FORMANT.

STRAIGHTFORWARD ACOUSTIC DESIGN

ISLES OF SCILLY MUSEUM & CULTURAL CENTRE

BASELINE NOISE SURVEY & BENCHMARK TESTS

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REVISION HISTORY

Date	Revision	Notes
21/10/2022	P01	For information

EXECUTIVE SUMMARY

Formant has been appointed to undertake a noise impact assessment for the proposed refurbishment and extension of the existing Town Hall and Museum in St Marys, Isles of Scilly. The project will involve the extension and reconfiguration of the existing museum, as well as the refurbishment and adaptation of the Town Hall to provide a flexible performance space/events venue, with its own foyer/café/bar. These changes, along with the new building services plant, have the potential to cause adverse noise impacts on nearby noise sensitive receptors (NSRs).

BASELINE NOISE SURVEY & BENCHMARK TESTS

The site is not exposed to any significant noise sources and ambient sound levels are relatively low at around **50-54 dBL_{Aeq}**. Background noise levels were also fairly low at **40/39 dBL_{A90} (day/night).**

During the site visit we undertook benchmark tests of the existing room acoustic conditions in the Hall. The reverberation time was around **1.8 secs** at mid-frequencies, which is higher than desirable for a multi-purpose hall and is likely to explain the issues being experienced by some users of the Hall.

We also assessed noise break-out from the Hall by using a sound system playing music at 91 dBA inside the hall and undertaking noise measurements and a subjective assessment at a number of locations outside the hall. **Music from the Hall was audible outside the building** as follows:

- At the rear of the building, where weaknesses in the building envelope (external doors, ventilation louvre and windows) resulted in clearly audible music at all frequencies;
- At the front of the building, where low frequency music was audible, probably as a result of the hall roof; and
- Inside the adjacent cottage where low frequency music was just audible, probably as a result of airborne noise from outside plus structure-borne noise through the common party wall.

DESIGN ADVICE

The low environmental noise levels at the site mean that natural ventilation is suitable for all spaces except the Hall, where mechanical ventilation is recommended to allow the venue to operate with all doors and windows closed during noisy events. To ensure noise impacts from entertainment noise break-out from the hall are no worse than existing, we have proposed some practically achievable design targets and initial design advice relating to building envelope improvements. We have also set out initial guidance on reducing the reverberation time in the hall and on attenuating the proposed building services plant in order to meet suitable noise emissions limits.

NOISE IMPACT ASSESSMENT

With the incorporation of the mitigation measures, the assessment concludes that it should be possible to adequately mitigate the potential noise impacts arising from the proposed development and no significant adverse noise impacts are therefore predicted.

1 INTRODUCTION

Formant has been appointed to undertake a noise impact assessment for to consider the potential noise impacts arising from the proposed refurbishment and extension of the existing Isles of Scilly Town Hall and Museum. The project involves changes to the layout and the use of some internal spaces, and provision of new building services plant. Most significantly in terms of noise impacts, the proposed development will create a performance space in the Hall which is likely to be used more frequently and therefore has the potential to result in adverse noise impacts for the users of the building and for noise-sensitive receptors (NSRs) outside the site. The room acoustics in the existing hall are also an issue which will need to be addressed in order to create a venue which is suitable for a broad range of different events.

This report provides:

1) A description of the proposed development and its potential noise impacts
2) A summary of applicable legislation, policy and guidance
3) Details of the baseline noise survey undertaken at the site
4) Initial acoustic design advice to be developed as the project progresses
5) An assessment of the potential noise impacts arising from the proposed development

2 PROPOSED DEVELOPMENT

2.1 EXISTING SITE

The site is located centrally within Hugh Town. The Parade runs immediately to the north, with Silver Street to the south and Ingram's Opening to the east. The immediate western boundary comprises adjacent residential buildings. A cottage, Parade Cottage and small associated yard are both owned by the Council, but are not part of the application site. We understand that the long-term plan for the cottage is for it to become part of the museum building, but at present it is a tenanted residential property.

The Town Hall, Parade Cottage and its outbuilding are all Grade II listed. The central location of the Site within Hugh Town means that the dominant local land use is residential and small-scale commercial and hardstanding.

2.2 NOISE SOURCES AND NOISE SENSITIVE RECEPTORS

The site is not exposed to any significant transportation, commercial or industrial noise sources. The soundscape is affected by occasional vehicles on the local roads, pedestrian activity, birdsong and distant noise from the sea.

A site location plan of the existing site is provided in Figure 1 overleaf, including a mark-up of the location of the measurement positions used in the baseline noise survey/benchmark tests (MP1-5). The nearest noise sensitive receptors (NSRs) are residential properties on all sides of the site, which are also marked on the plan in Figure 1.

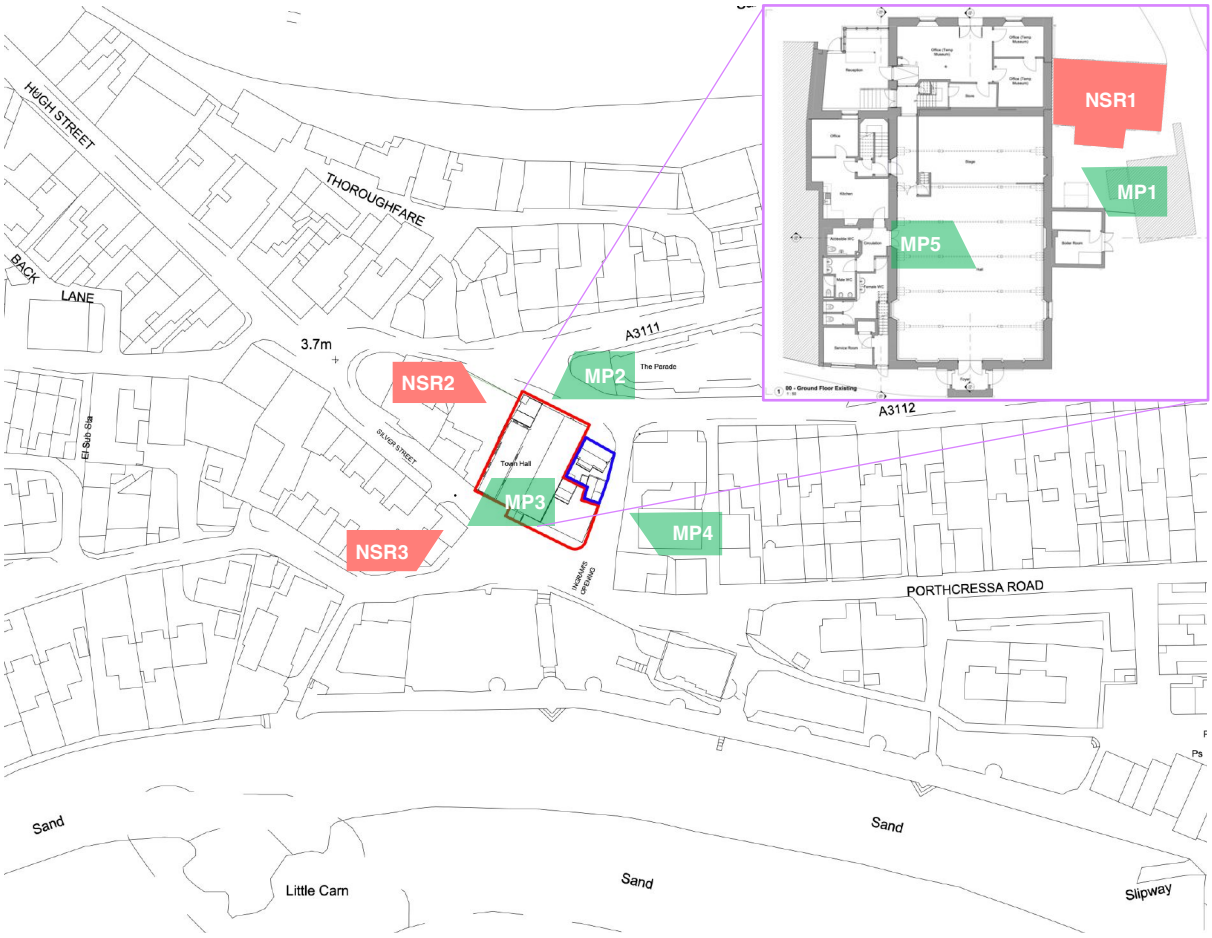

Figure 1 Site location plan showing noise sensitive receptor locations (NSRs) and external measurement positions (MP1-4). Inset: Ground Floor plan showing location of NSR1 and internal measurement position (MP5)

3 LEGISLATION, POLICY AND GUIDANCE

3.1 LEGISLATION & PLANNING POLICY

There are no legislative requirements which directly affect the noise assessment undertaken in this report. The Government's planning policies for England are contained in the National Planning Policy Framework (NPPF) and the long-term vision and aims of the Government's policy on noise is contained in the Noise Policy Statement for England (NPSE). NPPF policies are supplemented by additional advice contained in National Planning Practice Guidance (NPPG). The assessment in this report is in line with all applicable and relevant policies of the NPPF, NPSE and NPPG.

3.2 GUIDANCE

ENVIRONMENTAL NOISE BREAK-IN

BS 8233:2014 ***Guidance on sound insulation and noise reduction for buildings*** provides a method which has been adopted for calculating noise break-in to the proposed development, however it does not contain design criteria for performance spaces. The design criteria for the Hall have therefore been based on industry best practice and past project experience.

ENTERTAINMENT NOISE BREAK-OUT

There is no one specific guidance document which provides a methodology for assessing entertainment noise. The venue already exists and therefore an acceptable noise impact would normally mean ensuring that entertainment noise break-out is 'no worse than existing'. However the proposed development may result in an increased number of events taking place, therefore it is important to *reduce* the noise break-out to a reasonable level, thus ensuring the net impact is no worse than existing. To achieve this, various guidance has been considered, including:

- **The Noise Council's *Code of Practice on Noise Control for Concerts* (The Code)** was written to provide guidance on *"large music events involving high powered amplification ... held in sporting stadia, arenas, open air sites and within lightweight buildings".* Whilst some of the guidance in The Code is relevant, it was not intended for local theatres/arts centres with regular events, therefore the noise criteria have been used for assessing the impact of occasional 'very noisy' events only.

- **The IOA's *Good Practice Guide* (The IOA Guide)** provides guidance for assessing noise from the pubs, clubs, community/village halls and similar premises. The Guide's original intention was to include objective noise criteria, however it was not possible to subject the criteria to a satisfactory validation process. A draft version contained an Annex with noise limits based on the number of noisy performances taking place per year. The Annex was not included in the final document (arguably because its criteria were considered too onerous for existing venue operators to comply with), however in the absence of any other suitable guidance, we have used the criteria in the Annex to assess noise from regular events.

PLANT NOISE EMISSIONS

BS 4142:2014 ***Methods for Rating Industrial and Commercial Sound*** has been adopted as the method to assess potential noise impacts from M&E plant associated with the proposed development.

4 BASELINE NOISE SURVEY

4.1 MEASUREMENT METHODOLOGY

A baseline noise survey was undertaken by Paul Driscoll MIOA of Formant. Attended short-term measurements were made on 17 Oct 2022 between 1900-2030 hrs at locations outside the existing buildings (MP2-4), as shown in Figure 1. An unattended noise logger was left running at the site at position MP1 between 17-18 Oct 2022.

Measurements were also made inside the building at MP5, with a PA sound system provided by the client, to simulate a noisy event in the Hall. Measurements and a subjective assessment of noise break-out from the hall were made at positions outside the building whilst the music played on a loop in the hall.

All measurements were taken at approximately 1.5 metres above local ground/floor level, and in line with BS 7445:2003 *Description of Environmental Noise*. Unless otherwise stated in the results, measurements were made at a distance of at least 3 metres from the façade of buildings or any other reflecting surfaces (unless otherwise stated in the results).

Weather conditions during the attended survey were mild and partially overcast with no precipitation. During the attended survey, there was a gentle breeze and the windspeeds increased over the course of the unattended survey. However the location of the unattended noise logger was well screened from the wind therefore the weather conditions are not considered to have adversely affected the noise measurements and the results are considered representative of 'typical' site conditions.

4.2 EQUIPMENT

All measurement equipment owned or hired and operated by Formant has annual or bi-annual calibration checks carried out by external companies traceable to UKAS or national standards. Copies of all calibration records are kept and can be provided upon request. The following measurement equipment was used to conduct the survey:

- Nti XL2 Class 1 Sound level meter, SNo. A2A-18665-E0,
- Nti Larson Davies CAL200 Calibrator, SNo. 18652

4.3 DESCRIPTION OF EXISTING SOUNDSCAPE

In general, the existing soundscape around the site is considered to be fairly quiet. There were contributions from a small number of vehicles on the surrounding streets as well as general town centre noises (e.g. pedestrians walking, talking, etc.). No mechanical plant was audible at the site. Other noise sources included distant wind and waves on the seashore.

4.4 MEASUREMENT PARAMETERS

Three noise metrics are relevant to this assessment:

L_{Aeq} Time averaged sound pressure level. This is generally considered to be an acceptable representative descriptor of environmental noise.

L_{A10} The level exceeded for 10% of the measurement period. This is generally considered to be an acceptable descriptor of noisy individual events (e.g. car pass-bys) and is also useful for assessing music levels inside/outside the building.

L_{A90} The level exceeded for 90% of the measurement period. This is generally considered to be an acceptable descriptor of the underlying background noise level.

4.5 MEASUREMENT RESULTS

A summary of the key noise survey results is provided in Table 1 and the time history graph of the results from the unattended noise logger is provided in Figure 2.

Location/Time	Duration, T	$L_{Aeq,T}$ (dB)	$L_{A10,T}$ (dB)	$L_{A90,T}$ (dB)	Photo
MP1	Unattended noise logger position, in the rear courtyard of the adjacent cottage. The location is screened from all nearby roads.				
Daytime (0700-2300 hrs)	12 hrs	49	79	40	
Night-time (2300-0700 hrs)	8 hrs	40	56	39	
MP2	In front of the Museum/Town Hall, approx. 2 m from the building façade and 1 m from the edge of the road. First measurement made without any music in the hall. Second measurement made with music playing. When the music was playing, only low frequencies were audible, with no clear weak point in the building envelope being identifiable.				
19:01	7 min (music off)	54	65	39	
20:06	5 min (music on)	50	61	46	

Location/Time	Duration, T	$L_{Aeq,T}$ (dB)	$L_{A10,T}$ (dB)	$L_{A90,T}$ (dB)	Photo
MP3	Rear of Town Hall on the corner of Church St and Lower Strand. Music from the Hall was clearly audible, with weak points clearly identifiable via the rear doors to the building and a high level wall ventilation louvre. Further investigation around the east side of the building showed that the large single-glazed window on the west elevation was also a significant weak point. All frequencies were clearly audible, including mid/high frequencies.				
19:54	5 min	53	60	46	
MP4	Side of Town Hall on Ingram's Opening. Music from the Hall was clearly audible, but no individual weak point was identified, however the sound did appear to be coming more from the rear and/or roof of the building than the front. Low frequency music was dominant and mid/high frequencies were not clearly audible.				
20:00	5 min	51	64	44	
MP5	Inside Town Hall, music playing on a loop on a sound system provided by the client. Noise levels and choice of music considered to be representative of a typical noisy event which could be held in the hall.				
19:47	5 min	91	95	86	

Table 1: Noise survey results summary

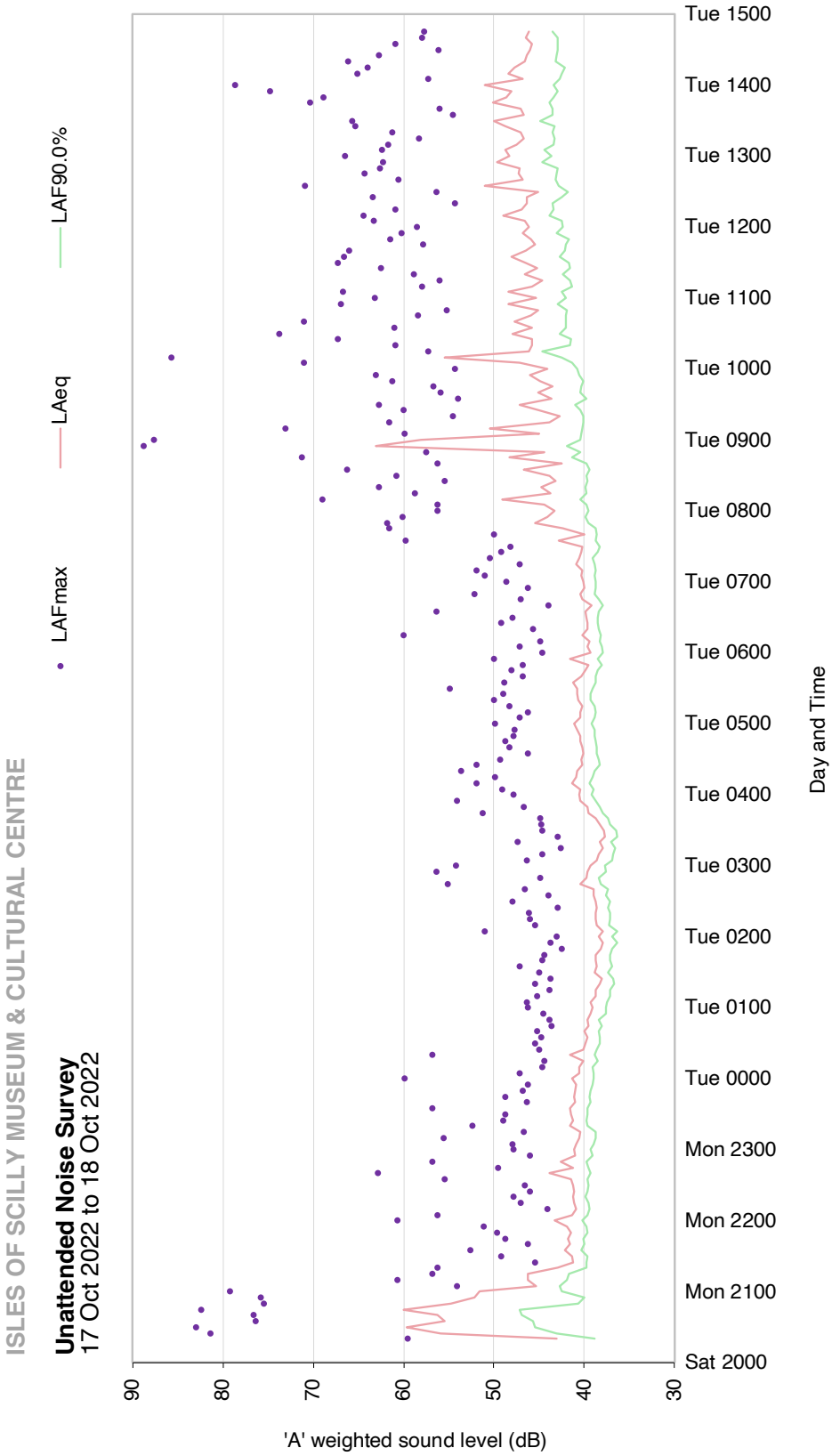

Figure 2: Time history graph showing the results from the unattended noise logger

4.6 ROOM ACOUSTIC CONDITIONS

We understand that the existing hall suffers from poor room acoustic conditions and this has led to significant operational issues such as cinema screenings being cancelled due to issues with dialogue clarity.

We undertook a set of reverberation time (RT) measurements inside the Hall to quantify the existing conditions. The measurement results are shown in the graph below, alongside a typical RT target curve for a multi-purpose hall of this size:

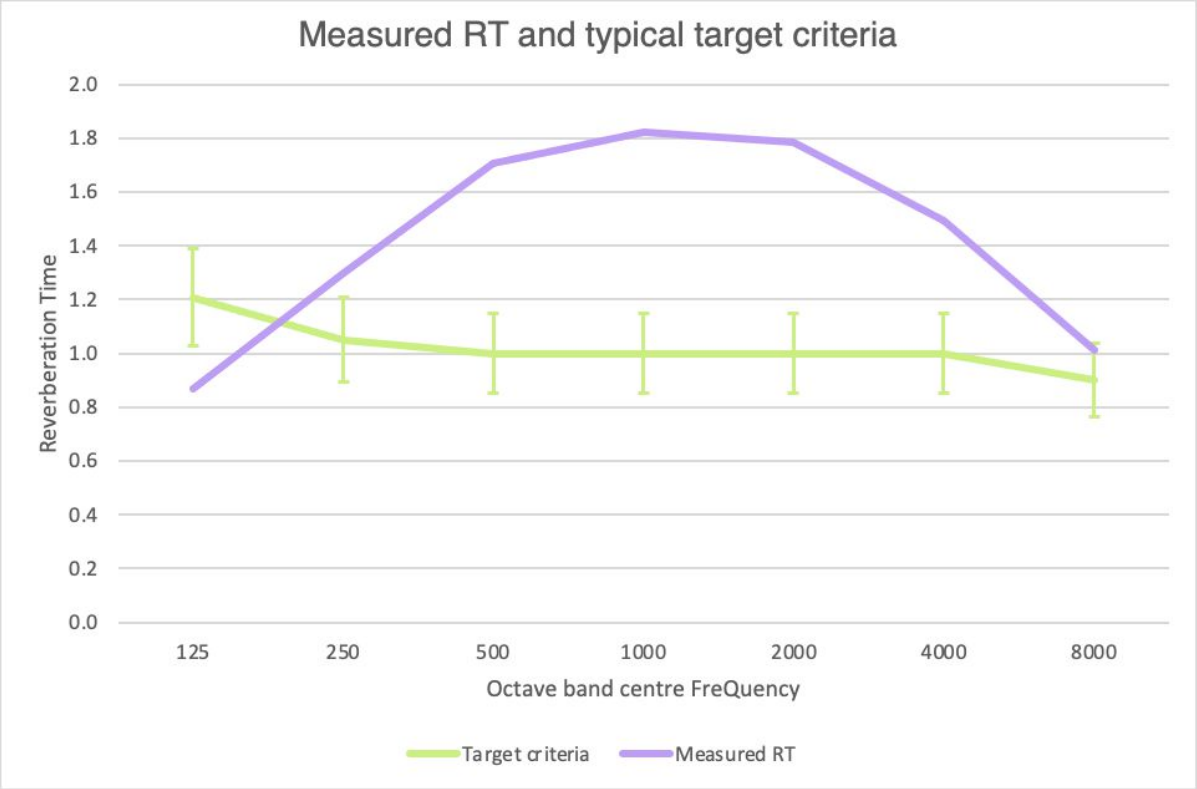

Figure 3: Measured RT and comparison with a typical design target.

The results show a significant exceedance of the typical design target in the mid-frequencies (500 Hz -2 kHz). These frequencies are the frequencies that are critical for speech clarity, which may explain the issues experienced with dialogue clarity in cinema screenings.

Whist the Hall was unoccupied and unfurnished during the tests, there were a significant number of objects being temporarily stored in the hall (e.g. chairs, tables, boxes, boards etc) which will have provided acoustic absorption and diffusion, and will have significantly affected the results of the measurements.

The low frequency RT appears to be close to the design target, but this is likely to have been significantly affected by the objects being stored in the room. When it is empty, we would expect the low frequency RT to be higher.

5 NOISE IMPACT ASSESSMENT

5.1 ENVIRONMENTAL NOISE BREAK-IN

The proposed indoor ambient noise level (IANL) criteria for the building are as follows:

Type of space	IANL criteria, L_{Aeq1hr} (dB)
Hall	**30**
Small meeting Rooms, Exhibition spaces, Staff areas, Offices	**40**
Foyer and Café Bar	**45**
Kitchen/Toilets/Circulation	**50**

Table 2: Proposed IANL criteria

Based on the environmental noise levels measured during the survey, the predicted internal noise levels with windows open for ventilation are around 35-39 dBL_{Aeq}, which would be compliant with the noise criteria for all spaces except the Hall.

On this basis, **a natural ventilation strategy is acoustically suitable for all spaces except the Hall. The hall should be provided with a mechanical ventilation system to control noise break-in and more importantly, noise break-out** (see the following section)**.**

5.2 MUSIC BREAK-OUT FROM THE HALL

INTERNAL MUSIC LEVELS

Typical 'noisy event' levels were simulated within the venue using a Mackie sound system provided and operated by the client. The methodology and results of the tests are provided in Section 4 above. With the music playing, the sound pressure level at each octave band frequency was as follows:

Measurement position	Sound pressure level (dBL_{eq}) Octave band centre frequency (Hz)								Overall A-weighted sound pressure level dBL_{Aeq}
	63	125	250	500	1000	2000	4000	8000	
MP5 (within Town Hall)	91	95	88	88	86	83	81	76	91

Table 3: Noise measurement results during live music simulation

In our experience, these levels are representative of a typical 'fairly noisy' event (e.g. a wedding disco, live musical theatre show or amateur cinema screening), but not a worst-case 'very noisy' event (e.g. a live amplified rock music concert or DJ playing amplified dance music). For those worst-case 'very noisy' events, a larger sound system might be brought in and we would expect overall noise levels to be up to 100 dBA with low frequency noise levels possibly around 100 dB at 63/125Hz.

SUBJECTIVE ASSESSMENT OF MUSIC BREAK-OUT

Full details of the subjective noise assessment outside the building are provided in Table 1 above and a summary is as follows:

- **Music break-out from the Hall was clearly audible at positions to the side and rear of the building** (including the courtyard of the adjacent cottage), with all frequencies audible.
- **Low frequency music was audible at the front of the building**, at a lower level than at the rear.
- **Low frequency music was just audible in the bedroom of the adjacent cottage**, although the residents of the property stated that they could not hear the music at all.
- The key reasons for the audible music at the side/rear were considered to be weaknesses in the building envelope as follows:
    - **The rear doors to the Hall** were fairly lightweight and poorly sealed.
    - **The ventilation louvre at high level** on the rear gable wall of the Hall appeared to be a source of mid-high frequency music break-out.
    - **The large single-glazed window** on the west elevation of the hall provided poor sound insulation at all frequencies.
- **The existing roof of the hall** is likely to be the main source of low frequency music break-out, on the assumption that it is more lightweight than the substantial stone walls of the hall.

ENTERTAINMENT NOISE LIMITS OUTSIDE NSRs

The Hall already functions as a live events space, so the proposed development will not introduce a new sound source to the existing site. However, the intensification of use could potentially increase the noise impact on nearby NSRs and it is therefore important that the development reduces the level of noise break-out from the Hall, to a pragmatic and achievable level. We have considered two relevant guidance documents, as described in Section 3, and proposed the following limits:

- **Occasional noisy events:** The Code's *"MNL should not exceed the background noise level by more than 15 dBA"* for up to 12 concerts per year and
- **All other events:** The IOA Good Practice Guide Draft Annex thresholds for weekly events (*"$L_{Aeq,15mins}$ (entertainment noise) should not exceed L_{A90} (without entertainment noise)"*).

We understand that the venue will not normally operate after 2300 hrs, therefore the limits are based on the daytime L_{A90} from the baseline survey. Applying these limits we can determine the required reduction in noise via the building envelope as follows:

Time period	Occasional noisy events	At all other times
MNL limit, dBL_{Aeq}	≤55	≤40
Assumed internal noise level in Hall, dBL_{Aeq}	≤100	≤90
Required reduction from building envelope, dB	**45**	**50**

Table 4: Proposed entertainment noise limits outside NSRs and required noise reduction to NSR locations

It is difficult to quantify the reduction achieved by the existing building envelope from the measurement results alone, due to the presence of other noise sources during the outdoor measurements. Based on the results we estimate that the existing building envelope is providing around a 35-40 dB reduction to nearby NSR locations, therefore an overall improvement of 10-15 dB is the target to meet the proposed MNL limits.

NOISE LEVELS INSIDE NEARBY NSRs

Our subjective assessment of noise levels inside the adjacent cottage was that low frequency music was just audible with a music level of 91 dBL_{Aeq} in the Hall. The most likely routes for the noise transmission between the two spaces was (a) airborne via the roofs/windows of the buildings and/or (b) structure-borne via the party wall. It is not possible to distinguish with absolute certainty between these two issues therefore we assume that both contributed to the noise transmission.

When the hall is used for occasional 'very noisy' events, the higher noise levels in the hall could result in music becoming clearly audible in the cottage. This may cause significant noise disturbance for the residents. It may be possible to reduce noise disturbance via upgrades to the Hall roof/windows, but reducing structure-borne noise transmission will not be practically possible.

We understand that you have discussed this issue with the current tenants of the cottage and they are happy to accept the risk of noise disturbance. Furthermore, when their tenancy expires, you intend to incorporate the cottage into the museum, therefore it will cease to be an NSR in future. In the meantime it may be necessary to monitor the situation and restrict some types of very noisy events.

We did not undertake noise measurements inside the residential properties to the east of the Hall, but they are buffered from the Hall by the intervening museum/office building, therefore the risk of structure-borne noise transmission to these properties should be significantly less.

SUMMARY OF NOISE BREAK-OUT ASSESSMENT

In order to ensure the proposed intensification of use of the Hall does not cause significant noise impacts for nearby NSRs, we recommend that improvements be made to the building envelope. Further details of the recommended upgrades are provided in Section 6 of this report and with the incorporation of these measures we believe it should be possible to achieve the target 10-15 dB reduction in noise break-out at NSR locations. On this basis **no significant adverse noise impacts are predicted as a results of entertainment noise break-out from the Hall.**

The only exception to this is the adjacent cottage which may experience significant adverse noise impacts as a result of structure-borne noise. It is unlikely that this issue can be mitigated given the constraints of the existing buildings.

5.3 BUILDING SERVICES PLANT NOISE EMISSIONS

BS 4142 states that a rating sound level equal to or lower than the background noise level at the NSR constitutes a 'low impact'. The representative background noise levels at the NSR locations are shown in Table 1 and for the purpose of this initial assessment we have assumed the plant could operate during day and night periods. Therefore **the building services plant noise emissions limits at the NSR locations are 40 and 39 $dBL_{A,r}$ during daytime and night time respectively**.

The proposed plant is located in a rooftop compound which is fairly well-screened from nearby NSRs. Once plant specifications are available it will be necessary to review these against the noise limits and provide a more detailed assessment in line with BS 4142.

Based on the plant location and the measured background sound levels, it is likely that the noise emissions limits can be achieved with fairly standard attenuation measures. Therefore **no significant adverse noise impacts are predicted as a result of plant noise emissions.**

5.4 ASSESSMENT UNCERTAINTY

The predicted noise levels in this assessment are based on robust calculations in line with the industry standard methods such as BS 8233:2014 and BS 4142:2014. Nonetheless real-world noise levels may vary from the predicted levels due to a number of factors, including:

1. Changes in future noise levels outside the building including the likely move away from internal combustion engine vehicles towards quieter electric vehicles, which could potentially reduce the traffic noise levels affecting the site.
2. Measurement uncertainty: the unattended logger was left in a location which was representative of the nearest NSR but the noise levels will vary according to distance from the nearby roads, and under different weather conditions, therefore natural some variation may occur.
3. Predictions of the sound insulation of the existing building envelope: Calculations have been made in line with industry standard calculation software and corrections have been incorporated to the assessment data to allow for uncertainty in the calculations. With existing and/or retained building elements there is inherent uncertainty in assessing their sound insulation because it is not possible to obtain exact specifications or to know the standard of construction detailing.
4. Construction detailing and workmanship for the finished building: This must be of a high standard to achieve the assumed sound insulation performance on site. With a historic building there is also a greater potential for unforeseen acoustic detailing issues which could reduce the sound insulation levels achieved on site.

6 INITIAL DESIGN ADVICE

6.1 REDUCING NOISE BREAK-OUT FROM THE HALL

The following noise mitigation and acoustic upgrades will need to be incorporated into the design:

VENTILATION STRATEGY

The Hall should be provided with a full mechanical ventilation system such that noisy events can run with the venue operating a 'windows closed, doors closed' policy. Windows and doors can be left open for less noisy events.

BUILDING ENVELOPE SOUND INSULATION UPGRADES

During the baseline noise survey it was not possible to quantify the sound insulation performance of the individual elements of the building with a high degree of accuracy. However, by comparing the internal/external measurement results and reviewing the build-up of each element, we have estimated the sound insulation performance for the existing building as follows and considered the upgrades which could realistically be incorporated to meet the noise limits in Table 4:

Element	Assumed build-up	Estimated sound insulation of existing element dBR_w	Upgraded performance required, dBR_w	Possible construction upgrade (to be developed)
Hall Roof	Slate tiles, ~300 mm clear void, timber ceiling	42	49	Add mass layer and mineral wool insulation into the roof build-up
External walls	~600 mm solid stone wall	60	None required – existing element already provides more than the recommended minimum.	
External glazing	6 mm single glazing	28	None required – existing windows will be enclosed by the new foyer building so will no longer be part of the external envelope. Upgrades may be required to other windows, unless sound lobbies can be incorporated into the internal layouts - TBC	
External access doors	~40 mm solid timber doors without seals (lobbied)	35	55	Existing doors to be infilled with masonry cavity wall + mineral wool insulation.
High level ventilation opening	Open weather louvre.	n/a	60	Louvre to be infilled with masonry or drywall cavity wall + mineral wool insulation.

Table 5: Assumed existing building envelope and estimated sound insulation performance

The proposed plans also show a new access door on the southeast corner of the Hall. This is a potential acoustic weak-point in the building envelope and it will either require a high performance acoustic doorset (e.g. Rw 55 dB) or alternatively the access could be provided via the existing lobbied entrance, with two more moderate performance doorsets (e.g. R_w 40 dB).

6.2 IMPROVING THE HALL ROOM ACOUSTICS

The reverberation time in the hall is currently too high for many of the proposed uses and it will be necessary to introduce a significant quantity of acoustic absorption in order to meet the target RT.

During the design, it will be necessary to develop room acoustic criteria for the Hall which suit the proposed use of the hall. As with all multi-purpose halls, there will need to be a compromise struck between the use for events which benefit from a longer RT (e.g. acoustic music, choral/classical music) and those which benefit from a shorter RT (e.g. amplified/rock music, dance music, cinema).

Calculations will need to be made to quantify the RT in the existing space and these calculations can then be used to explore options for acoustic absorption and diffusive finishes which meet the RT targets. At this stage we recommend the budget allows for a quantity of between 100-150 m^2 of acoustic absorption – TBC by calculation during the design.