



VAHNEA STUDENT RESIDENCES

ENVIRONMENTAL NOISE ASSESSMENT

Acoustics Report A1240 R01a

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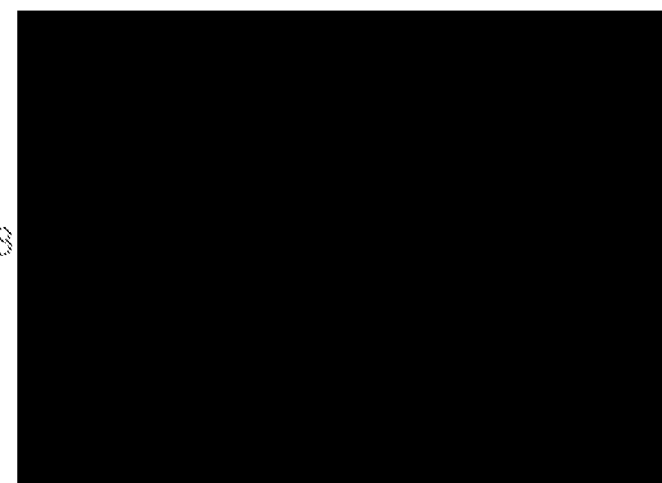
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Contents

1 Introduction 1

2 Scheme Details..... 1

3 Noise Criteria for Planning 2

 3.1 National Planning Policy Framework (NPPF)..... 2

 3.2 Noise Policy Statement for England (NPSE) 3

 3.3 Planning Practice Guidance – Noise (Web Publication) 4

 3.4 BS4142: 2014 – Assessment Principles..... 4

 3.5 ProPG: Planning & Noise 5

 3.6 Internal Noise Criteria – BS8233:2014..... 6

4 Noise Survey 7

5 Noise Survey Results.....11

6 ProPG Assessment.....13

7 BS4142 Assessment of Wilko Delivery Noise 13

8 Mitigation 15

9 Residual Impacts 16

10 Summary 16

Appendix A – Tabulated Noise Survey Data

Appendix B – Sample Building Envelope Calculations

1 Introduction

Ion Acoustics is appointed by Vahnea to advise them and the design team on environmental noise affecting the proposed conversion and extension of 18 – 20 London Road, Bognor Regis to provide for up to 104 student residential units. Six additional storeys over the existing rooftop are proposed. The existing building is occupied by Wilko.

This report describes the impact of the existing noise climate on the proposed residential scheme and will be submitted in support of a planning application for the scheme. Consideration is given to the noise impact of Wilko's deliveries. In particular, the report describes:

- The methodology and results of a noise survey carried out at the site over the period 12th – 13th January 2018;
- An assessment of the impact of the measured noise levels on the proposed student rooms and a discussion of required noise mitigation measures.

2 Scheme Details

The site is in the centre of Bognor Regis, on London Road, a pedestrian shopping street. To the rear of the building is Bedford Street, which is not a busy road and is primarily used for access to the rear of the commercial premises on London Road. On the opposite side of Bedford Street is Morrison's supermarket. Morrison's car park is accessed from Queensway, approximately 80m west of the site. The site and its surroundings are shown in the aerial photograph in Figure 1.



Figure 1 – Aerial photo of site (highlighted in blue) Photo © Google

The shop is at street level and comprises a double-height space with a 1st floor stock room at the front. There is an existing second floor level with a much smaller floor area but most of the second floor level is the existing roof with external plant. The second floor / roof level will become the ground floor of the proposed student accommodation with an external courtyard and bicycle storage. Four further floors will be provided above this with student accommodation. The proposed 'ground' floor above Wilcos is shown in Figure 2 below.



Figure 2 – Proposed Layout of Ground Floor of Student Accommodation (above the existing Wilko's store)

3 Noise Criteria for Planning

3.1 National Planning Policy Framework (NPPF)

In 2012 the National Planning Policy Framework (NPPF) replaced a number of Planning Policy Statements with a single document which is intended to promote sustainable development. The NPPF sets out the government's policies for the planning system in England. The



document is generally not prescriptive and does not provide noise criteria. Instead, it places the onus on local authorities to develop their own local plans and policies.

Sections of the NPPF relating to noise are stated below:

170. Planning policies and decisions should contribute to and enhance the natural and local environment by:

e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability.

180. 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:

a) 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

The NPPF has just been revised (24th July 2018) and certain aspects of the guidance changed. In particular a new principle of “agent of change” was introduced. This is of particular relevance to this scheme as it specifically places the onus on the new developments to provide suitable mitigation such that the operation of existing business is not affected.

182. 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.

3.2 Noise Policy Statement for England (NPSE)

The Noise Policy Statement for England (NPSE) sets out the Government's policy on environmental, neighbourhood and neighbour noise for England. The policy sets out three aims:

- *"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."*

The NPSE introduces the following terms which are also used in the NPPF Planning Practice Guidance:

"NOEL – No Observed Effect Level



This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise.

LOAEL – Lowest Observed Adverse Effect Level

This is the level above which adverse effects on health and quality of life can be detected.

SOAEL – Significant Observed Adverse Effect Level

This is the level above which significant adverse effects on health and quality of life occur.”

However, neither the NPSE, nor the NPPF Planning Practice Guidance, define numeric criteria for the NOEL, LOAEL or SOAEL¹. Instead, it is recommended in the NPSE that the limits of each effect level should be defined for each situation and location. The WHO “Guideline for Community Noise” and BS 8233:2014 recommend internal noise design targets for habitable rooms for the avoidance of negative health effects and to promote quality of life.

3.3 Planning Practice Guidance – Noise (Web Publication)

The planning practice guidance website² provides advice on the application of the NPPF and NPSE. The noise page “*Advises on how planning can manage potential noise impacts in new development*”.

Where residential development is planned close to sources of noise, the guidance gives examples of mitigation which may be included at the design stage: “*including noise barriers; and, optimising the sound insulation provided by the building envelope*”.

The guidance also gives some further advice on interpretation of SOAEL as the level at which noise is noticeable and disruptive and where “*the noise causes a material change in behaviour and/or attitude, e.g. 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 resulting in difficulty in getting to sleep, premature awakening and difficult in getting back to sleep...*”

3.4 BS4142: 2014 – Assessment Principles

The standard method for assessing commercial and industrial noise affecting nearby housing is British Standard BS 4142 “*Method for rating and assessing industrial and commercial sound*”. A BS 4142 assessment is made by determining the difference between the intrusive noise under consideration and the background sound level as represented by the L_{A90} parameter, determined in the absence of the intrusive noise. The L_{A90} parameter is defined as the level exceeded for 90% of the measurement time. Therefore, it represents the underlying noise in the absence of short-term events.

The intrusive noise under consideration is assessed in terms of the ambient noise level, L_{Aeq} , but a character correction penalty can be applied where the noise exhibits certain characteristics such as distinguishable tones, impulsiveness or, if the noise is distinctively intermittent. The

¹ Possible options for SOAEL and LOAEL thresholds were given in an AECOM report for Defra December 2015
<http://randd.defra.gov.uk/Default.aspx?Module=More&Location=None&ProjectID=18157&FromSearch=Y&Publisher=1&SearchText=soael&SortString=ProjectCode&SortOrder=Asc&Paging=10>

² <https://www.gov.uk/guidance/noise--2>

ambient noise level, L_{Aeq} is defined as the steady-state noise level with the same energy as the actual fluctuating sound over the same time period. It is effectively the average noise level during the period. The plant noise level (L_{Aeq}) with the character correction (if necessary) is known as rating level, L_{Ar} , and the difference between the background noise and the rating level is determined to make the BS 4142 assessment. The standard then states:

- *"Typically, the greater the difference, the greater the magnitude of the impact.*
- *A difference of around +10dB or more is likely to be an indication of a significant adverse impact, depending on the context.*
- *A difference of around +5dB is likely to be an indication of an adverse impact, depending on the context*
- *The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context."*

The standard outlines a number of methods for defining appropriate 'character corrections' to determine the rating levels to account for tonal qualities, impulsive qualities, other sound characteristics and/or intermittency.

The standard also highlights the importance of considering the context in which a sound occurs. The standard indicates that factors including the absolute sound level, the character of the sound, the sensitivity of the receptor and the existing acoustic character of the area should be considered when assessing the noise impact.

3.5 ProPG: Planning & Noise

The Professional Practice Guidance on Planning and Noise (May 2017) provides guidance on transportation noise affecting new residential developments. The guidance was prepared by a working group formed from members of the Institute of Acoustics (IoA), the Association of Noise Consultants (ANC) and the Chartered Institute of Environmental Health (CIEH). It has no formal planning status but nevertheless represents industry good practice. It is specifically for assessing noise from predominantly transportation sources. Therefore, it can be used in respect of road traffic noise on Bedford Street. However noise during deliveries falls outside the scope of ProPG. The guidance promotes a two stage assessment approach:

Stage 1 – Initial Site Noise Risk Assessment; and,

Stage 2 – Full assessment and systematic appraisal of four key elements.

The stage 1 initial risk assessment provides an indication of the likely risk of adverse effects from noise assuming in the first instance that no mitigation were included within the proposals. The risk assessment is based on measured or predicted noise levels during a "typical worst case" 24 hour period. Figure 1 of the document presents the Stage 1 assessment and indicates that higher noise levels result in increased noise risk without mitigation. This is summarised in Figure 3 below. Figure 3 (Figure 1 of ProPG) does not directly relate noise levels to specific risk categories although a negligible noise risk broadly correlates to noise levels not exceeding 50dB $L_{Aeq, 16hr}$ (daytime) and 40 dB $L_{Aeq, 8hr}$ (night).



Day L _{Aeq} , 16 Hr	50 dB	55 dB	60 dB	65 dB	70 dB
	NegligibleLowMediumHigh				
Night L _{Aeq} , 8 Hr	40 dB	45 dB	50 dB	55 dB	60 dB

Figure 3 – ProPG Stage 1 Noise Risk Assessment (adapted from ProPG Figure 1)

Where the initial noise assessment indicates a higher risk of adverse noise effects, a stage 2 assessment is required. The stage 2 assessment is more involved than the stage 1 and requires systematic consideration of four elements:

Element 1 – Good Acoustic Design Process

The acoustic design of a building and any mitigation should be considered at an early stage of the design process. Following a good acoustic design process is considered a part of achieving a good design as required by the NPSE and NPPF. Guidance on the requirements for providing an Acoustic Design Statement (ADS) is given in Figure 3 of the ProPG.

Element 2 – Internal Noise Level Guidelines

Guidance on internal noise levels can be found in BS8233:2014 Guidance on sound insulation and noise reduction for buildings. Figure 2 of the ProPG summarises the guidance from BS8233 but with a number of additions. The internal noise criteria presented in Figure 2 of ProPG and the relevant notes are presented in Table 1 below.

Element 3 – External Amenity Area Noise Assessment

The guidance of the ProPG reflects and extends on the advice of BS8233 and PPG Noise. The guidance in the ProPG presents five points for consideration, the first being “*If the external amenity spaces are an intrinsic part of the overall design, the acoustic environment of those spaces should be considered so that they can be enjoyed as intended*”.

Element 4 – Assessment of Other Relevant Issues

“Other relevant issues” within the context of the ProPG include relevant national and local policy which may have a bearing on the development.

3.6 Internal Noise Criteria – BS8233:2014

Noise limits for dwellings are usually set in terms of two noise parameters: the ambient level L_{Aeq} and the maximum level, L_{AFmax} . The L_{AFmax} is the highest noise level in a given period and is determined by individual events such as a vehicle pass-bys. An L_{AFmax} limit is usually only applied at night, when sleep disturbance is most likely to be an issue. The L_{Aeq} is defined as the steady-state noise level which has the same energy as the actual time-varying noise over the same time period. It is effectively the average noise level.

Appropriate internal noise levels are recommended in BS 8233:2014 (shown in Table 1 below) and in the World Health Organisation (WHO) Guidance "Guidelines for Community Noise", 1999.

Table 1 – Indoor Ambient Noise Levels from BS 8233: 2014

Activity	Location	Day (07:00 to 23:00)	Night (23:00 to 07:00)
Resting	Living rooms	35 dB $L_{Aeq, 16 \text{ hour}}$	
Dining	Dining room/area	40 dB $L_{Aeq, 16 \text{ hour}}$	
Sleeping - night Resting - day	Bedrooms	35 dB $L_{Aeq, 16 \text{ hour}}$	30 dB $L_{Aeq, 8 \text{ hour}}$

WHO Guidelines propose internal limits of L_{Aeq} 35 dB for living/dining rooms and L_{Aeq} 30 dB / 45 dB L_{AFmax} inside a bedroom at night.

The internal noise criteria in BS 8233:2014 are followed by a number of notes. Those relevant to this scheme are reproduced below:

"Note 3: These levels are based on annual average data and do not have to be achieved in all circumstances. For example it is normal to exclude occasional events, such as fireworks night on New Year's Eve."

"Note 4: Regular individual noise events (for example, scheduled aircraft or passing trains) can cause sleep disturbance. A guideline value may be set in terms of SEL or $L_{Amax,F}$ depending on the character and number of events per night. Sporadic noise events could require separate values."

"Note 5: If relying on closed windows to meet the guide values, there needs to be appropriate alternative ventilation that does not compromise the façade insulation or the resulting noise level."

"Note 6: Where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal target levels may be relaxed by up to 5 dB and reasonable internal conditions achieved."

The guidance detailed within the ProPG appends the guidance of BS8233 with the inclusion of the 45dB L_{AFmax} criterion to minimise impacts on sleep. This level is identified in the WHO Guidelines on Community Noise and represents the Lowest Observed Adverse Effect Level (LOAEL). At this level changes in sleep can be identified and for a good night's sleep the number of exceedances should be limited. ProPG states that: *'For a reasonable standard in noise-sensitive rooms at night (e.g. bedrooms) individual noise events should not normally exceed 45dB L_{AFmax} more than 10 times a night'*.

4 Noise Survey

A baseline noise survey was carried out over the period 12th – 13th January 2018 to determine external noise levels at the site. Unattended measurements were made continuously for 12-hours at location L1, shown in Figure 4. Location L1 was on the roof of Wilko's at the level of



the proposed “ground floor” of the student accommodation. Measurements were made from 23:10 – 11:20 hours to include almost the entire night and the busiest part of the day.

The initial intent had been to measure for a full 24 hours at L1, but security concerns and access restrictions made this impracticable. Therefore, daytime attended measurements were made at L3, which was at street level near the Wilko Bedford Street service entrance. Additional daytime measurements were also made at L2 to measure noise levels at the proposed London Road façade during the day. Location L2 was two floors above the pedestrian only London Road, at the level of the proposed ground floor of the student accommodation.

The microphone and windshield assemblies were mounted on tripods at 1.2 m above the ground/roof. Measurement location L3 was 1 m from the building façade. At the other two location microphones were at least 3.5 m from walls. The measurement locations are shown in Figure 1 and the photographs in Figure 4, 5 & 6.



Figure 4 – Noise Measurement Location L1



Figure 5 – Noise Measurement Location L2



Figure 6 – Noise Measurement Location L3



The meters were calibrated prior to and on completion of the measurements with a Brüel & Kjær Type 4231 calibrator. The logging meter was set up to log various noise indices including L_{Aeq} , $L_{Amax,F}$ & L_{A90} , L_{A01} , L_{A10} in octave bands. Measurements were made in consecutive 10-minute & 100ms periods. Audio of the entire measurement period was recorded by the meter.

During the survey winds were light and variable, generally from between the SE & E. Daytime temperatures were between 6°C & 8°C, falling to lows of around 3°C at night. There was no precipitation, although cloud cover was almost total.

5 Noise Survey Results

Noise levels measured at location L1 are shown graphically in Figure 7 in terms of the ten minute L_{Aeq} , $L_{Amax,F}$ and L_{A90} noise levels. The data is tabulated in Appendix A.

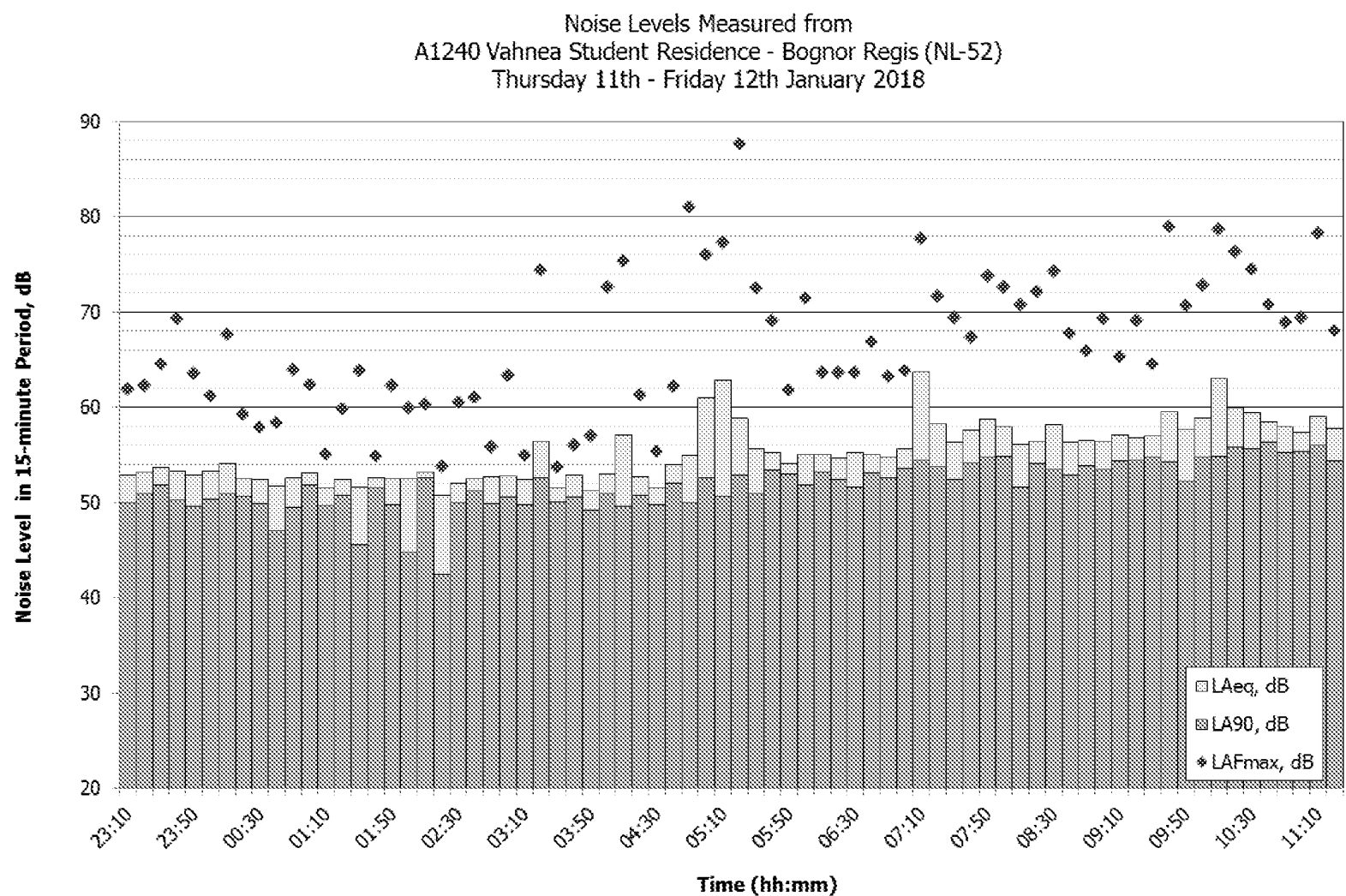


Figure 7 – Noise Monitoring Data

Plant noise was the dominant noise source during setup and collection and, from listening to the audio recordings, for most of the night. This included plant on the Wilko’s roof and from Morrison’s. The ambient noise levels are generally around 50 dB L_{Aeq} throughout the night until a delivery to Wilko at approximately 04:45. The highest night-time maximum noise levels (L_{Amax}) are from this delivery. Wilko generally has a single delivery per night. Delivery vehicles park in the loading bay directly behind Wilko on Bedford Street. Trolleys are used to unload vehicles, Wilko does not use forklifts. A time history plot of the 100ms noise levels at L1 for the period when the delivery occurred is presented in Figure 8.

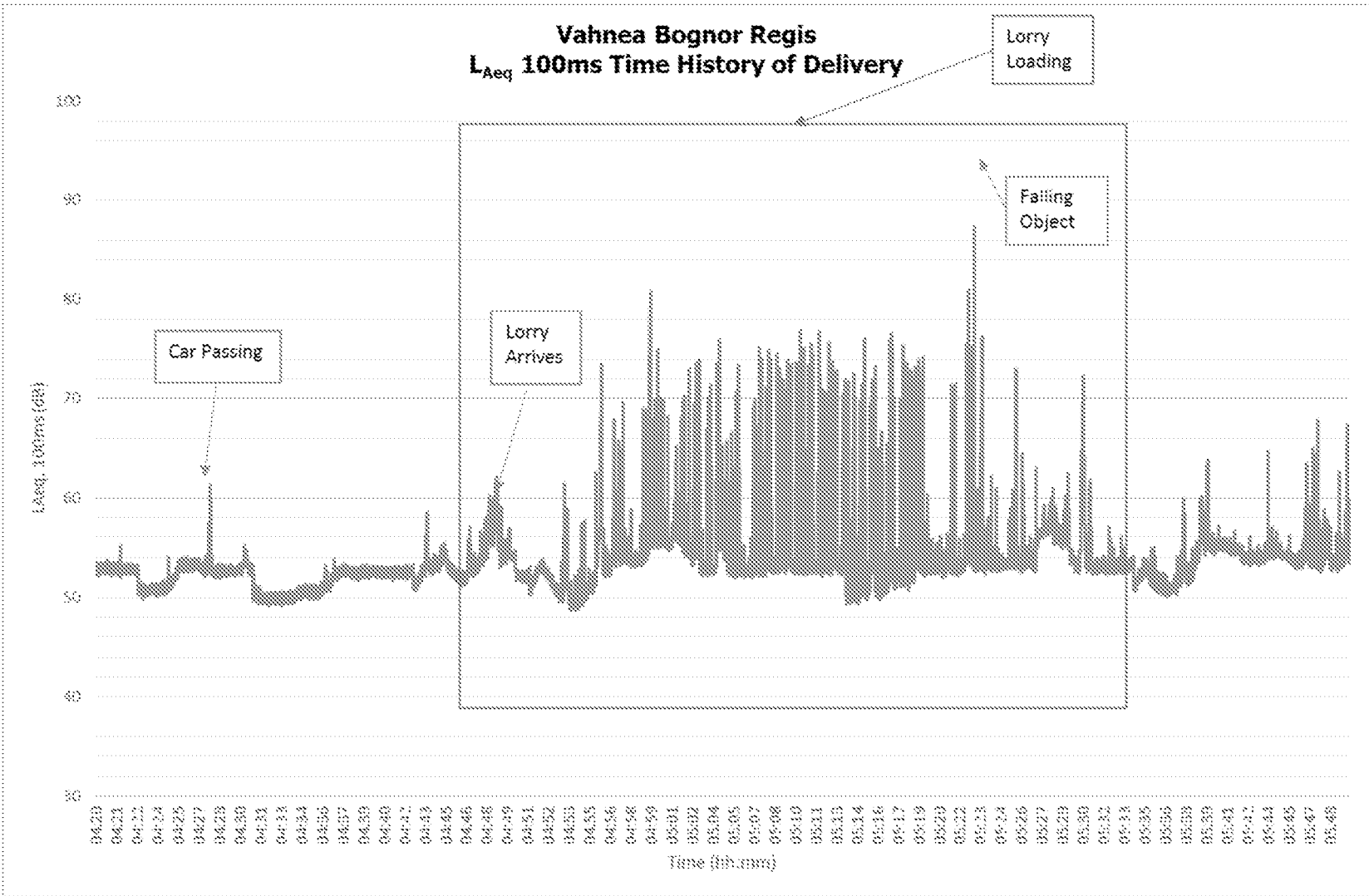


Figure 8 – Delivery Time History

Maximum noise levels from the deliveries are typically around 76 dB(A). The average noise levels over the period of the delivery, approximately 50 minutes, is 60 dB L_{Aeq} . The highest 15 minute noise level during the delivery was 61 dB L_{Aeq} .

The average daytime noise level from 07:00 to 11:20 was 59 dB L_{Aeq} . This was from plant, occasional vehicles on Bedford Street and in the Morrison’s carpark. The average for the entire 16-hour daytime period is likely to be lower than this as traffic on Bedford Street and in the Morrison’s carpark will decrease in the evening; Morrison’s closes at 21:00. Noise from seagulls was also significant during the day but not during the night. The average noise levels for the daytime and night-time periods are presented in Table 2 in terms of the total L_{Aeq} for the period and the mode average L_{A90} .

Table 2 – Measured External Noise Levels

Location	Period	Duration (hh:mm:ss)	$L_{Aeq,T}$ dB (total or energy average)	$L_{A90,T}$ dB (mode)
L1	Daytime (07:00 to 11:20)	04:20:00	59	55
	Night-time (23:10 to 07:00)	07:50:00	55	51

The results of the daytime attended measurements are presented in Table 3. Measurements at L3 have been corrected for the effect of the façade reflection by subtracting 3 dB.

Table 3 – Measured External Noise Levels

Location	Start Time	Duration (minutes)	L _{Aeq} dB	L _{Afmax} dB	L _{Af90} dB
L3	11/01/2018 16:58	10	60.8	78.8	44.0
L3	11/01/2018 17:08	10	59.4	77.2	44.5
L3	11/01/2018 17:18	10	59.7	78.4	42.8
L3 (Total)	11/01/2018 16:58	30	60.0	78.8	42.8
L2	12/01/2018 11:24	6	55.9	74.9	52.4
L2	12/01/2018 11:30	10	55.1	70.5	52.5
L2	12/01/2018 11:40	10	56.1	80.3	52.3
L2	12/01/2018 11:50	10	55.1	76.2	52.5
L2 (Total)	12/01/2018 11:24	36	55.6	80.3	52.3

Noise levels at L2 were determined by people on London Road and plant noise. The plant noise was predominantly from Wilko's roof top plant. Wilko's plant will be moved into a new enclosure and therefore noise levels will lower than measured in the future.

6 ProPG Assessment

In terms of the ProPG guidance, the site is in the low risk category for daytime noise. The noise levels measured at the London Road façade are low during the day and there is no pedestrian activity or other significant noise sources on this side of the building during the night. Therefore, internal noise levels from BS8233:2014 will be achieved inside habitable rooms at this side of the building with any standard glazing and vents.

Night-time noise levels at the Bedford Street façade are in the medium risk category in terms of ProPG. This is due to noise from plant and the Wilko's delivery bay. It should be noted that ProPG states that it has been developed in consideration of transportation noise only and therefore this categorisation is not strictly speaking valid – in terms of transportation noise the site remains in the low risk category. However, it is useful to note that the noise levels are not high for an urban site and typically residential development would be acceptable. To address the noise of Wilko's deliveries a BS4142 assessment has been carried out.

7 BS4142 Assessment of Wilko Delivery Noise

BS 4142 is a relative assessment technique as described above whereby the specific noise from commercial sources is compared to the background noise. The specific noise level from the single Wilko's delivery was measured at 61 dB L_{Aeq} over the BS4142 standard night-time



reference period of 15 minutes. The typical background sound level is taken as 51 dB L_{A90} . This is the mode average of the night-time 10 minute background sound levels (L_{A90}). The 10 minute background sound level may in some circumstances be slightly lower than the 15 minute level which is normally used for BS 4142 night-time assessments. However, in this case plant noise dominates the background noise and this is steady for the duration of the measurement. Therefore, there would be no difference between a 10 minute and 15 minute measurement. The BS4142 assessment is set out in Table 4.

Table 4 - BS4142 Assessment of Noise from Wilko’s Delivery

Results		Commentary
Typical Background Sound Level (L_{A90} , dB)	51	
Specific Sound Level - (L_{Aeq} , dB)	61	
Acoustic feature correction (dB)	+9	Impulsivity is highly perceptible
BS4142 Rating Level (L_{Ar} , dB)	70	
Excess of Rating Level over Background Sound level (dB)	(70 - 51) = 19	
The assessment indicates that a significant adverse impact is likely without mitigation.		Measurement uncertainty does not have any significance to the outcome of the survey as the rating level is well above the background sound level.

While the BS 4142 assessment indicates an adverse impact, BS 4142 states that the assessment depends on the context. It should be noted that the new residential receivers are being introduced close to the existing commercial activities of Wilko i.e. in an area where potential residents might expect this type of noise, this is likely to result in a lesser adverse impact compared to the situation where new noise sources are introduced close to existing residential receivers which can reasonably expect not to be subjected to a dramatic change in the noise environment. Furthermore, the context is very different from a residential location with an amenity space such as a garden where an intrusive noise would be considered relative to the background. In this case, it is the internal noise levels that are relevant to any impact and specifically those relating to sleep disturbance. It will also be possible for the developer to incorporate façade insulation treatment and ventilation strategies that reduce the need for windows to be opened and therefore reduce the sensitivity of the receptors.

BS 4142 specifically identifies the time of day as a factor in determining the significance of an impact. In this case, the deliveries occur in the early morning when most people are asleep. The effect on sleep quality is therefore the primary factor which will determine the noise impact rather than annoyance. Therefore, achieving noise limits designed to prevent sleep disturbance will be more important than a rather abstract BS 4142 rating. WHO Guidelines on Community Noise and ProPG both provide a review of research on the sleep effects of noise and criteria. A maximum level of 45 dB L_{Amax} is set. The bedroom criterion from BS 8233 is also relevant.



The fact that this is typically only a single event per night is important in terms of sleep quality and indicates less impact than if there were multiple deliveries per night. Furthermore, the timing of the delivery is predictable and regular which would result in a reduced impact on sleep. Nevertheless, to provide good conditions for sleep and protect the future commercial activity of Wilko, robust mitigation is required. Therefore, an assessment of the requirements for building envelope sound insulation and ventilation has been made to demonstrate that suitable internal noise levels to prevent sleep disturbance can be achieved and adequate protection against the delivery noise is feasible.

8 Mitigation

It is not expected that there is any opportunity to influence source levels from the delivery area as the delivery bay is on a public street and there is no suitable external space to provide an alternative loading bay for Wilko. Therefore, mitigation must comprise suitable building envelope sound insulation for the proposed student flats. BS4142 applies to external noise levels and is not suitable for setting noise limits within dwellings. Therefore, suitable limits on noise from Wilko’s deliveries in proposed bedrooms are derived from BS8233:2014, ProPG and the WHO Guidelines on Community Noise, as follows:

- 45dB L_{AFmax} no more than 10 times per night (23.00 to 07.00 hours),
- 30dB $L_{Aeq, 8\text{ hour}}$ (23.00 to 07.00 hours)

Sound insulation calculations for bedrooms at the Bedford Road facade have been prepared in accordance with BS EN 12354-3 to determine the extent of the sound insulation required to control noise levels and achieve these noise limits. Examples of these calculations are provided in Appendix B. The required window and vent sound insulation performance and external noise levels used in the calculations are set out in Table 5. Note that the proposed student accommodation ground floor is two floors above Bedford Street and London Road.

Table 5 – Windows and Vent Acoustics Specifications for Bedford Street Facade

Floor	L_{Aeq} Night dB	L_{Amax} Night dB	Minimum Window Spec	Vent Spec
Ground to 3 rd Floor	61	76	45 dB R_w (e.g. 10/16/9.1mm acoustic laminated double glazing)	48 dB $D_{n,e,w}$
3 rd & 4 th Floor	59	70	41 dB R_w (e.g. 6/12/6.4mm acoustic laminated double glazing)	36 dB $D_{n,e,w}$

The window specifications apply to the entire window unit including frame and any opaque panels which are part of the glazing system. The glazing examples are provided as a guide. Other combinations can provide similar levels of sound insulation.

The ventilator specification will require wall vents or large over window units. Standard slot vents will not be adequate. The ventilator performances can be achieved with products such as Sonovent ZEN series or Greenwood MA3051. The ventilator performance values are for a single vent. Where two vents are required the performance of each must be increased by $10 \times \text{Log}(n)$

where 'n' is the number of vents. E.g. if two vents are required in a ground floor bedrooms the performance of each must be $48 \text{ dB } D_{n,e,w} + 10 \times \log(2) = 51 \text{ dB } D_{n,e,w}$.

Trickle vents provide background ventilation only and it is often necessary to open windows on hotter days. Internal noise levels from deliveries with windows open would be around $64 \text{ dB } L_{Amax}$ even with a window just slightly open for ventilation. This will cause sleep disturbance and is likely to lead to complaints. Therefore, we recommend that a system for providing additional ventilation which precludes the need to open windows in habitable rooms on the Bedford Street facade. Where background ventilation is provided via trickle vents an overheating extract fan could be used to increase ventilation rates. Noise from the fan itself must not increase internal noise levels beyond $30 \text{ dB } L_{Aeq}$ in bedrooms.

Mechanical ventilation, e.g. MVHR, will provide a better performance in terms of the protection from external noise and would be recommended in this case. If MVHR is used the contribution of external noise via the ventilation can be excluded and the acoustic performance of the windows can be slightly reduced as follows:

- ground to 3rd floor bedrooms:- $38 \text{ dB } R_w$;
- third and fourth floors:- $32 \text{ dB } R_w$.

The MVHR systems should be capable of providing additional ventilation, or cooling, to control overheating without the need to open windows and without increasing internal noise levels beyond $30 \text{ dB } L_{Aeq}$ in bedrooms. An added benefit of mechanical ventilation systems is that the noise generated can actually make external noises less noticeable by providing masking noise.

9 Residual Impacts

With MVHR or trickle vents with an overheating fan, it is assumed that windows can usually remain closed and therefore external noise levels are not directly relevant to the impact on the future residents. Assessment of internal noise level is outside the scope of BS 4142:

"The standard is not intended to be applied to the derivations of indoor sound levels arising from sound levels outside, or the assessment of indoor sound levels."

Therefore, assessment of the residual effects is against the criteria from WHO Guidelines, ProPG and BS 8233 as stated in the previous section. With the specified facade sound insulation there will be fewer than 10 exceedances of $45 \text{ dB } L_{Amax}$ a night and the continuous noise levels will be well below $30 \text{ dB } L_{Aeq}$ even during the noisiest 15 minutes of a delivery. Therefore, although delivery noise will be audible, the noise levels are unlikely to significantly impact sleep or other activity within the proposed student flats.

10 Summary

Ion Acoustics has undertaken a noise assessment for proposed student accommodation above Wilko at 18 – 20, London Road, Bognor Regis. This assessment has considered the potential impact of existing noise on the proposed residential units. Noise levels at the site were measured over the period 12th – 13th January 2018. Noise levels are generally low. However, there is a need for robust mitigation to control noise from the loading bay on Bedford Street



which is used by Wilko. The required acoustic performance for windows and ventilators has been given for rooms affected by delivery noise.

The assessment and calculations presented within this report indicate that, with suitable consideration of building envelope sound insulation and ventilation, internal noise levels can be controlled to recommended standards set to prevent sleep disturbance.

Vahnea Student Residences
Environmental Noise Assessment
Appendix A – Tabulated Noise Survey Data



Time	L _{Aeq} dB	L _{Amax,F} dB	L _{AF90} dB	Time	L _{Aeq} dB	L _{Amax,F} dB	L _{AF90} dB
11/01/2018 23:10	52.9	61.9	50.0	12/01/2018 07:10	63.7	77.7	54.5
11/01/2018 23:20	53.2	62.3	51.0	12/01/2018 07:20	58.3	71.6	53.8
11/01/2018 23:30	53.7	64.5	51.8	12/01/2018 07:30	56.3	69.4	52.4
11/01/2018 23:40	53.3	69.3	50.3	12/01/2018 07:40	57.6	67.3	54.2
11/01/2018 23:50	52.9	63.5	49.6	12/01/2018 07:50	58.8	73.8	54.8
12/01/2018 00:00	53.3	61.2	50.4	12/01/2018 08:00	58.0	72.6	54.9
12/01/2018 00:10	54.1	67.6	51.0	12/01/2018 08:10	56.1	70.8	51.6
12/01/2018 00:20	52.5	59.2	50.7	12/01/2018 08:20	56.4	72.1	54.1
12/01/2018 00:30	52.4	57.9	49.9	12/01/2018 08:30	58.2	74.3	53.5
12/01/2018 00:40	51.7	58.4	47.1	12/01/2018 08:40	56.3	67.7	52.9
12/01/2018 00:50	52.6	63.9	49.5	12/01/2018 08:50	56.5	65.9	53.9
12/01/2018 01:00	53.1	62.4	51.8	12/01/2018 09:00	56.4	69.3	53.5
12/01/2018 01:10	51.5	55.1	49.7	12/01/2018 09:10	57.1	65.3	54.4
12/01/2018 01:20	52.4	59.8	50.8	12/01/2018 09:20	56.8	69.1	54.5
12/01/2018 01:30	51.6	63.8	45.6	12/01/2018 09:30	57.0	64.5	54.8
12/01/2018 01:40	52.6	54.9	51.5	12/01/2018 09:40	59.5	79.0	54.3
12/01/2018 01:50	52.5	62.3	49.8	12/01/2018 09:50	57.7	70.7	52.2
12/01/2018 02:00	52.5	59.9	44.8	12/01/2018 10:00	58.9	72.8	54.8
12/01/2018 02:10	53.2	60.3	52.6	12/01/2018 10:10	63.1	78.7	54.9
12/01/2018 02:20	50.8	53.8	42.5	12/01/2018 10:20	59.9	76.3	55.8
12/01/2018 02:30	52.0	60.5	50.0	12/01/2018 10:30	59.4	74.5	55.6
12/01/2018 02:40	52.5	61.0	51.2	12/01/2018 10:40	58.5	70.8	56.3
12/01/2018 02:50	52.7	55.8	49.9	12/01/2018 10:50	58.0	68.9	55.2
12/01/2018 03:00	52.8	63.3	50.6	12/01/2018 11:00	57.4	69.4	55.3
12/01/2018 03:10	52.4	55.0	49.8	12/01/2018 11:10	59.1	78.3	56.0
12/01/2018 03:20	56.4	74.4	52.6	12/01/2018 11:20	57.8	68.0	54.4
12/01/2018 03:30	51.5	53.7	50.1	12/01/2018 11:30			
12/01/2018 03:40	52.9	56.0	50.6	12/01/2018 11:40			
12/01/2018 03:50	51.2	57.0	49.2	12/01/2018 11:50			
12/01/2018 04:00	53.0	72.6	51.0	12/01/2018 12:00			
12/01/2018 04:10	57.1	75.3	49.6	12/01/2018 12:10			
12/01/2018 04:20	52.7	61.3	50.8	12/01/2018 12:20			
12/01/2018 04:30	51.5	55.3	49.8	12/01/2018 12:30			
12/01/2018 04:40	54.0	62.2	52.0	12/01/2018 12:40			
12/01/2018 04:50	55.0	81.0	50.0	12/01/2018 12:50			
12/01/2018 05:00	61.0	76.0	52.6	12/01/2018 13:00			
12/01/2018 05:10	62.9	77.3	50.7	12/01/2018 13:10			
12/01/2018 05:20	58.9	87.6	52.9	12/01/2018 13:20			
12/01/2018 05:30	55.6	72.5	51.0	12/01/2018 13:30			
12/01/2018 05:40	55.2	69.1	53.4	12/01/2018 13:40			
12/01/2018 05:50	54.1	61.8	53.0	12/01/2018 13:50			
12/01/2018 06:00	55.1	71.4	51.8	00/01/1900 00:00			
12/01/2018 06:10	55.1	63.6	53.2	00/01/1900 00:00			
12/01/2018 06:20	54.7	63.6	52.4	00/01/1900 00:00			
12/01/2018 06:30	55.2	63.6	51.6	00/01/1900 00:00			
12/01/2018 06:40	55.1	66.9	53.1	00/01/1900 00:00			
12/01/2018 06:50	54.8	63.2	52.6	00/01/1900 00:00			
12/01/2018 07:00	55.6	63.8	53.6	00/01/1900 00:00			



Building Envelope Sound Insulation Calculation According to EN 12354-3										
Vahnea Student Residences, Bognor Regis			Date	27/09/2018						
Wilkos Delivery Noise			Room	Bedford Street Bedroom						
Incident noise levels										
	Term	Label	Octave band centre frequency (Hz)							dB(A)
			63	125	250	500	1 k	2 k	4 k	
Leq,ff	Measured Leq	Location P1 Night	4.5	-3.1	-2.9	-4.5	-4.2	-6.8	-12.2	61.0
	Measured spectrum	L: Location P1 Night: Adj Spectrum	65.5	57.9	58.1	56.5	56.8	54.2	48.8	61.0
		K	3	3	3	3	3	3	3	
Lmax,ff	Measured Lmax	Location P1 Night	-0.7	0.5	1.1	-3.6	-5.2	-9.3	-10.2	76.0
		M: Location P1 Night: Adj Spectrum	75.3	76.5	77.1	72.4	70.8	66.7	65.8	76.0
		K	6	6	6	6	6	6	6	
Room Details										
	Term	Derivation	Value	Term		Derivation		Value		
	V	Volume (m³)	26.9	Sew		Sf - Swi		4.2		
	RT	RT (secs)	0.5	Srr		Area of ceiling (m²)		0.0		
	Sf	Facade area (inc. window) (m²)	6.2	S		Sf + Srr		6.2		
			0.0	Ao		Ref Area for Dnew		10.0		
	Swi	Window area (m²)	2.0	Attenuation to roof				0.0		
Sound Insulation Calculation elements										
	Term	Label/element	Octave band centre frequency (Hz)							Rw
			63	125	250	500	1 k	2 k	4 k	
vent openings	Dn,e	Sonovent Large 15mm (ZEN 250/15 AR)	35	31.9	35.5	46.1	55.2	62.1	35	48
	A0/S x 10 ^{-Dn/10}	B	0.001	0.001	0.000	0.000	0.000	0.000	0.001	
		Leq Internal SPL	34.2	29.7	26.3	14.1	5.3	-4.2	17.5	25
		Lmax Internal SPL	40.9	45.3	42.2	27.0	16.3	5.2	31.4	43
window	Rwi	10/16/9.1 Optiphon - 45Rw	25	29	33	44	46	49	57	45
	Swi/S x 10 ^{-Rwi/10}	C	0.001	0.000	0.000	0.000	0.000	0.000	0.000	
		Leq Internal SPL	40.2	28.6	24.8	12.2	10.5	4.9	-8.5	20.3
		Lmax Internal SPL	49.9	47.2	43.8	28.1	24.5	17.3	8.5	37.4
Primary wall	Rew	Metframe with 2x15mm Wallboard, 50mm Rock	20	33	41	46	50	48	48	48
	SeW/S x 10 ^{-Rew/10}	D	0.007	0.000	0.000	0.000	0.000	0.000	0.000	
		Leq Internal SPL	48.4	27.8	20.0	13.4	9.7	9.1	3.7	23.6
		Lmax Internal SPL	58.2	46.4	39.0	29.3	23.8	21.6	20.7	36.8
		None Trainable								
Calculated Internal Noise Levels										
	10 Log (B+C+D+E)	F	-20.8	-27.5	-31.8	-41.6	-47.1	-48.0	-32.9	
	A (furnished)	Room Absorption	9	9	9	9	9	9	9	
	10 log (S/A)	G	-1.4	-1.4	-1.4	-1.4	-1.4	-1.4	-1.4	
Leq	Calc Tolerance	T	3	3	3	3	3	3	3	
	Internal Leq,2	L+F+G+K+T	49.3	35.0	30.9	19.5	14.3	10.8	20.6	28.3
Lmax	Calc Tolerance	T								
	Internal Lmax,2	M+F+G+K+T	59.1	53.6	49.9	35.4	28.4	23.2	37.5	44.9



Building Envelope Sound Insulation Calculation According to EN 12354-3										
	Vahnea Student Residences, Bognor Regis			Date	27/09/2018					
	Wilkos Delivery Noise			Room	Bedford Street Bedroom - upper floors					
Incident noise levels										
	Term	Label	Octave band centre frequency (Hz)							dB(A)
			63	125	250	500	1 k	2 k	4 k	
L _{eq,ff}	Measured L _{eq}	Location P1 Night	4.5	-3.1	-2.9	-4.5	-4.2	-6.8	-12.2	59.0
	Measured spectrum	L: Location P1 Night: Adj Spectrum	63.5	55.9	56.1	54.5	54.8	52.2	46.8	59.0
		K	3	3	3	3	3	3	3	
L _{max,ff}	Measured L _{max}	Location P1 Night	-0.7	0.5	1.1	-3.6	-5.2	-9.3	-10.2	70.0
		M: Location P1 Night: Adj Spectrum	69.3	70.5	71.1	66.4	64.8	60.7	59.8	70.0
		K	6	6	6	6	6	6	6	
Room Details										
	Term	Derivation	Value	Term	Derivation	Value				
	V	Volume (m³)	26.9	Sew	Sf - Swi	4.2				
	RT	RT (secs)	0.5	Srr	Area of ceiling (m²)	0.0				
	Sf	Facade area (inc. window) (m²)	6.2	S	Sf + Srr	6.2				
			0.0	Ao	Ref Area for Dnew	10.0				
	Swi	Window area (m²)	2.0	Attenuation to roof		0.0				
Sound Insulation Calculation elements										
	Term	Label/element	Octave band centre frequency (Hz)							Rw
			63	125	250	500	1 k	2 k	4 k	
vent openings	D _{n,e}	Sonovent Large 25mm (ZEN 250/25 AR)	35	29.2	27.6	37.8	47.7	50.4	35	41
	A ₀ /S x 10 ^{-Dn/10}	B	0.001	0.002	0.003	0.000	0.000	0.000	0.001	
		L _{eq} Internal SPL	32.2	30.4	32.2	20.4	10.8	5.5	15.5	29
		L _{max} Internal SPL	34.9	42.0	44.1	29.3	17.8	10.9	25.4	43
window	R _{wi}	6/12/6.4 acoustic pvb double glazing	20	24	25	31	42	44	49	36
	S _{wi} /S x 10 ^{-Rwi/10}	C	0.003	0.001	0.001	0.000	0.000	0.000	0.000	
		L _{eq} Internal SPL	43.2	31.6	30.8	23.2	12.5	7.9	-2.5	25.7
		L _{max} Internal SPL	48.9	46.2	45.8	35.1	22.5	16.3	10.5	39.1
Primary wall	R _{ew}	Metframe with 2x15mm Wallboard, 50mm Rock	20	33	41	46	50	48	48	48
	S _{ew} /S x 10 ^{-Rew/10}	D	0.007	0.000	0.000	0.000	0.000	0.000	0.000	
		L _{eq} Internal SPL	46.4	25.8	18.0	11.4	7.7	7.1	1.7	21.6
		L _{max} Internal SPL	52.2	40.4	33.0	23.3	17.8	15.6	14.7	30.8
Calculated Internal Noise Levels										
	10 Log (B+C+D+E)	F	-19.8	-24.5	-24.1	-32.7	-42.7	-44.2	-32.8	
	A (furnished)	Room Absorption	9	9	9	9	9	9	9	
	10 log (S/A)	G	-1.4	-1.4	-1.4	-1.4	-1.4	-1.4	-1.4	
L _{eq}	Calc Tolerance	T	3	3	3	3	3	3	3	
	Internal L _{eq,2}	L+F+G+K+T	48.3	36.0	36.6	26.4	16.7	12.6	18.6	31.0
L _{max}	Calc Tolerance	T								
	Internal L _{max,2}	M+F+G+K+T	54.1	50.6	51.6	38.3	26.8	21.1	31.6	44.6



Building Envelope Sound Insulation Calculation According to EN 12354-3										
Vahnea Student Residences, Bognor Regis			Date	27/09/2018						
Wilkos Delivery Noise			Room	Bedford Street Bedroom						
Incident noise levels										
	Term	Label	Octave band centre frequency (Hz)							dB(A)
			63	125	250	500	1 k	2 k	4 k	
Leq,ff	Measured Leq	Location P1 Night	4.5	-3.1	-2.9	-4.5	-4.2	-6.8	-12.2	61.0
	Measured spectrum	L: Location P1 Night: Adj Spectrum	65.5	57.9	58.1	56.5	56.8	54.2	48.8	61.0
		K	3	3	3	3	3	3	3	
Lmax,ff	Measured Lmax	Location P1 Night	-0.7	0.5	1.1	-3.6	-5.2	-9.3	-10.2	76.0
		M: Location P1 Night: Adj Spectrum	75.3	76.5	77.1	72.4	70.8	66.7	65.8	76.0
		K	6	6	6	6	6	6	6	
Room Details										
	Term	Derivation	Value	Term		Derivation		Value		
	V	Volume (m³)	26.9	Sew		Sf - Swi		4.2		
	RT	RT (secs)	0.5	Srr		Area of ceiling (m²)		0.0		
	Sf	Facade area (inc. window) (m²)	6.2	S		Sf + Srr		6.2		
			0.0	Ao		Ref Area for Dnew		10.0		
	Swi	Window area (m²)	2.0	Attenuation to roof				0.0		
Sound Insulation Calculation elements										
	Term	Label/element	Octave band centre frequency (Hz)							Rw
			63	125	250	500	1 k	2 k	4 k	
vent openings	Dn,e	Mech Vent	100	100	100	100	100	100	100	101
	A0/S x 10 ^{-Dn/10}	B	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
		Leq Internal SPL	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		Lmax Internal SPL	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
window	Rwi	6/16/6.8 Optiphon - 38Rw	22	22	27	35	42	41	48	38
	Swi/S x 10 ^{-Rwi/10}	C	0.002	0.002	0.001	0.000	0.000	0.000	0.000	
		Leq Internal SPL	43.2	35.6	30.8	21.2	14.5	12.9	0.5	26.2
		Lmax Internal SPL	52.9	54.2	49.8	37.1	28.5	25.3	17.5	43.7
Primary wall	Rew	Metframe with 2x15mm Wallboard, 50mm Rock	20	33	41	46	50	48	48	48
	SeW/S x 10 ^{-Rew/10}	D	0.007	0.000	0.000	0.000	0.000	0.000	0.000	
		Leq Internal SPL	48.4	27.8	20.0	13.4	9.7	9.1	3.7	23.6
		Lmax Internal SPL	58.2	46.4	39.0	29.3	23.8	21.6	20.7	36.8
		Acoustic Glazing								
Calculated Internal Noise Levels										
	10 Log (B+C+D+E)	F	-20.5	-26.3	-31.6	-39.3	-45.7	-44.4	-48.0	
	A (furnished)	Room Absorption	9	9	9	9	9	9	9	
	10 log (S/A)	G	-1.4	-1.4	-1.4	-1.4	-1.4	-1.4	-1.4	
Leq	Calc Tolerance	T	3	3	3	3	3	3	3	
	Internal Leq,2	L+F+G+K+T	49.6	36.2	31.1	21.8	15.7	14.4	5.4	28.1
Lmax	Calc Tolerance	T								
	Internal Lmax,2	M+F+G+K+T	59.3	54.9	50.1	37.7	29.8	26.8	22.4	44.5



Building Envelope Sound Insulation Calculation According to EN 12354-3										
	Vahnea Student Residences, Bognor Regis			Date	27/09/2018					
	Wilkos Delivery Noise			Room	Bedford Street Bedroom - upper floors					
Incident noise levels										
	Term	Label	Octave band centre frequency (Hz)							dB(A)
			63	125	250	500	1 k	2 k	4 k	
Leq,ff	Measured Leq	Location P1 Night	4.5	-3.1	-2.9	-4.5	-4.2	-6.8	-12.2	59.0
	Measured spectrum	L: Location P1 Night: Adj Spectrum	63.5	55.9	56.1	54.5	54.8	52.2	46.8	59.0
		K	3	3	3	3	3	3	3	
Lmax,ff	Measured Lmax	Location P1 Night	-0.7	0.5	1.1	-3.6	-5.2	-9.3	-10.2	70.0
		M: Location P1 Night: Adj Spectrum	69.3	70.5	71.1	66.4	64.8	60.7	59.8	70.0
		K	6	6	6	6	6	6	6	
Room Details										
	Term	Derivation	Value	Term		Derivation		Value		
	V	Volume (m³)	26.9	Sew		Sf - Swi		4.2		
	RT	RT (secs)	0.5	Srr		Area of ceiling (m²)		0.0		
	Sf	Facade area (inc. window) (m²)	6.2	S		Sf + Srr		6.2		
			0.0	Ao		Ref Area for Dnew		10.0		
	Swi	Window area (m²)	2.0	Attenuation to roof				0.0		
Sound Insulation Calculation elements										
	Term	Label/element	Octave band centre frequency (Hz)							Rw
			63	125	250	500	1 k	2 k	4 k	
vent openings	Dn,e	Mech Vent	100	100	100	100	100	100	100	101
	A0/S x 10 ^{-Dn/10}	B	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
		Leq Internal SPL	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		Lmax Internal SPL	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
window	Rwi	4/12/4.4 acoustic pvb double glazing	19	22	22	26	37	46	47	32
	Swi/S x 10 ^{-Rwi/10}	C	0.004	0.002	0.002	0.001	0.000	0.000	0.000	
		Leq Internal SPL	44.2	33.6	33.8	28.2	17.5	5.9	-0.5	29.2
		Lmax Internal SPL	49.9	48.2	48.8	40.1	27.5	14.3	12.5	42.5
Primary wall	Rew	Metframe with 2x15mm Wallboard, 50mm Rock	20	33	41	46	50	48	48	48
	SeW/S x 10 ^{-Rew/10}	D	0.007	0.000	0.000	0.000	0.000	0.000	0.000	
		Leq Internal SPL	46.4	25.8	18.0	11.4	7.7	7.1	1.7	21.6
		Lmax Internal SPL	52.2	40.4	33.0	23.3	17.8	15.6	14.7	30.8
		Acoustic fabric								
Calculated Internal Noise Levels										
	10 Log (B+C+D+E)	F	-19.7	-26.3	-26.8	-30.9	-41.5	-47.3	-47.7	
	A (furnished)	Room Absorption	9	9	9	9	9	9	9	
	10 log (S/A)	G	-1.4	-1.4	-1.4	-1.4	-1.4	-1.4	-1.4	
Leq	Calc Tolerance	T	3	3	3	3	3	3	3	
	Internal Leq,2	L+F+G+K+T	48.5	34.2	33.9	28.3	17.9	9.6	3.8	29.9
Lmax	Calc Tolerance	T								
	Internal Lmax,2	M+F+G+K+T	54.2	48.9	48.9	40.2	28.0	18.0	16.7	42.8