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WORTHING
TP REF No.
WB/ /

Project: J 00395 - ADDENDUM
Environmental Noise Assessment:
BS4142:1997 – External Duct System
B&W Loudspeakers Ltd

Consultants: Sound Planning Ltd
48 Windermere Way
Farnham
Surrey
GU9 0DE

BOROUGH OF WORTHING
DEPOSITED 07/09/2009
TP REF No.
WB/ 09 / 0520/FULL

Client: Tim Hill
B&W Loudspeakers

Prepared by: D. M. Thomas
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Signed: [redacted]

D. M. Thomas
Acoustic Consultant

Dated: Monday 7th September 2009

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1.0 ADDENDUM

1.1 Introduction

Sound Planning has been informed that distances from B&W façade to nearest noise sensitive receiver, reported in J 00395, were incorrect.

The closest noise sensitive façade should be 100m and not 234m.

1.2 Calculation

The worst case scenario would be 24 hour operation.

Sound Planning has recalculated duct break-out noise at the nearest receiver using the distance of 100m:

Frequency	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz		
SWL_{duct}	85.2	88.1	86.6	82.2	84	83.8	80	79.1	94	dB
Attenuator	7	18	36	45	45	45	45	45		
Duct SRI	3	8	14	20	26	32	38	40		
10log (S/A)	29.9	29.9	29.9	29.9	29.9	29.9	29.9	29.9		
Reduction	3	3	3	3	3	3	8.1	10.1		
Power Level	75.2	67.1	47.6	34.2	36.0	35.8	26.9	24.0	76	dB
A-Weighted	49.0	51.0	39.0	31.0	36.0	37.0	27.9	22.9	53.5	dB(A)

A break-out level of ≤54dB(A) will provide a façade level where 'complaints are unlikely':

$39 - 10 = 54 - 10\log_{100} - 11 + 6$

1.3 Attenuator Specification

A rectangular duct splitter (200mm) attenuator with a Free Area of 30% and 2100mm in length will provide the required insertion loss:

Frequency	Hz							
	63	125	250	500	1k	2k	4k	8k
IL	7	18	36	45	45	45	45	45

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1.0 INTRODUCTION

Sound Planning has been commissioned to conduct an environmental noise assessment with regard to a proposed spray booth at B&W Loudspeakers.

The spray booth will require an extraction system with an external duct running around the perimeter of the B&W building.



Picture 1: Site Overview

The ductwork will run for 102m along the south elevation of the building before turning 90° and running 42m along the east elevation.

The extract fan will be housed internally within the building fabric.

The operational hours are currently unknown therefore Sound Planning will conduct a background noise assessment for a full 24 hour period, representative of the nearest noise sensitive dwellings.

Noise emissions from the proposed extract duct system should be calculated at the nearest noise sensitive façade using appropriate methodology; these noise levels should be compared to the measured background noise levels, in the assessment of the likelihood of complaint.

Planning applications within this area fall under the jurisdiction of Worthing Borough Council, therefore any acoustic report will act in accordance with Worthing's accepted Noise Criteria Assessment.

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Nadeem Shad (Environmental Health Officer – Worthing Borough Council) has requested that BS4142: 1997 is used with regards to the assessment methodology and criteria assessment.

2.0 METHODOLOGY

2.1 Noise Level Criteria

2.1.1 BS4142: 1997 [1]

Noise from industrial sources radiated to residential areas is usually assessed against British BS4142: 1997, `Method for Rating industrial noise affecting mixed residential and industrial areas'. This standard describes a method for assessing whether the `specific noise' from an industrial source is likely to give rise to complaints from residents of the adjacent dwellings.

The `specific noise' levels are determined outside dwellings. The specific noise level is determined for reference time periods of 1 hour for the *daytime* (07:00 to 23:00) and 5 minutes for the *night time* (23:00 to 07:00). Tonal or impulsive characteristics of a noise are likely to increase the scope for complaints and this taken into account by adding +5dB to the specific noise source level to obtain the `Rating Level'. BS4142: 1997 require that the Rating Level of a noise is compared with the existing background noise: (L_{A90}, T).

Guidance given in the standard states that if the difference between the Rating Level and the background noise (L_{A90}, T) is +5dB, it would be considered as being of *marginal significance*. This is usually taken as being an acceptable situation, as it is a reasonable compromise between the requirements of commerce and the amenity of residents.

A difference of around +10dB or more indicates that *complaints are likely*. Most Local Authorities use a difference of +10dB as the point at which they will take action against the organisation producing the noise.

If the Rating Level is more than 10dB below the background noise this is a positive indication that *complaints are unlikely.*

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BS4142: NOTE: *"For the purpose of this standard, background noise levels below about 30dB and rating levels below 35dB are considered to be very low".*

2.1.2 BS8233: 1999 – Sound Insulation and Noise Reduction for Buildings [2]

Criterion	Typical Situations	Design Range $L_{Aeq,\,T}$ dB	
		Good	Reasonable
Reasonable industrial working conditions	Heavy Engineering	70	80
	Light Engineering	65	75
	Garages, Warehouses	65	75
Reasonable speech or telephone conversations	Department Store	50	55
	Cafeteria, Canteen, Kitchen	50	55
	Wash Room, Toilet	45	55
	Corridor	45	55
Reasonable conditions for study and work requiring concentration	Library, Cellular Office, Museum	40	50
	Staff Room	35	45
	Meeting Room, Executive Office	35	40
Reasonable listening conditions	Classroom	35	40
	Church, Lecture Theatre, Cinema	30	35
	Concert Hall, Theatre	25	30
	Recording Studio	20	25
Reasonable resting/sleeping conditions	Living Rooms	30	40
	Bedrooms*	30	35

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2.2 Instrumentation

Equipment	Manufacturer	Model	Class	Serial Number	Calibration Certificate	Calibration Date
Sound Level Meter	Casella	CEL490	1	128950	UKAS 4401	11/03/2009
Field Calibrator	Casella	CEL 110/1	1	077948	UKAS 4402	11/03/2009
Environmental Tripod						
Wind Shield						
Bird Spike						
Laser Distance Measurer	Leica	Disto A5		1073750838		

Calibrated before run on	27/07/2009	12:15:50	at	113.6 dB @ 1kHz
Calibrated after run on	28/07/2009	16:25:51	at	113.7 dB @ 1kHz

Input: Microphone
Deviation detected: 0.1dB

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2.3 Noise Measurements

2.3.1 Background Noise

The background noise assessment was conducted between 12:57 hours Monday 27th July and 16:31 hours Tuesday 28th July, 2009.

Measurements were conducted in accordance with BS7445: 2003 [3] and ISO 9613: 1996 [4].



Picture 2: Monitoring Position

The Sound Meter was set to broadband measurement at 'Fast' time weighting.

The microphone was located 1.5m above ground level and at least 3.5m away from any vertical reflective façades.

The microphone position was representative of the nearest noise sensitive façades to the proposed external duct system; microphone location accepted by Kathryn Adderson (27/07/2009) in the absence of Nadeem Shad.

2.3.2 Duct Extract Break-Out Noise

Calculation methodology adhered to ISO 9613: 1996 [4] with guidance from Sharland [5] and Sound Research Laboratories: Noise Control in Industry [6].

2.4 Meteoric Conditions

Meteoric conditions were considered acceptable, see APPENDIX 2 for full details.

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3.0 RESULTS

3.1 Background Noise Levels

Time Reference	Reference Period (hours)	Lowest Background Level Occurred	Background Level ($L_{A90, 15mins}$)
Office Hours	0800 - 1800	17:41 – 17:56	48.5dB
Daytime	0700 - 2300	19:56 – 20:11	46.0dB
Night Time	2300 - 0700	01:26 – 01:41	39.0dB

See APPENDIX 2 for full results

3.2 Fan Sound Power Spectrum

Soler & Palau CMT/4 280/115 – 2.2kW

3.2.1 A-Weighted:

Freq	Hz							
	63	125	250	500	1k	2k	4k	8k
dB(A)	59	72	78	79	84	85	81	78

Broadband: 90dB(A)

3.2.2 Linear:

Freq	Hz							
	63	125	250	500	1k	2k	4k	8k
dB(A)	59	72	78	79	84	85	81	78
	26.2	16.1	8.6	3.2	0	-1.2	-1	1.1
dB(Z)	85.2	88.1	86.6	82.2	84.0	83.8	80.0	79.1

Broadband: 93.6dB(Z)

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4.0 DISCUSSION

4.1 Measurement Position

The selected location for background noise monitoring was approved by Kathryn Adderson; a representative measurement location where monitoring equipment could be securely left for a 24 hour period.

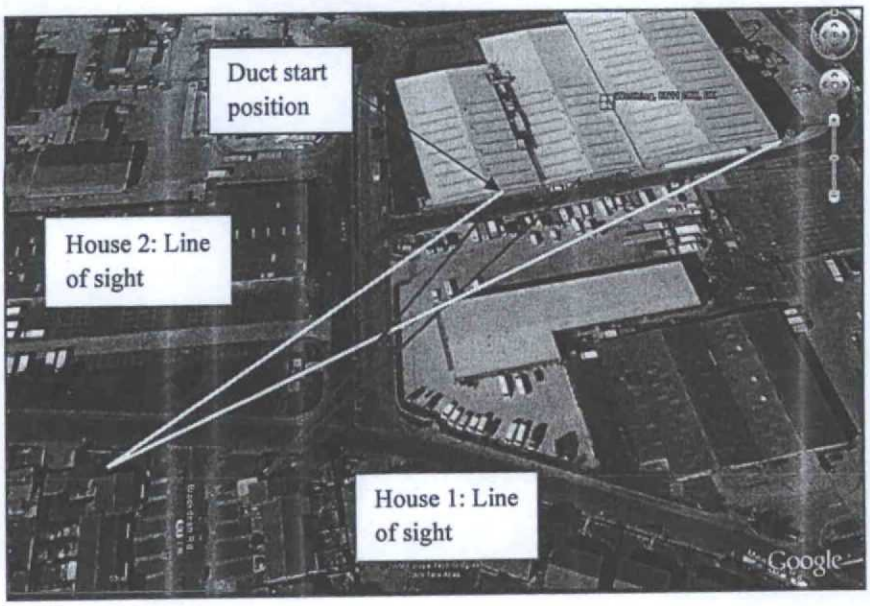
4.2 Acoustic Feature Characteristics

No distinct tones are present in the fan SWL spectrum.

4.3 Time Corrections

Extraction system could operate continually therefore no correction should be applied.

4.4 Visible Duct (relative to nearest noise sensitive façades)



Picture 3: Façades Line of Sight

The graphic above shows that the nearest noise sensitive façades would see different amounts of the ductwork, due to their relative positions.

House 1:	The closest noise sensitive façade	@ 234m
	Visible Duct: 30m	
House 2:	The second closest noise sensitive façade	@ 280m
	Visible Duct: 102m	

4.5 Directivity

The duct is to be located on a wall above a hard reflective surface i.e. Q=4 or DI = +6dB.

4.6 Distance Corrections

Sound Planning would consider the noise break-out to be a 'line-source' or concur with cylindrical divergence i.e. $SPL_2 = SPL_1 - 10\log_r - 11 + DI$

Where r = radius; SPL = Sound Pressure Level

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5.0 CRITERIA ASSESSMENT

5.1 Assessment Criteria

Nadeem Shad has requested the application of BS4142: 1997.

5.2 Break-Out Methodology

$SWL_{break\text{-}out} = SWL_{duct} - R + 10\log(S/A)$ [6]

Where

SWL	Sound Power Level	
S	Surface Area	$1.25m^2$ x Visible Duct
A	Cross Section	$0.13m^2$
R	Sound Reduction Index	

The term 'R' cannot give a greater break-out level than there is inside the duct. Therefore at low frequency the effective reduction is taken as 3dB [6].

5.3 Break-Out Calculation

5.3.1 House 1

Frequency	Hz							
	63	125	250	500	1k	2k	4k	8k
SWL_{duct}	85.2	88.1	86.6	82.2	84.0	83.8	80.0	79.1
R [5]	3	8	14	20	26	32	38	40
10log(S/A)	24.6	24.6	24.6	24.6	24.6	24.6	24.6	24.6
Reduction	3	3	3	3	3	7.4	13.4	15.4
$SWL_{breakout}$	82.2	85.1	83.6	79.2	81.0	76.4	66.6	63.7
A-Weight	56.0	69.0	75.0	76.0	81.0	77.6	67.6	62.6
Broadband	84dB(A)							

5.3.2 House 2

Frequency	Hz							
	63	125	250	500	1k	2k	4k	8k
SWL_{duct}	85.2	88.1	86.6	82.2	84.0	83.8	80.0	79.1
R	3	8	14	20	26	32	38	40
10log(S/A)	29.9	29.9	29.9	29.9	29.9	29.9	29.9	29.9
Reduction	3	3	3	3	3	3	8.1	10.1
$SWL_{breakout}$	82.2	85.1	83.6	79.2	81.0	80.8	71.9	69.0
A-Weight	56.0	69.0	75.0	76.0	81.0	82.0	72.9	67.9
Broadband	86dB(A)							

5.4 Distance Attenuation

As discussed in **4.6** the rules of cylindrical divergence will be applied:
$SPL_2 = SPL_1 - 10\log_r - 11 + DI$

5.4.1 House 1

$SPL_{house1} = 84 - 10\log_{234} - 11 + 6$

$SPL_{house1} = 55.3dB(A)$

5.4.2 House 2

$SPL_{house2} = 86 - 10\log_{280} - 11 + 6$

$SPL_{house2} = 56.5dB(A)$

5.4.3 Corrections

No tonal corrections should be applied; $SWL_{breakout}$ shows no tonal qualities.

No time corrections; spray booth could operate for a continuous 60 minute period.

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5.5 BS4142: 1997 Assessment

Hours of Operation	Time Reference	Background Level (dB L_{A90})	House 1 Excess (dB)	House 2 Excess (dB)
Office	0800 - 1800	48.5	6.8	8.0
Day	0700 - 2300	46.0	9.3	10.5
Night	2300 - 0700	39.0	16.3	17.5

6.0 CONCLUSIONS

6.1 Office Hours

House 2 shows the greatest excess over background of 8.0dB.

BS4142: 1997 suggests that 'complaints are likely'.

18dB attenuation is required in order to achieve BS4142: 1997 advice that 'Complaints are unlikely' i.e. 10dB below background.

6.2 Daytime

House 2 shows the greatest excess over background of 10.5dB.

BS4142: 1997 suggests that 'complaints are likely'.

20.5dB attenuation is required in order to achieve BS4142: 1997 advice that 'Complaints are unlikely' i.e. 10dB below background.

6.3 Night Time

House 2 shows the greatest excess over background of 17.5dB.

BS4142: 1997 suggests that 'complaints are likely'.

27.5dB attenuation is required in order to achieve BS4142: 1997 advice that 'Complaints are unlikely' i.e. 10dB below background.

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7.0 NOISE MITIGATION

7.1 Office Hours

7.1.1 Required Break-Out Level

In order to achieve noise levels where 'complaints are unlikely' at the worst affected noise sensitive façade (House 2), break-out levels need to be attenuated by 18dB.

A break-out level of ≤68dB(A) will provide a façade level where 'complaints are unlikely':

$48.5 - 10 = 68 - 10\log_{280} - 11 + 6$

7.1.2 Duct Attenuator Specification

A rectangular duct splitter (200mm) attenuator:

Free Area 32.5%
Length 600mm

Frequency	Hz							
	63	125	250	500	1k	2k	4k	8k
IL	5	6	11	20	27	26	25	20

Full calculations can be found in APPENDIX 3.

Please note pressure drop calculations have not been performed; attenuator should normally produce no more than 50Pa pressure drop. A greater than 50Pa pressure drop will require a transitional increase in duct side to incorporate the attenuator.

Supplier: Various

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7.2 Daytime

7.2.1 Required Break-Out Level

In order to achieve noise levels where 'complaints are unlikely' at the worst affected noise sensitive façade (House 2), break-out levels need to be attenuated by 20.5dB.

A break-out level of ≤65.5dB(A) will provide a façade level where 'complaints are unlikely':

$46 - 10 = 65.5 - 10\log_{280} - 11 + 6$

7.2.2 Duct Attenuator Specification

A rectangular duct splitter (200mm) attenuator:

Free Area 37.5%
Length 900mm

Frequency	Hz							
	63	125	250	500	1k	2k	4k	8k
IL	4	8	14	24	31	29	26	20

Full calculations can be found in APPENDIX 3.

Please note pressure drop calculations have not been performed; attenuator should normally produce no more than 50Pa pressure drop. A greater than 50Pa pressure drop will require a transitional increase in duct side to incorporate the attenuator.

Supplier: Various

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7.3 Night Time

7.3.1 Required Break-Out Level

In order to achieve noise levels where 'complaints are unlikely' at the worst affected noise sensitive façade (House 2), break-out levels need to be attenuated by 27.5dB.

A break-out level of ≤58.5dB(A) will provide a façade level where 'complaints are unlikely':

$39 - 10 = 58.5 - 10\log_{280} - 11 + 6$

7.3.2 Duct Attenuator Specification

A rectangular duct splitter (200mm) attenuator:

Free Area 30%
Length 1500mm

Frequency	Hz							
	63	125	250	500	1k	2k	4k	8k
IL	6	13	26	41	45	45	43	36

Full calculations can be found in APPENDIX 3.

Please note pressure drop calculations have not been performed; attenuator should normally produce no more than 50Pa pressure drop. A greater than 50Pa pressure drop will require a transitional increase in duct side to incorporate the attenuator.

Supplier: Various

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REFERENCES

1. British Standard BS 4142: 1997
Method for Rating Industrial Noise Affecting Mixed Residential and Industrial Sites. ISBN 0 580 28300 3

2. British Standard BS 8233:1999.
Sound insulation and noise reduction for buildings – Code of practice.
ISBN 0 580 33009 5

3. British Standard BS 7445-1: 2003.
Description and Measurement of Environmental Noise.
ISBN 0 580 43032 4

4. ISO 9613-2
Acoustics – Attenuation of sound during propagation outdoors.

5. Sharland. I. *Flakt Woods Practical Guide to Noise Control.*
The Print Connection (UK) Ltd (2005). ISBN 095029411X

6. Sound Research Laboratories
Noise Control in Industry. Courier International Ltd (1991)
ISBN 0 419 17170 3

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APPENDIX 1

Glossary of Terms

Sound Pressure	The variation of ambient pressure that is detected by the ear as sound.
Noise	Unwanted sound.
Decibel (dB)	Tend times the logarithm of the square of the ratio of the Sound Pressure to a reference pressure (20 micro-Pascal's).
Sound Pressure Level	The decibel version of the Sound Pressure.
A-Weighting	A frequency weighting which simulates the response of the ear. An A-Weighted Sound Pressure Level is denoted by L_{pA} and has units of **dB(A).**
$L_{Aeq,T}$	The value of the A-Weighted sound pressure level, in decibels dB(A), of a continuous steady sound that within a specified time interval (T), for example 16 hours, has the same mean-square sound pressure as a sound that varies with time. Therefore, the average over a 16 hour period would be denoted as $L_{Aeq,\ 16h}$.
$L_{Amax,T}$	The maximum A-Weighted sound pressure level that was encountered during the measurement period.
$L_{A90,T}$	The A-Weighted sound pressure level that is exceeded for 90% of the time (T). This is usually used as a measure of background noise.
Free Field	Where noise can propagate freely without any reflections from buildings etc.
Octave Band	A band of frequencies the upper limit of which is twice the lower limit. They are known by their centre frequency, e.g., 63, 125, 250, 500, 1000, 2000 Hz…

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APPENDIX 2

Background Noise Levels

Period	Date	Time	LAFmx	LAFmn	LAeq	LAF90.0	Wind Speed	Rain
			dB	dB	dB	dB	(kph)	(mm)
1	27/07/2009	12:56:51	84.9	49.1	58.8	51.0	16	0.0
2	27/07/2009	13:11:51	73.5	49.3	55.6	51.0	13	0.0
3	27/07/2009	13:26:51	80.7	48.3	61.7	51.0	13	0.0
4	27/07/2009	13:41:51	81.4	49.3	56.7	51.5	18	0.0
5	27/07/2009	13:56:51	88.4	52.2	61.4	54.0	21	0.0
6	27/07/2009	14:11:51	77.0	49.5	57.0	52.0	13	0.0
7	27/07/2009	14:26:51	83.9	48.5	57.2	51.0	10	0.0
8	27/07/2009	14:41:51	81.4	47.7	60.2	50.0	16	0.0
9	27/07/2009	14:56:51	85.5	48.5	57.9	51.0	13	0.0
10	27/07/2009	15:11:51	74.0	47.9	55.2	50.5	13	0.0
11	27/07/2009	15:26:51	76.8	48.4	56.2	50.5	24	0.0
12	27/07/2009	15:41:51	72.0	47.5	55.0	49.5	13	0.0
13	27/07/2009	15:56:51	66.7	48.7	55.5	51.5	10	0.0
14	27/07/2009	16:11:51	91.2	48.9	59.2	51.5	11	0.0
15	27/07/2009	16:26:51	76.2	48.6	58.3	51.0	16	0.0
16	27/07/2009	16:41:51	76.4	48.0	56.4	51.0	14	0.0
17	27/07/2009	16:56:51	77.9	47.5	60.1	50.0	10	0.0
18	27/07/2009	17:11:51	86.3	46.7	62.4	49.5	13	0.0
19	27/07/2009	17:26:51	75.4	45.8	56.3	49.0	18	0.0
20	27/07/2009	17:41:51	76.4	46.1	55.6	48.5	10	0.0
21	27/07/2009	17:56:51	74.3	47.4	55.5	50.0	13	0.0
22	27/07/2009	18:11:51	76.4	44.9	54.8	48.0	11	0.0
23	27/07/2009	18:26:51	67.6	45.5	51.1	48.0	16	0.0
24	27/07/2009	18:41:51	71.7	45.4	54.6	49.0	16	0.0
25	27/07/2009	18:56:51	70.9	45.8	52.7	49.0	16	0.0
26	27/07/2009	19:11:51	76.1	46.3	55.1	49.5	13	0.0
27	27/07/2009	19:26:51	75.1	45.9	53.2	49.5	8	0.0
28	27/07/2009	19:41:51	70.4	42.3	52.9	47.0	8	0.0
29	27/07/2009	19:56:51	63.3	42.9	50.9	46.0	6	0.0
30	27/07/2009	20:11:51	71.1	42.3	53.1	47.0	10	0.0
31	27/07/2009	20:26:51	77.5	43.2	61.7	47.5	10	0.0
32	27/07/2009	20:41:51	77.1	41.9	53.7	46.5	13	0.0
33	27/07/2009	20:56:51	73.9	41.9	55.5	48.5	13	0.0
34	27/07/2009	21:11:51	72.3	44.1	53.7	49.5	6	0.0

35	27/07/2009	21:26:51	76.8	44.2	56.1	49.0	10	0.0
36	27/07/2009	21:41:51	65.8	42.7	52.0	47.5	10	0.0
37	27/07/2009	21:56:51	72.6	46.5	55.2	49.5	10	0.0
38	27/07/2009	22:11:51	68.6	46.0	53.7	50.5	5	0.0
39	27/07/2009	22:26:51	71.4	43.4	53.4	49.0	8	0.0
40	27/07/2009	22:41:51	67.2	41.6	53.5	50.5	8	0.0
41	27/07/2009	22:56:51	69.6	45.2	52.5	50.0	6	0.0
42	27/07/2009	23:11:51	68.8	44.3	54.0	50.0	8	0.0
43	27/07/2009	23:26:51	67.8	42.2	53.3	50.5	5	0.0
44	27/07/2009	23:41:51	66.8	43.4	52.7	49.5	8	0.0
45	27/07/2009	23:56:51	60.7	43.4	52.5	50.0	5	0.0
46	28/07/2009	00:11:51	64.2	40.2	52.1	49.5	Calm	0.0
47	28/07/2009	00:26:51	66.9	44.5	53.3	50.0	Calm	0.0
48	28/07/2009	00:41:51	71.8	39.6	54.3	49.5	Calm	0.0
49	28/07/2009	00:56:51	67.6	43.6	54.7	51.0	Calm	0.0
50	28/07/2009	01:11:51	65.5	38.2	52.1	39.5	Calm	0.0
51	28/07/2009	01:26:51	70.4	37.6	44.8	39.0	Calm	0.0
52	28/07/2009	01:41:51	43.7	37.7	40.0	39.0	Calm	0.0
53	28/07/2009	01:56:51	48.3	38.2	40.3	39.5	Calm	0.0
54	28/07/2009	02:11:51	46.9	38.1	40.4	39.5	Calm	0.0
55	28/07/2009	02:26:51	55.4	38.2	40.7	39.5	Calm	0.0
56	28/07/2009	02:41:51	65.0	38.9	41.6	40.5	Calm	0.0
57	28/07/2009	02:56:51	64.0	38.5	42.6	40.5	Calm	0.0
58	28/07/2009	03:11:51	65.0	38.8	43.6	40.5	Calm	0.0
59	28/07/2009	03:26:51	64.3	38.3	42.6	40.0	Calm	0.0
60	28/07/2009	03:41:51	67.4	38.6	44.0	40.0	Calm	0.0
61	28/07/2009	03:56:51	69.8	38.5	50.7	41.5	Calm	0.0
62	28/07/2009	04:11:51	75.7	40.1	54.9	42.5	Calm	0.0
63	28/07/2009	04:26:51	74.8	41.1	56.0	44.5	Calm	0.0
64	28/07/2009	04:41:51	78.1	39.5	54.2	42.0	Calm	0.0
65	28/07/2009	04:56:51	70.9	39.9	52.4	42.5	Calm	0.0
66	28/07/2009	05:11:51	64.5	39.2	46.5	41.5	Calm	0.0
67	28/07/2009	05:26:51	83.2	39.8	56.4	42.0	3	0.0
68	28/07/2009	05:41:51	74.7	40.1	52.5	42.5	Calm	0.0
69	28/07/2009	05:56:51	73.4	40.1	53.7	42.5	6	0.0
70	28/07/2009	06:11:51	71.0	41.3	54.6	44.0	13	0.0
71	28/07/2009	06:26:51	82.9	42.2	53.1	44.5	11	0.0
72	28/07/2009	06:41:51	82.0	41.8	55.9	45.0	5	0.0
73	28/07/2009	06:56:51	78.8	43.4	63.2	46.5	6	0.0
74	28/07/2009	07:11:51	76.9	45.5	58.1	50.0	13	0.0
75	28/07/2009	07:26:51	75.7	46.9	57.9	49.5	10	0.0
76	28/07/2009	07:41:51	76.7	47.7	58.5	49.5	10	0.0

77	28/07/2009	07:56:51	72.0	47.4	58.7	49.5	6	0.0
78	28/07/2009	08:11:51	76.2	47.4	60.6	49.5	16	0.0
79	28/07/2009	08:26:51	79.0	47.8	59.5	49.5	13	0.0
80	28/07/2009	08:41:51	69.8	48.7	63.0	50.5	8	0.0
81	28/07/2009	08:56:51	82.0	48.0	63.5	50.5	21	0.0
82	28/07/2009	09:11:51	77.9	47.4	56.1	51.0	17	0.0
83	28/07/2009	09:26:51	72.9	49.5	55.4	51.0	15	0.0
84	28/07/2009	09:41:51	97.9	51.8	71.5	54.0	16	0.0
85	28/07/2009	09:56:51	74.0	47.7	56.1	49.5	10	0.0
86	28/07/2009	10:11:51	77.3	47.2	59.5	49.5	13	0.0
87	28/07/2009	10:26:51	72.2	47.4	55.5	50.0	10	0.0
88	28/07/2009	10:41:51	78.5	48.7	56.9	50.0	18	0.0
89	28/07/2009	10:56:51	69.1	48.1	53.0	49.5	18	0.0
90	28/07/2009	11:11:51	80.4	48.6	62.1	50.0	15	0.0
91	28/07/2009	11:26:51	83.1	48.2	58.3	50.0	18	0.0
92	28/07/2009	11:41:51	81.3	48.2	63.9	50.5	19	0.0
93	28/07/2009	11:56:51	78.3	48.1	62.0	50.5	11	0.0
94	28/07/2009	12:11:51	72.6	48.0	56.3	50.0	17	0.0
95	28/07/2009	12:26:51	83.0	47.6	62.8	49.5	13	0.0
96	28/07/2009	12:41:51	82.5	47.8	63.0	50.5	13	0.0
97	28/07/2009	12:56:51	82.8	47.4	59.2	49.5	21	0.0
98	28/07/2009	13:11:51	83.4	47.4	62.2	49.5	18	0.0
99	28/07/2009	13:26:51	72.0	48.2	54.8	50.5	18	0.0
100	28/07/2009	13:41:51	80.7	48.2	57.0	50.5	8	0.0
101	28/07/2009	13:56:51	81.9	48.2	59.7	50.5	10	0.0
102	28/07/2009	14:11:51	81.1	49.8	62.5	52.5	10	0.0
103	28/07/2009	14:26:51	77.5	49.2	58.2	51.5	18	0.0
104	28/07/2009	14:41:51	82.6	47.6	63.6	50.0	10	0.0
105	28/07/2009	14:56:51	73.7	48.5	58.4	51.0	12	0.0
106	28/07/2009	15:11:51	73.7	47.9	55.9	51.0	13	0.0
107	28/07/2009	15:26:51	78.5	49.6	57.6	51.5	16	0.0
108	28/07/2009	15:41:51	78.9	48.3	57.6	50.5	10	0.0
109	28/07/2009	15:56:51	75.5	47.8	58.6	51.0	11	0.0

soundplanning

APPENDIX 3

Attenuation Calculations (House 2)

Office										
Frequency	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz		
SWLduct	85.2	88.1	86.6	82.2	84	83.8	80	79.1	94	dB
Attenuator	5	6	11	20	27	26	25	20		
Duct SRI	3	8	14	20	26	32	38	40		
10log (S/A)	29.9	29.9	29.9	29.9	29.9	29.9	29.9	29.9		
Reduction	3	3	3	3	3	3	8.1	10.1		
Power Level	77.2	79.1	72.6	59.2	54.0	54.8	46.9	49.0	82	dB
A-Weighted	51.0	63.0	64.0	56.0	54.0	56.0	47.9	47.9	68	dB(A)

Day										
Frequency	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz		
SWLduct	85.2	88.1	86.6	82.2	84	83.8	80	79.1	94	dB
Attenuator	4	8	14	24	31	29	26	20		
Duct SRI	3	8	14	20	26	32	38	40		
10log (S/A)	29.9	29.9	29.9	29.9	29.9	29.9	29.9	29.9		
Reduction	3	3	3	3	3	3	8.1	10.1		
Power Level	78.2	77.1	69.6	55.2	50.0	51.8	45.9	49.0	81	dB
A-Weighted	52.0	61.0	61.0	52.0	50.0	53.0	46.9	47.9	65	dB(A)

Night										
Frequency	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz		
SWLduct	85.2	88.1	86.6	82.2	84	83.8	80	79.1	94	dB
Attenuator	6	13	26	41	45	45	43	36		
Duct SRI	3	8	14	20	26	32	38	40		
10log (S/A)	29.9	29.9	29.9	29.9	29.9	29.9	29.9	29.9		
Reduction	3	3	3	3	3	3	8.1	10.1		
Power Level	76.2	72.1	57.6	38.2	36.0	35.8	28.9	33.0	78	dB
A-Weighted	50.0	56.0	49.0	35.0	36.0	37.0	29.9	31.9	58	dB(A)