Environmental Noise Assessment

Childcare Centre, Lots 207 and 208 (#122 and #124) Coolibah Drive, Greenwood

Reference: 20035418-01B

Prepared for:
Planning Solutions
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1 INTRODUCTION

It is proposed to develop the land located at Lots 207 and 208 (#122 and #124) Coolibah Drive in Greenwood (refer Figure 1-1) into a childcare centre. The proposed childcare centre development will consist of the following:

- Five internal play spaces capable of accommodating up to 83 children, grouped as follows:
  - Activity areas 1A and 1B (3 years or over), 20 children in 2 groups (Kindy),
  - Activity area 2 (2 to 3 years old), 15 children in each group (Toddlers),
  - Activity area 3 (0-24 months), 16 children (Wobblers), and
  - Activity area 4 (0-24 months), 12 children (Babies).

- One landscaped outdoor play area located to the north of the building.

- One decked outdoor play area located to the north-east of the building.

- Amenities and associated mechanical plant such as:
  - One kitchen with range-hood and exhaust fan assumed to be located on the roof above,
  - Various exhaust fans (toilets, laundry, nappy room) assumed to be located on the roof above, and
  - AC plant located at ground level on the south side of the building near Store 2.

- Basement level covered car parking in the building with 24 bays comprising both dedicated staff and visitor bays.

This report presents the assessment of the noise emissions from child play, car doors closing in the covered car park and mechanical plant associated with the childcare centre against the Environmental Protection (Noise) Regulations 1997 (the Regulations) based on the development drawings shown in Appendix A.

The proposed hours of operation are 6.30am to 6.30pm Monday to Friday. Therefore, staff and visitors can arrive and park before 7.00am, which is during the night-time period of the Regulations. It is assumed outdoor child play would not occur until after 7.00am.

Appendix B contains a description of some of the terminology used throughout this report.
2 CRITERIA

Environmental noise in Western Australia is governed by the *Environmental Protection Act 1986*, through the *Environmental Protection (Noise) Regulations 1997* (the Regulations).

Regulation 7 defines the prescribed standard for noise emissions as follows:

“7. (1) Noise emitted from any premises or public place when received at other premises –

(a) Must not cause or significantly contribute to, a level of noise which exceeds the assigned level in respect of noise received at premises of that kind; and

(b) Must be free of –

   i. tonality;
   ii. impulsiveness; and
   iii. modulation,

when assessed under regulation 9”

A “…noise emission is taken to significantly contribute to a level of noise if the noise emission … exceeds a value which is 5 dB below the assigned level...”

Tonality, impulsiveness and modulation are defined in Regulation 9. Noise is to be taken to be free of these characteristics if:
(a) The characteristics cannot be reasonably and practicably removed by techniques other than attenuating the overall level of noise emission; and

(b) The noise emission complies with the standard prescribed under regulation 7 after the adjustments of Table 2-1 are made to the noise emission as measured at the point of reception.

<table>
<thead>
<tr>
<th>Table 2-1 Adjustments Where Characteristics Cannot Be Removed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Where Noise Emission is Not Music</td>
</tr>
<tr>
<td>Tonality</td>
</tr>
<tr>
<td>+ 5 dB</td>
</tr>
</tbody>
</table>

Note: The above are cumulative to a maximum of 15dB.

The baseline assigned levels (prescribed standards) are specified in Regulation 8 and are shown in Table 2-2.

<table>
<thead>
<tr>
<th>Table 2-2 Baseline Assigned Noise Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Premises Receiving Noise</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Noise sensitive premises: highly sensitive area</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Noise sensitive premises: any area other than highly sensitive area</td>
</tr>
<tr>
<td>Commercial</td>
</tr>
<tr>
<td>Industrial</td>
</tr>
</tbody>
</table>

1. Highly sensitive area means that area (if any) of noise sensitive premises comprising —
(a) a building, or a part of a building, on the premises that is used for a noise sensitive purpose; and
(b) any other part of the premises within 15 metres of that building or that part of the building.
The influencing factor, applicable at the noise sensitive premises has been calculated as 3 dB, as shown in Table 2-3. The transport factor has been calculated as 2 dB, due to either the Mitchell Freeway or Hepburn Avenue being considered a major road (> 15,000 vehicles per day – WA Traffic Maps (Hepburn Ave 32,430 VMPD 2018/2019) & (Mitchell Freeway SB 54,376 VMPD 2018/2019) within 450 metres of the residences. Lot 132, the location of the Coolibah Plaza Shopping centre is within 100 metres and is zoned commercial, based on the City of Joondalup shown on Figure 2-1. The property at # 126 Coolibah Drive is currently being used for commercial purposes and we understand will be re-developed as a medical centre in the future, as such this lot is treated as commercial for the purposes of this assessment.

**Table 2-3 Influencing Factor Calculation**

<table>
<thead>
<tr>
<th>Description</th>
<th>Within 100 metre Radius</th>
<th>Within 450 metre Radius</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industrial Land</td>
<td>0 %</td>
<td>0 %</td>
<td>0 dB</td>
</tr>
<tr>
<td>Commercial Land</td>
<td>11 %</td>
<td>1 %</td>
<td>0.6 dB</td>
</tr>
<tr>
<td><strong>Transport Factor</strong></td>
<td></td>
<td></td>
<td><strong>2 dB</strong></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td><strong>3 dB</strong></td>
</tr>
</tbody>
</table>

Table 2-4 shows the assigned noise levels including the influencing factor and transport factor at the receiving locations.

**Table 2-4 Assigned Noise Levels**

<table>
<thead>
<tr>
<th>Premises Receiving Noise</th>
<th>Time Of Day</th>
<th>Assigned Level (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>$L_{A10}$</td>
</tr>
<tr>
<td>Noise sensitive premises: highly sensitive area(^1)</td>
<td>0700 to 1900 hours Monday to Saturday (Day)</td>
<td>48</td>
</tr>
<tr>
<td></td>
<td>0900 to 1900 hours Sunday and public holidays (Sunday)</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td>1900 to 2200 hours all days (Evening)</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td>2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and public holidays (Night)</td>
<td>38</td>
</tr>
<tr>
<td>Commercial</td>
<td>All hours</td>
<td>60</td>
</tr>
</tbody>
</table>

1. **highly sensitive area** means that area (if any) of noise sensitive premises comprising —
   (a) a building, or a part of a building, on the premises that is used for a noise sensitive purpose; and
   (b) any other part of the premises within 15 metres of that building or that part of the building.

It is noted the assigned noise levels are statistical levels and therefore the period over which they are determined is important. The Regulations define the Representative Assessment Period (RAP) as a period of time of not less than 15 minutes, and not exceeding 4 hours, which is determined by an inspector or authorised person to be appropriate for the assessment of a noise emission, having

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regard to the type and nature of the noise emission. An inspector or authorised person is a person appointed under Sections 87 & 88 of the Environmental Protection Act 1986 and include Local Government Environmental Health Officers and Officers from the Department of Environment Regulation. Acoustic consultants or other environmental consultants are not appointed as an inspector or authorised person. Therefore, whilst this assessment is based on a 4 hour RAP, which is assumed to be appropriate given the nature of the operations, this is to be used for guidance only.

![Figure 2-1 Land Use Map](image-url)
3 METHODOLOGY

Computer modelling has been used to predict noise levels at each nearby receiver.

The software used was SoundPLAN 8.1 with the CONCAWE (ISO 171534-3 improved method) algorithms selected. These algorithms have been selected as they include the influence of wind and atmospheric stability. Input data required in the model are:

- Meteorological Information;
- Topographical data;
- Ground Absorption; and
- Source sound power levels.

3.1 Meteorological Information

Meteorological information utilised is provided in Table 3-1 and is considered to represent worst-case conditions for noise propagation. At wind speeds greater than those shown, sound propagation may be further enhanced, however background noise from the wind itself and from local vegetation is likely to be elevated and dominate the ambient noise levels.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Night (1900-0700)</th>
<th>Day (0700-1900)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature (°C)</td>
<td>15</td>
<td>20</td>
</tr>
<tr>
<td>Humidity (%)</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Wind Speed (m/s)</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Wind Direction*</td>
<td>All</td>
<td>All</td>
</tr>
<tr>
<td>Pasquill Stability Factor</td>
<td>F</td>
<td>E</td>
</tr>
</tbody>
</table>

* Note that the modelling package used allows for all wind directions to be modelled simultaneously.

It is generally considered that compliance with the assigned noise levels needs to be demonstrated for 98% of the time, during the day and night periods, for the month of the year in which the worst-case weather conditions prevail. In most cases, the above conditions occur for more than 2% of the time and therefore must be satisfied.

3.2 Topographical Data

Topographical data was based on that publicly available from GoogleEarth in the form of spot heights, noting the topography is relatively flat with no significant natural/manmade features between sources and receivers.

It is understood that adjacent to the west is a future residential development (at #20, #22 and #24 Kanangra Cres), which has planned retaining wall (up to 3m high) and boundary fence construction.
currently undergoing building permit application. These future ground heights and fences have been incorporated into the noise model – as shown in Figure 3-1.

3.3 Ground Absorption

Ground absorption varies from a value of 0 to 1, with 0 being for an acoustically reflective ground (e.g. water or bitumen) and 1 for acoustically absorbent ground (e.g. grass). In this instance, a value of 0.6 has been used as an average across the study area.

3.4 Buildings and Receivers

Surrounding existing buildings were included in the noise model, as these can provide noise shielding as well as reflection paths.

All adjacent houses are single storey and were modelled as 3.5 metre high buildings and with receivers located 1.5 metres above local ground level.

3.5 Source Sound Levels

The sound power levels used in the modelling are provided in Table 3-2.

<table>
<thead>
<tr>
<th>Description</th>
<th>Octave Band Centre Frequency (Hz)</th>
<th>Overall dB(A)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>63</td>
<td>125</td>
</tr>
<tr>
<td>Child Play 2-3 years old (15 kids), L_{10}</td>
<td>49</td>
<td>58</td>
</tr>
<tr>
<td>Child Play 3 years old or over (20 kids) x 2, L_{10}</td>
<td>54</td>
<td>63</td>
</tr>
<tr>
<td>AC plant, 22 kW unit (3 off), each, L_{10}</td>
<td>83</td>
<td>85</td>
</tr>
<tr>
<td>Toilet/Laundry Exhausts, each, L_{10}</td>
<td>60</td>
<td>65</td>
</tr>
<tr>
<td>Kitchen Exhaust Rangehood, L_{10}</td>
<td>50</td>
<td>64</td>
</tr>
</tbody>
</table>

The following is noted in relation to the source levels above:

- Child play source levels represent the group of children playing outside at the same time. Where child numbers differ slightly the levels were scaled logarithmically. It is noted that based on observations and measurements, the noise levels tend to increase with the children's age and therefore children 3 years or over were considered noisier than children aged 2-3 years. Noise from infant play was considered negligible. Outdoor child play was modelled as area sources at various heights to account for the slight difference in height between age groups as follows:
  - 3 year old or over - 1.0 metre above ground plane; and
  - 2-3 year old - 0.9 metre above ground plane.

- Based on the drawings, three AC units were assumed to be required for the various spaces. Each was modelled as a point source located 1.0 metres above ground level. These are
positioned on the south east corner of the undercroft parking area mounted on concrete plinths, as per the plans.

- Other mechanical plant includes five exhaust fans (toilets and laundry) and one kitchen exhaust fan/range hood fan. All were modelled as point sources approximately 0.5 metre above roof level and generally above the area serviced.
- The air conditioner condenser outdoor units are to be located in the basement car-park area.

3.6 Walls and Fences

The existing boundary fences of the residences generally consist of 1.8 metre high sheet metal fence. As discussed, the future colorbond fencing and retaining walls for #20-#24 Kanangara are also included in the noise model.

As per the proposed plans, no solid fencing is assumed to be present to the front of the decked play area towards Coolibah Road, as open slat style fencing is proposed. A brick base with glass balustrade is proposed for the northern side boundary.

*Figure 3-1 shows a view of the 3D model based on the information above in relation to topography and building and fence heights. Also shown are the outdoor play areas and point sources (e.g. mechanical plant) as dots.*
4 RESULTS

4.1 Outdoor Child Play

The childcare development will host up to 83 children with 55 children above the age of two and considered to make noise during child play i.e. babies and wobblers are not considered to make significant or prolonged noise during play. It is noted play time is generally staggered and therefore not all 55 children would be playing outside at once for extended periods of time. However, noise levels were predicted for the following worst-case scenario:

- 55 children are playing outside simultaneously for extended period of time.

Table 4-1 presents the predicted noise levels at each receiver, noting the predicted noise levels are from child play only i.e. mechanical plant noise is not included. Figure 4-1 also shows the predicted noise levels as noise contour maps at ground level (1.5 metres AGL).

<table>
<thead>
<tr>
<th>Receiver</th>
<th>Façade Facing</th>
<th>55 Children Outside $L_{A10}$ dB</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Kiama Court</td>
<td>NW</td>
<td>40</td>
</tr>
<tr>
<td>1 Kiama Court SW</td>
<td>SW</td>
<td>42</td>
</tr>
<tr>
<td>19 Kanangra Crescent</td>
<td>SE</td>
<td>32</td>
</tr>
<tr>
<td>20-22 Kanangra Crescent</td>
<td>E</td>
<td>40</td>
</tr>
<tr>
<td>21 Kanangra Crescent</td>
<td>SE</td>
<td>35</td>
</tr>
<tr>
<td>23 Kanangra Crescent</td>
<td>SE</td>
<td>35</td>
</tr>
<tr>
<td>25 Kanangra Crescent</td>
<td>E</td>
<td>33</td>
</tr>
<tr>
<td>26 Kanangra Crescent</td>
<td>E</td>
<td>49</td>
</tr>
<tr>
<td>28 Kanangra Crescent</td>
<td>E</td>
<td>41</td>
</tr>
<tr>
<td>119 Coolibah Drive</td>
<td>N</td>
<td>39</td>
</tr>
<tr>
<td>120 Coolibah Drive</td>
<td>W</td>
<td>39</td>
</tr>
<tr>
<td>121 Coolibah Drive</td>
<td>W</td>
<td>41</td>
</tr>
<tr>
<td>126 Coolibah Drive</td>
<td>NW</td>
<td>47</td>
</tr>
</tbody>
</table>

Reference: 20035418-01B
Figure 4-1

Predicted Noise level
\( L_{A10} \text{ dB} \)

- \( = 40 \)
- \( = 42 \)
- \( = 44 \)
- \( = 46 \)
- \( = 48 \)
- \( = 50 \)
- \( = 52 \)
- \( = 54 \)
- \( = 56 \)

Signs and symbols

- CCC building
- 1.8m solid fence
- Child Play source

Lots 207 and 208 (#122 and #124) Coolibah Drive, Greenwood CCC
Development - Predicted Noise Levels

\( L_{A10} \) Noise Level Contours - Children Playing Only - Ground Floor

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4.2 Mechanical Plant

Mechanical plant consists of AC plant and extraction fans for the kitchen, toilets and laundry. The AC plant is shown to be located in the basement car park area. The exhaust fans were assumed to be located on the roof and above the room being serviced.

Since the childcare centre opens from 6.30am, it was considered that all plant could be operating simultaneously at night-time (i.e. before 7.00am). The predicted mechanical plant noise levels are presented in Table 4-2.

<table>
<thead>
<tr>
<th>Receiver</th>
<th>Façade Facing</th>
<th>All Mechanical Plant Operating $L_{A10}$ dB</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Kiama Court</td>
<td>NW</td>
<td>25</td>
</tr>
<tr>
<td>1 Kiama Court SW</td>
<td>SW</td>
<td>26</td>
</tr>
<tr>
<td>19 Kanangra Crescent</td>
<td>SE</td>
<td>27</td>
</tr>
<tr>
<td>20 Kanangra Crescent</td>
<td>E</td>
<td>32</td>
</tr>
<tr>
<td>21 Kanangra Crescent</td>
<td>SE</td>
<td>28</td>
</tr>
<tr>
<td>23 Kanangra Crescent</td>
<td>SE</td>
<td>30</td>
</tr>
<tr>
<td>25 Kanangra Crescent</td>
<td>E</td>
<td>30</td>
</tr>
<tr>
<td>26 Kanangra Crescent</td>
<td>E</td>
<td>37</td>
</tr>
<tr>
<td>28 Kanangra Crescent</td>
<td>E</td>
<td>36</td>
</tr>
<tr>
<td>119 Coolibah Drive</td>
<td>N</td>
<td>28</td>
</tr>
<tr>
<td>120 Coolibah Drive</td>
<td>W</td>
<td>33</td>
</tr>
<tr>
<td>121 Coolibah Drive</td>
<td>W</td>
<td>25</td>
</tr>
<tr>
<td>126 Coolibah Drive</td>
<td>NW</td>
<td>29</td>
</tr>
</tbody>
</table>

It can be seen that at most receivers, the predicted mechanical plant noise is lower than the child play noise levels (*Table 4-1*). Therefore, child play noise would dominate the noise levels at most receivers except prior to 7.00am, when child play noise is not present.

The overall mechanical plant only noise levels are also shown on *Figure 4-2*. 
Lots 207 and 208 (#122 and #124) Coolibah Drive, Greenwood CCC Development - Predicted Noise Levels

$\text{LA}_{10}$ Noise Level Contours - Mech Plant Only - Ground Floor

Predicted Noise level $\text{LA}_{10}$ dB

- $35$
- $37$
- $39$
- $41$
- $43$
- $45$
- $47$
- $49$
- $51$

Signs and symbols
- CCC Building
- 1.8m solid fence
- Point source

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4.3 Indoor Child Play

An assessment of noise levels from indoor child play was carried out and the resulting noise levels at all locations were predicted to be well below that of outdoor child play considered in Section 4.1. This assessment was carried out based on the following considerations:

- External doors and windows will be closed during indoor activity / play;
- Internal noise levels within activity rooms would not exceed those from outdoor play for each age group; and,
- Any music played within the internal activity areas would be 'light' music with no significant bass content and played at a relatively low level.

5 ASSESSMENT

5.1 Outdoor Child Play

Although the childcare centre opens from 6.30am, outdoor child play will only occur after 7.00am, when the assigned noise levels are 48 dB LA10. Noise from child play is not considered to contain annoying characteristics within the definition of the Regulations and therefore no adjustments are made to the predicted noise levels.

Table 5-1 presents the assessment of the highest predicted noise levels from 55 children above the age of 2 playing outside against the LA10 assigned noise level at each receiver. It is noted that at the receivers shown in Table 5-1, that in general the child play noise is dominant. There are no locations where both source types contribute significantly to each other and therefore have been assessed separately. Mechanical plant noise is specifically addressed in Section 5-2.

<table>
<thead>
<tr>
<th>Receiver</th>
<th>Façade Facing</th>
<th>Assigned Noise Level L_{A10} dB</th>
<th>Children Playing Outside</th>
<th>Exceedence dB</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Kiama Court</td>
<td>NW</td>
<td>48</td>
<td>40</td>
<td>Complies</td>
</tr>
<tr>
<td>1 Kiama Court SW</td>
<td>SW</td>
<td>48</td>
<td>42</td>
<td>Complies</td>
</tr>
<tr>
<td>19 Kanangra Crescent</td>
<td>SE</td>
<td>48</td>
<td>32</td>
<td>Complies</td>
</tr>
<tr>
<td>20-22 Kanangra Crescent</td>
<td>E</td>
<td>48</td>
<td>40</td>
<td>Complies</td>
</tr>
<tr>
<td>21 Kanangra Crescent</td>
<td>SE</td>
<td>48</td>
<td>35</td>
<td>Complies</td>
</tr>
<tr>
<td>23 Kanangra Crescent</td>
<td>SE</td>
<td>48</td>
<td>35</td>
<td>Complies</td>
</tr>
<tr>
<td>25 Kanangra Crescent</td>
<td>E</td>
<td>48</td>
<td>33</td>
<td>Complies</td>
</tr>
<tr>
<td>26 Kanangra Crescent</td>
<td>E</td>
<td>48</td>
<td>49</td>
<td>+1</td>
</tr>
<tr>
<td>28 Kanangra Crescent</td>
<td>E</td>
<td>48</td>
<td>41</td>
<td>Complies</td>
</tr>
<tr>
<td>119 Coolibah Drive</td>
<td>N</td>
<td>48</td>
<td>39</td>
<td>Complies</td>
</tr>
</tbody>
</table>
From Table 5-1 it can be seen that exceedences are predicted at those receivers on the north, east and south side of the proposed development, with a exceedence of +1 dB predicted at #26 Kanangra Crescent the rear of development.

Based on the modelling assumptions and results, the following mitigation options are required to achieve compliance:

- Limit the number of children playing outside for those above the age of two. Of the three groups (one toddler group and two kindy groups), only up to two groups should play in the outdoor space at any one time. Note that children under the age of 2 can be outside without this restriction.

### 5.2 Mechanical Plant

Given the proposed opening hours of the childcare centre, the night-time period (i.e. before 7.00am) is most critical. The overall noise levels are generally attributed with a +5 dB adjustment for tonality (refer Table 2-1) is to be made to the predicted noise levels. After 7.00am, tonality is not considered likely and therefore no adjustment is made for the daytime period.

Based on the predicted noise levels in Table 4-2, the highest assessable night-time noise levels are therefore 42 dB $L_{A10}$ (including the tonality adjustment), at the receiver at #26 Kanangra Crescent. As such, the night-time $L_{A10}$ assigned noise level of 38 dB would be exceeded by up to 4 dB.

It must be noted this assessment is based on assumptions in relation to the size and type of exhaust fans. Therefore, mechanical plant noise must be reviewed by a qualified acoustical consultant during detailed design, when plant selections and locations become known. However, based on the modelling carried out, compliance can be achieved by implementing the following:

- Allow for silencers or interior duct lining in the duct design of exhaust fans.
- Orient the exhausts away from each nearest noise sensitive receiver.
- All plant to be mounted on suitable anti-vibration mounts.

<table>
<thead>
<tr>
<th>Receiver</th>
<th>Façade Facing</th>
<th>Assigned Noise Level $L_{A10}$ dB</th>
<th>Children Playing Outside</th>
<th>Exceedence dB</th>
</tr>
</thead>
<tbody>
<tr>
<td>120 Coolibah Drive</td>
<td>W</td>
<td>48</td>
<td>39</td>
<td>Complies</td>
</tr>
<tr>
<td>121 Coolibah Drive</td>
<td>W</td>
<td>48</td>
<td>41</td>
<td>Complies</td>
</tr>
<tr>
<td>126 Coolibah Drive</td>
<td>NW</td>
<td>60</td>
<td>47</td>
<td>Complies</td>
</tr>
</tbody>
</table>
6 CONCLUSIONS

The noise impacts from the proposed childcare centre to be located at Lots 207 and 208 (#122 and #124) Coolibah Drive in Greenwood have been assessed against the relevant criteria of the Environmental Protection (Noise) Regulations 1997.

Based on the modelling and assessments above in relation to the noise emissions from child play, mechanical plant it is concluded that compliance can be achieved provided that the following are implemented:

- Limit the number of children playing outside for those above the age of two. Of the three groups (one toddler group and two kindy groups), only up to two groups should play in the outdoor space at any one time. Note that children under the age of 2 can be outside without this restriction.

- Mechanical plant that runs prior to 7am to be selected to have a quiet noise output mode (subject to review and verification during detailed design) or to be attenuated to achieve a 4 dB reduction.

It is noted that the assessment of the mechanical plant is based on assumptions in relation to the size and type of exhaust fans. Therefore, mechanical plant noise should be reviewed by a qualified acoustical consultant during detailed design, when plant selections and locations become known.

Finally, the following best practices should be implemented:

- The behaviour and 'style of play' of children should be monitored to prevent particularly loud activity e.g. loud banging/crashing of objects, 'group' shouts/yelling,

- Favour soft finishes in the outdoor play area to minimise impact noise (e.g. soft grass, sand pit(s), rubber mats) over timber or plastic,

- Favour soft balls and rubber wheeled toys,

- Crying children should be taken inside to be comforted,

- No amplified music to be played outside,

- External doors and windows to be closed during indoor activity / play, and

- Any music played within the internal activity areas to be 'light' music with no significant bass content and played at a relatively low level.
Appendix A

Development Plans
Appendix B

Terminology
The following is an explanation of the terminology used throughout this report.

**Decibel (dB)**
The decibel is the unit that describes the sound pressure and sound power levels of a noise source. It is a logarithmic scale referenced to the threshold of hearing.

**A-Weighting**
An A-weighted noise level has been filtered in such a way as to represent the way in which the human ear perceives sound. This weighting reflects the fact that the human ear is not as sensitive to lower frequencies as it is to higher frequencies. An A-weighted sound level is described as $L_A\, \text{dB}$.

**Sound Power Level ($L_w$)**
Under normal conditions, a given sound source will radiate the same amount of energy, irrespective of its surroundings, being the sound power level. This is similar to a 1kW electric heater always radiating 1kW of heat. The sound power level of a noise source cannot be directly measured using a sound level meter but is calculated based on measured sound pressure levels at known distances. Noise modelling incorporates source sound power levels as part of the input data.

**Sound Pressure Level ($L_p$)**
The sound pressure level of a noise source is dependent upon its surroundings, being influenced by distance, ground absorption, topography, meteorological conditions etc and is what the human ear actually hears. Using the electric heater analogy above, the heat will vary depending upon where the heater is located, just as the sound pressure level will vary depending on the surroundings. Noise modelling predicts the sound pressure level from the sound power levels taking into account ground absorption, barrier effects, distance etc.

$L_{ASlow}$
This is the noise level in decibels, obtained using the A frequency weighting and the S (Slow) time weighting as specified in IEC 61672-1:2002. Unless assessing modulation, all measurements use the slow time weighting characteristic.

$L_{AFast}$
This is the noise level in decibels, obtained using the A frequency weighting and the F (Fast) time weighting as specified in IEC 61672-1:2002. This is used when assessing the presence of modulation only.

$L_{APeak}$
This is the greatest absolute instantaneous sound pressure in decibels using the A frequency weighting as specified in IEC 61672-1:2002.

$L_{Amax}$
An $L_{Amax}$ level is the maximum A-weighted noise level during a particular measurement.

$L_{A1}$
An $L_{A1}$ level is the A-weighted noise level which is exceeded for one percent of the measurement period and is considered to represent the average of the maximum noise levels measured.
\( L_{A10} \)

An \( L_{A10} \) level is the A-weighted noise level which is exceeded for 10 percent of the measurement period and is considered to represent the “intrusive” noise level.

\( L_{Aeq} \)

The equivalent steady state A-weighted sound level (“equal energy”) in decibels which, in a specified time period, contains the same acoustic energy as the time-varying level during the same period. It is considered to represent the “average” noise level.

\( L_{A90} \)

An \( L_{A90} \) level is the A-weighted noise level which is exceeded for 90 percent of the measurement period and is considered to represent the “background” noise level.

One-Third-Octave Band

Means a band of frequencies spanning one-third of an octave and having a centre frequency between 25 Hz and 20 000 Hz inclusive.

\( L_{A_{max}} \) assigned level

Means an assigned level which, measured as a \( L_{A\,slow} \) value, is not to be exceeded at any time.

\( L_{A1} \) assigned level

Means an assigned level which, measured as a \( L_{A\,slow} \) value, is not to be exceeded for more than 1% of the representative assessment period.

\( L_{A_{10}} \) assigned level

Means an assigned level which, measured as a \( L_{A\,slow} \) value, is not to be exceeded for more than 10% of the representative assessment period.

Tonal Noise

A tonal noise source can be described as a source that has a distinctive noise emission in one or more frequencies. An example would be whining or droning. The quantitative definition of tonality is:

the presence in the noise emission of tonal characteristics where the difference between -

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

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

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

This is relatively common in most noise sources.

Modulating Noise

A modulating source is regular, cyclic and audible and is present for at least 10% of the measurement period. The quantitative definition of modulation is:

a variation in the emission of noise that —
(a) is more than 3 dB $L_{A_{\text{Fast}}}$ or is more than 3 dB $L_{A_{\text{Fast}}}$ in any one-third octave band;

(b) is present for at least 10% of the representative.

**Impulsive Noise**

An impulsive noise source has a short-term banging, clunking or explosive sound. The quantitative definition of impulsiveness is:

a variation in the emission of a noise where the difference between $L_{A_{\text{peak}}}$ and $L_{A_{\text{Max slow}}}$ is more than 15 dB when determined for a single representative event;

**Major Road**

Is a road with an estimated average daily traffic count of more than 15,000 vehicles.

**Secondary / Minor Road**

Is a road with an estimated average daily traffic count of between 6,000 and 15,000 vehicles.

**Influencing Factor (IF)**

$$IF = \frac{1}{10}(\% \text{ Type } A_{100} + \% \text{ Type } A_{450}) + \frac{1}{20}(\% \text{ Type } B_{100} + \% \text{ Type } B_{450})$$

where:

- $\% \text{ Type } A_{100}$ = the percentage of industrial land within a 100m radius of the premises receiving the noise
- $\% \text{ Type } A_{450}$ = the percentage of industrial land within a 450m radius of the premises receiving the noise
- $\% \text{ Type } B_{100}$ = the percentage of commercial land within a 100m radius of the premises receiving the noise
- $\% \text{ Type } B_{450}$ = the percentage of commercial land within a 450m radius of the premises receiving the noise

+ Traffic Factor (maximum of 6 dB)
  - = 2 for each secondary road within 100m
  - = 2 for each major road within 450m
  - = 6 for each major road within 100m

**Representative Assessment Period**

Means a period of time not less than 15 minutes, and not exceeding four hours, determined by an inspector or authorised person to be appropriate for the assessment of a noise emission, having regard to the type and nature of the noise emission.

**Background Noise**

Background noise or residual noise is the noise level from sources other than the source of concern. When measuring environmental noise, residual sound is often a problem. One reason is that regulations often require that the noise from different types of sources be dealt with separately. This separation, e.g. of traffic noise from industrial noise, is often difficult to accomplish in practice. Another reason is that the measurements are normally carried out outdoors. Wind-induced noise, directly on the microphone and indirectly on trees, buildings, etc., may also affect the result. The character of these noise sources can make it difficult or even impossible to carry out any corrections.
**Ambient Noise**
Means the level of noise from all sources, including background noise from near and far and the source of interest.

**Specific Noise**
Relates to the component of the ambient noise that is of interest. This can be referred to as the noise of concern or the noise of interest.

**Chart of Noise Level Descriptors**

![Chart of Noise Level Descriptors](image)

**Typical Noise Levels**

![Typical Noise Levels](image)