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Consultants in Acoustics, Noise & Vibration

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Acorn House

Acoustic planning report

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Version	Date	Comments	Author	Reviewer
A	17 June 20	Draft issue	Kane Mitchell	Matthew Robinson
B	4 Aug 20	Minor amendments and updates to Section 8 and Section 9	Kane Mitchell	Matthew Robinson
C	19 Aug 20	Updated development proposals	Kane Mitchell	Matthew Robinson

Summary

Sandy Brown has been commissioned by Trium Environmental Consulting LLP to provide acoustic advice in relation to the proposed development at Acorn House, London.

An environmental noise survey has been carried out at the site. The noise survey was carried out between 11 September 2019 and 16 September 2019.

Representative background sound levels measured during the survey were:

- $L_{A90,15min}$ 54 dB during the daytime, and $L_{A90,15min}$ 50 dB during the night-time along Swinton Street.
- $L_{A90,15min}$ 52 dB during the daytime, and $L_{A90,15min}$ 48 dB during the night-time along Grays Inn Road.

Based on the requirements of the Camden Council and on the results of the noise survey, all normally operating plant must be designed such that the cumulative noise level at 1 m from the worst affected windows of the nearby noise sensitive premises does not exceed:

- L_{Aeq} 47 dB during the daytime, and L_{Aeq} 43 dB during the night-time along Swinton Street.
- L_{Aeq} 45 dB during the daytime, and L_{Aeq} 41 dB during the night-time along Grays Inn Road.

An assessment to determine the required sound insulation performances for the facades has been undertaken and guidance on glazing constructions and ventilation strategy provided.

High performance double glazing and mechanical ventilation will be required to control environmental noise ingress.

A mechanical ventilation system to each apartment is proposed as well as an option acoustically attenuated vents to help control summertime overheating. Specific guidance has been provided in relation to the required sound insulation performance of the vents.

For the ground level courtyard, ambient noise levels are expected to comply with the noise level limits recommended in BS:8233 during both the daytime and night-time.

For the Level 9 community terrace, ambient noise levels are expected to comply with the upper noise level limit recommended in BS:8233 during the night-time and marginally exceed this limit during the daytime.

Contents

1 Introduction

Sandy Brown has been commissioned by Trium Environmental Consulting LLP to provide acoustic advice in relation to the proposed development at Acorn House, London.

An environmental noise survey has been carried out to establish:

- Background sound levels around the site and by nearby noise sensitive premises
- Ambient and maximum noise levels at the site.

The background sound levels measured during the survey are used as the basis for setting limits for noise emission from proposed building services plant. These limits are set in accordance with the requirements of the Camden Council.

Ambient and maximum noise levels are used to assess building envelope sound insulation requirements to achieve appropriate internal noise levels for residences. These follow standards set in accordance with Camden Council guidelines.

This report provides details of the noise survey, including measurement results, and provides recommendations.

2 Site description

2.1 The site and its surroundings

The site location in relation to its surroundings is shown in Figure 1.

The labels refer to measurement positions which are discussed further in this report. The highlighted premises are the surrounding noise sensitive premises.

Figure 1 Aerial view of site (courtesy of Google Earth Pro)

2.2 Adjacent premises

The site is bounded by Swinton street to the north, Grays Inn road to the west, Acton street to the south and commercial properties adjacent to the site on the east and south.

Acorn House is adjacent to Arriva hotel and is opposite The Nuffield Hearing and Speech centre about 25 m from the site along Swinton street. These are highlighted in yellow and blue respectively in Figure 1.

A commercial building to the south of the site is highlighted in orange.

The Lucas Arms pub is opposite Acorn House along Grays Inn road. This is highlighted in green in Figure 1.

The nearest residential premises from the site, highlighted in red in Figure 1 are:

- 30 m from east of the site along Swinton street
- 36 m east and south of the site along Acton street.

3 Development proposals

Redevelopment of Acorn House as a part 6, part 10 storey building to provide 33 affordable housing units with affordable office space and a retail unit at ground and basement level together with cycle parking facilities. An external play space is proposed at level 6 and a community room with kitchenette and landscaped terrace for residents at level 9.

4 Assessment criteria

4.1 NPPF and NPSE

The National Planning Policy Framework, February 2019 (NPPF) sets out the UK government's planning policies for England. It supersedes previous guidance notes such as PPG24. No specific noise criteria are set out in the NPPF, or in the Noise Policy Statement for England (NPSE) to which it refers.

The NPPF states:

> *'Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:*
>
> - *mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life.*

- *identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason.'*

and

> *'Planning policies and decisions should ensure that new development can be integrated effectively with existing businesses and community facilities (such as places of worship, pubs, music venues and sports clubs). Existing businesses and facilities should not have unreasonable restrictions placed on them as a result of development permitted after they were established. Where the operation of an existing business or community facility could have a significant adverse effect on new development (including changes of use) in its vicinity, the applicant (or 'agent of change') should be required to provide suitable mitigation before the development has been completed.'*

The NPSE states that its aims are as follows:

> *'Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development:*
>
> - *Avoid significant adverse impacts on health and quality of life*
> - *Mitigate and minimise adverse impacts on health and quality of life and*
> - *Where possible, contribute to the improvement of health and quality of life.'*

As such, neither document sets out specific acoustic criteria for new residential developments, but they require consideration of the effect of existing noise on the new development and the effect of noise from the development on the surroundings.

4.2 Building services noise egress criteria

4.2.1 Standard guidance

BS 4142:2014+A1:2019 *Methods for rating and assessing industrial and commercial sound* (BS 4142) provides a method for assessing noise from items such as building services plant against the existing background sound levels at the nearest noise sensitive premises.

BS 4142 suggests that if the noise level is 10 dB or more higher than the existing background sound level, it is likely to be an indication of a significant adverse impact. If the level is 5 dB above the existing background sound level, it is likely to be an indication of an adverse impact. If the level does not exceed the background level, it is an indication of having a low impact.

If the noise contains 'attention catching features' such as tones, bangs etc, a penalty, based on the type and impact of those features, is applied.

4.2.2 Local Authority criteria

As per Camden Local Plan 2017, noise emissions associated with normally operating building services should be at least 10 dB below that of the background sound level ($L_{A90,15min}$).

4.1 Entertainment noise egress criteria

As per the Camden Local Plan 2017 criteria, entertainment noise from customer activities should not exceed the following levels at 1 m from the windows of the nearest noise sensitive premises:

- Daytime – $L_{Aeq,5min}$ 55 dB
- Evening – $L_{Aeq,5min}$ 50 dB
- Night-time – $L_{Aeq,5min}$ 45 dB.

For entertainment noise from amplified sound the noise limits in internal spaces are summarised in Table 1.

Table 1 Summary of Camden Local Plan 2017 guidance on entertainment noise

Room	Period	Noise limit
Bedrooms	23:00-07:00	NR 25 ($L_{eq,15min}$)
All habitable rooms	07:00-23:00	NR 35 ($L_{eq,15min}$)

4.2 Noise ingress

4.2.1 Local Authority requirements

Camden Local Plan 2017 provides internal noise criteria for bedrooms in terms of LOAEL and SOAEL, as well as maximum noise criteria. The LOAEL and maximum noise criteria is summarised in Table 2 below.

Table 2 Camden Council internal noise criteria

Space	Daytime (07:00-23:00)	Night-time (23:00-07:00)	
Bedroom	LOAEL (Green) < $L_{Aeq,\ 16hr}$ 35 dB	LOAEL (Green) < $L_{Aeq,\ 8hr}$ 30 dB	LOAEL (Green L_{AFmax} 42 dB
	LOAEL to SOAEL (Amber) < $L_{Aeq,\ 16hr}$ 35-45 dB	LOAEL to SOAEL (Amber) < $L_{Aeq,\ 8hr}$ 30-40 dB	LOAEL to SOAEL (Amber) L_{AFmax} 40-73 dB
	SOAEL (Red) > $L_{Aeq,\ 16hr}$ 45 dB	SOAEL (Red) > $L_{Aeq,\ 8hr}$ 40 dB	SOAEL (Red) > L_{AFmax} 73 dB

4.2.2 British Standard guidance

Guidance on acceptable internal noise levels in residential dwellings is given in BS 8233:2014 *Sound insulation and noise reduction for buildings*. The guidance limits are shown in Table 3.

These internal levels are based on annual average data and do not have to be achieved in all circumstances. It is normal to exclude occasional events, such as fireworks night or New Year's Eve.

Table 3 Internal noise criteria for sleeping/resting

Internal space	Indoor ambient noise level, L_{Aeq} (dB)	
	Daytime (07:00-23:00)	Night (23:00-07:00)
Living rooms	35	-
Dining room	40	-
Bedrooms	35	30[1]

[1] BS 8233 notes that individual noise events can cause sleep disturbance, and that a guideline value may be set depending on the character and number of events per night, although no specific limit is provided. For regular events, such as scheduled aircraft or passing trains, a guideline value may be set in terms of SEL or $L_{Amax,F}$. Sporadic noise events could require separate values.

The standard states that where development is considered necessary or desirable, the internal target levels may be relaxed by up to 5 dB and reasonable internal conditions still achieved.

For external amenity areas, such as gardens and patios, the standard states:

> *'it is desirable that the external noise level does not exceed 50 dB $L_{Aeq,T}$ with an upper guideline value of 55 dB $L_{Aeq,T}$ which would be acceptable in noisier environments. However, it is also recognized that these guideline values are not achievable in all circumstances where development might be desirable. In higher noise areas, such as city centres or urban areas adjoining the strategic transport network, a compromise between elevated noise levels and other factors, such as the convenience of living in these locations or making efficient use of land resources to ensure development needs can be met, might be warranted. In such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces, but should not be prohibited.'*

4.2.3 Acoustics, ventilation and overheating

Guidance on external noise levels from transport noise sources and the assessment of risk in an overheating condition is given in the Association of Noise Consultants *Acoustics Ventilation and Overheating, Residential Design Guide* (AVOG). External noise levels and the associated risk categories for a Level 1 assessment are adapted and summarised in Table 4, though consideration also has to be given the duration and frequency of any overheating periods.

Table 4 Guidance for Level 1 assessment of noise from transport sources relating to overheating condition

Risk category for Level 1 assessment	External free-field noise level	
	Daytime (07:00-23:00)	Night (23:00-07:00)
Low	L_{Aeq} ≤ 52 dB	L_{Aeq} ≤ 47 dB
Medium	L_{Aeq} > 52 dB and L_{Aeq} ≤ 62 dB	L_{Aeq} > 47 dB and L_{Aeq} ≤ 55 dB
High	L_{Aeq} > 62 dB	L_{Aeq} > 55 dB

If a Level 1 assessment finds that the development falls into a 'Medium' or 'High' risk category a Level 2 assessment should be carried out, assessing the expected internal noise levels for an overheating condition and the associated risk of adverse effect.

The guidance for suitable internal noise levels in order that noise ingress can be suitably controlled for an overheating condition are provided in AVOG. These are adapted and summarised in Table 5, though are not supposed to be taken as limits, rather guidelines to be assessed while also considering the adverse effect of any overheating (duration and severity).

The lowest observed affect level (LOAEL) and the significant observed affect level (SOAEL) for increased noise levels associated with controlling overheating are specific to each project as these depend on the magnitude of the increased internal noise levels and the duration for which they occur.

Table 5 Guidance for Level 2 assessment of noise from transport sources relating to overheating condition

Risk category for Level 2 assessment	Internal noise level		
	Daytime (07:00-23:00)	Night (23:00-07:00)	
Negligible	L_{Aeq} ≤ 35 dB	L_{Aeq} ≤ 30 dB	L_{AFmax} 45 dB not normally exceeded
Low	L_{Aeq} > 35 dB and L_{Aeq} ≤ 40 dB	L_{Aeq} > 30 dB and L_{Aeq} ≤ 35 dB	L_{AFmax} 65 dB not exceeded
Medium	L_{Aeq} > 40 dB and L_{Aeq} ≤ 50 dB	L_{Aeq} > 35 dB and L_{Aeq} ≤ 42 dB	-
High	L_{Aeq} > 50 dB	L_{Aeq} > 42 dB	-

The AVOG illustrates that there is a link between adverse effects, increasing internal ambient noise levels and the duration of exposure to noise for an overheating condition. These are indicated in Figure 2.

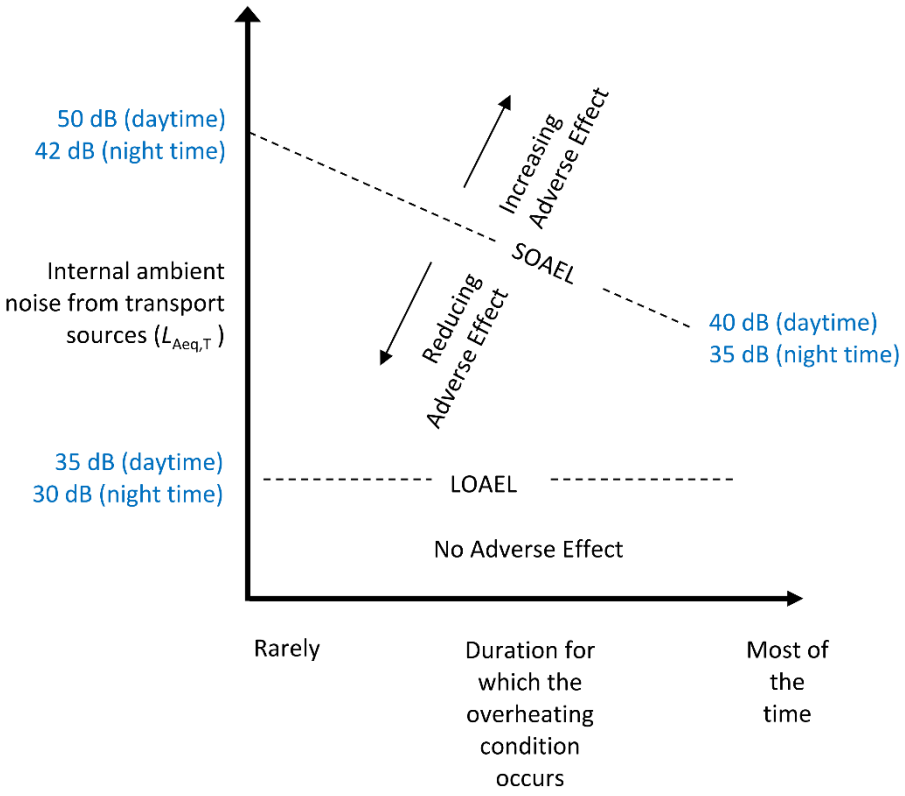


Figure 2 Internal ambient noise levels and increasing adverse effects for an overheating condition

When internal noise levels are above Significant Observed Adverse Effect Level (SOAEL), it is likely that there will be a high potential for an adverse outcome. These adverse outcomes will include:

- Material change in behaviour and/or attitude, eg avoiding certain activities during periods of intrusion
- Where there is no alternative ventilation, having to keep windows closed most of the time because of the noise
- Potential for sleep disturbance and difficulty in getting back to sleep
- Quality of life diminished.

As illustrated, the potential for adverse risk increases with the duration of exposure to noise, i.e. a shorter exposure will result in a lower risk of adverse outcomes.

5 Survey method

5.1 Noise survey method

The survey included unattended and attended noise measurements.

5.1.1 Unattended measurements

Unattended noise monitoring was undertaken at the site over 5 days.

Details of the equipment used and the noise indices measured are provided in Appendix A.

The unattended measurements were taken over 15 minute periods between 14:40 on 11 September 2019 and 23:55 on 16 September 2019.

The equipment was installed and collected by Matthew Elliott and George O'Connor.

The measurement position used during the survey is indicated in Figure 1, denoted by the letter 'A' and 'B'.

A photograph showing the measurement positions are provided in Figure 3 and Figure 4.

These positions were chosen to be reasonably representative of noise levels at the site and outside the nearest noise sensitive premises.

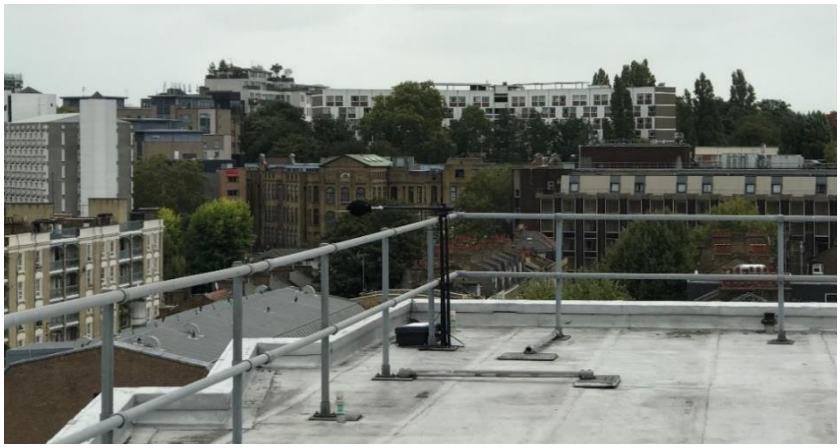


Figure 3 Photograph showing unattended noise monitoring position 'A' as per Figure 1

Figure 4 Photograph showing unattended noise monitoring position 'B' as per Figure 1

5.1.2 Attended measurements

Attended sample measurements were taken by Matthew Elliott and George O'Connor at two positions around Acorn House. These are indicated in Figure 1 as positions 1 and 2.

Attended measurements at positions 1 and 2 were carried out on 18 September 2019 over 15-minute periods, synchronised with the unattended noise monitoring measurements.

At each position the microphone was mounted on a tripod approximately 1.5 m above the ground level and at least 1.5 m from any other reflective surface.

Details of the equipment used and the noise indices measured are provided in Appendix A.

Dominant noise sources occurring during the measurements were noted.

5.2 Weather conditions

Weather conditions during the survey are described in Appendix A.

6 Measurement results

6.1 Observations

The dominant noise sources observed at the site during the survey were from road traffic on Swinton street and Grays Inn road. Less significant noise sources included pedestrians walking near the measurement positions.

6.2 Noise measurement results

A graph showing the results of the unattended measurements is provided in Appendix B and Appendix C.

6.2.1 Unattended measurement results – Position A (Swinton street)

Day and night-time ambient noise levels measured during the unattended survey are presented in Table 6.

Table 6 Ambient noise levels measured during the unattended survey at position 'A'

Date	Daytime (07:00-23:00) $L_{Aeq,16h}$ (dB)	Night (23:00-07:00) $L_{Aeq,8h}$ (dB)
Wednesday 11 September 2019	64[1]	60
Thursday 12 September 2019	64	60
Friday 13 September 2019	64	61
Saturday 14 September 2019	63	60
Sunday 15 September 2019	62	59
Monday 16 September 2019	64	60[1]
Average	63	60

[1] Measurement not made over full period due to monitoring start and end time (the measurement on 11 September 2019 was over 10.25 hours, and on September 2019 over 0.75 hours); not included in the average.

In line with BS 4142: 2014+A1:2019, representative background sound levels have been determined using statistical analysis of the continuous measurements.

Daytime and night-time statistical analysis of representative values for the site are given in Figure 5 and Figure 6.

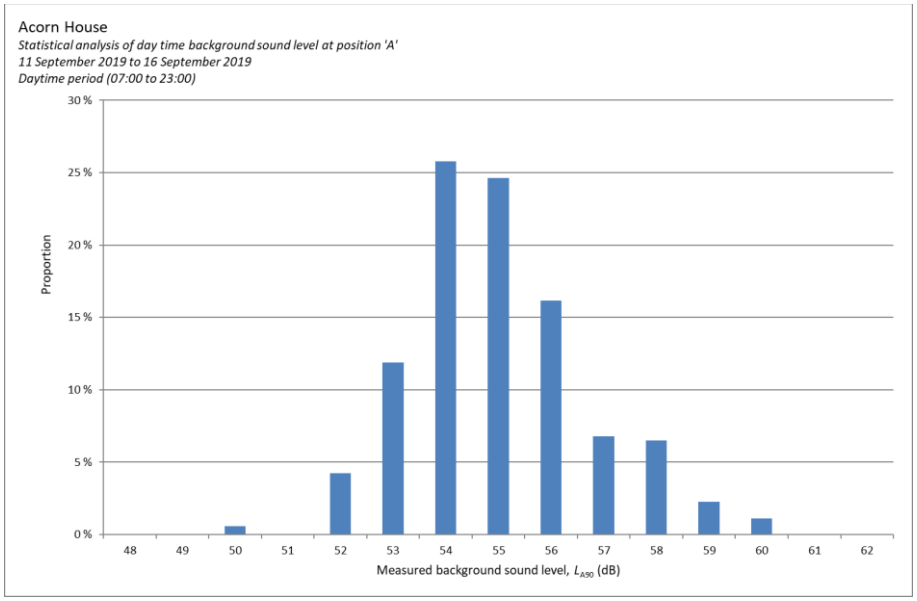


Figure 5 Statistical analysis of daytime background sound levels at position 'A'

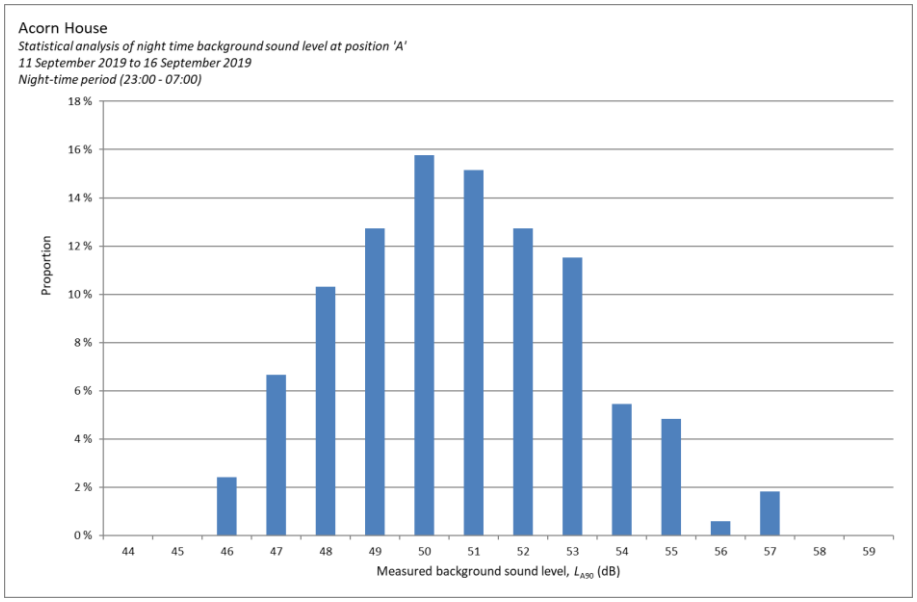


Figure 6 Statistical analysis of night-time background sound levels at position 'A'

From this analysis, the representative background sound levels measured during the survey were $L_{A90,15min}$ 54 dB during the daytime and $L_{A90,15min}$ 50 dB at night.

The octave band representative background sound levels at position 'A' are provided in Table 7.

Table 7 Octave-band representative background sound levels at position 'A'

Period	Representative background sound level, L_{90} (dB) Octave-band centre frequency (Hz)						
	63	125	250	500	1000	2000	4000
Daytime (07:00-23:00)	60	59	54	52	51	45	36
Night-time (23:00-07:00)	55	55	51	47	47	41	31

6.2.2 Unattended measurement results – Position B (Grays Inn road)

Day and night-time ambient noise levels measured during the unattended survey at position 'B' are presented in Table 8.

Table 8 Ambient noise levels measured during the unattended survey at position 'B'

Date	Daytime (07:00-23:00) $L_{Aeq,16h}$ (dB)	Night (23:00-07:00) $L_{Aeq,8h}$ (dB)
Wednesday 11 September 2019	62[1]	57
Thursday 12 September 2019	61	57
Friday 13 September 2019	60	56
Saturday 14 September 2019	59	56
Sunday 15 September 2019	59	55
Monday 16 September 2019	61	55[1]
Average	60	56

[1] Measurement not made over full period due to monitoring start and end time (the measurement on 11 September 2019 was over 10.25 hours, and on September 2019 over 0.75 hours); not included in the average.

In line with BS 4142: 2014+A1:2019, representative background sound levels have been determined using statistical analysis of the continuous measurements.

Daytime and night-time statistical analysis of representative values for the site are given in Figure 7 and Figure 8.

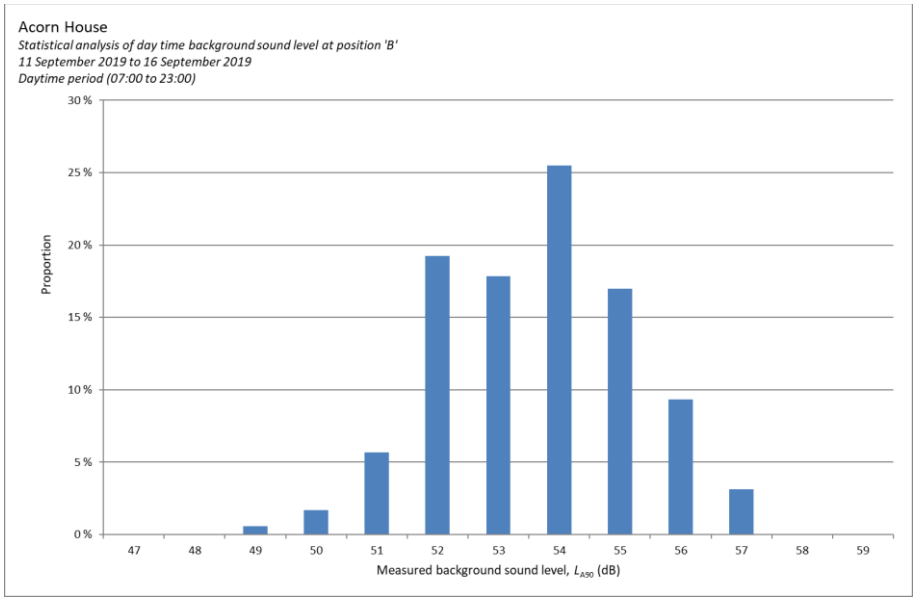


Figure 7 Statistical analysis of daytime background sound levels at position 'B'

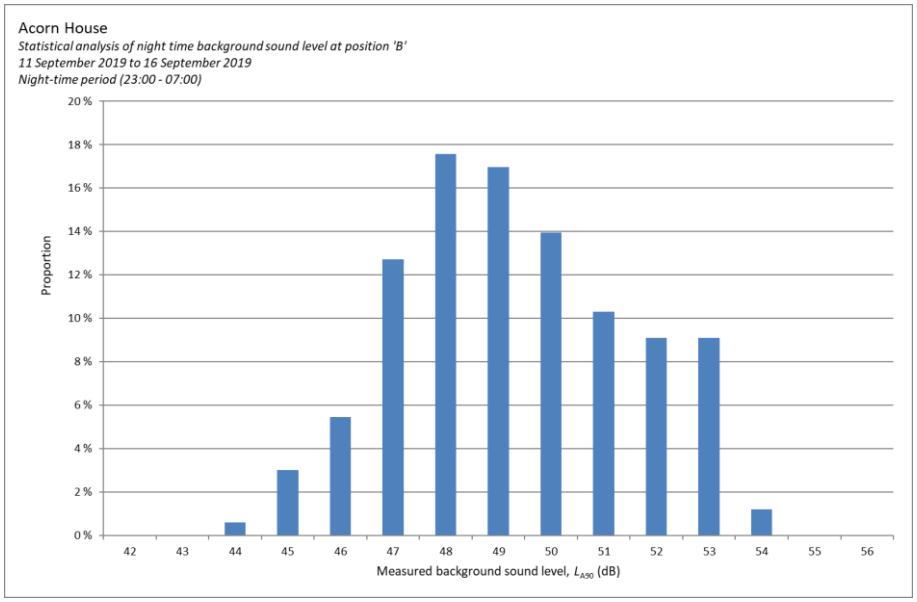


Figure 8 Statistical analysis of night-time background sound levels at position 'B'

From this analysis, the representative background sound levels measured during the survey were $L_{A90,15min}$ 52 dB during the daytime and $L_{A90,15min}$ 48 dB at night.

The octave band representative background sound levels at position 'B' are provided in Table 9.

Table 9 Octave-band representative background sound levels at position 'B'

Period	Representative background sound level, L_{90} (dB) Octave-band centre frequency (Hz)						
	63	125	250	500	1000	2000	4000
Daytime (07:00-23:00)	60	56	53	50	49	45	38
Night-time (23:00-07:00)	53	50	48	44	44	38	30

Camden Council provide entertainment noise egress criteria for daytime (07:00-19:00), evening (19:00-23:00) and night-time (23:00-07:00) periods. These limits are discussed further in Section 10.

Based on the current design, the noise levels measured at position 'B' are considered to be representative of the worst effected noise sensitive receptors. As such, the average ambient noise levels measured for these time periods are summarised in Table 10.

Table 10 Daytime, evening, and night-time external noise levels at position 'B'

Date	Daytime (07:00-19:00) $L_{Aeq,12h}$ (dB)	Evening (19:00-23:00) $L_{Aeq,4h}$ (dB)	Night (23:00-07:00) $L_{Aeq,8h}$ (dB)
Wednesday 11 September 2019	61 [1]	60	57
Thursday 12 September 2019	61	60	57
Friday 13 September 2019	60	59	56
Saturday 14 September 2019	60	59	56
Sunday 15 September 2019	59	59	55
Monday 16 September 2019	61	61	61[1]
Average	60	60	56

[1] Measurement not made over full period due to monitoring start and end time (the measurement on 11 September 2019 was over 6.25 hours, and on September 2019 over 0.75 hours); not included in the average.

6.2.3 Attended measurement results

Noise levels and key sources recorded during the attended measurements are summarised in Table 11. These measurements are considered to be free field.

Table 11 Noise levels and key noise sources from attended measurements

Position	Start time	Sound pressure levels (dB)			Noise sources
		$L_{Aeq,15min}$	$L_{AFmax,15min}$	$L_{A90,15min}$	
1	10:24	71	87	64	Idling traffic on Swinton street
2	10:40	70	89	63	Slow moving traffic on Grays Inn road, car horns and light pedestrian traffic.

7 Plant noise limits – noise egress

7.1 Basic limits

Based on the above criteria and the measurement results, the cumulative noise level from the operation of all new plant should not exceed the limits set out in Table 12.

The limits apply at 1 m from the worst affected windows of the nearest noise sensitive premises and are presented as facade levels. These have been corrected relative to the measured free-field background noise levels by the addition of 3 dB.

Table 12 Plant noise limits at 1 m from the nearest noise sensitive premises

Time of day	Maximum sound pressure level at 1 m from noise sensitive premises, $L_{Aeq,15min}$ (dB)
Position A (Swinton street)	
Daytime (07:00-23:00)	47
Night-time (23:00-07:00)	43
Position B - (Grays Inn road)	
Daytime (07:00-23:00)	45
Night-time (23:00-07:00)	41

The limits set out in Table 12 do not include any attention catching features. The penalty corrections for attention catching features may be significant and will need to be considered as the building services design progresses. This is discussed in Appendix D.

7.2 Assessment

All building services plant will be designed to achieve the noise limits set out above, including any corrections for attention catching features. At this stage, no information is available in relation to the proposed plant. This will need to be assessed as the design progresses.

8 Facade sound insulation – noise ingress

This section describes an assessment of facade sound insulation to control noise ingress. The required facade specification largely depends on the external noise levels and the internal noise criteria.

The following assessment is based on achieving the internal noise levels recommended in BS 8233 and by the Camden Council, which are set out in Section 4.

8.1 External noise levels

External noise level zones are presented in Table 13 and correspond to the external noise level mark-ups presented in Appendix E.

Table 13 External noise level zones

Zone	Daytime ambient noise level, L_{Aeq} (dB)	Night-time ambient noise level, L_{Aeq} (dB)	L_{AFmax} not normally exceeded at night (dB)
1	69-71	68-70	-
2	66-68	65-67	-
3	63 -	62-64	-
4	60-62	59-61	-
5	57-59	56-58	-
AA	-	-	83
BB	-	-	81

8.2 Facade sound insulation

Minimum facade sound insulation requirements for the facades are given in Table 14 for each zone. These have been determined to achieve the internal noise criteria for bedrooms and living areas using predicted external noise levels at the facades.

Table 14 Facade sound insulation zones

Facade zone	Minimum overall sound insulation performance, R'_w+C_{tr} (dB)		
	Bedrooms	Living rooms	
	Single aspect	Single aspect	Dual aspect
1	39	39	42
2	36	36	39
3	33	33	36
4	30	30	33
5	27	27	30

8.3 Guidance on glazing and ventilation strategy

The performance required by each element will depend on the relative areas of glazed and non-glazed elements, and the ventilation strategy.

As a guide, for a mechanically ventilated room with a 50% glazed facade, the glazing sound insulation requirement would typically be 3 dB lower than the overall facade sound insulation requirement. This is provided the non-glazed external wall elements provide at least 10 dB more sound insulation than the glazed elements.

Example glazing configurations capable of achieving the various sound insulation performance requirements for the different facade zones are provided in Table 15.

Table 15 Example glazing configurations

Glazing sound insulation, R'_w+C_{tr} (dB)	Example glazing configuration
27	6 mm glass/16 mm cavity/6 mm glass
29	8 mm glass/16 mm cavity/6 mm glass
31	8 mm glass/16 mm cavity/6 mm glass
33	6.8 mm acoustic laminate glass/16 mm cavity/6 mm glass

Glazing sound insulation, R'_w+C_{tr} (dB)	Example glazing configuration
35	8.8 mm acoustic laminate glass/16 mm cavity/6 mm glass
37	8.8 mm acoustic laminate glass/16 mm cavity/10 mm glass
39	8.8 mm acoustic laminate glass/20 mm cavity/10 mm glass

8.4 Acoustics, ventilation and overheating assessment

8.4.1 Level 1 assessment

A Level 1 assessment of noise ingress during an overheating condition has been carried out in line with Association of Noise Consultants *Acoustics Ventilation and Overheating, residential Design Guide*.

The Level 1 assessment has been carried out based on the external noise levels as per Table 13 and the relevant criteria as per Table 4.

The results of this assessment indicate that the proposed development falls into the high risk category and therefore a Level 2 assessment is required. This has been undertaken in the following section.

8.4.2 Proposed ventilation strategy

Apartments are to be mechanically ventilated via a mechanical ventilation and heat-recovery system and an air source heat pump. This system will also capable of controlling summertime overheating. Openable windows will not be relied upon for summertime overheating.

In addition to the above, as an option for residents, acoustically attenuated ventilation panels are to be provided in the facades of apartments. The performance requirements of these openable vents are discussed in the following sections.

8.4.3 Level 2 assessment

A Level 2 assessment has been carried out due to the proposed development being a high risk' site, ie, daytime and night-time external free-field noise levels are L_{Aeq} > 62 dB and L_{Aeq} >55 dB respectively.

The overheating assessment carried out by Atelier Ten, states that increasing the area of natural ventilation to bedrooms would improve thermal comfort, but the TM59 recommendations for night-time would be exceeded. In this case, an operable facade has been recommended to increase thermal comfort at night.

For the living room/kitchen and single bedroom with south-west facing facades, there is a higher risk of overheating, meaning that opening windows may be required more often and for longer periods.

An assessment of the internal noise levels based on using openable windows for longer periods of time as suggested by Atelier Ten has been carried out.The predicted internal noise levels for each facade zone are summarised in Table 16.

This assessment is based on controlling overheating via openable windows and then comparing the predicted levels of noise ingress to the criteria as per Table 5.

Table 16 Predicted internal noise levels due to opening windows

		Internal noise levels	
		Daytime (07:00-23:00)	Night-time (23:00-07:00)
		$L_{Aeq,16h}$ (dB)	$L_{Aeq,8h}$ (dB)
1		59	58
2		56	55
3		53	52
4		50	49
5		47	46

For all living rooms and bedrooms located within facade zones 1 to 4 and bedrooms located within facade zone 5, internal noise levels exceed the 'high' Level 2 assessment criteria as per Table 5. As such, the following expected outcome is provided:

> *The noise causes a material change in behaviour and/or attitude, e.g. avoiding certain activities during periods of intrusion and having to keep windows closed most of the time because of the noise where there is no alternative ventilation;*
>
> *Potential for sleep disturbance resulting in: difficulty getting to sleep, premature awakening and difficulty in getting back to sleep;*
>
> *Quality of life diminished due to change in acoustic character of the area.*

From this assessment, for a majority of facade areas the use of opening windows in addition to mechanical ventilation systems to control summertime overheating is expected to result in an exceedance of the recommended maximum internal noise levels.

The only areas where openable windows may be feasible would be living rooms located in facade zone 5 during the daytime (07:00-23:00).

8.4.4 Recommendations

Given the findings of the TM59 assessment which indicate the risk of overheating occurs for relatively long duration for Scenario 1, the minimum overall facade sound insulation performances required to meet SOAEL daytime and night-time internal noise levels as per Figure 2 are set out in Table 17.

Table 17 Overall minimum facade sound insulation performance – Overheating condition

Facade zone		Minimum overall sound insulation performance, R'_w+C_{tr} (dB)		
		Bedrooms	Living rooms	
		Single aspect	Single aspect	Dual aspect
1		28	24	27
2		25	21	24
3		22	18	21
4		19	15	18
5		16	12	15

The use of attenuated natural ventilation should control noise ingress such that it does not exceed the SOAEL internal noise criteria as per Figure 2.

To achieve the minimum overall facade sound insulation performances for bedrooms and living rooms in Table 17 the attenuator panels should provide a minimum element sound insulation performance of $D_{n,e,w}$ 28 dB when open (and a performance 10-15 dB higher when closed-off during the normal ventilation condition).

Scenario 2 assessed by Atelier Ten considers a decreased window to wall ratio (WWR) and the introduction of thermal mass. This approach reduces the risk of overheating and the potential duration of the overheating period, as such internal noise levels to achieve the SOAEL would become less onerous and in turn reduce the minimum performance of the attenuated natural ventilation.

9 External amenity areas

A number of apartments on the Gary's Inn Road facade have winter gardens proposed to them.

Typically, winter gardens attenuate noise levels incident upon their respective facade area by 3 dB, though the level of attenuation could be increased inf the winter gardens are fully enclosed. As such, the glazing sound insulation requirements to these areas would be 3 dB lower than those detailed in Table 14. The facade sound insulation requirements for other areas of the Gray's Inn Road facade will remain unchanged.

At ground level, there is an external courtyard to the west of the site. Here noise levels are expected to be L_{Aeq} 47 dB during the daytime and L_{Aeq} 45 dB during the night-time. These noise levels comply with the noise level limits recommended in BS:8233 as per section 4.2.2 during both the daytime and night-time.

At Level 1 there is a biodiverse roof, however this space is not accessible to occupants of the buildings.

At Level 9 there is a community terrace. Here noise levels are expected to be L_{Aeq} 57 dB during the daytime and L_{Aeq} 53 dB during the night-time. These noise levels comply with the noise levels recommended in BS:8233 as per section 4.2.2 during the night-time but marginally exceeds the upper recommended noise limit of L_{Aeq} 55 dB during the daytime. This is not expected to have a significant impact on the use of the space.

10 Entertainment noise egress

The retail unit is located at ground level within the north west corner of the building. The facades of the retail unit overlook both Swinton Street and Gray's Inn Road. The noise sensitive receiver 'The Lucas Arms pub' is considered the worst affected noise sensitive premises. If entertainment noise is suitably controlled to this receptor, it is expected that it will also be controlled to the other noise sensitive receptors in the area.

10.1 External noise levels

Camden Local Plan provides entertainment noise criteria for daytime (07:00-19:00), evening (19:00-23:00) and night-time (23:00-07:00). The noise levels measured for these periods are set out in Table 10.

10.2 Internal limits

Based on the limits within Section 4.1 and a minimum overall facade sound insulation performance of R_w+C_{tr} 28 dB, the permissible internal noise levels within the retail unit would be limited to the following:

- L_{Aeq} 100 dB during daytime
- L_{Aeq} 95 dB during evening
- L_{Aeq} 90 dB during night-time.

These limits would typically be suitable for amplified music.

If noise levels higher than those noted above were desirable, additional enhancement works would be required in order to ensure that the Camden Council criteria are still met. Typical enhancement works would be expected to include:

- Enhancements to external glazing

- Enhancements to the non-glazed elements of the facade
- Lobbied external doors.

11 Conclusion

An environmental noise survey has been carried out at the site. The noise survey was carried out between 11 September 2019 and 16 September 2019.

Representative background sound levels measured during the survey were:

- $L_{A90,15min}$ 54 dB during the daytime, and $L_{A90,15min}$ 50 dB during the night-time along Swinton Street.
- $L_{A90,15min}$ 52 dB during the daytime, and $L_{A90,15min}$ 48 dB during the night-time along Grays Inn Road.

Based on the requirements of the Camden Council and on the results of the noise survey, all normally operating plant must be designed such that the cumulative noise level at 1 m from the worst affected windows of the nearby noise sensitive premises does not exceed:

- L_{Aeq} 47 dB during the daytime, and L_{Aeq} 43 dB during the night-time along Swinton Street.
- L_{Aeq} 45 dB during the daytime, and L_{Aeq} 41 dB during the night-time along Grays Inn Road.

These limits are cumulative and apply with all plant operating under normal conditions. If plant items contain tonal or attention catching features, the limits will be more stringent.

An assessment to determine the required sound insulation performances for the facades has been undertaken and guidance on glazing constructions and ventilation strategy provided.

High performance double glazing is required to control environmental noise ingress.

A mechanical ventilation system is proposed as well as acoustically attenuated vents. Specific guidance has been provided in relation to the required sound insulation performance of the vents.

For the ground level courtyard, ambient noise levels are expected to comply with the noise level limit recommended in BS:8233 during both the daytime and night-time.

For the Level 9 community terrace, ambient noise levels are expected to comply with the upper noise level limit recommended in BS:8233 during the night-time and marginally exceed this limit during the daytime.

Appendix A

Survey details

Equipment

The unattended noise measurements were taken using two Rion NL52 sound level meters. The attended noise measurements were taken using a B&K 2250 sound level meter.

Calibration details for the equipment used during the survey are provided in Table A1.

Table A1 Equipment calibration data

Equipment description	Type/serial number	Manufacturer	Calibration expiry	Calibration certification number
Sound level meter	2250/3009283	Brüel & Kjær	12 Jun 20	UCRT18/1602
Microphone	4189/3005042	Brüel & Kjær	12 Jun 20	UCRT18/1602
Pre-amp	ZC0032/23792	Brüel & Kjær	12 Jun 20	UCRT18/1602
Calibrator	4231/3016124	Brüel & Kjær	12 Jun 20	UCRT18/1598
Sound level meter	NL-52/00320633	Rion	25 May 20	TCRT18/1462
Microphone	UC-59/12576	Rion	25 May 20	TCRT18/1462
Pre-amp	NH-25/10641	Rion	25 May 20	TCRT18/1462
Calibrator	N7-74/34125430	Rion	15 May 20	TRCT18/1420
Sound level meter	NL-52/00264550	Rion	24 Jul 20	TCRT18/1638
Microphone	UC-59/09698	Rion	24 Jul 20	TCRT18/1638
Pre-amp	NH-25/64675	Rion	24 Jul 20	TCRT18/1638
Calibrator	NC-74/34367631	Rion	24 Jul 20	TCRT18/1631

Calibration of the meters used for the measurements is traceable to national standards. Calibration certificates for the sound level meters used in this survey are available upon request.

Calibration checks were carried out on the meters and their measurement chains at the beginning and end of the survey. No significant calibration deviation occurred.

Noise indices

Noise indices recorded included the following:

- $L_{Aeq,T}$ The A-weighted equivalent continuous sound pressure level over a period of time, T.
- $L_{AFmax,T}$ The A-weighted maximum sound pressure level that occurred during a given period, T, with a fast time weighting.
- $L_{ASmax,T}$ The A-weighted maximum sound pressure level that occurred during a given period, T, with a slow time weighting.
- $L_{A90,T}$ The A-weighted sound pressure level exceeded for 90% of the measurement period. Indicative of the background sound level.

Sound pressure level measurements are normally taken with an A-weighting (denoted by a subscript 'A', eg L_{A90}) to approximate the frequency response of the human ear.

A more detailed explanation of these quantities can be found in BS7445: Part 1: 2003 *Description and measurement of environmental noise, Part 1. Guide to quantities and procedures.*

Weather conditions

During the attended noise measurements, the weather was generally clear and dry, and no rain occurred. Wind speeds were measured at each position and varied between 3 m/s and 5 m/s.

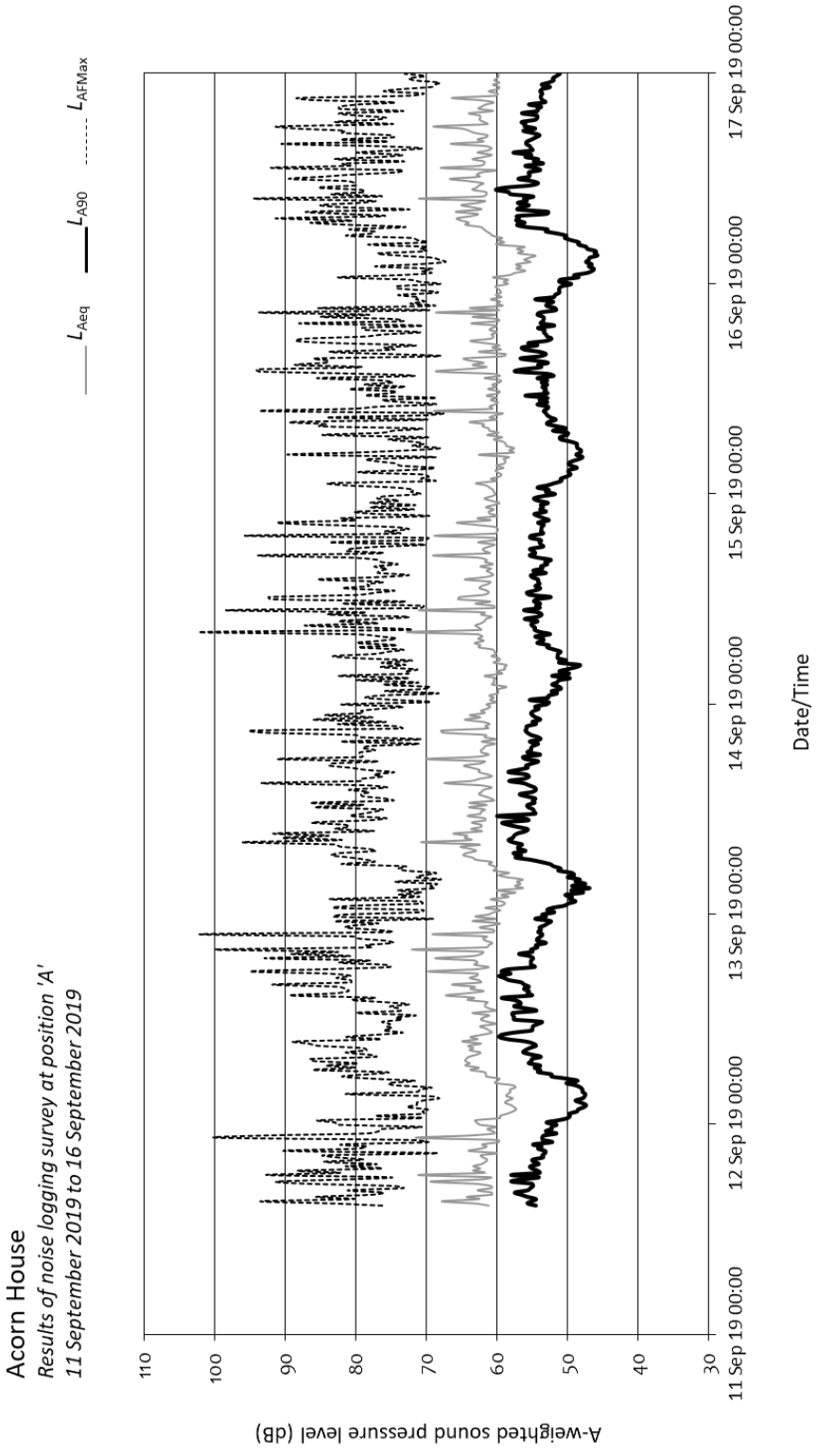
During the unattended noise measurements, weather reports for the area indicated that temperatures varied between 15°C at night and 21°C during the day, and the wind speed was less than 5 m/s.

These weather conditions are considered suitable for obtaining representative measurements.

.

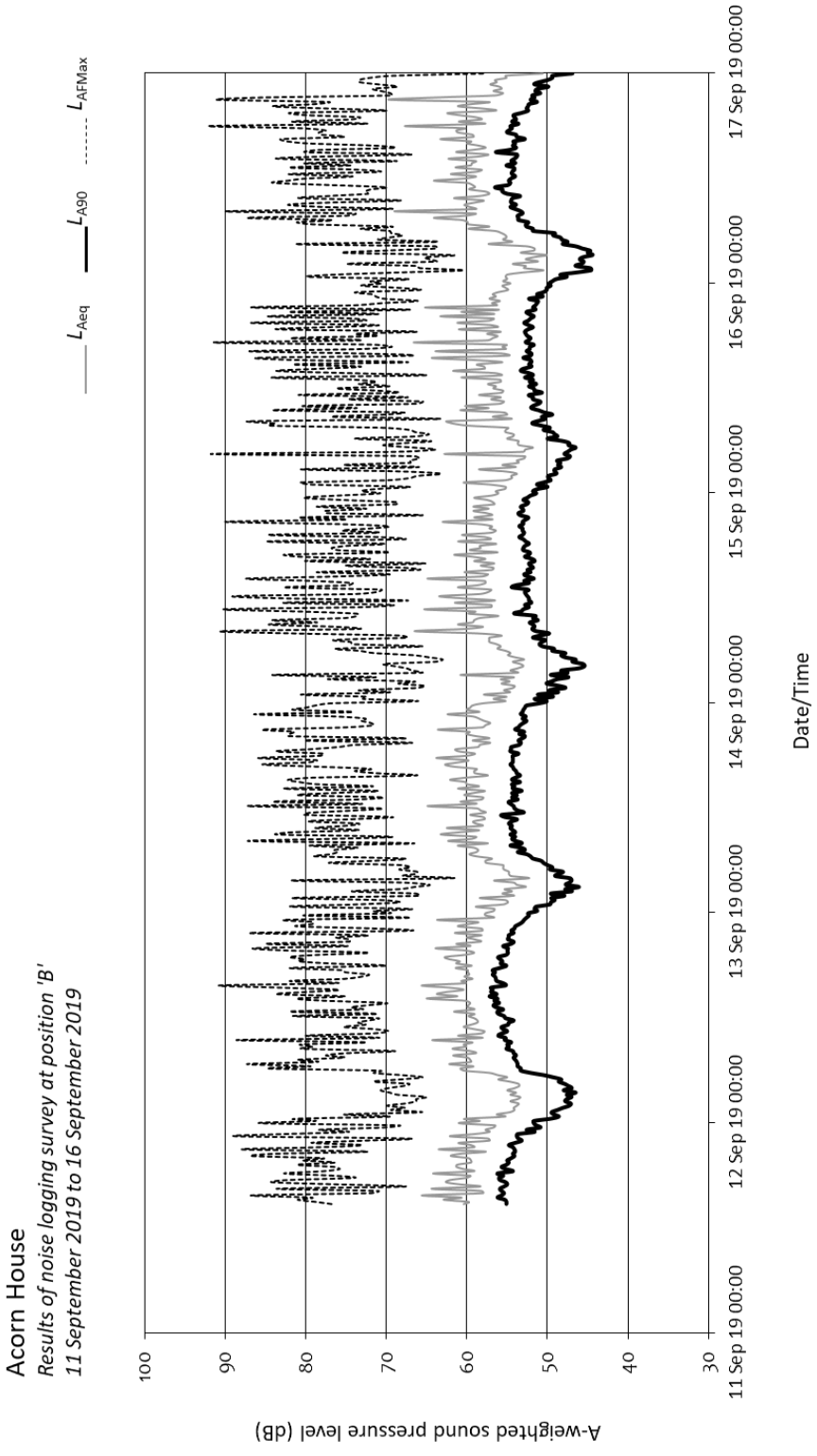
Appendix B

Results of unattended measurements at position ‘A’


Acorn House
Results of noise logging survey at position 'A'
11 September 2019 to 16 September 2019
L_{Aeq}
L_{A90}
L_{AFMax}
A-weighted sound pressure level (dB)
110
100
90
80
70
60
50
40
30
11 Sep 19 00:00
12 Sep 19 00:00
13 Sep 19 00:00
14 Sep 19 00:00
15 Sep 19 00:00
16 Sep 19 00:00
17 Sep 19 00:00
Date/Time

Appendix C

Results of unattended measurements at position ‘B’


Acorn House
Results of noise logging survey at position 'B'
11 September 2019 to 16 September 2019
L_{Aeq}
L_{A90}
L_{AFMax}
A-weighted sound pressure level (dB)
100
90
80
70
60
50
40
30
11 Sep 19 00:00
12 Sep 19 00:00
13 Sep 19 00:00
14 Sep 19 00:00
15 Sep 19 00:00
16 Sep 19 00:00
17 Sep 19 00:00
Date/Time

Appendix D

BS 4142 corrections for attention catching features

The following applies where plant noise is assessed in accordance with BS 4142:2014+A1:2019.

If the proposed plant noise contains attention catching features (such as tonal elements, whines, whistles, bangs etc), penalty corrections should be applied based on the type and impact of the features.

If appropriate, a subjective assessment of the plant features can be adopted. Where the plant noise contains tonal elements, the following corrections can be made depending on how perceptible the tone is at the noise receptor:

- 0 dB where the tone is not perceptible
- 2 dB where the tone is just perceptible
- 4 dB where the tone is clearly perceptible
- 6 dB where the tone is highly perceptible.

Where the plant noise is impulsive, the following corrections can be made depending on how perceptible the impulsivity is at the noise receptor:

- 0 dB where the impulse is not perceptible
- 3 dB where the impulse is just perceptible
- 6 dB where the impulse is clearly perceptible
- 9 dB where the impulse is highly perceptible.

For noise which is equally both impulsive and tonal, then both features can be accounted for by linearly summing the corrections for both characteristics.

If the plant has other distinctive characteristics, such as intermittency, then a 3 dB correction can be made.

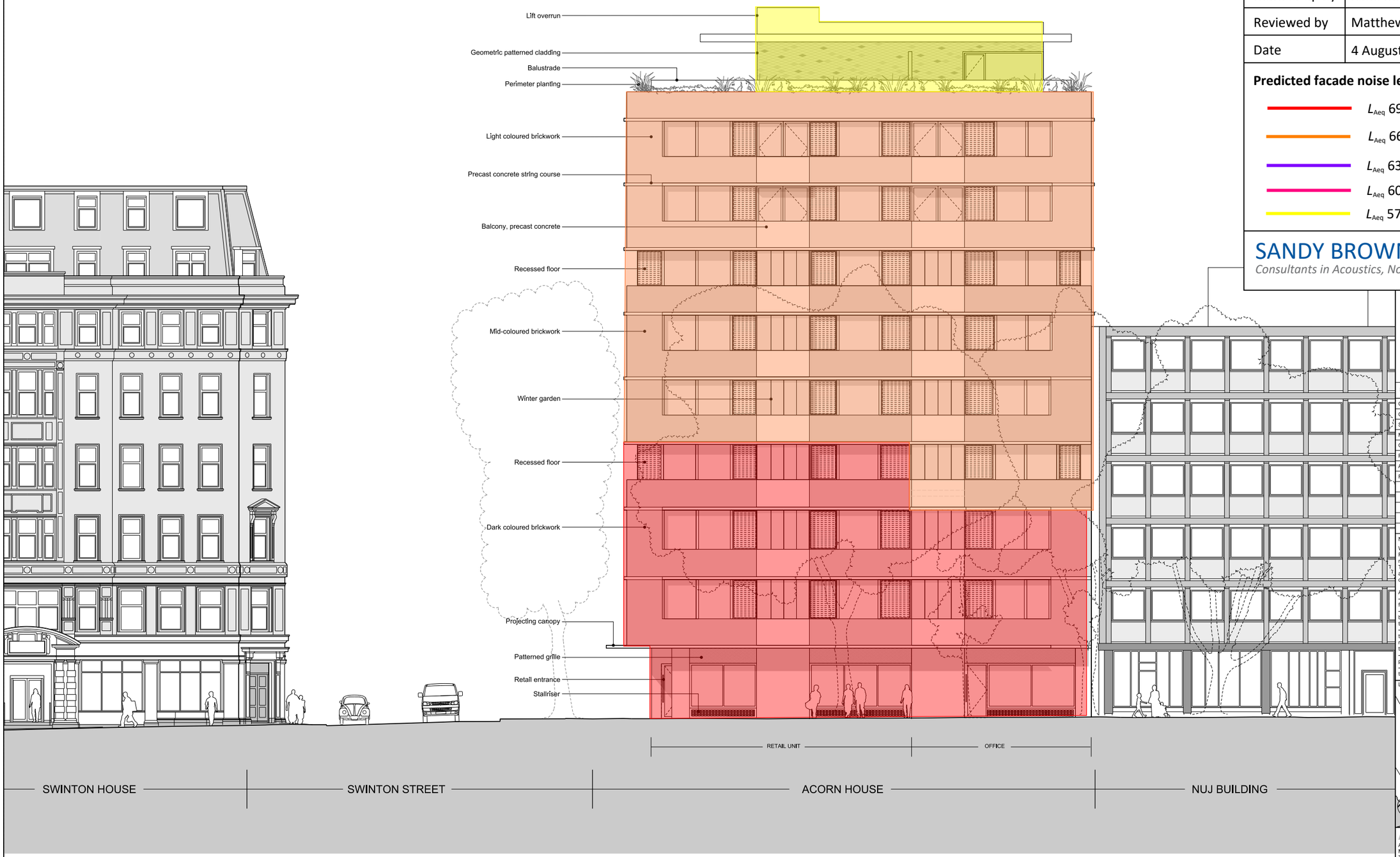
If a subjective assessment of tonality is not appropriate, an objective assessment can be made by analysis of time-averaged, third-octave band sound pressure levels. A noise source is deemed to be tonal if the level in a third-octave band exceeds the level in adjacent third-octave bands by the level differences given below:

- 15 dB in the low frequency third-octave bands (25 Hz to 125 Hz)
- 8 dB in the mid frequency third-octave bands (160 Hz to 400 Hz)
- 5 dB in the high frequency third-octave bands (500 Hz to 10000 Hz).

If an objective assessment identifies the plant noise to be tonal then a 6 dB correction must be made.

Appendix E

External noise levels



Title	Predicted daytime facade noise level
Project	Acorn House
Project no.	19373
Version	B
Marked-up by	Kane Mitchell
Reviewed by	Matthew Robinson
Date	4 August 2020

Predicted facade noise levels

- L_{Aeq} 69-71 dB ambient noise level
- L_{Aeq} 66-68 dB ambient noise level
- L_{Aeq} 63-65 dB ambient noise level
- L_{Aeq} 60-62 dB ambient noise level
- L_{Aeq} 57-59 dB ambient noise level

SANDY BROWN
Consultants in Acoustics, Noise & Vibration

REV	DATE
P1	27/07/20 PLANNING SUBMISSION

CONSULTANTS	NAME
CLIENT:	ACCESS STORAGE
STRUCTURAL ENGINEER:	AKT II
MECHANICAL ENGINEER:	ATELIER TEN
COST CONSULTANT:	CAST CONSULTANCY
PROJECT MANAGER:	RPM
ACOUSTIC CONSULTANT:	SANDY BROWN
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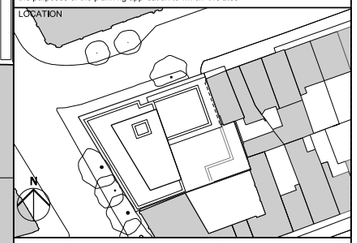

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job title
ACORN HOUSE

drawing title / location
ELEVATION 01
GRAY'S INN RD (SW FACING)

drawn by	checked	scale	status
AW	SS	1:100@A1; 1:200@A3	PLANNING

project	zone	source	classification	drawing no.	revision
18102		A	(00)_201		P1

Title	Predicted daytime facade noise level
Project	Acorn House
Project no.	19373
Version	B
Marked-up by	Kane Mitchell
Reviewed by	Matthew Robinson
Date	4 August 2020

Predicted facade noise levels

- L_{Aeq} 69-71 dB ambient noise level
- L_{Aeq} 66-68 dB ambient noise level
- L_{Aeq} 63-65 dB ambient noise level
- L_{Aeq} 60-62 dB ambient noise level
- L_{Aeq} 57-59 dB ambient noise level

SANDY BROWN
Consultants in Acoustics, Noise & Vibration

REV	DATE
P1	27/07/20 PLANNING SUBMISSION

CONSULTANTS	NAME
CLIENT:	ACCESS STORAGE
STRUCTURAL ENGINEER:	AKT II
MECHANICAL ENGINEER:	ATELIER TEN
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PROJECT MANAGER:	RPM
ACOUSTIC CONSULTANT:	SANDY BROWN
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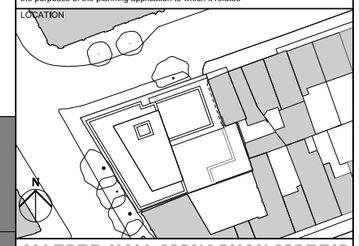

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job title
ACORN HOUSE

drawing title / location
ELEVATION 02
SWINTON STREET (NW FACING)

drawn by	checked	scale	status
AW	SS	1:100@A1; 1:200@A3	PLANNING

project	zone	source	classification	drawing no.	revision
18102		A	(00)_202		P1

Title	Predicted daytime facade noise level
Project	Acorn House
Project no.	19373
Version	B
Marked-up by	Kane Mitchell
Reviewed by	Matthew Robinson
Date	4 August 2020

Predicted facade noise levels

- L_{Aeq} 69-71 dB ambient noise level
- L_{Aeq} 66-68 dB ambient noise level
- L_{Aeq} 63-65 dB ambient noise level
- L_{Aeq} 60-62 dB ambient noise level
- L_{Aeq} 57-59 dB ambient noise level

SANDY BROWN
Consultants in Acoustics, Noise & Vibration

REV	DATE
P1	27/07/20 PLANNING SUBMISSION

CONSULTANTS	NAME
CLIENT:	ACCESS STORAGE
STRUCTURAL ENGINEER:	AKT II
MECHANICAL ENGINEER:	ATELIER TEN
COST CONSULTANT:	CAST CONSULTANCY
PROJECT MANAGER:	RPM
ACOUSTIC CONSULTANT:	SANDY BROWN
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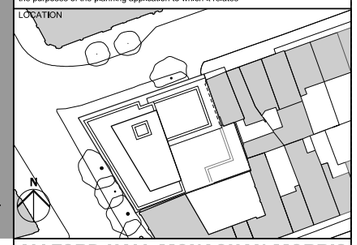

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job title
ACORN HOUSE

drawing title / location
ELEVATION 03
SWINTON STREET (NW FACING)

drawn by	checked	scale	status
AW	SS	1:100@A1; 1:200@A3	PLANNING

project	zone	source	classification	drawing no.	revision
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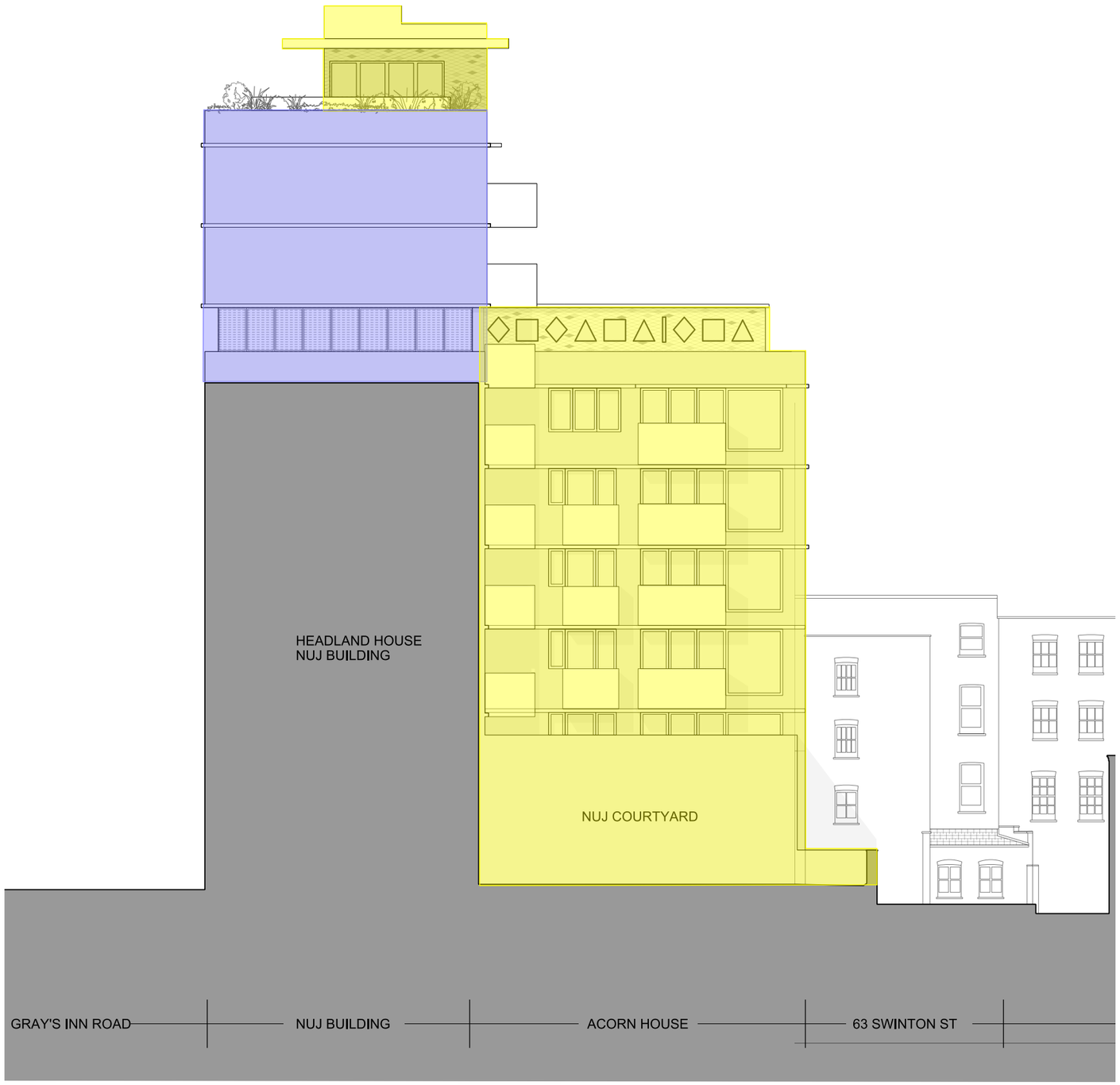

Title	Predicted daytime facade noise level
Project	Acorn House
Project no.	19373
Version	B
Marked-up by	Kane Mitchell
Reviewed by	Matthew Robinson
Date	4 August 2020

Predicted facade noise levels

- L_{Aeq} 69-71 dB ambient noise level
- L_{Aeq} 66-68 dB ambient noise level
- L_{Aeq} 63-65 dB ambient noise level
- L_{Aeq} 60-62 dB ambient noise level
- L_{Aeq} 57-59 dB ambient noise level

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REV	DATE
P1	27/07/20 PLANNING SUBMISSION

CONSULTANTS	NAME
CLIENT:	ACCESS STORAGE
STRUCTURAL ENGINEER:	AKT II
MECHANICAL ENGINEER:	ATELIER TEN
COST CONSULTANT:	CAST CONSULTANCY
PROJECT MANAGER:	RPM
ACOUSTIC CONSULTANT:	SANDY BROWN
FIRE & APPROVED INSPECTOR	BUREAU VERITAS

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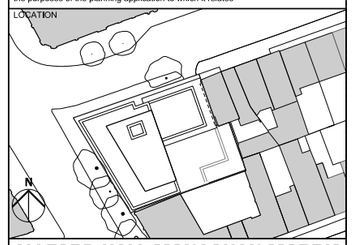

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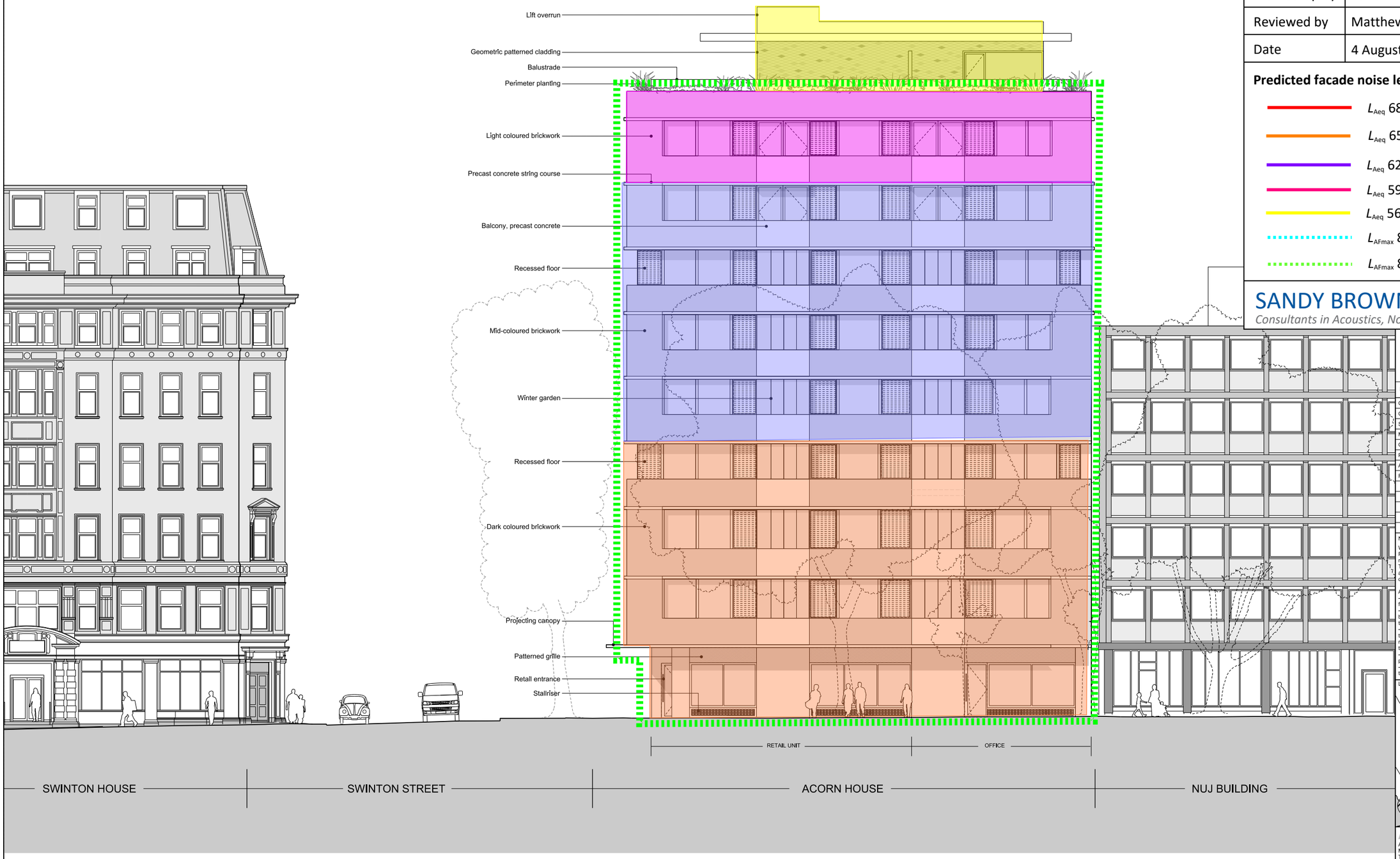
job title
ACORN HOUSE

drawing title / location
ELEVATION 04
COURTYARD ELEVATION (SE FACING)

drawn by	checked	scale	status
AW	SS	1:100@A1; 1:200@A3	PLANNING

project	zone	source	classification	drawing no.	revision
18102		A	(00)_204		P1



Title	Predicted night-time facade noise level
Project	Acorn House
Project no.	19373
Version	B
Marked-up by	Kane Mitchell
Reviewed by	Matthew Robinson
Date	4 August 2020

Predicted facade noise levels

- L_{Aeq} 68-70 dB ambient noise level
- L_{Aeq} 65-67 dB ambient noise level
- L_{Aeq} 62-64 dB ambient noise level
- L_{Aeq} 59-61 dB ambient noise level
- L_{Aeq} 56-58 dB ambient noise level
- L_{AFmax} 83 dB not normally exceeded
- L_{AFmax} 81 dB not normally exceeded

SANDY BROWN
Consultants in Acoustics, Noise & Vibration

REV	DATE
P1	27/07/20 PLANNING SUBMISSION

CONSULTANTS	NAME
CLIENT:	ACCESS STORAGE
STRUCTURAL ENGINEER:	AKT II
MECHANICAL ENGINEER:	ATELIER TEN
COST CONSULTANT:	CAST CONSULTANCY
PROJECT MANAGER:	RPM
ACOUSTIC CONSULTANT:	SANDY BROWN
FIRE & APPROVED INSPECTOR	BUREAU VERITAS

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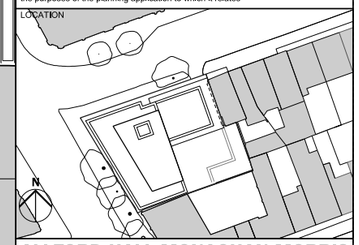
LOCATION



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job title
ACORN HOUSE

drawing title / location
ELEVATION 01
GRAY'S INN RD (SW FACING)

drawn by	checked	scale	status
AW	SS	1:100@A1; 1:200@A3	PLANNING

project	zone	source	classification	drawing no.	revision
18102		A	(00)_201		P1

Title	Predicted night-time facade noise level
Project	Acorn House
Project no.	19373
Version	B
Marked-up by	Kane Mitchell
Reviewed by	Matthew Robinson
Date	4 August 2020

Predicted facade noise levels

- L_{Aeq} 68-70 dB ambient noise level
- L_{Aeq} 65-67 dB ambient noise level
- L_{Aeq} 62-64 dB ambient noise level
- L_{Aeq} 59-61 dB ambient noise level
- L_{Aeq} 56-58 dB ambient noise level
- L_{AFmax} 83 dB not normally exceeded
- L_{AFmax} 81 dB not normally exceeded

SANDY BROWN
Consultants in Acoustics, Noise & Vibration

REV	DATE
P1	27/07/20 PLANNING SUBMISSION

CONSULTANTS	NAME
CLIENT:	ACCESS STORAGE
STRUCTURAL ENGINEER:	AKT II
MECHANICAL ENGINEER:	ATELIER TEN
COST CONSULTANT:	CAST CONSULTANCY
PROJECT MANAGER:	RPM
ACOUSTIC CONSULTANT:	SANDY BROWN
FIRE & APPROVED INSPECTOR	BUREAU VERITAS

NOTE

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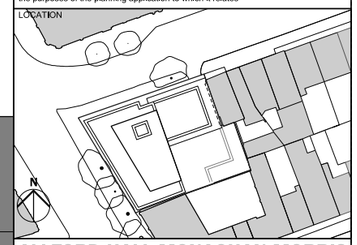
LOCATION



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job title
ACORN HOUSE

drawing title / location
ELEVATION 02
SWINTON STREET (NW FACING)

drawn by	checked	scale	status
AW	SS	1:100@A1; 1:200@A3	PLANNING

project	zone	source	classification	drawing no.	revision
18102		A	(00)_202		P1

Title	Predicted night-time facade noise level
Project	Acorn House
Project no.	19373
Version	B
Marked-up by	Kane Mitchell
Reviewed by	Matthew Robinson
Date	4 August 2020

Predicted facade noise levels

- L_{Aeq} 68-70 dB ambient noise level
- L_{Aeq} 65-67 dB ambient noise level
- L_{Aeq} 62-64 dB ambient noise level
- L_{Aeq} 59-61 dB ambient noise level
- L_{Aeq} 56-58 dB ambient noise level
- L_{AFmax} 83 dB not normally exceeded
- L_{AFmax} 81 dB not normally exceeded

SANDY BROWN
Consultants in Acoustics, Noise & Vibration

REV	DATE
P1	27/07/20 PLANNING SUBMISSION

CONSULTANTS	NAME
CLIENT:	ACCESS STORAGE
STRUCTURAL ENGINEER:	AKT II
MECHANICAL ENGINEER:	ATELIER TEN
COST CONSULTANT:	CAST CONSULTANCY
PROJECT MANAGER:	RPM
ACOUSTIC CONSULTANT:	SANDY BROWN
FIRE & APPROVED INSPECTOR	BUREAU VERITAS

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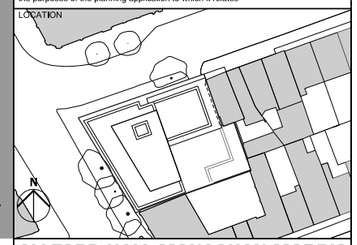
LOCATION



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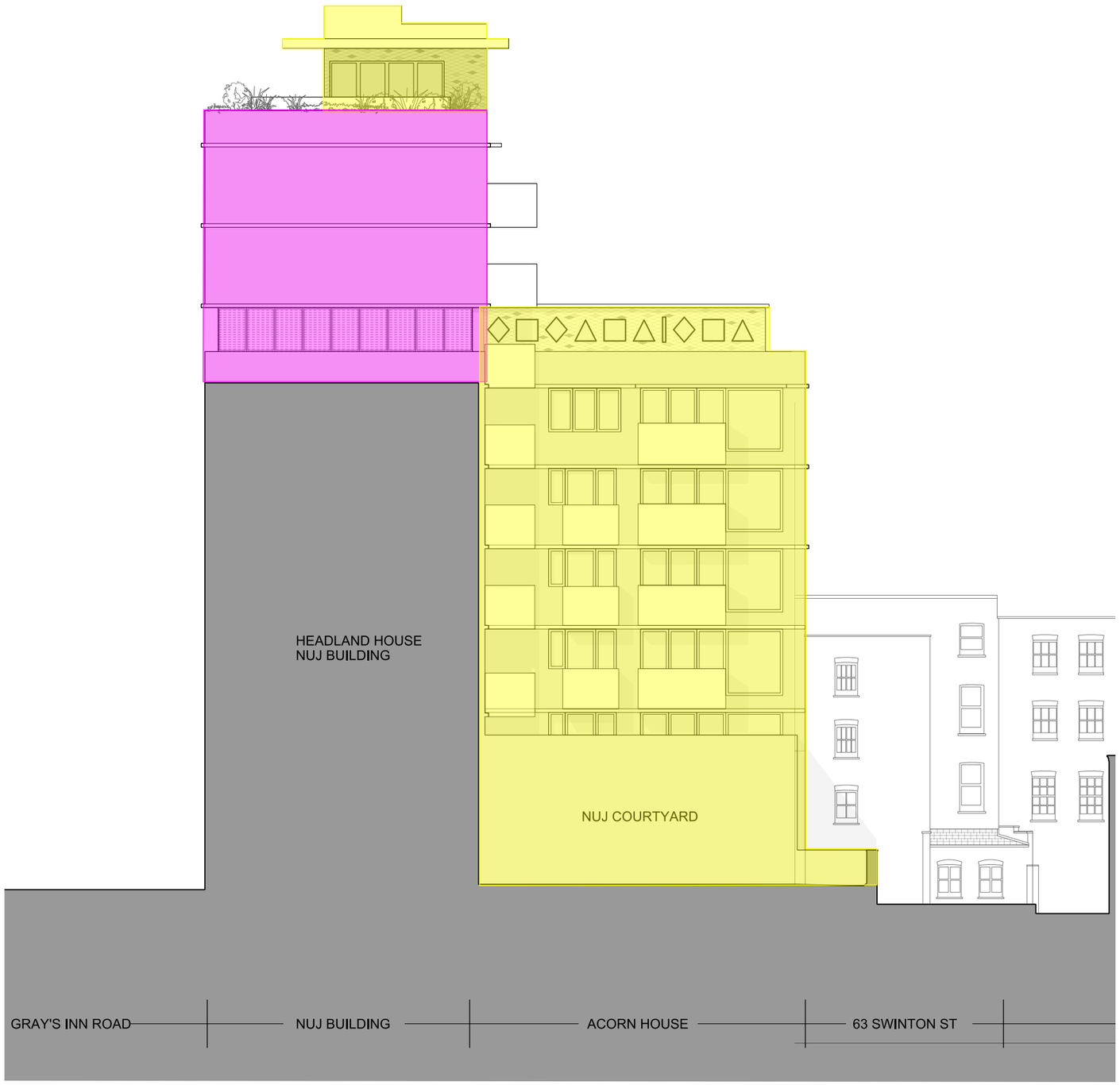
job title
ACORN HOUSE

drawing title / location
ELEVATION 03
SWINTON STREET (NW FACING)

drawn by	checked	scale	status
AW	SS	1:100@A1; 1:200@A3	PLANNING

project	zone	source	classification	drawing no.	revision
18102		A	(00)_203		P1



Title	Predicted night-time facade noise level
Project	Acorn House
Project no.	19373
Version	B
Marked-up by	Kane Mitchell
Reviewed by	Matthew Robinson
Date	4 August 2020

Predicted facade noise levels

- L_{Aeq} 68-70 dB ambient noise level
- L_{Aeq} 65-67 dB ambient noise level
- L_{Aeq} 62-64 dB ambient noise level
- L_{Aeq} 59-61 dB ambient noise level
- L_{Aeq} 56-58 dB ambient noise level
- L_{AFmax} 83 dB not normally exceeded
- L_{AFmax} 81 dB not normally exceeded

SANDY BROWN
Consultants in Acoustics, Noise & Vibration

REV	DATE
P1	27/07/20 PLANNING SUBMISSION

CONSULTANTS	NAME
CLIENT:	ACCESS STORAGE
STRUCTURAL ENGINEER:	AKT II
MECHANICAL ENGINEER:	ATELIER TEN
COST CONSULTANT:	CAST CONSULTANCY
PROJECT MANAGER:	RPM
ACOUSTIC CONSULTANT:	SANDY BROWN
FIRE & APPROVED INSPECTOR	BUREAU VERITAS

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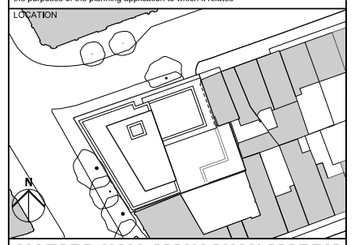

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job title
ACORN HOUSE

drawing title / location
ELEVATION 04
COURTYARD ELEVATION (SE FACING)

drawn by	checked	scale	status
AW	SS	1:100@A1; 1:200@A3	PLANNING

project	zone	source	classification	drawing no.	revision
18102		A	(00)_204		P1