sensitive receivers. This could adversely affect residential amenity or other sensitive land uses.

The risk pathways associated with surface vibration during operation are described in Table 11-25.

Table 11-25 Risk table – operation – vibration

| Risk ID | Risk pathway | Risk rating |
|------------|---|-------------|
| Risk SNV12 | Human impact vibration at sensitive receivers generated by the redistribution of traffic due to operation | Low |
| Risk SNV13 | Structural damage at sensitive receivers, resulting from traffic on North East Link | Low |

Vehicles using major surface roads typically result in vibration levels that are well below the threshold of perception in nearby sensitive receivers. Heavy trucks using smooth roads typically generate low vibration levels below 0.2 mm/s at footings of buildings approximately 20 metres from the road. This is consistent with the existing conditions measurements undertaken as part of this EES.

Consequently, the impacts from operational vibration have not been further assessed and risks SNV12 and SNV13 are considered low.

11.5 Conclusion

This chapter has identified and assessed surface noise and vibration existing conditions, impacts and associated risks for North East Link.

North East Link runs through a predominantly residential area with a section of the corridor within tunnels. The tunnels help to minimise the airborne noise to the community by removing traffic from surface roads. In addition, North East Link has adopted more stringent criteria than required by the VicRoads Traffic Noise Reduction Policy by utilising the criteria for new roads for the widening of the Eastern Freeway. Where Victoria has no assessment guidelines (for example, daytime construction guideline targets, human-comfort vibration assessment procedures, building damage guidelines), relevant interstate or accepted international guideline targets have been adopted.

The key findings of the assessment are:

- Modelling of construction scenarios identified potential noise and vibration impacts that would require additional mitigation or time restrictions. Routine construction works would be undertaken with reference to the Victorian EPA Noise Control Guidelines (EPA 1254) normal working hours. In localised areas there would be receivers which would exceed the nominated Noise Management Levels (NML) for varying periods of time, especially during some anticipated unavoidable works completed out-of-hours. For a small number of discrete operations, high noise impacts could be expected for a period of time. Construction works would be managed through a Construction Noise and Vibration Management Plan to minimise these impacts.
- There would be a short period of time (between two and six weeks) where a number of receivers along the Eastern Freeway would potentially experience increased levels of the current road noise due to existing noise walls being demolished before their replacement with new walls.
- A high number of receivers may fall within the empirical 'safe working distances' for human comfort and cosmetic damage from vibration-intensive plant equipment such as large rock-breakers and vibratory rollers. These empirical distances are generally conservative in nature, so further assessment would be undertaken, and works managed in accordance with a Construction Noise and Vibration Management Plan including vibration monitoring.
- Traffic noise was predicted to affect 11,476 residential or noise sensitive buildings. With the incorporation of mitigation such as low noise pavements and noise walls, 159 noise sensitive buildings exceed the 63 dBA assessment level for Category A and Category B buildings. These properties would qualify for further consideration of 'at-property' noise treatments to mitigate impacts, subject to further detailed design assessment post-approval.
- North East Link is predicted to reduce traffic noise levels across the study area by approximately 1 dBA. For residential or other noise sensitive properties, it is predicted that:
 - 2,300 properties would experience a reduction in traffic noise of more than 2 dBA
 - 8,287 properties would maintain their current traffic noise environment
 - 889 properties would experience a noise increase of more than 2 dBA.

- Many other properties in adjoining suburbs are predicted to experience reduced traffic during operation due to the removal of vehicles, particularly heavy vehicles, off the regional road network roads in the wider region.

Application of the project EPRs (described in full in Chapter 27 – Environmental management framework) would minimise impacts associated with construction noise and vibration, traffic noise and operation of fixed infrastructure such as the ventilation structures.

In response to the EES evaluation objective described at the beginning of this chapter, the impacts of the project from surface noise and vibration have been assessed and EPRs have been identified to minimise or avoid surface noise and vibration impacts to sensitive receivers.

