Acoustic assessment of proposed new mechanical services equipment

3 Duke Street, Richmond, TW9 1HP

Client: Bricks & Fuel (Duke St) Limited

Report Reference: 240307-R001

Date: 27th March 2024

Revision:	Date:	Author:	Checked:
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CONTENTS

0. SUMMARY

0.1. ACA Acoustics Limited has been commissioned to assess the acoustic impact of proposed new mechanical services equipment associated with flats to be installed at 3 Duke Street, Richmond.

0.2. The assessment is required to provide evidence that noise emissions from the equipment will not be detrimental to the amenity of nearby noise-sensitive properties and complies with the Local Authority's requirements.

0.3. A survey has been carried out in the vicinity to establish existing background sound levels. The background sound levels during the most sensitive time of the proposed operating hours are LA90 39dB at the monitoring position. Based on London Borough of Richmond upon Thames Council's criteria, noise from the new plant should not exceed a rating level of 34dBA outside the closest noise-sensitive windows.

0.4. The most noise-sensitive residential receptors (NSR) have been assessed as the skylight for Flat 3, 3 Duke Street, as well as the balcony door for Flat 4, at 3 Duke Street, and the windows at the rear of 43 George Street, which overlook the rear of 3 Duke Street.

0.5. Calculations using manufacturer's sound level data for the new equipment, allowing for the recommendations as set out in this report, confirm that the rating level from the new equipment at the receptor is at most LAr 33dB at the receptor.

0.6. Noise from the proposed equipment will not be disturbing or detrimental to the amenity of any nearby residential or other noise-sensitive receptors and complies with the planning requirements of London Borough of Richmond upon Thames Council.

1. INTRODUCTION

New mechanical services equipment associated with a new block of flats is to be installed at 3 Duke Street, Richmond.

ACA Acoustics Limited has been commissioned by Firstplan on behalf of the client to carry out an assessment of noise emissions from the proposed mechanical plant and, where necessary, to make recommendations for a mitigation scheme to ensure that the amenity of nearby noise-sensitive properties is not compromised.

This report presents results of the sound level survey, computer modelling, and assessment.

2. ACOUSTIC CRITERIA

London Borough of Richmond upon Thames Council's policies relating to noise are contained within the Council's Supplementary Planning Document *Noise Generated and Noise Sensitive Development*, written in conjunction with the Boroughs of Hillingdon and Hounslow.

Section 6 relates to noise generated from industrial and commercial development and confirms that "*all industrial and commercial development with the potential to generate noise will be assessed and, where relevant, controlled by planning conditions in order to protect residential amenity … the most relevant standard for assessing new industrial and commercial development is BS 4142:2014*". BS 4142:2014 has been superseded by the 2019 revision.

The scope of BS 4142:2014+A1:2019 advises that "*this British Standard describes methods for rating and assessing sound of an industrial and/or commercial nature … to assess the likely effects of sound on people who might be inside or outside a dwelling or premises used for residential purposes upon which sound is incident*". BS 4142:2014+A1:2019 is commonly used to assess the potential for loss of amenity due to noise from mechanical services equipment and is considered appropriate for this application.

The assessment method of BS 4142:2014+A1:2019 corrects the specific sound level from the source under investigation to account for characteristics that could make the sound more obtrusive to obtain a rating level. This rating level is compared against the prevailing background noise outside the noise-sensitive property. Section 11 of BS 4142:2014+A1:2019 provides a commentary of the assessment result and advises that:

a) The greater the difference between the rating level and the background sound level, the greater the magnitude of the impact;
b) A difference of around +10dB or more is likely to be an indication of a significant adverse impact, depending on the context;
c) A difference of around +5dB is likely to be an indication of an adverse impact, depending on the context;

d) The lower the rating level is to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context.

Richmond upon Thames Council have their own judgement of the BS 4142:2014+A1:2019 assessment outcome, as set out in Table 2 of the SPD and shown in Table 1 below.

Noise Impact from Relevant Proposed Industrial or Commercial Premises or Plant	**Development Outcome**
Rating level (LAr, Tr) is at least 5dBA below the Background Level LA90	Normally acceptable
Rating level (LAr, Tr) is no more than 5dBA above the Background Level LA90	Acceptable only if there are overriding economic or social reasons for development to proceed
Rating level (LAr, Tr) is more than 5dBA above the Background Level LA90	Normally unacceptable

Table 1: London Borough of Richmond upon Thames' external noise standards

3. REVIEW OF SITE LOCATION

New mechanical equipment, comprising of three identical Air Source Heat Pumps are being installed 3 Duke Street, Richmond.

The most noise-sensitive residential receptors (NSR) have been assessed as Flat 3 and 4 of 3 Duke Street, and the rear windows of 43 George Street, indicated by the NSR1, 2, and 3 labels below.

A marked-up aerial image is included in Figure 1, identifying the location of the proposed equipment and sound level survey measurement position.

The equipment will have the potential to operate at any time over a full 24-hour period, as required by the load on the system.

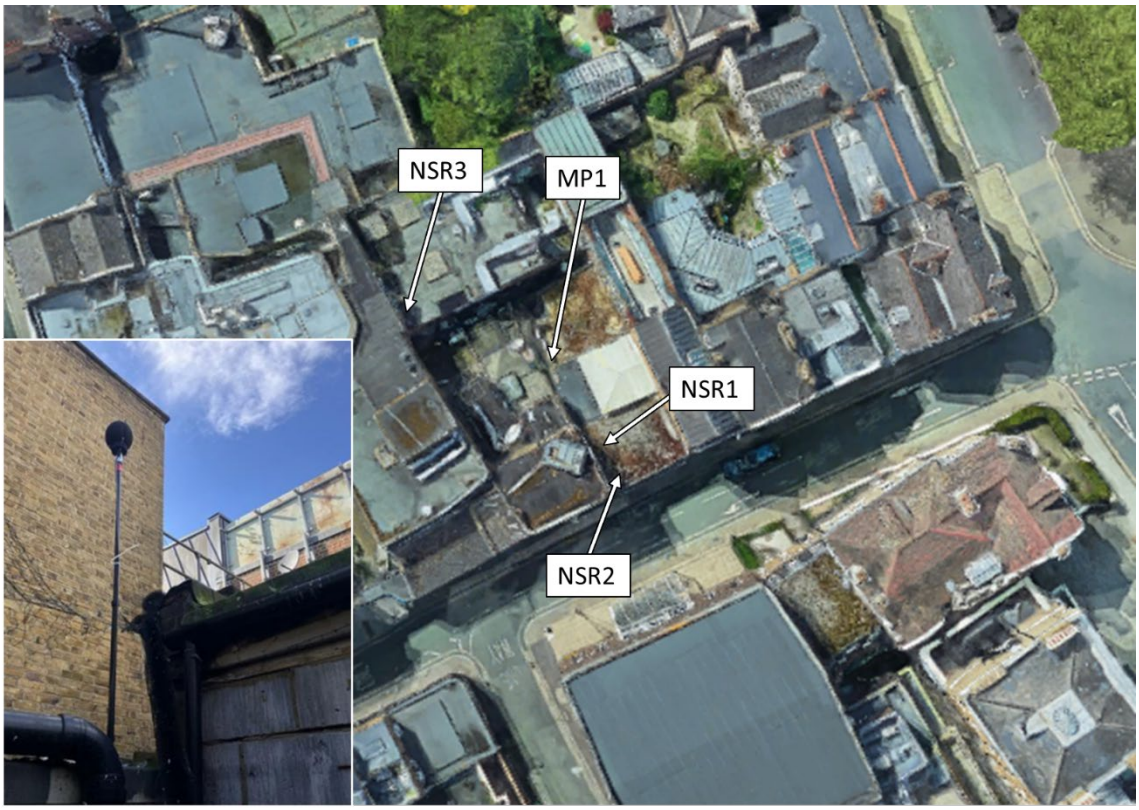


Figure 1: Equipment location, measurement position, and closest receptor (available at google.com/maps)

Receptor	Location
NSR1	Flat 3, 3 Duke Street, Skylight on roof near plant.
NSR2	Flat 4, 3 Duke Street, balcony glass door located on roof near plant.
NSR3	Rear windows of 43 George Street, overlooking existing rear flat roof

Table 2: Receptor Locations

4. SOUND LEVEL SURVEY

To assess sound levels from the new mechanical equipment, it is necessary to establish representative background sound levels in the vicinity during the proposed plant operating times.

The background sound level was measured via an unattended survey at the position indicated in Figure 1. This position was considered as being representative of the NSR1 receptor. The survey was set up by Sam Thorpe of ACA Acoustics and conducted between the 14th and 16th of March 2024.

The meter was set up atop a pole in the center of the rear flat roof.

During the survey, the soundscape in the vicinity was influenced predominantly by third party plant during daytime hours. Although not witnessed, results of the survey indicate that the plant switches off between 22:00 and 23:00 hours, and turns back on between 06:30 and 07:00 hours.

The following equipment was used during the survey. An on-site calibration check was conducted on the sound level meter prior to the survey and repeated after with no deviation noted.

Equipment	**Serial Number**
Rion Class 1 sound level meter type NL-52, complete with weatherproof outdoor environmental kit	564867
Svantek calibrator type SV33B. Compliant to IEC 60942-1:2003	83826

Table 3: Equipment used for the sound level survey

Weather conditions at the time of setting up the survey cool, clear and dry. Weather conditions have been reviewed at www.worldweatheronline.com, using the closest available commercial weather station. Weather conditions remained predominantly calm and dry with wind speeds below recommended limits during the proposed equipment operation times. Meteorological conditions are considered acceptable and will not have adversely impacted the survey results.

Results of the survey are shown in graphical form in Figure 2 below.

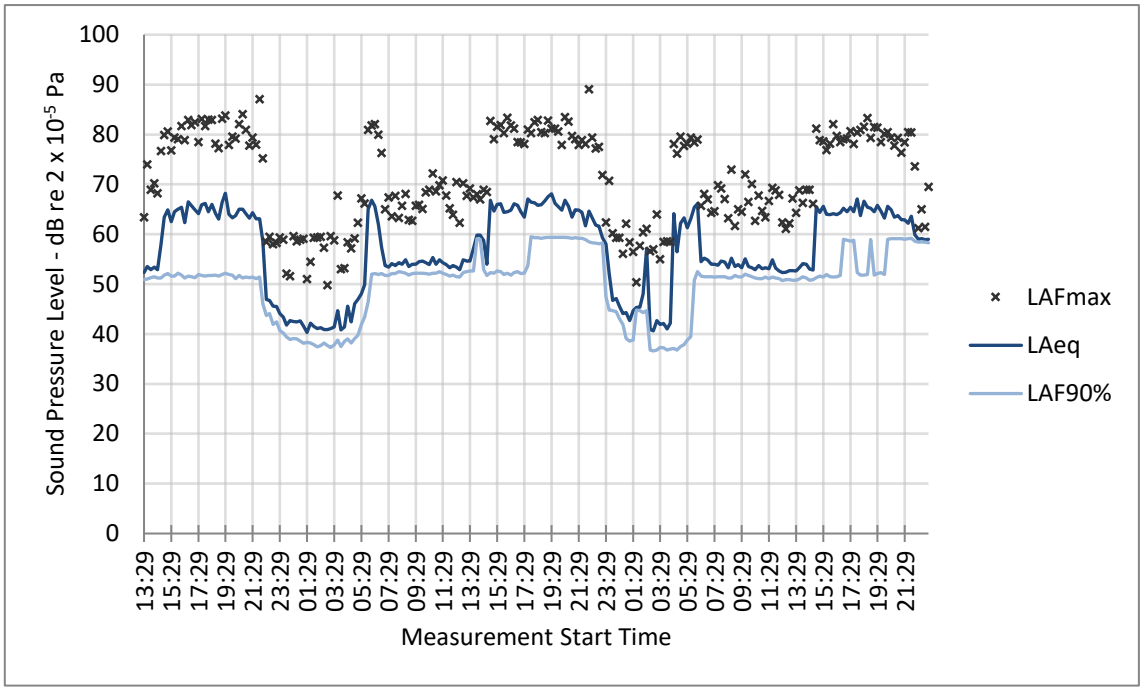


Figure 2: Sound level survey results – 14/03/24-16/03/24

In accordance with the methodology set out in BS 4142:2014+A1:2019, the background sound level is not necessarily the lowest recorded value. Instead, the background sound level should be a level which is representative of the underlying soundscape at the receptor location.

A statistical analysis of the measured LA90 results during the most sensitive operating period overnight is shown in Figure 3 below, following guidance set out in the Standard.

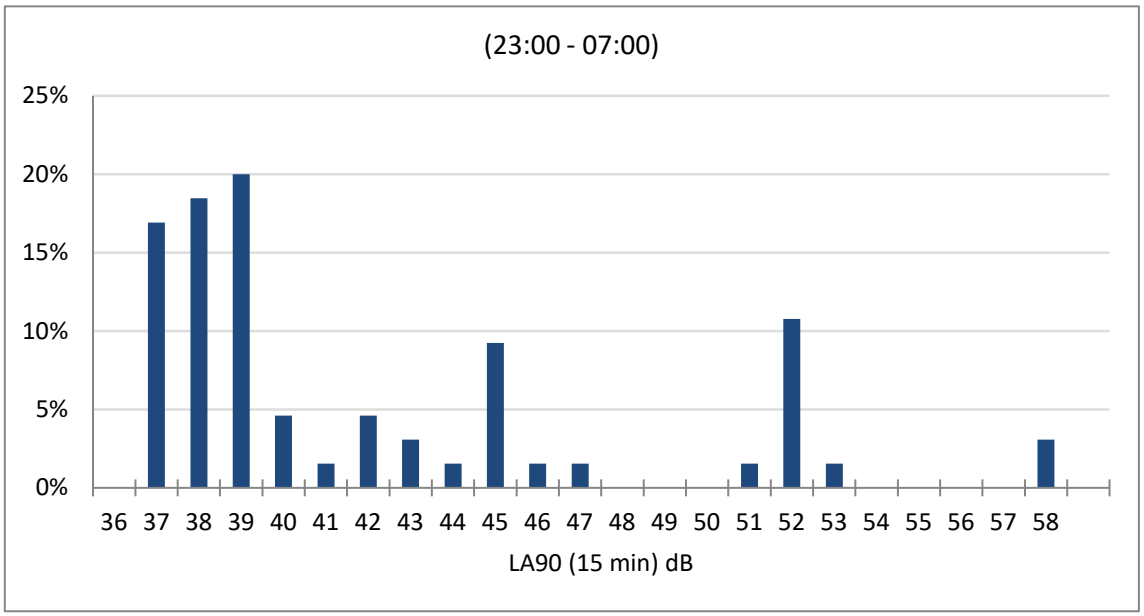


Figure 3: Statistical analysis of measured LA90 sound levels during the assessment period

Based on the statistical analysis of the survey results, the author considers a level of LA90 39dB is representative of the background sound level in the vicinity.

Summary results of the survey are provided in Table 4 below.

Receptor	Proposed Operating Period	Representative Background Sound Level During Operating Period LA90
NSR1-3	24 Hours	39dB

Table 4: Summary sound level survey results

5. ACOUSTIC ASSESSMENT

The development includes the installation of new air source heat pumps. Confirmation of the equipment models used in the assessment is provided in Table 5 below.

Description	Equipment Model	Sound Level (LwA)	Quantity
ASHP 1-3	Daikin RXM20R9	59dB	3

Table 5: Proposed new mechanical equipment used in the assessment

A computer model has been used to calculate the noise contribution from the proposed plant to outside nearest noise-sensitive windows, using manufacturer's published sound data for the proposed new plant. Environmental corrections have been calculated in accordance with ISO 9613-2.

The assessment has been undertaken using drawing references: 'PL-01A', 'PL-02C', 'PL-03C', 'PL-04A', 'PL-05', 'PL-09B', and 'PL-10B' as provided by the client.

Mitigation recommendations outlined in Section 6 of this report are included in the computer model.

The cumulative calculated specific sound level to outside the most sensitive receptors with all equipment operating is shown in Table 6 below. Summary printouts from the calculation models are included in Appendix A.

Receptor Location	Calculated Equipment Sound Level (All plant operating)
NSR1	30dBA
NSR2	28dBA
NSR3	21dBA

Table 6: Calculated cumulative equipment sound levels at 1m outside noise-sensitive windows

Assessment of the calculated rating levels in accordance with BS 4142:2014+A1:2019 is provided in Table 7 below.

Description	NSR1	NSR2	NSR3	Relevant Clause	Commentary
Calculated specific sound level to receptor	LAeq 30dB	LAeq 28dB	LAeq 21dB	7.1 7.3.6	New equipment operating. Refer to calculation sheets in Appendix A.
Background sound level	LA90 39dB	LA90 39dB	LA90 39dB	8.1.3 8.3	Measured representative background sound level.
Acoustic feature correction	+3dB	0dB	0dB	9.2	A 3dB correction has been applied to NSR1. For receptors NSR2 and 3 the specific sound level is at least 10dBA below the background sound level and noise from the equipment will not be readily distinguishable above the existing acoustic environment.
Rating level	LAr 33dB	LAr 28dB	LAr 21dB	9.2	
Excess of rating level over background sound level	-6dB	-11dB	-18dB	11	Assessment indicates a low likelihood of adverse impact.

Table 7: Assessment of results in accordance with BS 4142:2014+A1:2019

Table 7 shows the rating level of the proposed new equipment will be at least 6dB below the background LA90 sound level to outside the closest noise-sensitive properties.

BS 4142:2014+A1:2019 requires an assessment to consider the context of the development, rather than simply adhering to numerical values. Considering the calculated numerical value of the specific sound, allowing a reduction through partially open windows of 15dBA, as recommended in BS 8233:2014, sound levels inside the dwellings due to the proposed new equipment will be approximately 15dBA (30dBA – 15dBA). This is significantly below guideline levels for sleeping in bedrooms of LAeq 30dB / resting in living rooms and bedrooms of LAeq 35dB, set out in BS 8233:2014 and is further confirmation that sound levels from the new mechanical equipment should not be detrimental to the amenity of any noise-sensitive receptors in the vicinity.

Additionally, the proposals involve new items of mechanical equipment being introduced to an area with other commercial and retail uses in the vicinity. In this scenario, the change in acoustic character, and subsequent potential for loss of amenity, is lower than if, say, there were no other similar businesses in the area.

Finally, the two most-affected receptors are within the new development themselves. Therefore, these receptors would not be pre-conditioned to sound levels without the ASHPs operating.

6. ACOUSTIC MITIGATION TREATMENTS

As discussed in Section 5, noise control treatments have been included in the calculation model. Acoustic specification for the mitigation scheme is provided below.

6.1. Vibration Isolators

To control the potential for structure-borne noise and vibration from the mechanical equipment affecting adjoining residential and commercial occupants, it is recommended that the plant is installed on vibration isolators.

Vibration isolators for the air source heat pumps would typically be rubber or neoprene turret type mounts or pads. The isolator supplier should ensure their selection is suitable allowing for the condenser operating speed, point load, and installation location.

6.2. Louvred Enclosure

It is advised that the ASHPs are installed in an acoustic enclosure. A suitable enclosure would typically be formed using 150mm deep acoustic louvres such as Noico's 150mm deep louvres or equivalent. Minimum insertion loss performance for the acoustic enclosure is shown on the schedule in Appendix B.

Structural supports/steelwork and access panels or doors may be required and should be determined by the successful supplier accordingly.

7. CONCLUSION

A planning application is to be submitted for the installation of new mechanical plant and equipment associated with new flats at 3 Duke Street, Richmond.

ACA Acoustics have undertaken an assessment of noise from the proposed equipment using manufacturer's published acoustic data. Calculated rating level for the plant is at least 6dB below the background sound level overnight, when assessed at 1m from the closest noise-sensitive windows of residential receptors.

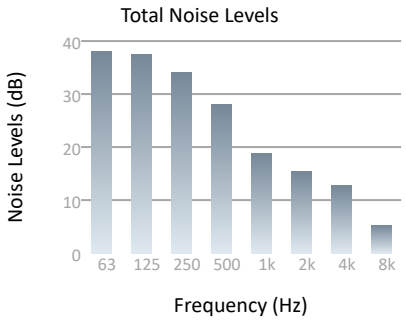
The author considers that allowing for the proposed mitigation scheme in this report, the proposed equipment achieve the Local Authority's planning requirements for this development and will not be detrimental to the amenity of nearby noise-sensitive occupants.

Appendix A

Acoustic Calculations

3 Duke Street

Project Name	3 Duke Street
Project Reference	240307
Reference	NSR1
Description	Flat 3 Roof Skylight
Noise Limit	39
dBA	30



Calculated Lp at Receptor

Reference	Quantity	Noise Levels (dB)							
		63	125	250	500	1k	2k	4k	8k
ASHP1	1	33	30	26	19	9	5	1	-8
ASHP2	1	34	33	30	24	15	12	9	2
ASHP3	1	34	33	30	24	15	12	9	2

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Calculation Sheet

ASHP1 to NSR1

	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Noise Source								
Noise Source - ASHP1								
-	**61.0**	**62.0**	**60.0**	**58.0**	**54.0**	**49.0**	**45.0**	**38.0**
Noise Control Treatments								
Treatment - AL01								
	-2.0	*-3.0*	*-4.0*	*-8.0*	*-13.0*	*-11.0*	*-9.0*	*-8.0*
Dc - Condenser Directivity								
	3.7	*1.3*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
Adiv - Geometrical Divergance								
	-24.8	*-24.8*	*-24.8*	*-24.8*	*-24.8*	*-24.8*	*-24.8*	*-24.8*
Aatm - Atmospheric Absorption								
	0.0	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*-0.2*	*-0.6*
Agr - Ground Attenuation								
	3.0	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*
Abar - Barrier Attenuation								
	-7.9	*-8.1*	*-8.3*	*-8.9*	*-9.7*	*-11.1*	*-12.9*	*-15.2*
External Receiver								
External Receiver - NSR1								
Sound Pressure, Lp:	**32.9**	**30.4**	**25.8**	**19.3**	**9.4**	**5.0**	**1.1**	**-7.6**

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Calculation Sheet

ASHP2 to NSR1

	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Noise Source								
Noise Source - ASHP2								
-	**61.0**	**62.0**	**60.0**	**58.0**	**54.0**	**49.0**	**45.0**	**38.0**
Noise Control Treatments								
Treatment - AL01								
	-2.0	*-3.0*	*-4.0*	*-8.0*	*-13.0*	*-11.0*	*-9.0*	*-8.0*
Dc - Condenser Directivity								
	6.0	*6.0*	*6.0*	*6.0*	*6.0*	*6.0*	*6.0*	*6.0*
Adiv - Geometrical Divergance								
	-26.7	*-26.7*	*-26.7*	*-26.7*	*-26.7*	*-26.7*	*-26.7*	*-26.7*
Aatm - Atmospheric Absorption								
	0.0	*0.0*	*0.0*	*0.0*	*0.0*	*-0.1*	*-0.2*	*-0.7*
Agr - Ground Attenuation								
	3.0	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*
Abar - Barrier Attenuation								
	-7.8	*-7.8*	*-7.8*	*-7.9*	*-8.0*	*-8.3*	*-8.7*	*-9.5*
External Receiver								
External Receiver - NSR1								
Sound Pressure, Lp:	**33.5**	**33.5**	**30.4**	**24.4**	**15.2**	**11.9**	**9.3**	**2.0**

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Calculation Sheet

ASHP3 to NSR1

	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Noise Source								
Noise Source - ASHP3								
-	**61.0**	**62.0**	**60.0**	**58.0**	**54.0**	**49.0**	**45.0**	**38.0**
Noise Control Treatments								
Treatment - AL01								
	-2.0	*-3.0*	*-4.0*	*-8.0*	*-13.0*	*-11.0*	*-9.0*	*-8.0*
Dc - Condenser Directivity								
	6.0	*6.0*	*6.0*	*6.0*	*6.0*	*6.0*	*6.0*	*6.0*
Adiv - Geometrical Divergance								
	-26.7	*-26.7*	*-26.7*	*-26.7*	*-26.7*	*-26.7*	*-26.7*	*-26.7*
Aatm - Atmospheric Absorption								
	0.0	*0.0*	*0.0*	*0.0*	*0.0*	*-0.1*	*-0.2*	*-0.7*
Agr - Ground Attenuation								
	3.0	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*
Abar - Barrier Attenuation								
	-7.8	*-7.8*	*-7.8*	*-7.9*	*-8.0*	*-8.3*	*-8.7*	*-9.5*
External Receiver								
External Receiver - NSR1								
Sound Pressure, Lp:	**33.5**	**33.5**	**30.4**	**24.4**	**15.2**	**11.9**	**9.3**	**2.0**

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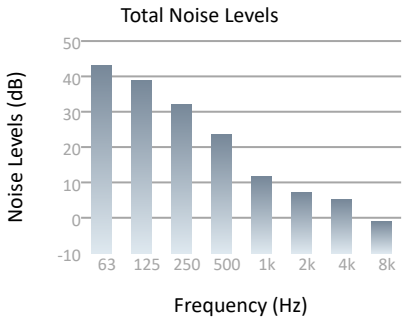
3 Duke Street

Project Name	3 Duke Street
Project Reference	240307
Reference	NSR2
Description	Flat 4 Balcony Window
Noise Limit	39
dBA	28



Calculated Lp at Receptor

Reference	Quantity	Noise Levels (dB)							
		63	125	250	500	1k	2k	4k	8k
ASHP1	1	36	32	26	17	5	0	-3	-9
ASHP2	1	39	35	28	19	7	3	1	-5
ASHP3	1	39	35	28	19	7	3	1	-5

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Calculation Sheet

ASHP1 to NSR2

	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Noise Source								
Noise Source - ASHP1								
-	**61.0**	**62.0**	**60.0**	**58.0**	**54.0**	**49.0**	**45.0**	**38.0**
Noise Control Treatments								
Treatment - AL01								
	-2.0	*-3.0*	*-4.0*	*-8.0*	*-13.0*	*-11.0*	*-9.0*	*-8.0*
Dc - Condenser Directivity								
	3.7	*1.3*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
Adiv - Geometrical Divergance								
	-19.0	*-19.0*	*-19.0*	*-19.0*	*-19.0*	*-19.0*	*-19.0*	*-19.0*
Aatm - Atmospheric Absorption								
	0.0	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*-0.1*	*-0.3*
Agr - Ground Attenuation								
	3.0	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*
Abar - Barrier Attenuation								
	-10.5	*-12.2*	*-14.3*	*-16.8*	*-19.5*	*-22.4*	*-23.0*	*-23.0*
External Receiver								
External Receiver - NSR2								
Sound Pressure, Lp:	**36.2**	**32.2**	**25.7**	**17.2**	**5.5**	**-0.4**	**-3.0**	**-9.3**

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Calculation Sheet

ASHP2 to NSR2

	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Noise Source								
Noise Source - ASHP2								
-	**61.0**	**62.0**	**60.0**	**58.0**	**54.0**	**49.0**	**45.0**	**38.0**
Noise Control Treatments								
Treatment - AL01								
	-2.0	*-3.0*	*-4.0*	*-8.0*	*-13.0*	*-11.0*	*-9.0*	*-8.0*
Dc - Condenser Directivity								
	3.7	*1.3*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
Adiv - Geometrical Divergance								
	-14.5	*-14.5*	*-14.5*	*-14.5*	*-14.5*	*-14.5*	*-14.5*	*-14.5*
Aatm - Atmospheric Absorption								
	0.0	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*-0.2*
Agr - Ground Attenuation								
	3.0	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*
Abar - Barrier Attenuation								
	-11.9	*-14.0*	*-16.5*	*-19.2*	*-22.0*	*-23.0*	*-23.0*	*-23.0*
External Receiver								
External Receiver - NSR2								
Sound Pressure, Lp:	**39.2**	**34.8**	**28.0**	**19.3**	**7.5**	**3.5**	**1.4**	**-4.7**

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Calculation Sheet

ASHP3 to NSR2

	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Noise Source								
Noise Source - ASHP3								
-	**61.0**	**62.0**	**60.0**	**58.0**	**54.0**	**49.0**	**45.0**	**38.0**
Noise Control Treatments								
Treatment - AL01								
	-2.0	*-3.0*	*-4.0*	*-8.0*	*-13.0*	*-11.0*	*-9.0*	*-8.0*
Dc - Condenser Directivity								
	3.7	*1.3*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
Adiv - Geometrical Divergance								
	-14.5	*-14.5*	*-14.5*	*-14.5*	*-14.5*	*-14.5*	*-14.5*	*-14.5*
Aatm - Atmospheric Absorption								
	0.0	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*-0.2*
Agr - Ground Attenuation								
	3.0	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*
Abar - Barrier Attenuation								
	-11.9	*-14.0*	*-16.5*	*-19.2*	*-22.0*	*-23.0*	*-23.0*	*-23.0*
External Receiver								
External Receiver - NSR2								
Sound Pressure, Lp:	**39.2**	**34.8**	**28.0**	**19.3**	**7.5**	**3.5**	**1.4**	**-4.7**

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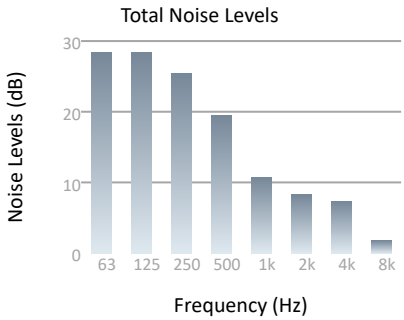
3 Duke Street

Project Name	3 Duke Street
Project Reference	240307
Reference	NSR3
Description	43 George St Rear Windows
Noise Limit	39
dBA	21



Calculated Lp at Receptor

Reference	Quantity	Noise Levels (dB)							
		63	125	250	500	1k	2k	4k	8k
ASHP1	1	24	24	21	15	7	4	4	-2
ASHP2	1	23	23	20	14	6	3	2	-3
ASHP3	1	23	23	20	14	6	3	2	-3

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Calculation Sheet

ASHP1 to NSR3

	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Noise Source								
Noise Source - ASHP1								
-	**61.0**	**62.0**	**60.0**	**58.0**	**54.0**	**49.0**	**45.0**	**38.0**
Noise Control Treatments								
Treatment - AL01								
	-2.0	*-3.0*	*-4.0*	*-8.0*	*-13.0*	*-11.0*	*-9.0*	*-8.0*
Dc - Condenser Directivity								
	6.0	*6.0*	*6.0*	*6.0*	*6.0*	*6.0*	*6.0*	*6.0*
Adiv - Geometrical Divergance								
	-36.1	*-36.1*	*-36.1*	*-36.1*	*-36.1*	*-36.1*	*-36.1*	*-36.1*
Aatm - Atmospheric Absorption								
	0.0	*0.0*	*0.0*	*0.0*	*-0.1*	*-0.2*	*-0.6*	*-2.1*
Agr - Ground Attenuation								
	3.0	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*
Abar - Barrier Attenuation								
	-7.7	*-7.7*	*-7.6*	*-7.5*	*-7.2*	*-6.5*	*-4.5*	*-3.0*
External Receiver								
External Receiver - NSR3								
Sound Pressure, Lp:	**24.1**	**24.2**	**21.2**	**15.4**	**6.7**	**4.3**	**3.7**	**-2.2**

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Calculation Sheet

ASHP2 to NSR3

	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Noise Source								
Noise Source - ASHP2								
-	**61.0**	**62.0**	**60.0**	**58.0**	**54.0**	**49.0**	**45.0**	**38.0**
Noise Control Treatments								
Treatment - AL01								
	-2.0	*-3.0*	*-4.0*	*-8.0*	*-13.0*	*-11.0*	*-9.0*	*-8.0*
Dc - Condenser Directivity								
	6.0	*6.0*	*6.0*	*6.0*	*6.0*	*6.0*	*6.0*	*6.0*
Adiv - Geometrical Divergance								
	-37.0	*-37.0*	*-37.0*	*-37.0*	*-37.0*	*-37.0*	*-37.0*	*-37.0*
Aatm - Atmospheric Absorption								
	0.0	*0.0*	*0.0*	*0.0*	*-0.1*	*-0.2*	*-0.7*	*-2.3*
Agr - Ground Attenuation								
	3.0	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*
Abar - Barrier Attenuation								
	-7.7	*-7.7*	*-7.7*	*-7.5*	*-7.3*	*-6.8*	*-5.4*	*-3.0*
External Receiver								
External Receiver - NSR3								
Sound Pressure, Lp:	**23.2**	**23.2**	**20.3**	**14.4**	**5.6**	**3.0**	**1.9**	**-3.4**

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Calculation Sheet

ASHP3 to NSR3

	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Noise Source								
Noise Source - ASHP3								
-	**61.0**	**62.0**	**60.0**	**58.0**	**54.0**	**49.0**	**45.0**	**38.0**
Noise Control Treatments								
Treatment - AL01								
	-2.0	*-3.0*	*-4.0*	*-8.0*	*-13.0*	*-11.0*	*-9.0*	*-8.0*
Dc - Condenser Directivity								
	6.0	*6.0*	*6.0*	*6.0*	*6.0*	*6.0*	*6.0*	*6.0*
Adiv - Geometrical Divergance								
	-37.0	*-37.0*	*-37.0*	*-37.0*	*-37.0*	*-37.0*	*-37.0*	*-37.0*
Aatm - Atmospheric Absorption								
	0.0	*0.0*	*0.0*	*0.0*	*-0.1*	*-0.2*	*-0.7*	*-2.3*
Agr - Ground Attenuation								
	3.0	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*
Abar - Barrier Attenuation								
	-7.7	*-7.7*	*-7.7*	*-7.5*	*-7.3*	*-6.8*	*-5.4*	*-3.0*
External Receiver								
External Receiver - NSR3								
Sound Pressure, Lp:	**23.2**	**23.2**	**20.3**	**14.4**	**5.6**	**3.0**	**1.9**	**-3.4**

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Appendix B

Noise Control Treatments

Schedule of Noise Control Treatments

Reference	Location	Description	Insertion Losses (dB)							
			63	125	250	500	1k	2k	4k	8k
AL01		Acoustic enclosure formed from 150mm deep acoustic louvres or similar	2	3	4	8	13	11	9	8

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