

1 Triton Square & St Anne's

Noise Assessment

DECEMBER 2016



British Land
1 Triton Square
Noise Assessment

R02

Issue | 7 December 2016

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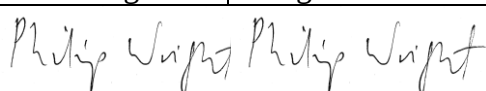
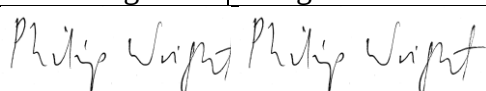
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ARUP

Document Verification

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Appendix A

Background noise measurements

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Typical plant noise emission calculation

Ove Arup & Partners (Arup) have been appointed by British Land to provide acoustic design consultancy services for the proposed refurbishment and new-build project at Triton Square, London.

London Borough of Camden (LBC) require a noise assessment and report to support the planning application for the project. LBC require that the acoustic report should be prepared by a qualified acoustician outlining details of:

- The existing background noise levels measured over 24hrs.
- Proposed noise output.
- The measures proposed to reduce noise, fume emissions and vibration.
- Cumulative noise levels including all existing and proposed units.
- The method used to compile the report and examples of the calculations and assumptions made.
- The system manufacturer's specifications.

This report sets out this information. At the time of writing, the project has completed RIBA work stage 2.

1 Existing background noise

Arup undertook the following background noise measurements at locations shown in Figure 1:

- Attended measurements at pavement level around 1 Triton Square (Locations 1, 2, 3 and 4) on 5th May 2016.
- Unattended noise measurements at rooftop level of 1 Triton Square (Location A) between 1st April and 6th April 2016.
- Unattended noise measurements at rooftop level of St Annes (Location B) between 1st December and 6th December 2016.

Table 1 sets out the lowest background levels that were measured.

Sensitive location	Lowest measured background levels ($L_{A90,5min}$), dB		Lowest measured ambient level ($L_{Aeq,5min}$), dB Daytime (7am – 7pm)
	Weekday daytime (7am – 7pm)	Other times	
Adjacent properties to the west, south and east	53	51	54
Adjacent properties to the north	45	43	47
Publically accessible locations	55		59

Table 1 Lowest background levels measured

Appendix A provides more detail of these background noise measurements.

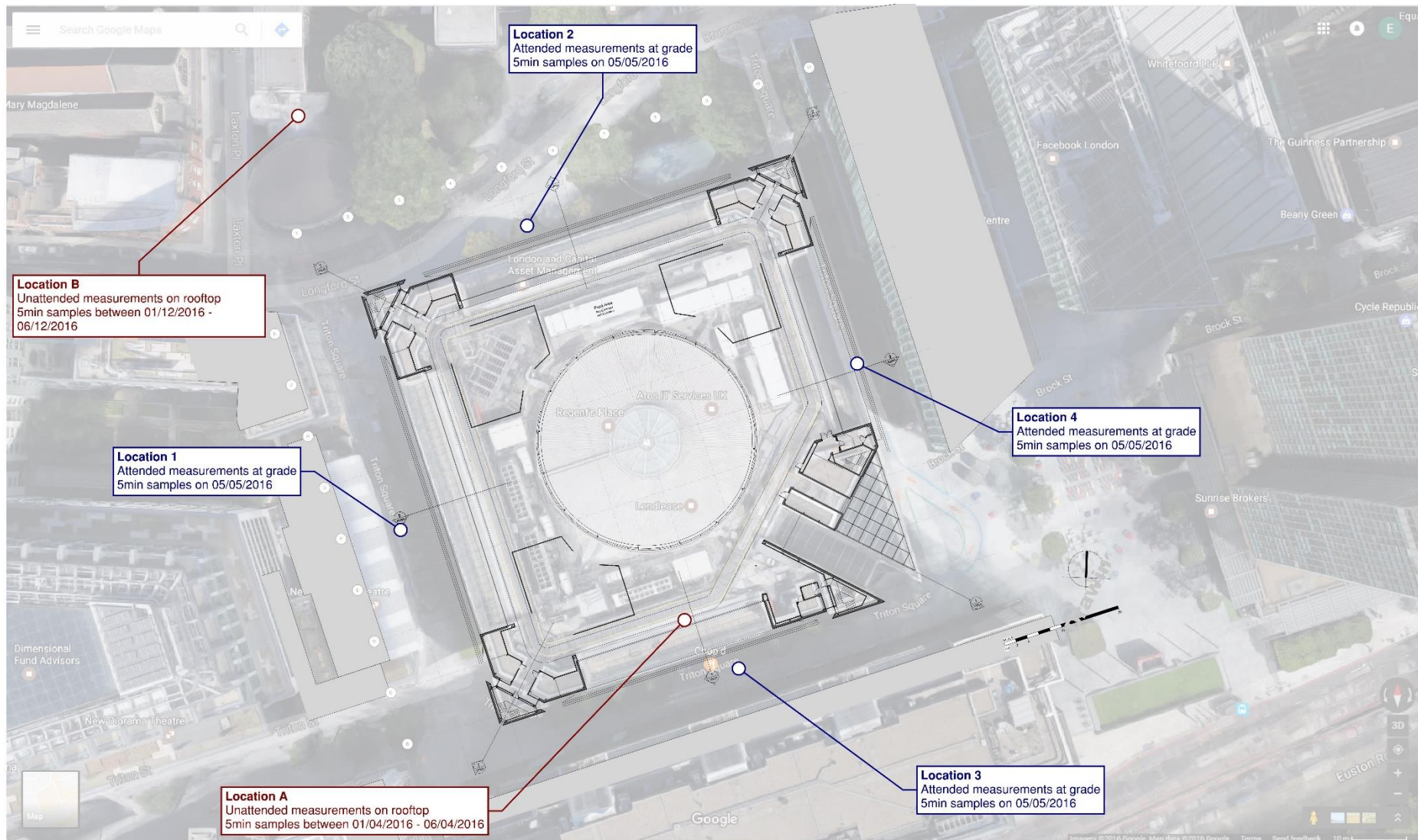


Figure 1 Noise measurement locations

2 Noise emission limits

External noise emissions will be controlled to meet Camden Council's requirements. These are set out in the council's development policy "DP28", an extract from which is shown below.

For non-tonal plant, noise emissions are to be at least 5dB below background noise levels at any time, at "sensitive" facades of nearby buildings. Elsewhere in the DP28 document it is stated that "noise sensitive development includes housing, schools and hospitals as well as offices, workshops and open spaces." Therefore the requirement can be considered in practice to apply to all of the adjacent buildings.

Table E: Noise levels from plant and machinery at which planning permission will not be granted

Noise description and location of measurement	Period	Time	Noise level
Noise at 1 metre external to a sensitive façade	Day, evening and night	0000-2400	5dB(A) <LA90
Noise that has a distinguishable discrete continuous note (whine, hiss, screech, hum) at 1 metre external to a sensitive façade.	Day, evening and night	0000-2400	10dB(A) <LA90
Noise that has distinct impulses (bangs, clicks, clatters, thumps) at 1 metre external to a sensitive façade.	Day, evening and night	0000-2400	10dB(A) <LA90
Noise at 1 metre external to sensitive façade where LA90 > 60dB	Day, evening and night	0000-2400	55dB _{LAeq}

Table 2: Camden Council's noise emissions requirements

Emergency generators used to maintain business continuity during power failures are subject to the same limits.

The LBC planning requirements do not apply to equipment that operates solely under emergency life safety conditions or for testing of such equipment.

The current LBC policy regarding noise from life-safety plant is that external noise emissions for emergency generators (life safety and communications only) is not to exceed the lowest daytime $L_{Aeq,15mins}$.

Table 3 sets out the noise emission limits for the development.

Sensitive location	Building services noise emission limit at 1m external to sensitive façade, dBL _{Ar, Tr}		
	Type of noise	Weekday daytime (7am – 7pm)	Other times
Adjacent properties to the west, south and east	Noise from plant	48	46
	Noise from plant that has a distinguishable continuous note or distinct impulses	43	41
	Noise from life safety and communications plant	54	54
	Noise from plant	40	38

Sensitive location	Building services noise emission limit at 1m external to sensitive façade, dBL _{Ar, Tr}		
	Type of noise	Weekday daytime (7am – 7pm)	Other times
Adjacent properties to the north	Noise from plant that has a distinguishable continuous note or distinct impulses	40	38
	Noise from life safety and communications plant	47	47
Publically accessible locations	Noise from plant	55	
	Noise from plant that has a distinguishable continuous note or distinct impulses	50	

Table 3 Plant noise emission limits at nearby locations

3 Proposed noise output

Figure 2 shows positions of rooftop plant and the nearest noise sensitive locations. Rooftop plant includes six cooling towers, ten AHUs, generator heat rejection, an exhaust flue and toilet extract fans. Areas are reserved for installation of plant items by tenants. Tenant plant will be subject to limiting sound power levels by the tenancy contract. Refer to Section 6 for a full list of rooftop plant.

Table 4 provides the calculated total noise emission from the 1 Triton Square development at these locations. This is based on provisional landlord plant selections at anticipated daytime duty. Where provisional plant selections are unavailable a typical selection has been used based on similar projects.

Sensitive location		Building services noise emission limit at 1m external to sensitive façade, dBL _{Ar, Tr}		Total noise level from rooftop plant (dB)	Level relative to night time limit (dB)
		Weekday daytime (7am – 7pm)	Other times		
NSR 1	10 Brock St	48	46	43	-6
NSR 2	10 Brock St	48	46	44	-9
NSR 3	10 Brock St	48	46	48	-4
NSR 4	2 Triton Square	48	46	36	-13
NSR 5	338 Euston Road	48	46	45	-5
NSR 6	20 Triton St	48	46	30	-17
NSR 7	20 Triton St	48	46	33	-14
NSR 8	St Anne's	40	38	31	-8
NSR 9	Westminster Kingsway College	40	38	29	-11

Table 4 Calculated noise emissions

The calculated levels are lower than all emission limits at all locations. The margin of at least 4dB at all locations allows suitable headroom for additional tenant plant. Guidance on the limits will be conveyed to tenants accordingly.

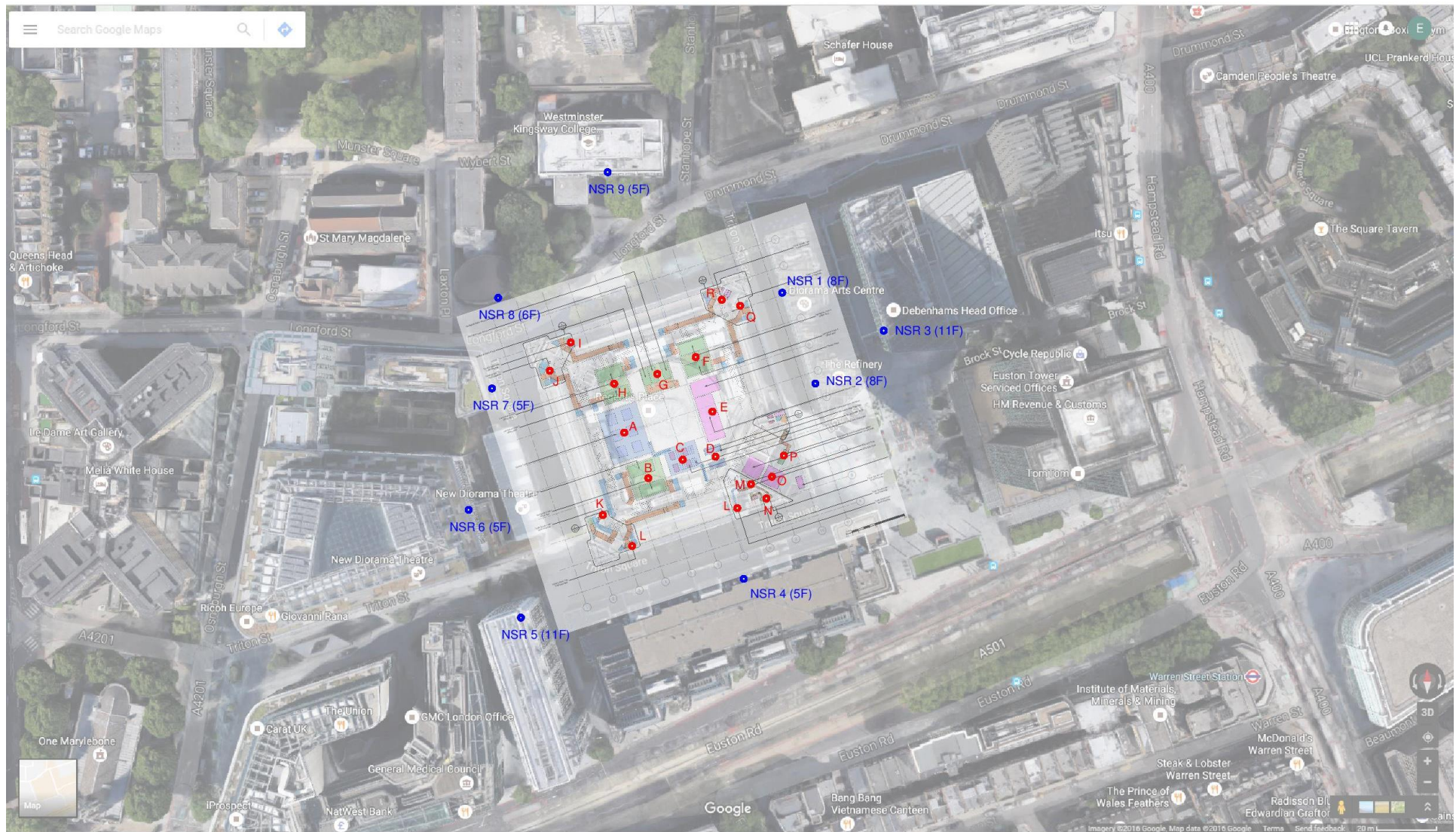


Figure 2 Rooftop plant locations and nearby sensitive locations

In addition to rooftop plant, louvres at pavement level provide air to landlord and tenant plant in the basement and ground floor. Ducts connecting to these louvres will include attenuation where necessary to ensure that the limits set out in Table 3 are not exceeded.

A landlord generator in the basement will serve life-safety systems. Airpaths and flues connecting with the external environment will be attenuated to ensure that noise from this plant does not exceed the lowest daytime $L_{Aeq,15mins}$ at the nearest sensitive locations

The basement includes space provision for a tenant generator to provide business continuity in case of power cut. The noise emissions limits will be communicated to tenants, and airpaths and flues connecting with the external environment will be attenuated to ensure that the limits set out in Table 3 are not exceeded.

4 Noise and vibration mitigation measures

The rooftop has a continuous solid plant screen around the perimeter. This will extend at least 3m above rooftop height.

An array of photovoltaic cells is located above the plant at rooftop at rooftop level. This will to some extent semi-enclose the rooftop plant, offering addition noise screening. The effect of this is difficult to predict and therefore as a worst case this effect has not been considered in the noise emission calculations.

Where necessary ducted connections to the external environment will be attenuated to meet the plant noise emission limits set out in this report.

Principal items of plant shall be installed on anti-vibration mounts to reduce any vibration transferred to the building fabric to an acceptable level. There is no direct structural connection to adjacent buildings.

5 Prediction method

The rooftop noise emission calculations follow the following algorithm:

- [1] For each cluster of rooftop plant, establish a sound power level (SWL_{item} , see Table 7 below) and correct for quantity of plant, N , according to

$$SWL_{cluster} = SWL_{item} + 10 \log_{10}(N)$$

- [2] For each item of plant and each sensitive location measure the plan distance, r . Assume point-source hemi-spherical spreading to determine the sound pressure level (SPL) from the total SWL.

$$SPL_{cluster,source} = SWL_{cluster} - 20 \log_{10}(r) - 11$$

- [3] Logarithmically add the each SPL from each source $SPL_{cluster,NSR}$ at each sensitive location.

$$SPL_{totalNSR} = 10 \log_{10} \left(\sum 10^{(SPL_{cluster,source}/10)} \right)$$

- [4] For each location, determine the average screening effect based on the building height at the sensitive location. Apply a barrier insertion loss according ISO 9613-2¹, assuming a barrier at the centre of a 60m path as per Table 5.

An example calculation sheet is shown in Appendix B.

Table 5 provides the barrier insertion losses derived from ISO 9613-2 to allow for screening effect of the building. Table 6 provides the relative height of each nearby sensitive location.

Sensitive location height of building, relative to 1 Triton Square	Effective barrier height due to screening of 1 Triton Square	Barrier insertion loss (dB) in octave bands (Hz)							
		63	125	250	500	1k	2k	4k	8k
3 floors lower	5m	-8	-10	-12	-14	-17	-20	-23	-25
Same height	1m	-5	-5	-5	-6	-7	-8	-10	-13
3 floors higher	No barrier	0	0	0	0	0	0	0	0

Table 5 Barrier insertion losses per building heights

Sensitive location		Building height relative to 1 Triton Square
NSR 1	10 Brock St	Same height
NSR 2	10 Brock St	Same height
NSR 3	10 Brock St	3 floors higher
NSR 4	2 Triton Square	3 floors lower
NSR 5	338 Euston Road	3 floors higher
NSR 6	20 Triton St	3 floors lower
NSR 7	20 Triton St	3 floors lower
NSR 8	St Anne's	3 floors lower
NSR 9	Westminster Kingsway College	3 floors lower

Table 6 Building heights at nearby sensitive locations

¹ ISO 9613-2:1996 Acoustics. Attenuation of sound during propagation outdoors. General method of calculation.

6 System manufacturer selections

Roof plant	Description	Qty	Landlord/ Tenant	Selection	Sound power level, dB(A)	Sound power level (dB) per octave band (Hz)							
						63	125	250	500	1k	2k	4k	8k
A	Cooling towers	6	Landlord	Provisional	73	88	81	72	69	64	63	61	60
B	AHU - office core 2	2	Landlord	Provisional	69	68	66	66	65	62	64	49	52
C	Plate heat exchange and pump	4	Landlord	Typical	67	60	60	60	60	60	60	60	60
D	Generator heat rejection	2	Landlord	Typical	68	69	83	65	55	55	50	46	41
E	Tenant plant area	1	Tenant										
F	AHU - office core 4	2	Landlord	Provisional	69	68	66	66	65	62	64	49	52
G	AHU - main atrium	3	Landlord	Provisional	69	68	66	66	65	62	64	49	52
H	AHU - office core 3	2	Landlord	Provisional	69	68	66	66	65	62	64	49	52
I	Toilet extract fan	1	Landlord	Limit based on existing	74	80	83	76	72	67	63	58	56
J	Toilet extract fan	1	Landlord	Limit based on existing	74	80	83	76	72	67	63	58	56
K	Toilet extract fan	1	Landlord	Limit based on existing	74	80	83	76	72	67	63	58	56
L	Toilet extract fan	1	Landlord	Limit based on existing	74	80	83	76	72	67	63	58	56
M	Toilet extract fan	1	Landlord	Limit based on existing	74	80	83	76	72	67	63	58	56
N	Toilet extract fan	2	Landlord	Limit based on existing	74	80	83	76	72	67	63	58	56
O	Exhaust flue	2	Landlord	Limit	67	80	75	70	65	65	65	65	65
P	Tenant plant area	1	Tenant										
Q	AHU - main entrance reception	1	Landlord	Provisional	69	68	66	66	65	62	64	49	52
R	Toilet extract fan	1	Landlord	Limit based on existing	74	80	83	76	72	67	63	58	56
S	Toilet extract fan	1	Landlord	Limit based on existing	74	80	83	76	72	67	63	58	56

Table 7 Sound power levels of plant selections

Appendix A

Background noise measurements

A1 Background noise measurements

Attended background spot measurements, taken at pavement level on 5th May 2016, are shown in Figure 3. The results are presented graphically for comparison with the unattended measurement results.

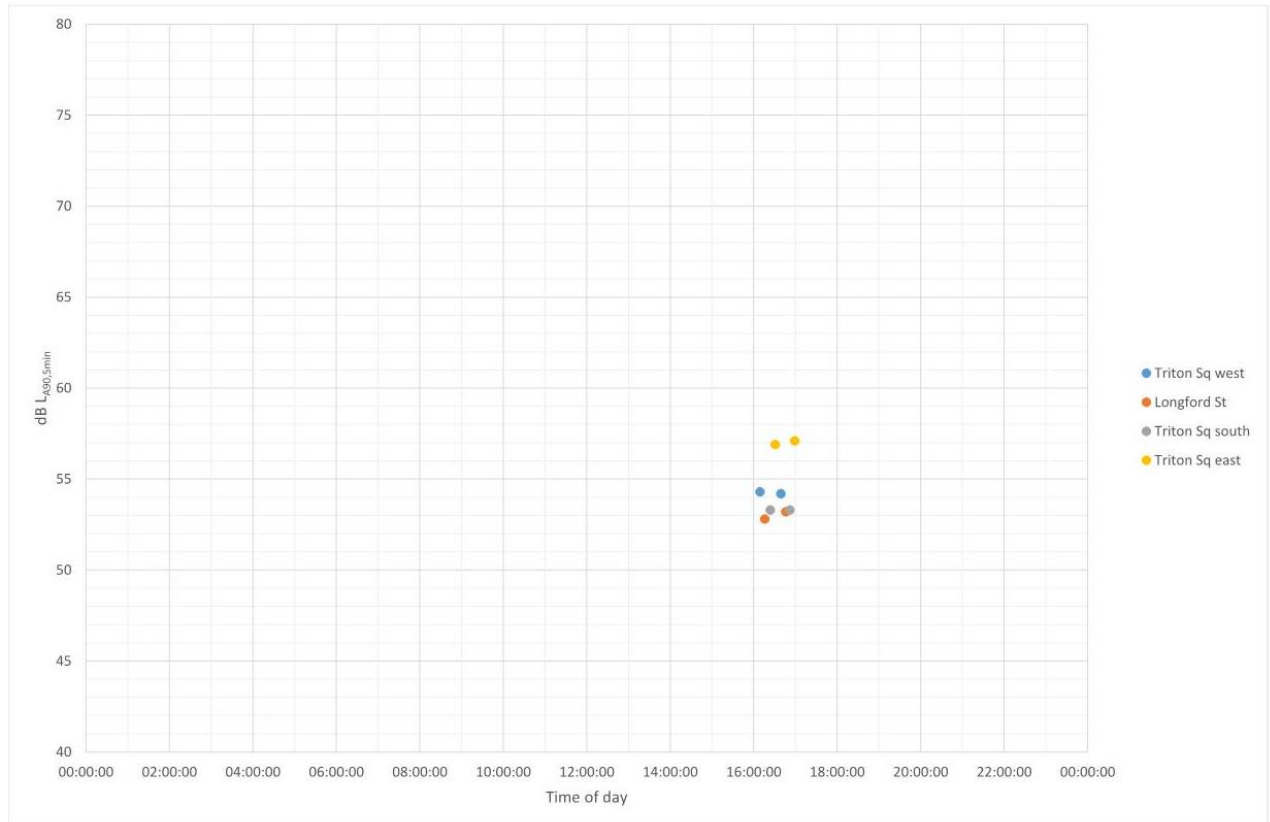


Figure 3 Background spot measurements

Unattended noise measurements were undertaken at rooftop level at 1 Triton Square between Fri 1st April and Wednesday 6th April 2016 at Location A (location indicated in Figure 1). The background and ambient noise levels are shown in Figure 4 and Figure 5.

Unattended noise measurements were undertaken at rooftop level at St Annes between Thu 1st December and Monday 5th December 2016 at Location B (location indicated in Figure 1). The background and ambient noise levels are shown in Figure 6 and Figure 7.



Figure 4 Unattended background noise measurements at 1 Triton Square

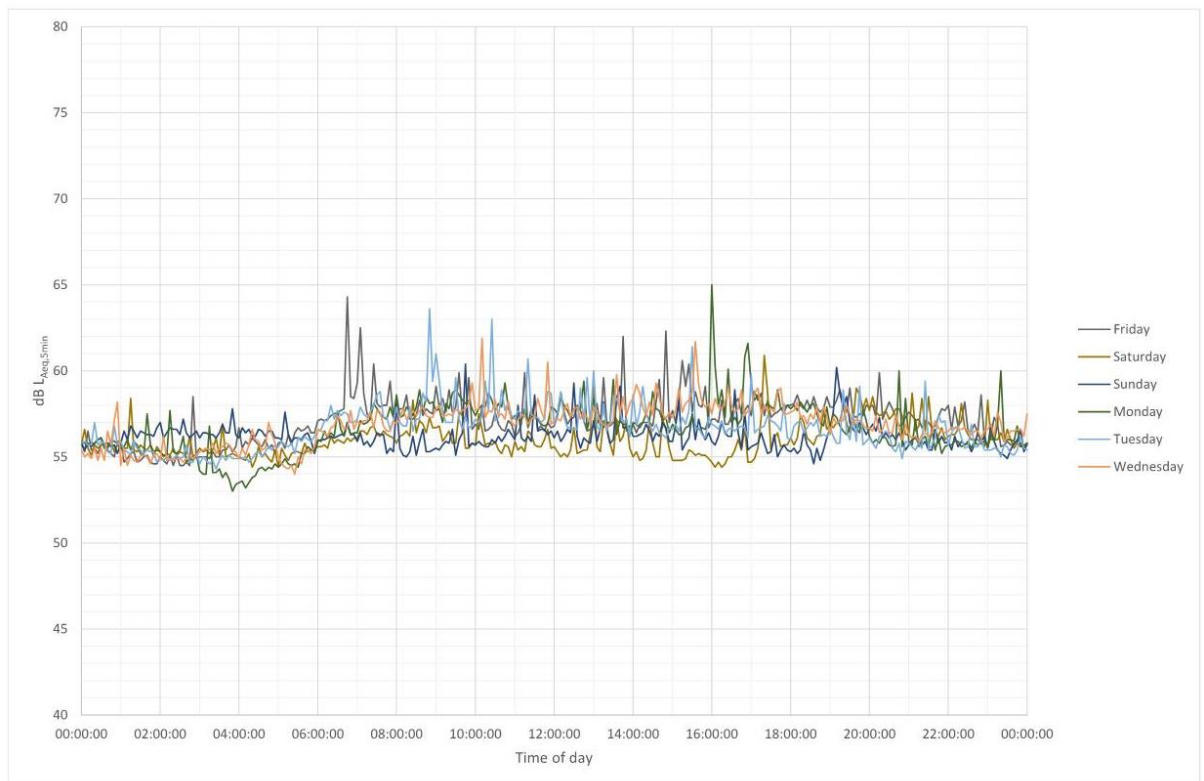


Figure 5 Unattended ambient noise measurements at 1 Triton Square

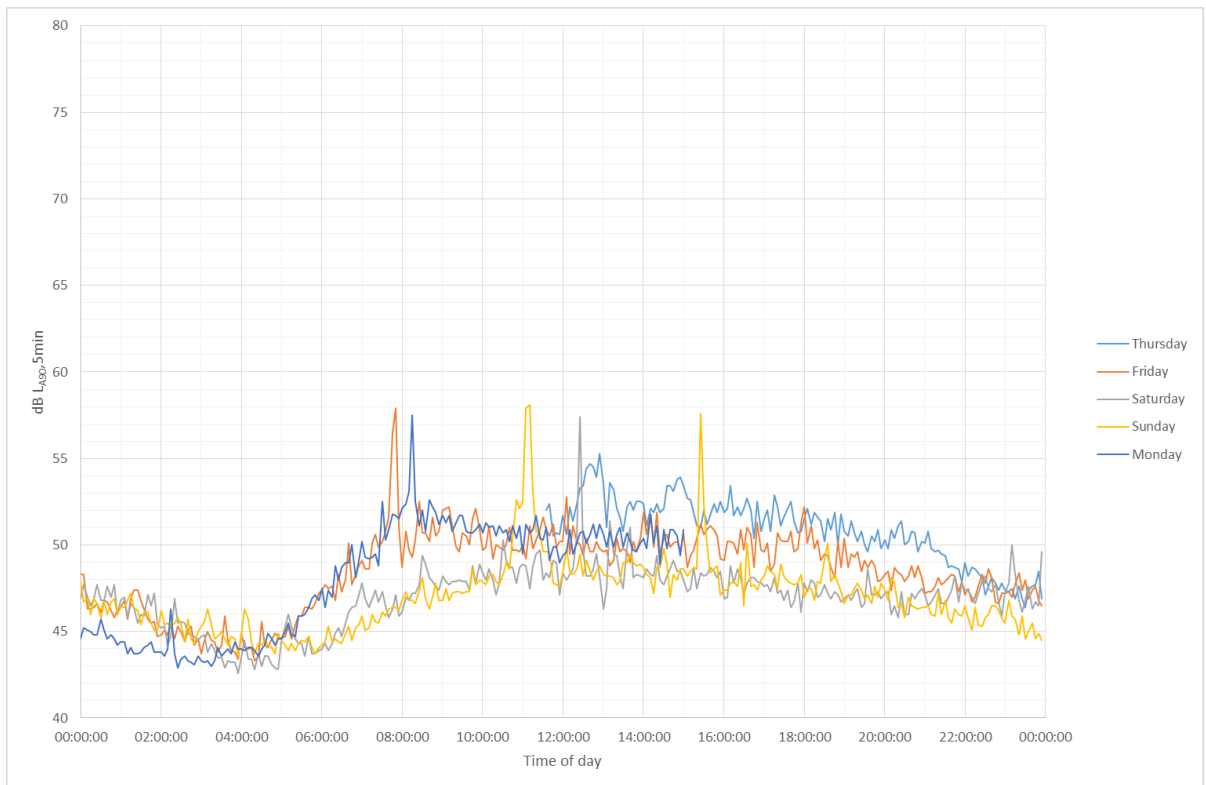


Figure 6 Unattended background noise measurements at St Annes

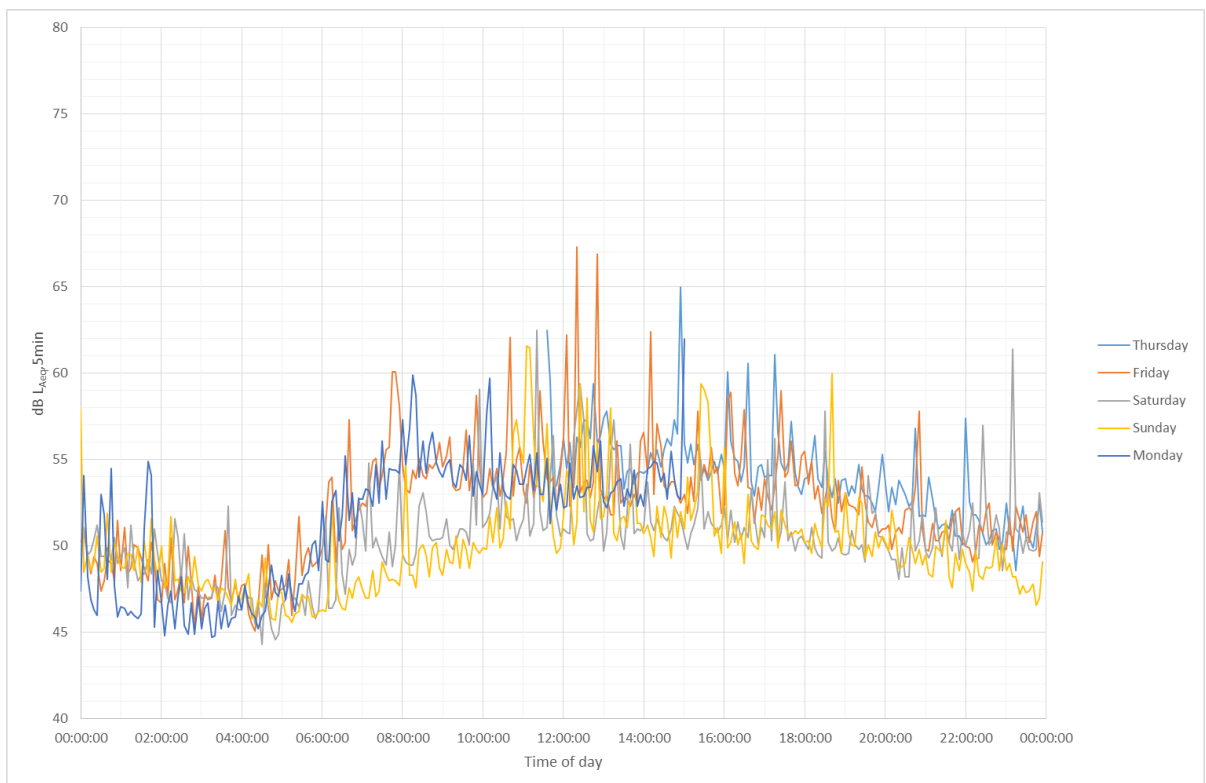


Figure 7 Unattended ambient noise measurements at St Annes

Appendix B

Typical plant noise emission calculation



Job No.	Job Title				
246868-13	Triton Square				
Date Created	By	Date Revised	Rev	Sheet	
05 Dec 2016	EE	06 Dec 2016	43	1	
Date Reviewed	By	Review Type	Review Status		

Triton Square - Summary of plant noise

Item / Description		Rating/Broadband/Input		dB(A)		Octave Band Centre Frequency, Hz							
		Rating	dB	dB(A)		63	125	250	500	1k	2k	4k	8k
NSRs	Address	Is NSR lower than roof?	Average Effective barrier height (m)	Plant noise limit (cont, non-tonal)		Use							
				Weekday 7am - 7pm	Other								
NSR 1	10 Brock St	Same height	1.0	48.0	46.0	Commercial							
NSR 2	10 Brock St	Same height	0.0	48.0	46.0	Commercial							
NSR 3	10 Brock St	3 floors higher	1.0	48.0	46.0	Commercial							
NSR 4	2 Triton Square	3 floors lower	5.0	48.0	46.0	Commercial							
NSR 5	338 Euston Road	3 floors higher	0.0	48.0	46.0	Commercial							
NSR 6	20 Triton St	3 floors lower	5.0	48.0	46.0	Commercial							
NSR 7	20 Triton St	3 floors lower	5.0	48.0	46.0	Commercial							
NSR 8	St Anne's	2 floors lower	5.0	42.0	40.0	Residential							
NSR 9	Westminster Kingsw ay College	3 floors lower	5.0	48.0	46.0	Educational							
ISO 9613.2 Barrier effects													
Barrier Attenuation - Theory: ISO 9613.2, Source H		1.0 m	30.0 m	30.0 m		-5	-5	-5	-6	-7	-8	-10	-13
Barrier Attenuation - Theory: ISO 9613.2, Source H		5.0 m	30.0 m	30.0 m		-8	-10	-12	-14	-17	-20	-23	-25
Roof plant	Description	Qty	Landlord/Tenant	Selection	Sound Power (each)								
					88	81	72	69	64	63	61	60	
A	Cooling towers	6	Landlord	Provisional	68	66	66	65	62	64	49	52	
B	AHU - office core 2	2	Landlord	Provisional	60	60	60	60	60	60	60	60	
C	Plate heat exchange and pump	4	Landlord	Typical	69	83	65	55	55	50	46	41	
D	Generator heat rejection	2	Landlord	Typical	90	85	80	80	75	75	75	75	
E	Tenant plant area	1	Tenant	Limit	68	66	66	65	62	64	49	52	
F	AHU - office core 4	2	Landlord	Provisional	68	66	66	65	62	64	49	52	
G	AHU - main atrium	3	Landlord	Provisional	68	66	66	65	62	64	49	52	
H	AHU - office core 3	2	Landlord	Provisional	68	66	66	65	62	64	49	52	
I	Toilet extract fan	1	Landlord	Limit based on existing	80	83	76	72	67	63	58	56	
J	Toilet extract fan	1	Landlord	Limit based on existing	80	83	76	72	67	63	58	56	
K	Toilet extract fan	1	Landlord	Limit based on existing	80	83	76	72	67	63	58	56	
L	Toilet extract fan	1	Landlord	Limit based on existing	80	83	76	72	67	63	58	56	
M	Toilet extract fan	1	Landlord	Limit based on existing	80	83	76	72	67	63	58	56	
N	Toilet extract fan	2	Landlord	Limit based on existing	80	83	76	72	67	63	58	56	
O	Exhaust flue	2	Landlord	Limit	80	75	70	65	65	65	65	65	
P	Tenant plant area	1	Tenant	Limit	90	85	80	80	75	75	75	75	
Q	AHU - main entrance reception	1	Landlord	Provisional	68	66	66	65	62	64	49	52	
R	Toilet extract fan	1	Landlord	Limit based on existing	80	83	76	72	67	63	58	56	
S	Toilet extract fan	1	Landlord	Limit based on existing	80	83	76	72	67	63	58	56	
Total level at NSRs		Total level (dB)	Limit (dB)	Margin under limit									
NSR 1	10 Brock St	42 (A)	46 (A)	-4 (A)									
NSR 2	10 Brock St	42 (A)	46 (A)	-4 (A)									
NSR 3	10 Brock St	46 (A)	46 (A)	-1 (A)									
NSR 4	2 Triton Square	35 (A)	46 (A)	-11 (A)									
NSR 5	338 Euston Road	43 (A)	46 (A)	-3 (A)									
NSR 6	20 Triton St	30 (A)	46 (A)	-16 (A)									
NSR 7	20 Triton St	33 (A)	46 (A)	-14 (A)									
NSR 8	St Anne's	31 (A)	38 (A)	-7 (A)									
NSR 9	Westminster Kingsw ay College	28 (A)	38 (A)	-10 (A)									

Strutt Version 5.16.09 (Compiled: 09/12/2016)\\arup.com\europa\Acoustics\London\Projects\246868-13 Project Mint\4 Internal Project Data\7 Calculations\2016\205 Stage 2 Plant Emissions - EE\2016\205 Stage 2 plant emissions v2.xlsx [Summary]

Distance to NSR									
NSR 1	NSR 2	NSR 3	NSR 4	NSR 5	NSR 6	NSR 7	NSR 8	NSR 9	
70.0	66.0	93.0	63.0	71.0	58.0	46.0	62.0	87.0	
76.0	64.0	93.0	46.0	63.0	61.0	60.0	78.0	103.0	
65.0	51.0	80.0	44.0	75.0	73.0	68.0	82.0	99.0	
59.0	41.0	71.0	41.0	85.0	84.0	78.0	90.0	101.0	
46.0	35.0	63.0	56.0	94.0	88.0	73.0	81.0	88.0	
36.0	41.0	63.0	75.0	105.0	92.0	69.0	69.0	69.0	
50.0	52.0	77.0	74.0	93.0	77.0	55.0	59.0	69.0	
63.0	67.0	92.0	77.0	85.0	64.0	41.0	48.0	72.0	
72.0	82.0	105.0	97.0	94.0	66.0	30.0	29.0	58.0	
81.0	89.0	112.0	94.0	84.0	54.0	21.0	29.0	69.0	
95.0	83.0	112.0	52.0	44.0	45.0	56.0	80.0	114.0	
98.0	81.0	111.0	39.0	44.0	56.0	71.0	93.0	125.0	
73.0	77.0	49.0	23.0	81.0	90.0	91.0	106.0	120.0	
69.0	69.0	41.0	23.0	92.0	99.0	99.0	111.0	121.0	
64.0	40.0	68.0	31.0	89.0	95.0	92.0	105.0	114.0	
62.0	34.0	61.0	35.0	96.0	101.0	98.0	109.0	115.0	
54.0	26.0	53.0	43.0	102.0	107.0	100.0	109.0	111.0	
15.0	36.0	49.0	91.0	127.0	113.0	87.0	81.0	63.0	
20.0	42.0	55.0	93.0	126.0	109.0	82.0	75.0	57.0	

SWL Distance attenuation (based on hemispherical point source)									
NSR 1	NSR 2	NSR 3	NSR 4	NSR 5	NSR 6	NSR 7	NSR 8	NSR 9	
-45	-44	-47	-44	-45	-43	-41	-44	-47	
-46	-44	-47	-41	-44	-44	-44	-46	-48	
-44	-42	-46	-41	-45	-45	-45	-46	-48	
-43	-40	-45	-40	-47	-46	-46	-47	-48	
-41	-39	-44	-43	-47	-47	-45	-46	-47	
-39	-40	-44	-45	-48	-47	-45	-45	-45	
-42	-42	-46	-45	-47	-46	-43	-43	-45	
-44	-45	-47	-46	-47	-44	-40	-42	-45	
-45	-46	-48	-48	-47	-44	-38	-37	-43	
-46	-47	-49	-47	-46	-43	-34	-37	-45	
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-44	-40	-45	-38	-47	-48	-47	-48	-49	
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-32	-39	-42	-47	-50	-49	-47	-46	-44	
-34	-40	-43	-47	-50	-49	-46	-45	-43	



Job No.	Job Title			
246868-13	Triton Square			
Date Created	By	Date Revised	Rev	Sheet
05 Dec 2016	EE	05 Dec 2016	4	3
Date Reviewed	By	Review Type	Review Status	

NSR 1

Rating/Broadband/Input					Octave Band Centre Frequency, Hz									
Item / Description		Rating	dB	dB(A)	31.5	63	125	250	500	1k	2k	4k	8k	
					Total SWL (includes quantity correction)									
Roof Plant		Quantity				Source quantity correction								
A	Cooling towers	6 x				7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8
B	AHU - office core 2	2 x				3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
C	Plate heat exchange and pump	4 x				6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
D	Generator heat rejection	2 x				3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
E	Tenant plant area	1 x				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
F	AHU - office core 4	2 x				3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
G	AHU - main atrium	3 x				4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8
H	AHU - office core 3	2 x				3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I	Toilet extract fan	1 x				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
J	Toilet extract fan	1 x				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
K	Toilet extract fan	1 x				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L	Toilet extract fan	1 x				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
M	Toilet extract fan	1 x				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
N	Toilet extract fan	2 x				3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
O	Exhaust flue	2 x				3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
P	Tenant plant area	1 x				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Q	AHU - main entrance reception	1 x				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
R	Toilet extract fan	1 x				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S	Toilet extract fan	1 x				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
					Total SWL (includes quantity correction)									
A	Cooling towers			80.4 (A)	95.8	88.8	79.8	76.8	71.8	70.8	68.8	67.8		
B	AHU - office core 2			71.8 (A)	71.1	69.0	69.1	68.1	65.1	67.2	52.0	55.2		
C	Plate heat exchange and pump			73.0 (A)	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0		
D	Generator heat rejection			70.8 (A)	72.0	86.0	68.0	58.0	58.0	53.0	49.0	44.0		
E	Tenant plant area			83.2 (A)	90.0	85.0	80.0	80.0	75.0	75.0	75.0	75.0		
F	AHU - office core 4			71.8 (A)	71.1	69.0	69.1	68.1	65.1	67.2	52.0	55.2		
G	AHU - main atrium			73.6 (A)	72.8	70.8	70.9	69.9	66.9	69.0	53.8	57.0		
H	AHU - office core 3			71.8 (A)	71.1	69.0	69.1	68.1	65.1	67.2	52.0	55.2		
I	Toilet extract fan			74.3 (A)	80.0	83.0	76.0	72.0	67.0	63.0	58.0	56.0		
J	Toilet extract fan			74.3 (A)	80.0	83.0	76.0	72.0	67.0	63.0	58.0	56.0		
K	Toilet extract fan			74.3 (A)	80.0	83.0	76.0	72.0	67.0	63.0	58.0	56.0		
L	Toilet extract fan			74.3 (A)	80.0	83.0	76.0	72.0	67.0	63.0	58.0	56.0		
M	Toilet extract fan			74.3 (A)	80.0	83.0	76.0	72.0	67.0	63.0	58.0	56.0		
N	Toilet extract fan			77.3 (A)	83.0	86.0	79.0	75.0	70.0	66.0	61.0	59.0		
O	Exhaust flue			75.5 (A)	83.0	78.0	73.0	68.0	68.0	68.0	68.0	68.0		
P	Tenant plant area			83.2 (A)	90.0	85.0	80.0	80.0	75.0	75.0	75.0	75.0		
Q	AHU - main entrance reception			68.8 (A)	68.1	66.0	66.1	65.1	62.1	64.2	49.0	52.2		
R	Toilet extract fan			74.3 (A)	80.0	83.0	76.0	72.0	67.0	63.0	58.0	56.0		
S	Toilet extract fan			74.3 (A)	80.0	83.0	76.0	72.0	67.0	63.0	58.0	56.0		

					Total SWL (includes quantity correction)							
A	Cooling towers			80.4 (A)	95.8	88.8	79.8	76.8	71.8	70.8	68.8	67.8
B	AHU - office core 2			71.8 (A)	71.1	69.0	69.1	68.1	65.1	67.2	52.0	55.2
C	Plate heat exchange and pump			73.0 (A)	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0
D	Generator heat rejection			70.8 (A)	72.0	86.0	68.0	58.0	58.0	53.0	49.0	44.0
E	Tenant plant area			83.2 (A)	90.0	85.0	80.0	80.0	75.0	75.0	75.0	75.0
F	AHU - office core 4			71.8 (A)	71.1	69.0	69.1	68.1	65.1	67.2	52.0	55.2
G	AHU - main atrium			73.6 (A)	72.8	70.8	70.9	69.9	66.9	69.0	53.8	57.0
H	AHU - office core 3			71.8 (A)	71.1	69.0	69.1	68.1	65.1	67.2	52.0	55.2
I	Toilet extract fan			74.3 (A)	80.0	83.0	76.0	72.0	67.0	63.0	58.0	56.0
J	Toilet extract fan			74.3 (A)	80.0	83.0	76.0	72.0	67.0	63.0	58.0	56.0
K	Toilet extract fan			74.3 (A)	80.0	83.0	76.0	72.0	67.0	63.0	58.0	56.0
L	Toilet extract fan			74.3 (A)	80.0	83.0	76.0	72.0	67.0	63.0	58.0	56.0
M	Toilet extract fan			74.3 (A)	80.0	83.0	76.0	72.0	67.0	63.0	58.0	56.0
N	Toilet extract fan			77.3 (A)	83.0	86.0	79.0	75.0	70.0	66.0	61.0	59.0
O	Exhaust flue			75.5 (A)	83.0	78.0	73.0	68.0	68.0	68.0	68.0	68.0
P	Tenant plant area			83.2 (A)	90.0	85.0	80.0	80.0	75.0	75.0	75.0	75.0
Q	AHU - main entrance reception			68.8 (A)	68.1	66.0	66.1	65.1	62.1	64.2	49.0	52.2
R	Toilet extract fan			74.3 (A)	80.0	83.0	76.0	72.0	67.0	63.0	58.0	56.0
S	Toilet extract fan			74.3 (A)	80.0	83.0	76.0	72.0	67.0	63.0	58.0	56.0
					Barrier attenuation							
Based on 1m effective barrier at centre of 60m distance					-4.9	-5.1	-5.4	-6.0	-6.9	-8.4	-10.3	-12.7
					Residual Level at NSR							
A	Cooling towers		-44.9		46.0	38.8	29.5	25.9	20.0	17.5	13.6	10.2
B	AHU - office core 2		-45.6		20.6	18.3	18.1	16.5	12.6	13.2	-3.9	-3.1
C	Plate heat exchange and pump		-44.3		16.9	16.7	16.4	15.8	14.9	13.4	11.5	9.1
D	Generator heat rejection		-43.4		23.7	37.5	19.2	8.6	7.7	1.2	-4.7	-12.1
E	Tenant plant area		-41.2		43.9	38.7	33.4	32.8	26.9	25.4	23.5	21.1
F	AHU - office core 4		-39.1		27.1	24.8	24.6	23.0	19.1	19.7	2.6	3.4
G	AHU - main atrium		-42.0		26.0	23.7	23.5	21.9	18.0	18.6	1.5	2.3
H	AHU - office core 3		-44.0		22.2	19.9	19.7	18.1	14.2	14.8	-2.3	-1.5
I	Toilet extract fan		-45.1		30.0	32.8	25.5	20.9	15.0	9.5	2.6	-1.8
J	Toilet extract fan		-46.2		28.9	31.7	24.4	19.8	13.9	8.4	1.5	-2.9
K	Toilet extract fan		-47.5		27.6	30.4	23.1	18.5	12.6	7.1	0.2	-4.2
L	Toilet extract fan		-47.8		27.3	30.1	22.8	18.2	12.3	6.8	-0.1	-4.5
M	Toilet extract fan		-45.3		29.8	32.6	25.3	20.7	14.8	9.3	2.4	-2.0
N	Toilet extract fan		-44.8		33.3	36.1	28.8	24.2	18.3	12.8	5.9	1.5
O	Exhaust flue		-44.1		34.0	28.8	23.5	17.9	17.0	15.5	13.6	11.2
P	Tenant plant area		-43.8		41.3	36.1	30.8	30.2	24.3	22.8	20.9	18.5
Q	AHU - main entrance reception		-42.6		20.5	18.3	18.1	16.5	12.5	13.2	-3.9	-3.2
R	Toilet extract fan		-31.5		43.6	46.4	39.1	34.5	28.6	23.1	16.2	11.8
S	Toilet extract fan		-34.0		41.1	43.9	36.6	32.0	26.1	20.6	13.7	9.3
Total level at NSR					50.9	50.2	43.0	39.6	33.9	31.0	26.8	24.2

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British Land
St Anne's
Noise Assessment

R03

Draft 1 | 5 December 2016

This report takes into account the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

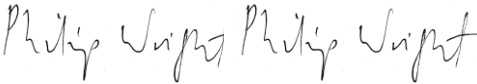
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Appendices

Appendix A

Background noise measurements

1 Introduction

Ove Arup & Partners (Arup) have been appointed by British Land to provide acoustic design consultancy services for the proposed redevelopment project at St Anne's, London.

London Borough of Camden (LBC) require a noise assessment and report to support the planning application for the project. LBC require that the acoustic report should be prepared by a qualified acoustician outlining details of:

- The existing background noise levels measured over 24hrs.
- Proposed noise output.
- The measures proposed to reduce noise, fume emissions and vibration.
- Cumulative noise levels including all existing and proposed units.
- The system manufacturer's specifications.
- The method used to compile the report and examples of the calculations and assumptions made.

This report sets out these details as far as available plant information makes possible at this stage.

In addition, this report considers noise ingress from external sources, and demonstrates how appropriate standards for internal noise levels will be achieved.

2 Existing background noise

Arup undertook an unattended background noise measurement at rooftop level of St Anne's (Location A) between 1st December and 5th December 2016. The Measurement location is shown in Figure 1.

This location was chosen as it was unaffected by nearby plant, and provided a convenient means of obtaining background noise levels representative of those at the adjacent existing residential premises, as well as the proposed residential development at St Anne's.

Table 1 sets out the lowest background levels that were measured at this location.

Sensitive locations	Lowest measured background levels (LA _{90,5min}), dB	
	Daytime (7am – 7pm)	Other times
Adjacent properties to St Anne's	45	43

Table 1: Lowest background levels measured.

The appendix provides more detail on this background noise levels recorded.

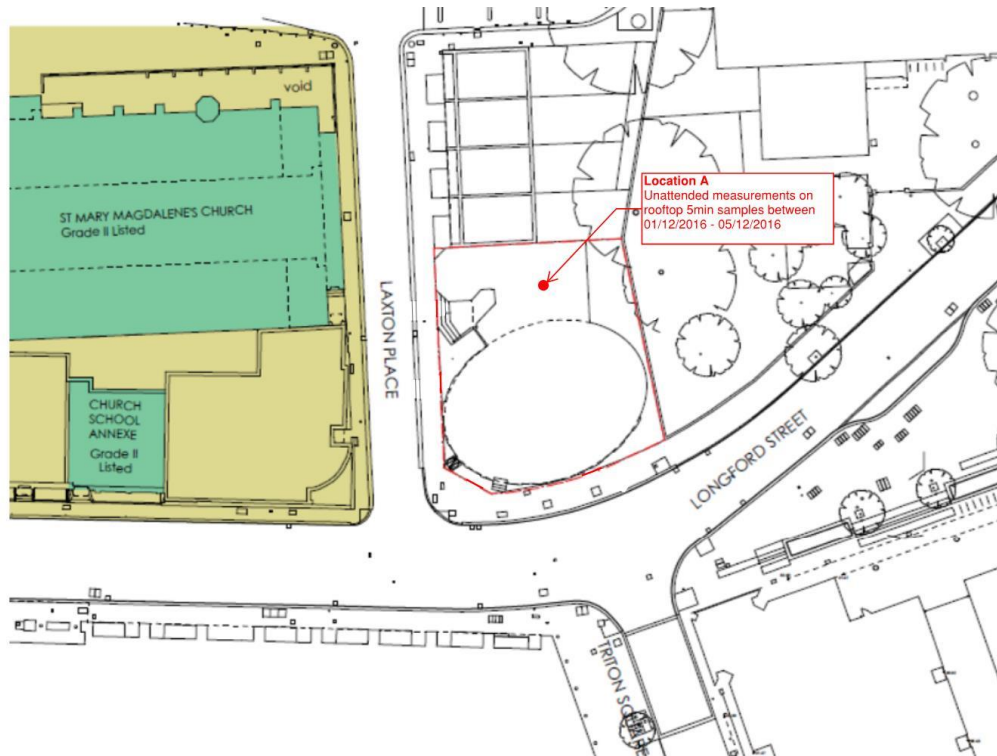


Figure 1: Background noise measurement location.

3 Noise emission limits

External noise emissions will be controlled to meet Camden Council's requirements. These are set out in the council's development policy "DP28", and extract from which is shown below.

For non-tonal plant, noise emissions are to be at least 5dB below background noise levels at any time, at "sensitive" facades of nearby buildings. Elsewhere in the DP28 document it is stated that "noise sensitive development includes housing, schools and hospitals as well as offices, workshops and open spaces." Therefore the requirement can be considered in practice to all of the adjacent buildings.

Table E: Noise levels from plant and machinery at which planning permission will not be granted

Noise description and location of measurement	Period	Time	Noise level
Noise at 1 metre external to a sensitive façade	Day, evening and night	0000-2400	5dB(A) <LA90
Noise that has a distinguishable discrete continuous note (whine, hiss, screech, hum) at 1 metre external to a sensitive façade.	Day, evening and night	0000-2400	10dB(A) <LA90
Noise that has distinct impulses (bangs, clicks, clatters, thumps) at 1 metre external to a sensitive façade.	Day, evening and night	0000-2400	10dB(A) <LA90
Noise at 1 metre external to sensitive façade where LA90>60dB	Day, evening and night	0000-2400	55dB _{LAeq}

Table 2: Camden Council's noise emissions requirements.

Emergency generators used to maintain business continuity during power failures are subject to the same limits.

The LBC planning requirements do not apply to equipment that operates solely under emergency life safety conditions or for testing of such equipment.

The current LBC policy regarding noise from life-safety plant is that external noise emissions for emergency generators (life safety and communications only) is not to exceed the lowest daytime $L_{Aeq,15mins}$.

Table 3 sets out the noise emission limits for the development on this basis.

Sensitive location	Building services noise emission limit at 1m external to sensitive façade, dBL _{Ar,Tr}		
	Type of noise	Daytime (7am-7pm)	Other times
Adjacent properties to St Annes	Noise from plant	40	38
	Noise from plant that has a distinguishable continuous note or distinct impulses	35	33
	Emergency generator	47	47

Table 3: Plant noise emission limits at nearby locations.

4 Assessment of noise emissions

4.1 Receivers

The figure below shows the principal nearby receivers, which are also listed in the table below:

NSRs	Address
NSR 1	9 Laxton Pl
NSR 2	1-4 Laxton Pl (west)
NSR 3	Westminster Kingsway College
NSR 4	1-4 Laxton Pl (east)

Table 4: sensitive receivers

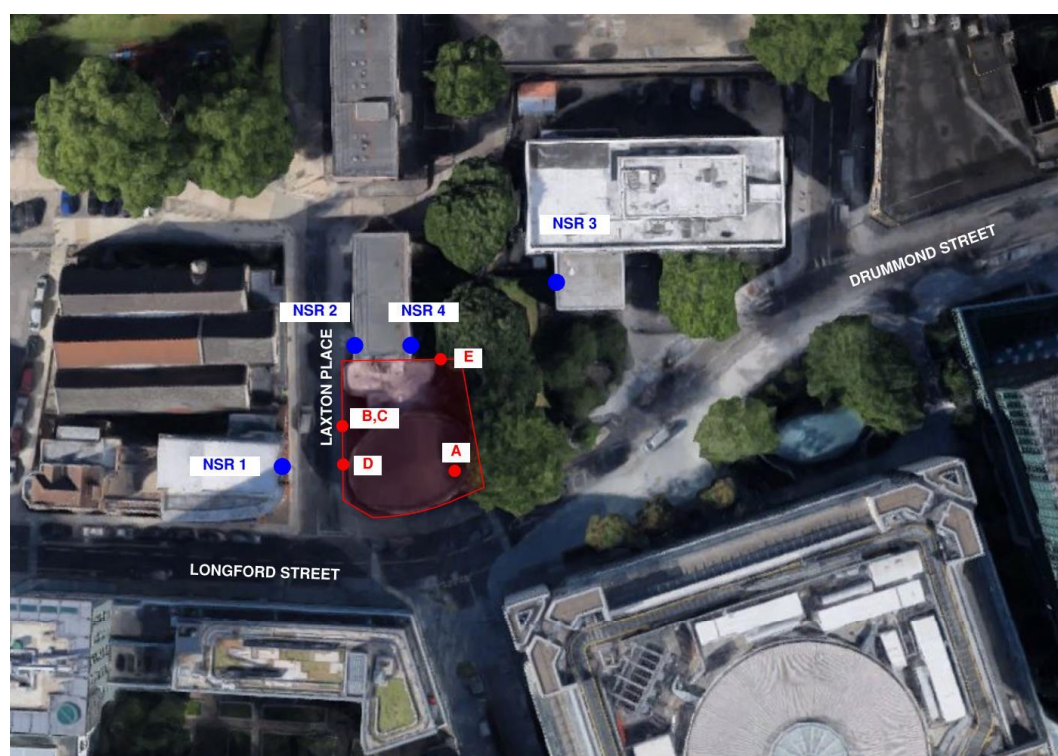


Figure 2: Plant locations and nearby sensitive locations

4.2 Sources

The principal items to be considered are:

- MVHR ventilation units serving each apartment, and with inlet and discharge connections to the façade elevations
- Generator located in the ground floor plant room
- Transformer at ground level
- Heat rejection plant at roof level.

At this stage of design not all units are selected, so reasonable assumptions have been made regarding noise emissions and the measures that will be required to achieve the necessary control.

MVHR units

Source sound power levels of candidate MVHR units is shown in the table below.

			Octave Band Centre Frequency, Hz								
		dB(A)	31.5	63	125	250	500	1k	2k	4k	8k
outlet		66.4 (A)		56.0	62.0	60.0	63.0	64.0	56.0	49.0	48.0
inlet		50.3 (A)		49.0	52.0	50.0	47.0	47.0	40.0	32.0	28.0

Table 5: candidate MVHR inlet and outlet sound power levels

Each elevation of the proposed development will have a number of connections from these to the façade. We have assumed as a worst case 8 connections facing north, and 6 facing west (towards Laxton Place).

As a worst case, approximately 16dB of attenuation will be required to the outlets in order to meet the noise criteria at the nearby residential receivers, 10m away.

A significant degree of attenuation will normally occur naturally through an MVHR system, but where required additional in-line attenuators will be installed to control noise output. A limiting sound power of approximately 50dBA from each façade connection is proposed at this stage.

Generator

Noise data has been provided for a typical enclosed generator set of the required electrical power rating, in the form of an overall sound power level of 93dBA.

Within the plant room – assuming a degree of absorptive treatment – our estimates indicate this will produce a sound pressure level of approximately 88dBA. Taking into account likely exposed Ground Floor louvre area, the sound power to atmosphere would be of the order of 86dBA.

At the opposite residential premises (9 Laxton Place) the resulting sound pressure level would be approximately 67dBA, which would exceed the requirement of 47dBA for emergency plant.

Therefore, attenuation will be installed at louvre connections to reduce noise levels by approximately 20dB.

Transformer

High sound pressure levels are not anticipated from the transformer. However, the tonal nature of transformers is noted, and measures will be taken to ensure the related emissions criteria are met. These will include:

- Isolating supports
- Acoustically rated doors to control break-out
- Attenuation as required to plantroom ventilation paths.

Heat Rejection

Candidate heat rejection plant has not yet been selected. However this plant will be located at roof level, and therefore calculations have been carried out to establish suitable limiting levels.

Because of the greater height of St Anne's relative to the closest receivers, a degree of screening will be obtained. A figure of 10dB is a reasonable conservative assumption, together with a conservative distance assumption of 15m.

Assuming point source propagation this suggests a limiting sound power level of approximately 70 to 75dBA will be appropriate. Heat rejection plant will be selected and attenuated accordingly.

4.2.1 Control of vibration

All plant items will be vibration isolated.

4.3 Noise emissions calculation method

The noise emission estimates have followed the following method:

1. For each item of plant, establish a sound power level (SWL_{item}) and correct for quantity of plant, N , according to

$$SWL_{cluster} = SWL_{item} + 10 \log_{10}(N)$$

2. For each item of plant and each sensitive location measure the plan distance, r . Assume point-source hemi-spherical spreading to determine the sound pressure level (SPL) from the total SWL.

$$SPL_{cluster,source} = SWL_{cluster} - 20 \log_{10}(r) - 11$$

3. For louvres, a plane source propagation model has been employed.

4.4 Conclusions

Noise emissions will be controlled to meet Camden's requirements. Although actual plant selections cannot be determined at this stage, candidate selection information and reasonable assumptions of source levels have been used to demonstrate how this will be achieved.

Appendix A

Background noise measurements

A1 Background noise measurements

The time-level trace for the unattended noise measurements undertaken at rooftop level at St Anne's between 1st December and 5th December 2016 are shown below.

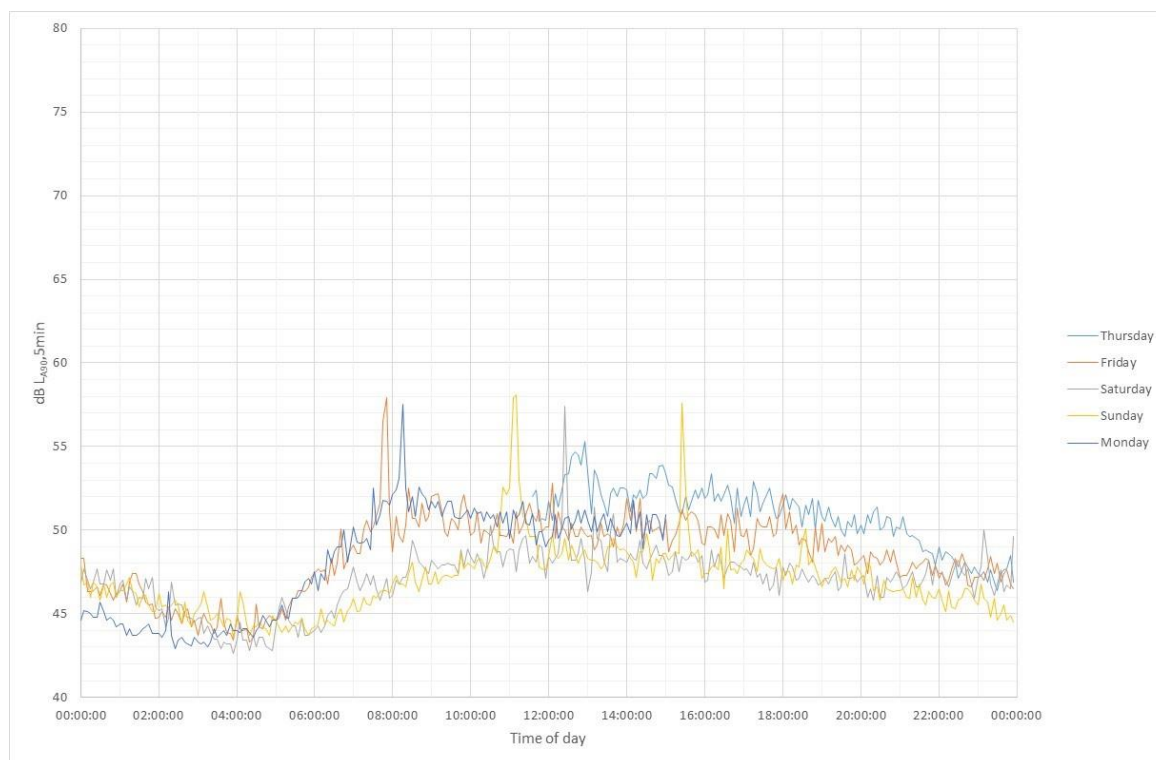


Figure 3: unattended background noise measurements