Mudgee Hospital Redevelopment

Noise Impact Assessment
## DOCUMENT CONTROL REGISTER

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1 INTRODUCTION

This report presents an analysis of acoustic impacts associated with the proposed Mudgee Hospital Redevelopment project located in the block Church Street, Meares Street and Lewis Streets Mudgee. The development has been identified as a State Significant Development and this report therefore includes the required acoustic assessment of site as detailed within the SEAR including items 4 and 10.

In this report we will:

- Conduct an external noise impact assessment (primarily traffic noise) and recommend acoustic treatments to ensure that a reasonable level of amenity is achieved for future tenants.
- Identify potential noise sources generated by the site, and determine noise emission goals for the development to meet Council acoustic requirements to ensure that nearby developments are not adversely impacted.
- Presents the Construction Noise and Vibration management plan for the site.

The relevant SEAR items and assessment are summarised below.

<table>
<thead>
<tr>
<th>SEAR Item</th>
<th>Requirements</th>
<th>Assessment in Response to SEAR Requirement</th>
</tr>
</thead>
</table>
| Item 4    | Environmental Amenity  
Detail amenity impacts including solar access, acoustic impacts, visual privacy, view loss, overshadowing, reflectivity from building facades and wind Impacts. A high levels of environmental amenity for any surrounding residential land use must be demonstrated.  
| An assessment of noise impact to the surrounding residential land uses has been undertaken including an assessment using the Environmental Protection Authorities Noise Policy for Industry requirements. |
| Item 10   | Noise and Vibration  
Identify and provide a qualitative assessment of the main noise and vibration generating sources during the construction and operation and outline measures to minimise and mitigate the potential noise impacts on surrounding occupancies of land.  
| An assessment of noise impact to the surrounding residential land uses has been undertaken including an assessment using the Environmental Protection Authorities Noise Policy for Industry requirements and during the construction stage including the EPA’s Interim Construction Noise Policy and AS2436, Assessing Vibration a Technical Guide 2006 and Development Near Rail Corridors and Busy Roads – Interim Guideline (Department of Interim Guideline 2008). |
2 SITE DESCRIPTION / PROPOSED DEVELOPMENT

The proposed development consists of a redevelopment of the existing hospital site and includes the following:

- Construction of a new two (2) storey plus plant acute clinical services building to accommodate relocated services including:
  - 26 acute/sub-acute beds for medicine, surgery, palliative care, rehabilitation, geriatric evaluation and conditions related to mental health and drug and alcohol
  - 2 paediatric beds;
  - 2 bed rooms suitable for birthing and short-term accommodation, 3 ante-natal/post-natal rooms, 1 assessment room, 2 antenatal assessment and 1 procedure room with 2 special care neonatal cots.
  - 5 emergency department bays, 1 resuscitation bay, a mental health safe assessment room, an isolation room and a triage area;
  - 2 operating theatres, 4 recovery spaces and 8 day-only beds;
  - 4 Hospital in the Home chairs, 4 oncology chairs, 8 renal chairs and 5 oral health chairs;
  - Primary and Community Health services comprised of meeting, consult and interview rooms, Gymnasium, ADL Kitchen and bathroom and outdoor spaces; and
  - Clinical support services, including medical imaging, pathology, pharmacy, satellite CSD service and medical records.
- On-grade car parking and drop off facilities, and overall improved wayfinding and access throughout the campus, including new roadworks and footpaths;
- Upgrades to IT and engineering services infrastructure supporting the MHS;
- Non-clinical support services, including LHD offices, MHS administration offices, kitchen, stores, linen and maintenance services; Associated landscaping works; and
- Demolition of vacated buildings.

Potential noise impacts on the site are primarily traffic noise from surrounding roadways.

Noise potentially generated by the operation of the site will consist of:

- Noise emissions from the car park and entry off Lewis and Meares Streets.
- Noise emissions from mechanical plant.

Additionally, an assessment of construction noise from the site has been assessed.

Noise impacts associated with these noise sources will be investigated.

The nearest potentially affected noise receivers are:

- The residential properties opposite to the site to the south on Meares Street.
- The residential properties opposite to the site to the west on Church Street.
- The residential properties opposite to the site to the east on Lewis Street.

Refer to Figure 1 below, which is an aerial photo of the proposed development.
Figure 1 – Site plan

- Attended noise measurement Location A – 102 Church Street
- Attended noise measurement Location B – 31 Meares Street
- Residential receivers
- Footprint of new hospital
- Unattended noise logger location
- Attended noise measurement Location 3 – 23 Meares Street
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 $L_{\text{Max}}$, $L_{\text{90}}$ and $L_{\text{eq}}$.

The $L_{\text{90}}$ 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 $L_{\text{90}}$ 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 $L_{\text{90}}$ level.

The $L_{\text{eq}}$ 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. $L_{\text{eq}}$ 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.

$L_{\text{Max}}$ levels represent is the loudest noise event during a measurement period.
4 NOISE IMPACT ASSESSMENT

This section of the report undertook the required assessment of noise impact from the operation of the completed report as detailed within the SEAR including items 4 and 10, which includes the following;

4. 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 must be demonstrated.

10. 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:
    - Noise Policy for Industry 2017 (EPA)
    - Interim Construction Noise Guideline (DECC)
    - Development Near Rail Corridors and Busy Roads – Interim Guideline (Department of Planning 2008)

Significant noise sources in the vicinity of the site are as follows:

- Traffic noise from surrounding roadways including Church Street, Mears Street and Lewis Streets.

As the proposed site is not with 60m of a railway line or a roadway which carries more than 20,000 AADT assessment with the Development Near Rail Corridors and Busy Roads is not required. Noise impacts should comply with the requirements of the Australian Standard AS2107:2000.
4.1 **NOISE MEASUREMENTS**

Measurement of traffic noise was conducted using hand held measurements at the boundary of the site as detailed in Figure 1 above.

Hand-held measurements were obtained using a Norsonics Type 140 Precision Sound Level Analyser. The Precision Sound Level Analyser was calibrated at the beginning and the end of the measurement using a Norsonics Type 1251 Precision Sound Level Calibrator. No significant drift was noted. All measurements were conducted on A-weighted fast response mode. There were no significant periods of adverse weather conditions during the measurement period.

Traffic noise measurements were conducted on 12th April, 2018 and are presented in the table below.

**Table 2 – Measured Traffic Noise Levels**

<table>
<thead>
<tr>
<th>Location</th>
<th>Measured Noise Level $\mathrm{dB(A)_{Leq(1hr)}}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Church Street (6m from kerb)</td>
<td>69</td>
</tr>
<tr>
<td>Meares Street (6m fro kerb)</td>
<td>61</td>
</tr>
</tbody>
</table>
4.2 ACOUSTIC OBJECTIVES

The determination of an acceptable level of traffic noise within the future hospital spaces requires consideration of the activities carried out within the space and the degree to which noise will interfere with those activities.

As sleep is the activity most affected by traffic noise, wards are the most sensitive rooms.

The noise impact assessment shall be conducted in accordance with Australian Standards AS 3671-1989 “Acoustics – Road Traffic Noise Intrusion – Building, Siting and Construction” and AS2107-2000 “Recommended Design Sound Levels and Reverberation Times for Building Interiors” and the Health Infrastructure requirements.

The Australian Standards recommend maximum design sound levels for different areas of occupancy in the residential development while AS 3671 -1989 “Road Traffic Noise Intrusion - Building Siting and Construction” recommends that an appropriate L_{eq} or L_{10} traffic noise descriptor be used for the occupancy being assessed.

Based on AS2107-2000 and Health Infrastructure requirements the following assessment criteria would apply to the proposed development.

**Table 3 - Internal Traffic Noise Criteria**

<table>
<thead>
<tr>
<th>Space/Activity Type</th>
<th>Noise Level dB(A) L_{eq}</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corridors and lobby spaces</td>
<td>50</td>
</tr>
<tr>
<td>Consulting rooms</td>
<td>45</td>
</tr>
<tr>
<td>Kitchens, sterilizing and service areas</td>
<td>55</td>
</tr>
<tr>
<td>Nurses’ stations</td>
<td>45</td>
</tr>
<tr>
<td>Office areas</td>
<td>45</td>
</tr>
<tr>
<td>Operating theatres</td>
<td>45</td>
</tr>
<tr>
<td>Surgeries</td>
<td>45</td>
</tr>
<tr>
<td>Wards</td>
<td>40</td>
</tr>
<tr>
<td>Waiting rooms, reception areas</td>
<td>50</td>
</tr>
</tbody>
</table>
4.3 RECOMMENDATIONS

Traffic noise intrusion into the proposed development is assessed using the measured external noise levels reported above as a basis. Internal noise levels will primarily be as a result of noise transfer through the windows and doors as these are relatively light building elements that offer less resistance to the transmission of sound. Noise transfer through the masonry elements will not be significant and need not be considered further.

A preliminary review of traffic noise intrusion has revealed that compliance with acoustic guidelines is achievable with medium-heavy single glazing with acoustic seals.

The recommended acoustic construction to the external façade of the project to treat environmental noise is a minimum of 6.38mm laminated glazing to all facades of the project.

Thicker glass may be required for structural, thermal or other requirements.

In addition to meeting the minimum glazing thickness requirements given, the design of the window mullions, perimeter seals and the installation of the windows/doors in the building openings shall not reduce the STC rating of the glazing assembly below the values nominated in the tables above.

The window/door suppliers should provide evidence that the systems proposed have been tested in a registered laboratory with the recommended glass thicknesses and comply with the minimum listed STC requirements. Also, the glazing installer should certify that the window/doors have been constructed and installed in a manner equivalent to the tested samples.

Table 4 - Minimum STC/Rw of Glazing (with Acoustic Seals)

<table>
<thead>
<tr>
<th>Glazing Thickness</th>
<th>Acoustic Seals</th>
<th>Minimum STC/Rw of Installed Window</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.38mm Laminated</td>
<td>Yes</td>
<td>30</td>
</tr>
</tbody>
</table>
5 NOISE EMISSION ASSESSMENT

Noise emissions goals for the site will be developed to ensure that the amenity of nearby land users (both new occupants in the development and residents in nearby properties) is not adversely affected.

Criteria for the following noise sources will be calculated:

- Mechanical plant noise.
- Noise from the car park and access way.

5.1 BACKGROUND NOISE MONITORING

5.1.1 Long Term Noise Logging

Long term monitoring was conducted using a noise monitor installed in the front yard of 23 Meares Street, a residential directly opposite the hospital (this being the only residential development were access to the front yard was possible).

Monitoring has been conducted on the site during the period of 7 and 15 August 2018 using an Acoustic Research Laboratories noise monitor set to A-weighted fast response. The monitor was calibrated at the start and end of the monitoring period using a Rion NC-73 calibrator. No significant drift was noted. Noise logger data is provided in Appendix 1 (included daily Assessment Noise Levels).

The measured background noise levels have been corrected for meteorological conditions (excessive wind and/or rain), as required by the EPA Noise Policy for Industry. Exceedances of the 5m/s average wind speed limit of the EPA were noted and corrected for in determining the background noise levels. These areas are highlighted in the logging data in Appendix 1. Weather data used was collected at Mudgee Airport.

Measured background noise levels are presented below at locations indicated in Figure 1 above.

Table 5 - Measured Ambient Noise Levels (Average/L_{eq} Level and Rating Background Level/L_{90})

<table>
<thead>
<tr>
<th>Location</th>
<th>Day Noise Level (7am to 6pm)</th>
<th>Evening Noise Level (6pm to 10pm)</th>
<th>Night Noise Level (10pm to 7am)</th>
</tr>
</thead>
<tbody>
<tr>
<td>23 Meares Street</td>
<td>55dB(A)L_{eq}(Period)</td>
<td>53dB(A)L_{eq}(Period)</td>
<td>51dB(A)L_{eq}(Period)</td>
</tr>
<tr>
<td></td>
<td>44dB(A)L_{90}</td>
<td>40dB(A)L_{90}</td>
<td>33dB(A)L_{90}</td>
</tr>
</tbody>
</table>
5.1.2 Attended Noise Survey

In addition, an attended noise survey was conducted on 15/16 August 2018 to supplement the long term noise logging.

All measurements were made using a Norsonic 140 Type 1 sound analyser set on A-weighted fast response mode.

Measurements were conducted between 4pm and 1am.

<table>
<thead>
<tr>
<th>Location</th>
<th>Time</th>
<th>Measured Noise Level</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>180 Church Street, 6m from kerb</td>
<td>4.00pm-4.30pm</td>
<td>69dB(A)(<em>{\text{L}</em>{eq}})(15min) and 56dB(A)(<em>{L</em>{90}})</td>
<td>(\text{L}<em>{eq}) noise level - predominantly traffic noise on Church Street. (L</em>{90}) noise level - predominantly distant traffic</td>
</tr>
<tr>
<td>33 Meares Street</td>
<td>4.30pm-5.00pm</td>
<td>61dB(A)(<em>{\text{L}</em>{eq}})(15min) and 51dB(A)(<em>{L</em>{90}})</td>
<td>(\text{L}<em>{eq}) noise level - predominantly traffic noise on Meares Street. (L</em>{90}) noise level - predominantly distant traffic</td>
</tr>
<tr>
<td></td>
<td>12.00-12.30am</td>
<td>43dB(A)(<em>{\text{L}</em>{eq}})(15min) and 31dB(A)(<em>{L</em>{90}})</td>
<td>(\text{L}<em>{eq}) noise level – distant traffic. (L</em>{90}) noise level - distant hospital plant noise</td>
</tr>
<tr>
<td>23 Meares Street</td>
<td>5.00pm – 5.30pm</td>
<td>61dB(A)(<em>{\text{L}</em>{eq}})(15min) and 45dB(A)(<em>{L</em>{90}})</td>
<td>(\text{L}<em>{eq}) noise level - predominantly traffic noise on Meares Street. (L</em>{90}) noise level - predominantly distant traffic</td>
</tr>
<tr>
<td></td>
<td>12.30-1.00am</td>
<td>48dB(A)(<em>{\text{L}</em>{eq}})(15min) and 32dB(A)(<em>{L</em>{90}})</td>
<td>(\text{L}<em>{eq}) noise level – distant traffic. (L</em>{90}) noise level - distant hospital plant noise</td>
</tr>
</tbody>
</table>

The attended measurement are generally compliant with the long term noise logging data, and indicates that the long term noise logging data is suitable for use for determining the Rating Background Noise Level at the site.
6   ACOUSTIC OBJECTIVES

The assessment of the operational noise levels are based on the following documents:

- The NSW Environmental Protection Authority (EPA) Noise Policy for Industry and
- The NSW Road Noise Policy (RNP).

6.1   NSW ENVIRONMENTAL PROTECTION AGENCY (EPA) DOCUMENT – ‘NOISE POLICY FOR INDUSTRY (NPFI)’

The NPfl 2017 provides guidelines for assessing noise impacts from developments. The recommended assessment objectives vary depending on the potentially affected receivers, the time of day, and the type of noise source. The NPfi has two requirements which both have to be complied with, namely an amenity criterion and an intrusiveness criterion.

6.1.1   Intrusiveness Criterion

The guideline is intended to limit the audibility of noise emissions at residential receivers and requires that noise emissions measured using the $L_{eq}$ descriptor not exceed the background noise level by more than 5 dB(A).

6.1.2   Amenity Criterion

The guideline is intended to limit the absolute noise level from all noise sources to a level that is consistent with the general environment.

The Industrial Noise Policy sets out acceptable noise levels for various land uses. Table 2.1 on page 16 of the policy has four categories to distinguish different residential areas. They are rural, suburban, urban and urban/industrial interface.

For the purposes of a conservative assessment, ALC will assess noise emissions in accordance with the ‘Urban’ category.

<table>
<thead>
<tr>
<th>Type of Receiver</th>
<th>Time of day</th>
<th>Recommended Project Acceptable Noise Level $L_{eq(15mins)}$ dB(A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential (Suburban)</td>
<td>Day</td>
<td>53</td>
</tr>
<tr>
<td></td>
<td>Evening</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td>Night</td>
<td>38</td>
</tr>
<tr>
<td>Commercial</td>
<td>When in Use</td>
<td>65</td>
</tr>
</tbody>
</table>
6.2 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:

  - $L_{A_{eq,15min}}$ 40dB(A) or the prevailing RBL plus 5 dB, whichever is the greater, and/or
  - $L_{A_{max}}$ 52 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 8 – Sleep Arousal Criteria (Average/Leq Noise Levels)

<table>
<thead>
<tr>
<th>Location</th>
<th>Rating Background Level dB(A)L90</th>
<th>Rating Background Level + 5dB(A)</th>
<th>Governing Criteria dB(A)L_{eq(15mins)}</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nearby Residential Development</td>
<td>33</td>
<td>38</td>
<td>40</td>
</tr>
</tbody>
</table>

Table 9 – Sleep Arousal Criteria (Maximum/L_{Max} Noise Events)

<table>
<thead>
<tr>
<th>Location</th>
<th>Rating Background Level dB(A)L90</th>
<th>Rating Background Level + 15dB(A)</th>
<th>Governing Criteria dB(A)L_{(Max)}</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nearby Residential Development</td>
<td>33</td>
<td>48</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 Industrial Noise Policy, 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.
6.3 NSW ROAD NOISE POLICY

This policy provides guidelines for the assessment of traffic noise generated by new developments on existing roads. Criteria set out by the RNP with regard to land use developments with potential to create additional traffic on local roads is detailed in the Table 3 below.

Table 10 – Road Noise Policy Criteria (Section 2.3 – Table 3, RNP)

<table>
<thead>
<tr>
<th>Road category</th>
<th>Assessment criteria – dB(A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of project / land use</td>
<td>Day (7 am – 10 pm)</td>
</tr>
<tr>
<td>Land use developments with potential to create additional traffic on local roads</td>
<td>( L_{Aeq} ) (15hour) 55 (external)</td>
</tr>
<tr>
<td>Existing residences affected by additional traffic on existing local roads generated by land use developments</td>
<td></td>
</tr>
</tbody>
</table>

6.4 SUMMARY OF OPERATIONAL NOISE OBJECTIVES

Operational noise objectives have been formulated for the development to comply with the requirements of EPA criteria. Noise emission objectives are detailed below.

Table 11 – Noise Objective for Residential Receivers

<table>
<thead>
<tr>
<th>Receivers</th>
<th>Time Period</th>
<th>Amenity Criteria dB(A) ( L_{eq} )</th>
<th>Intrusiveness Criteria Background + 5 dB(A) ( L_{eq}(15\text{min}) )</th>
<th>Additional Traffic Noise dB(A) ( L_{eq}(1\text{hr}) )</th>
<th>Sleep Disturbance Criteria dB(A) ( L_{AF \ max} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential Receivers</td>
<td>Day</td>
<td>53</td>
<td>49</td>
<td>55</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>Evening</td>
<td>43</td>
<td>45</td>
<td>55</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>Night</td>
<td>38</td>
<td>38</td>
<td>50</td>
<td>52</td>
</tr>
<tr>
<td>Commercial Receivers</td>
<td>When in Use</td>
<td>65</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

(Bolded numbers indicate governing noise limits).
6.5 ASSESSMENT

Noise emissions from the site will be assessed against the acoustic objectives presented in Section 5.2.

Noise sources that require assessment are:

- Cars entering and leaving via the car park access ramp from Church Street.
- Mechanical plant servicing the development.

6.5.1 Car Park Ramp

This section will present the assessment of the car park ramp, located at the eastern side of the site, off Lewis Street.

The nearest potentially affected receivers are:

- The residential property to the east of the site on Lewis Street.

Noise emissions from vehicles using the carpark access ramp will be predicted at the boundary of the commercial and the residential properties within the vicinity of the proposed Mudgee Hospital Redevelopment site.

Noise emissions will be predicted based on the following assumptions:

- Cars produce a sound power level of 84dB(A)Leq.
- During the peak Day and Evening period, up to 25 cars will use the driveway in a 1 hour period. This represents a potentially worst case conditions, compliance under these conditions represents compliance at all other times and day and evening time period.
- During the peak Night period, up to 15 cars will use the driveway in a 1 hour period. This represents a potentially worst case conditions, compliance under these conditions represents compliance at all other times of the night time period.
- The cars are driving past at an approximate speed of 10km/h.
The predicted noise level at the residential property to the west of the driveway, is presented below.

Table 12 – Predicted Noise Level at worst affected residential receiver (Residential)

<table>
<thead>
<tr>
<th>Time</th>
<th>Predicted Level – dB(A)<em>{l</em>{eq(15min)}}</th>
<th>Project Criteria - dB(A)<em>{l</em>{eq(Period)}}</th>
<th>Complies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day</td>
<td>37</td>
<td>49</td>
<td>Yes</td>
</tr>
<tr>
<td>Evening</td>
<td>37</td>
<td>43</td>
<td>Yes</td>
</tr>
<tr>
<td>Night</td>
<td>33</td>
<td>38</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Noise emissions from the use of the carpark and driveway are satisfactory at the residential properties located to the east of the proposed Mudgee Hospital redevelopment project.

6.5.2 Mechanical Plant

Mechanical plant items are not typically selected at selected at DA stage.

Detailed review of all external mechanical plant should be undertaken at construction certificate stage (once plant selections and locations are finalised). Acoustic treatments should be determined in order to control plant noise emissions to the levels set out in section 5.2 of this report.

All plant can be satisfactorily attenuated to levels complying with noise emission criteria through appropriate location and (if necessary) standard acoustic treatments such as noise screens, enclosures, in-duct treatments (silencers/lined ducting) or similar.

However, in principal:

- Plant and equipment serving the development will include cooling towers, air cooled and water cooled chillers, air handling units, fans and pumps. These will be acoustically treated as required, detailed in principal below.

- Level 1 plant room:
  - This plant room will use a combination of internal partitioning and blanking off of external louvres to minimise noise impacts.
  - Indicative chiller selection is 80dB(A) at 1m distance. The chiller plant room and the western façade (facing Church Street) of the air-handling plant room will be blanked off using fc sheeting behind external louvres. The upper half of the south facing louvres (facing Meares Street) will also be blanked off (such that only the lower part of the louvre remain open, and the building for of the hospital itself will act as screen between the open louvre and are the Meares Street residences.
  - Outside air ducts to air handling units are proposed to have internal insulation installed between the unit and the external air intake to control noise emitted to the nearest residences (Church Street).
- Pumps typically have a sound power of 74dB(A) and are located in plant areas with north facing louvres (not directly facing the residences) and will not require further acoustic treatment.

- The air-cooled chiller located in the north-western corner of the plant area has a sound power of approximately 80dB(A), and does not require additional acoustic treatment given its location.

- Cooling towers indicatively have a sound pressure of 79dB(A) at 3m distance. The towers are to have a noise screen (or plant room building shell) on the eastern and western sides of the tower. The inside faces of these screens (facing the cooling towers) will have acoustic lining incorporated to ensure that noise emitted via the north/south facing openings is compliant at the nearby residences.

- See indicative mark up below.
• Lower Ground floor plant room – outside air ducting to air handling units located on the lower ground floor to be internally lined (50mm thick insulation).

6.6 RECOMMENDATIONS

The constructions required in order to comply with the noise emission criteria outlined in Section 6.1 are outlined below.

• Detailed assessment of all mechanical plant should be conducted at CC stage to determine acoustic treatments (if any) required to ensure plant noise does not exceed acoustic criteria.

6.7 HELICOPTER NOISE LEVELS

The exiting hospital includes the use of emergency helicopters. The proposed redevelopment of the hospital does not propose the change the use of the site for emergency helicopters including an intensification of use.

Based on the proposed use of the future Mudgee Hospital redevelopment there will not be an increased noise level above the exiting conditions and therefore the future redevelopment is acoustically acceptable.
7 CONSTRUCTION NOISE AND VIBRATION

This section of the report details the assessment of construction noise and vibration as required by the SEAR in item 10 which includes the following:

10. 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:
- Noise Policy for Industry 2017 (EPA)
- Interim Construction Noise Guideline (DECC)
- Development Near Rail Corridors and Busy Roads – Interim Guideline (Department of Planning 2008)

This document presents a specification for the processes, which will be followed to manage noise and vibration associated with the proposed construction activities which are required as part of the Project and the potential for noise and vibration impact to receivers within close proximity.

The principal objective of this study is to undertake an evaluation of works to be performed during the operation of the various activities during construction and develop a management plan to ensure noise and vibration is:

1. Minimised to all surrounding receivers.

2. Is monitored when potentially high noise and vibration generating activities are being used.

This assessment will formulate/present the relevant noise and vibration criteria which construction activities are required to comply with. Additionally effective mitigation measures will be recommended where possible to ensure criteria is achieved and impacts are.

The principal issues, which will be addressed in this report, are:

- Identification of the noise and vibration standards which will be applicable to this project.

- Formulation of a strategy for construction activities to comply with the standards identified in the above point.

7.1 PROJECT OBJECTIVES

The objective of this management plan is to set up a protocol to ensure noise and vibration emissions from the construction works associated with the project comply with applicable standards, recommend required management controls and treatments are adopted where required and detail the required monitoring to ensure standards are met.
7.2 PROJECT DESCRIPTION AND POTENTIALLY EFFECTED PROPERTIES

The proposed project includes the excavation of material including infill and soft sandstone and construction of the development. The expected activities can be expected to include:

1. Demolition of existing buildings.
2. Excavation.

7.3 CONSTRUCTION NOISE CRITERIA

It is proposed to utilise Australian Standard AS2436:1981 “Guide to noise control on construction, maintenance and demolition sites”, which is the standard commonly applied by Councils for the regulation of construction noise, the New South Wales Construction Noise Guideline developed by The NSW EPA and OH&S requirements are presented in this section of the report.

7.3.1 Australian Standard AS2436:1981 “Guide to noise control on construction, maintenance and demolition sites

The Australian Standard AS2436 states that where all reasonable and available measures have been taken to reduce construction noise, mitigation strategies may be put in place to reduce levels noise levels to within a reasonable and acceptable level. For the control and regulation of noise from construction sites AS2436:1981 “Guide to noise control on construction, maintenance and demolition sites” nominates the following:

a. That reasonable suitable noise criterion is established,

b. That all practicable measures be taken on the building site to regulate noise emissions, including the siting of noisy static processes to locations of the site where they can be shielded, selecting less noisy processes, and if required regulating construction hours, and

c. The undertaking of noise monitoring where non-compliance occurs to assist in the management and control of noise emission from the demolition, excavation and construction site.

7.3.2 EPA Interim Construction Noise Guideline

The Department of Environment and Climate Change have developed a specific construction noise guideline in the aid of reducing the impact of construction associated noise.

The guideline reflects on feasible and reasonable mitigation strategies, management controls and public liaising in the effort to reach realistic comprises between construction sites and potential noise affected receivers.
7.3.3 EPA Interim Construction Noise Guideline - Qualitative Assessment Method

The guideline refers to a qualitative assessment method in which construction noise is assessed on a case by case basis with regard to various activities to be conducted on site. This assessment method was developed to smaller scale projects.

Essentially this method of assessment requires that the proponent take into consideration and employ all reasonable and feasible measures to ensure that the impact on noise receivers is minimised. This is generally conducted in the following manner:

- The drafting of a noise management plan outlining all reasonable and feasible mitigation methods for the reduction of noise impact;
- The assessment of high impact equipment such as rock-hammers and piling equipment for lower noise producing methods of construction/excavation;
- The implementation of a complaints handling register and community consultation system;
- Employee (builders, contractors etc) education in effective noise reducing techniques and site etiquette; and
- The operation of plant in a quiet and efficient manner (i.e. turning off machinery when not in use).

This qualitative assessment method has been used for the basis of this report and has been used as the basis for the development of acoustic management and treatments of proposed construction activities.

In addition, the guideline specifies goals which can be used in the effort of minimising noise from construction related activities. These noise goals are presented within the table below.

<table>
<thead>
<tr>
<th>Governing Body</th>
<th>Receiver Type</th>
<th>External sound level Goal, $L_{eq \ 15 \ min}$ dB(A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPA</td>
<td>Residential</td>
<td>Background + 10 dB(A)$^1$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>75 dB(A)$^2$</td>
</tr>
</tbody>
</table>

1: Where the predicted or measured $L_{Aeq \ (15 \ min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to minimise noise. (DECC CNG, 2008).

2: Where noise is above this level, the proponent should consider very carefully if there is any other feasible and reasonable way to reduce noise to below this level. If no quieter work method is feasible and reasonable, and the works proceed, the proponent should communicate with the impacted residents by clearly explaining the duration and noise level of the works, and by describing any respite periods that will be provided. (DECC CNG, 2008).

These criteria for resultant noise from construction activities are aimed at maintaining comfort levels within the surrounding residential dwellings. Additionally, noise mitigation techniques as discussed in this report should be used if noise emissions exceed the above criteria. All work is to be carried out in accordance with AS 2436:1981 “Guide to noise control on construction, maintenance and demolition sites”.
7.4 CONSTRUCTION VIBRATION CRITERIA

Construction vibration criteria associated with works on the project when measured at the potentially affected receivers should not exceed the following sets of vibration criteria to ensure no architectural or structural damage to surrounding buildings and human comfort is maintained. These standards have been selected as they are widely used in the assessment of vibration associated with construction activities within Australia, namely:

- **Assessing Vibration: a technical guideline (DEC, 2006).**
- German Standard DIN 4150-3 (1999-02): “Structural Vibration – Effects of Vibration on Structures”; and

The criteria and the application of these Standards are discussed in separate sections below.

7.4.1 German Standard DIN 4150-3 (1999-02)

German Standard DIN 4150-3 (1999-02) provides vibration velocity guideline levels for use in evaluating the effects of vibration on structures. The criteria presented in DIN 4150-3 (1999-02) are presented in the Table below.

It is noted that the peak velocity is the absolute value of the maximum of any of the three orthogonal component particle velocities as measured at the foundation, and the maximum levels measured in the x- and y-horizontal directions in the plane of the floor of the uppermost storey.

**Table 14 – DIN 4150-3 (1999-02) Safe Limits for Building Vibration**

<table>
<thead>
<tr>
<th>TYPE OF STRUCTURE</th>
<th>PEAK PARTICLE VELOCITY (mms⁻¹)</th>
<th>Plane of Floor of Uppermost Storey</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>At Foundation at a Frequency of</td>
<td>All Frequencies</td>
</tr>
<tr>
<td></td>
<td>&lt; 10Hz</td>
<td>10Hz to 50Hz</td>
</tr>
<tr>
<td>1 Buildings used in commercial purposes, industrial buildings and buildings of similar design</td>
<td>20</td>
<td>20 to 40</td>
</tr>
<tr>
<td>2 Dwellings and buildings of similar design and/or use</td>
<td>5</td>
<td>5 to 15</td>
</tr>
<tr>
<td>3 Structures that because of their particular sensitivity to vibration, do not correspond to those listed in Lines 1 or 2 and have intrinsic value (eg buildings that are under a preservation order)</td>
<td>3</td>
<td>3 to 8</td>
</tr>
</tbody>
</table>
7.4.2  British Standard BS 6472:1992

British Standard BS 6472:1992 develops criteria relating to levels of building vibration that may be expected to give rise to “adverse comment”, in the frequency range most applicable to impacts associated with construction, which is 1 to 80Hz. These threshold values are used as criteria for assessing the loss of amenity and are presented below in Table 3.

Table 15 – BS 6472:1992 Criteria to Avoid “Adverse Comment”

<table>
<thead>
<tr>
<th>Type of Occupancy</th>
<th>Time of Day</th>
<th>Peak Particle Velocity (mms⁻¹) between 1Hz to 80Hz Likely to Cause “Adverse Comment”</th>
<th>Continuous Vibration</th>
<th>Intermittent Vibration and Impulsive Vibration Excitation with Several Occurrences per day</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Vertical</td>
<td>Horizontal</td>
<td>Vertical</td>
</tr>
<tr>
<td>Residential</td>
<td>Day</td>
<td>0.3 to 0.6</td>
<td>0.8 to 0.6</td>
<td>8.4 to 12.6</td>
</tr>
<tr>
<td></td>
<td>Night</td>
<td>0.2</td>
<td>0.6</td>
<td>2.8</td>
</tr>
<tr>
<td>Offices</td>
<td>Day</td>
<td>0.6</td>
<td>1.6</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>Night</td>
<td>0.6</td>
<td>1.6</td>
<td>18</td>
</tr>
<tr>
<td>Workshops</td>
<td>Day</td>
<td>1.2</td>
<td>3.2</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>Night</td>
<td>1.2</td>
<td>3.2</td>
<td>18</td>
</tr>
</tbody>
</table>

The limits indicate that people in buildings are significantly less susceptible to horizontal vibration than to vertical vibration. Furthermore, Section 4.1 of BS 6472 notes that situations can exist where vibration magnitudes above those generally corresponding to minimal “adverse comment” levels can be tolerated, particularly for temporary disturbances and infrequent and intermittent events such as those associated with construction projects.

7.4.3  Amenity

Acceptable values for intermittent vibration shall comply with the requirements in Table 2.4 of EPA “Assessing Vibration: A technical guideline” detailed as below.

Table 16 - Acceptable Vibration Dose Values for Intermittent Vibration (m/s^1.75)

<table>
<thead>
<tr>
<th>Location</th>
<th>Day time preferred value</th>
<th>Day time maximum value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residences</td>
<td>0.20</td>
<td>0.40</td>
</tr>
</tbody>
</table>
7.5 CONSTRUCTION HOURS

Woking hours are subject to planning approval conditions. Typically the hours of work at sites will be:

- 7:00am to 5:00pm Monday to Friday
- 8:00am to 1:00pm on Saturdays
- No work on Sundays, Public Holidays or Saturdays adjacent to a Public Holiday.

Works which are proposed to be conducted outside of these hours will be subject to special approval.

7.6 CONTROL OF CONSTRUCTION NOISE AND VIBRATION

As a part of the noise management of noise and vibration on each site the following process should be conducted when investigating the impact and construction activities.
Figure 3 – Process Flowchart
7.7 NOISE AND VIBRATION CONTROL METHODS

The determination of appropriate noise control measures will be dependant on the particular activities and construction appliances. This section provides an outline of available methods.

7.7.1 Selection of alternate appliance or process

Where a particular activity or construction appliance is found to generate excessive noise levels, it may be possible to select an alternative approach or appliance. For example; the use of a hydraulic hammer on certain areas of the site may potentially generate high levels of noise. By carrying this activity by use of pneumatic hammers, bulldozers ripping and/or milling machines lower levels of noise will result.

7.7.2 Acoustic Barrier

Barriers or screens can be an effective means of reducing noise. Barriers can be located either at the source or receiver.

The placement of barriers at the source is generally only effective for static plant (tower cranes). Equipment which is on the move or working in rough or undulating terrain cannot be effectively attenuated by placing barriers at the source.

Barriers can also be placed between the source and the receiver.

The degree of noise reduction provided by barriers is dependant on the amount by which line of sight can be blocked by the barrier. If the receiver is totally shielded from the noise source reductions of up to 15dB(A) can be effected. Where only partial obstruction of line of sight occurs, noise reductions of 5 to 8dB(A) may be achieved. Where no line of sight is obstructed by the barrier, generally no noise reduction will occur.

As barriers are used to provide shielding and do not act as an enclosure, the material they are constructed from should have a noise reduction performance that is approximately 10dB(A) greater than the maximum reduction provided by the barrier. In this case the use of a material such as 10mm or 15mm thick plywood (radiata plywood) would be acceptable for the barriers.

7.7.3 Silencing devices

Where construction process or appliances are noisy, the use of silencing devices may be possible. These may take the form of engine shrouding, or special industrial silencers fitted to exhausts.

7.7.4 Material handling

The installation of rubber matting over material handling areas can reduce the sound of impacts due to material being dropped by up to 20dB(A).
7.7.5 Treatment of specific equipment

In certain cases it may be possible to specially treat a piece of equipment to dramatically reduce the sound levels emitted.

7.7.6 Establishment of Site Practices

This involves the formulation of work practices to reduce noise generation. A noise plan will be developed for this project outlining work procedures and methods for minimising noise.

7.7.7 Regular noise checks of equipment

To determine the requirement for silencing devices on machinery it is proposed to undertake fortnightly noise check. Noise levels of all machines on site will be measured and if they are found to be higher than nominated for that equipment type, items such as mufflers and engine shrouds will be examined to ensure they are in good working order.

A record of these measurements will be kept on a form similar to that shown in Appendix 1. This measure is expected to maintain noise at constant levels, and prevent any increases.

7.7.8 Treatment of existing equipment

An effective method of mitigating vibration on existing equipment would be to vibration isolated mounts to existing equipment and installations. Vibration isolation would be required to be investigated on a case by case basis and consist of neoprene mounts as specified (such as waffle pads, supershear flex or the like).

Based on investigations conducted at the site the areas which may be suitable for treatment include tables with sensitive equipment such as microscopes and the like.

7.7.9 Noise and vibration Monitoring

Noise and vibration monitoring will be undertaken to determine the effectiveness of measures which are been implemented. The results of monitoring can be used to devise further control measures.

7.7.10 Combination of methods

In some cases it may be necessary that two or more control measures be implemented to minimise noise.

7.7.11 Saw cutting

Introduction of a saw cut to manage vibration impacting on surrounding receivers from construction activities.
8 CONCLUSION

This report provides the results of Environmental Noise Study for the proposed Mudgee Hospital Redevelopment development located in the block bound by Church, Meares and Lewis Streets Mudgee. Noise at the site has been measured and noise goals have been set in accordance with the requirements of the local council and relevant statutory/regulatory authorities.

Traffic noise has been assessed and acoustic criteria for internal noise levels have been presented in Section 4 including Developments Near Rail Corridors and Busy Roads and AS2107:2016.

Determination of noise assessment criteria based on the EPA’s Noise Policy for Industry and have been determined based on both unmanned and manned noise monitoring conducted at the proposed development.

Noise emissions from vehicles using the carpark ramp have been assessed and will comply with the objectives set out in Section 5.1 provided the acoustic treatments recommended in Section 5.3 have been implemented.

An assessment of construction noise and vibration from the site has been undertaken in accordance with the EPA’s Interim Construction Noise Policy and details the methodologies and treatments to mitigate noise impacts to the surrounding residential receivers has been undertaken and presented within Section 7 of this report.

Please contact us should you have any further queries.

Yours faithfully,

[Signature]

Acoustic Logic Consultancy Pty Ltd
Thomas Taylor
## APPENDIX 1

### MEASURED AMBIENT NOISE LEVELS

**Daily Assessment Background Level Results - 23 Meares Street**

<table>
<thead>
<tr>
<th>Date</th>
<th>Measured Noise Level – dB(A)_{L90}</th>
<th>Night (6pm-10pm)</th>
<th>Daytime (7am-6pm)</th>
<th>Evening (6pm-10pm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>7/8/2018</td>
<td></td>
<td></td>
<td></td>
<td>40</td>
</tr>
<tr>
<td>8/8/2018</td>
<td>32</td>
<td>45</td>
<td>39</td>
<td></td>
</tr>
<tr>
<td>9/8/2018</td>
<td>34</td>
<td>46</td>
<td>42</td>
<td></td>
</tr>
<tr>
<td>10/8/2018</td>
<td>34</td>
<td>42</td>
<td>41</td>
<td></td>
</tr>
<tr>
<td>11/8/2018</td>
<td>34</td>
<td>45</td>
<td>41</td>
<td></td>
</tr>
<tr>
<td>12/8/2018</td>
<td>34</td>
<td>44</td>
<td>43</td>
<td></td>
</tr>
<tr>
<td>13/8/2018</td>
<td>32</td>
<td>43</td>
<td>39</td>
<td></td>
</tr>
<tr>
<td>14/8/2018</td>
<td>32</td>
<td>44</td>
<td>41</td>
<td></td>
</tr>
<tr>
<td>15/8/2018</td>
<td>33</td>
<td>45</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Rating Background Noise Level – dB(A)_{L90}**

<table>
<thead>
<tr>
<th></th>
<th>Night (6pm-10pm)</th>
<th>Daytime (7am-6pm)</th>
<th>Evening (6pm-10pm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rating Background Noise Level – dB(A)_{L90}</td>
<td>33</td>
<td>44</td>
<td>40</td>
</tr>
</tbody>
</table>