Appendix B
Train and Noise Vibration Study & Road Noise Study

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COCKBURN COAST DEVELOPMENT

TRAIN
NOISE and VIBRATION STUDY

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COCKBURN COAST

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APPENDICES

EXECUTIVE SUMMARY

Landcorp commissioned Herring Storer Acoustics to carry out an acoustic study with regards to rail related noise for the proposed Cockburn Coast development.

The purpose of the study was to:

- Monitor existing noise emissions from trains passing on the Freight Line.
- Assess the noise that would be received within the development area from freight trains passing on the neighbouring railway line.
- Assess ground vibration that would be received within the development area from the freight trains passing on the neighbouring railway line.
- Compare the results with accepted criteria and if exceedances exist, develop the framework for the management of noise and vibration.

With regards to noise received within the development from train movements on the freight railway line, the acoustic criteria used was as outlined in the WAPC State Planning Policy 5.4 "*Road and Rail Transportation Noise and Freight Consideration in Land Use Planning*".

With regards to ground vibration from train movements on the freight railway line, the criteria was based on 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)"*.

Under the Western Australian Planning Commission (WAPC) Planning Policy 5.4 *"Road and Rail Transport Noise and Freight Considerations in Land Use Planning"* (SPP5.4), we believe that the appropriate criteria for assessment for this development are as listed below for "Noise Limits".

EXTERNAL

$L_{Aeq(Day)}$ of 60 dB(A); and
$L_{Aeq(Night)}$ of 55 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.

Noise received at an outdoor area should also comply with the L_{Aeq} of 50 dB(A) during the night period.

We believe that the acceptable criteria for ground vibration from passing freight trains would be base curve x2 as defined in 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)"*. However, the Department of Environment and Conservation has expressed a preference that the 1.4 times the base curve be used as the criteria. Thus, for this study both criteria have been considered.

Noise levels recorded on site, indicate that noise emissions from passing trains varies slightly across the site and also with direction. The measurements and noise modelling indicate that using the number of train movements as outlined in the implementation guidelines (i.e. 1 per hour) that compliance with the above external criteria would occur at a distance of approximately 50 metres from the railway line. However, to maintain the amenity of future residence and to provide some "future proofing" to not apply any restrictions to the number of train movements, it is proposed that the noise level for a single train pass be used as the bases for any improved construction. To this end, it is recommended that any development located

within 150 metres of the railway line have an acoustic assessment, based on the noise levels as listed in Table 5.1, as part of the design, with an acoustic assessment submitted with the building license application.

We note that under the Planning Policy, as noise received within the proposed development would exceed the “Noise Target”, notification on Titles is required for residence with exposure to the Freight Line.

The measurements of ground vibration indicate that the propagation of ground vibration varies across the development area. We believe that at the southern end of the development site, due to the previous usage as a rail marshalling yard, that the ground has been compacted and the propagation of ground vibration is greater than for the northern end. Based on the ground vibration measurements recorded, the distance from the railway line to achieve compliance with both the 1.4 times and 2 times the base curve criteria would be as listed in the following Table.

Distance to Comply with Ground Vibration Criteria

Location	Criteria / Distance (m)	
	1.4 x Base Curve	2 X Base Curve
Northern End (Marshalling Yard)	80	65
Remainder of Development	50	30

Note: The above distances are approximate and variations will occur due to differences in geology.

We note that distances stated above do not exclude development within those distances, however, depending on the relative levels of the railway line and premises; the proposed barrier (if any) the distance to achieve compliance may be reduced or alternatively, additional amelioration may be required.

A plan indicating the locations requiring noise and / or vibration assessments are shown on Figure D1 attached in Appendix D.

1. INTRODUCTION

Landcorp commissioned Herring Storer Acoustics to carry out an acoustic study with regards to rail related noise for the proposed Cockburn Coast development.

The purpose of the study was to:

- Monitor and carry out hand held measurements of existing noise emissions from trains passing on the Freight Line.
- Assess the noise that would be received within the development area from freight trains passing on the neighbouring railway line.
- Measure and assess ground vibration that would be received within the development area from the freight trains passing on the neighbouring railway line.
- Compare the results with accepted criteria and if exceedances exist, develop the framework for the management of noise and vibration.

A concept plan is attached in Appendix A.

2. ACOUSTIC CRITERIA

2.1 WAPC PLANNING POLICY

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.

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.

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.

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."

5.4 Policy measures for infrastructure redevelopment proposals and freight handling facilities

5.4.1 Redevelopment proposals for existing major road and rail infrastructure

Where policy measures have been triggered by a redevelopment proposal for existing major road or railway infrastructure under section 5.2.2 or 5.2.3, the following policy measures apply.

1) *A screening noise assessment and, if necessary, a detailed assessment should be conducted in accordance with the guidelines.*
2) *Practicable noise management and mitigation measures should be considered in accordance with sections 5.6 and 5.8 of this policy, having regard to –*
    - *the existing transport noise levels;*
    - *the likely changes in noise emissions resulting from the proposal; and*
    - *the nature and scale of the works and the potential for noise amelioration.*

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).

3) *The proponent should prepare a noise management plan for the redevelopment works in accordance with the guidelines, and in consultation with the state environmental agency and local government.*

5.4.2 Proposed new freight handling facilities

In determining appropriate policy measures for proposed new freight handling facilities, it should be recognised that some noise emissions (for example, from trucks on the premises) are required to meet the Environmental Protection (Noise) Regulations 1997. The noise emissions from the operation of trains at the freight handling facility will depend on the nature of the operations; in the case of a proposed new freight handling facility, appropriate noise criteria must be developed in consultation with the state environmental agency.

If major or minor redevelopments of the railways in a freight handling facility trigger policy measures under section 5.2.3, the procedure in section 5.4.1 should be followed.

5.5 Noise assessment

All noise assessments carried out for the purposes of this policy should be conducted in accordance with the guidelines, and they are the responsibility of the developer and/or infrastructure provider.

The guidelines give detailed information on methods for measuring and predicting transport noise levels for the purpose of undertaking noise assessments.

For new noise-sensitive developments, noise assessments should generally be conducted as early as is practicable in the planning process, typically at the scheme amendment or structure planning stage. The implementation of the outcomes of a noise assessment may become a condition of approval of a subdivision.

In complex cases, it may be appropriate for the detailed assessment report or noise management plan to be referred to the state environmental agency for review.

5.6 Possible noise management and mitigation measures

A range of noise mitigation measures are available to meet the noise criteria. These include –

- *using distance to separate noise-sensitive land uses from noise sources;*
- *construction of noise attenuation barriers such as earth mounds and noise walls;*
- *building design, such as locating outdoor living areas and indoor habitable rooms away from noise sources;*
- *building construction techniques, such as upgraded glazing, ceiling insulation and sealing of air gaps. Note that where upgraded glazing is required, the benefit is only realised when windows are kept closed and, as such, mechanical ventilation should also be considered in these circumstances;*
- *planning and design of the road or rail project such as construction in cut, traffic management or the use of low-noise road surfaces.*

The guidelines provide more detail on the range of noise mitigation measures and their potential for noise reduction. It is expected that noise management and mitigation strategies will be identified and implemented through a noise management plan, having regard to the guidelines, and will be –

- *effective in reducing noise;*
- *practical and appropriate for the situation; and*
- *compatible with other relevant planning policies.*

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.

5.8 Reasonable and practicable measures

This policy applies a performance-based approach to the management and mitigation of transport noise.

It is recognised that in a number of instances it may not be reasonable and practicable to meet the noise target criteria. Where transport noise is above the target level, measures are expected to be implemented that best balance reasonable and practicable considerations, such as noise benefit, cost, feasibility, community preferences, amenity impacts, safety, security and conflict with other planning and transport policies. In these cases the community should also be consulted to assist in identifying best overall solutions. The guidelines assist in outlining ways in which some reasonable

and practicable limitations can be addressed in a manner that also minimises transport noise.

It is further acknowledged that there may also be situations in which the noise limit cannot practicably be achieved, especially in the case of major redevelopment of existing transport infrastructure. Similarly, it may not be practicable to achieve acceptable indoor noise levels if the new development is located very close to the transport corridor. In these situations the primary focus should be on achieving the lowest level of noise, with other reasonable and practicable considerations being secondary to this objective.

In cases where the noise limit or indoor noise criteria cannot practicably be met, longer term strategies for land use planning, transport policy and vehicle emissions should be considered to minimise transport noise impact over time.

2.2 VIBRATION

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. In this case where the axis of the occupants varies or is not known Curve 4(a) has been used as the bases of assessment.

Table 2 in Appendix A of the standard lists the 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 2.0 times the base curve. 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 Environment and Conservation has expressed a preference that the 1.4 times the base curve be used as the criteria. Therefore, for this study ground vibration has been assessed for compliance with both the 1.4 and 2.0 times the base curve.

2.3 APPROPRIATE CRITERIA

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

EXTERNAL

$L_{Aeq(Day)}$ of 60 dB(A); and
$L_{Aeq(Night)}$ of 55 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.

With regards to ground vibration, we believe that, given the frequency of passing trains, the appropriate criteria for ground vibration is the 2x base curve 4(a).

3. MEASUREMENTS AND OBSERVATIONS

3.1 NOISE MONITORING

Noise logging was conducted on the site to determine the existing noise received from freight trains travelling on the adjacent freight line. Monitoring was carried out between Thursday 14 April 2011 and Thursday 21 April 2011.

The logger locations are shown on the concept plan attached in Appendix A.

Monitoring instrumentation comprised a calibrated RTA Noise Logger and Rion Calibrator.

The results for the logger located at the edge of the rail reserve are summarised in Table 3.1 and are presented graphically in Figure B1 in Appendix B.

TABLE 3.1: SUMMARY OF MEASURED NOISE LEVELS

Parameter	Measured Level dB(A)*
$L_{Aeq,\ day\ (6am\ to\ 10pm)}$	55.5
$L_{Aeq,\ night\ (10pm\ to\ 6am)}$	52.3

* It is normal practice to quote decibels to the nearest whole number. Fractions are retained here to minimise any cumulative rounding error.

Note: Given the current number of train movements, we believe that the noise monitoring would be representative of the background noise level in the area, rather than the acoustic environment relating to train movements.

3.2 SHORT TERM MEASUREMENTS

As part of the acoustic assessment, short term hand held noise level measurements were undertaken of passing trains. The results of these measurements are summarised in Table 3.2.

TABLE 3.2: SUMMARY OF NOISE LEVELS FOR TRAIN PASS

Parameter	Distance (m)	L_{Aeq} Noise Level (dB(A))
Train from Fremantle (North end)	50	62 (100 seconds)
Train from Fremantle (South end)	50	65 (95 seconds)
Train to Fremantle (North end)	50	58 (120 seconds)
Train from Fremantle (North end)	10	69 (110 seconds)

For information, the octave band for the L_{Aeq} of 65 dB(A) noise level recorded is listed in Table 3.3.

TABLE 3.3 – OCTAVE BAND DATA AT 50M

Octave band Centre Frequency (Hz) / Noise Level								
63	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	**dB(A)**
83	72	68	61	54	56	54	47	65

3.3 GROUND VIBRATION

To assess the ground vibration emanating from passing freight trains, ground vibration measurements were carried out of existing trains passing at the following locations:

1. Eastern side of tracks, at northern end of development (within the old marshalling yard area).

2. Eastern side of tracks, adjacent to southern railway crossing.

Measurements were recorded simultaneously at 30 and 50 metres from the railway line. Measurements were carried out in the 3 directional axis, parallel, perpendicular and vertically to the railway line. The results of the ground vibration measurements are summarised below in Table 3.4. The graphical representation of the ground vibrations are attached in Appendix C.

TABLE 3.4 – SUMMARY OF VIBRATION MEASUREMENTS

Train Direction	Measurement Axis	Distance from Train / Vibration Curve	
		30m	50m
1	Parallel to line	>4x	Base curve
	Perpendicular to line	>4x	<1.4x
	Vertical	Base Curve	Base curve
2	Parallel to line	<1.4x	Base curve
	Perpendicular to line	<2x	Base curve
	Vertical	<1.4x	Base curve

4. TRAIN MOVEMENTS

4.1 CURRENT USAGE

It is understood that the current number of trains passing through the development is approximately 4 per day.

4.2 FUTURE USE

From previous assessments, we understand that by the year 2017 the number of train movements would be 10 per day.

On a pro-rata basis, the number of train movements during the critical night period would be 4.

Based on the measured noise levels, noise emissions from passing trains, even at 1 movement from the Fremantle Port per hour, would comply with the acoustic criteria at a distance of less than 50 metres. However, to ensure that the amenity of residences are protected, regardless of the number of movements, it is proposed that noise emissions from a single train pass be used to determine the "Quiet House" design requirements. Based on the current proposed development plan, noise modelling was undertaken to determine the proposed developments that are likely to be influenced by train movements. It is proposed that those building, as shown on Figure D1 in Appendix D will require an acoustic assessment to be undertaken as part of the design process.

5. CALCULATIONS

Although we believe that projected number of train movements is unlikely, under the Implementation Guidelines, where the number of trains is unknown, it should be assumed that the number of train movements is 24 a day or 1 per hour. Based on the maximum noise level of 65 dB(A), the L_{Aeq} for day and night periods would be approximately 49 dB(A) at 50 metres. Based on this noise level, noise emissions from trains would comply with the 'Target' noise level of State Planning Policy 5.4 within a distance of 50 metres.

Additional to the above, noise modelling was undertaken to determine the noise level that would be received at various distances from the railway line. Noise modelling was undertaken using 'SoundPlan'. Additional noise modelling was also undertaken for noise received at various building facades. The resultant noise levels at various sources are listed in Table 5.1.

TABLE 5.1 - TRAIN NOISE LEVEL AT VARIOUS DISTANCES

Distance (m)	LOCATION / Noise Level (dB(A))			
	Northern End		Southern End	
	Facade Facing Railway	Facades Side-on to Railway	Facade Facing Railway	Facades Side-on to Railway
15	67	63	70	66
20	66	62	69	65
25	65	61	68	64
30	64	60	67	63
40	63	59	66	62
50 Measured	62	58	65	61
60	61	57	64	60
70	60	56	63	59

Note: Some noise levels within Table 5.1 have been rounded.

The Northern End refers to the low, medium to high density residential premises with the Southern End being from the activity centre. Refer to the divisional plan attached in Appendix A.

Given the distance that train noise emissions would influence noise received at a residence, noise modelling was undertaken using SoundPlan 7.0, utilising the Nordic Rail Prediction Method (Kilde rep. 130) algorithms.

Based on the measured noise levels, noise emissions from passing trains would comply with the requirements of the SPP 5.4 at a distance of less than 50 metres. However, to ensure the amenity of residence is protected regardless of the number of train movements, it is proposed that noise emissions from a single train pass be used to determine the "Quiet House" design requirements.

6. DESIGN CONSIDERATIONS

Based on the noise levels listed in Table 5.1, an assessment was made to determine the noise reduction rating (R_W) that would be required at the facade facing the railway line at various distances. R_W ratings were determined for both bedrooms and living spaces, based on the facade facing the railway line being glazed.

Based on the external noise levels, preliminary calculations were carried out to determine various acoustic ratings required to achieve acceptable internal noise levels. The required R_W ratings were calculated and the preliminary determination of glazing for bedrooms and living spaces are listed in Tables 6.1 and 6.2.

Table 6.1 – Bedroom Glazing Requirements

External Noise Level (dB(A))	R_w Value	Description of Construction
50 to 53	20 to 24	Openable - 6mm horizontal sliding window Fixed – 4mm glass
54 to 56	25 to 27	Openable – 6mm glass in awning type windows with mechanical winders closing on compressible seals. Fixed – 6mm glass
57 to 59	28 to 30	Openable – 6.38mm laminated glass in awning type windows with mechanical winders closing on compressible seals. Fixed – 6.38mm laminated glass Fixed – 10mm glass
60 to 63	31 to 34	Openable – 10.38mm laminated glass in awning type windows with mechanical winders closing on compressible seals. Fixed – 10.38mm laminated glass
64 to 66	35 to 37	Openable – 10.5mm laminated glass in awning type windows with mechanical winders closing on compressible seals. Fixed – 10.5mm laminated glass

Table 6.2 – Living Spaces Glazing Requirements

External Noise Level (dB(A))	R_w Value	Description of Construction
53 to 57	20 to 24	Openable - 6mm horizontal sliding window Fixed – 4mm glass
58 to 60	25 to 27	Openable – 6mm glass in awning type windows with mechanical winders closing on compressible seals. Fixed – 6mm glass
61 to 63	28 to 30	Openable – 6.38mm laminated glass in awning type windows with mechanical winders closing on compressible seals. Fixed – 6.38mm laminated glass Fixed – 10mm glass
64 to 67	31 to 34	Openable – 10.38mm laminated glass in awning type windows with mechanical winders closing on compressible seals. Fixed – 10.38mm laminated glass
67 to 70	35 to 37	Openable – 10.5mm laminated glass in awning type windows with mechanical winders closing on compressible seals. Fixed – 10.5mm laminated glass

Note: The above requirements are based on flat ground and the above may vary when the rail line is in a cutting.

At the southern end of the development area for residential developments located within 25 metres of the railway line with the R_W rating of 38 dB and higher, special or double glazing to bedrooms would be required.

7. DISCUSSION

7.1 TRAIN NOISE

Based on the measured noise levels, noise emissions from passing trains would comply with the requirements of the SPP 5.4 at a distance of less than 50 metres. However, to ensure that acceptable internal noise level within residences, regardless of the number of trains, it is proposed that noise emissions from a single train pass be used to determine the "Quiet House" design requirements. Based on the current proposed development plan, noise modelling was undertaken to determine the proposed developments that are likely to be influenced by trains movements.

To provide guidance on the noise reduction (R_W) and glazing that would be required for residential buildings within this development, an analysis of noise that would be received at various distances was undertaken. Based on the calculated noise levels as listed in Table 5.1, the required R_W and glazing required to achieve acceptable internal noise levels within bedrooms and living spaces were determined and the results are listed in Tables 6.1 and 6.2.

The R_W ratings listed would also apply to other external wall constructions and although the acoustic performance of these should be assessed as part of the design process, from experiences on previous projects, we believe that compliance with the required R_W ratings would be achieved with standard constructions.

It is recommended that any development located within 150 metres of the railway line have an acoustic assessment as part of the design, with an acoustic assessment submitted with the building license application.

7.2 TRAIN VIBRATION

We believe that the acceptable criteria for ground vibration from passing passenger trains would be base curve x 2 as defined in 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)"*. However, as the Department of Environment and Conservation has expressed a preference that the 1.4 times the base curve be used as the criteria. Thus, for this study both criteria have been considered.

The measurements of ground vibration undertaken as part of this study, indicate that the propagation of ground vibration varies across the development area. We believe that at the northern end of the development site, that due to the previous usage as a rail marshalling yard, that the ground has been compacted and the propagation of ground vibration is greater than for the southern end. Based on the ground vibration measurements recorded, the distance from the railway line to achieve compliance with both the 1.4 times and 2 times the base curve criteria would be as listed in Table 7.1.

Table 7.1 – Distance to Comply with Ground Vibration Criteria

Location	Criteria / Distance (m)	
	1.4 x Base Curve	2 X Base Curve
Northern End (Marshalling Yard)	80	65
Remainder of Development	50	30

Note: The above distances are approximate and variations will occur due to differences in geology.

We note that distances stated above do not exclude development within those distances, however, depending on the relative levels of the railway line and premises; the proposed barrier (if any) the distance to achieve compliance may be reduced or alternatively, additional amelioration may be required.

8. CONCLUSION

In accordance with the WAPC Planning Policy 5.4 an assessment of the noise that would be received within the development of Cockburn Coast Development Area from trains passing on the Freight Railway Line has been undertaken. Additionally, an assessment of ground vibration has also been undertaken.

8.1 TRAIN NOISE

In accordance with the Policy, the following would be the acoustics criteria applicable to this project:

External

Day	Maximum of 60 dB(A) L_{Aeq}
Night	Maximum of 55 dB(A) L_{Aeq}
Outdoor Living Areas	Maximum of 50 dB(A) L_{Aeq}

Internal

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

Noise received at an outdoor area should also comply with the L_{Aeq} of 50 dB(A) during the night period.

As part of the noise assessment, noise monitoring was undertaken using a noise data logger located at the edge of the rail reserve. For information, the results of the noise data logging are contained in Appendix B as Figure B1.

Noise levels recorded on site, indicate that noise emissions from passing trains varies slightly across the site and also with direction. The measurements and noise modelling indicate that using the number of train movements as outlined in the implementation guidelines (i.e. 1 per hour) that compliance with the above external criteria would occur at a distance of approximately 50 metres from the railway line. However, to maintain the amenity of future residence and to provide some "future proofing" to not apply any restrictions to the number of train movements it is proposed that the noise level for a single train pass be used as the bases for any improved construction. To this end, it is recommended that any development located within 150 metres of the railway line have an acoustic assessment, based on the noise levels as listed in Table 5.1, as part of the design, with an acoustic assessment submitted with the building license application.

We note that under the Planning Policy, as noise received within the proposed development would exceed the “Noise Target”, notification on Titles is required for residence with exposure to the Freight Line.

A plan indicating the locations requiring a noise assessment are shown on Figure D1 attached in Appendix D.

8.2 TRAIN VIBRATION

As part of the noise assessment, vibration monitoring and hand held ground vibration measurements were undertaken and the results are attached in Appendix C.

We believe that the acceptable criteria for ground vibration from passing passenger trains would be base curve x 2 as defined in 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)"*. However, as the Department of Environment and Conservation has expressed a preference that the 1.4 times the base curve be used as the criteria. Thus, for this study both criteria have been considered.

The measurements of ground vibration indicate that the propagation of ground vibration varies across the development area. We believe that at the southern end of the development site, that due to the previous usage as a rail marshalling yard, that the ground has been compacted and the propagation of ground vibration is greater than for the northern end. Based on the ground vibration measurements recorded, the distance from the railway line to achieve compliance with both the 1.4 times and 2 times the base curve criteria would be as listed in Table 8.1.

Table 8.1 – Distance to Comply with Ground Vibration Criteria

Location	Criteria / Distance (m)	
	1.4 x Base Curve	2 X Base Curve
Northern End (Marshalling Yard)	80	65
Remainder of Development	50	30

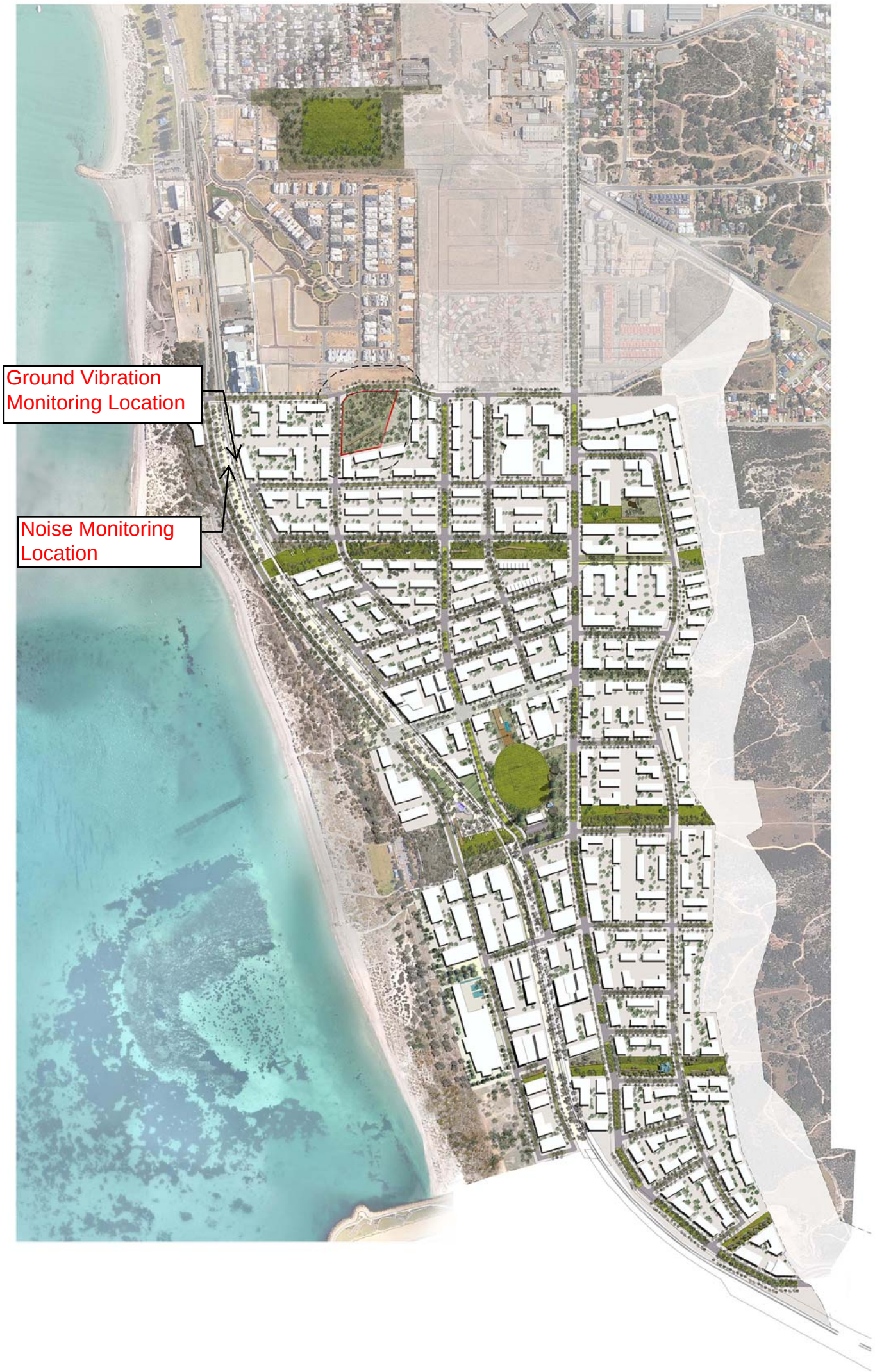
Note: The above distances are approximate and variations will occur due to differences in geology.

We note that distances stated above do not exclude development within those distances, however, depending on the relative levels of the railway line and premises; the proposed barrier (if any) the distance to achieve compliance may be reduced or alternatively, additional amelioration may be required.

A plan indicating the locations requiring a ground vibration assessment are shown on Figure D1 attached in Appendix D.

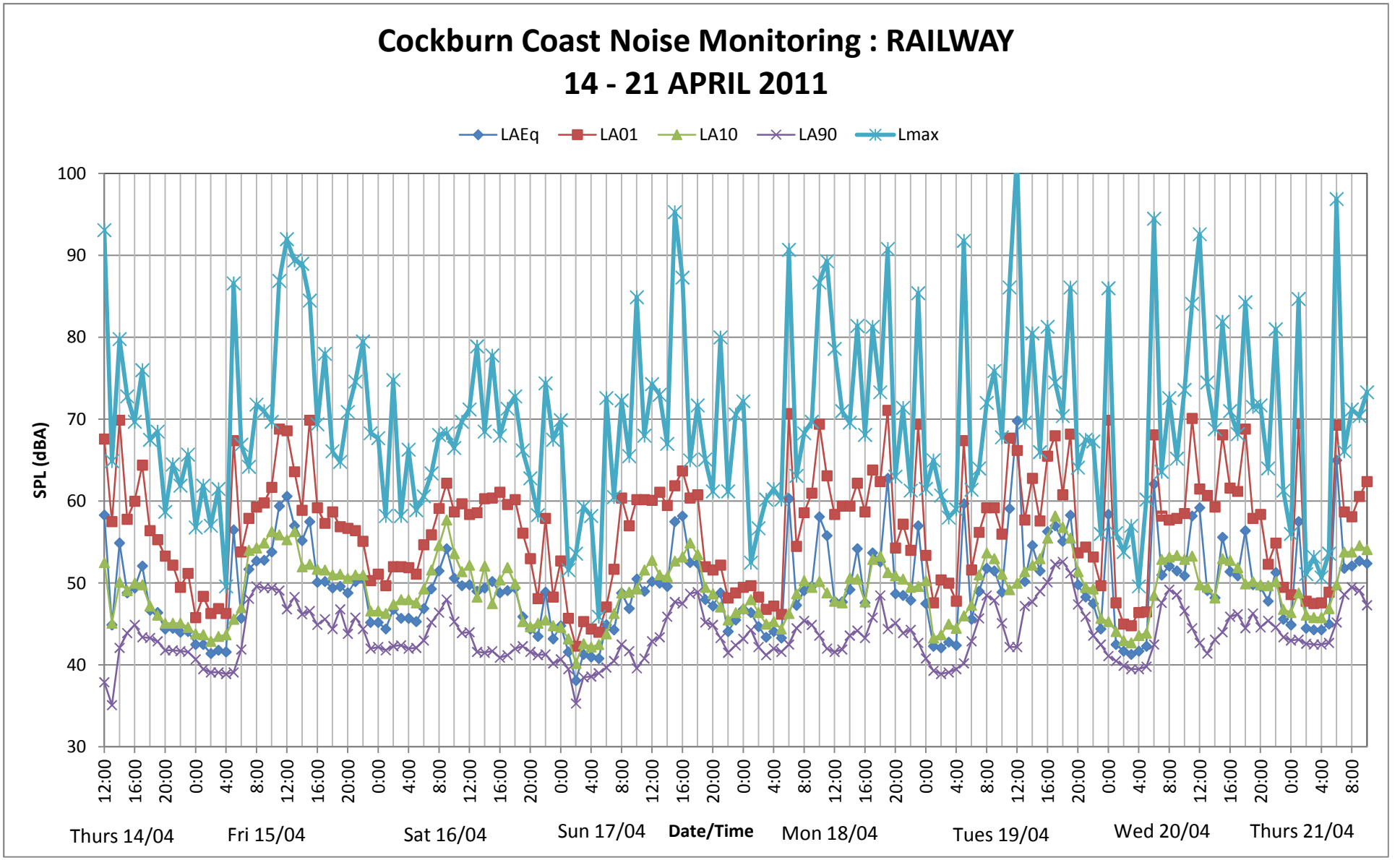
APPENDIX A

Site Layout – Master Plan


Ground Vibration Monitoring Location
Noise Monitoring Location

APPENDIX B

Graphical Representation of Logged Noise Levels



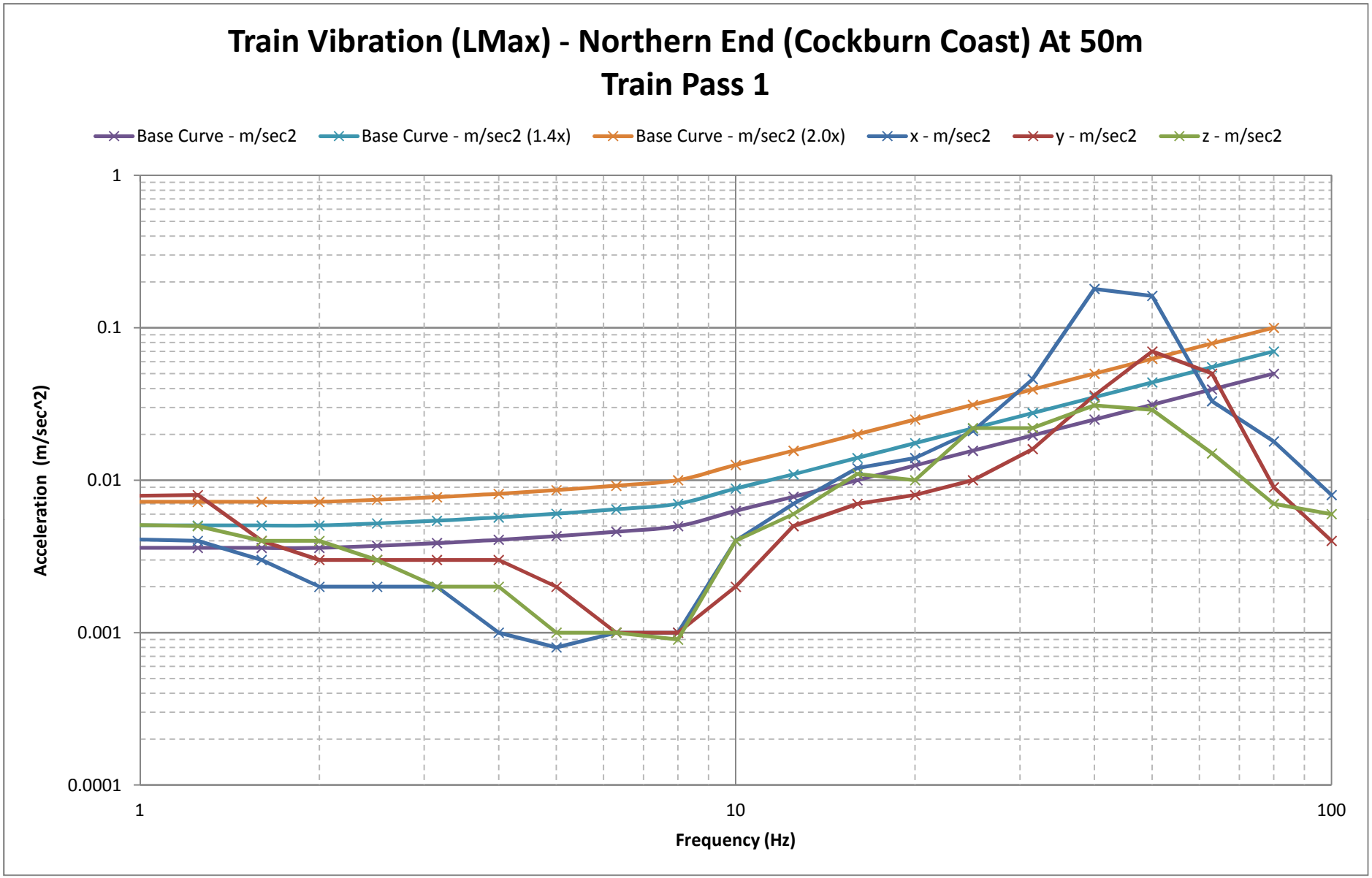
Herring Storer Acoustics
Job No : 11070
Date : 12 Oct 2011

Figure B1
Appendix B

APPENDIX C

Ground Vibration Measurements

Train Vibration (LMax) - Northern End (Cockburn Coast) At 50m
Train Pass 1



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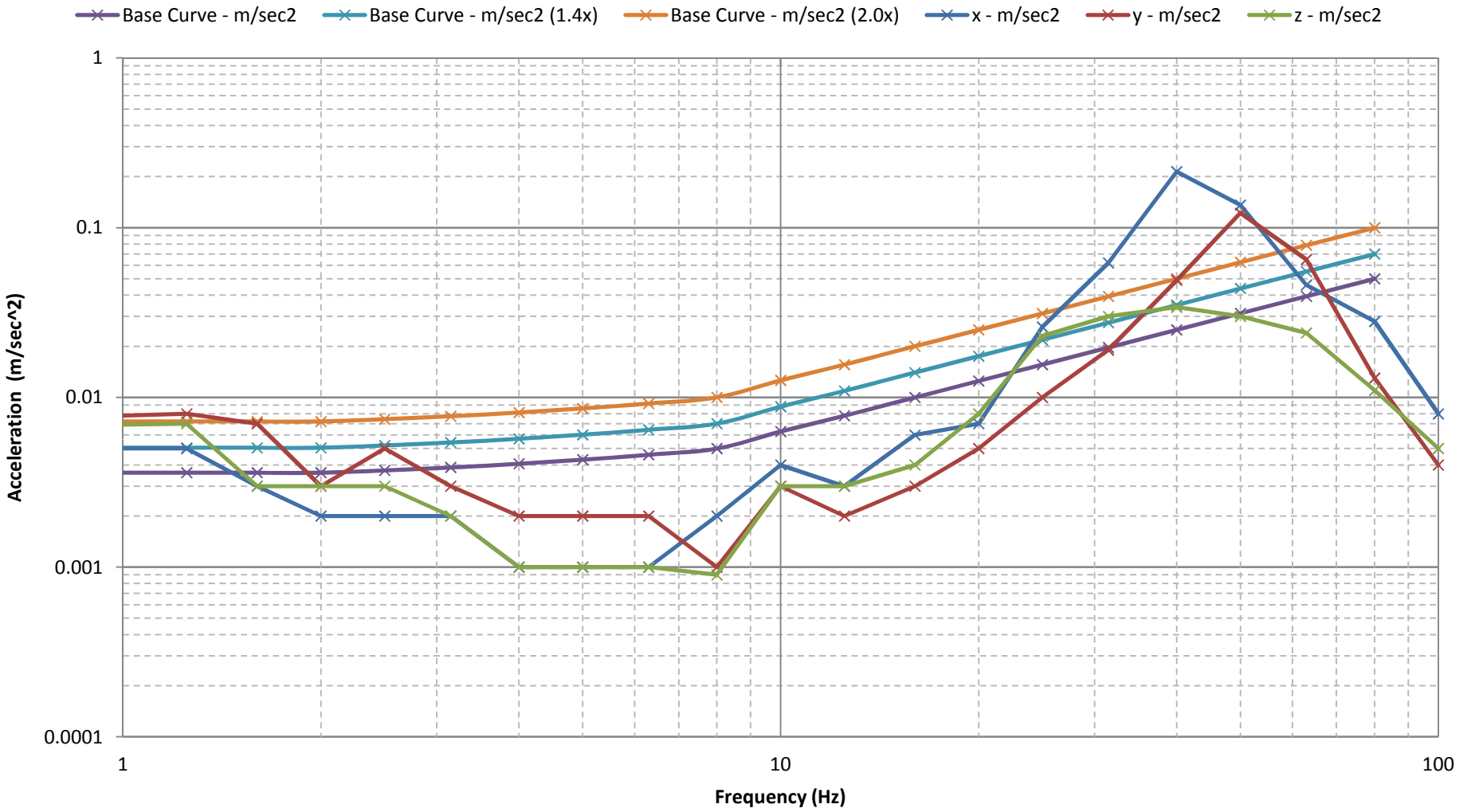
File : Vib North

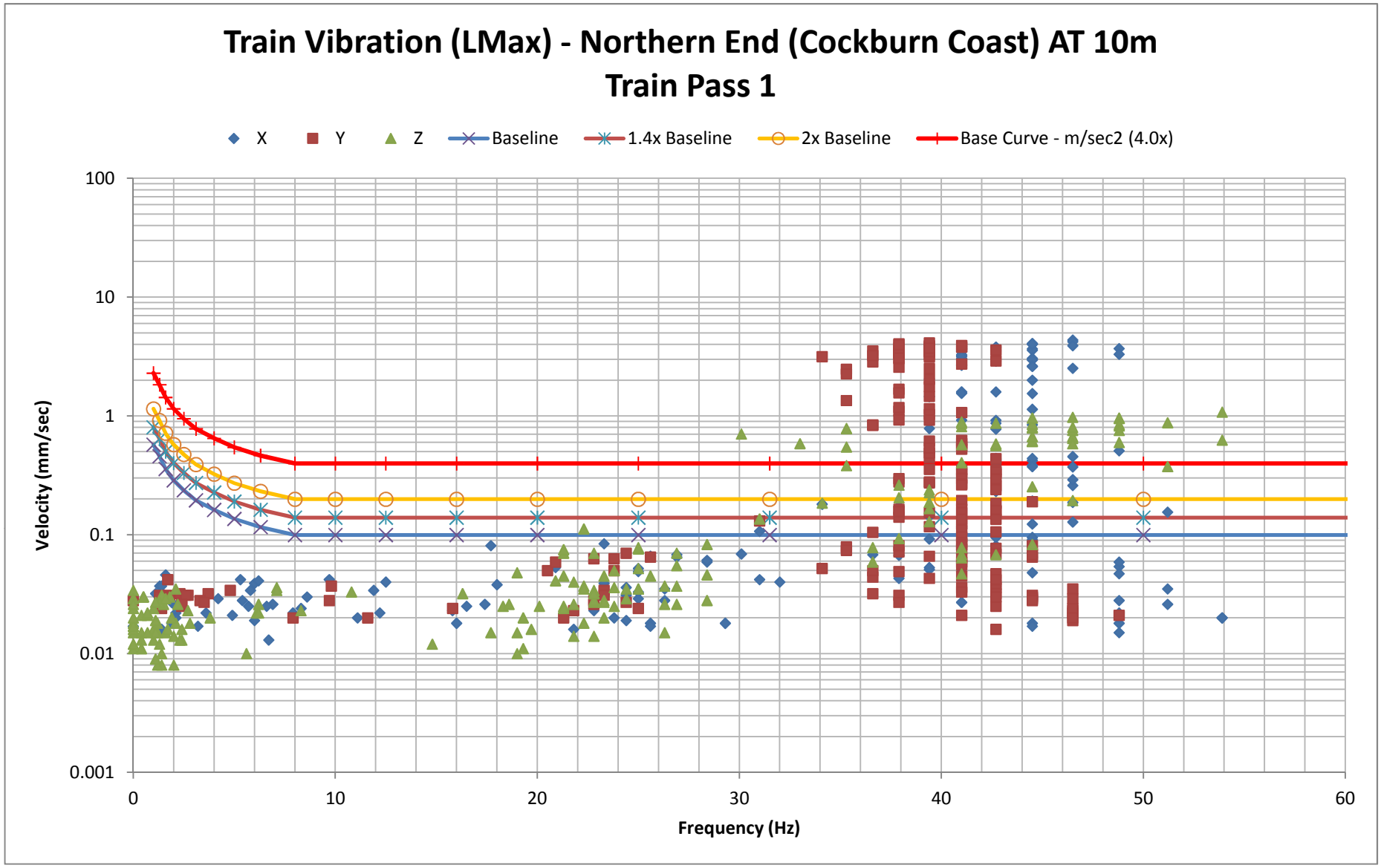
Figure C1
Appendix C

Train Vibration (LMax) - Northern End (Cockburn Coast) AT 50m
Train Pass 2



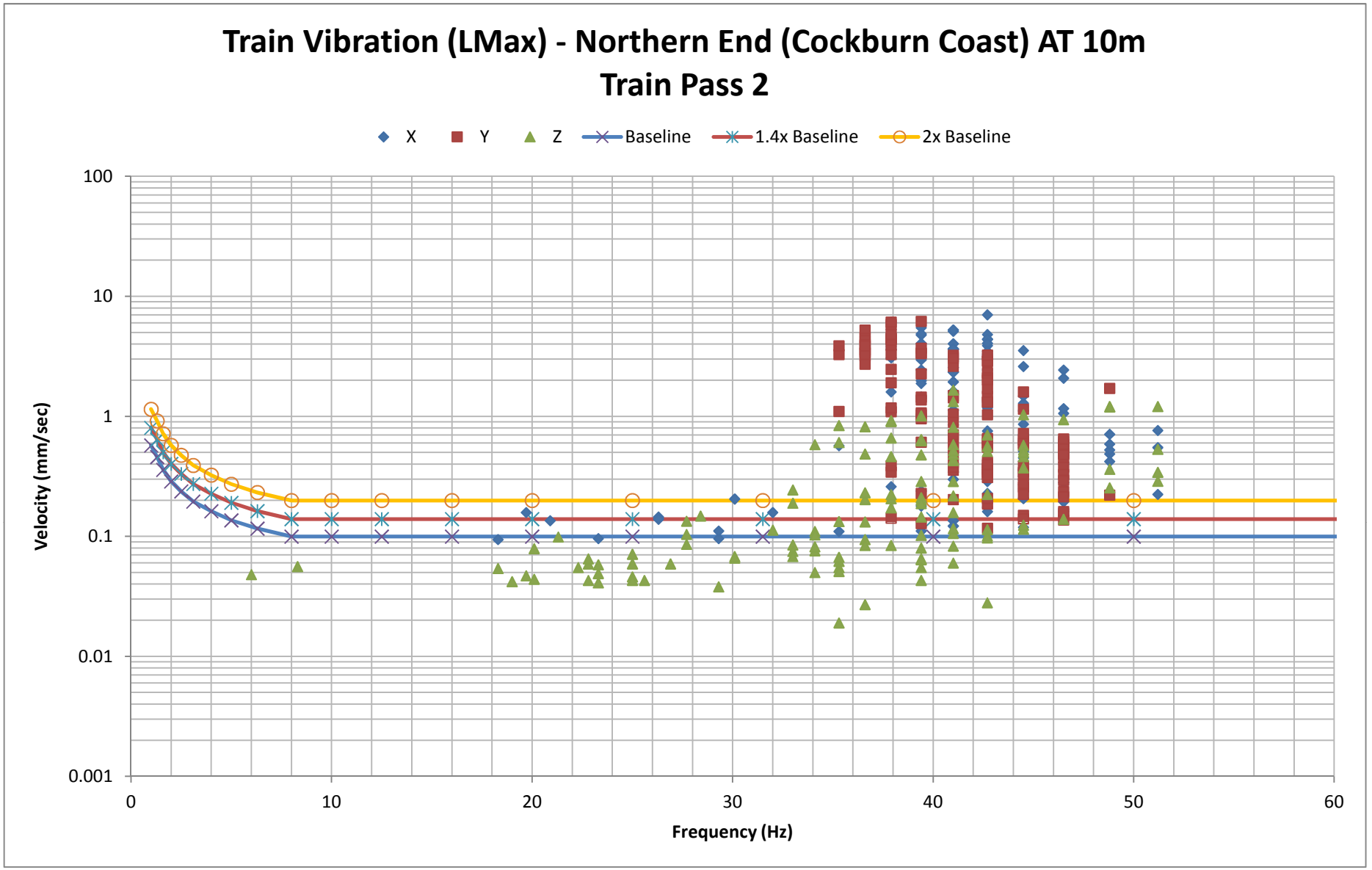
Herring Storer Acoustics
Job No : 11070
File : Vib North

Figure C2
Appendix C



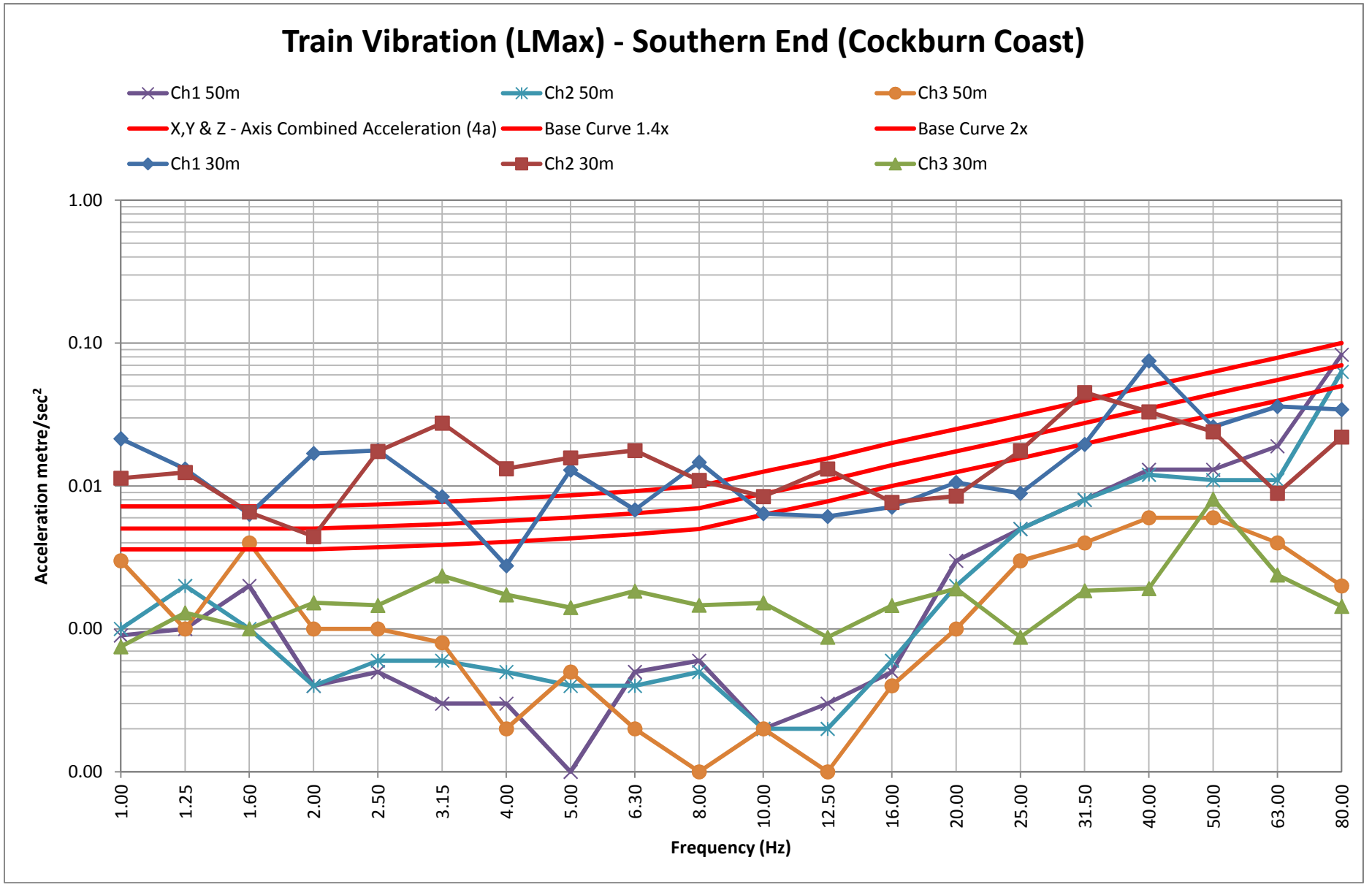
Herring Storer Acoustics
Job No : 11070
File : Vibro Train

Figure C3
Appendix C



Herring Storer Acoustics
Job No : 11070
File : Vibro Train

Figure C4
Appendix C

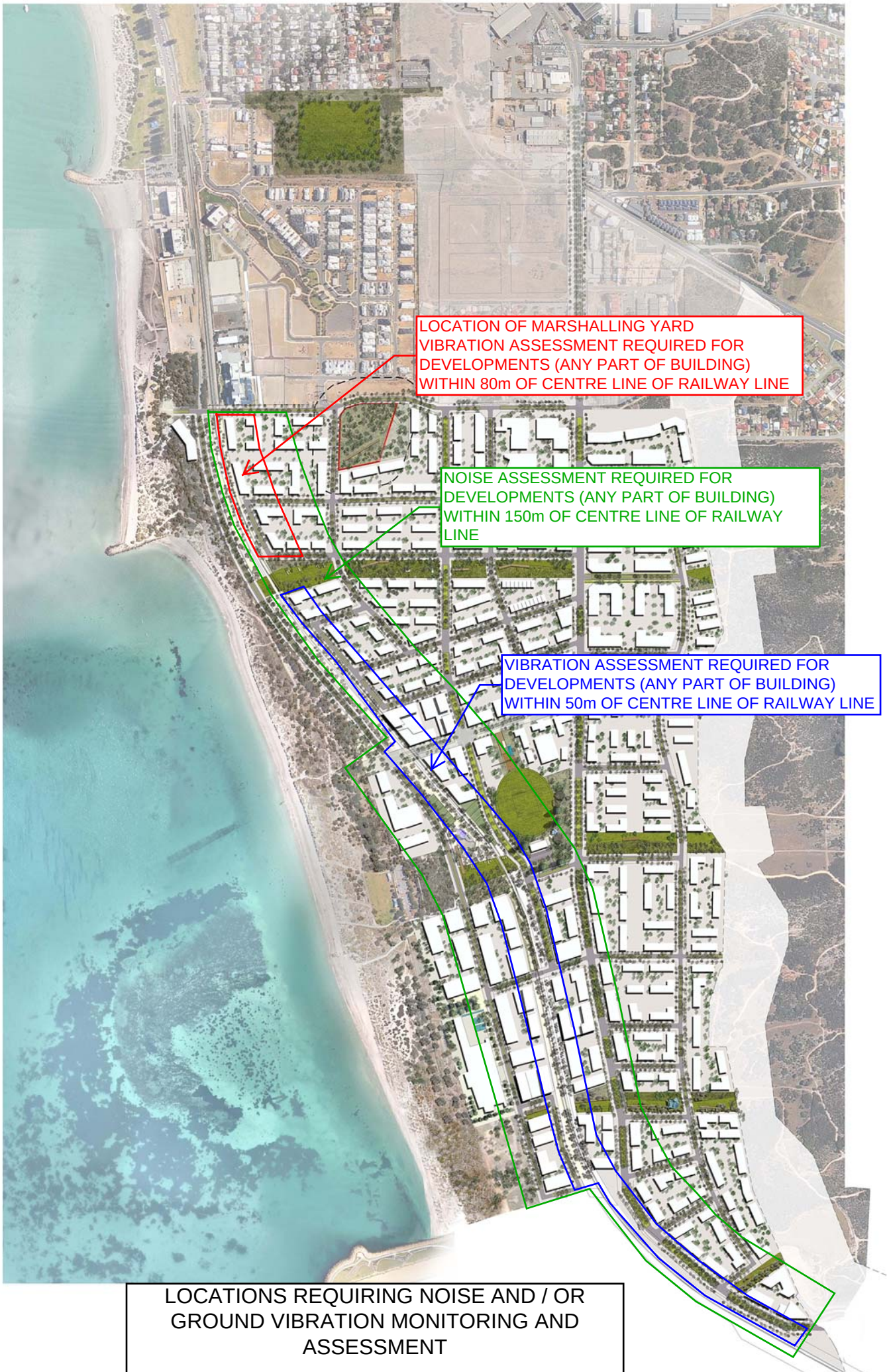


Herring Storer Acoustics
Job No : 11070
File : Vib South

Figure C6
Appendix C

APPENDIX D

Distance from Railway Line Requiring Noise
and / or Vibration Assessments



LOCATIONS REQUIRING NOISE AND / OR GROUND VIBRATION MONITORING AND ASSESSMENT

Figure D1
Appendix D

Rochdale Holdings Pty Ltd A.B.N. 85 009 049 067 trading as:
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LANDCORP

PROPOSED COCKBURN COAST DEVELOPMENT

ROAD NOISE ASSESSMENT

OCTOBER 2011

OUR REFERENCE: 13754-2-11070

DOCUMENT CONTROL PAGE

NOISE ASSESSMENT
COCKBURN COAST PROJECT

Job No: 11070

Document Reference: 13754-2-11070

FOR

LANDCORP

DOCUMENT INFORMATION			
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CONTENTS

APPENDICES

EXECUTIVE SUMMARY

Landcorp commissioned Herring Storer Acoustics to carry out an acoustic study relating to both road and rail related noise for the proposed Cockburn Coast development.

The purpose of this report was to assess noise received within the development from vehicles travelling along both Cockburn Road and the proposed Cockburn Coast Drive and if exceedance with the stated criteria were determined, establish the required attenuation measures to control noise intrusion to acceptable levels. The traffic noise assessment has been carried out in accordance with the new WAPC State Planning Policy 5.4 *"Road and Rail Transportation Noise and Freight Consideration in Land Use Planning"*.

Under the Western Australian Planning Commission (WAPC) Planning Policy 5.4 *"Road and Rail Transport Noise and Freight Considerations in Land Use Planning"* (SPP5.4), we believe that the appropriate criteria for assessment for this development are as listed below for "Noise Limits".

EXTERNAL

$L_{Aeq(Day)}$ of 60 dB(A); and
$L_{Aeq(Night)}$ of 55 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.

Noise received at an outdoor area should also comply with the L_{Aeq} of 50 dB(A) during the night period.

From the monitoring undertaken, we also note that as the difference between the $L_{Aeq(day)}$ and the $L_{Aeq(night)}$ is greater than 5 dB (i.e. 5.3 dB) and the day period is the critical period for compliance. Given the difference, if compliance is achieved for the day period, then compliance would also be achieved for the night period.

Even though with the construction of Cockburn Coast Drive, the flow of vehicles along Cockburn Road will significantly reduced, it is proposed that the current noise emissions from vehicles travelling along Cockburn Road be used for the design criteria and bases for any "Quiet House" design. Based on the acoustic assessment and modelling of current noise emissions from Cockburn Road, the following noise level should be used for developments located adjacent to Cockburn Road:

Facing Cockburn Road	-	62 dB(A)
Side (perpendicular) to Cockburn Road	-	59 dB(A)

Note: For facades on the opposite side to Cockburn Road, except for developments shown on Figure D2 in Appendix D, standard constructions can be used. For those developments indicated on Figure D2, due to the additive effect of noise received from both Cockburn Road and Cockburn Coast Drive, it is recommended that a noise level of 58 dB(A) be used for the facades on the opposite side to Cockburn Road, but not directly exposed to Cockburn Coast Drive.

Initial modelling indicates that noise emissions from the proposed Cockburn Coast Drive would exceed the above acoustic criteria by up to 8 dB(A). Given the given the topography of the land, for this development, a barrier located at the boundary of the lots and the road reserve would be in some locations, fairly ineffectual and in these locations it is recommended that a barrier be incorporated within the road reserve and be included in the design of the road. Additionally, given that the residential developments located adjacent to Cockburn Coast Drive would be multi storey developments, it is recommended that "Quiet House" design be incorporated in the design of all levels (including ground floor). Guidance on the required glazing requirements are outlined in Tables 6.1 and 6.2. The noise that would be received at development located adjacent to the proposed Cockburn Coast Drive varies and the calculated day period noise level that would be received at various locations within the development are shown on Figures D1 and D2 attached in appendix D. It is recommended that these noise levels be used for the determination of "Quiet House" design to achieve compliance with the internal acoustic criteria.

Given the proposed layout, it is noted that the first row of buildings located on the western side of Cockburn Road will act as an acoustic barrier to the developments located behind them. However, to the east of Cockburn Road, with the additive effect of Cockburn Coast Drive, this may not be the case. Therefore, for the locations listed below it is recommended that as part of the design process, an acoustic assessment report be included in the building license submission:

- First row of buildings located adjacent to the western side of Cockburn Road.
- Buildings located between Cockburn Road and Cockburn Coast Drive.

Finally, we note that under the Planning Policy, as noise received within the proposed development would exceed the “Noise Target”, notification on Titles is required for those residence exposed to transportation noise.

1. INTRODUCTION

Landcorp commissioned Herring Storer Acoustics to carry out an acoustic study relating to noise emissions from both Cockburn Road and the proposed Cockburn Coast Drive as part of the proposed Cockburn Coast development.

The purpose of this report was to assess noise received within the development from vehicles travelling along both Cockburn Road and the proposed Cockburn Coast Drive and if exceedance with the stated criteria were determined, establish the required attenuation measures to control noise intrusion to acceptable levels. The traffic noise assessment has been carried out in accordance with the new WAPC State Planning Policy 5.4 *"Road and Rail Transportation Noise and Freight Consideration in Land Use Planning"*.

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

- Undertake noise monitor of noise received from vehicles travelling along Cockburn Road.
- Determine by modelling, the noise that would be received at residences within the development from vehicles travelling on both Cockburn Road and the proposed Cockburn Coast Drive.
- Assess the predicted noise levels for compliance with the appropriate criteria.
- If exceedances are predicted, comment on possible noise amelioration options for compliance with the appropriate criteria.

For information, a locality plan is attached in Appendix A.

2. SUMMARY

For this development, noise emissions from vehicle travelling along both Cockburn Road and the proposed Cockburn Coast Drive need to be considered.

Under the Western Australian Planning Commission (WAPC) Planning Policy 5.4 *"Road and Rail Transport Noise and Freight Considerations in Land Use Planning"* (SPP5.4), we believe that the appropriate criteria for assessment for this development are as listed below for "Noise Limits".

EXTERNAL

$L_{Aeq(Day)}$ of 60 dB(A); and
$L_{Aeq(Night)}$ of 55 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.

Noise received at an outdoor area should also comply with the L_{Aeq} of 50 dB(A) during the night period.

For this development, noise emissions from vehicles travelling along both Cockburn Road and the proposed Cockburn Coast Drive need to be considered.

From the monitoring undertaken, we also note that as the difference between the $L_{Aeq(day)}$ and the $L_{Aeq(night)}$ is greater than 5 dB (i.e. 5.3 dB) and the day period is the critical period for compliance. Given the difference, if compliance is achieved for the day period, then compliance would also be achieved for the night period.

In the future, with development of Cockburn Coast and the construction of Cockburn Coast Drive, the flow of vehicles along Cockburn Road will significantly reduced. However, as it is unclear as to when Cockburn Coast Drive will be constructed, to be conservative and to provide some degree of protection for both residence and future commercial developments it is proposed that the current noise emissions from vehicles travelling along Cockburn Road be used for the design criteria and bases for any "Quiet House" design. Based on the acoustic assessment and modelling of current noise emissions from Cockburn Road, the following noise level should be used for developments located adjacent to Cockburn Road:

Facing Cockburn Road	-	62 dB(A)
Side (perpendicular) to Cockburn Road	-	59 dB(A)

Note: For facades on the opposite side to Cockburn Road, except for developments located at the southern end of the project area (between Cockburn Road and Cockburn Coast Drive) and as shown on Figure D2 in Appendix D, standard constructions can be used. For those developments indicated on Figure D2, due to the additive effect of noise received from Cockburn Coast Drive, it is recommended that a noise level of 58 dB(A) be used for the facades on the opposite side to Cockburn Road, but not directly exposed to Cockburn Coast Drive.

Initial modelling, indicates that without any noise amelioration, noise emissions from the proposed Cockburn Coast Drive would exceed the above acoustic criteria by up to 8 dB(A). For the proposed Cockburn Coast Drive, it is noted that under the WAPC State Planning Policy 5.4, it is a requirement that the infrastructure provider design mitigation measures to achieve the "Noise Limits" these being $L_{Aeq(Day)}$ of 60 dB(A); and $L_{Aeq(Night)}$ of 55 dB(A). Additionally, under State Planning Policy 5.4, all practicable noise mitigation should be implemented. However, given the topography of the land, barriers located at the boundary of the lots and the road reserve would be in some locations, fairly ineffectual (i.e. in locations where the ground level of the road is above that of the residential development) and in these locations, it is recommended that a barrier be incorporated within the road reserve and be included in the design of the road. However, given that the residential developments located adjacent to Cockburn Coast Drive would be multi storey developments, it is recommended that "Quiet House" design be incorporated in the design of all levels (including ground floor). Guidance on the required glazing requirements are outlined in Tables 6.1 and 6.2. The noise that would be received at development located adjacent to the proposed Cockburn Coast Drive varies and the calculated day period noise level that would be received at various locations within the development are shown on Figures D1 and D2 attached in appendix D. It is recommended that these noise levels be used for the determination of "Quiet House" design to achieve compliance with the internal acoustic criteria.

For those developments located adjacent to Cockburn Road or located between Cockburn Road and the proposed Cockburn Coast Drive that, as part of the design process, an acoustic assessment be undertaken. Additionally, an acoustic assessment report should be included in the building licence submission.

We note that under the Planning Policy, as noise received within the proposed development would exceed the “Noise Target”, notification on Titles is required for those residence exposed to transportation noise.

3. ACOUSTIC CRITERIA

3.1 WAPC PLANNING POLICY

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 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}
Outdoor Living Areas	Maximum of 50 dB(A) L_{Aeq}

Internal

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

4. MEASUREMENTS AND OBSERVATIONS

Noise logging was conducted on the site to determine the existing noise received from vehicles travelling along the Cockburn Road. Monitoring was carried out between Thursday 14th April 2011 and Thursday 21st April 2011.

Test instrumentation comprised a calibrated RTA Noise Loggers and Rion Calibrator.

The results for the logger located adjacent to the Cockburn Road are summarised in Table 4.1 and are presented graphically in Figure B1 in Appendix B.

TABLE 4.1 – SUMMARY OF MEASURED NOISE LEVELS

Parameter	Measured Level dB(A)*	Difference between $L_{10(18hour)}$ and $L_{Aeq(parameter)}$ dB(A)
$L_{A10\ (18\ hour)}$	63.7	N/A
$L_{Aeq,\ day\ (6am\ to\ 10pm)}$	62.1	= $L_{A10\ (18\ hour)}$ – 1.6
$L_{Aeq,\ night\ (10pm\ to\ 6am)}$	56.8	= $L_{A10(18\ hour)}$ – 6.9

* It is normal practice to quote decibels to the nearest whole number. Fractions are retained here to minimise any cumulative rounding error.

We also note that as the difference between the $L_{Aeq(day)}$ and the $L_{Aeq(night)}$ is 5.3 dB. Given the difference, if compliance is achieved for the day period, then compliance would also be achieved for the night period and the day period is the critical period for compliance.

5. METHODOLOGY

To determine the noise received within the development from the Cockburn Road and the proposed Cockburn Coast Drive, noise modelling was carried out using SoundPlan, using the Calculation of Road Traffic Noise (CoRTN) algorithms. Noise modelling was undertaken in accordance with the "Implementation Guidelines" for the State Planning Policy 5.4.

The input data for the model included:

- Topographical data, with the ground level within the subdivision from information supplied by client;
- Existing traffic volumes as obtained from the Main Roads Metropolitan Traffic Digest.
- Future traffic volumes as obtained from the WorleyParsons traffic study, as listed in Table 5.1.
- A +2.5 dB adjustment to allow for façade reflection.

TABLE 5.1 – NOISE MODELLING INPUT DATA

Parameter	Value	
	Cockburn Road	Cockburn Coast Drive
Existing Traffic for 2006	15540 vpd	NA
Traffic flows for 2031	7000 vpd	21000 vpd
Heavy Vehicles (%)	7.6%	7.6%
Current Speed (km/hr)	60/70	NA
Future Speed (km/hr)	50	70
Receiver Level (m)	+1.5 above ground	+1.5 above ground
Current Road Surface	Chip Seal	NA
Future Road Surface	Dense Graded Asphalt	Dense Graded Asphalt

The traffic volume for the year 2031 was based on the data as provided and as contained within the Transport Study.

The noise model was calibrated, based on the existing traffic volumes detailed in Table 5.1, the current road alignment and the existing topography, the existing traffic noise levels have been calculated to verify the prediction model and calibrated to correlate with the monitored noise levels. Calculations are free field as the noise logger was located away from any building façades. The SoundPlan computer model was calibrated with the monitored data as listed in Table 3.1.

Noise modelling for the future road network, with Cockburn Coast Drive, was undertaken and the noise contour plot is attached in Appendix C as Figure C1.

6. DESIGN CONSIDERATIONS

The policy states that the outdoor criteria apply to the ground floor level only. The policy also states that noise mitigation measures should be implemented with a view to achieving the target levels in least one outdoor living area. Although, we believe that the policy only applies to ground floor of residences, comments and recommendations with regards to first storeys have also been included.

The results of the acoustic assessment indicate that noise received at the residences located adjacent to the proposed Cockburn Coast Drive in the year 2031 would exceed the “Noise Limits” as outlined in the Western Australian Planning Commission (WAPC) Planning Policy 5.4 “Road and Rail Transport Noise and Freight Considerations in Land Use Planning” by up to 8 dB(A).

For the proposed Cockburn Coast Drive, it is noted that under the WAPC State Planning Policy 5.4, it is a requirement that the infrastructure provider design mitigation measures to achieve the "Noise Limits" these being $L_{Aeq(Day)}$ of 60 dB(A); and $L_{Aeq(Night)}$ of 55 dB(A). Additionally, under State Planning Policy 5.4, all practicable noise mitigation should be implemented. However, given the given the topography of the land, a barrier located at the boundary of the lots and the road reserve would be in some locations, fairly ineffectual (i.e. in locations where the ground level of the road is above that of the residential development) and in these locations, it is recommended that a barrier be incorporated within the road reserve and be included in the design of the road. Additionally, given that the residential developments located adjacent to Cockburn Coast Drive would be multi storey developments, it is recommended that "Quiet House" design be incorporated in the design of all levels (including ground floor).

Generally, for these types of developments, the first row of buildings along the road(s) of concern normally act as acoustic barriers to those developments located behind. Hence, improved construction is usually only required for the first row of buildings. Given the proposed layout, we believe that this would apply to the western side of Cockburn Road. However, for developments located between Cockburn Road and the Cockburn Coast Drive, due to the additive effect of noise received from both these roads (especially where these two roads converge at the southern end of the development) this may not be the case. Additionally, for this area, noise received at facades on the opposite sides to Cockburn Road and Cockburn Coast Drive also need to be considered.

In the future, with development of Cockburn Coast and the construction of Cockburn Coast Drive, the flow of vehicles along Cockburn Road will be significantly reduced. However, as it is unclear as to when Cockburn Coast Drive will be constructed, to be conservative and to provide some degree of protection for both residence and future commercial developments it is proposed that the current noise emissions from vehicles travelling along Cockburn Road be used for the design criteria and bases for any "Quiet House" design. Based on the acoustic assessment and modelling of current noise emissions from Cockburn Road, the following noise level should be used for developments located adjacent to Cockburn Road:

Facing Cockburn Road	-	62 dB(A)
Side (perpendicular) to Cockburn Road	-	59 dB(A)

Note: For facades on the opposite side to Cockburn Road, standard constructions can be used on developments located on the western side of Cockburn Road and the northern section of developments located on the eastern side of Cockburn Road. However, for developments located at the southern end of the project area (between Cockburn Road and Cockburn Coast Drive) and as shown on Figure D2 in Appendix D, improved construction is also required. For these developments as shown on Figure D2, it is recommended that a noise level of 58 dB(A) be used for the facades on the opposite side to Cockburn Road, but not directly exposed to Cockburn Coast Drive.

With regards to developments located adjacent to Cockburn Coast Drive, the recommended external noise levels to be used as the design bases for "Quiet House" design are shown on the plan attached as Figures D1 and D2 in Appendix D.

Calculations were carried out to determine the noise that would be received within the proposed apartments due to passing vehicles. Guidance on the calculations was taken from *AS 3671-1989 "Acoustics – Road traffic noise intrusion-Building siting and construction"*.

Based on the calculated noise levels, preliminary calculations were carried out to determine various acoustic ratings required to achieve acceptable internal noise levels. The required R_W ratings were calculated and the preliminary determination of glazing for bedrooms and living spaces are listed in Tables 6.1 and 6.2.

Table 6.1 – Bedroom Glazing Requirements

Noise level (dB(A))	R_w Value	Description of Construction
55 to 57	20 to 24	Openable - 6mm horizontal sliding window Fixed – 4mm glass
58 to 59	25 to 27	Openable – 6mm glass in awning type windows with mechanical winders closing on compressible seals. Fixed – 6mm glass
60 to 61	28 to 30	Openable – 6.38mm laminated glass in awning type windows with mechanical winders closing on compressible seals. Fixed – 6.38mm laminated glass Fixed – 10mm glass
62 to 64	31 to 34	Openable – 10.38mm laminated glass in awning type windows with mechanical winders closing on compressible seals. Fixed – 10.38mm laminated glass
65 to 67	35 to 37	Openable – 10.5mm laminated glass in awning type windows with mechanical winders closing on compressible seals. Fixed – 10.5mm laminated glass

Table 6.2 – living Spaces Glazing Requirements

Noise level (dB(A))	R_w Value	Description of Construction
59 to 61	20 to 24	Openable - 6mm horizontal sliding window Fixed – 4mm glass
62 to 63	25 to 27	Openable – 6mm glass in awning type windows with mechanical winders closing on compressible seals. Fixed – 6mm glass
64 to 65	28 to 30	Openable – 6.38mm laminated glass in awning type windows with mechanical winders closing on compressible seals. Fixed – 6.38mm laminated glass Fixed – 10mm glass
66 to 69	31 to 34	Openable – 10.38mm laminated glass in awning type windows with mechanical winders closing on compressible seals. Fixed – 10.38mm laminated glass
69 to 71	35 to 37	Openable – 10.5mm laminated glass in awning type windows with mechanical winders closing on compressible seals. Fixed – 10.5mm laminated glass

Notes:

1. The increased construction requirements detailed above are only effective when doors and windows are closed.
2. For glazing requiring an R_W rating in the order of 38 dB and higher is likely to require a double glazed system with a reasonable air gap (in the order of 125mm and higher).

7. CONCLUSION

In accordance with the WAPC Planning Policy 5.4, an assessment of the noise that would be received within the Cockburn Coast Development, from vehicles travelling on both Cockburn Road and the proposed Cockburn Coast Drive has been undertaken.

In accordance with the Policy, the following would be the acoustic criteria applicable to this project:

External

Day	Maximum of 60 dB(A) L_{Aeq}
Night	Maximum of 55 dB(A) L_{Aeq}
Outdoor Living Areas	Maximum of 50 dB(A) $L_{Aeq\ (Night\ Period)}$

Internal

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

For this development, noise emissions from vehicle travelling along both Cockburn Road and the proposed Cockburn Coast Drive need to be considered.

From the previous monitoring undertaken, we also note that as the difference between the $L_{Aeq(day)}$ and the $L_{Aeq(night)}$ is greater than 5 dB (i.e. 5.3 dB) and the day period is the critical period for compliance. Given the difference, if compliance is achieved for the day period, then compliance would also be achieved for the night period.

In the future, with development of Cockburn Coast and the construction of Cockburn Coast Drive, the flow of vehicles along Cockburn Road will be significantly reduced. However, as it is unclear as to when Cockburn Coast Drive will be constructed, to be conservative and to provide some degree of protection for both residence and future commercial developments it is proposed that the current noise emissions from vehicles travelling along Cockburn Road be used for the design criteria and bases for any "Quiet House" design. Based on the acoustic assessment and modelling of current noise emissions from Cockburn Road, the following noise level should be used for developments located adjacent to Cockburn Road:

Facing Cockburn Road	-	62 dB(A)
Side (perpendicular) to Cockburn Road	-	59 dB(A)

Note: For facades on the opposite side to Cockburn Road, standard constructions can be used, except for developments located at the southern end between Cockburn Road and Cockburn Coast Drive, as shown on Figure D2 in Appendix D. For these developments, due to the additive effect of noise received from Cockburn Coast Drive, it is recommended that a noise level of 58 dB(A) be used for the facades on the opposite side to Cockburn Road, but not directly exposed to Cockburn Coast Drive.

Initial modelling, indicates that noise emissions from the proposed Cockburn coast Drive would exceed the above acoustic criteria by up to 8 dB(A). For the proposed Cockburn Coast Drive, it is noted that under the WAPC State Planning Policy 5.4, it is a requirement that the infrastructure provider design mitigation measures to achieve the "Noise Limits" these being $L_{Aeq(Day)}$ of 60 dB(A); and $L_{Aeq(Night)}$ of 55 dB(A). However, given the topography of the land, barriers located at the boundary of the lots and the road reserve would be in some locations, fairly ineffectual and in these locations it is recommended that a barrier be incorporated within the road reserve and be included in the design of the road. Additionally, given that the residential developments located adjacent to Cockburn Coast Drive would be multi-storey developments, it is recommended that "Quiet House" design be incorporated in the design of all levels (including ground floor). Guidance on the required glazing requirements are outlined in Tables 6.1 and 6.2. The noise that would be received at development located adjacent to the proposed Cockburn Coast Drive varies and the calculated day period noise level that would be received at various locations within the development are shown on Figures D1 and D2 attached in Appendix D. It is recommended that these noise levels be used for the determination of "Quiet House" design to achieve compliance with the internal acoustic criteria.

Given the proposed layout, it is noted that the first row of buildings located on the western side of Cockburn Road will act as an acoustic barrier to the developments located behind them. However, to the east of Cockburn Road, with the additive effect of Cockburn Coast Drive, this may not be the case. Therefore, for the locations listed below it is recommended that as part of the design process, an acoustic assessment report be included in the building license submission:

- First row of buildings located adjacent to the western side of Cockburn Road.
- Buildings located between Cockburn Road and Cockburn Coast Drive.

Finally, we note that under the Planning Policy, as noise received within the proposed development would exceed the “Noise Target”, notification on Titles is required for those residence exposed to transportation noise.

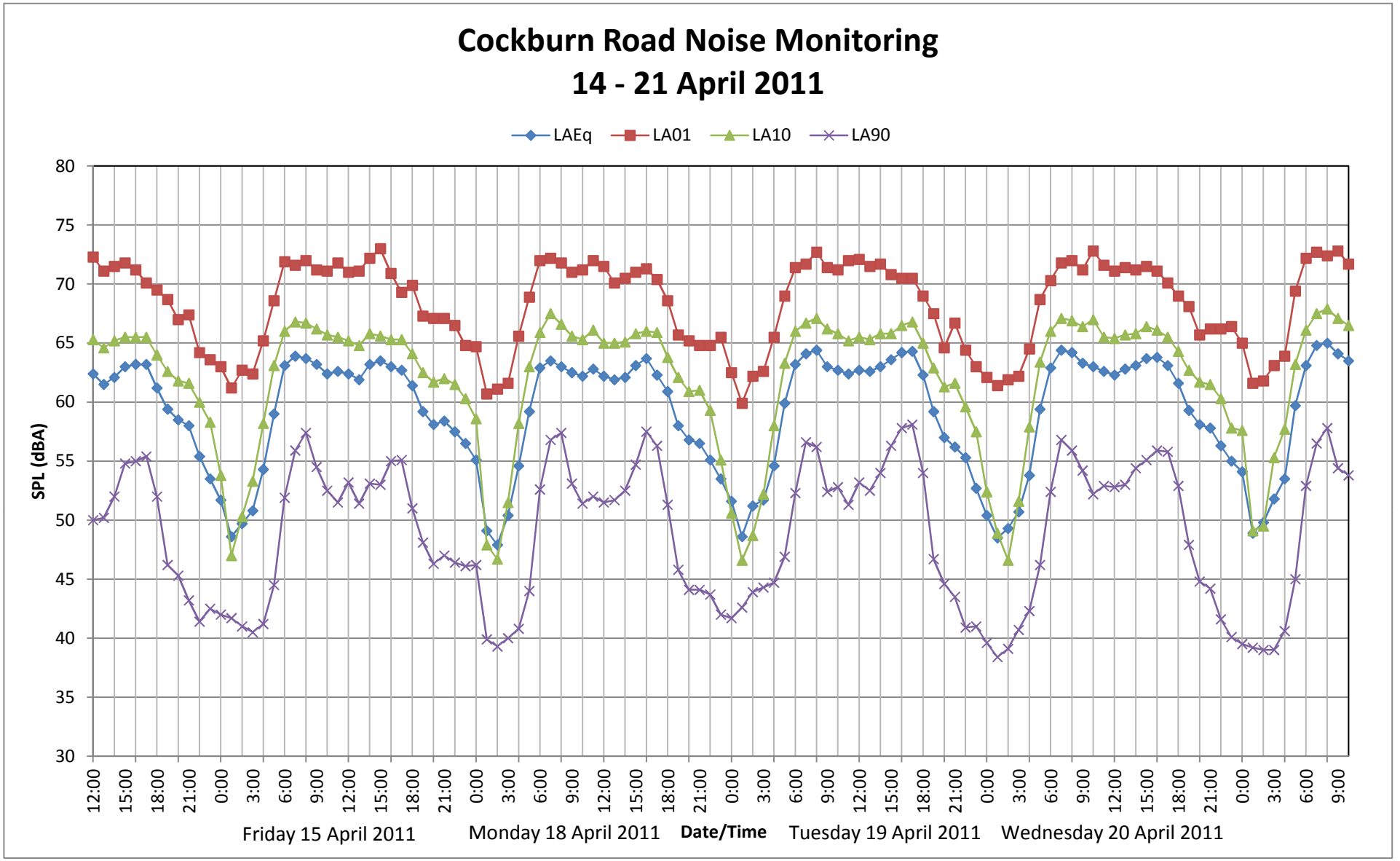
APPENDIX A

MASTER PLAN


Noise Monitoring Location

APPENDIX B

GRAPH OF LOGGED NOISE LEVELS

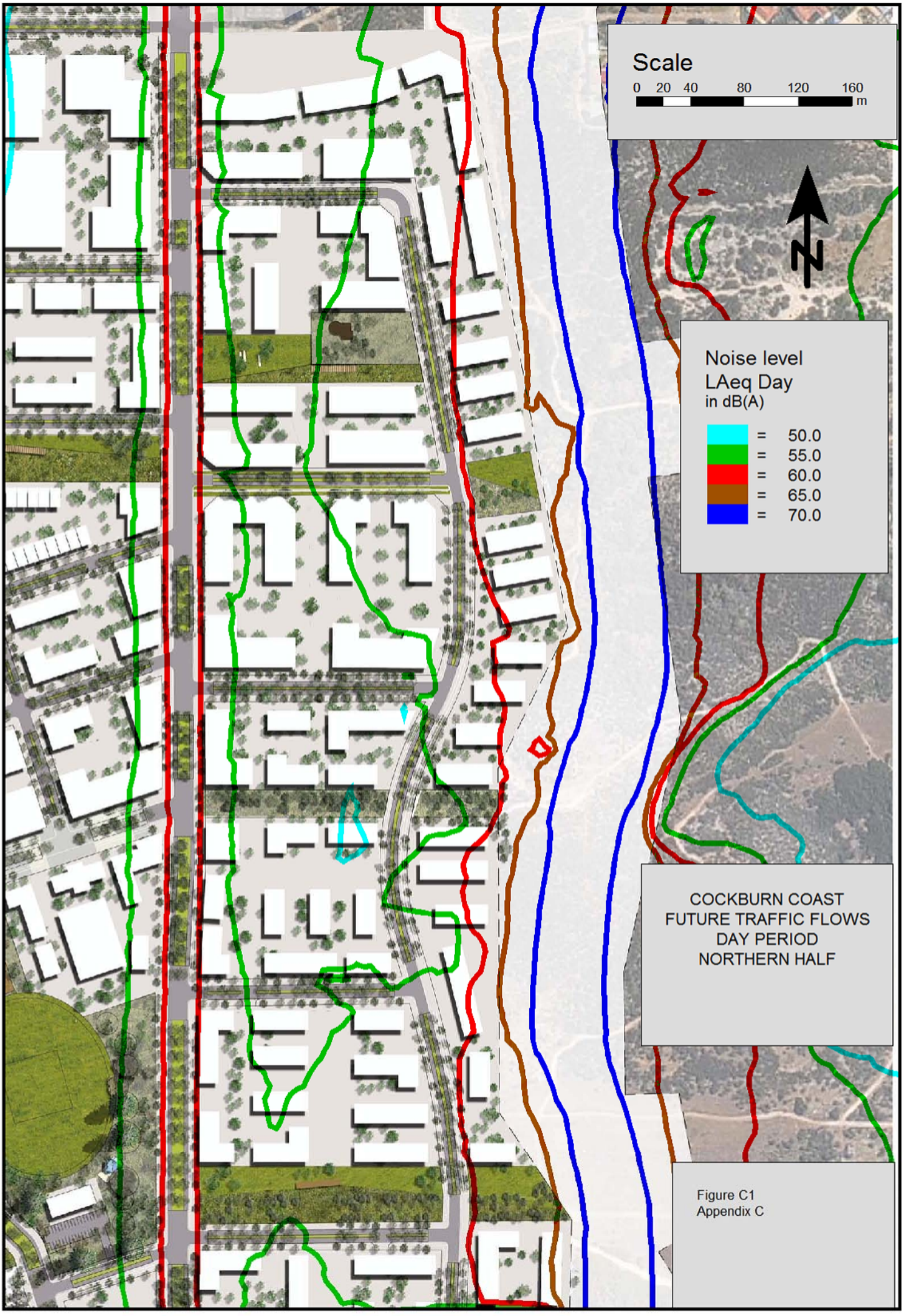


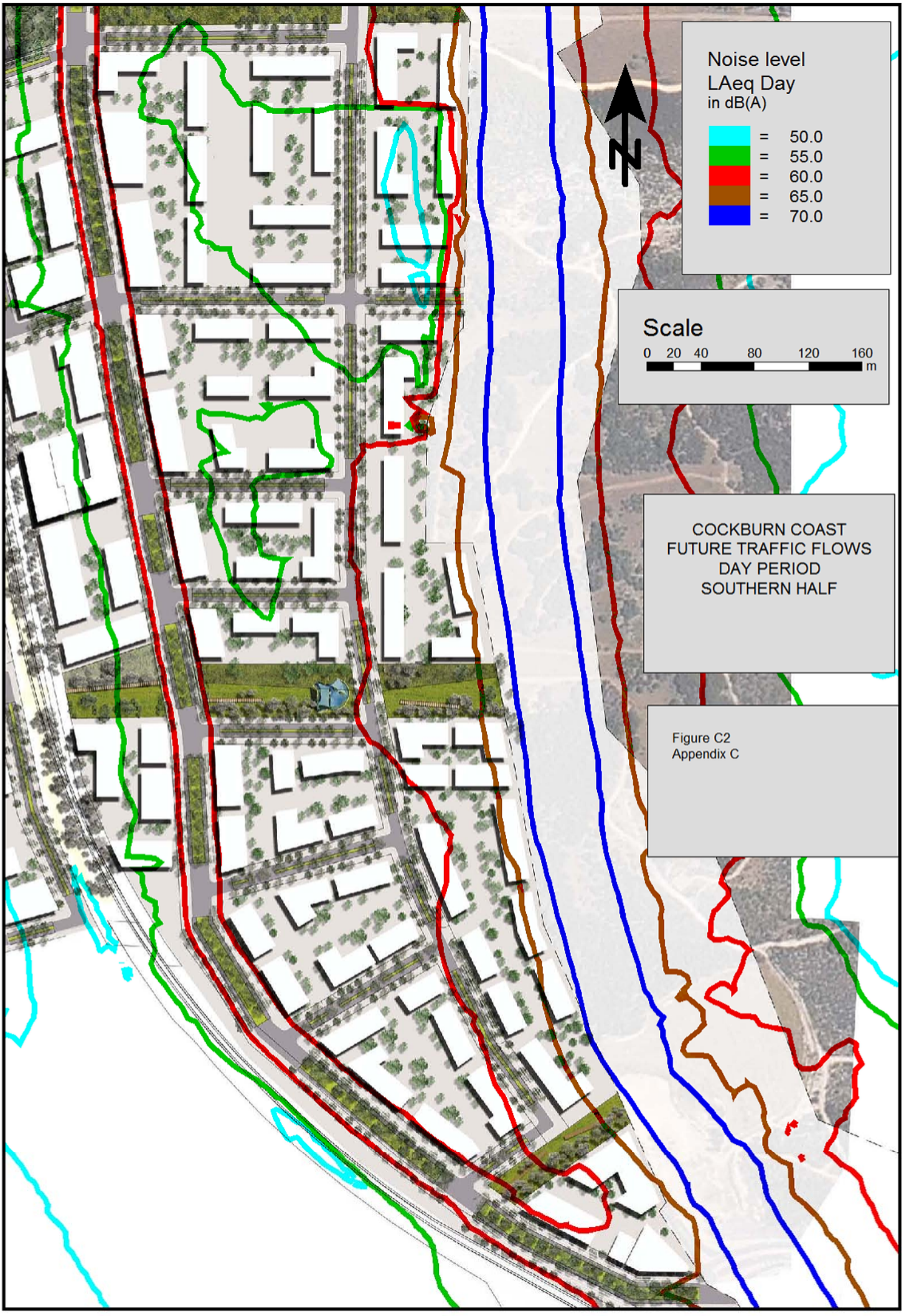
Herring Storer Acoustics
Job No : 11070
File : Logger

Figure B1
Appendix B

APPENDIX C

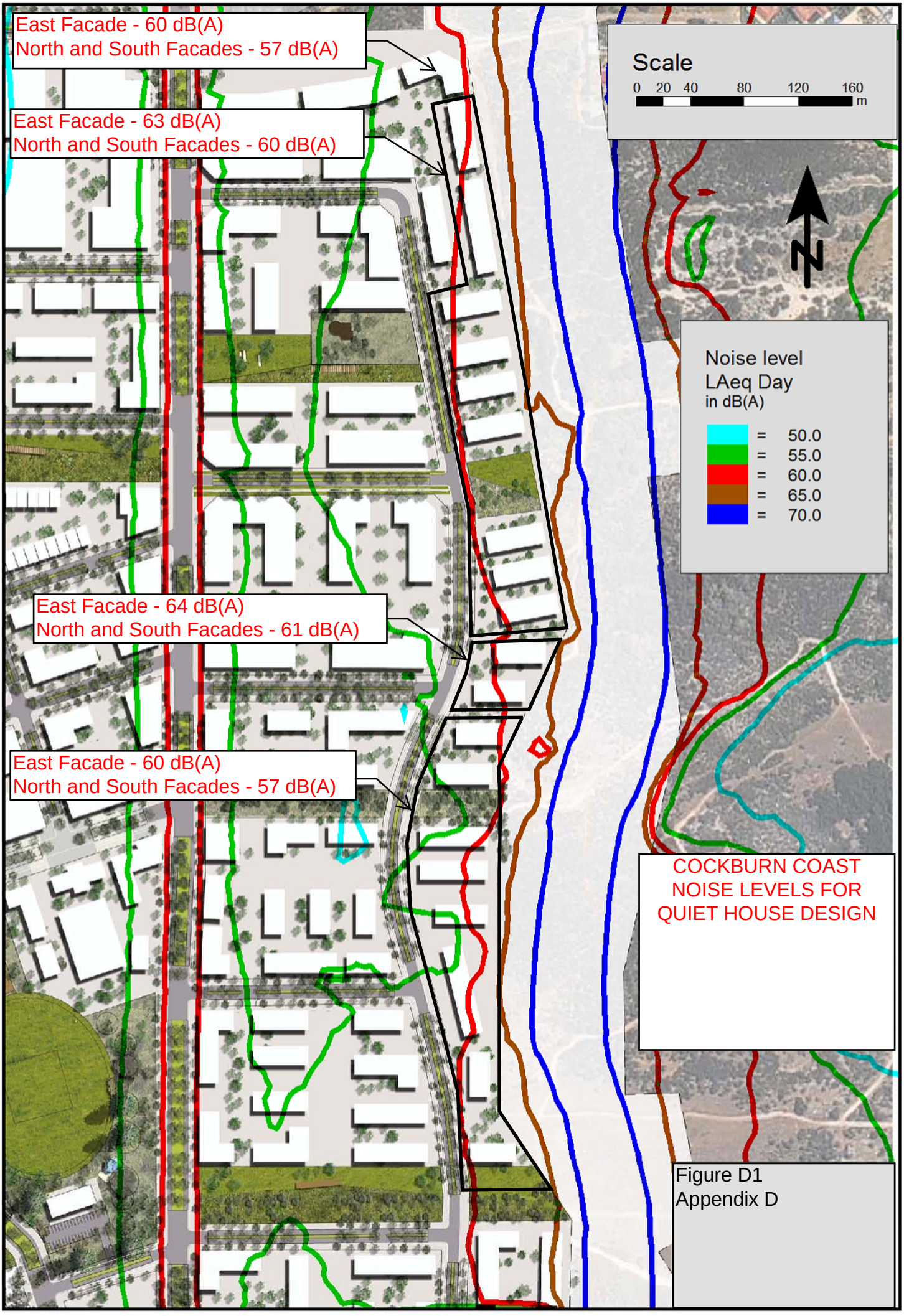
NOISE CONTOUR PLOTS

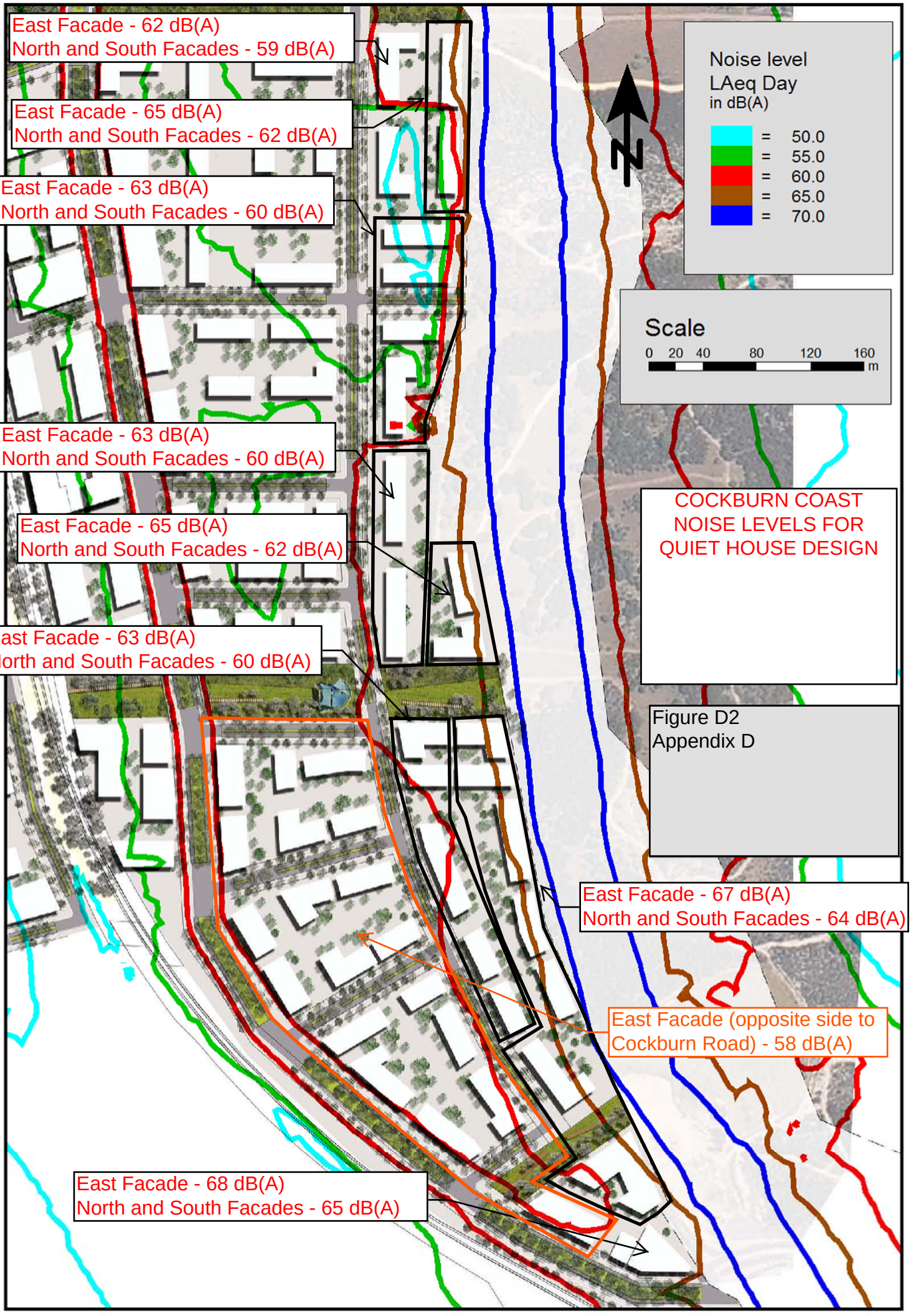

Scale
0 20 40 80 120 160
m
N
Noise level
LAeq Day
in dB(A)
= 50.0
= 55.0
= 60.0
= 65.0
= 70.0
COCKBURN COAST
FUTURE TRAFFIC FLOWS
DAY PERIOD
NORTHERN HALF
Figure C1
Appendix C


Noise level
LAeq Day
in dB(A)
= 50.0
= 55.0
= 60.0
= 65.0
= 70.0
N
Scale
0 20 40 80 120 160
m
COCKBURN COAST
FUTURE TRAFFIC FLOWS
DAY PERIOD
SOUTHERN HALF
Figure C2
Appendix C

APPENDIX D

NOISE LEVELS FOR QUIET HOUSE DESIGN


East Facade - 60 dB(A)
North and South Facades - 57 dB(A)
East Facade - 63 dB(A)
North and South Facades - 60 dB(A)
East Facade - 64 dB(A)
North and South Facades - 61 dB(A)
East Facade - 60 dB(A)
North and South Facades - 57 dB(A)
Scale
0 20 40 80 120 160
m
N
Noise level
LAeq Day
in dB(A)
= 50.0
= 55.0
= 60.0
= 65.0
= 70.0
COCKBURN COAST
NOISE LEVELS FOR
QUIET HOUSE DESIGN
Figure D1
Appendix D


East Facade - 62 dB(A)
North and South Facades - 59 dB(A)
East Facade - 65 dB(A)
North and South Facades - 62 dB(A)
East Facade - 63 dB(A)
North and South Facades - 60 dB(A)
East Facade - 63 dB(A)
North and South Facades - 60 dB(A)
East Facade - 65 dB(A)
North and South Facades - 62 dB(A)
East Facade - 63 dB(A)
North and South Facades - 60 dB(A)
East Facade - 67 dB(A)
North and South Facades - 64 dB(A)
East Facade (opposite side to Cockburn Road) - 58 dB(A)
East Facade - 68 dB(A)
North and South Facades - 65 dB(A)
Noise level
LAeq Day
in dB(A)
= 50.0
= 55.0
= 60.0
= 65.0
= 70.0
N
Scale
0 20 40 80 120 160
m
COCKBURN COAST
NOISE LEVELS FOR
QUIET HOUSE DESIGN
Figure D2
Appendix D