Concord Repatriation General Hospital Redevelopment -
1 Hospital Road, Concord

Acoustic Report for SSD 9036
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1 INTRODUCTION

Acoustic Logic Consultancy has been engaged to undertake an assessment of operational and construction noise likely to be associated with the proposed Concord Repatriation General Hospital Development Project (Concept Stage 1 and 2, and Detailed Stage 1 Works).

In this report, we will:

- Identify nearby noise sensitive receivers and anticipated operational noise sources with the potential to adversely impact nearby development.
- Identify relevant NSW Planning and EPA acoustic criteria applicable to the development.
- Predict operational noise emissions and assess them against acoustic criteria.
- If necessary, determine building and/or management controls necessary to ensure ongoing compliance with noise emission goals.
- Conduct a review of construction noise and vibration. This will identify relevant EPA and Australian Standard criteria for noise and vibration impacts on nearby developments arising during the construction period.

1.1 SEARS REQUIREMENTS

This report has been prepared to address the following SEARs requirements:

**Concept Proposal**

- Requirement 4 - Environmental Amenity.

  Assess amenity impacts on surrounding locality, including solar access, acoustic impacts, visual privacy and view loss. A high level of environmental amenity for any surrounding residential land uses must be demonstrated.

**Stage 1 – Clinical Services Building and Multi-Storey Car Park.**

- Requirement 2 – Environmental Amenity.

  Detail amenity impacts including solar access, acoustic impacts, visual privacy, view loss, overshadowing, reflectivity from building facades and wind impacts. A high level of environmental amenity for any surrounding residential land uses and areas of public open space must be demonstrated.

- Requirement 4 – Noise and Vibration

  Identify and provide a quantitative assessment of the main noise and vibration generating sources during construction and operation and outline measures to minimise and mitigate the potential noise impacts on surrounding occupiers of land.

**Relevant Policies and Guidelines**

- Interim Construction Noise Guideline (DECC).
2 SITE DESCRIPTION AND PROPOSED WORKS

The site is located within the Concord General Hospital precinct (on Hospital Road, Currawang Street and Boronia Street, Concord). The boundaries of the precinct and the position of the new works within the precinct are shown in the aerial photo below.

This SSDA report seeks consent for the proposed redevelopment of Concord Repatriation General Hospital to improve and replace outmoded facilities to meet the substantial growth in clinical service demand across the hospital’s catchment:

Concept approval is sought for the redevelopment indicatively comprising 82,000sqm GFA, to be undertaken in two stages including:

- Clinical Services Building (CSB) and multi storey carpark (Stage 1); and
- Acute Services Building (ASB) and multistorey carpark (Stage 2).

Detailed approval is sought for the Stage 1 construction of the proposed CSB (44,000sqm GFA) and the construction of a multi-storey car park located to the north of Hospital Road.

Detailed development approval for the proposed Stage 2 works will be completed at a later date and does not form part of this SSDA. The Stage 1 Detailed works are estimated to be completed by end 2021.

See aerial photo below.

The proposed Concept redevelopment is in accordance with the concept architectural package prepared by Jacobs.

The proposed Stage 1 detailed development (CSB and multistorey carpark) is in accordance with the architectural drawings prepared by Jacobs.

We note that enabling works associated with the project (demolition of existing buildings and services upgrade/relocation works) are the subject of an early works package and are not a part of this assessment.
2.1 IDENTIFICATION OF NOISE SENSITIVE RECEIVERS.

Noise sensitive developments outside of the hospital precinct are residences on Fremont Street, Hospital Road, Currawang Street and Nullawarra Avenue, as identified in the aerial photo below.

Receivers that are located within the hospital grounds which are adjacent to the Clinical Services Building have been identified below.

- Hospital Receiver 1 – Multi Building (Concord Hospital) located to the north of the site.
- Hospital Receiver 2 – Palliative Care (Building 44) located to the north-east of the enabling works.
- Hospital Receiver 3 – Chapel (Building 9) located to the north of the enabling works.
- Hospital Receiver 4 – Veteran Day Centre (Building 69-70) located to the south of enabling works.
- Hospital Receiver 5 – Engineering offices (Building 74 and 76) located to the west.

A site map, measurement description and surrounding receivers is presented below.
Figure 1: Site Survey

Proposed Multistorey Car Park (Stage 1 and 2)

Lovedale Place

North

Fremont Street Residences

Hospital Road

Proposed Acute Services Building (Stage 2)

Drop Off Area

Proposed Clinical Services Building (Stage 1)

Loading Dock

Currawang Street Residences

Nullawarra Ave Residences

Hospital Precinct Boundaries

Primary Service Vehicle Access Routes
3 NOISE DESCRIPTORS

Environmental noise constantly varies. Accordingly, it is not possible to accurately determine prevailing environmental noise conditions by measuring a single, instantaneous noise level.

To accurately determine the environmental noise a 15-minute measurement interval is utilised. Over this period, noise levels are monitored on a continuous basis and statistical and integrating techniques are used to determine noise description parameters.

In analysing environmental noise, three-principle measurement parameters are used, namely $L_{10}$, $L_{90}$ and $L_{eq}$.

The $L_{10}$ and $L_{90}$ measurement parameters are statistical levels that represent the average maximum and average minimum noise levels respectively, over the measurement intervals.

The $L_{10}$ parameter is commonly used to measure noise produced by a particular intrusive noise source since it represents the average of the loudest noise levels produced by the source.

Conversely, the $L_{90}$ level (which is commonly referred to as the background noise level) represents the noise level heard in the quieter periods during a measurement interval. The $L_{90}$ parameter is used to set the allowable noise level for new, potentially intrusive noise sources since the disturbance caused by the new source will depend on how audible it is above the pre-existing noise environment, particularly during quiet periods, as represented by the $L_{90}$ level.

The $L_{eq}$ parameter represents the average noise energy during a measurement period. This parameter is derived by integrating the noise levels measured over the 15-minute period. $L_{eq}$ is important in the assessment of traffic noise impact as it closely corresponds with human perception of a changing noise environment; such is the character of environmental noise.

$L_{Max}$ levels represent is the loudest noise event during a measurement period.
4 SURVEY OF EXISTING NOISE CONDITIONS

Both long term unattended noise logging and attended noise measurements were conducted to quantify the existing acoustic environment at the site.

The aerial photograph below indicates the position of all attended measurements and long-term noise logging positions.

Equipment consisted of:

- All long-term monitoring was undertaken using Acoustic Research Laboratories monitors set on A-weighted fast response mode. The monitors were calibrated before and after the measurements using a Rion Type NC-73 calibrator. No significant drift was recorded.

- All attended measurements were undertaken using Norsonic 140 sound analyser set on A-weighted fast response mode. The monitors were calibrated before and after the measurements using a Rion Type NC-73 calibrator. No significant drift was recorded.

The long-term noise monitoring locations were selected because:

- They were as close as practicable to the residences nearest to the proposed development (be it the car park or the new Clinical Services Building).

- They were adjacent to the roadways that service the proposed new building and car park.

The short-term measurement locations (locations as detailed in the aerial photograph in section 2) were selected as they enabled observation at the long-term monitoring locations to determine if the logging location was affected by plant noise, road traffic noise or some other significant noise source.

Analysis of both the long term and short-term noise logging then enables appropriate ambient noise levels at the site. In turn, this enables the EPA Noise Policy for Industry to be applied to set appropriate noise emission goals for the site.

Unattended and attended noise measurements have been undertaken as per the procedures outlined in Fact Sheet A and B of the NSW EPA Noise Policy for Industry.

Weather affected data (rain fall and wind speeds above 5m/s) have been excluded from the assessment as per Fact Sheet A and B. Where interval periods (day, evening and night) have 18%, 13% and 11% respectively, these periods have been excluded from the assessment.

Detailed graphs of the measured noise levels from the unattended noise monitors are presented in Appendix 1-4. Calibration certificates for all equipment used are in Appendix 5.

A site map showing all measurement locations is presented below.
Figure 2: Monitoring Positions

- Attended Measurement – A1
- Attended Measurement – A2
- Attended Measurement – A3
- Attended Measurement – A4
- Attended Measurement – A5
- Attended Measurement – A6
- Logger Location M1
- Logger Location M2
- Logger Location M3
- Logger Location M4

North
## 4.1 ATTENDED NOISE MEASUREMENT RESULTS

A summary of the attended noise measurements is presented below.

### Table 1 – Attended Noise Measurements

<table>
<thead>
<tr>
<th>Measurement Location (see figure 2)</th>
<th>Time of Day</th>
<th>Measured Noise Level</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1 Lovedale Place (North End)</td>
<td>Friday 2(^{nd}) March 2018 – 12:30pm-2:00pm</td>
<td>47dB(A)(L_{eq})(Period) 45dB(A)(L_{90})(Period)</td>
<td>Distant traffic noise from Concord Road.</td>
</tr>
<tr>
<td></td>
<td>Wednesday 7(^{th}) March 2018 – 11:00pm-1:30am</td>
<td>41dB(A)(L_{eq})(Period) 40dB(A)(L_{90})(Period)</td>
<td>Distant mechanical noise from existing hospital (Roof Plant).</td>
</tr>
<tr>
<td>A2 Lovedale Place (South End)</td>
<td>Friday 2(^{nd}) March 2018 – 12:30pm-2:00pm</td>
<td>46dB(A)(L_{eq})(Period) 44dB(A)(L_{90})(Period)</td>
<td>Distant traffic noise from Concord Road.</td>
</tr>
<tr>
<td></td>
<td>Wednesday 7(^{th}) March 2018 – 11:00pm-1:30am</td>
<td>41dB(A)(L_{eq})(Period) 40dB(A)(L_{90})(Period)</td>
<td>Distant mechanical noise from existing hospital (Roof Plant).</td>
</tr>
<tr>
<td>A3 Fremont Street</td>
<td>Friday 2(^{nd}) March 2018 – 12:30pm-2:00pm</td>
<td>57dB(A)(L_{eq})(Period) 45dB(A)(L_{90})(Period)</td>
<td>Distant mechanical noise from existing hospital (Roof Plant).</td>
</tr>
<tr>
<td></td>
<td>Wednesday 7(^{th}) March 2018 – 11:00pm-1:30am</td>
<td>45dB(A)(L_{eq})(Period) 44dB(A)(L_{90})(Period)</td>
<td>Distant mechanical noise from existing hospital.</td>
</tr>
<tr>
<td>A4 Hospital Road</td>
<td>Friday 2(^{nd}) March 2018 – 12:30pm-2:00pm</td>
<td>63dB(A)(L_{eq})(Period) 48dB(A)(L_{90})(Period)</td>
<td>Traffic noise from Hospital Road.</td>
</tr>
<tr>
<td></td>
<td>Wednesday 7(^{th}) March 2018 – 11:00pm-1:30am</td>
<td>60dB(A)(L_{eq})(Period) 46dB(A)(L_{90})(Period)</td>
<td>Distant mechanical noise from existing hospital.</td>
</tr>
<tr>
<td>A5 Currawang Street</td>
<td>Friday 2(^{nd}) March 2018 – 12:30pm-2:00pm</td>
<td>50dB(A)(L_{eq})(Period) 48dB(A)(L_{90})(Period)</td>
<td>Distant mechanical noise from existing hospital (Condensers – western façade of Main Building).</td>
</tr>
<tr>
<td></td>
<td>Wednesday 7(^{th}) March 2018 – 11:00pm-1:30am</td>
<td>45dB(A)(L_{eq})(Period) 44dB(A)(L_{90})(Period)</td>
<td>Distant mechanical noise from existing hospital (Condensers – western façade of Main Building).</td>
</tr>
<tr>
<td>A6 Nullawarra Avenue</td>
<td>Friday 2(^{nd}) March 2018 – 12:30pm-2:00pm</td>
<td>66dB(A)(L_{eq})(Period) 52dB(A)(L_{90})(Period)</td>
<td>Traffic noise from Nullawarra Avenue.</td>
</tr>
<tr>
<td></td>
<td>Wednesday 7(^{th}) March 2018 – 11:00pm-1:30am</td>
<td>54dB(A)(L_{eq})(Period) 43dB(A)(L_{90})(Period)</td>
<td>Distant mechanical noise from existing hospital (Roof Plant).</td>
</tr>
</tbody>
</table>
4.2 UNATTENDED NOISE MONITORING RESULTS

Unattended noise monitoring was conducted over the following dates:

- Unattended Noise Monitor M1 – (Lovedale Place – Behind Existing Car Park) – Friday 16\textsuperscript{th} February 2018 to Tuesday 27\textsuperscript{th} February 2018.

- Unattended Noise Monitor M2 – (Hospital Road – Outside Hospital Bus Stop) – Tuesday 27\textsuperscript{th} February 2018 to Saturday 3\textsuperscript{rd} March 2018.

- Unattended Noise Monitor M3 (Currawang Street) – Friday 16\textsuperscript{th} February 2018 to Tuesday 27\textsuperscript{th} February 2018.

- Unattended Noise Monitor M4 – (Nullawarra Avenue) – Tuesday 27\textsuperscript{th} February 2018 to Thursday 8\textsuperscript{th} March 2018.

Measured noise levels are presented below.

Table 2 – Unattended Long-Term Noise Monitoring (Leq and Rating Background Noise Level)

<table>
<thead>
<tr>
<th>Monitor Location</th>
<th>Measured Noise Level - Time of Day</th>
<th>Comment</th>
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</thead>
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<tr>
<td></td>
<td>Daytime (7am-6pm)</td>
<td>Evening (6pm-10pm)</td>
</tr>
<tr>
<td>Monitor M1</td>
<td>59dBA(L\text{eq}(Period))</td>
<td>51dBA(L\text{eq}(Period))</td>
</tr>
<tr>
<td>(Lovedale Place/Fremont Street)</td>
<td>45dBA(L\text{90}(period))</td>
<td>43dBA(L\text{90}(period))</td>
</tr>
<tr>
<td>Monitor M2</td>
<td>66dBA(L\text{eq}(Period))</td>
<td>63dBA(L\text{eq}(Period))</td>
</tr>
<tr>
<td>(Hospital Road – 4m from kerb)</td>
<td>53dBA(L\text{90}(period))</td>
<td>47dBA(L\text{90}(period))</td>
</tr>
<tr>
<td>Monitor M3</td>
<td>57dBA(L\text{eq}(Period))</td>
<td>52dBA(L\text{eq}(Period))</td>
</tr>
<tr>
<td>(Currawang Street)</td>
<td>46dBA(L\text{90}(period))</td>
<td>46dBA(L\text{90}(period))</td>
</tr>
<tr>
<td>Monitor M4</td>
<td>61dBA(L\text{eq}(Period))</td>
<td>60dBA(L\text{eq}(Period))</td>
</tr>
<tr>
<td>(Nullawarra Avenue – 4m from kerb)</td>
<td>49dBA(L\text{90}(period))</td>
<td>43dBA(L\text{90}(period))</td>
</tr>
</tbody>
</table>

*This logger was used primarily to examine road traffic noise on Hospital Road, and not to determine a rating background noise level.
5 NOISE EMISSION CRITERIA

In Stage 1 SEAR requirement 4, the following noise controls and guidelines were identified in the SEARS:


In addition, in order to fore full the Environmental Amenity assessment requirement (Concept SEAR 4, Stage 1 SEAR 2), the following acoustic guidelines will also be considered:

- NSW EPA ‘Noise Policy for Industry (NPfI) 2017’.
- NSW EPA ‘Road Noise Policy (RNP) 2011’.

The acoustic requirements pursuant to these guidelines are detailed below.

5.1 NSW EPA – ‘NOISE POLICY FOR INDUSTRY (NPfI) 2017’

Noise sources covered by this code will include vehicle noise (generated on the site) and mechanical services noise. Both the Intrusiveness and the Project Amenity criteria (as set out below) must be complied with.

5.1.1 NSW EPA NPfI - Intrusiveness Noise Goals

Intrusiveness criteria permit noise generation to be no more than 5dB(A) above existing background noise levels. The criteria are as follows:
Table 3 - EPA Intrusiveness Criteria

<table>
<thead>
<tr>
<th>Location</th>
<th>Time of Day</th>
<th>Background noise Level dB(A)_{L90(Period)}</th>
<th>Intrusiveness Noise Objective dB(A)_{Leq(15min)}</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fremont Street/Hospital Road Residences</td>
<td>Day Time (7am - 6pm)</td>
<td>45</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>Evening (6pm - 10pm)</td>
<td>43</td>
<td>48</td>
</tr>
<tr>
<td></td>
<td>Night (10pm - 7am)</td>
<td>41</td>
<td>46</td>
</tr>
<tr>
<td>Currawang Street Residences</td>
<td>Day Time (7am - 6pm)</td>
<td>46</td>
<td>51</td>
</tr>
<tr>
<td></td>
<td>Evening (6pm - 10pm)</td>
<td>46</td>
<td>51</td>
</tr>
<tr>
<td></td>
<td>Night (10pm - 7am)</td>
<td>43</td>
<td>48</td>
</tr>
<tr>
<td>Nullawarra Ave Residences</td>
<td>Day Time (7am - 6pm)</td>
<td>49</td>
<td>54</td>
</tr>
<tr>
<td></td>
<td>Evening (6pm - 10pm)</td>
<td>43</td>
<td>48</td>
</tr>
<tr>
<td></td>
<td>Night (10pm - 7am)</td>
<td>37</td>
<td>42</td>
</tr>
</tbody>
</table>

5.1.2 NSW EPA NPI - Project Amenity Goals

Project amenity criteria are determined based on the land use in the area (residential/commercial/industrial). The residential land use is then further categorised into rural, sub-urban and urban areas.

For the purpose of this assessment the existing residential dwellings will be considered suburban.

Table 4 - EPA Project Amenity Criteria

<table>
<thead>
<tr>
<th>Noise Receiver</th>
<th>Amenity Noise Level – dB(A)_{Leq(15min)}</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Daytime</td>
</tr>
<tr>
<td>Existing Residential (Sub-urban)</td>
<td>53</td>
</tr>
<tr>
<td>Commercial (Hospital – External Noise Level)</td>
<td>65</td>
</tr>
</tbody>
</table>
However, we note that the noise emission goals in the table above should be modified for areas already affected by pre-existing industrial or road traffic noise. We note that the residences on Currawang Street are affected by pre-existing plant noise during day, evening and night, and the residences on Fremont Street are affected by pre-existing plant noise in the night time periods. Being local roads, traffic noise levels at these locations are low and are not sufficient to be considered high traffic areas when setting Project Amenity Noise Goals.

The Project Amenity criteria are adjusted in accordance with the NPfl guidelines for being the existing plant noise $L_{eq}$ level minus 10dB(A) (and minus 15 if the primary ambient noise source is traffic).

**Table 5 - EPA Project Amenity Criteria (Adjusted)**

<table>
<thead>
<tr>
<th>Location</th>
<th>Time of Day</th>
<th>Project Amenity Noise Objective $L_{eq(15min)}$ dB(A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fremont Street /Hospital Road Residences</td>
<td>Day Time (7am - 6pm)</td>
<td>53</td>
</tr>
<tr>
<td></td>
<td>Evening (6pm - 10pm)</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td>Night (10pm - 7am)</td>
<td>38</td>
</tr>
<tr>
<td>Currawang Street Residences</td>
<td>Day Time (7am - 6pm)</td>
<td>53</td>
</tr>
<tr>
<td></td>
<td>Evening (6pm - 10pm)</td>
<td>42*</td>
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<tr>
<td></td>
<td>Night (10pm - 7am)</td>
<td>38*</td>
</tr>
<tr>
<td>Nullawarra Ave Residences</td>
<td>Day Time (7am - 6pm)</td>
<td>46**</td>
</tr>
<tr>
<td></td>
<td>Evening (6pm - 10pm)</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td>Night (10pm - 7am)</td>
<td>38</td>
</tr>
<tr>
<td>Hospital Precinct (External Noise Level)</td>
<td>All times</td>
<td>65</td>
</tr>
</tbody>
</table>

*Being the $L_{eq}$ plant noise level (table 2) minus 10.

**Being the traffic noise level (table 2) minus 15.
5.2 SLEEP AROUSAL ASSESSMENT

Potential sleep arousal impacts should be considered for noise generated after 10pm.

Sleep arousal is a function of both the noise level and the duration of the noise.

As recommended in the NPfI, to assess potential sleep arousal impacts, a two-stage test is carried out:

- Step 1 – Section 2.5 Maximum noise level event assessment from the NPfI states the following:
  
  Where the subject development/premises night-time noise levels at a residential location exceed:
  
  - $L_{Aeq,15min} 40\text{dB(A)}$ or the prevailing RBL plus 5 dB, whichever is the greater, and/or
  
  - $L_{AF,max} 52\text{dB(A)}$ or the prevailing RBL plus 15 dB, whichever is greater,
  
  a detailed maximum noise level event assessment should be undertaken.

Based on the above the following noise objectives apply:

Table 6 – Sleep Arousal Criteria (Average/$L_{eq}$ Noise Levels)

<table>
<thead>
<tr>
<th>Location</th>
<th>Rating Background Level $dB(A)L_{90}$</th>
<th>Rating Background Level + 5dB(A)</th>
<th>Governing Criteria $dB(A)L_{eq(15mins)}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fremont Street/Hospital Road Residences</td>
<td>41</td>
<td>46</td>
<td>46</td>
</tr>
<tr>
<td>Currawang Street Residences</td>
<td>43</td>
<td>48</td>
<td>48</td>
</tr>
<tr>
<td>Nullawarra Ave Residences</td>
<td>37</td>
<td>42</td>
<td>42</td>
</tr>
</tbody>
</table>
### Table 7 – Sleep Arousal Criteria \((Maximum/L_{\text{Max}} \text{ Noise Events})\)

<table>
<thead>
<tr>
<th>Location</th>
<th>Rating Background Level dB(A)(L_{90})</th>
<th>Rating Background Level + 15dB(A)</th>
<th>Governing Criteria dB(A)(L_{\text{Max}})</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fremont Street / Hospital Road Residences</td>
<td>41</td>
<td>56</td>
<td>56</td>
</tr>
<tr>
<td>Currawang Street Residences</td>
<td>43</td>
<td>58</td>
<td>58</td>
</tr>
<tr>
<td>Nullawarra Ave Residences</td>
<td>37</td>
<td>52</td>
<td>52</td>
</tr>
</tbody>
</table>

- **Step 2** - If there are noise events that could exceed the average/maximum criteria detailed in the tables above, then an assessment of sleep arousal impact is required to be carried out taking into account the level and frequency of noise events during the night, existing noise sources, etc. This test takes into account the noise level and number of occurrences of each event with the potential to create a noise disturbance. As is recommended in the explanatory notes of the EPA NPfI, this more detailed sleep arousal test is conducted using the guidelines in the EPA Road Noise Policy. Most relevantly, the Road Noise Policy states:

> For the research on sleep disturbance to date it can be concluded that:

- Maximum internal noise levels below 50-55dB(A) are unlikely to awaken people from sleep.
- One to two noise events per night with maximum internal noise levels of 65-70dB(A) are not likely to affect health and wellbeing significantly.

#### 5.3 NOISE FROM INCREASED TRAFFIC GENERATION ON PUBLIC STREETS

For land use developments with the potential to create additional traffic on public streets the development should comply with the EPA Road Noise Policy.

Noise levels generated by traffic should not exceed the noise levels set out in the table below when measured at a nearby property.
Table 8 – Criteria for Traffic Noise Generator by New Developments

<table>
<thead>
<tr>
<th>Road Type</th>
<th>Time of day</th>
<th>Permissible Noise Generation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arterial (Hospital Road)</td>
<td>Day (7am to 10pm)</td>
<td>60 dB(A)_{Leq(15hr)}</td>
</tr>
<tr>
<td></td>
<td>Night (10pm to 7am)</td>
<td>55 dB(A)_{Leq(9hr)}</td>
</tr>
<tr>
<td>Local Road (Currawang/Boronia Street)</td>
<td>Day (7am to 10pm)</td>
<td>55 dB(A)_{Leq(1hr)}</td>
</tr>
<tr>
<td></td>
<td>Night (10pm to 7am)</td>
<td>50 dB(A)_{Leq(1hr)}</td>
</tr>
</tbody>
</table>

However, if existing noise levels exceed those in the table above, section 3.4 of the Road Noise Policy is applicable, which requires noise impacts are reduced through feasible and reasonable measures. However, in determining what is feasible/reasonable, the Policy notes that an increase of less than 2dB(A) is a minor impact and would be barely perceptible.

5.4 CONSTRUCTION NOISE AND VIBRATION IMPACTS

5.4.1 Construction Noise - EPA Interim Construction Noise Guidelines

EPA guidelines adopt differing strategies for noise control depending on the predicted noise level at the nearest residences:

- “Noise affected”/ “Noise Management” level. Where construction noise is predicted to exceed the “noise effected” level at a nearby residence, the proponent should take reasonable/feasible work practices to ensure compliance with the “noise effected level”. For residential properties, the “noise effected” level occurs when construction noise exceeds ambient levels by more than:
  - 10dB(A)_{Leq(15min)} for work during standard construction hours (7am-6pm Monday to Friday and 8am to 1pm on Saturdays).

- “Highly noise affected level”. Where noise emissions are such that nearby properties are “highly noise affected”, noise controls such as respite periods should be considered. For residential properties, the “highly noise affected” level occurs when construction noise exceeds 75dB(A)_{Leq(15min)} at nearby residences.

A summary of noise emission goals for standard hours of construction is presented below.
<table>
<thead>
<tr>
<th>Location</th>
<th>“Noise Affected” / “Noise Management Level” - dB(A)_{eq(15min)}</th>
<th>“Highly Noise Affected” Level - dB(A)_{eq(15min)}</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fremont Street / Hospital Road Residences</td>
<td>55 (Standard Construction Hours) (External Noise Level)</td>
<td>75 (External Noise Level)</td>
</tr>
<tr>
<td>Currawang Street Residences</td>
<td>56 (Standard Construction Hours) (External Noise Level)</td>
<td>75 (External Noise Level)</td>
</tr>
<tr>
<td>Nullawarra Ave Residences</td>
<td>59 (Standard Construction Hours) (External Noise Level)</td>
<td>75 (External Noise Level)</td>
</tr>
<tr>
<td>Hospital Wards</td>
<td>45 (When in use – Internal Noise Level)</td>
<td>N/A</td>
</tr>
<tr>
<td>Place of Worship</td>
<td>45 (When in use – Internal Noise Level)</td>
<td>N/A</td>
</tr>
<tr>
<td>Commercial</td>
<td>70 (When in use – External Noise Level)</td>
<td>N/A</td>
</tr>
</tbody>
</table>
5.4.2 Construction Vibration

Vibration goals for the amenity of nearby land users are those recommended by the EPA document *Assessing Vibration: A technical guideline*. These levels are presented below:

<table>
<thead>
<tr>
<th>Location</th>
<th>Time</th>
<th>Peak velocity (mm/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Preferred</td>
</tr>
<tr>
<td><strong>Continuous Vibration</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residences</td>
<td>Daytime</td>
<td>0.28</td>
</tr>
<tr>
<td>Hospitals – Office Areas</td>
<td>When in use</td>
<td>0.56</td>
</tr>
<tr>
<td>Hospitals – Theatres</td>
<td>When in use</td>
<td>0.14</td>
</tr>
<tr>
<td><strong>Impulsive Vibration</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residences</td>
<td>Daytime</td>
<td>8.6</td>
</tr>
<tr>
<td>Hospitals – Office Areas</td>
<td>When in use</td>
<td>18</td>
</tr>
<tr>
<td>Hospitals – Theatres</td>
<td>When in use</td>
<td>0.14</td>
</tr>
</tbody>
</table>
6 NOISE EMISSION ASSESSMENT

An assessment of construction and operational noise emissions is presented below.

The following noise sources are assessed:

- Vehicular noise on site (multi-storey car park, drop of area, loading dock).
- Noise created on public roads as a result of traffic generated by the site.
- A preliminary assessment of noise from mechanical plant.
- A discussion of construction noise will be presented.

The assessment is broken into a review of Stage 1 and Stage 2 works.

6.1 STAGE 1 WORKS

6.1.1 Noise from the Multi-Storey Car Park (Stage 1)

6.1.1.1 Peak Hour Noise Generation

Noise generated on site (within the car park building) is assessed with reference to the EPA Noise Policy for Industry.

Noise emission predictions are based on the following data/assumptions:

- Primary noise created by the car park is from cars circulating. Primary means of noise egress is via the building façade, which is open to enable natural ventilation of the car park.

- It is assumed that there are up to 20 cars circulating within the car park at any one time. (This is an extremely conservative assumption – assuming a 590 car capacity car park empties over a 1 hour period, and approximately 1 minute travel time per car, there would be on average 10 cars circulating within the car park at any one time).

- Typical sound power of a car circulating/driving within the car park is assumed to be 82dB(A)\( L_{eq} \). Operational noise levels are predicted and assessed against Noise Policy for Industry requirements detailed in section 5.2.

<table>
<thead>
<tr>
<th>Noise Source</th>
<th>Noise Receiver Location</th>
<th>Predicted Noise Level – ( dB(A))( L_{eq(15min)} )</th>
<th>Compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cars Manoeuvring within Car Park</td>
<td>Fremont Street Residences</td>
<td>38dB(A)( L_{eq(15min)} )</td>
<td>Complies – day criteria from section 5.2. – tables 3 and 5. ((50dB(A))( L_{eq} ))*</td>
</tr>
</tbody>
</table>

*A peak period of use of the car park occurs between 7am and 6pm (daytime).
6.1.2 Late Night Sleep Disturbance Assessment

With respect to late night use of the car park (sleep arousal assessment), noise emissions are predicted based on a typical peak noise event of \(90\text{dB}(A)_{\text{Lmax}}\) (door close/engine start).

Table 12 – Multi-Storey Car Park Noise to Freemont Street Residences Assessment (Sleep Arousal/\(L_{\text{max}}\) Assessment)

<table>
<thead>
<tr>
<th>Activity</th>
<th>Criteria</th>
<th>Permitted Noise Level</th>
<th>Predicted Noise Level</th>
<th>Complies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Car door slam/car start</td>
<td>Sleep Disturbance – Maximum Noise Level</td>
<td>56dB(A)(_{\text{Lmax}})</td>
<td>40dB(A)(_{\text{Leq(Max)}})</td>
<td>Yes</td>
</tr>
<tr>
<td>Car leaving site</td>
<td></td>
<td>56dB(A)(_{\text{Lmax}})</td>
<td>&lt;35dB(A)(_{\text{Leq(Max)}})</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Use of the multi-storey car park is predicted to comply with EPA guidelines.

6.1.2 Stage 1 Loading Docks (Deliveries/Waste Removal)

The loading dock is proposed to be located in a basement area of the new Clinical Services Building. Noise associated with the use of the loading dock will consist of:

- Trucks moving into or out of the loading dock.
- Materials Handling.

Noise generated the loading dock is assessed with reference to the EPA Noise Policy for Industry. The primary vehicle movement path of large services vehicles is via the Boronia Street driveway, making the nearest potentially impacted residences those on Nullawarra Avenue, directly opposite the Boronia Street intersection.

Predictions are made based on the following data/assumptions:

- Noise levels used in calculations:

Table 13 – Loading Dock Acoustic Data

<table>
<thead>
<tr>
<th>Noise Source</th>
<th>Noise Level (sound power level)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Truck engine (large rigid truck/garbage truck at approx 5km/h)</td>
<td>100dB(A)(_{\text{Leq}})</td>
</tr>
<tr>
<td>Materials Handling (pallet jacks or similar)</td>
<td>90dB(A)(_{\text{Leq}})</td>
</tr>
</tbody>
</table>
• Relative position of the noise source (boundary of hospital grounds at the eastern end of Boronia Street) and noise receiver (Boronia Street/Nullawarra Ave intersection), taking into account distance attenuation and the duration of the truck movement.

• There are up to four truck movements associated with the site in a peak one-hour period.

Operational noise levels are predicted and assessed against the NPfI criteria detailed in section 5.2. Noise from both manual handling in the loading dock, and the noise created by the truck as it enters/leaves the site are assessed.

**Table 14 – Loading Dock Noise Emission Assessment**

<table>
<thead>
<tr>
<th>Noise Source</th>
<th>Nearest Noise Receiver Location</th>
<th>Predicted Noise Level – dB(A)\text{L}_{eq(15\text{min})}</th>
<th>Compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Truck manoeuvring to/from site</td>
<td>Nullawarra Avenue residences.</td>
<td>37dB(A)\text{L}_{eq(15\text{min})}</td>
<td>Complies – day, evening and night criteria from section 5.2. – tables 3 and 5.</td>
</tr>
<tr>
<td>Materials Handling (in loading dock)</td>
<td>Currawang Street residences.</td>
<td>&lt;30dB(A)\text{L}_{eq(15\text{min})}</td>
<td>Complies – day, evening and night criteria from section 5.2. – tables 3 and 5.</td>
</tr>
</tbody>
</table>

Noise emissions from the loading dock are complaint with Noise Policy for Industry requirements.

### 6.1.3 Stage 1 Drop Off Area

The drop off area is located inbound from property boundaries, well away from residential properties.

Operational noise levels are predicted and assessed against the Noise Policy for Industry criteria, as detailed in section 5.2. Assessment with reference to night time noise goals (the most stringent) will be conducted. The assessment will include review of both average (\(L_{eq}\)) and maximum/sleep disturbance (\(L_{max}\)) criteria.

Noise from the use of the drop-off area is based on the following assumptions:

- 5 inbound and 5 outbound movements in a peak 15 minute night time period (one arrival and departure every three minutes, a conservative assumption in our experience).

- Passenger vehicle sound power:
  - 82dB(A)\text{L}_{eq} (car engine at 10km/h) and
  - 90dB(A)\text{L}_{max} (door close/engine start).

- Vocal noise from drop off area:
  - 72dB(A)\text{L}_{eq} sound power (10 people, 50% speaking):
Assessment of average and peak noise events is as follows:

**Table 15 – Drop Off Area – Noise Impact Assessment on Freemont Street Residences (Average/Leq Noise Emission Assessment)**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Criteria</th>
<th>Permitted Noise Level</th>
<th>Predicted Noise Level</th>
<th>Complies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle Noise/Conversational Noise (Cumulative Noise Level)</td>
<td>Intrusiveness Criteria</td>
<td>46dB(A)Leq(15min)</td>
<td>&lt;30dB(A)Leq(15min)</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Amenity Criteria</td>
<td>38dB(A)Leq(15min)</td>
<td>&lt;30dB(A)Leq(15min)</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Sleep Disturbance – Average/Leq Noise Level</td>
<td>46dB(A)Leq(15min)</td>
<td>&lt;30dB(A)Leq(15min)</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Given the comfortable degree of compliance with respect to Drop of Area noise emissions, significantly higher volumes of vehicles can be accommodated without any exceedance of noise emission guidelines.

**Table 16 – Drop Off Area – Noise Impact Assessment on Freemont Street Residences (Sleep Arousal/Lmax Assessment)**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Criteria</th>
<th>Permitted Noise Level</th>
<th>Predicted Noise Level</th>
<th>Complies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raised Voice/Door Close in Drop Off Bay</td>
<td>Sleep Disturbance – Maximum Noise Level</td>
<td>56dB(A)Lmax</td>
<td>&lt;30dB(A)Leq(Max)</td>
<td>Yes</td>
</tr>
<tr>
<td>Car leaving site</td>
<td></td>
<td>56dB(A)Lmax</td>
<td>&lt;35dB(A)Leq(Max)</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Use of the drop off bay is predicted to comply with EPA guidelines.
6.1.4 Noise from Mechanical Plant (Stage 1)

An assessment of primary mechanical plant items is presented below.

The relevant noise emission goals (section 5.1) have been determined taking into account the existing plant noise impacts on Freemont Street and Currawang Street residences, and therefore implicitly address potential cumulative noise impacts from the existing hospital.

Primary plant items will include:

- Roof top cooling towers.
- Basement Plant (water cooled chillers).
- On floor plant rooms.

With respect to the above, we note:

- Roof top plant:
  - Cooling towers
    - These are proposed to be located in the north-eastern corner of the roof of the new Clinical Services Building.
    - We note that the Cooling towers are positioned such that the building shell of the existing Main Building forms a noise screen (i.e. – it breaks the line of sight) to the Freemont Street residences.
    - In the event that a cooling tower sound power level exceeds 100dB(A), there is potentially an exceedance of NPfI noise emission requirements at residences on Freemont Street if roof top cooling towers are not acoustically treated.
    - To ensure compliance with EPA requirements during day, evening and night time - all cooling towers are to have variable speed drives, to allow for reduced fan speed during periods of low load. Typically, a fan speed of no more than 50% would be expected at night time.
  - Major fans (typically with a sound power over 90(A) – such as kitchen exhaust, major toilet exhaust and major relief air fans) will require acoustic treatment if located externally. Whenever possible, for major fans, it is recommended that axial (as opposed to roof mounted fans) are to be used as this will enable acoustic treatment to be incorporated within ductwork running to atmosphere.
  - Basement plant rooms – loudest typical plant items in this space will be chillers (typically 85dB(A) at 1m distance). Any ventilation opening to basement plant rooms is likely to require an acoustic louvre, although the exact length will be determined following equipment selection and plant room ventilation opening requirements.
  - On-floor Plant Rooms: The room is likely to house air handling plant (air handling units, return air fans, exhaust air fans). We note:
• The plant room are located on the southern façade of the proposed Clinical Services building (not facing a residential development).

• It is unlikely that anything more than internal lining of any ductwork connected to atmosphere will be required to ensure compliant noise levels at the nearest residences (Nullawarra Ave).

• Emergency power back-up generators (if any).
  - In the event that the generator is located within a plant room (generator sound power of 125dB(A)), acoustic attenuators will be required to the plant room air inlet and air discharge (indicatively 2.4m long, 40% open area attenuators). Additionally, the exhaust gas discharge will require a muffler such that it creates a noise level of no more than 75dB(A) at 1m distance.
  - In the event that the generator comes with a proprietary acoustic enclosure (typically 75dB(A) at 7m distance), the length of attenuators will potentially be reduced to 600mm long.
  - Detailed acoustic performance of plant room (or any acoustic enclosure) to be finalised following final generator selection/location.

Compliance with EPA acoustic criteria (as set out in Section 5.1) will be achievable, provided that detailed acoustic review of plant items is undertaken once plant is selected, and acoustic treatments similar to those outlined above are adopted.

6.1.5 Construction impacts (Stage 1)

6.1.5.1 Construction Noise

With respect to general construction noise, the impacts on nearby development will be dependent on the activity in question and where on the site the activity is undertaken.

With respect to potential noise impacts on nearby development, we note that both the multistorey car park and the Clinical Services Building are located away from residential property boundaries. In the case of the Clinical Services Building, there are also other hospital buildings in between the work site and the nearest residences.

Although a detailed construction program has not been completed at this stage, based on an analysis of typical construction methods, we note:

• Multi-storey car park:
  - The majority of construction works (form-working, concrete pours/finishing, use of hand tools and vehicles) will result in noise levels of between 50-58dB(A)\(L_{eq}\) at the nearest residences (Freemont Street). This is either compliant, or intermittently marginally exceeding the “Background+10dB(A)” Noise Management Level (55dB(A), as per table. 9 in section 5.4.1).
• Only use of percussive demolition equipment (hydraulic hammers) and potentially asphalting plant (if required) would result in sustained periods where the “Background+10dB(A)” Noise Management Level would be exceeded. However even these works will not exceed the “Highly Noise Affected” threshold of 75dB(A).

• Noise mitigation for these works is generally not warranted. In the event that sustained use of a hydraulic hammer is required (demolition of existing on grade car park), we recommend that residences on Freemont Street facing the site be notified of the likely date and duration of the work.

• Clinical Services Building:

  • Excavation/soil retention phase - Primary construction noise emissions occur during excavation and earth retention (piling), with equipment items typically having sound power levels of approximately 110dB(A)\(_{eq(15min)}\) (and 115-120dB(A) if excavation of rock using hydraulic hammers is required).

  • Given the location of the site (removed from residential property boundaries, screened by other development within the hospital precinct) construction noise levels exceeding EPA “Noise Management Level” (see table 9) is unlikely.

  • The only exception to this is:

    ▪ If extensive use of hydraulic hammers is required for excavation in rock.

    ▪ In the event a diesel crane with a cabin overlooking the other hospital buildings (i.e. – a line of sight to the Currawang Street residences) is used.

  • During erection of structure, it is the use of hand tools (angle grinders etc for formwork) and concrete pumps which are the loudest typical activity (sound power levels of approximately 105dB(A)\(_{eq(15min)}\)). Noise levels exceeding EPA “Noise Management” levels are unlikely to occur.

  • Once construction of the building shell is complete, noise from hand tools will be relatively low, as the new building façade will provide considerable noise attenuation. Once the building shell is largely complete, use of hand tools in internal areas is unlikely to exceed EPA recommended levels. Vehicle noise and crane noise will create the greatest possibility of noise disturbance during this phase.

Noise impacts can be minimised using the following:

• Location of static plant (concrete pumps, cranes) as far as practicable away from southern boundary as possible.

• Use of augured rather than driven or vibratory piling should be considered if feasible.

• Letter box drops or similar to advise the residents on Currawang Street in the event that significant excavation in rock (requiring use of hydraulic hammers) is required.

• Construction vehicles which are stationary onsite to queuing, should have their engines switched off to minimise impacts on residential receivers.
Through adoption of the above, noise impacts on nearby development can be suitably managed to prevent unreasonable impact.

Noise impacts on other buildings within Concord Hospital will be addressed through internal hospital management.

6.1.5.2 Construction Vibration

Excavation and earth retention works (piling) are the primary vibration generating activities.

Given the distance between the site and the nearest residential buildings (Currawang Street being the nearest), it is unlikely that construction vibration will exceed EPA guidelines.

However, as a precaution, if bulk excavation in rock or driven/vibrated piles are proposed, we recommend:

- Where practicable, excavation in rock should be done using rock saws as opposed to pneumatic hammers.
- For at least the initial stages of excavation in rock, vibration monitoring should be conducted to ensure excessive levels of vibration are not achieved. Monitoring at the residential property on Currawang Street should be considered.
- Any vibration monitoring system should allow for rapid feedback to the contractor (for example, SMS notification) in the event that excessive levels are reached.

Vibration impacts on other buildings within Concord Hospital will be addressed through internal hospital management.

6.2 STAGE 2 CONCEPT WORKS

Although concept approval only is sought at this stage, we note the following:

- Stage 2 car park. The new stage 2 car park will have a smaller capacity (approximately 520 cars), is located further away from the nearest residences (Fremont Street) and is shielded by the Stage 1 car park. The further increase in noise level as a result of the Stage 2 car park as it impacts the Fremont Street residences will be less than 2dB(A) (from 38dB(A) to 40dB(A). This is comfortably compliant with noise emission limit of 50dB(A), as detailed in table 11.

- Plant and Equipment Noise.

Being located adjacent to Hospital Road, the Stage 2 Acute Services Building will be 130m from the nearest residential development (Fremont Street). Typical primary equipment items will consist of cooling towers, chillers, generator and fans/HVAC equipment, however even indicative equipment locations have not been determined at this point. However, we note:

- Any cooling tower with a sound power of over 90dB(A) is likely to require either a noise screen or that the building form itself break any line of sight between the equipment item and the Fremont Street residences. Ideally, the cooling towers would be located away from the northern façade.
- Plant rooms located on the northern façade will potentially require acoustic louvres depending on equipment selections. Any plant room containing a water-cooled chiller (sound power typically 102dB(A)) or suction pumps is likely to require acoustic treatment to any north facing louvres.

- As with the Clinical Services Building, in the event that a generator is located within a plant room (generator sound power of 125dB(A)), acoustic attenuators will be required to the plant room air inlet and air discharge (indicatively 2.4m long, 40% open area attenuators). Additionally, the exhaust gas discharge will require a muffler such that it creates a noise level of no more than 75dB(A) at 1m distance.

- Construction Noise and Vibration.

  - With the exception of demolition using percussive equipment (hydraulic hammers), construction activities are unlikely to exceed the Noise Management Levels of the Interim Construction Guidelines, and highly unlikely to exceed the Highly Noise Effected threshold of 75dB(A).

  - In the event that extensive use of hydraulic hammers is required, letter box drops or similar to advise residents on Freemont Street should be considered.

  - Vibration levels exceeding EPA recommended criteria (table 10) are unlikely outside of the hospital precinct.

  - As with the Clinical Service Building, noise and vibration impacts on other buildings within the hospital precinct will be addressed through internal hospital management procedures.

6.3 NOISE FROM TRAFFIC GENERATION ON PUBLIC ROADS – STAGES 1 AND 2

The proposed new multistorey car parks (Stages 1 and 2) are predicted to result in an increase in peak hour traffic generation from 986 to 1,304, a 32% increase on existing levels (table 11 of Arup Transport and Parking Report dated June 2018).

This will result in an increase in noise level of traffic on public roads of 1.2dB(A), which will not be a perceptible change.

Even looking at the road with the highest project traffic increase (45% at the Hospital Road/Fremont St intersection in table 13 of the Arup report), the resultant noise increase would be 1.6dB(A), which would not be perceptible, and is compliant with the EPA Road Noise Policy requirement that the development not result in an increase in existing road traffic noise levels by more than 2dB(A).
7 RECOMMENDATIONS

We recommend the following acoustic treatments/management controls to ensure compliance with EPA noise emission guidelines.

- A detailed construction noise and vibration management plan should be undertaken following preparation of the construction program. Review of the mitigation techniques including those outlined in section 6.1.5 and 6.3 of this report should be done and implemented where feasible.

- Construction vehicles which are stationary onsite during queuing, should have their engines switched off to minimise impacts on residential receivers.

- Construction equipment which require reversing or movement alarms should use a ‘quacker’ type alarm instead of traditional beepers

- Multistorey car parks:
  - Detailed review of concrete surface finishes is recommended to ensure tyre squeal is eliminated.
  - If perforated façade panels are proposed, these should be subject to acoustic (wind) testing to ensure excessive rattling or similar will not occur.

- Detailed acoustic review of all plant items should be undertaken following equipment selection and duct layout design. Initial analysis (Section 6.1.4) indicates that with acoustic treatment, all plant items will be capable of meeting noise emission requirements. However, this is likely to require (for both the Clinical Services Building and the Acute Services Buildings):
  - Noise screening (using either a dedicated noise screen or the building shell) for roof top cooling towers (both the Clinical Services Building and the Acute Services Building).
  - A proprietary acoustic enclosure for any externally located back-up generator.
  - Use of axial fans (as opposed to roof mounted fans) to enable in-duct acoustic lining to major external fans ducted to atmosphere.
  - Upgrade of external plant room wall construction for any plant room housing chiller plant.
  - Detailed acoustic review of external louvres for any plant room to determine whether acoustic louvres/attenuators or blanking off of those louvres is required, particularly on the southern façade of on-floor plant rooms and the basement level chiller plant room.
8 CONCLUSION

Noise emissions associated with the proposed Concord Repatriation General Hospital Redevelopment Project (concept Stage 1 and 2, detailed Stage 1) have been assessed with reference to relevant EPA acoustic guidelines for both operational and construction noise and vibration in order to address the acoustic impacts of the site as required by SEAR 4 (Concept Design) and SEARS 3 and 4 (Stage 1 Design).

An analysis of typical operational noise indicates that the site (Stages 1 and 2) is capable of complying with relevant noise emission criteria (see section 5.1, 5.2 and 5.3).

Although initial analysis indicates that plant and equipment is capable of meeting noise emission requirements, additional acoustic review should be conducted once final equipment selections are made to ensure appropriate levels of acoustic treatment are implemented. Both Stage 1 (Clinical Services Building) and Stage 2 (Acute Serves Building) are capable of complying with EPA Noise Policy for Industry requirements.

Acoustic treatment other than that identified in section 7 will not be required to the Stage 1 multi-storey car park given its separation to the nearest residences. The Stage 2 car park is located even further away and will also not require acoustic treatment.

Review of construction noise and vibration indicates that:

- Use of percussive equipment for ground slab demolition and excavation will potentially cause a minor exceedance of the EPA Noise Management Level on the Fremont Street and Currawang Street. However, the noise levels will not exceed the “Highly Noise Affected” threshold. This applies for both Stage 1 and 2 works.

- Construction noise and vibration mitigation methods are presented in section 6.1.5 and 6.3.

Provided that the recommendations in this report are adopted, the proposal is capable of compliance with relevant legislations and SEARS.

Please contact us if you have any queries.

Yours faithfully,

Acoustic Logic Consultancy Pty Ltd
Thomas Taylor
APPENDIX 1 – UNATTENDED NOISE MONITORING RESULTS
LOCATION M1 – FREEMONT STREET / LOVEDALE PLACE

(WEATHER DATA HAS BEEN COLLECTED FROM SYDNEY OLYMPIC PARK
ARCHERY CENTRE WEATHER TOWER)
## Appendix 1 – Freemont Street / Lovedale Place Tabulated Results

<table>
<thead>
<tr>
<th>Date</th>
<th>Measured Background Noise Level $dB(A)<em>{L</em>{10d}}$ (Period)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Day (7am – 6pm)</td>
</tr>
<tr>
<td>Friday, 16ᵗʰ February, 2018</td>
<td>45</td>
</tr>
<tr>
<td>Saturday, 17ᵗʰ February, 2018</td>
<td>45</td>
</tr>
<tr>
<td>Sunday, 18ᵗʰ February, 2018</td>
<td>43</td>
</tr>
<tr>
<td>Monday, 19ᵗʰ February, 2018</td>
<td>44</td>
</tr>
<tr>
<td>Tuesday, 20ᵗʰ February, 2018</td>
<td>46</td>
</tr>
<tr>
<td>Wednesday, 21ˢᵗ February, 2018</td>
<td>43</td>
</tr>
<tr>
<td>Thursday, 22ⁿᵈ February, 2018</td>
<td>44</td>
</tr>
<tr>
<td>Friday, 23ʳᵈ February, 2018</td>
<td>46</td>
</tr>
<tr>
<td>Saturday, 24ᵗʰ February 2018</td>
<td>45</td>
</tr>
<tr>
<td>Sunday, 25ᵗʰ February, 2018</td>
<td>45</td>
</tr>
<tr>
<td>Monday, 26ᵗʰ February, 2018</td>
<td>42</td>
</tr>
<tr>
<td><strong>Median</strong></td>
<td><strong>45</strong></td>
</tr>
</tbody>
</table>
APPENDIX 2 – UNATTENDED NOISE MONITORING RESULTS
LOCATION M2 – HOSPITAL ROAD

(WEATHER DATA HAS BEEN COLLECTED FROM SYDNEY OLYMPIC PARK
ARCHERY CENTRE WEATHER TOWER)
## Appendix 2 – Hospital Road Tabulated Results

<table>
<thead>
<tr>
<th>Date</th>
<th>Day (7am – 6pm)</th>
<th>Evening (6pm-10pm)</th>
<th>Night (10pm-7am)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tuesday, 27th February, 2018</td>
<td>47</td>
<td>45</td>
<td></td>
</tr>
<tr>
<td>Wednesday, 28th February, 2018</td>
<td>54</td>
<td>51</td>
<td>47</td>
</tr>
<tr>
<td>Thursday, 1st March, 2018</td>
<td>51</td>
<td>47</td>
<td>45</td>
</tr>
<tr>
<td>Friday, 2nd March, 2018</td>
<td>52</td>
<td>47</td>
<td>46</td>
</tr>
<tr>
<td><strong>Median</strong></td>
<td><strong>52</strong></td>
<td><strong>47</strong></td>
<td><strong>45</strong></td>
</tr>
</tbody>
</table>
Hospital Road, Concord Hospital (Near Bus Stop): Wednesday 28 February, 2018

[Graph showing noise levels (dB(A)) and wind speed (mph) over a 24-hour period.]
APPENDIX 3 – UNATTENDED NOISE MONITORING RESULTS
LOCATION M3 – CURRAWANG STREET

(WEATHER DATA HAS BEEN COLLECTED FROM SYDNEY OLYMPIC PARK
ARCHERY CENTRE WEATHER TOWER)
# Appendix 3 – Currawang Street Tabulated Results

<table>
<thead>
<tr>
<th>Date</th>
<th>Day (7am – 6pm)</th>
<th>Evening (6pm-10pm)</th>
<th>Night (10pm-7am)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Friday, 16th February, 2018</td>
<td>48</td>
<td>46</td>
<td>43</td>
</tr>
<tr>
<td>Saturday, 17th February, 2018</td>
<td>46</td>
<td>45</td>
<td>44</td>
</tr>
<tr>
<td>Sunday, 18th February, 2018</td>
<td>45</td>
<td>45</td>
<td>45</td>
</tr>
<tr>
<td>Monday, 19th February, 2018</td>
<td>47</td>
<td>46</td>
<td>46</td>
</tr>
<tr>
<td>Tuesday, 20th February, 2018</td>
<td>49</td>
<td>45</td>
<td>42</td>
</tr>
<tr>
<td>Wednesday, 21st February, 2018</td>
<td>46</td>
<td>44</td>
<td>43</td>
</tr>
<tr>
<td>Thursday, 22nd February, 2018</td>
<td>46</td>
<td>45</td>
<td>43</td>
</tr>
<tr>
<td>Friday, 23rd February, 2018</td>
<td>47</td>
<td>46</td>
<td>44</td>
</tr>
<tr>
<td>Saturday, 24th February 2018</td>
<td>46</td>
<td>46</td>
<td>45</td>
</tr>
<tr>
<td>Sunday, 25th February, 2018</td>
<td>49</td>
<td>57</td>
<td>46</td>
</tr>
<tr>
<td>Monday, 26th February, 2018</td>
<td>49</td>
<td>47</td>
<td>43</td>
</tr>
<tr>
<td>Tuesday, 27th February, 2018</td>
<td>46</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Median</strong></td>
<td><strong>47</strong></td>
<td><strong>46</strong></td>
<td><strong>44</strong></td>
</tr>
</tbody>
</table>
APPENDIX 4 – UNATTENDED NOISE MONITORING RESULTS
LOCATION M4 – NULLAWRRA AVE

(WEATHER DATA HAS BEEN COLLECTED FROM SYDNEY OLYMPIC PARK
ARCHERY CENTRE WEATHER TOWER)
## Appendix 4 – Nullawarra Avenue

<table>
<thead>
<tr>
<th>Date</th>
<th>Measured Background Noise Level $dBA_{L90}$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Day (7am – 6pm)</td>
</tr>
<tr>
<td>Tuesday, 27th February, 2018</td>
<td>0</td>
</tr>
<tr>
<td>Wednesday, 28th February, 2018</td>
<td>50</td>
</tr>
<tr>
<td>Thursday, 1st March, 2018</td>
<td>50</td>
</tr>
<tr>
<td>Friday, 2nd March, 2018</td>
<td>49</td>
</tr>
<tr>
<td>Saturday, 3rd March, 2018</td>
<td>46</td>
</tr>
<tr>
<td>Sunday, 4th March, 2018</td>
<td>42</td>
</tr>
<tr>
<td>Monday, 5th March, 2018</td>
<td>50</td>
</tr>
<tr>
<td>Tuesday, 6th March, 2018</td>
<td>53</td>
</tr>
<tr>
<td>Wednesday, 7 March, 2018</td>
<td>49</td>
</tr>
<tr>
<td>Median</td>
<td>49</td>
</tr>
</tbody>
</table>
Nullawarra Avenue, Concord Hospital: Friday 02 March, 2018

- Acoustic Weather
- Day Period (06:00 - 19:00)
- Night Period (20:00 - 05:00)
- Wind Speed (m/s)
- Rain Period
APPENDIX 5 – MEASUREMENT EQUIPMENT CALIBRATION CERTIFICATES

EQUIPMENT SERIAL NUMBERS

- MONITOR LOCATION M1: ARL 194678
- MONITOR LOCATION M2: ARL 194449
- MONITOR LOCATION M3: ARL 194449
- MONITOR LOCATION M4: ARL 194678
- ATTENDED MEASUREMENTS: NORSONIC 118-30642
Sound Level Meter
Calibration Certificate
Calibration Number C16273

Client Details
Acoustic Research Labs Pty Ltd - Hire
Level 7, Building 2, 423 Pennant Hills Road
PENNANT HILLS NSW 2120

Equipment Tested/Model Number: ARL EI-215
Instrument Serial Number: 194678
Microphone Serial Number: N/A
Pre-amplifier Serial Number: N/A

Atmospheric Conditions:
Ambient Temperature: 20.6°C
Relative Humidity: 38.1%
Barometric Pressure: 100.3 kPa

Calibration Technician: Dennis Kim
Calibration Date: 28/07/2016
Secondary Check: Sandra Minio
Report Issue Date: 28/07/2016
Approved Signatory: Ken Williams

<table>
<thead>
<tr>
<th>Class and Characteristic Tested</th>
<th>Result</th>
<th>Class and Characteristic Tested</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.2.2. Alarming sensitivity</td>
<td>Pass</td>
<td>10.4.2. Time weighting characteristic T and S</td>
<td>Pass</td>
</tr>
<tr>
<td>10.2.3. Frequency weighting</td>
<td>Pass</td>
<td>10.4.3. Time weighting characteristic 1</td>
<td>Pass</td>
</tr>
<tr>
<td>10.3.1. Overload indicators</td>
<td>Pass</td>
<td>10.4.5. R.M.S. performance</td>
<td>Pass</td>
</tr>
<tr>
<td>10.3.3. Accuracy of level range control</td>
<td>Pass</td>
<td>9.3.2. Time averaging</td>
<td>Pass</td>
</tr>
<tr>
<td>8.9.1. Detector-indicator linearity</td>
<td>Pass</td>
<td>9.3.3. Overload indicators</td>
<td>Pass</td>
</tr>
</tbody>
</table>

Least Uncertainties of Measurement:

Acoustic Tests
23.5 Hz to 10 kHz: 0.126 dB
125 Hz: 0.153 dB
1 kHz: 0.435 dB

Environmental Conditions
Temperature: 0.3°C
Relative Humidity: 0.4%
Barometric Pressure: 0.01 kPa

All uncertainties are derived at the 95% confidence level with a coverage factor of 2.

The sound level meter under test has been shown to confirm to the type 2 requirements for periodic testing as described in AS 1259.1:1990 and AS 1259.2:1990 for the tests stated above.

This calibration certificate is to be read in conjunction with the calibration test report.
Acoustic Research Labs Pty Ltd is NATA Accredited Laboratory Number 1472.
Accredited for compliance with ISO/IEC 17025.
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/National standards.

Monitor Location M1: ARL 194678
## Sound Level Meter
### Calibration Certificate

**Calibration Number:** C17514

**Client Details:** Acoustic Research Labs Pty Ltd
- level 7, Bld 2, 423 Pennant Hills Road
- Pennant Hills NSW 2120

**Equipment Tested/Model Number:** ARL EL-315
**Instrument Serial Number:** 194449
**Microphone Serial Number:** N/A
**Pre-amplifier Serial Number:** N/A

---

**Atmospheric Conditions**
- **Ambient Temperature:** 22.6°C
- **Relative Humidity:** 47.2%
- **Barometric Pressure:** 99.59kPa

**Calibration Technician:** Jason Gomes
**Secondary Check:** Riley Cooper
**Calibration Date:** 23/10/2017
**Report Issue Date:** 23/10/2017

**Approved Signatory:** Ken Williams

<table>
<thead>
<tr>
<th>Clause and Characteristic Tested</th>
<th>Result</th>
<th>Clause and Characteristic Tested</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.2.2: Absolute sensitivity</td>
<td>Pass</td>
<td>10.3.4: Inherent system noise level</td>
<td>Pass</td>
</tr>
<tr>
<td>10.2.3: Frequency weighting</td>
<td>Pass</td>
<td>10.4.2: Time weighting characteristic F and S</td>
<td>Pass</td>
</tr>
<tr>
<td>10.3.2: Overload indications</td>
<td>Pass</td>
<td>10.4.3: Time weighting characteristic I</td>
<td>Pass</td>
</tr>
<tr>
<td>10.3.3: Accuracy of level range control</td>
<td>Pass</td>
<td>10.4.5: RMS performance</td>
<td>Pass</td>
</tr>
<tr>
<td>8.5: Detector-indicator linearity</td>
<td>Pass</td>
<td>9.3.2: Time averaging</td>
<td>Pass</td>
</tr>
<tr>
<td>8.10: Differential level linearity</td>
<td>Pass</td>
<td>9.3.5: Overload indication</td>
<td>Pass</td>
</tr>
</tbody>
</table>

---

**Ambient Tests:**
- 31.3 Hz to 16 kHz: ±0.16dB
- 12.5kHz: ±0.24dB
- 1kHz: ±0.26dB

**Electrical Tests:**
- 31.3 Hz to 20 kHz: ±0.17dB

---

**Least Uncertainties of Measurement**

- **Temperature:** ±0.05°C
- **Relative Humidity:** ±0.45%
- **Barometric Pressure:** ±0.007kPa

---

All uncertainties are derived at the 95% confidence level with a coverage factor of 2.

*The sound level meter under test has been shown to conform to the type 2 requirements for periodic testing as described in AS 1259.1:1990 and AS 1259.2:1990 for the tests stated above.*

---

This calibration certificate is to be read in conjunction with the calibration test report.

Acoustic Research Labs Pty Ltd is NATA Accredited Laboratory Number: 04172.

Accredited for compliance with ISO/IEC 17025.

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian National standards.

NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration and inspection reports.

---

Monitor Location M2: ARL 194449
Sound Level Meter
Calibration Certificate

Calibration Number: C17514

Client Details: Acoustic Research Labs Pty Ltd
level 7, Bld 3, 423 Pennant Hills Rd
Pennant Hills NSW 2120

Equipment Tested/Model Number: ARL EL-315
Instrument Serial Number: 194449
Microphone Serial Number: N/A
Pre-amplifier Serial Number: N/A

Atmospheric Conditions
Ambient Temperature: 22.6°C
Relative Humidity: 47.2%
Barometric Pressure: 99.59kPa

Calibration Technician: Jason Gomes
Calibration Date: 23/10/2017

Approved Signatory: Ken Williams

Clause and Characteristic Tested | Result | Clause and Characteristic Tested | Result
--- | --- | --- | ---
10.2.1: Absolute sensitivity | Pass | 10.3.4: 'Inherent system noise level | Pass
10.2.3: Frequency weighting | Pass | 10.4.2: Time weighting characteristic F and S | Pass
10.3.2: Overload indications | Pass | 10.4.3: Time weighting characteristic I | Pass
10.3.3: Accuracy of level range control | Pass | 10.4.5: RMS performance | Pass
8.9: Detector-indicator linearity | Pass | 9.3.2: Time averaging | Pass
8.10: Differential level linearity | Pass | 9.3.5: Overload indication | Pass

Least Uncertainty of Measurement:
Acoustic Tests:
3.5 Hz to 8 kHz: ±0.16dB
12.5 kHz: ±0.24dB
16kHz: ±0.36dB

Electrical Tests:
3.5 Hz to 20 kHz: ±0.13dB

Environmental Conditions:
Temperature: ±0.05°C
Relative Humidity: ±0.4%
Barometric Pressure: ±0.03kPa

All uncertainties are derived at the 95% confidence level with a coverage factor of 2.

The sound level meter under test has been shown to conform to the type 2 requirements for periodic testing as described in AS 1259.1:1990
and AS 1259.2:1990 for the tests stated above.

This calibration certificate is to be used in conjunction with the calibration test report.

Acoustic Research Labs Pty Ltd is NATA Accredited Laboratory Number 14172.
Accredited for compliance with ISO/IEC 17025.

NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration and inspection reports.
Monitor Location M4: ARL 194678 (Same as above)
Sound Level Meter
IEC 61672-3:2013
Calibration Certificate
Calibration Number C18025

Client Details: Acoustic Logic Consultancy Pty Ltd
© Sarah Street
MASCOT NSW 2020

Equipment Tested: Model Number: Norsonic 118
Instrument Serial Number: 30642
Microphone Serial Number: 312923
Pre-amplifier Serial Number: 20813

Pre-Test Atmospheric Conditions
Ambient Temperature: 22.5°C
Relative Humidity: 43.4%
Barometric Pressure: 99.571 kPa

Post-Test Atmospheric Conditions
Ambient Temperature: 22.3°C
Relative Humidity: 43.4%
Barometric Pressure: 99.46 kPa

Calibration Technician: Vicky Jaswal
Calibration Date: 18 Jan 2018

Secondary Check: Aaron Skeanes-Ludy
Report Issue Date: 22 Jan 2018

Approved Signatory: Juan Aguerro

<table>
<thead>
<tr>
<th>Clause and Characteristic Tested</th>
<th>Result</th>
<th>Clause and Characteristic Tested</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>12: Automotive use tests of a frequency weighting</td>
<td>Pass</td>
<td>17: Level in a noise, incl. the test range control</td>
<td>Pass</td>
</tr>
<tr>
<td>13: Electrical use tests of frequency weightings</td>
<td>Pass</td>
<td>18: Sound response</td>
<td>Pass</td>
</tr>
<tr>
<td>14: Frequency range weightings at 1 kHz</td>
<td>Pass</td>
<td>19: C Weighted Peak Sound Level</td>
<td>Pass</td>
</tr>
<tr>
<td>15: Long Term Stability</td>
<td>Pass</td>
<td>20: Overload indication</td>
<td>Pass</td>
</tr>
<tr>
<td>16: Level linearity on the reference level range</td>
<td>Pass</td>
<td>21: High Level Stability</td>
<td>Pass</td>
</tr>
</tbody>
</table>

Approved signature:

The sound level meter submitted for testing has successfully completed the class 1 periodic tests of IEC 61672-3:2013, for the environmental conditions under which the tests were performed. However, no general statement or conclusion can be made about conformance of the sound level meter to the full requirements of IEC 61672-3:2013 because evidence was not provided, to demonstrate that the model of sound level meter fully conforms to the requirements in IEC 61672-3:2013 and became the periodic tests of IEC 61672-3:2013 cover only a limited subset of the specifications in IEC 61672-3:2013.

<table>
<thead>
<tr>
<th>Acoustic Tests</th>
<th>Least Uncertainty of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>115 Hz to 88 Hz</td>
<td>+0.16 dB</td>
</tr>
<tr>
<td>125 Hz</td>
<td>+0.25 dB</td>
</tr>
<tr>
<td>1 kHz</td>
<td>+0.29 dB</td>
</tr>
<tr>
<td>Electrical Tests</td>
<td>31.5 Hz to 20 kHz</td>
</tr>
<tr>
<td>Environmental Conditions</td>
<td>Temperature</td>
</tr>
<tr>
<td></td>
<td>Relative Humidity</td>
</tr>
<tr>
<td></td>
<td>Barometric Pressure</td>
</tr>
</tbody>
</table>

All uncertainties are derived at the 95% confidence level with a coverage factor of 2.

The calibration certificate is to be read in conjunction with the calibration test report.

Acoustic Research Labs Pty Ltd is NATA Accredited Laboratory Number 14172.
Accredited for the test: IEC 17025 - calibration.

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian National Standards.
NATA accredits the EAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration and inspection reports.

NATA

Attended Measurements: Norsonic 118-30642