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Ivory House
St Katharine Docks
East Smithfield
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Noise Impact Assessment Report
Report 24155.NIA.01 Rev. A

Dockside Vaults Limited
32 Woodstock Grove
London
W128LE

Report 24155.NIA.01 Revision History			
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1.0 INTRODUCTION

KP Acoustics Ltd has been commissioned by Dockside Vaults Limited, 32 Woodstock Grove London, W12 8LE, to assess the suitability of the site at Ivory House, St Katharine Docks, East Smithfield, London, E1W 1BP, for conversion to function space use in relation to potential noise breakout or disturbance to existing residences within the same building.

This report presents the results of the noise breakout measurements and environmental survey undertaken in order to measure prevailing background noise levels.

The assessment includes calculations undertaken to demonstrate the likely impact of noise emissions from the proposed function space, and outlines any necessary mitigation measures within a noise management plan.

2.0 SITE SURVEYS

2.1 Site Description

The site is bounded by East Smithfield (A1203), Commercial and residential buildings to the north, and St Katharine Docks to the west, south, and east. At the time of the survey, the background noise climate was dominated by road traffic noise from surrounding roads, noise from neighboring plant units and noise from fly over airplanes. .

2.2 Environmental Noise Survey Procedure

A noise survey was undertaken on the proposed site as shown in Figure 2.1. The location was chosen in order to collect data representative of the worst-case levels expected on the site due to all nearby sources.

Continuous automated monitoring was undertaken for the duration of the survey between 16:06 on 02/03/2022 and 15:56 on 03/03/2022.

Weather conditions were generally dry with light winds and therefore suitable for the measurement of environmental noise. The measurement procedure complied with ISO 1996-2:2017 Acoustics '*Description, measurement and assessment of environmental noise - Part 2: Determination of environmental noise levels*'.

2.3 Measurement Positions

Measurement positions are as described within Table 2.1 and shown within Figure 2.1.

Icon	Descriptor	Location Description
	Noise Measurement Position (Representative of Receiver Above)	The microphone was installed on a window close to the nearest residential receiver to the primary noise egress point. A correction of 3dB has been applied to cater for non-free field conditions.

Table 2.1 Measurement position and description

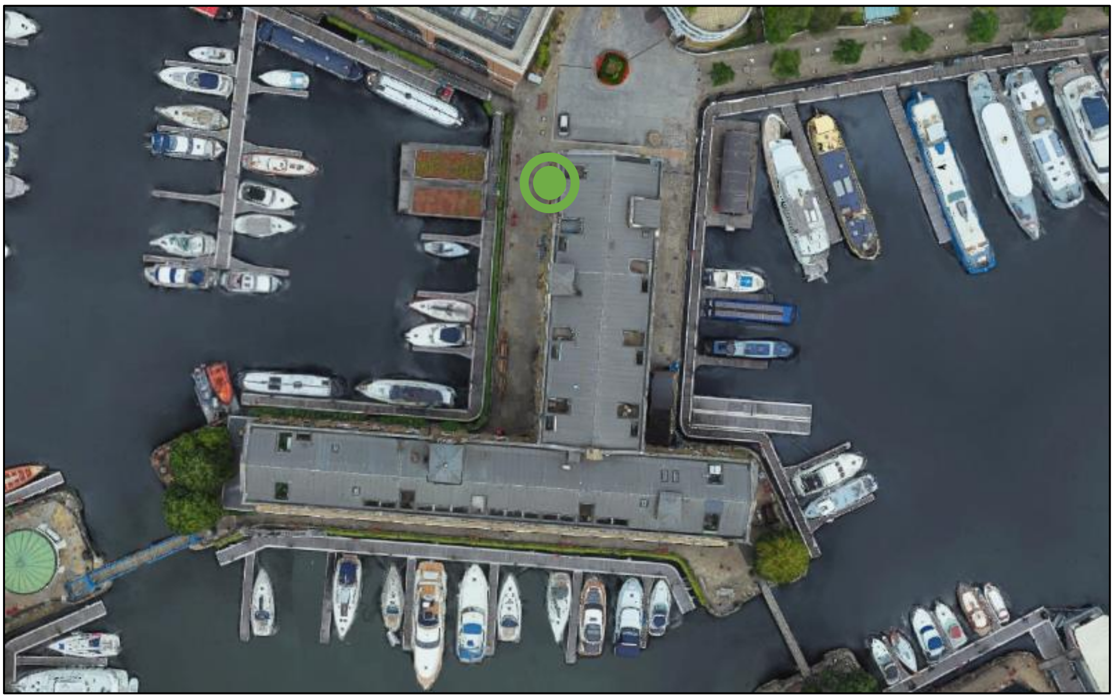

Figure 2.1 Site measurement position (Image Source: Google Maps)

2.4 Equipment

The equipment calibration was verified before and after use and no abnormalities were observed. The equipment used is described within Table 2.2.

Measurement instrumentation		Serial no.	Date	Cert no.
Noise Kit 4	Svantek Type 958A Class 1 Sound Level Meter	34579	25/01/2022	1501654-4
	Free-field microphone PCB 377B02	168689		
	Preamp PCB 426M07	041444		
	Svantek External windshield	-	-	-
Larson Davis CAL200 Class 1 Calibrator		17148	27/04/2021	05223/1

Table 2.2 Measurement instrumentation

3.0 SOUND INSULATION INVESTIGATION

In order to assess direct noise transfer from the proposed basement level function space to the existing residential units above, as well as noise breakout from the building, a sound insulation investigation was undertaken as described below.

3.1 Procedure

High volume pink noise was generated from a loudspeaker within the basement level space, positioned to obtain a diffuse sound field. A spatial average of the resulting one-third octave band noise levels between 100 Hz and 3150 Hz was obtained by using a moving microphone technique over a minimum period of 30 seconds at each of three positions within the basement space, reflective of the noise egress points under investigation.

The same measurement procedure was used in a number of receiver positions, including within Flat 8 (located on 2nd floor directly above the main entrance/exit to the function space), the main entrance/exit to the basement space, as well as the fire escape to the rear.

The results of the tests were rated in accordance with BS EN ISO 717-1: 1997 '*Rating of sound insulation in buildings and of building elements. Part 1 Airborne sound insulation*'.

3.2 Equipment

The instrumentation used during the sound insulation investigation is shown in Table 3.1 below.

Instrument	Manufacturer and Type	Serial Number
SLM4 Precision integrating sound level meter & analyser	NTi Audio, XL2-TA Calibration No: UCRT21/2324, UCRT21/2333 & UCRT21/2328 Calibration Dates: 26th and 27th October 2021 Calibration Due: 25/10/2023	A2A-09207-E0
LS4 Active Loudspeaker	RCF ART 310A	PEQC02196
GEN 4 Pink Noise Source	NTi Audio Minirator MR-PRO	G2P-RAEXP-G0
CAL1 Calibrator 1	Larson Davis CAL200 Calibration No: 05223/1 Calibration Date: 27/04/2021 Calibration Due: 26/04/2022	17148

Table 3.1 Instrumentation used during testing

4.0 IN-SITU MUSIC NOISE LEVEL ASSESSMENT

As a supplement to the noise breakout and direct transfer tests undertaken, an in-situ music noise level assessment has been undertaken in order to define the maximum music noise levels permissible within the basement space in its existing form with no further mitigation measures.

For this test, a looped sample of music, with strong low frequency content and distinct impulsive characteristics was played from the test speaker within the proposed basement space.

Critical listening from the residence on 2nd floor (Flat 8) enabled the music noise level to be reduced to a point where the music was only faintly audible, and subjectively considered unlikely to create adverse impact on residents.

Inherently, this test considers all paths including direct transfer through floors, and flanking transmission via external elements.

The result of this test enables a noise limiter to be set for the basement level space, which in turn provides the highest music noise levels possible within the function space.

Defined noise limiter levels, and their subsequent received noise levels within Flat 8 are shown in Table 5.3.

5.0 RESULTS

5.1 Noise Survey

The $L_{Aeq: 5min}$, $L_{Amax: 5min}$, $L_{A10: 5min}$ and $L_{A90: 5min}$ acoustic parameters were measured throughout the duration of the survey. Measured levels are shown as a time history in Figure 24155.TH1.

Measured noise levels are representative of worst-case noise exposure levels expected to be experienced by existing residences in the area, and are shown in Table 5.1.

It should be noted that the representative background noise level has been derived from the most commonly occurring $L_{A90,5\ min}$ levels measured during the environmental noise survey undertaken on site, as shown in 24155.Daytime.LA90, 24155.Night-time.LA90, 24155.Daytime Opening Hours.LA90 and 24155.Night-time Opening Hours.LA90 attached.

Time Period	Noise Measurement Position (Measured Noise level – dBA)	Representative background noise level L_{A90} dB(A)
Daytime $L_{Aeq,16hour}$	56	50
Night-time $L_{Aeq,8hour}$	51	47
Daytime Opening Hours (10:00-23:00)	56	50
Night-time Opening Hours (23:00-00:30)	52	47

Table 5.1 Site average noise levels for daytime and night time

5.2 Sound Insulation Investigation

The main parameter used throughout this document to express airborne sound insulation of separating constructions is D_w. All specifications in this report will therefore be given with respect to this descriptor. Summarised results of the airborne tests are shown in Table 5.2.

Test Element	Source	Receiver	D_w Performance dB
Main Entrance/Exit	Proposed basement space	1m from façade outside, West Façade Main Doors	D_w 36dB
Separating Floors/Flanking Paths to Residences	Proposed basement space	Flat 8 Living Room	D_w 75dB
Separating Floors/Flanking Paths to Residences	Proposed basement space	Flat 8 Bedroom	D_w 76dB
Separating Floor to ground floor reception	Proposed basement space	Main Reception Space	D_w 39B
Fire Escape to Rear	Proposed basement space	1m from façade outside, East Façade Fire Escape	D_w 42dB

Table 5.2 Airborne test results

It should be noted that the assessment undertaken between main entrance and proposed basement has been undertaken with all windows and entrance door shut.

5.3 Music Noise In-Situ Study

The music limiter levels defined within the testing, and subsequent received noise levels in Flat 8 are shown in Table 5.3.

Noise Limiter	Octave band centre frequency, dB								
	63	125	250	500	1000	2000	4000	8000	**dB(A)**
Received noise level in Flat 8 Living Room	38.9	40.4	29.4	24	23	18.3	16.6	16.5	**29.6**
Received noise level in Flat 8 Bedroom	46.7	42.8	28.6	19.6	13.4	12.8	13.9	15.5	**29.2**
Maximum permissible levels within the proposed space as measured	94.4	94.9	86.8	81.1	81.7	79.8	76.1	71.5	**87.4**

Table 5.3 Maximum permissible noise levels within the proposed venue

6.0 NOISE ASSESSMENT GUIDANCE

6.1 Noise Policy Statement For England 2021

The National Planning Policy Framework (NPPF) has superseded and replaces Planning Policy Guidance Note 24 (PPG24), which previously covered issues relating to noise and planning in England. Paragraph 174 of NPPF 2021 states that planning policies and decisions should aim to:

- 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. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans

In addition, Paragraph 185 of the NPPF 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 the quality of life
- Identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason

The Noise Policy Statement for England (NPSE) was developed by DEFRA and published in March 2010 with the aim to 'Promote good health and good quality of life through the effective management of noise within the context of Government policy on sustainable development.'

Noise Policy Statement England (NPSE) noise policy aims are as follows:

Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development.

- *Avoid significant adverse impacts on health and quality of life;*
- *Mitigate and minimise adverse impacts on health and quality of life; and*
- *Where possible, contribute to the improvement of health and quality of life*

The Noise Policy Statement England (NPSE) outlines observed effect levels relating to the above, as follows:

- NOEL – No Observed Effect Level
  - This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise.
- LOAEL – Lowest Observed Adverse Effect Level
  - This is the level above which adverse effects on health and quality of life can be detected.
- SOAEL – Significant Observed Adverse Effect Level
  - This is the level above which significant adverse effects on health and quality of life occur.

As stated in The Noise Policy Statement England (NPSE), it is not currently possible to have a single objective based measure that defines SOAEL that is applicable to all sources of noise in all situations. Specific noise levels are not stated within the guidance for this reason, and allow flexibility in the policy until further guidance is available.

7.0 NOISE TRANSFER AND BREAKOUT PREDICTIONS

7.1 Noise Breakout to 2nd Floor Windows from Basement Area

Using a typical source level of 87dB(A) to represent a worst case source noise levels within the proposed space with the limiter in place as defined in section 5, and taking into account the measured D_w rating of the main egress point, Table 7.1 shows the predicted sound pressure level at 1m from the residential bedroom windows directly above basement space exit. This has been compared with the measured representative background noise level during the Venue night-time operating hours (23:00-00:30). Detailed calculations are shown in Appendix B1.

Receiver	Representative Background Noise L_{A90}	Noise Level at Receiver (1m from window)
Flat 8 Bedroom Window	47 dB(A)	38 dB(A)

Table 7.1 Predicted noise level at 1m from the closest noise sensitive bedroom window

As shown in Table 7.1, noise breakout from the Main Entrance/Exit façade at Ground Floor level is below the measured representative background noise level. Therefore, the buildings in its current state would be sufficient in controlling noise breakout to the windows above.

Furthermore, the value of 38dB(A) is to be considered outside of the building. Windows may be closed or partially closed leading to further attenuation, as follows.

Further calculations have been undertaken to assess whether noise breakout from the proposed venue would be expected to meet the recognised British Standard recommendations, in order to further ensure the amenity of nearby noise sensitive receivers.

British Standard 8233:2014 'Guidance on sound insulation and noise reduction for buildings – Code of Practice', gives recommendations for acceptable internal noise levels in residential properties. Assuming worst case conditions, of the closest window being for a bedroom, BS8233:2014 recommends 30dB(A) as recommended internal resting/sleeping conditions during night time hours.

With a calculated external level of 38dB(A), the residential window itself would need to provide an additional 8dB attenuation in order for the recommended internal levels to be achieved. According to BS8233:2014, even a partially open window offers 10-15dB attenuation, thus leading to a further reduced interior noise level.

Receiver	Design Range – *For resting/sleeping conditions in a bedroom, in BS8233:2014*	Noise Level at Receiver (due to breakout noise)
Inside Nearest Residential Space facing Main Entrance	30dB(A)	23-28dB(A)

Table 7.2 Noise levels and criteria inside nearest residential space due to breakout noise

Predicted levels are shown in Table 7.2. It can therefore be stated that noise breakout from the Ground Floor Venue would be expected to meet the most stringent recommendations of the relevant British Standard.

8.0 ASSESSMENT FOR PATRON INGRESS/EGRESS/SMOKING AREAS

A significant factor in the proposed use of the space would be the consideration of noise emissions from patrons entering and existing the premises. The most significant issue here is the potential for complaints to arise as a result of anti-social behaviour in the early hours of the morning. Noise emissions from patrons should therefore be assessed in comparison to background noise levels measured during hours representative of premises closing time.

In order to cater for this, and define the maximum number of patrons to be outside at any one time while maintaining compliance with the recommended criteria, calculations have been undertaken as shown in Appendix B2.

In order to provide representative calculations, noise emissions are based on those for typical human speech, as shown in Table 8.1 below.

	Octave Band Sound Pressure Level (dB) at 1m								Overall dB(A)
Typical unamplified speech	48	51	57	60	54	49	44	39	60

Table 8.1 Source Noise Levels

Receiver	Representative Background Noise L_{A90}	Maximum number of patrons conversing
Flat 8 Bedroom Window	47 dB(A)	4

Table 8.2 Predicted noise level at 1m from the closest noise sensitive bedroom window

As shown in Appendix B2, a maximum of 4 No. patrons are able to talk outside the proposed site on the Main Entrance/Exit façade while maintaining compliance with background noise level measured.

However, it is important to give context on the historic use of the Premises for approximately, the last 30 years until November 2020, being used as the Medieval Banquet, a large event space which catered for tourist events and parties. The assessment of patron entering and exiting the premisses should, therefore, be undertaken in the context of that historic use.

Based on the above, a greater number of patrons standing outside the Premises may be permissible, whilst conversing in a respectful manner. However, should shouting or raised voices be experienced, staff interaction should be in place, requesting that attendees avoid unnecessary noise, as mentioned in Section 9.2.

Furthermore, it is understood that for Patrons that are permitted to temporarily leave and then re-enter the premises, a designated area near the Elephant Gates has been recommended, entailing 10 persons (max.) at any one time. Therefore, the likelihood of any issues with patrons standing immediately outside the premisses, would be significantly minimised.

It should be noted that the levels generated would be in the category of 'Noticeable and not intrusive', as stipulated in the National Planning Policy Guidance as shown in Table 8.3 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	Significant Observed Adverse Effect	Avoid

Perception	Examples of Outcomes	Increasing Effect Level	Action
	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.		
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 8.3 Noise exposure hierarchy based on likely average response (NPP Guidance)

Furthermore, in order to further protect the amenity of the local residents due to patrons' noise, The Dispersal Policy document at section 2 and 4 states the following conditions:

"Notices shall be prominently displayed at all exits requesting patrons to respect the needs of local residents and businesses and leave the area quietly."

"Patrons permitted to temporarily leave and then re-enter the premises, e.g. to smoke, shall be limited to 10 persons at any one time. Smokers will be directed to smoke in a designated area near the Elephant Gates."

"In the event a customer wants to book a car home, the customer will be requested to wait inside the Premises until their car has arrived to ensure a quick and quiet exit."

In addition, it is advised that patrons are made aware of the importance to limit conversation and excessive noise while arriving and departing the premises. Should signage not have the desired effect on customer behaviour, staff interaction would be necessary, requesting that attendees avoid unnecessary noise (such as shouting or uses of raised voices).

Given the above noise measures it is expected that the access and egress of patrons, during the opening hours period would not have an impact on the amenity of the local residents.

9.0 NOISE MITIGATION PROPOSALS

Further to the findings outlined in the report, we would recommend the following mitigations measures in order to ensure that noise generated within the proposed venue does not have any negative effect on the amenity of the existing local residents.

9.1 Mitigation Measures for the Basement Venue

Installation of a Sound Limiter

In order to ensure that the source noise levels are controlled within the proposed Basement Venue, we would recommend that a sound limiter is installed by the future Venue occupier. The system designer should be able to advise on the type and standard of sound limiter suitable for the proposed installation.

The limiter should enable the separate control of the different zones and incorporate all elements of the sound system, including any additional filters or amplifiers. Programmable limiters are preferred as these permit more sophisticated control of frequency content and volume and are fully tamper-proof. Programmed limits should match those shown in Table 9.1.

Noise Limiter	Octave band centre frequency SRI, dB							
	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
Maximum permissible levels within the proposed Venue	94	95	87	81	82	80	76	72

Table 9.1 Maximum permissible noise levels within the Venue

On-going attention will need to be given by the Venue to transmitted noise levels to ensure that the final operational conditions do not undermine the settings of the limiter. Different types of music and activities can result in varied subjective effects. It is strongly recommended that the management remain aware as the operation becomes established and reset the limiter, if necessary.

Distributed Sound System

A loudspeaker system employing relatively few speakers requires each unit to generate high noise levels to maintain a given noise level in the space.

A distributed system with numerous speakers allows each speaker to operate at a lower volume. This ensures that localised noise levels are lower, which reduces the noise directly incident on the structure.

The specifications of the speakers will be dependent on the use of each zone or focus area but should allow sufficient capacity for them to operate at optimum efficiency.

Loudspeaker Mounting

Rigid mounting systems are entirely inadequate for the control of transmitted sound from the speakers. To ensure efficient control of noise it is recommended that a proprietary frame support is used for each speaker.

This must incorporate suitable anti-vibration mounting between support and speaker enclosure, with no rigid connections permitted to short-circuit the isolation

The use of neoprene mounts or hangers is recommended. These are expected to provide a static deflection of approximately 3-5mm (i.e. under the load of the speaker). High stiffness neoprene / rubber and metal springs should be avoided in general. The use of neoprene mounts or hangers in fully-enclosed metal casings is not advisable as if these are angled the casings can short circuit. Any mount / hanger must be capable of maintaining a 30 degree offset without any rigid components short-circuiting the mount. It must be noted, however, that vertical alignment is more effective.

Generally available speaker vibration mountings are not typically effective for isolation of this standard. Use of heavy duty, proprietary supports coupled with hangers / mounts will be far more effective.

Should the suspended installation of bass cabinets not be possible, we would recommend the use of a proprietary resilient pad on which the cabinets can rest. We would therefore recommend a product such as Regupol 6010BA which would isolate the speakers from generating any vibro-acoustic excitation of the structure.

9.2 Noise Management Plan for the proposed Venue

In order to minimise the possibility of any complaints due to noise from the proposed Venue operations and patrons entering and exiting the premises, we would highly recommend the adoption of a noise-management plan. The key considerations are shown below, with additional measures presented in the Dispersal Policy document:

- The core operations of the proposed venue should be carried out between the hours of 10:00am to 00:30. Activities which include live and recorded music, should be caried out between the hours of 10:00am to 00:00, and typical background music would be allowed at any time between 10:00am to 00:30. No other activities are allowed outside of the proposed operating hours.
- Deliveries and servicing operations are not allowed between 23:00 and 8:00am
- Please ensure that deliveries and servicing are undertaken by suppliers, transport operators and any other vehicles that follow good practice guidance for quiet deliveries.

Good practice guidance can be found in the TFL code of practice for quiet deliveries: http://content.tfl.gov.uk/codeofpractice.pdf.

- In addition, in order minimise the risk of any noise disturbance caused by the patrons, clear signage should be displayed in the area requesting all who use the space to respect local residents and use the premises in a quiet and respectful manner.
- Should signage not have the desired effect on customer behaviour, staff interaction would be necessary, requesting that attendees avoid unnecessary noise (such as shouting or uses of raised voices).
- All doors and windows facing St Katharine Docks shall be kept closed except for access and egress.

Given the above noise-management plan measures and the additional management controls included in the Dispersal Policy at section 4 and the Deliveries, Collection and Servicing Procedures at section 5, it is expected that the proposed venue operations, deliveries during the opening period would not have an impact on the amenity of the local residents.

10.0 CONCLUSION

An environmental noise survey has been undertaken at Ivory House, St Katharine Docks, East Smithfield, London, E1W 1BP, allowing the assessment of daytime and night-time levels likely to be experienced by the proposed venue.

The calculation and assessment show that noise breakout is non-significant, and there would be no negative impact on the occupiers of the identified closest noise sensitive receiver, as well as other nearby residential receivers.

Furthermore, activity noise of patrons leaving the premises would be non-significant whether it be by foot or vehicle and would fall well below the existing ambient noise profile of the area.

In addition, a noise management plan has been proposed, which if implemented, would be expected to protect the amenity of the closest noise sensitive receivers, as well as other local residents and therefore, comply with Building Management requirements.

No further mitigation measures should be required in order to protect the proposed residential units from external noise intrusion and internal noise intrusion from the Basement Venue.

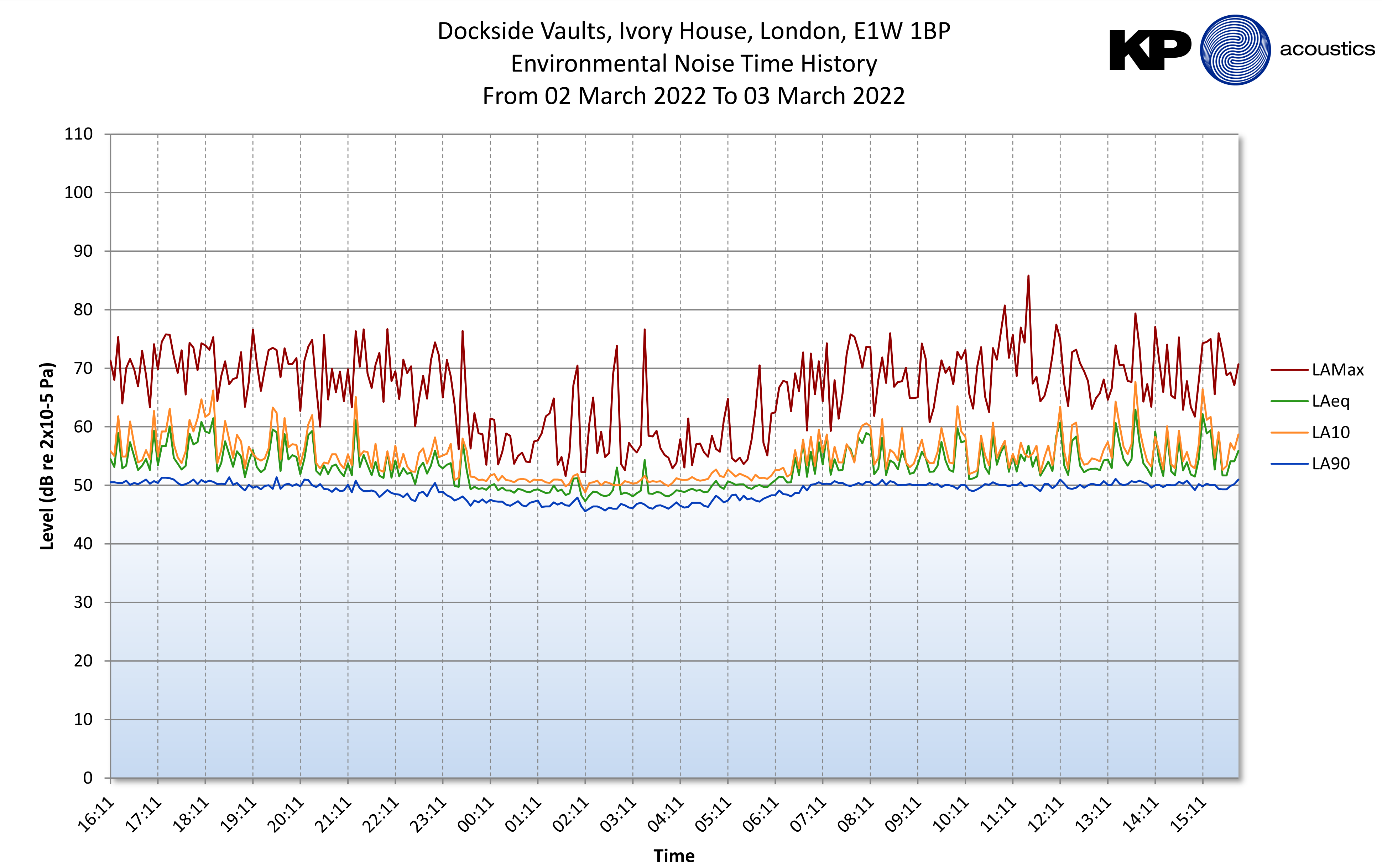

Figure 24155.TH1

Dockside Vaults, Ivory House, London, E1W 1BP
Representative Daytime Background Noise Level
From 02 March 2022 To 03 March 2022

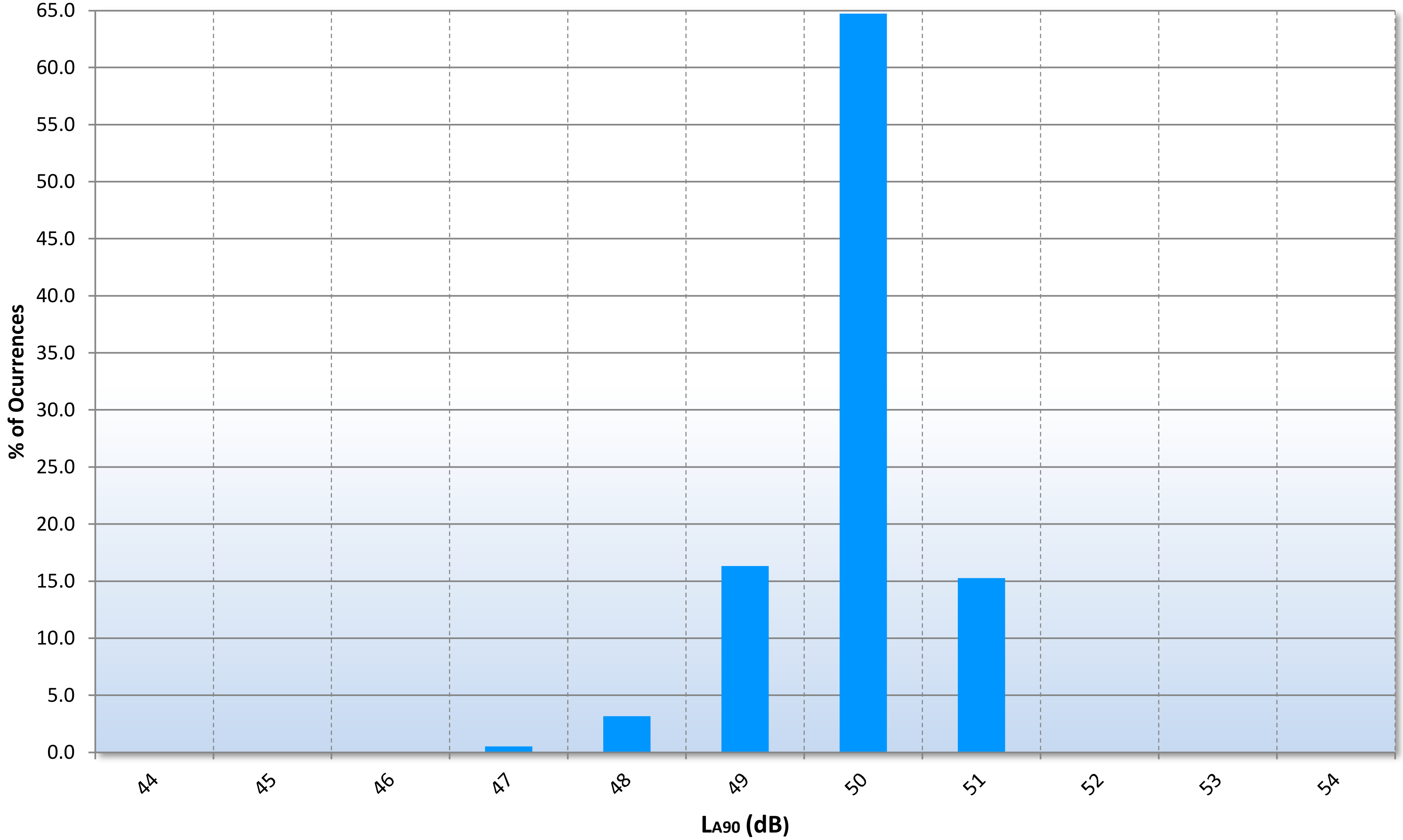

Figure 24155.L90

Dockside Vaults, Ivory House, London, E1W 1BP
Representative Night-time Background Noise Level
From 02 March 2022 To 03 March 2022

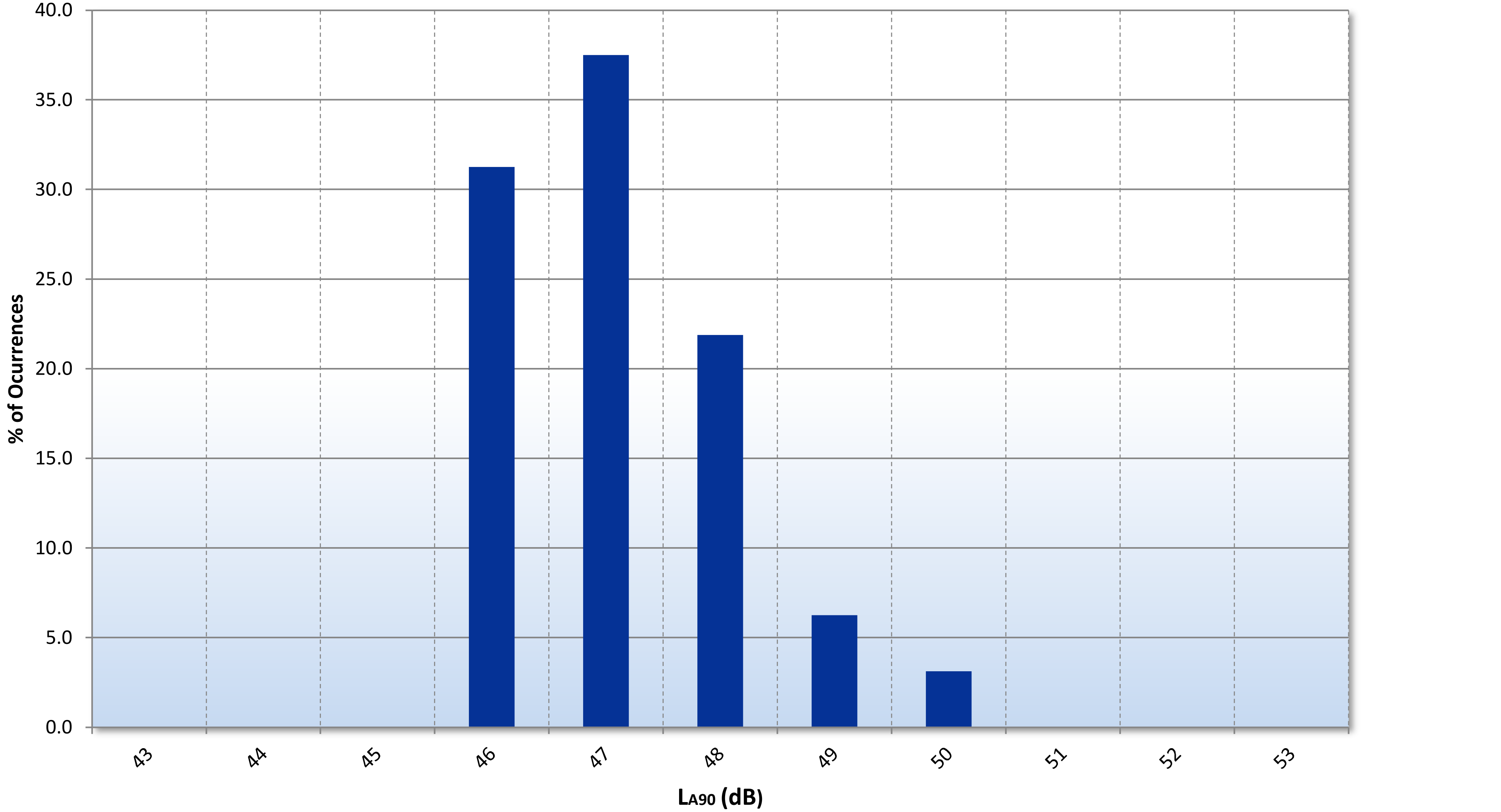

Figure 24155.L90

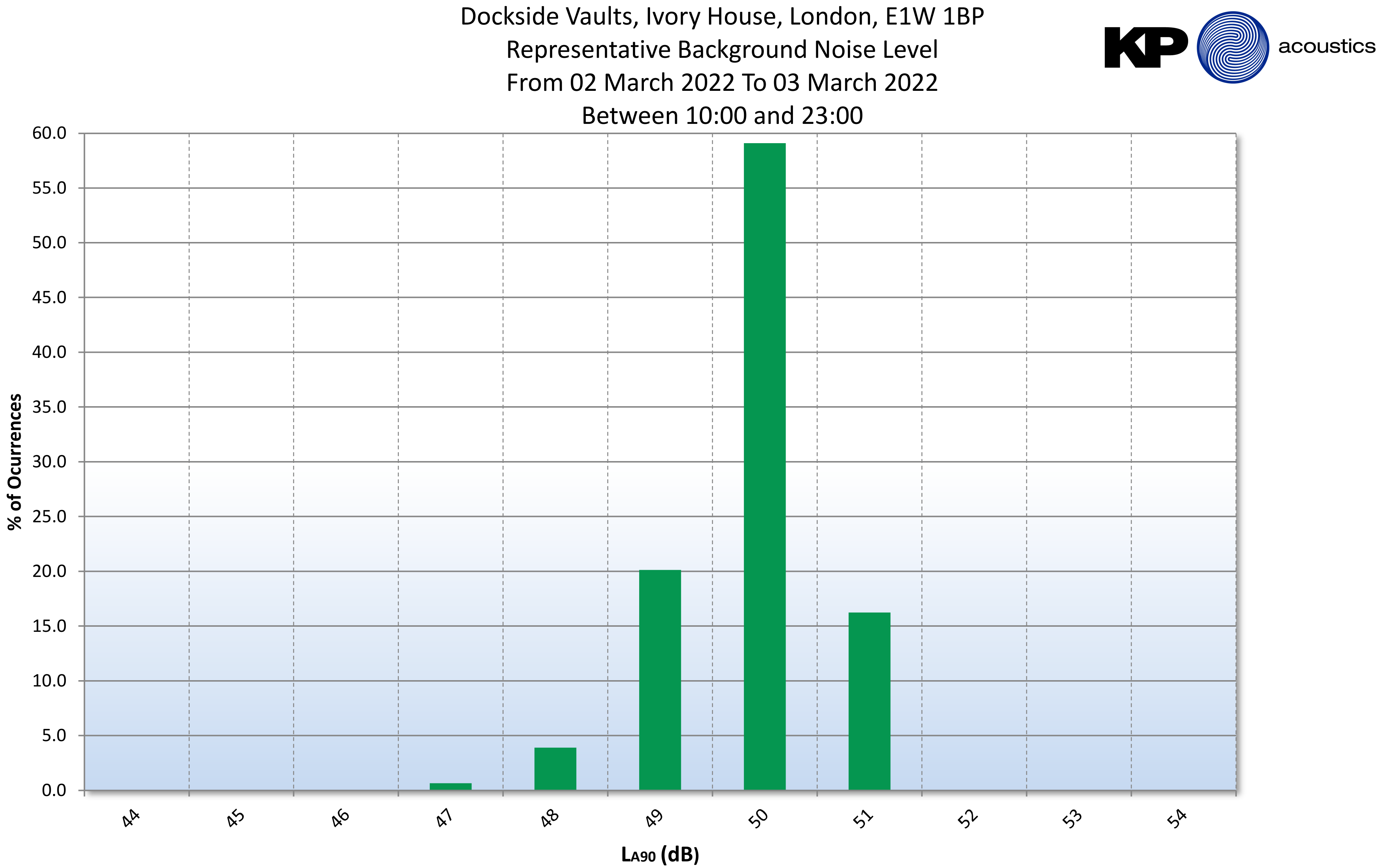

Figure 24155.L90

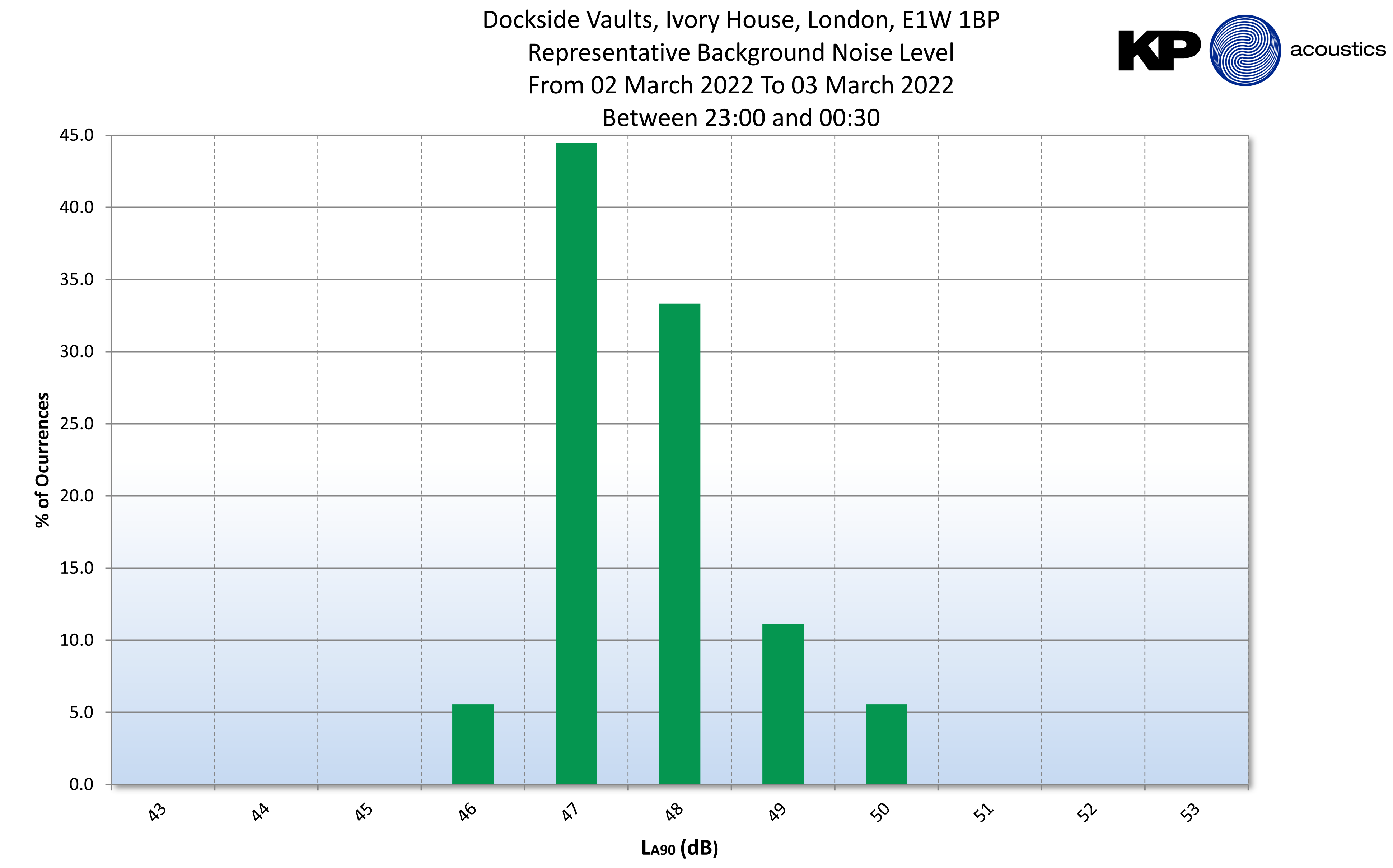

Figure 24155.L90

APPENDIX A

GENERAL ACOUSTIC TERMINOLOGY

Decibel scale - dB

In practice, when sound intensity or sound pressure is measured, a logarithmic scale is used in which the unit is the 'decibel', dB. This is derived from the human auditory system, where the dynamic range of human hearing is so large, in the order of 10^{13} units, that only a logarithmic scale is the sensible solution for displaying such a range.

Decibel scale, 'A' weighted - dB(A)

The human ear is less sensitive at frequency extremes, below 125Hz and above 16Khz. A sound level meter models the ears variable sensitivity to sound at different frequencies. This is achieved by building a filter into the Sound Level Meter with a similar frequency response to that of the ear, an A-weighted filter where the unit is dB(A).

L_{eq}

The sound from noise sources often fluctuates widely during a given period of time. An average value can be measured, the equivalent sound pressure level L_{eq}. The L_{eq} is the equivalent sound level which would deliver the same sound energy as the actual fluctuating sound measured in the same time period.

L_{10}

This is the level exceeded for no more than 10% of the time. This parameter is often used as a "not to exceed" criterion for noise.

L_{90}

This is the level exceeded for no more than 90% of the time. This parameter is often used as a descriptor of "background noise" for environmental impact studies.

L_{max}

This is the maximum sound pressure level that has been measured over a period.

Octave Bands

In order to completely determine the composition of a sound it is necessary to determine the sound level at each frequency individually. Usually, values are stated in octave bands. The audible frequency region is divided into 11 such octave bands whose centre frequencies are defined in accordance with international standards. These centre frequencies are: 16, 31.5, 63, 125, 250, 500, 1000, 2000, 4000, 8000 and 16000 Hertz.

Environmental noise terms are defined in BS7445, *Description and Measurement of Environmental Noise*.

APPENDIX A

APPLIED ACOUSTIC TERMINOLOGY

Addition of noise from several sources

Noise from different sound sources combines to produce a sound level higher than that from any individual source. Two equally intense sound sources operating together produce a sound level which is 3dB higher than a single source and 4 sources produce a 6dB higher sound level.

Attenuation by distance

Sound which propagates from a point source in free air attenuates by 6dB for each doubling of distance from the noise source. Sound energy from line sources (e.g. stream of cars) drops off by 3dB for each doubling of distance.

Subjective impression of noise

Hearing perception is highly individualised. Sensitivity to noise also depends on frequency content, time of occurrence, duration of sound and psychological factors such as emotion and expectations. The following table is a guide to explain increases or decreases in sound levels for many scenarios.

Change in sound level (dB)	Change in perceived loudness
1	Imperceptible
3	Just barely perceptible
6	Clearly noticeable
10	About twice as loud

Transmission path(s)

The transmission path is the path the sound takes from the source to the receiver. Where multiple paths exist in parallel, the reduction in each path should be calculated and summed at the receiving point. Outdoor barriers can block transmission paths, for example traffic noise. The effectiveness of barriers is dependent on factors such as its distance from the noise source and the receiver, its height and construction.

Ground-borne vibration

In addition to airborne noise levels caused by transportation, construction, and industrial sources there is also the generation of ground-borne vibration to consider. This can lead to structure-borne noise, perceptible vibration, or in rare cases, building damage.

Sound insulation - Absorption within porous materials

Upon encountering a porous material, sound energy is absorbed. Porous materials which are intended to absorb sound are known as absorbents, and usually absorb 50 to 90% of the energy and are frequency dependent. Some are designed to absorb low frequencies, some for high frequencies and more exotic designs being able to absorb very wide ranges of frequencies. The energy is converted into both mechanical movement and heat within the material; both the stiffness and mass of panels affect the sound insulation performance.

APPENDIX B

Dockside Vaults, Ivory House, London, E1W 1BP

NOISE BREAKOUT CALCULATIONS

Source: Rooptop (first floor) bar area Receiver: Nearby windows at building B5 on site	Frequency, Hz 63	125	250	500	1k	2k	4k	8k	dB(A)
Maximum permissible levels within the proposed space, dB	**94**	**95**	**87**	**81**	**82**	**80**	**76**	**72**	**87**
Approximate area (S) of the façade overlooking receiver location (m²)	17	17	17	17	17	17	17	17	
Correction for area (S), dB	12	12	12	12	12	12	12	12	
On site composite SRI of façade (Main Entrance/Exit), dB	**-24**	**-27**	**-30**	**-34**	**-36**	**-36**	**-40**	**-43**	
Correction for distance, dB	**-16**	**-16**	**-16**	**-16**	**-16**	**-16**	**-16**	**-16**	
Correction due to no reverberant field externally + propagation effect of the wall surface, dB	**-14**	**-14**	**-14**	**-14**	**-14**	**-14**	**-14**	**-14**	
Sound Pressure Level at 1m from Receiving Façade	**53**	**51**	**39**	**30**	**28**	**26**	**19**	**11**	**38**

Breakout Noise Criterion	47

The main model was designed around the following formula:
SPL2 = SPL1 - SRI + 10log(S) + 20log(r) - 14

where:
SPL2 is the sound pressure level at the receiver's facade
SPL1 is the sound pressure level within the source room
S is the area of the main wall
r is the distance correction
SRI is the sound reduction index of the break-out facade
The 14dB term occurs due to no reverberant sound field in the open (6dB) plus the propagation effect of the wall ($10\log(2/4\pi 1^2)$=8dB)

APPENDIX B2

Dockside Vaults, Ivory House, London, E1W 1BP

External Area Emissions Calculations

Source: External Area Attendees Receiver: Residences on 2nd Floor	*Frequency, Hz* ***63***	***125***	***250***	***500***	***1k***	***2k***	***4k***	***8k***	***dB(A)***
Typical unamplified speech sound pressure level at 1m	48	51	57	60	54	49	44	39	60
Correction for number of attendees (4)	6	6	6	6	6	6	6	6	
Correction for 50% conversational time	-3	-3	-3	-3	-3	-3	-3	-3	
Minimum attenuation provided by distance (6m), dB	-16	-16	-16	-16	-16	-16	-16	-16	
Sound Pressure Level 1m from Noise Sensitive Window	35	38	44	47	41	36	31	26	47
Sound pressure level 1m from front sensitive receiver									**47**

Representative Background Noise Level	**47**