NORTH ELLENBROOK (PRECINCT A)
DISTRICT STRUCTURE PLAN

ROAD TRAFFIC (SPP 5.4) ACOUSTIC ASSESSMENT
and
ENVIRONMENTAL IMPACT ACOUSTIC ASSESSMENT

AUGUST 2019

OUR REFERENCE: 24664-3-19088

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ACOUSTIC ASSESSMENT

NORTH ELLENBROOK (PRECINCT A)
DISTRICT STRUCTURE PLAN

Job No: 19088

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FOR

PARCEL PROPERTY

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APPENDICIES

1. INTRODUCTION

Herring Storer Acoustics was commissioned by Parcel Property to undertake an acoustical assessment of noise received within the proposed North Ellenbrook (Precinct A) Local Structure Plan (LSP) which is bounded by Cooper and Maralla Road, Ellenbrook.

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

- Determine by noise modelling the noise levels that would be received within the LSP from vehicles travelling on the future Perth to Darwin Highway.
- Assess the predicted noise levels received at residence for compliance with the requirements of the WAPC State Planning Policy 5.4 *"Road and Rail Transportation Noise and Freight Consideration in Land Use Planning"* (SPP 5.4).
- If exceedances are predicted, comment on possible noise amelioration options for compliance with the appropriate criteria.
- Assess noise received from the proposed industry to the north in respect to the *Environmental Protection (Noise) Regulations 1997*.
- Assess noise received from the extraction operations to the south in respect to the *Environmental Protection (Noise) Regulations 1997*.

For information, the local structure plan is attached in Appendix A.

2. SUMMARY

Under the WAPC State Planning Policy 5.4, for this development, the "Noise Limits" as listed in Table 1 are the appropriate noise levels for to be achieved for this development. Under SPP 5.4, the "Noise Limits" criteria which are applicable external to a residence are:

External

Day	Maximum of 60 dB(A) L_{Aeq}
Night	Maximum of 55 dB(A) L_{Aeq}

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 "Noise Target" levels in least one outdoor living area. The Policy states the following acceptable internal noise levels:

Internal

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

For this development, compliance with the requirements of SP 5.4, noise modelling and assessment are based on the day period for residence located adjacent to the Perth To Darwin Highway.

The results of the acoustic assessment indicate that noise received at residences located adjacent to Perth To Darwin Highway would exceed the "Noise Limits" as outlined in SPP 5.4. To comply with the requirements of SPP 5.4, the following noise mitigation methods are recommended:

- Buffer to residential use

  If no noise control in the form of barriers are instituted, then a buffer, or setback for residential land use can be adopted. Based on the modelled noise levels for the future highway, distances for the setback would be in the order of 170 metres from the boundary of the development.

  This setback is based on there being no development within this zone and only residential housing for the future.

  Alternative development such as commercial use could be used in this area abutting the highway, with this commercial development providing a barrier for the residential premises behind. With this scenario it is likely that the setback for residential use would be reduced to be directly behind the commercial component.

- Barriers

  Noise control in the form of barriers, such as noise wall or earthen bunds have been investigated as a way of ameliorating the noise levels for future development.

  Noise contour plots for a 3.0 metre noise wall at the eastern boundary of the development reduces the buffer distance for residential land to around 100 metres from the boundary.

  It is noted that due to the distance of the highway from the boundary of the development, the effectiveness of barriers such as noise walls is reduced. The most efficient use of walls is incorporated into the road design, hence are located close to the traffic noise source.

- Quiet House Design

  If considering residential development within areas above 60 dB(A) as per the previous two scenarios, "Quiet House Design" as outlined in SPP 5.4 guidance would be required to further ameliorate noise levels to meet internal noise level criteria.

  The package requirement depends on the external noise levels, however, for guidance Figure 5.4 details the quiet house design for the future noise levels associated with the highway, without any noise control in the form of barriers.

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

With regards to the noise levels for surrounding environmental impacts, such as industry, analysis showed no significant impact. Noise contour plot of the industry sources has been included in Appendix E for reference. It is noted that as there are existing residential premises throughout the proposed LSP, any future industry in the vicinity of the development would be required to comply with the regulatory criteria contained in the *Environmental Protection (Noise) Regulations 1997*.

3. CRITERIA

3.1 STATE PLANNING POLICY 5.4

The Western Australian Planning Commission (WAPC) released on 22 September 2009 State Planning Policy 5.4 "Road and Rail Transport Noise and Freight Considerations In Land Use Planning". Section 5.3 – Noise Criteria, which outlines the acoustic criteria, states:

"5.3 - NOISE CRITERIA

Table 1 sets out the outdoor noise criteria that apply to proposals for new noise-sensitive development or new major roads and railways assessed under this policy.

These criteria do not apply to—

- *proposals for redevelopment of existing major roads or railways, which are dealt with by a separate approach as described in section 5.4.1; and*
- *proposals for new freight handling facilities, for which a separate approach is described in section 5.4.2.*

The outdoor noise criteria set out in Table 1 apply to the emission of road and rail transport noise as received at a noise-sensitive land use. These noise levels apply at the following locations—

- *for new road or rail infrastructure proposals, at 1 m from the most exposed, habitable façade of the building receiving the noise, at ground floor level only; and*
- *for new noise-sensitive development proposals, at 1 m from the most exposed, habitable façade of the proposed building, at each floor level, and within at least one outdoor living area on each residential lot.*

Further information is provided in the guidelines.

TABLE 1: OUTDOOR NOISE CRITERIA

Time of day	*Noise Target*	*Noise Limit*
Day (6 am–10 pm)	$L_{Aeq(Day)}$ *= 55 dB(A)*	$L_{Aeq(Day)}$ *= 60 dB(A)*
Night (10 pm–6 am)	$L_{Aeq(Night)}$ *= 50 dB(A)*	$L_{Aeq(Night)}$ *= 55 dB(A)*

The 5 dB difference between the outdoor noise target and the outdoor noise limit, as prescribed in Table 1, represents an acceptable margin for compliance. In most situations in which either the noise-sensitive land use or the major road or railway already exists, it should be practicable to achieve outdoor noise levels within this acceptable margin. In relation to greenfield sites, however, there is an expectation that the design of the proposal will be consistent with the target ultimately being achieved.
Because the range of noise amelioration measures available for implementation is dependent upon the type of proposal being considered, the application of the noise criteria will vary slightly for each different type. Policy interpretation of the criteria for each type of proposal is outlined in sections 5.3.1 and 5.3.2.

The noise criteria were developed after consideration of road and rail transport noise criteria in Australia and overseas, and after a series of case studies to assess whether the levels were practicable. The noise criteria take into account the considerable body of research into the effects of noise on humans, particularly community annoyance, sleep disturbance, long-term effects on cardiovascular health, effects on children's learning performance, and impacts on vulnerable groups such as children and the elderly. Reference is made to the World Health Organization (WHO) recommendations for noise policies in their publications on community noise and the Night Noise Guidelines for Europe. See the policy guidelines for suggested further reading.

5.3.1 Interpretation and application for noise-sensitive development proposals

In the application of these outdoor noise criteria to new noise-sensitive developments, the objective of this policy is to achieve –

- *acceptable indoor noise levels in noise-sensitive areas (for example, bedrooms and living rooms of houses, and school classrooms); and*
- *a reasonable degree of acoustic amenity in at least one outdoor living area on each residential lot[1].*

If a noise-sensitive development takes place in an area where outdoor noise levels will meet the noise target, no further measures are required under this policy.

In areas where the noise target is likely to be exceeded, but noise levels are likely to be within the 5dB margin, mitigation measures should be implemented by the developer with a view to achieving the target levels in a least one outdoor living area on each residential lot[1]. Where indoor spaces are planned to be facing any outdoor area in the margin, noise mitigation measures should be implemented to achieve acceptable indoor noise levels in those spaces. In this case, compliance with this policy can be achieved for residential buildings through implementation of the deemed-to-comply measures detailed in the guidelines.

In areas where the outdoor noise limit is likely to be exceeded (i.e. above $L_{Aeq(Day)}$ of 60 dB(A) or $L_{Aeq(Night)}$ of 55 dB(A)), a detailed noise assessment in accordance with the guidelines should be undertaken by the developer. Customised noise mitigation measures should be implemented with a view to achieving the noise target in at least one outdoor living or recreation area on each noise-sensitive lot or, if this is not practicable, within the margin. Where indoor spaces will face outdoor areas that are above the noise limit, mitigation measures should be implemented to achieve acceptable indoor noise levels in those spaces, as specified in the following paragraphs.

For residential buildings, acceptable indoor noise levels are $L_{Aeq(Day)}$ of 40 dB(A) in living and work areas and $L_{Aeq(Night)}$ of 35 dB(A) in bedrooms[2]. For all other noise-sensitive buildings, acceptable indoor noise levels under this policy comprise noise levels that meet the recommended design sound levels in Table 1 of Australian Standard AS 2107:2000 Acoustics—Recommended design sound levels and reverberation times for building interiors.

1 For non residential noise-sensitive developments, (e.g. schools and child care centres) consideration should be given to providing a suitable outdoor area that achieves the noise target, where this is appropriate to the type of use.
2 For residential buildings, indoor noise levels are not set for utility spaces such as bathrooms. This policy encourages effective "quiet house" design, which positions these non-sensitive spaces to shield the more sensitive spaces from transport noise (see guidelines for further information).

These requirements also apply in the case of new noise-sensitive developments in the vicinity of a major transport corridor where there is no existing railway or major road (bearing in mind the policy's 15-20 year planning horizon). In these instances, the developer should engage in dialogue with the relevant infrastructure provider to develop a noise management plan to ascertain individual responsibilities, cost sharing arrangements and construction time frame.

If the policy objectives for noise-sensitive developments are not achievable, best practicable measures should be implemented, having regard to section 5.8 and the guidelines."

The Policy, under Section 5.7, also provides the following information regarding "Notifications on Titles":

"5.7 - NOTIFICATION ON TITLE

If the measures outlined previously cannot practicably achieve the target noise levels for new noise-sensitive developments, this should be notified on the certificate of title.

Notifications on certificates of title and/or advice to prospective purchasers advising of the potential for noise impacts from major road and rail corridors can be effective in warning people who are sensitive to the potential impacts of transport noise. Such advice can also bring to the attention of prospective developers the need to reduce the impact of noise through sensitive design and construction of buildings and the location of outdoor living areas.

The notification is to ensure that prospective purchasers are advised of –

- *the potential for transport noise impacts; and*
- *the potential for quiet house design requirements to minimise noise intrusion through house layout and noise insulation (see the guidelines).*

Notification should be provided to prospective purchasers and be required as a condition of subdivision (including strata subdivision) for the purposes of noise-sensitive development as well as planning approval involving noise-sensitive development, where noise levels are forecast or estimated to exceed the target outdoor noise criteria, regardless of proposed noise attenuation measures. The requirement for notification as a condition of subdivision and the land area over which the notification requirement applies, should be identified in the noise management plan in accordance with the guidelines.

An example of a standard form of wording for notifications is presented in the guidelines."

3.2 ENVIRONMENTAL PROTECTION (NOISE) REGULATIONS 1997

The criteria used are in accordance with the *Environmental Protection (Noise) Regulations 1997 (as amended)*. These regulations stipulate maximum allowable external noise levels determined by the calculation of an influencing factor, which is then added to the base levels shown below. The influencing factor is calculated for the usage of land within the two circles, having radii of 100m and 450m from the premises of concern. The baseline assigned noise levels for the different types of receivers and during the different periods of the day are listed in Table 2.1.

TABLE 2.1 - BASELINE ASSIGNED OUTDOOR NOISE LEVEL

Premises Receiving Noise	Time of Day	Assigned Level (dB)		
		L_{A10}	L_{A1}	L_{Amax}
Within 15m of a noise sensitive premises building	0700 - 1900 hours Monday to Saturday	45	55	65
	0900 - 1900 hours Sunday and Public Holidays	40	50	65
	1900 - 2200 hours all days	40	50	55
	2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and Public Holidays	35	45	55
Further than 15m from a noise sensitive premises building	All hours	60	75	80
Commercial premises	All hours	60	75	80
Industrial and utility premises	All hours	65	80	90

Note: The L_{A10} noise level is the noise that is exceeded for 10% of the time.
The L_{A1} noise level is the noise that is exceeded for 1% of the time.
The L_{Amax} noise level is the maximum noise level recorded.

For premises within the proposed LSP the influencing factor would range from 2 dB for those adjacent to the industrial park to 0 for those residence located at a greater distance of 450 metres from the boundary of the park. The assigned noise levels for the critical location (within 450m of the boundary) are listed in Table 2.2.

TABLE 2.2 - ASSIGNED OUTDOOR NOISE LEVEL AT CRITICAL LOCATIONS

Premises Receiving Noise	Time of Day	Assigned Level (dB)		
		L_{A10}	L_{A1}	L_{Amax}
Within 15m of a noise sensitive premises building	0700 - 1900 hours Monday to Saturday	47	57	67
	0900 - 1900 hours Sunday and Public Holidays	42	52	67
	1900 - 2200 hours all days	42	52	57
	2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and Public Holidays	37	47	57

Note: The L_{A10} noise level is the noise that is exceeded for 10% of the time.
The L_{A1} noise level is the noise that is exceeded for 1% of the time.
The L_{Amax} noise level is the maximum noise level recorded.

Under the Regulations it is also a requirement that noise from the site be free of annoying characteristics (tonality, modulation and impulsiveness) at other premises, defined below as per Regulation 9.

"impulsiveness" means a variation in the emission of a noise where the difference between L_{Apeak} and $L_{Amax\ Slow}$ is more than 15dB when determined for a single representative event;

"modulation" means a variation in the emission of noise that –

(a) is more than 3dB $L_{A\ Fast}$ or is more than 3dB $L_{A\ Fast}$ in any one-third octave band;

(b) is present for more at least 10% of the representative assessment period; and

(c) is regular, cyclic and audible;

"tonality" means the presence in the noise emission of tonal characteristics where the difference between –

(a) the A-weighted sound pressure level in any one-third octave band; and

(b) the arithmetic average of the A-weighted sound pressure levels in the 2 adjacent one-third octave bands,

is greater than 3 dB when the sound pressure levels are determined as $L_{Aeq,T}$ levels where the time period T is greater than 10% of the representative assessment period, or greater than 8 dB at any time when the sound pressure levels are determined as $L_{A\ Slow}$ levels.

Where the above characteristics are present and cannot be practicably removed, the adjustments as listed in Table 2.4 are made to the measured or predicted level at other premises.

TABLE 2.4 - ADJUSTMENTS TO MEASURED LEVELS

Where **tonality** is present	Where **modulation** is present	Where **impulsiveness** is present
+5 dB(A)	+5 dB(A)	+10 dB(A)

Note: These adjustments are cumulative to a maximum of 15 dB

With respect to residential receivers, noise emissions may be tonal in characteristic, particularly under conditions where received noise levels are predicted to be above 35 dB(A). The most significant acoustic parameter is the L_{A10} noise level.

For the case of an industrial estate such as the northern section of the LSP, it is expected that more than one individual industry will contribute to noise levels at noise sensitive premises surrounding the park. Should the cumulative noise emission approach the 'assigned level' under the regulations, then the requirements of Regulation 7(2) apply. This sub-regulation is:

*7(2) For the purposes of sub-regulation (1)(a), a noise emission is taken to "**significantly contribute to**" a level of noise if the noise emission as determined under sub-regulation (3) exceeds a value which is 5 dB below the assigned level at the point of reception.*

Thus, under the requirements of the *Environmental Protection (Noise) Regulations 1997* there are two criteria that can be used to achieve compliance with the Regulations. The first is the overall noise level received from all industries. In this case, if the overall noise level received at premises complies with the applicable assigned noise level (L_{A10} during the night period of between 35 – 37 dB(A) depending on locations), then noise emissions from all industries would be deemed to comply with the requirements of the Regulations. However, if the overall noise level received at premises from all industries exceeds the applicable noise level, compliance will still be achieved if the noise received at a premises from an individual industry is at least 5 dB(A) below the applicable assigned noise level.

We believe any new industry would need to be considered NOT significantly contributing. Therefore, noise received at any residence (including possible future residence) would need to be 5 dB(A) below the assigned noise level. For this Industrial Park, the critical location for compliance would be residence located at 250 metres from the edge of the Park and the L_{A10} noise level received at these residences needs to be less than 32 dB(A), this being the assigned night period noise level of 37 dB(A) less 5 dB(A).

3.3 APPROPRIATE CRITERIA

Based on the above, the following criteria are proposed for this development:

External

Day	Maximum of 60 dB(A) L_{Aeq}
Night	Maximum of 55 dB(A) L_{Aeq}

Internal

Sleeping Areas	35 dB(A) $L_{Aeq(night)}$
Living Areas	40 dB(A) $L_{Aeq(day)}$

Additional to these criteria, noise received at an outdoor area, where practicable, should also achieve an L_{Aeq} of 50 dB(A) during the night period.

4. MODELLING

4.1 ROAD TRAFFIC

The future Perth to Darwin road traffic volumes were based on information provided on the Northlink web site. This and other information relevant to the calculations are shown below in Table 5.1.

TABLE 5.1 - NOISE MODELLING INPUT DATA

Parameter	North Bound 2031	South Bound 2031
Traffic flows VPD Perth to Darwin Highway	15,400	15,500
Heavy Vehicles (%)	19%	20%
Traffic Speed km/hr	110	110
Road Surface	Chip seal	Chip seal
Façade Correction	+2.5	+2.5

Other input data for the model included:

- Traffic data from MRWA (https://northlinkwamap.mainroads.wa.gov.au)
- Noise source heights for the three road source strings (Passenger Vehicles, Heavy Vehicles Engine and Heavy Vehicle Exhausts) are +0.5, +1.5 and +3.6m, with a noise correction of -0.8 and -8.0 applied to the heavy vehicles engine and exhaust noise sources.
- Topographical data, with the ground level within the development based on natural ground levels as per Google Earth.

- A +2.5 dB adjustment to allow for façade reflection.
- Development receiver heights at 1.4m above ground level.

To determine the noise that would be received within the development from the surrounding road network, acoustic modelling was carried out using the computer program 'SoundPlan'.
The following scenarios were modelled:

1. Future traffic volumes, without any noise amelioration.
2. Future traffic volumes, with a 3.0 metre wall at the development boundary.

Based on the above, the noise contours plots for day periods for the above modelling scenarios are attached in Appendix B.

4.2 INDUSTRY NOISE EMISSIONS

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

Noise "area" sources were used to represent the noise emissions of multiple industries to the north of the development. An input sound power level of 64 dB(A) /m^2 was used.

Modelling for the southern portion of the site relates to sand operations to the south of the development. The main influence is truck accessing the private road, however, compliance is achieved as it is day time (0700 to 1900 hours) operations. It should also be noted that the truck access via the private road is only temporary and will be removed upon development of the site.

Resultant noise contour plots for the surrounding industrial use are contained in Appendix E.

5. DISCUSSION / RECOMMENDATION

Under the WAPC State Planning Policy 5.4, for this development, the "Noise Limits" as listed in Table 1 are the appropriate noise levels for to be achieved for this development. Under SPP 5.4, the "Noise Limits" criteria which are applicable external to a residence are:

External

Day	Maximum of 60 dB(A) L_{Aeq}
Night	Maximum of 55 dB(A) L_{Aeq}

The policy states that the outdoor criteria apply to the ground floor level only, however, it also states that noise mitigation measures should be implemented with a view to achieving the "Noise Target" levels in least one outdoor living area. The Policy states the following acceptable internal noise levels:

Internal

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

For this development, compliance with the requirements of SP 5.4, noise modelling and assessment are based on the day period for residence located adjacent to the Perth to Darwin Highway.

The results of the acoustic assessment indicate that noise received at residences located adjacent to the Perth to Darwin Highway would exceed the "Noise Limits" as outlined in SPP 5.4. Figure 5.1 shows the spread of noise across the proposed development, with the areas in red highlighting the noise levels above the noise "limit" criteria.

It is understood that due to the construction of the highway already being undertaken, noise levels at the proposed development have not been considered by the infrastructure provider as the land is rural. Therefore, no noise amelioration in the form of noise walls are likely to be implemented for this section of the highway.

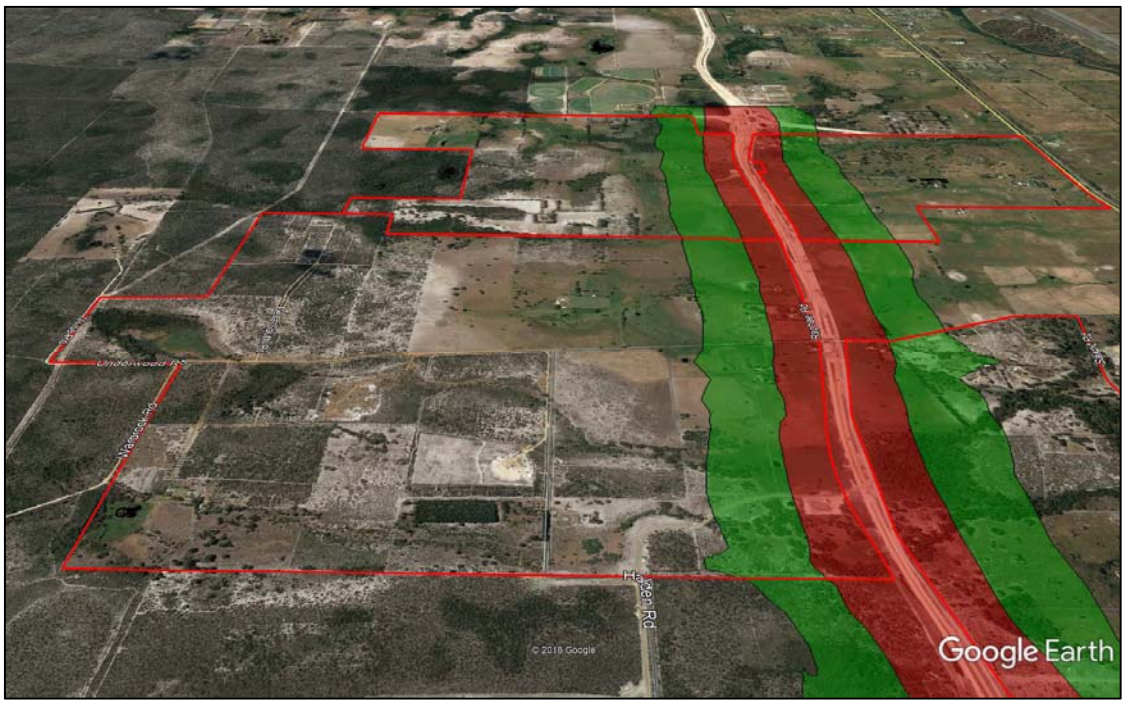


Figure 5.1 Perth to Darwin Noise Contour – No Noise Control

To comply with the requirements of SPP 5.4, the following noise mitigation options are recommended:

- Buffer to residential use.

  If no noise control in the form of barriers are instituted, then a buffer, or setback for residential land use can be adopted. Based on the modelled noise levels for the future highway, distances for the setback would be in the order of 170 metres from the boundary of the development. Figure 5.2 shows this in more detail.

  This setback is based on there being no development within this zone and only residential housing for the future.

  Alternative development such as commercial use could be used in this area abutting the highway, with this commercial development providing a barrier for the residential premises behind. With this scenario it is likely that the setback for residential use would be reduced to be directly behind the commercial component.

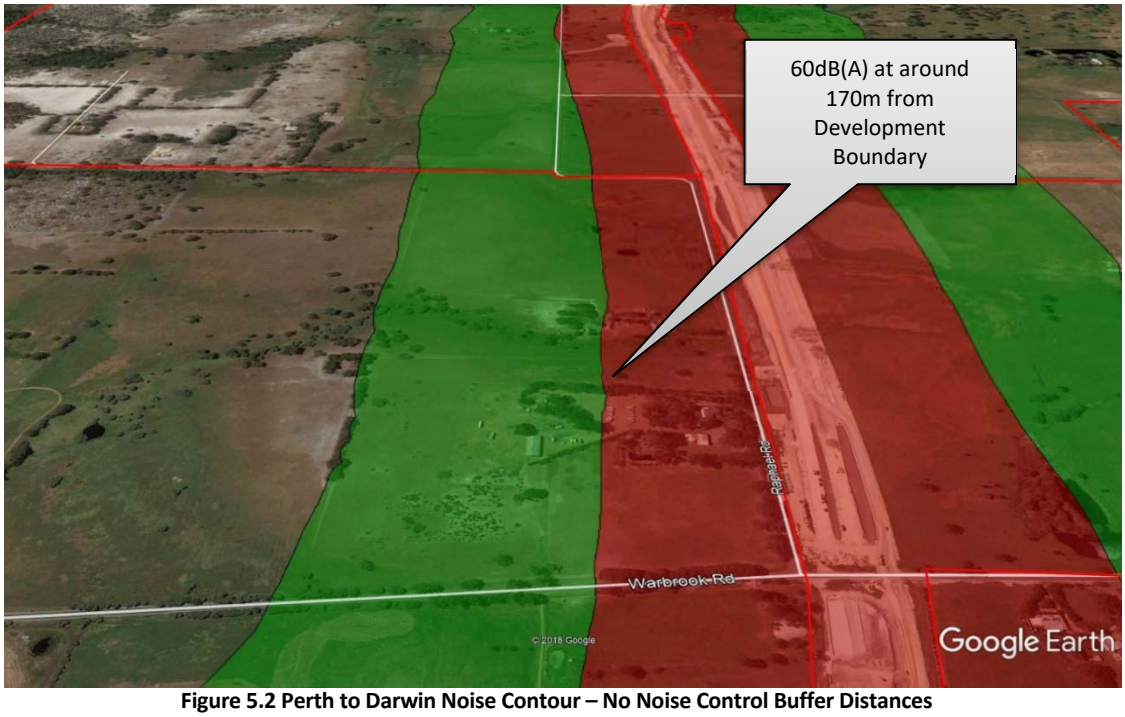


Figure 5.2 Perth to Darwin Noise Contour – No Noise Control Buffer Distances

- Barriers

  Noise control in the form of barriers, such as noise wall or earthen bunds have been investigated as a way of ameliorating the noise levels for future development.

  Figure 5.3 details the noise contour plot for a 3.0 metre noise wall at the eastern boundary of the development. A wall at this height reduces the buffer distance for residential land to around 100 metres from the boundary.

  It is noted that due to the distance of the highway from the boundary of the development, the effectiveness of barriers such as noise walls is greatly reduced. The most efficient use of walls is incorporated into the road design, hence are located close to the traffic noise source.

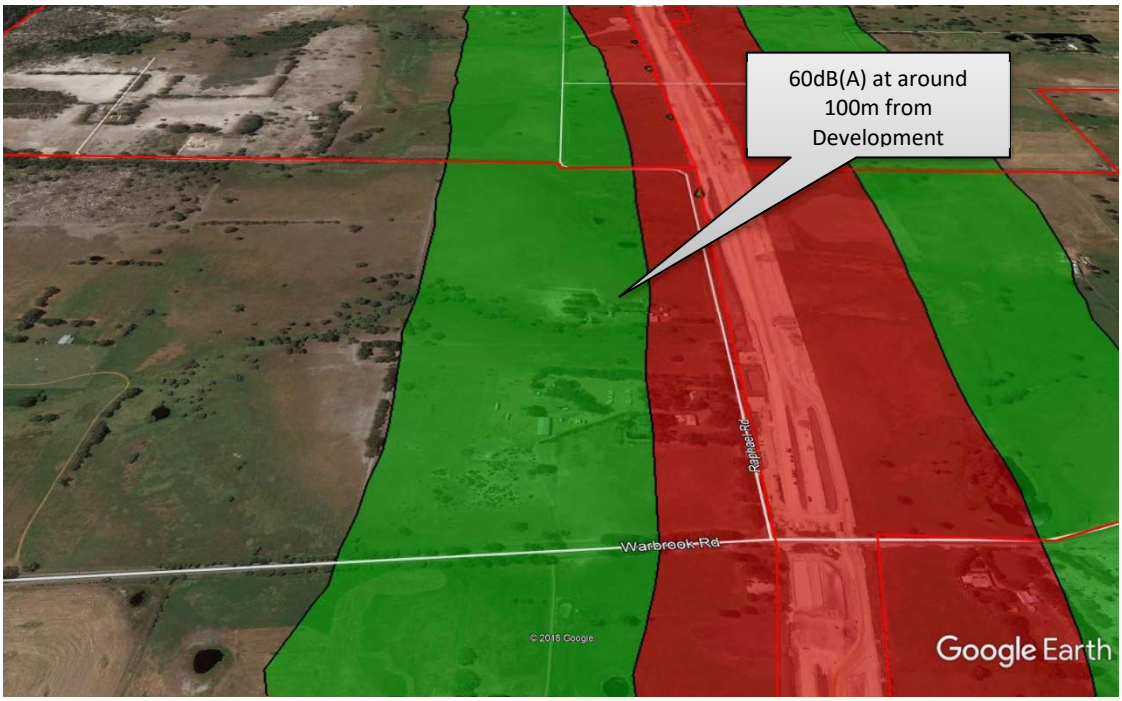


Figure 5.3 Perth to Darwin Noise Contour – 3.0m Noise Wall at Eastern Boundary

- Quiet House Design

  If considering residential development within areas above 60 dB(A) as per the previous two scenarios, quiet house design as outlined in SPP 5.4 guidance would be required to further ameliorate noise levels to meet internal noise level criteria.

  The package requirement depends on the external noise levels, however, for guidance Figure 5.4 details the quiet house design for the future noise levels associated with the highway, without any noise control in the form of barriers.

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

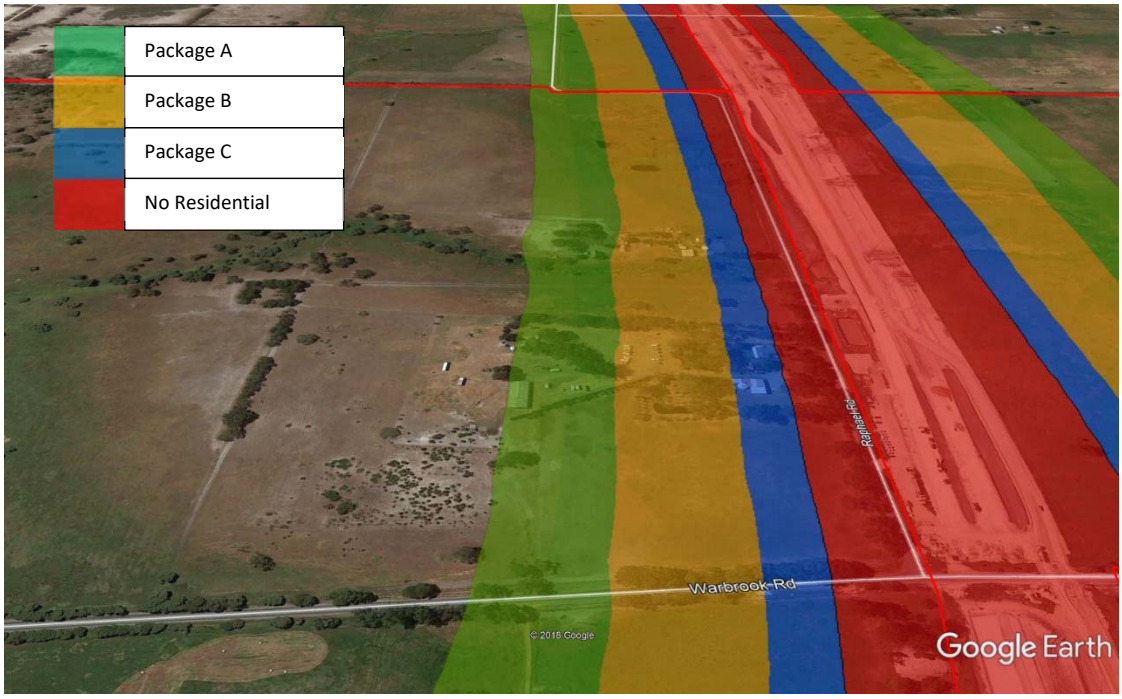


Figure 5.3 Perth to Darwin Noise Contour – Quiet House Design – No Barriers

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 is 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 We understand that the development is a structure plan stage, hence the information contained in Appendix D regarding areas requiring "Quiet House" design will need to be refined once the lots have been defined. Additionally, any modifications to the Structure Plan, would vary the noise mitigation requirements relating to barriers and "Quiet House" design outlined in Appendix C.

3 The summary of the Quiet House Design Packages are attached in Appendix 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.

4 For residence with access roads between the residence and the Perth Darwin Highway (i.e. front of residence facing the highway) incorporate "Quiet House" design into the design of each residence. In these cases, the residence itself provides a barrier to the back yard, thus noise received at the outdoor area would comply with the required acoustic criteria.

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

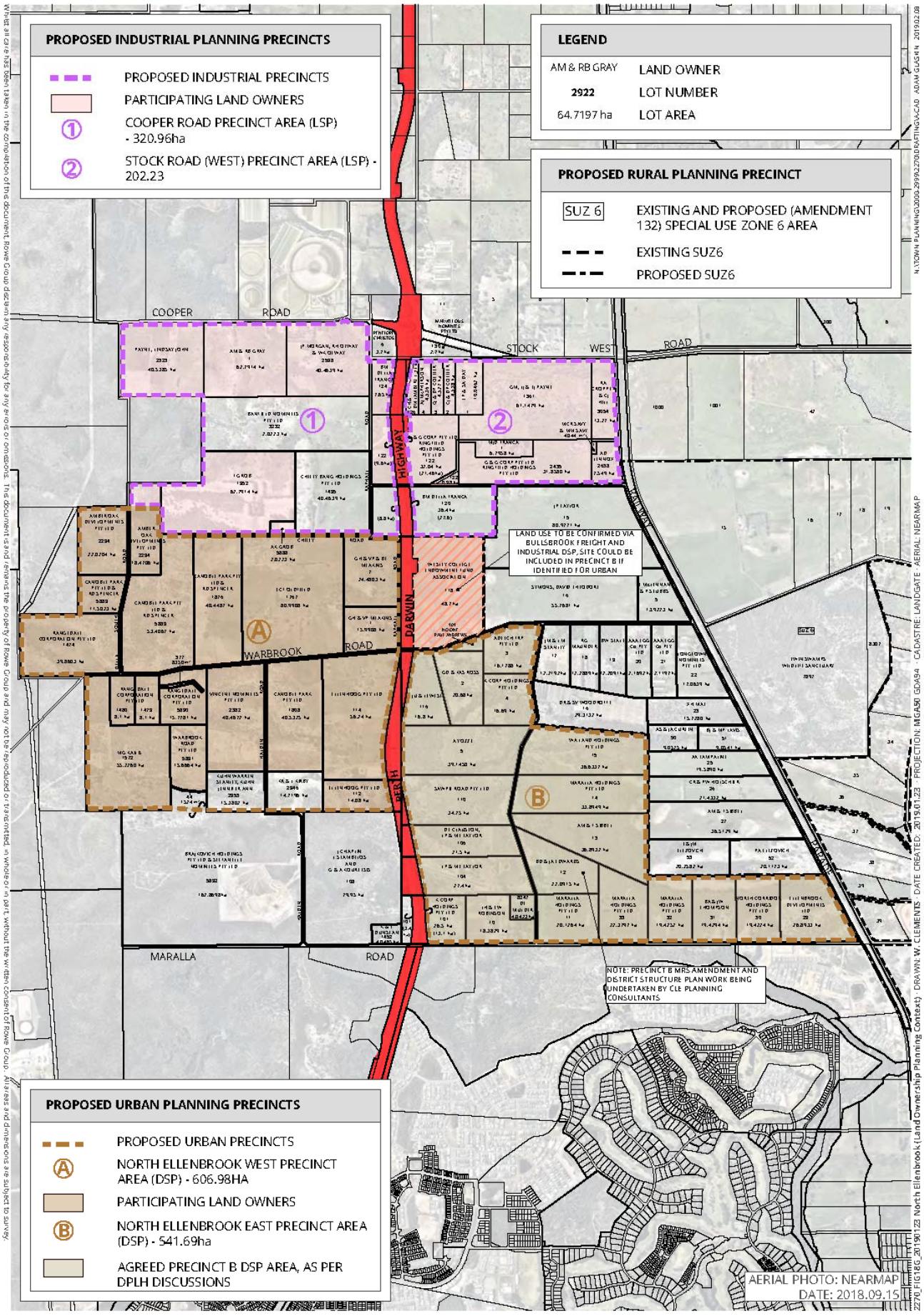
6 Additionally, these residences also require Notifications on Titles.

7 Assessment of noise for the southern portion of the site relates to sand operations to the south of the development. The main influence is truck accessing the private road, however, compliance is achieved as it is day time (0700 to 1900 hours) operations. It should also be noted that the truck access via the private road is only temporary and will be removed upon development of the site.

With regards to the noise levels for surrounding environmental impacts, such as industry, analysis showed no significant impact. Noise contour plot of the industry sources has been included in Appendix E for reference. It is noted that as there are existing residential premises throughout the proposed LSP, any future industry in the vicinity of the development would be required to comply with the regulatory criteria contained in the *Environmental Protection (Noise) Regulations 1997*.

APPENDIX A

LOCAL STRUCTURE PLAN



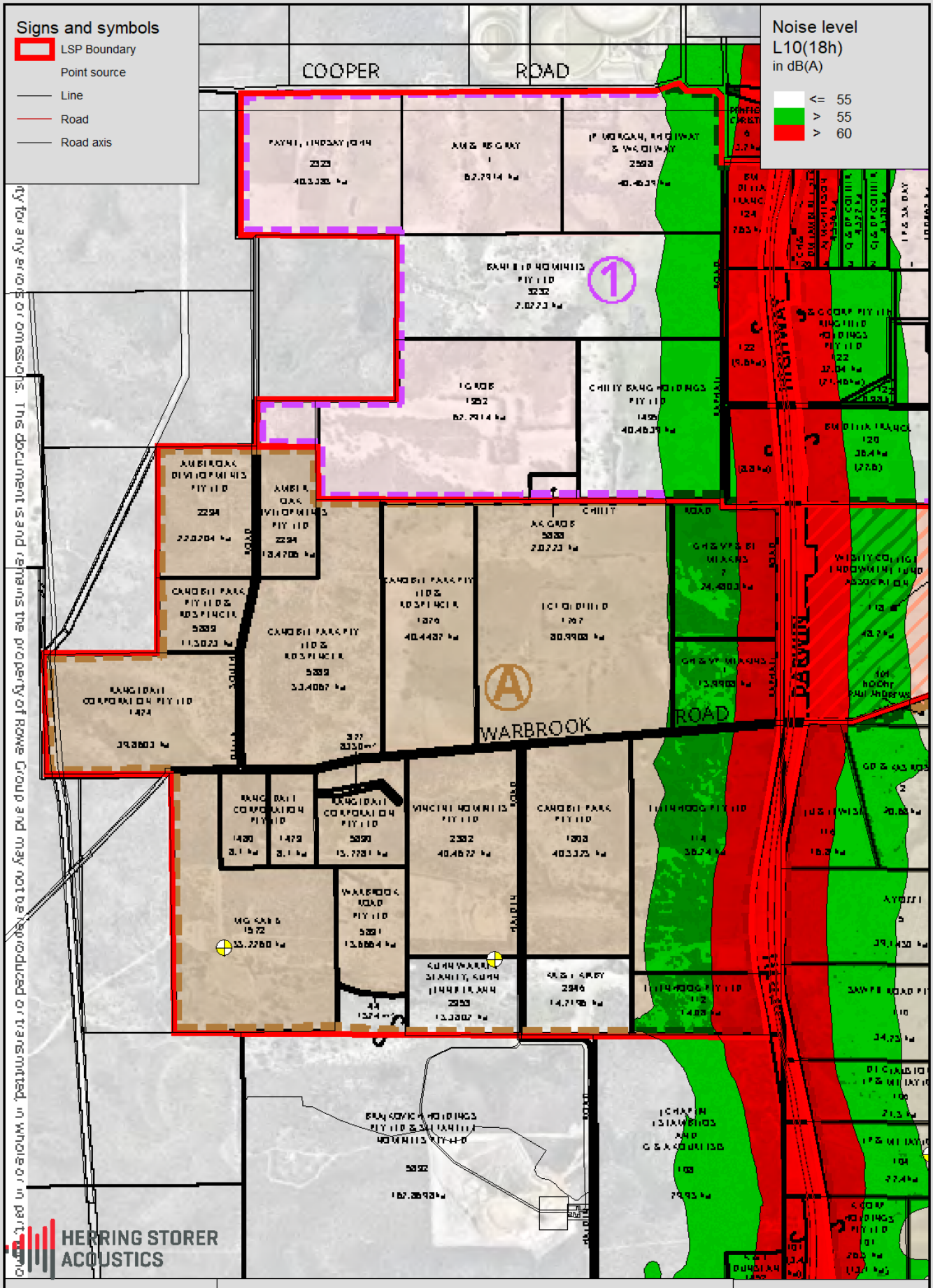
N:\TOWN PLANNING\2000-2999\2270\DRAFTING\A-CAD ADAM GUGLIA 20190228
2270_FIG18G_20190123 North Ellenbrook (Land Ownership Planning Context) DRAWN: W. CLEMENTS DATE CREATED: 2019.01.23 PROJECTION: MGA50 GDA94 CADASTRE: LANDGATE AERIAL: NEARMAP

0 1000 m
SCALE @ A4: 1:40,000

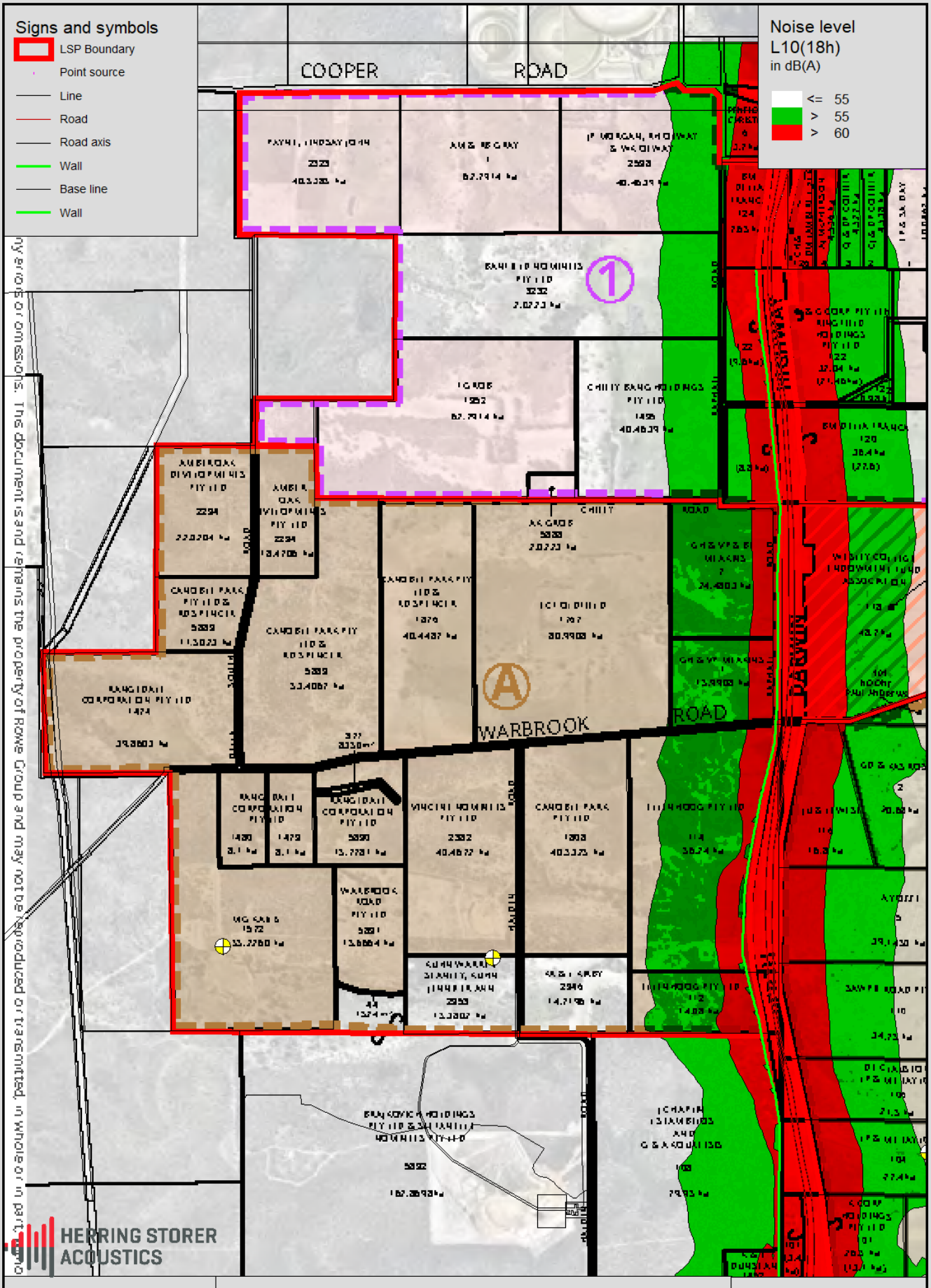
FIGURE 11
PLANNING CONTEXT AND LAND OWNERSHIP

APPENDIX B

FIGURES B1 and B2
$L_{Aeq(16hr)}$ DAY
NOISE CONTOURS FOR PERTH – DARWIN HIGHWAY



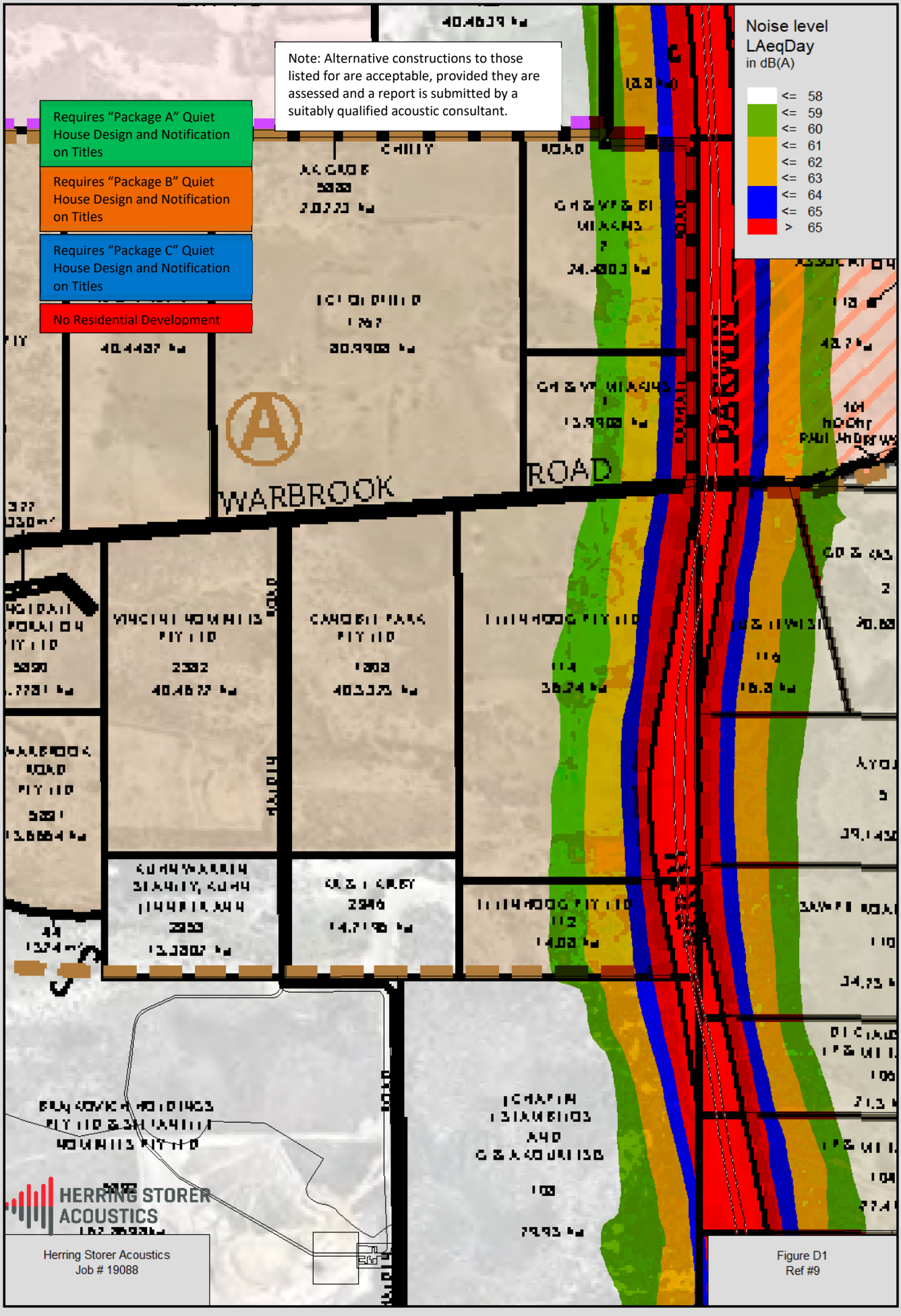
Herring Storer Acoustics Job # 19088	ROAD TRAFFIC FUTURE NOISE LEVELS LAEQ DAY NOISE LEVEL CONTOUR PLOT	Figure B1 Ref #9



Herring Storer Acoustics Job # 19088	ROAD TRAFFIC FUTURE NOISE LEVELS LAEQ DAY NOISE LEVEL CONTOUR PLOT 3.0 METRE WALL AT EASTERN BOUNDARY	Figure B2 Ref #13

APPENDIX C

AREAS REQUIRING “QUIET HOUSE” DESIGN AND NOTIFICATIONS


Noise level
LAeqDay
in dB(A)
<= 58
<= 59
<= 60
<= 61
<= 62
<= 63
<= 64
<= 65
> 65
Note: Alternative constructions to those listed for are acceptable, provided they are assessed and a report is submitted by a suitably qualified acoustic consultant.
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
No Residential Development
WARBROOK ROAD
HERRING STORER ACOUSTICS
Herring Storer Acoustics
Job # 19088
Figure D1
Ref #9

APPENDIX D

"QUIET HOUSE" DESIGN – GENERAL INFORMATION

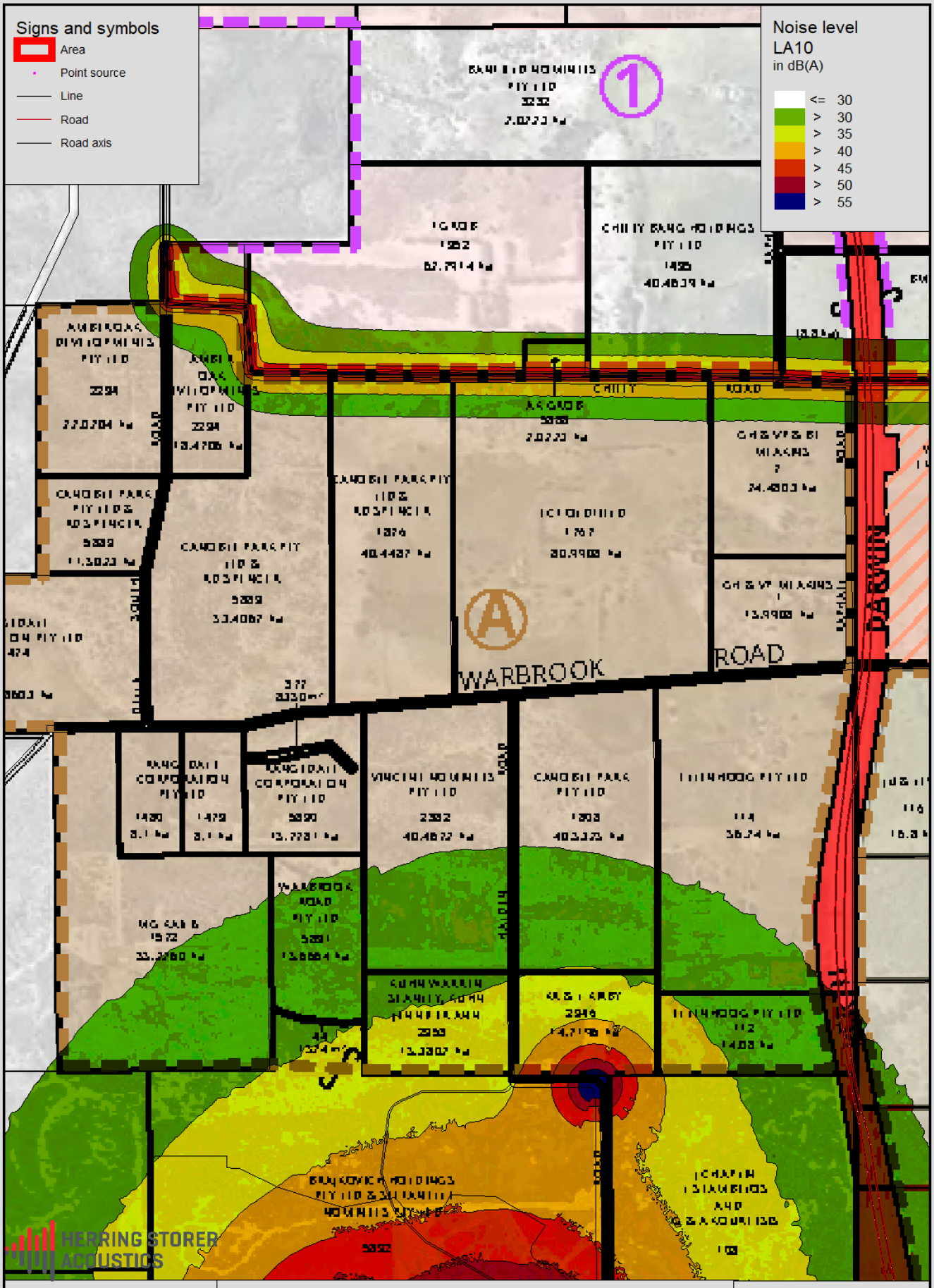
SPP 5.4 TABLE 6.3 – ACCEPTABLE TREATMENT PACKAGES

Area	Orientation to road or rail corridor	Package A L_{Aeq},Day up to 60dB L_{Aeq},Night up to 55dB	Package B L_{Aeq},Day up to 63dB L_{Aeq},Night up to 58dB	Package C L_{Aeq},Day up to 65dB L_{Aeq},Night up to 60dB
Bedrooms	Facing	• Walls to R_w+C_{tr} 45dB • Windows and external door systems: Minimum R_w+C_{tr} 28dB (Table 6.4), total glazing area up to 40% of room floor area. [if R_w+C_{tr} 31dB: 60%] [if R_w+C_{tr} 34dB: 80%] • Roof and ceiling to R_w+C_{tr} 35dB (1 layer 10mm plasterboard) • Mechanical ventilation as per Section 6.3.1	• Walls to R_w+C_{tr} 50dB • Windows and external door systems: Minimum R_w+C_{tr} 31dB (Table 6.4), total glazing area up to 40% of room floor area. [if R_w+C_{tr} 34dB: 60%] • Roof and ceiling to R_w+C_{tr} 35dB (1 layer 10mm plasterboard) • Mechanical ventilation as per Section 6.3.1	• Walls to R_w+C_{tr} 50dB • Windows and external door systems: Minimum R_w+C_{tr} 34dB (Table 6.4), total glazing area limited to 40% of room floor area [if 20% of floor area or less, R_w+C_{tr} 31dB] • Roof and ceiling to R_w+C_{tr} 40dB (2 layers 10mm plasterboard) • Mechanical ventilation as per Section 6.3.1
	Side-on	•As above, except glazing Rw+Ctr values for each package may be 3dB less, or max % area increased by 20%		
	Opposite	• No requirements	• As per Package A 'Side On'	• As per Package A 'Facing'
Indoor living and work Areas	Facing	• Walls to Rw+Ctr 45dB • Windows and external door systems: Minimum Rw+Ctr 25dB (Table 6.4), total glazing area limited to 40% of room floor area. [if Rw+Ctr 28dB: 60%] [if Rw+Ctr 31dB: 80%] • External doors other than glass doors to Rw+Ctr 26dB (Table 6.4) • Mechanical ventilation as per Section 6.3.1	• Walls to Rw+Ctr 50dB • Windows and external door systems: Minimum Rw+Ctr 28dB (Table 6.4), total glazing area up to 40% of room floor area. [if Rw+Ctr 31dB: 60%] [if Rw+Ctr 34dB: 80%] • External doors other than glass doors to Rw+Ctr 26dB (Table 6.4) • Mechanical ventilation as per Section 6.3.1	• Walls to R_w+C_{tr} 50dB • Windows and external door systems: Minimum R_w+C_{tr} 31dB (Table 6.4), total glazing area up to 40% of room floor area. [if R_w+C_{tr} 34dB: 60%] • External doors other than glass doors to R_w+C_{tr} 30dB (Table 6.4) • Mechanical ventilation as per Section 6.3.1
	Side-on	• As above, except the glazing R_w+C_{tr} values for each package may be 3dB less, or max % area increased by 20%		
	Opposite	• No requirements	• As per Package A 'Side On'	• As per Package A 'Facing'
Other indoor areas	Any	• No requirements	• No requirements	• No requirements
Outdoor living areas	Any (Section 6.2.3)	• As per Package C, 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	• As per Package C, and/or • At least one ground level outdoor living area screened using a solid continuous fence or other structure of minimum 2.4 metres height above ground level	• At least one outdoor living area located on the opposite side of the building from the transport corridor

Note: The above treatments are a deemed to satisfy construction. Alternative designs are acceptable, provided they are certified by a suitable qualified acoustic consultant

APPENDIX E

INDUSTRY NOISE CONTOUR PLOT



Herring Storer Acoustics Job # 19088	Noise Contour Plot Industry Noise Sources	Figure B3 Ref #11