MUSEUMS DISCOVERY CENTRE EXPANSION
ENVIRONMENTAL IMPACT STATEMENT

# APPENDIX E
# ACOUSTIC REPORT

Northrop

NSW GOVERNMENT

NORTHROP

ACOUSTIC REPORT FOR STATE SIGNIFICANT DEVELOPMENT APPLICATION

# Powerhouse Museum Discovery Centre

2 Green Road, Castle Hill, NSW 2154

**PREPARED FOR**
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# Acoustic Report for State Significant Development Application

## Revision Schedule

| Date | Revision | Issue | Prepared By | Approved By |
|---|---|---|---|---|
| 26.06.2020 | 1 | Preliminary – draft | J. Ameli | I. Adlington |
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# 1. Executive summary

Northrop Consulting Engineers Pty Ltd (Northrop Acoustics) have been engaged by Lahznimmo Architects to provide an acoustic report for state significant development application for Museums Discovery Centre at 2 Green Road, Castle Hill, NSW. The application will involve the addition of a new building on the existing site.

A noise survey was conducted on site to make noise measurements and to investigate the surroundings. This assessment discusses the potential noise impact from the development on the nearest most-affected receivers, and noise intrusions into the building, and provides recommendations where exceedances occur.

The assessment has been prepared considering the following documentation:

- NSW EPA Industrial Noise Policy 2017
- Architectural Drawings provided by Lahznimmo Architects
- NSW Road Noise Policy
- NSW EPA Interim Construction Noise Guideline

# 2. Site description

The existing site is located at 2 Green Road, Castle Hill. The project involves addition of a new building to the existing site. The site is bound by Showground Road to the south, existing Museums Discovery Centre Site to the west, Castle Hill TAFE to the east, residences and playground/public park to the north.

The location of the site is shown in Figure 1.


***Figure 1:*** *Aerial view of site, the proposed building and noise measurement locations*

The nearest neighbouring buildings which have potential noise impact are:

- Residential buildings across the north boundary mainly 2 Peppertree Place and 10 Sunderland Avenue.
- The TAFE internal teaching spaces across the east boundary.
- Commercial buildings on the south across Showground Road.

# 3. Project appreciation

**Introduction**

The report supports a State Significant Development (SSD) Application for the proposed construction and use of a new building to facilitate the expansion of the Museums Discovery Centre (MDC) site at 2 Green Road, Castle Hill.

The primary objective of the SSD Application is to provide expanded facilities to accommodate the Powerhouse collection including spaces for storage, conservation, research and display and spaces to facilitate increased public access to the collection through education, public programs, workshops, talks, exhibitions and events. The expansion of the existing MDC facility within the site at 2 Green Road Castle Hill will integrate with the existing MDC site located at 172 Showground Road, Castle Hill and its operations on a permanent basis.

The proposal is a type of *"Information and Education Facility"* with a Capital Investment Value (CIV) in excess of $30 million and is classified as SSD under Schedule 1 Clause 13 of the State Environmental Planning Policy (State and Regional Development) 2011 (State and Regional Development SEPP).

Create Infrastructure is the proponent of the SSD Application.

**Background**

The MDC is owned and operated by the Museum of Applied Arts and Sciences (MAAS) and features exhibitions and displays in collaboration with Australian Museum and Sydney Living Museums, who also maintain collection storage and conservation facilities on the site. The MDC is located at 172 Showground Road, Castle Hill. There are six buildings primarily providing collection storage as well as areas for displays and education and public programs, accessible to visitors (Building E). During 2017-2018 a total of 17,481 persons visited the MDC site.

The MDC Expansion is part of the renewal of the Museum of Applied Arts and Sciences, known as the Powerhouse Program, that includes:

- **Powerhouse Parramatta**: A new benchmark in cultural placemaking for Greater Sydney that will be a symbol of a new approach to creative activity and engagement.
- **Powerhouse Ultimo:** The NSW Government recently announced that the Museum's Ultimo site will be retained and the Museum will operate over four sites across the Greater Sydney area.
- **Powerhouse Collection Relocation and Digitisation Project:** The relocation of the Powerhouse collection and digitisation of around 338,000 objects, enhancing the collection's accessibility for local, national and international audiences.

The MDC expansion is an integral component of the Powerhouse Program and will provide the opportunity to increase visitation to the site, forming an important and significant cultural institution within The Hills Shire. In addition to the storage component of the proposal, the expansion will increase access to the Powerhouse collection through a range of spaces for visible storage, research and viewing of the collection, as well as flexible spaces for education and public programs, workshops, talks, exhibitions and events.

## Site Description

The proposed Building J site is located within the property known as 2 Green Road, Castle Hill which comprises a single lot legally described as Lot 102 DP 1130271. The site is generally square in shape with a splay corner to the intersection of Green Road and Showground Road and a total area of approximately 3.8ha. The site has a primary frontage of approximately 183m to Green Road and a secondary frontage of approximately 186m to Showground Road. Refer to **Figure 1.** The location of the proposed new MDC building (to be known as "Building J") is located on the western end of the site and is marked on **Figure 1** in a dashed yellow line (referred as the Building J Site). The overall site contains large institutional buildings set within a landscaped setting featuring a high tree canopy.

The overall site is a TAFE campus that caters for approximately 400 enrolled students, and provides courses on business and financial services, hospitality, general education, community services, health, nursing, carpentry, building and retail. The site currently includes TAFE buildings, car parking and vegetated open space areas. A dam is situated in the north eastern part of the site.

The MDC site is located immediately west of the existing TAFE site at 172 Showground Road, Castle Hill. A subdivision application (included within this SSD Application) will consolidate the site of the proposed Building J with the existing MDC site. The main public vehicle access to the MDC site is via Windsor Road. There is also a vehicular access point to the MDC on Showground Road. The MDC and TAFE have a longstanding arrangement, that permits vehicle access to the MDC site from Green Road, allowing vehicles to traverse across the TAFE site to access the MDC site.


***Figure 2:*** Existing site layout plan and proposed development site *Source: Lahznimmo Architects*

Development surrounding the site to the east, and north consists of established residential neighbourhoods generally comprising two storey detached dwellings. Opposite the site to the south east and south west are a mix of warehouses, industrial units, and large format bulky goods retail premises. Views into the TAFE and MDC site from the surrounding roads is obscured by dense trees and vegetation along the perimeter of the sites.

A public park and children's playground is adjacent to the north of the site that is bound by Sunderland Avenue to the east and Castlegate Place to the west. The dwellings along Sunderland Avenue and the southern side of Pentonville Parade are the nearest residential properties to the proposed Building J site.

**Overview of Proposed Development**

The successful delivery of this SSD project supports a priority cultural infrastructure project and is a NSW Government 2019 election commitment (Powerhouse Precinct at Parramatta). This application will deliver a significant cultural institution for Castle Hill and The Hills Shire.

The proposed Building J will offer many opportunities for public engagement as part of a desire to increase public access to the Powerhouse collection. The renewal of the site offers a range of opportunities to increase public access including visible storage facilities, booked tours, Open Days, public and education programs, workshops, talks and other events. The facilities in Building J will serve the needs of a variety of user groups including staff, volunteers, education groups, researchers, artists, scientists, industry partners and the general public.

The SSD Application seeks consent for the delivery of the MDC expansion as a single stage, comprising:

- Site preparation works, including the termination/relocation and installation of site services and infrastructure, tree removal (337 trees in total), earthworks, and the erection of site protection hoardings and fencing.
- Demolition of existing car park and vehicle accessway along the eastern and north eastern parts of the site. A new at-grade car park is proposed to be constructed on the eastern side of the TAFE site and will accommodate 24 car parking spaces removed from the Building J site.
- Construction of the proposed new Building J. The proposed new Building J will cater for the following uses:
- Storage for the Powerhouse collection and archives (both collected archives and institutional archives).
- Flexibles spaces for education and public programs, workshops, talks, exhibitions and events.
- Suites of conservation laboratories and collection work spaces.
- Photography, digitisation and collection documentation facilities.
- Work space for staff, researchers, industry partners and other collaborators. This will include amenities, meeting and storage rooms, collection research and study areas as well as other ancillary facilities.
- Components of the image and research library.
- Object and exhibition preparation, packing, quarantine and holding areas.
- Construction of new vehicle accessways to maintain connectivity to the MDC and TAFE sites.
- Subdivision of the proposed Building J site from the TAFE site including creation of right-of-carriageway easement to facilitate access over the new realigned accessway by TAFE vehicles and consolidation to form a single lot with the existing MDC site.

**Assessment Requirements**

The Department of Planning, Industry and Environment have issued Secretary's Environmental Assessment Requirements (SEARs) to the applicant for the preparation of an Environmental Impact Statement for the proposed development. This report has been prepared having regard to the SEARs as follows:

| SEAR | Where Addressed |
|---|---|
| 7. Amenity<br>The EIS shall: | |
| assess potential overshadowing, noise, reflectivity, visual privacy, including any amenity impacts of the proposal on surrounding development and the public domain | *Refer to Section 7 of this Report* |
| include a noise and vibration assessment in accordance with the relevant EPA guidelines. This assessment must detail construction and operational noise impacts on nearby sensitive receivers and outline the proposed management and mitigation measures that would be implemented. | *Refer to Section 7 of this Report* |

## 3.1 Project appreciation

The Museums Discovery Centre is already operational. The centre provides services such as storage of the museum items, conservation, research and display and provides spaces to facilitate increased public access to the collection through education, public programs, workshops talks, exhibitions and events. The MDC features exhibitions and displays in collaboration with Sydney Living Museums and the Australian Museum who also maintain collection storage and conservation facilities on the site.

Building J will complement the existing store and public facing operations of MDC. The location of Building J is shown in Figure 2.

The main entry to the building is located on the West side of Ground Floor between Grids 4 and 5. A generous foyer space and stair connects through to a secondary building entry on the east at Lower Ground. This double height foyer space divides the functions of the building, with a more public, exhibition/education and admin functions located to the South. The general storage and handling of collections, and conservation operations are located to the north of the foyer space.

**Lower Ground**

Lower Ground contains the following functions:

**North of the Entry**

- The double height Very Large Objects store (Occupying 2,600m2)
- Loading Dock
- Photography studio and associated spaces
- Isolation room (To isolate and inspect objects prior to entering the collection store)

**South of the Entry**

- Open Plan Admin space and associated lunch room, meeting rooms, and change facilities
- Shared public/staff amenities
- Services rooms/plant

**Ground Floor**

Ground Floor West is considered the main entry to the building. Ground Floor contains:

**North of the Foyer**

- A receiving room off the Loading dock goods lift.
- The upper volume of the double height Very Large Objects, Store

**South of the Foyer**

- Triple height flexible area to facilitate workshops and exhibitions, connected to:
- Single storey flexible area with furniture store

**Level 1**

Sitting above the East-West foyer space below, is a mezzanine space that will be a more discrete version of the Ground floor flexible areas. This area will be used to either view objects from the high security collections, first nations collections or it could host smaller curated objects on exhibition. It is primarily for viewing collections objects and is open to the triple height flexible area on Ground floor.

**North of the mezzanine viewing area**

- Small objects store
- Collections workroom and packing spaces
- Conservation laboratory for research, and treatment of objects
- High security and First Nations collections
- Mechanical services plant room

**South of the mezzanine viewing area**

- Conservation store for the storage of archival material and chemicals

The building will use chilled water and hot water system. The main plantroom is on the south side and will include AHUs, Chillers, Pumps and VRV units. The north plantroom will accommodate a small reverse cycle chiller and 4 AHUs serving miscellaneous areas such as photography, and temporary storage areas.

# 4. Environmental noise criteria

## 4.1 NSW EPA Noise Policy for Industry (2017)

The NSW Environment Protection Authority (EPA) Noise Policy for Industry (2017) sets out noise criteria to control the noise emission from industrial noise sources. Mechanical and operational noise from the development shall be addressed following the guideline in the NSW EPA Noise Policy for Industry.

The determination of the criteria is based on the results of the ambient and background noise unattended monitoring, addressing two components:

- Controlling intrusive noise into nearby residences (Intrusiveness Criteria)
- Maintaining noise level amenity for particular land uses (Amenity Criteria)

Once both criteria are established the most stringent for each considered assessment period (day, evening, night) is adopted as the Project Noise Trigger Level (PNTL). The project noise trigger level becomes the benchmark for assessing the noise impact from the proposed site upon the surrounding noise-sensitive receivers for the external noise emissions from the development. The assessment periods are:

- Day: 7am – 6pm Monday – Saturday, 8am – 6pm Sunday
- Evening: 6pm – 10pm Monday – Sunday
- Night: 10pm – 7am Monday – Saturday, 10pm – 8am Sunday

The applicable parts of Table 2.2: Amenity noise levels from the Noise Policy for Industry which are relevant to the project are reproduced in Table 1 below:

***Table 1:*** *Amenity criteria for external noise levels*

| **Receiver** | **Noise amenity area** | **Time of Day** | **Recommended Amenity Noise Level, $L_{Aeq}$ dBA** |
|---|---|---|---|
| Residential | suburban residential | Day | 55 |
| | | Evening | 45 |
| | | Night | 40 |
| Commercial premises | All | When in use | 65 |

## 4.2 NSW Road Noise Policy

Noise from the vehicles associated with the development has been assessed using NSW Road Noise Policy. Table 2 presents the noise assessment criteria for land use developments with potential to create additional traffic on existing surrounding roads.

***Table 2:*** *Noise levels- Road Noise Policy*

| **Road category** | **Type of project/Land use** | **Assessment criteria, dBA** | |
|---|---|---|---|
| | | **Day** | **Night** |
| Freeway/arterial/Sub-arterial roads | Existing residences affected by additional traffic on existing freeway/arterial/sub-arterial roads generated by land use developments | $L_{Aeq,15hr}$ 60 (External) | $L_{Aeq,9hr}$ 55 (External) |

RNP recommends that “Where feasible, existing noise levels should be mitigated to meet the noise criteria. In this regard, the RNP states that for existing roads there is limited potential for noise control as the development is not linked to road improvements. It does however advise that applicable strategies include appropriate location of private access roads, regulating time of use, using clustering, and using barriers and acoustic treatments”.

Section 3.4.1 of the RNP specifies a limit of 2 dB for vehicular noise level increase over existing noise level of local roads for such developments/projects.

### 4.3 NSW EPA Interim Construction Noise Guideline

Construction noise is a major environmental noise issue in NSW and it is well accepted that this activity can adversely affect, sleep, concentration and learning performance and mental and physical health. While construction noise is temporary in nature, its impacts need to be controlled.

The NSW Interim Construction Noise Guideline (ICNG) is specifically aimed at managing noise from construction works. From a regulatory perspective, the local Council is the appropriate regulatory authority for non-scheduled construction activities.

***Table 3:*** *IGCN noise criteria at residences, using quantitative assessment, $L_{Aeq}$*

| **Time of Day** | **Management Level – $L_{Aeq}$ (15min)** | **How to apply** |
|---|---|---|
| Recommended Standard Hours:<br>Monday to Friday 7am to 6pm<br>Saturday 8am to 1pm<br>No work on Sundays or public holidays | Noise affected RBL + 10 dB | The noise affected level represents the point above which there may be some community reaction to noise.<br>Where the predicted or measured $L_{Aeq\ (15min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level.<br>The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration as well as contact details. |
| | Highly noise affected 75 dB(A) | The highly noise affected level represents the point above which there may be strong community reaction to noise.<br>Where noise is above this level, the relevant authority (consent, determining, regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account:<br>Times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences)<br>If the community is prepared to accept longer period of construction in exchange for restrictions on construction times. |

| Time of Day | Management Level – $L_{Aeq}$ (15min) | How to apply |
|---|---|---|
| Outside recommended standard hours | Noise affected RBL + 5 dB | A strong justification would typically be required for work outside the recommended standard hours<br>The proponent should apply all feasible and reasonable work practices to meet the noise affected level<br>Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community<br>For guidance on negotiating agreements see Section 7.2.2 (NSW Interim Construction Noise Guideline) |
| Active Play Areas (Childcare Centres) | 65 dB(A) | When in Use |

### 4.3.1 Construction Vibration Limits

Construction vibration levels depend on several factors. These include the activity, the equipment being used, the ground geology and the distance between the building and the source. In Australia there is no current specific standard for construction vibration. This methodology is equivalent to the guidelines issued in current international standards and described in *'AS 2670:2001 Vibration and shock - Guide to the evaluation of human exposure to whole body vibration'*, as shown below in Figure 3.

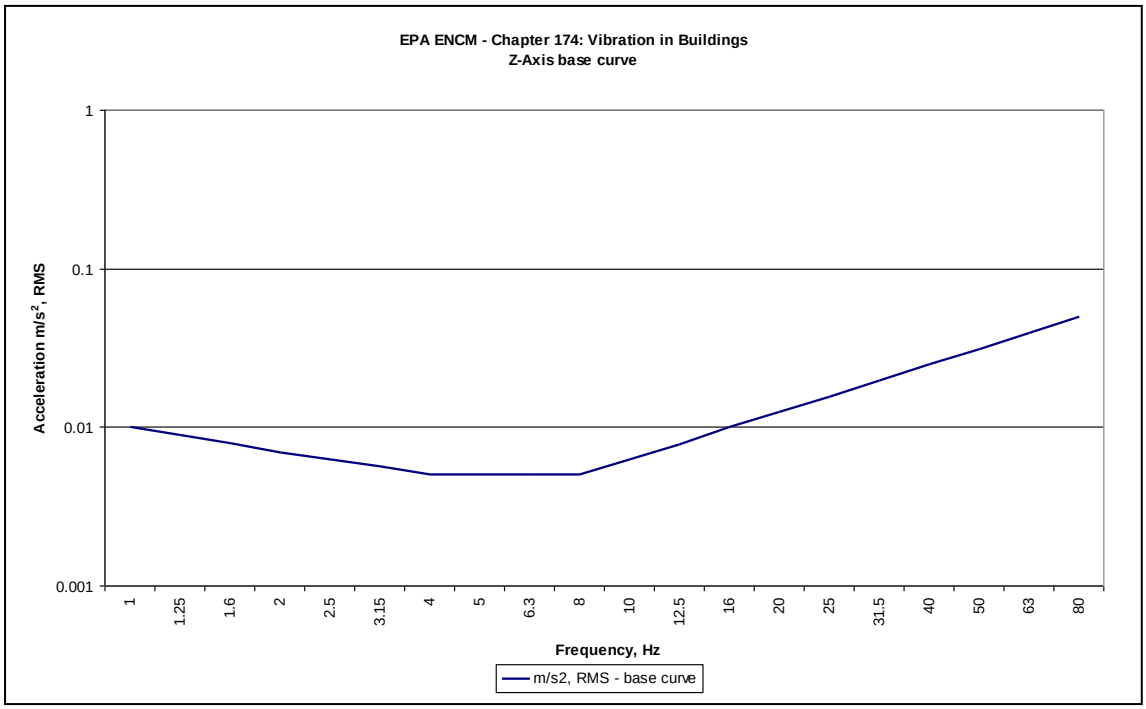



***Figure 3:*** *AS2670 Base Vibration Criteria*

To assess vibration impact to different types of buildings, for example residential, multiplying factors shown in Table 4 need to be applied to the base criteria.

***Table 4:*** *Multiplying factors to obtain limit vibration levels*

| Place | Multiplying factors | | |
|---|---|---|---|
| | **Time** | **Continuous vibration** | **Intermittent or impulsive** |
| Residential | Day 0700-2200 | 2 | 60 |
| | Night 2200-0700 | 1.4 | 20 |
| Office | Day 0700-2200 | 4 | 128 |
| | Night 2200-0700 | 4 | 128 |
| Workshops | Day 0700-2200 | 8 | 128 |
| | **Night 2200-0700** | **8** | **128** |

The NSW Office of Environment and Heritage (OEH) does not directly relate to damage levels to buildings. The German DIN4150 and NSW OEH/British Standard BS6472 provide guidelines relevant to this assessment. These criteria are summarised below in Table 5.

***Table 5:*** *Typical vibration limit criteria (mm/s)*

| Criterion | Typical Vibration Velocity | Standard |
|---|---|---|
| Disturbance to persons (day) 0700-2200 | 0.3 – 0.6 peak | BS6472 |
| Disturbance to persons (night) 2200-0700 | 0.2 peak | BS6472 |
| Damage to dwellings | 5 – 15 rms | DIN 4150 |
| **Damage to heritage buildings** | **3 – 8 rms** | **DIN 4150** |

Management of noise and vibration impacts during construction is best mitigated through the implementation of a site noise and vibration management plan by the prospective builder.

#### 4.3.2 Vibration management

The management objective for the site is to limit vibration from construction activities so as to avoid building damage and human discomfort associated with the construction works. It is noted that buildings in the vicinity of development are residential. Vibration impacts on the buildings and their occupants should be considered for the assessment of structural damage and human annoyance, respectively. Typical vibration levels from construction plant equipment most likely to cause significant vibration are summarised in Table 6 below.

***Table 6:*** *Typical ground vibration generated by construction plant*

| Activity | Typical ground vibration |
|---|---|

| | |
|---|---|
| Bulldozers/ Excavators | Typical ground vibration from bulldozers range from 1mm/s to 2mm/s at distances of approximately 5m and at distances greater than 20m, vibration levels are usually below 0.2mm/s. |
| Jack Hammers | Typical ground vibrations from jack hammers are generally greater than 5mm/s at distances of 1m and no more than 2mm/s for distances of 5m or more. |
| Truck traffic | Typical vibration from heavy trucks passing over normal (smooth) road surfaces generate relatively low vibration in the range 0.01-0.2mm/s at the footings of buildings located 10-20m from a roadway. In general ground vibration from trucks is usually imperceptible in nearby buildings. |

Therefore, vibration management strategies implemented on site shall consider these items of plant and construction activities involving these items of plant.

### 4.3.3 Buffer Distances for Vibration Control

The relationship between vibration and the probability of causing human annoyance or damage to structures is complex. This complexity is mostly due to the magnitude of the vibration source, the particular ground conditions between the source and receiver, the foundation-to-footing interaction and the large range of structures that exist in terms of design (i.e. dimensions, materials, type and quality of construction and footing conditions).

The intensity, duration, frequency content and number of occurrences of a vibration, all play an important role in both the annoyance caused and the strains induced in structures.

As the pattern of vibration radiation is very different to the pattern of airborne noise radiation, and is very site specific, below are some indicative minimum 'buffer' distances determined for some common construction plant with data available from recent projects, which assist to avoid human discomfort in terms of perceptible (or tactile) vibration during daytime construction hours:

***Table 7:*** *Recommended Minimum Buffer Distances for Construction Plant*

| Plant Item | Recommended Minimum Buffer Distance (m) |
|---|---|
| CFA (Continuous Flight Auger) Piling rig | 10 |
| Excavators | 10 |
| Jack hammers | 5 |

For this project, nearest affected receivers are located more than 10m from the construction site, and it is considered that no vibration impacts will be experienced.

# 5. Site measurements

The site was visited on 4th and 12th June for a noise survey. Attended and unattended noise measurements were conducted on site. A noise monitor was installed on site for a period of 8 days from 4th to 12th of June 2020 to measure the ambient noise. The noise monitor was installed on the northern end of the site close to the residential boundary, as shown in Figure 1.

The survey was conducted with the following instruments:

- ARL noise monitor type EL- 215, Serial number 194513
- NTI Precision Integrating Octave Band Sound Level Meter, Type XL2 with 1/3 Oct band filter unit, which conforms to applicable standards of IEC 61672-1:2002-05 CLASS1 & IEC 60651 TYPE1.

All equipment was calibrated before and after the measurements using a Brüel & Kjær Acoustic Calibrator. No calibration deviations were recorded. All equipment carries traceable calibration certificates.

Attended noise measurements were also taken along Showground Road to measure the ambient and traffic noise levels. Measurements were taken at the same setback as the façade of Building J from the kerb. The operator attended noise measurement location is shown on Figure 1.

# 6. Noise levels and environmental noise criterion

Long-term noise monitoring was conducted on the north side near the residential boundary. Detailed results of the logger measurements are shown in graphical form in Appendix B. During monitoring the weather was good, calm and dry. For those occasional periods where adverse weather condition prevailed, the data was excluded. The results of the automatic logging measurements are shown in Table 8, below.

***Table 8:*** *Unattended noise measurement results*

| **Location** | **Equivalent Continuous Noise level, $L_{Aeq, 15minute}$ – dBA** | | | **Background Noise Level – RBL ($L_{A90, 15minute}$) values – dBA** | | |
|---|---|---|---|---|---|---|
| | Day | Evening | Night | Day | Evening | Night |
| L1 | 49 | 45 | 40 | 44 | 43 | 37 |

Based on the monitoring results and the method presented in NSW Noise Policy for Industry the Project Trigger Levels are obtained. Table 4 presents the measured noise data and the criterion. Results of the attended noise measurements are presented in Table 9.

***Table 9:*** *EPA Noise Policy for Industry 2017 - Project Noise Trigger Levels*

| **Period** | **Intrusiveness Noise Level – $L_{Aeq, 15minute}$ dBA** | **Project Amenity Noise Level – $L_{Aeq, 15minute}$ dBA** | **Project Noise Trigger Level – $L_{Aeq, 15minute}$ dBA** |
|---|---|---|---|
| Day | 49 | 53 (55-5+3) | 49 |
| Evening | 48 | 43 (45-5+3) | 43 |
| Night | 42 | 38 (40-5+3) | 38 |

***Table 10:*** *Operator attended noise measurements - Traffic*

| **Time of Day** | **$L_{Aeq, period}$ (dBA)** | **$L_{A90}$ (dBA)** |
|---|---|---|
| 2:00 pm | 64 | 58 |

The acoustic environment is highly dominated by traffic noise of Showground Road.

# 7. Acoustic assessment

Noise intrusions into the building and noise breakouts from the operation have been considered as follows:

## 7.1 Noise intrusion into the building

The main noise ingress into Building J will be from traffic on Showground Road. Considering the measured traffic noise levels and the design criteria for internal spaces of Building J, the building elements have been checked/designed. The external walls will be constructed of blockwork masonry with outer metal cladding. The acoustic performance of such structure will be in excess of $R_w$ 45 and was considered in the calculations.

Drawings indicate that on the south façade, the only glazed parts leading to working spaces is on the ground floor. The glazed spaces are lunch room and staff area for which the recommended internal noise level is 45-50 dBA. Considering the traffic noise level outside, the glazing requirements were assessed. For this façade, a standard glass $R_w$ 25 will be sufficient. However, for such commercial building we recommend installation of 6.38mm laminated glass as a minimum.

Other facades, i.e. west, east and north are not exposed to any traffic or high level noise, hence for doors and windows of those facades the use of standard glass and frame will be sufficient.

## 7.2 Operational noise emissions

The operational noise from the Building J should be considered in the assessment. Noise emissions from the north end and the east façade should be considered at the residential buildings and the TAFE teaching spaces.

Noise from all operations must comply with the criteria for respective receiver as shown in the following Table 11.

***Table 11:*** *Noise emission criteria at surrounding receivers*

| **Receiver** | **Period** | **Noise criteria, $L_{Aeq,\ 15minute}$, dBA** |
|---|---|---|
| Residential (north) | Day | 49 |
| | Evening | 43 |
| | Night | 38 |
| Commercial (south, across Showground Road) | When in use | 65 |
| TAFE (east) | Noisiest 1 hour – When in use | 35 (classroom internal noise level) |

Most operations such as storage, conservation, research and display such as education, workshops, talks and exhibition are proposed to be indoors. Considering that most activities are low noise generating and the fact that they are all enclosed and considering that the masonry external walls have performance value in excess of $R_w$ 45, we do not anticipate any environmental noise impact from internal spaces.

In addition, there is not proposed to be any outdoor seating nor any operation involving outdoor noise emissions, therefore noise impacts from any outdoor area is not anticipated.

## 7.3 Noise from mechanical services

The accumulated noise from the mechanical plant should not exceed 49 dBA during the day and 48 dBA in the evening (background + 5 dBA) at the residential boundary, 65 dBA at the commercial buildings and 35 dBA inside TAFE teaching buildings when in use.

The new mechanical plants are at two locations, one at the south end and others at the north end of the Building J.

The mechanical plant at the north end is closer to the residential buildings, although the plant is enclosed there is a potential for noise impact from the air inlets and exhausts, specifically it should be assessed for night time sleep disturbance if refrigeration equipment is used.

At this stage the mechanical equipment have not been finalised/selected therefore their noise levels are not known. Once the equipment is selected, the noise levels can be obtained and a mechanical noise assessment can be conducted for the CC stage. Compliance with environmental noise criteria can be achieved through normal engineering controls such as the following:

- Location of mechanical equipment to be away from noise sensitive receivers
- No direct line of site between the plant and the noise receivers
- Installation of low noise condenser units or installation of barriers, acoustic enclosures and louvres around noise sources where the above measures are not adequate
- Installation of all mechanical equipment on vibration mounts as recommended by the manufacturers

## 7.4 Vehicular noise emissions

To assess the vehicular noise impact, the information provided in the traffic report was used (Transport assessment, report prepared by JMT Consulting dated 4 August 2020).

Vehicular noise emissions are in two parts and are assessed as follows:

### 7.4.1. Noise impact from generated traffic upon the surrounding road network:

Section 4.1 and 4.2 of traffic report consider the traffic generation and state that the MDC expansion will provide space for up to 50 staff members at any one time, an increase from the current 10-15 employees on site. Figures are also provided for generated traffic during the day and for peak times. They indicate that the proposal may generate 15 traffic movements on the adjacent road network during the critical AM peak. It concludes that the generated traffic is negligible compared to the existing traffic flows of Windsor Road and Showground Road which are well over 2000 vehicles per hour.

We have calculated the noise increase due to the generated traffic and assessed against the RNP criteria. A summary of results is presented in Table 12.

*Table 12: Noise level status from generated traffic*

| Location | Period | Existing traffic, Vehicle/Hr | Generated traffic, Vehicle/Hr | Resulting noise increase, dBA | Permitted noise increase, dBA | Complies (Y/N) |
|---|---|---|---|---|---|---|
| Windsor Road / Showground Road | AM Peak | 2000 | 15 | 0.03 | 2 | Y |

The above summary results indicate that generated traffic will be a small proportion of the traffic volume on the surrounding roads, the resulting noise increase will be marginal and will be within RNP noise limit increase.

### 7.4.2. Noise emissions from the loading dock

Section 4.6 of the traffic report is on Servicing and Loading and provides high level details such as truck routes and loading docks as follows.

All vehicles will enter and exit the site in a forward direction. Trucks would enter the site from Showground Road and travel north within the site before reversing back into the loading dock Trucks will exit the site via Windsor Road by travelling in an anti-clockwise direction along the existing carriageway. Truck circulation routes on site are shown on Figure 3.


*Figure 4: Truck circulation route on site.*

It is stated that there will be numerous days where Building J will not generate any service vehicle movements however on a busy day there will be 5-10 vehicles and those will be distributed over the course of the day. Truck noise impact will depend on the size of truck and the exposure time of the noise receiver. The residential buildings to the north on Peppertree Place are considered the closest as they may have the highest exposure. Those residences may be exposed to truck noise in the following ways:

- Truck noise emissions while reversing into the loading dock.
- Truck noise emissions whilst waiting and idling in front of the loading dock
- Truck noise during truck exit while truck is driving between building I and the north boundary

The trucks will generally be small to medium size up to 12.5 m length. On occasions 2-3 times a year where there is extra large or heavy load, larger trucks such as 20 T or single articulated trucks will be coming to site.

Considering the above, we have calculated the noise emissions from the service vehicles to the residential boundary to the north.

From our database, noise from a medium sized truck has a Sound Power Level of 97 dBA. Delivery trucks will travel from Windsor Road entry along the route parallel to the north boundary to the loading dock located at the north end of Building J. As the loading dock is an enclosed space, truck and other internal noise such as lift noise will be attenuated by the building envelope. It is assumed that the trucks manoeuvre or idle outside the loading dock will be limited to 1 minute, the noise emissions to the boundary of the nearest affected residential neighbours approximately 32m away is hence calculated. The attenuation effect of distance and directivity were considered in the calculation. The boundary barrier is an old timber fence and assumed to have negligible acoustic attenuation. A summary of results is presented in Table 13.

***Table 13:*** *Truck noise emission levels*

| **Period** | **1 Truck SWL, dBA** | **Truck SPL at 10 m, dBA** | **Truck SPL at residences 32m away, $L_{Aeq, 1minute}$, dBA** | **Truck SPL at residences 32m, $L_{Aeq, 15minute}$, dBA** | **Criteria $L_{Aeq, 15minute}$, dBA** | **Complies (Y/N)** |
|---|---|---|---|---|---|---|
| Day | 97 | 69 | 59 | 47 | 49 | Yes |
| Evening | 97 | 69 | 59 | 47 | 43 | No |
| Night | 97 | 69 | 59 | 47 | 38 | No |

The above summary results indicate that noise emissions from trucks while outside the loading dock will comply with the daytime criterion but exceeds the evening and night limits.

In a same way we have assessed the truck noise during exit. After trucks leave the loading dock they pass a 27m driveway between Building I and the residential boundary, at the speed of 10 km/hour, the truck will take 10 seconds to pass that driveway. This will expose the residences for approximately 10 seconds and the resulting equivalent Sound Pressure Level at the residences will be 51 dBA. This is a marginal exceedance, not at a noticeable level, and as it does not happen frequently it can be easily tolerated by the residential neighbours.

For larger trucks where the Sound Power Level is 107 dBA, the noise levels at the boundary will be 10 dBA higher. For noise events which are single events and last up to 2.5 hours the NSW EPA Noise Policy for Industry (Table C1 of NPfI) allows an additional 20 dBA correction added to the noise criteria. Since the larger trucks visit is limited and is 2-3 times a year, the visits can be considered as single events, applying this correction the noise levels will be within the permitted limit.

The followings are our recommendations to minimise the noise.

- Trucks should drive straight to the loading dock and drive straight inside. If the trucks need to stop in front of the dock, the engine should be switched off as soon as the trucks are in position. In this regard, the truck drivers should be trained and signage to be posted outside the loading dock.

- All deliveries/pick-ups to be made during daytime whenever possible. No deliveries to be made in the evening unless the delivery vehicle is of a small size or is a ute. Where truck delivery at nighttime is unavoidable, the residences at the north boundary should be contacted beforehand to be informed.

## 7.5 Construction noise

At this stage, the proposed nature of construction works, and activity has not been finalised and will be subject to final input by the construction contractor. However, as the proposed facility will include excavation works, we have assumed typical plant and activity will entail the following stages and typical plant items as follows:

- Site establishment and excavation works – bump in, truck deliveries, site excavation works, spoil removal, screw piling;
- Structural works – main structural works, crane hoists, concrete pumps, concrete saws, grinding hammering;
- Fit out works – mainly enclosed finishing works. For the purposes of this assessment we have assumed a typical shielding loss of 20 dB.

Representative plant and plant sound power levels have been derived from the UK Department for Environment Food and Rural Affairs (DEFRA 2005) *'Update of Noise Data Base for the Prediction of Noise on Construction Sites.'*

*Table 14: Typical construction noise SWLs from various works phases, $L_{Aeq,15minute}$ – dB(A)*

| Plant | Octave band centre frequency | | | | | | | | dB(A) |
|---|---|---|---|---|---|---|---|---|---|
| | 63Hz | 125Hz | 250Hz | 500Hz | 1kHz | 2kHz | 4kHz | 8kHz | |
| **1. Site establishment and excavation works** | | | | | | | | | |
| Excavator,5t | 99 | 99 | 94 | 87 | 87 | 86 | 82 | 76 | 93 |
| Screw piler | 114 | 110 | 105 | 102 | 98 | 94 | 90 | 83 | 104 |
| Truck delivery/spoil | 104 | 101 | 90 | 94 | 90 | 86 | 82 | 77 | 95 |
| Hammer | 94 | 94 | 96 | 96 | 91 | 85 | 83 | 79 | 97 |
| Angle grinder | 85 | 79 | 80 | 88 | 98 | 105 | 101 | 101 | 109 |
| **2. Structural works** | | | | | | | | | |
| Excavator | 99 | 99 | 94 | 87 | 87 | 86 | 82 | 76 | 93 |
| Truck delivery | 104 | 101 | 90 | 94 | 90 | 86 | 82 | 77 | 95 |
| Concrete pump, 25kW | 99 | 99 | 94 | 87 | 87 | 86 | 82 | 76 | 93 |
| Concrete saws, 3kW | 110 | 110 | 100 | 99 | 97 | 96 | 90 | 92 | 104 |
| Mobile crane | 113 | 101 | 95 | 99 | 100 | 97 | 91 | 84 | 104 |
| Angle grinder | 85 | 79 | 80 | 88 | 98 | 105 | 101 | 101 | 109 |
| Hammer | 94 | 94 | 96 | 96 | 91 | 85 | 83 | 79 | 97 |
| **3. Fit out works** | | | | | | | | | |
| Angle grinder | 85 | 79 | 80 | 88 | 98 | 105 | 101 | 101 | 109 |
| Hammer | 94 | 94 | 96 | 96 | 91 | 85 | 83 | 79 | 97 |
| Truck delivery | 104 | 101 | 90 | 94 | 90 | 86 | 82 | 77 | 95 |

The noise emission levels at the receivers are calculated and are presented in Table 15.

***Table 15:*** *Predicted construction noise levels, $L_{Aeq\ 15minute}$ dB(A)*

| Residential receivers | Works phase | | |
|---|---|---|---|
| | Site establishment and excavation works | Structural | Fit out |
| **Typical operating distances, m** | 50 | | |
| **Predicted construction noise levels, dB(A)** | 67 | 69 | 51 |
| **IGCN criteria, dB(A)** | (49 + 10) = 59 | | |
| **Complies?** | No | No | Yes |
| **Predicted exceedances** | 8 | 10 | - |

The noise level perceived at the assessment point will vary and depends on many factors such as the equipment noise level, distance, directivity and shielding from intervening structures. The above summary results indicate that for residential receivers, noise emissions from some activities during excavation and structural works stages exceed the Noise Affected Level criteria and in most cases comply with Highly Noise affected Level. At times when two or three pieces of equipment work simultaneously (e.g. excavator and loader could be working simultaneously) the accumulated noise and hence the exceedances will be higher and in some cases may exceed the Highly Noise Affected Level.

For exceedances above the Noise Affected Level, ICNG requires reduction of the noise to meet the level as follows.

*The noise affected level represents the point above which there may be some community reaction to noise.*

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

*The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration as well as contact details.*

Noise emissions are classified as “Noise Affected” and “Highly Noise Affected” under the NSW Interim Construction Noise Guideline (ICNG) and as such mitigation and management controls are recommended for the excavation and construction phases. For exceedances and the required mitigation measures when construction noise exceeds the Noise Affected Level and Highly Noise Affected Level see Table 3.

### 7.5.1 Construction noise mitigation recommendations

Australian Standards AS 2436:2010 *‘Guide to Noise and Vibration Control on Construction Demolition Sites*’ provides a list of measures for controlling noise from site related activity. Information in Table 16 referenced from AS 2436:2010 details the potential noise reduction of standard engineering mitigation measures, typically utilised on construction and demolition sites.

***Table 16:*** *AS 2436:2010 – Construction noise mitigation measures*

| Noise mitigation measure | Typical noise reduction, $L_p$ – dB(A) |
|---|---|
| Distance attenuation | 6 dB per doubling of distance |
| Screening and barriers | Typically, 5 to 10 dB(A) maximum 15 dB(A) |

| Noise mitigation measure | Typical noise reduction, $L_p$ – dB(A) |
|---|---|
| Enclosure | Typically, 15 to 25 dB(A) maximum 50 dB(A) |
| Silencing | Typically, 5 to 10 dB(A) maximum 20 dB(A) |

Based upon predicted noise levels it is anticipated that the use of screens and acoustic rated hoardings with a minimum transmission loss of >$R_w$ 25 around the site could be utilized to minimize noise impacts from the site to residential receivers.

### 7.5.2 Construction noise management recommendations

The highly noise affected level represents the point above which there may be strong community reaction to noise. The construction noise mitigation measures detailed in Section 7.5.1 above do not provide sufficient attenuation to achieve construction noise levels compliant with the ICNG criteria, therefore, noise from construction activity must be managed to minimise the temporary loss of acoustic amenity on the nearest affected receivers and surrounding community. Noise management can be achieved through scheduling, community engagement and operational practices to minimise noise impact.

#### Standard Hours for Construction Work

The recommended standard hours for construction (including demolition and excavation) work are as follows

- Monday to Friday 7 am to 6 pm
- Saturday 8 am to 1 pm
- No work on Sundays or public holidays

Section 2.2 of the “DECC Interim Construction Noise Guideline” (2009) specifies five categories of work that might be taken outside the standard hours. The categories relevant to this project are:

- The delivery of oversized plant or structures that police or other authorities determine require special arrangements to transport along public roads.
- Emergency work to avoid loss of life or damage to property, or to prevent environmental harm.
- Maintenance and repair of public infrastructure where disruption to essential services and/or consideration of worker safety do not allow work within the standard hours.

The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account:

- Times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences)
- If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.

#### Community engagement

From a community point of view, there is a need for a range of actions and processes for the construction works that aim to reduce noise and vibration impacts from the construction activities while encouraging community involvement and providing clarity for the developer and builder on what is required of them.

As a project moves towards the construction phase more details normally becomes available on the planned work methods, location of plant and equipment, and scheduling. For the development construction works, contact with the nearest affected community is desirable once approval has been given to commence works and should be undertaken prior to any work beginning. The type of community engagement should relate to the likelihood and extent of noise and vibration impacts from the construction works.

The aim of community engagement is to:

- establish good working relationships between the developer, builder, the community and other stakeholders in relation to the construction project
- receive feedback on the project's environmental performance, discuss community concerns and identify opportunities for the resolution of community complaints and concerns
- gain advice on how best to communicate relevant information on the project and its environmental performance to the broader community
- work cooperatively towards outcomes of benefit to the project, immediate neighbours and the local and regional community.

The Building Contractor shall nominate one of its staff as a community liaison officer for the project as a point of contact for the community regarding issues related to the construction of the development, including issues relating to noise and vibration. The secondary contact for the nearest affected community and other members of the public would be the site manager of the site. Any formal complaints received regarding noise and vibration matters at the construction site shall be passed on to the Building Contractor for the complaints to be addressed and resolved.

Being up-front with the noise affected community from the outset can assist in transferring information to the affected community. An example of being up-front is to present noise and vibration related information on the construction works to noise affected community before commencing works. The most noise sensitive properties likely to be most affected by site works and the operation of plant machinery particularly during the demolition and excavation phases are the residences.

### Operational practices to minimise construction noise impacts

The best management practices involve adopting particular operational procedures that minimise noise while retaining production efficiency. Some common noise reduction strategies include:

- Replacing high noise  level activities/equipment with the quieter ones, for example using circular saw in place of hammering, or using auger piling in place of impact piling.
- Changing the activity to reduce the noise impact or disturbance (e.g. reorganising the way the activity is carried out).
- Choosing a suitable time — schedule noisy activity to less sensitive times of the day. There are sensitive times of the day for different people, for example, schools during the day, times of religious services, and residences during evenings and night. Where several noisy pieces of equipment are used, their operation should be scheduled to minimise impacts.
- Keeping neighbours informed of a planned noisy activity, its duration and the reasons for the activity. Neighbours may be more accepting of temporary noise if they know when and why the noise is happening, and how long it will last.
- Educating staff and contractors about noise and quiet work practices. This could include signage, for example, some construction sites have signs reminding contractors to consider neighbours and be quiet, and to not start noisy work too early (e.g. before 7.30 am).

# 8. Conclusion

Northrop Consulting Engineers Pty Ltd (Northrop Acoustics) have been engaged by Lahznimmo Architects to provide an acoustic report for state significant development application for Museums Discovery Centre at 2 Green Road, Castle Hill, NSW. The application will involve the addition of a new building on the existing site.

A noise survey was conducted on site to make noise measurements and to investigate the surroundings. The noise criteria was established based on noise measurement results and the methodology of NSW Noise Policy for Industry. Noise emissions from the site were assessed at the nearest noise sensitive receivers and recommendations were given where exceedances occurred.

This assessment also discusses the potential noise impact from construction upon the nearest affected receivers, and noise intrusions into the building, and provides recommendations where exceedances occur.

Providing our recommendations are implemented, noise emissions due to operation of Building J are expected to comply with the noise requirements of NSW Noise Policy for Industry and relevant Australian standards and guidelines.

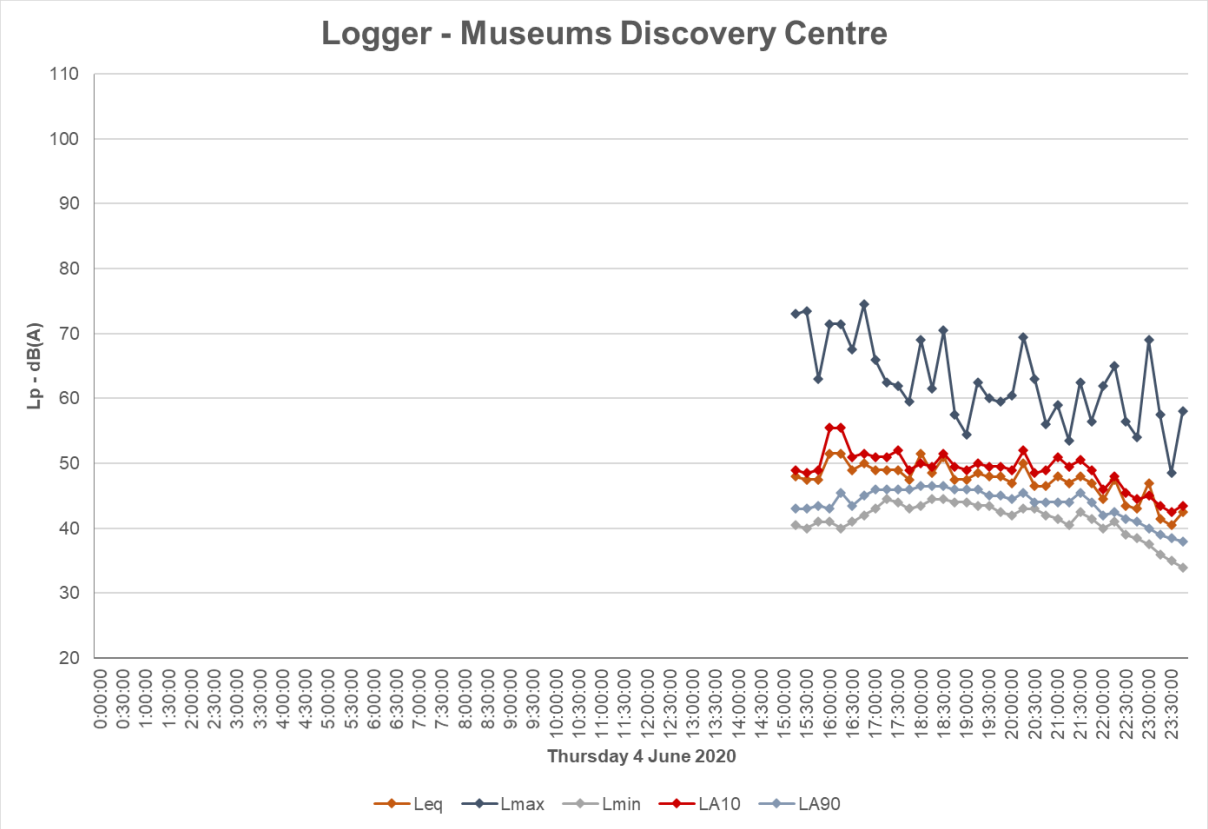
# Appendix A: Architectural drawings

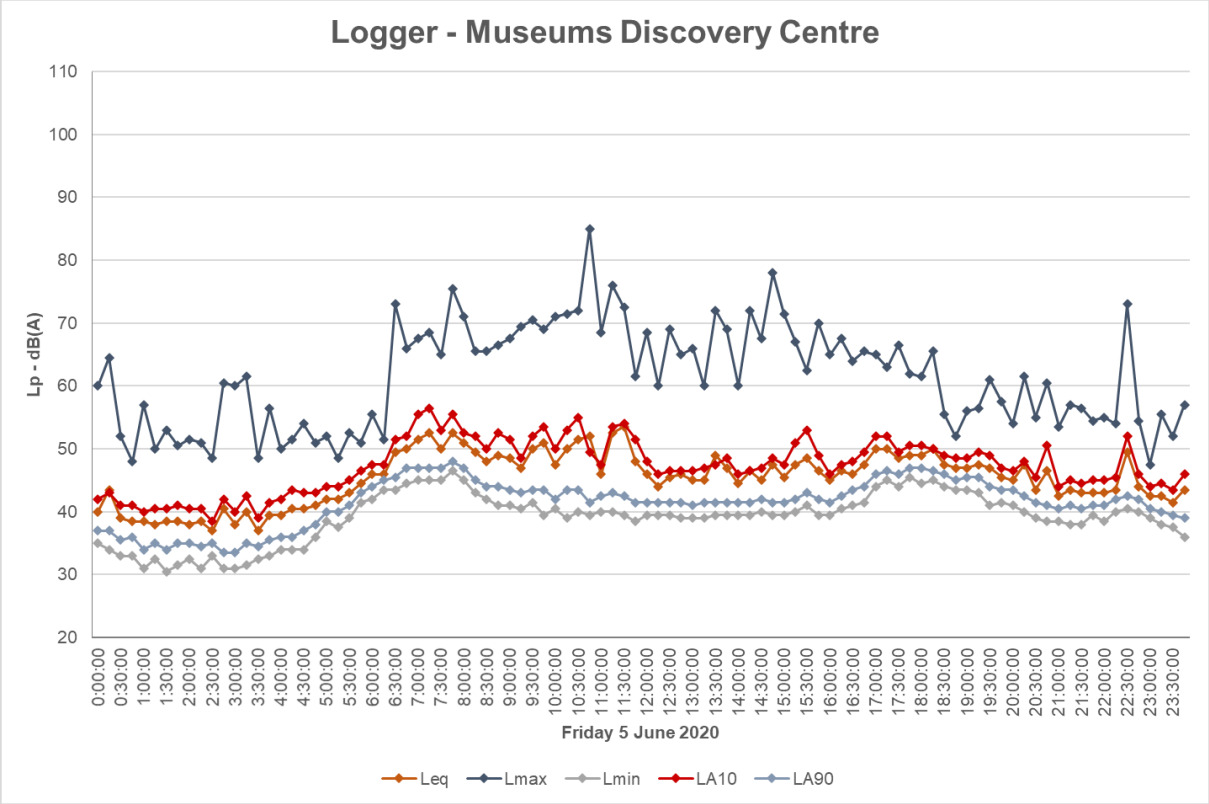
The following drawings provided by Lahznimmo Architects were used in the assessment:

| Drawing number | Revision | Drawing title |
|---|---|---|
| A-DA-1100 | 07 | Existing site plan |
| A-DA-1101 | 12 | Proposed site plan |
| A-DA-1400 | 12 | Lower ground floor plan |
| A-DA-1401 | 12 | Ground floor plan |
| A-DA-1402 | 14 | Level 1 floor plan |
| A-DA-1403 | 11 | Level 2 floor plan |
| A-DA-1404 | 05 | Roof plan |
| A-DA-2000 | 09 | Elevations |
| A-DA-2001 | 09 | Elevations |
| A-DA-3000 | 11 | Sections |
| 200501 (art work) | - | East elevation |
| 200501 (art work) | - | West elevation |
| 20051- Option 6- concept report | - | Concept report |
| 200501 (art work) | - | South elevation |

# Appendix B: Noise Data (Graphical)

The following presents the noise monitor data in the graphical form. Sections highlighted in blue have been removed from the assessment due to rainfall.

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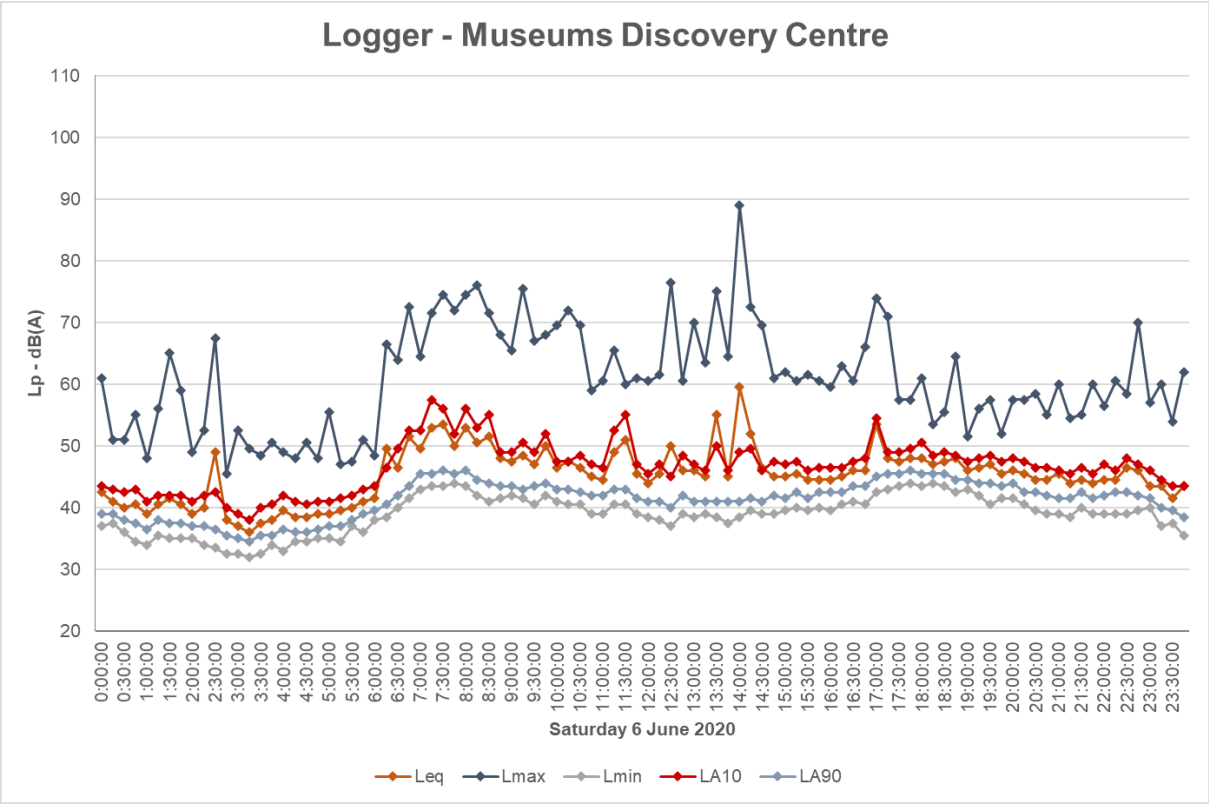
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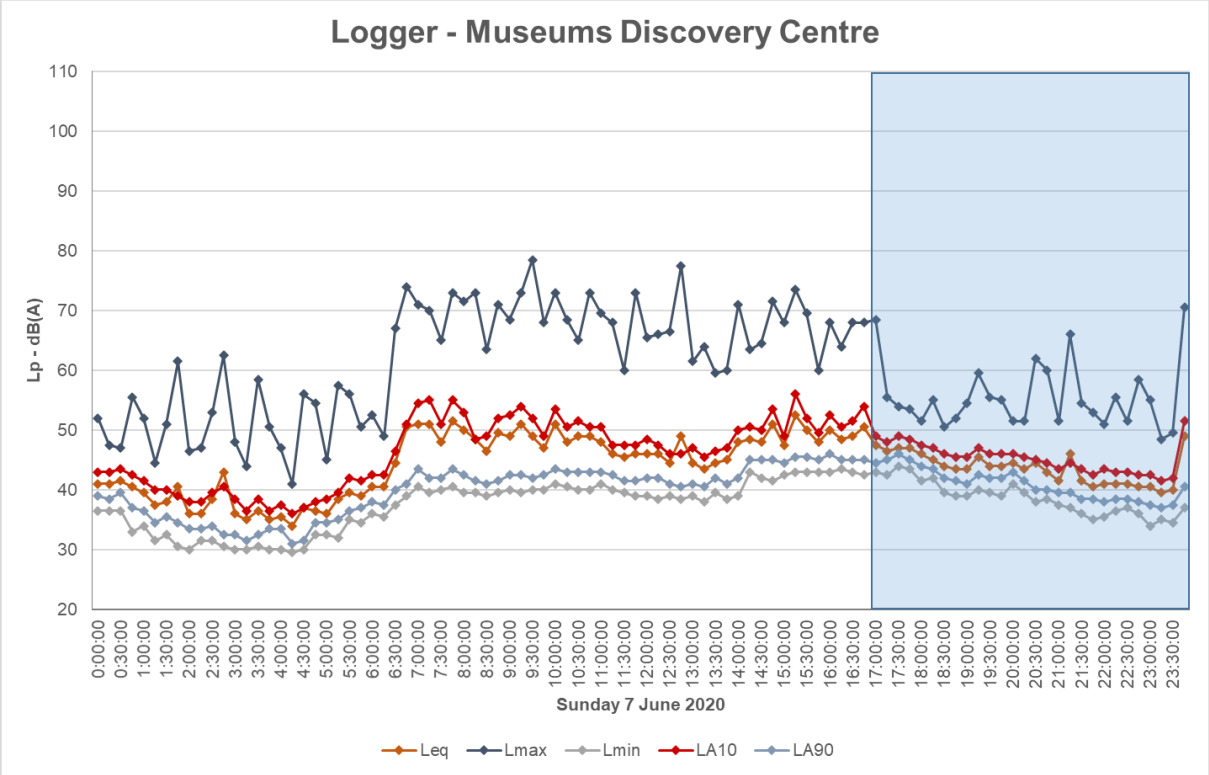
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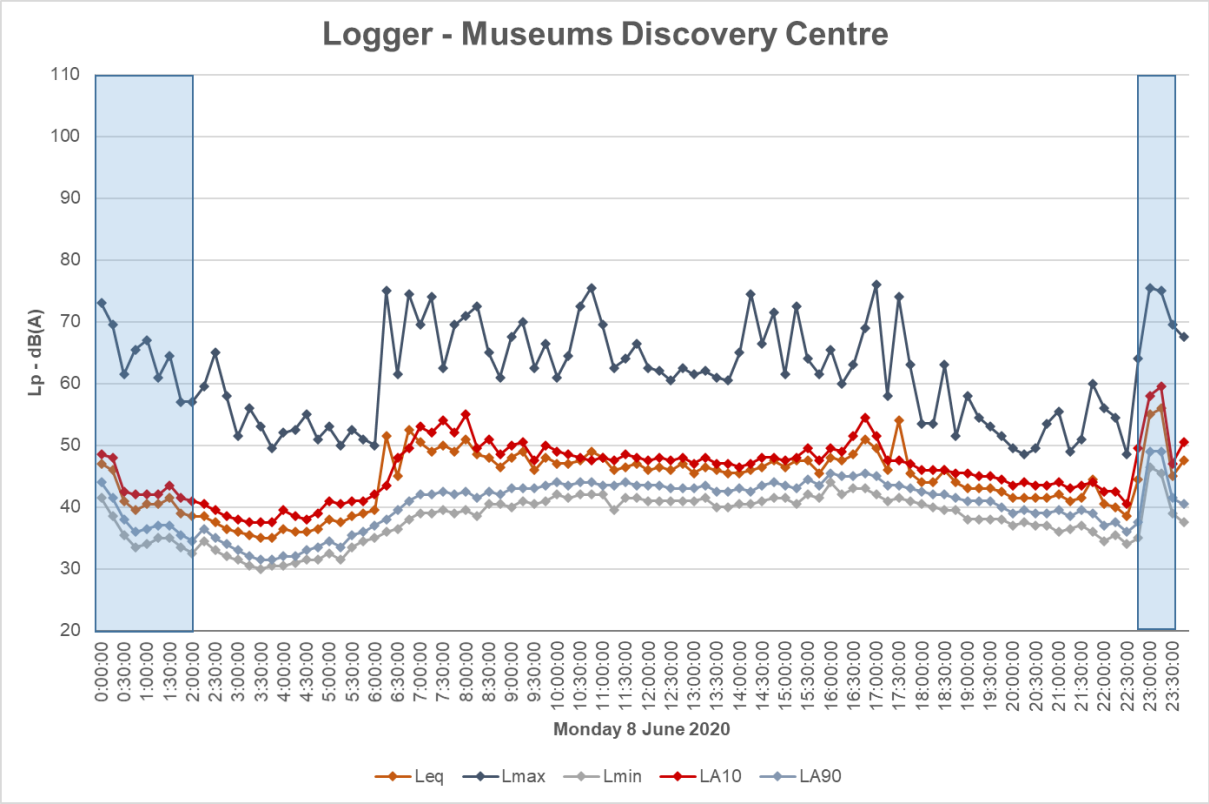
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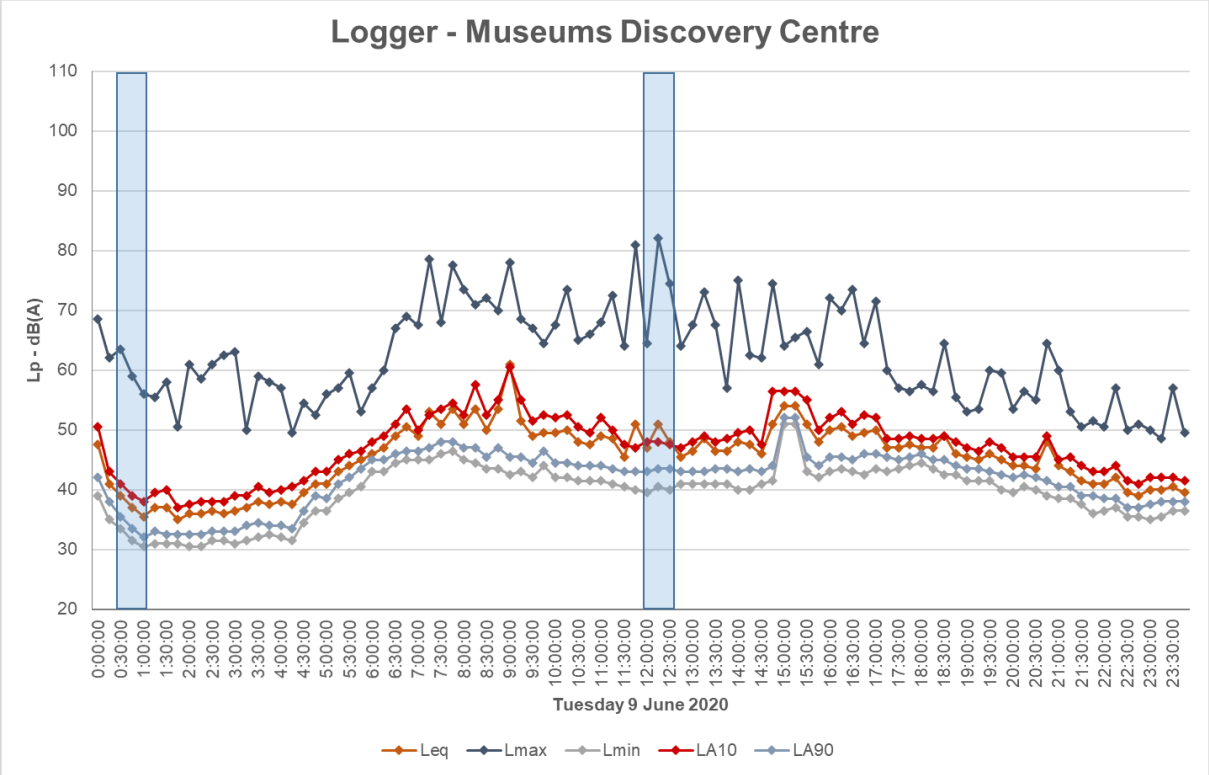
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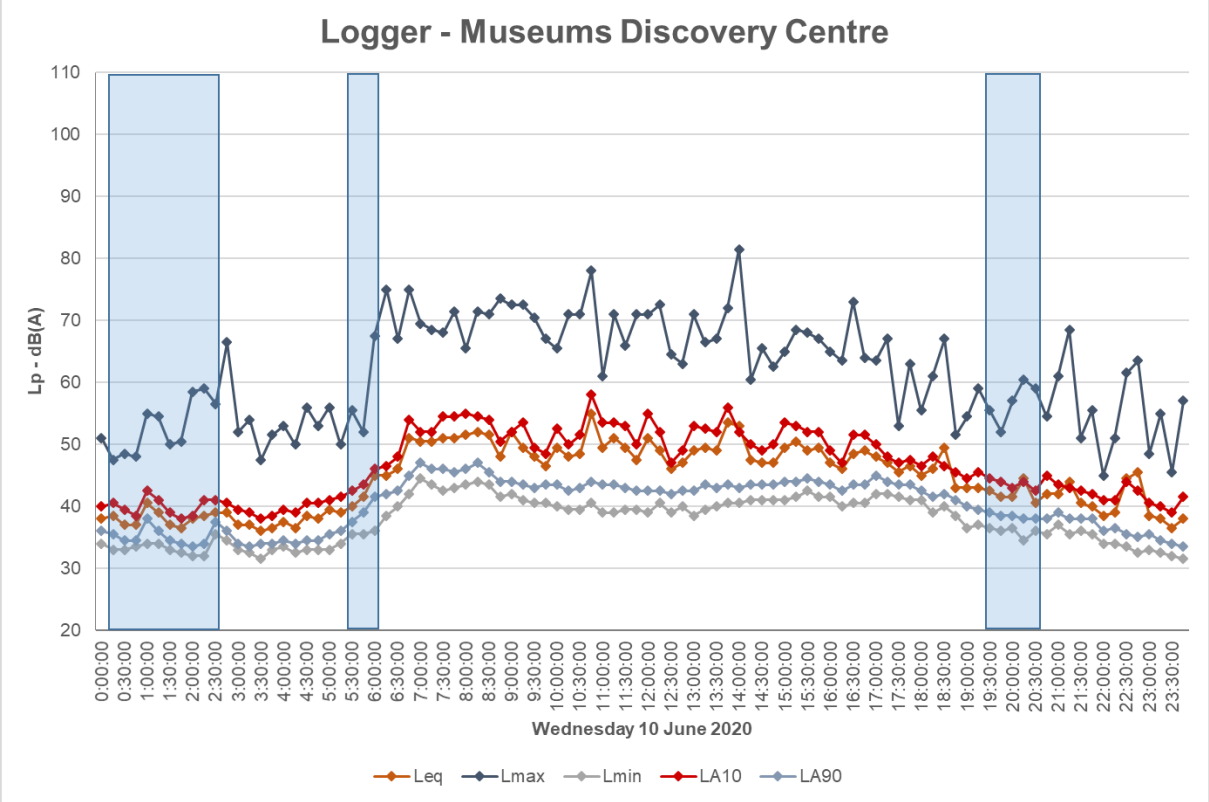
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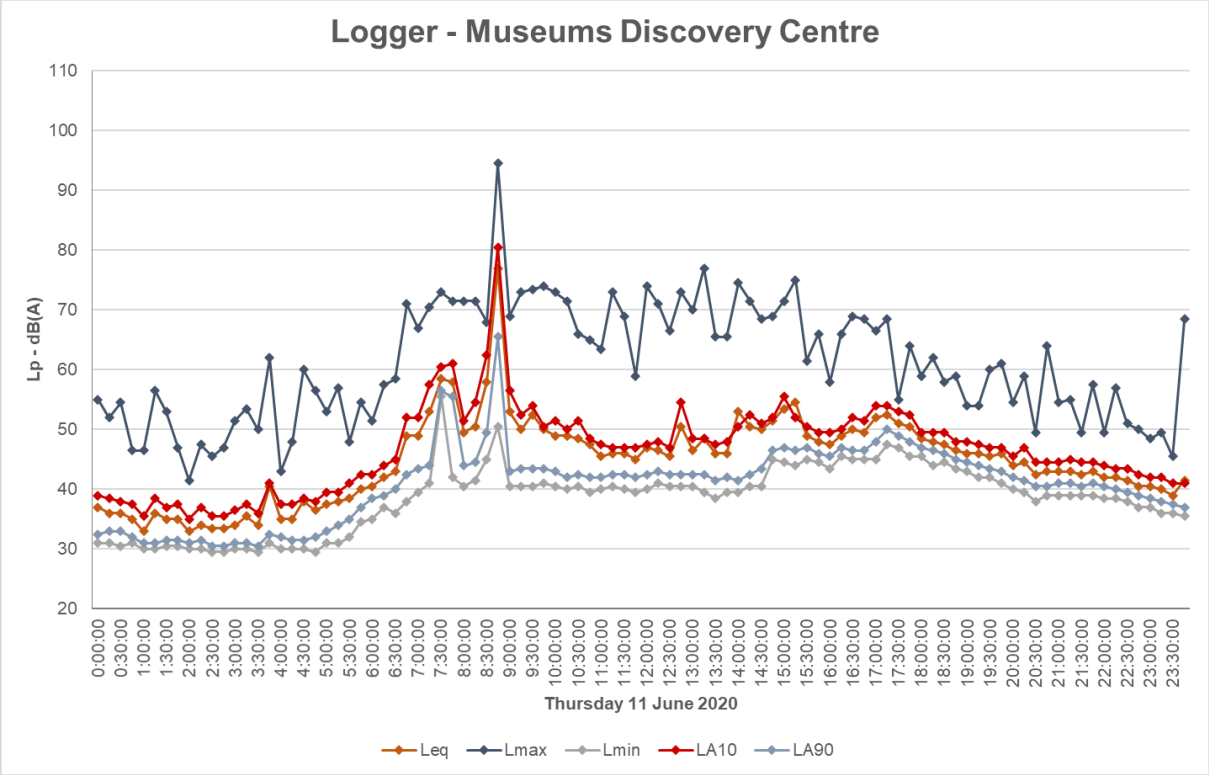
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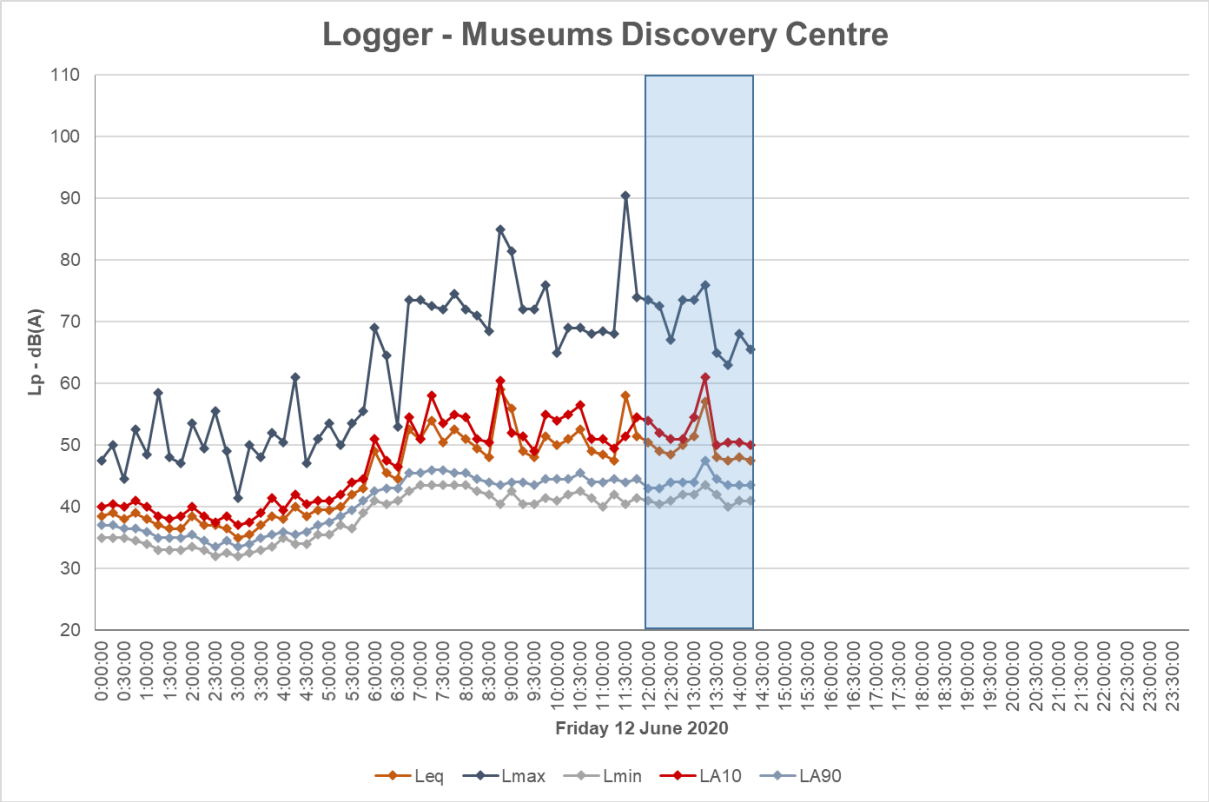
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# Appendix C: Glossary of Acoustic Terms

- dB relative to standard levels.
- A-weighted decibel – dBA – Unit of acoustic measurement weighted approximately to human hearing to sound.
- SPL – Sound Pressure Level – 20 times the logarithm to the base 10 of the ratio of r.m.s. sound pressure to the reference pressure of 20 micro Pascals, sound pressure level is measured using a microphone and a sound level meter and varies with distance from the source.
- SWL – Sound Power Level – 10 times the logarithm to base 10 of the ratio of the sound power of the source to the reference sound power of 1 Pico Watt. Sound power level cannot be directly measured using a microphone and a sound level meter, and it does not change with distance. The sound power of a machine will vary depending on the operation conditions or load.
- $R_w$ – Weighted Sound Reduction Index – Measured sound reduction of a building element in a laboratory, corrected for room volume and reverberation time, the higher values correspond to better sound insulation.
- $L_{Amax}$ – The Maximum Noise Level over a sample period is the maximum level, measured on fast response, during the sample period.
- $L_{A10}$ – The noise level which is exceeded for 10% of the sample period. During the sample period, the noise level is below the $L_{A10}$ level for 90% of the time. The $L_{A10}$ is a common noise descriptor for environmental noise and road traffic noise.
- $L_{Aeq}$ – The equivalent continuous sound level is the energy average of the varying noise over the sample period and is equivalent to the level of a constant noise which contains the same energy as the varying noise environment. This measure is also a common measure of environmental noise and road traffic noise.
- $L_{A90}$ – The noise level which is exceeded for 90% of the sample period. During the sample period, the noise level is below the LA90 level for 10% of the time. This measure is commonly referred to as the background noise level or RBL.
- $L_{Amin}$ – The Minimum Noise Level over a sample period is the minimum level, measured on fast response, during the sample period.