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THE ONE TUN, BLOOMSBURY

KITCHEN EXTRACT: ACOUSTIC REPORT

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WSP | PARSONS BRINCKERHOFF

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KITCHEN EXTRACT: ACOUSTIC REPORT

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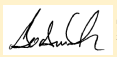
Signature		 neil.bodsworth@wspgroup.com I am approving this document 2015.09.09 11:35:09 +01'00'		
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1 INTRODUCTION

1.1.1 WSP | Parsons Brinckerhoff Acoustics has been commissioned by Young's and Co Brewery PLC to investigate a complaint and abatement notice relating to noise from the kitchen extract system on the rear elevation of The One Tun public house, situated in the London Borough of Camden (LBC).

1.1.2 The LBC have issued The One Tun public house a noise abatement notice relating to noise from the kitchen extract (dated 19 March 2015, reference E&CP/MZM/Requests/184990). In response to the abatement notice Young's and Co. Brewery PLC are applying for planning permission to modify to the kitchen extract system.

1.1.3 An ambient sound survey has been carried out at a position representing the adjacent residential property in order to inform the assessment. Further measurements were carried out to determine the specific sound level of the existing kitchen extract system.

1.1.4 This report presents the results of the survey and an assessment of the noise from the existing extract system. An assessment of noise from the kitchen extract system once the proposed modifications have installed is also presented

1.1.5 Both assessments have been carried out in accordance with the planning requirements of the LBC.

1.1.6 This report is necessarily technical in nature and, to assist the reader, a glossary of acoustics terminology is presented in Appendix A.

2 SITE DESCRIPTION AND PROPOSALS

2.1 LOCATION

2.1.1 The One Tun is located on north side of the A5204 Goodge Street in the Bloomsbury district of the London Borough of Camden.

2.1.2 The surrounding area contains a mixture of residential and commercial properties, with commercial uses mainly at ground floor level facing onto Goodge Street.

2.1.3 The pub has a small external area to the rear (north) of the building at first floor level. This area is overlooked by residential properties on Goodge Place, Goodge Street and Cleveland Street.

2.2 NOISE-SENSITIVE RECEPTORS

2.2.1 The nearest noise-sensitive receptors to the pub are the residential uses on the upper floors of the buildings immediately adjacent on Goodge Place, Goodge Street and Cleveland Street. These properties have windows overlooking the location of the kitchen and plant area.

2.2.2 The nearest residential property on Goodge Place is 26 Goodge Place, to the north west of the pub, which has windows overlooking the rear façade of the pub.

2.2.3 The location of The One Tun and the surrounding residential properties are shown in Figure 2.1.

Figure 2.1: Location of The One Tun and the nearest noise-sensitive receptor

2.3 THE KITCHEN EXTRACT SYSTEM

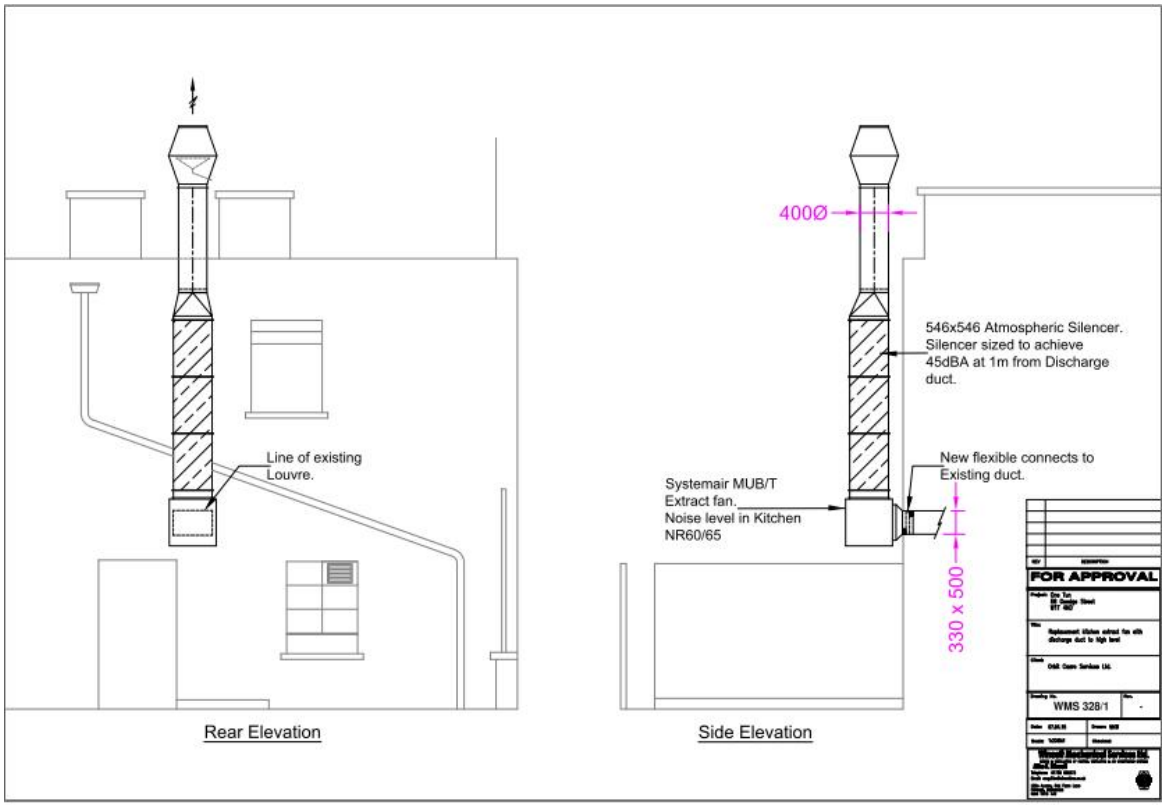
2.3.1 The One Tun kitchen is located on the first floor of the building on the rear elevation. Currently, the kitchen extract fan is located internally and terminates at a louvre on the rear elevation.

2.3.2 Modifications to the kitchen extract system are proposed in response to the noise abatement notice. The proposed improvements consist of the following:

- Installation of a new kitchen extract fan and associated ductwork on the rear elevation of the pub.
- The proposed ductwork will carry extract air to a terminal above roof level.
- The proposals include a silencer to attenuate duct-borne fan noise.

2.3.3 A drawing showing the proposed changes to the kitchen extract system is shown in Figure 2.2.

Figure 2.2: Proposed changes to the kitchen extract system



3 DESIGN REQUIREMENTS

3.1 ENVIRONMENTAL PROTECTION ACT 1990

3.1.1 The abatement notice issued by LBC requires the premises to 'abate' the noise amounting to a statutory nuisance. There are no numerical parameters associated with the notice against which to assess the level of abatement required so guidance is sought from alternative British Standards and Local Policy documents.

3.2 BRITISH STANDARD 4142: 2014

3.2.1 British Standard (BS) 4142:2014 '*Methods for rating and assessing industrial and commercial sound*' describes methods for assessing sound of an industrial and/or commercial nature, including sound from:

- industrial and manufacturing processes;
- fixed installations (such as mechanical and electrical plant);
- loading and unloading of goods and materials; and
- mobile plant or vehicles operating on or around an industrial and/or commercial site (where it is an intrinsic part of the overall sound emanating from the site).

3.2.2 It provides a method of determining rating levels for sources of industrial or commercial sound for the purposes of investigating complaints, assessing sound from new, modified, or additional sources of sound, and assessing sound at new residential premises.

3.2.3 The assessor is required to carry out an initial appraisal to gain an understanding of the situation (context) to be rated and assessed. This includes:

- Identifying and understanding all the sounds that can be heard, and identifying their source;
- Identifying the most appropriate measurement methods, instruments and metrics;
- Identifying potential measurement locations;
- Identifying the necessary measurement frequencies, durations and timings; and
- Understanding what kind of sound a new industrial source would introduce, where a new development is to be assessed.

3.2.4 Once this appraisal has been carried out the assessment procedure is as stated below.

3.2.5 For each period of interest (1 hour during the day and 15 minutes during the night):

- Determine the specific sound level at the assessment location(s) during time intervals that are representative of the period of interest. For a source that is not yet operating the specific sound level is determined by calculation.
- Measure the background sound level at the assessment location(s) (or location at which the residual sound is comparable to the assessment location) during time intervals that are sufficient to obtain a representative value of the background sound level for the period of interest, and under representative weather conditions. This is to include observations and description of the sources of sound which comprise the acoustic environment in order to understand the context in which the specific sound source is being assessed.

- Determine the rating level at the assessment location(s) depending on the acoustic characteristics of the specific sound. This involves applying corrections for distinguishing characteristics that will attract attention (tonality, impulsivity, intermittency and/or any other distinctive features).
- Report the level and potential effects of uncertainty in measurement data and associated calculations.
- Estimate the impact of the specific sound by subtracting the measured background sound level from the rating level considering that:
  - Typically, the greater the difference, the greater the magnitude of the impact, and the lower the rating level is relative to the background sound level, the less likely it is that the specific sound source will have an adverse impact.
  - A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on context.
  - A difference of around +5 dB is likely to be an indication of an adverse impact, depending on context.
  - 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.

3.2.6 The Standard contains detailed guidance on measurement procedure and includes a requirement to monitor weather conditions during the survey. The Standard also states that more than one assessment may be necessary, for example, to account for varying weather conditions.

3.3 LOCAL POLICY

3.3.1 London Borough of Camden Development Policy (DP) 28 contains the local planning policy on noise and vibration and includes the following relevant statement:

The Council will seek to ensure that noise and vibration is controlled and managed and will not grant planning permission for:

a) development likely to generate noise pollution; or

b) development sensitive to noise in locations with noise pollution, unless appropriate attenuation measures are provided.

Development that exceeds Camden's Noise and Vibration Thresholds will not be permitted.

The Council will only grant permission for plant or machinery if it can be operated without cause harm to amenity and does not exceed our noise thresholds.

In assessing planning applications the Council will have regard to the Noise and Vibration Thresholds set out in DP28. The thresholds for noise from plant and machinery are reproduced in Table 3-1.

Table 3-1: DP28 thresholds for noise from plant and machinery

NOISE DESCRIPTION AND LOCATION OF MEASUREMENT	PERIOD	TIME	NOISE LEVEL
Noise at 1 metre external to a sensitive façade	Day, evening & night	00:00-24:00	5 dB(A) less than L_{A90}
Noise that has a distinguishable discrete continuous note (whine, hiss, screech, hum) at 1 metre external to a sensitive façade.	Day, evening & night	00:00-24:00	10 dB(A) less than L_{A90}
Noise that has distinct impulses (bangs, clicks, clatters, thumps) at 1 metre external to a sensitive façade.	Day, evening & night	00:00-24:00	10 dB(A) less than L_{A90}
Noise at 1 metre external to sensitive façade where L_{A90} > 60 dB	Day, evening & night	00:00-24:00	55 dB L_{Aeq}

4 INITIAL APPRAISAL

4.1 INTRODUCTION

4.1.1 BS 4142:2014 requires that the assessor carries out an initial appraisal to gain an understanding of the situation (context) to be rated and assessed. This section summarises the initial appraisal carried out before the survey and assessment were carried out.

4.1.2 The appraisal was carried out by Daniel Doherty MIOA (Member of the Institute of Acoustics), who has over eight years of experience in acoustics, noise and vibration, which has included the assessment of noise and vibration from the operation of similar developments to that proposed.

4.2 DESK STUDY

4.2.1 A desk study of the site location was carried out in order to inform the survey methodology. This was divided into the aspects discussed further below.

DETERMINING ASSESSMENT LOCATIONS

4.2.2 Various maps and drawings were reviewed to identify assessment locations. The key assessment was determined to be the rear facade of the nearest residential property (26 Goodge Place). It is understood from the management of the pub that the complaints have arisen from this address.

BACKGROUND SOUND DETERMINATION

4.2.3 A methodology of measuring the typical background sound levels at the assessment locations was developed based on the ability to switch off the specific plant in the external area. The background sound level in the absence of noise from the specific plant could then be determined.

SPECIFIC SOUND DETERMINATION

4.2.4 The source of industrial sound to be assessed was identified as the kitchen extract fan (via the louvre). The sound level of this source was to be determined via measurement.

HOURS OF USE

4.2.5 It is understood through consultation with The One Tun management team that the kitchen extract system operates when the kitchen is in use, generally between 10:00 hours and the late evening.

4.2.6 For this reason it was necessary to plan the survey to obtain measurements of background sound during the most sensitive times when the kitchen extract system operates. This was judged to be in the late evening, after the kitchen extract system has been switched off.

CONTEXT AND SENSITIVITY OF THE ASSESSMENT LOCATIONS

4.2.7 It was noted from the desk study that the area contains a mix of commercial and residential properties developments adjacent to the assessment locations. It was therefore considered likely that, in the absence of the specific sound source under investigation, some sound of a commercial nature would be experienced at the assessment location.

5 NOISE SURVEY

5.1 METHODOLOGY

5.1.1 An environmental noise survey was undertaken on 7 May 2015.

5.1.2 The noise monitoring was carried out in the flat roof at first floor level to the rear of The One Tun.

5.1.3 Measurements were taken as follows:

- Measurements of the specific sound level of the kitchen extract system (via the louvre). Measurements were taken at 1 metre from the louvre, and 1 metre from the rear façade of 26 Goodge Place, in the vicinity of the second floor window.
- Measurements of the background sound level where taken 1 metre from the rear façade of 26 Goodge Place, in the vicinity of the second floor window.

5.1.4 Background noise levels were measured after the kitchen extract system ceased operation for the day.

5.1.5 Photographs showing the position of the kitchen extract system and the nearest noise-sensitive receptor are presented in Figure 5.1 and Figure 5.2.

Figure 5.1: Photograph showing the location of The One Tun kitchen extract louvre

Figure 5.2: Photograph showing the microphone position at the nearest noise-sensitive receptor

5.2 EQUIPMENT

5.2.1 The equipment used for the noise monitoring is shown in Table 5.1.

5.2.2 The sound level meters used meets the 'Class 1' specification of IEC 61672-1:2002 standard '*Electroacoustics – Sound level meters – Part 1: Specifications*'.

5.2.3 The equipment was calibrated in situ using an acoustic calibrator before and after use. No significant drift in calibration was observed (0.1 dB).

Table 5-1: List of Noise Survey Equipment

EQUIPMENT DESCRIPTION	MANUFACTURER AND MODEL TYPE	SERIAL NUMBER	CALIBRATION DUE DATE
Sound Level Meter	01dB-Stell Solo Master	11810	6 July 2016
Pre-amplifier	01dB-Stell PRE 21 S	12495	
Microphone	Microtech Gefell GmbH MCE212	67311	
Calibrator	01dB-Stell Cal 21	34323996	4 July 2015
Sound Level Meter	01dB-METRAVIB Solo Master	65811	23 October 2015
Pre-amplifier	01dB-Stell PRE 21 S	16485	
Microphone	Microtech Gefell GmbH MCE212	166394	
Calibrator	01dB-Metravib Cal 21	34634224	9 January 2016

5.3 RESULTS

5.3.1 A summary of observed noise levels is shown in Table 5.2 and Table 5.3 below.

5.3.2 The plant noise measurement results are shown in Table 5.2. These measurements were taken with each item operating in isolation and the contribution of background noise during these measurements was insignificant.

5.3.3 Measurements at the nearest noise-sensitive receptor are present in Table 5.3. All of these measurements were taken at the position shown in Figure 5.2.

5.3.4 The observed sources of noise are described in the following section.

Table 5-2: Summary of plant noise measurement results

MEASUREMENT POSITION	NUMBER OF MEASUREMENTS	EQUIVALENT CONTINUOUS SOUND LEVEL [dB $L_{Aeq,T}$]	VARIATION
1.0m from kitchen extract louvre, in front of louvre	2	71	0.3

Table 5-3: Summary of noise measurement results at the noise-sensitive receptor

DESCRIPTION	START TIME	DURATION [T]	EQUIVALENT CONTINUOUS SOUND LEVEL [dB $L_{Aeq,T}$]	BACKGROUND SOUND LEVEL [dB $L_{A90,T}$]
Kitchen extract and condenser operating	20:14	00:05	61	61
Kitchen extract and condenser operating	21:11	00:05	61	61
Condenser only operating	21:25	00:05	59	58
Background measurement	21:36	00:15	57	56

5.4 OBSERVATIONS

5.4.1 On arrival in the external area to the rear of The One Tun the following observations were made:

- Noise from The One Tun plant included that from the kitchen extract system (via the louvre) and that from an adjacent condensing unit in the external area.
- Noise from the kitchen extract system was continuous and steady.
- Noise from the adjacent condensing unit was intermittent, as the unit turned on and off as dictated by the cellar thermostat. The condensing unit was switched off during the specific sound level measurements of the kitchen extract system.
- Noise from activity in the kitchen could be heard, however, the effect of this source on the specific sound level was not significant.

5.4.2 Activity in the kitchen was stopped for the evening and the kitchen extract system was switched off at 21:30. Measurements of the background sound level were then taken. The following observations were made at first floor level:

- The dominant source of noise was the ducted ventilation system on the ground floor roof of 62 Goodge Street. Noise from this source was continuous and steady.
- Other intermittent and low level sources of noise were aircraft (including a helicopter), and voices and activity noise from the upper floors of The One Tun building.

5.4.3 The dominant source of background sound at the second floor level was the ventilation system on the ground floor roof of 62 Goodge Street. The operating hours of ventilation system at 62 Goodge Street are not known, however since the ventilation system serves a commercial restaurant (and kitchen) that is open later than the One Tun, it is considered likely that it would operate beyond 23:00 hours.

5.4.4 The noise levels measured between 21:36 and 21:51 are therefore considered to be representative of the background levels that would prevail until 23:00 hours and therefore adequately represent the background sound level during the operating hours of the proposed plant (which would not extend beyond 23:00 hours).

5.5 EXTERNAL PLANT NOISE LIMITS

5.5.1 It can be seen from the measurement results that the background sound level at the nearest noise-sensitive receptor is 56 dB $L_{A90,15min}$ between 21:36 and 21:51. This level is considered representative of the background sound level that would be experienced at the nearest noise-sensitive receptor during the evening, while the kitchen plant is not operating.

5.5.2 In order to satisfy the noise requirements from LBC, the proposed plant noise levels should be designed to ensure that they do not exceed the following cumulative limit, applicable at 1 metre external to the nearest noise-sensitive windows:

- Noise containing a distinguishable discrete continuous note or distinct impulses: 46 dB $L_{Aeq,15min}$.
- Noise without these features: 51 dB $L_{Aeq,15min}$.

5.5.3 It is noted that the main source contributing to the background sound level during the evening was the ventilation system at 62 Goodge Street. Background sound levels are anticipated to be lower in the absence of this noise.

6 ASSESSMENT

6.1 CURRENT SOUND LEVELS AND ASSESSMENT

6.1.1 The measurement results presented in Table 5.3 demonstrate that the equivalent continuous sound level at the assessment location while the kitchen extract system and the adjacent condensing unit are operating is 61 dB $L_{Aeq,5min}$.

6.1.2 The specific sound level from the kitchen extract system has been determined by removing the influence of the residual sound level (the level of ambient sound remaining at the assessment location in the absence of the specific sound source), following para 7.3.3 of BS 4142:2014. The residual sound level includes that from both the adjacent condensing unit and the ventilation system at 62 Goodge Street.

6.1.3 The specific sound level from each item are estimated to be as follows:

- → Kitchen extract and condensing unit: 59 dB $L_{Aeq,5min}$.
- → Kitchen extract alone: 58 dB $L_{Aeq,5min}$.

6.1.4 An analysis of measured third-octave band frequency spectra has been carried out, following Annex C of BS 4142:2014. Using this method no tones have been detected. However, based on subjective observations on site a 2 dB tonality correction shall be applied to the specific sound level, to account for '*a tone which is just perceptible at the noise-sensitive receptor*'.

6.1.5 The assessment of noise from kitchen extract system in the current situation is shown in Table 6.1.

Table 6-1: Summary of assessment of noise from kitchen plant in the current situation

REFERENCE	KITCHEN EXTRACT LOUVRE
Specific sound level	58 dB L_{Aeq}
Acoustic feature correction	+2 dB
Rating level	60 dB L_{Ar}
Background sound level (21:30 hours, while neighbouring ventilation system is active)	56 dB $L_{A90,15min}$
Excess of rating over background sound level	(60 – 56) = +4 dB
Assessment result	Indication of an adverse impact (although not significant), depending on context
Excess of local authority criterion (L_{A90} – 5 dB)	(60 – 51) = +9 dB

6.2 FUTURE SOUND LEVEL AND ASSESSMENT

6.2.1 Calculations of the future sound pressure level from the kitchen extract system have been carried out based on the information received from the fan and silencer manufacturer.

6.2.2 Detailed calculation tables for both ductborne fan noise and noise break-out from the extract fan are shown in Appendix B.

6.2.3 The predicted sound pressure level at the nearest noise-sensitive receptor is shown in Table 6.2.

Table 6-2: Cumulative sound pressure level from the kitchen extract system

	SOUND LEVEL PER OCTAVE FREQUENCY BAND (dB rel. 20μPA)								dB(A)
	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	
Sound pressure level from duct-borne fan noise	51	43	40	36	32	28	23	18	38
Sound pressure level of break-out noise	45	41	15	-2	-9	1	11	14	26
Cumulative sound pressure level at receptor façade	**52**	**45**	**40**	**36**	**32**	**28**	**23**	**20**	**39**

6.2.4 The assessment of noise from kitchen plant in the future situation is shown in Table 6.3.

Table 6-3: Summary of assessment of noise from kitchen plant in the future situation

REFERENCE	KITCHEN EXTRACT SYSTEM WITH PROPOSED CHANGES
Specific sound level	39 dB L_{Aeq}
Acoustic feature correction	+2 dB
Rating level	41 dB L_{Ar}
Background sound level (21:30 hours, while neighbouring ventilation system is active)	56 dB $L_{A90,15min}$
Excess of rating over background sound level	(41 – 56) = -15 dB
Assessment result	Indication that the specific source will have a low impact, depending on context
Excess of local authority criterion (L_{A90} – 5 dB)	(41 – 51) = -10 dB

6.3 DISCUSSION

6.3.1 The assessment of noise from the kitchen extract louvre in the current situation indicates that this noise is likely to result in an adverse impact, although this impact is not considered to be significant. However, noise from the kitchen extract louvre currently exceeds the requirements of the Local Authority by 9 dB.

6.3.2 The predictions of noise from the kitchen plant with the proposed modifications demonstrate that the proposed changes will vastly reduce noise from the extract system. The assessment in future situation concludes that noise from the kitchen plant will have a low impact.

6.3.3 With the proposed changes in place, noise from the extract system will meet the requirements of the Local Authority.

7 CONCLUSION

7.1.1 WSP | Parsons Brinckerhoff Acoustics was commissioned by Young's and Co Brewery to investigate a complaint and abatement notice relating to noise from the kitchen extract system at The One Tun public house, Bloomsbury. The One Tun public house have been served an abatement notice and are therefore applying for planning permission to modify the kitchen extract system.

7.1.2 WSP | Parsons Brinckerhoff Acoustics carried out an ambient sound survey at a position representing the adjacent residential property in order to inform the assessment. Further measurements were carried out to determine the specific sound level of the existing system. This report has presented the results of these measurements.

7.1.3 It was noted that the main source contributing to the background sound at the adjacent noise sensitive receptor was the ventilation system at 62 Goodge Street. It is anticipated that this system, as it serves a commercial restaurant, would operate over similar hours to The One Tun kitchen extract system.

7.1.4 An assessment of noise from the kitchen extract system has been carried out for both the existing situation and the future situation, incorporating the proposed modifications to the extract system.

7.1.5 The assessment of noise from the existing kitchen extract louvre concludes that this noise could result in an adverse impact although this impact is unlikely to be significant. Additionally, noise from the existing kitchen extract louvre exceeds the Local Authority criterion.

7.1.6 The predictions of noise from the kitchen extract system with the proposed modifications indicate that the sound pressure level at the adjacent noise-sensitive receptor will be greatly reduced. The assessment in future situation concludes that noise from the kitchen plant will have a low impact.

7.1.7 With the proposed changes in place, noise from the kitchen plant will meet the requirements of the Local Authority.

APPENDIX A

ACOUSTIC TERMINOLOGY

APPENDIX A: ACOUSTIC TERMINOLOGY

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. Perception 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.
An indication of the range of sound levels commonly found in the environment is given in the following table.

Table A.1: Typical sound levels found in the environment

SOUND LEVEL	DESCRIPTION
0 dB(A)	Threshold of hearing
20 to 30 dB(A)	Quiet bedroom at night
30 to 40 dB(A)	Living room during the day
40 to 50 dB(A)	Typical office
50 to 60 dB(A)	Inside a car
60 to 70 dB(A)	Typical high street
70 to 90 dB(A)	Inside factory
100 to 110 dB(A)	Burglar alarm at 1m away
110 to 130 dB(A)	Jet aircraft on take off
140 dB(A)	Threshold of pain

SOUND LEVEL	DESCRIPTION
Sound Pressure	Sound, or sound pressure, is a fluctuation in air pressure over the static ambient pressure.
Sound Pressure Level (Sound Level)	The sound level is the sound pressure relative to a standard reference pressure of 20 µPa (20 microPascals) on a decibel scale.
Decibel (dB)	A scale for comparing the ratios of two quantities, including sound pressure and sound power. The difference in level between two sounds s_1 and s_2 is given by 20 log10 (s_1 / s_2). The decibel can also be used to measure absolute quantities by specifying a reference value that fixes one point on the scale. For sound pressure, the reference value is 20 µPa.
A-weighting, dB(A)	The unit of sound level, weighted according to the A-scale, which takes into account the increased sensitivity of the human ear at some frequencies.
Noise Level Indices	Noise levels usually fluctuate over time, so it is often necessary to consider an average or statistical noise level. This can be done in several ways, so a number of different noise indices have been defined, according to how the averaging or statistics are carried out.
$L_{Aeq,T}$	A noise level index called the equivalent continuous noise level over the time period T. This is the level of a notional steady sound that would contain the same amount of sound energy as the actual, possibly fluctuating, sound that was recorded.
$L_{Amax,T}$	A noise level index defined as the maximum A-weighted sound pressure level during the period T. L_{Amax} is sometimes used for the assessment of occasional loud noises, which may have little effect on the overall L_{Aeq} noise level but will still affect the noise environment. Unless described otherwise, it is measured using the 'fast' sound level meter response.
Background sound level, $L_{A90,T}$	A noise level index. The L_{A90} is the A-weighted sound pressure level that is exceeded by the residual sound for 90% of the time over the period T. The L_{90} is often used to describe the background sound level.
$L_{A10,T}$	A noise level index. The L_{A10} is the A-weighted sound pressure level exceeded for 10% of the time over the period T. L_{10} can be considered to be the "average maximum" noise level. Generally used to describe road traffic noise.
Free-field	Far from the presence of sound reflecting objects (except the ground), usually taken to mean at least 3.5 m.
Façade	At a distance of 1 m in front of a large sound reflecting object such as a building façade.
Fast/Slow Time Weighting	Averaging times used in sound level meters.
Octave Band	A range of frequencies whose upper limit is twice the frequency of the lower limit.
Ambient sound	The totally encompassing sound in a given situation, at a given time, usually composed of sound from many sources, both near and far.
Specific sound source	The sound source being assessed.
Specific sound level	The equivalent continuous A-weighted sound pressure level produced by the specific sound source at the assessment location over a given reference time interval, T.
Residual sound	The ambient sound remaining at the assessment location when the specific sound source is suppressed to such a degree that it does not contribute to the ambient sound.
Specific sound level	The equivalent continuous A-weighted sound pressure level of the residual sound at the assessment location over a given reference time interval, T.

APPENDIX B

CALCULATION TABLES

APPENDIX B: CALCULATION TABLES

OVERVIEW

The following appendix contains calculation tables for the propagation of noise from the kitchen extract system to the adjacent residential receptor. The calculation is split into the two contributing sources: duct-borne noise from the roof terminal and noise break-out from the extract fan encased in the duct-work.

SOURCE DATA

Manufacturer data has been provided for the proposed kitchen extract fan and the proposed silencer. The relevant sound power levels and insertion losses are shown in Table B.1 and Table B.2.

Table B.1: Manufacturer sound power levels for the proposed extract fan

	SOUND POWER LEVEL (dBZ rel. 20μPA)							
	63 Hz	**125 Hz**	**250 Hz**	**500 Hz**	**1 kHz**	**2 kHz**	**4 kHz**	**8 kHz**
Sound power level of fan at outlet	87	79	76	70	68	64	59	54
Break-out sound power level	70	62	59	55	51	47	42	37

Table B.2: Manufacturer insertion losses for the proposed silencer

	INSERTION LOSS PER OCTAVE FREQUENCY BAND (dBZ rel. 20μPA)							
	63 Hz	**125 Hz**	**250 Hz**	**500 Hz**	**1 kHz**	**2 kHz**	**4 kHz**	**8 kHz**
Attenuator insertion loss	11	12	37	50	55	37	19	11

Data sheets for the proposed extract fan and attenuator are presented on the following pages.

Appendix Figure 1: Extract fan specification and sound power levels

Appendix Figure 2: Attenuator specification and insertion loss

Attenuator Quotation

Calibre Acoustics Limited, Ground Floor, Building 1000, Lakeside North Harbour, Western Road, Portsmouth, Hampshire, PO6 3EZ
Tel: 023-9270-4099 Email: info@calibreacoustics.co.uk Fax:023-9270-4001

Quote No: CA42609/GS/01

Project: The One Tun, Goodge Street

Date: 07/03/2015

Ref.	Description	Construction Code	Dimensions (mm) Width	Height	Length	Static Insertion Loss (dB) 63	125	250	500	1k	2k	4k	8k	Vol (m^3/s)	PL (Pa)	Wt (Kg)	No. Off	Sell Each	Sell Total
ATT01	KITCHEN EXHAUST	LA/P3V/WMX	546	546	2400	11	22	37	50	55	37	19	11	0.93	45	85	1	£ 422.00	£ 422.00
	CARRIAGE																1	£ 65.00	£ 65.00
																		Total sell price	£ 487.00

Codes

Code Section	Code	Description
Model	LA	Rectangular attenuator with lining elements
End Connection	P	30mm profile flanges are compatible with Doby, Mez & Metu
Pressure Rating	3	High pressure (+2000/-750Pa)
Element Type	V	Elements installed in the vertical plane
Packing	W	Lightweight pallet wrapping on casing ends
Optional Features	M	Infill protected by standard melinex polyester film suitable for kitchen extract
	X	Rectangular attenuator to be supplied in 2 sections, 1200mm long

Additional Information

Delivery Period: 2-3 weeks from receipt of order and / or approval of drawings
Delivery Price: Included on a 45' artic curtain sider lorry in normal working hours
Payment Terms: Net 30 days from invoice date, subject to account approval
Acceptance: This quotation is valid for 14 days from date of issue
VAT: The above prices are exclusive of VAT
Terms & Conditions: Subject to Calibre Acoustics Ltd standard terms and conditions of sale

Calibre Acoustics Ltd use insertion loss data that has been based on tests undertaken in an independent UKAS accredited ISO 7235:2009 test rig. The claimed attenuator unit pressure loss values are based on these tests. This Standard provides pressure loss values based upon aerodynamically straight airflows approaching and leaving the attenuator. The building services design engineer must make due allowance for increased pressure loss where unfavourable high air velocity and turbulent airflow conditions arise local to the attenuator due to duct bends, etc. In thesecircumstances substantially increased pressure loss values will occur. The independent UKAS schedule of accreditation is available upon request.

Registered Office : Calibre Acoustics Limited. Appledram Barns, Birdham Road, Chichester, West Sussex PO20 7EQ. Registered No.6627546

Calibre Acoustics Ltd

BREAK-OUT NOISE CALCULATION

The prediction of the propagation of noise break-out from the extract fan encased in the duct-work is shown in Table B.3. The calculation follows the methodology within International Standard ISO 9613-2:1996: '*Acoustics -- Attenuation of sound during propagation outdoors -- Part 2: General method of calculation*'.

Table B.3: Sound propagation prediction for break-out noise from the extract fan

	SOUND LEVEL PER OCTAVE FREQUENCY BAND (dBZ rel. 20μPA)								dB(A)
	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	
Break-out sound power level, L_W	70	62	59	55	51	47	42	37	57
D_c (source on a wall) [dB]	3	3	3	3	3	3	3	3	
Distance to receptor, d [metres]	5								
A_{div} = 20*log10 (d/d_0) + 11 [dB]	25	25	25	25	25	25	25	25	
Façade effect at receptor [dB]	3	3	3	3	3	3	3	3	
Sound pressure level at receptor facade, $L_P = L_W + D_c - A_{div}$ + façade correction	**51**	**43**	**40**	**36**	**32**	**28**	**23**	**18**	**38**

DUCT-BORNE NOISE CALCULATION

The prediction of the propagation of duct-borne noise from the roof terminal is shown in Table B.4. The calculation follows the methodology within both BS EN 12354-5:2009: '*Building acoustics – Estimation of acoustic performance of building from the performance of elements: Part 5: Sound levels due to the service equipment*' and International Standard ISO 9613-2:1996.

Table B.4: Sound propagation prediction for duct-borne noise from the extract fan

	SOUND LEVEL PER OCTAVE FREQUENCY BAND (dBZ rel. 20μPA)								dB(A)
	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	
In-duct Sound power level at outlet, L_W	87	79	76	70	68	64	59	54	74
A, Silencer insertion loss [dB]	11	12	37	50	55	37	19	11	
B, End reflection from 400x400 mm grill	9	4	2	0	0	0	0	0	
Sound power at roof terminal, $L_{WR} = L_W - A - B$	67	63	37	20	13	27	40	43	50
D_c (directivity loss at 90 degrees from opening) [dB]	0	0	0	0	0	-4	-7	-7	
Distance to receptor, d [metres]	5								
A_{div} = 20*log10 (d/d0) + 11 [dB]	25	25	25	25	25	25	25	25	
Façade effect at receptor [dB]	3	3	3	3	3	3	3	3	
Sound pressure level at receptor facade, $L_P = L_{WR} + D_c - A_{div}$ + façade correction	**45**	**41**	**15**	**-2**	**-9**	**1**	**11**	**14**	**26**

CUMULATIVE SOUND PRESSURE LEVEL

The cumulative sound pressure level from the kitchen extract system at the nearest noise-sensitive receptor is shown in Table B.5.

Table B.5: Cumulative sound pressure level from the kitchen extract system

	SOUND LEVEL PER OCTAVE FREQUENCY BAND (dB rel. 20μPA)								dB(A)
	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	
Sound pressure level from duct-borne fan noise	51	43	40	36	32	28	23	18	38
Sound pressure level of break-out noise	45	41	15	-2	-9	1	11	14	26
Cumulative sound pressure level at receptor façade	**52**	**45**	**40**	**36**	**32**	**28**	**23**	**20**	**39**

APPENDIX C

LIMITATIONS

APPENDIX C: LIMITATIONS

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