TECHNICAL NOTE

Project	**Facebook – Triton Square**
Subject	**Acoustic Review of Tenant Plant**
Author	**Dr Stephen Smyth**
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awnconsulting
A Trinity Consultants Company

The Tecpro Building,
Clonshaugh Business & Technology Park,
Dublin 17, Ireland.

T: + 353 1 847 4220
F: + 353 1 847 4257
E: info@awnconsulting.com
W: www.awnconsulting.com

1.0 INTRODUCTION

This document summarises the assessment of noise emissions from the tenant plant at the proposed Facebook fitout at Triton Square, London. The tenant plant is located at several locations throughout the building as follows:

- L6 north terrace – Various Condenser plant;
- L6 north terrace – Kitchen Supply AHU;
- L6 east terrace – Kitchen Extract AHU
- Roof (south eastern stair core) – Concept kitchen intake and extract louvres.

2.0 DESIGN CRITERIA AND GUIDANCE

In terms of adopted design criteria consideration has been given to both local authority requirements and the BREEAM Pol 05 credit associated with the project.

2.1 Local Authority Guidance

Plant noise emissions limits for the 1 Triton Square building have been set in accordance with London Borough of Camden Council requirements. These requirements stipulate plant noise at nearby noise sensitive receptors must be 5 dB below measured background noise or 10 dB below measured background noise where plant noise contains distinguishable tones or impulses at all times of the day.

Baseline noise surveys have been conducted previously by Arup on behalf of the landlord. Table 1 below summarises the noise levels measured during the baseline noise survey.

Cork Office
Unit 5, ATS Building,
Carrigaline Industrial Estate,
Carrigaline, Co. Cork.
T: + 353 21 438 7400
F: + 353 21 483 4606

AWN Consulting Limited
Registered in Ireland No. 319812

Sensitive Location (see Figure 1)	Lowest Measured Background Noise Level ($L_{A90,15\ min}$)[1]	
	Weekday (07:00 – 19:00 hours)	All Other Times
Adjacent properties to the west, south and east (NSR 1 – 7)	53 dB	51 dB
Adjacent properties to the north (NRR 8 & 9)	45 dB	43 dB

Table 1 Summary of Baseline Noise Levels

Taking the above condition and the baseline noise levels measured by Arup into account the overall noise limits to be achieved from plant serving the building is as per Table 2.

Noise Limit for Building Services Plant/Equipment (L_{Ar})			
$L_{Aeq.,15min}$	Sensitive Location (see Figure 1)	Weekday (07:00 – 19:00 hours)	All Other Times
No acoustic features	Adjacent properties to the west, south and east (NSR 1 – 7)	48	46
	Adjacent properties to the west, south and east (NSR 1 – 7)	40	38

Table 2 Summary of Plant Noise Limits on Building Plant

In this instance tenant plant will be designed not to have any acoustic features.

2.2 BREEAM

BREEAM pol 05 requirements are as follows:

Where the building does have noise-sensitive areas or buildings within 800m radius of the site, one credit can be awarded as follows:

- *Where a noise impact assessment in compliance with BS 7445 has been carried out and the following noise levels measured/determined:*
  - *Existing background noise levels at the nearest or most exposed noise-sensitive development to the proposed development or at a location where background conditions can be argued to be similar.*
  - *The rating noise level resulting from the new noise source.*

The noise impact assessment must be carried out by a suitably qualified acoustic consultant holding a recognised acoustic qualification and membership of an appropriate professional body.

The noise level from the proposed site/building, as measured in the locality of the nearest or most exposed noise-sensitive development, is a difference no greater than +5dB during the day (07:00 to 23:00) and +3dB at night (23:00 to 07:00) compared to the background noise level.

Where the noise source(s) from the proposed site/building is greater than the levels described, measures have been installed to attenuate the noise at its source to a level where it will comply.

These planning noise limits outlined in Section 2.1 are more onerous than the BREEAM Pol 05 requirements which require plant noise rating level to be below 5dB above background during the day and below 3dB above background during the night. Therefore, in meeting the planning requirements, Pol 05 compliance will be achieved.

[1] Source: Arup report *R02 Triton Square - Noise report for planning*

3.0 NOISE IMPACT ASSESSMENT

3.1 Noise Sources Description

The tenant condensers are proposed to be located externally on the Level 6 north terrace. There will be two ARUM160LTE5 condenser units and three ARUN040LSS0 units. Only one of the two ARUM160LTE5 condenser units and one ARUN040LSS0 units will operate at any one time. In addition, kitchen condenser units are also located on this terrace. These are assumed to operate continuously to present a worst-case situation.

The sound power level associated with the condenser units is as per Table 3.

Description	Number of Units (Duty+Standby)	Location	Sound Power Level, dB @ Octave Band Centre Frequencies (Hz)							
			63	125	250	500	1k	2k	4k	8k
ARUM160LTE5	(2+1)	Level 6 Terrace (North)	77	78	78	74	69	66	66	62
ARUN040LSS0	(1+2)		--	77	72	69	68	61	51	51
Condenser A & B Note A	(2+0)		--	65	65	63	61	56	49	40
Condenser C Note A	(1+0)		--	74	71	70	67	63	58	50
Condenser D Note A	(1+0)		--	68	67	64	64	60	52	43

Table 3 Sound Power Emissions from Condenser Units

Note A All plant items assumed to be operating on a continuous basis

A solid screen is proposed in front plant on the northern and eastern Level 6 terraces as shown in Figure 1. Attenuation afforded by these elements have been considered in the predicted presented in this note.

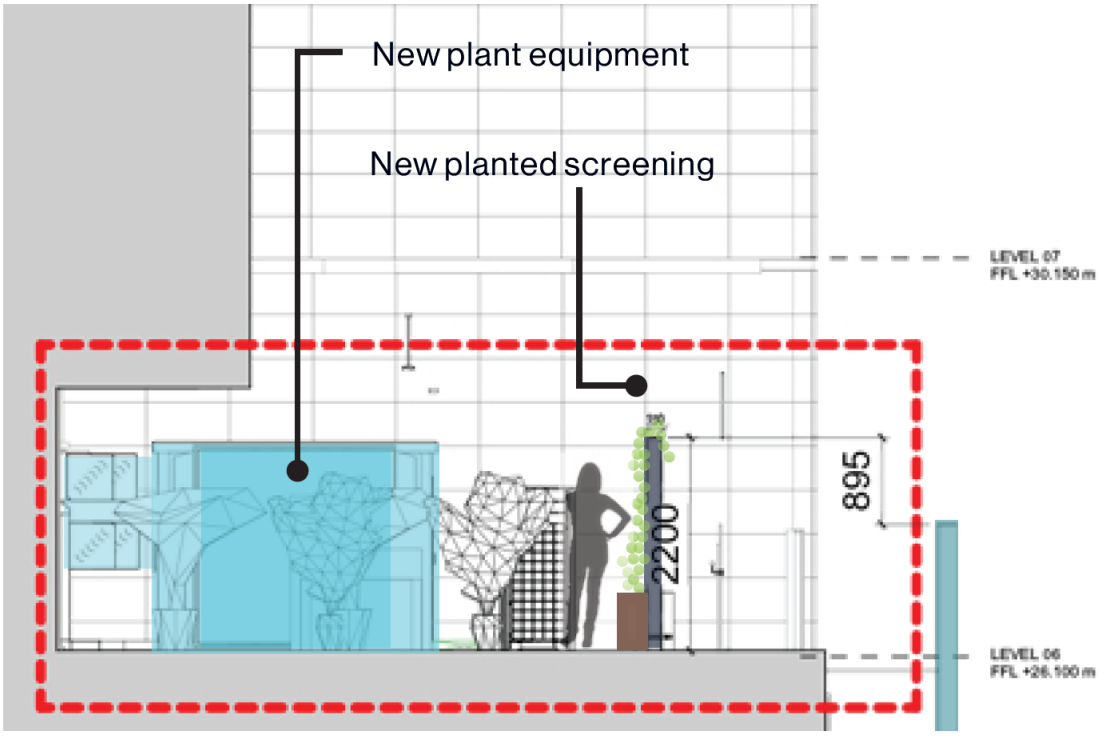

Figure 1 Section of Proposed Level 6 Terrace Screens

In addition to the condensers, consideration has also been given to the other tenant plant items so that the cumulative noise impact can be assessed. Table 5 details the sound power levels currently assumed for each tenant noise source.

Description	Location	Sound Power Level, dB @ Octave Band Centre Frequencies (Hz)							
		63	125	250	500	1k	2k	4k	8k
Kitchen Supply AHU Intake	Level 6 Terrace (North)	--	86	82	81	82	69	56	56
Kitchen Supply AHU Casing	Level 6 Terrace (North)	--	79	77	64	61	57	43	38
Kitchen Extract AHU Exhaust	Level 6 Terrace (East)	--	97	96	96	92	88	82	80
Kitchen Extract AHU Casing	Level 6 Terrace (East)	--	84	79	65	60	55	46	38
Concept Kitchen Supply AHU Intake	Roof	--	93	91	94	93	88	81	77
Concept Kitchen Extract AHU Exhaust	Roof	--	83	79	80	82	74	67	61

Table 4 Sound Power Emissions from other Tenant Plant

Table 5 details the attenuation added to each of the plant items in the noise assessment.

Description	Attenuation Type	Attenuation Level, dB @ Octave Band Centre Frequencies (Hz)							
		63	125	250	500	1k	2k	4k	8k
Kitchen Supply AHU Intake	Attenuator	5	13	27	34	39	37	29	22
Kitchen Extract AHU Exhaust	Attenuator	5	13	27	34	39	37	29	22
Concept Kitchen Supply AHU Intake	Attenuator	5	13	27	34	39	37	29	22

Table 5 Sound Attenuation to Tenant Plant

3.2 Nearest Sensitive Locations

Figure 2 illustrates the location of the nearest noise sensitive locations to the Triton Square building. Note the aerial photography is out of date and does not show the redeveloped Triton Square building.

Figure 2 Noise Sensitive Locations

3.3 Noise Calculations

3.3.1 Landlord Plant Contributions

The Arup assessment of landlord plant noise impacts has been reviewed and the predicted contributions from landlord plant associated with the Triton Square building at the locations identified in Figure 1 are outlined in Table 6.

Ref.	Floor	Landlord Contribution dB $L_{Aeq,T}$
NSR 01 (10 Brock Street)	8	33
NSR 02 (10 Brock Street)	8	35
NSR 03 (10 Brock Street)	11	42
NSR 04 (2 Triton Square)	5	27
NSR 05 (338 Euston Road)	11	43
NSR 06 (20 Trinton Street)	5	25
NSR 07 (20 Trinton Street)	5	27
NSR 08 (8 St Anne's)	6	25
NSR 09 (Westminster Kingsway College)	5	28

Table 6 Review of Landlord Plant Predicted Noise Levels

3.3.2 Tenant Plant Contributions

This section discusses the methodology behind the noise prediction process in relation to the tenant plant items. Section 4.0 presents an assessment of the results of the prediction exercise.

Proprietary noise calculation templates have been used for the purposes of this prediction exercise. The templates calculate noise levels in accordance with *ISO 9613: Acoustics – Attenuation of sound during propagation outdoors, Part 2: General method of calculation, 1996*. In general, the resultant noise level is calculated taking into account a range of factors affecting the propagation of sound, including:

- the magnitude of the noise source in terms of A weighted sound power levels (L_{WA});
- the distance between the source and receiver;
- the presence of obstacles such as screens or barriers in the propagation path;
- the presence of reflecting surfaces;
- the hardness of the ground between the source and receiver;
- Attenuation due to atmospheric absorption; and
- Meteorological effects such as wind gradient, temperature gradient and humidity (these have significant impact at distances greater than approximately 400m).

The noise calculations have been prepared using data from various sources as follows:

Site Layout The general site layout has been obtained from the drawings of the development.

Local Area The location of noise sensitive locations has been obtained from a combination of site drawings provided.

Heights The heights of buildings on site have been obtained from site drawings forwarded.

Contours The site has been assumed to be flat for the purposes of this assessment.

The final critical aspect of the noise model development is the inclusion of the various plant noise sources. Details of the source noise data is presented in Tables 4 and 5.

Table 7 presents the predicted noise levels associated with the proposed tenant items outlined in this assessment.

Ref.	Floor	Tenant Contribution dB $L_{Aeq,T}$
NSR 01 (10 Brock Street)	8	45
NSR 02 (10 Brock Street)	8	45
NSR 03 (10 Brock Street)	11	35
NSR 04 (2 Triton Square)	5	23
NSR 05 (338 Euston Road)	11	23
NSR 06 (20 Trinton Street)	5	24
NSR 07 (20 Trinton Street)	5	27
NSR 08 (8 St Anne's)	6	36
NSR 09 (Westminster Kingsway College)	5	32

Table 7 Review of Tenant Plant Predicted Noise Levels

4.0 ASSESSMENT OF CUMULATIVE PLANT NOISE

Noise levels have been predicted at the nearest residential locations identified in Figure 1. In all instances, the noise levels have been calculated at each floor level of the adjacent apartment blocks to assess the worst-case. The tenant plant has been selected to ensure no acoustic characteristics such as tones or impulses.

The predicted noise levels associated with landlord plant outlined in Table 5 have been added to the tenant plant noise levels presented in Table 6 to give a cumulative level associated with the Triton Square building.

Table 8 below lists the calculated noise levels from the landlord and tenant plant during all periods.

Ref.	Floor	Lowest Criterion dB $L_{Aeq,T}$	Landlord dB $L_{Aeq,T}$	Tenant dB $L_{Aeq,T}$	Total dB $L_{Aeq,T}$	Excess
NSR 01 (10 Brock Street)	8	46	33	45	46	-1
NSR 02 (10 Brock Street)	8	46	35	45	46	0
NSR 03 (10 Brock Street)	11	46	42	35	43	-3
NSR 04 (2 Triton Square)	5	46	27	23	29	-18
NSR 05 (338 Euston Road)	11	46	43	23	43	-3
NSR 06 (20 Trinton Street)	5	46	25	24	28	-19
NSR 07 (20 Trinton Street)	5	46	27	27	30	-16
NSR 08 (8 St Anne's)	6	38	25	36	36	-2
NSR 09 (Westminster Kingsway College)	5	38	28	32	34	-4

Table 8 Comparison of Predicted Noise Levels vs. Limits

In summary, the predicted noise levels achieve the noise limits as discussed in Section 2.0 as ascribed by London Borough of Camden Council requirements.

APPENDIX A

CALCULATION SHEETS

NSR01

Source Data			L_w per Octave Band Centre Freq (Hz)									
Item	Number	Item	63	125	250	500	1000	2000	4000	8000	dB(A)	**Note**
LT-CU6 and LT-CU7	2	--		65	65	63	61	56	49	40	65	All operate at the same time
HT8-1 to HT8-6	1	--		74	71	70	67	63	58	50	72	All operate at the same time
HT9-1 to HT9-8	1	--		68	67	64	64	60	52	43	68	All operate at the same time
ARUM160LTE5	3	--	77	78	78	74	69	66	66	62	76	2 duty 1 standby - assume cooling mode (60.5dB(A) at 1m)
ARUN040LSS0	3	--		77	72	69	68	61	51	51	72	1 duty 2 standby (assume cooling mode)
KS AHU	1	Outlet		86	82	81	82	69	56	56	84	
		Casing		79	77	64	61	57	43	38	71	Assumes casework attenuation already allowed for
KE AHU	1	Outlet		97	96	96	92	88	82	80	97	
		Casing		84	79	65	60	55	46	38	73	Assumes casework attenuation already allowed for
CKE AHU	1	Outlet		93	91	94	93	88	81	77	97	
CKS AHU	1	Outlet		83	79	80	82	74	67	61	84	

	North	East	Concept
Distance (m)	35	12	45
Screening (dB)	15	0	5

NSR01			L_p per Octave Band Centre Freq (Hz)								
Item	Number	Item	63	125	250	500	1000	2000	4000	8000	dB(A)
LT-CU6 and LT-CU7	2	--	-51	14	14	12	10	5	-2	-11	14
HT8-1 to HT8-6	1	--	-54	20	17	16	13	9	4	-4	18
HT9-1 to HT9-8	1	--	-54	14	13	10	10	6	-1	-11	14
		Total	-48	22	20	18	16	12	6	-3	**21**

NSR01			L_p per Octave Band Centre Freq (Hz)								
Item	Number	Item	63	125	250	500	1000	2000	4000	8000	dB(A)
ARUM160LTE5	2	--	26	27	27	23	18	15	15	11	25
ARUN040LSS0	1	--	-54	23	18	15	14	7	-3	-3	18
KS AHU	1	Outlet	-56	19	1	-7	-11	-22	-27	-20	4
		Casing	-54	25	23	10	7	3	-11	-16	17
KE AHU	1	Outlet	-32	54	39	32	23	21	23	28	40
		Casing	-30	54	49	35	30	25	16	8	44
CKE AHU	1	Outlet	-48	34	18	14	8	5	6	9	20
CKS AHU	1	Outlet	-48	24	6	0	-3	-9	-8	-7	9
		Total	26	58	50	37	32	27	25	29	**45**

Overall Total	26	58	50	38	32	27	25	29	**45**

NSR02

Source Data			L_w per Octave Band Centre Freq (Hz)									
Item	Number	Item	63	125	250	500	1000	2000	4000	8000	dB(A)	**Note**
LT-CU6 and LT-CU7	2	--		65	65	63	61	56	49	40	65	All operate at the same time
HT8-1 to HT8-6	1	--		74	71	70	67	63	58	50	72	All operate at the same time
HT9-1 to HT9-8	1	--		68	67	64	64	60	52	43	68	All operate at the same time
ARUM160LTE5	3	--	77	78	78	74	69	66	66	62	76	2 duty 1 standby - assume cooling mode (60.5dB(A) at 1m)
ARUN040LSS0	3	--		77	72	69	68	61	51	51	72	1 duty 2 standby (assume cooling mode)
KS AHU	1	Outlet		86	82	81	82	69	56	56	84	
		Casing		79	77	64	61	57	43	38	71	Assumes casework attenuation already allowed for
KE AHU	1	Outlet		97	96	96	92	88	82	80	97	
		Casing		84	79	65	60	55	46	38	73	Assumes casework attenuation already allowed for
CKE AHU	1	Outlet		93	91	94	93	88	81	77	97	
CKS AHU	1	Outlet		83	79	80	82	74	67	61	84	

	North	East	Concept
Distance (m)	50	12	30
Screening (dB)	15	0	5

NSR02			L_p per Octave Band Centre Freq (Hz)								
Item	Number	Item	63	125	250	500	1000	2000	4000	8000	dB(A)
LT-CU6 and LT-CU7	2	--	-54	11	11	9	7	2	-5	-14	11
HT8-1 to HT8-6	1	--	-57	17	14	13	10	6	1	-7	15
HT9-1 to HT9-8	1	--	-57	11	10	7	7	3	-5	-14	11
		Total	-51	19	17	15	13	9	3	-6	**18**

NSR02			L_p per Octave Band Centre Freq (Hz)								
Item	Number	Item	63	125	250	500	1000	2000	4000	8000	dB(A)
ARUM160LTE5	2	--	23	24	24	20	15	12	12	8	22
ARUN040LSS0	1	--	-57	20	15	12	11	4	-6	-6	15
KS AHU	1	Outlet	-59	16	-2	-10	-14	-25	-30	-23	1
		Casing	-57	22	20	7	4	0	-14	-19	14
KE AHU	1	Outlet	-32	54	39	32	23	21	23	28	40
		Casing	-30	54	49	35	30	25	16	8	44
CKE AHU	1	Outlet	-45	37	21	17	11	8	9	12	24
CKS AHU	1	Outlet	-45	27	9	3	0	-6	-5	-4	13
		Total	23	58	50	37	31	27	25	29	**45**

Overall Total	23	58	50	37	32	27	25	29	**45**

NSR03

Source Data			L_w per Octave Band Centre Freq (Hz)									
Item	Number	Item	63	125	250	500	1000	2000	4000	8000	dB(A)	Note
LT-CU6 and LT-CU7	2	--		65	65	63	61	56	49	40	65	All operate at the same time
HT8-1 to HT8-6	1	--		74	71	70	67	63	58	50	72	All operate at the same time
HT9-1 to HT9-8	1	--		68	67	64	64	60	52	43	68	All operate at the same time
ARUM160LTE5	3	--	77	78	78	74	69	66	66	62	76	2 duty 1 standby - assume cooling mode (60.5dB(A) at 1m)
ARUN040LSS0	3	--		77	72	69	68	61	51	51	72	1 duty 2 standby (assume cooling mode)
KS AHU	1	Outlet		86	82	81	82	69	56	56	84	
		Casing		79	77	64	61	57	43	38	71	Assumes casework attenuation already allowed for
KE AHU	1	Outlet		97	96	96	92	88	82	80	97	
		Casing		84	79	65	60	55	46	38	73	Assumes casework attenuation already allowed for
CKE AHU	1	Outlet		93	91	94	93	88	81	77	97	
CKS AHU	1	Outlet		83	79	80	82	74	67	61	84	

	North	East	Concept
Distance (m)	60	12	40
Screening (dB)	15	10	5

NSR03			L_p per Octave Band Centre Freq (Hz)								
Item	Number	Item	63	125	250	500	1000	2000	4000	8000	dB(A)
LT-CU6 and LT-CU7	2	--	-56	9	9	7	5	0	-7	-16	10
HT8-1 to HT8-6	1	--	-59	15	13	11	9	5	-1	-9	13
HT9-1 to HT9-8	1	--	-59	10	9	6	6	2	-6	-15	10
		Total	-53	17	15	14	12	7	1	-7	**16**

NSR03			L_p per Octave Band Centre Freq (Hz)								
Item	Number	Item	63	125	250	500	1000	2000	4000	8000	dB(A)
ARUM160LTE5	2	--	21	22	22	18	13	10	10	6	20
ARUN040LSS0	1	--	-59	18	13	10	9	2	-8	-8	13
KS AHU	1	Outlet	-61	14	-4	-12	-16	-27	-32	-25	-1
		Casing	-59	20	18	5	2	-2	-16	-21	12
KE AHU	1	Outlet	-42	44	29	22	13	11	13	18	30
		Casing	-40	44	39	25	20	15	6	-2	34
CKE AHU	1	Outlet	-47	35	19	15	9	6	7	10	21
CKS AHU	1	Outlet	-47	25	7	1	-2	-8	-7	-6	10
		Total	21	48	40	28	22	18	16	19	**35**

Overall Total	21	48	40	28	23	19	16	19	**35**

NSR04

Source Data			L_w per Octave Band Centre Freq (Hz)									
Item	Number	Item	63	125	250	500	1000	2000	4000	8000	dB(A)	Note
LT-CU6 and LT-CU7	2	--		65	65	63	61	56	49	40	65	All operate at the same time
HT8-1 to HT8-6	1	--		74	71	70	67	63	58	50	72	All operate at the same time
HT9-1 to HT9-8	1	--		68	67	64	64	60	52	43	68	All operate at the same time
ARUM160LTE5	3	--	77	78	78	74	69	66	66	62	76	2 duty 1 standby - assume cooling mode (60.5dB(A) at 1m)
ARUN040LSS0	3	--		77	72	69	68	61	51	51	72	1 duty 2 standby (assume cooling mode)
KS AHU	1	Outlet		86	82	81	82	69	56	56	84	
		Casing		79	77	64	61	57	43	38	71	Assumes casework attenuation already allowed for
KE AHU	1	Outlet		97	96	96	92	88	82	80	97	
		Casing		84	79	65	60	55	46	38	73	Assumes casework attenuation already allowed for
CKE AHU	1	Outlet		93	91	94	93	88	81	77	97	
CKS AHU	1	Outlet		83	79	80	82	74	67	61	84	

	North	East	Concept
Distance (m)	85	60	30
Screening (dB)	15	15	10

NSR04			L_p per Octave Band Centre Freq (Hz)								
Item	Number	Item	63	125	250	500	1000	2000	4000	8000	dB(A)
LT-CU6 and LT-CU7	2	--	-59	6	6	4	2	-3	-10	-19	6
HT8-1 to HT8-6	1	--	-62	12	10	8	5	2	-4	-12	10
HT9-1 to HT9-8	1	--	-62	7	6	3	3	-1	-9	-18	7
		Total	-56	14	12	11	9	4	-2	-10	**13**

NSR04			L_p per Octave Band Centre Freq (Hz)								
Item	Number	Item	63	125	250	500	1000	2000	4000	8000	dB(A)
ARUM160LTE5	2	--	18	19	19	15	10	7	7	3	17
ARUN040LSS0	1	--	-62	15	10	7	6	-1	-11	-11	10
KS AHU	1	Outlet	-64	11	-7	-15	-19	-30	-35	-28	-4
		Casing	-62	17	15	2	-1	-5	-19	-24	9
KE AHU	1	Outlet	-61	25	10	3	-6	-8	-6	-1	11
		Casing	-59	25	20	6	1	-4	-13	-21	15
CKE AHU	1	Outlet	-50	32	16	12	6	3	4	7	19
CKS AHU	1	Outlet	-50	22	4	-2	-5	-11	-10	-9	8
		Total	18	35	25	18	13	10	9	10	**23**

Overall Total	18	35	25	19	15	11	10	10	**23**

NSR05

Source Data			L_w per Octave Band Centre Freq (Hz)									
Item	Number	Item	63	125	250	500	1000	2000	4000	8000	dB(A)	**Note**
LT-CU6 and LT-CU7	2	--		65	65	63	61	56	49	40	65	All operate at the same time
HT8-1 to HT8-6	1	--		74	71	70	67	63	58	50	72	All operate at the same time
HT9-1 to HT9-8	1	--		68	67	64	64	60	52	43	68	All operate at the same time
ARUM160LTE5	3	--	77	78	78	74	69	66	66	62	76	2 duty 1 standby - assume cooling mode (60.5dB(A) at 1m)
ARUN040LSS0	3	--		77	72	69	68	61	51	51	72	1 duty 2 standby (assume cooling mode)
KS AHU	1	Outlet		86	82	81	82	69	56	56	84	
		Casing		79	77	64	61	57	43	38	71	Assumes casework attenuation already allowed for
KE AHU	1	Outlet		97	96	96	92	88	82	80	97	
		Casing		84	79	65	60	55	46	38	73	Assumes casework attenuation already allowed for
CKE AHU	1	Outlet		93	91	94	93	88	81	77	97	
CKS AHU	1	Outlet		83	79	80	82	74	67	61	84	

	North	East	Concept
Distance (m)	85	105	85
Screening (dB)	15	15	0

NSR05			L_p per Octave Band Centre Freq (Hz)								
Item	Number	Item	63	125	250	500	1000	2000	4000	8000	dB(A)
LT-CU6 and LT-CU7	2	--	-59	6	6	4	2	-3	-10	-19	6
HT8-1 to HT8-6	1	--	-62	12	10	8	5	2	-4	-12	10
HT9-1 to HT9-8	1	--	-62	7	6	3	3	-1	-9	-18	7
		Total	-56	14	12	11	9	4	-2	-10	**13**

NSR05			L_p per Octave Band Centre Freq (Hz)								
Item	Number	Item	63	125	250	500	1000	2000	4000	8000	dB(A)
ARUM160LTE5	2	--	18	19	19	15	10	7	7	3	17
ARUN040LSS0	1	--	-62	15	10	7	6	-1	-11	-11	10
KS AHU	1	Outlet	-64	11	-7	-15	-19	-30	-35	-28	-4
		Casing	-62	17	15	2	-1	-5	-19	-24	9
KE AHU	1	Outlet	-65	21	6	-1	-10	-12	-10	-5	6
		Casing	-63	21	16	2	-3	-8	-17	-25	10
CKE AHU	1	Outlet	-49	33	17	13	7	4	5	8	20
CKS AHU	1	Outlet	-49	23	5	-1	-4	-10	-9	-8	9
		Total	18	35	24	18	13	10	9	10	**23**

Overall Total	18	35	24	19	15	11	10	10	**23**

NSR06

Source Data			L_w per Octave Band Centre Freq (Hz)									
Item	Number	Item	63	125	250	500	1000	2000	4000	8000	dB(A)	**Note**
LT-CU6 and LT-CU7	2	--		65	65	63	61	56	49	40	65	All operate at the same time
HT8-1 to HT8-6	1	--		74	71	70	67	63	58	50	72	All operate at the same time
HT9-1 to HT9-8	1	--		68	67	64	64	60	52	43	68	All operate at the same time
ARUM160LTE5	3	--	77	78	78	74	69	66	66	62	76	2 duty 1 standby - assume cooling mode (60.5dB(A) at 1m)
ARUN040LSS0	3	--		77	72	69	68	61	51	51	72	1 duty 2 standby (assume cooling mode)
KS AHU	1	Outlet		86	82	81	82	69	56	56	84	
		Casing		79	77	64	61	57	43	38	71	Assumes casework attenuation already allowed for
KE AHU	1	Outlet		97	96	96	92	88	82	80	97	
		Casing		84	79	65	60	55	46	38	73	Assumes casework attenuation already allowed for
CKE AHU	1	Outlet		93	91	94	93	88	81	77	97	
CKS AHU	1	Outlet		83	79	80	82	74	67	61	84	

	North	East	Concept
Distance (m)	55	90	80
Screening (dB)	15	15	15

NSR06			L_p per Octave Band Centre Freq (Hz)								
Item	Number	Item	63	125	250	500	1000	2000	4000	8000	dB(A)
LT-CU6 and LT-CU7	2	--	-55	10	10	8	6	1	-6	-15	10
HT8-1 to HT8-6	1	--	-58	16	13	12	9	5	0	-8	14
HT9-1 to HT9-8	1	--	-58	10	10	7	6	2	-5	-15	10
		Total	-52	18	16	14	12	8	2	-7	**17**

NSR06			L_p per Octave Band Centre Freq (Hz)								
Item	Number	Item	63	125	250	500	1000	2000	4000	8000	dB(A)
ARUM160LTE5	2	--	22	23	23	19	14	11	11	7	21
ARUN040LSS0	1	--	-58	19	14	11	10	3	-7	-7	14
KS AHU	1	Outlet	-60	15	-3	-11	-15	-26	-31	-24	0
		Casing	-58	21	19	6	3	-1	-15	-20	13
KE AHU	1	Outlet	-64	22	7	0	-9	-11	-9	-4	8
		Casing	-62	22	17	3	-2	-7	-16	-24	11
CKE AHU	1	Outlet	-63	19	3	-1	-7	-10	-9	-6	5
CKS AHU	1	Outlet	-63	9	-9	-15	-18	-24	-23	-22	-6
		Total	22	29	26	20	16	12	11	8	**23**

Overall Total	22	30	26	21	17	14	11	8	**24**

NSR07

Source Data			L_w per Octave Band Centre Freq (Hz)									
Item	Number	Item	63	125	250	500	1000	2000	4000	8000	dB(A)	Note
LT-CU6 and LT-CU7	2	--		65	65	63	61	56	49	40	65	All operate at the same time
HT8-1 to HT8-6	1	--		74	71	70	67	63	58	50	72	All operate at the same time
HT9-1 to HT9-8	1	--		68	67	64	64	60	52	43	68	All operate at the same time
ARUM160LTE5	3	--	77	78	78	74	69	66	66	62	76	2 duty 1 standby - assume cooling mode (60.5dB(A) at 1m)
ARUN040LSS0	3	--		77	72	69	68	61	51	51	72	1 duty 2 standby (assume cooling mode)
KS AHU	1	Outlet		86	82	81	82	69	56	56	84	
		Casing		79	77	64	61	57	43	38	71	Assumes casework attenuation already allowed for
KE AHU	1	Outlet		97	96	96	92	88	82	80	97	
		Casing		84	79	65	60	55	46	38	73	Assumes casework attenuation already allowed for
CKE AHU	1	Outlet		93	91	94	93	88	81	77	97	
CKS AHU	1	Outlet		83	79	80	82	74	67	61	84	

	North	East	Concept
Distance (m)	40	90	95
Screening (dB)	15	15	15

NSR07			L_p per Octave Band Centre Freq (Hz)								
Item	Number	Item	63	125	250	500	1000	2000	4000	8000	dB(A)
LT-CU6 and LT-CU7	2	--	-52	13	12	11	9	3	-3	-12	13
HT8-1 to HT8-6	1	--	-55	19	16	15	12	8	3	-5	17
HT9-1 to HT9-8	1	--	-55	13	12	9	9	5	-3	-12	13
		Total	-49	21	19	17	15	11	5	-4	**20**

NSR07			L_p per Octave Band Centre Freq (Hz)								
Item	Number	Item	63	125	250	500	1000	2000	4000	8000	dB(A)
ARUM160LTE5	2	--	25	25	26	21	16	14	13	10	24
ARUN040LSS0	1	--	-55	22	17	14	13	6	-4	-4	17
KS AHU	1	Outlet	-57	18	0	-8	-12	-23	-28	-21	3
		Casing	-55	24	22	9	6	2	-12	-17	16
KE AHU	1	Outlet	-64	22	7	0	-9	-11	-9	-4	8
		Casing	-62	22	17	3	-2	-7	-16	-24	11
CKE AHU	1	Outlet	-65	17	1	-3	-9	-12	-11	-8	4
CKS AHU	1	Outlet	-65	7	-11	-17	-20	-26	-25	-24	-7
		Total	25	31	28	23	18	15	14	10	**26**

Overall Total	25	31	29	24	20	16	14	11	**27**

NSR08

Source Data			L_w per Octave Band Centre Freq (Hz)									
Item	Number	Item	63	125	250	500	1000	2000	4000	8000	dB(A)	Note
LT-CU6 and LT-CU7	2	--		65	65	63	61	56	49	40	65	All operate at the same time
HT8-1 to HT8-6	1	--		74	71	70	67	63	58	50	72	All operate at the same time
HT9-1 to HT9-8	1	--		68	67	64	64	60	52	43	68	All operate at the same time
ARUM160LTE5	3	--	77	78	78	74	69	66	66	62	76	2 duty 1 standby - assume cooling mode (60.5dB(A) at 1m)
ARUN040LSS0	3	--		77	72	69	68	61	51	51	72	1 duty 2 standby (assume cooling mode)
KS AHU	1	Outlet		86	82	81	82	69	56	56	84	
		Casing		79	77	64	61	57	43	38	71	Assumes casework attenuation already allowed for
KE AHU	1	Outlet		97	96	96	92	88	82	80	97	
		Casing		84	79	65	60	55	46	38	73	Assumes casework attenuation already allowed for
CKE AHU	1	Outlet		93	91	94	93	88	81	77	97	
CKS AHU	1	Outlet		83	79	80	82	74	67	61	84	

	North	East	Concept
Distance (m)	40	85	100
Screening (dB)	9	15	15

NSR08			L_p per Octave Band Centre Freq (Hz)								
Item	Number	Item	63	125	250	500	1000	2000	4000	8000	dB(A)
LT-CU6 and LT-CU7	2	--	-46	19	18	17	15	9	3	-6	19
HT8-1 to HT8-6	1	--	-49	25	22	21	18	14	9	1	23
HT9-1 to HT9-8	1	--	-49	19	18	15	15	11	3	-6	19
		Total	-43	27	25	23	21	17	11	2	**26**

NSR08			L_p per Octave Band Centre Freq (Hz)								
Item	Number	Item	63	125	250	500	1000	2000	4000	8000	dB(A)
ARUM160LTE5	2	--	35	36	36	32	27	24	24	20	34
ARUN040LSS0	1	--	-45	32	27	24	23	16	6	6	27
KS AHU	1	Outlet	-52	26	10	-7	-8	-15	-23	-12	11
		Casing	-45	34	32	19	16	12	-2	-7	26
KE AHU	1	Outlet	-69	20	7	-9	-15	-13	-14	-5	6
		Casing	-62	22	17	3	-2	-7	-16	-24	11
CKE AHU	1	Outlet	-70	15	1	-12	-15	-14	-16	-9	1
CKS AHU	1	Outlet	-70	5	-11	-26	-26	-28	-30	-25	-10
		Total	35	39	38	33	28	25	24	20	**35**

Overall Total	35	40	38	33	29	26	24	20	**36**

NSR09

Source Data			L_w per Octave Band Centre Freq (Hz)									
Item	Number	Item	63	125	250	500	1000	2000	4000	8000	dB(A)	**Note**
LT-CU6 and LT-CU7	2	--		65	65	63	61	56	49	40	65	All operate at the same time
HT8-1 to HT8-6	1	--		74	71	70	67	63	58	50	72	All operate at the same time
HT9-1 to HT9-8	1	--		68	67	64	64	60	52	43	68	All operate at the same time
ARUM160LTE5	3	--	77	78	78	74	69	66	66	62	76	2 duty 1 standby - assume cooling mode (60.5dB(A) at 1m)
ARUN040LSS0	3	--		77	72	69	68	61	51	51	72	1 duty 2 standby (assume cooling mode)
KS AHU	1	Outlet		86	82	81	82	69	56	56	84	
		Casing		79	77	64	61	57	43	38	71	Assumes casework attenuation already allowed for
KE AHU	1	Outlet		97	96	96	92	88	82	80	97	
		Casing		84	79	65	60	55	46	38	73	Assumes casework attenuation already allowed for
CKE AHU	1	Outlet		93	91	94	93	88	81	77	97	
CKS AHU	1	Outlet		83	79	80	82	74	67	61	84	

	North	East	Concept
Distance (m)	45	80	110
Screening (dB)	9	15	15

NSR09			L_p per Octave Band Centre Freq (Hz)								
Item	Number	Item	63	125	250	500	1000	2000	4000	8000	dB(A)
LT-CU6 and LT-CU7	2	--	-47	18	17	16	14	8	2	-7	18
HT8-1 to HT8-6	1	--	-50	24	21	20	17	13	8	0	22
HT9-1 to HT9-8	1	--	-50	18	17	14	14	10	2	-7	18
		Total	-44	26	24	22	20	16	10	1	**25**

NSR09			L_p per Octave Band Centre Freq (Hz)								
Item	Number	Item	63	125	250	500	1000	2000	4000	8000	dB(A)
ARUM160LTE5	2	--	31	31	32	27	22	20	19	16	30
ARUN040LSS0	1	--	-49	28	23	20	19	12	2	2	23
KS AHU	1	Outlet	-56	22	6	-11	-12	-19	-27	-16	7
		Casing	-49	30	28	15	12	8	-6	-11	22
KE AHU	1	Outlet	-68	21	8	-8	-14	-12	-13	-4	7
		Casing	-61	23	18	4	-1	-6	-15	-23	12
CKE AHU	1	Outlet	-71	14	0	-13	-16	-15	-17	-10	0
CKS AHU	1	Outlet	-71	4	-12	-27	-27	-29	-31	-26	-11
		Total	31	36	34	28	24	21	20	16	**31**

Overall Total	31	36	34	29	26	22	20	16	**32**