CITIPADS

ST JAMES COURT, LIVERPOOL

NOISE ASSESSMENT FOR PLANNING PURPOSES

24 November 2017

AEC REPORT: P3490/R1/PJK

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1.0 INTRODUCTION

1.1 Acoustic & Engineering Consultants Limited (AEC) has been appointed by CitiPads to assess the noise levels affecting the proposed residential block on land between New Bird Street and Greenland Street, Liverpool. This noise assessment is required to accompany the associated planning application for the development.

1.2 This report presents the results of the daytime and night-time noise level measurements undertaken on the site, and provides an assessment of the potential impact on the acoustic design of the site taking into account available guidance and the Local Authority's requirements.

1.3 Due to time constraints, and adverse weather conditions, noise level measurements were only possible during the night-time period. Adjacent to the proposed development site are two event spaces; Constellations and Observatory and Hangar 34, and the date and time of the site visit was selected to measure noise levels in the area with both venues operating simultaneously.

1.4 In terms of daytime noise levels, as the two event venues can both operate during the daytime it has been deemed reasonable to assume that the glazing and ventilation requirements to living rooms could be determined based on the measured night-time noise levels.

1.5 It should be noted that AEC have previously measured background noise levels in the area around New Bird Street during the night-time period on a weekday night. These measured levels have been used to provide a night-time noise level limit for plant noise only.

1.6 Acoustic terminology used throughout the report is described in brief in Appendix A.

2.0 SITE DESCRIPTION

2.1 A scheme to redevelop existing commercial land adjacent to St James Street, Liverpool has been prepared by Falconer Chester Hall architects (FCH).

Existing Site Layout

2.2 The proposed development site is located within an area of Liverpool known as the Baltic Triangle and is bound to the north by New Bird Street, St James Street to the east, Greenland Street to the south and Lee Floorstok Ltd premises to the west. The site location is presented on Figure 1.

2.3 Currently there is a commercial unit opposite the site on New Bird Street, however, the site has planning permission for a multi-storey residential development.

2.4 To the east is St James Street, which is a relatively busy road into Liverpool City Centre. Opposite the site is a light shop and commercial unit who provide screen printing products to the print and sign industry.

2.5 To the south of the site is Greenland Street which is a cul-de-sac. To the southwest of the site is Constellations and Observatory event venue. The venue has an external garden area and an internal event space.

2.6 Between the external garden and Greenland Street is a 4m high wall, through which the garden is accessed via two 4m high wrought iron gates. It is understood that music events can take place in the garden area during the summer months.

2.7 On the weekend of the site measurements, Constellations and Observatory had a club night between 2300 and 0300h. During the measurement period amplified music was being played in the garden area and the large gates were open to Greenland Street.

2.8 To the west of the site, is Lee Floorstok Ltd, a distributor of flooring materials, and the proposed development will be separated from this unit by a narrow path.

2.9 Beyond Lee Floorstock to the west is Hangar 34, which is an event space that operates on a Friday and Saturday night. The venue is not open every weekend, however, Hangar 34 is licensed to operate up to 0400h. On the weekend of the site measurements, Hangar 34 also had a club night operating between 2200 until 0400h.

Proposed Site Layout

2.10 Based on the drawings provided by FCH Architects, the proposed development will be horseshoe shaped around a Residents Communal Deck Terrace (RCDT) which is open to the west, as identified on Figure 2.

2.11 The building will be stepped in height, with the section overlooking New Bird Street being 11 storeys high and the sections facing St James Street will be 12 storeys high. The Greenland Street section will be stepped from 9 storeys to 12 storeys.

2.12 In addition, there will be a car park and two commercial units on the lower ground floor level.

2.13 The provided elevation drawings show that balconies will only be provided to the flats on the corner of St James Street and Greenland Street. The drawing also shows there will be no windows on the gable ends of the sections of the building which run along New Bird Street and Greenland Street. However, there will be habitable rooms which overlook the RCDT.

2.14 The nearest noise sensitive properties to the proposed development will be either the proposed residential development on New Bird Street, or the flats within this scheme.

3.0 NOISE CLIMATE

3.1 Weekend noise levels were measured by AEC on Friday 18 and Saturday 19 November 2017 between 2300 and 0430h, when both Constellations and Observatory and Hangar 34 where having events.

3.2 All noise level measurements were undertaken in general accordance with BS7445 Part 1: 2003 '*Description and measurement of environmental noise. Guide to quantities and procedures*' and full details of the noise surveys are presented in Appendix B with measured noise data presented in Table B1.

3.3 Noise measurements were undertaken at five locations around the proposed site, identified as A to E on Figure 1. All measurements were undertaken under free-field conditions, with the exception of those taken at Location C, which were façade measurements.

3.4 BS4142: 2014 '*Methods for rating and assessing industrial and commercial sound*' states that where measurements are made 1m from a façade "*the measured level can be adjusted to an equivalent free-field level by subtracting a 3dB correction factor*." Therefore, a -3dB correction has been applied to all measurements undertaken at Location C.

Constellations and Observatory

3.5 Locations A and C were selected to measure the noise levels from activities associated with Constellations and Observatory event venue, including taxis dropping off and picking up patrons before and after club night. The gates were open during all the measurements of the venue operating.

3.6 The free-field ambient and maximum noise levels with patrons arriving before the event were 60dB$L_{Aeq,\ 10min}$ and 76dBL_{Amax}. After the event when patrons were leaving the free-field ambient and maximum noise levels were and 61dB$L_{Aeq,\ 10min}$ and 78dBL_{Amax}. The noise climate during both periods was due to a combination of patrons talking and taxis driving along Greenland Street.

3.7 The free-field ambient and typical maximum noise level measured when Constellations and Observatory was open ranged from 64 to 69dB$L_{Aeq,\ 10mins}$ and 75 to 82dBL_{Amax}.

3.8 The noise climate was due to noise from the speakers in the venue's garden, and taxis on Greenland Street. The range in ambient and maximum noise levels was dependent on the number of taxis driving past the measurement location.

Hangar 34

3.9 The free-field ambient noise levels measured at Location B, (due to noise breaking out of Hangar 34) and taxis on New Bird Street ranged from 60 to 63dB$L_{Aeq,\ 10mins}$. Typical maximum noise levels ranged from 75 to 83dBL_{Amax} due to taxi pass bys.

3.10 Noise levels were also measured when patrons were leaving Hangar 34 at the end of the night, however, it was not possible to measure accurate noise levels due to patrons deliberately affecting the noise levels by shouting into the microphone.

3.11 Free-field ambient and maximum noise levels of 61dB$L_{Aeq,\ T}$ and 71dBL_{Amax} respectively were measured at Location E due to noise breaking out of Hangar 34 only.

Other Noise Sources

3.12 Location D was selected to measure noise level due to road traffic on St James Street to the east. The free-field ambient noise level at this location was consistently around 63dB$L_{Aeq,\ 10mins}$ with a highest maximum noise level of 74dBL_{Amax}.

3.13 AEC measured the background noise level in the area during a night-time period on a weekday night in July 2016 when neither of the event venues were operating. Based on these measurements, the lowest night-time background noise level in the area was 37dB$L_{A90,\ 10mins}$ measured New Bird Street.

3.14 It is anticipated that the daytime background noise levels would be at least 10dB higher around the site.

4.0 BASIS OF ASSESSMENT

National Planning Policy Framework

4.1 The latest Planning Policies are included in the National Planning Policy Framework published by the Department for Communities and Local Government and dated March 2012. This document provides little mention of planning polices with regard to noise with the exception of paragraph 123 that states:

'Planning policies and decisions should aim to:

- *avoid noise from giving rise to significant adverse impacts on health and quality of life as a result of new development;*
- *mitigate and reduce to a minimum other adverse impacts on health and quality of life arising from noise from new development, including through the use of conditions;*
- *recognise that development will often create some noise and existing businesses wanting to develop in continuance of their business should not have unreasonable restrictions put on them because of changes in nearby land uses since they were established; and*
- *identify and protect areas of tranquillity which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason.'*

4.2 The terms '*significant adverse'* and '*adverse*' above are referenced to the Noise Policy Statement for England (NPSE), published by Department for Environment, Food and Rural Affairs (DEFRA) dated March 2010. One of the main aims of this policy is also to avoid significant adverse effects on health and quality of life.

4.3 With respect to the two terms above, the explanatory note for the NSPE introduces two concepts from toxicology that are currently being applied to noise impacts, for example, by the World Health Organisation (WHO). They are:

- *"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.*

  Extending these concepts for the purpose of this NPSE leads to the concept of a significant observed adverse effect level.

- *SOAEL – Significant Observed Adverse Effect Level - This is the level above which significant adverse effects on health and quality of life occur*."

4.4 National Planning Practice Guidance, an online resource, brings together the aims of the NPPF and NPSE and tries to indicate how the likely perception and average response to noise relates to the effect levels. This is summarised in Appendix C below.

4.5 Further to the above, the Governments '*Planning Practice Guidance*' dated 6 March 2014 indicates:

'Noise needs to be considered when new developments may create additional noise and when new developments would be sensitive to the prevailing acoustic environment. When preparing local or neighbourhood plans, or taking decisions about new development, there may also be opportunities to consider improvements to the acoustic environment.'

4.6 In addition, the guidance indicates that, whilst noise can override other planning concerns, it should not be considered in isolation from the economic, social and other environmental dimensions of any proposed development.

Local Authority Requirements

Noise Break-In

4.7 Liverpool City Council issued document '*Noise Control Requirements for Residential and Other Developments on the City Centre*' in October 2000. The aim of this document was to provide guidance in relation to the noise insulation requirements for new residential developments in the city centre.

4.8 Paragraph 2.1 of Section 2 of this document states that ideally the following glazing would be installed:

"*double window having well sealed inner and outer panes in which, for a gap between the inner and outer pane of 200 mm, an inner pane thickness of 4 mm is satisfactory and for a gap of 100 mm an inner pane thickness of at least 6mm is required*. *Where it is not possible to achieve this specification (e.g. because the window reveals will not permit such a gap) then a reduced gap may be permitted or thermal double glazing having panes of 6mm and 10mm thickness and a minimum of a 12mm gap between*."

4.9 In regards to ventilation, paragraph 2.2 states that where windows need to be closed to maintain the sound insulation performance of the external envelope, mechanical ventilation would need to be provided.

4.10 It has previously been agreed with Ian Rushforth, an Environmental Health Officer at LCC, that internal noise level limits due to steady external noise sources, such as road traffic, should be controlled to meet the levels presented in BS 8233:2014 '*Guidance on sound insulation and noise reduction for buildings' and* World Health Organisation (WHO) document '*Guidelines for Community Noise*'.

4.11 BS8233 provides desirable internal ambient noise levels that should not generally be exceeded in habitable rooms, which are reproduced in Table 1, below.

Table 1 – Internal Noise Level Limits within Habitable Rooms

Activity	Location	Ambient Noise Level, $dBL_{Aeq,T}$	
		Daytime 0700 – 2300h	Night-Time 2300 – 0700h
Resting	Living Room	35	-
Dining	Dining Room/Area	40	-
Sleeping (daytime resting)	Bedroom	35	30

4.12 In regards to night-time maximum noise levels within bedrooms, the WHO guidelines state that, for a good night's sleep, it is believed that indoor sound pressure levels should not exceed approximately $45dBL_{Amax}$ more than 10 to 15 times per night.

4.13 In relation to noise from the event spaces, which have a strong low frequency content, it has been agreed with Ian Rushforth that noise from these sources should be controlled to no greater than $NR25L_{max}$ in the bedrooms at night and $NR30L_{max}$ in the living rooms during the daytime.

4.14 Where these internal noise levels can be achieved with an alternative glazing and ventilation strategy other than the one provided in the LCC guidance document, the suggested alternative scheme would need to be agreed with LCC.

External Areas

4.15 The LCC guidance document does not discuss balconies, therefore, guidance has been sought in BS8233, which states:

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

"Other locations, such as balconies, roof gardens and terraces, are also important in residential buildings where norm an external amenity spaces might be limited or not available, i.e. flats, flat blocks, etc. In these locations, ***specification of noise levels is not necessarily appropriate.*** *Small balconies may be included for uses such as drying washing or growing pot plants, and noise limits should not be necessary for these uses."*

4.16 Taking the above into account, and the fact that site is located within the city centre, it is anticipated that there will be no practical mitigation measures to reduce noise levels on the balconies. As such this assessment simply reports the measured external noise levels only.

Noise Egress

4.17 Following discussions with LCC, AEC has been informed that any items of plant should be assessed using BS4142: 2014 '*Methods for rating and assessing industrial and commercial sound*', and the 'rating' level should not exceed the existing background at the nearest noise sensitive residential property.

4.18 Paragraph 9.1 of BS4142 identifies that "*Certain acoustic features can increase the significance of impact over that expected from a basic comparison between the specific sound level and the background sound level. Where such features are present at the assessment locations, add a character corrections to the specific sound level to obtain the rating level."*

4.19 The noise levels from ground floor daytime activities would not only need to be controlled externally to no greater than the background at the nearest noise sensitive properties, but there would also be a need to control noise to the flats above. Controlling noise levels in the flats above to not exceed NR30L_{max} would be expected to be acceptable in the day.

5.0 ASSESSMENT OF PROPOSED DEVELOPMENT

External Noise Levels

5.1 The night-time ambient and maximum noise levels affecting each elevation of the proposed development have been determined based on the noise levels measured around the site, discussed in Section 3, taking into account any screening or distance attenuation and are presented in Table 2, below.

5.2 It should be noted that while the habitable rooms overlooking the RCDT would be screened from the majority of noise sources in the area, they would have direct line of sight over Hangar 34, therefore, the ambient and maximum noise levels affecting these areas has been determined based on the noise levels measured at Location E.

5.3 The main noise source(s) affecting each elevation is also presented in Table 2.

Table 2 – Anticipated Noise Levels due to Existing Noise Sources

Elevation	Source	Night-Time Noise Level, dB 2300-0700	
		$L_{Aeq, 8h}$	L_{Amax}
Greenland Street	Constellations and Observatory / Road Traffic	69	79
New Bird Street	Hangar 34 / Road Traffic	63	83
RCDT	Hangar 34	58	65
St James Street	Road Traffic	63	74

Glazing and Ventilation Requirements

5.4 The glazing and ventilation requirements to achieve the internal noise levels agreed with LCC have been calculated and are presented in Table 3, below. Example glazing build ups to achieve the required sound insulation performances are also presented in Table 4, below.

5.5 The calculations have been undertaken with reference to the living room and bedroom dimensions and glazing areas presented on the FCH drawings and the determined external noise levels. All calculations were undertaken using full octave band centre frequencies measured on site.

5.6 In relation to the ventilation strategy, as stated LCC usually require that all habitable rooms in properties in the city centre are mechanically ventilated. The calculations indicate that in some areas ventilation could be provided by systems which include openings in the external envelope. The required sound insulation performance of any opening is presented in Table 3, however, they would need to be agreed with LCC.

Table 3 – Outline Requirements to Achieve Internal Noise Levels in Habitable Rooms

Elevation	Room	Sound Insulation Performance	
		Glazing	Ventilation
Greenland Street	Living Room	$42dBR_w$ / $37dBR_w + C_{tr}$	MV
	Bedroom / Night	$51dBR_w$ / $46dBR_w + C_{tr}$	MV
New Bird Street	Living Room / Day	$42dBR_w$ / $35dBR_w + C_{tr}$	MV
	Bedroom / Night	$45dBR_w$ / $41dBR_w + C_{tr}$	MV
RCDT	Living Room / Day	$38dBR_w$ / $32dBR_w + C_{tr}$	$41dBD_{n,e,w}$
	Bedroom / Night	$42dBR_w$ / $35dBR_w + C_{tr}$	MV
St James Street	Living Room / Day	$34dBR_w$ / $29dBR_w + C_{tr}$	$38dBD_{n,e,w}$
	Bedroom / Night	$38dBR_w$ / $32dBR_w + C_{tr}$	$44dBD_{n,e,w}$

*** MV = Mechanical Ventilation**

Table 4 – Example Glazing Build Ups to Achieve the Required Sound Insulation Performances

Glazing Sound Insulation Performance	Example Glazing Build Up
$34dBR_w$ / $29dBR_w + C_{tr}$	10mm thick glass / Thermal Cavity / 4mm thick glass
$38dBR_w$ / $32dBR_w + C_{tr}$	10mm thick glass / Thermal Cavity / 6mm thick glass
$42dBR_w$ / $35dBR_w + C_{tr}$	10mm thick glass / Thermal Cavity / 8.8mm thick glass
$42dBR_w$ / $37dBR_w + C_{tr}$	8.76mm thick LamiGlass SR (PVB) / Thermal Cavity / 4mm Float Glass / Thermal Cavity / 6mm Float Glass *1*2
$45dBR_w$ / $41dBR_w + C_{tr}$	17.52mm thick LamiGlass SR (PVB) / Thermal Cavity / 10mm Float Glass *1
$51dBR_w$ / $46dBR_w + C_{tr}$	8.5mm thick LamiGlass SR (PVB) / Thermal Cavity / 6mm Float Glass / Thermal Cavity / 14.5mm thick LamiGlass SR (PVB)*1*2

***1 – High Performing Glazing**
***2 – Triple Glazing System**

5.7 The window build-ups with a sound insulation performance of 45dBR_w and 51dBR_w are very high performing glazing and the calculation have been based on Guardian Glass systems. Alternative systems can be used, however, manufacturers test certificate would be required.

5.8 Windows can be openable providing that they are effectively acoustically sealed when closed and it is important that any frames and seals do not downgrade the sound insulation performance of the glazing. For glazing achieving a sound insulation performance of at least 45dBR_w this will require careful consideration.

5.9 The ventilation systems proposed are based on the provision of one opening into each room, with the exception of the rooms identified as requiring mechanical ventilation, where it is assumed there are no external openings to the rooms.

5.10 It should be noted that the glazing and ventilation requirements presented in Table 3 are based on the night-time measured noise levels only. In relation to the elevations affected by noise from Constellations and Observatory and Hangar 34, the daytime noise level when these event venues are operating would be anticipated to be similar to those measured during a night-time event.

5.11 The only location where daytime noise levels would be expected to be significantly different from the night-time is on St James Street. However, AEC have specified similar glazing and ventilation to that presented in Table 3 for another site a similar distance from St James Street in Liverpool.

Other Façade Elements

5.12 The other elements of the external envelope need to achieve a sound insulation performance at least 10dB greater than those indicated in Table 5. The minimum required on-site sound insulation performance (dBR'_w) for each elevation is presented in Table 5, below.

Table 5 – Minimum Required Sound Insulation Performance of External Envelope

Elevation	On-site Sound Insulation Performance (R'_w)
Greenland Street	61
New Bird Street	55
RCDT	52
St James Street	48

Noise Egress

Noise Breakout from Commercial Units

5.13 Noise breakout from the commercial units in terms of typical maximum (L_{Amax}) levels should be controlled to not exceed the existing background noise levels in the area. Based on previously measured night-time background noise level, when the event spaces were not operating, the lowest background noise level in the area was around 37dBL_{A90}..

5.14 It is understood that the commercial units would be used for small commercial enterprises and potentially a small supermarket, therefore, the areas would not include music venues. Based on this, it is anticipated that the noise level within the retail units would not be expected to exceed the values stated in Table 6, below.

Table 6 – Typical Noise Levels in Retail Units without Background Music

Noise Level	Maximum Noise Level, dBL_{max}							
	Overall A-weighted	Octave Band Centre Frequency, Hz						
		63	125	250	500	1k	2k	4k	8k
Typical Maximum Noise Level	Approx 85	75	75	80	80	80	80	75	75

5.15 The weakest element, acoustically, in the external envelope would typically be the glazing. Assuming that any curtain walling to the commercial provides a sound insulation of at least $38dBR_w$, and $32dBR_w + C_{tr}$, (e,g, 10mm glass/Thermal Cavity/4mm glass) then noise breaking out of the commercial units would be adequately controlled to meet the proposed requirement during the night-time.

5.16 Therefore, as it is anticipated that the daytime background noise levels would be at least around 10dB higher than the night-time level, therefore, it is expected that there will be no impact during the daytime either.

5.17 The noise levels from ground floor activities would not only need to be controlled externally, but there would also be a need to control noise transfer into the flats above. As a minimum, the separating floor between the ground floor commercial units and the first floor flats would need to achieve a sound insulation performance of at least $45dBD_{nT,w} + C_{tr}$ to comply with Approved Document E of The Building Regulations 2010.

5.18 However, a higher sound insulation performance of around $55dBD_{nT,w} + C_{tr}$ is likely to be required to control noise level to below $NR30L_{max}$ in the flat above. This will require further development once the floor construction has been confirmed.

5.19 If the operators of the commercial units did want to use a music system for background entertainment purposes only, then a limiting device could be installed as part of a tenancy agreement, to ensure that breakout levels are suitably controlled.

Plant Noise

5.20 Although it is not yet known what plant is to be associated with this development and where it will be located, control of plant noise at the nearest noise sensitive properties should not be onerous. As identified above, the nearest noise sensitive properties will be either the proposed development opposite New Bird Street or the flats within this development.

5.21 In order to comply with LCC plant noise requirement, the plant should be selected as to not exceed a total rating noise level of $37dBL_{Aeq,\,T}$ during the night-time period at the nearest noise sensitive receptor with all the plant operating simultaneously.

5.22 As identified above, it is anticipated that daytime background noise levels are expected to be around 10dB higher than the night-time levels, therefore, controlling the noise emitted from the plant to meet the more onerous night-time requirement should mean the daytime noise level limit would also be achieved.

6.0 SUMMARY AND CONSULSIONS

6.1 Acoustic and Engineering Consultants Limited has been appointed by CitiPads to assess the noise levels affecting the proposed residential block on land between New Bird Street and Greenland Street, Liverpool. The scheme consists of one continuous building in a horse shoe shape around a central Residents Communal Deck Terrace with two ground floor commercial units.

6.2 Following a consultation with Ian Rushforth, an Environmental Health Officer at Liverpool City Council (LCC) it was confirmed that internal levels due to noise from the surrounding roads and would need to be controlled to meet the levels presented in BS 8233:2014 '*Guidance on sound insulation and noise reduction for buildings'* and World Health Organisation (WHO) document '*Guidelines for Community Noise'*.

6.3 In relation to noise from the surrounding event venues, including Constellations and Observatory and Hangar 34, maximum noise levels from amplified music should be controlled to NR30L_{max} in living rooms during the day and NR25L_{max} in bedrooms at night.

6.4 Based on the measured noise levels affecting the proposed development site, the sound insulation requirements of the building envelope and ventilation, to achieve the appropriate internal noise levels presented in Section 4 have been determined and are presented in Section 5. The glazing and ventilation specifications required to meet the internal noise levels limits has been based on night-time noise levels only.

6.5 Measures to control the potential impact of noise break out of the ground floor commercial units on the nearest noise sensitive properties and the first floor flats are also presented in Section 5.

6.6 In order to meet LCC requirement for noise egress from any building services plant, the total rating noise level, with all plant operating simultaneously should not exceed 37dB$L_{Aeq, T}$ at the nearest noise sensitive receptor.

6.7 The above assessment demonstrates that, while the external noise levels are relatively high, the required internal noise levels can be achieved with enhanced glazing and mechanical ventilation. Therefore, noise should not be considered a determining factor in relation to any planning being sought.

FIGURE 1 – Site Location Plan Identifying Monitoring Locations

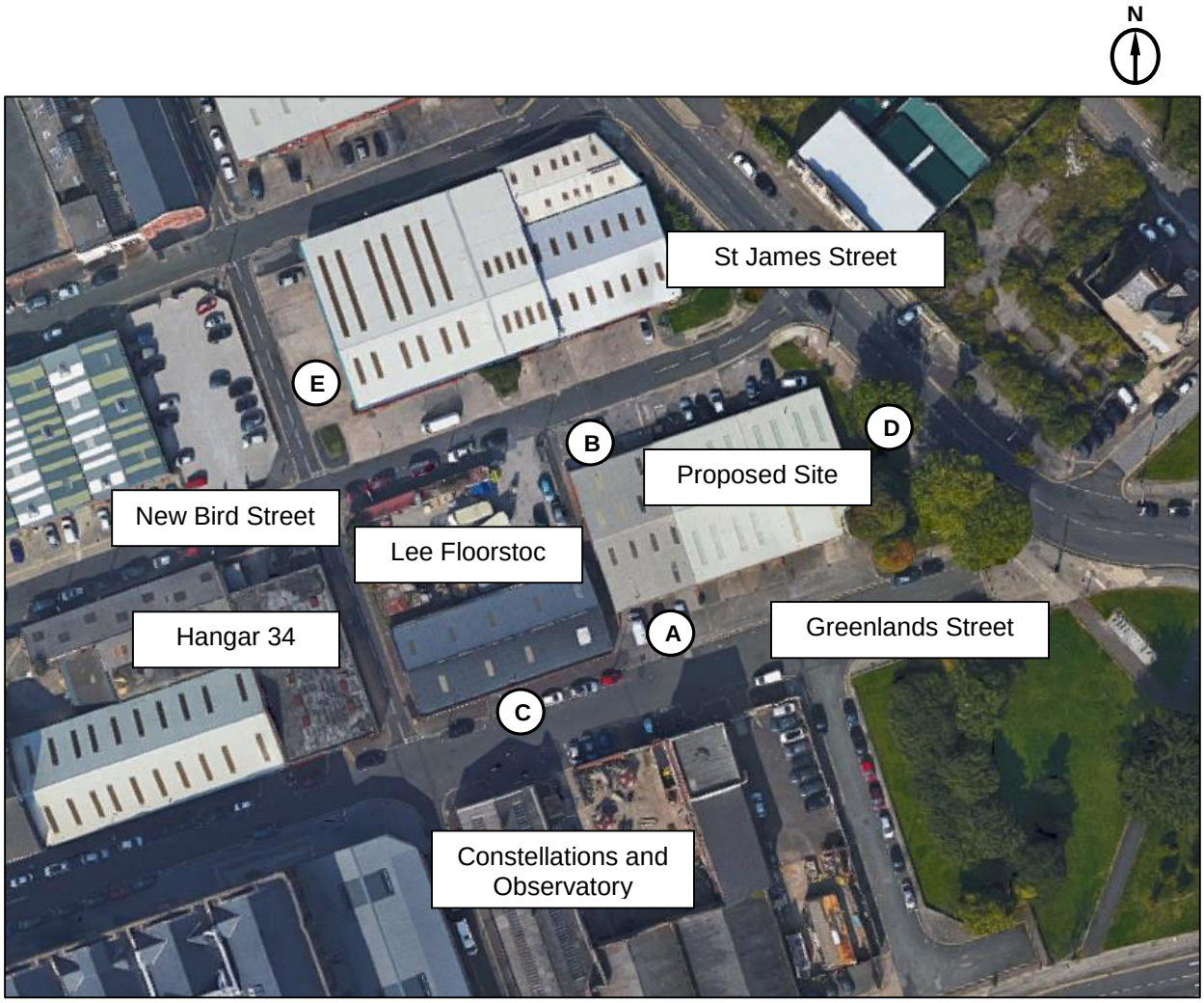
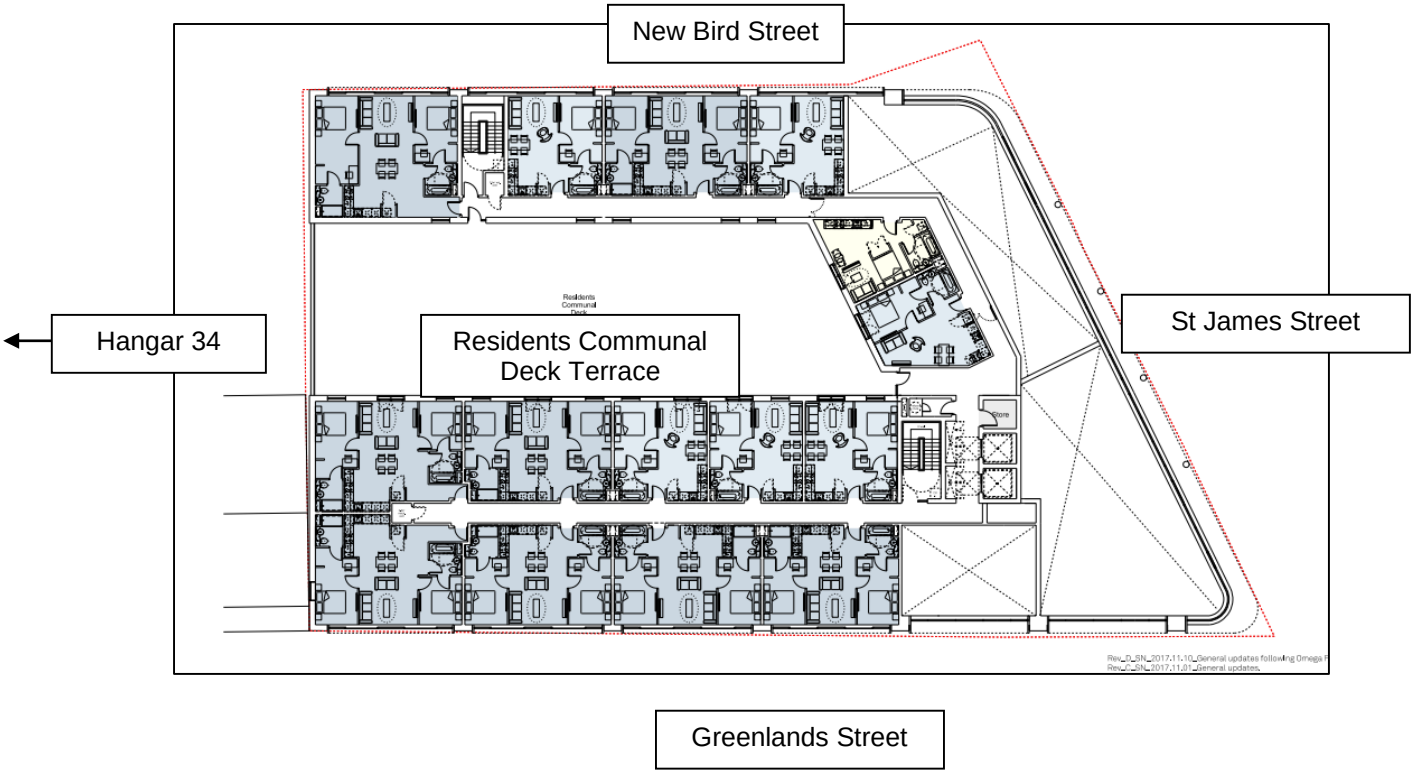


FIGURE 2 – Proposed Site Layout



APPENDIX A – Acoustic Terminology in Brief

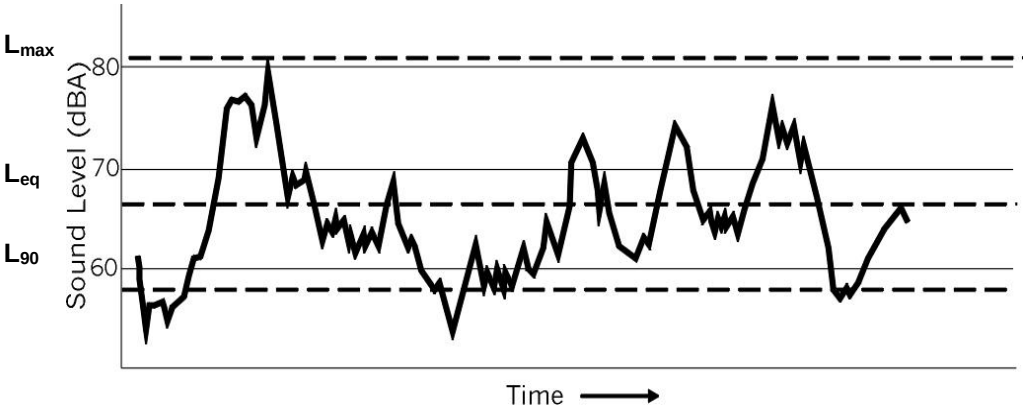
Sound is produced by mechanical vibration of a surface, which sets up rapid pressure fluctuations in the surrounding air. The rate at which the pressure fluctuations occur determines the pitch or *frequency* of the sound. The frequency is expressed in Hertz *(Hz)*, that is, cycles per second. The human ear is sensitive to sounds from about 20 Hertz to 20,000 Hertz. Although sound can be of one discreet frequency – a 'pure tone' – most noise is made up of many different frequencies.

The human ear is more sensitive to some frequencies than others, and modern instruments can measure sound in the same subjective way. This is the basis of the A-weighted sound pressure level *dBA,* normally used to assess the effect of noise on people. The dBA weighting emphasizes or reduces the importance of certain frequencies within the audible range.

Noise Units

In order to assess environmental noise, measurements are carried out by sampling over specific periods of time, such as fifteen minutes or one hour, the statistically determined results being used to quantify various aspects of the noise.

The figure below shows an example of sound level varying with time. Because of this time variation the same period of noise can be described by several different levels. The most common of these are described below.



Example of Sound Level Varying With Time

$L_{Aeq,T}$	The equivalent continuous (A-weighted) sound level may be considered as the "average" sound level over a given time, T. It is used for assessing noise from various sources including transportation, industrial and construction sources and can be considered as the "ambient" noise level.
L_{A90}	The (A-weighted) sound level exceeded for 90% of a measurement period. It is the value used to describe the "background" noise.
L_{Amax}	The maximum (A-weighted) sound level during a measurement period.
Free-field Level	This refers to the sound level measured outside, away from reflecting surfaces.

R_w	Single number rating used to describe the airborne sound insulation properties of a material or building element over a range of frequencies, typically 100-3150Hz, when ***measured in a laboratory***.
$R_w + C_{tr}$	Single number rating used to describe the laboratory airborne sound insulation properties of a material or building element (normally windows) over a range of frequencies, typically 100-3150Hz, adjusted to adjusted by a spectrum adaptation to provide the reduction of traffic noise.
$D_{n,e,w}$	Weighted element-normalised level difference. Single number rating used to describe the performance of a ventilation unit.
$D_{nT,w} + C_{tr}$	As above only the resultant figure is adjusted by a spectrum adaptation term in relation to the low frequency sound insulation performance.

APPENDIX B – Noise Survey Details

Dates & Times of Survey:	Night-Time: Friday 17 to Saturday 18 November 2017, between 2230 and 0440h
Personnel Present:	Paul Knowles (AEC)
Equipment Used:	Cirrus CR:171B Real Time Analyser (AEC Kit 3)
Weather Conditions:	Night-time: Dry, 4°C, upto 5m/s easterly wind and cloud cover around 60%.
Measurement Procedure:	Baseline noise levels were measured at fives location, identified as A - E on Figure 1 and described below.

A – 2m from the nearest carriageway of Greenland Street and 5 from the existing garage units.

B – 2m from the nearest carriageway of New Bird Street and 5 from the existing garage units.

C – 1m from the existing Lee Floorstok Ltd opposite the gates to external garden of Constellations and Observatory.

D – 5m from the nearest carriageway of St James Street.

E – 1m from the nearest carriageway of Newhall Street, 35m from the nearest elevation of Hangar 34.

All locations were selected to measure noise levels from road traffic on the surrounding roads and amplified music breaking out of the event spaces. Noise was measured in terms of L_{Aeq}, L_{A10}, L_{A90} and L_{Amax} (fast response) typically over 5 to 15 minute periods at a height of 1.5m above ground. All the measurements, were taken under free-field, with the exception of Location C which was a façade measurement.

The sound level analyser, which conforms to BS EN 61672-1: 2013 *'Electroacoustics. Sound level meter. Specifications'* for Class 1 sound level meter. The meter was in calibration and check calibrated before and after the measurement periods using a Brüel & Kjær type 4231 (94dB) calibrator. There was no significant drift of calibration. Calibration certificates are available on request.

Measured Data:	A summary of the noise levels measured on-site are presented in Table B1, below.

TABLE B1 – Measured Night-Time Noise Levels

Location	Period, h	Noise Level, dB			Comments
		L_{Aeq}	L_{A90}	$L_{Amax, F}$	
A	2301-2311	59.9	55.0	75.8	Noise climate due to pedestrians and taxis on Greenland Street. Maximum noise levels due to taxis.
	0322-0332	60.6	55.2	77.7	
B	2312-2322	60.8	53.0	75.7	Noise climate due to pedestrians, taxis on New Bird Street and amplified music noise breaking out of the external envelope of Hangar 34.
	0015-0025	62.7	57.4	75.2	
	0052-0102	60.7	56.0	77.9	
	0333-0343	60.8	54.7	78.5	
	0354-0404	61.4	54.7	78.6	
	0404-0414	59.6	53.4	77.1	
	0417-0427	61.7	54.8	83.0	
C	2332-2342	69.8	66.3	81.5	Noise climate due to pedestrians, taxis on Greenland Street and amplified music noise breaking out of the external garden of Constellations and Observatory.
	2342-2352	71.8	66.7	79.9	
	2352-0002	69.0	65.9	81.2	
	0030-0040	67.1	63.9	75.4	
D	0004-0014	63.1	55.6	74.0	Noise climate due to road traffic on St James Street.
	0041-0051	61.5	51.9	74.0	
E	0104-0114	62.8	59.9	75.9	Noise climate due to taxis on New Bird Street and amplified music noise breaking out of the external envelope of Hangar 34.
	0138-0148	63.2	60.3	80.5	
	0343-0353	60.1	54.8	71.8	

APPENDIX C – National Planning Practice Guidance

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 in 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	Prev