HERRING STORER ACOUSTICS

PROPOSED
SUBDIVISION PLAN
LOT 1 SIMPER ROAD, LOT 22 ERCEG ROAD AND LOT 12 SHALLCROSS STREET, YANGEBUP

FREIGHT RAIL (SPP 5.4)
NOISE AND VIBRATION
IMPACT ASSESSMENT

OCTOBER 2020

OUR REFERENCE: 26436-2-20247

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ACOUSTIC ASSESSMENT

PROPOSED SUBDIVISION
YANGEBUP

Job No: 20247

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FOR

TERRANOVIS

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CONTENTS

APPENDICIES

EXECUTIVE SUMMARY

Herring Storer Acoustics were commissioned by Terranovis on behalf of the landowners to carry out an acoustical assessment of noise and vibration received for the proposed Subdivision Plan of the development located at Lot 1 Simper Road, Lot 22 Erceg Road and Lot 12 Shallcross Street, Yangebup.

NOISE

Under the Western Australian Planning Commission (WAPC) Planning Policy 5.4 "Road and Rail Noise" (SPP 5.4), the appropriate criteria for assessment for this development are:

EXTERNAL

$L_{Aeq(Day)}$ of 55 dB(A);
$L_{Aeq(Night)}$ of 50 dB(A).

INTERNAL

$L_{Aeq(Day)}$ of 40 dB(A) in living and work areas; and
$L_{Aeq(Night)}$ of 35 dB(A) in bedrooms.

Additional to the above, noise received at an outdoor living area should also be reduced as far as practicable, with an aim of achieving an L_{Aeq} of 50 dB(A) during the night period.

Therefore, to comply with the Policy, the following option has been provided:

- Quiet House Design Package A.

Any lots exceeding the 50 dB(A) night target criteria would require notification on Titles.

VIBRATION

Vibration levels were below the “Target” 1.4x base curve for highest train events analysed.

As the measured vibration levels were conducted at the boundary of the development, or the closest location in regard to the freight line, and all Lots were at a greater distance than the measurement point, the measured vibration levels as per this report would be considered as the highest received within the development. Therefore, no vibration control to the proposed development is recommended and standards construction would be suitable.

1. INTRODUCTION

Herring Storer Acoustics were commissioned by Terranovis on behalf of the landowners to carry out an acoustical assessment of noise and vibration received for the proposed Subdivision Plan of the development located at Lot 1 Simper Road, Lot 22 Erceg Road and Lot 12 Shallcross Street, Yangebup.

The subdivision contains both residential and industrial land use, however this assessment considerers only the noise and vibration impact onto the residential component of the development.

It is noted that freight rail movement on this section of the Cockburn rail line is limited (3 trains passed during the monitoring 10 day period).

As part of the study, the following was carried out:

- Measurement of the existing (2020) freight rail noise levels at the proposed development.
- Measurement of the freight rail vibration levels at the proposed development.
- Determine by noise modelling the noise that would be received at proposed residences within this subdivision from trains travelling on the Cockburn Rial Line for the future (1 per hour).
- Assess the predicted noise levels for compliance with the appropriate criteria.
- Assess the measured vibration levels for compliance with the appropriate criteria.
- Provide detailed information as to noise and vibration control requirements such as quiet house design, setbacks and notification on titles.

2. CRITERIA

2.1 RAIL TRAFFIC NOISE

The Western Australian Planning Commission (WAPC) released on 6th September 2019 State Planning Policy 5.4 *"Road and Rail Noise".* The requirements of State Planning Policy 5.4 are outlined below.

POLICY APPLICATION (Section 4)

When and where it applies (Section 4.1)

SPP 5.4 applies to the preparation and assessment of planning instruments, including region and local planning schemes; planning strategies, structure plans; subdivision and development proposals in Western Australia, where there is proposed:

*a) noise-sensitive land-use within the policy's trigger distance of a transport corridor as specified in **Table 1**;*

*b) New or major upgrades of roads as specified in **Table 1** and maps **(Schedule 1,2 and 3);** or*

*c) New railways or major upgrades of railways as specified in maps (**Schedule 1, 2 and 3);** or any other works that increase capacity for rail vehicle storage or movement and will result in an increased level of noise.*

Policy trigger distances (Section 4.1.2)

***Table 1** identifies the State's transport corridors and the trigger distances to which the policy applies.*

*The designation of land within the trigger distances outlined in **Table 1** should not be interpreted to imply that land is affected by noise and/or that areas outside the trigger distances are un-affected by noise.*

*Where any part of the lot is within the specified trigger distance, an assessment against the policy is required to determine the likely level of transport noise and management/ mitigation required. An initial screening assessment (**guidelines: Table 2: noise exposure forecast**) will determine if the lot is affected and to what extent."*

TABLE 1: TRANSPORT CORRIDOR CLASSIFICATION AND TRIGGER DISTANCES

Transport corridor classification	***Trigger distance***	***Distance measured from***
Roads		
Strategic freight and major traffic routes *Roads as defined by Perth and Peel Planning Frameworks and/or roads with either 500 or more Class 7 to 12 Austroads vehicles per day, and/or 50,000 per day traffic volume*	*300 metres*	*Road carriageway edge*
Other significant freight/traffic routes *These are generally any State administered road and/or local government road identified as being a future State administered road (red road) and other roads that meet the criteria of either >=23,000 daily traffic count (averaged equivalent to 25,000 vehicles passenger car units under region schemes)*	*200 metres*	*Road carriageway edge*
Passenger railways		
	100 metres	*Centreline of the closest track*
Freight railways		
	200 metres	*Centreline of the closest track*

Proponents are advised to consult with the decision making authority as site specific conditions (significant differences in ground levels, extreme noise levels) may influence the noise mitigation measures required, that may extend beyond the trigger distance.

POLICY MEASURES (Section 6)

The policy applies a performance-based approach to the management and mitigation of transport noise. The policy measures and resultant noise mitigation will be influenced by the function of the transport corridor and the type and intensity of the land-use proposed. Where there is risk of future land-use conflict in close proximity to strategic freight routes, a precautionary approach should be applied. Planning should also consider other broader planning policies. This is to ensure a balanced approach takes into consideration reasonable and practical considerations.

Noise Targets (Section 6.1)

***Table 2** sets out noise targets that are to be achieved by proposals under which the policy applies. Where exceeded, an assessment is required to determine the likely level of transport noise and management/mitigation required.*

In the application of the noise targets the objective is to achieve:

- *indoor noise levels as specified in **Table 2** in noise sensitive areas (for example, bedrooms and living rooms of houses, and school classrooms); and*

- *a reasonable degree of acoustic amenity for outdoor living areas on each residential lot. For non-residential noise-sensitive developments, for example schools and child care centres the design of outdoor areas should take into consideration the noise target.*

It is recognised that in some instances, it may not be reasonable and/or practicable to meet the outdoor noise targets. Where transport noise is above the noise targets, measures are expected to be implemented that balance reasonable and practicable considerations with the need to achieve acceptable noise protection outcomes.

TABLE 2: NOISE TARGETS

Proposals	***New/Upgrade***	***Noise Targets***		
		Outdoor		***Indoor***
		Day (L_{Aeq}(Day) dB) (6 am-10 pm)	***Night (L_{Aeq}(Night) dB) (10 pm-6 am)***	***(L_{Aeq} dB)***
Noise-sensitive land-use and/or development	*New noise sensitive land use and/or development within the trigger distance of an existing/proposed transport corridor*	*55*	*50*	*L_{Aeq} (Day) 40(Living and work areas)* *L_{Aeq} (Night) 35 (bedrooms)*
Roads	*New*	*55*	*50*	*N/A*
	Upgrade	*60*	*55*	*N/A*
Railways	*New*	*55*	*50*	*N/A*
	Upgrade	*60*	*55*	*N/A*

Notes:

- *The noise target is to be measured at one metre from the most exposed, habitable façade of the proposed building, which has the greatest exposure to the noise-source. A habitable room has the same meaning as defined in State Planning Policy 3.1 Residential Design Codes.*

- *For all noise-sensitive land-use and/or development, indoor noise targets for other room usages may be reasonably drawn from Table 1 of Australian Standard/New Zealand Standard AS/NZS 2107:2016 Acoustics – Recommended design sound levels and reverberation times for building interiors (as amended) for each relevant time period.*

- *The 5dB difference in the criteria between new and upgrade infrastructure proposals acknowledges the challenges in achieving noise level reduction where existing infrastructure is surrounded by existing noise-sensitive development.*

- *Outdoor targets are to be met at all outdoor areas as far as is reasonable and practical to do so using the various noise mitigation measures outlined in the guidelines. For example, it is likely unreasonable for a transport infrastructure provider to achieve the outdoor targets at more than 1 or 2 floors of an adjacent development with direct line of sight to the traffic.*

Noise Exposure Forecast (Section 6.2)

When it is determined that SPP 5.4 applies to a planning proposal as outlined in Section 4, proponents and/or decision makers are required to undertake a preliminary assessment using ***Table 2****: noise exposure forecast in the guidelines. This will provide an estimate of the potential noise impacts on noise-sensitive land-use and/ or development within the trigger distance of a specified transport corridor. The outcomes of the initial assessment will determine whether:*

- *no further measures is required;*
- *noise-sensitive land-use and/or development is acceptable subject to deemed-to- comply mitigation measures; or*
- *noise-sensitive land-use and/or development is not recommended. Any noise-sensitive land-use and/ or development is subject to mitigation measures outlined in a noise management plan."*

2.2 VIBRATION CRITERIA

From previous projects we understand that AS 2670.2-1990 *"Evaluation of human exposure to whole-body vibration; Part 2: Continuous and shock-induced vibration in buildings (1 to 80 Hz)"* has been used to assess compliance with ground vibration. However, this standard has been revised and redesignated as AS ISO 2631.2-2014 *Mechanical vibration and shock – Evaluation of human exposure to whole-body vibration. Part : Vibration in buildings (1 Hz to 80 Hz).*

As AS ISO 2631.2014 provides guidance to vibration source types and measurement methodology, it does not provide an acceptable level for vibration. Therefore, guidance from AS2670.2-1990 is also used as a reference when considering an acceptable level of vibration.

Table 2 in Appendix A of the AS2670.2-1990 lists acceptable criteria. In this situation the passing trains would be considered as transient vibration. As such the recommended range of multiplying factors range from 1.4 to 4.0 times the base curve is provided. We believe that from previous studies the 2.0 times the base curve should be used as the acceptable criteria. However, we understand that the Department of Environmental Regulation has expressed a preference that the 1.4 times the base curve be used as the criteria. However, as per AS2631.2-2014 the transient nature and duration of the vibration also requires consideration.

AS 2670.2-1990 states that:

The vibration evaluations shall always include measurements of the weighted root-mean-square (r.m.s.) acceleration as defined as

$$rms = \sqrt{\left[\frac{1}{T}\int_0^T {a_w}^2(t)\,dt\right]}$$

Where

$a_w(t)$ *is the weighted acceleration as a function of time in metres per second squared;*

T *is the duration of the measurements in seconds.*

Using the 'running rms' method *AS2670.1-2001 Section 6.3.1* which is entitled *"Additional evaluation of vibration when the basic evaluation method is not sufficient".* Indicates that the basic evaluation method would be sufficient for most cases, except under specified circumstances. Further to this, the *Section 6.2 "Applicability of the basic evaluation method"* states *"For vibration with crest factors below or equal to 9, the basic evaluation method is normally sufficient."*

AS2670.2-1990 3.3 "Characterization of transient, continuous and intermittent vibration with respect to human response" states "*intermittent vibration is a string of vibration incidents, each of short duration, separated by intervals of much lower vibration magnitudes… (for example intermittent machinery, lifts **railway trains and traffic passing by**).*" Which indicates that railway trains would fall under the intermittent type of vibration type.

Based on the information provided in the above standards, and from experience in the assessment of rail vibration within the distances considered, we believe the appropriate criteria is as follows:

Target Criteria	1.4 times the base curve
Limit Criteria	4 times the base curve

Whilst the above forms the basis of the assessable criteria, for completeness, the maximum vibration level for each train pass has also been provided for informational purposes. The maximum is the highest level of vibration (acceleration) in each frequency for the pass-by event.

3. MONITORING

3.1 NOISE

Noise monitoring was undertaken at the boundary of the proposed development between the 14th and 23rd September 2020. From these measurements, the noise received at the development from trains travelling along the Cockburn freight line was determined.

Due to the intermittent nature of the usage of this section of track, only three trains passed during the 10 day monitoring period. As the time of the second and third trains are within a few minutes of each other, it is likely that this was the same train travelling back and forth.

The results of the noise data logging are summarised in Table 3.1.

TABLE 3.1 – DETERMINATION OF TRANSPORTATION NOISE AT LOGGER, dB(A)

Location	Date Time	Duration of Train Pass	L_{Aeq}
Boundary of Development (18 metres from the rail line)	14/09/2020 20:02	0:01:20	60.1
	15/09/2020 0:09	0:01:20	54.1
	15/09/2020 0:21	0:02:35	42.5

The results for the noise logging show that for an individual train, the noise received from a passing event was $L_{Aeq(80sec)}$ of 60 dB(A). Information provided from the landowner who lives on this lot, (confirmed by the lack of trains in the monitoring period), is that there is limited use of trains on this rail line, being around one to two trains per month. Also, as per experience and observations for this section of rail, trains move slowly, likely using it for a passing / siding track. As such, the measured noise event captured during the monitoring period was taken to be representative of the limited usage.

For information, the results of the monitoring are shown graphically in Appendix E with figure 3.1 showing the location map, 3.2 showing the monitor in situ and 3.3 showing the rail alignment.

FIGURE 3.1 NOISE MONITOR LOCATION PLAN

FIGURE 3.2 NOISE MONITOR INSITU

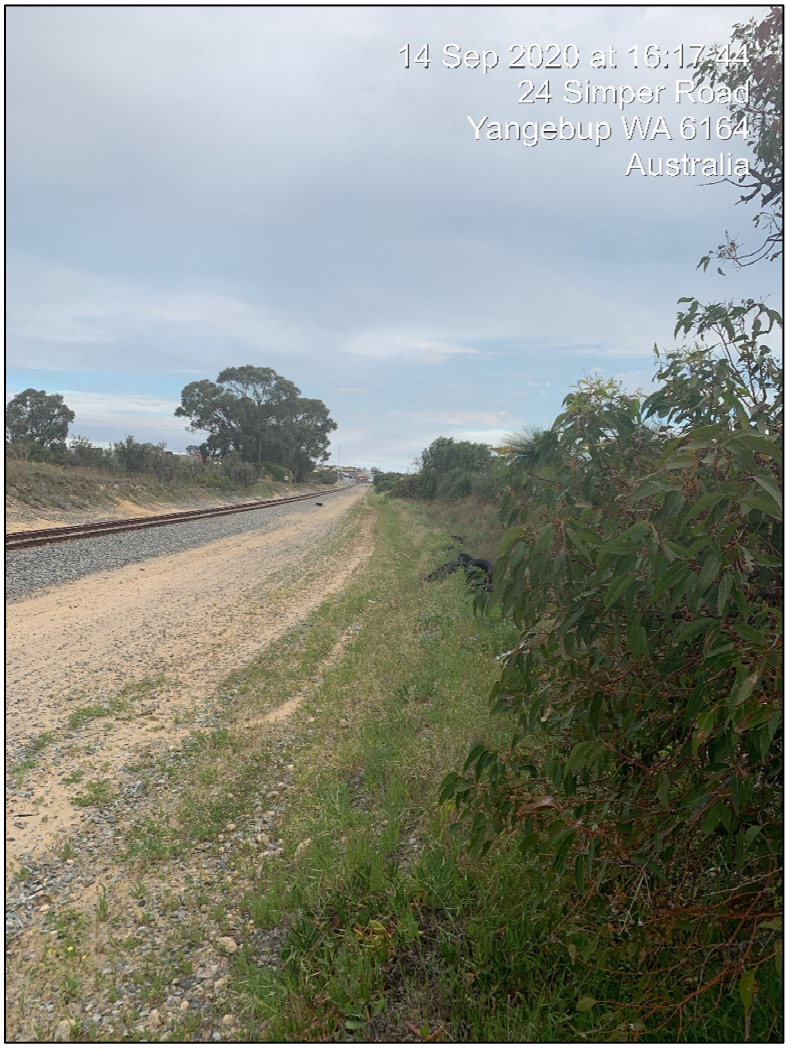

FIGURE 3.3 RAIL LINE OPPOSITE MONITOR

3.2 VIBRATION

Measured vibration levels were conducted at the development façade as per the location shown in the previous section.

Analysis of the measured vibration level for each train pass has been undertaken. As previously stated, only three trains passed during the 10 day monitoring period. An example time history of a single train pass is shown below in Figure 3.4.

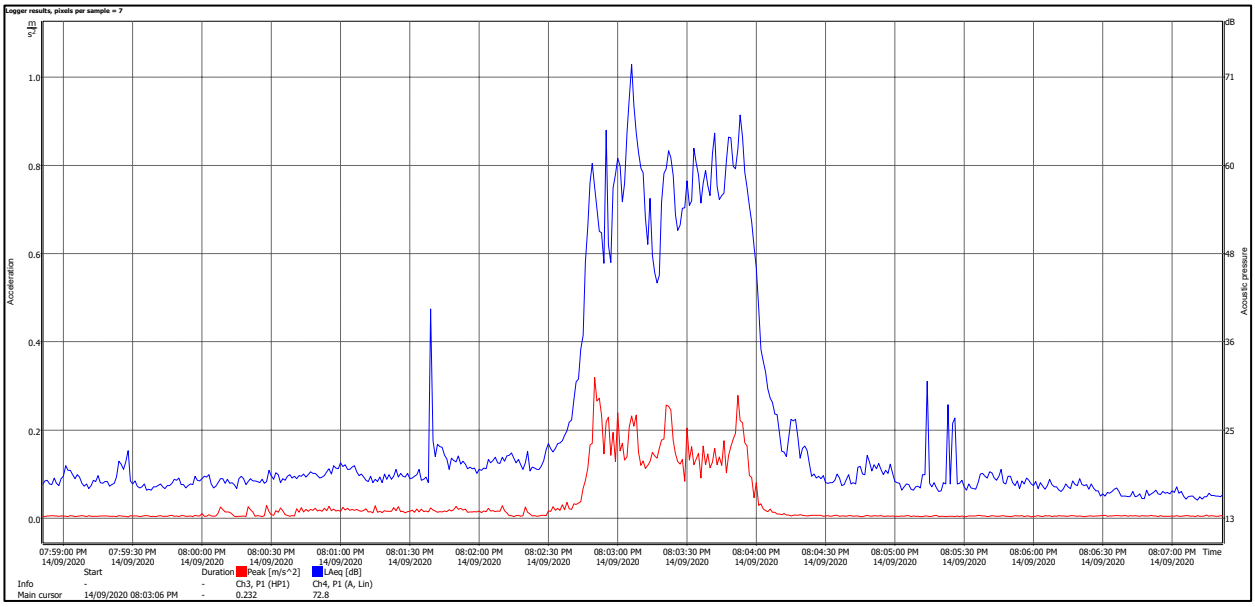

FIGURE 3.4 - TRAIN PASS BY EVENT VIBRATION TIME HISTORY

Using the above time history, analysis of the peak vibration level compared to the RMS vibration level has been made. This is to confirm that the standard method of assessment as per AS2631.2-2014 is that the crest factor of the vibration event is not greater than 9.

TABLE 4.2 CREST FACTOR ASSESSMENT

Date & time	***X Axis***		***X Axis***		***X Axis***	
	Peak [m/s^2]	***RMS [m/s^2]***	***Peak [m/s^2]***	***RMS [m/s^2]***	***Peak [m/s^2]***	***RMS [m/s^2]***
14/09/2020 20:02	0.211	0.061	0.064	0.019	0.32	0.094
Crest Factor	**3.5**		**3.4**		**3.4**	

Individual train vibration events for the monitoring period are contained graphically in Appendix B with an example of the above event and comparison to the criteria, shown in Figure 3.5 below.

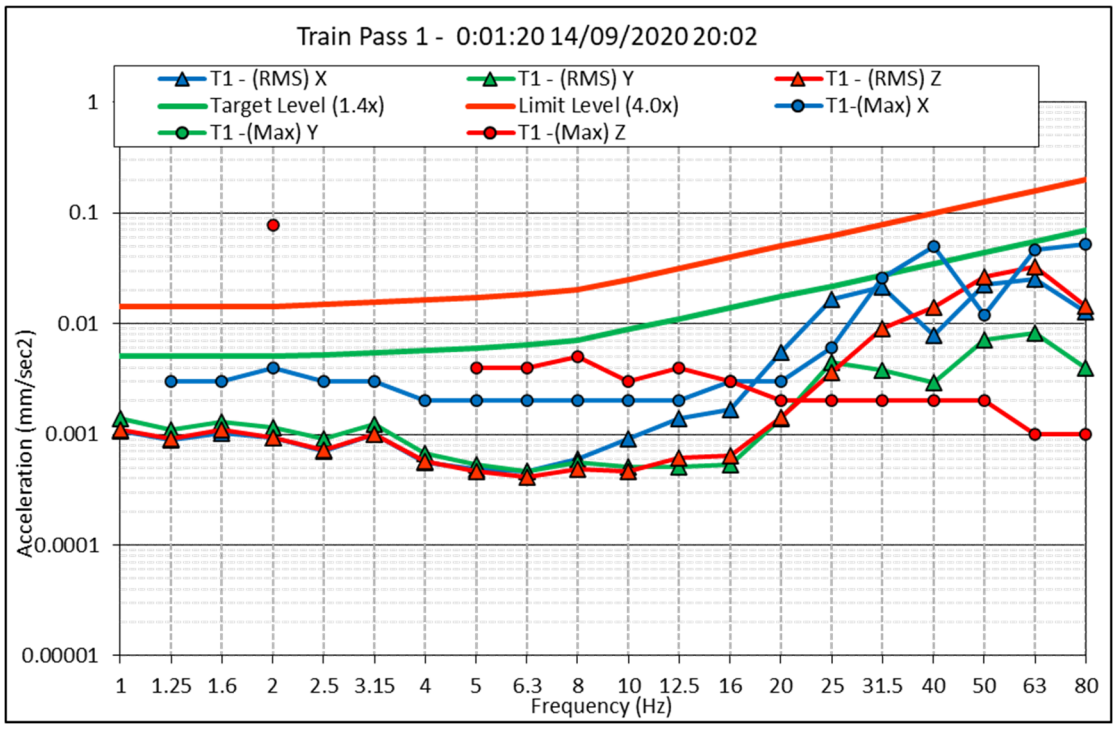

FIGURE 4.4 - TRAIN PASS BY EVENT VIBRATION PLOT

4. MODELLING

To determine the requirements of any noise amelioration, acoustic modelling was carried out using the computer program 'SoundPlan'.

As previously stated, there is limited train movement on this line impacting the ability to measure current noise levels and provide a basis for a statistical analysis. Therefore, rather than using the single train pass noise level and calculating the worst case of one per hour for 24 hours, being an $L_{Aeq(16hour)}$, or $L_{Aeq(8hour)}$ of 43.6 dB(A), the predictive noise model was calibrated to 60.1 $L_{Aeq(1hour)}$ at the monitoring location, 18m from the rail line.

Reference was made to other monitoring conducted on the Cockburn freight line as to the validity of using the 60.1 dB(A) as an $L_{Aeq(1hour)}$ level for calibration of this assessment. Previous studies resulted in an $L_{Aeq(130seconds)}$ of 68.7 dB(A) for busier sections of the freight line. This was at a monitoring point 20m from the freight line, hence would be comparable to this study. For information, calculating this noise level to the equivalent $L_{Aeq(1hour)}$ gives a resultant noise level of 54.3 dB(A).

Whilst the difference in the time the noise is present from train events is taken into account, the current assessment of Lot 1 Simper road is around 5.8 dB(A) higher in noise level for the $L_{Aeq(1hour),}$ providing a highly conservative noise assessment. Whilst this is not in strict accordance with the policy, as the movements of freight rail for this section of track is irregular and unpredictable, there is a level of futureproofing inbuilt in the assessment using this methodology.

To determine the noise that would be received within the development from the surrounding rail network, acoustic modelling was carried out using the computer program 'SoundPlan'.

The following scenarios were modelled:

1. Ultimate capacity volumes, ie 24 per 24 hours at 1 per hour, without any noise amelioration.

It is noted that for the lot side on to the rail line in the northern section of the development, a side and rear fence has been included.

Based on the above, the noise contours plots for day and night period for the above modelling scenarios are attached in Appendix B with the resultant level discussed further in the next section.

5. NOISE ASSESSMENT

Under the WAPC State Planning Policy 5.4, for this development, the Noise Targets as listed in Table 2 are the appropriate noise levels to be achieved. Based on the noise monitoring, the difference between the $L_{Aeq(16hr)}$ and the $L_{Aeq(8hr)}$ would be less than 5 dB(A). Therefore, the night period would be the critical period for compliance and if compliance with the night period noise target is achieved, then compliance with the day period noise target would also be achieved. The policy states that the outdoor criteria applies to the ground floor level only, however, it also states that noise mitigation measures should be implemented with a view to achieving the target levels in least one outdoor living area.

For residential premises, the Policy states that residence should be designed to meet the following acceptable internal noise levels:

Living and Work Areas	$L_{Aeq(Day)}$ of 40 dB(A)
Bedrooms	$L_{Aeq(Night)}$ of 35 dB(A)

The results of the acoustic assessment indicate that noise received at the ground floor level of residences located adjacent to the freight rail line, could exceed the above acoustic criteria. In the worst-case location, the level of exceedance would be approximately 5 dB(A). Table 4.1 details the noise level at the building envelop for each proposed development Lot and the "Quiet House" design package required to achieve compliance. Figure 5.1 shows the location map of the receivers.

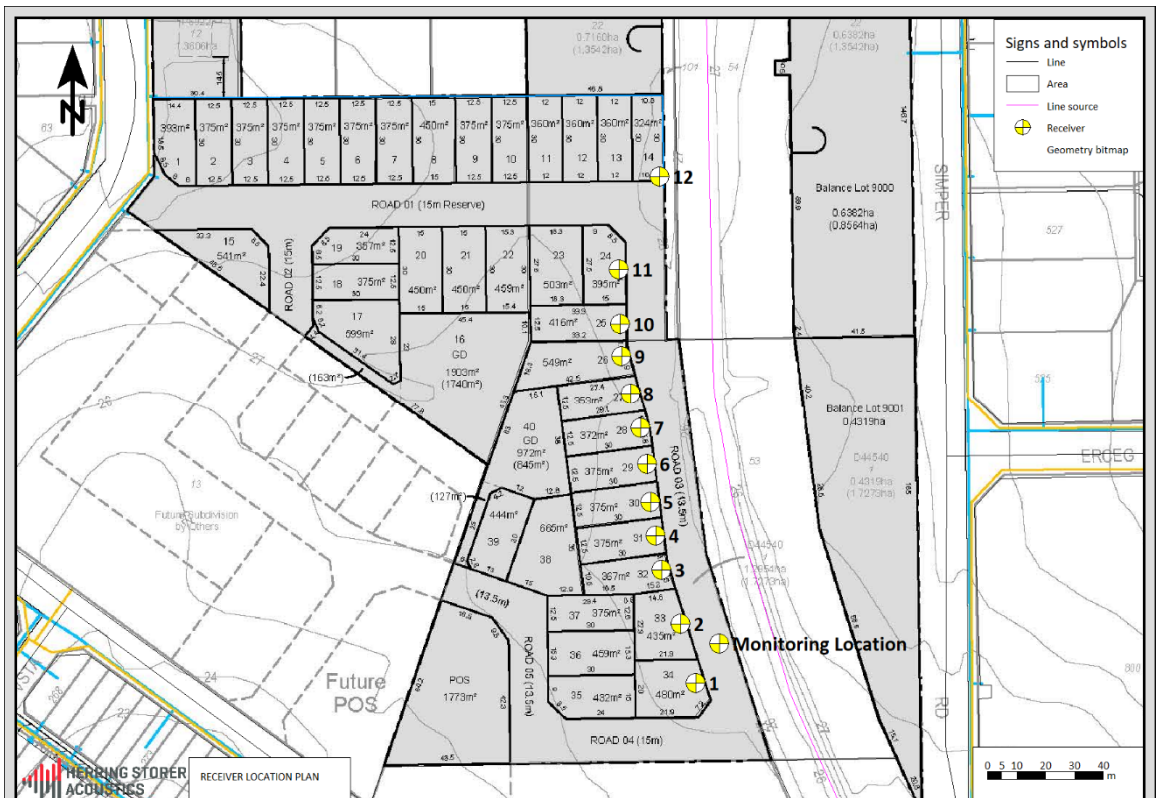

FIGURE 5.1 - RECEIVER LOCATION PLAN

TABLE 5.1 – DEVELOPMENT NOISE LEVELS dB(A)

Location	One Train Per Hour (24 per day)	
	Noise Level dB(A)	QHD Package Requirement
1	55	A
2	55	A
3	55	A
4	55	A
5	55	A
6	55	A
7	55	A
8	55	A
9	54	A
10	54	A
11	54	A
12	51	A

Nil No Requirements
N Notification on Title
A Package A Quiet House Design
B Package B Quiet House Design
C Package C Quiet House Design

Therefore, to comply with the Policy, the following options have been provided:

- Quiet House Design Packages as per Table 5.1

Any lots exceeding the 50 dB(A) night target criteria would require notification on Titles.

Information on the deemed to satisfy constructions for the various “Quiet House Design” packages are contained in Appendix D.

Notes:

1 Given the location of the development and the projected market, we understand that 2 storey residences are unlikely, hence the “Quiet House” Design packages stated are for single storey residence only. If double storey residences are proposed, then it is recommended that specialist acoustic advice be sought by the proponent.

2 The summary of the Quiet House Design Packages attached in Appendix C and D, are “Deemed to Satisfy” constructions. Alternative constructions would be acceptable, provided they are supported by an acoustic report prepared by a suitably qualified acoustic consultant.

3 Quiet House Design requirements are likely to lessen for residential premises set back from the highway, as the façade residences will barrier those behind.

4 Additionally, these residences also require Notifications on Titles.

6. VIBRATION ASSESSMENT

Vibration levels were below the “Target” 1.4x base curve for highest train events analysed.

As the measured vibration levels were conducted at the boundary of the development, or the closest location in regard to the freight line, and all Lots were at a greater distance than the measurement point, the measured vibration levels as per this report would be considered as the highest received within the development. Therefore, no vibration control to the proposed development is recommended and standards construction would be suitable.

APPENDIX A

PROPOSED SUBDIVISION PLAN

Subdivision Plan

Lot 1 Simper Rd, Lot 22 Erceg Rd and Lot 12 (56) Shallcross St, Yangebup

Date: 17 Sep 2020 Scale: 1:2000 @ A3 1:1000 @ A1 File 20-414 SU01A Staff JP GW Checked JP

element.

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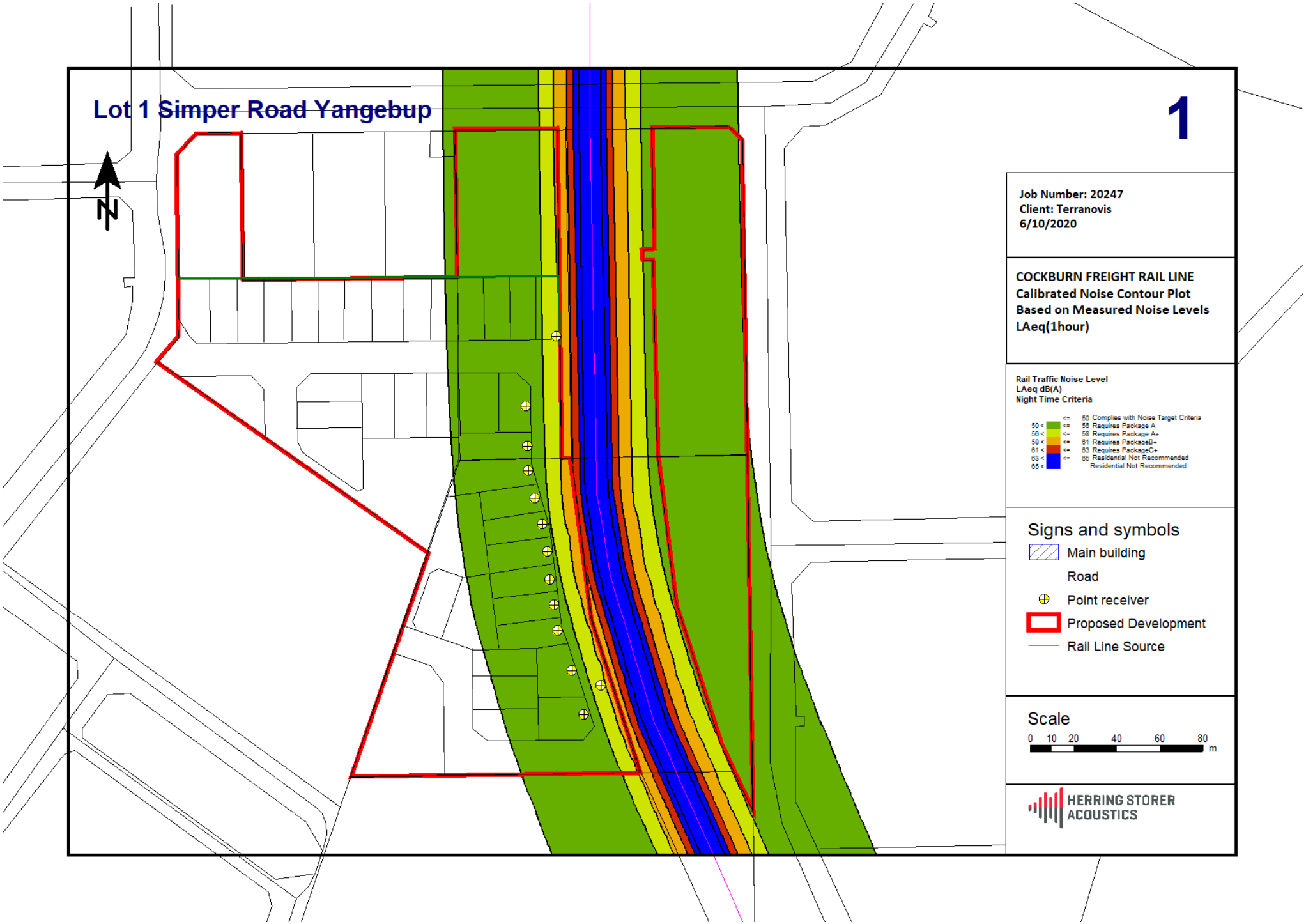
APPENDIX B

NOISE CONTOUR PLOTS


Lot 1 Simper Road Yangebup
N
1
Job Number: 20247
Client: Terranovis
6/10/2020
COCKBURN FREIGHT RAIL LINE
Calibrated Noise Contour Plot
Based on Measured Noise Levels
LAeq(1hour)
Rail Traffic Noise Level
LAeq dB(A)
Night Time Criteria
50 < <= 55 Requires Package A
55 < <= 58 Requires Package A+
58 < <= 61 Requires PackageB+
61 < <= 63 Requires PackageC+
63 < <= 65 Residential Not Recommended
65 < Residential Not Recommended
Signs and symbols
Main building
Road
Point receiver
Proposed Development
Rail Line Source
Scale
0 10 20 40 60 80 m
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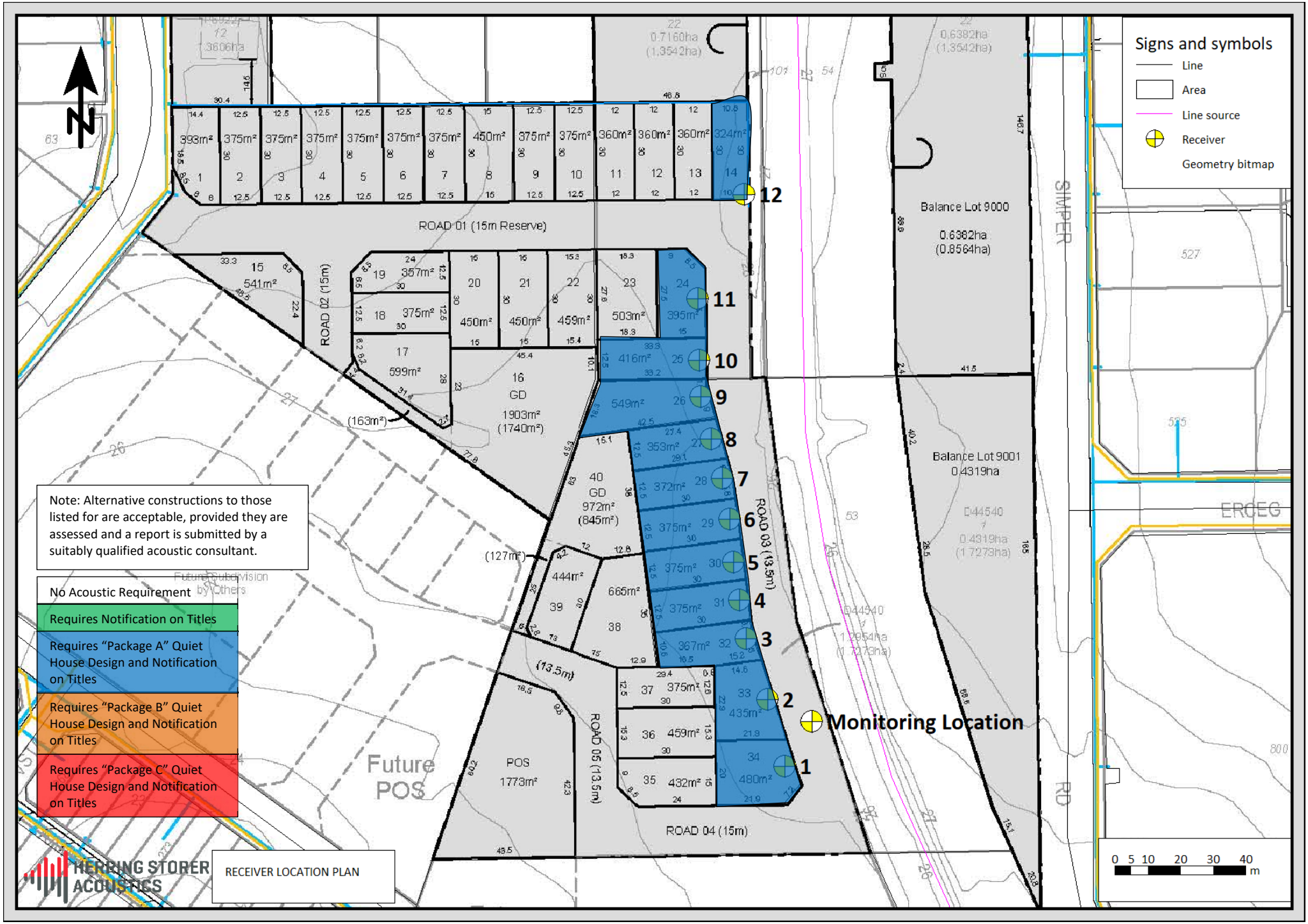
APPENDIX C

"QUIET HOUSE" DESIGN REQUIREMENTS


Signs and symbols
Line
Area
Line source
Receiver
Geometry bitmap
Note: Alternative constructions to those listed for are acceptable, provided they are assessed and a report is submitted by a suitably qualified acoustic consultant.
No Acoustic Requirement
Requires Notification on Titles
Requires "Package A" Quiet House Design and Notification on Titles
Requires "Package B" Quiet House Design and Notification on Titles
Requires "Package C" Quiet House Design and Notification on Titles
Monitoring Location
ROAD 01 (15m Reserve)
ROAD 02 (15m)
ROAD 03 (13.5m)
ROAD 04 (15m)
ROAD 05 (13.5m)
Balance Lot 9000
0.6382ha
(0.8564ha)
Balance Lot 9001
0.4319ha
Future POS
POS
1773m²
SIMPER
ERCEG
0 5 10 20 30 40
m
HERRING STORER ACOUSTICS
RECEIVER LOCATION PLAN

APPENDIX D

"QUIET HOUSE" DESIGN PACKAGES

Road Traffic and Passenger Rail
Quiet House Requirements
(*Based on Table 3 of State Planning Policy 5.4 2019*)

Exposure Category	Orientation to corridor	Acoustic rating and example constructions					Mechanical ventilation/air conditioning considerations
		Walls	**External doors**	**Windows**	**Roofs and ceilings of highest floors**	**Outdoor Living areas**	
A **Quiet House A**	**Facing**	**Bedroom and Indoor Living and work areas to Rw + Ctr 45dB** **Stud Frame Walls** ➢ One row of 92mm studs at 60mm centres with: ➢ Resilient steel channels fixed to the outside of the studs; and ➢ 9.5mm hardboard or 9mm fibre cement weatherboards or one layer of 19mm board cladding fixed to the outside of the channels; and ➢ 75mm glass wool (11kg/m3) or 75mm polyester (14kg/m3) insulation, positioned between the studs; and ➢ -Two layers of 16mm fire-protective grade plasterboard fixed to the inside face of the studs. **Brick Walls** ➢ Single leaf of 150mm brick masonry with 13mm cement render on each face: **OR** ➢ Double brick: two leaves of 90 mm clay brick masonry with a 20mm cavity between leaves.	**Bedrooms**: ➢ Fully glazed hinged door with certified R_w+C_{tr} **28dB** rated door and frame including seals and 6mm glass **Indoor Living and work areas:** ➢ 35mm solid core timber hinged door and frame system certified to **Rw 28dB** including seals**: OR** ➢ Glazed sliding door with 10 mm glass and weather seals	**Bedrooms**: ➢ Total external door and window system area up to 40% of room floor area: Sliding or double hung with minimum 10 mm single or 6mm-12mm-10mm double insulted glazing (R_w+C_{tr} **28 dB**). Sealed awning or casement windows may use 6 mm glazing instead**: OR** ➢ Up to 60% floor area: as per above but must be sealed awning or casement type windows (R_w+C_{tr} **31dB**). **Indoor Living and work areas** ➢ Up to 40% floor area: Sliding, awning, casement or double hung with minimum 6mm single pane or 6mm-12mm-6mm double insulted glazing (R_w+C_{tr} **25dB**)**: OR** ➢ Up to 60% floor area: As per Bedrooms at up to 40% area (**Rw+Ctr28 dB : OR** ➢ Up to 80% floor area: As per Bedrooms at up to 60% area (R_w+C_{tr} **31 dB**).	**To R_w+C_{tr} 35dB** ➢ Concrete or terracotta tile or metal sheet roof with sarking and at least 10mm plasterboard ceiling	➢ At least one outdoor living area located on the opposite side of the building from the transport corridor and/or at least one ground level outdoor living area screened using a solid continuous fence or other structure of minimum **2 metres** height above ground level	➢ Acoustically rated openings and ductwork to provide a minimum sound reduction performance of **Rw 40dB** into sensitive spaces ➢ Evaporative systems require attenuated ceiling air vents to allow closed windows ➢ Refrigerant-based systems need to be designed to achieve National Construction Code fresh air ventilation requirements ➢ Openings such as eaves, vents and air inlets must be acoustically treated, closed or relocated to building sides facing away from the corridor where practicable
	Side On		As per "Facing" above, except R_w+C_{tr} values may be 3dB less, e.g. glazed sliding door with 10 mm glass and weather seals for bedrooms	As above, except R_w+C_{tr} values may be 3dB less, or max % area increased by 20%			
	Opposite		No specific requirements	No specific requirements			