

Acoustic assessment of a proposed residential development at Unit 4, Hawthorn Road, Littlehampton

Report Reference: 180801-R001E

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ARUN DISTRICT COUNCIL

Site Address: Unit 4
Hawthorn Road
Littlehampton
BN17 7LA

Client: Envision Contracting Limited

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0. SUMMARY

- ACA Acoustics Limited have been commissioned to assess external noise intrusion to a proposed new residential development at Unit 4, Hawthorn Road, Littlehampton. The assessment is required to support an application for prior approval.
- A sound level survey has been carried out between Thursday 9th and Monday 13th August 2018.
- The existing property is to offices. A prior approval application is to be submitted to Arun District Council for the change of use to residential properties. Existing ambient sound levels incident on the southern façade of the development are comprised primarily of traffic on the A259. To the west of the property loading and compactor noise is audible at periods during the day. To the north of the site levels from commercial units are inaudible, and to the east levels from use of the Morrisons loading bay are audible at times during the week. It is of benefit to note that assessment of environmental noise from transport sources is outside the scope of the GPDO.
- An assessment of commercial and industrial noise to relevant facades of the development has been undertaken in accordance with procedures set out in BS 4142:2014.
- The initial BS 4142:2014 assessment result indicates that without suitable mitigation measures, noise from commercial equipment is likely to have a significant adverse impact to future residents of the development. In accordance with guidance in the Standard, the context of the assessment must be considered, including potential benefit of façade sound insulation.
- An outline scheme for sound insulation of the building envelope has been developed such that internal sound levels during the daytime do not exceed LAeq 20dB within the studio flats. This is at least 15dBA below recommended guideline limits set out in BS 8233:2014 during the daytime period when the nearby commercial units currently operate.
- Based on short-term measurements of individual commercial and industrial activity, it is confirmed that noise intrusion due to the compactor will be LAeq 25dB inside the flats for no more than three minutes per hour. To the opposite façade the highest 30-second measurement during the cycle of a lorry arriving, manoeuvring, unloading, and departing the Morrisons supermarket will be LAeq 26dB inside the proposed flats. Each of these highest-measured short-term events will be significantly below the BS 8233:2014 daytime guideline limits. Although not anticipated, in a potential 'worst-case' scenario even if these operations were to continue for a full 8-hour period overnight then the calculated levels are below BS 8233:2014 guideline criteria for bedrooms.
- It is the author's opinion that, provided the installed sound insulation scheme complies with the recommended specification set out in this report, internal sound levels within the new residential units should not be detrimental to the amenity of future occupants and no further noise mitigation measures shall be necessary. The site is therefore considered suitable for residential development.

1. INTRODUCTION

ACA Acoustics Limited has been commissioned to carry out a survey and assessment of external sound levels at the site of a proposed residential development at Unit 4, Hawthorn Road, Littlehampton.

The sound level survey and assessment is required by the Local Planning Authority to assist their consideration of an application for prior approval under The Town and Country Planning (General Permitted Development) (England) (Amendment) Order 2016.

The objective of the assessment is to determine the impact that existing commercial and industrial noise sources would have on the proposed new development in accordance with national planning policies and other relevant British Standards and guidance documents. This report presents results of the sound level survey and assessment.

This revision of the report includes additional clarifications following comments within the Decision Notice refusing a previous application.

2. REVIEW OF PRIOR APPROVAL REFERENCE LU/286/18/PD

Arun District Council has previously refused an application for permitted development at the site (reference number: LU/286/18/PD). The reasons stated for refusal of the application, provided in the Decision Notice itself and the associated officer's report include reference to noise intrusion to the proposed residential flats. Review of the noise issues of the decision is provided below.

The Decision Notice advises the reason for refusal is:

“By reason of the sites close proximity to neighbouring commercial uses, the proposed change of use of the premises to dwellinghouse use will result in unacceptable levels of noise and disturbance to prospective occupiers in conflict with paragraphs 170e and 180a of the National Planning Policy Framework 2018”.

The previous acoustic report issued (180801-R001B) and subsequent addendums (180801-R002 and 180801-R003) demonstrated that use of high-performance façade sound insulation and mechanical ventilation will ensure that a good standard of acoustic amenity can be achieved inside the proposed residential flats. Sound from the commercial activities would be low and should not be disturbing to future occupants.

This revision to the report provides further details and clarifications to demonstrate that requirements of the National Planning Policy Framework have been achieved.

The Planning Officer's recommendation report includes consultation response provided by the Environmental Health Officer, which expands on the reason in the Decision Notice. Concerns raised by the Environmental Health Officer are:

“They note that the application is sited within an area where there are B2 uses in close proximity to the application site e.g. to the west of the site with no time use restrictions on it, and a further B2 use at Unit 14 of Martello Enterprise Centre directly behind the proposed site again with no time use restrictions on it. The worst case uses of these two sites (for example 24/7 sheet metal production) and it is considered that this worst case has not been taken into account by the acoustic report.”

It is usual to assess sound levels from commercial and industrial sources over the actual operating hours of the unit. It is acknowledged that operators of the businesses may extend their trading times during busy periods however an extension of trading over an hour or two would have little impact on the acoustic assessment result and therefore would not alter the recommended mitigation included in our original report. In the author's extensive experience of undertaking assessments in support of planning applications all over the country, it is not common practice for an acoustic assessment to consider possible 'worst-case' scenarios to the extent suggested by the Council of the units trading 24-hours a day. If this were imposed on all development it would mean significant over-attenuation for façade sound insulation schemes.

However, to ensure that the Council's concerns have been adequately considered, this report will demonstrate that the façade sound insulation mitigation scheme proposed would reduce sound levels to significantly below BS 8233:2014 guideline values overnight, even if the existing industrial and commercial activity were to continue during this time; thus, mitigating against the potential 'worst-case' scenario.

Source sound levels used in the current assessment of commercial and industrial noise use emissions from an external compactor associated with one of the B2 units. This was measured at a level of LAeq 82dB at 2m from the unit, equating to a level of LAeq 65dB at the façade of the proposed residential units. Allowing the additional distance from the commercial units to the development site and a reasonable assumption of the acoustic performance of the commercial unit's building envelope it is calculated that sound levels inside any of the surrounding B2 units would need to be in the order of 110dBA to achieve equivalent sound levels to outside the residential properties. At this level, noise at work health and safety regulations would require control of sound levels within the B2 units, and so source sound levels from the industrial units would be reduced by operators accordingly.

Similarly, if sound emissions from the industrial units were to exceed current levels from the compactor to outside the development site (LAeq 65dB), then this would mean they would be at a level of around LAeq 50-55dB to outside existing residential properties on Colebrook Road and Willow Brook. A level of LAeq 50-55dB overnight would likely cause disturbance to these existing residential properties which wouldn't have the benefit of the high-performance acoustic glazing and mechanical ventilation proposed to this development. As such, operators of the B2 units would be obliged to reduce operational noise accordingly. Finally, any new external plant or equipment would need new planning permission and appropriate criteria would be achieved accordingly.

As a result, if there were a change of operator or activity within the B2 units, for example to sheet metal work factory operating 24-hours a-day, as suggested by the Environmental Health Officer, sound emissions from these units would remain at a level below that from the external compactor used in this assessment. This is confirmation that ACA Acoustics' assessment is robust and considers the practical 'worst-case' scenario.

Additionally, the Environmental Health Officer has concerns that the acoustic report has also underestimated the noise impact of deliveries at the Morrisons supermarket site.

During the sound level survey, Morrisons loading bay manager advised the loading bay operating times which were stated in our report (08:00 – 21:00 hours). Although, it is now acknowledged that these could be extended to the permitted times (06:00 – 22:00 hours) should Morrisons require in the future.

However, lorries unloading were witnessed reversing up to a tight opening so all operational activity occurs inside the lorry or within the building; there are no forklift trucks or cages being

moved outside in the external yard. As such there is no significant airborne sound transmission path for loading noise to propagate to the new development.

In addition, a BS 4142:2014 assessment compares the rating level of the source against the prevailing background sound level during the assessment period. Background sound levels assessed in accordance with BS 4142:2014 between 06:00 – 22:00 were measured at LA90 47dB, and between 08:00 – 21:00 were measured at LA90 47dBA. As a result, there is no change in the background sound level if Morrisons were to extend delivery times to the extremes of their permitted hours and there would be no detrimental impact on the amenity of residential occupants.

Serious concerns that allowing residential use at this site will directly contravene Paragraph 170e and 180a of the revised NPPF.

Noise is likely to give rise to significant adverse impacts on health and quality of life from excessive noise and potential Statutory Nuisance from the surrounding land uses.

As discussed above, the previous acoustic report and subsequent addendums including this report, demonstrated that use of high-performance façade sound insulation and mechanical ventilation will ensure that a good standard of acoustic amenity can be achieved inside the proposed residential flats. Internal sound levels will be significantly better than the standards set out in BS 8233:2014 and World Health Organisation guidelines.

This revision to the report provides further details and clarifications to demonstrate that requirements of the National Planning Policy Framework have been achieved

Finally, although the comments from Private Sector Housing are detailed, it should be noted that due to the internal flats, it is highly likely that Category 1 and significant Category 2 Hazards (under the HHSRS) may be present which would result in either a Prohibition Order or Improvements Notices being served.

The Housing Health and Safety Rating System: Guidance for Property Related Professionals (May 2006) by the Department for Communities and Local Government provides guidance for owners and landlords on how housing conditions are assessed by local authorities.

The following intolerable noises are identified within the guidance. Clarification has been detailed next to each of their applicability to this assessment.

Identified Intolerable Noise	Response
Loud, continuous or apparently unnecessary noises which seem to go on indefinitely	Noise emissions from commercial and industrial activity to inside the property are very low and significantly below BS 8233:2014 guideline values. As such they would not be considered loud and do not continue indefinitely.
Seemingly inconsiderate noises, especially at night	This does not relate to commercial and industrial noise and therefore cannot be taken into account as part of this application.
Emotive, frightening noises, shouting or violent rows	This does not relate to commercial and industrial noise and therefore cannot be taken into account as part of this application.
Night time traffic noise	This does not relate to commercial and industrial noise and therefore cannot be taken into account as part of this application.
Location of dwelling in particularly noisy environment	Measured ambient sound levels in the vicinity are LAeq, 16 hour 57 – 59dB. This is not considered a particularly noisy environment. Considering guidance contained in the Institute of Acoustics, Association of Noise Consultant's, and Chartered Institute of Environmental Health's document <i>ProPG: Planning & Noise</i>, a façade sound level of LAeq, 16 hour 57 – 59dB is described as being a Noise Risk Assessment level of "Low". In addition, as previously discussed due to the high-performance acoustic specification of the façade then internal sound levels will be low and would not be disturbing to future occupants.
Inadequate internal insulation	This does not relate to commercial and industrial noise and therefore cannot be taken into account as part of this application.
Disrepair of windows/internal/external doors allowing increased noise penetration	This does not relate to commercial and industrial noise and therefore cannot be taken into account as part of this application.
Inappropriate siting of plumbing/fittings/facilities	This does not relate to commercial and industrial noise and therefore cannot be taken into account as part of this application.
Noisy equipment or facilities	This does not relate to commercial and industrial noise and therefore cannot be taken into account as part of this application.
Overly strong door closers resulting in banging	This does not relate to commercial and industrial noise and therefore cannot be taken into account as part of this application.

Table 1: HHSRS Noise Hazards

As identified in Table 1, most hazards identified in the HHSRS do not relate to noise from industrial and commercial sources and are therefore not applicable to this assessment. Indeed, the Environmental Health Officer's comments specifically relate to the internal flats. Sound levels from industrial and commercial sources to these will be even lower than those calculated to flats on the perimeter.

3. ACOUSTIC CRITERIA

The proposed noise measurement and assessment methodology is based on ACA Acoustics' experience of undertaking noise assessments for similar developments.

A review of the relevant parts of each of the routinely used planning guidance documents and British Standards is provided below.

3.1. The Town and Country Planning (General Permitted Development) (England) (Amendment) Order 2016

The application for prior approval is being made under The Town and Country Planning (General Permitted Development) (England) (Amendment) Order 2016, Class O (GPDO). In accordance with paragraph 7.(1)(c) of the Order;

"development under Class O is permitted subject to the condition that before beginning the development, the developer must apply to the local planning authority for a determination as to whether the prior approval of the authority will be required as to ... (d) impacts of noise from commercial premises on the intended occupiers of the development".

It is important to consider the GPDO specifically refers to noise from commercial premises to the proposed development. Noise from other sources, including traffic on nearby routes or internal sound insulation between dwellings is not considered under the GPDO.

The Order does not include any assessment methodology nor criteria to be achieved and therefore it is relevant to consider guidance provided in relevant British Standards and other documents.

3.2. National Planning Policy Framework (NPPF) and Noise Policy Statement for England (NPSE)

The National Planning Policy Framework (referred to as NPPF) was published by the Ministry of Housing, Communities and Local Government in July 2018.

The NPPF sets out the Governments' planning policies for England and provides guidance on how these are expected to be applied, providing a framework within which Local Authorities can produce their own distinctive local and neighbourhood plans, which reflect the needs and priorities of their communities.

Paragraph 170 of the NPPF states that;

"planning policies and decisions should contribute to and enhance the natural and local environment by ... 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".

Paragraph 180 also talks specifically about noise and states that;

“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 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.”*

Paragraph 182 discusses the impact of development on existing uses and advises that;

“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”.

It is of benefit to consider that this explicitly acknowledges that appropriate treatments, such as façade acoustic insulation, may be used to mitigate potential significant adverse impacts due to noise emissions from existing businesses.

In March 2010, the Department for Environment, Food and Rural Affairs (Defra) issued Noise Policy Statement for England (referred to as NPSE). This sets out the Government’s long-term policy aims that are intended to be considered by Local Planning Authorities when developing their own Local Policies relating to noise. Aims of NPSE are;

“Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy of 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.”*

Paragraphs 2.19 to 2.24 clarify the above aims, referring to established concepts from toxicology; NOEL (No Observed Effect Level) and LOAEL (Lowest Observed Adverse Effect Level). It also introduces a new concept relating to “significant adverse” of SOAEL (Significant Observed Adverse Effect Level), however stating;

“it is not possible to have a single objective noise-based measure that describes SOAEL that is applicable to all sources of noise in all situations. Consequently, the SOAEL is likely to be different for different noise sources, for different receptors and at different times”.

The second aim of the NPSE refers to the situation where the impact lies somewhere between LOAEL and SOAEL. It requires that all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life while also considering the guiding principles of sustainable development, as set out in the NPPF. As neither the NPPF or NPSE includes any numerical criteria, it is necessary to consider guidance provided in other documents to determine suitable limits that would define the LOAEL on an individual basis.

3.3. Planning Practise Guidance – Noise (PPG-N)

Related to the NPPF and NPSE, The Ministry of Housing, Communities & Local Government has published additional guidance and clarifications within the Planning Practice Guidance – Noise (PPG-N), available at <https://www.gov.uk/guidance/noise--2>.

Paragraph 003 of the PPG advises;

“Local planning authorities’ plan-making and decision taking should take account of the acoustic environment and in doing so consider:

- *Whether or not a significant adverse effect is occurring or likely to occur;*
- *Whether or not an adverse effect is occurring or likely to occur; and*
- *Whether or not a good standard of amenity can be achieved.*

In line with the Explanatory Note of the Noise Policy Statement for England, this would include identifying whether the overall effect of the noise exposure ... is, or would be, above or below the significant observed adverse effect level and the lowest observed adverse effect level for the given situation.”

This guidance is very like that set out in the NPPF and NPSE, however, Paragraph 005 of the PPG provides outline guidance on the definition of ‘significant adverse effect’ and ‘adverse effect’. Copy of the table provided within Paragraph 005 is repeated below.

Perception	Examples of Outcomes	Increasing Effect Level	Action
Not noticeable	No effect	No Observed Effect	No specific measures required
Noticeable and not intrusive	Noise can be heard, but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life	No Observed Adverse Effect	No specific measures required
Lowest Observed Adverse Effect Level			
Noticeable and intrusive	Noise can be heard and causes small changes in behaviour and/or attitude, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a perceived change in the quality of life	Observed Adverse Effect	Mitigate and reduce to a minimum
Significant Observed Adverse Effect Level			
Noticeable and disruptive	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 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	Significant Observed Adverse Effect	Avoid
Noticeable and very disruptive	Extensive and regular changes in behaviour and/or an inability to mitigate effect of noise leading to psychological stress or physiological effects, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory	Unacceptable Adverse Effect	Prevent

Table 2: Likely average response to noise exposure

Although this provides description of definitions for the LOAEL and SOAEL, as with the NPPF and NPSE there are no numerical values provided and consideration of guideline values provided in

other British Standards, including BS 8233:2014, may be considered appropriate. Discussion of BS 8233:2014 is provided below.

3.4. British Standard 8233:2014

The introduction to BS 8233:2014 *Guidance on sound insulation and noise reduction for buildings* advises that;

“this guide suggests criteria, such as suitable sleeping/resting conditions, and proposes noise levels that normally satisfy these criteria.”

Guidance limits for internal sound levels within living rooms and bedrooms, taken from Table 4 of BS 8233:2014, are shown in Table 3 below:

Activity	Location	07:00 – 23:00	23:00 – 07:00
Resting	Living Room	35dB LAeq, 16hr	-
Dining	Dining Room/Area	40dB LAeq, 16hr	-
Sleeping (daytime resting)	Bedroom	35dB LAeq, 16hr	30dB LAeq, 8hr

Table 3: BS 8233:2014 indoor ambient sound levels for dwellings

However, whilst the above criteria are generally considered suitable for noise from traffic and other ‘anonymous’ sources, Section 7.7.1 notes;

“Occupants are usually more tolerant of noise without a specific character than, for example, that from neighbours which can trigger complex emotional reactions. For simplicity, only noise without character is considered in Table 4... Noise has a specific character if it contains features such as a distinguishable, discrete and continuous tone, is irregular enough to attract attention, or has strong low-frequency content, in which case lower noise limits might be appropriate.”

In this instance impulsive noise from the morrisons loading bay is partially audible to the eastern façade of the development site. To the western façade, impulsive and tonal noise from goods loading and the compactor can be heard. Both are described as having a specific character and as such lower noise limits would be appropriate.

3.5. British Standard 4142:2014

The scope of BS 4142:2014 advises that *“this British Standard describes methods for rating and assessing sound of an industrial and/or commercial nature ... to assess the likely effects of sound on people who might be inside or outside a dwelling or premises used for residential purposes upon which sound is incident”*. BS 4142:2014 is considered appropriate for this application, to consider

the acoustic impacts where any industrial or commercial noise sources significantly contribute to the acoustic climate in the area.

The assessment method of BS 4142:2014 corrects the specific sound level from the source under investigation to account for characteristics that could make the sound more obtrusive to obtain a rating level. This rating level is compared against the prevailing background noise outside the noise-sensitive property. Section 11 of BS 4142:2014 provides a commentary of the assessment result and advises that:

- a) The greater the difference between the rating level and the background sound level, the greater the magnitude of the impact;*
- b) A difference of around +10dB or more is likely to be an indication of a significant adverse impact, depending on the context;*
- c) A difference of around +5dB is likely to be an indication of an adverse impact, depending on the context;*
- d) The lower the rating level is to the measured background sound level, the less likely it is that the specific sound source 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.*

It is important to note however, that this initial assessment conclusion is dependent on the context of the assessment, including acoustic performance of façade mitigation measures, which may materially alter the assessment result.

4. REVIEW OF SITE LOCATION & DEVELOPMENT PROPOSALS

The application for prior approval includes the change of use of Unit 4, Hawthorn Road, Littlehampton, to residential properties. Existing units are to offices.

The front of the property faces onto the A259. At the rear there is a car parking area and the rear wall of industrial units beyond. No noise was subjectively audible from these industrial units during the survey.

To the western façade a compactor was audible during periods of operation. Operators of the industrial unit advised this equipment runs for approximately three minutes in any one-hour period and not more than once per hour. During the attended survey loading occurred in the outside yard of this industrial unit, using an electric forklift truck. Noise from the forklift was practically inaudible to outside the façade of the development site.

Morrisons supermarket loading bay is located beyond a 3m high boundary wall to the east of the site. A lorry was witnessed delivering to the store during the survey. This reversed up to a tight opening so all operational activity occurs inside the lorry or within the building; there are no forklift trucks or cages being moved outside in the external yard. As such there is no significant airborne sound transmission path for loading noise to propagate to the new development and only the occasional low-level bang was audible to the development site.

During the sound level survey, Morrisons loading bay manager advised deliveries only occur between 08:00 and 21:00 hours. However, it is acknowledged that these could be extended to permitted times (06:00 – 22:00 hours) should Morrisons require in the future.

A marked-up aerial photograph is included in Figure 1 below.

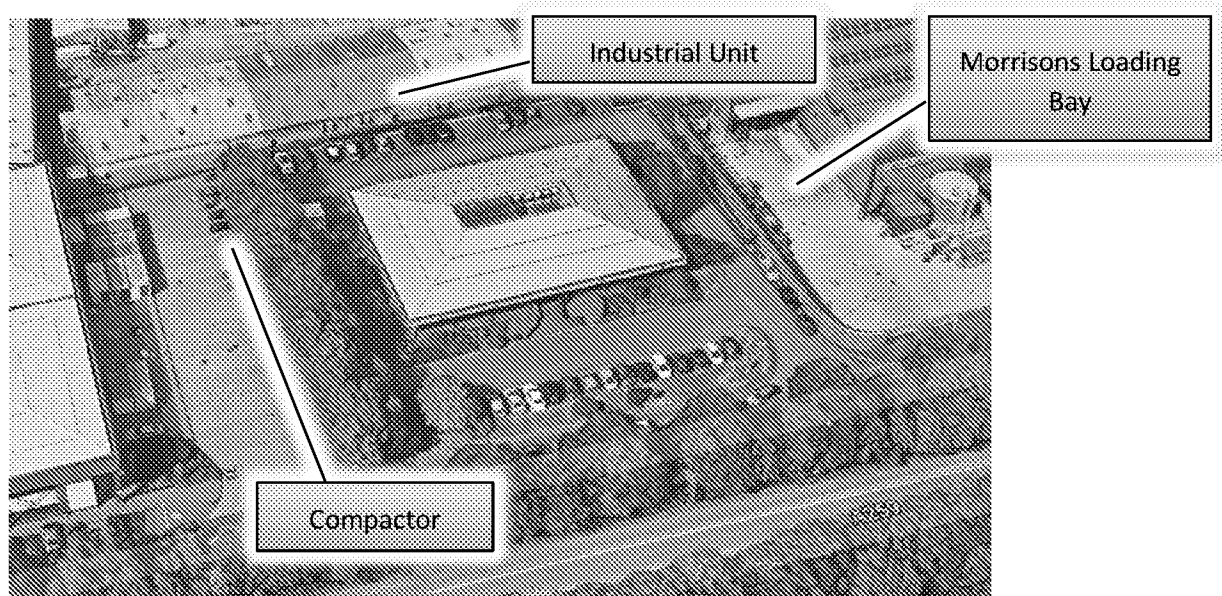


Figure 1: Aerial photograph of development site. Available at www.google.com/maps



A layout drawing showing the proposed location of the new development has been provided by the client and is shown below in Figure 2.

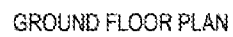


Figure 2: Proposed development

5. SOUND LEVEL SURVEY

To assess the impact of existing noise sources, a sound level survey was conducted at the development site to determine levels incident on the proposed residential units.

The site was considered secure and therefore an unmanned survey was carried out between Thursday 9th August and Monday 13th August 2018. Levels were measured to the front of the property.

During the visit to site to set up the survey, weather conditions were dry and calm, recorded as no precipitation and wind speeds of around 1.5m/s. These fully comply with appropriate meteorological conditions as set out within BS 7445-2:1991. Due to the nature of un-manned sound level surveys, weather conditions cannot be verified for much of the survey. However, historical weather websites have been consulted to provide an insight into the weather conditions. The nearest weather station at Wick, although slightly removed from the location of the site, provides a representative indication of the weather in the location over the period. This shows low levels of precipitation and wind speeds at, or only slightly above the BS 7445-2:1991 guidelines over the duration of the survey.

During the visits to site additional monitoring was undertaken of specific commercial and industrial activity in the vicinity, including loading and the compactor in use to the west of the site, along with unloading of a morrisons lorry to the east of the site.

Sound level measurements were recorded in consecutive 15-minute samples of overall LAFmax, LAeq and LA90 values along with other statistical indices.

The following equipment was used during the survey; the sound level meters were calibrated before the survey and checked after with no change noted.

Equipment	Serial Number	Calibration Certificate
Rion sound level meter type NL31 Class 1 complete with weatherproof and lockable outdoor environmental kit	00431030	1512668
NTi Audio sound level meter type XL2 Class 1 complete with weatherproof and lockable outdoor environmental kit	A2A-06294-E0	160915
NTi Audio calibrator type CAL200 94/114dB. Compliant to IEC 60942-1:2003 (Calibrated to a reference traceable to NIST)	11441	42940-11441-CAL200

Table 4: Equipment used

Summary of the daytime and night time sound level survey results are shown in tabular form in Table 4 and graphical form in Figure 3 on the following page.

Description	Daytime (07:00 – 23:00) LAeq	Night Time (23:00 – 07:00) LAeq	Night Time (23:00 – 07:00) Typical LAFmax
Overlooking the front of the development between 9 th August – 13 th August 2018	57dB	52dB	71dB

Table 5: Summary sound level survey results

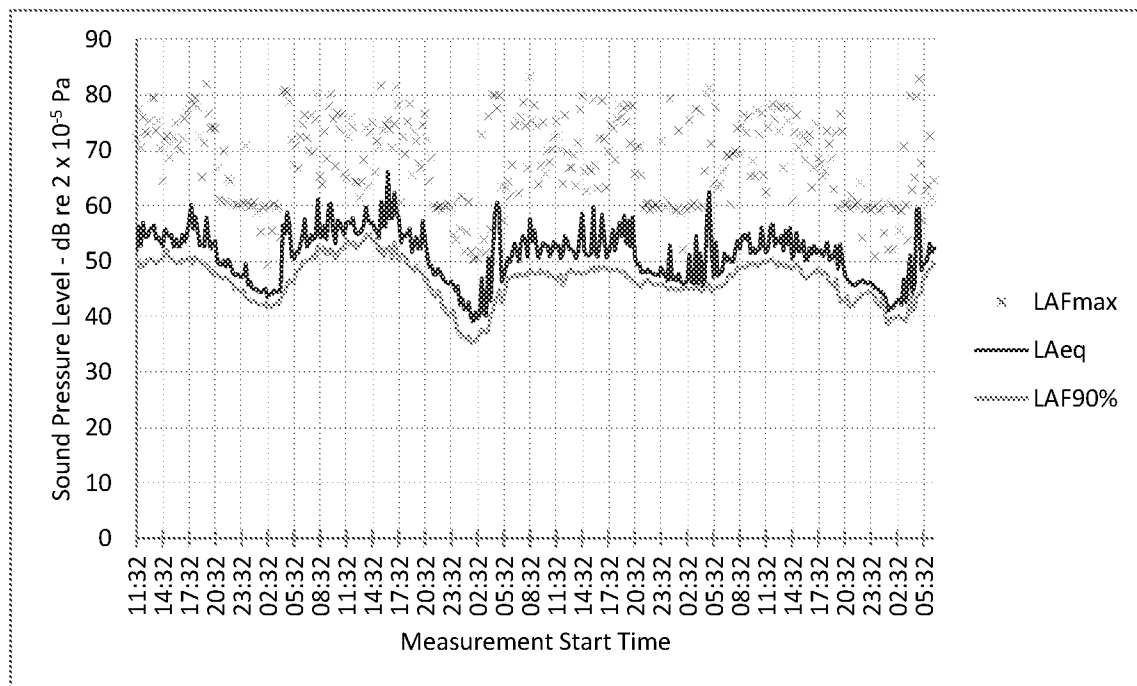


Figure 3: Sound level survey results to the front façade

Considering guidance contained in the Institute of Acoustics, Association of Noise Consultant's, and Chartered Institute of Environmental Health's document *ProPG: Planning & Noise*, a façade sound level of LAeq, 16 hour 57 – 59dB is described as being a Noise Risk Assessment level of "Low". Pre-planning application advice associated with this level, discussed in Figure 1 of the ProPG notes:

"The site is likely to be acceptable from a noise perspective provided that a good acoustic design process is followed and is demonstrated in an ADS [acoustic design statement] which confirms how the adverse impacts of noise will be mitigated and minimised in the finished development".

Assessment of commercial/industrial noise in Section 6 and acoustic specification of suitable façade elements in Section 7 of this report form the acoustic design statement and demonstrate that adverse impacts of noise will be mitigated to ensure a good standard of acoustic amenity for future residents.

Summary of short-term sound levels of specific industrial/commercial noise sources is provided in Table 6 below.

Description	Ambient Sound Level
Compactor measured at 2m from the equipment	LAeq, 3 min 81dB
Lorry unloading, including manoeuvring into position, unloading, starting engine and driving away from the Morrisons store. Measured at façade of development site.	LAeq, 49 min 58dB
Lorry unloading. Highest 30-second short-term measurement over duration of vehicle on site. Measured at façade of development site.	LAeq, 30 second 63dB
Background level after lorry left site	LAeq, 5 min 58dB

Table 6: Summary sound level survey results of specific industrial/commercial activity and equipment

As shown in Table 6, the highest short-term 30-second measurement of activity during the lorry reversing into position, unloading, and leaving site increased the existing residual sound level by 5dBA. However, when assessed over the entire period there was no change in the overall sound level. This confirms the subjective opinion of the consultant undertaking the survey on site; although the occasional short-term low-level noise was audible, it was not dominant and did not have any significant influence on the overall measured sound levels. Log of industrial activity noted along with measured short-term sound levels throughout a lorry delivering to the supermarket is provided in Appendix A.

6. ASSESSMENT OF INDUSTRIAL AND COMMERCIAL NOISE

Measured sound levels to the eastern and western facades of the development include contribution of noise from industrial sources. Results of the manned sound level survey have been used to assess this commercial noise source in accordance with BS 4142:2014.

Assessment of the measured sound level of commercial noise to the western façade of the proposed development is provided in Table 5 below and to the eastern façade in Table 6.

Description	Assessment of Western Facade	Relevant Clause	Commentary
Ambient sound level at the western façade	LAeq 65dB	7.3.2	Measured level of 81dBA at 2m from the compactor. Corrected to a level at the façade of the proposed development ($10 \times \log_{10}(13\text{m}/2\text{m}) = -16\text{dBA}$ distance correction to facade)
Existing residual level	LAeq 54dB	7.3.3	Short-term residual sound level measured with the industrial sources not operating
On time correction	$10 \times \log\left(\frac{180}{3600}\right) = -13$		The compactor operates for around 3 minutes at a time, occurring not more than once in an hour.
Specific level	LAeq 52dB		
Background sound level	LA90 48dB	8.1	Background sound level measured around 12:30 when equipment switched off.
Acoustic feature correction	+12dB	9.2	The source levels were witnessed as being tonal and impulsive. Therefore, in accordance with Section 9.2, a +9 dB correction is applied for impulsive characteristics, and +3dB is applied for tonal characteristics.
Rating level	LAr 64dB	9.2	
Excess of rating level over background sound level	+16dB	11	Assessment indicates likelihood of significant adverse impact, depending on the context.

Table 7: BS 4142:2014 Assessment of Western Facade

Description	Assessment of Eastern Facade	Relevant Clause	Commentary
Ambient sound level at the Eastern façade	LAeq 58dB	7.3.2	Measured level with loading in operation at 1m from the façade of the proposed development.
Existing residual level	LAeq 56dB	7.3.3	Lowest measured residual sound level during attended survey with lorry not loading.
On time correction	$10 \times \log\left(\frac{3600}{3600}\right) = -0$		The loading was witnessed to take around 49 minutes, however Morrisons loading manager confirmed deliveries can take up to an hour, therefore as a worst-case no correction is applied.
Specific level	LAeq 54dB		
Background sound level	LA90 51dB	8.1	Background sound level measured when loading not in operation.
Acoustic feature correction	+3dB	9.2	The source levels were witnessed as being impulsive. Therefore, in accordance with Section 9.2, a +3dB correction is applied for impulsive characteristics.
Rating level	LAr 57dB	9.2	
Excess of rating level over background sound level	6dB	11	Assessment indicates likelihood of adverse impact, depending on the context

Table 8: BS 4142:2014 Assessment of Eastern Facade

BS 4142:2014 requires an assessment to consider the context of a development, rather than simply adhere to numerical figures. The context of the assessment is the development of new residential properties to an area of existing commercial units. In the author's experience the likelihood of adverse impact is reduced in this context, compared to the reverse situation of bringing a new noise-generating use to an existing residential dwelling; in situations where a new noise source is introduced, residents notice a change in the acoustic climate, potentially causing a reduction of amenity. However, in this instance residents moving into the new residential flats would not be conditioned to any pre-existing lower levels.

Notwithstanding this, 16dB is a significant excess of rating level over background level and indicates that without further mitigation measures there is potential for adverse impact.

Section 11 of BS 4142:2014 discusses potential aspects which may alter the initial assessment result and advises that:

“where the initial estimate of the impact needs to be modified due to the context, take all pertinent factors into consideration, including the following ... the sensitivity of the receptor and whether dwellings ... will incorporate design measures that secure good internal and/or outdoor acoustic conditions, such as:

- i) Façade insulation treatment;*
- ii) Ventilation and/or cooling that will reduce the need to have windows open so as to provide rapid or purge ventilation”.*

This confirms that designing the sound insulation performance of façade elements to achieve appropriate internal sound levels mitigates the adverse impact, particularly where the scheme includes mechanical ventilation such that residents can achieve both background and rapid ventilation rates without needing to open windows.

7. ASSESSMENT OF FAÇADE SOUND INSULATION

A scheme for sound insulation is necessary to ensure sound levels inside rooms of the new residential apartments are reasonable and mitigate potential adverse impacts of noise intrusion from nearby commercial and industrial sources.

A computer model has been set up using the measured sound levels incident on the façade of the flats along with expected performance of the façade elements. The computer model is based on the calculation procedures outlined in BS EN ISO 12354-3:2000 and BS 8233:2014.

Confirmation of the acoustic performance of the building envelope elements used in the calculation model is provided below. *Consideration of non-acoustic aspects including, but not limited to, Building Regulations Approved Documents and structural calculations are outside the scope of ACA Acoustics Limited and should be considered by others accordingly.*

Description	R _w (dB)	R _w + C _{tr} (dB)	Typical Construction
Façade Walls	69	64	Brick – Cavity – Block construction with fully-filled 75mm cavity. New lining of 12.5mm WallBoard plasterboard on battens to the internal face, with nominal 50mm mineral wool insulation in the formed void.
Windows	42	39	High performance acoustic double-glazing with asymmetric panes such as 10-12-8 configuration or similar. Alternatively the client may prefer to utilise triple-glazing or secondary glazing systems. Alternative configurations would be appropriate, so long as the sound insulation performance achieves the specified levels.
Roof	66	62	Corrugated steel on Z-purlins, 2 layers 15mm SoundBloc plasterboard to the underside, then independent ceiling of two layers 15mm SoundBloc on MF systems with acoustic hangers. Minimum 100mm mineral wool insulation in the cavity.
Ventilators	-	-	Mechanical ventilation such as MVHR or similar.

Table 9: Acoustic performance specification for facade elements

Note that the constructions provided are typical and slight variations on the specification would be acceptable, so long as the installed construction achieved the specified sound insulation performance. The specification provided for glazed elements is for the window/door as a complete unit, including frames and seals, and it is recommended the successful glazing supplier confirm their unit supplied will comply with the specified performance.

Copy of acoustic calculations for noise intrusion into sample rooms is provided in Appendix B. Summary results are confirmed in Table 10.

Plot / Room	Calculated Internal Sound Level	BS 8233:2014 Criteria
Typical studio flat to western façade	L _{Aeq, 1-hour} 20dB	≤ 35dB
Typical studio flat to northern façade	L _{Aeq, 1-hour} 16dB	≤ 35dB
Typical studio flat to eastern façade	L _{Aeq, 1-hour} 20dB	≤ 35dB
Typical studio flat to southern façade	L _{Aeq, 1-hour} 19dB	≤ 35dB

Table 10: Summary internal sound levels within sample habitable rooms

It should be noted that calculated levels include contribution from both industrial and commercial noise as well as environmental noise. Noise from commercial sources in isolation will be consequently lower.

Based on the highest levels of commercial/industrial noise measured, short-term sound levels inside the worst-case flats will be L_{Aeq} 25dB to the western façade for a maximum of 3 minutes per hour. Worst-case flats to the eastern façade will be L_{Aeq} 26dB based on the highest 30-second measurement of a lorry unloading. Even these short-term events are considerably lower than the BS 8233:2014 guideline criteria of L_{Aeq} 35dB during the daytime and L_{Aeq} 30dB at night.

As discussed in Section 2 of this report, source levels used in the assessment are around the highest that would occur, as internal sound levels within the B2 units exceeding these source levels would result in other adverse impacts, such as exceeding noise at work regulations limits or causing disturbance to existing residential properties further removed. As such the assessment considered the worst-case and there would be no likelihood of higher sound levels to the residential flats in the future.

To ensure noise from external sources is not detrimental to the amenity of future occupants, it will be necessary to incorporate an acoustic ventilation scheme into the design such that residents can achieve adequate ventilation without necessarily needing to open windows. Suitable systems must also incorporate summer bypass mode to minimise the potential for overheating during warmer periods.

It is recommended that a mechanical ventilation system such as MVHR or equivalent is provided to habitable rooms of the proposed development. Suppliers including Titan or Envirovent would be able to offer suitable ventilation systems for residential purposes. It is important that any self-noise (i.e. noise from the fans) and external noise intrusion through the ducted system must not cause internal sound levels to exceed the design requirements.

9. CONCLUSION

An application for prior approval under The Town and Country Planning (General Permitted Development) (England) (Amendment) Order 2016, Class O is to be submitted to the Local Planning Authority to form new residential flats at Unit 4, Hawthorn Road, Littlehampton.

ACA Acoustics have undertaken background sound level surveys in the vicinity along with subjective listening and clarification of the acoustic environment. Noise from nearby commercial sources was audible, and therefore an assessment has been carried out in accordance with BS 4142:2014. The initial assessment result indicates potential for adverse impact, however a high-performance scheme for façade sound insulation is proposed, such that suitable internal sound levels are achieved and there is therefore a low likelihood of adverse impact to future residents.

The scheme is fully in accordance with Paragraph 170 of the NPPF as future occupants will not be adversely affected by noise pollution. Similarly, the scheme fully complies with Paragraph 180, as the proposed façade sound insulation scheme ensures that potential adverse impacts have been fully considered, mitigated, and reduced to a minimum. The outcome of the assessment demonstrates that levels within habitable rooms are significantly below appropriate guideline criteria and are a clear indication there would be no adverse impact on health or quality of life.

The author considers that the site is suitable for residential development.

APPENDIX A

Log of Activity During Delivery to Morrisons Supermarket

Time	LAeq, 30 seconds	Comments
19:12:32	60.5	Lorry waiting outside loading yard with engine switched off. Vehicle witnessed
19:13:02	57.6	arriving at 19:09
19:13:32	58	
19:14:02	60.1	
19:14:32	57.2	
19:15:02	57.6	
19:15:32	62.8	
19:16:02	60.8	
19:16:32	60.2	
19:17:02	56.6	
19:17:32	56	
19:18:02	58.9	
19:18:32	60.4	
19:19:02	56.6	
19:19:32	59	
19:20:02	59.2	
19:20:32	58.6	
19:21:02	59.4	Gate opened, low clunk audible.
19:21:32	58.7	
19:22:02	58.3	
19:22:32	59.9	Lorry engine switched on and vehicle starts reversing
19:23:02	57.3	Lorry reversing
19:23:32	59.5	Lorry reversing and stops with back of lorry up to tight opening
19:24:02	57.3	Gate closed
19:24:32	58	
19:25:02	54.5	
19:25:32	57.8	Lorry rear shutter opened. Practically inaudible to measurement position
19:26:02	58.5	Occasional bumps
19:26:32	54.5	Nothing noted
19:27:02	57.7	
19:27:32	58.6	
19:28:02	57.2	
19:28:32	60.8	Movement in trailer
19:29:02	55.9	Dragging metal trolley
19:29:32	58.5	Movement in trailer continued to 19:53. Low level bumps audible
19:30:02	56.7	typically every 30-seconds to 1 minute apart.
19:30:32	61.5	
19:31:02	61.4	
19:31:32	52.2	
19:32:02	53.9	
19:32:32	59.3	
19:33:02	57.3	
19:33:32	59.2	
19:34:02	57.8	
19:34:32	57.3	
19:35:02	57.5	
19:35:32	56.6	
19:36:02	57.3	
19:36:32	60	
19:37:02	63	Movement in trailer. Highest measured 30-second measurement

19:37:32	59.8
19:38:02	57.1
19:38:32	57.4
19:39:02	58.9
19:39:32	59.8
19:40:02	57.8
19:40:32	58.8
19:41:02	59.5
19:41:32	59.6
19:42:02	56.2
19:42:32	59.1
19:43:02	58.6
19:43:32	53.4
19:44:02	58.2
19:44:32	54.6
19:45:02	58.9
19:45:32	58.3
19:46:02	52.4
19:46:32	57.5
19:47:02	55.8
19:47:32	61.1
19:48:02	59.5
19:48:32	59.1
19:49:02	59.5
19:49:32	59.2
19:50:02	58.8
19:50:32	59.9
19:51:02	61
19:51:32	57.7
19:52:02	58.6
19:52:32	60
19:53:02	58.3 Tail lift moved up.
19:53:32	59.3
19:54:02	59.4 Driver in cab and appears to be filling in paperwork.
19:54:32	55.8
19:55:02	58
19:55:32	55.4
19:56:02	56.6
19:56:32	54.9
19:57:02	56.6
19:57:32	56.9
19:58:02	54.4
19:58:32	58.4
19:59:02	58.3
19:59:32	59.1
20:00:02	55.5
20:00:32	59.1
20:01:02	54.2
20:01:32	57.3
20:02:02	56.3
20:02:32	60.4
20:03:02	60.7

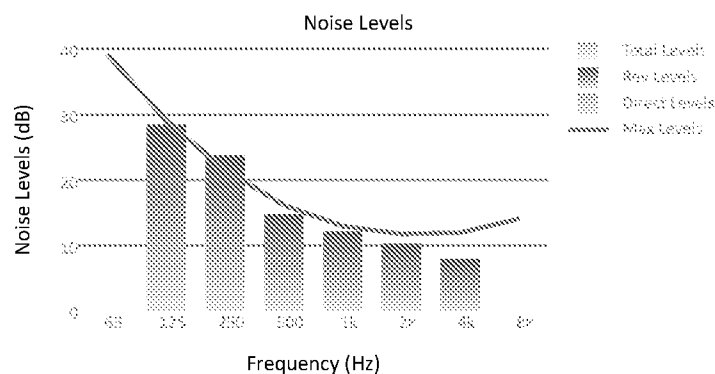
20:03:32	52.1
20:04:02	58.8
20:04:32	57.4
20:05:02	58.3
20:05:32	58.9
20:06:02	56
20:06:32	55.7
20:07:02	58.9
20:07:32	56
20:08:02	56.6
20:08:32	58.4
20:09:02	57.5
20:09:32	58.6
20:10:02	55.7 Gate Opens
20:10:32	58.7 Lorry engine switched on and drives straight out.
20:11:02	54.7 No activity in service yard.
20:11:32	57.6
20:12:02	58.1
20:12:32	58.2
20:13:02	59.2
20:13:32	58.2
20:14:02	59.4
20:14:32	57.5
20:15:02	58.3
20:15:32	57.9
20:16:02	57
20:16:32	55.4
20:16:44	56.7

APPENDIX B

Acoustic Calculations

Unit 4 Hawthorn Road

Reference	Typical Western Studio
Description	
Target Sound Level	-
Max Sound Level	22dB(A)
Calculated Sound Level	20dB(A)
Calculated Tmf T60 (s)	0.48
Volume (m³)	39



Calculated Internal Sound Levels

Reference	Quantity	Noise Levels (dB)							
		63	125	250	500	1k	2k	4k	8k
Leq,ff	1	-	28	24	15	12	10	8	-

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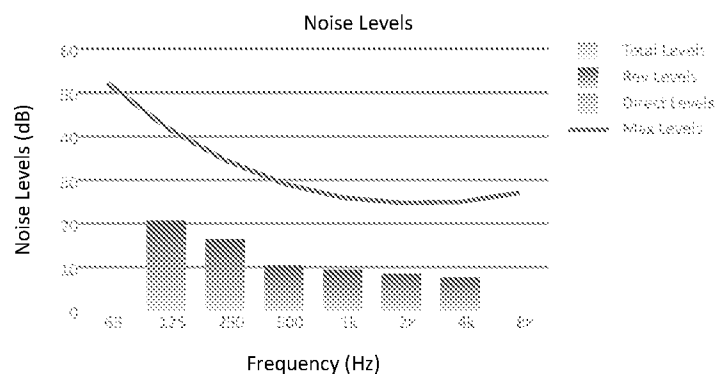
Calculation Sheet

Typical Western Studio

		Octave Band Centre Frequency (Hz)								
		63	125	250	500	1k	2k	4k	8k	
Sound Level at Facade										
Source dBA	59.0									
Octave Band Frequencies										
Leq,ff		63.0	61.0	57.0	55.0	55.0	51.0	46.0	40.0	Row A
Facade Wall Element										
		-59.4	-63.4	-65.4	-75.4	-79.4	-80.4	-87.4	-	
Facade Glazed Element										
		-	-39.0	-39.0	-47.0	-51.0	-50.0	-55.0	-	
Facade Roof Element										
		-41.8	-54.8	-59.8	-62.8	-69.8	-70.8	-80.8	-	
Arithmetic Subtract										
Result		18.2	3.2	-5.8	-10.8	-17.8	-22.8	-37.8	-	Row E
		-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-	
Cumulative Lp										
Result		-	22.1	18.1	9.2	6.5	5.1	3.3	-	
ISO 12354-3 Lfs Correction										
		-	0.0	0.0	0.0	0.0	0.0	0.0	-	
Room Corrections										
		-	6.4	5.6	5.6	5.6	5.1	4.6	-	
Internal Receiver Noise										
Internal Receiver Noise - Typical Western Livingroom Daytime LAeq Reverberant Field, LPrev:										
		-	28.5	23.7	14.8	12.1	10.3	7.9	-	

Unit 4 Hawthorn Road

Reference	Typical Northern Studio
Description	
Target Sound Level	-
Max Sound Level	35dB(A)
Calculated Sound Level	16dB(A)
Calculated Tmf T60 (s)	0.48
Volume (m³)	39



Calculated Internal Sound Levels

Reference	Quantity	Noise Levels (dB)							
		63	125	250	500	1k	2k	4k	8k
Leq,ff	1	-	21	16	10	9	9	8	-

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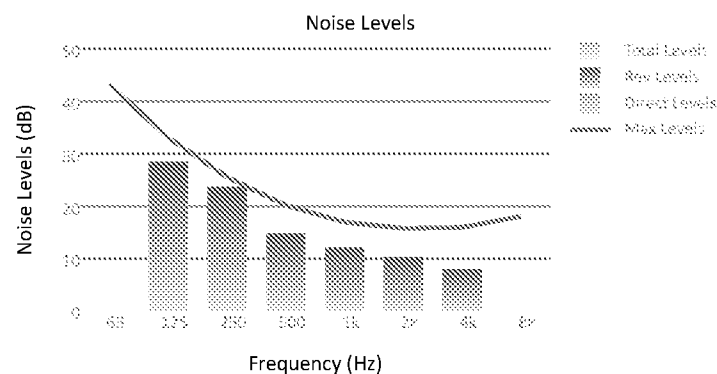
Calculation Sheet

Typical Northern Studio

		Octave Band Centre Frequency (Hz)								
		63	125	250	500	1k	2k	4k	8k	
Sound Level at Facade										
Source dBA	51.0									
Octave Band Frequencies										
Leq,ff		55.0	53.0	49.0	47.0	47.0	43.0	38.0	32.0	Row A
Facade Wall Element										
		-59.4	-63.4	-65.4	-75.4	-79.4	-80.4	-87.4	-	
Facade Glazed Element										
		-	-39.0	-39.0	-47.0	-51.0	-50.0	-55.0	-	
Facade Roof Element										
		-41.8	-54.8	-59.8	-62.8	-69.8	-70.8	-80.8	-	
Arithmetic Subtract										
Result		10.2	-4.8	-13.8	-18.8	-25.8	-30.8	-45.8	-	Row E
		-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-	
Cumulative Lp										
Result		-	14.4	10.8	4.8	3.8	3.4	3.1	-	
ISO 12354-3 Lfs Correction										
		-	0.0	0.0	0.0	0.0	0.0	0.0	-	
Room Corrections										
		-	6.4	5.6	5.6	5.6	5.1	4.6	-	
Internal Receiver Noise										
Internal Receiver Noise - Typical Northern Livingroom Daytime LAeq Reverberant Field, LPrev:										
		-	20.7	16.4	10.4	9.4	8.6	7.7	-	

Unit 4 Hawthorn Road

Reference	Typical Eastern Studio
Description	
Target Sound Level	-
Max Sound Level	26dB(A)
Calculated Sound Level	20dB(A)
Calculated Tmf T60 (s)	0.48
Volume (m³)	39



Calculated Internal Sound Levels

Reference	Quantity	Noise Levels (dB)						
		63	125	250	500	1k	2k	4k
Leq,ff	1	-	28	24	15	12	10	8

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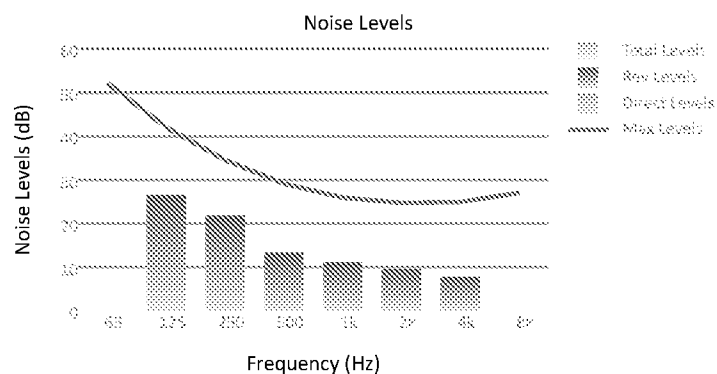
Calculation Sheet

Typical Eastern Studio

		Octave Band Centre Frequency (Hz)								
		63	125	250	500	1k	2k	4k	8k	
Sound Level at Facade										
Source dBA	59.0									
Octave Band Frequencies										
Leq,ff		63.0	61.0	57.0	55.0	55.0	51.0	46.0	40.0	Row A
Facade Wall Element										
		-59.4	-63.4	-65.4	-75.4	-79.4	-80.4	-87.4	-	
Facade Glazed Element										
		-	-39.0	-39.0	-47.0	-51.0	-50.0	-55.0	-	
Facade Roof Element										
		-41.8	-54.8	-59.8	-62.8	-69.8	-70.8	-80.8	-	
Arithmetic Subtract										
Result		18.2	3.2	-5.8	-10.8	-17.8	-22.8	-37.8	-	Row E
		-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-	
Cumulative Lp										
Result		-	22.1	18.1	9.2	6.5	5.1	3.3	-	
ISO 12354-3 Lfs Correction										
		-	0.0	0.0	0.0	0.0	0.0	0.0	-	
Room Corrections										
		-	6.4	5.6	5.6	5.6	5.1	4.6	-	
Internal Receiver Noise										
Internal Receiver Noise - Typical Eastern Livingroom Daytime LAeq Reverberant Field, LPrev:										
		-	28.5	23.7	14.8	12.1	10.3	7.9	-	

Unit 4 Hawthorn Road

Reference	Typical Southern Studio
Description	
Target Sound Level	-
Max Sound Level	35dB(A)
Calculated Sound Level	19dB(A)
Calculated Tmf T60 (s)	0.48
Volume (m³)	39



Calculated Internal Sound Levels

Reference	Quantity	Noise Levels (dB)							
		63	125	250	500	1k	2k	4k	8k
Leq,ff	1	-	26	22	13	11	10	8	-

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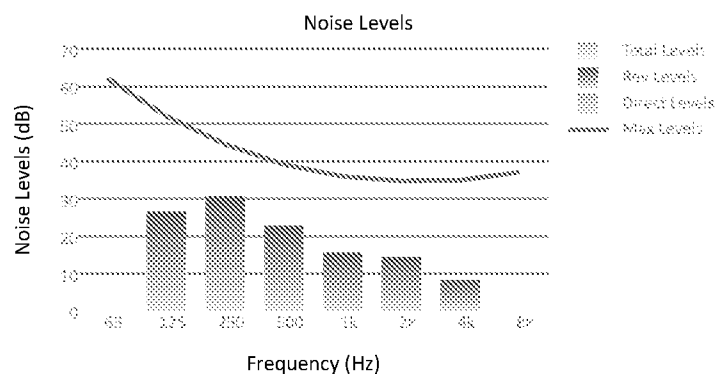
Calculation Sheet

Typical Southern Studio

		Octave Band Centre Frequency (Hz)								
		63	125	250	500	1k	2k	4k	8k	
Sound Level at Facade										
Source dBA	57.0									
Octave Band Frequencies										
Leq,ff		61.0	59.0	55.0	53.0	53.0	49.0	44.0	38.0	Row A
Facade Wall Element										
		-59.4	-63.4	-65.4	-75.4	-79.4	-80.4	-87.4	-	
Facade Glazed Element										
		-	-39.0	-39.0	-47.0	-51.0	-50.0	-55.0	-	
Facade Roof Element										
		-41.8	-54.8	-59.8	-62.8	-69.8	-70.8	-80.8	-	
Arithmetic Subtract										
Result		16.2	1.2	-7.8	-12.8	-19.8	-24.8	-39.8	-	Row E
		-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-	
Cumulative Lp										
Result		-	20.1	16.2	7.8	5.5	4.5	3.2	-	
ISO 12354-3 Lfs Correction										
		-	0.0	0.0	0.0	0.0	0.0	0.0	-	
Room Corrections										
		-	6.4	5.6	5.6	5.6	5.1	4.6	-	
Internal Receiver Noise										
Internal Receiver Noise - Typical Southern Livingroom Daytime LAeq Reverberant Field, LPrev:										
		-	26.5	21.8	13.4	11.1	9.6	7.8	-	

Unit 4 Hawthorn Road

Reference	Short-term Event to Western Studio
Description	
Target Sound Level	-
Max Sound Level	45dB(A)
Calculated Sound Level	25dB(A)
Calculated Tmf T60 (s)	0.4
Volume (m³)	32.5



Calculated Internal Sound Levels

Reference	Quantity	Noise Levels (dB)							
		63	125	250	500	1k	2k	4k	8k
Leq,ff	1	-	26	31	23	16	14	8	-

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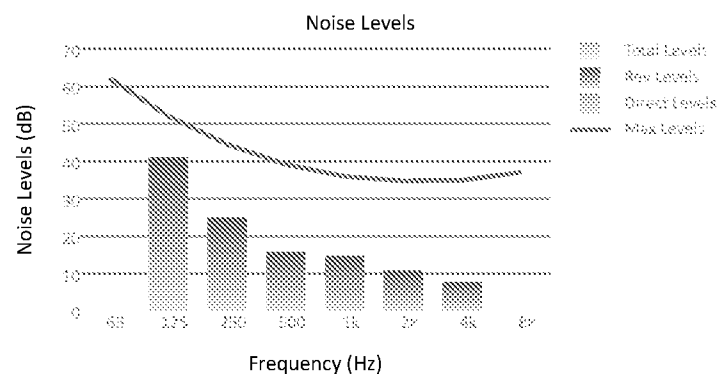
Calculation Sheet

Highest Short-term Noise Event to Western Studio

Octave Band Centre Frequency (Hz)								
	63	125	250	500	1k	2k	4k	8k
Sound Level at Facade								
Source dBA	59.0	59.0	64.0	64.0	60.0	58.0	50.0	44.0
Row A								
Facade Wall Element								
	-59.4	-63.4	-65.4	-75.4	-79.4	-80.4	-87.4	-
Facade Glazed Element								
	-	-39.0	-39.0	-47.0	-51.0	-50.0	-55.0	-
Facade Roof Element								
	-41.8	-54.8	-59.8	-62.8	-69.8	-70.8	-80.8	-
Arithmetic Subtract								
Result	14.2	1.2	1.2	-1.8	-12.8	-15.8	-33.8	-
Row E								
	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-
Cumulative Lp								
Result	-	20.1	25.0	17.2	10.0	9.2	3.6	-
ISO 12354-3 Lfs Correction								
	-	0.0	0.0	0.0	0.0	0.0	0.0	-
Room Corrections								
	-	6.4	5.6	5.6	5.6	5.1	4.6	-
Internal Receiver Noise								
Internal Receiver Noise - Typical								
Western Bedroom Nighttime LAfmax								
Reverberant Field, LPrev:	-	26.5	30.6	22.8	15.6	14.3	8.3	-

Unit 4 Hawthorn Road

Reference	Short-term Event to Eastern Studio
Description	
Target Sound Level	-
Max Sound Level	45dB(A)
Calculated Sound Level	26dB(A)
Calculated Tmf T60 (s)	0.4
Volume (m³)	32.5



Calculated Internal Sound Levels

Reference	Quantity	Noise Levels (dB)							
		63	125	250	500	1k	2k	4k	8k
Leq,ff	1	-	41	25	16	15	11	8	-

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Calculation Sheet

Highest Short-term Noise Event to Eastern Studio

Octave Band Centre Frequency (Hz)								
	63	125	250	500	1k	2k	4k	8k
Sound Level at Facade								
Source dBA	78.7	73.7	58.3	56.2	59.0	52.4	40.6	- Row A
Facade Wall Element								
	-59.4	-63.4	-65.4	-75.4	-79.4	-80.4	-87.4	-
Facade Glazed Element								
	-	-39.0	-39.0	-47.0	-51.0	-50.0	-55.0	-
Facade Roof Element								
	-41.8	-54.8	-59.8	-62.8	-69.8	-70.8	-80.8	-
Arithmetic Subtract								
Result	33.9	15.9	-4.5	-9.6	-13.8	-21.4	-43.2	- Row E
	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-
Cumulative Lp								
Result	-	34.7	19.4	10.1	9.2	5.7	3.1	-
ISO 12354-3 Lfs Correction								
	-	0.0	0.0	0.0	0.0	0.0	0.0	-
Room Corrections								
	-	6.4	5.6	5.6	5.6	5.1	4.6	-
Internal Receiver Noise								
Internal Receiver Noise - Typical								
Eastern Bedroom Nighttime LAFmax								
Reverberant Field, LPrev:	-	41.1	25.0	15.7	14.8	10.8	7.7	-