

Statement of Evidence

Reference: Macquarie Point Multi-Purpose Stadium Project Of
State Significance Integrated Assessment Process

Author: Dr Neil Mackenzie

Field of expertise: Acoustics, Noise, Vibration

Filed on behalf of: Macquarie Point Development Corporation

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1 QUALIFICATIONS AND EXPERIENCE

- 1.1 I am based in Adelaide, South Australia, and I have been working as a consulting engineer since 1993, initially with Marshall Day Acoustics in New Zealand (1993-1996), Vipac Engineers & Scientists in Adelaide (1996-2005) and Singapore (2005-2006), Aurecon (nee Connell Wagner) in Adelaide (2006-2018), Mott MacDonald in Adelaide (2018-2024) and now KBR (2024-Present). My curriculum vitae is provided at Section 16 “**Attachment A**”.
- 1.2 I hold a Bachelor of Engineering Degree (conferred in 1990) and a Doctorate in Mechanical Engineering (specialising in acoustics and vibration, conferred in 1997) from the University of Adelaide.
- 1.3 During my career, I have carried out numerous acoustics, noise and vibration projects across a diverse range of sectors (transport, utilities, buildings, industrial, resources, etc) and geographies (Australia, New Zealand, Asia, Europe, Middle East, and North America).
- 1.4 I am a member of Engineers Australia and a Chartered Professional Engineer. I was made a Fellow (FIEAust) and an Engineering Executive (EngExec) of Engineers Australia in 2018, and I am listed on the National Engineering Register (NER). I have been a member of the Australian Acoustical Society, and I am eligible for membership – I have not maintained membership as I consider membership of Engineers Australia is overarching.
- 1.5 I have a particular expertise in sports stadia, with projects of relevance being:
 - a) Canterbury Mixed Use Arena (CMUA or Te Kaha) which is currently under construction in Christchurch, New Zealand. This stadium is relevant as it is an enclosed arena with natural turf, hosts large scale concerts and regular football matches, is enclosed with an acoustically transparent roof (ETFE) and is near sensitive use. I led the Engineering Sciences (acoustics, vibration, wind engineering, etc) aspects of the design. <https://ccc.govt.nz/the-council/future-projects/major-facilities/canterbury-arena>. The stadium is in close proximity to residents, with statutory controls here: [Noise Controls - Christchurch City Council](#)
 - b) Forsyth Barr Stadium, located in Dunedin, New Zealand, and completed in time for the 2011 Rugby World Cup. This stadium is relevant as it was the first enclosed arena with natural turf, having an acoustically transparent roof (ETFE). I led the acoustic (and electro-acoustic) design of this stadium while employed by Aurecon. https://en.wikipedia.org/wiki/Forsyth_Barr_Stadium The stadium is in close proximity to residents, with statutory controls here: [Noise Controls - Dunedin City Council](#)
 - c) Adelaide Oval Redevelopment, Adelaide, South Australia, Australia. This project is of relevance due to its scale, transparency and proximity to surrounding sensitive use. I led the acoustics, vibration and wind engineering aspects of the design and construction. https://en.wikipedia.org/wiki/Adelaide_Oval The stadium is in close proximity to residents, with statutory controls here: [Adelaide City Council Event Noise Controls](#)

- d) Gabba (Brisbane Cricket Ground) Redevelopment for the Brisbane Olympics, 2032. This project is of relevance due to its scale, transparency and proximity to surrounding sensitive use. I prepared the Project Validation Report, leading the Engineering Sciences (noise, vibration, wind, etc) aspects of the design.

https://en.wikipedia.org/wiki/The_Gabba

1.6 Other stadia I have worked on include:

- a) Stadium Australia Redevelopment (currently known as Accor Stadium, previously known as Telstra or ANZ stadium), Sydney Olympic Park, New South Wales, Australia - https://en.wikipedia.org/wiki/Stadium_Australia
- b) Abu Dhabi Velodrome, United Arab Emirates – UCI Category 1, 3,500 seat indoor velodrome on Al Hudayriyat Island.
- c) Combank Stadium (formerly BankWest or Western Sydney Stadium), Parramatta, New South Wales, Australia - https://en.wikipedia.org/wiki/Western_Sydney_Stadium
- d) GMHBA Stadium (formerly known as Simonds Stadium or Kardinia Park), Geelong, Victoria, Australia - [https://en.wikipedia.org/wiki/Kardinia_Park_\(stadium\)](https://en.wikipedia.org/wiki/Kardinia_Park_(stadium))
- e) Eden Park Redevelopment, Auckland, New Zealand. The stadium now boasts a 50,000 permanent seating capacity, which was temporarily increased to 60,000 for the 2011 rugby events. The upgrade included constructing a three-tier 22 000-seat South Stand, a 12 000-seat, two-tier East Stand, and a Western Concourse. I led the wind engineering study, which included pollution dispersion and natural ventilation.
https://en.wikipedia.org/wiki/Eden_Park Eden Park is located in close proximity to residents, with noise controls summarized here: [Auckland City Council - Eden Park](#)
- f) ASB Tennis Arena, Auckland, New Zealand. Upgrade to weather-proof the ASB Tennis Arena including the replacement of the Yock (western) Stand and a retractable roof over Centre Court. Total budget of around NZD \$20m. I led the wind and thermal engineering design, including wind tunnel testing. The stadium is in close proximity to residents, with noise controls here: [Auckland City Council - ASB Arena](#)

1.7 I have previous experience with the subject site and the proposed development:

- a) I led the Engineering Sciences (noise, vibration, wind, sustainability, etc) work while at Mott MacDonald, to support Populous architects' submission for the lead primary consultant (architect) tender. Populous were unsuccessful, with Cox architects awarded the tender.
- b) I was previously an expert witness for TasWater in their appeal against Macquarie Point Development Corporation for early development of the Macquarie Point site prior to decommissioning of TasWater's waste-water treatment plant (WWTP). My area of expertise in that matter related to noise and odour issues.

- 1.8 I am aware that as an expert witness:
- a) I have a paramount duty to the Tasmanian Planning Commission (**TPC**) and not to any party in the proceeding;
 - b) I have an overriding duty to assist the TPC impartially on matters relevant to my area of expertise; and
 - c) I am not an advocate.
- 1.9 I have been supported in the preparation of this statement by Abeer Ahmed, project engineer at KBR, who carried out modelling and monitoring work with me. This statement was reviewed by Moharis Kamis, principal engineer at KBR. Both are members of the Australian Acoustical Society.
- 1.10 I have made all the inquiries that I believe are desirable and appropriate and no matters of significance which I regard as relevant have to my knowledge been withheld from the TPC.

2 SCOPE OF WORK

2.1 I have been engaged as an expert witness by MinterEllison on behalf of Macquarie Point Development Corporation (**MPDC**) regarding the Macquarie Point Multipurpose Stadium Project of State Significance (**POSS**) development (the **Project**). The proponent of the Project is the Crown in Right of Tasmania, represented by MPDC (the **Proponent**). The Proponent engaged a design team led by Cox Architecture and Cumulus Studio, with various sub-consultants including acoustic engineers, AECOM.

2.2 The scope of work briefed by MinterEllison follows:

- a) *Review the background materials, including the Guidelines, Macquarie Point Multipurpose Stadium Summary Report and Appendices filed as part of MPDC's submission to the **TPC** (Tasmanian Planning Commission);*
- b) *Review other relevant documents, including the Sullivans Cove Planning Scheme (1997);*
- c) *Consider the **Draft IAR** (Integrated Assessment Report) and any representations relevant to your area of expertise and respond to any relevant issues raised;*
- d) *Consider the noise and vibration impacts of the Project and form an opinion as to whether it is worthy of approval having regard to the Act, the Guidelines and other relevant matters, including the applicable planning controls, policy framework and site context;*
- e) *Identify all facts, matters and assumptions upon which your expert witness report proceeds;*
- f) *Identify any documents or other materials you have been instructed to consider or take into account in preparation of your evidence report, and the literature or other material used in preparing your expert witness report;*
- g) *Provide a summary of your opinion or opinions;*
- h) *Include a statement identifying:*
 - *any opinions which are provisional and why they are provisional (i.e. why such opinions have not been or cannot be fully researched); and*
 - *any matters falling outside your expertise;*

3 PROJECT UNDERSTANDING

3.1 I have reviewed Volume 1, “Summary Report” [Ref. 14.3] and Appendix B, “Stadium Design Description” [Ref. 14.4], of the Project brief.

3.2 I understand the key elements of the Project are to comprise:

- a) an all-weather, roofed multipurpose stadium with a seating capacity of 23,000 and standing room for 1,500 patrons for major sports events and a 31,500 patron capacity for major concert events;
- b) an accessible external concourse and arrival plazas;
- c) relocation and integration of the heritage Railway Goods Shed building within the stadium complex;
- d) outdoor cricket wickets; and
- e) a basement car park comprising approximately 536 car spaces.

3.3 I further understand regarding number of events that:

- a) Sports or games:
 - Australian Football (AFL) – up 15 games per year
 - Cricket – up 11 games per year
 - Rugby – 1 game every 3 to 4 years
 - Soccer – up to 16 games per year
- b) Concerts: 1 major concert per year
- c) Other events: weekly functions, community events, smaller events

3.4 The Proponent engaged AECOM as the acoustic engineer. I have reviewed the AECOM’s “Macquarie Point Multipurpose Stadium – Project of State Significance, Noise and Vibration Assessment”, August 2024 (**POSS Noise and Vibration Assessment Report**) [Ref. 14.5] and their subsequent “Macquarie Point Multipurpose Stadium – Noise Assessment Supplementary Report”, January 2025 (**POSS Noise Assessment Supplementary Report**) [Ref. 14.6].

4 SUMMARY AND CONCLUSION

- 4.1 I have reviewed the Macquarie Point Multipurpose Stadium Project of State Significance (**POSS**) Guidelines dated 16 February 2024 (**TPC Guidelines**) [Ref. 14.1], to which the Proponent has responded with the submission of reports authored by AECOM (the acoustic engineer) addressing noise and vibration impacts from the proposed development.
- 4.2 I have reviewed the POSS Noise and Vibration Assessment Report [Ref. 14.5] and the POSS Noise Assessment Supplementary Report [Ref. 14.6] submitted by the Proponent (on behalf of AECOM, the acoustic engineer).
- a) I consider that AECOM did not consider the broader legislative context required by the TPC Guidelines (ie., Relevant aspects of the Sullivans Cove Planning Scheme (**SCPS**) 1997 [Ref. 14.13], the Hobart Interim Planning Scheme (**HIPS**) 2015 [Ref. 14.12]), nor provide definitive noise and vibration criteria for review by the TPC Panel. I have considered these, and other legislation and guidelines in my response.
 - b) I have reservations regarding the short-term nature of noise surveys carried out by AECOM and I have therefore carried out my own independent noise surveys and defined appropriate assessment criteria.
 - c) I have reservations regarding AECOM's noise modelling methodology, and I have therefore carried out my own modelling of noise emissions from the stadium.
 - d) Based on my noise modelling of noise impacts from operations, with controls and design amendments as set out herein, the assessment criteria I have proposed can be reasonably met.
 - e) I have undertaken independent modelling of potential noise and vibration impacts from construction activities and note that the impacts at sensitive receivers can be practicably mitigated to meet assessment criteria appropriate for similar scale projects in Australia.
- 4.3 I have reviewed the Draft Integrated Assessment Report (**Draft IAR**) prepared by the Tasmanian Planning Commission's (**TPC**) Panel, in response to POSS submissions regarding noise and vibration from the proposed stadium.
- a) I consider the TPC Panel was disadvantaged in its ability to review compliance with relevant legislation as AECOM did not provide definitive noise and vibration criteria nor consider broader legislative context.
 - b) I disagree with the TPC Panel that "reserve capacity" should be allowed for future development of transport routes as these are assessed separately to noise from industry and commercial activities.
 - c) I consider statutory controls can be introduced to ensure that environmental values are protected from the proposed stadium development, as is common for similar developments in Australia (and globally).
 - d) I consider that the proposed stadium design can be amended to ensure

compliance with reasonable noise and vibration criteria for both Game Day events and concerts.

- e) I agree with the TPC Panel that noise from concerts will be audible relative to existing ambient noise levels, however I consider that environmental values can be protected with a detailed Event Management Plan and Operational Noise Management Plan, as is common for other stadia in Australia (and globally).
- f) I agree with the TPC Panel that a detailed Construction Noise and Vibration Management Plan needs to be developed by the proponent at the time a Construction Contractor is engaged, and a detailed construction schedule is developed. In my opinion, noise and vibration from construction activities can be mitigated and managed to protect environmental values.

4.4 In my opinion, the proposed stadium is worthy of approval with appropriate statutory controls as set out in section 10, summarised below:

- a) Scheduled noise criteria both internal and external to the stadium.
- b) Limits on hours of operation and frequency for Major Concert events and Game Day events.
- c) Limits on hours of construction.
- d) Requirements for an Events Management Plan, Operational Noise Management Plan and Construction Noise and Vibration Management Plan.
- e) Permanent noise monitoring for events, available for independent review.
- f) Independent review of the design at various stages of development and prior to construction.

4.5 I have reviewed the Draft Macquarie Point Planning Permit, “Draft Project Permit” [Ref. 14.29], and note the proposed conditions require modifications to reflect the noise and vibration control measures that I have proposed.

4.6 I have reviewed representations to the Draft IAR and note issues raised in these representations have been considered herein.

5 TASMANIAN PLANNING COMMISSION GUIDELINES AND RESPONSE

- 5.1 A Ministerial Direction from the Premier dated 16 October 2023 directed the Tasmanian Planning Commission (TPC) to undertake an integrated assessment of the Project, in accordance with the *State Policies and Projects Act 1993* and Resource Management and Planning System (RMPS) legislation.
- 5.2 The TPC issued the Macquarie Point Multipurpose Stadium Project of State Significance Guidelines dated 16 February 2024 (TPC Guidelines) [Ref. 14.1]. The TPC Guidelines set out the material the Proponent must submit to the TPC and the TPC's assessment of the Project.
- 5.3 Regarding Noise and Vibration, the TPC Guidelines note that: *"The reports are to describe the existing noise and vibration conditions of the project site and vicinity. The reports are to describe all sources of noise and vibration that can be reasonably identified from the use of the proposed project, considering all types of expected and possible events. The reports are to analyse the potential effects of impacts from noise and vibration, considering, but not limited by, the following:*
- *the maximum potential impact (maximum capacity and maximum sound amplification) for each proposed or possible type of event;*
 - *noise and vibration generated by the operation of the proposed development outside of event times, including mechanical plant, loading and waste collection;*
 - *noise and vibration generated by crowds arriving at and departing from the venue;*
 - *noise and vibration generated by any entertainment provided outside the venue;*
 - *noise levels estimated at the boundary of land owned or controlled by the Proponent and at the curtilage of noise-sensitive uses in the locality;*
 - *how and where noise and vibrations are likely to travel, based on contour predictions;*
 - *the nature of the noise and its potential to cause nuisance (tonal components, impulsive or intermittent noise, etc.);*
 - *time of day (day, evening and night) and day of the week;*
 - *meteorological conditions, including normal and 'worst case' conditions and the expected frequency of 'worst case' conditions;*
 - *the nature of noise-sensitive uses that may be affected by noise and vibration;*
 - *the proximity of current, proposed or potential noise-sensitive uses;*
 - *impacts and effects on fauna;*
 - *cumulative impacts, taking into account surrounding sources of noise and vibration; and*
 - *comparison between the predicted emission levels with existing noise and vibration levels."*
- 5.4 The TPC Guidelines note that: *"The reports are to review and detail appropriate noise and vibration assessment methodology, standards and acceptable limits. Where relevant, the choice of a particular methodology over alternative methodologies is to be explained. Assessment of impacts and effects is to include information on the significance and duration of the impact. Assumptions and judgements are to be stated clearly and the nature and magnitude of uncertainties*

are to be clearly defined.”

- 5.5 TPC Guidelines note that: *“The reports are to provide an outline of relevant objectives, principles and process from the RMPS Acts related to the assessment of applications for permits for use and development under the:*
- *Land Use Planning and Approvals Act 1993;*
 - *Environmental Management and Pollution Control Act 1994 (EMPC Act); and*
 - *Historic Cultural Heritage Act 1995 (HCH Act).”*
- 5.6 TPC Guidelines note that: *“The reports are to provide an outline of relevant objectives of and outcomes to be achieved under these Acts, with reference to the:*
- *parts B and C of the Sullivans Cove Planning Scheme (SCPS) 1997, the Hobart Interim Planning Scheme (HIPS) 2015 and the draft Hobart Local Provisions Schedule;*
 - *Objectives and Principles of the Sullivans Cove Planning Review 1991;*
 - *codes and guidelines related to planning schemes, including relevant Australian Standards and any referenced, applied, adopted or incorporated documents in the Sullivans Cove Planning Scheme 1997, Hobart Interim Planning Scheme 2015 and draft Hobart Local Provisions Schedule;*
 - *principles, codes or guidelines related to assessments under the EMPC Act; and*
 - *registers and inventories of places of cultural significance under the HCH Act.”*
- 5.7 TPC Guidelines note that: *“The reports are to provide an overview summary of these objectives and outcomes and cross referenced to where these matters relate to these Acts and associated documents have been addressed or referred to in the reports.”*
- 5.8 In response, the Proponent issued detailed response documents as noted at 3.1 and 3.4 herein.
- 5.9 On the 19 Nov 2024, the TPC requested further information regarding noise [ref. 14.2]:
- *“Further analysis and evidence would assist to understand the effects of proposed uses on existing uses in the vicinity of the project site and proposed management and programming regimes relating to the proposed uses and their effects on surrounding uses (including effects relating to traffic, parking, noise and pedestrian movement) (section 7.0 of the Guidelines).”*
 - *“Reports relating to noise should consider noise levels at all levels of multistorey buildings and include an analysis of whether receivers on the Eastern Shore should be considered in the assessment (section 8.4 of the Guidelines).”*
- 5.10 In response, the Proponent issued supplementary reports as noted at 3.4 herein.

6 REVIEW OF THE DRAFT INTEGRATED ASSESSMENT REPORT (IAR)

- 6.1 I refer to the “Draft Integrated Assessment Report – Macquarie Point Multipurpose Stadium – Project of State Significance” (**Draft IAR**) prepared by the TPC Panel, issued 31 March 2025 [**Ref. 14.7**].

Legislative Context

- 6.2 Regarding 8.5(c), the TPC Panel notes AECOM’S reference to the Environment Protection Policy (Noise) 2009 (**EPP Noise**) [**Ref. 14.9**] as “*setting the overarching principles and objectives for noise control in Tasmania*”, further referring to an excerpt in the EPP Noise which states that environmental values are “*protected for the majority of the human population where the acoustic environment indicator levels are not exceeded, and there are no individual sources of noise with dominant or intrusive characteristics*”.
- 6.3 There are several important factors not considered by both AECOM and the TPC Panel when referring to the EPP Noise:
- a) As noted in the EPP Noise, “*The acoustic environment indicator levels specified in Table 1 are values presented in Table 1 of the World Health Organisation publication Guidelines for Community Noise (Berglund B, Lindvall T and Schwela D H, 1999). They are indicative, not mandatory noise levels.*”
 - b) Table 1 in the EPP Noise is copied from the World Health Organisation’s “Guidelines for Community Noise” (Berglund B, Lindvall T and Schwela D H, 1999) [**Ref. 14.10**] with the averaging time for the noise levels being 16 hours for daytime (nominally 7am to 11pm though not prescribed) and 8 hours for night-time (nominally 11pm to 7am though this is not prescribed).
 - c) The EPP Noise makes reference to Tasmania’s “Noise Measurement Procedures Manual” (**NMPM**) [**Ref. 14.11**] also referred to by AECOM: “*Any measurement of noise carried out for the purposes of this policy must be made in accordance with the relevant requirements of the Noise Measurement Procedures Manual, issued by the Director of Environmental Management in July 2004 and amended in July 2005, as amended from time to time.*” The NMPM notes regarding “Industrial and Commercial Activities” that “*In general, the measurement interval must be equal to or greater than 10 minutes. Intervals can be subdivided for measurement convenience with the composite result being derived by the appropriate calculations. Measurement intervals greater than 1 hour should always be subdivided into intervals of duration less than 1 hour.*”
 - d) The EPP Noise further states regarding “Noise impact studies” that, “*where a noise impact study is carried out, it should consider:*”
 - *noise levels at appropriate locations compared with noise limits applicable to the activity in any legislation, approval or proposed approval;*
 - *compliance with any other relevant requirements of legislation, approval or proposed approval;*
 - *the potential for reducing the impact of the activity’s noise emissions or*

- *proposed emissions on the acoustic environment; and*
 - *the cumulative effect of the noise emissions or proposed emissions from the activity.”*
- e) The EPP Noise provides acoustic indicator levels as a reference for *“considering the condition of the acoustic environment and the effectiveness of noise control measures and strategies”* and does not take in account the influence of existing elevated ambient noise in the environment (e.g. from traffic noise) to determine whether a particular noise source is potentially causing environmental harm.
- 6.4 Given the shortcomings of the EPP Noise and the “indicative” nature of the noise levels in the EPP Noise, in my opinion the EPP Noise is a useful reference that provides overarching principles and objectives and should be used with consideration of other relevant policy framework (such as planning schemes) and approaches adopted for other similar stadium development.
- 6.5 The TPC Guidelines refer to the need to consider the Hobart Interim Planning Scheme, 2015 (**HIPS**) [Ref. 14.12] and the Sullivans Cove Planning Scheme, 1997 (**SCPS**) [Ref. 14.13].
- a) The HIPS provides the “Acceptable Solutions” or “Performance Criteria” objectives for non-residential uses within quiet localities:
- *“Acceptable Solutions” typically have prescribed noise limits of “55dBA (LAeq) between the hours of 8:00am to 6:00pm”; “5dBA above the background (LA90) level or 40dBA (LAeq), whichever is lower, between the hours of 6:00pm to 8:00am”; and “65dBA (LAmax) at any time”. Measurements to be made in accordance with the NMPM, with adjustments for tonality and impulsiveness, using a 15-minute time interval.*
 - *“Performance Criteria” states that “noise emissions measured at the boundary of the site must not cause environmental harm”, as defined in the EMPC Act.*
- b) The SCPS provides qualitative requirements regarding noise:
- *“Buildings shall be sited and designed having regard to current noise levels in the area as well as their intended use.*
 - *Where activities with the potential to generate significant noise are proposed in proximity to residential accommodation and other ‘noise sensitive’ activities, appropriate measures to mitigate and minimise noise emissions must be undertaken.*
 - *New ‘noise sensitive’ activities such as residential accommodation shall be located and where necessary incorporate acoustic measures to minimise the potentially adverse impacts of existing or likely future activities on nearby land.”*
- c) The SCPS however provides “Deemed to Comply (Permitted)” or

“Performance Criteria (Discretionary)” objectives for the “Macquarie Point Site Development” (section 32.0 of the SCPS) notes at 32.6 “Use Standards” in particular at 32.6.2 “Residential and Visitor Accommodation Uses”:

- *“Deemed to Comply (Permitted): Residential or Visitor Accommodation development must demonstrate that design elements are able to achieve internal noise levels in accordance with relevant Australian Standards for acoustics control (including AS3671:1989 – Road Traffic Noise Intrusion (Building Siting and Construction) and AS2107:2000 – Acoustics (Recommended Design Sound Levels and Reverberation Times for Building Interiors)).”*
 - *“Performance Criteria (Discretionary): Residential or Visitor Accommodation development is adequately protected from environmental harm from noise from transport movements, the operational port and likely noise from major public events at Macquarie Point.”*
- d) The SCPS also provides “Deemed to Comply (Permitted)” or “Performance Criteria (Discretionary)” objectives for the “Macquarie Point Site Development” (section 32.0 of the SCPS) notes at 32.7 “Development Standards for Buildings or Works”:
- *“Deemed to Comply (Permitted):*
 - *(a) Within 50 metres of the boundary adjoining the Port of Hobart must include design elements that are able to achieve internal noise levels in accordance with the relevant Australian Standards for acoustics control (including AS3671:1989 –Road Traffic Noise Intrusion (Building Siting and Construction), and AS2107:2000 – Acoustics (Recommended Design Sound Levels and Reverberation Times for Building Interiors);*
 - *(b) Within 20 metres of the boundary adjoining the Port of Hobart must not have private outdoor areas, decks or balconies; and*
 - *(c) Within 10 metres of the boundary adjoining the Port of Hobart must only have fixed windows (non-opening). “*
 - *“Performance Criteria (Discretionary): Buildings are adequately protected from noise arising from port activities including the movement of heavy vehicles to safeguard occupants’ health and amenity”*

6.6 The EMPC Act [Ref. 14.14] defines environmental harm¹. In my opinion, noise and vibration emissions can be considered to cause environmental harm when:

- a) Noise: Frequent or continuous noise emissions exceed both the existing background noise level by 5dBA, and the indicator levels provided in the EPP Noise.

¹ “any adverse effect on the environment (of whatever degree or duration) and includes an environmental nuisance.”

- b) Vibration: Vibration levels exceed those provided in the relevant references used in Australia by regulatory authorities to protect human comfort and integrity of buildings, heritage structures and utility, as follows:
- Human Comfort: As noted by AECOM, the vibration limits provided in the British Standard BS 6472:2008 “Guide to evaluation of human exposure to vibration in buildings Part 1: Vibration sources other than blasting” (**BS 6472:2008**) [Ref. 14.16]. The vibration limits are provided as “Vibration Dose Values (VDV)” and used to assess continuous, intermittent and impulsive vibration. BS 6472:2008 is the more contemporary and simplified approach to assessing vibration impacts than the superseded BS 6472:1992 that is referenced in the NSW EPA “Assessing Vibration: A Technical Guide” (**AVATG**) ²[Ref. 14.15].
 - Buildings, Heritage Structures and Utilities: As noted by AECOM, the vibration level provided in German Standard DIN 4150-3:2016 “Vibration in buildings - part 3: effects on structures” (**DIN 4150-3:2016**)³ [Ref. 14.18] as peak particle velocity limits.
 - Vibration induced structure-borne noise within buildings that exceeds amenity criteria within buildings (as defined by Australian Standard AS 2107:2016 “Acoustics - Recommended design sound levels and reverberation times for building interiors”)(**AS 2107:2016**)⁴ [Ref. 14.30]).

6.7 In my opinion, AECOM has adopted rigid use of the EPP Noise, without reflecting on the broader planning documents. They have not carried out sufficient long-term noise surveys to be able to justify appropriate assessment criteria for relevant sensitive users, nor have they attempted to put forward appropriate assessment criteria, specific to the unique nature of the Project in the context of the existing environment. I have resolved this by carrying out independent noise and vibration surveys to define appropriate assessment criteria.

6.8 Similarly, the TPC Panel have followed AECOM’s adoption of rigid use of the EPP Noise without reflecting on the broader planning documents noted in the TPC Guidelines. The TPC Panel has been disadvantaged by not having proposed assessment criteria from AECOM, however I have carried out subsequent noise and vibration surveys to define appropriate assessment criteria, the basis of which can be adopted as conditions of approval by the TPC.

Transport Noise

6.9 I agree with the TPC Panel that existing transport routes dominate the ambient noise levels in the vicinity of the development, along with other sources of noise from the Port of Hobart (shipping activities), the existing waste-water treatment

² While the AVATG was released by the NSW EPA, it has been adopted in other jurisdictions across Australia as an appropriate guide in assessing vibration impacts. The AVATG was released in 2006 and references the BS 6472:1992 for suitable levels to control vibration impacts on human comfort. The BS 6472:1992 has since been superseded by BS 6472:2008 which is more contemporary, and therefore I consider suitable for the project.

³ DIN 4150-3:2016 is widely used across Australia as an appropriate standard to limit vibration impacts with respect to project structural integrity of buildings, heritage structures and underground infrastructure.

⁴ AS 2107:2016 is an Australian Standard that provides recommendations for internal noise levels for different types to buildings, to protect the amenity of occupants. The previous version of the standard is also referenced in the SCPS as appropriate to control internal noise of buildings.

plant, and community services (Royal Hobart Hospital, in particular helicopter activities and emergency vehicles).

- 6.10 The Tasmanian Government's "State Road Traffic Noise Management Guidelines", 2015 [Ref. 14.19] control noise from State Roads, with noise from State Roads (Tasman Highway, Davey St, Macquarie St, Brooker Avenue as shown on Figure 15-3) affecting the surrounding area of the development. Traffic noise criteria are based on the $L_{A10,18hr}$ noise descriptor over an 18-hour period, with noise levels below $L_{A10,18hr}$ 63dBA deemed acceptable and $L_{A10,18hr}$ 68dBA being a practical upper limit.
- 6.11 The EPP Noise is used to control noise from industrial and commercial sources, not traffic from State Roads, with noise levels assessed using an $L_{Aeq,16hr}$ limit (during a 16-hour day period). As noted above, traffic noise levels are assessed as an $L_{A10,18hr}$ level which the "State Road Traffic Noise Management Guidelines" notes are 2dBA greater than the $L_{Aeq,16hr}$ level. This equates to a noise limit away from the facade of a building (allowing for a 3dBA facade correction) of $L_{Aeq,16hr}$ 58dBA which is greater than the 55dBA noise indicator level provided by the EPP Noise.

Reserve Capacity

- 6.12 At 8.5(g), TPC Panel notes that *"The reports provided by the Proponent do not address the principle of retaining a reserve capacity in the acoustic environment as outlined by the EPP. The Panel considers that retaining a reserve capacity in this locality is important to provide for future growth and unrestricted operation of both the Port of Hobart and the strategic road network and the Royal Hobart Hospital."*
- 6.13 Regarding "reserve capacity", the EPP Noise states:
- "regulatory authorities may determine not to require a reserve capacity if –*
- (a) (i) best practice environmental management is employed in the activity; and*
- (ii) it is highly unlikely that there will be significant additional sources of noise in the vicinity; or*
- (b) this would prevent a proposal that is clearly in the public interest from proceeding."*
- 6.14 In my opinion, a "reserve capacity" is not warranted as:
- a) Traffic noise around the development is dominated by noise from State Roads, with the traffic noise limit up to 3dBA greater than the EPP Noise indicator level.
 - b) It is highly unlikely that there will be significant additional sources of noise in the vicinity. The stadium is a dominant noise source in the locality.
 - c) The stadium will not operate concurrently with peak traffic demands allowing for uninhibited growth of the traffic network.
 - d) Existing operations from the Port of Hobart and Royal Hobart Hospital already exceed the EPP Noise indicator levels. As per the SCPS, sensitive use near the Port of Hobart must have increased sound insulation provisions as has been incorporated into sensitive developments in the mixed use and operating wharf zones of the SCPS.

- e) Existing operations from the Royal Hobart Hospital (i.e., helicopters and emergency vehicles) already exceed the EPP Noise indicator levels and will significantly exceed maximum (L_{AFmax}) noise levels from the stadium (with greater occurrence).
- 6.15 The EPP Noise further states that where an activity may provide insufficient reserve capacity, the responsible regulatory authority should ensure that *“appropriate statutory tools are prepared to avoid or reduce conflict with noise sensitive use or development.”* While I maintain a reserve capacity is not warranted, I am also of the opinion that statutory tools are required to ensure that the environmental values are protected. For example:
- a) Development of a detailed “Construction Noise and Vibration Management Plan” (CNVMP) that is independently reviewed.
 - b) Development of an “Event Noise Management Plan” (ENMP) that is independently reviewed.
 - c) Prescribed internal noise levels from installed/fixed sound systems, with fixed noise monitoring locations within the venue to audit operations.
 - d) Prescribed external noise limits both for overall noise levels and low frequency noise levels, with fixed noise monitors at prescribed locations around the venue.

Stadium Operating Noise Emissions

- 6.16 I agree with the TPC Panel that *“The main noise emissions associated with the operation of the stadium would be generated during concerts and sporting events.”*
- 6.17 The TPC Panel has relied upon the POSS Noise Assessment Supplementary Report [Ref. 14.6] provided as further information on 31 January 2025 which is an amendment of that originally lodged with the TPC.
- 6.18 I have reservations regarding the assessment by AECOM, hence I have also independently carried out my own modelling of noise emissions from operations (refer section 9) and construction emissions. I have also carried out supplementary attended (short-term) and unattended (long-term) noise monitoring, as well as assessed the sound insulation provisions for sensitive receivers near the development as outlined here-in.
- 6.19 I have partly relied upon the POSS Noise Assessment Supplementary Report when subsequently responding to the TPC Panel’s comments regarding noise and vibration.
- 6.20 Regarding the TPC comment at 8.5(i), first dot point, that *“the crowd within the stadium, patrons arriving and departing, are likely to be noticeable for receptors adjacent to the stadium”* I note that AECOM’s report states:
- a) Crowd noise (In Bowl): *“It would likely be just noticeable for receptors adjacent to the Stadium. The continuous traffic noise is expected to still be the dominant noise source.”* I agree with AECOM but note that this noise could be noticeably mitigated by closing the openings (or introducing acoustic louvres) to the south facade of the stadium.

- b) Patrons Arriving / Departing: *"The predicted levels are below the measured existing ambient noise levels. They are unlikely to be noticeable for the majority of the receptors except the apartments directly across Evans Street."* I note that AECOM has not considered the additional sound insulation provisions prescribed for sensitive use alongside the Port Zone in the SCPS. I have inspected the apartments along Evans Street and carried out sound insulation measurements. The highest noise level predicted by AECOM is 47dBA at the closest sensitive receiver (Sullivan Cove Apartments), which is no greater than the EPP Noise indicator levels of 50-55dBA outside living areas and 30 dBA within bedrooms (equivalent to 55dBA outside with windows closed, as prescribed by the HIPS).

6.21 Regarding the TPC comment at 8.5(i), second dot point, *"concerts, the public announcement (PA) system, game sirens and noise from crowds in the bowl are likely to clearly audible over ambient noise for uses in the vicinity of the stadium."*, I note that AECOM's report states:

- a) "Ambient noise level" is noted by the TPC Panel. The Association of Australian Acoustical Consultants (AAAC) "Acoustical & Vibration Terminology" [Ref. 14.20]) defines this as *"The ambient noise level at a particular location is the overall environmental noise level caused by all noise sources in the area, both near and far, including all forms of traffic, industry, lawnmowers, wind in foliage, insects, animals, etc. Usually assessed as an energy average over a set time period 'T' (LAeq, T)."*
- b) Intrusiveness of noise is usually considered relative to the "background noise level", which has not been considered by the TPC Panel. The AAAC [Ref. 14.20] defines this as *"The Background Noise Level is the minimum repeatable level of noise measured in the absence of the noise under investigation and any other short-term noises such as those caused by all forms of traffic, industry, lawnmowers, wind in foliage, insects, animals, etc.. It is quantified by the noise level that is exceeded for 90 % of the measurement period 'T' (LA90, T)."*

Concerts - Noise Emissions

- c) I agree that noise from concerts will be audible relative to existing ambient noise levels, however with limits on the number of concerts and noise levels from concerts, in my opinion noise levels can be controlled to comply with international standards that protect the amenity of sensitive users. In the POSS Noise and Vibration Assessment Report [Ref. 14.5], assessment criteria were provided for various stadia operating successfully in Australia and New Zealand. These criteria come from The Noise Council, "Code of Practice on Environmental Noise Control at Concerts" (**Code of Practice**)[Ref. 14.21], which provides a noise limit of 75dBA (LAeq,15min) for "Urban Stadia or Arena" hosting 1-3 events per year (restricted to 9am to 11pm). I have carried out independent modelling of noise emissions from the proposed development (refer section 9), and together with recommendations outlined below, a noise limit of 75dBA is achievable at nearby sensitive receivers and in my experience will adequately protect nearby sensitive receivers.

- d) “Sample Conditions for Environmental Noise Control at Concerts” are also provided in the Code of Practice [Ref. 14.21], which in my experience is customary for management of noise from events, ordinarily included in statutory controls:
- Noise limits at nearby sensitive use, including fixed monitoring positions;
 - Limits on hours that concerts can operate;
 - Noise limits within concert venues (e.g., at the mixing desk), both overall and spectral (relative to frequency).
- e) Wheeler et al (2020) [Ref. 14.22], “An evaluation of UK and International Guidance for the Control of Noise at Outdoor Events” refers to the “Code of Practice on Environmental Noise at Concerts” as well as references from which that guideline was derived, which aligns with my experience:
- Wheeler et al (2020) also refers to research and guidance on low frequency noise limits, suggesting that a noise limit of L_{Ceq} 90dBC (15-minute average) would not be unreasonable. In my experience, this is equivalent to limits imposed for other stadia in Australia and New Zealand. AECOM has not proposed a limit to control low frequency noise emissions, nor has the impact been assessed; however, I have considered this through independent modelling as noted in section 9.
 - Wheeler et al (2020) refers to noise level spectra (octave band levels) that produce an A-Weighted level of 98dBA (the primary target front-of-house level used at events” – refer to Figure 15-4. In my opinion, an internal noise limit is required to control noise emissions from the stadium to avoid environmental harm. The internal noise level used by AECOM in their modelling exceeded these levels in part. I have considered this through independent modelling as noted in section 9, with a proposed limit provided in section 10.

Game Day - Noise Emissions from the PA System and Crowds in the Bowl

- f) The Code of Practice [Ref. 14.21] also notes that “*For indoor venues used for up to about 30 events per calendar year an MNL (Music Noise Level) not exceeding the background noise (LA90) by more than 5dBA over a fifteen minute period is recommended for events finishing no later than 2300 hours*”. This is equivalent to the assessment criterion I have proposed, and that used in Tasmanian legislation, for Game Day events (refer to 6.6 and preceding paragraphs). I have carried out independent modelling of noise emissions from the development, and together with recommendations outlined below, a noise limit of no more than 5dBA greater than the background noise is achievable at nearby sensitive receivers. At this level, as noted by AECOM, noise from the “PA System” and “crowds in the bowl” would likely be “*just noticeable for receptors adjacent the stadium*”. Whilst I agree the PA system and crowd noise may be audible at the closest sensitive receivers, the levels will not be significantly greater than the existing ambient noise levels and will not cause environmental harm.

Game Day - Noise Emissions from Sirens

- g) I agree with the TPC Panel and AECOM that “... *game sirens are likely to clearly audible over ambient noise for uses in the vicinity of the stadium*”, but they would not exceed all existing ambient noise levels. I agree with AECOM that noise from sirens should be considered as a maximum noise level (L_{AFmax}), and not averaged over 15 minutes (or any other period). I agree with AECOM that it would be of a similar level to maximum noise levels already in the environment, with less frequency (e.g., maximum noise levels from helicopters servicing the Royal Hobart Hospital will exceed noise from the game day sirens with a greater frequency – potentially 4 to 6 times a day, arriving and departing; likewise sirens from emergency vehicles, with the Royal Hobart Hospital in close proximity to the proposed stadium). I note AECOM predicts maximum noise levels from sirens (L_{AFmax}) and most sensitive receivers comply with the maximum noise limit in the HIPS of 65dBA. In my opinion, with minor amendments to the concept design or control measures similar to those outlined in section 10, compliance can be achieved at all sensitive receivers.
- 6.22 Regarding the TPC comment at 8.5(j), I disagree with the TPC Panel’s comment that “*predicted noise levels in the vicinity of the Stadium during sporting events and concerts would exceed the existing ambient noise levels at nearby sensitive receptors*”. As noted herein, ambient noise is all noise in the environment, which ordinarily exceeds the background noise level (the noise level exceeded for 90% of the time). Noise from the stadium will noticeably be above the ambient noise for concerts, but otherwise noise from Game Day events and general operations of the stadium, as noted by AECOM will be “just noticeable” or “unlikely to be noticeable” relative to existing ambient noise in the environment.
- 6.23 Regarding 8.5(k), the TPC Panel “*considers that it likely that the noise level from a concert has the potential to cause sleep disturbance during nighttime*”. Night-time is normally classified as 10pm to 7am. If the statutory limits are established which limits operation of the stadium for concerts to 10pm, I disagree with the TPC Panel. If the stadium operates to 11pm (as per other stadia in Australia and New Zealand, and as per the Code of Practice [Ref. 14.21], Major Concert events will have a marginal impact on sleep disturbance which should be considered relative the frequency of the event.
- 6.24 Regarding 8.5(k), the TPC Panel notes that “*The degree to which other noises from sources, such as sirens and crowds for example, affect the ability of people to sleep and relax without unreasonable interference may depend on the duration and frequency of these activities*”. As noted herein, compliance with a noise limit ($L_{Aeq,15min}$) of no more than 5dBA above the existing background noise levels, and a maximum (L_{AFmax}) noise level of 65dBA is consistent with other planning legislation used in Tasmania and Australia. Limiting operations of the stadium for Game Day events to 10pm will ensure there is no unreasonable interference to the ability of people to sleep and relax.

Construction Noise and Vibration

- 6.25 Regarding 8.5(l), the TPC Panel states that it “*does not have the CNVMP and it is not*

clear what construction hours or days are proposed". I disagree with the TPC Panel's statement on the basis that Construction Noise and Vibration Management Plans (CNVMP) have been submitted, with hours of construction in accordance with the NSW Department of Environment & Climate Change "Interim Construction Noise Guideline", 2009 (ICNG) [Ref. 14.25]:

- a) While in my opinion the POSS Noise and Vibration Assessment Report provided an inadequate review of the impact of construction noise and vibration from the development, it includes a framework that references the existing MPDC Construction Noise Management Plan (CNMP) [Ref 14.8] and requires the Construction Contractor to prepare a comprehensive CNVMP with consideration of the specific construction methodology and program for the stadium. The POSS submission also includes at:
 - Appendix 2.0 "List of proposed Conditions" of the "Summary Report" [Ref. 14.3], development of a Construction Environmental Management Plan (CEMP), ordinarily submitted by the Construction Contractor.
 - Appendix AA "Construction Management Plan" [Ref. 14.24] which also outlines under "Daily Work Timeframes for the Construction Process" compliance with the non-prohibited hours prescribed in the EMPC Noise Regulations.
- b) The POSS Noise Assessment Supplementary Report provides a much more detailed review of noise from construction activities using methodology outlined in ICNG, as well as referencing a "Construction Noise and Vibration Management Plan" prepared by Hanson Associates, October 2024. The report refers to the following standard construction hours:
 - Monday to Friday: 7am to 6pm
 - Saturday: 8am to 1pm
 - No work on Sundays or Public Holidays

6.26 Regarding 8.5(n), the TPC Panel notes from AECOM's POSS Noise Assessment Supplementary Report that *"bulk excavation and piling is predicted to have the highest noise levels at sensitive receptors. The Proponent's reports indicate the activities most likely to be 'moderately intrusive' or 'highly noise affected' occur over the first 18 months of construction. Construction associated with bulk excavation and piling is classified as 'highly noise affected', at two sensitive uses adjacent to the stadium."* I refer to AECOM's report and note that AECOM has used a conservative estimate of the sound power generated by a rock breaker at 121dBA (Table 15), with all other noise sources almost 10dBA lower (subjectively half as loud) as this activity. As noted in the ICNG (page 17), different types of rock breakers can be used on site, with an example given of one type with a similar sound power level to that used by AECOM of 124dBA, while another has a significantly lower level of 98dBA, with the Transport for NSW (TfNSW), "Construction Noise and Vibration Guideline" (CNVG) [Ref 14.26] also recommending a similar noise management strategy. Additionally, I note that:

- a) AECOM's report further states that *"For each scenario, construction works were modelled as occurring across the expected work area such that the*

highest predicted noise level for works in any location in the modelled work area could be determined for each noise-sensitive location". That is, the highest noise levels would occur with the rock breaker 40m from the most sensitive sites (R1 and R2) – this is a very conservative assumption as this area is already at the required ground level. AECOM notes that this activity near sensitive use, "could last for up to a month" (Table 18, Comments section), which is not unrealistic (if it occurs at all).

- b) Acoustic shrouds could be incorporated on the impact bit for the rock breaker, which will provide up to 10dBA noise reduction.
- c) Solid site hoardings could be implemented along Davey Street, which will provide a noise reduction up to 10dBA.

6.27 At 8.5(o), the TPC Panel notes an inconsistency in the Proponent's reports regarding the duration of rock breaking:

- a) As noted above, the POSS Noise Assessment Supplementary Report by AECOM suggests this activity "*could last for up to a month*".
- b) Appendix AA "Construction Management Plan" by ZANCON notes that "*the excavation of hard rock over an indicative period of 13 to 17 months*"
- c) As noted above, rock breaking may last 13 to 17 months (as noted by ZANCON, across the whole site) but is likely to last up to a month (as noted by AECOM) only near the closest sensitive receivers.

6.28 I refer to 8.5(p), with the TPC Panel noting that "*the surrounding noise environment would be highly impacted during the bulk excavation and piling stage of construction, without the implementation of any mitigation measures.*" I agree with the TPC Panel that mitigation measures are required to manage noise and vibration impacts from construction. Mitigation measures will need to be defined when the construction contractor is appointed, and a detailed schedule and equipment list is developed as part of a detailed CNVMP. In my opinion, based on previous project experience, noise and vibration impacts can be controlled to acceptable levels through a range of mitigation and management measures as set-out by AECOM.

6.29 I refer to 8.5(q), with the TPC noting "*sounds that have tonal or impulsive qualities may have adverse effects on people that are not accurately reflected or addressed when converted to a broadband sound. Consequently, the level of disturbance and annoyance may be higher than reflected in the Proponent's reports*". I refer to the footnote (1) to Table 15 which states "*In accordance with TfNSW Construction Noise and Vibration Guideline [Ref. 14.26], the overall SWL has been increased by 5 dBA to account for special audible characteristics from rock breaking and concrete sawing.*" I therefore disagree with the TPC Panel.

6.30 Regarding 8.5(r), the TPC Panel suggests that "*there is the potential for cumulative construction noise from other project activities occurring in the vicinity of the proposed stadium during construction*", noting the proposed redevelopment of Macquarie Point Wharfs 4-6 (<https://tasports.com.au/volumes/images/Project-Brief-Macquarie-Wharf-Redevelopment.pdf>). I note the redevelopment is remote from the proposed stadium site and shielded by existing Port buildings (refer to

Figure 15-7). I am not aware of a construction schedule for the proposed redevelopment (other than a tender call for a construction partner for Wharf 6 issued 2 April 2025), hence I am unable to comment on the need to consider cumulative noise impacts.

Historic Cultural Heritage and Community Values - Cenotaph

- 6.31 The TPC Panel have made separate comments regarding noise and vibration impacts related to the Cenotaph and the Federation Concert Hall which are considered below.
- 6.32 The TPC Panel refers to noise impacts on the Cenotaph at section 4.1, noting that *“the proposed building, along with associated elements of its use such as noise ... would conflict with and diminish the Cenotaph’s values, including: the reverential ambience and opportunity for quiet reflection and contemplation which are central to its role”*. I note that noise (and vibration emissions) from use other than on Game Days and Major Concerts will be unlikely to have an adverse effect on environmental values at the Cenotaph. I have independently carried out a long-term noise survey (unattended and attended) at the Royal Hobart Regatta Grounds (near the Cenotaph), with noise from TasWater’s Wastewater Treatment Plant (WWTP) and traffic noise defining noise amenity at the site. In my opinion, given the infrequent use of the stadium, the opportunity for quiet reflection and contemplation at the Cenotaph will not be materially diminished.

Use and Activity – Federation Concert Hall (TSO Facilities)

- 6.33 Regarding 6.2.2(c), Part 2 of the EPP Noise outlines the objectives as *“(a) to further the objectives of the Act as they relate to the acoustic environment; and (b) to protect the environmental values specified in clause 7.”* The environmental values to be protected under the EPP Noise are *“the wellbeing of the community or a part of the community, including its social and economic amenity;”* In my opinion, Tasmanian legislation (not limited to the EPP (Noise)) is required to protect the environment to a degree, allowing special development (such as the TSO facilities) to be constructed knowing the environmental values in which they are located. Thereafter, any specific or additional noise and vibration mitigation required to allow special use is the responsibility of the proponent (ie. TSO or operator of the Federation Concert Hall) for that use.
- 6.34 At 6.2.2(c) the TPC Panel notes that *“the reports provided by the Proponent make an assumption that the absorptive capacity of the Federation Concert Hall building may reduce the level of A-weighted sound by 20dB (Appendix Q, page16).”* In my opinion the TPC Panel have misunderstood the footnote (1) to Table 9 of Appendix Q (page 16) which states *“Where results are noted as negligible, it indicates that the predicted level is less than 20 dB(A), which is not noticeable above background noise”*. This does not suggest the *“absorptive capacity of the Federation Concert Hall building may reduce the level of A-weighted sound by 20dB”*. I have independently inspected and measured the sound insulation rating of the Federation Concert Hall, with the construction of double skin comprising (refer to Section 21 **“ATTACHMENT F”**):
- a) Walls: external concrete filled “thermacell” blocks, and internal 150mm thick precast concrete;

- b) Roof: concrete soffit and an upper roof cladding presumably with additional sound insulation material (such as Durra Panel or similar);
- c) The Federation Concert Hall was built to a budget, with the internal shell not vibration isolated. Ordinarily, for acoustically sensitive performance spaces alongside major arterial roads, the internal shell is vibration isolated.
- d) In my opinion, the sound insulation rating of at least the façade (with the roof likely designed to the same acoustic performance) will provide a noise reduction of at least 65dBA (based on the mass and air space separating the building elements). This will be limited by structure-borne noise flanking between building elements (as the internal shell is not vibration isolated). A conservative assumption would be a noise reduction of at least 50dBA.
- e) The measured noise reduction on-site (concurrently monitoring inside and outside the venue) is on average (across 200Hz to 4kHz) 50dBA (refer to Section 21 **"ATTACHMENT F"**), however this is affected by the background noise level within the Federation Concert Hall (noise from traffic was inaudible during the measurement period suggesting the noise reduction is greater than 50dBA).

6.35 Regarding 6.2.2(g), and noting the results from my inspection and measurements of the sound insulation performance of the Federation Concert Hall, in addition to noise survey results I have independently carried out at the Federation Concert Hall (Section 18 **"ATTACHMENT C"**) and those from others engaged by MPDC (Section 20 **"ATTACHMENT E"**) I note that:

- a) External noise levels are typically average (L_{Aeq}) 60dBA, with maximum (L_{AFmax}) noise levels up to 100dBA at the facade of the Federation Concert Hall. For example, helicopter fly-overs were measured as $L_{Aeq,15min}$ 62-64dBA and L_{AFmax} 79-81dBA (at 6:45pm on 3rd April 2025 arriving at the Royal Hobart Hospital, and at 7:45pm departing from the Royal Hobart Hospital – within 3 days of monitoring there were three helicopter events in the evening, late afternoon, and early morning). These events would equate to a predicted internal noise level of $L_{Aeq,15min}$ 15-17dBA (barely noticeable over a 15-minute period) and an L_{AFmax} 32-34dBA (audible given the measured background noise level of 22dBA within the Federation Concert Hall). Considering helicopter noise has not been noticed by users of the Federation Concert Hall, the internal noise level from the helicopter is likely lower than those predicted. It follows that the estimated noise reduction across the facade of the building into the Federation Concert Hall is likely underestimated and that the predicted internal noise levels are higher than actual.
- b) AECOM predicts the average noise level ($L_{Aeq,15min}$) from Game Day events (PA System and Crowd Noise in the Bowl) as $L_{Aeq,15min}$ 54-58dBA at the facade of the Federation Concert Hall. This will not be audible within the Federation Concert Hall, and is less than the frequent helicopter noise levels which has not been noticed by users of the Federation Concert Hall.
- c) AECOM predicts the maximum (L_{AFmax}) noise level from Game Day Sirens as 68dBA. This is less than the maximum (L_{AFmax}) noise level from helicopter fly-

overs, and less than typical maximum noise levels from traffic or other ambient events. This would result in an internal maximum noise level that is lower than road traffic and the of 18dBA within the Federation Concert Hall (lower than the measured background noise level of 22dBA).

- d) AECOM predicts the average noise level ($L_{Aeq,15min}$) from Major Concert events at the stadium to be at worst 73dBA (and 99 dBC) outside the Federation Concert Hall. This would equate to an internal noise level of 25dBA (mostly audible given the measured background noise level of 22dBA within the Federation Concert Hall). Noting the infrequency of these events, statutory controls can be set out to limit noise levels (both in dBA and dBC levels) at the external facade of the Federation Concert Hall (e.g., 75 dBA and 90 dBC), and management measures set out to liaise timing of the stadium concert with the Federation Concert Hall events.
- e) I have undertaken independent modelling of Major Concert events noise from the stadium and predict noise levels to be at worst 73 dBA (and 87 dBC) outside the Federation Concert Hall with reasonable control measures in place (as noted Section 9). This equates to an internal noise level of 20 dB(A) and will be lower than the measured background noise level in the Federation Concert Hall. The combined noise level will be less than 25 dBA which is the typical design background noise level inside a concert hall.

6.36 Regarding 6.2.2(j), other than for concerts at the stadium, noise levels impacting the Federation Concert Hall will be no more than those to which the Federation Concert Hall is already exposed. Construction noise and vibration from the project can be managed such that their impacts at the Federation Concert Hall are no more than the existing impacts of other existing noise sources in the environments (such road traffic), or be managed to limit their levels to those considered acceptable through the implementation of mitigation and management measures established in a CNVMP, as noted at 6.28.

6.37 Regarding 6.2.2(k), I refer to para 6.29, and note that AECOM has included adjustments to account for tonal and other characteristics likely to cause annoyance. In my opinion, and as noted above for rock-breaking activities, the development of a detailed construction noise and vibration management plan will be sufficient to *“mitigate the effect construction stage noise has on the current operations at the Concert Hall”*.

Use and Activity – Upper Queens Domain

6.38 Regarding 6.2.3(k), noise impact on the Queens Domain will be no more than that on the Cenotaph outlined at 6.32. I note the TPC Panel also finds that *“this would not be a significant issue”*.

Use and Activity – Other Use and Activity in the Surrounding Area

6.39 Regarding 6.2.4(h), the TPC Panel notes that *“The Proponent’s Construction Management Plan (Appendix AA) does not provide a significant amount of detail on how construction issues would be managed”* which I agree with. A detailed construction noise and vibration management plan (CNVMP) needs to be developed by the Construction Contractor. As noted at paragraphs 6.25 to 6.30, in my opinion

appropriate mitigation measures can be set-out to minimize impacts on primarily UTAS, Sullivans Cove Apartments and Zero Davey Apartments through selection of plant and equipment, timing of construction, site hoardings and localized treatment to plant and equipment. In my experience on projects of similar scale, it is common practice for a detailed CNVMP to be prepared by the Construction Contractor with project specific detail and information incorporated.

6.40 Regarding 6.2.4(i) and (k), acoustic amenity in the Wapping area the TPC Panel notes:

- a) *“pedestrian infrastructure linking the stadium to the northern end of Collins Street”* with construction noise and subsequent use from patrons leaving events at the stadium likely to cause disturbance to residential use in and around the Wapping area.
- b) *“The Proponent’s Noise and Vibration Assessment notes that noises from the PA system and sirens are the most likely to be audible to residential uses in Wapping and the Royal Hobart Hospital.”* The TPC Panel compared noise from these events to “cruise ship foghorns”, suggesting these events have the potential to cause sleep disturbance.

6.41 In response to 6.2.4(i) and (k), I note that the Wapping area is bordered by the Royal Hobart Hospital Precinct, and major arterial roads (Liverpool St, Macquarie St and Davey St – designated as State Roads) diverting traffic to/from the Tasman Highway. I carried out an independent long-term noise survey (attended and unattended) at 1 Collins Street on an apartment balcony facing into the Wapping area (away from the major roads) – Refer to Section 18 **“ATTACHMENT C”**. Average noise levels in the Wapping area are dominated by noise from nearby major traffic routes, emergency vehicles and helicopters servicing the Royal Hobart Hospital. As noted from the survey results:

- a) Day: Ambient ($L_{Aeq,15min}$) noise levels are typically about 60dBA, maximum (L_{AFmax}) noise levels are typically 65-85dBA, and background ($L_{A90,15min}$) noise levels are typically 53dBA.
- b) Night: Ambient ($L_{Aeq,15min}$) noise levels are typically about 53dBA, maximum (L_{AFmax}) noise levels are typically 60-80dBA, and background ($L_{A90,15min}$) noise levels are typically 50dBA.
- c) Helicopter fly-overs were noted each day during the survey, and measured while attending site to deploy and retrieve the long-term noise logger (additional flights throughout the week, one per day, were noted from the survey at the Federation Concert Hall, also in Section 18 **“ATTACHMENT C”**). These are identified on the long-term noise survey results (Figure 18-6) with further details (spectra) provided in Section 23 **“ATTACHMENT H”**:
 - Maximum (L_{AFmax}) noise levels from helicopter fly-overs were typically 80-90dBA, which is consistent with AECOM’s predictions of helicopter noise levels.
 - Average noise levels ($L_{Aeq,15min}$) 70dBA from helicopter fly-overs. These events were typically 10dBA above the ambient noise level (55-60dBA),

and up to 20dBA above the background noise level (50-55dBA).

- d) AECOM has predicted noise levels at “R14 – One Collins St” and “R15-Royal Hobart Hospital):
- Noise levels from the sirens were estimated to be 67dBA (L_{AFmax}) at both R14 and R15, likely to occur at the start of the game, each quarter and at the end of the game (4 times in about 2 hours in one week). This level is more than 10 dBA lower (subjectively more than halving the loudness) than the noise level from the helicopter (occurs approximately twice per day at any time of the day/night every day of the year). This level is less than maximum noise levels already in the environment from traffic.
 - Noise levels from the PA System were estimated to be 54dBA ($L_{Aeq,15min}$) which is less than 5dBA above the background noise level ($L_{AF90,15min}$), and less than the existing ambient noise level in the Wapping area.
 - Noise levels from patrons arriving/departing the stadium have been estimated by AECOM as 25-28dBA, noting that a pedestrian movement study (refer to Figure 15-6 from Appendix B “Stadium Design Description” [Ref. 14.4] does not show patrons passing through the Wapping area, but rather along the State Roads. This level would not be intrusive given it is less than the existing background noise level in the environment.
- e) Given the existing noise environment in the Wapping area, I disagree with the TPC Panel’s suggestion that acoustic amenity in the Wapping area would be impacted by the proposed stadium.

6.42 Regarding 6.2.4 (g), (i) and (l), acoustic amenity in the mixed use zone adjoining Sullivans Cove “Working Port”, Macquarie Point Wharf and Sullivans Cove Gateway (as per SCPS), the TPC Panel notes:

- a) *“There are a number of noise sensitive receptors close to the stadium, including hotels and apartments such as MACq 01, Sullivans Cove Apartments, Zero Davey, Grand Chancellor, Old Woolstore Apartments and the Henry Jones Art Hotel, residential and visitor accommodation apartments in the Wapping area, educational facilities such as UTAS and the Baha’i Centre of Learning for Tasmania.”*
- b) *“The Panel considers noise from events held at the stadium would likely cause some level of nuisance to users closest to the stadium. For the hotels and apartments on Evans and Hunter Streets in particular, guests not connected to events at the stadium would be impacted. This impact includes noise generated by a large volume of pedestrians leaving the stadium after an event. While the stadium may benefit surrounding hotels or apartments for guests attending stadium events, it is likely to reduce their desirability for those guests not attending stadium events.”*
- c) *“Noise has the potential to affect nearby educational uses, particularly UTAS,*

and to a lesser degree the Baha'i Centre. The Panel accepts the conclusions of the Proponent's reports that it is unlikely for major events to significantly overlap with learning activities at these facilities. However, the Panel considers it is likely that daytime construction noise would significantly affect educational activities, particularly at UTAS given its proximity to the stadium building."

6.43 In response to 6.2.4 (g), and (l), acoustic amenity of apartments and hotels:

- a) Long term noise surveys were carried out by MPDC and independently by myself with results provided in Section 18 "**ATTACHMENT C**" and Section 19 "**ATTACHMENT D**". These results suggest that existing noise levels are:
 - Background ($L_{AF,90,15min}$): 55dBA (day), 50dBA (night)
 - Ambient ($L_{Aeq,15min}$): 60dBA (day), 50dBA (night)
 - Maximum (L_{AFmax}): 70-80dBA up to 90dBA on occasion
- b) AECOM has estimated noise levels from Game Day events at R1, R2, R4 and R5 as follows:
 - PA System and Crowd Noise in the Bowl: Average noise levels ($L_{Aeq,15min}$) 49-56dBA are less than existing ambient daytime noise levels, and less than 5dBA above the background noise level at night-time. With minor amendments to the concept design, noise amenity at these sites can be protected.
 - Siren: Maximum noise levels (L_{AFmax}) 64-67dBA are less than existing maximum noise levels at the site, with acoustic amenity protected.
 - Concerts: Average noise levels ($L_{Aeq,15min}$) are estimated to be between 74-76dBA, exceeding existing ambient noise levels. I refer to my opinion at 6.21, which notes that noise levels from concerts can be controlled to comply with international standards that protect the amenity of sensitive users given such events are held on a few occasions per year.
- c) A site inspection and sound insulation survey (by way of concurrent noise measurements inside and outside the apartments) carried out at Sullivans Cove Apartments (IXL), with results provided in Section 22 "**ATTACHMENT G**"
 - A secondary facade is noted along the majority of the facade facing the proposed stadium, with a single facade only to the western end of the building adjacent Zero Davey apartments.
 - As shown in Figure 22-3, the noise reduction provided by the double facade is significantly greater (by about 20dB at low frequencies, less than 125Hz) and greater (by about 10dB) than the single facade, with the average noise reduction about 35dBA (across all frequencies).
 - This results in a greater noise reduction to apartments immediately facing the stadium than assumed by AECOM.

6.44 In response to 6.2.4 (g), and (l), acoustic amenity of educational facilities:

- a) Long term noise surveys were carried out by MPDC and independently by myself with results provided in Section 18 “**ATTACHMENT C**” and Section 20 “**ATTACHMENT E**”. These results suggest that existing noise levels are:
 - Background ($L_{AF,90,15min}$): 55dBA (day), 50dBA (night)
 - Ambient ($L_{Aeq,15min}$): 60dBA (day), 50dBA (night)
 - Maximum (L_{AFmax}): 70-80dBA up to 90dBA on occasion
- b) As noted by the TPC Panel, “*UTAS anticipates it can manage its teaching programs to minimise the disruption caused by any major events.*”, with noise during the construction period and from the stadium operating in business as usual (BAU), or non-game day event mode of concern.
- c) AECOM has estimated noise levels from BAU events at R3 as an average noise level ($L_{Aeq,15min}$) of 38dBA, which is less than existing ambient daytime and night-time noise levels.
- d) Notwithstanding the above comments, and noting the impact of construction noise and vibration, a site inspection and sound insulation survey (by way of concurrent noise measurements inside and outside classrooms) carried out at UTAS Creative School, with results provided in Section 24 “**ATTACHMENT I**”
 - The heritage facade has been retained, with secondary “glazing” by way of a Perspex inner pane has been provided to some sensitive spaces within the building.
 - The heritage facade provides limited noise reduction (about 10dBA), with the additional Perspex pane improving the noise reduction marginally (about 20dBA).
- e) Construction noise levels at the facade of the building have been estimated by AECOM as up to 89dBA (during rock breaking), but otherwise 68-74dBA. Noise mitigation during rock-breaking would be required to ensure amenity is not compromised within the UTAS building, otherwise for most of the construction period internal noise levels are estimated to be 48-54dBA (with retro-fit Perspex pane) which is not unreasonable.

7 REVIEW OF PROPONENT'S POSS NOISE AND VIBRATION ASSESSMENT REPORT

- 7.1 I refer to the POSS Noise and Vibration Assessment Report [Ref. 14.5] submitted by the Proponent (on behalf of AECOM), dated 21 August 2024 and the associated noise prediction model "1.-Sound-Plan-Model---MacPoint-Stadium-Hobart---PoSS-Submission" provided by the Proponent (obtained from AECOM) upon request.

Existing Sensitive Receivers and the Acoustic Environment

- 7.2 The nearest sensitive receivers surrounding the Project site have been appropriately identified in the report. Compliance with the noise objectives at all the identified nearest sensitive receivers would secure compliance at all other sensitive receivers and land uses not assessed.
- 7.3 AECOM has included the Hobart Cenotaph (R13) as a sensitive receiver. While in my opinion the noise impact at the Hobart Cenotaph should be considered to ensure noise from the development does not adversely affect the environmental values at the site, the noise criteria established to protect residential land uses should not strictly apply.
- 7.4 AECOM has carried out short-term noise surveys at locations around the Project and references historical long-term noise data collected by Hanson Associates at three locations. In section 1.2 of the report, AECOM suggests that there are limitations to the use of the data (such as the operation of the Port has not been captured to its full scale), and further site surveys will be undertaken at a later design stage.
- 7.5 In my opinion, as noted at 6.7, AECOM has not carried out sufficient long-term noise surveys (at all sensitive sites or localities) to be able to quantify the existing acoustic conditions at the sensitive receivers. A detailed description of the existing conditions is necessary to ensure a robust approach with respect to establishing appropriate criteria for the sensitive receivers which then can be adopted by TPC Panel as statutory conditions. I have therefore carried out additional noise surveys (long-term unattended, and short-term attended) at relevant sensitive sites around the proposed development.

Legislation and Guidelines

- 7.6 AECOM has appropriately considered the EMPC Act, EMPC Noise Regulations, EPP Noise and NMPM, however has not considered the HIPS and SCPS as referred to in the TPC Guidelines. The HIPS and SCPS include noise control measures that protect sensitive receivers from existing and new noise sources (such as Port activities and other non-residential activities) in the area. The noise control measures in place provide benefit of mitigating noise from the stadium.

Noise Criteria

- 7.7 AECOM references the EPP Noise indicator levels (in Table 4 of the report) and other relevant subjective requirements in the EPP Noise to protect environmental values. AECOM also provides a comparison (in Table 5 of the report) of the noise restrictions applied for other stadia in other jurisdictions relating to stadium events. Whilst these are appropriate references for consideration, AECOM does not propose any specific noise criteria for the development.
- 7.8 Regarding the EPP Noise, it provides overarching principles and objectives which are

to be used with consideration of other relevant policy framework (as noted in 6.4). The EPP Noise provides indicators noise levels which in my opinion are “indicative” and non-mandatory. Any noise criteria should take into consideration several factors, including the existing background noise levels, the frequency, the duration and the period of the noise impact, and the number of receivers being impacted.

- 7.9 In my opinion, specific noise criteria for the development should already be proposed at this stage for consideration of the TPC Panel. The proposed criteria would enable the TPC to evaluate the potential impacts of the proposal and set control limits that will form the basis for future design development and compliance processes consistent with relevant planning and environmental requirements. It is common practice for Planning Application submissions to propose specific noise criteria for the planning authority to approve.
- 7.10 In the absence of specific noise criteria proposed by AECOM, I have considered the following operational noise criteria outside sensitive receivers (based on my previous experiences on similar projects) to determine whether the predicted noise levels at sensitive receivers are acceptable to protect environmental values:
- a) Major Concert event (up to 3 per year): $L_{eq,15min}$ of 75 dBA and 90 dBC (to control low frequency noise).
 - b) Major Concert event (4 to 12 per year): $L_{eq,15min}$ of 65 dBA and 80 dBC (to control low frequency noise).
 - c) Games sirens: $L_{Amax,15min}$ of 65 dBA or the typical existing $L_{Amax,15min}$ levels, whichever is greater.
 - d) Other noise sources: $L_{Aeq,15min}$ no more than the EPP Noise indicator levels (with daytime, evening and night-time defined as per Noise Measurement Procedures Manual) or 5 dB above the background noise level ($L_{A90,15min}$), whichever is the greater.

Noise Modelling and Assessment

- 7.11 I have reviewed the noise model that was provided by the Proponent (from AECOM) and reviewed the modelling approach as described in section 6.0 of the report. I note the following:
- a) The noise model was established in SoundPLANnoise 8.2 noise modelling software and implements the CONCAWE⁵ [Ref 14.27] noise prediction algorithm. The CONCAWE algorithm was developed in the 1980's based on empirical noise data for distances 100m to 2000m from a noise source. At distances outside of this range, SoundPLANnoise appears to extrapolate propagation effects consistent with the ISO 9613-2:2024 [Ref 14.28] methodology (as observed from my experiences with the software). However, the predicted noise levels at distances outside the range above is generally

⁵ This empirical method was developed by CONCAWE (established by a group of leading oil companies to carry out research on environmental issues relevant to the oil industry) for the prediction of noise from petroleum and petrochemical complexes to neighbouring communities. At the time of release, the CONCAWE method was considered the latest and had been used for the prediction of environmental noise from various noise sources, including in Australia. With the advancement of computer technology, other prediction methods have since been developed, including the ISO 9613-2 method (first released in 1996), which has been tested and validated as an alternative prediction method and in some cases, the preferred method for predicting industrial and commercial noise sources.

higher (1 to 5dB) when using the CONCAWE method compared to using the ISO 9613-2:2024 method, *ceteris paribus*.

- b) The noise model uses inputs that relate to worst-case meteorological conditions (conditions that are conducive for noise propagation from noise source to receiver and result in highest predicted noise levels). These input meteorological conditions are consistent with the default meteorological conditions of ISO 9613-2:2024. I agree with AECOM's approach of using worst-case meteorological conditions as it results in the highest predicted noise levels in any meteorological conditions and therefore a conservative assessment of noise impacts.
- c) The ground absorption in the noise model was set to 0.0 value (non-absorptive ground) for the water surface and 0.5 value (half absorptive) for other areas (parks, residential and built-up areas), although I note that the report states 0.5 value was meant to be used for parks and 0.0 value used for residential and build-up areas.
- d) The stadium build form input was simplified with a flat roof top at 39.0m Finished Floor Level (FFL). The domed-shape roof starts at approximately 25.5m FFL and extends to a maximum roof height at 54.0m FFL. I note that there is limitation to the SoundPLANnoise software's ability to model complex roof geometry and that geometry simplification along with source inputs adjustments would be required to better replicate the noise emission profile from the domed-shape roof of the development.
- e) The noise model includes noise through the ETFE roof structure and the facade openings (acoustically transparent). Noise emissions from other building elements have not been included as they are considered not significant, and I agree with this approach.
- f) The noise sources and assumptions are summarised in Table 13 of the report. The high-intensity concerts with sound pressure level of 115 dBA at the reference position (located at 50m from the stage) corresponds to a maximum sound pressure level of 107 dBA at the roof surface and facade openings, and a highest C-weighted sound pressure level of 130 dBC at the roof (124 dBC at the facade openings).
- g) There is no indication of acoustic absorption within the stadium to control internal reverberation and reverberant noise levels. The ETFE roof provides limited sound absorption at mid to high frequencies, with sound absorptive treatment required to provide suitable conditions for amplified music and public address systems, as well as to control reverberant noise levels.

7.12 Regarding 7.11a), considering the limitations of CONCAWE and the ISO9613-2:2024 being the more contemporary and extensively validated noise prediction method, in my opinion, the ISO9613-2:2024 method provides more accurate predictions of noise levels at the closest sensitive receivers to the development (with hard ground surface input). With the use of the ISO9613-2:2024 method, noise levels at the sensitive receivers are estimated to be 1 to 4dB lower than when using the CONCAWE method.

- 7.13 Regarding 7.11c), given the ground cover surrounding the stadium is likely hard (reflective to sound). the use of 0.5 value (half absorptive) for ground cover around the stadium is likely to underpredict noise levels (1-2 dB) at the closest sensitive receivers.
- 7.14 Regarding 7.11d), in my opinion, AECOM has oversimplified the stadium's roof geometry (noting SoundPLANnoise limitation to import complex geometry) and that the noise emissions from the domed-shape roof to the closest sensitive receivers have not been appropriately modelled. AECOM has modelled the stadium with a flat roof geometry and has not made adjustments to account for the emissions from the vertical projection of the domed roof (from 25.5m FFL to 54.0m FFL). This component of noise is likely significant considering sensitive receivers that have direct line of sight to the domed roof. AECOM's oversimplified geometry also overpredicts the shielding effects provided by the roof bottom edge. With appropriate adjustments incorporated into the model, I expect the predicted noise levels from the stadium to be higher than those predicted by AECOM which will counteract the overestimates made earlier. I have made these adjustments as outlined in section 9.
- 7.15 Regarding 7.11f), in my opinion, AECOM's music level input in the noise model for a Major Concert event is significantly higher than levels that would normally be considered, particularly low frequency content. AECOM's music level input at the roof is provided in Table 9-1, for comparison with music levels which I have used previously on other projects.
- 7.16 AECOM has modelled noise from music concerts, the PA system, game sirens, crowd noise (in bowl), patron noise outside the stadium when arriving and departing, patron noise at outdoor food and beverage, function rooms, OCR lounges and goods shed, bus plaza, permanent building services plant, temporary generators, loading dock operation and waste collection. AECOM has considered the cumulative noise impact from daily operations (section 7.2), however the cumulative noise impacts during events (such as PA system crowd noise) have not been provided.
- 7.17 AECOM has not considered the noise associated with increased traffic flow during operation (and construction).
- 7.18 Given that AECOM does not propose any specific noise criteria, AECOM has compared the predicted noise levels from the stadium with noise limits imposed at other similar venues (for concert noise), the EPP Noise indicator levels and/or the available existing ambient noise data (other operational noise sources).
- 7.19 The comparison of the predicted concert levels with noise limits imposed at other similar venues only provides an indication of the ability of the proposal to comply with limits imposed at other venues. As noted above, AECOM does not propose specific noise limits for the development nor provide context to whether the limits imposed at the other venues are adequate or otherwise to protect the environment values at the sensitive receivers surrounding the development.
- 7.20 Regarding noise impact other than Major Concert events, in my opinion, it is not unreasonable to compare predicted noise levels with the noise that is already present in the environment. However, the comparison should be made against

ambient and background noise levels based on robust long-term noise surveys at a sufficient number of representative sensitive receivers. In my opinion the available noise data (based on survey at three locations) is not representative of most sensitive receivers surrounding the stadium and may have been affected by data filtering to exclude construction activity (likely during the day). I have therefore carried out additional noise surveys (long-term unattended, and short-term attended) at relevant sensitive sites around the proposed development.

7.21 When assessing noise impact other than Major Concert events, a comparison with the EPP Noise indicator levels is also not an unreasonable approach provided that the existing ambient and/or background noise levels are also taken into consideration. I agree that if a noise source does not make a perceptible noise change, then it cannot cause environmental harm.

7.22 In assessing perceptibility and occupant disturbance at sensitive receivers, AECOM assumes that all windows and doors are closed during events. While this assumption may be applicable and achievable at some sensitive receivers, it is unreasonable to assume each sensitive receiver can and will have all windows and doors closed during events. This may be limited by ventilation, access, etc requirements.

Operational Vibration

7.23 AECOM has identified building services plant and equipment, loading dock operations and patrons walking around the precinct as the primary vibration generating sources. Given the separation distance between these vibration sources and sensitive receivers, and the typical vibration isolation incorporated in the structural and mechanical design of the project, I agree with AECOM that *“the likelihood of operational vibration s form the Stadium affecting adjacent sensitive receptors is minimal”*.

Construction Noise and Vibration

7.24 With regards to construction noise, the report provides the factors to be considered when assessing noise impact, the construction hours and an example of an impact assessment based on piling and excavation activities. As noted at 6.25a), in my opinion, the report provided an inadequate review of the construction noise and vibration impact from the development. However, the report provides a framework for the Construction Contractor to prepare a comprehensive CNVMP to appropriately mitigate and manage construction noise and vibration impacts as is standard practice in Australia for similar scale projects.

7.25 Regarding construction vibration, AECOM references BS 6472:2008 for human amenity criteria and DIN 4150-3:2016 for structural integrity of buildings, heritage structures and utilities. I consider these references to be appropriate for the management of construction vibration impacts.

Mitigation Strategies

7.26 Section 11 of the report outlines the environmental noise and vibration mitigation strategies to minimise emissions during the construction and operation stages, including establishing target limits for Major Concert events that covers the maximum noise and event finish times. In my opinion, these are relevant high-level mitigation strategies. However, some measures such as the target noise limits for

operations, should already be defined at this stage by AECOM and be demonstrated to the TPC that the proposal can practicably meet those limits.

- 7.27** AECOM notes that a comprehensive CNVMP specific to the construction methodology and program of works for the stadium will be developed by the Construction Contractor to mitigate construction noise and vibration impacts. AECOM provides examples of potential measures that may be implemented to control construction noise and vibration impacts. As noted at 6.28, in my opinion, based on previous project experience, noise and vibration impacts can be controlled to acceptable levels through a range of mitigation and management measures as set-out by AECOM as is standard practice in Australia for similar scale projects.

8 REVIEW OF PROPONENT'S POSS NOISE AND VIBRATION ASSESSMENT SUPPLEMENTARY REPORT

- 8.1 I refer to the POSS Noise Assessment Supplementary Report [Ref. 14.6] submitted by the Proponent (on behalf of AECOM), dated 31 January 2025. The report was prepared to address comments from the TPC following review of the POSS Noise and Vibration Assessment Report (to be read in conjunction with this report) and provides the following additional information:
- a) Additional noise survey results including unattended long-term surveys at two locations at the site and attended short-term survey at three locations on the site
 - b) A high-level assessment of construction noise based on a preliminary construction schedule.
 - c) Comparison of the predicted noise levels from the stadium with the existing noise levels in the environment.
 - d) Updated noise modelling includes predictions at upper levels of sensitive receivers.
- 8.2 AECOM had undertaken additional long-term noise surveys at two locations at the site, which in my opinion, does not provide much added information with respect to the existing noise environment at the sensitive receiver locations (as noted in 6.7 and 7.5). Additional long-term noise surveys are recommended at the sensitive receiver locations where long-term surveys have not been undertaken to get a more accurate description of the background noise levels. To inform my opinion, I have conducted independent long-term noise surveys at five selected locations surrounding the stadium (refer Section 18 “**ATTACHMENT C**”).
- 8.3 The report provides an assessment of the existing helicopter noise from Royal Hobart Hospital based on predicted noise levels for the loudest helicopter type servicing the hospital. The maximum helicopter noise levels (L_{AFmax}) predicted at the closest sensitive receivers to the stadium are between 78 and 94 dBA. The predicted noise levels are marginally lower than the noise levels observed in the independent long-term noise survey data (Section 18 “**ATTACHMENT C**”). Nevertheless, it is noted that the highest predicted L_{AFmax} events from the stadium (i.e., games sirens as provided in Table 9 of the report) are still below the helicopter noise levels. Helicopter events can occur at any time of day or night. Therefore, the daytime L_{AFmax} events at the stadium are not expected to have an impact greater than the helicopter noise.
- 8.4 AECOM provides updated noise level predictions due to changes to the building design. The updated noise levels are generally slightly lower than those predicted previously in the POSS Noise and Vibration Assessment Report (due to updates to the building facade design). AECOM makes subjective comparisons between the predicted noise and the existing noise environment, albeit it is not clear how the subjective outcomes were evaluated. While in my opinion comparison with the existing environment is an acceptable approach, the comparison should be objective and uses criteria established with the existing ambient levels considered.

- 8.5 The report provides a high-level and conservative construction noise impact review using the ICNG and CNVG approach, based on a preliminary construction program assuming worst case source sound power levels, durations in the vicinity of sensitive receivers, notional mitigation etc. The report notes that a comprehensive CNVMP will be prepared by the Construction Contractor that will incorporate the specific construction methodology and program of works for the stadium. In my opinion construction noise and vibration impacts can be reasonably and practicably mitigated, however a more detailed assessment is required in consultation with key stakeholders (sensitive receivers, contractors etc).

9 INDEPENDENT NOISE MODELLING

- 9.1 As noted at 6.18, I have independently carried out modelling of noise emissions from the stadium. I have used the following inputs and approach for my modelling which differs from those used by AECOM:
- a) The ISO9613-2:2024 methodology which I consider provides more accurate predictions of noise levels at the closest sensitive receivers to the development (with hard ground surface input).
 - b) The default meteorological conditions in ISO9613-2:2024 and hard ground cover. Both inputs result in the highest prediction noise levels at the sensitive receivers and ensure a worst-case assessment consideration.
 - c) An amended stadium building geometry input (AECOM's noise model was used as a basis) to better account for the proposed height of the stadium roof and the influence of noise from the domed roof (from the vertical projections). The amended geometry results in higher predicted noise levels at the sensitive receivers in comparison to AECOM's flat roof geometry.
 - d) Nominal modifications to the concept design (to be confirmed through design development) such as:
 - An improvement of the sound insulation performance of openings to the southern and western facade of the stadium (which could be achieved either by infilling or incorporating acoustic louvres or similar).
 - A modification to the extent of the ETFE roof at the southern end closest to the Evans Street sensitive receivers to improve the sound insulation performance, particularly at low frequencies.
 - Acoustic treatment internally by way of sound absorption to exposed soffits/linings to reduce reverberant noise incident on the ETFE roof.
 - Directional loudspeakers (such as beam steered line arrays) to reduce direct noise incident on the ETFE roof.
- 9.2 The changes to the modelling methodology, ground surface type and stadium building geometry each has the effect of either increasing or reducing the predicted noise levels from the stadium. I consider AECOM's predicted noise levels to be indicative of the stadium operations, except for Major Concert events which are overestimated when modelled using my methodology and AECOM's high music level input (noted at 7.15). The predicted concert noise levels exceed the music limits of 75dBA and 90dBC which I consider appropriate (refer 7.10).
- 9.3 The 75dBA and 90dBC music limits can be achieved by controlling the music level emissions from the stadium. By restricting the concert music level emissions to the levels provided in Table 9-1 ("Restricted Maximum Concert Music Level") and the amendments to the stadium (as noted at 9.1) implemented, I predict the concerts music events to meet the noise limits at all relevant sensitive receivers. The restricted maximum music levels in Table 9-1 (indoors at the roof of the stadium) have reduced low frequency noise are consistent with those that I have considered

on other previous projects.

Table 9-1 Maximum Concert Music Levels (incident on roof)

Music Level	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	Total
Proponent's Maximum Concert Music Level								
L _{eq,15min} in dB	130	109	105	101	101	96	90	130
Restricted Maximum Concert Music Level								
L _{eq,15min} in dB	112	108	104	100	97	95	93	114

- 9.4 I have conducted my own predictions of construction noise and vibration at the closest sensitive receivers to the stadium. Based on my predictions:
- a) Construction noise levels at the closest sensitive receivers along Evans Street (and others) can be mitigated to achieve a noise management level that is reasonable for daytime works consistent with the ICNG and CNVG.
 - b) Vibration levels at the closest sensitive receivers along Evan Street can achieve threshold levels that protect against potential building damage.
 - c) Vibration from rock breaking at the project site will achieve threshold levels for human comfort and will not be perceptible inside the Federation Concert Hall. Structure-borne noise from rock breaking activity at the project site is predicted to be well below the background noise level inside the Federation Concert Hall.
- 9.5 Based on my findings above and from my experience on previous projects, it is my opinion that environmental noise and vibration impacts from the project construction works can be sufficiently managed through implementation of a CNVMP that includes noise and vibration management levels consistent with accepted guidelines such as the ICNG and CNVG.

10 PROPOSED CONTROL MEASURES

10.1 To ensure that the environmental values are protected, the following control measures may be considered by the TPC as part of the conditions of approval for the Project:

- a) Major Concert events shall not commence before 9am and cease before 11pm and be restricted as follows:
 - Up to three events per annum with noise levels ($L_{eq,15min}$) no greater than 75 dBA and 90 dBC when measured at any off-site sensitive location.
 - An additional nine events per annum with noise levels ($L_{eq,15min}$) no greater than 65 dBA and 80 dBC when measured at any off-site sensitive location.
 - Unless otherwise approved by the Secretary for the Department of State Growth (or delegate), in consultation with the Director EPA (or delegate), and subject to post-occupancy operational review.
- b) Noise limits other than for Major Concert events (ie. Business-as-Usual and Game Day events) shall be limited to an $L_{Aeq,15min}$ no more than the EPP Noise indicator levels (with daytime, evening and night-time defined as per Noise Measurement Procedures Manual) or 5 dB above the background noise level ($L_{A90,15min}$), whichever is the greater. Maximum noise levels (L_{AFmax}) shall be limited to 65dBA or the typical existing maximum noise levels (L_{AFmax}), whichever is greater.
- c) Permanent noise monitors should be located outside the stadium at the boundaries of the site (west, south and east) and to the north at the Cenotaph (recognizing the cultural significance of the site ensuring its location is unobtrusive). All noise loggers shall be mounted 10m above ground, incorporate environmental protection, be able to provide a live/real-time monitoring capability, and be maintained and calibrated as required.
- d) Noise levels from the Public Address system should not exceed the levels provided in Table 10-1 when measured at any facade (inside) of the stadium. Permanent noise monitors shall be positioned within the stadium, providing live/real-time monitoring capability to demonstrate compliance with these noise levels (octave bands).

Table 10-1 Public Address System Noise Levels

Noise Level	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	Total
$L_{eq,15min}$ in dB	81	91	83	84	81	77	74	93

- e) Major concert music levels should not exceed the levels provided in Table 10-2 when measured at any facade (inside) of the stadium. Permanent noise monitors shall be positioned within the stadium, providing live/real-time monitoring capability to demonstrate compliance with these noise levels (octave bands).

Table 10-2 Major Concert Music Noise Levels

Noise Level	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	Total
$L_{eq,15min}$ in dB	112	108	104	100	97	95	93	114

- f) A comprehensive Operational Noise Management Plan (ONMP) shall be prepared by the Stadium Management Authority (SMA), and include as a minimum:
- Practices and procedures to be adopted to ensure compliance with the noise limits set-out here-in, including roles and responsibilities for noise management, monitoring, reporting and complaints handling.
 - Details and locations of the permanent noise monitors
 - Reference to the Event Management Plan (EMP)
- g) A comprehensive Event Management Plan (EMP) for general operations (including Game Day events) and specifically for a Major Concert event shall include as a minimum:
- Location and type of Concert Sound System, including predicted noise levels internally, location of mixing desk, sound system testing etc
 - Bump-in/out timings and durations.
 - timing of rubbish removal.
 - Management of heavy vehicles on-site.
- h) A comprehensive Construction Noise and Vibration Management Plan (CNVMP) shall be prepared by the Construction Contractor that, as a minimum, incorporates the following:
- Specific construction work methodology, technique and program.
 - Results of baseline noise surveys of the existing environment are representative of all relevant sensitive receivers surrounding the Project.
 - Defined noise management levels for all sensitive receivers that consider the existing noise levels in the environment, in accordance with NSW ICNG and CNVG.
 - Defined vibration management level for all sensitive receivers, in accordance with BS 6472:2008 (for human comfort) and DIN 4150-3:2016 (for building and structural integrity).
 - Modelling noise and vibration impacts from high noise and vibration generating activities.
 - Details of all standard and specific noise and vibration mitigation measures that will be implemented.

- Proposed attended and unattended monitoring will be required through-out the construction program to ensure that the noise and vibration management levels are met.
 - A complaint response and management procedure.
- i) All management plans relevant to noise and vibration (such as the Construction Noise and Vibration Management Plan, Event Noise Management Plan, Operational Noise Management Plans) shall be prepared in consultation with relevant key stakeholders surrounding the project, including, but not limited to, the TSO, UTAS, Baha'i Centre of Learning and others.
 - j) All management plans (and detailed noise modelling) relevant to noise and vibration (such as the Construction Noise and Vibration Management Plan, Event Noise Management Plan, Operational Noise Management Plans) shall be independently reviewed by an Acoustic Engineer/Consultant (a person that is eligible for membership with the Australian Acoustical Society and is a Chartered Professional Engineer of the Institution of Engineers Australia).
 - k) Where attended measurements are required (eg. To investigate complaints, monitor adhoc events, construction activities, etc) or All noise and vibration measurements shall be undertaken in accordance with the NMPM by an Acoustic Engineer/Consultant (a person that is eligible for membership with the Australian Acoustical Society and is a Chartered Professional Engineer of the Institution of Engineers Australia).

11 REVIEW OF DRAFT MACQUARIE POINT PLANNING PERMIT

- 11.1 I have reviewed the Draft Macquarie Point Planning Permit, “Draft Project Permit” [Ref. 14.29].
- 11.2 Condition D1 should include a requirement for an Operational Noise Management Plan and an Events Management Plan to be approved prior to operations commencing (as per Condition D7).
- 11.3 Condition D2, “Multipurpose Stadium Event Operational Hours” should be contingent on demonstrating compliance with condition D12 and specific noise limits (as noted in Section 10). Notwithstanding that, I consider concerts should cease at 11pm, not 11:30pm, as recommended by The Noise Council, “Code of Practice on Environmental Noise Control at Concerts” to reduce the potential for sleep disturbance.
- 11.4 Condition D7, “Events Management Plan”, is not unreasonable and is consistent with the proposed control measures I have set-out in section 10, though I recommend it should be expanded to include noise management for major events such as concerts, and as a minimum reference D12.
- 11.5 Condition D12, “Operational Noise Management Plan”, is not unreasonable and is consistent with the proposed control measures I have set out in section 10, though I recommend specific locations for monitoring and that results are available online for independent audit.
- 11.6 Regarding Schedule 5:
- a) A detailed Construction Noise and Vibration Management Plan is required as noted in the proposed control measures I have set out in section 10. This should be listed as a sub-plan in Schedule 5, CN2.
 - b) Operating hours for construction should be limited to 8am to 1pm on Saturdays (not to 6pm as proposed) and no work should be allowed on Sundays or Public Holidays as is consistent elsewhere in Australia (as noted in the ICNG [Ref. 14.25], unless otherwise approved by the Secretary for the Department of State Growth (or delegate), in consultation with the Director EPA (or delegate).
- 11.7 Noise limits should be scheduled in the conditions at the site boundaries of the stadium (outside the stadium) for a Concert event and Game Day events as I have noted at Section 10.
- 11.8 Noise limits should be scheduled in the conditions within the stadium for a Concert Sound System and installed Public Address system, as I have noted at Section 10.

12 RESPONSE TO REPRESENTATIONS

12.1 I was requested to review 29 representations, as provided by MinterEllison. Where necessary, a response has been provided below.

12.2 Crown in Right of Tasmania (Representation Numbers 29,141 and 474):

- a) I agree with the statement in Representation Number 29 that *“The Project can be planned and managed to (i) avoid unacceptable impacts during construction, including noise, dust and traffic impacts via an appropriate Construction Management Plan; (ii) provide for acceptable operating impacts during peak usage via appropriate event management planning, scheduling and integration with relevant agencies; and (iii) ensure impacts are appropriately managed through conditions.”*
- b) Regarding Representation Number 141:
 - Issue 96: I agree that the TPC Panel has *“not explained the basis for, or justified, this comment”*.
 - Issue 97: I partly agree/disagree that the TPC Panel has *“not explained the basis for, or justified, this comment”*. I agree with the TPC Panel that the *“Proponent’s Construction Management Plan (Appendix AA) does not provide a significant amount of detail on how construction issues would be managed...”*, however I disagree with the TPC Panel that *“it is likely that occupancy rates for the hotels and apartments closest to the site would be significantly impacted by the construction stage, and this would have a material detrimental effect on those businesses.”* as sufficient detail has not been provided by the Proponent as noted by the TPC Panel and therefore by it’s own admission the TPC Panel cannot form an opinion without that evidence.
 - Issue 98: I agree with the representation that *“assessment assumes an expansion of the Project scope beyond the Project as described.”* and I refer to my survey results of ambient noise in the Wapping area, from which I that conclude that noise from patrons leaving the stadium will not affect the amenity of residents in that area.
- c) Regarding Representation Number 474:
 - At 3.32 I agree that noise generated by the Project during operation *“will not be out of keeping with the surrounding noise-related land use in this context”*, however I disagree regarding noise from construction activities.
 - At 3.33(a), I agree that *“construction noise and vibration can be appropriately managed through the Construction Environment Management Plan (CEMP), and specific Construction Noise and Vibration Management Plan”*
 - At 3.33(b), I agree that *“noise from sporting events and general operations of the Stadium are predicted to be ‘just noticeable’ or ‘unlikely to be noticeable’ relative to existing ambient noise levels at sensitive receptors around the site. Noise from sirens and during concerts will exceed those noise levels, but intermittently and not inconsistently with current experiences during events and otherwise.”*
- d) Regarding Representation Number 474, “Attachment 1, H4. Noise and Vibration”, specifically “Issues identified in Draft IAR”:

- Issue 1 – I agree with the response.
- Issue 2 - I am in general agreement with the response, though I have considered objective criteria related to infrequent concert events rather than a subjective opinion as represented.
- Issue 3 – I have addressed “reserve capacity” herein and I am in general agreement with the response.
- Issue 4 – The stadium design is conceptual only, and I don’t disagree that “the acoustic mitigation measures are uncertain” as they will need to be developed and reviewed to confirm that the design will ensure compliance with appropriate design criteria.
- Issue 5 - : I agree that the TPC Panel has “*not explained the basis for, or justified, this comment*”.
- Issue 6 – I refer to my response to “Representation 2, Issue 97” above.
- Issue 7 - I refer to my response to “Representation 2, Issue 98” above

12.3 City of Hobart (Representation Number 336):

- a) The City of Hobart engaged an independent review by GHD.
- b) In response to “Key Findings”:
 - I partly agree with GHD that “*the NVIA is consistent with relevant noise and vibration assessment practices*” with reservations set out herein, including the assessment of low frequency noise emissions as noted by GHD.
 - I agree with GHD that “*The Project Guidelines do not prescribe noise and vibration limits. The NVIA considers relevant regulatory documentation and noise criteria applicable to other projects but does not suggest project specific goals. This may create difficulties in assessing compliance of noise and vibration impacts from the project, managing complaints and assessing effectiveness of suggested noise mitigation measures. It is expected that clear noise and vibration criteria, mitigation measures and predictions should be defined before commencing construction of the project, which are then refined at design finalisation and commissioning.*”
 - I agree with GHD that AECOM did not assess operational vibration or confirm that an assessment of “*operational vibration assessment is not necessary, due to low risk of perceivable vibration*”.
 - I agree with GHD that “*The NVIA does not contain a detailed construction noise and vibration assessment, rather an overview of the requirements, indicative noise assessment from piling and excavator use, and a list of construction noise and vibration mitigation measures. It is assumed that a Construction Noise and Vibration Management Plan (CNVMP) will address construction impacts separately as the NVIA does not contain sufficient information to make conclusions about associated*

risks.”

12.4 Tasmanian Museum and Art Gallery (TMAG) (Representation Number 461):

- a) I agree with TMAG that a construction noise and vibration management plan will include monitoring requirements and controls to ensure that heritage artefacts are protected.

12.5 Tasmanian Symphony Orchestra (Representation Number 387):

- a) As noted herein, I have carried out extensive noise and vibration surveys both concurrent external and internal to the Federation Concert Hall, reviewed the construction of the TSO facilities and carried out long-term and intermitted short-term surveys.
- b) The TSO engaged engineering firm Arup to provide independent advice regarding noise and vibration impacts. I refer to Arup’s report ARP-AC-R03[rev0] dated 15 April 2025, and ARP-AC-R04[rev0] dated 29 April 2025, attached as part of the representation and comment:
 - Regarding “Regulatory Requirements”, my reservations are similar to Arup’s regarding AECOM’s POSS reports.
 - Regarding “Risk of Impacts” I refer to my response at 12.5c) below.
 - Regarding “Mitigation Options – Engineering Controls - Stadium”, I have noted improvements can be made to the stadium design to reduce emissions with internal noise controls required to control emissions from concert sound systems.
 - Regarding “Mitigation Options – Engineering Controls – Federation Concert Hall”, I note Arup concurs with my opinion regarding the lack of isolation of the Concert Hall. I disagree that upgrading soundlock doors will improve isolation from external noise, likewise for the upgrade of the mechanical services system. As noted, noise levels from internal activities affect the acoustic amenity of the Concert Hall rather than from external sources. I disagree that upgrading sound absorption to the building envelope will provide a “noticeable improvement” as the Concert Hall is already compromised by lack of structural isolation (as noted by Arup).
 - Regarding “Mitigation Options – Engineering Controls – Studio”, I refer to my opinion noted herein that suggests the insulated concrete external skin has been used as per the Concert Hall, with presumably a separate internal masonry layer, which Arup could confirm as original designers. I agree with Arup regarding the lack of isolation of the Studio. I am unable to comment on whether there is existing sound absorption within the cavity of the building envelope construction (Arup would have this information on file as original designers). I disagree that upgrading Studio doors would mitigate external noise.
 - Regarding “Mitigation Options – Management Controls”, I agree with

those proposed by Arup as being consistent with those I have proposed herein.

- Regarding Arup's "Preliminary Review of POSS Construction Management Plan", I agree generally with their comments which are consistent with those herein. As noted above, Arup suggests "percussive piling" will occur, however in this report they note that "Continuous Flight Augured" (CFA) piling will be used instead (essentially piles screwed into the ground, not hammered, with significantly reduced noise and vibration levels). Arup appears to suggest that peak heavy goods vehicle movements require assessment without recognizing the heavy goods vehicles already using the major arterial routes adjoining the Federation Concert Hall.
- c) I refer to the summary table in TSO's representation (included here as Figure 15-9) and note:
- "High Noise Level Construction" activities are referenced as "Percussive piling". This activity will not occur during construction and therefore can be ignored.
 - "High vibration construction" activities are referenced as "Vibratory compaction" (or rock-breaking). This activity will be intermittent and is unlikely to occur at the site boundary. Notwithstanding, I have predicted vibration levels from this activity and note it is less than the measured background noise level within the Federation Concert Hall – similarly I have assessed the vibration sensitivity of the studio microphones used by the TSO and note that vibration induced noise measured by the microphones will be less than background airborne noise levels within the Federation Concert Hall. I therefore reject the assertion that the operations of the Federation Concert Hall will be impacted.
 - I have proposed that low frequency noise levels from "High Intensity Concert" will be controlled through limits on noise levels within the Stadium. I have predicted noise levels within the Federation Concert Hall from the Major Concert events within the stadium and note they are less than the background noise levels measured within the Federation Concert Hall. I reject the assertion that noise emissions from Major Concert events at the stadium will affect the operations of the TSO.
 - As noted herein, noise levels incident on the TSO facilities will be no more than those currently experienced by the TSO, with noise generated from internal activities within the TSO and adjoining Grand Chancellor hotel more disruptive and perceptible than external noise.

12.6 Federal Group (Representation Number 862):

- a) The representation notes "Unaddressed construction noise risks business viability", noting the Draft IAR comments in relation to an inadequate

construction management plan, cumulative effects, penalties for tonal/impulsive characteristics etc. These issues have been considered herein, and in my opinion construction noise and vibration impacts can be managed to control noise impacts on the Federal Group's properties.

12.7 Dr Kate Shield (Representation Number 473):

- a) I refer to the "Noise" section of this representation and note:
 - "Pile driving" will not occur, with auger or screw piles nominated.
 - No quantitative evidence has been provided to justify the claim regarding noise from "earth moving vehicles"
 - No quantitative evidence has been provided to justify the claim regarding adverse impacts of noise from operations, and I refer to modelling results by AECOM, which I have independently reviewed and modelled, which confirms that with appropriate mitigation measures acoustic amenity will not be compromised.

12.8 Professional Historians Association Victoria and Tasmania (Representation Number 424):

- a) The representation states that they are "*deeply concerned about the ..., noise, ... during construction and beyond*" but do not provide the basis or justification for the concern. As noted herein, construction and operation noise and vibration impact from the project can be appropriately mitigated and managed through statutory noise control measures.

12.9 National Spiritual Assembly of the Baha'is of Australia (Representation Number 448):

- b) Regarding noise from patrons traversing the property, traffic on Brooker Avenue and Tasman Highway (which are existing noise sources) will have higher noise levels and dominate the overall noise impact on the property.
- c) I agree that the National Spiritual Assembly (and other relevant key stakeholders surrounding the development) should be included during consultation as part of preparation of the CNVMP and EMP, as stated in section 10.

12.10 Glebe Residents Association (Representation Number 273):

- a) The representation refers to "*Unresolved issues about the impact of noise on the Federation Concert Hall and the Tasmanian Symphony Orchestra, both during the construction stage and associated with events.*" I disagree that there are unresolved issues regarding the impact of noise from construction and operation of the Stadium on the Federation Concert Hall for reasons outlined herein.
- b) The representative refers to "*Noise both during construction and associated with specific events will be a significant problem that Glebe residents have already experienced to some extent with existing Macquarie Point activities.*"

The proponents appear not to have fully examined how noise impacts will be mitigated.” I note that acoustic amenity within the suburb of Glebe is already compromised by major transport routes, including the Brooker Highway, confirmed by long-term noise surveys I have carried out. I therefore disagree with this claim.

12.11 Stadiums Tasmania (Representation Number 326):

- a) I agree with Stadiums Tasmania note with regards to noise that “ ... *the Draft IAR does not discuss conditions although suitable conditions can be put in place to manage the operational effects of the Stadium including ..., noise, ...*”.

12.12 Jeanette McDonald (Representation Number 334):

- a) Regarding noise “*The use of the bridge will create significant noise disturbance to residents of the Apartment Complex. Currently, I can hear, even with all windows shut, the conversations of just a couple of passers-by walking along the Brooker Hwy at night.*”; I disagree with this claim given the significant noise generated from traffic on the Brooker Highway as evidenced from my survey. I refer to AECOM’s and my assessment of noise from patrons leaving the Stadium relative to traffic noise from surrounding major arterial routes.

12.13 Jamie Wood (Representation Number 313):

- a) Regarding noise, the representative notes that “*the only solution appears to be to locate the stadium at another location or the management of events so as to minimise disruption to these other facilities*”. I reject this assertion with reference to modelling results by AECOM, which I have independently reviewed and modelled, which confirms that with appropriate mitigation measures acoustic amenity will not be compromised.

13 ASSUMPTIONS AND LIMITATIONS

- 13.1 My review of the Federation Concert Hall was limited due to limited access to drawings and acoustic reports from the owner/operator. Additionally, access was limited to the “Studio” which was being used for practice purposes by the TSO at the time of my visit. I was not provided with Arup’s detailed reports ARP-AC-R01[rev0], dated 25 September 2024 and ARP-AC-R02[rev1], dated 9 April 2025 referenced in TSO’s representation (Representation Number 387).
- 13.2 I was unable to inspect Zero Davey Apartments due to fire damage to the building that meant safe access was compromised.

14 REFERENCES

- 14.1 Tasmanian Planning Commission, “Guidelines: Macquarie Point Multipurpose Stadium – Project of State Significance”, 16 February 2024.
- 14.2 Tasmanian Planning Commission, “Macquarie Point Multipurpose Stadium – Project of State Significance: Request for Further Information”, 19 November 2024.
- 14.3 Volume 1, “Summary Report”, Macquarie Point Multipurpose Stadium – Project of State Significance, September 2024, Rev 01.
- 14.4 Appendix B, “Stadium Design Description”, Macquarie Point Multipurpose Stadium – Project of State Significance, September 2024, Rev 01.
- 14.5 AECOM Australia, “Macquarie Point Multipurpose Stadium – Project of State Significance, Noise and Vibration Assessment” [**POSS Noise and Vibration Assessment Report**], Rev 1, 21 August 2024.
- 14.6 AECOM Australia, “Macquarie Point Multipurpose Stadium – Noise Assessment Supplementary Report” [**POSS Noise Assessment Supplementary Report**], Rev 0, 31 January 2025.
- 14.7 Tasmanian Planning Commission, “Draft Integrated Assessment Report” [**Draft IAR**], 31 March 2025.
- 14.8 Macquarie Point Development Corporation “Construction Noise Management Plan (CNMP)”, DOC/21/4643, approved June 2021, reviewed June 2024 .
- 14.9 EPA Tasmania, “Environment Protection Policy (Noise)” [**EPP Noise**], 2009
- 14.10 Berglund B, Lindvall T and Schwela D H, “Guidelines for Community Noise”, World Health Organisation, 1999.
- 14.11 EPA Tasmania, “Noise Measurement Procedures Manual” [**NMPM**], July 2008.
- 14.12 Hobart Interim Planning Scheme [**HIPS**], 2015.
- 14.13 Sullivans Cove Planning Scheme [**SCPS**], 1997.
- 14.14 Tasmanian Government, Environmental Management and Pollution Control Act [**EMPC Act**], 1994.
- 14.15 NSW Department of Environment and Conservation, “Assessing Vibration: A Technical Guide” [**AVATG**], 2006.
- 14.16 British Standard BS 6472:1992 “Guide to evaluation of human exposure to vibration in buildings (1Hz to 80Hz)” [**BS 6472:1992**].
- 14.17 British Standard BS 6472-1:2008 “Guide to evaluation of human exposure to vibration in buildings Part 1: Vibration sources other than blasting” [**BS 6472:2008**].
- 14.18 German Standard DIN 4150-3:2016, “Vibrations in buildings - part 3: effects on structures” [**DIN 4150-3:2016**].
- 14.19 Tasmanian Government, “State Road Traffic Noise Management Guidelines”, Rev 1, October 2015.
- 14.20 Association of Australasian Acoustical Consultants (AAAC), “Acoustical & Vibration Terminology”, <https://aaac.org.au/Terminology>.
- 14.21 The Noise Council, “Code of Practice on Environmental Noise Control at Concerts”

[**Code of Practice**] 1995.

- 14.22 Wheeler, P, Sharp, D and Taherzadeh, S, “An evaluation of UK and International Guidance for the Control of Noise at Outdoor Events”, Proc. IoA, Vol.42, Pt.3, 2020.
- 14.23 Tasmanian Government, Environmental Management and Pollution Control (Noise) Regulations [**EMPC Noise Regulations**], 2016.
- 14.24 Appendix AA, “Construction Management Plan”, Macquarie Point Stadium – Project of State Significance, ZANCON, August 2024, Rev 01.
- 14.25 NSW Department of Environment & Climate Change, “Interim Construction Noise Guideline” [**ICNG**], July 2009.
- 14.26 Transport for NSW, “Construction Noise and Vibration Guideline” [**CNVG**], September 2023.
- 14.27 CONCAWE Report no 4/81, “The propagation of noise from petroleum and petrochemical complexes to neighbouring communities” [**CONCAWE**], 1981.
- 14.28 International Standard ISO 9613-2:2024 “Acoustics-Attenuation of sound during propagation outdoors, Part 2: Engineering method for the prediction of sound pressure levels outdoors” [**ISO 9613-2:2024**].
- 14.29 Draft Macquarie Point Planning Permit, “Draft Project Permit” ([Macquarie Point Planning Permit Bill 2025](#))
- 14.30 Australian Standard, AS2107:2016 “Acoustics - Recommended design sound levels and reverberation times for building interiors” [**AS 2107:2016**]

15 FIGURES

Specific environment	Critical health effect(s)	L _{Aeq} [dB(A)]	Time base [hours]	L _{Amax,fast} [dB]
Outdoor living area	Serious annoyance, daytime and evening	55	16	-
	Moderate annoyance, daytime and evening	50	16	-
Dwelling, indoors	Speech intelligibility & moderate annoyance, daytime & evening	35	16	-
Inside bedrooms	Sleep disturbance, night-time	30	8	45
Outside bedrooms	Sleep disturbance, window open (outdoor values)	45	8	60
School class rooms & pre-schools, indoors	Speech intelligibility, disturbance of information extraction, message communication	35	during class	-
Pre-school bedrooms, indoor	Sleep disturbance	30	sleeping-time	45
School, playground outdoor	Annoyance (external source)	55	during play	-
Hospital, ward rooms, indoors	Sleep disturbance, night-time	30	8	40
	Sleep disturbance, daytime and evenings	30	16	-
Hospitals, treatment rooms, indoors	Interference with rest and recovery	(1)		
Industrial, commercial, shopping and traffic areas, indoors and outdoors	Hearing impairment	70	24	110
Ceremonies, festivals and entertainment events	Hearing impairment (patrons:<5 times/year)	100	4	110
Public addresses, indoors and outdoors	Hearing impairment	85	1	110
Music and other sounds through headphones/earphones	Hearing impairment (free-field value)	85 ⁽²⁾	1	110
Impulse sounds from toys, fireworks and firearms	Hearing impairment (adults)	-	-	140 ⁽³⁾
	Hearing impairment (children)	-	-	120 ⁽³⁾
Outdoors in parkland and conservation areas	Disruption of tranquillity	(4)		

Footnotes to Table 1, Clause 18

(1) As low as possible.

(2) Under headphones, adapted to free-field values.

(3) Peak sound pressure (not L_{AF,max}) measured 100mm from the ear.

(4) Existing quiet outdoor areas should be preserved and the ratio of intruding noise to natural background sound should be kept low.

Note that for the purposes of this Table, 'time base' means the period of time over which the equivalent continuous sound pressure level L_{Aeq} is determined.

Figure 15-1 Acoustic environment indicator levels from the EPP Noise.

Target traffic noise level	Application	Comments
L _{A10} (18 hour) 63 dB(A)	On road construction and upgrade projects, the Department will aim to meet a design traffic noise level of L _{A10} (18 hour) 63 dB(A) or below for noise sensitive land uses, subject to what is considered reasonable, practical and cost-effective.	A traffic noise level of 63 dB(A) or less (measured at a building façade), is considered by the Department to be acceptable for most adjacent uses for most people.
L _{A10} (18 hour) 68 dB(A)	Outside road construction and upgrade projects, where increases in traffic noise levels occur the Department will consider an operational traffic noise level of L _{A10} (18 hour) 68 dB(A) to be a practical upper limit.	As levels increase above 63 dB(A) impacts become less acceptable to more people. A level above 68 dB(A) (measured at a building façade) is considered by the Department to be undesirable for sensitive uses.

Figure 15-2 Traffic noise criteria for new roads and major road upgrades

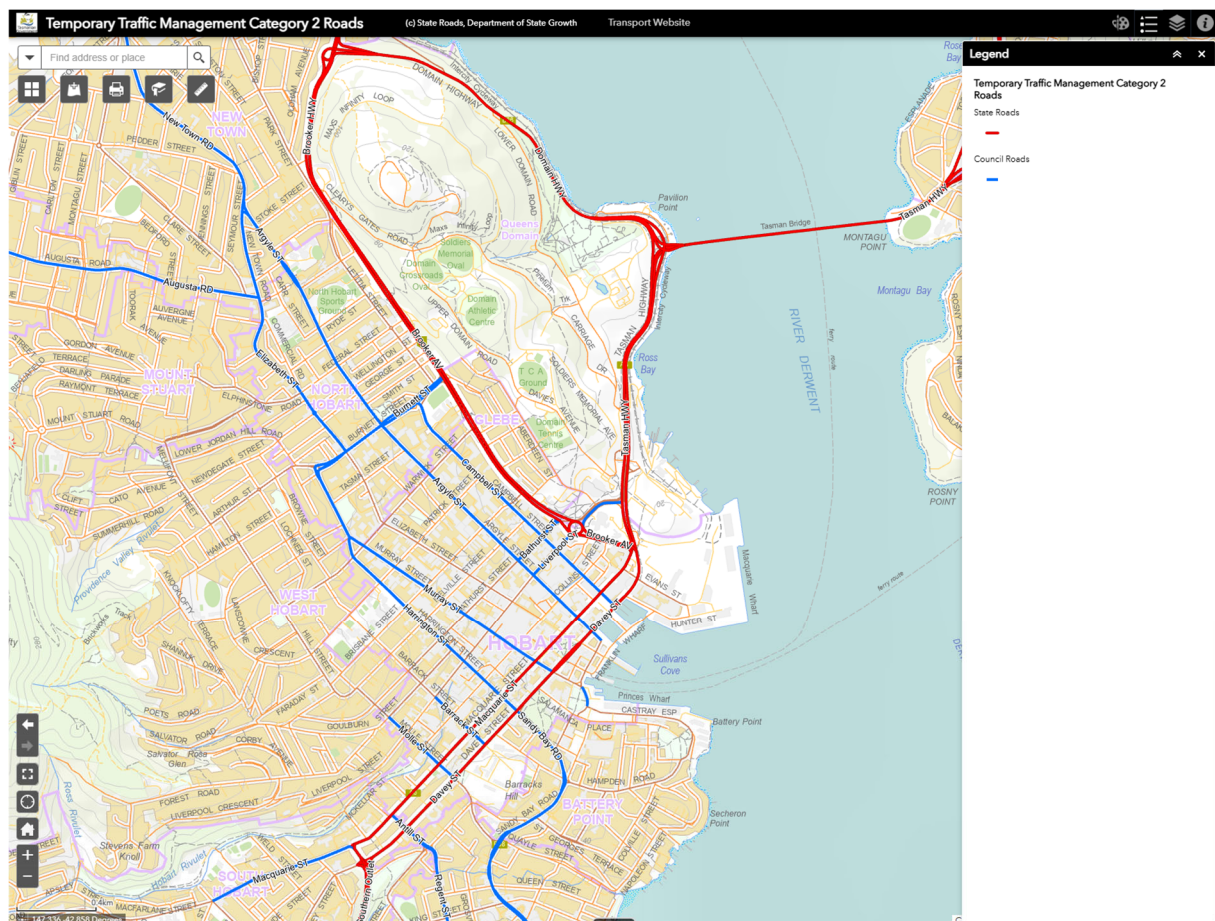


Figure 15-3 Tasmania State Roads Map ([Tasmania State Road Designation](#))

	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	L_{Aeq}	L_{Ceq}
Pop	108	98	95	95	94	90	84	81	98	110
Alt & Rock	109	100	97	97	92	88	84	78	98	110
Urban	113	98	96	94	94	90	86	84	98	114
Dance	116	101	96	94	93	89	85	83	98	116

Figure 15-4 Average octave band levels (L_{eq}) and overall A-weighted (L_{Aeq}) and C-Weighted (L_{Ceq}) noise levels of different music genres at front-of-house (from Wheeler et al [Ref. 14.22])

INTERFACE CONSIDERATIONS

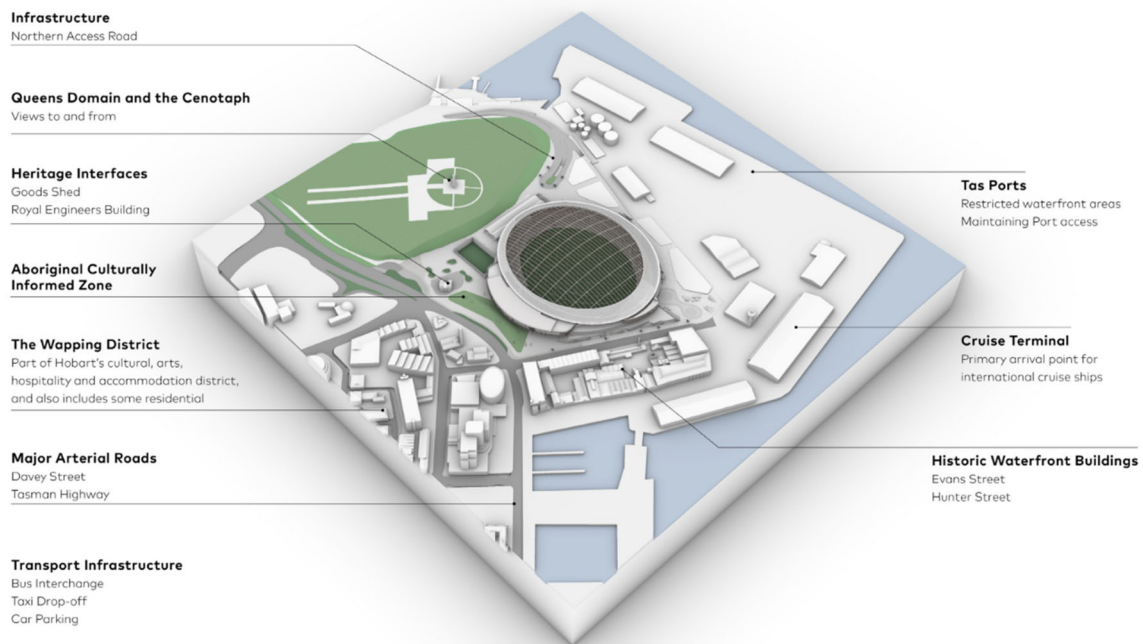


Figure 15-5 Interface considerations – Key areas around the proposed development

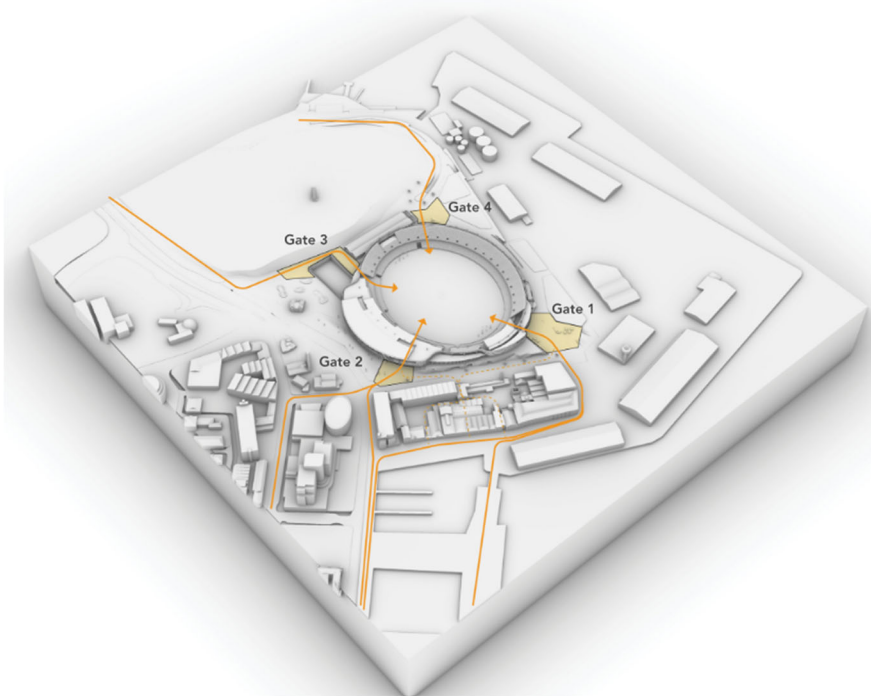
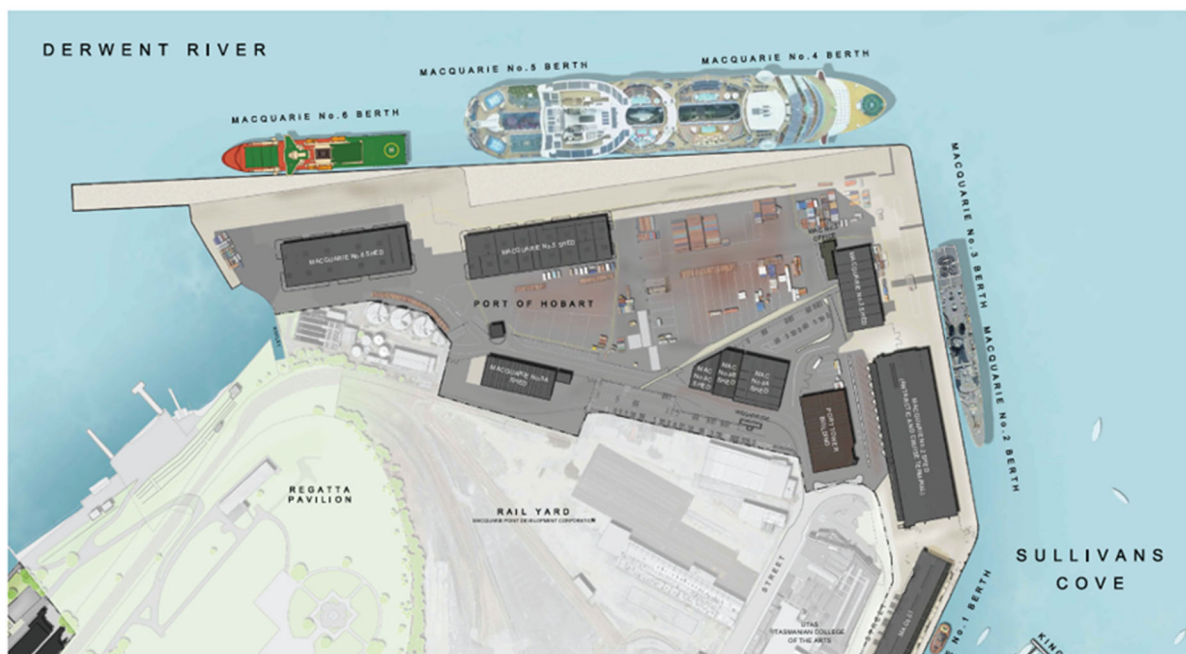


Figure 15-6 Crowd movement study



Proposed redevelopment (L-R): RSV *Nuyina* at Mac 6, an Oasis-class cruise ship at Mac 4 & Mac 5, and a RAN Anzac-class vessel at Mac 2 & Mac 3.

Figure 15-7 Proposed Redevelopment of Macquarie Point Wharf

(<https://tasports.com.au/volumes/images/Project-Brief-Macquarie-Wharf-Redevelopment.pdf>)

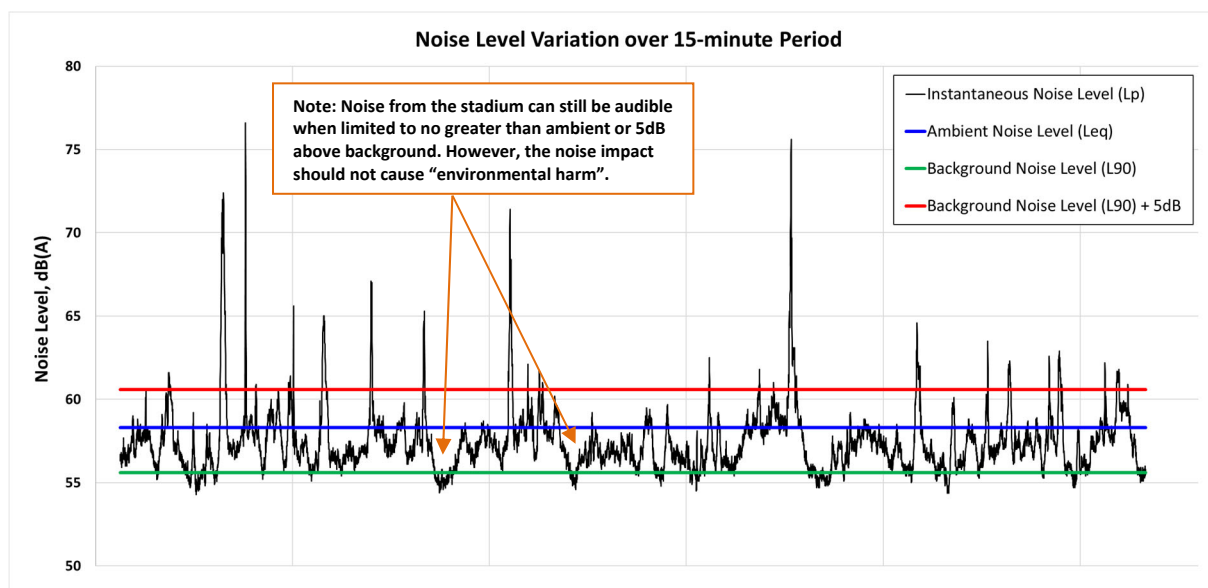


Figure 15-8 Noise level variation over 15-minute period (measured outside the Federation Concert Hall at 5:45pm on 3 April 2025).

Space	TSO Operation	High Intensity Concert	High Noise Level Construction ¹	High Vibration Construction ²	Other Activities
Federation Concert Hall	Tactility (feel)	Unlikely	Unlikely	Unlikely-Possible	Unlikely
	Audibility (human ear)	Possible-Likely	Possible	Possible	Unlikely
	Recording (microphone)	Likely	Likely	Likely	Unlikely
TSO Studios	Tactility (feel)	Unlikely	Unlikely	Unlikely-Possible	Unlikely
	Audibility (human ear)	Very Likely	Possible-Likely	Unlikely	Unlikely
	Recording (microphone)	Very Likely	Likely	Unlikely	Unlikely

¹ Percussive piling

² Vibratory compaction

Figure 15-9 Noise and vibration impact assessment by Arup (engaged by the TSO)

16 **ATTACHMENT A:** Curriculum Vitae

Dr Neil C. MACKENZIE

Qualifications:

Ph.D., University of Adelaide, 1997.
B.E. (Mech, Hons-1st), University of Adelaide, 1990.

Accreditations:

Chartered Professional Engineer, CPEng – NER (National Engineers Register)
Fellow of Engineers Australia
Engineering Executive (EngExec)

Memberships

Engineers Australia – Fellow, CPEng, EngExec
Australian Acoustical Society (AAS)
Australasian Wind Engineering Society (AWES)
Clean Air Society of Australia and New Zealand (CASANZ)

AWARDS AND PRIZES (Personal)

- Engineers Australia – Australia's Most Innovative Engineers - 2018
- Mott MacDonald - Digital Delivery Award – Sydney Metro Acoustic Assurance Tool
- The Johns-Perry Prize in Mechanical Engineering
- The Society of Automotive Engineers (Australasia) Prize
- Altona Petrochemical Co. Ltd Engineering Scholarship
- Shell Prize for Mechanical Engineering

PROFESSIONAL EXPERIENCE

2025 –present National Engineering Sciences Leader KBR Pty Ltd

Commenced work with KBR in January 2025, based in Adelaide, responsible for developing and Engineering Sciences practice in Australia. The Engineering Sciences Practice works across sectors (Buildings & Defence, Transport, Energy & Resources, Sustainability, Advisory, and Water).

2018 –2024 Global Practice Leader – Engineering Sciences Mott MacDonald

Commenced work with Mott MacDonald in November 2018, based in Adelaide, responsible for developing and Engineering Sciences practice in Australia. The Engineering Sciences Practice works across sectors (Built Environment, Transport, Energy, Environment & Advisory, and Water).

Practice skills developed included:

- Acoustics
- Vibration
- Wind/Fluid Dynamics
- Digital Technology
- Data Analytics
- Security
- Fire
- Façade
- Sustainability
- Smart Infrastructure
- Computational modelling
- Aeronautical
- Air Quality

Within 3 months had grown the team to ~ 10 engineers in Adelaide, Melbourne, Sydney and Singapore; within 12 months ~ 20 engineers, and at present ~60 engineers. This level was maintained through Covid.

Significant achievements included the Digital Delivery Award for 2019, described as *“A standout example of true digital innovation representing the intersection of data science, analytics and engineering outcomes. This project was a prime example of how we’re delivering data-driven solutions for our clients.”*

Other major achievements included:

- **Sydney Metro – City and South-west (C&SW)** – Led the operational noise and vibration design and Acoustic Integration work across all contracts
- **Stadium Australia Redevelopment** – Wind Engineering of the redeveloped stadium, including enclosed roof options
- **EDS (Engineering Design Solutions) contract with Sydney Metro** – Leading reference designs for Sydney Metro West and Western Sydney Airports, including EIS for operational noise and vibration, and precinct developments (aeronautical, reflectivity, noise/vibration, air quality ...); Development of a track-side monitoring platform. Development of optimised track-form to enable a cost-effective design.
- **Aboriginal Arts & Cultural Centre (Tarrkarri)** – Wind/Aeroacoustics of an innovative design/façade using 3D print technology
- **King Bridge Tower, Bangkok** – Wind Engineering of a super tall tower
- **Hong Kong New Convention Centre** – Total Engineering, in particular development of innovative differentiators
- **North East Link** – Reference Design (Noise/Vibration & Air Quality) and development of an innovative monitoring platform for a suite of environmental factors
- **North-South Corridor (TEAS contract)** – Development of InSAR technology for settlement assessment
- **Canterbury Mixed Use Arena (Te Kaha)** – Led the engineering sciences disciplines – Wind, Acoustics, Pitch Health, Thermal Comfort etc.
- **NGV Contemporary** – New contemporary art gallery in Melbourne
- **Regency to Pym (R2P)** – Noise, vibration and air quality review – Development of IoT based environmental monitoring platform
- **Victoria Cross** – OSD – Wind engineering, reflectivity, CFD
- **Barangaroo Station** – CFD modelling of station comfort leading to reduction in plat-room sizes
- **Auckland Airport Redevelopment** – Wind and acoustic engineering
- **Sydney Fish Market** – Condensation analysis and design optimisation
- **Ontario Line** – Canada – Application of the Acoustic Assurance Tool to rapidly (within 6 weeks) develop and optimise track-form for the new metro in Toronto
- Various other projects:
 - Monash Health & Knowledge Precinct (MHKP) & Murdoch Lot 118 - Wind
 - 88 O’Connell St (Mixed Use Development) – Wind/CFD, Acoustics
 - Adelaide Festival Square - Wind
 - Adelaide Oval Hotel - Acoustics
 - LA Convention Centre - FDB

- Circular Quay Precinct Renewal – Bid phase
- Rhodes Central – Heliostat – Aeroacoustics
- Ovingham Level Crossing Removal
- Powerhouse Parramatta – Bid phase to MPX
- Central Barangaroo – Peer review to iNSW
- Adelaide Airport – Wind shear assessments for various developments
- Jubilee Place – Vibration
- 60 King William – Wind, Vibration, Acoustics
- Victoria Tower – Wind, Acoustics, Sustainability
- Hobart Cable Car – Expert Evidence – Odour, Noise
- Hallett Cove Boardwalk – Wind Noise
- JTC Wind Driven Rain
- Geelong Cov & Exh Centre – Bid phase with LL

2006 – 2018

**Technical Expertise Leader, Global
Aurecon (formerly Connell Wagner)**

I approached Connell Wagner (now Aurecon) to initiate and develop an “Acoustics & Vibration” expertise, and I became the Global “Service Line” (now “Technical Expertise”) Leader for “Wind, Acoustics & Vibration” within Aurecon.

Responsible for the service line's development of technical skills, financial performance and growth (with projects across Asia, Africa, Middle East, New Zealand and Australia), or more specifically:

- Budgetary control
- Technical guidance of multi-discipline teams
- Quality and timeliness of deliverables
- Commercial assessment of project opportunities
- Resource coordination
- Business development
- Marketing programs
- Contractual negotiations
- Recruitment, staff development and training
- Eminence through conference attendance and awards

Developed annual business plans to grow the team from inception to a \$3m pa revenue stream with profit of around 20%. This was achieved through:

- Establishing a “critical mass” of staff in Adelaide to enable growth to other regions
- Selective tendering on challenging/niche work (low volume, high margin)
- Skill diversification – Air Quality, Wind Engineering, Audio-Visual, Thermal etc
- Differentiation through Innovation – Refer to my publications list for some novel services and products.

Our service line survived through the GFC (Global Financial Crisis) and the demise of the mining boom and is prospering with the advent of the infrastructure boom (albeit with different challenges).

Refer to projects listed below (last 10 years) for examples of projects that I have led.

I established my own company for equity investments (MP Trading Co. Pty. Ltd. ATF MP Trust).

I established my own company (Soundmatrix Pty Ltd) that designed, tested, certified, manufactured and delivered an innovative loudspeaker product (over 400) to the QEII Courts (refer to project details below).

1996 – 2006

Vipac Engineers & Scientists

2005 – 2006: Asian Regional Manager

(12 month contract, <http://www.vipac.com.au/>)

Based in Singapore, I was responsible for Vipac's operations throughout South East Asia (offices in Singapore and Hong Kong). Duties included:

- Budgetary control
- Technical guidance of multi-discipline teams
- Commercial assessment of project opportunities
- Resource coordination
- Business development
- Marketing programs

Due to the short-term nature of my contract, and a challenging budget, I targeted imminent landmark projects, and limited business development to countries with high construction targets and limited competition (such as Vietnam). Less attention was required in Hong Kong due to past successful business development (refer below).

Success was achieved within the first 3 months with significant project awards in Vietnam (previously not considered by Vipac), Malaysia and Thailand. At the same time, I was working on major underground train systems in Singapore and Turkey, and Symphony Stage in Singapore.

My major success came from the award of the Burj Dubai Tower, the world's tallest building (<http://www.burjdubai.com/>). Three firms were bidding for the Building Services Contract to the Main Contractor (based in SE Asia). Due to my past work in Dubai, I was aware of the strengths of each firm, given their relationships and locale, and was therefore able to target Vipac's bid appropriately. Vipac's competition came from consultants based in New York, Japan, Singapore, London and Dubai. I developed the proposal, presented to the client, assessed risk, negotiated the contract terms, sourced sub-consultants, developed the management plan (delivery, resourcing and financing requirements) and led the project across all disciplines including presentation of technical reports to the Developer, Main Contractor, and Project Manager.

Work on the Burj Dubai project involved extending Vipac's standard scope of work from Noise and Vibration Engineering, to include Seismic Engineering, Pipe Stress Analysis and Structural Engineering of all Building Services. The height of the tower, and the introduction of new services to Vipac, meant that I had to overcome many technical difficulties new to Vipac.

Because of my work, Vipac's profitability in South East Asia underwent a major positive transformation. Consequently, I was asked to extend my contract, but I witnessed the specialist services companies being taken-over by the large multi-discipline companies, and I was seeking an equity stake with my employer.

2003 – 2005: Corporate Manager - Building & Infrastructure

I was responsible for the development of the Middle East and Australian markets, including a significant business development budget. I increased my group's income by at least 20% in each financial year (Previous years had stagnant or negative growth). I independently sourced resources internationally to cover short falls in staffing across disciplines. I was

responsible for the introduction of measures to protect intellectual property I had developed for Vipac (refer below).

- Middle East: Within one year of my appointment, I was responsible for the development of income equal to or exceeding that of any of Vipac's existing offices. Major projects were distributed among Vipac's existing operations, and included:

General Projects:

- ... Burj Dubai Residential Towers (nine 40-60 storey towers)
- ... WAFI City extension (pyramid 5 star hotel and major retail extension)
- ... Qatar Science and Technology Park (science and technology incubator)
- ... Kuwait Trade Centre (60 storey twisted tower)
- ... Mall of the Emirates (5 star hotel, indoor ski slope, major retail centre)
- ... Park Place Tower (60 storey tower with vented facade)

Dubai Festival City Projects (www.dubaifestivalcity.com):

- ... Dubai Intercontinental Group Hotels (3 and 5 stars), Office complex (30 storey) and Convention Centre.
- ... Festival Centre (major retail centre)

Dubai International Finance Centre Projects (www.difc.ae):

- ... Gate Gardens (nine 10-20 storey commercial buildings within the Dubai International Finance Centre precinct)
- ... The Gate Building

- Australia: On my own initiative, I extended my expertise into the growing field of environmentally sustainable design. In South Australia, I led a project (among other sustainable projects) that obtained an RIAA National Award for Sustainability (Mawson Lakes School). I also gained a contract to develop the City of Adelaide's "Greenhouse Neutral Strategy". Other contracts gained included:

- ... WA – Perth CBD Courts (PPP)
- ... SA/NT – Darwin Waterfront Redevelopment (PPP)
- ... NSW – Joint Operations Command HQ (PPP)
- ... QLD – SW1 (Office/Retail)

- South East Asia: With limited time (one visit), I was instrumental in the award of a confidential landmark project in Hong Kong, involving world-class theatres, museums, art galleries and entertainment venues that required the broad range of services offered by Vipac.

Success in Australia and the Middle East enabled me to offload leadership of a strong performing group and relocate to Singapore to head the development of the SE Asian market (which had been under-performing).

2000 – 2003: SA/NT Manager - Building & Infrastructure

In 2000, Vipac created groups that focus on specific industry sectors. I was appointed Manager of the Building & Infrastructure Group for SA/NT in Vipac's Adelaide office.

I managed a range of specialist engineering disciplines (acoustic, thermal, structural and environmental engineering) provided by Vipac on a range of major projects including:

- ... Infrastructure : Adelaide Airport Noise Insulation Project
- ... Sport : Adelaide Oval Redevelopment
- ... Transport : Adelaide Airport-New Terminal

... Public : Adelaide Convention Centre
... Judicial : Commonwealth Law Courts
... Health : Private Hospital Redevelopments (Wakefield, Burnside etc)
... Education : University of SA Blueprint 2005

Through this period the group's income practically doubled, and major income streams were provided to Vipac's centres of expertise (for computational fluid dynamics, air quality and wind engineering). Vipac became the dominant acoustic engineering consultancy in SA/NT with double the staff of its nearest competitor. The financial performance of my group was unmatched by any other group in the company.

During this period, I was seconded to represent Vipac's Defence and Aerospace group on a Trade Mission to the Middle East; With my own initiative I took advantage of any spare time on this mission to investigate the building and infrastructure sector in the Middle East, and was awarded two projects and developed one lead that was to prove invaluable to Vipac the following year (refer WAFI City above).

This success led to my appointment as Corporate Manager – Building & Infrastructure throughout Australia and the Middle East. I was offered the chance to include South East Asia in my brief, but I declined because I thought separate managers were required for each region.

1996 – 2000: Senior Engineer

On return from New Zealand my Brief was to re-established Vipac's presence in the acoustic area of the Construction Sector. As a result of my marketing skills (previously undeveloped), annual income generated by me quadrupled over this period from the award of the following major projects:

... Commercial – EDS Building
... Education – University of Adelaide Lower Level Site Redevelopment
... Retail – Parade Central, Adelaide Central Plaza
... Health – Royal Adelaide and Darwin Hospitals
... Public – Alice Springs Convention Centre
... Industrial – Intercast & Forge
... Residential – Queen Victoria Apartments
... Judicial – SAPOL Relocation
... Transport – Adelaide Airport Terminal
... Power – Osborne Cogeneration Plant

I introduced a number of management tools for project tracking and overall budgetary purposes, which were implemented corporately. I developed a suite of software tools for noise and vibration analysis, which have been distributed corporately for standard use (as these were not protected and taken by departing employees, I continually lobbied for IP protection).

Acting on my own initiative, I began to branch out into areas outside my discipline, including:

- Audio-Visual - eg. I designed and installed a noise masking system for National Australia Bank's Wealth Management Centre (from this I marketed built numerous others). This experience led to the design of A/V systems for new lecture theatres and court-rooms.
- Air Quality - eg. I carried out monitoring of indoor and external emissions from diesel engines using the new extension of the Adelaide Convention Centre over the Adelaide Railway Station.
- Structural/Wind Engineering – eg. I carried out measurements and assessment of wind shear resulting from the new Adelaide Airport Terminal to ensure safe take-off and landing of aircraft.

- Environmentally Sustainable Design – Computational fluid dynamics (CFD) modelling of the Australian Science and Maths School.
- Thermal – CFD modelling of the thermal environment in the pre-function space of the Adelaide Convention Centre.

During this bid I was also seconded to Lockheed Martin at Atlanta, USA to provide noise and vibration expertise for their bid for the AEW&C's bid. This involved using tuned mass dampers fixed to the fuselage of the C130J aircraft to control interior noise levels.

1993 - 1996

Project Engineer

Marshall Day Associates, Auckland, New Zealand

<http://www.marshallday.com/>

Gained experience working with an internationally recognised consultancy in all aspects of Acoustics (ie. Auditorium and Studio Acoustics, Building Noise Control, Industrial Noise Control, Environmental Noise, Research and Development). Major projects included:

- Bruce Mason Theatre (variable acoustics, multi-purpose venue modelled in Odeon)
- State Highway 20 (bespoke version of CoRTN method for complex highway)
- Port Otago (developed innovative method of modelling)
- Skycity Casino, Theatre and Tower

With my own initiative I successfully applied for two research grants from the New Zealand Government (relating to adapting Sabine's equation to include diffusion, and an active noise control application ~\$NZD 50k).

EDUCATION

1990 - 1992

**Postgraduate Degree
University of Adelaide**

My thesis focused on the development of a more stable algorithm for the electronic control aspect of system design. The algorithm was proven on a practical vibro-acoustic system, with results in a number of international technical publications. I completed my thesis while working for Marshall Day.

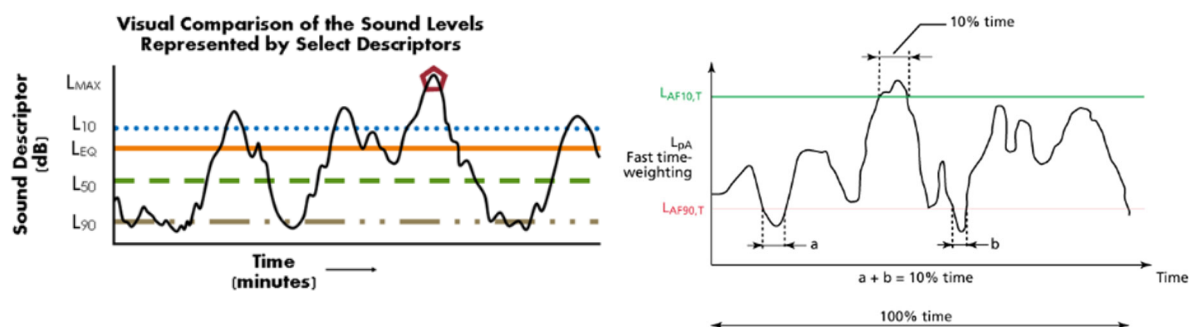
1986 - 1989

**Engineering Degree
University of Adelaide**

Gained a 1st Class Honours Degree in Mechanical Engineering, with every subject studied passed at Distinction level. I was awarded a number of prizes and scholarships as a result of my endeavours.

During vacation periods I worked for Peko-Wallsend as a Trades Assistant at their Warrego mining settlement in Tennant Creek, Northern Territory; I also worked for BHP at their steel mill at Whyalla, South Australia (developing a model to determine throughput and financial viability for their proposed continuous caster). I also worked for Vipac primarily on towed underwater hydrophone arrays (modelling self-noise and shape).

17 **ATTACHMENT B:** Glossary



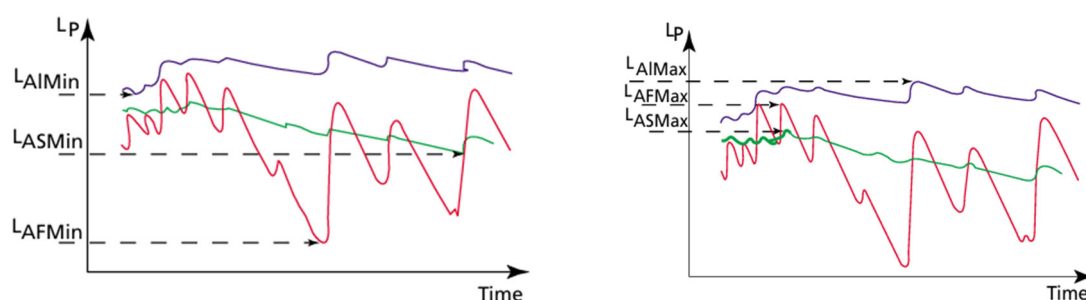
The $L_{10,T}$ is a statistical descriptor of the sound level exceeded for 10% of the time of the measurement period (T). It can be obtained using short-term measurements; however, it cannot be accurately added to or subtracted from other L_{10} measures or other descriptors. Typically, the L_{10} is about 3 dB(A) above the $L_{EQ,T}$ (for continuous traffic noise). This is typically referred to as the **Average Maximum Noise Level** in the environment.

The $L_{50,T}$ is a statistical descriptor of the sound level exceeded for 50% of the time of the measurement period (T). This descriptor is rarely used, but should not be confused with the L_{EQ} .

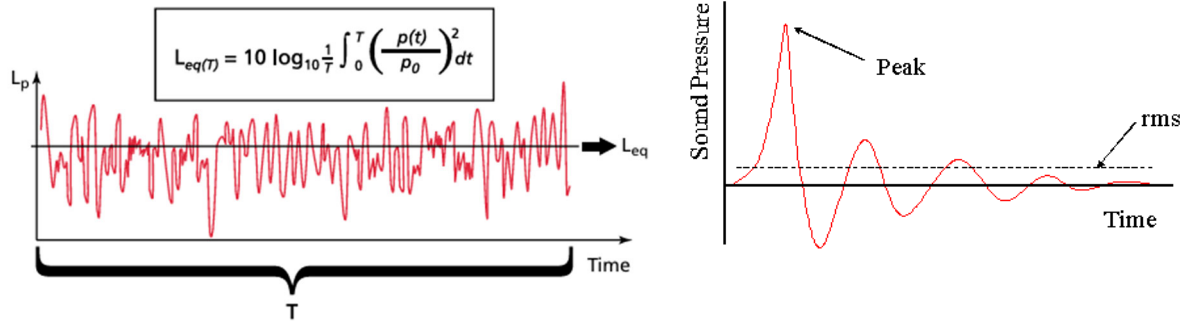
The $L_{90,T}$ is a statistical descriptor of the sound level exceeded 90% of the time of the measurement period (T). This is considered to represent the **Background Noise Level** within the environment.

The L_{EQ} , or **Time-Equivalent Sound Level**, descriptor accounts for noise fluctuations from moment to moment by averaging louder and quieter moments and giving more weight to the louder moments. It represents the equivalent continuous sound pressure level over a given period. It can be obtained using short-term measurements. L_{EQ} should not be confused with L_{50} ; L_{EQ} is a measure of sound energy, not a statistical measure or statistical average.

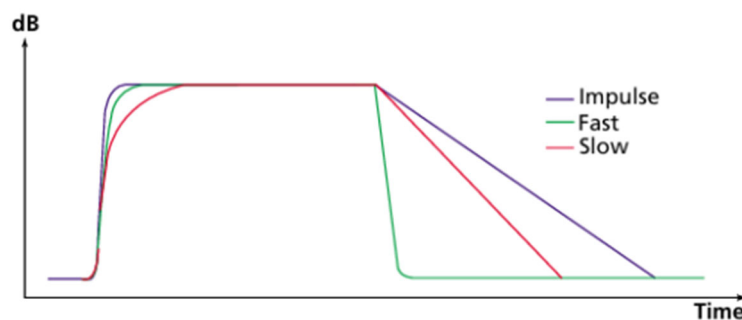
The L_{MAX} , or **Maximum Sound Level**, descriptor is the highest sound level measured during a single noise event (such as a vehicle pass by), in which the sound level changes value as time goes on. The maximum sound level is important in judging the interference caused by a noise event with common activities. The maximum noise level depends on the response time (refer below), with ordinarily a fast response used (a slow response is often used for train or aircraft noise events):



The L_{PK} , or **Peak Sound Level**, is a descriptor representing the true peak of the sound pressure wave. It is not the same as the L_{MAX} . The L_{PK} is the maximum value reached by the sound pressure. It is useful for capturing impulsive sounds, where the true instantaneous sound pressure is of interest. Neither A or C weighting, nor is a time-constant applied. This parameter is typically used for regulating mining and blasting operations.

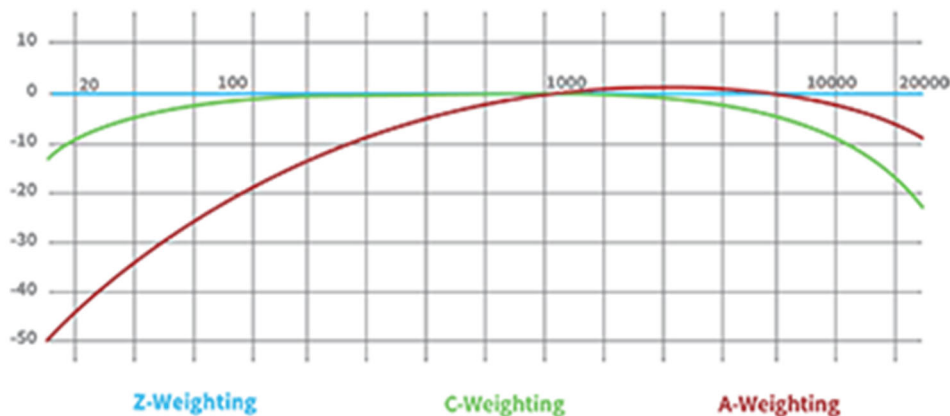


Fast, Slow and Impulse time weightings: Standardised response times were originally built into noise measuring instruments to provide visual indication of fluctuating noise levels. Environmental assessment standards usually specify which time weighting to use: Fast, F (1/8 second time constant), Slow, S (1 second time constant) or Impulsive, I (time constant is 35ms for the rise and 1500 ms for the decay).



Frequency Weighting: Frequency weightings are commonly used frequency filters that adjust the amplitude of all parts of the frequency spectrum of the sound or vibration:

- **A-Weighting:** A weighting filter that most closely matches how humans perceive sound, especially low to moderate levels. This weighting is most often used for evaluation of environmental sounds. Notated by the "A" in measurement parameters including dBA, L_{Aeq} , L_{AF} , L_{AS} , etc.
- **C-Weighting:** Commonly used filter that adjusts the levels of a frequency spectrum in the same way the human ear does when exposed to high or impulsive levels of sound. This weighting is most often used for evaluation of equipment sounds.
- **Flat, Linear Weighting or Z-Weighting:** No longer used in current standards. Flat weighting indicated that no filter was applied, across a stated frequency range. Since 2003, IEC 61672 standard notes use of Z-weighting. Z-Weighting: "Zero" or no frequency weighting applied: in actuality, a passband filter from 10 Hz to 20 kHz. Often shown as dBZ, L_{Zeq} , L_{ZS} , etc.



Major Concert Events: Events that would generate noise levels more than Business-as-Usual or Game Day events, and not readily comply with the EPA's environmental noise policies (as interpreted herein), hence requiring specific controls to limit the number of events and noise levels from such events as set out herein.

Game Day Events: Events that will utilize the installed public address sound system and comply with the EPA's environmental noise policies as interpreted herein

Business-as Usual (BAU) Events: Events that will not utilize the installed public address system and comply with the EPA's environmental noise policies as interpreted herein.

18 **ATTACHMENT C:** Independent Long-Term Noise Survey Results

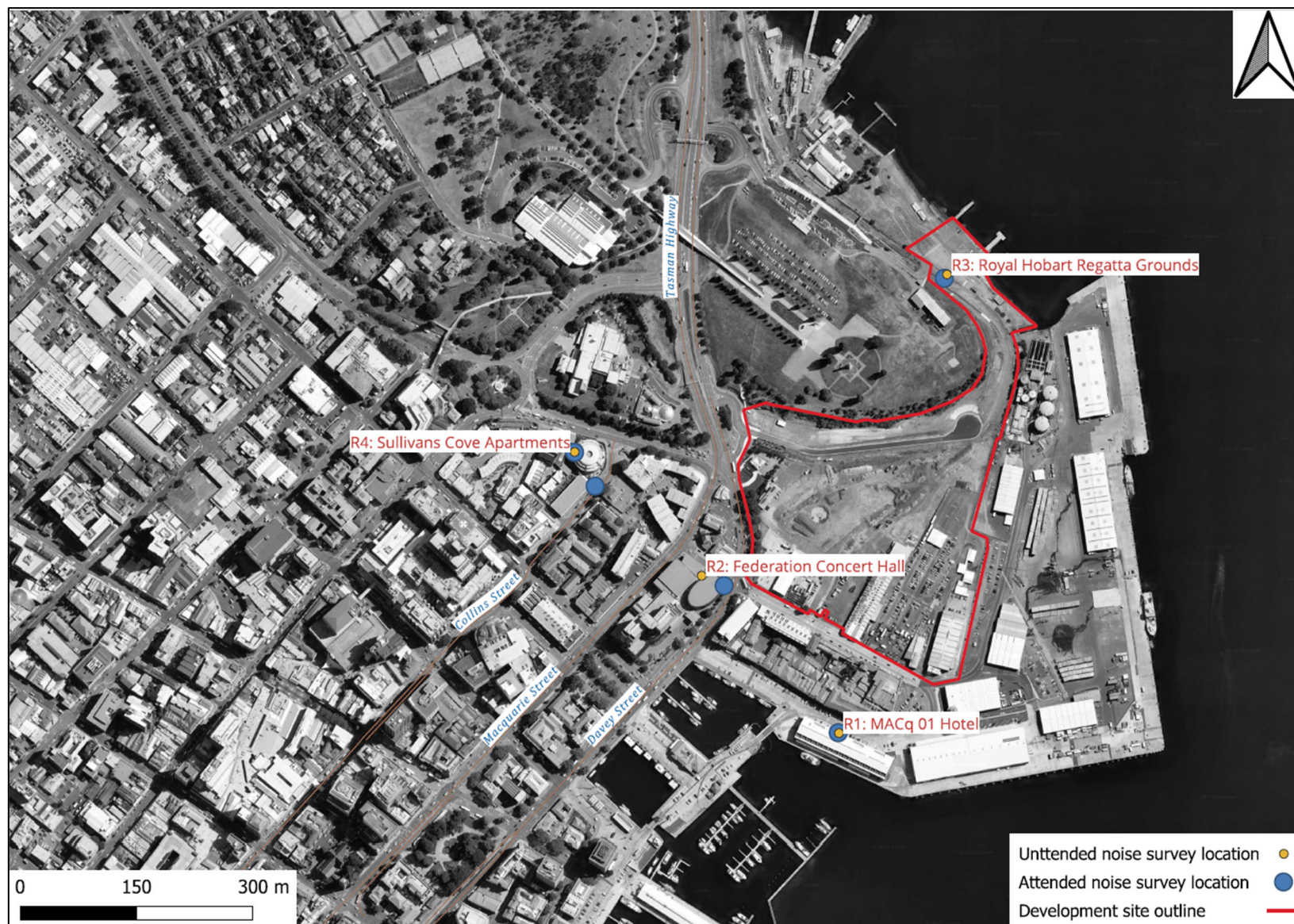


Figure 18-1 Noise survey locations (Sullivan Cove Area)

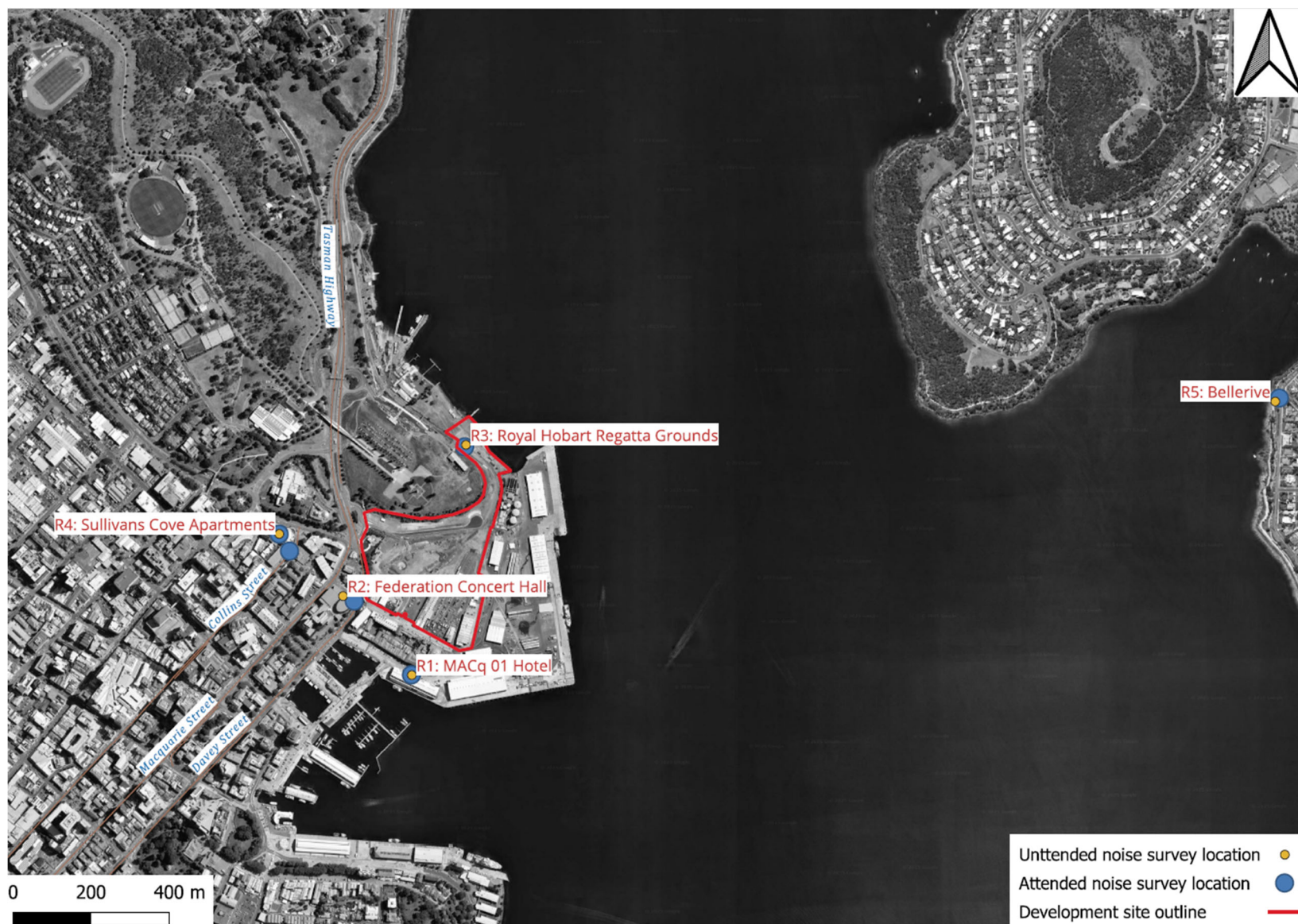


Figure 18-2 Noise survey locations (extended across the Derwent River)

Table 18-1 Photographs of long-term noise survey position at each location

R1: MACq 01 Hotel  Logger deployed at MACq 01 Hotel facing Hunter Street/UTAS	R2: Federation Concert Hall 	R3: Royal Hobart Regatta Grounds 
R4: Wapping area (Sullivan Cove Apartments – Collins Street) 	R5: Bellerive 	

R1: MACq 01 Hotel

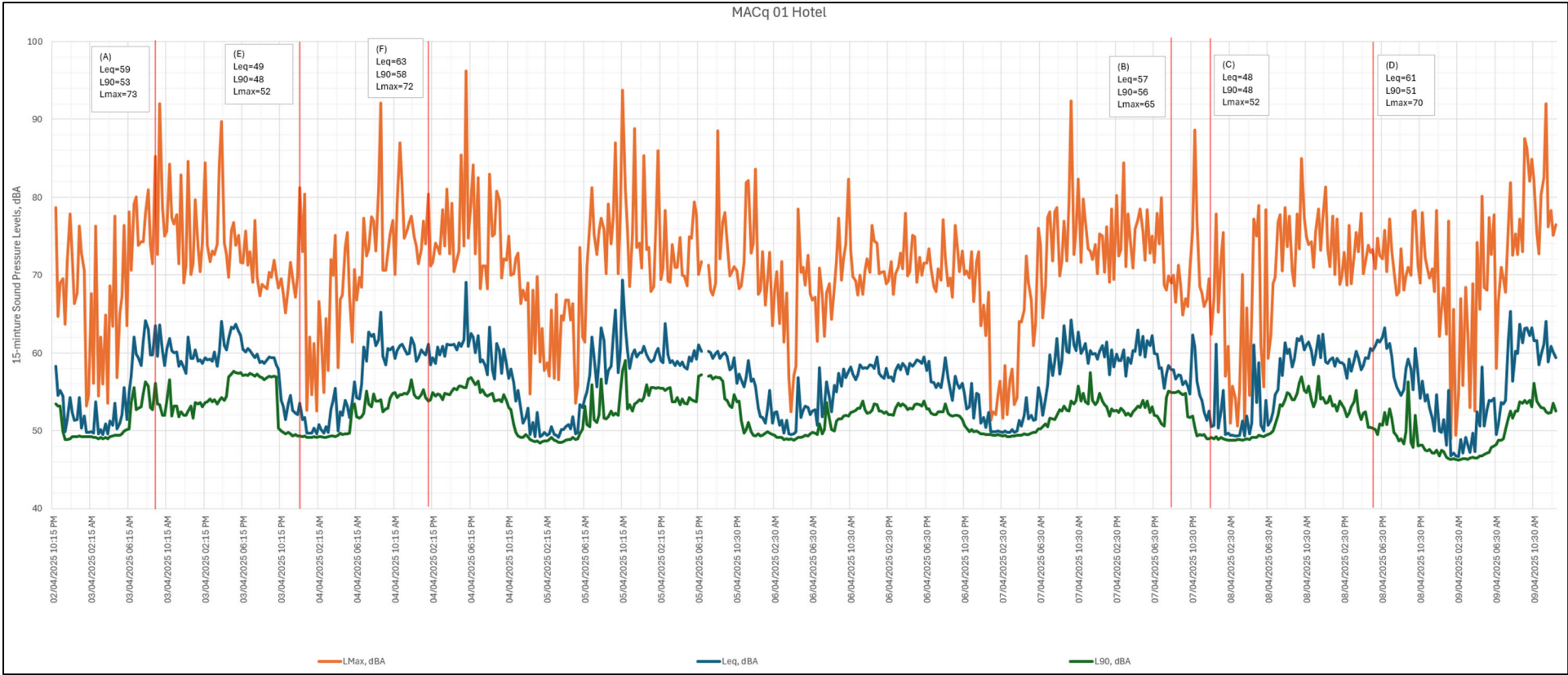


Figure 18-3 Noise survey results at R1: MACq 01 Hotel

R2: Federation Concert Hall

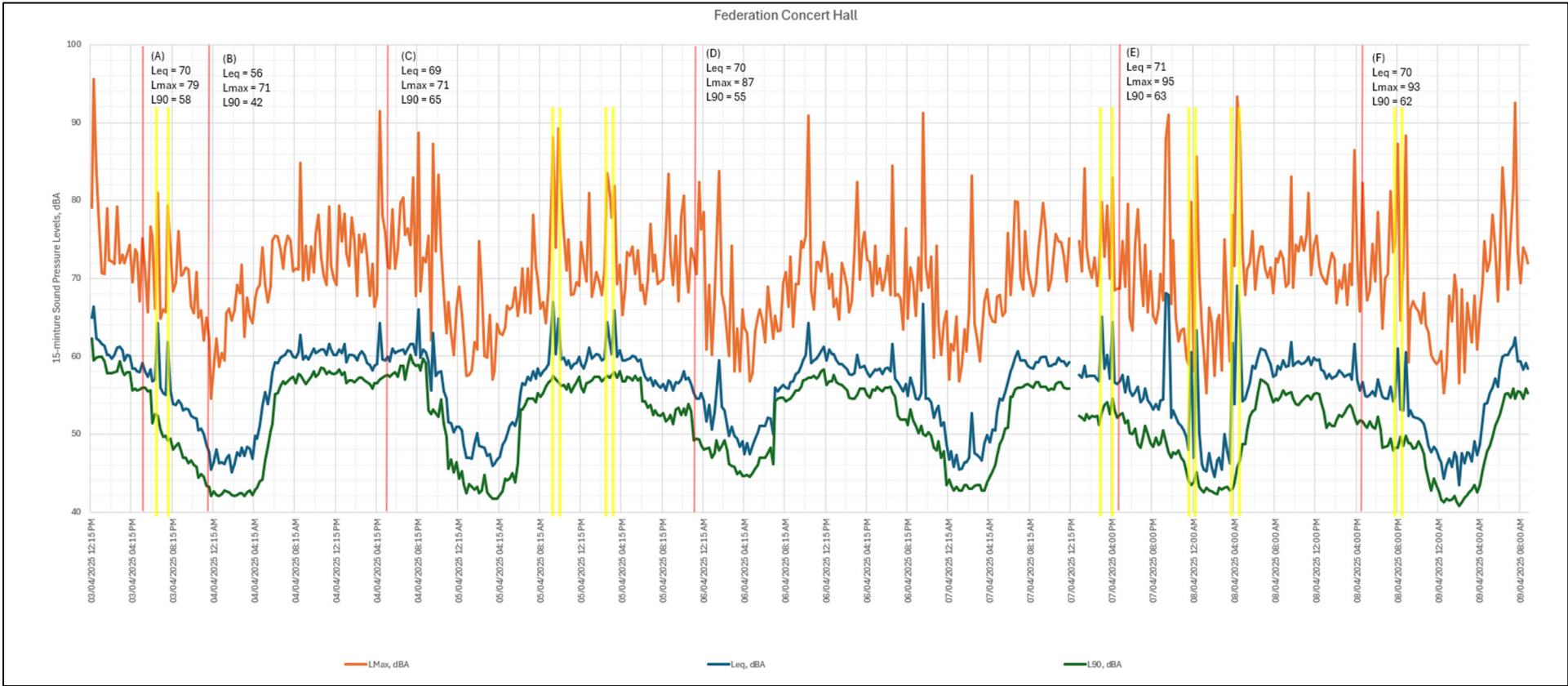


Figure 18-4 Noise survey results at R2: Federation Concert Hall (helicopter events shown in yellow)

R3: Royal Hobart Regatta Grounds

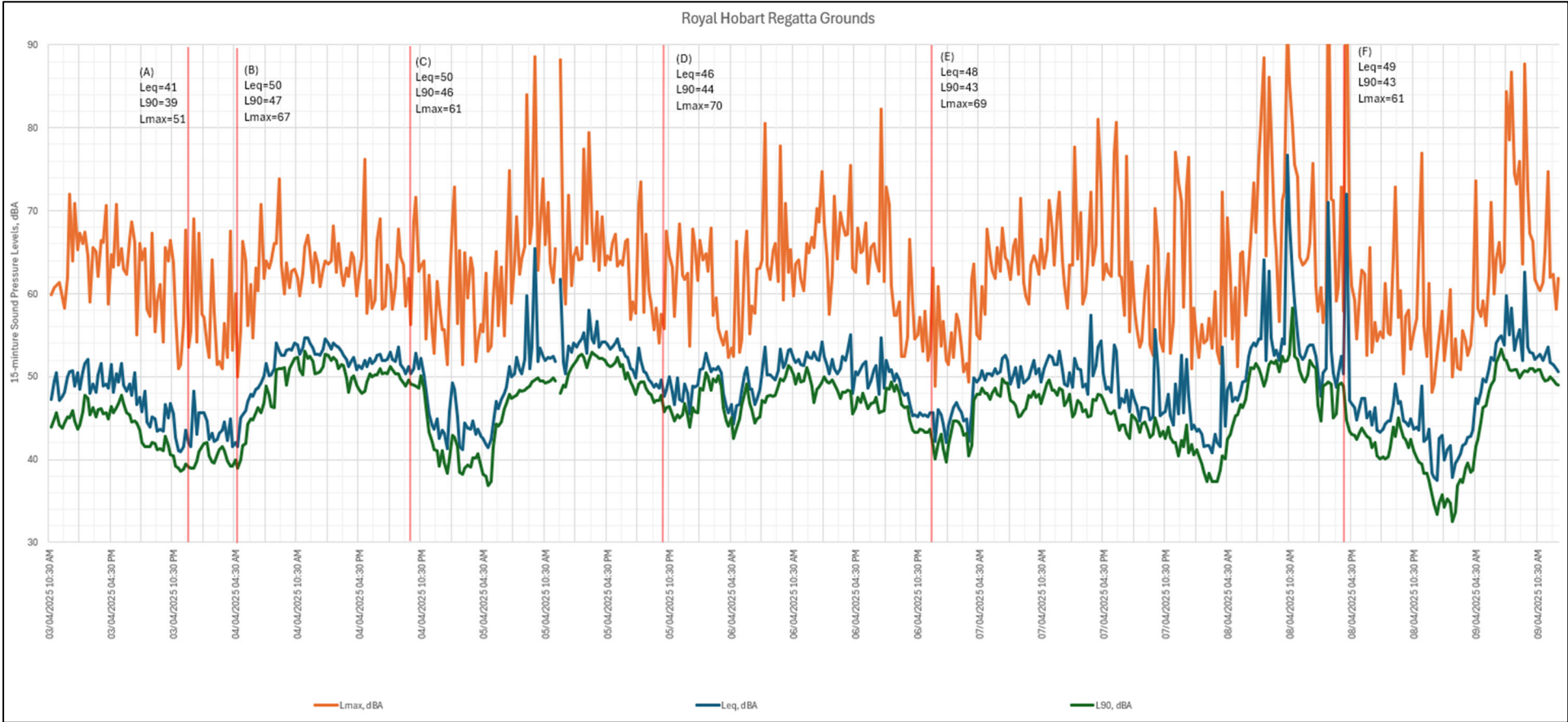


Figure 18-5 Noise survey results at R3: Royal Hobart Regatta Grounds

R4 - Wapping area (Sullivan Cove Apartments – Collins Street)

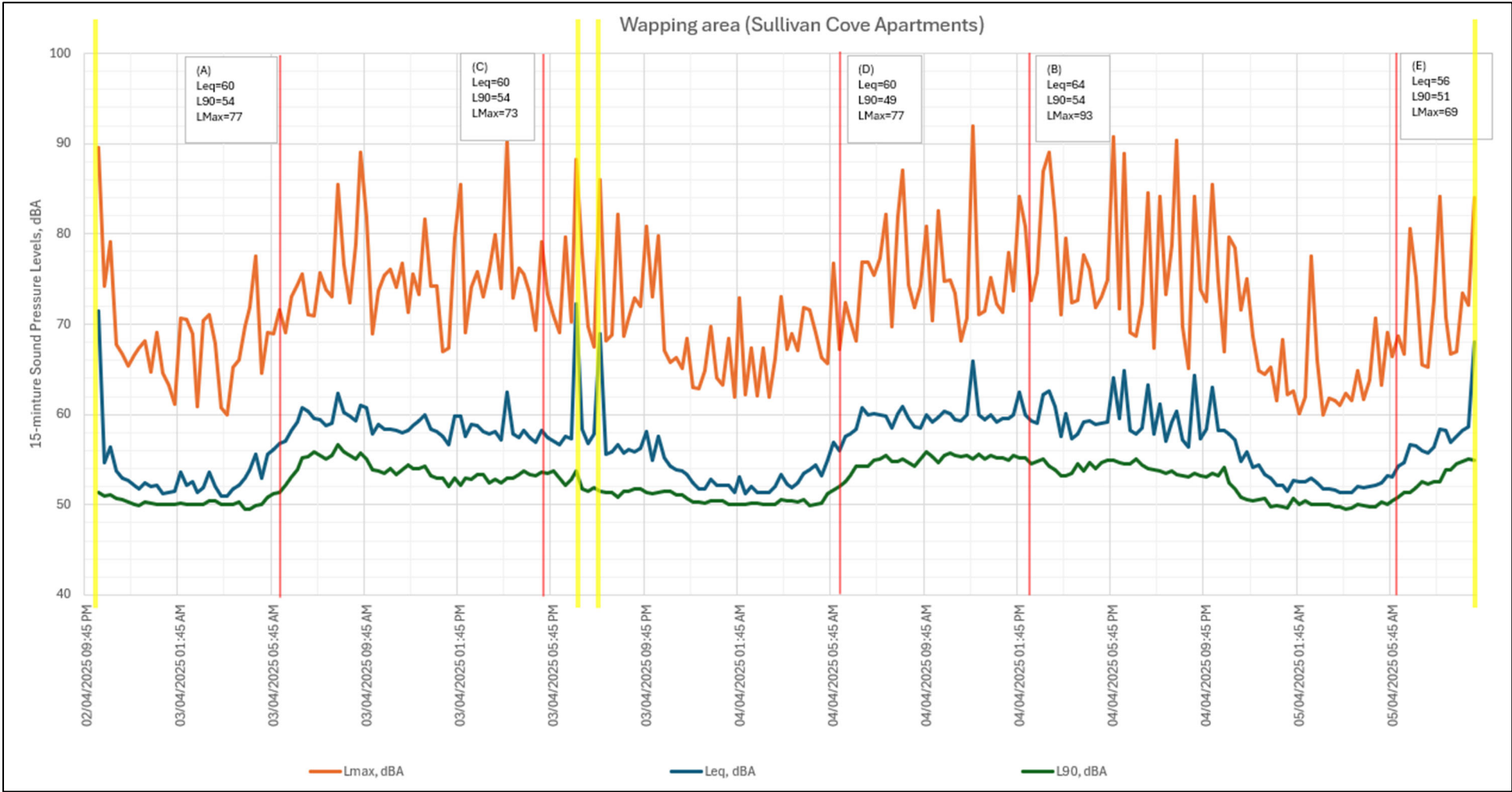


Figure 18-6 Noise survey results at R4: Wapping area (Sullivan Cove Apartments – Collins Street) (helicopter events shown in yellow)

R5: Bellerive

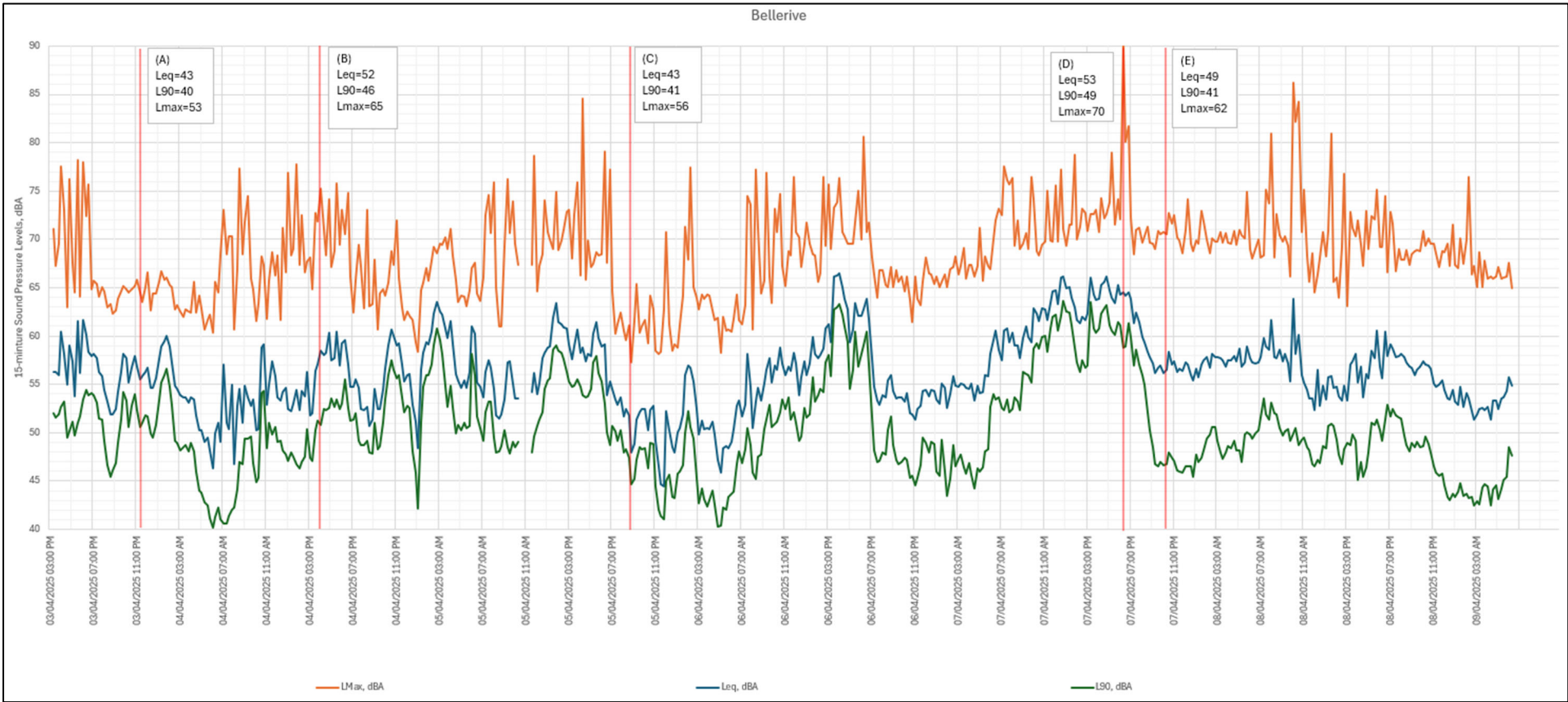


Figure 18-7 Noise survey results at R5: Bellerive (results affected by noise from tidal waves breaking against the shore)

19 **ATTACHMENT D:** Attended Noise Surveys

Table 19-1 R1: MACq 01 Hotel - Attended noise surveys and observations

Measurement Time	L _{AFmax} , dB	L _{A10} , dB	L _{Aeq} , dB	L _{A90} ,dB	Observations
3 April 2025 9:05 AM (A)	73	62	59	53	Noise levels skewed by loading activities and bus pick up/drop off. Additional noise from traffic passbys and mechanical plant as UTAS.
4 April 2025 2:00 PM (F)	72	65	63	58	Noise levels controlled by loading activities and truck idling in the area. Plant noise audible in the background. Additional contributions from truck beeper and students talking/interacting.
7 April 2025 8:20 PM (B)	65	58	57	56	Noise levels controlled by loading activities and traffic on Hunter Street. Mechanical plant from UTAS faintly audible.
8 April 2025 12:46 AM (C)	52	49	48	48	Plant noise from UTAS Arts building dominating the ambient environment.
8 April 2025 5:44 PM (D)	70	65	61	51	Steady traffic noise controlling the ambient environment. Plant noise contributing to the background noise environment.
4 April 2025 12:29 AM (E)	52	49	49	48	Plant noise from UTAS Arts building dominating the ambient environment.

Table 19-2 Federation Concert Hall - Attended noise surveys and observations
(measurements undertaken at the Davey Street/Evans Street intersection)

Measurement Time	L _{AFmax} , dB	L _{A10} , dB	L _{Aeq} , dB	L _{A90} ,dB	Observations
3 April 2025 5:28 PM (A)	79	73	70	58	Peak hour traffic controlling the environment, additional contributions from foot traffic and people talking, interacting, etc.
3 April 2025 11:44 PM (B)	71	58	56	42	Steady mechanical noise from the bottle shop across the road controlling the L ₉₀ level. Transient pedestrian crossing buzzer controlling the L _{eq} level. L _{max} levels controlled by traffic passbys.
4 April 2025 5:13 PM (C)	82	71	69	65	Noise levels controlled by heavy traffic. Transient beeps from pedestrian crossing.
5 April 2025 11:07 PM (D)	87	70	67	55	Noise levels controlled by beeping noise from pedestrian crossing. Wind induced noise and intermittent traffic noise present.
7 April 2025 5:27 PM (E)	95	72	71	63	Steady noise and vibration levels controlled by peak hour traffic, including heavy vehicles.

Measurement Time	L _{AFmax} , dB	L _{A10} , dB	L _{Aeq} , dB	L _{A90} ,dB	Observations
8 April 2025 4:40 PM (F)	93	71	70	62	Heavy traffic controlling the noise environment. Plant noise from the bottle shop was not audible.

Table 19-3 Royal Hobart Regatta Grounds - Attended noise surveys and observations

Measurement Time	L _{AFmax} , dB	L _{A10} , dB	L _{Aeq} , dB	L _{A90} ,dB	Observations
3 April 2025 11:26 PM (A)	51	42	41	39	Noise levels controlled by plant with intermittent contributions from fauna and traffic passbys.
4 April 2025 4:40 PM (B)	67	51	50	47	Controlled by fauna and traffic on Tasman Bridge. Mechanical noise from wastewater treatment plant faintly audible. Additional intermittent contributions from car parking activity (vehicle start up, idle, door closing, etc).
5 April 2025 9:20 PM (C)	61	50	48	46	Controlled by steady traffic on Tasman Highway. Mechanical noise from wastewater treatment plant audible.
7 April 2025 7:26 PM (D)	70	47	46	44	Noise levels controlled by steady traffic on Tasman Highway, mechanical plant at wastewater treatment facility and fauna activity.
7 April 2025 11:51 PM (E)	69	51	48	43	Ambient environment controlled by steady mechanical noise from the wastewater treatment plant and fauna noise. Some intermittent contributions from truck passbys and other road traffic.
8 April 2025 4:10 PM (F)	61	49	47	43	Ambient environment controlled by fauna activity. Background noise controlled by steady plant noise.

Table 19-4 Wapping area -Attended noise surveys and observations

Measurement Time	L _{AFmax} , dB	L _{A10} , dB	L _{Aeq} , dB	L _{A90} ,dB	Observations
3 April 2024 6:29 AM (A)	77	63	60	54	Typical urban environment with steady traffic from Highway controlling the environment.
4 April 2025 2:24 PM (B)	93	63	64	54	Typical urban environment with steady traffic from Highway controlling the environment.
4 April 2025 5:37 PM (C)	73	62	60	54	Typical urban environment with steady traffic from Highway controlling the environment.
4 April 2025 6:04 AM (D)	77	65	60	49	Typical urban environment with steady traffic from Highway controlling the environment.

Measurement Time	L _{AFmax} , dB	L _{A10} , dB	L _{Aeq} , dB	L _{A90} ,dB	Observations
5 April 2025 6:04 AM (E)	69	59	56	51	Typical urban environment with steady traffic from Highway controlling the environment.
The following measurements were undertaken on Collins Street; no long-term monitoring undertaken during this period.					
5 April 2025 10:06 PM	68	57	55	48	Typical urban environment with steady traffic from Highway controlling the environment. Intermittent contribution from traffic and car parking activity (idling, start up, door closing, etc) on Collins street. Some contribution from wind induced noise.
7 April 2025 11:24 PM	74	47	47	40	Typical urban environment with light traffic controlling the environment. Some intermittent contribution from car parking activity (idling, start up, door closing, etc). Helicopter activity contributing to the background noise environment
7 April 2025 6:04 PM	77	65	60	49	Typical urban environment with steady traffic from Highway controlling the environment. Noise levels skewed by idling van in vicinity of the attended measurement. Intermittent contribution from traffic and car parking activity (idling, start up, door closing, etc) on Collins Street.
8 April 2025 5:14PM	89	65	61	50	Typical urban environment with steady traffic from Highway controlling the environment. Intermittent contribution from traffic and car parking activity (idling, start up, door closing, etc) on Collins Street.

Table 19-5 Bellerive - Attended noise surveys and observations (measurements undertaken on Victoria Esplanade)

Measurement Time	L _{AFmax} , dB	L _{A10} , dB	L _{Aeq} , dB	L _{A90} ,dB	Observations
3 April 2025 11:04 PM (A)	53	44	43	40	Noise controlled by river ripples and light wind. Light mist, not affecting measurements.
4 April 2025 4:00 PM (B)	65	54	52	46	Ambient environment controlled by wind induced vegetation noise, ripples from the river and activities on the wharf.

Measurement Time	L _{AFmax} , dB	L _{A10} , dB	L _{Aeq} , dB	L _{A90} ,dB	Observations
5 April 2025 8:40 PM (C)	56	45	43	41	Noise levels controlled by steady traffic noise from Tasman Highway. Mechanical noise from Rosny Water Tank infrastructure slightly audible. Some low frequency music noise audible.
7 April 2025 6:50 PM (D)	70	55	53	49	Controlled by river ripples, noise from mechanical plant at Rosny Water Tank infrastructure audible. Distant road traffic audible in the background.
7 April 2025 10:30 PM (E)	62	52	49	41	Ambient environment controlled by noise from the river ripples and whine from Rosny Water Tank infrastructure. Intermittent road traffic passbys audible.

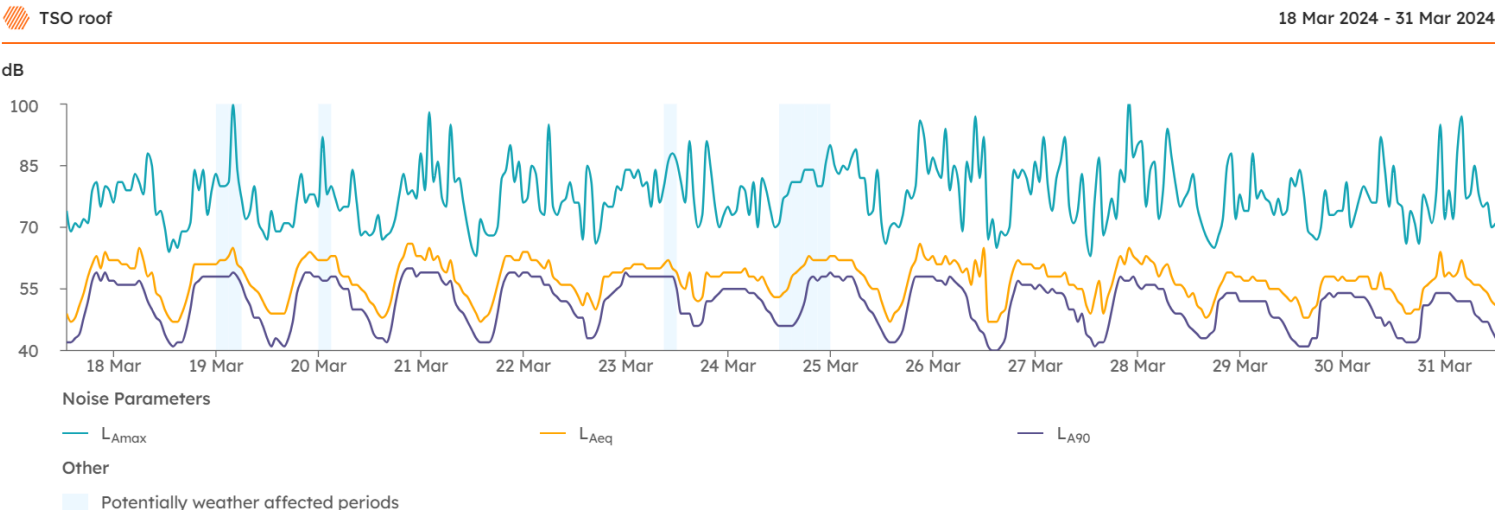
20 **ATTACHMENT E:** Long-Term Noise Surveys by Others



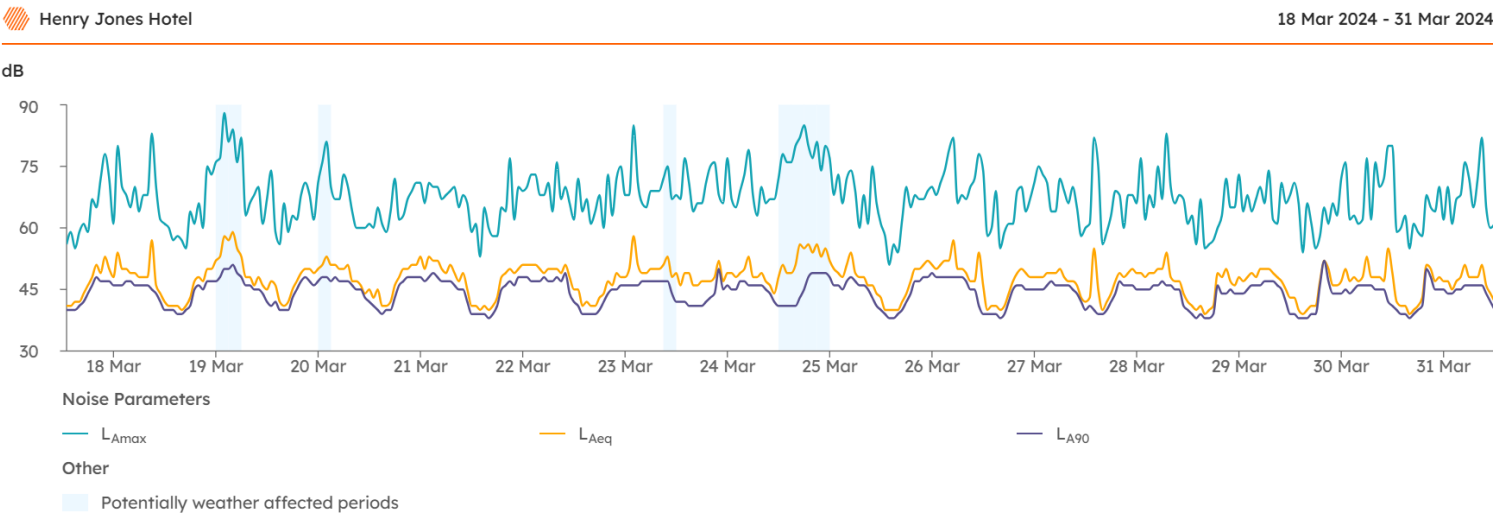
BASELINE & CONSTRUCTION MONITORING
PROPOSED LOCATIONS FOR
NOISE & VIBRATION MONITORING
EQUIPMENT & SPOT MEASUREMENTS

DATA LOGGED FROM 18 Mar to 31 Mar 2024

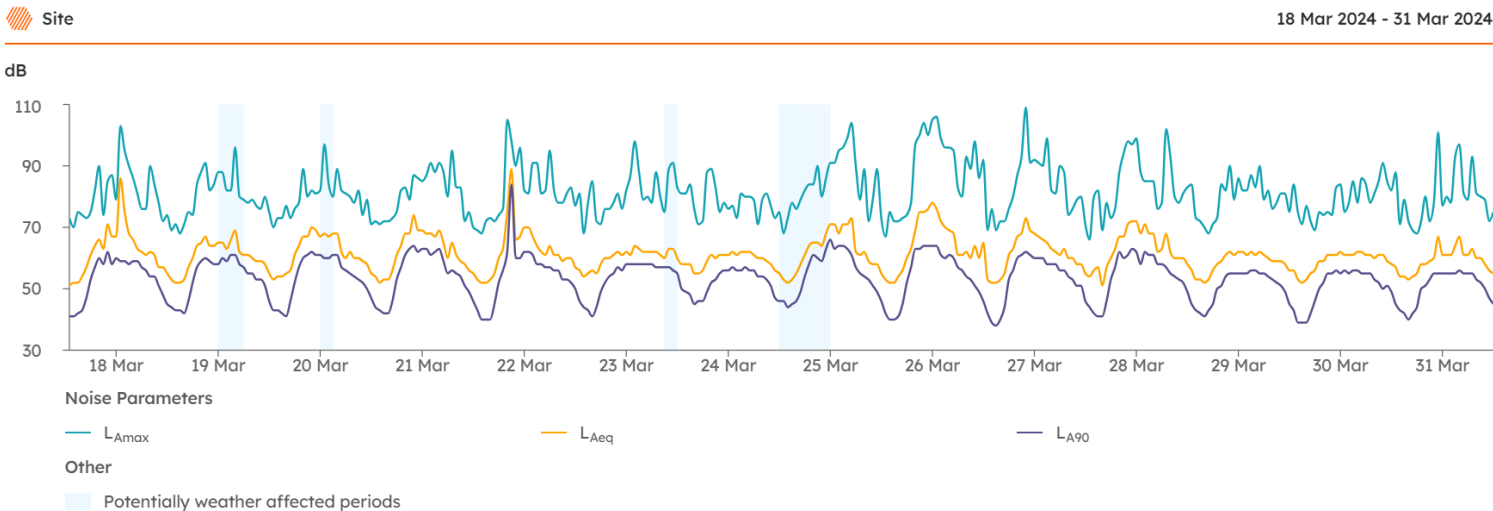
TSO Roof noise logger n3:



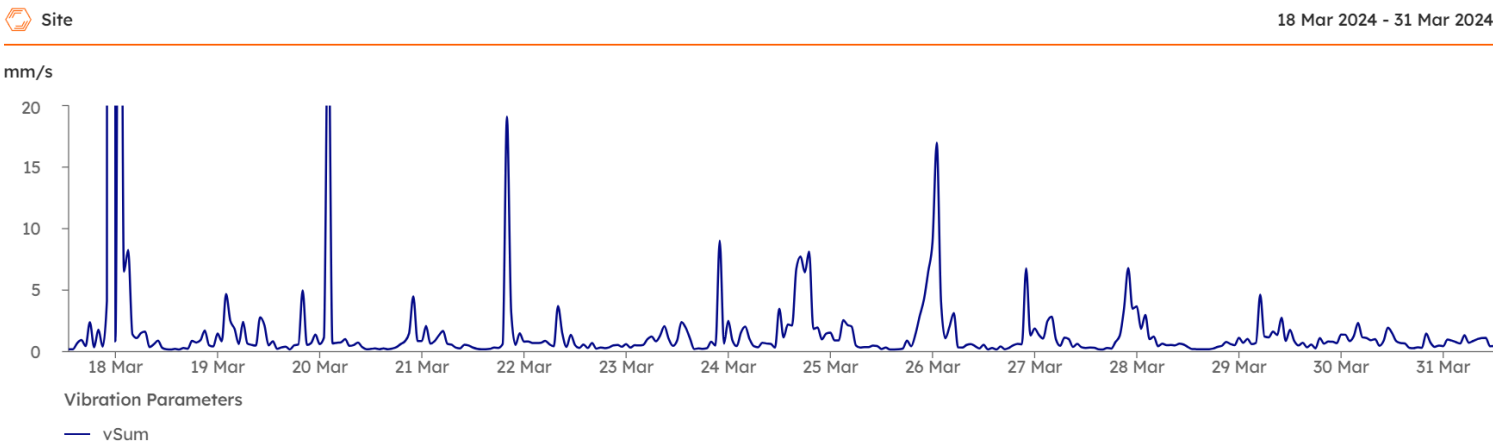
Henry Jones Hotel noise logger n4:



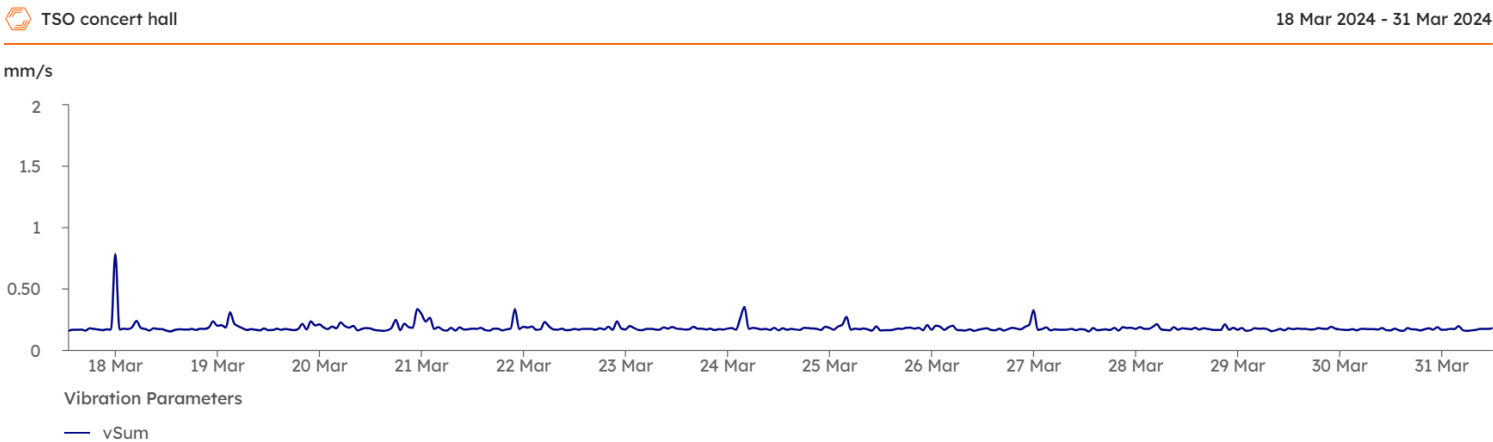
Site noise logger n5:



Site vibration logger v2:

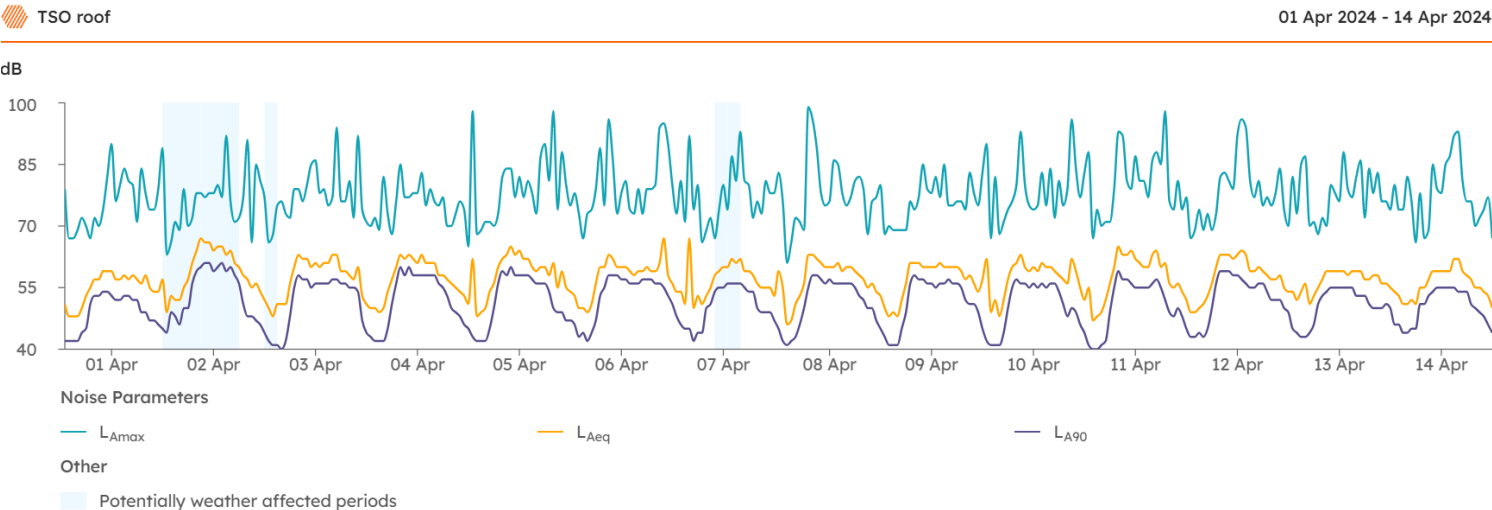


TSO Concert Hall vibration logger v1:

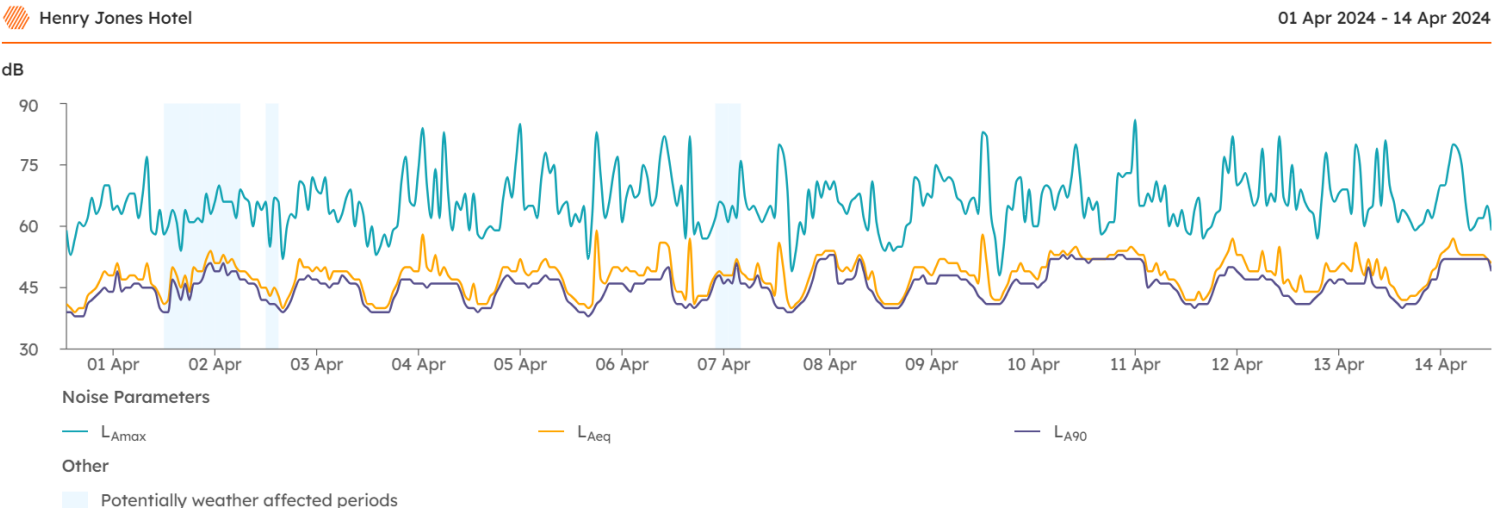


DATA LOGGED FROM 1 Apr to 14 Apr 2024

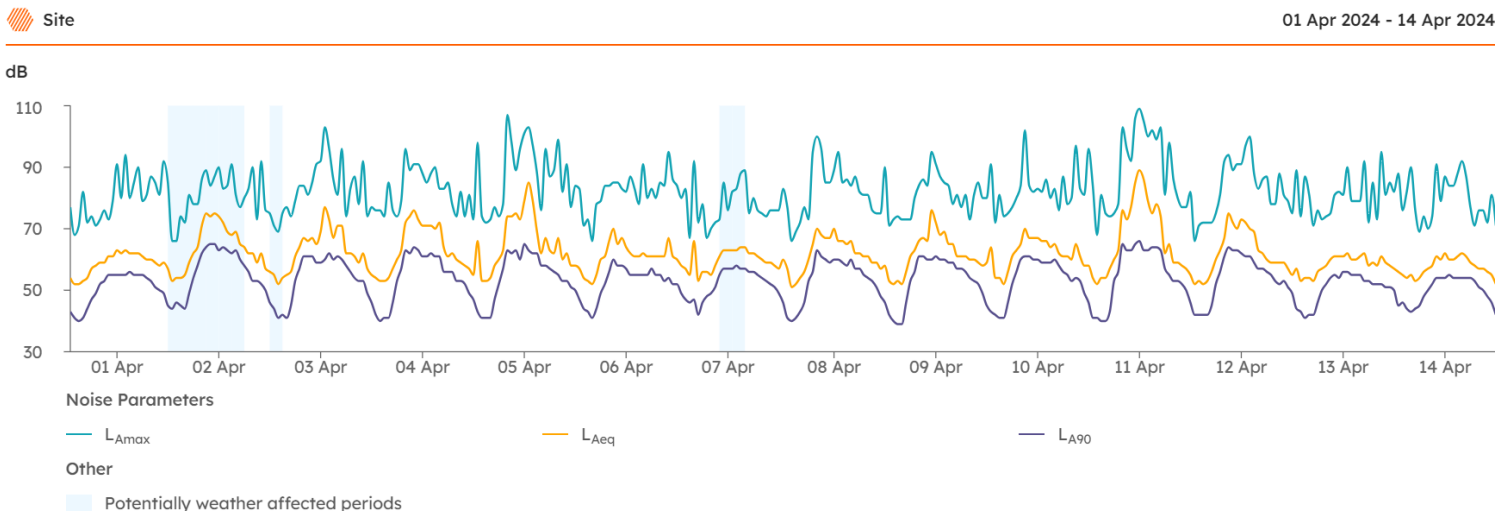
TSO Roof noise logger n3:



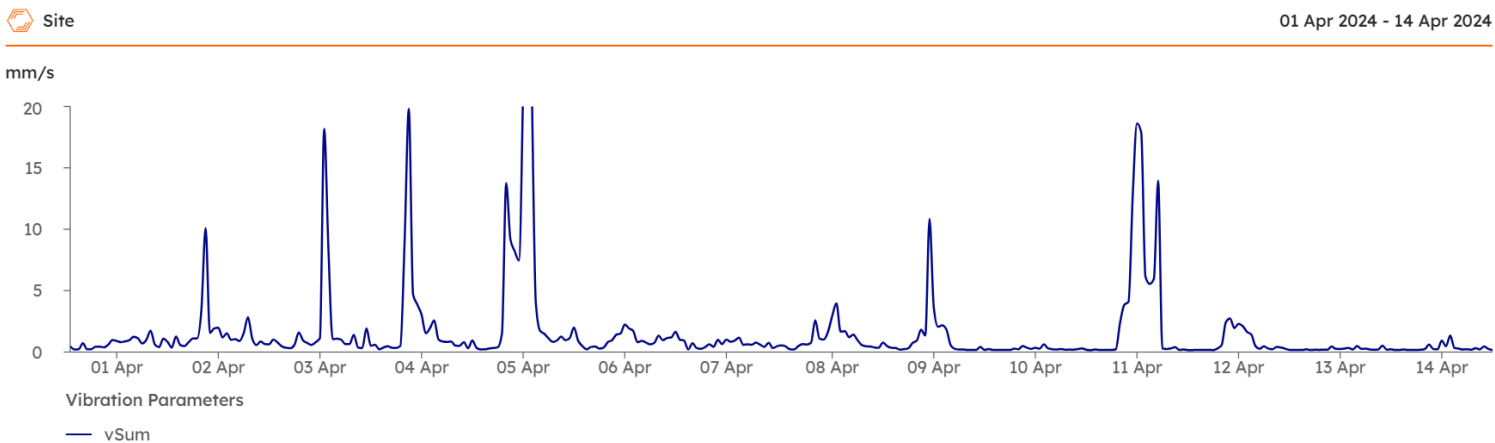
Henry Jones Hotel noise logger n4:



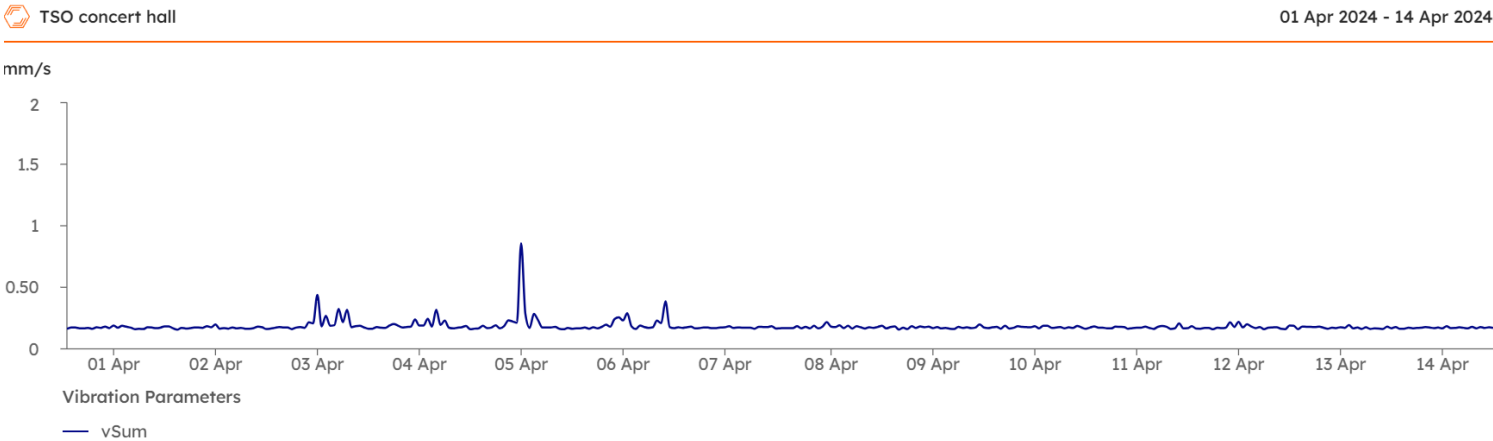
Site noise logger n5:



Site vibration logger v2:

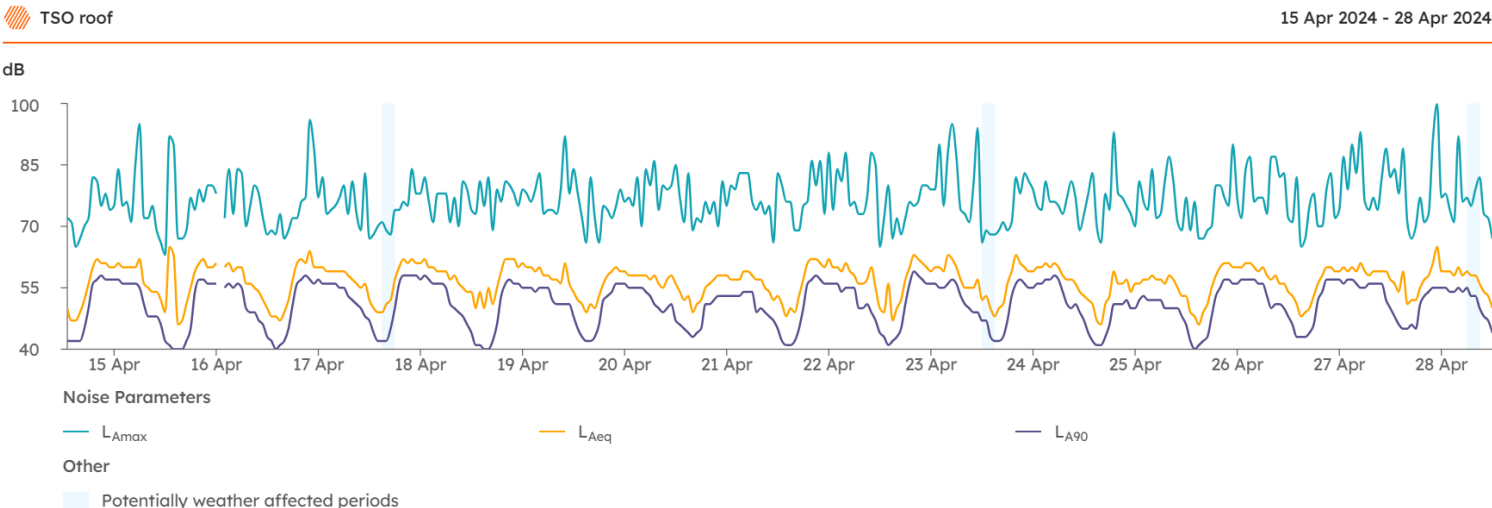


TSO Concert Hall vibration logger v1:

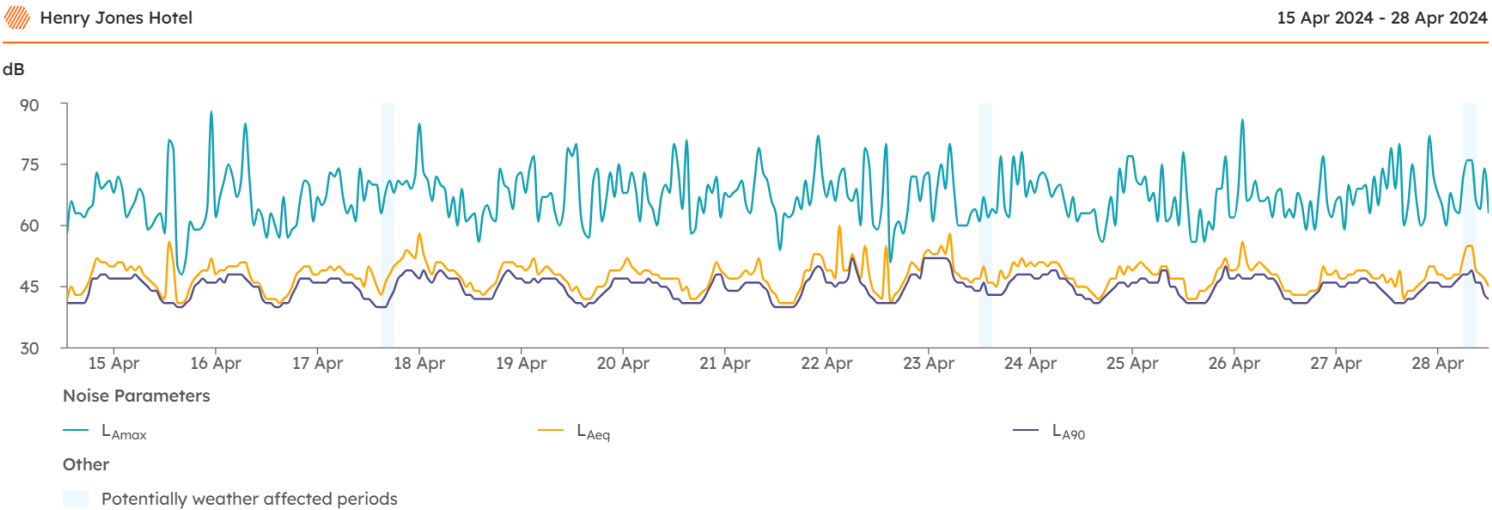


DATA LOGGED FROM 15 Apr to 28 Apr 2024

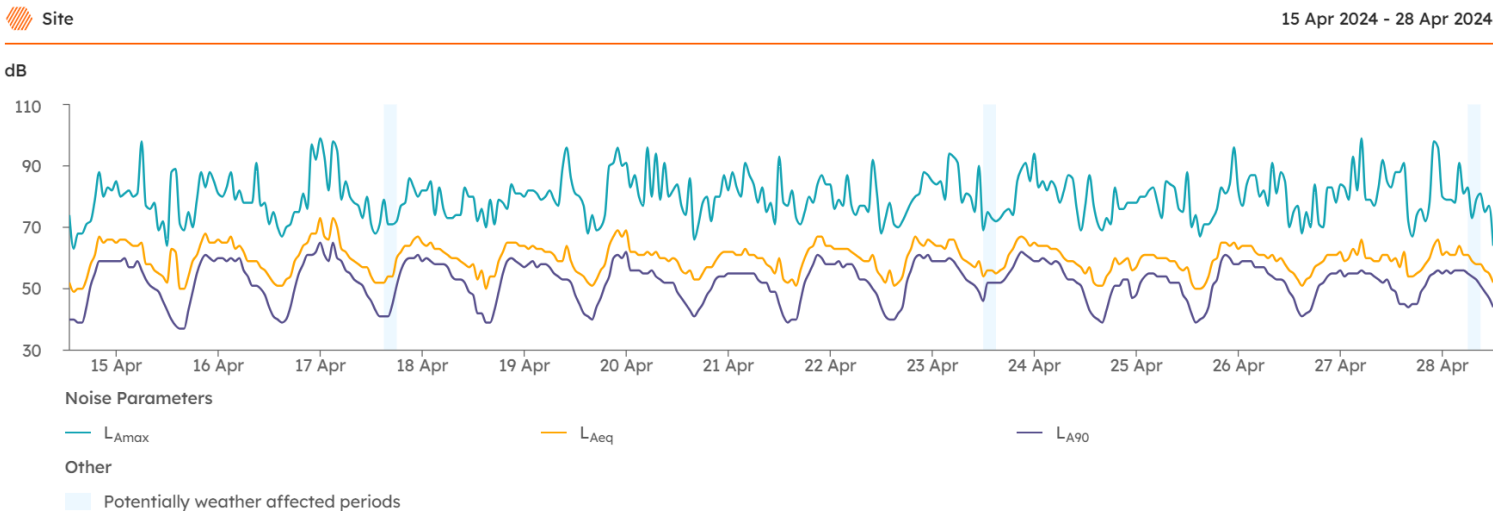
TSO Roof noise logger n3:



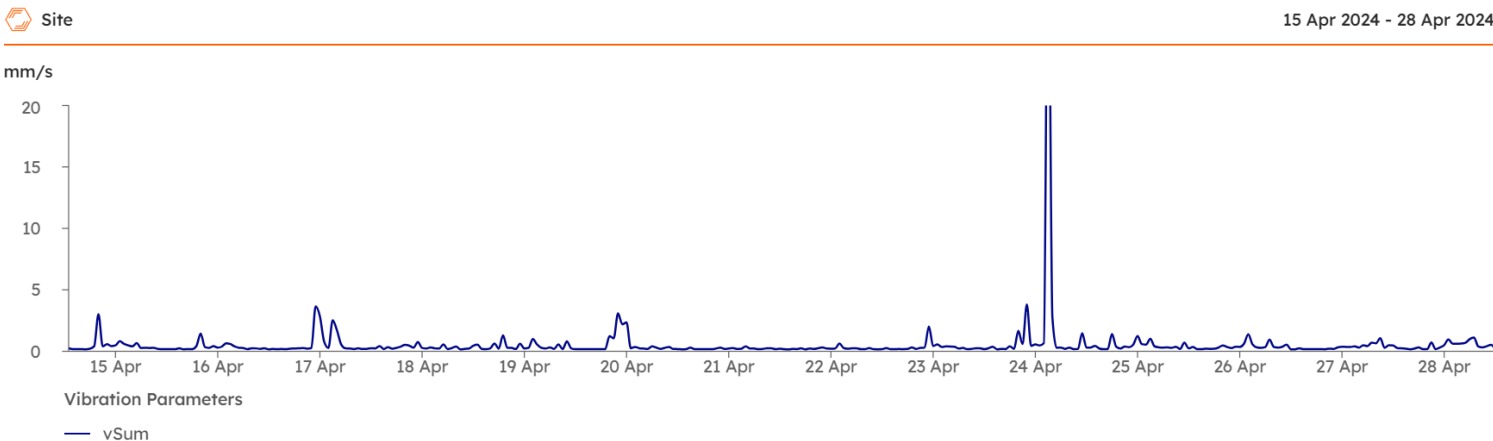
Henry Jones Hotel noise logger n4:



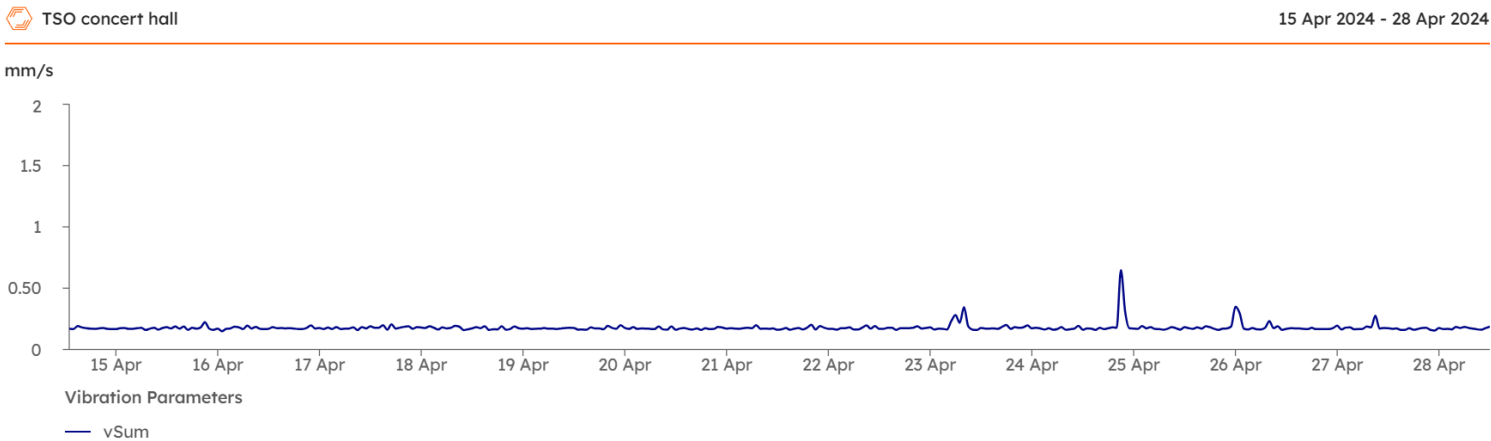
Site noise logger n5:



Site vibration logger v2:

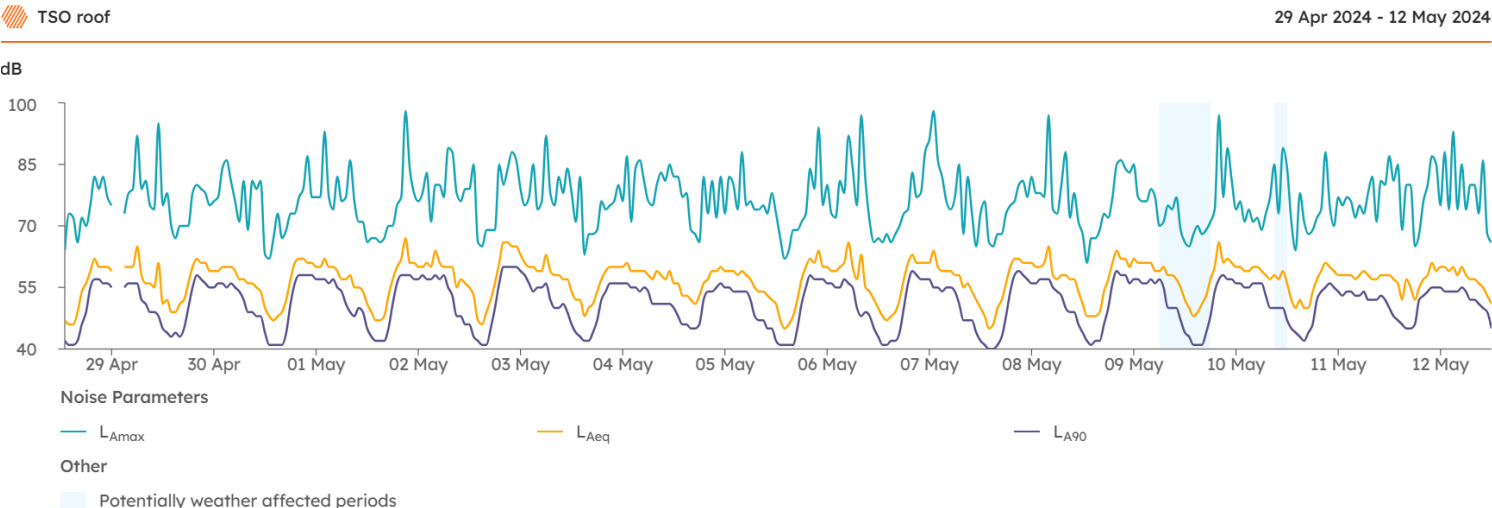


TSO Concert Hall vibration logger v1:

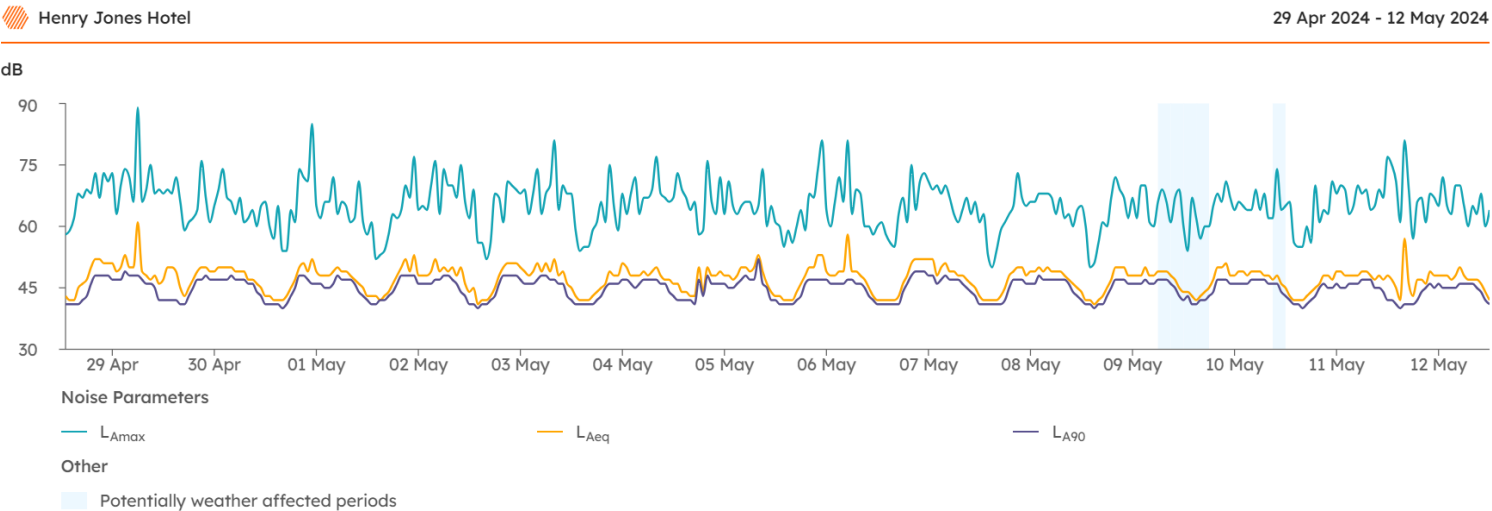


DATA LOGGED FROM 29 Apr to 12 May 2024

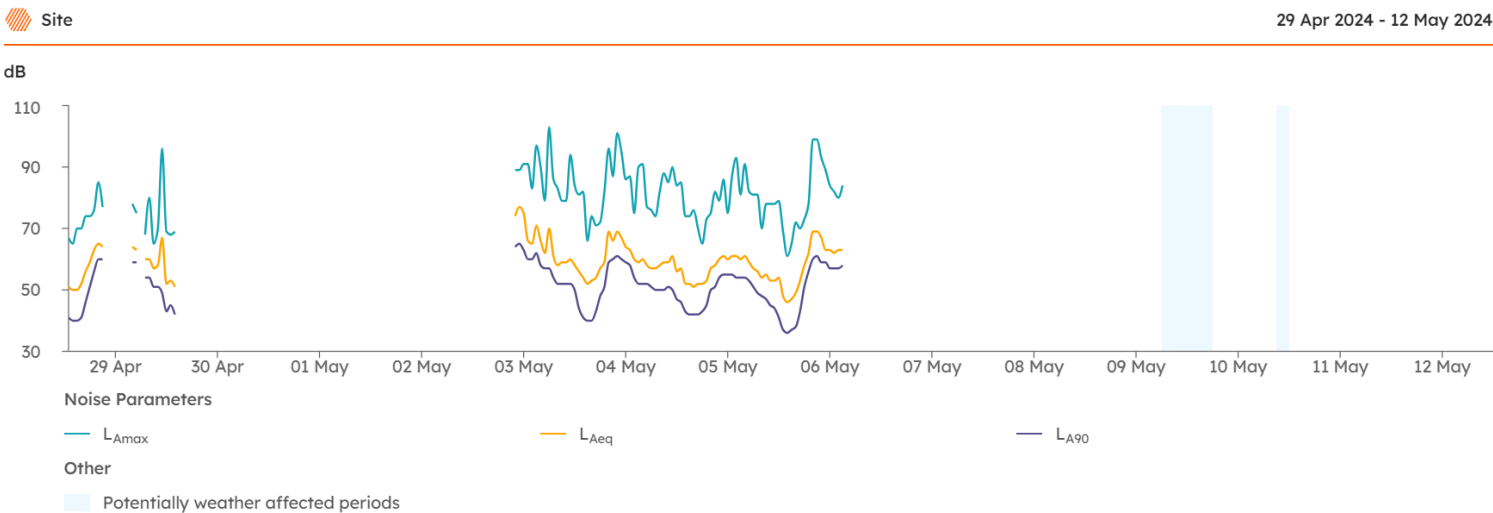
TSO Roof noise logger n3:



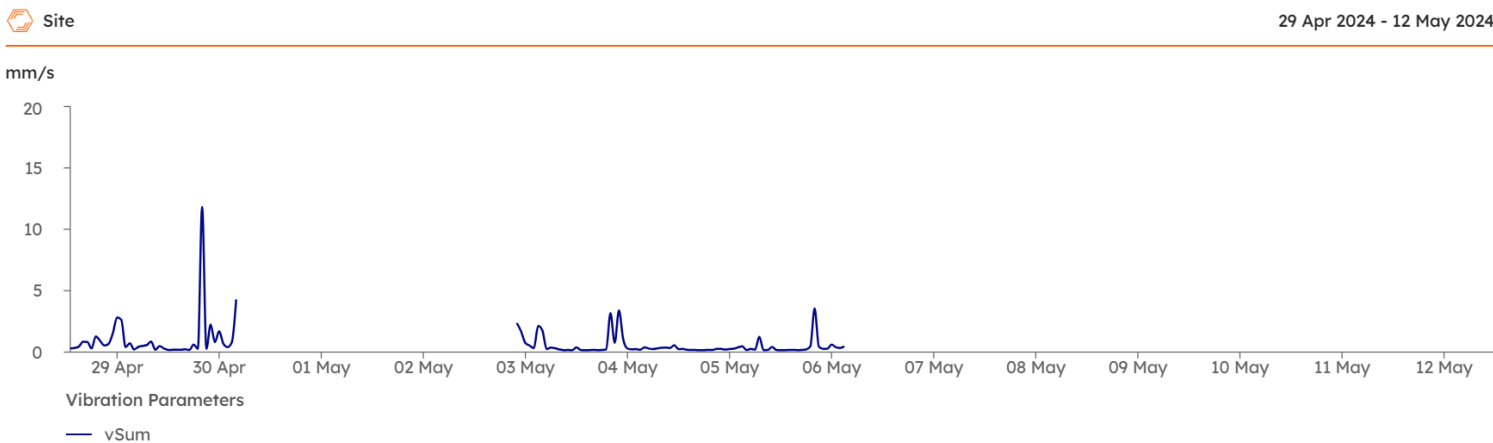
Henry Jones Hotel noise logger n4:



Site noise logger n5:



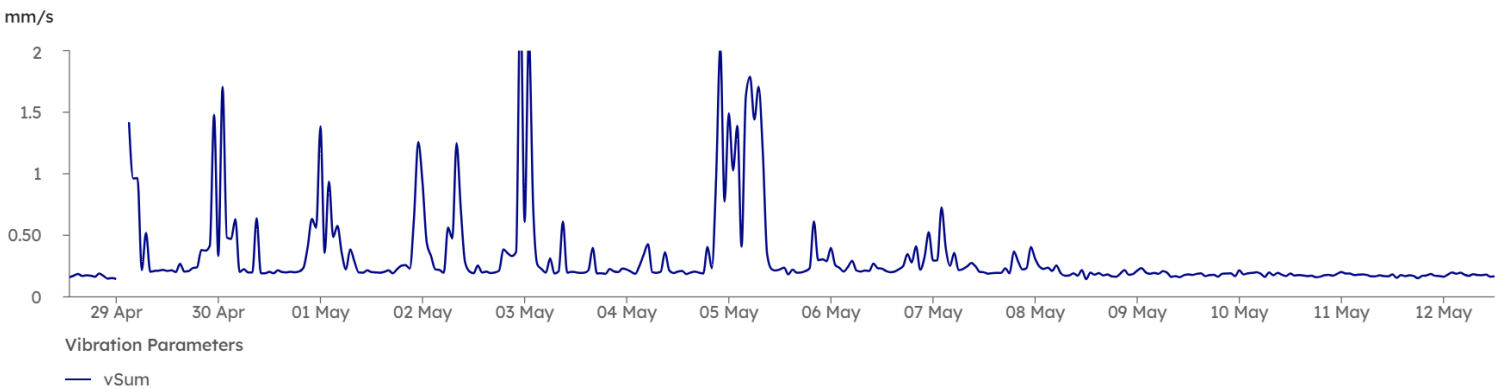
Site vibration logger v2:



TSO Concert Hall vibration logger v1:

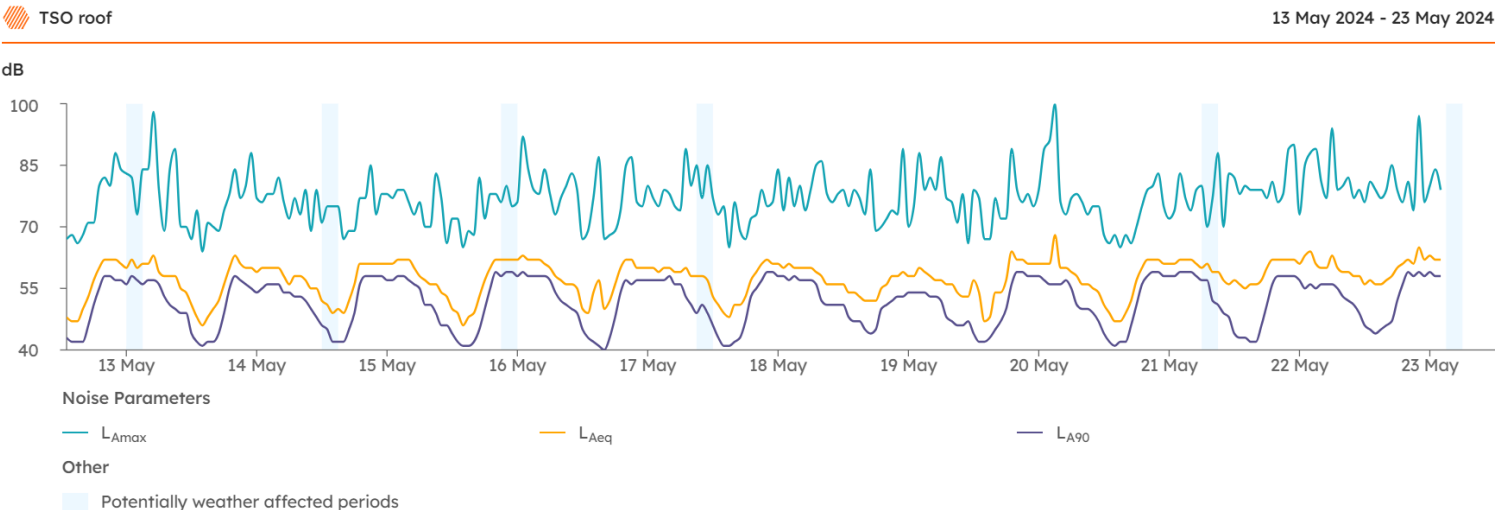
 TSO concert hall

29 Apr 2024 - 12 May 2024

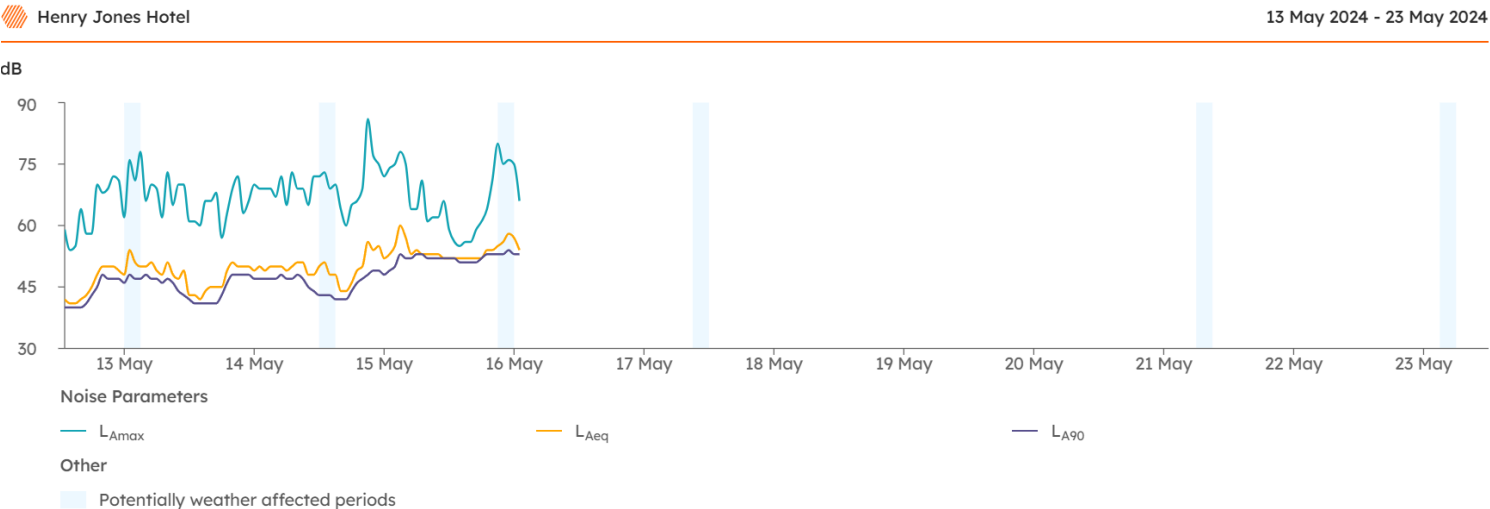


DATA LOGGED FROM 13 May to 23 May 2024

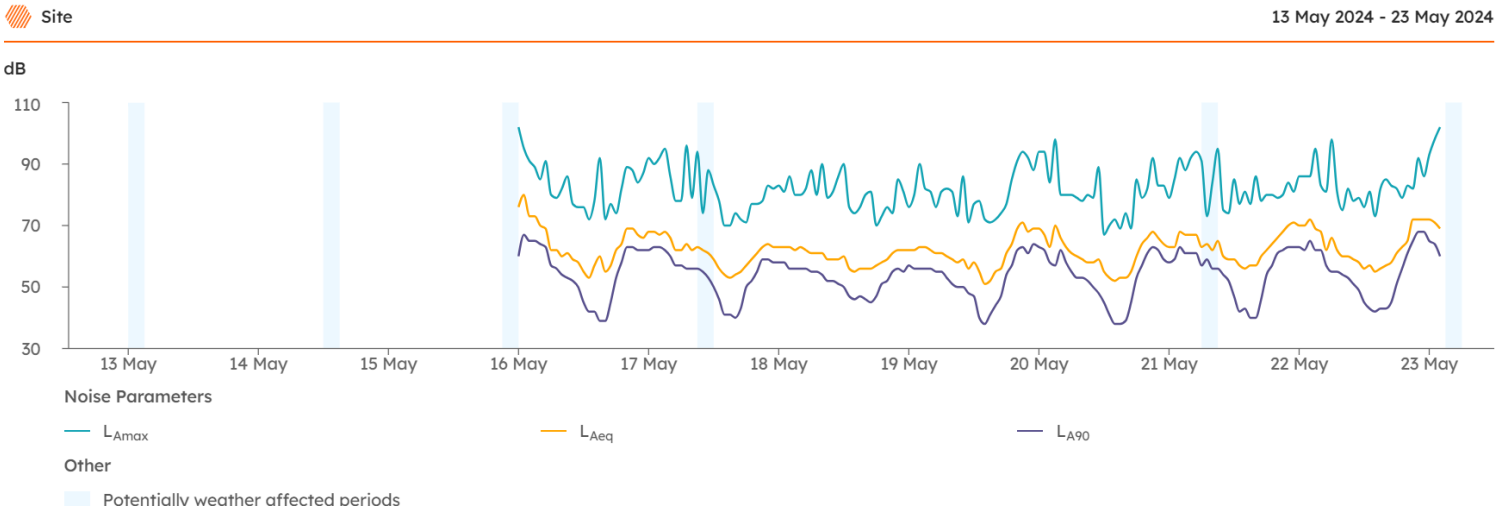
TSO Roof noise logger n3:



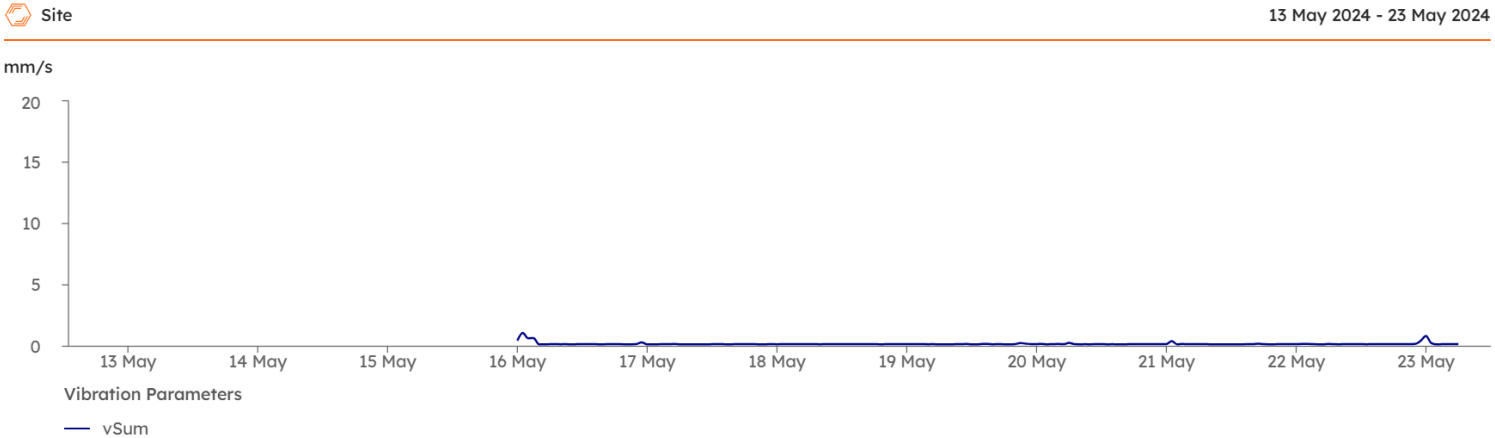
Henry Jones Hotel noise logger n4:



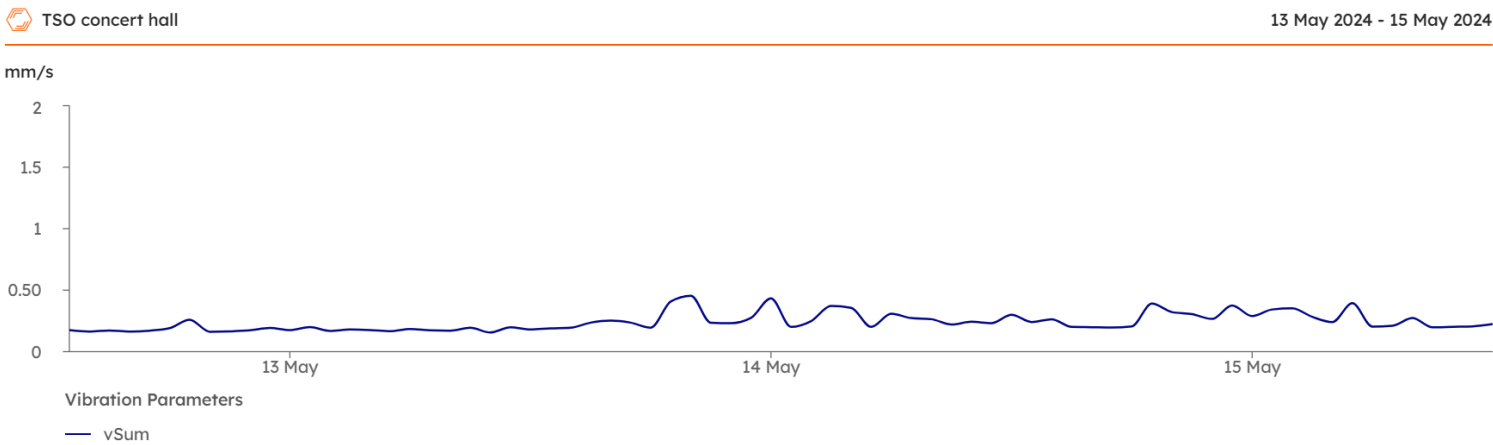
Site noise logger n5:



Site vibration logger v2:



TSO Concert Hall vibration logger v1:



21 **ATTACHMENT F:** Federation Concert Hall Inspection, Sound Insulation and Vibration Measurements

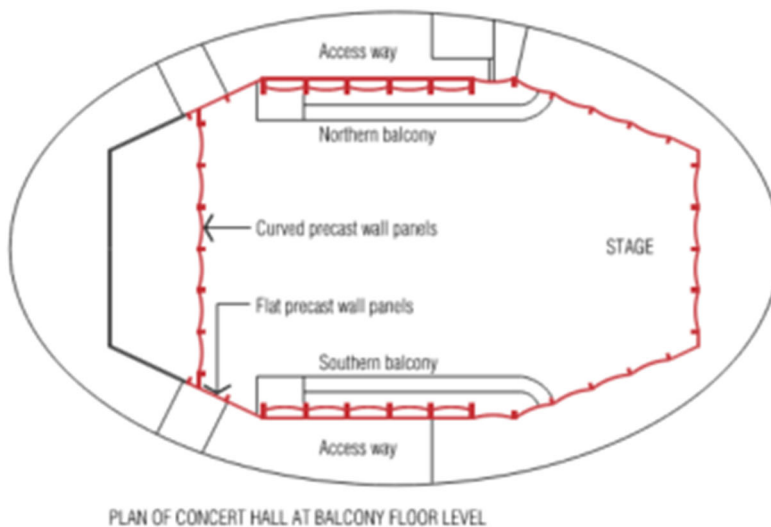
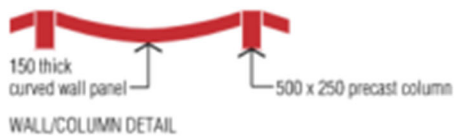
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Panorama of the Hobart waterfront featuring the brass-coloured Federation Concert Hall on the right of the photograph and the Convention Centre

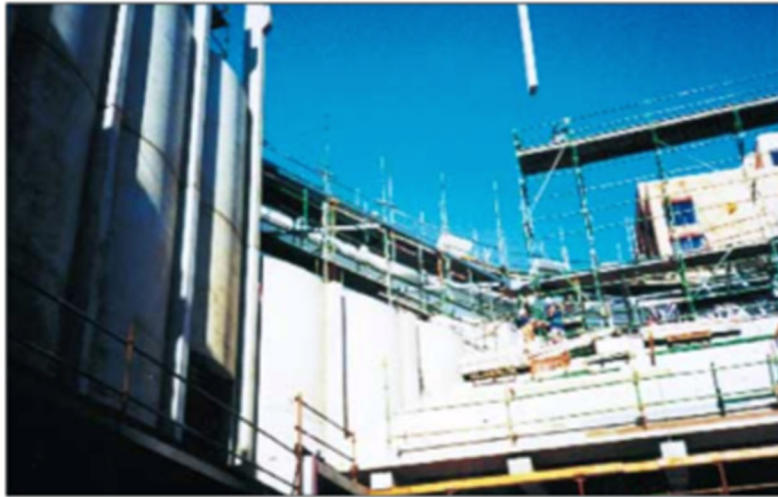


PLAN OF CONCERT HALL AT BALCONY FLOOR LEVEL

FEDERATION Concert Hall – Hobart

Last year's opening of the Federation Concert Hall on the Hobart waterfront, with tiered auditorium space for 1100 people, not only provides a new home for the Tasmanian Symphony Orchestra but gives local citizens and visitors an exciting new venue for concerts and conferences.

The Concert Hall, designed as an integrated annexe to the existing Hotel Grand Chancellor, is now the dominant element in this waterfront city block with its arresting brass-coloured oval shape. Architects Forward Brianese and Partners, and acoustic designers, Arup Acoustics, collaborated on the project to conceive its unique external oval shape enclosing the trapezoidal-shaped inner skin. The oval form provides an historic link to the site's industrial architecture as up until the 1930's,



Erection of upper level precast blade columns (top) and erection of 4.1 m high curved panels which form auditorium's main interior walls (above).

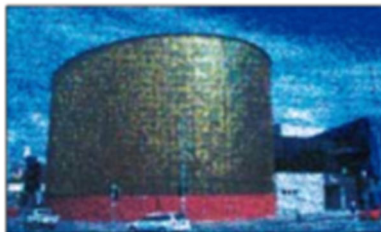
there was a round gasholder of the Hobart Gas Company on and close to the site.

Acoustic design considerations strongly influenced the shape of the inner skin; the room is tall and narrow, with predominantly parallel side walls to provide excellent acoustic strength, resonance, envelopment and intimacy. Painted concrete and timber

flooring dominate the Hall's internal appearance, along with the purpose-built orchestra reflectors which allow sound to 'bounce' back down to the performers and the audience. The painted precast concrete walls and the concrete ceiling help to isolate the Hall from outside noise. These walls comprise curved panels stacked to 18 metre height which are laterally supported by spliced precast columns.

Third-generation Huon Valley company and NPCAA Member, Duggans Pty Ltd provided in precast construction the entire 'inner skin' of the Hall structure which comprised over 600 elements totalling 1350 tonnes. The breakdown of these components are as follows:

- 168 curved panels (typically 2500 mm width x 4100 mm height)
- 78 flat panels
- 88 columns (typically 3000 mm high, 1125 mm wide)
- 85 seating plats and stringer beams
- 198 roof infill beams.



Close-up elevation of brass-clad oval shaped Concert Hall

Figure 21-2 Excerpt (page 2) from "National Precaster"



Figure 21-3 Construction image from "Thermacell"



Figure 21-4 Construction image from "Thermacell"



Figure 21-5 Construction image from "Thermacell"



Figure 21-6 Construction image from "Thermacell"

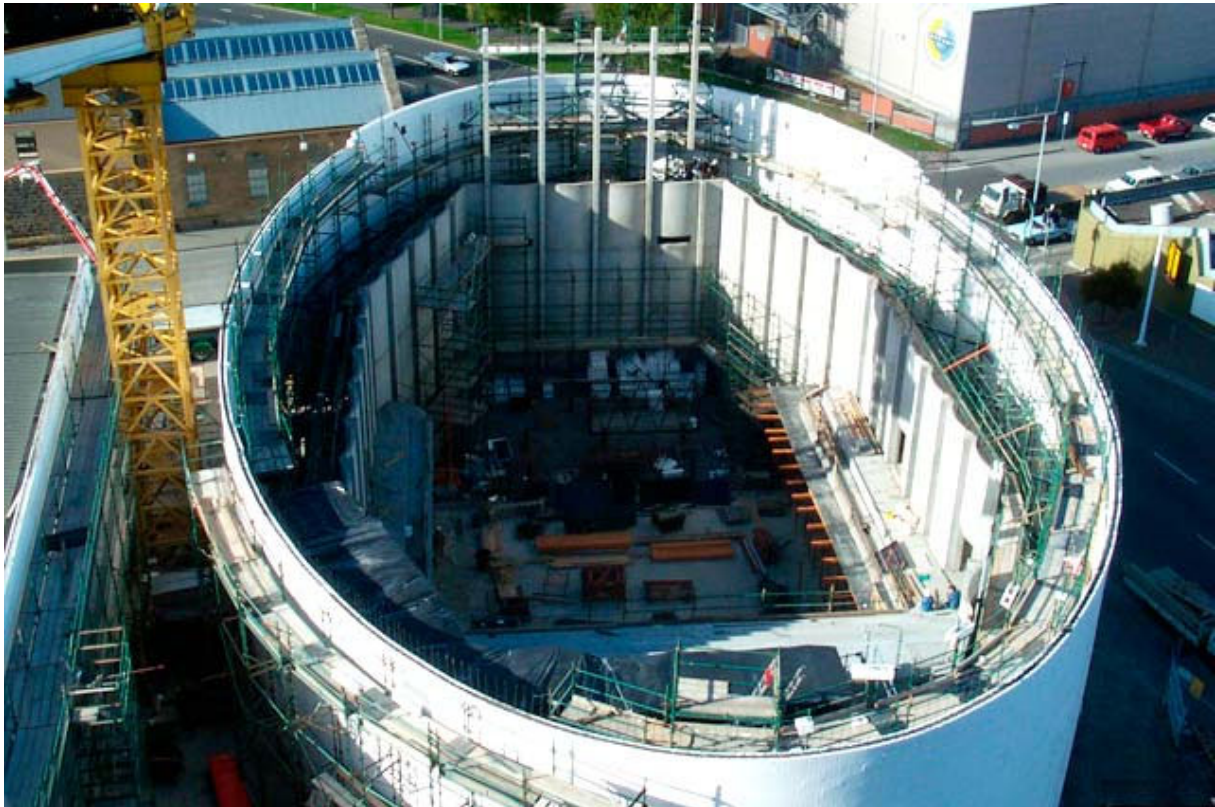


Figure 21-7 Construction image from "Thermacell"



Figure 21-8 Construction image from "Thermacell"



Figure 21-9 Construction image from "Thermacell"



Figure 21-10 Construction image from "Thermacell"



Figure 21-11 Structural coupling between internal shell and external facade

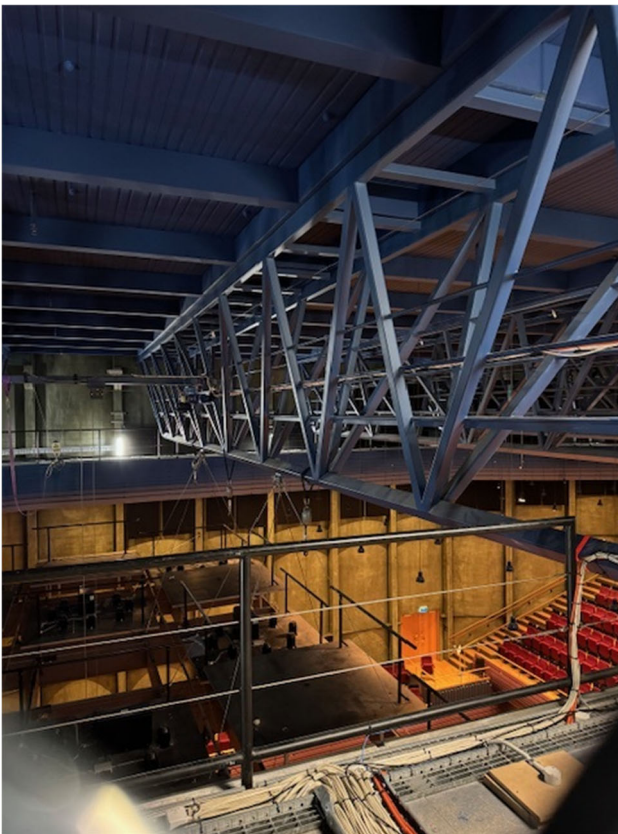
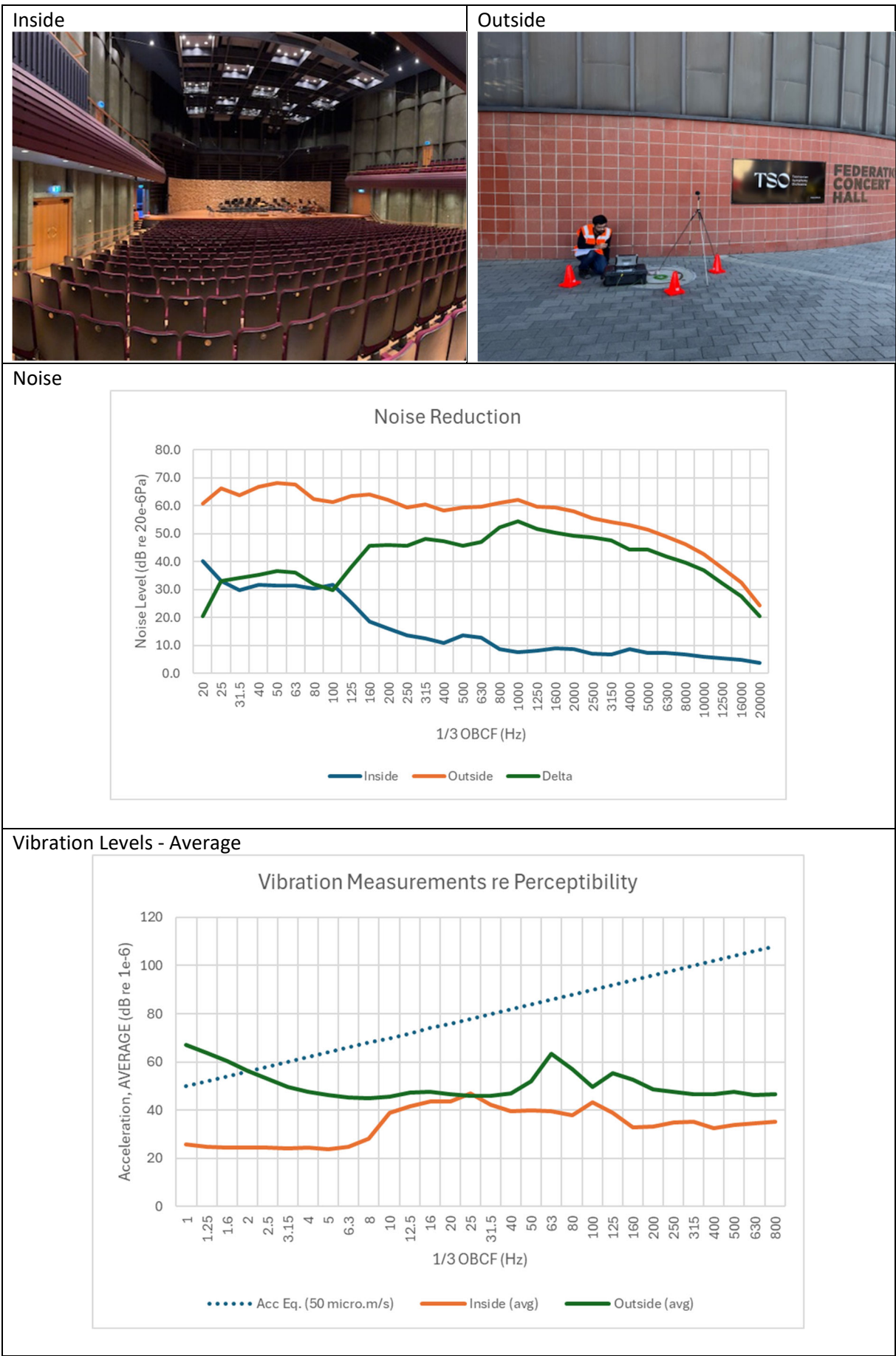
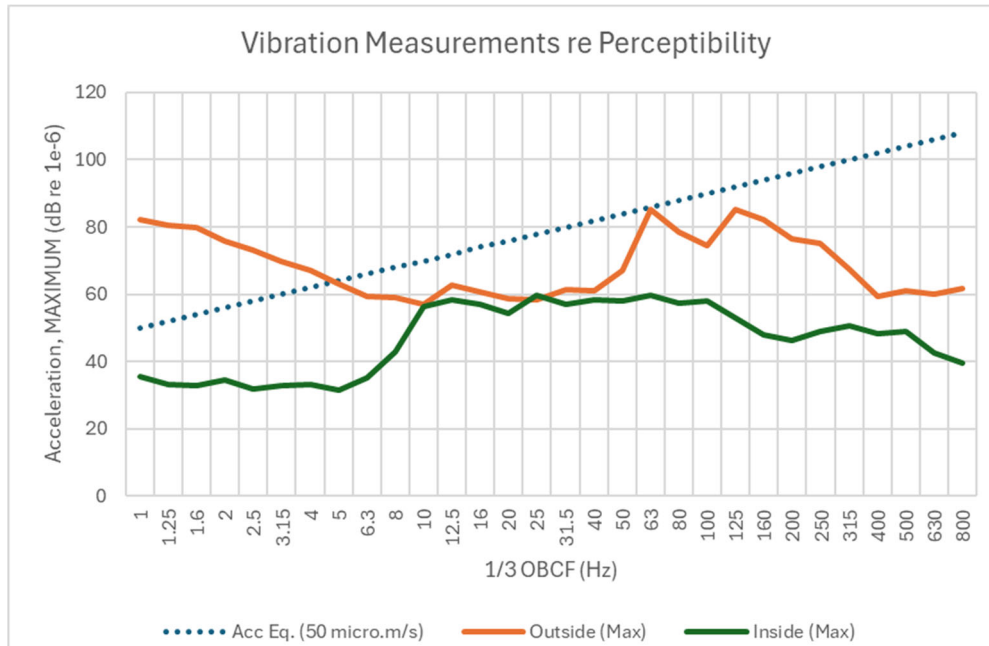


Figure 21-12 Roof structure (lost form-work with concrete deck, assuming light-weight roof with Durra Panel or similar above)

Table 21-1 Sound insulation measurements at Federation Concert Hall



Vibration Levels – Maximum



freq.(Hz)	R(dB)	R(dB)
50	59	
63	60	60
80	62	
100	63	
125	64	64
160	65	
200	67	
250	67	68
315	69	
400	74	
500	78	77
630	82	
800	86	
1000	90	89
1250	93	
1600	96	
2000	100	99
2500	103	
3150	106	
4000	110	109
5000	113	

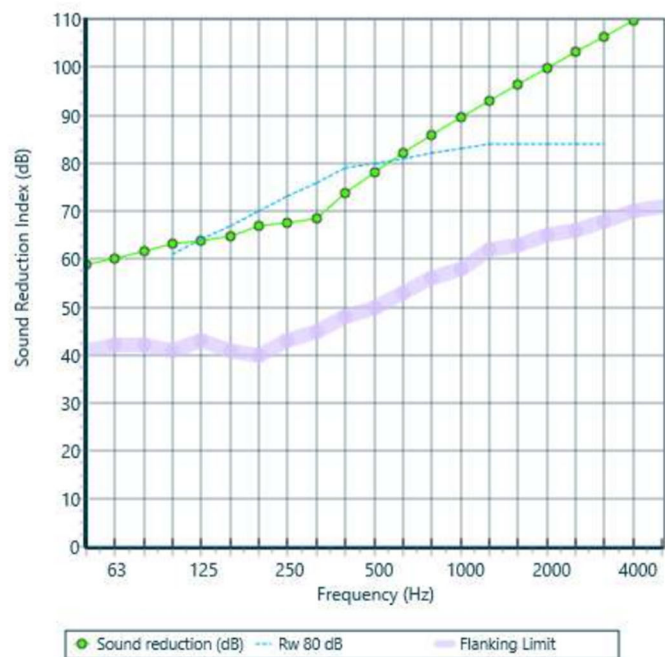


Figure 21-13 Predicted sound transmission loss through cavity masonry structure with flanking limit (rigid connection between walls at top/base)

22 **ATTACHMENT G:** Sullivans Cove
Apartments (IXL) Inspection and Sound
Insulation and Vibration Measurements



Figure 22-1 Secondary facade to Sullivans Cove Apartments



Figure 22-2 Fixed glazing within Sullivans Cove Apartments

Table 22-1 Sound insulation measurements for single facade (Apartment 511)

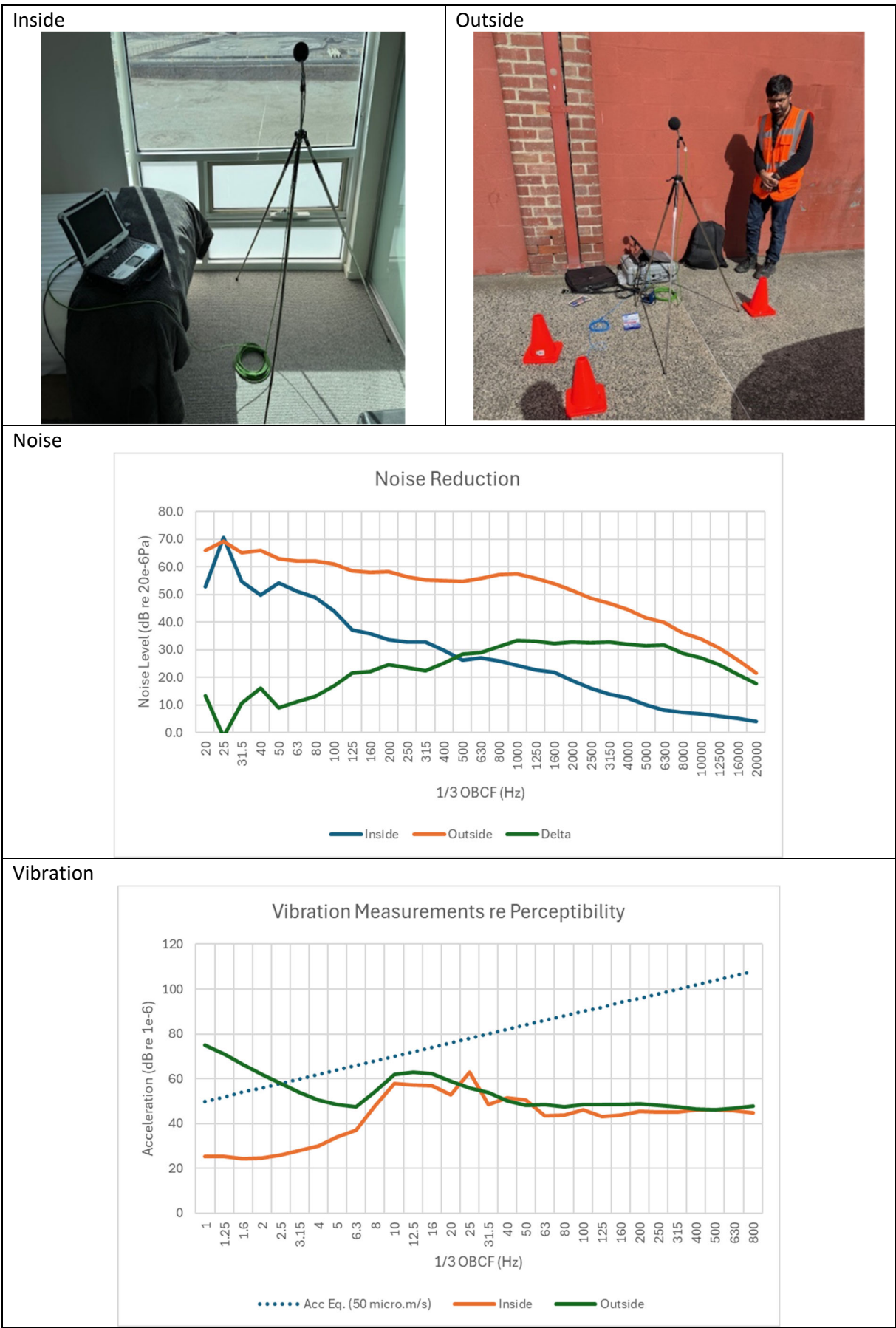
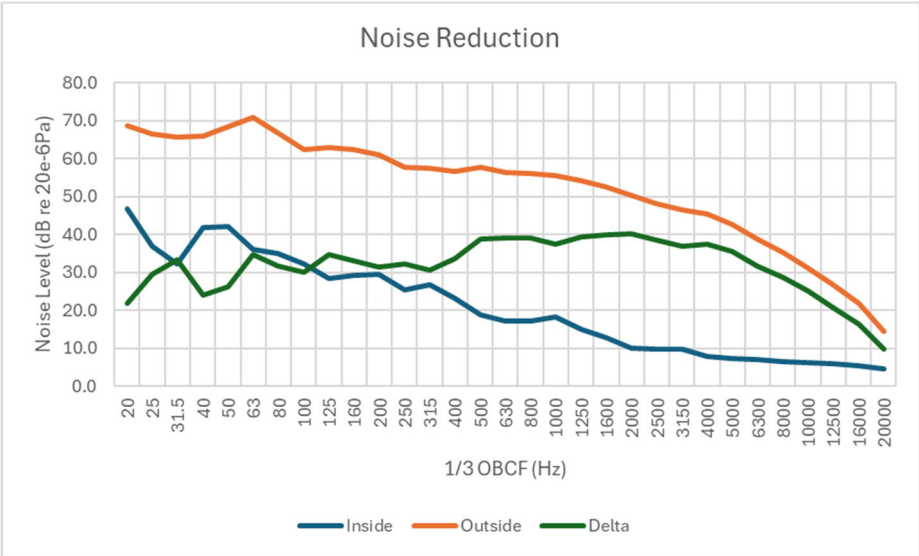
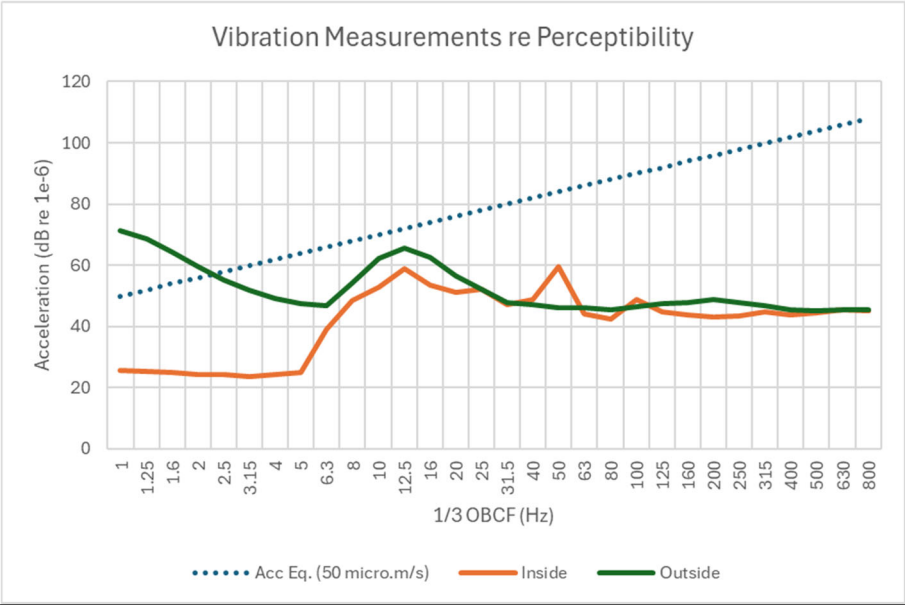


Table 22-2 Sound insulation measurements for double facade (Apartment 304)

Inside No photo was taken, but similar to Apartment 511 (located in bedroom adjacent internal void)	Outside 
Noise 	
Vibration 	

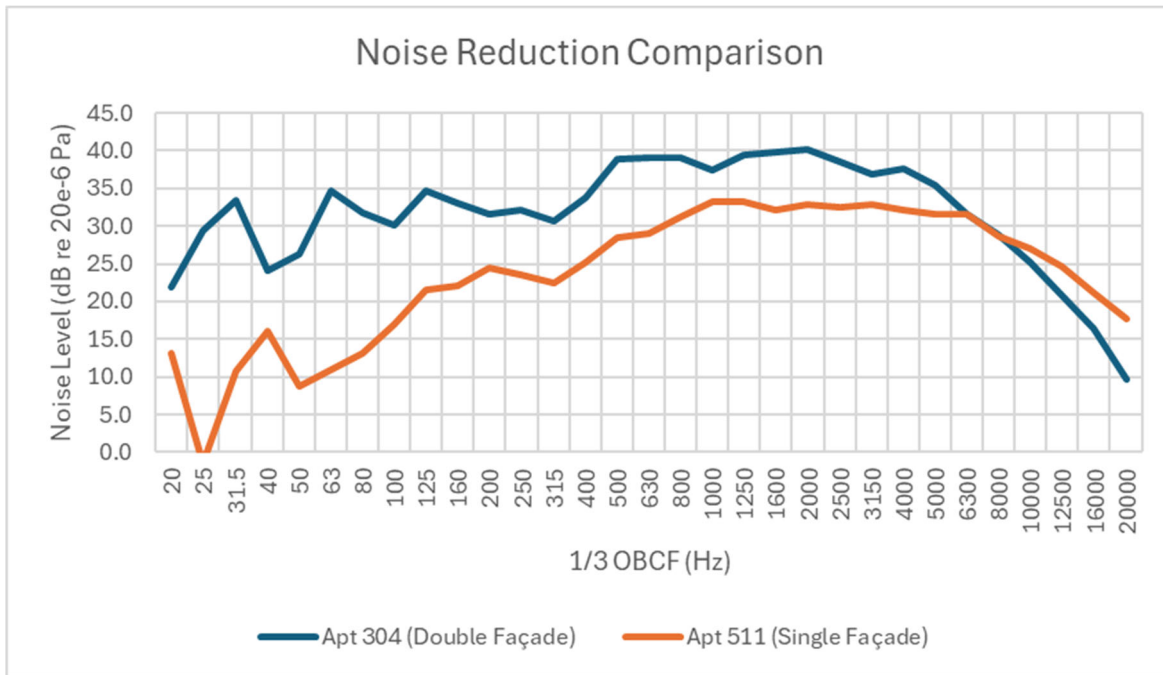


Figure 22-3 Noise reduction comparison between single facade and double facade for Sullivans Cove Apartments

23 **ATTACHMENT H:** Helicopter Noise
Measurements at Sullivans Cove
Apartments (Collins Street)

Table 23-1 Noise measurements with and without the helicopter

Noise Measurement Descriptor	Average Noise Level, L_{Aeq} (dB)	Maximum Noise Level, L_{AFmax} (dB)	Background Noise Level, L_{AF90} (dB)	Average Maximum Noise Level, L_{AF10} (dB)
Without helicopter (6:00-6:30am)	56	69	51	59
With helicopter (9:00-9:15am)	78	88	73	81
Noise Level Difference, dB	22	19	22	22

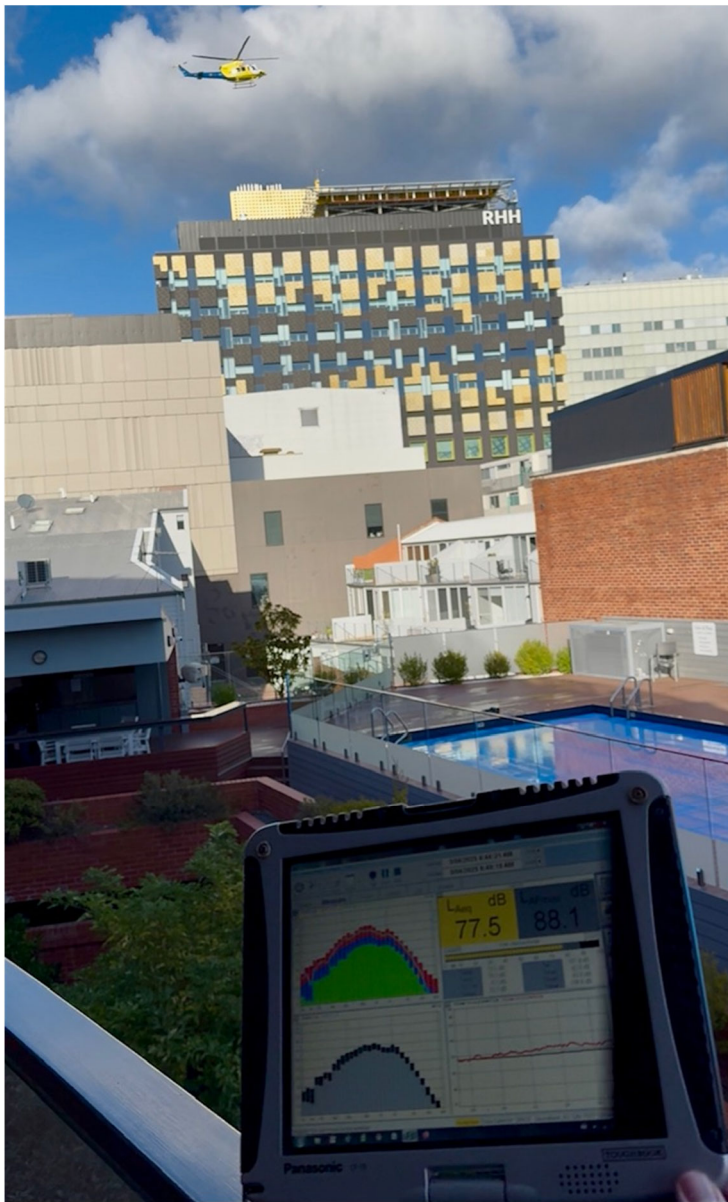
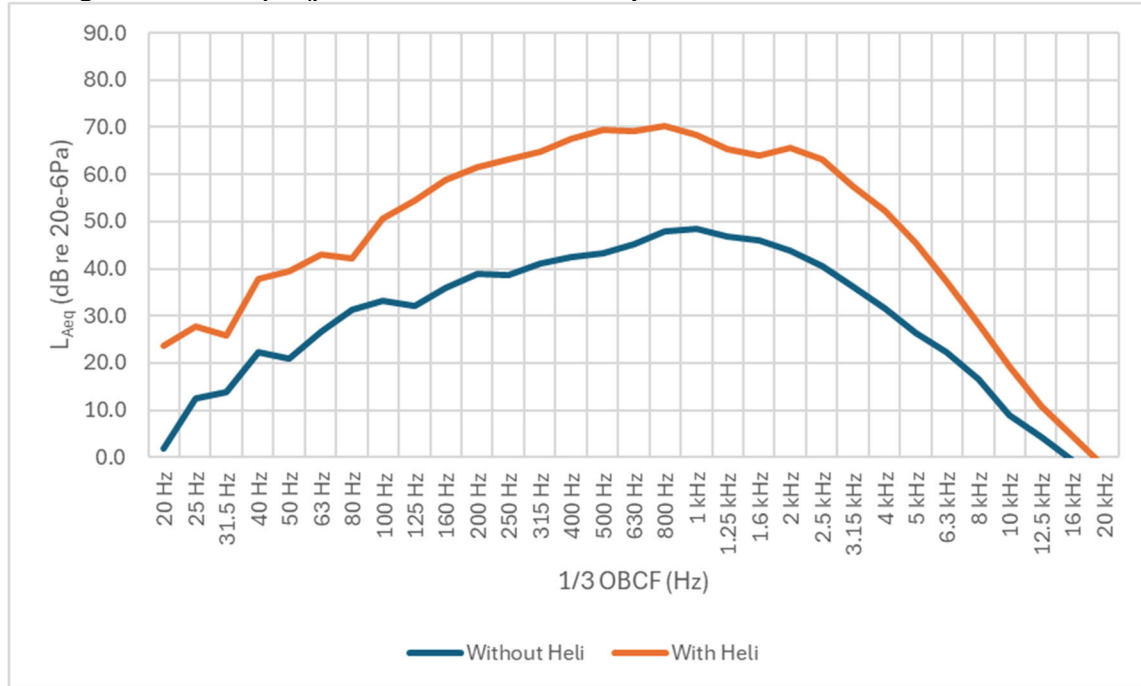


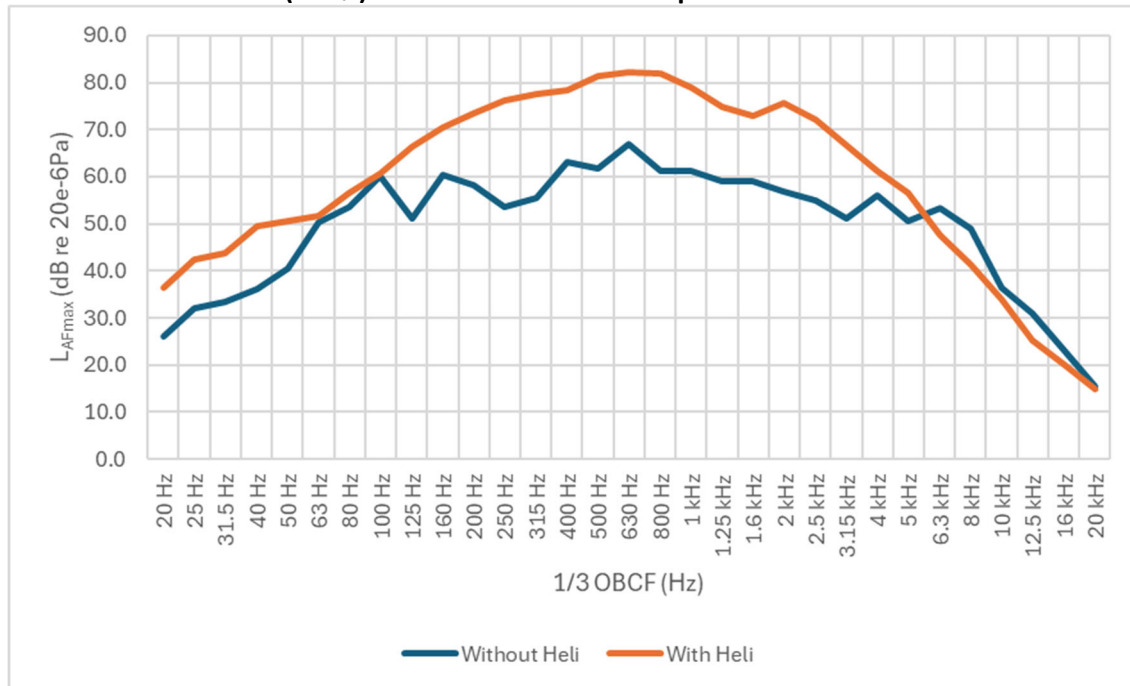
Figure 23-1 Noise measurements during helicopter arrival and departure

Table 23-2 Noise spectra for descriptors, with and without the helicopter

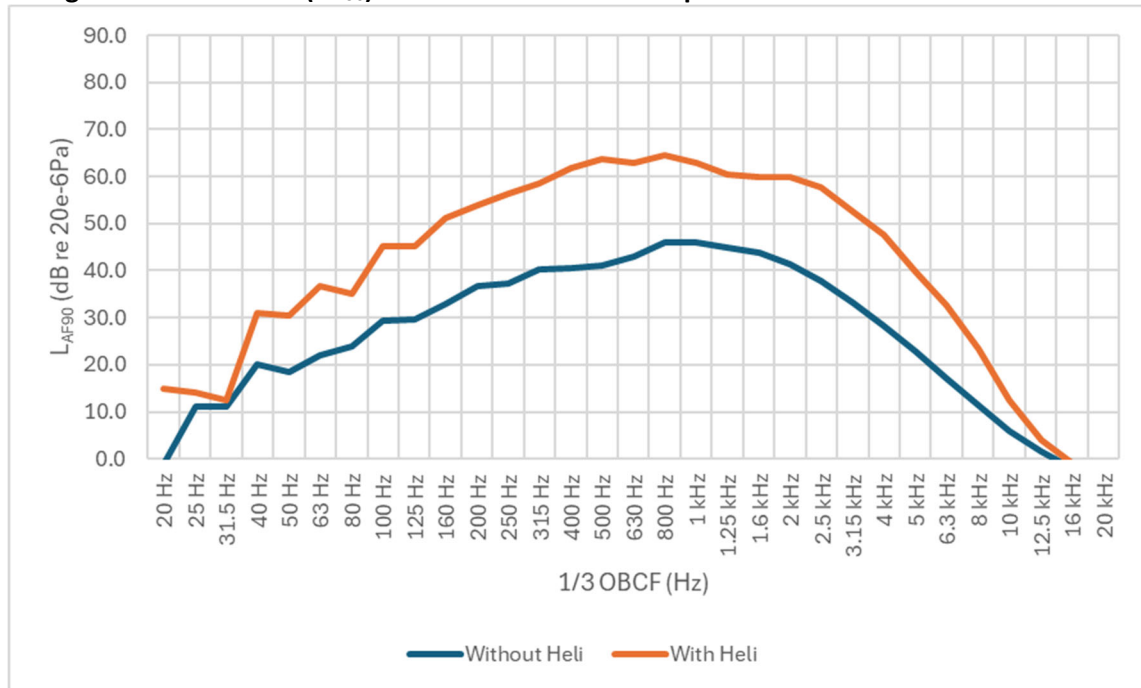
Average Noise Level (L_{Aeq}) With and Without Helicopter



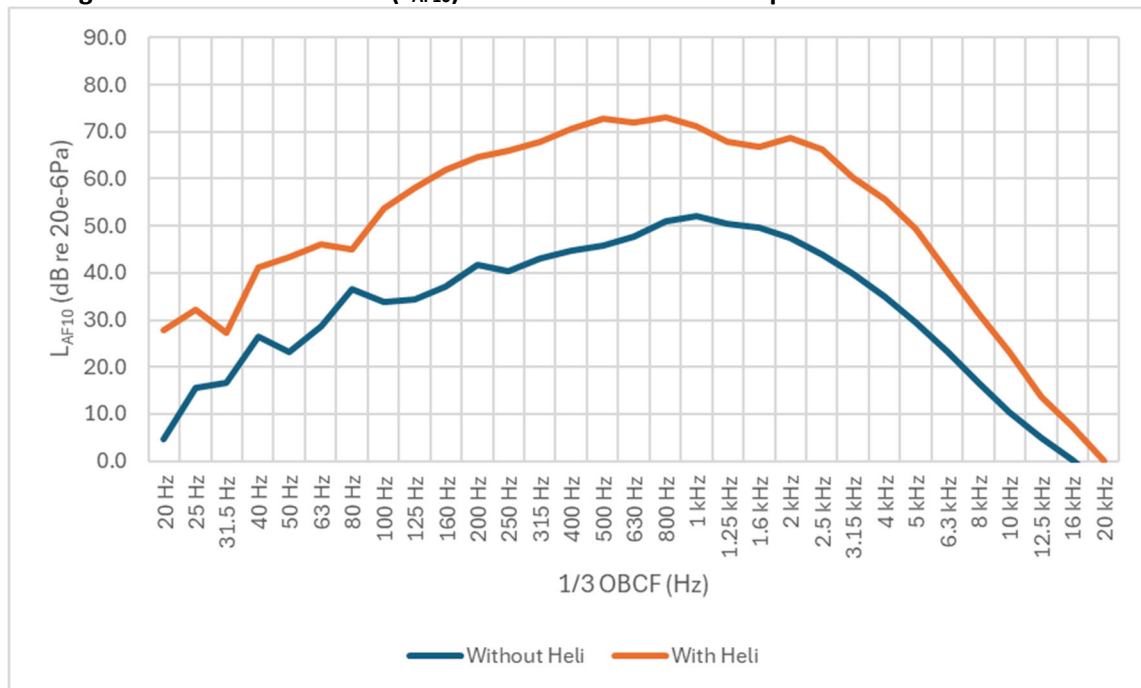
Maximum Noise Level (L_{AFmax}) With and Without Helicopter



Background Noise Level (L_{AF90}) With and Without Helicopter

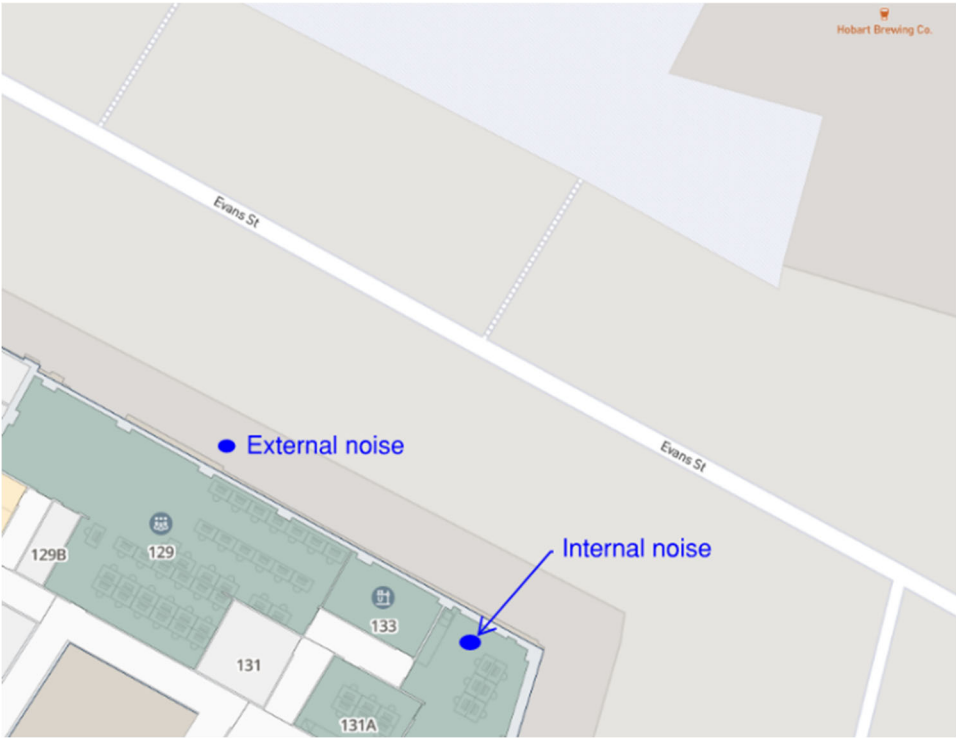


Average Maximum Noise Level (L_{AF10}) With and Without Helicopter



24 **ATTACHMENT I:** UTAS Creative Arts Site Inspection and Sound Insulation Measurements

Table 24-1 Room details (Level 1 – HDR Office)

Measurement Location: 	
Inside 	Outside  Typical UTAS Facade
Site notes: The existing glazing construction is comprised of a retrofitted secondary glazing and single panel float glass with a large air gap. Some leak and cracks observed on the building envelope.	

Noise

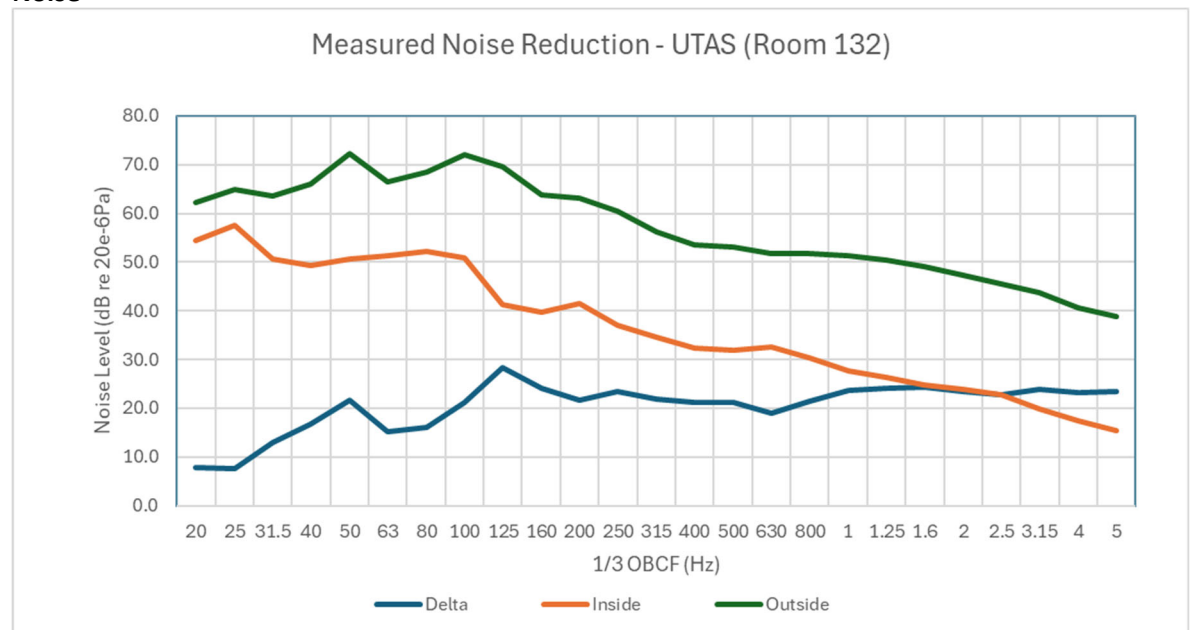
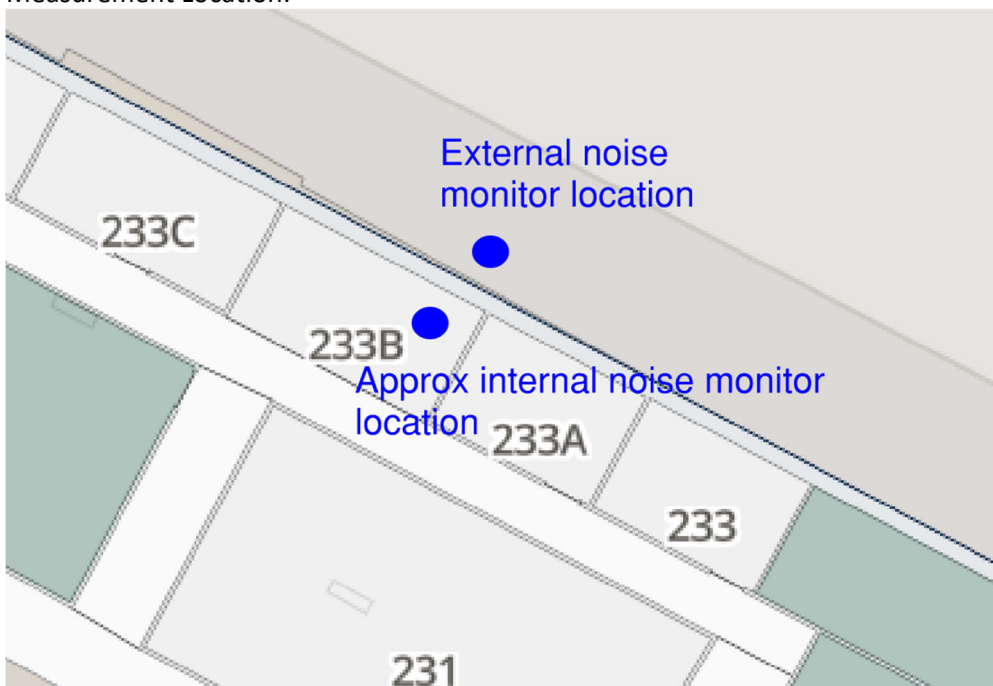


Table 24-2 Room details – Level 2 Common Areas

Measurement Location: 	
Inside 	Outside 
Site notes: The existing glazing construction is comprised of a retrofitted secondary glazing and single panel float glass with a large air gap. Some leak and cracks observed on the building envelope.	

Noise

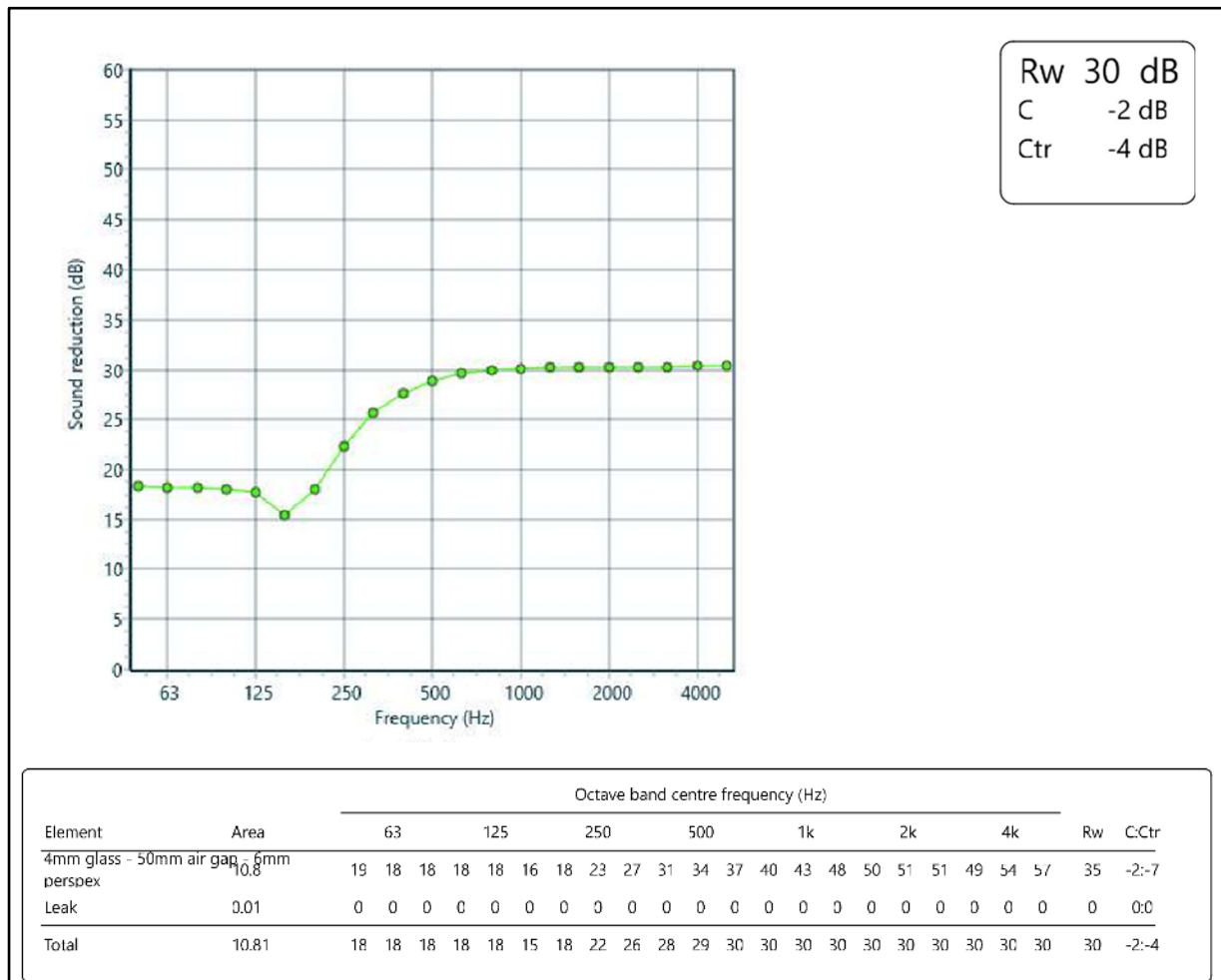
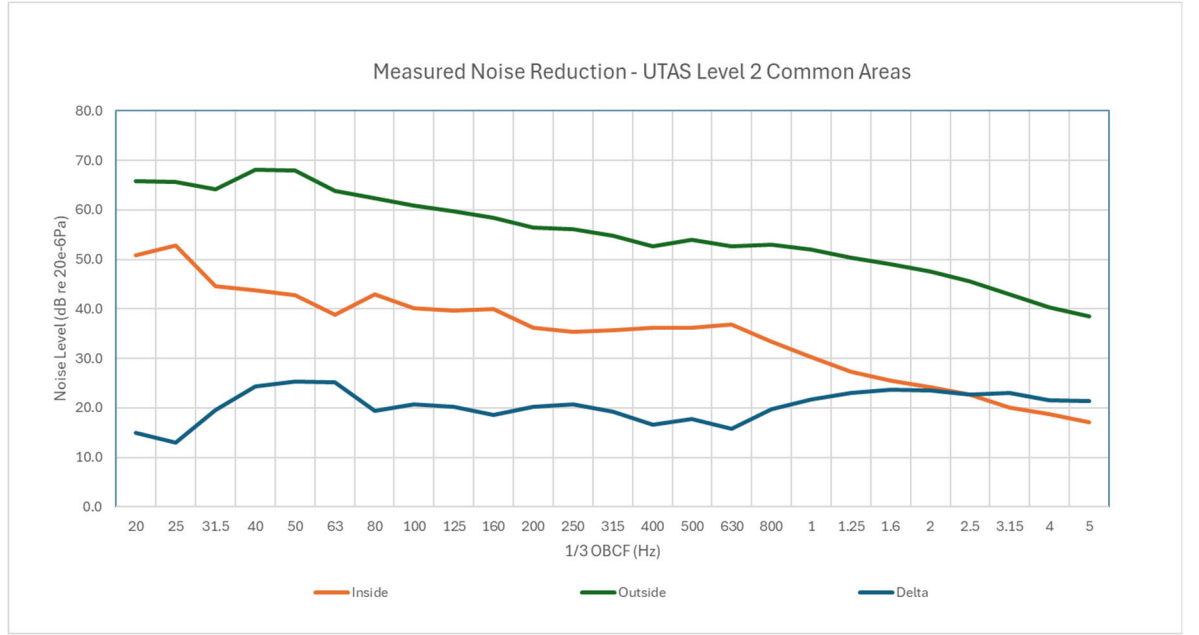
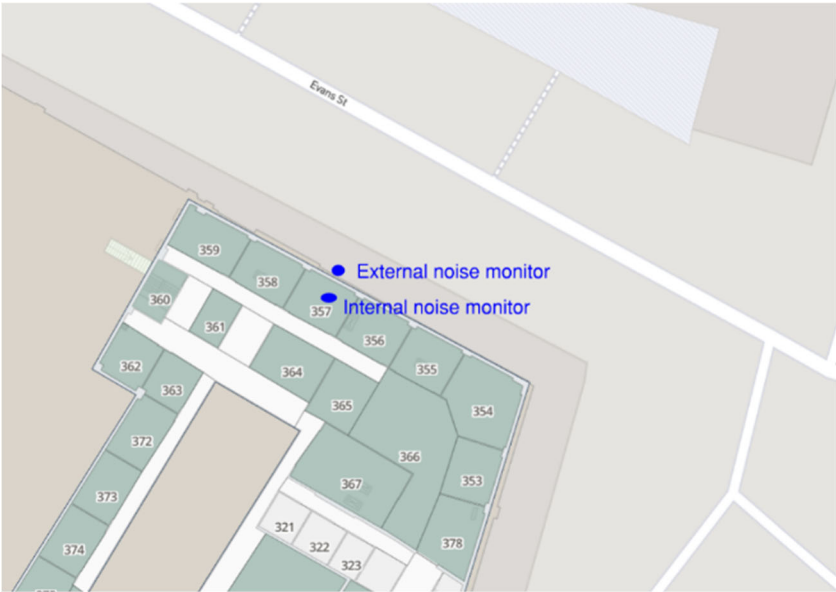


Figure 24-1 Sound transmission loss estimate for secondary glazing systems (noise reduction is about 5dB less than the transmission loss in these cases – overall about 20-25dBA)

Table 24-3 Room details – Level 3 Offices (Single Glazed)

Measurement Location
 A site map of a building complex with rooms numbered 321 through 378. Two blue dots indicate noise monitor locations: 'External noise monitor' and 'Internal noise monitor'. The map shows the building's layout relative to Evans St.
Outside
 A photograph of a brick building facade featuring two large, multi-paned windows. A white box at the bottom center of the image is labeled 'Generic Facade'.
Site notes: The existing glazing construction is a single pane float glass fixed window with an operable awning. Some leak and cracks observed on the building envelope.

Noise

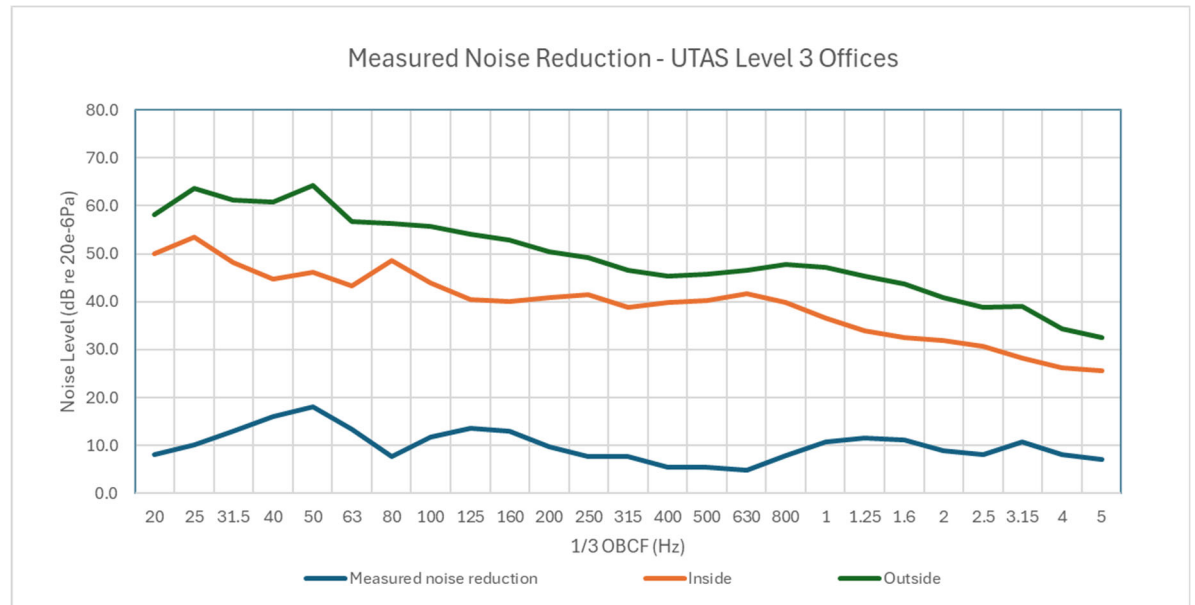
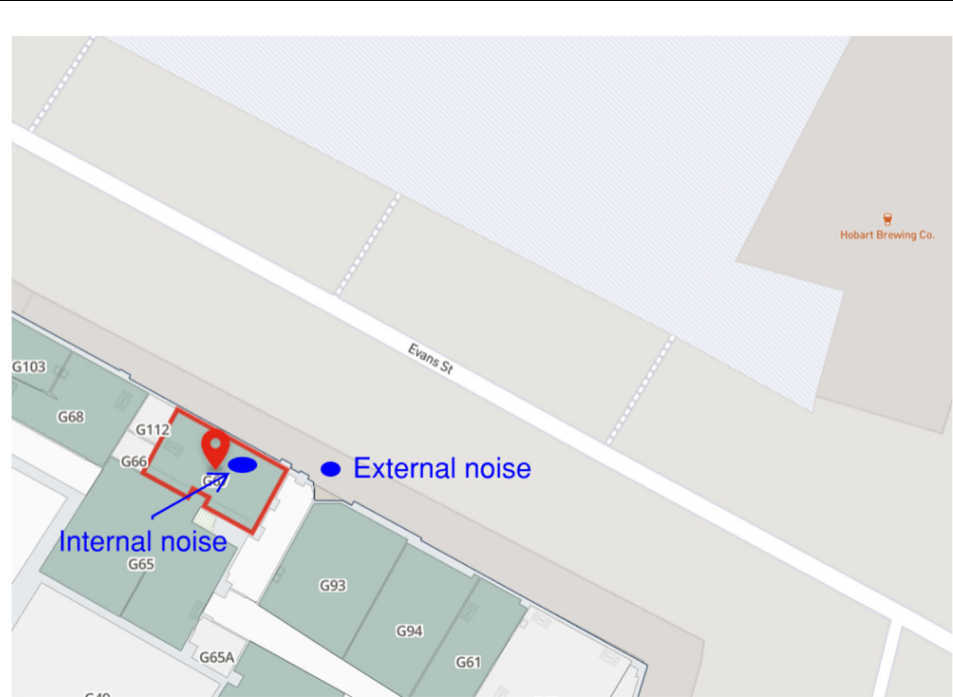


Table 24-4 Room details (Ground Floor – Ceramics Lab)


Outside  Typical UTAS Facade
Site notes: The existing glazing construction is a single pane float glass window. Some leak and cracks observed on the building envelope.

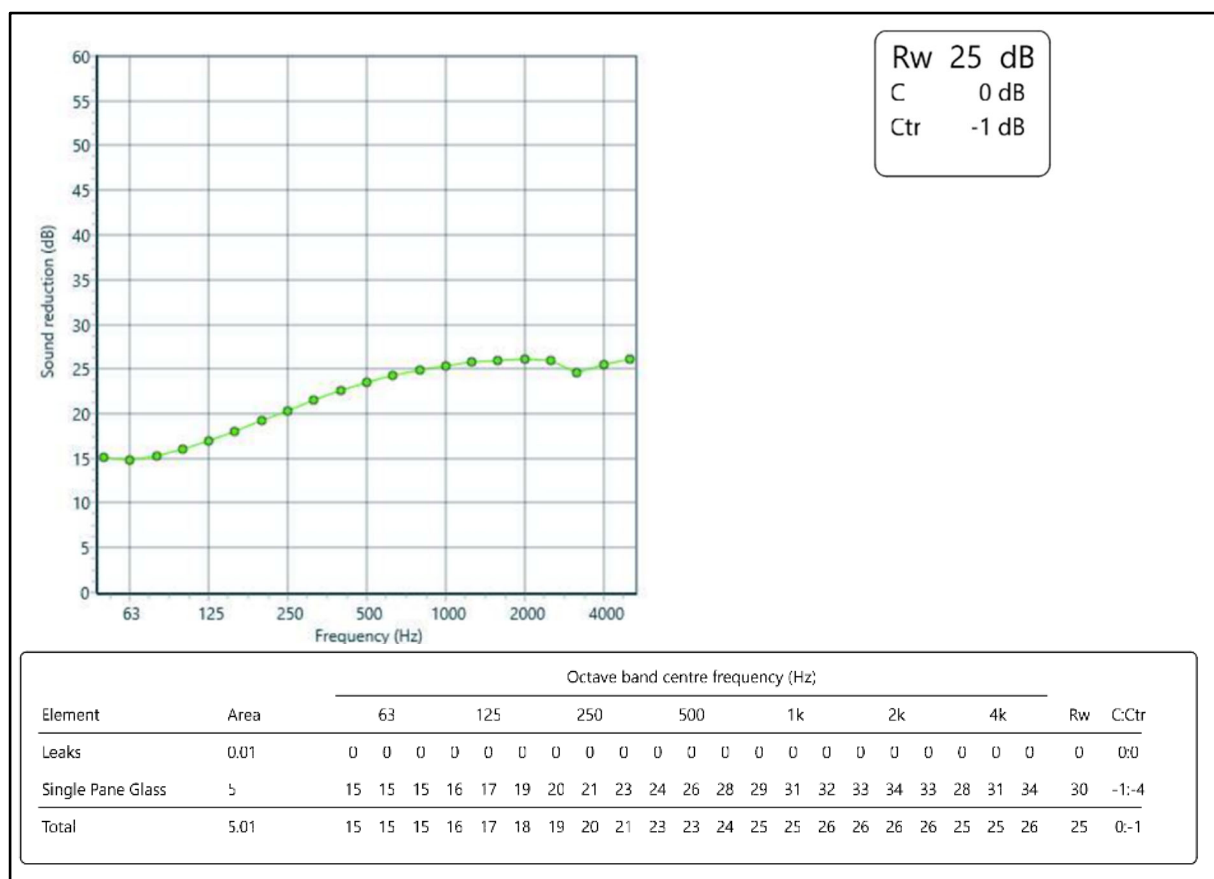
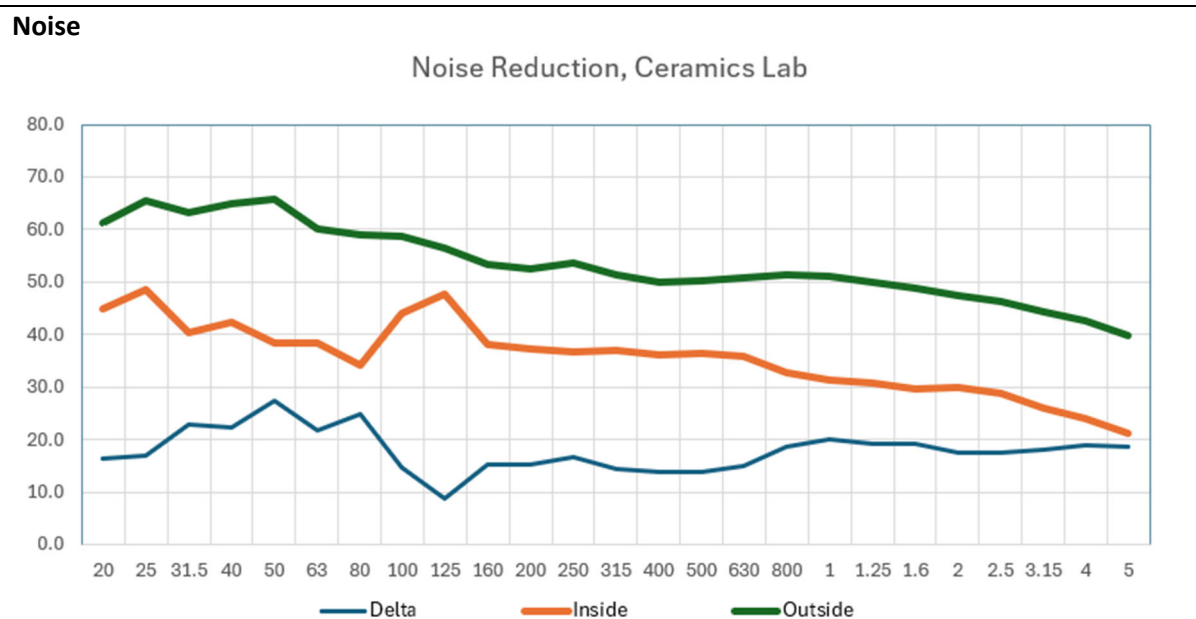


Figure 24-2 Sound transmission loss estimate for single pane glazing systems (noise reduction is about 5dB less than the transmission loss in these cases – overall about 10-20dB)