AJM Joint Venture

MELBOURNE AIRPORT RAIL

MAR STATE LAND AIRBORNE NOISE IMPACT ASSESSMENT

MAR-AJM-PWD-PWD-REP-XEV-NAP-0001716

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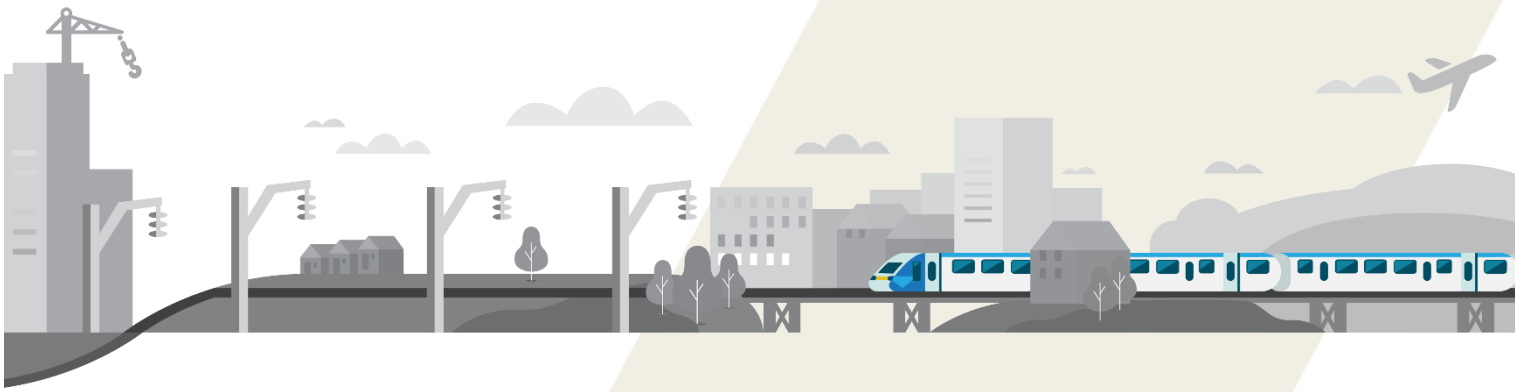

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Table of Abbreviations

Abbreviation	Definition
ARTC	Australian Rail Track Corporation – manage and maintain freight across Australia
BG	Broad Gauge
CCBDG	Environment Protection Authority (EPA) Publication 1834, Civil construction, building and demolition guide, November 2020
CSR	Combined Services Route
DELWP	Department of Environment, Land, Water and Planning
DMU	Diesel Multiple Unit (train)
DoT	Department of Transport
EMF	Environmental Management Framework
EMU	Electric Multiple Unit (train)
EMR	Environmental Management Requirements
FRP	Fibre Reinforced Polymer
HCMT	High Capacity Metro Train
MTP	Metro Tunnel Project
NSA	Noise Sensitive Area
OHW	Overhead Wiring
ORT	Off Reservation Treatment
PRINP	Passenger Rail Infrastructure Noise Policy
PSA	Planning Scheme Amendment
RRL	Regional Rail Link
SBY	Sunbury
SG	Standard Gauge
WME	Western Metro Extension

Glossary of Acoustic Terminology

Term	Definition
Alternative Accommodation	Relocation of residents, exposed to highly intrusive noise levels during the evening/night period, to alternative accommodation away from the construction activities.
Ambient Noise Level	The prevailing noise level at a location due to all noise sources but excluding the noise from the specific noise source under consideration. Generally measured as a dB(A) noise level.
Avoidable Works	Works that are not defined as Unavoidable Works, Low-noise Impact Works, or Managed Impact Works.
Background Noise Level	The A-weighted sound pressure level that is exceeded for 90 per cent of the measurement period, L_{A90}.
Commercial, industrial and trade premises	As defined in the Environment Protection Regulations 2021: Any premises except the following — (a) residential premises (other than common plant under the control of an owners' corporation) (b) a street or road, including every carriageway, footpath, reservation and traffic island on any street or road (c) a railway track used by rolling stock in connection with the provision of a freight service or passenger service— (i) while travelling on a railway track or tramway track; or (ii) while entering or exiting a siding, yard, depot or workshop

Term	Definition
	(d) a railway track used by rolling stock in connection with the provision of a passenger service, while in a siding, yard, depot or workshop and is — (i) powering up to commence to be used in connection with the provision of a passenger service; or (ii) shutting down after being used in connection with the provision of a passenger service (e) the premises situated at Lower Esplanade, St Kilda and known as "Luna Park" and being the whole of the land more particularly described in Certificate of Title Volume 1204 Folio 109 *Note:* *The maintenance, cleaning or loading of rolling stock stabled in a siding, yard, depot or workshop are included within the meaning of commercial, industrial and trade premises.*
Decibel	Sound pressure levels are expressed in decibels as a ratio between the measured sound pressure level and the reference pressure.
dB(A)	The A-weighted sound pressure level in decibels, denoted dB(A) is the unit generally used for the measurement of environmental, transportation or industrial noise. The A-weighting scale approximates the sensitivity of the human ear when exposed to normal levels and correlates well with subjective perception of typical sounds. An increase or decrease in sound level of approximately 10 dB(A) corresponds to a subjective doubling or halving in loudness. A change in sound level of 3 dB(A) is considered subjectively just noticeable and a change of 1 to 2 dB(A) is subjectively not noticeable.
Frequency	The rate of repetition of a sound wave. The unit of frequency is Hertz (Hz), defined as one cycle per second. Human hearing ranges approximately from 20 Hz to 20,000 Hz. Octave bands are the most commonly used frequency bands. For more detailed analysis each octave band may be split into three one-third octave bands or narrow frequency bands.
Habitable Room	Any room of a dwelling or residential building other than a bathroom, laundry, toilet, pantry, walk-in wardrobe, corridor, stair, lobby, photographic darkroom, clothes drying room and other space of a specialised nature occupied neither frequently nor for extended periods.
Inaudibility	The quality of not being perceptible by ear (i.e. cannot be heard).
$L_{Aeq,T}$	The equivalent continuous A-weighted sound pressure level is the value of the A-weighted sound pressure level of a continuous steady sound that has the same acoustic energy as a time-varying A-weighted sound pressure level when determined over the same measurement period, T.
$L_{Aeq,16hr}$, $L_{Aeq,day}$	16-hour equivalent continuous A-weighted sound pressure level in dB(A) during day period 6am to 10pm.
$L_{Aeq,8hr}$, $L_{Aeq,night}$	Eight-hour equivalent continuous A-weighted sound pressure level in dB(A) during night period 10pm to 6am.
$L_{Amax,\ period}$	The maximum A-weighted sound pressure level during either the day or night period. For rail noise, this is the 95th percentile of the highest value of the A-weighted sound pressure level reached within the day or night periods.
Low-noise Impact Works	From the CCBDG: these are works that are inherently quiet or unobtrusive, for example, manual painting, internal fitouts and cabling. Low-noise works do not have intrusive characteristics such as impulsive noise or tonal movement alarms. The relevant authority must be contacted, and any necessary approvals sought.
Managed Impact Works	From the CCBDG: works where the noise emissions are managed through actions specified in a noise and vibration management plan to minimise impacts on sensitive receivers. Managed impact works do not have intrusive characteristics such as impulsive noise or tonal movement alarms. The relevant authority must be contacted, and any necessary approvals obtained.
Noise barrier / noise wall / noise attenuation wall	A contiguous non-porous construction with no gaps or holes and a minimum surface density of 20 kg/m^2 or a weighted sound reduction index of no less than 25 dB. Noise walls may be reflective, sound absorbing or diffusive.
Noise Sensitive Area	As defined in the Environment Protection Regulations (2021): – (a) that part of the land within the boundary of a parcel of land that is • within 10 metres of the outside external walls of any of the following buildings: (A) a dwelling (including a residential care facility but not including a caretaker's house); (B) a residential building; (C) a noise sensitive residential use, or • within 10 m of the outside of the external walls of any dormitory, ward, bedroom, or living room of one or more of the following buildings: (A) a caretaker's house; (B) a hospital; (C) a hotel; (D) a residential hotel; (E) a motel; (F) specialist disability accommodation; (G) a corrective institution; (H) a tourist establishment; (I) a retirement home (J) a residential village

Term	Definition
	• within 10 m of the outside of the external walls of a classroom or any room in which learning occurs in the following buildings (during their operating hours): (A) a childcare centre; (B) a kindergarten; (C) a primary school; (D) a secondary school (b) subject to paragraph (c), in the case of a rural area only, that part of the land within the boundary of (i) a tourist establishment or (ii) a campground or (iii) a caravan park, or (c) despite paragraph (b), in the case of rural area only, where an outdoor entertainment event or outdoor entertainment venue is being operated, that part of the land within the boundary of the following are not noise sensitive areas for the purposes of that event or venue: (i) a tourist establishment or (ii) a campground or (iii) a caravan park.
Noise Sensitive Receiver	Premises that are used for purposes sensitive to noise.
Noise Reduction Coefficient (NRC)	The NRC is the arithmetic average (rounded to the nearest 0.05) of the absorption coefficients of a material at the 250 Hz, 500 Hz, 1 kHz and 2 kHz octave band frequencies.
Off Reservation Treatment	Off Reservation Treatment (ORT) is a form of mitigation which is applied “off-site” from the project i.e. at a residence. This may be, and not limited to, a localised noise barrier, upgrade of façade / glazing, acoustic treatment of natural ventilation paths, installation of HVAC systems, upgrade of underfloor/ceiling treatments.
Primary Matter	Exceedance to an Investigation Threshold as defined in the *Passenger Rail Infrastructure Noise Policy*.
Reasonably Practicable	As defined in EPA 1856: Reasonably practicable, September 2020.
Secondary Matter	No exceedances to the Investigation Threshold as defined in the *Passenger Rail Infrastructure Noise Policy*.
Sensitive Room (EPA 1826.2)	Any habitable room (as defined in the Environment Protection Act 2017) within a Noise Sensitive Area or any learning room within a kindergarten, childcare centre, primary or secondary school.
Sound Exposure Level (SEL)	The Sound Exposure Level is the A-weighted sound level of a train pass-by, measured over the time of the train pass-by and normalised to a duration of 1 second.
Sound Pressure Level (SPL)	The sound pressure expressed in decibels.
Tonality	Sound containing a prominent discrete frequency or frequencies.
Unavoidable Works	From the CCBDG: works that cannot practicably meet the schedule requirements because the work involves continuous works such as a concrete pour or would otherwise pose an unacceptable risk to life or property or risk a major traffic hazard.

1. Executive Summary

Overview

The Melbourne Airport Rail (MAR) project (the Project) will connect Melbourne Airport's Integrated Terminal Precinct with a rail service for the first time. The Project, as relevant to State land, is based on three reference design packages, including two location specific packages, the Corridor Section, and the Sunshine Section and one line-wide Rail Systems package.

Aurecon Jacobs Mott Macdonald Joint Venture (AJM-JV) has been engaged by Rail Projects Victoria (RPV) to prepare the MAR State Land Airborne Noise Impact Assessment.

Noise impact assessment

Noise from construction and operation of MAR has the potential to impact noise sensitive receivers and management of noise will be required.

The Project Environment Management Framework (EMF) will include requirements for management of construction and operational noise.

Existing conditions

The project area includes a mix of uses including residential, community, education, places of worship, commercial, and industrial. There are also significant passenger and freight rail operations including the Regional Rail Link, the Sunbury Line, the Albion-Jacana Rail Line and freight services between Sunshine and Newport

Noise monitoring of baseline conditions has not been undertaken due to disruption associated with the COVID-19 pandemic. The timing of these measurements will be dependent on return to normal operations following lockdowns.

Construction noise

Construction activities for both Corridor and Sunshine Sections of MAR are planned to start in 2022 and be completed by 2027. While construction noise has the potential to impact noise sensitive receivers, the duration of impact on individual receivers is expected to vary considerably across the project.

Construction scenarios have been developed by RPV and the scenarios at risk of the most significant noise impacts have been identified. Construction noise levels for these scenarios have been predicted and assessed in accordance with the Civil construction building and demolition guide (CCBDG).

Where possible, construction works are to be conducted during Normal Working Hours (NWH) as defined in the CCBDG (7am to 6pm Monday to Friday and 7am to 1pm Saturday), however, significant construction activities will need to be undertaken outside NWH to avoid impacts on the rail and road networks. These will be Unavoidable Works and while noise limits do not apply, mitigation and management measures will be required.

The construction works have the potential to be intrusive at some residential locations, particularly for works undertaken during the night period. Where possible, noisier works would be undertaken at times when they are less likely to impact on sleep. Where noisy works cannot be undertaken during NWH or adequately controlled with mitigation, then management measures would be required. If night works risk an unreasonable impact on sleep, management measures may include relocation of residents and provision of Alternative Accommodation.

The impacts of noise would need to be carefully mitigated and managed by the Project Contractor using a comprehensive Construction Noise and Vibration Management Plan (CNVMP). Specific requirements relating to the management of construction noise will be included in the EMF for the Project.

Operational rail noise

Significant rail works are associated with the Project. Rail noise has been predicted and the potential impacts assessed in compliance with the Passenger Rail Infrastructure Noise Policy (PRINP).

In areas where track-works are proposed rail noise has been predicted at noise sensitive receivers. Rail noise was found to be a Primary Matter (exceedance to a PRINP Investigation Threshold (IT)) in areas in both the Corridor and Sunshine Sections. Accordingly, Noise Mitigation Workshops have been undertaken with senior participants from both RPV and AJM-JV, the outcomes of which have shaped the project noise mitigation strategy.

The noise mitigation strategy agreed to be proposed as part of the Project scope, based on the Reference Design, is provided in Table 1.1 and the noise mitigation is shown on figures in Appendix B.

Table 1.1 Rail noise mitigation

Indicative Chainages	Noise Barrier Location	Noise barrier height above ground unless otherwise stated (metres)	Comments / additional mitigation
Corridor Section			
14670 to 15430	Noise barriers on the western side of the track in the rail reserve in proximity to the MAR track.	2.5	Noise barriers are to be sound absorbing on the rail side. Noise barrier extends between Corridor and Sunshine sections.
14670 to 15200	Noise barriers on the eastern side of the track in the rail reserve along the VicTrack boundary.	2.5	Noise barriers are to be sound absorbing on the rail side.
17330 to 17890 (Maribyrnong River Bridge)	Parapets (noise barriers) on both sides of bridge.	1.4 (above top of rail)	Parapets (noise barriers) are to be sound absorbing on the rail side. Resilient rail fixings (22.5 kN/mm) with fixing spacing of 0.685 m.
17800 to 18020	Noise barriers on the eastern side of the track on the VicTrack boundary.	3.5	Noise barriers are to be sound absorbing on the rail side.
18020 to 18720	Noise barriers on the eastern side of the track on the VicTrack boundary.	3.0	-
18950 to 19880	Noise barriers on the eastern side of the track on the VicTrack boundary.	3.5	Noise barriers are to be sound absorbing on the rail side.
19860 to 20270	Noise barriers on the eastern side of the track between pipeline and tracks approximately 3.5 m from centreline of fuel pipeline.	3.5	Noise barriers are to be sound absorbing on the rail side.
20590 to 20750	Noise barriers on the eastern side of the track on the VicTrack boundary.	2.5	-
20800 to 22200 (Viaduct over M80)	Parapets (noise barriers) on both sides of bridge.	1.4 (above top of rail)	Sound absorption tiles between the rail tracks.[Note 4] Resilient rail fixings (22.5 kN/mm) with fixing spacing of 0.685 m.
Sunshine Section			
13000 to 14500	Parapet on both sides of viaduct	1.4 (above top of rail)	Resilient rail fixings (22.5 kN/mm) with fixing spacing of 0.685 m.
14500 to 14640	Noise barriers on western side of track on the Sunshine viaduct approach structure.	1.4	Noise barriers are to be sound absorbing on the rail side.

Indicative Chainages	Noise Barrier Location	Noise barrier height above ground unless otherwise stated (metres)	Comments / additional mitigation
		(above top of rail)	Noise barrier extends between Corridor and Sunshine sections.
14640 to 14670	Noise barriers on the western side of the track in the rail reserve in proximity to the MAR track.	2.5 m	Noise barriers are to be sound absorbing on the rail side. Noise barrier extends between Corridor and Sunshine sections.

Notes:

1) Noise mitigation has not been provided for noise sensitive receivers around McIntyre Road where rail noise was predicted to be a Primary Matter. This is because the exceedances to the ITs were marginal and the area is affected by noise from road traffic.

2) Noise mitigation has not been provided for two noise sensitive receivers on Drayton Street where rail noise was predicted to be a Primary Matter. This is because the predicted exceedances were marginal, applied to the day period, and the noise levels predicted were of the same order as at neighbouring properties.

3) If noise barriers are not effective for upper levels of residential buildings, then offers of Off Reservation Treatment (ORT) will be considered.

4) If sound absorption tiles are not type-approved, then parapets are to be sound absorbing on the rail side of the adjacent barriers.

5) Parapets to be a surface mass of minimum of 20 kg/m^2.

6) The noise wall between the Sunshine Section viaduct and Corridor package interface can be continuous or overlap. If a continuous noise wall is used, the noise wall on the transition structure will need to be a minimum height of 2.5 m above the ground level (this means that the overall height of the noise barrier sitting on the transition structure may vary.)

The noise mitigation strategy includes noise barriers up to a height of 3.5 m above ground level (reflective and sound absorbing), viaduct parapets (reflective and sound absorbing) and acoustic tiles between the rail tracks. Overshadowing due to noise barriers is to be addressed by using transparent barrier materials.

The noise mitigation proposed is predicted to reduce rail noise levels by up to 12 dB(A) with respect to the Base Case (1-day prior to project opening, assuming the project did not proceed) at noise sensitive receivers where noise is a Primary Matter. The rail noise levels at many noise sensitive receivers in areas with mitigation, are predicted to be lower than the noise levels predicted for the Base Case.

Off Reservation Treatment will be considered in locations where noise barriers are not effective at upper levels of residential buildings.

Rail noise has also been assessed within the extent of the project area where no track-works are proposed. In all cases the predicted increase in noise level was less than 3 dB(A). Consequently, rail noise is a Secondary Matter (no exceedance to a PRINP Investigation Threshold) in these areas and no further consideration of rail noise is required.

Operational noise due to fixed infrastructure

Fixed infrastructure proposed for the project includes substations at three sites. The substations at the McIntyre sidings in Sunshine North and at Fullarton Road in Keilor Park are in industrial areas and are 350 m and 140 m from the nearest Noise Sensitive Areas (NSA) respectively. The substation at Brimbank Park in Keilor East is located east of the Western Ring Road at approximately 150 m from the nearest NSA.

Noise associated with each substation has been assessed with respect to the Environment Protection Act 2017 (the Act) and subordinate legislation. Substation noise levels in all NSAs are predicted to comply with the relevant Noise Limits. The predicted effective noise levels are at least 10 dB(A) below the Noise Limits and are expected to be below the ambient (and potentially background) noise levels at the NSAs. Substation noise levels are therefore expected to comply with the General Environmental Duty (GED) to avoid harm to human health and the environment.

2. Introduction

Aurecon Jacobs Mott Macdonald Joint Venture (AJM-JV) has been engaged by Rail Projects Victoria (RPV) to prepare the Melbourne Airport Rail (MAR) State Land Airborne Noise Impact Assessment (the Impact Assessment).

Noise from both construction and operation have the potential to impact on noise sensitive receivers. Understanding the extent of the impact will allow development of an appropriate approach to manage noise.

The Environment Management Framework (EMF) will include requirements for management of construction and operational noise.

2.1 Purpose

The purpose of the Noise Impact Assessment is to:

- Identify legislation and guidelines applicable to airborne noise from the project
- Predict and assess airborne noise from construction of MAR
- Predict and assess airborne noise from operation of MAR
- Identify practicable mitigation to manage noise impacts

The outcomes from the Impact Assessment will support the State-based approvals for the project and assessment against the *Ministerial Guidelines for Assessment of Environmental Effects* (the Ministerial Guidelines) under the *Environment Effects Act 1978* to determine the potential the need for referral of the project.

2.2 Context

MAR is in an urban environment and will traverse diverse communities including residential, commercial, and industrial. Noise sensitive receivers in these areas may be impacted by noise from construction and/or operation of MAR.

Adverse impacts of noise on the community could include:

- Loss of amenity
- Sleep disturbance
- Adverse health effects (stress, loss of concentration, increase in blood pressure).

Noise impacts on people vary widely and may be due to:

- Differences within their existing acoustic environment
- Proximity to other noise sources such as existing rail or busy roads
- The activities people are undertaking, (i.e. working, relaxing, sleeping), and
- Differences in sensitivity to noise within the population.

2.3 Overview of assessment

Noise impacts from construction and operation of MAR have been assessed and mitigation proposed to manage impacts in compliance with relevant legislation and guidelines.

The Impact Assessment includes:

- Review of the scope of works and mapping presented in the ‘MAR Corridor and Sunshine Sections Project Description for Environmental Specialists’ (MAR-AJM-PWD-PWD-MEM-XLP-NAP-0001505, Revision C) (the Project Description).

- Existing conditions – Section 4
- Identification of relevant legislation and guidelines – Section 5
- Construction noise impact assessment – Section 6
- Rail noise impact assessment – Section 7
- Fixed infrastructure noise impact assessment – Section 8

2.4 Assumptions and Limitations

The following assumptions and limitations apply:

- Public and privately owned State land is considered. Commonwealth-owned land or the 'Airport' design section is not included and will form part of a separate suite of impact assessments.
- The Impact Assessment is based on the scope of works detailed in the Project Description and State Project Land derived from MAR 'Project Land' Revision A.7 (MAR-AJM-PWD-PWD-MAP-XLP-MMN-0111172).
- Noise monitoring has not been undertaken due to disruption associated with the COVID-19 pandemic.
- Residences north of Sharps Road, Tullamarine will be included in the noise assessment for Airport land.
- This assessment includes impacts in the Corridor and Sunshine Sections and the wider network within the MAR State Project Land. Impacts of the project on the wider network outside the project land have not been assessed. This is because the Passenger Rail Impact Noise Policy (PRINP) does not apply to the 'increase in passenger services that result solely from an increase in services on existing passenger rail infrastructure.'
- Rail noise predictions are based on the timetables provided by RPV and included in this report. Should there be changes to the timetable then the outcomes presented may also change.
- Road traffic noise is not expected to be relevant to this assessment as the MAR does not significantly affect road alignments.
- Future buildings not eligible for consideration for noise mitigation include:
  - Prospective developments for which planning permits were sought after announcement of the MAR alignment
  - Approved precinct plans – for approved precinct plans, planning and transport portfolios are expected to work together to develop an integrated land use and transport approach to address rail noise and protect receivers through the application of planning controls.
- Prospective developments which have applied for planning permits prior to the announcement of the MAR alignment have been assessed for noise mitigation as part of the MAR project.
- The Solomon Heights sub-division has not been included in the assessments, as it is expected to be a mix of commercial and industrial development only (i.e. there will not be any residential development).
- RPV has confirmed that training is not undertaken at the Mambourin Nursery, 50 Stanford Street, Sunshine and, consequently, it is not included as a noise sensitive receiver.
- Use of train horns is a safety requirement and is therefore not included in the assessments.
- Deflection walls have not been included in the acoustic model.
- Blasting is not proposed for construction.

2.5 References

The following information was reviewed in the preparation of this assessment:

- Policies
  - > Environment Protection Act 2017 (the Act)
  - > Environment Protection Authority (EPA) *Civil construction building and demolition guide* Publication 1834, November 2020 (CCBDG)
  - > Environmental Protection Regulations 2021 S.R. No. 47/2021 (EPR 2021)
  - > *Noise limit and assessment protocol for the control of noise from commercial, industrial and trade premises and entertainment venues*, 1826.4, dated May 2021 (Noise Protocol)
  - > EPA Publication 1856: *Reasonably practicable*, September 2020 (EPA 1856)
  - > EPA Publication 1996: *Noise guideline – assessing low frequency noise*, June 2021 (EPA 1996)
  - > *Passenger Rail Infrastructure Noise Policy*, Victorian Government, 2013 (PRINP)
- Standards
  - > ISO 9613-2:1996 *Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation* (ISO 9613-2)
  - > Australian Standard / New Zealand Standard AS/NZS 2107:2016 – *Acoustics – Recommended design sound levels and reverberation times for building interiors* (AS/NZS 2107)
  - > Australian Standard AS 2374.6-1994 *Power transformers Part 6: Determination of transformer and reactor sound levels* (AS 2374.6)
  - > Australian Standard AS1055.1-2018 *Acoustics-Description and measurement of environmental noise, Part 1: General procedures* (AS 1055.1)
  - > AS 2436-2010 *Guide to noise and vibration control on construction, demolition and maintenance sites* (AS 2436)
  - > BS 5228.1-2009 *Code of practice for noise and vibration control on construction and open sites* (BS5228.1)
- Other
  - > Building footprints, 2017-2018 Greater Melbourne LiDAR Project
  - > Train information, provided by RPV (operational train data) and AJM-JV design team (line speeds) – summarised in Appendix B.

3. Background

3.1 Strategic Context

The MAR project (the Project) is a once-in-a-generation transformation of Victoria's transport network, connecting Melbourne Airport's Integrated Terminal Precinct with a rail service for the first time.

Melbourne Airport handled more than 37 million passenger movements in 2018-19[1] and by 2038, this figure is projected to almost double to more than 67 million[2],which is an average growth of 3.2% per annum. Transport connectivity from Melbourne Airport to Melbourne's Central Business District (CBD) is currently limited to the Tullamarine Freeway, and therefore, the Victorian Government is committed to delivering an efficient, competitive alternative to cater for the ongoing increase in passenger numbers at Melbourne Airport.

In 2002, the Victorian Government considered possible corridor and alignment options for a Melbourne Airport Rail Link, ultimately selecting the Sunshine route as the preferred option. At this time, land was reserved between the Albion-Jacana rail corridor and extending through to Sharps Road, Tullamarine for the construction of a rail link.

In 2018, the Victorian Government released the Melbourne Airport Rail Link Sunshine Route Strategic Appraisal, which confirmed that the Sunshine route remains the best solution for an airport rail link. The Sunshine route would provide superior connections to regional Victoria, Melbourne's growth areas in the north and west and Melbourne's south eastern suburbs and could be delivered sooner and at a significantly lower cost than other route options.

3.2 Project Land

The State Project Land defines the land within which the Project components and construction activities are planned to be contained. It sets out the full extent of land identified as potentially required for the delivery of the Project.

The Project Land encompasses all State land areas that would be used for permanent structures and temporary construction areas. It provides the basis for and informs the Impact Assessment.

Project Land relevant to State-based approvals generally includes:

- Land between Sharps Road and the Albion-Jacana rail corridor, including land crossing the M80 Freeway
- The existing Albion-Jacana rail corridor generally between Jacana and Albion Stations
- Land around Sunshine and Albion Stations, including the existing rail corridor
- Land required for the Project from Jacana Station in the north-east to Newport Station in the south-west and Middle Footscray Station in the east. This largely includes the Albion-Jacana rail corridor via Sunshine and Albion stations and land required for a new rail corridor between Sharps Road and the Albion-Jacana rail corridor.

The extent of the State Project Land is shown in Figure 3.1.

[1] https://www.bitre.gov.au/publications/ongoing/airport_traffic_data
[2] https://www.melbourneairport.com.au/Corporate/Planning-projects/Master-plan

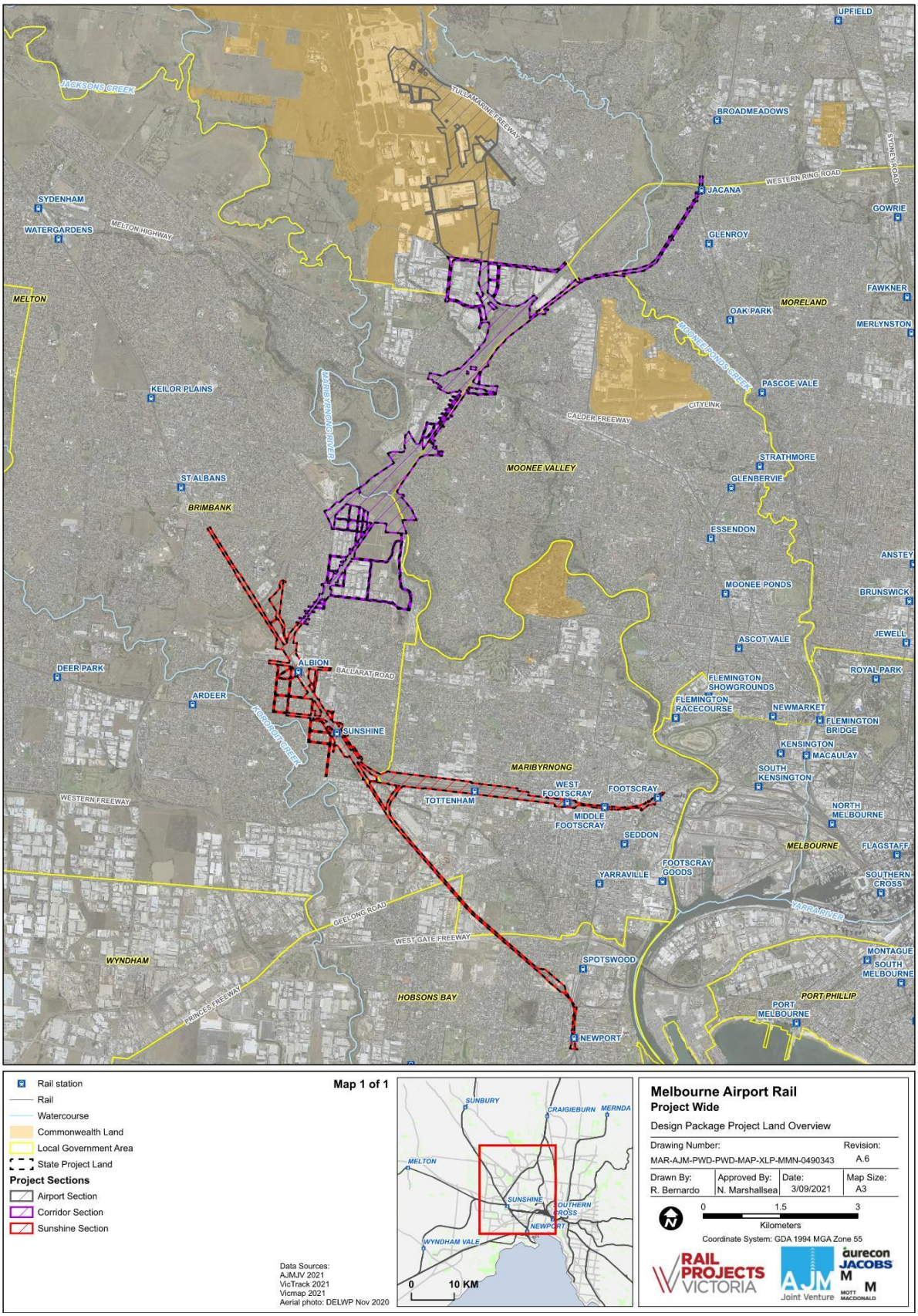

Figure 3.1 MAR State Project Land

3.3 Main Works Scope

3.3.1 Project Sections

The main works for the Project comprise of three geographically distinct sections. The sections are summarised in Table 3.1 and the location of the sections are shown in Figure 3.1.

Table 3.1 Summary of Project sections

Section	Summary
Airport Section Not considered in State land approvals.	The Airport section generally includes all land relevant to the Project between Sharps Road, Tullamarine and Melbourne Airport and is located on Commonwealth owned land and is subject to a separate approvals process under the *Commonwealth Airports Act 1996*
Corridor (COR) Section	The COR section generally includes the Albion-Jacana rail corridor between Jacana Station and south of Barwon Avenue, Sunshine North, as well as land between Sharps Road, Tullamarine and the Albion-Jacana rail corridor.
Sunshine (SUN) Section	The SUN section generally includes the existing rail corridor between Barwon Avenue, Sunshine North and Middle Footscray Station. The SUN Section also includes the Sunbury rail corridor to Ginifer Station and the Brooklyn freight corridor to Newport Station.

3.4 Corridor Section Summary

The COR section of the Project includes the following main works:

- Construction of the new MAR tracks, comprising an approximately 8 km dual track railway and associated overhead line equipment (OHLE), combined services route (CSR) and track drainage works, including:
  - A 2.3 km long elevated twin track viaduct structure between Sharps Road, Tullamarine and the Albion-Jacana rail corridor, crossing Steele Creek and the Western Ring Road including emergency and maintenance access points.
  - New at-grade MAR tracks within the existing Albion-Jacana rail corridor, located on the Western side of the existing Australian Rail Track Corporation (ARTC) tracks.
  - An elevated twin track viaduct structure across the Maribyrnong River valley, adjacent to the Western side of the existing state significant heritage bridge.
  - Slewing of ARTC tracks between Keilor Park Drive and the Calder Freeway.
- Signalling works along the Albion-Jacana rail corridor between Jacana Station and Barwon Avenue, Sunshine North and within the new MAR corridor North of the Western Ring Road.
- Construction of an intake supply substation at Terror Street or the Northeast area of Brimbank Park and two traction substations at Fullarton Road and within the McIntyre Sidings, Sunshine North.
- Construction of two new Digital Train Radio System (DTRS) facilities one North or South of Keilor Park Drive, Keilor East and a second at Airport Drive, Tullamarine.
- Diversion, relocation and replacement works associated with utilities and underground services, including the existing ARTC CSR, high voltage (HV) transmission lines and numerous miscellaneous assets
- Protection works associated with the Exxon Mobil jet fuel pipeline along the Albion-Jacana rail corridor.
- Modifications to existing structures, including structural modifications and strengthening works at Calder Freeway inbound and outbound bridges, Fullarton Road bridge, Western Ring Road on-ramp and off-ramp bridges, Keilor Park Drive and McIntyre Road bridges.
- Replacement of shared use path (SUP) connections at Calder Freeway / Fullarton Road, provision of a new SUP overpass at Cranbourne Avenue, and provision of a Strategic Cycling Corridor link between Western Ring Road and Airport Drive via Steele Creek.

- The provision of retention basins at several locations along the Albion-Jacana rail corridor
- Establishment of temporary construction laydown areas, site offices, worksites, storage, parking areas and access roads

3.5 Sunshine Section Summary

The SUN section of the Project includes the following main works:

- Construction of a new 1.8 km long MAR twin track viaduct structure, including associated OHLE and CSR between Sunshine Station and the Albion-Jacana corridor, crossing Anderson Road, Ballarat Road, the Sunbury rail corridor, St Albans Road and Stony Creek.
- Signalling works, including the installation of trackside equipment along the Sunbury line towards Ginifer Station, along the Brooklyn freight corridor towards Newport Station, and along the Western rail corridor to West Footscray Station.
- Modifications to the tracks, formation, drainage, CSR, OHLE and signalling equipment for the MAR, Sunbury and Bendigo tracks from Albion to the beginning of the Jacana freight corridor
- Modifications to the Western and Eastern Albion Station forecourts and car parks.
- Modifications to Sunshine Station, including modifications to platforms, the Sunshine Station western car park and the construction of a new concourse.
- Modifications to the existing Sunshine and Sunshine West substations
- Diversion, relocation and protection of existing utilities and underground services.
- Establishment of temporary construction laydown areas, site offices, worksites, storage, parking areas and access roads

4. Existing Conditions

The current occupancy/building types in proximity to the Project include:

- Residential throughout Sunshine, Sunshine North, Keilor East, Airport West
- Commercial precinct in proximity to Sunshine Station
- Industrial areas, located in Sunshine North, Keilor East and Tullamarine
- Learning centres and places of worship

Many rail operations occur within the project area, including:

- Passenger (V/Line) and freight services to Deer Park via the Regional Rail Link
- Passenger (V/Line and Metro Trains Melbourne (MTM)) and freight services to Sunbury via the Sunbury Line
- Passenger (V/Line and XPT) and freight services to Jacana via the Albion-Jacana Rail Link
- Freight services Sunshine to Newport

Baseline noise measurements are proposed to be conducted at residential locations in the vicinity of the Project, however, these measurements have been delayed because of disruption due to the COVID-19 pandemic.

5. Applicable Legislation and Guidelines

5.1 Environment Protection Act 2017

The Environment Protection Act 2017 (the Act) mandates that businesses have a General Environmental Duty (GED) to manage their activities to avoid the risk of environmental damage. Under the Act the GED requires that *'any person who is engaging in an activity that may give rise to risks of harm to human health or the environment from pollution or waste must minimise those risks, so far as reasonably practicable'*.

Noise is included in the definition of pollution within the Act. Consequently, an asset owner is required to eliminate or reduce the risk of harm from emissions of noise as far as reasonably practicable.

For noise, harm may include:

- Adverse health effects such as sleep disturbance or stress
- Impacts on amenity that unreasonably interfere with enjoyment of the place or premises such as noise that disturbs or interferes with residents talking together, reading, watching television, listening to music, or enjoying a backyard barbecue.

EPA Publication 1856 *Reasonably practicable*, provides guidance concerning what must be considered when assessing the proportionate controls to mitigate or minimise the risk of harm. These measures include a hierarchy of controls, including:

- Elimination of risk
- Consideration of the likelihood of the risk – how often harm would occur
- Consideration of the degree of harm (consequence)
- Ensuring a state of knowledge – awareness of the risks the activities pose
- Consideration of availability and suitability of controls
- Consideration of cost and effectiveness of controls.

In addition to the GED, Section 166 of the Act describes an obligation on any individual not to emit an *unreasonable noise* or permit an unreasonable noise to be emitted.

Unreasonable Noise is defined in Section 3(1) of the Act as noise that *is (a) unreasonable having regard to the following – (i) its volume, intensity or duration; (ii) its character; (iii) the time, place or other circumstances in which it is emitted; (iv) how often it is emitted; (v) any prescribed factors; or (b) is prescribed to be unreasonable noise.*

5.2 Construction Noise

The document applicable to construction noise on State land is:

- EPA Publication 1834, November 2020 – Civil construction building and demolition guide (CCBDG)

The CCBDG is EPA industry guidance to inform compliance with the GED. The CCBDG is not a compliance document or legislation . It provides:

- An overview of duties under the Act, and
- Controls to help manage these obligations. In the case of noise this includes:
  - > Scheduling of works
  - > Community consultation
  - > Managing noise at the source
  - > Managing noise using offsite controls.

The GED includes understanding the impact of excessive noise and eliminating/reducing the risks as far as reasonably practicable. This is achieved by putting appropriate controls in place which are proportionate to the risk.

The risk management process consists of:

1) Identifying hazards i.e. equipment in use

1) Assessing risk i.e. prediction of noise levels

2) Implementing controls to manage risk

3) Checking controls i.e. including a verification process to ensure the controls are completed

The Noise Requirements from CCBDG for a major rail infrastructure project are provided in Table 5.1. The relevant definitions are:

- **Low-noise impact works:** these are inherently quiet or unobtrusive, for example, manual painting, internal fit-outs, and cabling. Low-noise works do not have intrusive characteristics such as impulsive noise or tonal movement alarms.
- **Managed-impact works:** are works where the noise emissions are managed through actions specified in a noise and vibration management plan, to minimise impacts on sensitive receivers. Managed-impact works do not have intrusive characteristics such as impulsive noise or tonal movement alarms.
- **Unavoidable Works:** are works which pose an unacceptable risk to life or property, would cause a major traffic hazard or work which once commenced cannot be stopped. A Project Contractor must demonstrate that planned Unavoidable Works cannot be reasonably moved to Normal Working Hours. Examples of Unavoidable Works include:
  - > The delivery of oversized plant or structures that police or other authorities determine require special arrangements to transport along public roads
  - > Emergency work to avoid loss of life or damage to property, or to prevent environmental harm
  - > Maintenance and repair of public infrastructure where disruption to essential services and/or considerations of worker safety do not allow work within standard hours
  - > Rail occupations or works that would cause a major traffic hazard
  - > Works where a proponent demonstrates and justifies a need to operate outside Normal Working Hours such as work that once started cannot practically be stopped until completed such as concrete pouring or construction of diaphragm walls.

Table 5.1 CCBDG Time Periods and Noise Requirements

Time Period	Applicable Hours	Noise Requirements	
		Up to 18 months after project commencement	18 months or more after project commencement
Normal Working Hours (NWH)	7am to 6pm Monday to Friday 7am to 1pm Saturday	No specified Noise Level -– noise reduction measures apply	
Weekend / Evening work	6pm to 10pm Monday to Friday 1pm to 10pm Saturday 7am to 10pm Sunday and Public Holiday	Noise level at any residential premises not to exceed background noise by 10 dB(A) or more	Noise level at any residential premises not to exceed background noise by 5 dB(A) or more
Night	10pm to 7am Monday to Sunday	Noise is to be inaudible within a habitable room of any residential premises	

Notes:

1) The CCBDG requires the project to minimise noise and vibration.

2) Projects should aim to constrain works to NWH. Where necessary (and with approvals from the relevant authority), works or activities outside NWH may occur for (i) Low-noise impact works (ii) Managed-impact works and (iii) Unavoidable Works.

3) Where there is justification for out of hours work, which includes low-noise impact works or managed impacts works, the activities are required to comply with the outside NWH schedule (Table 5.1).

4) Inaudibility is defined as not being perceptible to the ear (i.e. cannot be heard). It is not meant to be a measurable criterion. To assess predicted construction noise levels with respect to inaudibility, an assessment level set at 'background level +0 dB' could be used (with adjustments for tonality, impulsiveness etc). This approach is not suitable for testing compliance.

5) Construction work during NWH or for Unavoidable Works may include intrusive characteristics such as impulsive noise

Aspects to be considered in planning include:

- Identifying people and sensitive receivers that may be affected by noise
- Carrying out appropriate engagement as early as possible
- Avoiding the generation of noise where possible
- Facilitating construction during NWH where possible
- Reducing noise by using the most appropriate equipment or work practices for the activities
- Choosing alternative equipment that makes less noise
- Maintaining equipment and vehicles according to the manufacturer's instructions
- Attenuating noise by obstructing the path between noise source and receiver
- Mitigating off-site noise with measures such as respite offers and acoustic treatment
- Undertaking a noise impact assessment to predict noise generated by planned works.

5.3 Rail Noise

Section 251B of the *Transport (Compliance and Miscellaneous) Act 1983* exempts passenger rail operations from liability and prosecution for nuisance in relation to noise. This does not mean that rail noise impacts should not be addressed. The Passenger Rail Infrastructure Noise Policy (PRINP) has been developed to guide transport bodies and planning authorities in their consideration of the impact of rail noise from improved or new passenger rail infrastructure and from changes to land use near existing and planned rail corridors.

A PRINP assessment is triggered for new passenger rail infrastructure or the redevelopment of passenger rail infrastructure when any of the following will, or is likely to be required:

- An assessment and approval under the *Major Transport Projects Facilitation Act 2009*
- An assessment under the *Environment Effects Act 1978*
- A planning scheme amendment under the *Planning and Environment Act 1987*

  or

- The Minister responsible for the transport body directs the transport body to have regard to the policy when exercising powers or performing functions.

As a statutory approval is required for MAR, the PRINP is applicable.

The PRINP is based on principles and provides Investigation Thresholds (ITs) to guide transport bodies when assessing the impacts of rail noise on communities. If an IT is exceeded, then rail noise is considered a Primary Matter and consideration is required of options for avoiding, minimising and mitigating rail noise. The ITs are not noise limits.

The ITs for (i) new and (ii) redeveloped rail infrastructure (as applicable to MAR) are shown in Table 5.2. For redeveloped railway infrastructure, the ITs consist of both an 'absolute' (a specific noise level) and a 'relative' level (increase in noise level), both of which must be exceeded for an IT to be exceeded.

Table 5.2 PRINP Investigation Thresholds

Time	Type of receiver	Investigation thresholds for Passenger Rail infrastructure	
		New	Redeveloped
Day 6am – 10pm	Residential dwellings and other buildings where people sleep including aged persons homes, hospitals, motels and caravan parks. Noise sensitive community buildings, including schools, kindergartens, libraries.	60 dBL_{Aeq} or 80 dBL_{Amax}	65 dBL_{Aeq} and a change of 3 dB(A) or more or 85 dBL_{Amax} and a change of 3 dB(A) or more
Night 10pm – 6am	Residential dwellings and other buildings where people sleep including aged persons homes, hospitals, motels and caravan parks.	55 dBL_{Aeq} or 80 dBL_{Amax}	60 dBL_{Aeq} and a change of 3 dB(A) or more or 85 dBL_{Amax} and a change in 3 dB(A) or more

Notes:

1) The location of assessment is not defined in PRINP and is chosen to be 1 m (external) from the centre of the window of the most exposed habitable room.

2) For a Redeveloped Railway the *increase in noise level* (relative level) is typically based on the difference between Base and Redeveloped Cases defined as:

   Base Case: 1-day prior to project opening, assuming the project did not proceed

   Redeveloped Case: 10-years after project opening, assuming the project proceeds

3) For areas of new railway: noise levels are assessed 10 years after project opening, assuming the project proceeds.

4) Noise from both passenger and freight rail activity are included in an assessment of passenger rail noise.

Where predicted rail noise levels do not exceed an IT, noise impacts should be considered a Secondary Matter and no further action needs to be considered. If, however, an assessment shows that an IT is predicted to be exceeded, then noise impacts are considered a Primary Matter and transport bodies and planning authorities should consider options for avoiding, minimising, and mitigating rail noise in accordance with the principles in the PRINP.

These principles include:

a. Integrated early consideration: impacts of noise should be considered early in the development of a proposal and an integrated approach taken to identify options to avoid or reduce noise and its impacts.

b. Balancing objectives: decisions about managing the impact of rail noise should balance economic, social, and environmental objectives within the context of the wider objectives of the project.

c. Best fit solutions: all reasonable efforts to limit impacts of noise should be made taking account of what is (i) practical, (ii) reasonable and (iii) cost-effective given the specific local circumstances and the broader public good.

The budget implications of providing noise mitigation should be financially prudent and transport bodies and planning authorities may find that there are no appropriate options.

The following specific approach was agreed for the Project:

1) Policy Application - PRINP applies to rail noise from MAR on State land.

2) Future Development - Noise mitigation measures be considered for developments which have applied for planning approval by the date that the project alignment is announced. Noise mitigation measures are not considered for future developments which apply for planning approval after this date.

3) Mitigation Strategy - A PRINP ‘principles-based approach’ be the basis for determining the noise mitigation strategy for MAR. Structured workshops to be undertaken to consider mitigation options in areas where noise is identified as a Primary Matter. The outcome of the workshops to be auditable minutes detailing the agreed mitigation strategy with supporting explanations.

5.4 Noise from Fixed Infrastructure

Airborne noise from fixed infrastructure such as stabling, substations, fans, air-conditioners etc must comply with the Act and the GED.

The Environment Protection Regulations (EP Regulations), subordinate legislation, and the *Noise limit and assessment protocol for the control of noise from commercial, industrial and trade premises and entertainment venues* (Publication 1826) (Noise Protocol), an incorporated document, define Unreasonable Noise for fixed infrastructure such as stabling, substations, fans, air-conditioners etc. Unreasonable Noise is defined as exceeding the Noise Limits defined within these documents.

The following noise categories are not assessed with respect to the Noise Limits for noise from commercial, industrial and trade premises:

- Music, voices, crowds
- Construction / demolition
- Intruder / emergency / safety alarms
- Fire pump used in an emergency
- Noise from non-commercial vehicles (except for maintenance activities)
- A railway track used by rolling stock in connection with the provision of a freight service or passenger service – (i) while travelling of a railway track or (ii) while entering or existing a siding, yard, depot or workshop
- A railway track used by rolling stock in connection with the provision of a passenger service while in a siding yard, depot or workshop and is (i) powering up to commence to be used in connection with the provision of a passenger service; or (ii) shutting down after being used in connection with the provision of a passenger service
- Road traffic noise.

Frequency spectrum is a prescribed factor which applies to noise from commercial, industry and trade premises with respect to Unreasonable Noise. EPA Publication 1996: *Noise Guideline – assessing low frequency noise* provides a methodology for the assessment of low frequency noise.

For proposed developments where noise will be emitted, such as substations, the EPA environment management framework requires that the asset owner:

1) Complies with the GED – i.e. eliminates or reduces the risk of harm to human health and the environment from noise so far as reasonably practicable.
2) Assesses residual noise – check whether any remaining noise would be unreasonable by:
    - Considering the volume, intensity, duration and character of the noise, how often it is emitted, and the time, place and other circumstances in which it is emitted
    - Assessing low frequency content of noise
    - Ensuring the noise does not exceed the Noise Limits (determined using the EP Regulations and Noise Protocol)
    - If all actions that are reasonably practicable to minimise risks of harm to human health and the environment implemented to meet the GED leave residual noise that does not comply with the Noise Limits or is otherwise unreasonable then further action is required
3) Prevents or mitigates Unreasonable Noise
    - Implement any additional controls to avoid Unreasonable Noise i.e. additional mitigation measures, noise control treatments or changing works processes and schedules.

Noise is assessed in a Noise Sensitive Area (NSA) where the maximum effective noise level occurs or, for proposed premises, is predicted to occur.

The assessment of noise from commercial, industrial and trade premises includes:

- Determination of the Effective Noise Level in the NSA with adjustments for noise character (i.e. tonality, impulsiveness, intermittency), duration, and measurement position
- Determination of the Noise Limit based on the measured background noise level and land use zoning of the area around the NSA under the local planning scheme. The NSA is defined in EP Regulations as the part of the land within the apparent boundaries of any piece of land which is within a distance of 10 m outside the external walls of the sensitive building (e.g. residences, hotels, hospitals, schools, childcare etc)
- A comparison between the Effective Noise Level and the Noise Limit. The Effective Noise Level is not to exceed the Noise Limit.

The Noise Limits for the Project are determined using the Urban Method from the Noise Protocol which consists of:

- Determination (by measurement) of the existing background noise level
- Determination of the Influencing Factor (based on the zoning type in a circle of 140 m and 400 m in diameter, centred on the NSA)
- Calculation of the Zoning Level, based on the Influencing Factor (for each time period)
- Determination of the Noise Limit based on the Zoning Level and background noise level. The Noise Limit determined must not be lower than the Base Noise Limit.

The time periods and Base Noise Limits are provided in Table 5.3

Table 5.3 Time Periods and Base Noise Limits from the Environment Protections Regulations and the Noise Protocol

Time Period	Days / Hours	Base Noise Limit $dBL_{Aeq,30minutes}$ Note 1
Day	Monday to Saturday (except public holidays): 7am to 6pm	45
Evening	Monday to Saturday: 6pm to 10pm Sunday and Public Holidays: 7am to 10pm	40
Night	All Days: 10pm to 7am	35

Notes:

1. The Base Noise Limits are detailed in the Environment Protection Regulations and are the lowest decibel value that may be set as a Noise Limit.

The Noise Limits are applicable to the combined level of noise associated with all commerce, industry and trade i.e. associated with the MAR and any other facilities. Therefore, the noise from each facility may need to be less than the given Noise Limit for compliance.

Where the noise source under consideration is used solely in relation to emergencies, the relevant Noise Limit applying to the testing or maintenance of such equipment is increased by 10 dB(A) for a day period and by 5 dB(A) for all other periods.

6. Impact Assessment - Construction Noise

Construction activities for both Corridor and Sunshine Sections of MAR are planned to start in 2022 and be completed by 2027. Construction noise has the potential to impact on noise sensitive receivers and the duration of impact on individual locations is expected to vary considerably across the project.

Construction scenarios have been developed by RPV and the scenarios at risk of the most significant noise impacts have been modelled and assessed. Other construction scenarios would be undertaken; however, the impacts are expected to be lower.

Where possible, construction activities would be undertaken during of Normal Working Hours (NWH) when ambient noise levels are highest and to provide respite from construction noise outside of these hours. Many of the construction activities will, however, need to be undertaken outside of NWH to avoid impacts on the rail and road networks. Consequently, these works have been classified as Unavoidable Works and noise requirements (noise limits) do not apply.

An assessment of noise from construction vehicles on public roads has not been undertaken, however, mitigation and management measures for construction vehicles are provided in this document and included in the EMF. The *MAR State Land Traffic and Transport Impact Assessment* MAR-AJM-PWD-PWD-REP-XTR-NAP-0001724 states:

- Compared to other major transport infrastructure works in Melbourne, such as the MTP, construction traffic generation is relatively modest with only five out of the 15 construction areas anticipated to generate 40 or more truck movements a day (includes arrivals and departures) outside short intense peak activity demand periods. Three of these sites would typically generate less than this but may include intense periods when truck movements are closer to 100 vehicle movements per day.
- Overall construction traffic is not anticipated to have a material impact on the operation of the road network, however access to individual sites will need further consideration when more information is available.

All construction works will need to be managed using a Construction Noise and Vibration Management Plan (CNVMP) to be developed by the Project Contractor.

6.1 Approach

The assessment of construction noise consists of:

- Identification of project specific Noise Requirements (as per the CCBDG) for residential noise sensitive receivers and determination of project specific noise criteria for non-residential noise sensitive receivers
- Identification of typical worst-case construction scenarios (including construction equipment)
- Determination of representative construction equipment source noise levels
- Prediction of the construction noise impacts
- Consideration of noise mitigation and management.

6.2 Project Specific Noise Criteria

6.2.1 Victorian Legislation and Guidelines

The noise requirements for construction at specific residential locations are provided in Table 5.1.

The specific Noise Requirements for Avoidable Works (i.e. works that are not Unavoidable Works) occurring outside NWH are based background noise levels. These need to be provided as per Table 6.1, however, appropriate noise monitoring has not been possible due to the COVID 19 pandemic. These measurements will need to be undertaken by a Project Contractor prior to commencing construction activities.

Inaudibility would be assessed as ‘background noise level +0 dB’ as per the CCBDG.

Table 6.1 Noise Requirements Residential

Location	Noise Requirements $dBL_{Aeq,15minutes}$			Comment
	Evening		Night (Inaudibility)	
	Up to 18 months after project commencement	18 months or more after project commencement		
Specific residential areas in the vicinity of construction works	To be determined	To be determined	To be determined	Noise measurements to be undertaken.

6.2.2 Additional requirements

The CCBDG does not provide numerical Noise Management Levels at non-residential sensitive receivers. To address this, additional Noise Management Levels are provided in Table 6.2.

Table 6.2 Noise management levels for non-residential noise sensitive receivers

Land Use	Construction Noise Management Level (internal) at Non-residential Receivers $dBL_{Aeq,15mins}$
Classrooms in schools and other educational institutions	45
Hospital wards, operating theatres, intensive care, surgeries	45
Childcare facilities	45
Places of worship	45
Other noise sensitive receivers (including community centres)	Depends of the intended use – refer to the highest design sound levels in AS/NZS 2107

Notes:

1) Construction noise management levels are applicable when the facilities are in use.

2) If construction noise exceeds the internal noise management level then; (i) consider the duration of the noise, (ii) consider the relevant ambient noise level, (iii) consider the acoustic requirements of the space, (iv) consult with the owner/operator.

6.3 Construction Noise Modelling

Airborne noise from proposed construction activities has been predicted using ISO 9613-2 which has been implemented in SoundPLAN version 8.1. The model in SoundPLAN includes:

- Topography
- Building structures
- Noise sources
- Noise sensitive receivers
- Ground absorption
- Air absorption
- Existing noise barriers
- Meteorology

The following assumptions have been made:

- All plant for each scenario operates concurrently. This is a conservative approach and is unlikely to occur in practice.

- Construction vehicles on public roads are not included in the assessment. This is because there are no specific noise requirements for construction vehicles on public roads.

Inputs for the noise modelling are provided in Appendix A and include:

- Noise model inputs
- Equipment source noise levels
- Project construction scenarios and equipment
- Additional information about the construction scenario activities.

6.4 Results

The construction scenarios assessed and a summary of the results of the construction noise predictions, without additional mitigation, are provided in Table 6.3. The detailed predicted construction noise levels are shown on noise contour maps in Figure A.1 Predicted Construction Noise levels for Scenario 1 - Sunshine Station platform piling works

to Figure A.18 in Appendix A. The predicted noise levels are expected to be worst-case because all construction equipment is operating concurrently which is not expected to occur in practice. Where Unavoidable Works are to be undertaken over an extended period, this does not imply that construction activity will occur on a nightly basis.

Table 6.3 : Results of construction noise modelling without mitigation

Construction Scenario	Results
Sunshine to Albion	
1. Sunshine Station / Platform Piling	Construction works, associated with this construction scenario, are planned to be undertaken over 16 days over 24-hours. These works require track occupation and are classified Unavoidable Works. The highest predicted noise levels are 75 to 80 $dBL_{Aeq,15minutes}$ at noise sensitive receivers along Station Place, Sunshine. The predicted construction noise levels are provided in Figure A.1 in Appendix A.
2. Chaplin Reserve to Anderson Road / CSR Construction	Construction works, associated with this construction scenario, are planned to be undertaken over 16 days over 24-hours. These works require track occupation and are classified Unavoidable Works. The highest predicted noise levels are 70 to 75 $dBL_{Aeq,15minutes}$ at noise sensitive receivers along Anderson Road, Sunshine. The predicted construction noise levels are provided in Figure A.2 in Appendix A.
3. Anderson Road to Ballarat Road / CSR Trenching	Construction works, associated with this construction scenario, are planned to be undertaken over 100 days which includes weekend track occupation over 24-hours. These are classified Unavoidable Works. The highest predicted noise levels are 70 to 80 $dBL_{Aeq,15minutes}$ at noise sensitive receivers along Anderson Road and King Edward Avenue, Sunshine. The predicted construction noise levels are provided in Figure A.3 in Appendix A.
4. St Albans / ARTC Track formation works	Construction works, associated with this construction scenario, are planned to be undertaken over 13 days over 24-hours. These works require track occupation and are classified Unavoidable Works. The highest predicted noise levels are 75 to 80 $dBL_{Aeq,15minutes}$ at noise sensitive receivers in the vicinity of the proposed viaduct alignment. The predicted construction noise levels are provided in Figure A.4 in Appendix A. This prediction extends the length of the viaduct and does not take topography into consideration (i.e. worst-case as shielding is not included). The works are presented for the entire viaduct, however, in practice these are linear works and will occur in a specific location before moving along the viaduct length.
5. St Albans / CSR construction works	Construction works, associated with this construction scenario, are planned to be undertaken over 16 days over 24 hours, which includes track occupation. These are classified Unavoidable Works. The highest predicted noise levels are 75 to 80 $dBL_{Aeq,15minutes}$ at noise sensitive receivers in the vicinity of the proposed viaduct alignment The predicted construction noise levels are provided in Figure A.5 in Appendix A. This prediction extends the length of the viaduct and does not take topography into consideration (i.e. worst-case as shielding is not included). The works are presented for the entire viaduct, however, in practice these are linear works and will occur in a specific location before moving along the viaduct length.

Construction Scenario	Results
M80 Viaduct	
6. Airport West / Substructure	Construction works, associated with this construction scenario, are planned to be undertaken over a year during NWH. The highest predicted noise levels are 70 to 80 $dBL_{Aeq,15minutes}$ at noise sensitive receivers along Roberts Road and Parer Road, Airport West. Refer to Figure A.6Figure A.6 and Figure A.7 in Appendix A.
7. Western Ring Rd / Substructure	Construction works, associated with this construction scenario, are planned to be undertaken over 90 days over 24-hours. These works require road occupation and are classified Unavoidable Works. The highest predicted noise levels are 60 to 65 $dBL_{Aeq,15minutes}$ at noise sensitive receivers along Parer Road, Airport West. The predicted construction noise levels are provided in Figure A.8 in Appendix B.
8. Tullamarine / Substructure	Construction works, associated with this construction scenario, are planned to be undertaken over 180 days over a 24-hours. These are classified Unavoidable Works. The highest predicted noise levels are in the order of 70 $dBL_{Aeq,15minutes}$ at noise sensitive receivers along Parer Road, Airport West. The predicted construction noise levels are provided in Figure A.9a for bored piling and Figure A.9b for driven piling and these are in Appendix A. This prediction extends the length of the viaduct and does not take topography into consideration (i.e. worst-case as shielding is not included). The works are presented for the entire viaduct, however, in practice these are linear works and will occur in a specific location before moving along the viaduct length.
Corridor	
9. Sunshine North / CSR trenching works	Construction works, associated with this construction scenario, are planned to be undertaken over 120 days during NWH. These works require road occupation and are classified Unavoidable Works. The highest predicted noise levels are 70 to 80 $dBL_{Aeq,15minutes}$ at noise sensitive receivers in the vicinity of the rail corridor in Sunshine North. The predicted construction noise levels are provided in Figure A.10 and Figure A.11 in Appendix A.
10. Sunshine North / Track formation works	Construction works, associated with this construction scenario, are planned to be undertaken over 230 days over 24-hours. These works require road occupation and are classified Unavoidable Works. The highest predicted noise levels are 70 to 85 $dBL_{Aeq,15minutes}$ at noise sensitive receivers in the vicinity of the rail corridor in Sunshine North. The predicted construction noise levels are provided in Figure A.12 and Figure A.13 in Appendix A.
11. McIntyre Rd / Bridge Upgrade	Construction works, associated with this construction scenario, are planned to be undertaken over 100 days over 24-hours. These works require road occupation and are classified Unavoidable Works. The highest predicted noise levels are 75 to 80 $dBL_{Aeq,15minutes}$ at noise sensitive receivers on Mansfield Avenue, Sunshine North. The predicted construction noise levels are provided in Figure A.14 in Appendix A.
12. Keilor Park Drive / Bridge Upgrade	Construction works, associated with this construction scenario, are planned to be undertaken over 45 days over 24-hours. These works require road occupation and are classified Unavoidable Works. The highest predicted noise levels are 75 to 80 $dBL_{Aeq,15minutes}$ at noise sensitive receivers along Sterling Drive, Keilor East. The predicted construction noise levels are provided in Figure A.15 in Appendix A.
13. Calder Freeway / Bridge Upgrade	Construction works, associated with this construction scenario, are planned to be undertaken over 240 days over 24-hours. These works require road occupation and are classified Unavoidable Works. The highest predicted noise levels are 75 to 80 $dBL_{Aeq,15minutes}$ at noise sensitive receivers along Borva Drive, Keilor East. The predicted construction noise levels are provided in Figure A.16 in Appendix A.
Maribyrnong River Bridge	
14. Maribyrnong River / Tower Mobilisation	Construction works, associated with this construction scenario, are planned to be undertaken over 100 days over 24-hours. These works require overnight delivery and assembly of Tower Cranes and are classified Unavoidable Works. The highest noise level predicted are 70 to 75 $dBL_{Aeq,15minutes}$ at noise sensitive receivers on Hedgerow Court, Keilor East. The predicted construction noise levels are provided in Figure A.17 in Appendix A.
15. Maribyrnong River / Piling and Excavation	Construction works, associated with this construction scenario, are planned to be undertaken over 500 days during NWH.

Construction Scenario	Results
	The highest noise levels predicted are 70 to 85 $dBL_{Aeq,15minutes}$ at noise sensitive receivers at Hedgerow Court and Hawthorn Court, Keilor East, including an Aged Care Facility on Sterling Drive, Keilor East. The predicted construction noise levels are provided in Figure A.18 in Appendix A.

6.5 Mitigation

6.5.1 General Mitigation

The following mitigation from the CCBDG, is to be provided during construction.

Source

- Preparatory work offsite where there is low potential for impacting people (e.g. formwork, cutting or prefabrication of materials offsite prior to transporting to the construction site)
- Connecting to the electricity grid as early as possible to avoid the use of diesel generators
- Restricting areas where mobile plant can operate so that it is away from people who could be affected by noise
- Locating site vehicle access and waiting areas away from people who could be affected by noise
- Planning vehicle movements to avoid manoeuvres and idling at location nearest to nearby people
- Using quieter equipment or methods. This may require considering:
  - > buying or leasing quieter equipment
  - > avoiding metal-to-metal and metal-to-stone contact
  - > installing mufflers
  - > reducing throttle and turning off equipment when not in use
  - > placing things down rather than throwing
  - > educating drivers to use driving practices that minimise noise.
- Using low noise saw blades
- Using electrical equipment rather than equipment driven by a diesel generator
- Using low noise emitting generators
- Using effective alternatives to ‘beeper’ alarms (e.g. broadband alarms, proximity sensors)
- Avoiding reversing alarms by designing site layout to avoid reversing (e.g. drive-through for parking and deliveries)
- Maintaining equipment by:
  - > inspecting regularly and maintaining equipment to ensure good working order
  - > checking machines with enclosures, including doors and door seals
  - > maintaining air lines on pneumatic equipment so they do not leak
- Maintaining vehicles by:
  - > considering good working conditions of mufflers
  - > securing loose parts that may rattle
- Limiting noise caused by people onsite. This may include procedures to avoid yelling and shouting onsite
- Minimising the use and volume of electrical amplified sound-reproducing equipment

- Planning transport and haulage routes to minimise the number of trucks/vehicles. Where there are large numbers of truck movements, consider truck route and truck waiting protocols (e.g. engines on/off and restart requirements)
- Substituting methods taking into consideration:
  - > alternatives to rock-breaking work methods, such as hydraulic splitters for rock and concrete, hydraulic jaw crushers, chemical rock and concrete splitting, and controlled blasting such as penetrating cone fractures
  - > alternatives to diesel and petrol engines and pneumatic units, such as hydraulic or electrical generator located away from nearby people

Between source and receivers

- Planning to have as much distance as possible between equipment and impacted receivers
- Maximising shielding taking into consideration:
  - > topography of the site (e.g. use of earth mounds as barriers)
  - > existing structures, temporary buildings, and material stockpiles
  - > early construction of permanent walls so they can be used as noise barriers
  - > avoiding placing noise-producing equipment in locations where reflected noise will increase exposure
- Prioritising construction of structures such as buildings and walls that can contribute to shielding noise from the construction site
- Obstructing the transmission path of sound (e.g. using acoustical walls or barrier, flexible noise barriers such as noise curtain or blankets, acoustic sheds, or enclosures)
- Protecting noise sensitive receivers (e.g. increasing window sound insulation by retrofitting acoustic glazing or suitable double glazing)

Offsite

- Providing respite offers that reflect the level of impact (e.g. movie tickets)
- Offering alternative accommodation where there is sustained noise impact (such as ongoing sleep disturbance over many nights) or where residents may have underlying health conditions that could be adversely impacted
- Relocating affected residents for the agreed period of construction activity if noise levels cannot be reduced sufficiently

Additional controls for weekend, evening or night activities on site

- Planning quieter Unavoidable Work activities outside NWH
- Scheduling noisy Unavoidable Work when it is less likely to affect residents' sleep and for shorter periods, wherever possible
- Scheduling respite periods if Unavoidable Work is near residents. Consult with most-affected residents about restricting the number of nights per week and/or per calendar month for works
- Stockpiling material from Unavoidable Work activities that occur outside normal hours in, for example, an acoustic enclosure. Also restrict load-out to occur during NWH
- Training all workers regarding Unavoidable Work activities that occur outside NWH

6.5.2 Specific Mitigation

The CCBDG proposes *obstructing the transmission path of sound (e.g. using acoustical walls or barrier, flexible noise barriers such as noise curtain or blankets).* Reducing the extent of airborne noise impacts from

construction work sites can be achieved with the use of temporary noise barriers. Temporary noise barriers should be contiguous with no gaps or holes, with a mass per unit area of minimum 10 kg/m^2 and a minimum height of 2 metres. The noise barriers will be most effective if placed close to the noise sources or to the impacted receivers. The effectiveness of temporary 2 m high noise barriers has been considered and is discussed in Section 6.6.

6.5.3 Management Measures

Much of the construction work will be undertaken during rail or road occupations and these works would be categorised as Unavoidable Works.

While there are no specific Noise Requirements (in terms of noise limits) for Unavoidable Works, noise impacts would need to be mitigated and managed. A typical framework for management of these impacts is provided in Table 6.4 and in the EMF. The Project Contractor would need to provide a plan incorporating Management Measures.

The management measures provided would be applied in addition to reasonably practicable noise mitigation measures as described in Sections 6.5.1 and 6.5.2.

Table 6.4 : Management Measures for Construction Noise for Unavoidable Works

Exceedance above background noise level (external) $dBL_{A90,15minutes}$	Management Measures	Comment
0 to 5	Notification	Construction noise may be becoming noticeable
5 to 10	Notification	Construction noise likely to be noticeable
10 to 20	Notification Respite Period	Construction noise likely to be clearly noticeable
20 to 30	Notification Individual Briefing Respite Period	Construction noise likely to be moderately intrusive
Greater than 30	Notification Individual Briefing Earplugs/earphones Respite Period Alternative Accommodation (Evening / Night period works)	Construction noise likely to be highly intrusive

Notes:

1) Notification may be a letterbox drop or equivalent – advanced warning of works.

2) The purpose of a respite offer is to provide residents subjected to lengthy periods of noise or vibration respite from ongoing impact. Examples of respite include:

   > an hour break between 3-hour periods of construction activity with special audible characteristics (such as piling, jack hammering)

   > movie tickets or meal vouchers or similar

   > no more than two consecutive nights of noisy works.

3) Alternative Accommodation is one of a range of measures to address noise at night and is expected to be offered when a night-time exceedance occurs for two or more nights and a resident is adversely impacted.

4) For long term impacts of work at a fixed site ‘at receiver’ noise mitigation may be appropriate.

These management measures are for Unavoidable Works, on the basis that all other construction works comply with the Noise Requirements in Table 6.1.

6.5.4 Construction vehicles

While the noise limits are not applicable to construction vehicles on public roads, if construction vehicles are in the vicinity of noise sensitive receivers then the following should apply:

- Where practicable, limit heavy construction vehicles to NWH
- Where practicable, prioritise traffic routes with existing heavy vehicle usage and avoid local roads (residential streets) particularly outside of NWH
- Identify suitable locations for trucks to idle pending arrival at construction sites.

6.6 Discussion

Construction of MAR on state land will be undertaken over five years although construction in each area would be less than this. The scenarios which are expected to have the largest noise impacts have been modelled and a discussion for each of these and is provided in Table 6.5.

The noise levels predicted and provided in Table 6.5 are expected to be the worst-case as they are based on all equipment operating at the same time. Much of the equipment will also be mobile and at times further from the receivers in which case the noise levels are likely to be lower.

The discussion includes the effectiveness of 2 m high temporary noise barriers for all scenarios except Scenarios 4, 5 and 8 which are for the construction of viaducts and topography has not been included in the prediction.

For all scenarios the Project Contractor will need to prepare a comprehensive CNVMP which explains how mitigation measures will be applied to minimise construction noise levels and how management measures will be applied.

Table 6.5 : Discussion of construction noise impacts for each scenario

Construction Scenario	Discussion
Sunshine to Albion	
1. Sunshine Station / Platform Piling	Construction works, associated with this scenario, are planned to take 16 days over 24-hours. These works would be undertaken during a track occupation whilst trains are not running and would be classified Unavoidable Works. The works will be time critical with piling to be completed at platforms 2 and 3 during the occupation and therefore night activity is likely to be required. The effectiveness of temporary noise barriers has been assessed: • 2 m high noise barriers located along the east side of rail corridor at the rear of noise sensitive receivers along Station Place were predicted to reduce the noise impact from construction works by up to 5 dB(A) • 2 m high noise barriers located west of the rail corridor along Thorpe Street, Sunshine were predicted to not be effective Management measures are expected to be required including Alternative Accommodation for some noise sensitive receivers at night. Refer to Figure A.19 in Appendix A for barrier locations and predicted construction noise levels.
2. Chaplin Reserve to Anderson Road / CSR Construction	Construction works, associated with this scenario, are planned to take 16 days over 24-hours. These works would be undertaken during a track occupation whilst trains are not running and would be classified Unavoidable Works. The effectiveness of temporary noise barriers has been assessed: • 2 m high noise barriers along the west side of rail corridor adjacent to the Chaplin Reserve were predicted to reduce the noise impact from construction works by up to 5 dB(A) • 2 m high noise barriers along east of the corridor adjacent to Harvester Rd were predicted to reduce the noise impact from construction works by up to 5 dB(A) Management measures are expected to be required including Alternative Accommodation for some noise sensitive receivers at night. Refer to Figure A.20 in Appendix A for barrier locations and predicted construction noise levels.
3. Anderson Road to Ballarat Road / CSR Trenching	Construction works, associated with this construction scenario, are planned to be undertaken over 100 days. This would include weekend Track Occupation over 24-hours as some of these works are close to the tracks and need to be undertaken when trains are not running. These works would be classified Unavoidable Works. The effectiveness of temporary noise barriers has been assessed:

Construction Scenario	Discussion
	• 2 m high noise barriers along east side of rail corridor were predicted not to be effective • 2 m high noise barriers adjacent to the Chaplin Reserve and Talmage Street, west of the corridor were predicted to reduce the noise impact from construction works by up to 5 dB(A) Management measures are expected to be required including Alternative Accommodation for some noise sensitive receivers at night. Refer to Figure A.21 in Appendix A for barrier locations and predicted construction noise levels..
4. St Albans / ARTC Track formation works	Construction works, associated with this scenario, are planned to be undertaken over 13 days. This would include weekend track occupation over 24-hours as some of these works are close to the tracks and need to be undertaken when trains are not running. These works would be classified Unavoidable Works. Topography has not been included for this scenario and consequently, the predictions are considered to be worst-case as they do not include any shielding. The effectiveness of noise barriers has not been taken into consideration as it would be dependent on the topography in a particular area. Management measures are expected to be required including Alternative Accommodation for some noise sensitive receivers at night.
5. St Albans / CSR construction	Construction works, associated with this scenario, are planned to be undertaken over 16 days. This would include weekend Track Occupation over 24-hours as some of these works are close to the tracks and need to be undertaken when trains are not running. These works would be classified as Unavoidable Works. Topography has not been included for this scenario and consequently, the predictions are considered to be worst-case as they do not include any shielding. The effectiveness of noise barriers has not been taken into consideration as it would be dependent on the topography in a particular area. Management measures are expected to be required including Alternative Accommodation for some noise sensitive receivers at night.
M80 Viaduct	
6. Airport West / Substructure	Construction works, associated with this scenario, are planned to be undertaken over about a year during NWH. The effectiveness of temporary noise barriers has been assessed: • 2 m high noise barriers on the eastern side of the rail tracks in Airport West were predicted to reduce the impact of noise from construction works by up to 5 dB(A) for noise sensitive receivers adjacent to the rail tracks along Parer Road, Airport West • 2m high noise barriers on the eastern side of the rail tracks were predicted to reduce the impact of noise from construction works by up to 5 dB(A) for noise sensitive receivers along Roberts Road, Airport West Management measures will be required. Refer to Figure A.22 and FigureA.23 in Appendix A for barrier locations and predicted construction noise levels.
7. Western Ring Rd / Substructure	Construction works, associated with this scenario, are planned to be undertaken over 90 days over a 24-hour period. These works require Road Occupation and are classified as Unavoidable Works. The effectiveness of temporary noise barriers has been assessed: • 2 m high noise barriers on the north eastern side of Western Ring Road were predicted to not be effective Management measures will be required, and Alternative Accommodation may also be required for some noise sensitive receivers at night. Refer to Figure A.24 in Appendix A for barrier locations and predicted construction noise levels.
8. Tullamarine / Superstructure	Construction works, associated with this scenario, are planned to be undertaken for 180 days over 24-hours. These are Unavoidable Works. Topography has not been included for this scenario and consequently, the predictions are considered to be worst-case as they do not include any shielding. The effectiveness of noise barriers has not been taken into consideration as it would be dependent on the topography in a particular area. Management measures are expected to be required and Alternative Accommodation may be required for some noise sensitive receivers at night.
Corridor	

Construction Scenario	Discussion
9. Sunshine North / CSR Trenching work	Construction works, associated with this scenario, are planned to be undertaken over 120 days during NWH. The effectiveness of temporary noise barriers has been assessed: • 2 m high noise barriers along the eastern and western side across the CSR works were predicted to not be effective. Refer to Figure A.25 and Figure A.26 in Appendix A for barrier locations and predicted construction noise levels.
10. Sunshine North / Track, formation & drainage works	Construction works, associated with this construction scenario, are planned to be undertaken over 230 days over 24-hours. These works can only be undertaken during night rail occupations where trains are not in operation and are classified Unavoidable Works. The effectiveness of temporary noise barriers has been assessed: • 2 m high noise barriers along the eastern western side across the track formation works were predicted to not be effective. Management measures are expected to be required and Alternative Accommodation may be required for some noise sensitive receivers at night. Refer to Figure A.27 and Figure A.28 in Appendix A for barrier locations and predicted construction noise levels.
11. McIntyre Rd / Bridge Upgrade	Construction works, associated with this scenario, are planned to be undertaken over 100 days over 24-hours. These works would require full road lane closures and cannot be conducted during the day, as they would result in unacceptable road traffic disruptions at peak travel times. The works are therefore classified Unavoidable Works. The effectiveness of noise barriers has been assessed: • 2 m high noise temporary barriers along the western side of rail corridor at the back houses of Mansfield Ave noise sensitive receivers were predicted to reduce the noise impact from construction works by up to 10 dB(A) along Mansfield Avenue, Sunshine North Management measures are expected to be required including Alternative Accommodation for some noise sensitive receivers at night. Refer Figure A.29 in Appendix A for barrier locations and predicted construction noise levels.
12. Keilor Park Drive / Bridge Upgrade	Construction works, associated with this scenario, are planned to be undertaken over 45 days over 24-hours. These works would require full road lane closures and cannot be conducted during the day, as they would result in unacceptable road traffic disruptions at peak travel times. The works are therefore classified Unavoidable Works. The effectiveness of temporary noise barriers has been assessed: • 2 m high noise barriers along the eastern side of the rail corridor at the back houses of Sterling Dr noise sensitive receivers were predicted to reduce the noise impact from construction works by up to 5 dB(A) for noise sensitive receivers along Sterling Drive, Keilor East Management measures are expected to be required including Alternative Accommodation for some noise sensitive receivers at night. Refer to Figure A.30 in Appendix A for barrier locations and predicted construction noise levels.
13. Calder Freeway / Bridge Upgrade	Construction works, associated with this scenario, are planned to be undertaken over 240 days over 24-hours. These works would require full road lane closures and cannot be conducted during the day, as they would result in unacceptable road traffic disruptions at peak travel times. The works are therefore classified Unavoidable Works. The effectiveness of temporary noise barriers has been assessed: • 2 m high noise barriers along the eastern side of the rail corridor at the back houses of Borva Drive and Moyangul Drive, Keilor East were predicted to reduce the noise impact from construction works by up to 5 dB(A) Management measures are expected to be required including Alternative Accommodation for some noise sensitive receivers at night. Refer to Figure A.31 in Appendix A for barrier locations and predicted construction noise levels.
Maribyrnong River Bridge	
14. Maribyrnong River / Tower Mobilisation	Construction works, associated with this construction scenario, are planned to be undertaken over 100 days over 24-hours. These works require an overnight delivery of the Tower Cranes and are classified Unavoidable Works. The effectiveness of temporary noise barriers has been assessed:

Construction Scenario	Discussion
	• 2 m high noise barriers along the eastern side of the rail corridor at the back houses of Hedgerow Court and Sterling Drive, Keilor were predicted to reduce the noise impact from construction works by up to 5 dB(A) Management measures are expected to be required including Alternative Accommodation for some noise sensitive receivers at night. Refer to Figure A.32 in Appendix A for barrier locations and predicted construction noise levels.
15. Maribyrnong River / Piling and Excavation	Construction works, associated with this scenario, are planned to be undertaken over 500 days during NWH. The effectiveness of temporary noise barriers has been assessed: • 2 m high noise barriers along the eastern side of the rail corridor at the rear of houses on Hedgerow Ct and Sterling Dr, Keilor East were predicted to reduce the noise impact from construction works by up to 5 dB(A) Management measures are expected to be required. Refer to Figure A.33Figure A.33 in Appendix A for barrier locations and predicted construction noise levels.

The construction works have the potential to be intrusive at times, particularly for works undertaken during the night period. The effectiveness of 2 m high temporary noise barriers has been considered and found to be effective for some scenarios. A Project Contractor may find other mitigation measures are more effective such as higher temporary noise walls, noise walls in alternative locations etc.

Where possible construction works are to be conducted during NWH, however, significant work is expected to be undertaken outside of NWH to avoid impacts on the road and rail networks. These would be Unavoidable Works for which approval from the appropriate authority is required and Noise Requirements (noise limits) do not apply. Practicable mitigation is, however, required.

Examples of Unavoidable works are provided in the CCBDG and include:

- The delivery of oversized plant or structures that police or other authorities determine require special arrangements to transport along public roads
- Emergency work to avoid loss of life or damage to property, or to prevent environmental harm (approval from the authority is not required)
- Maintenance and repair of public infrastructure where disruption to essential services and/or considerations of worker safety do not allow work within standard hours
- Rail occupations or works that would cause a major traffic hazard
- Works where a proponent demonstrates and justifies a need to operate outside Normal Working Hours such as work that once started cannot practically be stopped until completed such as concrete pouring or construction of diaphragm walls.

Where possible, noisy works should be undertaken at times when they are less likely to impact on sleep. In instances where noise impacts cannot be adequately controlled with mitigation or be undertaken during NWH then management measures would be required. Where night works would have an unreasonable impact on sleep Alternative Accommodation would need to be offered.

The impacts of noise would need to be carefully managed by the Project Contractor using a comprehensive CNVMP.

7. Impact Assessment – Operational Rail Noise

The Project includes changes to existing rail, introduction of new rail tracks / viaducts and rail volumes will increase to cater for travel to and from Melbourne Airport. These changes have the potential to cause noise impacts on noise sensitive receivers in the vicinity of the railway. Rail noise levels have been predicted and assessed with respect to the requirements of the Passenger Rail Infrastructure Noise Policy (PRINP).

7.1 Approach

The assessment of operational rail noise consists of:

1) Identification of noise requirements (legislation / guidelines). The relevant planning document is the PRINP.

   The PRINP is based on principles and provides Investigation Thresholds (ITs) to guide transport bodies when assessing the impacts of rail noise on communities. If an IT is exceeded, then rail noise is considered a Primary Matter and options to avoid, minimise and mitigate rail noise are to be considered. The ITs are provided in Table 5.2

   The PRINP does not present noise limits. Rather, where noise has been determined to be a Primary Matter, the best fit solution for the project is to be determined based on the policy principles which are provided in Section 5.3.

2) Identification of the relevant rail scenarios to determine if an IT is exceeded. These are defined for:

   - Redevelopment of existing passenger rail infrastructure
     - > Base Case: one day prior to Project opening, if the Project did not proceed (applicable in areas where there is existing railway infrastructure)
     - > Redeveloped Case: 10 years after Project opening
   - New Passenger Rail Infrastructure
     - > 10 years after Project opening

   For this assessment on State Land there is no ‘New Passenger Rail Infrastructure' in the vicinity of noise sensitive receivers i.e. in the absence of existing rail.

3) Determination of representative rail source noise levels. These have been based on noise measurements and information in literature. For viaducts, reradiated noise (from the train travelling over the viaduct) has been included.

4) Prediction of the rail noise for the Base Case and the Redeveloped Case and identification of areas where noise was found to be a Primary Matter.

   Within the MAR State Project Land (see Figure 3.1), in areas where no track infrastructure changes are proposed, High-Level Noise Assessments (HLNAs) have been undertaken. In areas where track-works are proposed, Detailed Noise Assessments (DNAs) have been undertaken.

   An HLNA determines the change in source rail noise level, due to the change in rail services on the line, between (i) the Base Case and (ii) the Redeveloped Case. If an increase in source rail noise level of 3 dB(A) or more is unlikely, then an Investigation Threshold would not be exceeded, and rail noise would be a Secondary Matter. If an increase in source rail noise level of 3 dB(A) or more is identified, then a Detailed Noise Assessment (as described below) would be undertaken.

   A DNA involves detailed acoustic modelling to predict rail noise levels at noise sensitive receivers. This approach is proposed for locations where track-works are proposed or where an increase in rail noise level of 3 dB(A) or more has been identified in the HLNA.

5) Participation in principles-based Noise Mitigation Workshops to determine the noise mitigation strategy, i.e. the best fit solutions for the project, in areas where noise has been predicted to be a Primary Matter.

In some locations additional investigations were undertaken following the workshops. The final mitigation strategy is required to be approved by the Project Director.

A diverse group from both AJM-JV and RPV attended the workshops, typically including:

- Senior RPV representative
- RPV and AJM-JV stakeholder and communications team representatives
- RPV and AJM-JV engineering leads
- AJM-JV Acoustics representatives
- RPV and AJM-JV LPE leads
- Urban design leads

The following were considered in the workshops:

- Existing noise levels (based on judgement because noise monitoring was delayed due to the COVID-19 pandemic)
- Change in noise level
- Nature of the noise
- No. of noise sensitive receivers affected
- Benefits of the project
- Rail noise in similar locations
- Physical / practical constraints
- Effectiveness of mitigation
- Use of Off Reservation Treatment
- Community views
- Safety and security
- Financial implication
- Urban design / visual impacts

The outcome of the workshops was the rail noise mitigation strategy for a particular area.

7.2 Rail Noise Modelling and inputs

Airborne rail noise has been predicted using the methodology from Nord 2000 - *New Nordic Prediction Method for Rail and Traffic Noise* (NORD2000). This methodology allows the prediction of the day average ($L_{Aeq,16hour}$), night average ($L_{Aeq,8hour}$) and maximum (L_{Amax}) noise levels. NORD2000 has be implemented in SoundPLAN version 8.1.

The noise model includes the following:

- One-third octave band source noise levels
- Operational timetables
- Train lengths / speed
- Air absorption
- Atmospheric refraction
- Split height source modelling

- Ground effects
- Meteorological effects
- Screening
- Reflection
- A façade reflection of 2.5 dB for predicted noise levels at buildings.

The rail noise inputs are provided in Appendix B and include:

- Train types, volumes, speed, length
- Modelling input files
- Location of cross overs
- Train source noise levels and corrections.

The noise model includes existing noise barriers located at the following locations but does not include typical timber back fences:

- The rear of a section of the properties on Drayton Street, Sunshine
- At the rear of properties southeast of Calder Freeway overpass in Keilor Park
- At the rear of properties northwest of Calder Park overpass and adjacent to Western Ring Road in Keilor Park.

These are shown on figures in Appendix B.

7.3 Results

7.3.1 High Level Noise Assessment

HLNAs have been conducted in areas within the scope of the MAR project boundary where no change to track infrastructure is proposed.

These sections of rail are located between:

- Footscray Station and Sunshine Station
- Newport Station and Sunshine Station
- St Albans Station and Sunshine Station
- Albion-Jacana link and intersection with Craigieburn line

The predicted change in source noise levels, between the Base Cases and Redeveloped Cases are presented in Table 7.1

Table 7.1 The relative noise source levels between the Redeveloped Case and the Base Case in areas where there are no track-works proposed

Descriptor	Change in source noise levels from Base Case to Redeveloped Case (+/- dB)	Comments
Footscray Station to Sunshine Station		
$L_{Aeq, day}$	-1	Reduction in DMU train volumes. DMU trains are to be replaced with EMUs, which are quieter.
$L_{Aeq, night}$	-1	
$L_{Amax, day}$	0	
$L_{Amax, night}$	0	

Descriptor	Change in source noise levels from Base Case to Redeveloped Case (+/- dB)	Comments
Newport Station to Sunshine Station		
$L_{Aeq, day}$	0	No change is proposed in the rail types and volumes.
$L_{Aeq, night}$	0	
$L_{Amax, day}$	0	
$L_{Amax, night}$	0	
St Albans Station to Sunshine Station		
$L_{Aeq, day}$	0	Increase in HCMT train length from 7 to 10 cars.
$L_{Aeq, night}$	1	
$L_{Amax, day}$	0	
$L_{Amax, night}$	0	
Albion-Jacana link to intersection with Craigieburn line		
$L_{Aeq, day}$	0	Decrease in VLocity (DMU) trains. Increase in EMU trains.
$L_{Aeq, night}$	-1	
$L_{Amax, day}$	0	
$L_{Amax, night}$	0	

No increases of 3 dB(A) or greater are predicted and therefore noise is a Secondary Matter in these areas. Predicted increases in noise levels are due to increase in HCMT train length from HCMT-7 to HCMT-10 while predicted decreases in noise levels are due to replacement of DMUs with quieter EMUs.

7.3.2 Detailed Noise Assessment

Rail noise levels, $L_{Aeq,day}$, $L_{Aeq,night}$ and L_{Amax} have been predicted at noise sensitive receivers in the vicinity of the railway for both the Base Case and the Redeveloped Case. Noise sensitive receivers, where noise is predicted to be a Primary Matter have been identified and are shown on the figures in Appendix B.

7.3.2.1 Corridor Section

Areas where noise has been predicted to be a Primary Matter in the Corridor Section are discussed in Table 7.2

Table 7.2. Areas where noise is predicted to be a Primary Matter in the Corridor Section

Location where noise is a Primary Matter	Comments
Properties in Sunshine North west of track (indicative chainages 14600 to 15400)	Rail noise is predicted to be a Primary Matter at 80 ground floor residential receivers west of the proposed track in Sunshine North. Exceedances to ITs apply to $L_{Aeq,16hour}$ (day period average) and $L_{Aeq,8hour}$ (night period average) and are predicted to be up to 6 dB(A). Exceedances to an IT are predicted at 6 first floor residential receivers.
Properties in Sunshine North east of track (indicative chainages 14600 to 15400)	Rail noise is predicted to be a Primary Matter at 37 ground floor residential receivers east of the proposed track in Sunshine North. Exceedances to the ITs apply to the $L_{Aeq,16hour}$ and $L_{Aeq,8hour}$ and are predicted to be up to 5 dB(A). An IT is predicted to be exceeded at one first floor residential receiver.
Properties near McIntyre Rd road overpass (indicative chainages 15600 to 15900)	Rail noise is predicted to be a Primary Matter at 9 ground floor residential receivers in the vicinity of the McIntyre Road overpass, Sunshine North. Exceedances to the ITs apply to the $L_{Aeq,16hour}$ and $L_{Aeq,8hour}$ and are predicted to be 1 dB(A). These receivers are exposed to traffic noise from McIntyre Road.

Location where noise is a Primary Matter	Comments
In the vicinity of Maribyrnong River Bridge, Keilor East (indicative chainages 17700 to 18020)	Rail noise is predicted to be a Primary Matter at 14 ground floor residential receivers in the vicinity of the Maribyrnong River Bridge. Exceedances to ITs apply to the $L_{Aeq,16hour}$ and $L_{Aeq,8hour}$ and are predicted to be up to 6 dB(A).
Properties along Sterling Drive, Keilor East (indicative chainages 18020 to 18720)	Noise is predicted to be a Primary Matter at 35 ground floor residential receivers along Sterling Drive, Keilor East. Exceedances to ITs apply to the $L_{Aeq,16hour}$ and $L_{Aeq,8hour}$ and are predicted to be up to 6 dB(A). Exceedances to an IT are predicted at 4 first floor residential receivers.
Properties in Keilor East between Keilor Park Dr and Calder Freeway road overpass (indicative chainages 18700 to 20300)	Rail noise is predicted to be a Primary Matter at 84 ground floor residential receivers in Keilor East between Keilor Park Drive and Calder Freeway road overpass. Exceedances to ITs apply to the $L_{Aeq,16hour}$ and $L_{Aeq,8hour}$ and are predicted to be up to 8 dB(A). Exceedances to an IT are predicted at 14 first floor residential receivers.
Properties in the vicinity of Roberts Road, Airport West (indicative chainages 20400 to 21000)	Rail noise is predicted to be a Primary Matter at 4 ground floor residential receivers. Exceedances to ITs apply to the $L_{Aeq,8hour}$ and are predicted be up to 4 dB(A). Exceedances to an IT are predicted at 3 first floor residential receivers.
Properties in the vicinity of Parer Rd, Airport West (indicative chainages 20800 to 21500)	Rail noise is predicted to be a Primary Matter at 22 ground floor residential receivers. Exceedances to the ITs apply to the $L_{Aeq,8hour}$ and are predicted to be 1 dB(A).

7.3.2.2 Sunshine Section

Areas where noise has been predicted to be a Primary Matter in the Sunshine Section are discussed in Table 7.3.

Table 7.3 Areas where noise is a Primary Matter in Sunshine Section

Location where noise is a Primary Matter	Comments
Station Street / Drayton Place, Sunshine (indicative chainages 11750 to ch11800)	Rail noise is predicted to be Primary Matter at two ground floor noise sensitive receivers on Drayton Street. Exceedances to the ITs apply to the $L_{Aeq,16hour}$ (day period average) and are predicted to be 1 dB(A).

7.4 Mitigation

Principles-based Noise Mitigation Workshops have been undertaken and noise mitigation strategies agreed for the project. Details of these are discussed in Section 7.4.1 and 7.4.2 for the Corridor and Sunshine sections respectively. The mitigation agreed for the project is shown on the figures in Appendix B.

7.4.1 Corridor Section

The noise mitigation strategy to be proposed as part of the Project scope for the Corridor Section is provided in Table 7.4. This includes noise barriers up to a height of 3.5 m above ground level (reflective and sound absorbing), viaduct parapets (reflective and sound absorbing) and acoustic tiles between the rail tracks. Overshadowing due to noise barriers is to be addressed by using transparent barrier materials.

Table 7.4 Noise Mitigation Strategy for the Corridor Section

Indicative Chainages	Noise barrier location	Noise barrier height above ground unless otherwise stated (metres)	Comments / additional mitigation	Effectiveness of mitigation at noise sensitive receivers where rail noise is predicted to be a Primary Matter[Note1, Note 2]
Corridor Section				

Indicative Chainages	Noise barrier location	Noise barrier height above ground unless otherwise stated (metres)	Comments / additional mitigation	Effectiveness of mitigation at noise sensitive receivers where rail noise is predicted to be a Primary Matter[Note1, Note 2]
14670 to 15430	Noise barriers on the western side of the track in the rail reserve in proximity to the MAR track.	2.5	Noise barriers are to be sound absorbing on the rail side. Barrier extends between Corridor and Sunshine sections.	The predicted noise levels with mitigation are the same or lower than the Base Case at most noise sensitive receivers. At noise sensitive receivers where the absolute noise level (of the IT) is exceeded and an increase in noise level is predicted, the increase in noise level is 1 dB(A). Noise mitigation is predicted to reduce the rail noise levels by up to 8 dB(A).
14670 to 15200	Noise barriers on the eastern side of the track in the rai reserve along the VicTrack boundary.	2.5	Noise barriers are to be sound absorbing on the rail side.	The predicted noise levels with mitigation are the same or lower than for the Base Case at most noise sensitive receivers. At noise sensitive receivers where the absolute level (of the IT) is exceeded and an increase in noise level is predicted, the increase in noise level is 1 dB(A). Noise mitigation is predicted to reduce the rail noise levels by up to 8 dB(A).
17330 to 17890 (Maribyrnong River Bridge)	Parapet noise barriers on both sides of bridge.	1.4 (above top of rail)	Noise barriers are to be sound absorbing on the rail side. Resilient rail fixings (22.5 kN/mm) with fixing spacing of 0.685 m.	Noise levels are predicted to increase with respect to the Base Case at most of the properties where noise was found to be a Primary Matter. Exceedances to the absolute levels (of the IT) of up to 3 dB(A) for the day and night averages have been predicted. Noise mitigation is predicted to reduce the rail noise levels by up to 8 dB(A).
17800 to 18020	Noise barriers on the eastern side of the track on the VicTrack boundary.	3.5	Noise barriers are to be sound absorbing on the rail side.	
18020 to 18720	Noise barriers on the eastern side of the track on the VicTrack boundary.	3.0		The predicted noise levels with mitigation are the same or lower than for the Base Case at most noise sensitive receivers. Where an increase in noise level is predicted, the increase the noise level does not result in a noise level which exceeds the absolute level (of the IT). Noise mitigation is predicted to reduce the rail noise levels by up to 8 dB(A).
18950 to 19880	Noise barriers on the eastern side of the track on the VicTrack boundary.	3.5	Noise barriers are to be sound absorbing on the rail side.	The predicted noise levels with mitigation, during the day period, are the same or lower than for the Base Case at most noise sensitive receivers. During the night period, the predicted increases in noise level do not exceed the absolute level (of the IT). Noise mitigation is predicted to reduce the rail noise levels by up to 12 dB(A).
19860 to 20270	Noise barriers on the eastern side of the track between pipeline and tracks approximately	3.5	Noise barriers are to be sound absorbing on the rail side.	The predicted noise levels with mitigation, during the day period, are the same or lower than for the Base

Indicative Chainages	Noise barrier location	Noise barrier height above ground unless otherwise stated (metres)	Comments / additional mitigation	Effectiveness of mitigation at noise sensitive receivers where rail noise is predicted to be a Primary Matter[Note1, Note 2]
	3.5 m from centreline of fuel pipeline.			Case at most noise sensitive receivers. During the night period predicted increases in noise levels do not exceed the absolute level (of the IT). Noise mitigation is predicted to reduce the rail noise levels by up to 10 dB(A).
20590 to 20750	Noise barriers on the eastern side of the track on the VicTrack boundary.	2.5	-	Exceedances to the absolute threshold of up to 2 dB(A) are predicted at 2 noise sensitive receivers. Increasing the height of the noise barrier in this location was not effective at reducing the rail noise levels at these noise sensitive receivers. Noise mitigation is predicted to reduce the rail noise levels by up to 4 dB(A).
20800 to 22200 (Viaduct over M80)	Parapet noise barriers on both sides of bridge.	1.4 (above top of rail)	Sound absorption between the rail tracks.[Note 5] Resilient rail fixings (22.5 kN/mm) with fixing spacing of 0.685 m.	In most cases the predicted noise levels do not exceed an absolute level of an IT. A few exceedances to the absolute level (of the IT) are predicted and are 1 dB(A). Noise mitigation is predicted to reduce the rail noise levels by up to 1 dB(A).

Note:

1) This commentary applies only to the ground floor $L_{Aeq,day}$ and $L_{Aeq,night}$ in areas where noise mitigation has been provided. The L_{Amax} parameter is not discussed as the IT associated with L_{Amax} was not exceeded at any noise sensitive receivers.

2) The parapets are not included in the discussion of the effectiveness of mitigation. This is because they are part of the base design. The effectiveness of adding sound absorption to the parapets is, however, included.

3) Noise mitigation has not been provided for noise sensitive receivers around McIntyre Road where rail noise was predicted to be a Primary Matter. This is because the exceedances to the ITs were marginal and the area is affected by noise from road traffic.

4) If noise barriers are not effective for upper levels of residential buildings, then offers of Off Reservation Treatment (ORT) will be considered.

5) If sound absorption tiles are not type-approved, then parapets are to be sound absorbing on the rail side of these barriers.

6) Parapets to be a surface mass of minimum of 20 kg/m^2.

7) The noise wall between the Sunshine Section viaduct and Corridor package interface can be continuous or overlap. If a continuous noise wall is used, the noise wall on the transition structure will need to be a minimum height of 2.5 m above the ground level (this means that the overall height of the noise barrier sitting on the transition structure will vary.)

7.4.2 Sunshine Section

The noise mitigation strategy to be proposed as part of the Project scope for the Sunshine Section is provided in Table 7.5.

Table 7.5 Noise Mitigation Strategy for the Sunshine Section

Indicative Chainages	Noise Barrier Location	Noise barrier height above ground height unless otherwise stated (metres)	Comments / additional mitigation	Effectiveness of mitigation at Noise Sensitive Receivers where rail noise was predicted to be a Primary Matter Note 1 Note 2
13000 to 14500	Parapet noise barriers on both sides of bridge	1.4 (above top of rail)	Resilient rail fixings (22.5 kN/mm) with fixing spacing of 0.685 m.	Rail noise was not identified as being a Primary Matter at any noise sensitive receivers in this area.
14500 to 14640	Noise barriers on western side of track on the Sunshine viaduct approach structure	1.4 (above top of rail)	Noise barriers are to be sound absorbing on the rail side. Barrier extends between Corridor and Sunshine sections.	See comments for Corridor Section chainages 14670 to 15430.
14640 to 14670	Noise barriers on the western side of the track in the rail reserve in proximity to the MAR track.	2.5 m	Noise barriers are to be sound absorbing on the rail side. Noise barrier extends between Corridor and Sunshine sections.	

Notes:

1) This commentary applies only to $L_{Aeq,day}$, and $L_{Aeq,night}$ in areas where noise mitigation has been provided. The L_{Amax} parameter is not discussed as the IT associated with L_{Amax} was not exceeded at any noise sensitive receivers.

2) The parapets are not included in the discussion of the effectiveness of mitigation. This is because they are part of the base design. The effectiveness of adding sound absorption to the parapets is, however, included.

3) Noise mitigation has not been provided for two noise sensitive receivers on Drayton Street where rail noise was predicted to be a Primary Matter. This is because predicted exceedances were marginal, applied to the day period, and the noise levels predicted for the Redeveloped Case were of the same order as at neighbouring properties.

4) If noise barriers are not effective for upper levels of residential buildings, then offers of ORT will be considered.

5) Parapets to be a surface mass of minimum of 20 kg/m^2.

6) The noise wall between the Sunshine Section viaduct and Corridor package interface can be continuous or overlap. If a continuous noise wall is used, the noise wall on the transition structure will need to be a minimum height of 2.5 m above the ground level (this means that the overall height of the noise barrier sitting on the transition structure will vary).

8. Impact Assessment - Noise from fixed infrastructure

8.1 Introduction

Fixed infrastructure proposed for the Project includes:

- One traction substation on the McIntyre sidings, Sunshine North (McIntyre site)
- One traction substation at Fullarton Road, Keilor Park (Fullarton site)
- One intake substation at Brimbank Park, Keilor East (Keilor East site).

The substations would operate over 24-hours, 7 days per week and operation would vary with number of trains, train speed, train acceleration and temperature (i.e. ventilation requirements). Ventilation is expected to consist of split units with compressors and condensers. Noise associated with these substations has been assessed.

Modifications to existing substations are proposed in Sunshine and Sunshine West. The proposed modifications are expected to be minor i.e. installation of additional 1500 V DC switchboards and cable reticulation. The proposed changes are not expected increase noise levels and therefore, no assessment has been undertaken. Stabling and / or train maintenance facilities are not proposed.

8.1.1 McIntyre Site Substation

The McIntyre site will have a 4 MW substation in a prefabricated structure in an industrial location on Munro Avenue in Sunshine North. This location is shown in Figure 8.1. The nearest residential locations are approximately 350 m from the substation site and are shown in Figure 8.2.

The subdivision (Solomon Heights) adjacent to the industrial site, where the substation is proposed to be located, is assumed to be commercial / industrial.

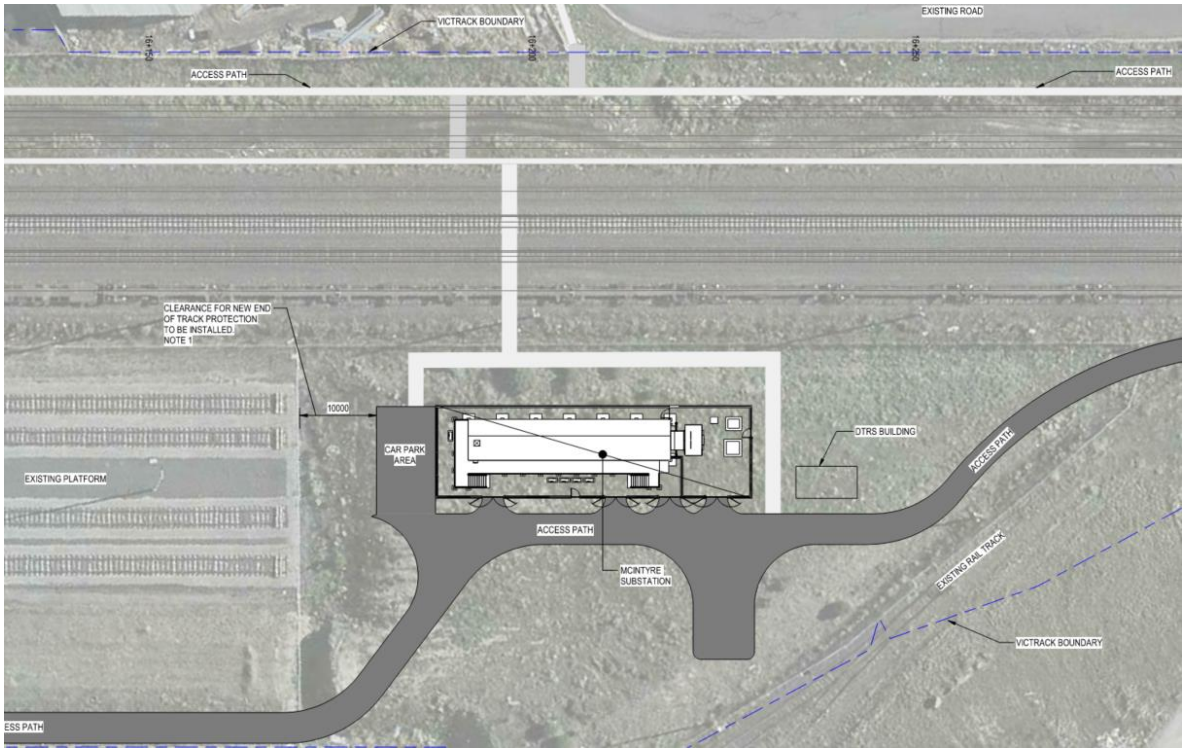

Figure 8.1 McIntyre Substation

Figure 8.2: The McIntyre substation site and the nearest residential locations

8.1.2 Fullarton Site Substation

The Fullarton site will have a 4 MW substation in a prefabricated enclosure.

The substation site is to the east of the Economix site on Terror Street, Keilor Park and to the west of the railway lines and is shown in Figure 8.3.

Nearby residences are located on Roberts Road, Keilor Park at approximately 140 m from the site and further away on the far side of the Western Ring Road at approximately 230 m from the site. The substation site and the nearest residential locations are shown in Figure 8.4.

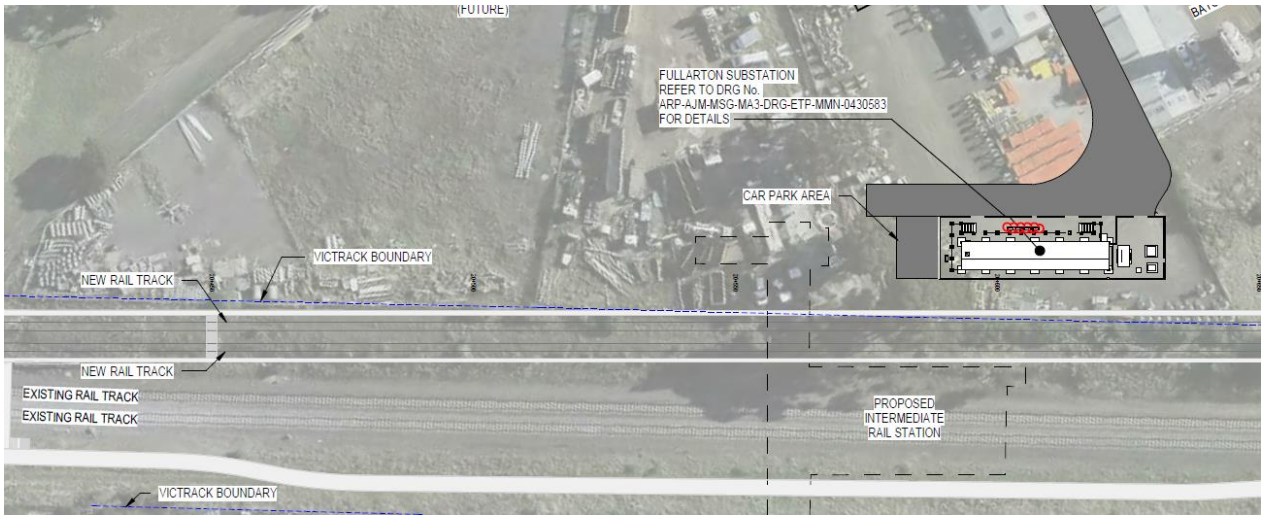

Figure 8.3 Fullarton Substation

Figure 8.4 The Fullarton substation site and the nearest residential locations

8.1.3 Keilor East Site Substation

The Keilor East site will have a 66kV/22kV intake substation in an in-situ building. The site is to the east of the Western Ring Road in Keilor East and is shown in Figure 8.5.

Nearby residences are located on Sterling Dr, Keilor East at approximately 150 m from the site. The substation site and the nearest residential locations are shown in Figure 8.6.

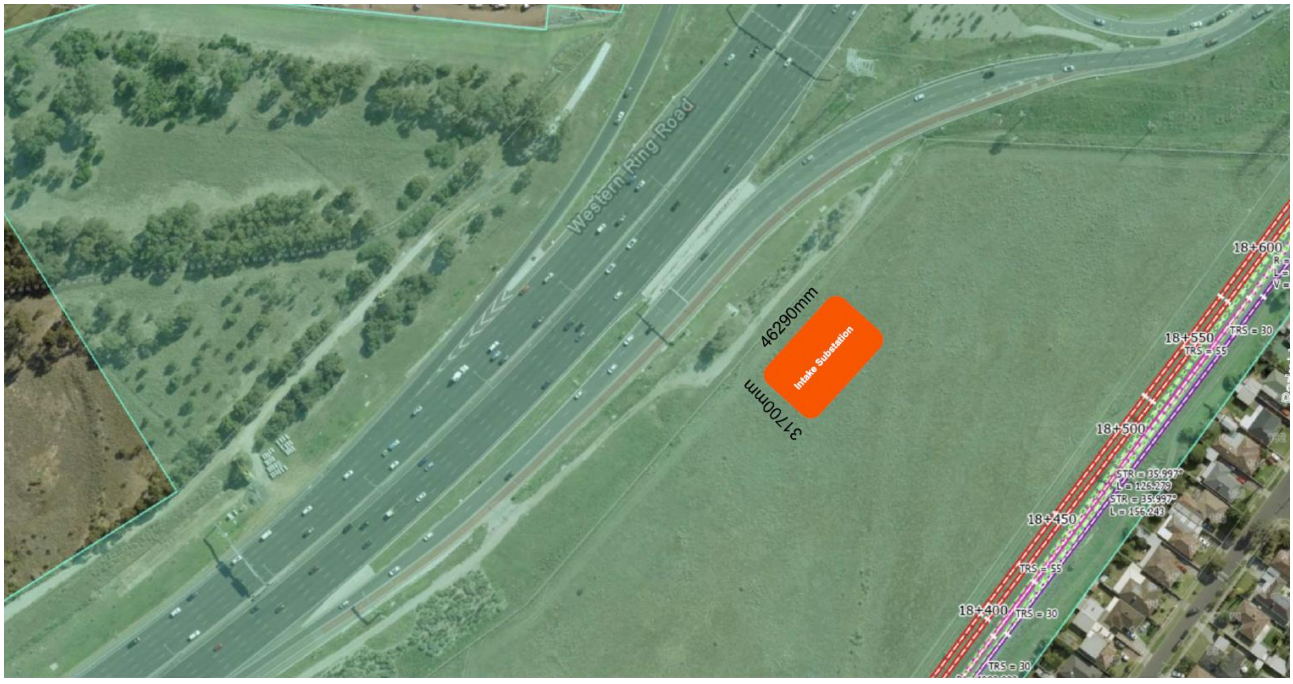

Figure 8.5 Keilor East Intake Substation

Figure 8.6 The Keilor East intake substation site and the nearest residential locations

8.2 Approach

The assessment of substation noise consists of:

1) Check of compliance with the GED by eliminating or reducing the risk of harm to human health and the environment from noise so far as reasonably practicable.
2) Assessment of residual noise - checking whether any remaining noise will be Unreasonable Noise by:
   > Consideration of the volume, intensity, duration and character of the noise, how often it is emitted, and the time, place and other circumstances in which it is emitted
   > Assessment of low frequency content of noise
   > Compliance with the Noise Limits
3) Prevention of or mitigation of Unreasonable Noise (residual noise that does not comply with the Noise Limits or is otherwise unreasonable, further action is required):
   > Implementation of any additional controls required to avoid Unreasonable Noise i.e. additional mitigation measures, noise control treatments or changing works processes and schedules

To undertake this assessment, the following has been required:

- Identification of noise requirements (EP Regulations / Noise Protocol) and determination of project specific Noise Limits
- Identification of typical substation equipment
- Determination of representative source noise levels for the equipment
- Identification of the nearest NSAs
- Prediction of the noise levels at NSAs
- Consideration of additional noise mitigation where required.

8.3 Project Specific Noise Limits

Airborne noise from fixed infrastructure, such as substations, fans, air-conditioners, etc, must comply with the Noise Limits determined in compliance with the EP Regulations. As the project is in metropolitan Melbourne, the Noise Limits have been determined using the Urban Area Method from the Noise Protocol. The project-specific noise limits are provided in Table 8.1

Table 8.1 Noise Requirements in NSAs

Time Period	Background Noise Level Note 1 dBL_{A90}	Zoning Level	Background Noise Level relevance to Zoning Level High / Neutral / Low Note 2	Noise Limit $dBL_{Aeq,30\ minutes}$
NSA: McIntyre Rd, Sunshine North				
Day	To be completed	56	Neutral	56
Evening	To be completed	50	Neutral	50
Night	To be completed	45	Neutral	45
NSA: Roberts Rd, Airport West				
Day	To be completed	56	Neutral	56
Evening	To be completed	50	Neutral	50
Night	To be completed	45	Neutral	45
NSA: Eliza St, Keilor Park				
Day	To be completed	59	Neutral	59
Evening	To be completed	52	Neutral	52
Night	To be completed	47	Neutral	47
NSA: Sterling Dr, Keilor East				
Day	To be completed	53	Neutral	53
Evening	To be completed	47	Neutral	47
Night	To be completed	42	Neutral	42

Notes:

1) Noise measurements have not been conducted (due to the restrictions associated with the COVID 19 pandemic). Consequently, the background noise levels are assumed to be Neutral (see Note 2). The Noise Limits presented may be conservative where an NSA is in the vicinity of a major road.

2) Low, neutral and high background noise levels are defined in the Noise Protocol. Where the background noise level is neutral, the noise limit is based on the planning zones.

3) The zoning maps and the assessment circles are provided in Appendix C. If zoning changes because of this project, then the Noise Limits may change marginally. This is not expected to change the outcome of this assessment.

8.4 Noise Modelling

Airborne noise from the proposed substations have been predicted using ISO 9613-2. This methodology assumes meteorological conditions conducive to the propagation of noise. ISO 9613-2 has been implemented in SoundPLAN version 8.1. The model in SoundPLAN includes:

- Topography
- Building structures
- Noise sources
- Noise sensitive receivers

- Ground absorption
- Air absorption
- Meteorology

The source noise levels for the equipment are shown in Table 8.2. They are based on information provided by AJM-JV.

Table 8.2: Source noise levels – fixed infrastructure

Equipment item	Height above ground (metres)	Linear Sound Power Level (SWL) (dB) Octave Band Frequency (Hz)								Overall SWL dB(A)
		63	125	250	500	1k	2k	4k	8k	
Essential Services Transformer Note 1	1.8	58	61	56	55	50	45	40	33	56
Intake substation	1.5	58	61	56	55	50	45	40	33	56
Rectifier Transformer (4 MW) Note 2	3.1	68	71	66	65	60	55	50	43	66
Condenser Unit / Air Handling Unit	0.8	75	77	73	68	65	63	57	49	71
Ventilation fan	Top of roof	82	76	68	54	46	40	35	37	64
Intake Substation 66/22 kV transformer Note 3	5.7	67	69	64	64	58	53	48	41	64
Equipment item	**Height above ground (metres)**	**Sound Pressure Level (SPL) at 1 m**								**Overall SPL @ 1 m dB(A)**
UPS Note 4 – to be located internally	1 m (internal)	-	-	-	-	-	-	-	-	68

Notes:

1) The Essential Services Transformer is based on information from AJM-JV.

2) The Rectifier transformer is based on manufacturer information from Sécheron and the spectrum based on information from *Engineering Noise Control*[3].

3) The 66/22kV transformer data is obtained from AS2374.6 and spectrum derived from *Engineering Noise Control*[3].

4) UPS noise level is provided by LXRA for the Thycon 200KVa Uninterruptible Power Supply (UPS) – 180314- MB AD-CDP UPS Measurements dated 15 March 2018. Tonal at 630 and 1250 Hz.

This prediction assumes the following:

- All noise emitting equipment is operating concurrently
- The noise emitting equipment is at 100% capacity

8.5 Results

Noise levels due to substation operation have been predicted at NSAs closest to the substations and the results are provided in Table 8.3. Compliance with the Noise Limits at these NSAs is expected to result in compliance at all NSAs in the vicinity of the substations.

[3] Bies D., Hansen C., Howard C., *Engineering Noise Control*. CRC Press – 5th Edition.

Table 8.3 Predicted noise level due to substation operations

Time Period	Noise Limit $dBL_{Aeq, 30\ minutes}$	Predicted Noise Level $dBL_{Aeq, 30\ minutes}$	Character Adjustments Note 1,2 (tonality, impact…)	Effective Noise Level $dBL_{Aeq, 30\ minutes}$	Compliance (Y/N)
Residential locations in the vicinity of McIntyre Substation (based on closest property on McIntyre Rd, Sunshine North)					
Day	56	12	+5	17	Y
Evening	50	12	+5	17	Y
Night	45	12	+5	17	Y
Residential locations on eastern side of Fullarton Substation (based on closest property on Roberts Rd, Airport West)					
Day	56	23	+5	28	Y
Evening	50	23	+5	28	Y
Night	45	23	+5	28	Y
Residential locations on far side of Western Ring Road in the vicinity of Fullarton Substation (based on closest property on Eliza St, Keilor Park)					
Day	59	20	+5	25	Y
Evening	52	20	+5	25	Y
Night	47	20	+5	25	Y
Residential locations on eastern side of Keilor Park Intake Substation (based on closest property on Sterling Dr, Keilor East)					
Day	53	24	+5	29	Y
Evening	47	24	+5	29	Y
Night	42	24	+5	29	Y

Notes:

1) Significant tonality has been assumed, which as per the Noise Protocol, has an adjustment of +5 dB(A). This is potentially a conservative approach, as tonality may not be present.

2) Other adjustments (impulsive, duration, intermittency, reflection, indoor) are not considered to be applicable.

The predicted noise levels are more than 10 dB(A) below the Noise Limits. Consequently, substation noise is not contributing to noise levels that would lead to an exceedance of the Noise Limits from cumulative noise.

8.6 Discussion / Mitigation

To show that the GED is satisfied the project must minimise risk of harm to human health so far as reasonably practicable. EPA Publication 1856 provides measures to be considered when assessing proportionate controls to mitigate or minimise the risk of harm to human health. These measures are addressed in Table 8.4, Table 8.6 and Table 8.8.

To show that the proposed developments comply with the EPA Environment Management Framework the items in Table 8.5, Table 8.7 and Table 8.9 have been considered.

8.6.1 McIntyre Site Substation

Table 8.4: Assessment of reasonably practicable approach to risk of harm to human health – McIntyre Substation

Consideration	Comment
1. Eliminate risk	The risk of harm to human health from substation noise is low because the houses are at least 350 m away and are shielded from the noise source by factories.
2. Likelihood of the risk: how often harm would occur	Harm to human health is not expected to occur even though the substation would operate over 24 hours because the predicted noise levels are very low.

Consideration	Comment
3. Degree of harm (consequence)	Consequences from harm to human health is not expected. This is because the predicted noise levels are very low and are expected to be lower than the background noise level.
4. State of knowledge: awareness of the risks the activities pose	The type of equipment to be used is known, as are typical noise levels associated with the equipment. The location of the equipment and the NSAs are also known.
5. Availability and suitability of controls	As the noise levels predicted are not expected to be audible, additional controls are not expected to be required.
6. Cost and effectiveness of controls	Not applicable.
7. Other	The project EMF will have specific requirements for a Project Contractor to comply with the Noise Limits and the GED (including with respect to low frequency noise).

Table 8.5: Compliance with the *EPA Environmental Management Framework* – McIntyre Substation

Consideration	Comment
1. Compliance with the GED i.e. eliminated or reduced the risk of harm to human health and the environment from noise so far as reasonably practicable	See Table 8.4.
2. Assessment of residual noise: • Noise is to comply with the Noise Limits • Consideration of the volume, intensity, duration and character of the noise, how often it is emitted, and the time, place and other circumstances in which it is emitted • Assessing low frequency content of noise	The predicted noise levels comply with the Noise Limits. Tonality has been taken into consideration, although it is not expected to be audible. Volume and intensity: noise is not expected to be audible. Duration and time: the substation will operate 24 hours. Character of the noise: tonality has been taken into consideration even though it is not expected to be audible at the low noise levels predicted. Location: the substation is a minimum of 350 m from the nearest NSA. The predicted noise levels are low and noise from the substation is not expected to be audible. While low frequency noise has not been specifically assessed it is not expected to be audible at the NSAs.
3. Prevent or mitigate Unreasonable Noise	Noise is not considered to be unreasonable based on the information in this table. Hence, additional mitigation measures, noise control treatments or change to works processes or schedules are not expected to be required.
4. Other	This assessment is based up on the reference design and the Project Contractor has specific requirements in the project EMF to manage noise to avoid harm to Human Health.

8.6.2 Fullarton Site Substation

Table 8.6: Assessment of reasonably practicable approach to risk of harm to human health – Fullarton Substation

Consideration	Comment
1. Eliminate risk	The risk of harm to human health from noise is low because the houses are at least 140 m away and are partially shielded from the substation by existing industrial buildings.
2. Likelihood of the risk: how often harm would occur	Harm to human health is not expected to occur even though the substation would operate over 24 hours because the predicted noise levels are low.

Consideration	Comment
3. Degree of harm (consequence)	Consequences from harm to human health is not expected. This is because the predicted noise levels are low and are expected be lower than the ambient (and potentially the background) noise level.
4. State of knowledge: awareness of the risks the activities pose	The type of equipment to be used is known, as are typical noise levels associated with the equipment. The location of the equipment and the NSAs are also known.
5. Availability and suitability of controls	As the noise levels predicted are not expected to be audible, additional controls are not expected to be required.
6. Cost and effectiveness of controls	Not applicable.
7. Other	The project EMF will have specific requirements for a Project Contractor to comply with the Noise Limits and the GED (including with respect to low frequency noise).

Table 8.7: Compliance with the *EPA Environmental Management* Framework – Fullarton Substation

Consideration	***Comment***
1. Compliance with the GED i.e. eliminated or reduced the risk of harm to human health and the environment from noise so far as reasonably practicable	See Table 8.6.
2. Assessment of Residual noise: • Noise is to comply with the Noise Limits • Consideration of the volume, intensity, duration and character of the noise, how often it is emitted, and the time, place and other circumstances in which it is emitted • Assessing low frequency content of noise	The predicted noise levels comply with the Noise Limits. Tonality has been taken into consideration. Volume and intensity: noise is not expected to be audible. Duration and time: the substation will operate 24 hours. Character of the noise: tonality has been taken into consideration. Location: the substation is a minimum of 140 m from the nearest NSA. The predicted noise levels are low. Noise from the substation is not expected to be audible.
3. Prevent or mitigate Unreasonable Noise	Noise is not considered to be unreasonable based on the information in this table. Hence, additional mitigation measures, noise control treatments or change to works processes or schedules are not expected to be required.
4. Other	This assessment is based up on the reference design and the Project Contractor has specific requirements in the EMF to manage noise to avoid harm to Human Health.

8.6.3 Keilor East Site Substation

Table 8.8: Assessment of reasonably practicable approach to risk of harm to human health – Keilor East Site Substation

Consideration	Comment
1. Eliminate risk	The risk of harm to human health from noise is low because the houses are at least 150 m away.
2. Likelihood of the risk: how often harm would occur	Harm to human health is not expected to occur even though the substation would operate over 24 hours.
3. Degree of harm (consequence)	Consequences from harm to human health is not expected. This is because the predicted noise levels are low and are expected to be less than the ambient (and potentially the background) noise level.

Consideration	Comment
4. State of knowledge: awareness of the risks the activities pose	The type of equipment to be used is known, as are typical noise levels associated with the equipment. The location of the equipment and the NSAs are also known.
5. Availability and suitability of controls	As the noise levels predicted are not expected to be audible, additional controls are not expected to be required.
6. Cost and effectiveness of controls	Not applicable.
7. Other	The project EMF will have specific requirements for a Project Contractor to comply with the Noise Limits and the GED (including with respect to low frequency noise).

Table 8.9: Compliance with the *EPA Environmental Management Framework* – Keilor East Site Substation

Consideration	Comment
1. Compliance with the GED i.e. eliminated or reduced the risk of harm to human health and the environment from noise so far as reasonably practicable	See Table 8.8.
2. Assessment of Residual noise: • Noise is to comply with the Noise Limits • Consideration of the volume, intensity, duration and character of the noise, how often it is emitted, and the time, place and other circumstances in which it is emitted • Assessing low frequency content of noise	The predicted noise levels comply with the Noise Limits. The risk of tonality has been taken into consideration. Volume and intensity: noise is not expected to be audible. Duration and time: the substation will operate 24 hours. Character of the noise: tonality has been taken into consideration. Location: the substation is a minimum of 150 m from NSAs. The predicted substation noise levels are low and are not expected to be audible.
3. Prevent or mitigate Unreasonable Noise	Noise is not considered to be unreasonable based on the information in this table. Hence, additional mitigation measures, noise control treatments or change to works processes or schedules are not expected to be required.
4. Other	This assessment is based up on the reference design and the Project Contractor has specific requirements in the project EMF to manage noise to avoid harm to Human Health.

Additional noise mitigation is not proposed for the substations because the predicted noise levels are low i.e. below the Base Noise Limits. Based on the information provided above the GED is predicted to be met.

If the source noise levels of equipment are higher than provided in Table 8.2, then further assessment may be required. Should exceedances to the Noise Limits be predicted, compliance is expected to be achieved with the implementation of standard mitigation measures.

9. Conclusion

The Environment Management Framework (EMF) will include requirements for management of construction and operational noise.

Construction noise

Construction activities for both Corridor and Sunshine Sections of MAR are planned to start in 2022 and will be completed by 2027. Construction noise has the potential to adversely impact on noise sensitive receivers and the duration of impact on individual locations is expected to vary considerably across the project.

Where possible construction works are to be conducted during Normal Working Hours (NWH), however, significant work is expected to be undertaken outside of NWH to avoid impacts on the road and rail networks.

The construction works are have the potential to be intrusive at times, particularly for works undertaken during the night period. Where possible, noisier works should be undertaken at times when they are less likely to impact on sleep. Where noise would potentially have an unreasonable impact on sleep and cannot be adequately controlled with mitigation, Alternative Accommodation may need to be offered.

The impacts of noise would need to be carefully mitigated and managed by the Project Contractor using a comprehensive Construction Noise and Vibration Management Plan (CNVMP).

Operational rail noise

In areas where track-works are proposed rail noise has been predicted at noise sensitive receivers. Noise mitigation strategies have been developed, in Noise Mitigation Workshops, for areas where noise was found to be a Primary Matter in accordance with the Passenger Rail Infrastructure Noise Policy (PRINP).

The specific noise mitigation agreed to be proposed as part of the Project scope has been based upon the PRINP principles taking account of the specific local circumstances and consists of mitigation considered to be practicable, reasonable and cost effective.

The noise mitigation strategy includes noise barriers up to a height of 3.5 m above ground level (reflective and sound absorbing), viaduct parapets (reflective and sound absorbing) and acoustic tiles between the rail tracks. Overshadowing due to noise barriers is to be addressed by using transparent barrier materials. Off Reservation Treatment will be considered in locations where noise barriers are not effective at upper levels of residential buildings.

The noise mitigation proposed is predicted to reduce rail noise levels by up to 12 dB(A) with respect to the Base Case (1-day prior to project opening, assuming the project did not proceed) at noise sensitive receivers where noise is a Primary Matter. The rail noise levels at many noise sensitive receivers in areas with mitigation, are predicted to be lower than the noise levels predicted for the Base Case.

Rail noise has also been assessed within the extent of the project area where no track-works are proposed. In all cases the predicted change in noise level was less than 3 dB(A). Consequently, rail noise is a Secondary Matter (no exceedance to a PRINP Investigation Threshold) in these areas and no further consideration of rail noise is required.

Operational noise due to fixed infrastructure

Fixed infrastructure proposed for the project includes substations at three sites. The substations at the McIntyre sidings in Sunshine North and at Fullarton Road in Keilor Park are in industrial areas and are 350 m and 140 m from the nearest Noise Sensitive Areas (NSAs) respectively. The substation at Brimbank Park in Keilor East is located east of the Western Ring Road at approximately 150 m from the nearest NSA.

Stabling and / or train maintenance facilities are not proposed.

Noise associated with the substations has been assessed with respect to the relevant Noise Limits determined in compliance with the Environment Protection Regulations and the Noise Protocol. The noise levels predicted from operation of the substations easily comply with the Noise Limits in all NSAs. Noise from

the substations is not expected to cause harm to human health and is expected to comply with the GED. Consequently, no additional mitigation has been proposed.

If source noise levels of equipment are higher than used in this assessment, then further consideration may be required. Should exceedances to the noise requirements be predicted, compliance with the requirements is expected to be achieved with the implementation of standard mitigation measures.