

ENVIRONMENT

Legal & General Assurance (Pensions
Management) Ltd
Unit E3, One Piccadilly Gardens
Manchester

Noise Impact Assessment

ENVIRONMENT

Legal & General Assurance (Pensions Management) Ltd
Unit E3, One Piccadilly Gardens
Manchester
Noise Impact Assessment

Birmingham
Livery Place, 35 Livery Street, Colmore Business District
Birmingham, B3 2PB
T: 0121 233 3322

Leeds
Whitehall Waterfront, 2 Riverside Way
Leeds, LS1 4EH
T: 0113 233 8000

London
11 Borough High Street
London, SE1 9SE
T: 0207 407 3879

Manchester
11 Portland Street
Manchester, M1 3HU
T: 0161 233 4260

Nottingham
5th Floor, Waterfront House, Station Street
Nottingham, NG2 3DQ
T: 0115 924 1100

July 2023

DOCUMENT ISSUE RECORD

Document Number:	OPG-BWB-ZZ-ZZ-RP-YA-01_P01
BWB Reference:	221769

Revision	Date of Issue	Status	Author:	Checked:	Approved:
P01	13/07/2023	For Comment	Jago Edwards BEng(Hons) MIOA	Luke Smith BEng(Hons) MIOA	Mike Barrett BSc(Hons) MIOA

Notice

This document has been prepared for the sole use of the Client in accordance with the terms of the appointment under which it was produced. BWB Consulting Limited accepts no responsibility for any use of or reliance on the contents of this document by any third party. No part of this document shall be copied or reproduced in any form without the prior written permission of BWB.

EXECUTIVE SUMMARY

BWB Consulting (BWB) was instructed by Legal & General Assurance (Pensions Management) Ltd (the Client) to carry out a Noise Impact Assessment for the proposed kitchen extract at Unit E3, One Piccadilly Gardens.

A baseline noise survey was undertaken in June 2023 and the subsequent assessment work has been undertaken in accordance with current standards and guidance, following consultation with Manchester City Council.

Noise limits have been set at nearby receptors to which any fixed plant items should meet, based on the results of the baseline noise survey and the requirements set out in condition 3a of the planning consent for the development.

When assessed in accordance with BS 4142, the proposed kitchen extract system is expected to have a low impact at the closest NSR for weekday and weekend periods and meets the requirements set out in condition 3a. Therefore, no further mitigation will be required.

CONTENTS

EXECUTIVE SUMMARY	iii
1. INTRODUCTION.....	1
Site Location.....	1
Proposed Development	3
2. POLICY, STANDARDS & GUIDANCE.....	4
National Planning Policy Framework (NPPF)	4
Manchester City Council Planning Policy	5
Consultation with MCC.....	6
BS 4142:2014+A1:2019 Methods for Rating and Assessing Industrial and Commercial Sound	7
3. BASELINE NOISE SURVEY	9
Survey Methodology	9
Survey Equipment.....	10
Meteorological Conditions.....	10
Measurement Results	11
4. ASSESSMENT	12
Extract Fan Noise Limits.....	12
Proposed Plant.....	13
5. CONCLUSION	16
Noise.....	19
Acoustic Terminology	20

FIGURES

Figure 1:1: Site Location and Worst Affected NSR

Figure 1:2: Floor Plan

Figure 3:1: Noise Measurement Location

Figure 4:1: Proposed Front Elevation

Figure 4:2: MaXfan Compac Octave Band Sound Power Levels – Outlet Levels (Highlighted)

Figure 4:3: Standard Circular Silencer Insertion Loss Data (Highlighted)

TABLES

Table 3.1 Noise Measurement Equipment

Table 3.2 Daytime Noise Levels

Table 4.1 Noise Limits for Fixed Plant

Table 2.2: Ductborne Noise Attenuation, Weekday

Table 4.3: BS 4142 Assessment of Operational Noise at NSR

APPENDICES

APPENDIX A: Glossary of Acoustic Terms

1. INTRODUCTION

1.1 BWB Consulting (BWB) was instructed by Legal & General Assurance (Pensions Management) Ltd (the Client) to carry out a Noise Impact Assessment to support with discharging a condition for the consented development at Unit E3, at One Piccadilly Gardens, Manchester ('the Site').

1.2 Planning consent was granted in October 2022 for the installation of a new window vent and door onto the front elevation of the building (Application number 133296/FO/2022). There were a number of noise-related Planning Conditions associated with the Decision Notice, including Planning Condition 3 a), which states the following:

'3 a) Externally mounted ancillary plant, equipment and servicing shall be selected and/or acoustically treated in accordance with a scheme designed so as to achieve a rating level of 5dB (LAeq) below the typical background (LA90) level at the nearest noise sensitive location. Prior to commencement of the use hereby approved the scheme shall be submitted to and approved in writing by the City Council as local planning authority in order to secure a reduction in the level of noise emanating from the site. The scheme shall be implemented in full before the use commences or as otherwise agreed in writing by the City Council as local planning authority.'

Reason – To minimise the impact of the development and to prevent a general increase in pre-existing background noise levels around the site pursuant to policies SP1 and DM1 of the Core Strategy for the City of Manchester'.

1.3 The assessment has been undertaken based on a baseline noise survey carried out outside 11 Westminster House, Portland Street, adjacent to the Site. The results of the survey have been assessed in accordance with current standards and guidance, including Manchester City Council (MCC) Noise and Planning guidance.

1.4 Where appropriate, consideration has been given to noise mitigation measures to demonstrate how an appropriate level of protection could be afforded to future and existing Noise Sensitive Receptors (NSRs) within the vicinity of the Site.

1.5 This report is necessarily technical in nature, so to assist the reader, a glossary of acoustic terminology can be found in **Appendix A**.

Site Location

1.6 The Site is located at One Piccadilly Gardens, an existing building in Manchester city centre comprising commercial use at ground floor and office use above at first to fifth floor. The Site is surrounded by existing commercial uses including a number of cafés, restaurants and take away units located at the ground floor of One Piccadilly Gardens. Unit E3 is situated within the southwestern corner of One Piccadilly Gardens and is adjacent to a pedestrianised area to the east and a pedestrian walkway and the Piccadilly Gardens Metrolink Tram Stop to the west. To the south is Portland Street with existing commercial uses beyond.

- 1.7 The Ibis Styles Hotel, located at 3-5 Portland Street has been identified as the worst affected noise sensitive receptor. **Figure 1.1** presents the location of The Application Site and the location of the NSR, denoted as NSR1 in the figure below.

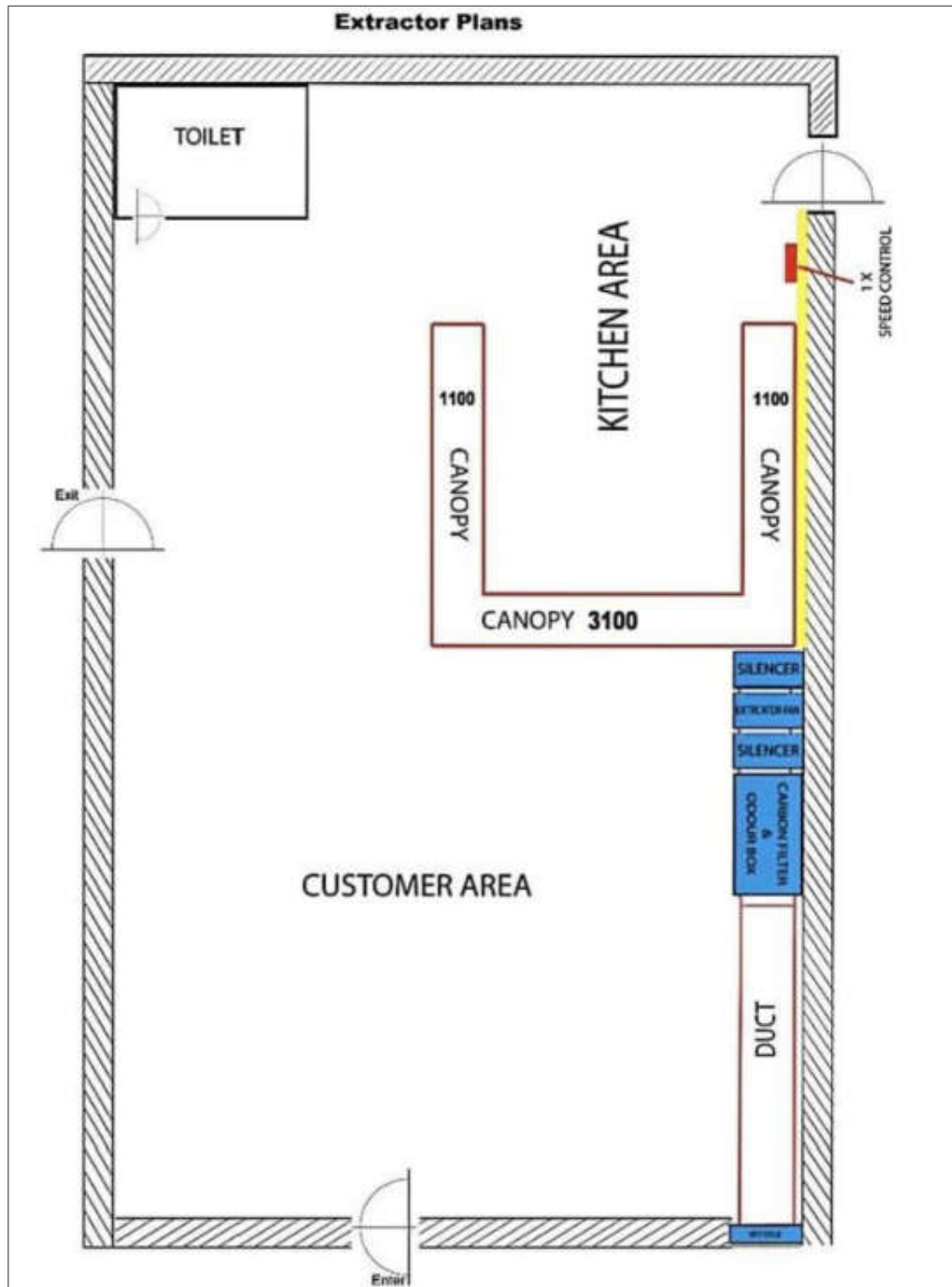
Figure 1.1: Site Location and Worst Affected NSR



Proposed Development

- 1.8 The proposed development relates to the opening of a new Mexican-style restaurant including a commercial kitchen. The development is anticipated to consist of an extract fan which will be installed by the new tenant of Unit E3 which will be located within the retail unit. **Figure 1.2** presents the floor plan of One Piccadilly unit E3.

Figure 1.2: Floor Plan



2. POLICY, STANDARDS & GUIDANCE

- 2.1 The following section presents the planning policy and guidance relevant to The Proposed Development.

National Planning Policy Framework (NPPF)

- 2.2 Published in July 2021, this document sets out the Government's planning policies for England and supersedes the previous NPPF published in 2012. It makes the following reference to noise in the section entitled Conserving and enhancing the natural environment:

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

[...]

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

- 2.3 It also makes the following references to noise in the Section entitled Ground conditions and pollution:

"185. 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 Application Site or the wider area to impacts that could arise from the development. In doing so they should:

a) mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life⁶⁰;

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

⁶⁰ See Explanatory Note to the Noise Policy Statement for England (Department for Environment, Food & Rural Affairs, 2010)."

Manchester City Council Planning Policy

Manchester Core Strategy – Policy DM 1 Development Management

- 2.4 The following guidance for the management of new developments covers noise and other pollutants:

“All development should have regard to the following specific issues for which more detailed guidance may be given within a supplementary planning document:-

[...]

- *Effects on amenity, including privacy, light, **noise**, vibration, air quality, odours, litter, vermin, birds, road safety and traffic generation. This could also include proposals which would be sensitive to existing environmental conditions, such as **noise**”*

- 2.5 The following section presents the supplementary guidance referred to in Policy DM 1.

Planning & Noise Technical Guidance, December 2015

- 2.6 Manchester City Council have developed their own noise guidance on which all planning applications will be assessed against to determine if the proposals are in line with their planning policy.
- 2.7 The guide states that noise from all developments must aim for No Observed Effect Level. Manchester City Council require the following design objective for noise from fixed plant, equipment and machinery:

*“Externally mounted ancillary plant, equipment and servicing shall be selected and/or acoustically treated in accordance with a scheme designed so as to **achieve a rating level of 5dB (LAeq) below the typical background (LA90) level** at the nearest noise sensitive location”.*

Consultation with MCC

- 2.8 At the outset of the project, consultation was undertaken with Gerry Reilly at the Manchester City Council, setting out the proposed methodology as follows:

"Undertake an unattended noise survey from a 1st floor balcony at Westminster House, 11 Portland Street which, like Ibis Styles, is affected by traffic noise on Portland Street. The measurements will be carried out in 15-minute periods over the course of 24hrs on a weekday to capture typical background noise levels over the day and night. If access at the location described above cannot be granted then we will carry out attended monitoring at the quietest times during the proposed times unit E3 will operate in. Background (L_{A90}) and ambient (L_{Aeq}) noise levels will be recorded, as per the methodology in BS 4142:2014 + A1:2019 Methods for rating and assessing industrial and commercial sound."

- 2.9 A response was received from Sue Jones via email, which is reproduced below:

"I have been forward [sic] the methodology for the above from our planning department.

The method for the scheme appears fine and I agree for the verification, as the plant should be operating below background it will be difficult to measure at the NSR and so we would accept taking measurements close to the noise source and then calculating the levels at the NSR."

- 2.10 Due to health and safety concerns regarding the 1st floor balcony at 11 Westminster Street, it was decided to take attended measurements on Portland Street during the quietest times of the weekday and weekend. MCC were contacted to inform them of the change in method however a response was not provided.

BS 4142:2014+A1:2019 Methods for Rating and Assessing Industrial and Commercial Sound

2.11 BS 4142:2014+A1:2019 (BS 4142) describes methods for rating and assessing the following:

- Sound from industrial and manufacturing processes;
- Sound from fixed installations which comprise mechanical and electrical plant and equipment;
- Sound from the loading and unloading of goods and materials at industrial and/or commercial premises; and
- Sound from mobile plant and vehicles that is an intrinsic part of the overall sound emanating from premises or processes, such as that from forklift trucks, or that from train movements on or around an industrial and/or commercial site.

2.12 The methods use outdoor sound levels to assess the likely effects of sound on people who might be inside or outside a dwelling or premises used for residential purposes. The Standard advises that the purpose of the methodology should include the assessment of sound from any plant and activities associated with existing industrial and/or commercial uses at proposed or existing residential dwellings.

2.13 If appropriate, the specific sound level of the source ($L_{Aeq,T}$) is corrected by the application of one or more corrections for acoustic features such as tonal qualities and/or distinct impulses, to give a 'rating' level ($L_{Ar,Tr}$). The method compares and rates the difference between the rating level of the specific sound and the typical background sound level ($L_{A90,T}$), measured in the absence of the specific sound.

2.14 The standard confirms that the background sound level can in some circumstances legitimately include industrial and/or commercial sounds that are present in the area, such as noise from existing plant.

2.15 The Standard advises that the time interval ('T') of the background sound measurement should be sufficient to obtain a representative or typical value of the background sound level at the time(s) the source in question operates or is proposed to operate in the future.

2.16 Comparison of the Rating Level to background noise level indicates the significance of the new noise source at the receptor under assessment. If the Rating Level is higher than the background noise level, then there may be an impact:

- A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.
- A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context.

- The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an 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.

3. BASELINE NOISE SURVEY

Survey Methodology

- 3.1 A baseline noise survey has been carried out to determine the existing background noise levels at Noise Sensitive Receptors (NSRs) in the area. Noise measurements were undertaken at the Measurement Location (ML) shown in **Figure 3.1**.

Figure 3.1: Noise Measurement Location



Measurement Location 1 (ML1)

- 3.2 Due to the risk of antisocial behaviour from members of the public affecting the health and safety of the surveyors, the location of ML1 was selected to be close to the security at Westminster House, 11 Portland Street.

- 3.3 Observations on site at the NSR and at ML1 indicate that the noise climate at ML1 is representative and other noise sources, namely tram pass-bys, have been excluded from the measurement results where possible.
- 3.4 Attended monitoring was carried out at ML1 from 22:00 until 23:00 on Wednesday 7th and Sunday 25th June 2023. The microphone was fixed to a tripod 1.5m above local ground level in free-field conditions.
- 3.5 During attendance it was noted that the noise climate at ML1 was dominated by road & tram traffic, with noise from passing people also prevalent. The background noise climate comprises typical urban noise, i.e., building services plant from neighbouring buildings and vehicles on Portland Street. It was also noted that during the survey period a distant alarm near Piccadilly Gardens carpark was in operation, however, this alarm ceased shortly before the measurement ended.
- 3.6 A second period of attended monitoring was undertaken at ML1 from 22:00 until 23:00 on Sunday 25th June 2023. The microphone was fixed to a tripod 1.8m above local ground level in free-field conditions.
- 3.7 During attendance it was noted that the noise climate at ML1 did not change from the previous measurement.

Survey Equipment

- 3.8 The baseline noise survey was undertaken using the Class 1 specification noise measurement equipment detailed in **Table 3.1**.
- 3.9 Equipment was calibrated using a portable calibrator immediately before and after the measurements with no significant drift in calibration observed. The sound level meter, pre-amplifier and microphone were calibrated to traceable standards at an accredited laboratory within the 24 months prior to the measurements. The portable calibrator was calibrated within the 12 months preceding the date of the survey.

Table 3.1 Noise Measurement Equipment

ML	Equipment	Make & Model	Serial Number
1	Sound Level Meter	SVAN 971	79616
	Microphone	ACO Pacific 7052E	69463
	Pre-amp	SVAN SV18	72283
	Calibrator	SVAN SV33A	73421

Meteorological Conditions

- 3.10 The weather throughout the survey remained conducive to environmental noise measurement, it being dry with negligible winds (<5ms⁻¹).

Measurement Results

- 3.11 The NSR is located at greater distance from the tramline than the adopted measurement location, therefore the data including tram pass-bys has been omitted from the L_{Aeq} results. The short duration in noise level meant that the L_{A90} were not affected by the tram pass-bys. A summary of the measured levels to be used within the assessment are provided in **Table 3.2**.

Table 3.2 Daytime Noise Levels

Period	Date & Time	Lowest Ambient noise level ($L_{Aeq,1hr}$), dB	Lowest background noise level ($L_{A90,1hr}$), dB
Weekday	07/06/2023 22:00-23:00	64	59
Weekend	25/06/2023 22:00-23:00	64	57

4. ASSESSMENT

Extract Fan Noise Limits

- 4.1 The noise generated from the proposed extract fan will need to be limited in line with MCC planning guidance. **Table 4.1** presents the noise limits which must be achieved at the noise sensitive receptor.

Table 4.1 Noise Limits for Fixed Plant

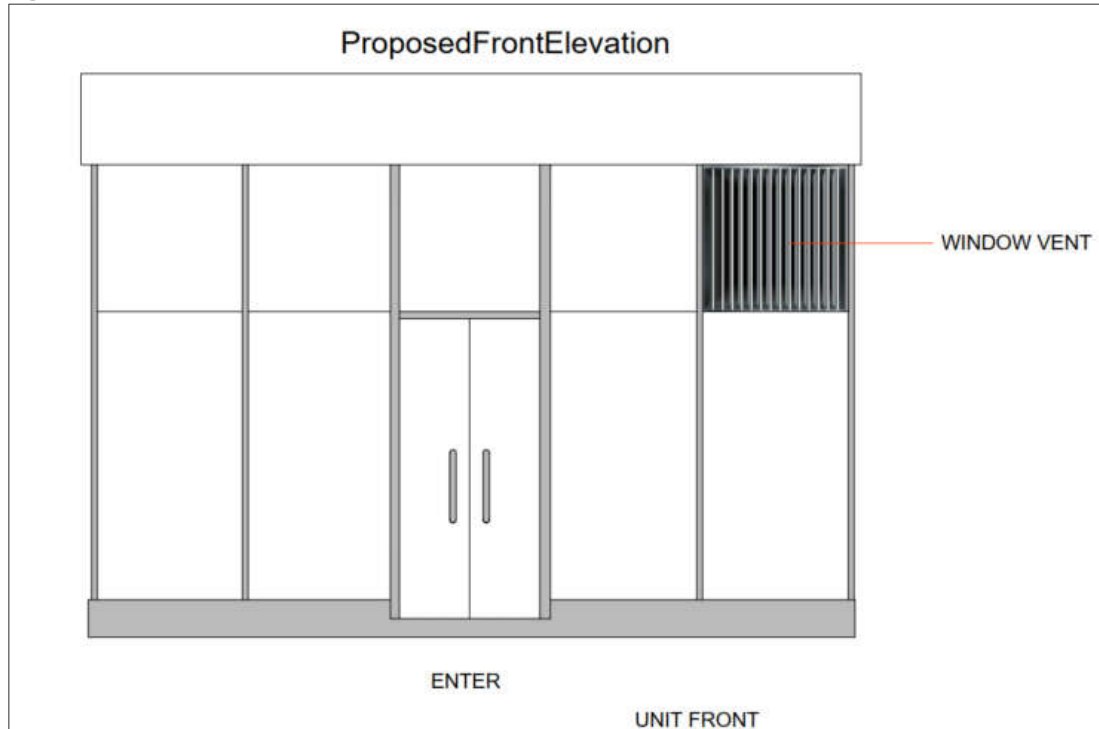
Noise sensitive receptor	Rating Level Limit to be Achieved at NSRs ($L_{A,Tr}$), dB	
	Weekday	Weekend
NSR1	54	52

- 4.2 In accordance with BS 4142, the assessment of plant noise emissions should include appropriate rating corrections for tonal, irregular, or intermittent plant where applicable, before comparison with the above limits.
- 4.3 It should be noted that the derived rating level limits would be applicable to the total noise from the simultaneous operation of all external plant serving the Proposed Development. As such, noise emissions from individual items of plant will need to be lower than the given limit, although the exact limit for each individual item of plant will be dependent upon its type, noise characteristics, location etc.

Proposed Plant

- 4.4 The proposed plant consists of a 500 mm MaXfan Compac extract fan which is internally mounted inside the retail unit, the ducting of which terminates on the Portland Street elevation and with a non-acoustic louvre, shown below in **Figure 4.1**.

Figure 4.1: Proposed Front Elevation



- 4.5 A technical specification has been provided by the Client which specifies the octave band sound power level of the fan at the outlet and is shown in **Figure 4.2**.

Figure 4.2: MaXfan Compac Octave Band Sound Power Levels – Outlet Levels (Highlighted)

	Sound Spectrum (Hz)								Overall	
	63	125	250	500	1k	2k	4k	8k	Lw*	LpA @ 3 m**
Inlet*	87	82	91	93	91	89	84	79	98	75
Outlet*	88	82	93	93	91	89	84	80	98	75
Breakout*	78	64	71	70	66	61	62	56	79	51

* Lw dB re 10⁻¹² W
Sound data at requested duty.

** dBA re 2x10⁻⁵ Pa

- 4.6 The ventilation system comprises a circular silencer, an excerpt of the data sheet is reproduced below in **Figures 4.3**.

Figure 4.3: Standard Circular Silencer Insertion Loss Data (Highlighted)

STANDARD CIRCULAR SILENCER INSERTION LOSS DATA										
@ +20oC and 5m/sec FACE VELOCITY										
SILENCER SIZE	CODE	P.A	OCTAVE BAND CENTRE FREQUENCIES (Hz)							
			63	125	250	500	1K	2K	4K	8K
200-550 dia	CDA.1D	ALL	2	4	6	10	14	10	7	8
		A	4	8	13	17	23	17	12	11
		B	4	8	12	17	23	17	12	10
	CDA.2D	C	4	7	10	15	19	16	12	9
		A	4	6	8	12	21	21	18	15
		B	4	6	8	11	18	19	17	14
	CDAP.1D	C	4	6	8	11	14	16	11	10
		A	7	10	12	24	29	29	27	23
		B	7	10	12	21	26	26	24	22
	CDAP.2D	C	7	10	11	18	21	20	17	15

Noise at Noise Sensitive Receptors from Fixed Plant

- 4.7 Specific noise rating levels due to ductborne noise have been calculated at the closest NSR. The attenuation calculations across each octave band are presented below in **Table 4.2**.

Table 2.2: Ductborne Noise Attenuation, Weekday

Row	Item	Octave band							dBA
		63	125	250	500	1k	2k	4k	
1	Extract fan outlet sound power, dB (L _w)	88	82	93	93	91	89	84	98
2	200-550mm diameter, type CDAP.2D silencer (Option B) insertion loss, dB	4	8	12	17	23	17	12	-
3	Duct losses for 500mm diameter duct (4.1m duct run), dB	0.3	0.3	0.3	0.4	0.7	0.7	0.7	-
4	End reflection loss – 500mm diameter, dB	9	5	2	0	0	0	0	-
5	Louvre insertion losses, dB	3	2	2	2	2	3	3	-
6 [row 1-2-3-4-5]	Sound power at louvre, dB (L _w)	72	67	77	74	65	69	68	76

Row	Item	Octave band							dBA
		63	125	250	500	1k	2k	4k	
7	Distance attenuation over 37m, quarter sphere radiation $[10 \cdot \log(4/(4 \cdot \pi \cdot (r^2)))]$	-36	-36	-36	-36	-36	-36	-36	-
8 [row 6+7]	Specific sound level @ NSR, dB (L_s)	35	31	41	37	29	33	32	40

- 4.8 The specific noise rating levels have then been assessed in accordance with BS 4142 as outlined in **Table 4.3**. The representative noise rating level limits in **Table 4.1** will be used in this assessment in accordance with the MCC Planning & Noise Technical Guidance and BS 4142.

Table 4.3: BS 4142 Assessment of Operational Noise at NSR

Description	Operational Noise (07:00 – 23:00) Noise Levels (dB) Weekday	Operational Noise (07:00 – 23:00) Noise Levels (dB) Weekend	Relevant BS 4142 Clause
Specific sound level, dB ($L_{s,1hr}$)	40	40	7.3.5
Acoustic feature correction ² , dB	0	0	9.2
Rating level, dB ($L_{Ar,1hr}$)	40	40	9.2
Background noise level, dB ($L_{A90,1hr}$)	59 ¹	57 ¹	8
Noise Rating Level Limit, dB ($L_{A,Tl}$)	54	52	-
Excess over Noise Rating Level Limit, dB	-19	-17	11
BS 4142 impact	Low Impact	Low Impact	-
Commentary	¹ Based on $L_{A90,1hr}$ level measured between 2200hrs-2300hrs. ² No penalty applied as specific sound level falls significantly below prevailing background level.		

- 4.9 The assessment above shows that the rating noise level of the proposed plant is likely to be significantly below the background noise level, indicating that it is unlikely amenity at the noise sensitive receptor is unlikely to be impacted and the proposed mitigation is acceptable.

5. CONCLUSION

- 5.1 BWB Consulting (BWB) was instructed by Legal & General Assurance (Pensions Management) Ltd (the Client) to carry out a Noise Impact Assessment for the proposed kitchen extract at Unit E3, One Piccadilly Gardens.
- 5.2 A baseline noise survey was undertaken in June 2023 and the subsequent assessment work has been undertaken in accordance with current standards and guidance, following consultation with MCC.
- 5.3 Noise limits have been set at nearby receptors to which any fixed plant items should meet, based on the results of the baseline noise survey and requirements of BS 4142 and MCC.
- 5.4 The results of the noise assessment demonstrate that the predicted noise level is expected to be 5dBA below background noise level representative of the NSR for weekday and weekend periods. Therefore, the proposed plant meets the requirements of planning condition 3a without further mitigation.

APPENDICES

APPENDIX A: Glossary of Acoustic Terms

Noise

Noise is defined as unwanted sound. Human ears are able to respond to sound in the frequency range 20 Hz (deep bass) to 20,000 Hz (high treble) and over the audible range of 0 dB (the threshold of perception) to 140 dB (the threshold of pain). The ear does not respond equally to different frequencies of the same magnitude but is more responsive to mid-frequencies than to lower or higher frequencies. To quantify noise in a manner that approximates the response of the human ear, a weighting mechanism is used. This reduces the importance of lower and higher frequencies, in a similar manner to the human ear.

Furthermore, the perception of noise may be determined by a number of other factors, which may not necessarily be acoustic. In general, the impact of noise depends upon its level, the margin by which it exceeds the background level, its character and its variation over a given period of time. In some cases, the time of day and other acoustic features such as tonality or impulsiveness may be important, as may the disposition of the affected individual. Any assessment of noise should give due consideration to all of these factors when assessing the significance of a noise source.

The most widely used weighting mechanism that best corresponds to the response of the human ear is the 'A'-weighting scale. This is widely used for environmental noise measurement, and the levels are denoted as dB(A) or L_{Aeq} , L_{A90} etc., according to the parameter being measured.

The decibel scale is logarithmic rather than linear, and hence a 3 dB increase in sound level represents a doubling of the sound energy present. Judgement of sound is subjective, but as a general guide a 10 dB(A) increase can be taken to represent a doubling of loudness, whilst an increase in the order of 3 dB(A) is generally regarded as the minimum difference needed to perceive a change under normal listening conditions.

Acoustic Terminology

Term	Description
dB (decibel)	The scale on which sound pressure level is expressed. Sound pressure level is defined as 20 times the logarithm of the ratio between the root-mean-square pressure of the sound field and a reference pressure (2×10^{-5} Pa).
dB(A)	A-weighted decibel. This is a measure of the overall level of sound across the audible spectrum with a frequency weighting (i.e. 'A' - weighting) to compensate for the varying sensitivity of the human ear to sound at different frequencies.
$L_{Aeq,T}$	L_{Aeq} is defined as the notional steady sound level which, over a stated period of time (T), would contain the same amount of acoustical energy as the A - weighted fluctuating sound measured over that period.
L_{10} and L_{90}	If a non-steady noise is to be described, it is necessary to know both its level and the degree of fluctuation. The L_n indices are used for this purpose, and the term refers to the level exceeded for n% of the time. Hence L_{10} is the level exceeded for 10% of the time, and the L_{90} is the level exceeded for 90% of the time.
Sound Power Level, L_w	logarithm of the ratio of a given sound power to the reference sound power. Such power level in decibels is ten times the logarithm to the base ten of the ratio. unless otherwise specified, the reference sound power is 1 pW. Sound power is the total sound energy radiated by a sound source and measured in watts (W). Sound power level
Free-field Level	A sound field determined at a point away from reflective surfaces other than the ground with no significant contributions due to sound from other reflective surfaces. Generally, as measured outside and away from buildings.
Façade Level	A sound field determined at a distance of 1m in front of a large sound reflecting object such as a building façade.
Insertion Loss	The difference, in decibels, between the sound pressure level before and after a sound-attenuating device.

