Road Traffic Noise Intrusion Assessment

Seniors Living Development
2 Jarvisfield Road, Picton

REPORT No 6446-1.1R

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17 April 2018

Prepared For:
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Camden NSW 2570

Attention: Mr Michael Brown
Revision History

<table>
<thead>
<tr>
<th>Report</th>
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<th>Checked</th>
<th>Comment</th>
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<td>Draft</td>
<td>13/03/2018</td>
<td>Matthew Bruck</td>
<td>Stephen Gauld</td>
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<td>Stephen Gauld</td>
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1.0 CONSULTING BRIEF

Day Design Pty Ltd has been engaged by Michael Brown Planning Strategies Pty Ltd on behalf of Mr William Mallam and Mr Tim Mallam to carry out a road traffic noise intrusion study for a seniors living development comprising of 62 residential Lots to be subdivided at 2 Jarvisfield Road, Picton, NSW as required by Wollondilly Shire Council.

This commission involves the following:

- Measure the noise level from traffic on Remembrance Driveway.
- Determine the acceptable noise level inside future residential dwellings.
- Carry out noise intrusion analysis assuming typical building construction.
- Design sound insulation of the residences to meet the requirements of State Environmental Planning Policy (Infrastructure) 2007 and Department of Planning’s Development near Rail Corridors and Busy Roads.
- Prepare a Road Traffic Noise Intrusion Report.
2.0 PROJECT DESCRIPTION

A new seniors living development comprising of 62 residential Lots is proposed to be constructed at 2 Jarvisfield Road, Picton, NSW, Lot 4/-/DP873571.

The development site and surrounds are currently zoned RU2 – Rural Landscape in accordance with Wollondilly Local Environmental Plan 2011. The site adjoins Remembrance Driveway.

Long and short term road traffic noise levels have been measured on site as shown in Figure 1. Road traffic noise levels are presented in Section 5.0 of this Report.

Acceptable intrusive noise levels from road traffic noise are based on the requirements of the NSW Department of Planning document “Development Near Rail Corridors and Busy Roads – Interim Guidelines” (2008) as well as the State Environmental Planning Policy 2007 (Infrastructure).

It is likely that noise controls will be required to reduce the noise intrusion to within acceptable internal noise levels and are detailed in Section 6.0 of this report.

Once the land is subdivided and dwellings proposed, a further review will be required to confirm whether the proposed construction will achieve the internal noise levels required by the NSW Department of Planning and SEPP (Infrastructure) 2007.
Figure 1 – Location Plan, 2 Jarvisfield Road, Picton
3.0 NOISE SURVEY INSTRUMENTATION

Noise level measurements and analysis were made with instrumentation as follows in Table 1:

<table>
<thead>
<tr>
<th>Description</th>
<th>Model No</th>
<th>Serial No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infobyte Noise Logger (Type 2)</td>
<td>iM4</td>
<td>118</td>
</tr>
<tr>
<td>Condenser Microphone 0.5” diameter</td>
<td>MK 250</td>
<td>118</td>
</tr>
<tr>
<td>Infobyte Noise Logger (Type 2)</td>
<td>iM4</td>
<td>116</td>
</tr>
<tr>
<td>Condenser Microphone 0.5” diameter</td>
<td>MK 250</td>
<td>116</td>
</tr>
<tr>
<td>Modular Precision Sound Analyser</td>
<td>B&amp;K 2270 G4</td>
<td>3010781</td>
</tr>
<tr>
<td>Condenser Microphone 0.5” diameter</td>
<td>B&amp;K 4189</td>
<td>2754884</td>
</tr>
<tr>
<td>Acoustical Calibrator</td>
<td>B&amp;K 4231</td>
<td>2721949</td>
</tr>
</tbody>
</table>

An environmental noise logger is used to continuously monitor ambient noise levels and provide information on the statistical distribution of noise during an extended period of time. The Infobyte Noise Monitor iM4 is a Type 2 precision environmental noise monitor meeting all the applicable requirements of AS1259 for an integrating-averaging sound level meter.

The B&K 2270 G4 Sound Analyser is a real-time precision integrating sound level meter with octave and third octave filters, that sample noise at a rate of 10 samples per second and provides $L_{eq}$, $L_{10}$ and $L_{90}$ noise levels using both Fast and Slow response and $L_{peak}$ noise levels on Impulse response time settings. The meter is frequency weighted to provide dBA, dBC or Linear sound pressure level readings as required.

All instrument systems had been laboratory calibrated using instrumentation traceable to Australian National Standards and certified within the last two years thus conforming to Australian Standards. The measurement system was also field calibrated prior to and after noise surveys. Calibration drift was found to be less than 0.5 dB during attended and less than 1 dB for unattended measurements. No adjustments for instrument drift during the measurement period were warranted.
4.0 ACCEPTABLE NOISE INTRUSION LEVELS

4.1 NSW Department of Planning

The NSW Department of Planning document “Development Near Rail Corridors and Busy Roads – Interim Guidelines” (2008) recommends noise criteria as shown in Table 2 below.

**Table 2** Required Indoor Noise Levels – Residential Buildings

<table>
<thead>
<tr>
<th>Type of Occupancy</th>
<th>Noise Level, dBA</th>
<th>Applicable Time Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sleeping areas (bedrooms)</td>
<td>35</td>
<td>Night 10 pm to 7 am</td>
</tr>
<tr>
<td>Other habitable rooms (excl. garages, kitchens, bathrooms &amp; hallways)</td>
<td>40</td>
<td>At any time</td>
</tr>
</tbody>
</table>

Note: airborne noise is calculated as $L_{eq}$ (9h)(night) and $L_{eq}$ (15hr)(day).

In addition, it also states that:

“if internal noise levels with windows or doors open exceed the criteria by more than 10 dBA, the design of the ventilation for these rooms should be such that occupants can leave windows closed, if they so desire, and also to meet the ventilation requirements of the Building Code of Australia”.

4.2 NSW State Environmental Planning Policy (Infrastructure) 2007

The NSW State Environmental Planning Policy (Infrastructure) 2007 details the following in Clause 102 with regards to road noise and vibration:

**102 Impact of road noise or vibration on non-road development**

(3) If the development is for the purposes of a building for residential use, the consent authority must not grant consent to the development unless it is satisfied that appropriate measures will be taken to ensure that the following $L_{Aeq}$ levels are not exceeded:

(a) in any bedroom in the building—35 dB(A) at any time between 10.00 pm and 7.00 am,

(b) anywhere else in the building (other than a garage, kitchen, bathroom or hallway)—40 dB(A) at any time.

(4) In this clause, *freeway, tollway* and *transitway* have the same meanings as they have in the Roads Act 1993.
4.3 **Project Specific Internal Noise Criteria**

Taking into consideration the above documents and policies, we recommend that the acceptable noise criteria for this development be as follows:

**With Windows Closed:**

- \( L_{eq,\,9\,hr} \) 35 dBA inside bedrooms at night (10 pm to 7 am); and
- \( L_{eq,\,15\,hr} \) 40 dBA inside other habitable rooms during the day (7 am to 10 pm).

**With Windows Open:**

- \( L_{eq,\,9\,hr} \) 45 dBA inside bedrooms at night (10 pm to 7 am); and
- \( L_{eq,\,15\,hr} \) 50 dBA inside other habitable rooms during the day (7 am to 10 pm).
5.0 ROAD TRAFFIC NOISE LEVELS

5.1 Measured Road Traffic Noise Levels

The proposed subdivision is affected by road traffic noise from Remembrance Driveway, which carries moderate traffic volumes.

A long term noise monitor was placed at 2 Jarvisfield Road, Picton 24 metres from Remembrance Driveway at an approximate location of the proposed rear façade of Lot 12. The location of this noise monitor is designated Location ‘A’, as shown in Figure 1.

Another long term noise monitor was placed at 2 Jarvisfield Road, Picton 56 metres from Remembrance Driveway at an approximate location of the proposed front façade of Lot 22. The location of this noise monitor is designated Location ‘B’, as shown in Figure 1.

The noise monitors measured traffic noise levels over a period of seven days, from Friday 23 February to Friday 2 March 2018.

The following noise levels were measured during the day time and night time periods shown in Table 3 and attached as Appendix A:

<table>
<thead>
<tr>
<th>Location</th>
<th>Daytime $L_{Aeq, 15 \text{ hour}}$ Noise Level (dBA)</th>
<th>Night Time $L_{Aeq, 9 \text{ hour}}$ Noise Level (dBA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location ‘A’ – 2 Jarvisfield Road, Picton</td>
<td>60 dBA</td>
<td>55 dBA</td>
</tr>
<tr>
<td>Location ‘B’ – 2 Jarvisfield Road, Picton</td>
<td>56 dBA</td>
<td>52 dBA</td>
</tr>
</tbody>
</table>

Meteorological conditions during the long term monitoring typically consisted of clear skies with temperatures ranging between 12°C to 31°C. Noise measurements were therefore considered reliable and typical for the receptor area.

Short term attended noise measurements were also carried out to ascertain a representative traffic noise spectrum between 5.15 pm and 7.30 pm on Friday 23 February. Traffic noise measurements were taken at the same location as the long term noise monitor Location ‘A’ and Location ‘B’, as shown in Figure 1.
The attended short term measured noise level is shown in Table 4.

**Table 4  Measured Road Traffic Sound Pressure Levels**

<table>
<thead>
<tr>
<th>Location</th>
<th>dBA</th>
<th>Measured Sound Pressure Levels (dB) at Octave Band Centre Frequencies (Hz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traffic Noise Level</td>
<td></td>
<td>63  125  250  500  1k  2k  4k  8k</td>
</tr>
<tr>
<td>Location ‘A’ – 2 Jarvisfield Road, Picton</td>
<td>58</td>
<td>63  61  55  51  54  52  46  39</td>
</tr>
<tr>
<td>Traffic Noise Level</td>
<td></td>
<td>63  56  44  48  54  49  40  30</td>
</tr>
<tr>
<td>Location ‘B’ – 2 Jarvisfield Road, Picton</td>
<td>56</td>
<td>63  56  44  48  54  49  40  30</td>
</tr>
</tbody>
</table>

Using the long term and short term noise measurements, we were able to determine the level of noise at the façades facing Remembrance Driveway of the proposed dwellings. These calculated noise levels are shown in Table 5.

**Table 5  Calculated Long Term Road Traffic Sound Pressure Levels (Fast response)**

<table>
<thead>
<tr>
<th>Location - 2 Jarvisfield Road, Picton</th>
<th>Daytime $L_{Aeq, 15 hour}$ Noise Level (dBA)</th>
<th>Night Time $L_{Aeq, 9 hour}$ Noise Level (dBA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lots 19-27</td>
<td>56</td>
<td>52</td>
</tr>
<tr>
<td>Lots 1-18, Lots 28-31 &amp; Lots 57-62</td>
<td>60</td>
<td>55</td>
</tr>
<tr>
<td>Lots 32-56</td>
<td>&lt; 55</td>
<td>&lt; 50</td>
</tr>
</tbody>
</table>

We are of the opinion that the noise levels in Table 3 to 5 above will be typical for this area, and have adopted these values in the design of noise insulation for the proposed residential dwelling.
5.2 Required Road Traffic Noise Reduction

Based on the acceptable noise levels established in Section 4 of this report, the required noise reduction from road traffic is shown below in Table 6:

Table 6 Required Road Traffic Noise Reduction (TNR)

<table>
<thead>
<tr>
<th>Location - 2 Jarvisfield Road</th>
<th>Room Description</th>
<th>Required TNR (dBA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lots 19-27 (Windows Closed)</td>
<td>Living Areas</td>
<td>Up to 16</td>
</tr>
<tr>
<td>Lots 19-27</td>
<td>Sleeping Areas</td>
<td>Up to 17</td>
</tr>
<tr>
<td>Lots 19-27 (Windows Open)</td>
<td>Living Areas</td>
<td>Up to 6</td>
</tr>
<tr>
<td>Lots 19-27 (Windows Open)</td>
<td>Sleeping Areas</td>
<td>Up to 7</td>
</tr>
<tr>
<td>Lots 1-18, Lots 28-31 &amp; Lots 57-62 (Windows Closed)</td>
<td>Living Areas</td>
<td>Up to 20</td>
</tr>
<tr>
<td>Lots 1-18, Lots 28-31 &amp; Lots 57-62 (Windows Open)</td>
<td>Living Areas</td>
<td>Up to 10</td>
</tr>
<tr>
<td>Lots 3-18, Lots 28-31 &amp; Lots 57-62 (Windows Open)</td>
<td>Living Areas</td>
<td>Up to 10</td>
</tr>
<tr>
<td>Lots 32-56 (Windows Closed)</td>
<td>Living Areas</td>
<td>Up to 15</td>
</tr>
<tr>
<td>Lots 32-56 (Windows Open)</td>
<td>Living Areas</td>
<td>Up to 5</td>
</tr>
<tr>
<td>Lots 32-56 (Windows Open)</td>
<td>Sleeping Areas</td>
<td>Up to 5</td>
</tr>
</tbody>
</table>
5.3 Mechanical Ventilation Requirements

For natural ventilation of dwellings, with 20% of the windows and external doors open, the level of noise inside the rooms from road traffic should not exceed 10 dB above the internal noise criteria.

Up to 10 dB noise reduction can be achieved with the windows/doors open. A noise reduction of up to 10 dB is however required for the Bedrooms and 10 dB in Living Rooms with the windows/doors open facing Remembrance Driveway. Therefore, no mechanical ventilation will required for any dwelling.
6.0 RECOMMENDED ACOUSTICAL TREATMENT

We have modelled the proposed residential Lots (Appendix B) with standard construction since architectural plans have been not been approved. We calculated the level of road traffic noise intrusion through a typical sized roof, walls, glazed doors and windows using the noise levels established in Section 5.0.

All bedrooms are assumed to be carpeted. All other rooms, such as the family / kitchen room and bathroom are assumed to have hard, reflective floors such as timber or tiles.

The necessary noise reduction for the rooms can be achieved if the following noise control recommendations are complied with, and there are no gaps at construction joints, around plumbing penetrations in external walls, at window sills, door frames, etc., through which sound may penetrate.

6.1 External Walls

Lots 1-18, Lots 28-31, Lots 57-62

Option 1 – Masonry Construction:

External walls may be of standard brick veneer, single brick and stud plasterboard or cavity brick construction.

Normal cavity-brick walls make an excellent sound barrier, reducing outside noise intrusion by as much as 50 dBA. Brick veneer walls also make good sound barriers. However, care must be exercised with brick-veneer walls to minimise sound penetration near the eaves as shown in the attached Figure AC 806-MH. Bricklayers should be instructed to ensure the perp-ends are filled and suitable cement-mortar used to eliminate shrinkage gaps during curing.

Option 2 – Lightweight Construction

Lightweight stud walls shall comprise of the following construction:

- One external layer of selected cladding with a minimum surface density of 12 kg/m², such as Hardies ‘Axon’ or ‘Easylap’, fixed to;
- 90 mm timber studs, with;
- Insulation batts between the studs. The recommended insulation specifications are 90 mm thick glasswool (min 11 kg/m³ density);
- One internal layer of 13 mm fire rated plasterboard fixed to the studs.
Lots 19-27

Option 1 – Masonry Construction:
External walls may be of standard brick veneer, single brick and stud plasterboard or cavity brick construction.

Option 2 – Lightweight Construction
Lightweight stud walls shall comprise of the following construction:

- One external layer of selected cladding with a minimum surface density of 9 kg/m$^2$, such as Hardies 'Blueboard', fixed to;
- 90 mm timber studs, with;
- One internal layer of 10 mm plasterboard fixed to the studs.

Lots 32-56
External walls may be of standard construction.

6.2 Ceiling and Roof System

- All roofs may be of metal deck construction with thermal insulation blankets laid below the roof.
- Ceilings under the roof should comprise one layer of 10 mm plasterboard, and
- Insulation batts are to be placed between the ceiling joists. The recommended insulation specifications are a minimum 160 mm thick glasswool (min 10 kg/m$^3$ density).
### 6.3 Glazing and Glazed Doors

Unless otherwise specified, window frames may be either sliding / awning, or hinged casement style and be of robust sound-barrier construction having interlocking stiles and neoprene (Q-lon or similar) or vinyl finned seals to minimise sound leakage.

Table 7 specifies minimum weighted sound reduction index ($R_w$) ratings required for various windows and glazed doors. Glazing in all rooms other than those specified in Table 7 may be of standard thickness with a minimum $R_w$ 24.

A typical glazing specification is given in Table 7, however an alternative glazing specification may be used if the $R_w$ is achieved or exceeded.

**Table 7 Schedule of Glazed Windows and Door Constructions**

<table>
<thead>
<tr>
<th>Room Description</th>
<th>Min $R_w$</th>
<th>Typical Glazing Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lots 1-18, Lots 28-31, Lots 57-62</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Façades facing Remembrance Driveway</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bedrooms</td>
<td>30</td>
<td>6.38 mm laminated glass in a sliding / awning frame with acoustic seals</td>
</tr>
<tr>
<td>Living / Kitchen / Dining Rooms</td>
<td>30</td>
<td>6.38 mm laminated glass in a sliding frame with acoustic seals</td>
</tr>
<tr>
<td><em>Façades perpendicular to Remembrance Driveway</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bedrooms</td>
<td>26</td>
<td>5 mm glass in a sliding / awning frame with acoustic seals</td>
</tr>
<tr>
<td>Living / Kitchen / Dining Rooms</td>
<td>26</td>
<td>5 mm glass in a sliding frame with acoustic seals</td>
</tr>
<tr>
<td>Lots 1-2, Lots 19-27</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Façades facing Remembrance Driveway</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bedrooms</td>
<td>26</td>
<td>5 mm glass in a sliding / awning frame with acoustic seals</td>
</tr>
<tr>
<td>Living / Kitchen / Dining Rooms</td>
<td>26</td>
<td>5 mm glass in a sliding frame with acoustic seals</td>
</tr>
<tr>
<td>Lots 32-56</td>
<td></td>
<td></td>
</tr>
<tr>
<td>All rooms</td>
<td>24</td>
<td>Standard construction</td>
</tr>
</tbody>
</table>
This schedule of construction is typical and for general guidance to the architect in preparing final construction drawings and specifications. Other constructions that provide the same or better Sound Transmission Loss performance may also be acceptable.

It is most important that any sound leakage paths around the windows be sealed off. We recommend that prior to the fitting of the architraves around the windows, the space between the frames and the wall structure be sealed off with silicone or polyurethane mastic and backing rods installed behind. The window architraves can then be fitted.

6.4 Eligible Suppliers of Windows and Glass Doors

The windows and doors are the most critical sound paths in a building. Only those companies who have conducted laboratory testing of their windows should be considered as eligible suppliers. Companies that we are aware of having conducted satisfactory testing include:

- **Architectural Window Systems**, Wetherill Park, NSW Phone: 8783 7611
- **Micos Aluminium Pty Ltd**, Hillsdale, NSW Phone: 9661 5233
- **Christoffel Pty Ltd**, Riverstone, NSW Phone: 9627 4811
- **Aska Windows**, Greenacre, NSW Phone: 9642 8588
- **James Hardie (Trend) Windows**, Girraween, NSW Phone: 9840 2000
- **Boral Window Systems**, Smithfield, NSW Phone: 9757 0555
- **Stegbar (Windows) Pty Ltd**, Lansvale, NSW Phone: 9794 5200

Approval should be sought from Day Design before any other manufacturers’ products are considered. $R_w$ ratings claimed should be supported by acoustical laboratory test reports. We suggest that you obtain confirmation from the glazier that the glazing supplied will meet the required $R_w$ rating above.

6.5 Entry Doors

The entry doors should be of solid core timber construction with a nominal thickness of 35 mm.
6.6 Construction Disclaimer

Recommendations made in this report are intended to resolve acoustical problems only. We make no claim of expertise in other areas and draw your attention to the possibility that our recommendations may not meet the structural, fire, thermal or other aspects of building construction.

We encourage clients to check with us before using materials or equipment that are alternative to those specified in our Acoustical Report.

The integrity of acoustic structures is very dependent on installation techniques. For example, a small crack between the top of a wall and a ceiling can reduce the effective sound transmission loss of a wall from $R_w 50$ to $R_w 40$. Therefore the use of contractors that are experienced in acoustic construction is encouraged. Furthermore, two insulation products may have the same thermal R rating but the sound absorption of one may be entirely deficient, therefore the use of materials and equipment that are supported by acoustic laboratory test data is encouraged.
7.0  NOISE INTRUSION STATEMENT

Day Design Pty Ltd was engaged by Michael Brown Planning Strategies on behalf of Mr William Mallam and Mr Tim Mallam to carry out a road traffic noise intrusion study for a proposed subdivision of a seniors living development to be constructed at 2 Jarvisfield Road, Picton, NSW.

Existing levels of road traffic noise were measured at 2 Jarvisfield Road adjacent to Remembrance Driveway. We are confident that the noise levels used in our assessment are typical of the average noise levels in this area.

Based on assumed typical building construction and provided that all the recommendations in Section 6.0 of this report are satisfactorily carried out, we are confident that the intrusive road traffic noise levels will comply with the acceptable intrusive noise levels required State Environmental Planning Policy (Infrastructure) 2007 and Department of Planning’s Development near Rail Corridors and Busy Roads and therefore considered acceptable.

A further review should be carried out once architectural drawings are prepared, to confirm that the indoor noise levels will be met.

Matthew Bruck,  BE(Mech) Hons, BS (MatSc)
Acoustic Engineer
for and on behalf of Day Design Pty Ltd

AAAC MEMBERSHIP
Day Design Pty Ltd is a member company of the Association of Australasian Acoustical Consultants, and the work herein reported has been performed in accordance with the terms of membership.

Attachments:
- Appendix A – Ambient Noise Surveys (Road Traffic)
- Appendix B – Lot Layout
- AC108-1 to 4 – Glossary of Acoustical Terms
<table>
<thead>
<tr>
<th>Time (hh:mm)</th>
<th>Thursday, 22 February 2018</th>
<th>Friday, 23 February 2018</th>
<th>Saturday, 24 February 2018</th>
<th>Sunday, 25 February 2018</th>
<th>Monday, 26 February 2018</th>
<th>Tuesday, 27 February 2018</th>
<th>Wednesday, 28 February 2018</th>
<th>Thursday, 1 March 2018</th>
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<tbody>
<tr>
<td>Noise Level (dBA)</td>
<td>L10</td>
<td>Leq</td>
<td>L90</td>
<td></td>
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Located at Location A - 2 Jarvisfield Road, Picton, NSW
ACOUSTICAL – Pertaining to the science of sound, including the generation, propagation, effects and control of both noise and vibration.

AMBIENT NOISE – The ambient noise level at a particular location is the overall environmental noise level caused by all noise sources in the area, both near and far, including road traffic, factories, wind in the trees, birds, insects, animals, etc.

AUDIBLE – means that a sound can be heard. However, there are a wide range of audibility grades, varying from “barely audible” to “just audible”, “clearly audible” and “prominent”. Chapter 83 of the NSW Environment Protection Authority – Environmental Noise Control Manual (1985) states:

“noise from a particular source might be offensive if it is clearly audible, distinct from the prevailing background noise and of a volume or character that a reasonable person would be conscious of the intrusion and find it annoying or disruptive”.

It follows that the word “audible” in an environmental noise context means “clearly audible”.

BACKGROUND NOISE LEVEL – Silence does not exist in the natural or the built-environment, only varying degrees of noise. The Background Noise Level is the average minimum dBA level of noise measured in the absence of the noise under investigation and any other short-term noises such as those caused by cicadas, lawnmowers, etc. It is quantified by the $L_{A90}$ or the dBA noise level that is exceeded for 90% of the measurement period (usually 15 minutes).

- **Assessment Background Level (ABL)** is the single figure background level representing each assessment period – day, evening and night (i.e., three assessment background levels are determined for each 24hr period of the monitoring period). Determination of the assessment background level is by calculating the tenth percentile (the lowest tenth percent value) of the background levels ($L_{A90}$) for each period (refer: NSW Industrial Noise Policy, 2000).

- **Rating Background Level (RBL)** as specified by the Environment Protection Authority is the overall single figure ($L_{A90}$) background noise level representing an assessment period (day, evening or night) over a monitoring period of (normally) three to seven days.

  The RBL for an assessment period is the median of the daily lowest tenth percentile of $L_{90}$ background noise levels.

  If the measured background noise level is less than 30 dBA, then the Rating Background Level (RBL) is considered to be 30 dBA.

DECIBEL – The human ear has a vast sound-sensitivity range of over a thousand billion to one. The decibel is a logarithmic unit that allows this same range to be compressed into a somewhat more comprehensible range of 0 to 120 dB. The decibel is ten times the logarithm of the ratio of a sound level to a reference sound level. See also Sound Pressure Level and Sound Power Level.

Decibel noise levels cannot be added arithmetically since they are logarithmic numbers. If one machine is generating a noise level of 50 dBA, and another similar machine is placed beside it, the level will increase to 53 dBA, not 100 dBA. Ten similar machines placed side by side increase the sound level by 10 dBA, and one hundred machines increase the sound level by 20 dBA.

dBA – The human ear is less sensitive to low frequency sound than high frequency sound. We are most sensitive to high frequency sounds, such as a child’s scream. Sound level meters have an inbuilt weighting network, termed the dBA scale, that approximates the human loudness response at quiet sound levels (roughly approximates the 40 phon equal loudness contour).
However, the dBA sound level provides a poor indication of loudness for sounds that are dominated by low frequency components (below 250 Hz). If the difference between the “C” weighted and the “A” weighted sound level is 15 dB or more, then the NSW Industrial Noise Policy recommends a 5 dBA penalty be applied to the measured dBA level.

**dBC** – The dBC scale of a sound level meter is similar to the dBA scale defined above, except that at high sound intensity levels, the human ear frequency response is more linear. The dBC scale approximates the 100 phon equal loudness contour.

**EQUIVALENT CONTINUOUS NOISE LEVEL, L_{Aeq}** – Many noises, such as road traffic or construction noise, vary continually in level over a period of time. More sophisticated sound level meters have an integrating electronic device inbuilt, which average the A weighted sound pressure levels over a period of time and then display the energy average or L_{Aeq} sound level. Because the decibel scale is a logarithmic ratio the higher noise levels have far more sound energy, and therefore the L_{Aeq} level tends to indicate an average which is strongly influenced by short term, high level noise events. Many studies show that human reaction to level-varying sounds tends to relate closely to the L_{Aeq} noise level.

**FREE FIELD** – This is a sound field not subject to significant reflection of acoustical energy. A free field over a reflecting plane is usually outdoors with the noise source resting on hard flat ground, and not closer than 6 metres to any large flat object such as a fence or wall; or inside an anechoic chamber.

**FREQUENCY** – The number of oscillations or cycles of a wave motion per unit time, the SI unit being the Hertz, or one cycle per second.

**IMPACT ISOLATION CLASS (IIC)** – The American Society for Testing and Materials (ASTM) has specified that the IIC of a floor/ceiling system shall be determined by operating an ISO 140 Standard Tapping Machine on the floor and measuring the noise generated in the room below. The IIC is a number found by fitting a reference curve to the measured octave band levels and then deducting the sound pressure level at 500 Hz from 110 decibels. Thus the higher the IIC, the better the impact sound isolation.

**IMPACT SOUND INSULATION (L_{nT,w})** – Australian Standard AS ISO 717.2 – 2004 has specified that the Impact Sound Insulation of a floor/ceiling system be quantified by operating an ISO 140 Standard Tapping Machine on the floor and measuring the noise generated in the room below. The Weighted Standardised Impact Sound Pressure Level (L_{nT,w}) is the sound pressure level at 500 Hz for a reference curve fitted to the measured octave band levels. Thus the lower L_{nT,w} the better the impact sound insulation.

**IMPULSE NOISE** – An impulse noise is typified by a sudden rise time and a rapid sound decay, such as a hammer blow, rifle shot or balloon burst.

**INTRUSIVE NOISE LEVEL, L_{Aeq}** – The level of noise from a factory, place of entertainment, etc. in NSW is assessed on the basis of the average maximum noise level, or the L_{Aeq (15 min)}. This is the energy average A weighted noise level measured over any 15 minute period.

**LOUDNESS** – The degree to which a sound is audible to a listener is termed the loudness. The human ear perceives a 10 dBA noise level increase as a doubling of loudness and a 20 dBA noise increase as a quadrupling of the loudness.
MAXIMUM NOISE LEVEL, $L_{A_{max}}$ – The rms maximum sound pressure level measured on the "A" scale of a sound level meter during a noise survey is the $L_{A_{max}}$ noise level. It may be measured using either the Fast or Slow response time of the meter. This should be stated.

NOISE RATING NUMBERS – A set of empirically developed equal loudness curves has been adopted as Australian Standard AS1469-1983. These curves allow the loudness of a noise to be described with a single NR number. The Noise Rating number is that curve which touches the highest level on the measured spectrum of the subject noise. For broadband noise such as fans and engines, the NR number often equals the dBA level minus five.

NOISE – Noise is unwanted sound. Sound is wave motion within matter, be it gaseous, liquid or solid. "Noise includes sound and vibration".

NOISE REDUCTION COEFFICIENT – See: "Sound Absorption Coefficient".

(a) that, by reason of its level, nature, character or quality, or the time at which it is made, or any other circumstances:
   (i) is harmful to (or likely to be harmful to) a person who is outside the premise from which it is emitted, or
   (ii) interferes unreasonably with (or is likely to interfere unreasonably with) the comfort or repose of a person who is outside the premises from which it is emitted, or
(b) that is of a level, nature, character or quality prescribed by the regulations or that is made at a time, or in other circumstances prescribed by the regulations."

PINK NOISE – Pink noise is a broadband noise with an equal amount of energy in each octave or third octave band width. Because of this, Pink Noise has more energy at the lower frequencies than White Noise and is used widely for Sound Transmission Loss testing.

REVERBERATION TIME, $T_{60}$ – The time in seconds, after a sound signal has ceased, for the sound level inside a room to decay by 60 dB. The first 5 dB decay is often ignored, because of fluctuations that occur while reverberant sound conditions are being established in the room. The decay time for the next 30 dB is measured and the result doubled to determine the $T_{60}$. The Early Decay Time (EDT) is the slope of the decay curve in the first 10 dB normalised to 60 dB.

SOUND ABSORPTION COEFFICIENT, $\alpha$ – $\alpha$ Sound is absorbed in porous materials by the viscous conversion of sound energy to heat energy as the sound waves pass through it. Sound is similarly absorbed by the flexural bending of internally damped panels. The fraction of incident energy that is absorbed is termed the Sound Absorption Coefficient, $\alpha$. An absorption coefficient of 0.9 indicates that 90 % of the incident sound energy is absorbed. The average $\alpha$ from 250 to 2000 Hz is termed the Noise Reduction Coefficient (NRC).

SOUND ATTENUATION – If an enclosure is placed around a machine, or a silencer is fitted to a duct, the noise emission is reduced or attenuated. An enclosure that attenuates the noise level by 30 dBA, reduces the sound energy by one thousand times.

SOUND EXPOSURE LEVEL (SEL) – The total sound energy of a single noise event condensed into a one second duration or in other words it is an $L_{eq}$ (1 sec).
SOUND PRESSURE LEVEL, \( L_p \) – The level of sound measured on a sound level meter and expressed in decibels, dB, dBA, dBC, etc. \( L_p = 20 \times \log \left( \frac{P}{P_0} \right) \) ... dB

where \( P \) is the rms sound pressure in Pascal and \( P_0 \) is a reference sound pressure of 20 µPa. \( L_p \) varies with distance from a noise source.

SOUND POWER LEVEL, \( L_w \) – The Sound Power Level of a noise source is an absolute that does not vary with distance or with a different acoustic environment.

\( L_w = L_p + 10 \times \log A \) ... dB, re: 1pW,

where \( A \) is the measurement noise-emission area in square metres in a free field.

SOUND TRANSMISSION CLASS (STC) – An internationally standardised method of rating the sound transmission loss of partition walls to indicate the decibels of noise reduction of a human voice from one side to the other. (Refer: Australian Standard AS1276 – 1979)

SOUND TRANSMISSION LOSS – The amount in decibels by which a random sound is reduced as it passes through a sound barrier. A method for the measurement of airborne Sound Transmission Loss of a building partition is given in Australian Standard AS1191 - 2002.

STATISTICAL EXCEEDENCE SOUND LEVELS, \( L_{A90}, L_{A10}, L_{A1}, \text{ etc} \) – Noise which varies in level over a specific period of time (usually 15 minutes) may be quantified in terms of various statistical descriptors:

The \( L_{A90} \) is the dBA level exceeded for 90 % of the time. In NSW the \( L_{A90} \) is measured over periods of 15 minutes, and is used to describe the average minimum or background noise level.

The \( L_{A10} \) is the dBA level that is exceeded for 10 % of the time. In NSW the \( L_{A10} \) measured over a period of 10 to 15 minutes. It was until recently used to describe the average maximum noise level, but has largely been replaced by the \( L_{Aeq} \) for describing level-varying noise.

The \( L_{A1} \) is the dBA level that is exceeded for 1 % of the time. In NSW the \( L_{A1} \) may be used for describing short-term noise levels such as could cause sleep arousal during the night.

STEADY NOISE – Noise, which varies in level by 6 dBA or less, over the period of interest with the time-weighting set to “Fast”, is considered to be “steady”. (Refer AS 1055.1 1997)

WEIGHTED SOUND REDUCTION INDEX, \( R_w \) – This is a single number rating of the airborne sound insulation of a wall, partition or ceiling. The sound reduction is normally measured over a frequency range of 100 to 3,150 Hertz and averaged in accordance with ISO standard weighting curves (Refer AS/NZS 1276.1:1999).

Internal partition wall \( R_w + C \) ratings are frequency weighted to simulate insulation from human voice noise. The \( R_w + C \) is always similar in value to the STC rating value. External walls, doors and windows may be \( R_w + C_{tr} \) rated to simulate insulation from road traffic noise. This is normally a lower number than the STC rating value.

WHITE NOISE – White noise is broadband random noise whose spectral density is constant across its entire frequency range. The sound power is the same for equal bandwidths from low to high frequencies. Because the higher frequency octave bands cover a wider spectrum, white noise has more energy at the higher frequencies and sounds like a hiss.