Regional Rail Revival
North-East & Shepparton

PREPARED FOR RAIL PROJECTS VICTORIA

NES-AJM-NES-AWD-REP-XAV-NAP-0000260
SHEPPARTON LINE UPGRADE
OPERATIONAL RAIL NOISE

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Aurecon, Jacobs, Mott MacDonald

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222 Exhibition Street
Melbourne VIC 3000

PO Box 23061 Docklands VIC 8012 Australia

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Author signature		**Approver signature**	
Name	David Larner	**Name**	Craig McKiernan

Contents

Appendices

Glossary and Abbreviations

The meanings of the terms used in this report are set out below.

<table>
<tr><th>TERM</th><th>MEANING</th></tr>
<tr><td>dB</td><td>Sound pressure levels are expressed in decibels as a ratio between the measured sound pressure level and the reference pressure. The reference pressure is $2x10^{-6}$ Pascal (Newtons per square meter). Some typical noise levels are presented below:
<table>
<tr><th>Sound Pressure Level, dB(A)</th><th>Example</th></tr>
<tr><td>130</td><td>Threshold of pain</td></tr>
<tr><td>120</td><td>Jet aircraft take-off at 100 m</td></tr>
<tr><td>110</td><td>Power tool at 1 m</td></tr>
<tr><td>100</td><td>Nightclub</td></tr>
<tr><td>90</td><td>Heavy trucks at 5 m</td></tr>
<tr><td>80</td><td>Kerbside of busy street</td></tr>
<tr><td>70</td><td>Loud radio (in typical domestic room)</td></tr>
<tr><td>60</td><td>Office</td></tr>
<tr><td>50</td><td>Domestic fan heater at 1m</td></tr>
<tr><td>40</td><td>Quiet, night-time urban area</td></tr>
<tr><td>30</td><td>Quiet whispering</td></tr>
<tr><td>20</td><td>Rural environment on still night</td></tr>
<tr><td>10</td><td>Sound insulated test chamber</td></tr>
<tr><td>0</td><td>Threshold of hearing</td></tr>
</table></td></tr>
<tr><td>dB(A)</td><td>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 it is exposed to normal levels and correlates well with the subjective perception of a number of different types of sounds.

An increase or decrease in sound level of approximately 10 dB corresponds respectively to a subjective doubling or halving in loudness. A change in sound level of 3dB is considered to be just noticeable.</td></tr>
</table>

TERM	MEANING
Frequency	The rate of repetition of a sound wave. The unit of frequency is the Hertz (Hz), which is defined as one cycle per second. Human hearing ranges approximately from 20 Hz to 20,000 Hz. For design purposes, the octave bands between 63 Hz to 8 kHz are generally used. The most commonly used frequency bands are octave bands. For more detailed analysis each octave band may be split into three one-third octave bands or in some cases, narrow frequency bands.
L_{Aeq}	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 given time-varying A-weighted sound pressure level when determined over the same measurement time interval.
$L_{AMax,}$	The maximum A-weighted sound pressure level. 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.
PRINP	Victorian *Passenger Rail Infrastructure Noise Policy*, April 2013
PSA	Planning Scheme Amendment
SEL	The sound exposure level is a measure of the total acoustic energy of an acoustic event presented as the same amount of energy over a period of one second.
TEL	Transit Exposure Level. A-weighted sound level of a train pass-by, measured for a time interval and normalised to the pass-by time.
Sound Power Level	The Sound Power Level of a source is a measure of the total acoustic power radiated by a source. It is a characteristic of the sound source which is not affected by the environment within which the source is located.

Executive Summary

The Shepparton Line Upgrade Stage 2 (the Project) includes corridor works such as level crossing upgrades, platform extensions, a crossing loop extension at Murchison East and stabling at Shepparton. The Project areas are provided in the document *NES – Environmental Specialist Scope of Works*[1].

An assessment of the operational rail noise impact for the Project corridor works (excluding stabling) has been undertaken in accordance with the *Passenger Rail Infrastructure Noise Policy* (PRINP). PRINP assessment is triggered as a planning scheme amendment (PSA) is required for the corridor works under the *Planning and Environment Act 1987*. It is anticipated that a separate PSA will be sought for the development of new stabling facilities on the Shepparton line. Therefore, this report does not include a noise assessment for the stabling facilities.

Predicted outcomes of the Project include:

- Average rail noise levels are typically lower because the N-Class locomotive services are to be replaced by quieter VLocity trains
- Maximum rail noise levels are typically lower because N-Class locomotive services are to be replaced by quieter VLocity trains, and the maximum noise level is controlled by the slower freight locomotives

No exceedances to the PRINP Investigation Thresholds were predicted for the Project corridor works. Consequently, noise is considered a secondary matter for the PSA and no further action needs to be considered.

[1] Regional Rail Revival North-East and Shepparton *NES – Environmental Specialist Scope of Works*. Prepared by Aurecon Jacobs Mott MacDonald Joint Venture. Doc. No. NES-AJM-NES-AWD-SOW-XLP-NAP-0000139. Rev F, dated 24 June 2019.

1 Introduction

The Aurecon Jacobs Mott MacDonald Joint Venture (AJM-JV) has been engaged by Rail Projects Victoria (RPV) to undertake an operational rail noise assessment pursuant to PRINP requirements for the Project.

1.1 Project Description

The Regional Rail Revival (RRR) program is a joint initiative of the Federal and Victorian State governments to improve the rail public transport services and amenities for regional communities across every rail corridor in the state. The upgrades are proposed to improve rail-based public transport services across the Victorian regional rail network. As part of the RRR program, the Project has been developed to address capacity constraints on the Shepparton line. This package is planned to deliver a more reliable train service, enabling VLocity trains to run to Shepparton. The Project is planned to:

- Improve both the amenity and reliability of the Shepparton line
- Enable VLocity trains to run to and from Shepparton
- Improve safety along the Shepparton line by upgrading 88 level crossings between Donnybrook and Shepparton.

The scope of the Project consists of:

- Corridor works between Donnybrook and Shepparton:
  - » Platform extensions and minor station upgrades at Nagambie, Murchison East and Mooroopna.
  - » Level crossing upgrades (upgrades to up to 59 level crossings).
  - » Crossing loop extension at Murchison East.
- New stabling facilities (options are under consideration by RPV). Noise impacts associated with new stabling facilities are not being considered in this assessment. These impacts will be investigated under a separate impact assessment.

The PSA Project Land for the corridor works between Donnybrook and Shepparton is shown at Appendix A of this report.

1.2 Purpose of Assessment

An assessment of the operational rail noise impact of the Shepparton Line Upgrade corridor works has been undertaken in accordance with the PRINP (refer to Section 2.1). As a PSA is required for the corridor works, the PRINP is the appropriate guiding policy for assessing operational rail noise of the proposed works and addressing any exceedances identified.

Assessment of noise from the stabling facility is not within the scope of works for this report, as a separate PSA will be sought for the stabling facility. Potential noise impacts associated with the stabling facility will therefore be investigated further under a separate impact assessment during preparation of this PSA.

2 Regulatory Context

2.1 Passenger Rail Infrastructure Noise Policy (PRINP)

Operational rail noise associated with the Project has been assessed in compliance with the PRINP. The PRINP is a state government policy that is triggered when a statutory approval is required (most notably, a PSA) for a rail project. As a PSA is required for the Project, the PRINP is the appropriate guiding policy for operational rail noise for the Project.

The PRINP provides Investigation Thresholds to guide transport bodies when assessing the impacts of rail noise on nearby communities. They are not a limit on allowable noise emissions but if exceeded, operational rail noise is considered a 'primary matter'. When operational rail noise is a 'primary matter', consideration of options for avoiding, minimising and mitigating rail noise is required. If an assessment shows the Investigation Thresholds are not exceeded, noise impacts should be considered a 'secondary matter' and no further action is needed pursuant to PRINP.

The Investigation Thresholds for 'redevelopment of existing passenger rail infrastructure' are applicable for the Project and are provided in Table 2-1. The Investigation Thresholds consist of both an 'absolute' noise level and 'relative' level, both of which must be exceeded for the Investigation Thresholds to be exceeded.

TABLE 2-1: EXTERNAL INVESTIGATION THRESHOLDS FOR REDEVELOPMENT OF EXISTING PASSENGER RAIL INFRASTRUCTURE (AS DEFINED IN PRINP)

TIME	TYPE OF RECEIVER	INVESTIGATION THRESHOLDS
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.	65 dBL_{Aeq} and a change in 3 dB(A) or more or 85 dBL_{Amax} and a change in 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.	60 dBL_{Aeq} and a change in 3 dB(A) or more or 85 dBL_{Amax} and a change in 3 dB(A) or more.

Notes:

1. The external location of assessment is at 1 metre from the centre of the window of the most exposed habitable room.

3 Noise Modelling

Noise modelling has been undertaken to predict rail noise levels needed to undertake the PRINP assessment.

3.1 Introduction

3.1.1 BACKGROUND

The impact of airborne train noise due to the Project has been assessed. Airborne noise from operational railway infrastructure is generally due to the following factors:

- Rolling noise from the wheel-rail interface (this includes wheel squeal, flanging). The primary source of rail noise from the wheel-rail interface is due to:
  - » Roughness of the rail and wheel (including wheel flats)
  - » Rail corrugation
  - » Wheel squeal (or track curves)
  - » Track imperfections
  - » Joints, switches and crossings
- Traction systems
- Fans and air-conditioning units
- Exhaust
- Engine and motor noise
- Aerodynamics noise (this would not apply to the Project as it only usually occurs at trains speeds above approximately 250 km/h).

3.1.2 APPROACH

Airborne operational noise is assessed using the following methodologies:

- High-Level Noise Assessment: undertaken in locations where track-works are not proposed as part of the train infrastructure modifications (i.e. level crossings upgraded from passive to active).
- Detailed Noise Assessment: undertaken in locations where track-works are proposed or where the High-Level Noise Assessment has indicated a risk of exceeding the Investigation Thresholds.

Both methods compare the noise levels associated with the Base Case train movements and Future Case train movements. These ‘cases’ are defined as follows:

- Base Case: defined as one day prior to the Project opening, if the Project did not proceed. For this assessment, the Base Case is the existing operational scenario
- Future Case: defined as the N-Class passenger locomotives travelling to Shepparton, being replaced by the newer VLocity trains

Further details for each methodology are provided below.

3.2 Modelling Procedure

3.2.1 METHODOLOGY

3.2.1.1 High-Level Noise Assessment

The High-Level Noise Assessment is a comparison of the source noise levels for the Base Case and Future Case in project locations where track-works do not occur. If the predicted increase in source noise level is less than 3 dB, then the “relative” Investigation Threshold of the PRINP will not be triggered. Noise is then a ‘secondary matter’ for this area of the Project and no further actions considered.

Where the predicted increase in source noise level is 3 dB or greater, a Detailed Noise Assessment has been undertaken.

3.2.1.2 Detailed Noise Assessment

A Detailed Noise Assessment has been undertaken to predict the rail noise impacts for the Project in locations where track-works are proposed near to noise sensitive receivers and also in areas where the High-Level Noise Assessment has predicted a source noise level increase of 3 dB or more.

The Detailed Noise Assessment has involved:

1. Creation of an acoustic model of the existing operational railway in areas where track works are proposed
2. Updating the acoustic model to include the infrastructure associated with the proposed track works
3. Prediction of noise levels at sensitive receivers for Base Case and Future Case

3.2.2 PREDICTION METHODOLOGY

Airborne railway noise levels have been assessed using the methodology from Nord 2000 - *New Nordic Prediction Method for Rail and Traffic Noise* (NORD2000). This methodology allows the prediction of daytime ($L_{Aeq,16hour}$), night time ($L_{Aeq,8hour}$) and L_{Amax} noise levels. NORD2000 has been implemented in SoundPLAN version 8.0.

The High-Level Noise Assessments require the following inputs:

- One-third octave band source noise levels
- Operational timetables
- Train lengths / speed

The Detailed Noise Assessments also require the following inputs:

- Air absorption
- Atmospheric refraction
- Split height source modelling
- Ground effects
- Meteorological effects

- Screening
- Reflection

3.2.3 NOISE MONITORING

Noise monitoring has not been conducted for this assessment. The train source noise levels used in this assessment are consistent with those used for other RRR projects.

3.2.4 SOURCE NOISE LEVELS

3.2.4.1 Noise Emissions

Rail noise emissions have been based on the following:

- Rail noise measurements from multiple projects across Victoria (SEL, L_{Amax})
- The NSW Rail Noise Database Stage III Measurement and Analysis - January 2015 prepared by SLR for the NSW Transport Asset Authority (TfNSW train noise database)
- NORD2000 for the reference source noise levels for trains
- Noise source heights are as defined by default in NORD2000. All noise source heights are above rail height and are:
  - 0.01 m (wheel / rail)
  - 0.35 m (wheel)
  - 0.7 m (engine)
  - 2.5 m (engine – low frequency content)
  - 4.2 m (exhaust)
- A façade reflection of 2.5 dB has been included for predicted noise levels at buildings

TABLE 3-1: NOISE LEVELS FOR TRAINS TRAVELLING AT 80 KM/H

TRAIN SET	$L_{SEL(100M)}$ DB(A)	$L_{MAX(10M)}$ DB(A)
VLocity (DMU)	84	88
Locomotives (Vline/Freight)[2]	88	96
Wagon (Freight/Passenger)[3]	79	-

Notes:

1. Locomotives are 20 m in length
2. Since wagons are always hauled by an accompanying locomotive, the maximum noise level is determined by the locomotive

Source noise measurements have been undertaken for the XPT train which operates within the rail corridor from Melbourne to Mangalore until the North East line diverges to Albury on ARTC tracks.

At a normalized distance of 15 m, the measured Transit Exposure Level (TEL) and L_{Amax} noise levels were consistent with the XPT measurements conducted in the “NSW Rail Noise Database Stage III Measurement and Analysis - January 2015” document. The reference noise levels used for this train are shown in Table 3-2.

TABLE 3-2: REFERENCE NOISE LEVELS FOR XPT (BASED ON NSW RAIL NOISE DATABASE AND AJM MEASUREMENTS)

TRAIN SET	LENGTH (M)	SPEED (KM/H)	$L_{SEL(15M)}$ DB(A)	$L_{MAX(15M)}$ DB(A)
XPT (NSW Fleet)	156	125	95	88

3.2.4.2 Track Joint, Switch and Crossing Noise

Switches and crossings built into rail tracks can result in noise from interaction with the wheel and the rail head joints. Noise from this effect can increase with severity depending on the complexity of the joint.

The following overall noise corrections have been applied to these sections of track:

- 6 dB addition to the source noise levels for level crossings/turnouts (NORD2000)

3.2.4.3 Curve noise

Curve noise is expected in locations with tight radius curves. These sections of track are located in the following locations along the Project:

- Murchison East, north of the station
  - Approximate track radii of 350 m
- Dookie Line, north of Grahamvale Road level crossing, Grahamvale
  - Approximate track radii of 350 m.

The following overall noise corrections have been applied to these sections of track:

- 3 dB addition to the source noise levels for curves with radii of curvature between 300 m and 500 m [3]

3.2.5 TRAIN TIMETABLES

The type and number of rail vehicles assumed to be travelling in the rail corridor are provided in Table 3-3. This information has been supplied by RPV[4].

[3] Schall 03 2006, Richtlinie zur Berechnung der Schallimmissionen von Eisenbahnen und Straßenbahnen (Draft, 21.12.2006)

[4] RPV email, dated 8/01/2019

TABLE 3-3: TRAIN TIMETABLE FOR BASE AND FUTURE CASES

TRAIN TYPE	NUMBER OF TRAINS				OPERATIONAL SPEED (KM/H)	MAXIMUM LENGTH (M)
	BASE CASE		FUTURE CASE			
	DAY PERIOD	NIGHT PERIOD	DAY PERIOD	NIGHT PERIOD		
Donnybrook – Seymour Station						
N-Class	11	0	-	-	115	160
Freight (Shepparton Line)	2	2	2	2	80	1200
Freight (North East Line)	8	3	8	3	80	1800
VLocity	5	1	32	0	130	160
Sprinter	16	3	16	3	115	160
XPT	4	-	10	-	130	180
Seymour Station - Mangalore (split of North East and Shepparton Line)						
N-Class	10	-	-	-	115	160
Freight (Shepparton Line)	2	2	2	2	80	1200
Freight (North East Line)	9	2	9	2	80	1800
XPT	4	-	10	-	130	180
VLocity	-	-	10	-	130	160
Mangalore (split of North East and Shepparton Line) - Avenel						
Freight	9	2	9	2	80	1800

TRAIN TYPE	NUMBER OF TRAINS				OPERATIONAL SPEED (KM/H)	MAXIMUM LENGTH (M)
	BASE CASE		FUTURE CASE			
	DAY PERIOD	NIGHT PERIOD	DAY PERIOD	NIGHT PERIOD		
VLocity	-	-	-	-	130	160
XPT	4	-	10	-	130	180
Mangalore (split of North East and Shepparton Line) – Nagambie						
N-Class	10	-	-	-	115	160
Freight	2	2	2	2	80	1200
VLocity	-	-	10	-	130	160
Nagambie – Murchison East Loop – Mooroopna Loop						
N-Class	9	1	-	-	115	160
Freight	2	2	2	2	80	1200
VLocity	-	-	10	-	130	160
Mooroopna Loop – Mooroopna Siding						
N-Class	9	1	-	-	115	160
Freight	1	1	1	1	80	1200
VLocity	-	-	10	-	130	160
Mooroopna Siding – Shepparton Station						
N-Class	10	-	-	-	115	160
Freight	2	2	2	2	80	1200
VLocity	-	-	10	-	130	160

TRAIN TYPE	NUMBER OF TRAINS				OPERATIONAL SPEED (KM/H)	MAXIMUM LENGTH (M)
	BASE CASE		FUTURE CASE			
	DAY PERIOD	NIGHT PERIOD	DAY PERIOD	NIGHT PERIOD		
Shepparton Station – Tocumwal						
Freight	2	2	2	2	80	1200

Notes:

1. The number of trains is combined for up and down movements
2. All trains are assumed to operate at their maximum length

3.2.6 SPEED RESTRICTIONS

Speed restrictions that are applicable to the Project are defined in Table 3-4.

TABLE 3-4: LOCATIONS OF SPEED RESTRICTIONS

APPROXIMATE LOCATION OF CURVE	SPEED RESTRICTION (KM/HR)
Seymour Railyard (North of Seymour Station)	80
Mangalore split (where North East and Shepparton lines deviate)	95
Murchison East Curve – North of Murchison East Station	50

3.2.7 METEOROLOGY

'Downwind' meteorological conditions have been used when predicting the train noise levels. Other meteorological parameters were:

- Relative Humidity: 70%
- Temperature: 15 degrees Celsius
- Air Pressure: 1013 mbar

3.2.8 LIMITATIONS

The following limitations apply to the assessment:

- Elevation contours (1 to 2 m increment LiDAR) were not available and consequently 10 m increment VICMAP elevation contours were used for modelling. This has resulted in reasonably flat terrain models between the rail and noise sensitive locations. More refined elevation data could affect the predicted noise levels.
- While 3D rail centreline data was available for Murchison East, in other areas of assessment only 2D rail centreline data was available. This 2D rail centreline was fitted to the 3D terrain model. This approach may not be as accurate as use of a 3D rail centreline.

4 Results

4.1 High-Level Noise Assessment

A High-Level Noise Assessment has been conducted for areas identified as having no track works. These locations extend from Donnybrook to the new stabling site in Shepparton (124 km of project chainage).

The predicted change in source noise level between the Future Case and Base Case are presented in Table 4-1.

TABLE 4-1: THE DIFFERENCE IN SOURCE NOISE LEVELS BETWEEN BASE CASE AND FUTURE CASE WHERE NO TRACKWORK IS PROPOSED

RAIL SIGNALLING SECTION	CHANGE IN SOURCE NOISE LEVELS FROM BASE CASE TO FUTURE CASE (+/- DB)	
	DAY PERIOD	NIGHT PERIOD
Donnybrook to Seymour Station		
L_{Aeq}	1	0
L_{Amax}	-5	-5
Seymour Station to Mangalore (split of North East and Shepparton Line)		
This area was deemed inappropriate to model at a high level due to the distance between the three tracks (ARTC / Shepparton / Albury lines), therefore a detailed model was prepared.		
Mangalore (Shepparton Line) to Nagambie		
L_{Aeq}	-2	-2
L_{Amax}	-5	-5
Nagambie to Murchison East Loop to Mooroopna Loop		
L_{Aeq}	-2	-2
L_{Amax}	-5	-5
Mooroopna Loop to Mooroopna Siding		
L_{Aeq}	-2	-3
L_{Amax}	-5	-5
Mooroopna Siding to Shepparton Station		
L_{Aeq}	-2	0
L_{Amax}	-5	-5
Shepparton Station to Tocumwal		
L_{Aeq}	0	0
L_{Amax}	0	0

4.1.1 OUTCOMES OF THE HIGH-LEVEL NOISE ASSESSMENT:

- The average noise levels for the Future Case are generally lower than for the Base Case. This is because the quieter VLocity trains are to replace the N-Class locomotive services.

- The maximum noise levels for the Future Case are generally lower than for the Base Case. This is because the slower freight locomotives are the dominant noise source in the Future Case which is lower when compared to the faster moving N-Class locomotive services in the Base Case.

Therefore:

- Compliance with the PRINP Investigation Thresholds is predicted for the following project area:
  - » Donnybrook to Seymour Station
  - » Mangalore to Tocumwal

A detailed model is not required in these areas, except for Murchison East Loop (as trackworks occur).

4.2 Detailed Noise Assessment

4.2.1 LOCATIONS OF DETAILED ASSESSMENT

Detailed noise modelling has been undertaken in project areas where:

- Trackworks are proposed near noise sensitive receivers; and
- An increase of 3 dB or more has been identified in the High-Level Noise Assessment

Areas assessed are:

- Seymour Station to the Mangalore split (as this area was deemed inappropriate to model at a high level due to the distance between the three tracks (ARTC / Shepparton / Albury lines))
- Murchison East Loop (due to trackworks proposed near noise sensitive receivers)

4.2.2 SEYMOUR STATION TO MANGALORE

186 noise sensitive receivers have been assessed in the areas between Seymour station and the diversion of the North East Line rail services from the Shepparton Line services in Mangalore, as shown in Figure 4-1.

FIGURE 4-1: SEYMOUR STATION (LEFT) TO MANGALORE (RIGHT) ASSESSMENT AREA.

No exceedances to the PRINP Investigation Thresholds were predicted in this project area. Consequently, noise is considered a secondary matter for this area and no further action needs to be considered.

4.2.3 MURCHISON EAST LOOP

At Murchison East, 26 noise sensitive receivers have been assessed, in proximity to the crossing loop area. The extent of assessment is shown in Figure 4-2.

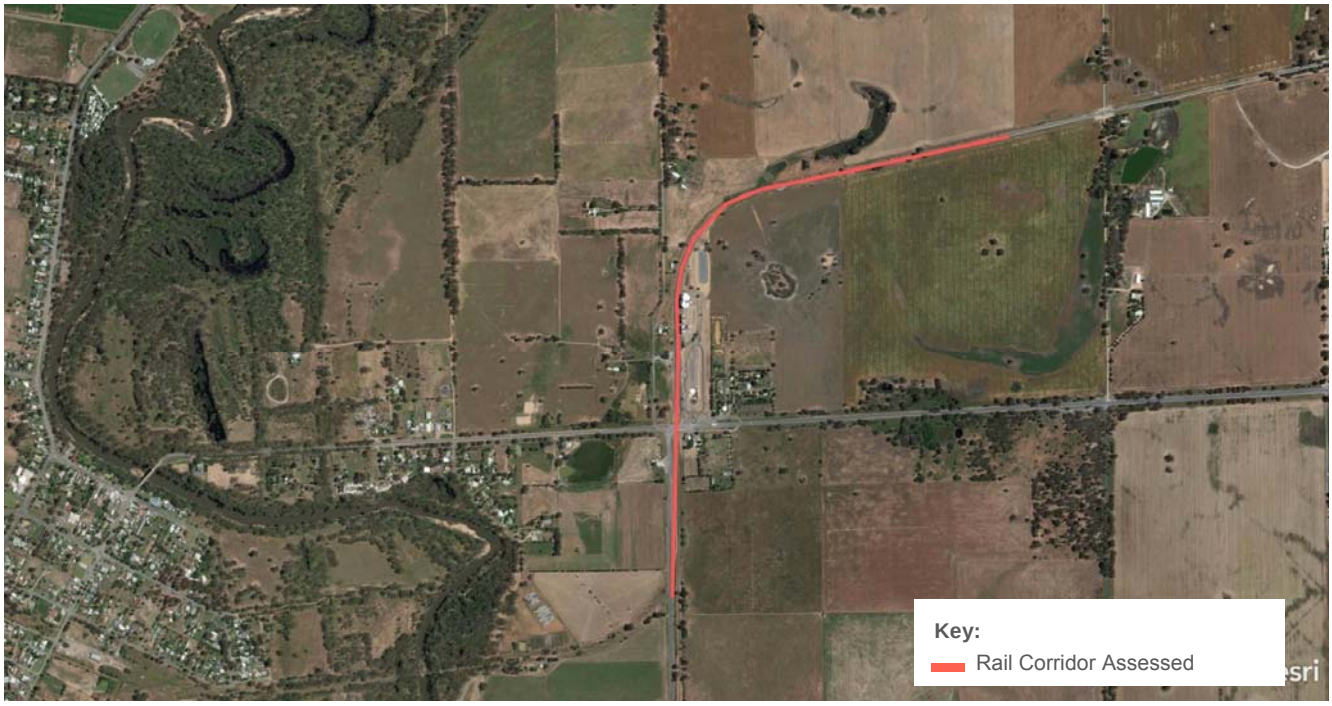

FIGURE 4-2: MURCHISON EAST ASSESSMENT AREA

No exceedances to the PRINP Investigation Thresholds were predicted in this project area. Consequently, noise is considered a secondary matter for this area and no further action needs to be considered.

5 Conclusion

An assessment of the operational rail noise impact of the Shepparton Line Upgrade corridor works has been undertaken in accordance with the PRINP. As a PSA is required for the corridor works, the PRINP is the appropriate guiding policy for assessing operational rail noise of the proposed works and addressing any exceedances identified.

The assessment found no exceedances to the PRINP Investigation Thresholds were predicted as a result of the corridor works. Consequently, noise is considered a secondary matter and no further action needs to be considered pursuant to PRINP.

Appendix A

Project Areas

Appendix A - Project Areas

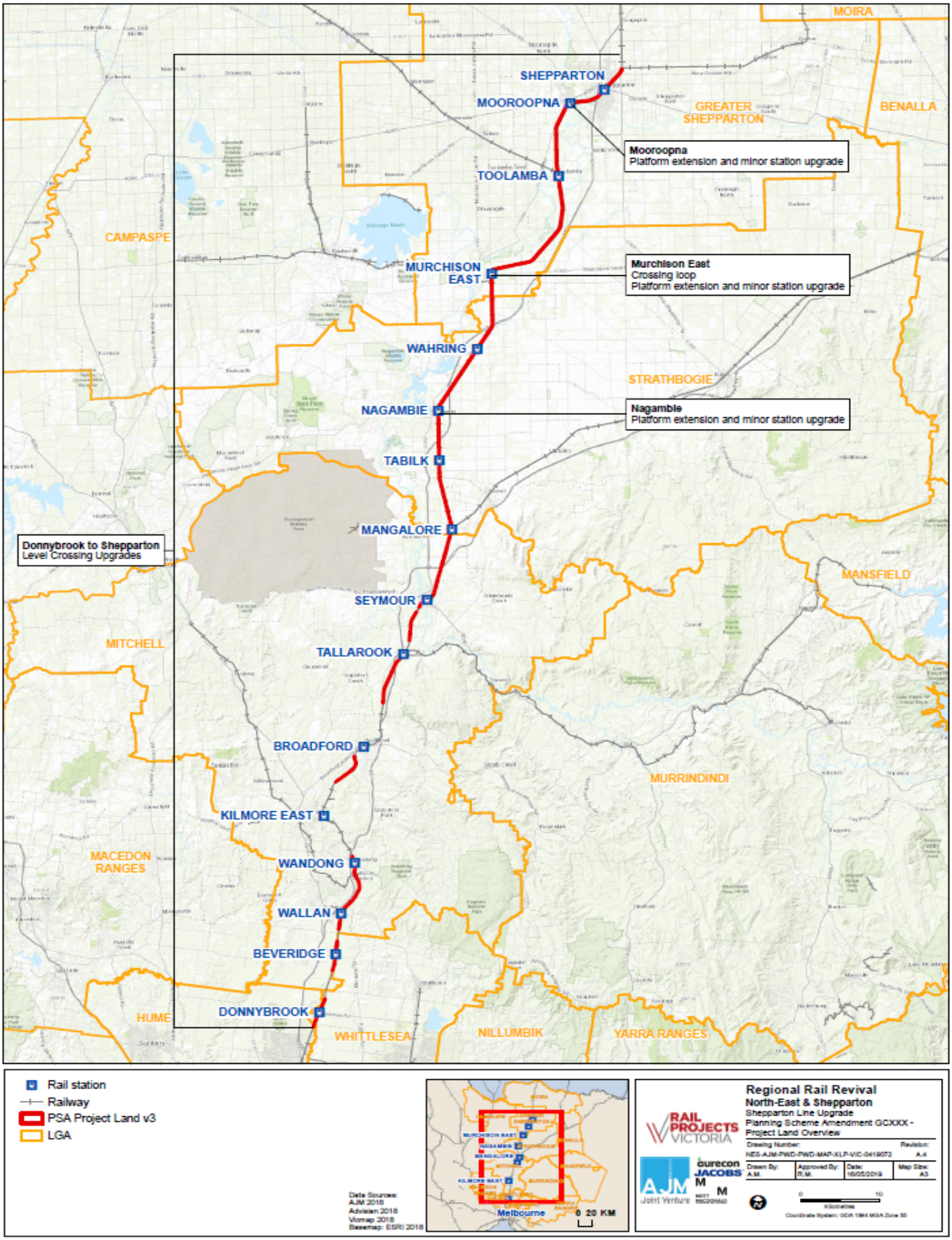

FIGURE A-1: PSA AREAS ALONG THE SHEPPARTON LINE

222 EXHIBITION STREET, MELBOURNE VIC 3000
PO BOX 23061 DOCKLANDS VIC 8012 AUSTRALIA