



REPORT REFERENCE:

IMP5184-1

ENVIRONMENTAL NOISE IMPACT ASSESSMENT

British Standard 8233: 2014

CLIENT:

Charter House Planning

SITE:

Mulberry House, 1A Eldon Road, Reading, RG1 4DS

(Longitude: 51.45'33.22°, Latitude: 0.95'81.68°)

SURVEY DATES:

4th – 7th September 2017

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1 EXECUTIVE SUMMARY

1.1 Instruction

Impact Acoustics have been instructed to undertake a background noise survey to ISO1996:2007 to determine the impact of existing noise sources on the proposed residential properties at Mulberry House, 1A Eldon Road, Reading, RG1 4DS in accordance with BS8233:2014.

1.2 Scope of Report

The measurements will be undertaken in accordance with ISO 1996 – Part 2: 2007 to determine the existing background noise levels and British Standard 8233:2014 will be used to determine the impact of existing traffic on the internal noise environment within the proposed residential properties. This report aims to establish the following:

- Existing background noise levels with reference to the existing premises in accordance with ISO1996-2:2007;
- A 3D working noise model of the site with reference to the entered and calibrated measured noise levels per position and noise source. This will allow an understanding of the resulting noise levels per daytime, night time and L_{max} (night time) at any point within the site;
- Assess the potential internal noise levels on the proposed residential properties both with the BS8233:2014 calculation methodology as well as with a partially open window;
- Provide specifications for the ventilation and window glazing with the proposed residential properties;
- Assess the impact of environmental noise within external amenity space;

1.3 Summary of Results

1.3.1 Background Noise Levels

A background noise surveys were undertaken from 4th – 7th September 2017 at the road facing boundary along with spot measurements at the two car park facing boundaries to the proposed site in order to establish the underling background noise levels. To allow for a robust conclusion the highest measured daytime and night time noise levels will be used to form the noise assessment for control of environmental noise.

The maximum day time levels from the overall continual noise measurement at assessment position 1 were found to be L_{Aeq,16hour} 60 dB and the maximum night time levels from the overall continual noise measurement were found to be L_{Aeq,8hour} 50 dB. A representative modal analysis of the typical L_{AMAX} that is present at night time at the assessment position was found to be L_{AMAX} 65 dB

The maximum day time and night time levels are summarised in the table below per assessment position:

1.3.1.1 Assessment Position 1

Assessment Position		LAeq	
		Day	Night
		(0700 - 2300)	(2300 -0700)
1	04/09/2017	56.1	48.0
1	05/09/2017	58.1	48.3
1	06/09/2017	56.3	47.1
1	07/09/2017	60.2	49.5
Arithmetical Average		57.7	48.2

		Leq (63Hz)	Leq (125Hz)	Leq (250Hz)	Leq (500Hz)	Leq (1kHz)	Leq (2kHz)	Leq (4kHz)
04/09/2017	Day	62.8	54.0	49.0	46.3	50.7	49.2	34.7
04/09/2017	Night	61.0	49.7	45.3	43.5	44.7	40.1	28.5
05/09/2017	Day	65.8	57.1	51.9	49.3	54.3	53.4	39.4
05/09/2017	Night	61.0	50.2	45.9	44.1	44.8	40.8	30.0
06/09/2017	Day	65.6	57.1	51.7	49.2	52.5	51.0	38.6
06/09/2017	Night	58.2	48.9	44.4	42.5	43.7	39.6	30.2
07/09/2017	Day	65.8	57.3	52.2	49.2	53.2	57.8	38.8
07/09/2017	Night	58.9	50.3	46.2	44.3	45.6	43.0	36.2

1.3.2 Proposed Residential Façade Noise Levels

A detailed noise map was produced and calibrated to background noise measurements. The noise map indicated that the maximum noise levels that are likely to be present at the proposed residential façade will during the day time period be $L_{Aeq, 16 \text{ hour}}$ 65 dB and during the night time period be $L_{Aeq, 8 \text{ hours}}$ 54 dB.

The L_{AMAX} has also been modelled within the noise map. The average maximum noise levels that are likely to be present at the proposed residential façade will during the night time period be L_{AMAX} , 70 dB

Detailed calculations indicated that internal noise levels within the proposed residential properties will comply with the requirements of British Standard 8233: 2014 for average daytime and night time noise and the requirements of the WHO Guidelines for L_{Amax} Levels.

1.3.3 Requirements for noise mitigation

In order to meet reasonable internal levels in accordance with BS8233:2014; all facades should implement the following mitigation measures:

Construction of Walls	Standard masonry construction
Construction of Ceiling	2 layer of 12mm Fireline plasterboard
Construction of Windows	4mm glass / 16mm air gap / 4mm glass
Construction of Ventilation	MVHR

Detailed calculations indicated that internal noise levels within the proposed residential properties will comply with the requirements of British Standard 8233: 2014.

Time Period	Façade / Area	Specification	Room	Resulting Internal Level dB(A)	Criteria Limit
Day	West	4/16/4 and MVHR	4 th Floor	29 dB LAeq,16hour	35dB
Lmax	West	4/16/4 and MVHR	4 th Floor	33 dB LAmax	45dB
Night	West	4/16/4 and MVHR	4 th Floor	18 dB LAeq, 8hour	30dB
Day	Roof Top	1.2m barrier	Garden / Terrace	55 dB LAeq, 16hour	55dB
Resulting Internal Levels calculated in accordance with BS8233:2014 per time period					

1.4 Conclusions

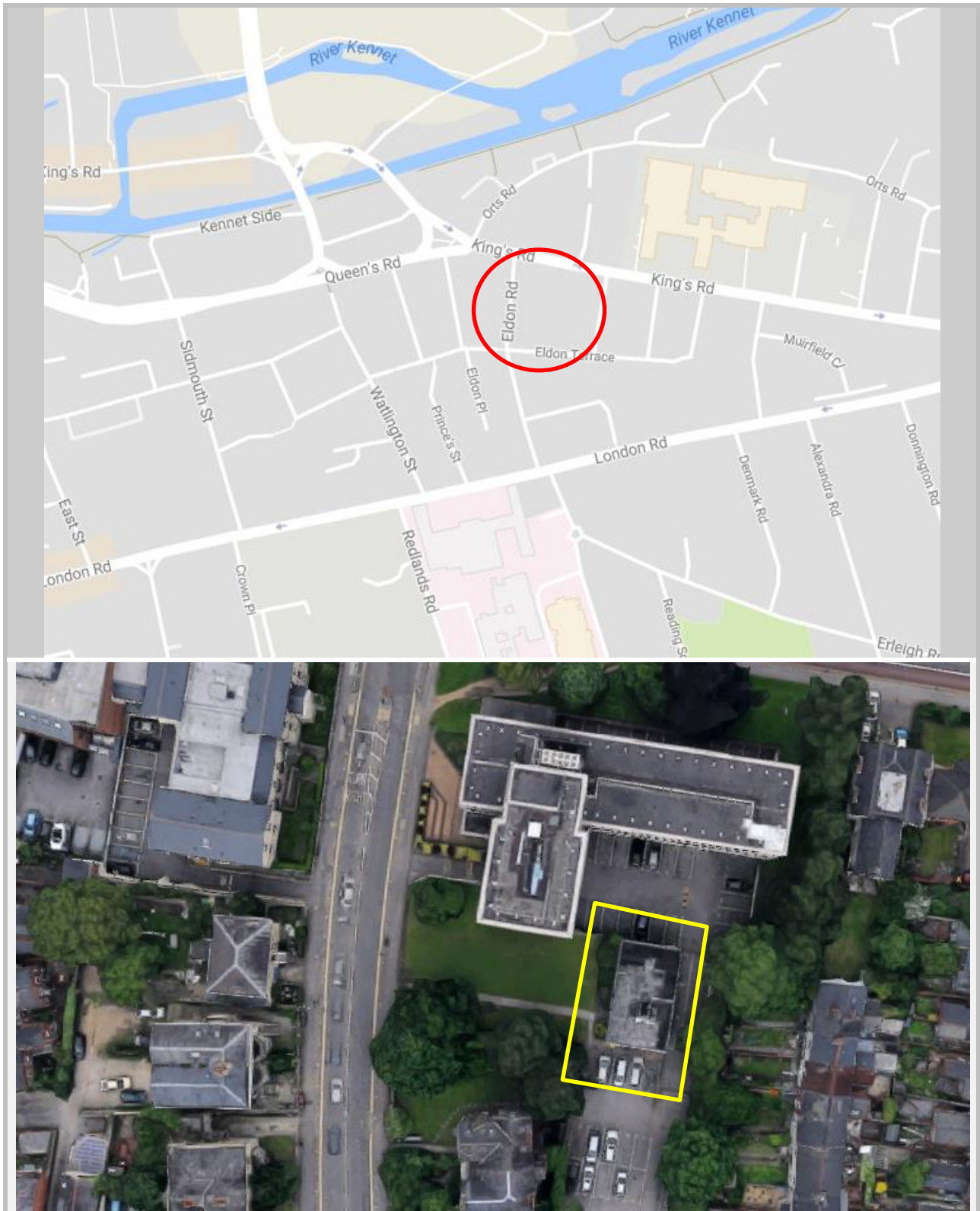
It would be proposed that the development should be undertaken with glazing (4 – 16 - 4) with a mechanical ventilation system to alleviate the requirement for partially open windows to specified facades to ensure the internal noise levels are acceptable in terms of the assessment to British Standard 8233: 2014 and WHO Guidelines.

A requirement for a 1.2m barrier at the balcony / garden / roof terrace is recommended to control external noise below the upper limit of 55dB LAeq,16hout in accordance with WHO Guidelines.

2 SITE LOCATION AND RELEVANT NOISE SOURCES

2.1 Position of Site

The site is located in Reading. Whilst there is a commercial building to the north of the proposed site with car park movements; the dominant noise source considered is road traffic noise from the Eldon Road and Kings Road. This has been confirmed by on site measurements and audible assessment.



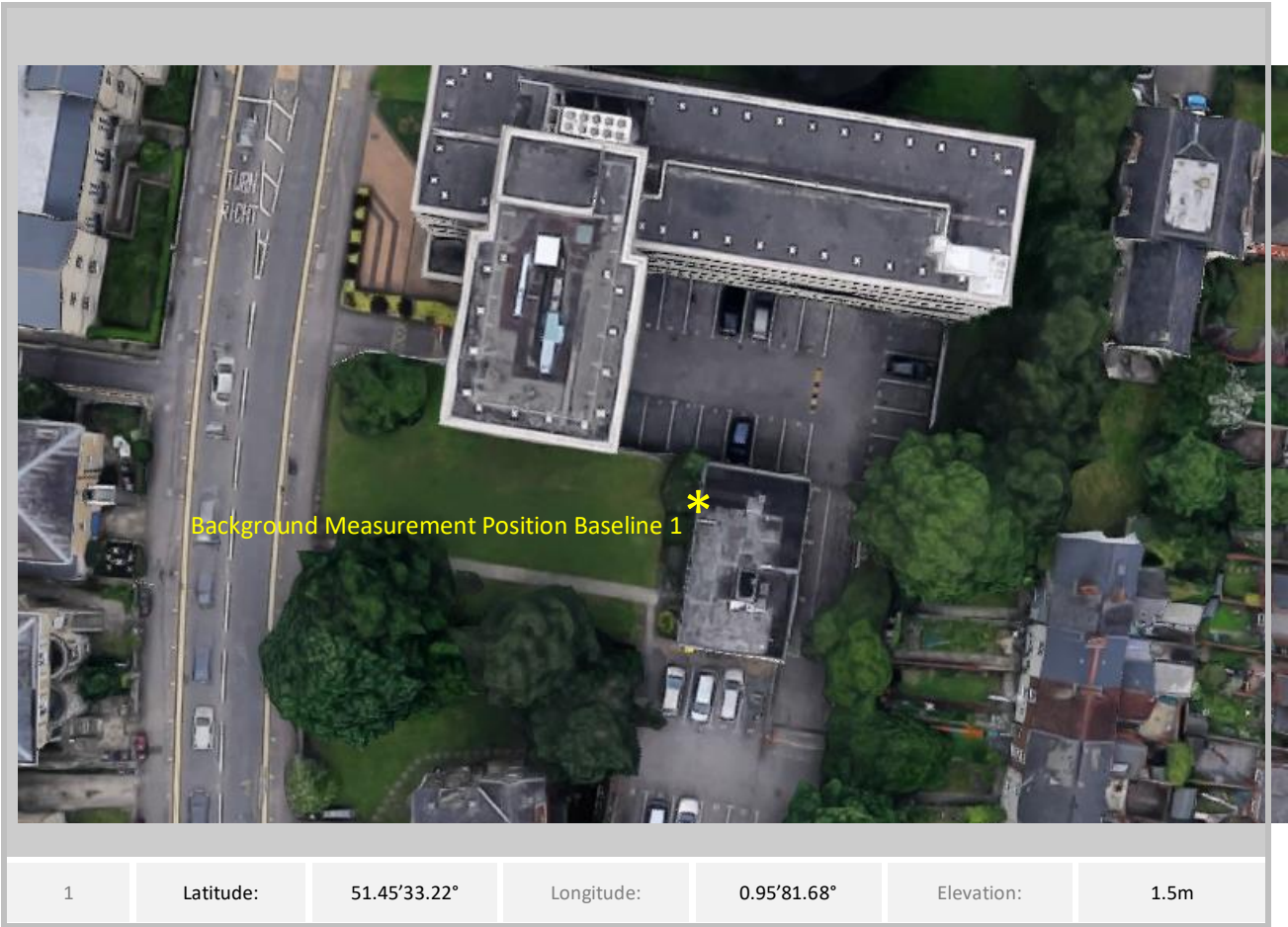
2.2 Proposed Development







3 BACKGROUND NOISE LEVELS
3.1 Location of Measurements



Measurements were taken in accordance with ISO1996:2007 in the free field and in clear line of sight of the applicable sources. The detailed results are listed below and the results of the average levels are summarised below as 3D noise maps. The noise maps have been created and calibrated to the background noise data with the standard traffic flow rates adjusted and source levels (line and point) adjusted accordingly.

3.2 Background Noise Levels

Background noise levels are summarised below. Full measurement data is shown in Appendix B. The continuous measurement per location has been analysed to form the working daytime (0700 – 2300) and night time (2300 – 0700) time periods in accordance with BS8233:2014. The highest measured time period per day and night have been chosen for assessment and for input into the working noise model. This rationale will lead to a more robust conclusion when forming mitigation against the existing noise climate.

3.2.1.1 Assessment Position 1

Assessment Position		LAeq	
		Day	Night
		(0700 - 2300)	(2300 -0700)
1	04/09/2017	56.1	48.0
1	05/09/2017	58.1	48.3
1	06/09/2017	56.3	47.1
1	07/09/2017	60.2	49.5
Arithmetical Average		57.7	48.2

		Leq (63Hz)	Leq (125Hz)	Leq (250Hz)	Leq (500Hz)	Leq (1kHz)	Leq (2kHz)	Leq (4kHz)
04/09/2017	Day	62.8	54.0	49.0	46.3	50.7	49.2	34.7
04/09/2017	Night	61.0	49.7	45.3	43.5	44.7	40.1	28.5
05/09/2017	Day	65.8	57.1	51.9	49.3	54.3	53.4	39.4
05/09/2017	Night	61.0	50.2	45.9	44.1	44.8	40.8	30.0
06/09/2017	Day	65.6	57.1	51.7	49.2	52.5	51.0	38.6
06/09/2017	Night	58.2	48.9	44.4	42.5	43.7	39.6	30.2
07/09/2017	Day	65.8	57.3	52.2	49.2	53.2	57.8	38.8
07/09/2017	Night	58.9	50.3	46.2	44.3	45.6	43.0	36.2

3.2.2 Event Monitoring

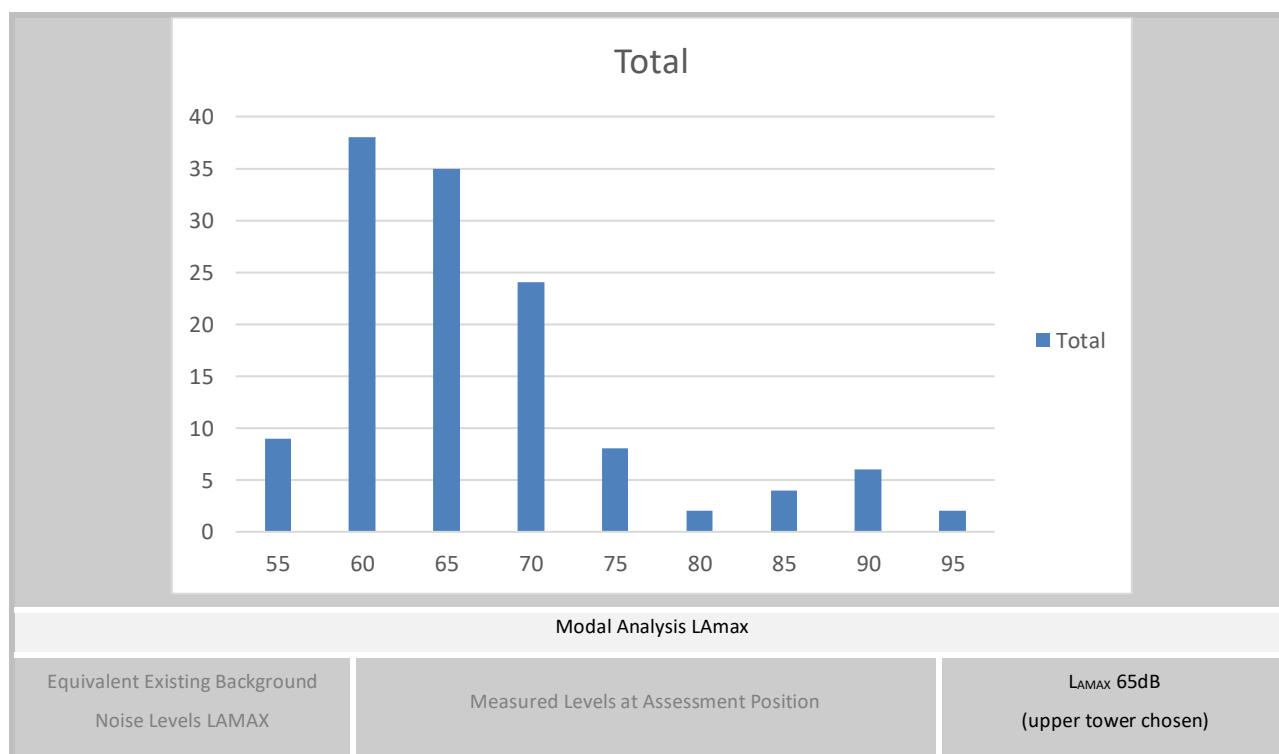
During measurement period, the baseline trigger was set at 90dB LAMax. The majority of audio recordings during the measurement period were standard road traffic movements and HGV movements. However, there were other events deemed not representative of the standard noise climate and were removed from the overall measurement:

Date	Time	LAFmax	Commentary
04/09/2017	20:00	93	Police / Ambulance Siren
05/09/2017	08:00	93	Police / Ambulance Siren
05/09/2017	21:00	92	Car horn
07/09/2017	20:30	93	Car horn

3.3 LAMax Assessment (Night Time)

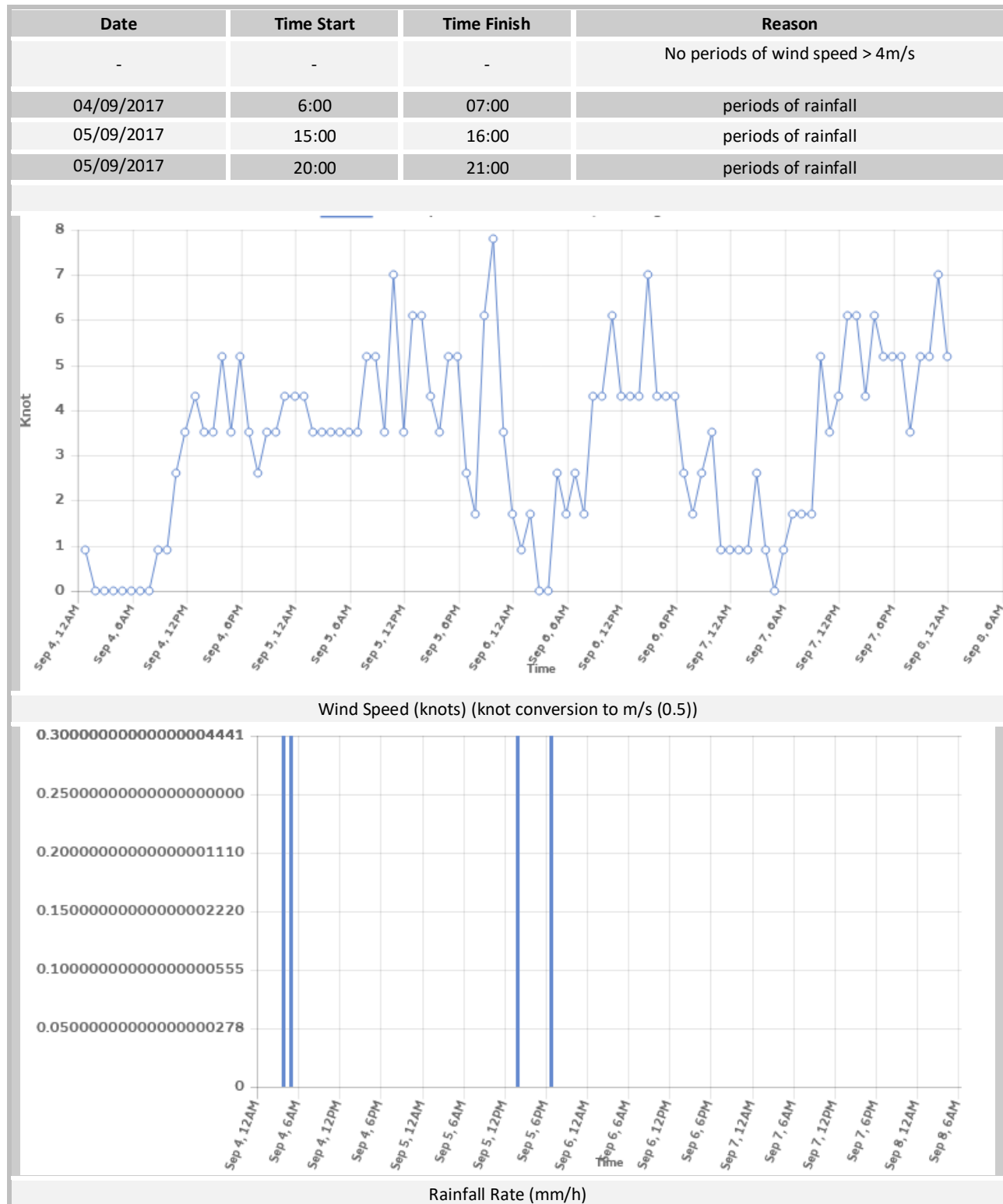
In order to have an understanding of the existing noise climate with reference to the instantaneous maximum recorded noise levels per working time period (LAMax), a modal analysis of the recorded LAMax per measurement position has been analysed. By understanding the maximum noise (i.e LAMax,15min rounded to the nearest 5dB(A)) that repeats itself most often during the night time measurement period we can increase certainty that the LAMax formed can be considered representative of the noise climate for the complete measurement period and can be used for input into the working 3D noise model as a controllable noise level. For clarity, the resulting LAMax levels will be controlled against the parameters set out for night time noise and sleep disturbance of 45dB LAMax internal.

3.3.1 Modal Analysis LAMax (Assessment Position 1)



3.4 Weather Analysis¹

Where periods of Weather exceeded 4m/s or there were periods of rainfall; measurements have been excluded from time history. Periods of unsettled weather not conducive to a representative baseline were as follows:



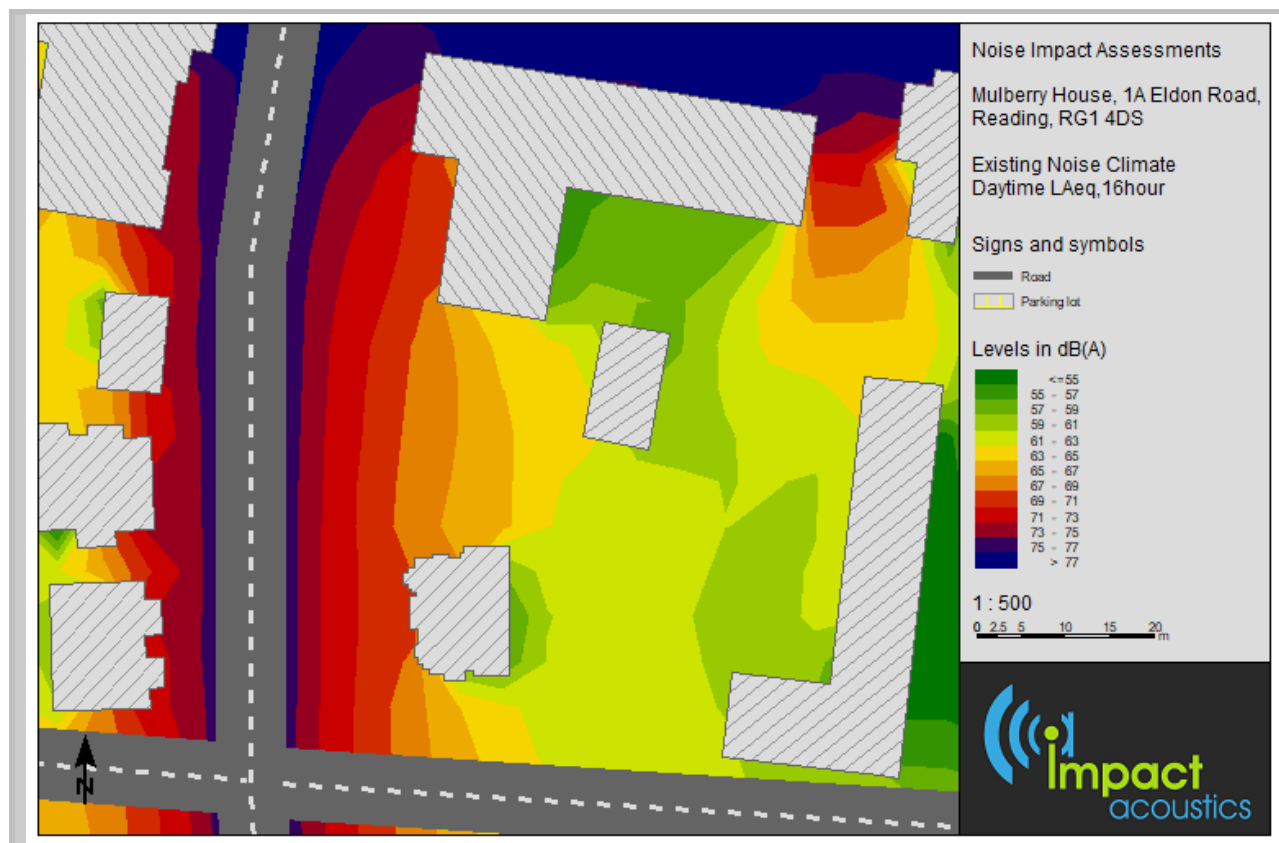
¹ Weather data obtained from Weather Observation Met Office Data (<http://www.metoffice.gov.uk/observations/>)

3.5 3D Noise Maps of Background Noise Levels – Existing (Pre-Development)

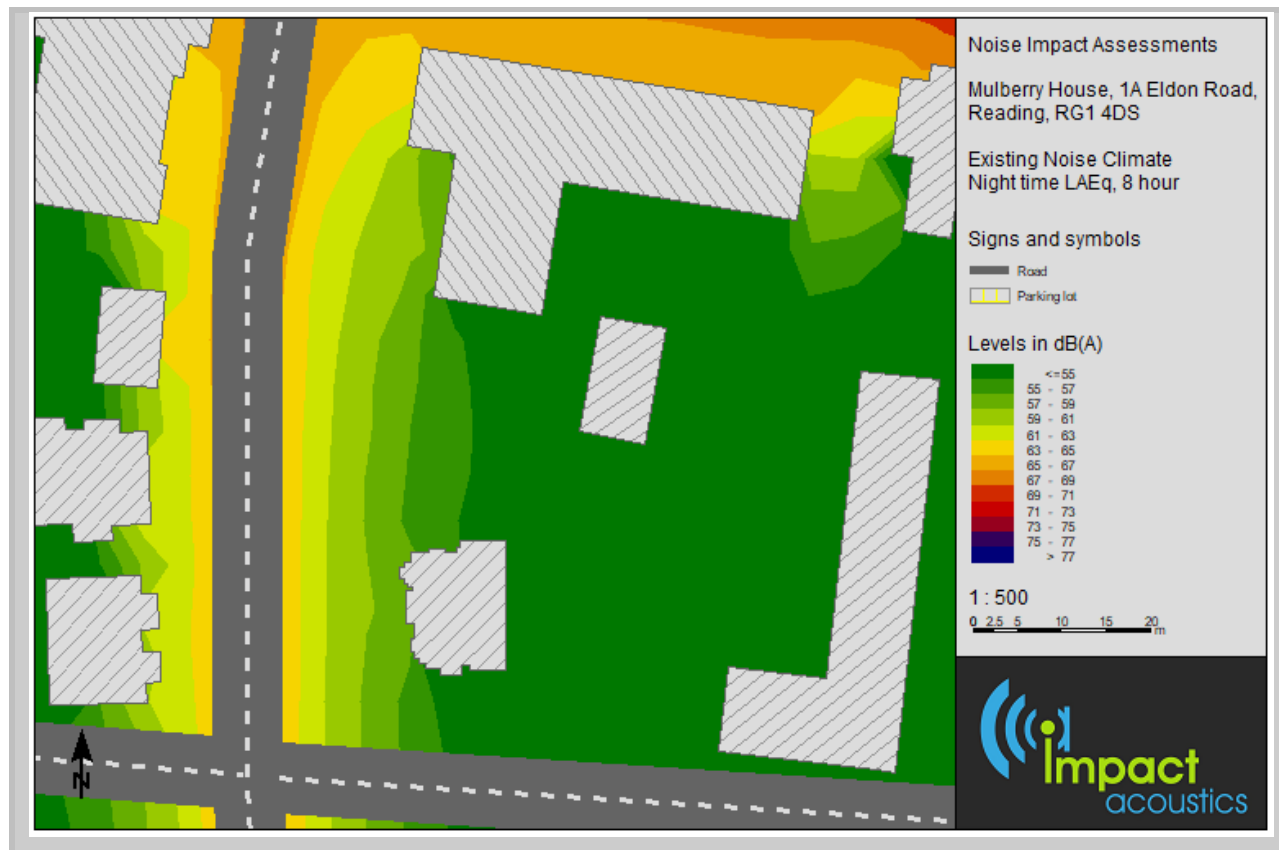
3.5.1 24 hour Levels



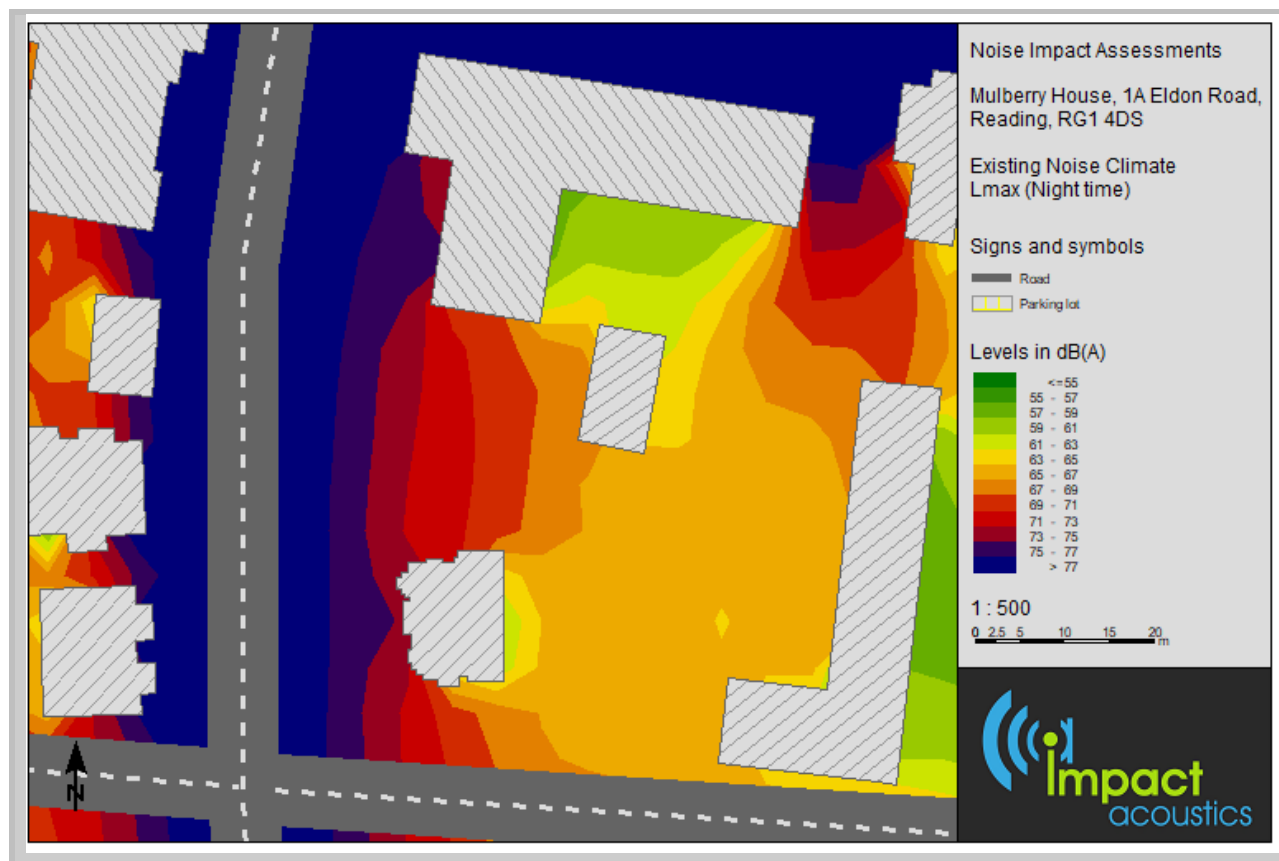
3.5.2 Day time (0700 – 2300)



3.5.3 Night Time (2300 – 0700)



3.5.4 LAMax Night Time (2300 – 0700)



4 NOISE CRITERION

4.1 British Standard 8233: 2014 ("BS8233")

4.1.1 Scope of Document

British Standard 8233:2014 provides guidance on the sound insulation and the reduction of noise in and around buildings and replaced the original 1999 standard in February 2014.

"This British Standard provides guidance for the control of noise in and around buildings. It is applicable to the design of new buildings....."

The standard goes onto to provide details of the approach to be taken when assessing the design in terms of planning:

- "a) Assess the site, identify significant existing and potential noise sources, measure or estimate noise levels and evaluate layout options.*
- b) Determine design noise levels for spaces in and around the building (s).*
- c) Determine sound insulation of the building envelope, including the ventilation strategy.*
- d) Identify internal sound insulation requirements.*
- e) Identify and design appropriate noise control measures.*
- f) Establish quality control and ensure good workmanship."*

4.1.2 Internal Ambient Noise Levels for dwellings

British Standard 8233:2014 provides desirable internal ambient noise levels within different rooms and at different times for external noise sources that are considered steady within section 7.7.2.:

Activity	Location	07:00 to 23:00	23:00 to 07:00
Resting	Living Room	$L_{Aeq, 16 \text{ hour}}$ 35 dB	--
Dining	Dining Room	$L_{Aeq, 16 \text{ hour}}$ 40 dB	--
Sleeping (Daytime Resting)	Bedroom	$L_{Aeq, 16 \text{ hour}}$ 35 dB	$L_{Aeq, 8 \text{ hour}}$ 30 dB

4.1.3 External Amenity Space

British Standard 8233:2014 provides guidance on the acceptable noise levels for external amenity and gardens:

"For traditional external areas that are used for amenity space, such as gardens and patios, it is desirable that the external noise level does not exceed $L_{Aeq, T}$ 50 dB with an upper guideline value of $L_{Aeq, T}$ 55 dB which would be acceptable in noisier environment...."In higher noise areas...a compromise between elevated noise levels and other factors, such as the convenience of living in these locations or making efficient use of land resources to ensure development needs can be met, might be warranted."

4.2 ISO 1996 – Part 2:2007

4.2.1 Scope of ISO 1996 – Part 2:2007

Part 2 of ISO 1996 describes the determination and assessment of environmental noise levels through either direct measurement, by extrapolation of measurement results, or by means of calculation.

4.2.2 Measurement Time Interval

The selection of the measurement time interval has been chosen in accordance to this standard. The measurements have been taken over a continuous period and includes both the day and night time period.

4.2.3 Instrumentation

The instrumentation and all components associated with the instrument used to measure the sound levels comply with the instrumentation system given in section 5.1 of this standard.

4.2.4 Calculation Methods

Although there are no internationally recognised calculation methods other national standards have been used for this assessment.

4.3 WHO Guidelines for Community Noise

4.3.1 World Health Organisation

The document describes guideline levels that are “essentially values for the onset of health effects from noise exposure”. A table of guideline values is included, relating to adverse health effects, referred to as any temporary or long term deterioration in physical, psychological, or social functioning that is associated with noise exposure. The following is an extract from the Table 4.1: Guideline values for community noise in specific environments, as stated in the document.

Specific Environment	Critical Health Effect(s)	L _{Aeq} (dB)	Time Base (hours)	L _{Amax,F} (dB)
Outdoor living area	Serious annoyance, daytime and evening	55	16	-
	Moderate annoyance, daytime and evening	50	16	-
Dwelling, indoors	Speech intelligibility and moderate annoyance, daytime and evening	35	16	-
Inside bedrooms	Sleep disturbance, night-times	30	8	45
Outside bedrooms	Sleep disturbance, window open (outdoor values)	45	8	60

Guideline values for community noise in specific environments

4.4 Night Noise Guidelines (“NNGL”)

The European Union and the World Health Organisation jointly published a document entitled “Night Noise Guidelines” in 2009 (“NNGL”). The overall goal of the document was detailed within the summary pages:

“The goal of the NNGL project was to provide and expand scientific advice to the European Commission and its Member States in developing future legislation in the area of night noise exposure, control and surveillance. The key objective of the project was to reach a consensus of experts and key stakeholders on the following subjects:

a) Guideline values for night noise to protect the public from adverse health effects.....”

4.4.1 No Observed Adverse Effect Level (NOAEL)

The section entitled “*Threshold for Observed Effects*” within the executive summary of the NNGL a list of the absolute level at which there is sufficient evidence available for the no observed adverse effect level (NOAEL):

Effect of Noise	Description	Indicator	Threshold (NOAEL)
Biological Effects	EEG awakening	L _{Amax,inside}	35 dB
	Motility, onset of motility	L _{Amax,inside}	32 dB
	Changes in duration of various stages of sleep, in sleep structure and fragmentation of sleep	L _{Amax,inside}	35 dB
Sleep Quality	Waking up in the night and / or too early in the morning	L _{Amax,inside}	42 dB

4.4.2 Vulnerable Groups

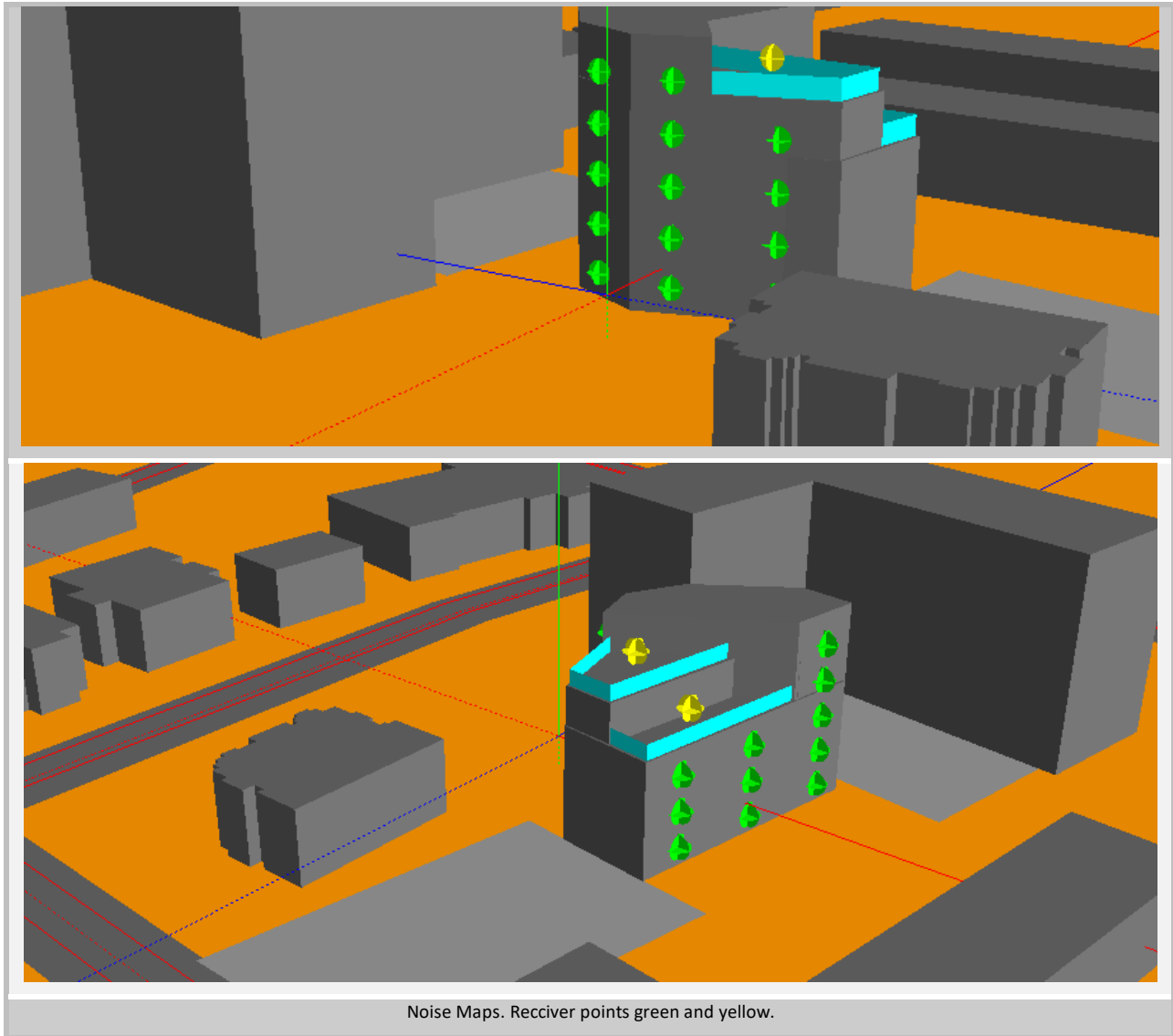
In setting the LOAEL and the SOAEL within the scope of the NPSE consideration has been made for the statement made under the title “*Vulnerable Groups*” which indicates that young children, elderly adults and shift workers should be considered vulnerable groups and more likely to be effected by unwanted noise.

4.4.3 Attenuation of an Open Window

The NNGL indicates an attenuation of around 10 – 15 dB(A) through an open window. It could therefore be appropriate to consider an overall reduction of 10 dB(A) through a partially open window.

5 INTERNAL NOISE ASSESSMENTS

The proposed development has been added into the existing noise map and the resulting façade levels have been calculated. The modelling software used is SoundPLAN and the resulting levels have been predicted within the software in accordance with ISO9613-2 and Calculation of Road Traffic Noise.



Full resulting façade levels are shown in appendix C.

Noise Impact Assessments

Mulberry House, 1A Eldon Road,
Reading, RG1 4DS

Existing Noise Climate
Daytime / Lmax / Night time

Post Development

Signs and symbols

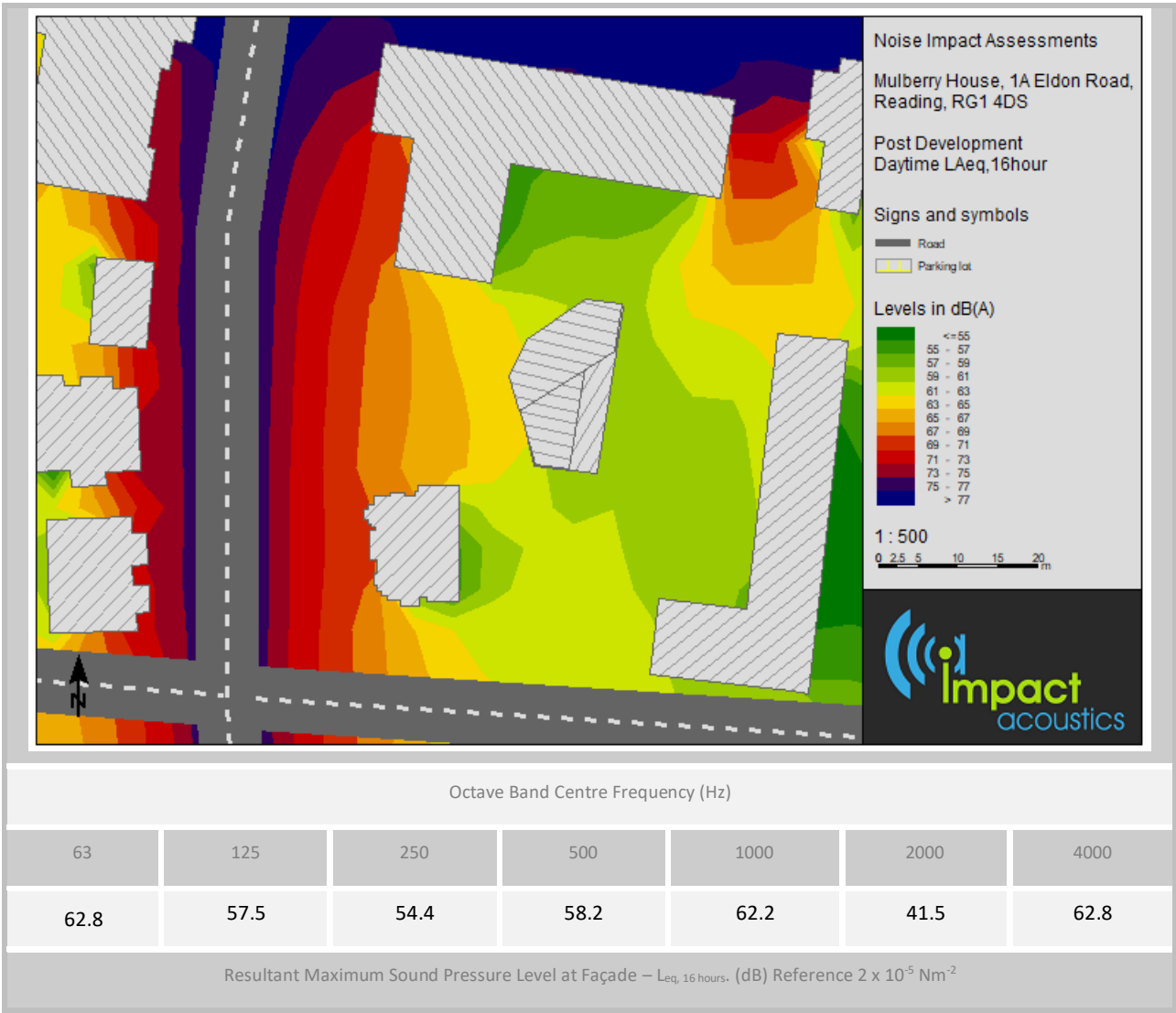
- Receiver at building
- Road
- Parking lot
- Facade with conflict

1 : 500

0 2.5 5 10 15 20 m

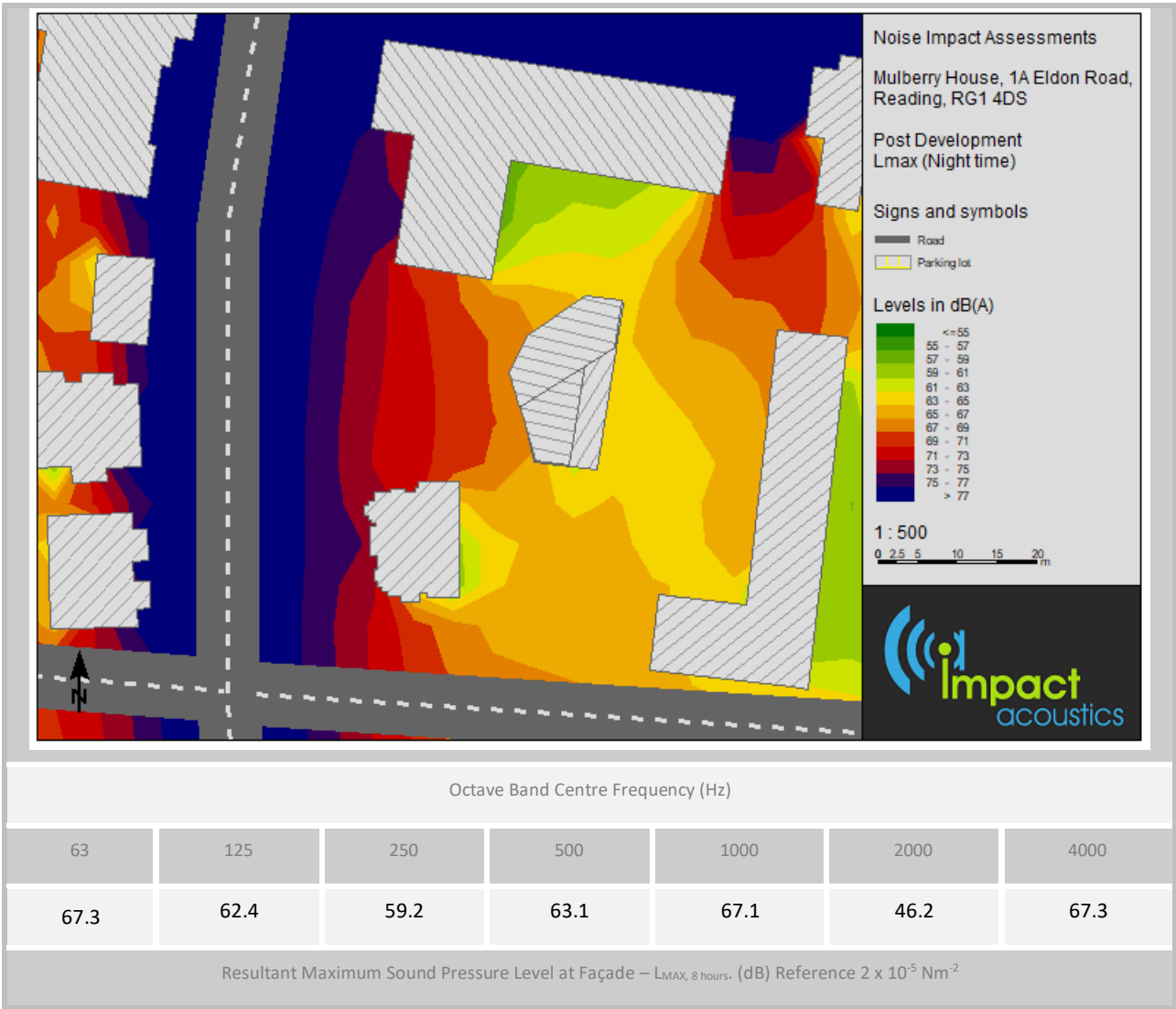
Impact acoustics

5.1.2 Day Time (07:00 – 23:00)



The above levels equate to an overall broad band level of LAeq, 16 hours 65 dB

5.1.3 L_{Amax}



The above levels equate to an overall broad band level of L_{AMAX} 70 dB

5.1.4 Night Time (23:00 to 07:00)



The above levels equate to an overall broad band level of LAeq, 8 hours 54 dB.

5.2 Calculation Procedure

$$L_{eq,2} \approx L_{eq,ff} + 10 \cdot \log_{10} \left(\frac{A_0}{S} \cdot 10^{-\frac{D_{n,e}}{10}} + \frac{S_{wi}}{S} \cdot 10^{-\frac{R_{wi}}{10}} + \frac{S_{ew}}{S} \cdot 10^{-\frac{R_{ew}}{10}} + \frac{S_{rr}}{S} \cdot 10^{-\frac{R_{rr}}{10}} \right) + 10 \cdot \log_{10} \left(\frac{S}{A} \right) + 3$$

$L_{eq,2}$ = Equivalent sound pressure level internally within the room (dB) – reference $2 \times 10^{-5} \text{Nm}^{-2}$.

$L_{eq,ff}$ = Equivalent sound pressure level externally outside the room under consideration (dB) – reference $2 \times 10^{-5} \text{Nm}^{-2}$.

A_0 = Reference absorption area within room of 10m^2 and independent of frequency.

S_f = Total façade area of room in question (m^2).

S_{wi} = Area of windows or glazing within the room (m^2).

S_{ew} = Area of external wall within the room (m^2).

S_{rr} = Area of the ceiling within the room (m^2).

S = Total area of elements through which sound enters the room (m^2). i.e. $S = S_f + S_{rr}$

$D_{n,e}$ = Sound insulation of the trickle vent measured to British Standard 20140 – Part 10: 1992 (Withdrawn)

R_{wi} = Sound reduction index of the window (dB)

R_{ew} = Sound reduction index of the external wall (dB)

R_{rr} = Sound reduction index of the ceiling (dB)

A = Equivalent absorption of the room under consideration (m)

5.3 Ventilation (D_{ne})

In accordance with Note 5 from BS8233:2014 below a mechanical ventilation system or MVHR is recommended:

NOTE 5 *If relying on closed windows to meet the guide values, there needs to be an appropriate alternative ventilation that does not compromise the facade insulation or the resulting noise level.*

Note 5 Page 25 BS8233:2014

Due to the façade levels at certain section of the site being in excess of 45dB LAeq, daytime; suitable mechanical ventilation is recommended that meets the requirements of Part F of the Building Regulations to alleviate the requirement for ventilation by open windows.

5.4 Glazing (R_{wi})

Octave Band Frequency	63	125	250	500	1000	2000	4000
Acoustic Glazing (4/16/4)							
30dB Rw	24	18	26	40	45	39	38

5.5 Walls (R_{ew})

Octave Band Frequency	63	125	250	500	1000	2000	4000
Brick and Concrete Block							
	40	43	42	45	53	55	55

The above are minimum construction attenuation values and should alternative methods be selected; these should be equal to or greater than the above corresponding values. Calculations carried out have indicated the following specifications should be installed for this site

5.6 Assessments

5.6.1 Daytime (highest impinging level)

British Standard 8233: 2014 Assessment						
Day Time – 07:00 to 23:00 Hours						
Internal Noise Level from External Noise Sources						
Location of Measurements	Front Façade Proposed (FF Level)					
Construction of Walls	External Brick, 75mm cavity and 100mm internal concrete block					
Construction of Ceiling	1 layer of 12mm Fireline plasterboard					
Construction of Windows	4mm glass / 16mm air gap / 4 glass					
Construction of Ventilation	MVHR					
window height	1.5					
window width	2	S (window)	3			
room height	2.3	S (façade)	11.5			
room width	5	S (room)	81.4			
Room depth	4	volume	46			
Rt	0.5	A	14.812			
			125	250	500	1000
						2000
Leq,ff	Sound pressure Level outside	62.8	57.5	54.4	58.2	62.2
Dn,e	Insulation of the ventilator	44	51	61	71	76
Rwi	Window Sound reduction	24	18	26	40	45
Rew	Wall sound reduction index	44	51	61	71	76
Rrr	Roof ceiling sound reduction index					
A	Absorption area of the room	14.812	14.812	14.812	14.812	14.812
Sf	Façade Area (including window)	11.5	11.5	11.5	11.5	11.5
Swi	Window Area	3	3	3	3	3
Sew	Sf-Si	8.5	8.5	8.5	8.5	8.5
Srr	Area of Ceiling					
S	Sf + Srr	11.5	11.5	11.5	11.5	11.5
Ao	Given in BSEN 20140-10	10	10	10	10	10
Leq,ff	A	62.8	57.5	54.4	58.2	62.2
Dn,e		44	51	61	71	76
(Ao/S)*10 [^] (-Dne/10)	B	3.46E-05	6.91E-06	6.91E-07	6.91E-08	2.18E-08
Rwi		24	18	26	40	45
(Swi/Sf)*10 [^] (-Rwi/10)	C	0.001039	0.004135	0.000655	2.61E-05	8.25E-06
Rew		44	51	61	71	76
(Sew/Sf)*10 [^] (-Rew/10)	D	2.94E-05	5.87E-06	5.87E-07	5.87E-08	1.86E-08
Rrr		0	0	0	0	0
(Srr/Sf)*10 [^] (-Rrr/10)	E	0	0	0	0	0
10*log(B+C+D+E)	F	-29.5759	-23.8224	-31.8273	-45.8145	-50.8145
A						
10*log(S/A)	G	-1.09916	-1.09916	-1.09916	-1.09916	-1.09916
Leq,2 = A+F+G+3	A+F+G+3	35.1	35.6	24.5	14.3	13.3
A weighting		-16	-9	-3	0	1
Leq,2 + Aweighting, freq		19.1	26.6	21.5	14.3	14.3
Leq,2 + Aweighting		28.64				

5.6.2 LAmx (highest impinging level)

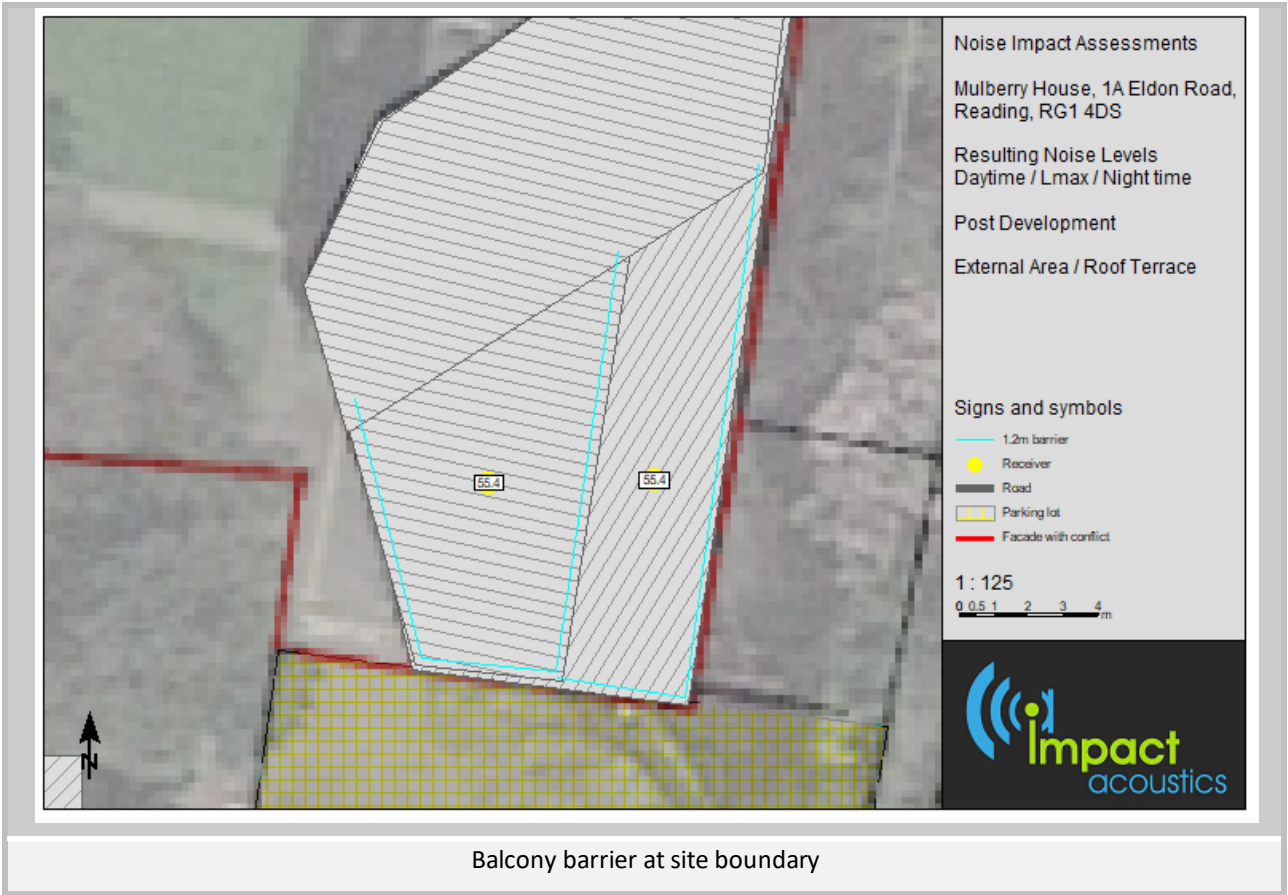
British Standard 8233: 2014 Assessment						
LAMAX (night time)						
Internal Noise Level from External Noise Sources						
Location of Measurements	Front Façade Proposed (FF Level)					
Construction of Walls	External Brick, 75mm cavity and 100mm internal concrete block					
Construction of Ceiling	1 layer of 12mm Fireline plasterboard					
Construction of Windows	4mm glass / 16mm air gap / 4 glass					
Construction of Ventilation	MVHR					
window height	1.5					
window width	2	S (window)	3			
room height	2.3	S (façade)	11.5			
room width	5	S (room)	81.4			
Room depth	4	volume	46			
Rt	0.5	A	14.812			
		125	250	500	1000	2000
Leq,ff	Sound pressure Level outside	67.3	62.4	59.2	63.1	67.1
Dn,e	Insulation of the ventilator	44	51	61	71	76
Rwi	Window Sound reduction	24	18	26	40	45
Rew	Wall sound reduction index	44	51	61	71	76
Rrr	Roof ceiling sound reduction index					
A	Absorption area of the room	14.812	14.812	14.812	14.812	14.812
Sf	Façade Area (including window)	11.5	11.5	11.5	11.5	11.5
Swi	Window Area	3	3	3	3	3
Sew	Sf-Si	8.5	8.5	8.5	8.5	8.5
Srr	Area of Ceiling					
S	Sf + Srr	11.5	11.5	11.5	11.5	11.5
Ao	Given in BSEN 20140-10	10	10	10	10	10
Leq,ff	A	67.3	62.4	59.2	63.1	67.1
Dn,e		44	51	61	71	76
(Ao/S)*10 [^] (-Dne/10)	B	3.46E-05	6.91E-06	6.91E-07	6.91E-08	2.18E-08
Rwi		24	18	26	40	45
(Swi/Sf)*10 [^] (-Rwi/10)	C	0.001039	0.004135	0.000655	2.61E-05	8.25E-06
Rew		44	51	61	71	76
(Sew/Sf)*10 [^] (-Rew/10)	D	2.94E-05	5.87E-06	5.87E-07	5.87E-08	1.86E-08
Rrr		0	0	0	0	0
(Srr/Sf)*10 [^] (-Rrr/10)	E	0	0	0	0	0
10*log(B+C+D+E)	F	-29.5759	-23.8224	-31.8273	-45.8145	-50.8145
A						
10*log(S/A)	G	-1.09916	-1.09916	-1.09916	-1.09916	-1.09916
Leq,2 = A+F+G+3	A+F+G+3	39.6	40.5	29.3	19.2	18.2
A weighting		-16	-9	-3	0	1
Leq,2 + Aweighting, freq		23.6	31.5	26.3	19.2	19.2
Leq,2 + Aweighting		33.47				

5.6.3 Night Time (highest impinging level)

British Standard 8233: 2014 Assessment						
Night Time (2300 - 0700)						
Internal Noise Level from External Noise Sources						
Location of Measurements	Front Façade Proposed (FF Level)					
Construction of Walls	External Brick, 75mm cavity and 100mm internal concrete block					
Construction of Ceiling	1 layer of 12mm Fireline plasterboard					
Construction of Windows	4mm glass / 16mm air gap / 4 glass					
Construction of Ventilation	MVHR					
window height	1.5					
window width	2	S (window)	3			
room height	2.3	S (façade)	11.5			
room width	5	S (room)	81.4			
Room depth	4	volume	46			
Rt	0.5	A	14.812			
			125	250	500	1000
						2000
Leq,ff	Sound pressure Level outside	53.4	46.2	43.1	46.9	50.9
Dn,e	Insulation of the ventilator	44	51	61	71	76
Rwi	Window Sound reduction	24	18	26	40	45
Rew	Wall sound reduction index	44	51	61	71	76
Rrr	Roof ceiling sound reduction index					
A	Absorption area of the room	14.812	14.812	14.812	14.812	14.812
Sf	Façade Area (including window)	11.5	11.5	11.5	11.5	11.5
Swi	Window Area	3	3	3	3	3
Sew	Sf-Si	8.5	8.5	8.5	8.5	8.5
Srr	Area of Ceiling					
S	Sf + Srr	11.5	11.5	11.5	11.5	11.5
Ao	Given in BSEN 20140-10	10	10	10	10	10
Leq,ff	A	53.4	46.2	43.1	46.9	50.9
Dn,e		44	51	61	71	76
(Ao/S)*10 [^] (-Dne/10)	B	3.46E-05	6.91E-06	6.91E-07	6.91E-08	2.18E-08
Rwi		24	18	26	40	45
(Swi/Sf)*10 [^] (-Rwi/10)	C	0.001039	0.004135	0.000655	2.61E-05	8.25E-06
Rew		44	51	61	71	76
(Sew/Sf)*10 [^] (-Rew/10)	D	2.94E-05	5.87E-06	5.87E-07	5.87E-08	1.86E-08
Rrr		0	0	0	0	0
(Srr/Sf)*10 [^] (-Rrr/10)	E	0	0	0	0	0
10*log(B+C+D+E)	F	-29.5759	-23.8224	-31.8273	-45.8145	-50.8145
A						
10*log(S/A)	G	-1.09916	-1.09916	-1.09916	-1.09916	-1.09916
Leq,2 = A+F+G+3	A+F+G+3	25.7	24.3	13.2	3.0	2.0
A weighting		-16	-9	-3	0	1
Leq,2 + Aweighting, freq		9.7	15.3	10.2	3.0	3.0
Leq,2 + Aweighting		17.60				

5.7 External Amenity

The resulting external areas prior to development were measured between 58-62 LAeq, 16hour. A 1.2m barrier at the roof terrace/ balcony boundary is recommended to reduce the potential disturbance in external areas of the site as defined in WHO criteria:



6 CONCLUSION

6.1 Summary of Results

6.1.1 Background Noise Levels

A background noise surveys were undertaken from 4th – 7th September 2017 at the road facing boundary along with spot measurements at the two car park facing boundaries to the proposed site in order to establish the underling background noise levels. To allow for a robust conclusion the highest measured daytime and night time noise levels will be used to form the noise assessment for control of environmental noise.

The maximum day time levels from the overall continual noise measurement at assessment position 1 were found to be $L_{Aeq,16hour}$ 60 dB and the maximum night time levels from the overall continual noise measurement were found to be $L_{Aeq,8hour}$ 50 dB. A representative modal analysis of the typical L_{AMAX} that is present at night time at the assessment position was found to be L_{AMAX} 65 dB

The maximum day time and night time levels are summarised in the table below per assessment position:

6.1.1.1 Assessment Position 1

Assessment Position		LAeq	
		Day	Night
		(0700 - 2300)	(2300 -0700)
1	04/09/2017	56.1	48.0
1	05/09/2017	58.1	48.3
1	06/09/2017	56.3	47.1
1	07/09/2017	60.2	49.5
Arithmetical Average		57.7	48.2

		Leq (63Hz)	Leq (125Hz)	Leq (250Hz)	Leq (500Hz)	Leq (1kHz)	Leq (2kHz)	Leq (4kHz)
04/09/2017	Day	62.8	54.0	49.0	46.3	50.7	49.2	34.7
04/09/2017	Night	61.0	49.7	45.3	43.5	44.7	40.1	28.5
05/09/2017	Day	65.8	57.1	51.9	49.3	54.3	53.4	39.4
05/09/2017	Night	61.0	50.2	45.9	44.1	44.8	40.8	30.0
06/09/2017	Day	65.6	57.1	51.7	49.2	52.5	51.0	38.6
06/09/2017	Night	58.2	48.9	44.4	42.5	43.7	39.6	30.2
07/09/2017	Day	65.8	57.3	52.2	49.2	53.2	57.8	38.8
07/09/2017	Night	58.9	50.3	46.2	44.3	45.6	43.0	36.2

6.1.2 Proposed Residential Façade Noise Levels

A detailed noise map was produced and calibrated to background noise measurements. The noise map indicated that the maximum noise levels that are likely to be present at the proposed residential façade will during the day time period be $L_{Aeq, 16 hour}$ 65 dB and during the night time period be $L_{Aeq, 8 hours}$ 54 dB.

The L_{AMAX} has also been modelled within the noise map. The average maximum noise levels that are likely to be present at the proposed residential façade will during the night time period be L_{AMAX} , 70 dB

Detailed calculations indicated that internal noise levels within the proposed residential properties will comply with the requirements of British Standard 8233: 2014 for average daytime and night time noise and the requirements of the WHO Guidelines for L_{Amax} Levels.

6.1.3 Requirements for noise mitigation

In order to meet reasonable internal levels in accordance with BS8233:2014; all facades should implement the following mitigation measures:

Construction of Walls	Standard masonry construction
Construction of Ceiling	2 layer of 12mm Fireline plasterboard
Construction of Windows	4mm glass / 16mm air gap / 4mm glass
Construction of Ventilation	MVHR

Detailed calculations indicated that internal noise levels within the proposed residential properties will comply with the requirements of British Standard 8233: 2014.

Time Period	Façade / Area	Specification	Room	Resulting Internal Level dB(A)	Criteria Limit
Day	West	4/16/4 and MVHR	4 th Floor	29 dB LAeq,16hour	35dB
L _{max}	West	4/16/4 and MVHR	4 th Floor	33 dB L _{Amax}	45dB
Night	West	4/16/4 and MVHR	4 th Floor	18 dB LAeq, 8hour	30dB
Day	Roof Top	1.2m barrier	Garden / Terrace	55 dB LAeq, 16hour	55dB
Resulting Internal Levels calculated in accordance with BS8233:2014 per time period					

6.2 Conclusions

It would be proposed that the development should be undertaken with glazing (4 – 16 - 4) with a mechanical ventilation system to alleviate the requirement for partially open windows to specified facades to ensure the internal noise levels are acceptable in terms of the assessment to British Standard 8233: 2014 and WHO Guidelines.

A requirement for a 1.2m barrier at the balcony / garden / roof terrace is recommended to control external noise below the upper limit of 55dB LAeq,16hout in accordance with WHO Guidelines.

6.2.1 Uncertainty

It is expected that the reported expanded uncertainty with reference to the background noise measurement with a confidence limit of 95% and assuming a convergence of k=2 is likely to be +/- 3.9dB. Uncertainty, in this instance has been minimised by undertaking longer background noise measurements over a 96-hour period. Background noise measurement uncertainty budget is shown in Appendix D.

7 APPENDIX A – INFORMATION TO BE REPORTED

7.1 a) Competency

1)	Name	Role	Competency
	I.Broom	Noise Consultant	IoA Diploma Acoustics Noise Control Associate Member of the Institute of Acoustics (AMIOA)

7.2 b) Source under Investigation

1)	Description of Source	Source Location	Hours of Operation	Mode of Operation
	Road Traffic Noise	Predominantly North and West of the site	24/7	Continuous
	Description of Premises	Site is at Mulberry House, 1A Eldon Road, Reading, RG1 4DS		

7.3 c) Subjective Impression of Source at Assessment Position

1)	Dominance	Sources are dominant at assessment positions
	Audibility	Sources are audible at assessment positions
2)	Residual Noise Sources	Traffic Noise / car park noise

7.4 d) Existing Contexts

1)	Type of Receptor	Period	Sensitivity	Description
	Residential	Day	Moderate	Noise can disturb outside amenity space Noise can disturb inside living space
		Night	High	Noise can disturb sleeping

7.5 e) Relative Positions

3)	Background Measurement	At assessment positions in report		
	Justification		Details	Compliance with Criteria
			Measurement Height	1.5m
			Distance to Reflecting Surface	3.5m
4)	Topography, surfaces etc.	Hard		

7.6 f) Noise Measurement Equipment Calibration

7.6.1 Continuous Measurement

1)	Type	Sound Level Meter	Microphone	Calibrator
		CR:171C	MK:224	CR:515
2)	Manufacturer	Cirrus	Cirrus	Cirrus
3)	Serial Number	G067012	1920791	67239
4)	Verification Date	7 th August 2018	7 th August 2018	7 th August 2018

7.7 g) Noise Measurement Equipment Operation Test

1)	Ref. Level of Calibrator	94 dB@1000Hz
2)	Meter Reading Before	94 dB – Meter operation checked. Meter in good working order.
	Meter Reading After	94 dB - Meter operation checked. Meter in good working order.

7.8 h) Weather Conditions

1)	Weather Conditions	Dry Measurement Period
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7.9 i) Date and Time of Measurements

1)	Background Measurements	4 th – 9 th September 2017
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7.10 j) Measurement Time Interval

1)	Background Measurements	Day Time	Night Time
		(07:00 – 23:00)	(23:00 – 07:00)
		T _m = 16 hours	T _m = 8 hours

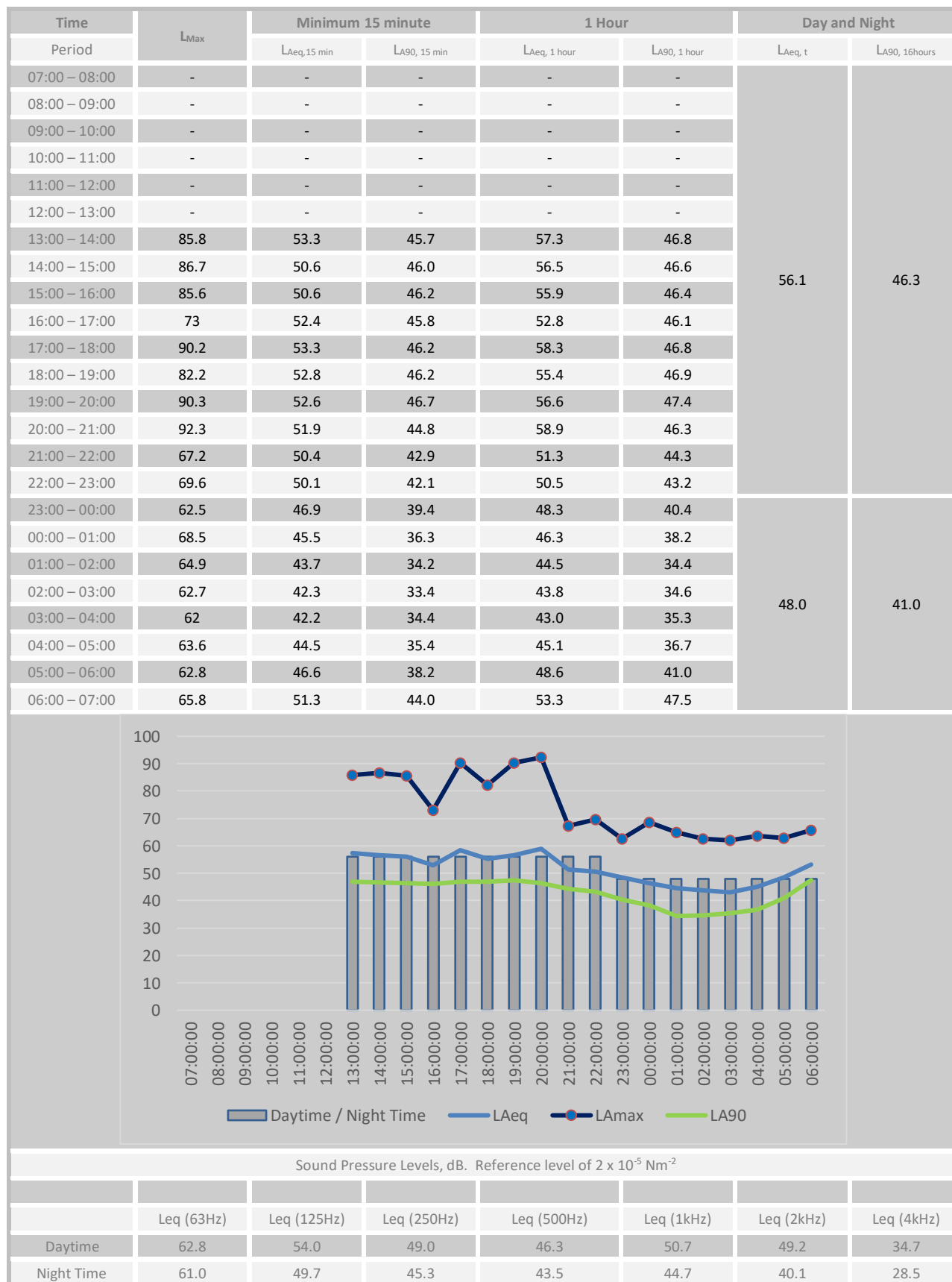
7.11 k) Reference Time Interval

1)	Reference Time Interval	Day Time	Night Time
		(07:00 – 23:00)	(23:00 – 07:00)
		T _r = 1 hour	T _r = 1 hour

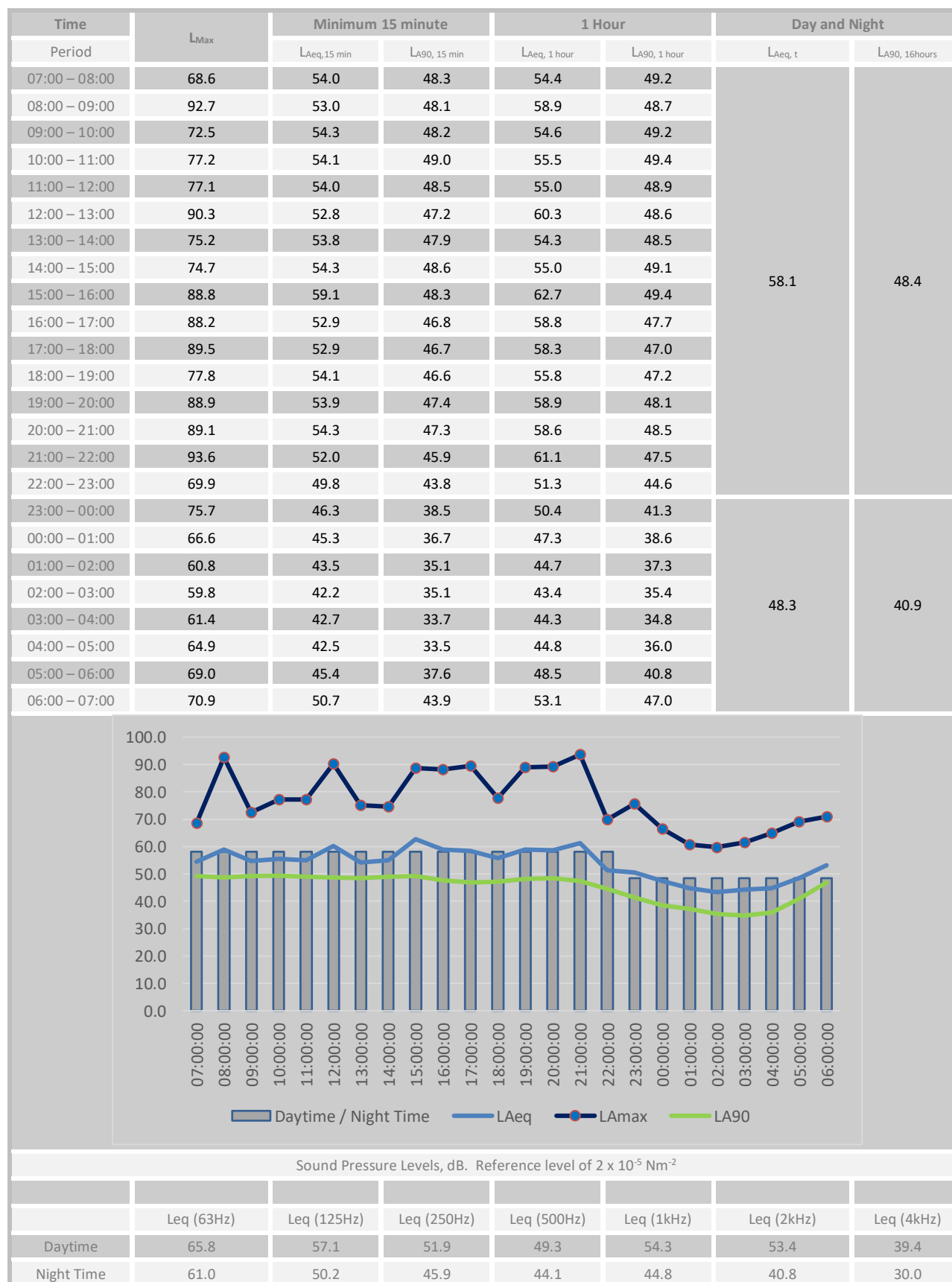
8 APPENDIX B – MEASUREMENT DATA

8.1 Baseline Assessment Position 1

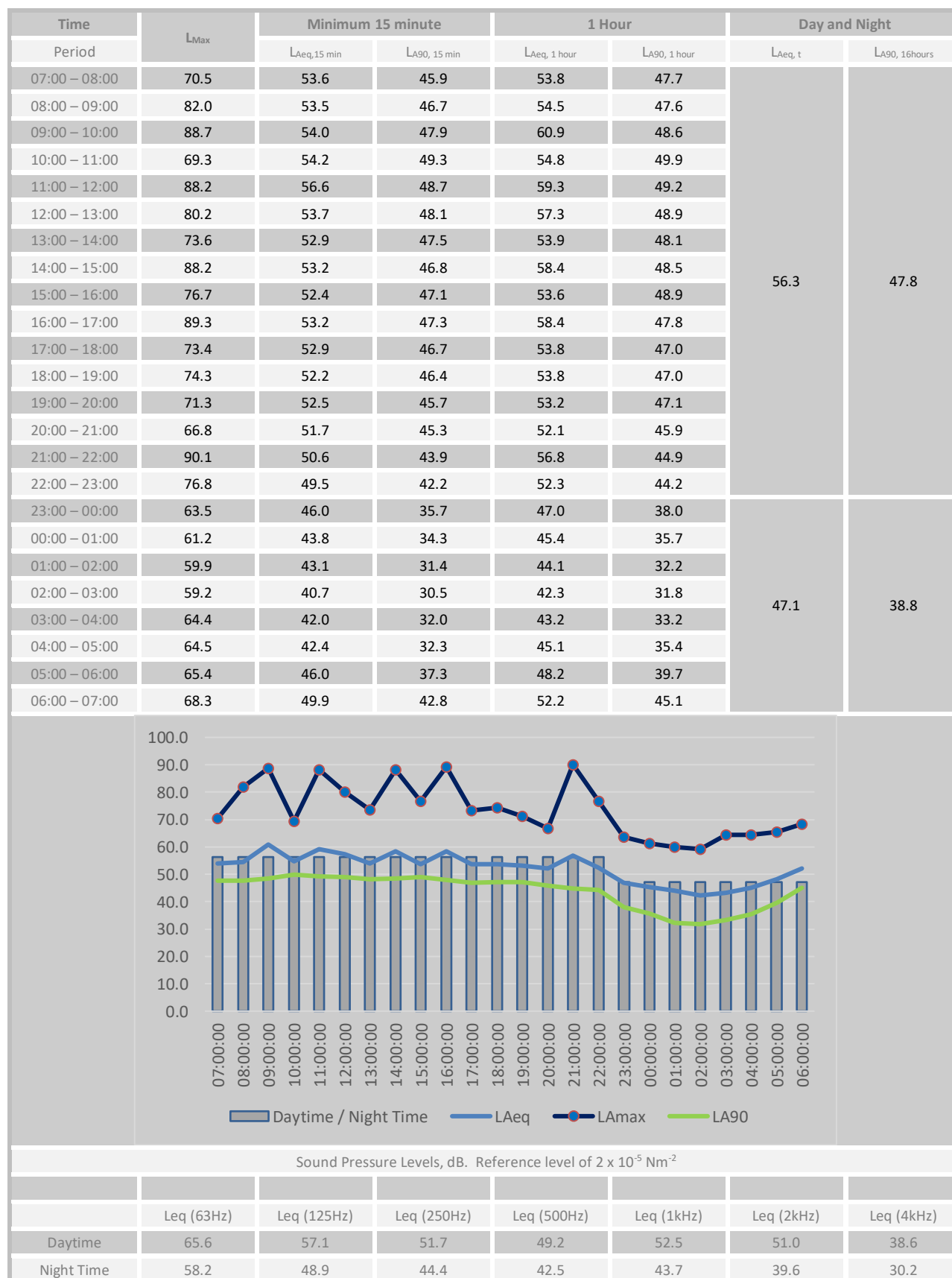
8.1.1 04/09/2017



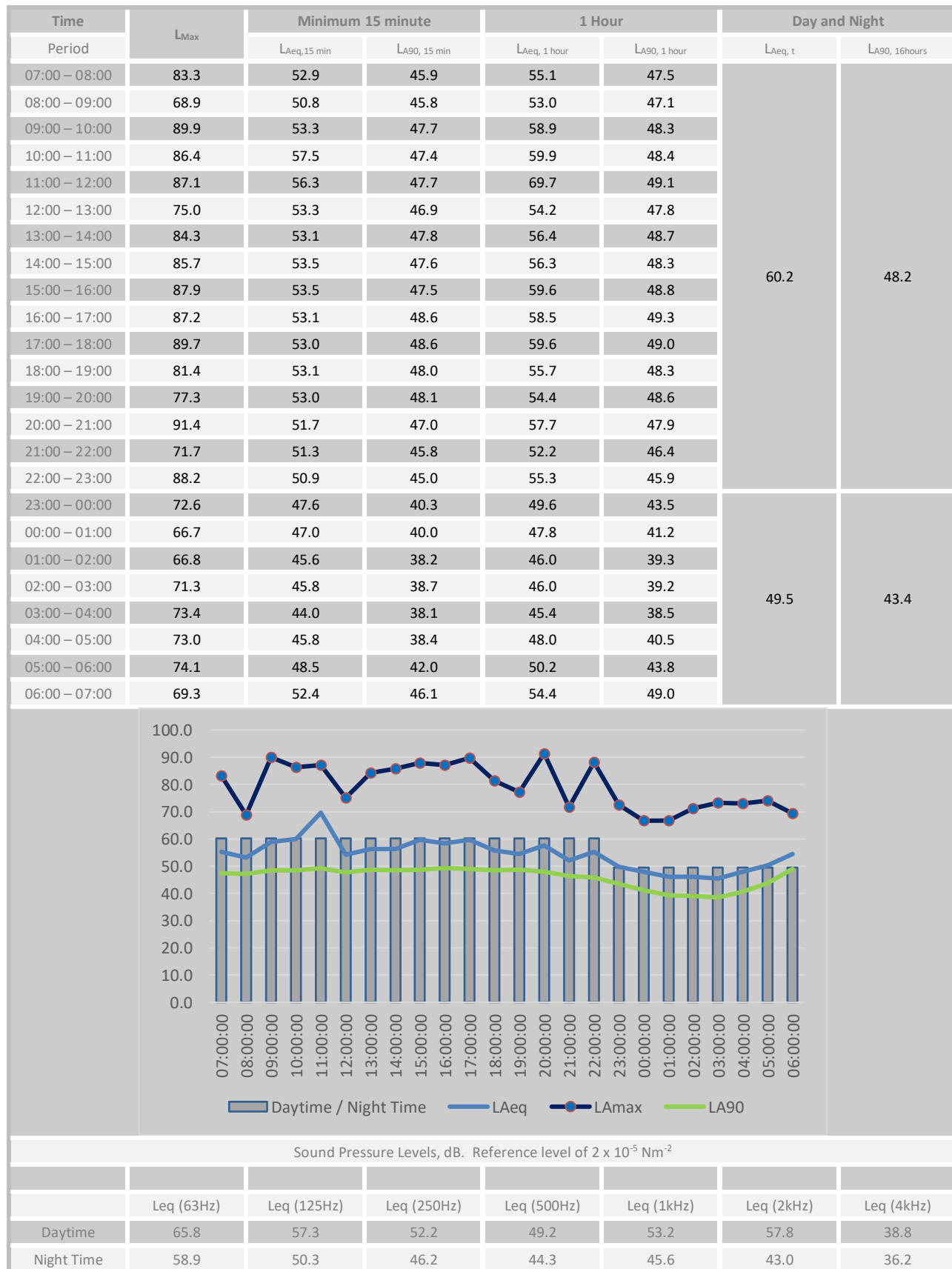
8.1.2 05/09/2017



8.1.3 06/09/2017



8.1.4 07/09/2017



9 APPENDIX C – RESULTING FAÇADE LEVELS

9.1 Overall Resulting Façade Levels and Spectra

Receiver name	Building	Floor	Level	Lmax (Night)	Night
	side		dB(A)		
2	West	GF	62.1	67	50.9
2	West	1.Fl	63.5	68.3	52.2
2	West	2.Fl	64.9	69.8	53.6
2	West	3.Fl	65.3	70.2	54
2	West	4.Fl	65.4	70.3	54.1
2	West	GF	61.8	66.7	50.6
2	West	1.Fl	63.2	68	51.9
2	West	2.Fl	64.6	69.4	53.3
2	West	3.Fl	64.9	69.8	53.6
2	West	4.Fl	65	69.9	53.7
3	West	GF	61.6	66.4	50.7
3	West	1.Fl	62.8	67.6	51.7
3	West	2.Fl	64.1	69	52.9
3	West	3.Fl	64.8	69.7	53.5
4	East	GF	58	62.7	47.7
4	East	1.Fl	58.7	63.5	48.1
4	East	2.Fl	59.6	64.4	48.7
5	East	GF	58.6	63.5	47.8
5	East	1.Fl	59.4	64.2	48.4
5	East	2.Fl	60.4	65.2	49.3
6	East	GF	59.1	63.8	48.6
6	East	1.Fl	59.9	64.7	49.2
6	East	2.Fl	60.9	65.7	50
6	East	3.Fl	61.7	66.6	50.7
6	East	4.Fl	61.8	66.7	50.8

9.1.1 Results Spectra

Name	Floor	Time slice	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz
2	GF	Day	68.6	60.1	54	51.1	55.4	59.4	38.7
2	GF	Lmax	73.3	64.1	58.9	55.9	60.2	64.3	43.1
2	GF	Night	58.1	51.8	42.8	40	44.1	48	29.4
2	1.FI	Day	69.8	61.2	55.5	52.5	56.7	60.7	40
2	1.FI	Lmax	74.6	65.6	60.4	57.4	61.6	65.6	44.5
2	1.FI	Night	59.1	52	44.3	41.4	45.4	49.3	30.2
2	2.FI	Day	71.1	62.6	57.1	54.1	58.1	62.1	41.2
2	2.FI	Lmax	75.9	67.1	62	59	63	67	45.9
2	2.FI	Night	60.2	52.9	45.8	42.9	46.8	50.7	31
2	3.FI	Day	71.7	63.2	57.8	54.6	58.6	62.5	41.5
2	3.FI	Lmax	76.5	67.8	62.6	59.5	63.5	67.4	46.2
2	3.FI	Night	60.6	53.3	46.5	43.3	47.2	51.2	31.1
2	4.FI	Day	71.7	63.2	57.9	54.9	58.7	62.6	41.7
2	4.FI	Lmax	76.6	67.8	62.8	59.7	63.6	67.5	46.5
2	4.FI	Night	60.7	53.2	46.6	43.6	47.3	51.2	31.1
2	GF	Day	68.2	60	53.8	51.1	55.1	59	38.7
2	GF	Lmax	72.8	63.6	58.7	55.9	59.9	63.9	42.9
2	GF	Night	58.1	52.5	42.7	40	43.8	47.7	29.9
2	1.FI	Day	69.5	61	55.3	52.5	56.4	60.4	39.9
2	1.FI	Lmax	74.2	65.1	60.1	57.3	61.3	65.3	44.4
2	1.FI	Night	59	52.5	44.2	41.4	45.1	49	30.5
2	2.FI	Day	70.7	62.2	56.8	53.9	57.8	61.8	41.2
2	2.FI	Lmax	75.5	66.6	61.6	58.8	62.7	66.7	45.8
2	2.FI	Night	60	53.1	45.6	42.7	46.5	50.4	31.2
2	3.FI	Day	71.3	62.8	57.4	54.2	58.1	62.1	41.5
2	3.FI	Lmax	76.1	67.2	62.2	59.1	63	67	46.1
2	3.FI	Night	60.5	53.5	46.1	43	46.8	50.7	31.3
2	4.FI	Day	71.6	62.8	57.5	54.4	58.2	62.2	41.5
2	4.FI	Lmax	76.4	67.3	62.4	59.2	63.1	67.1	46.2
2	4.FI	Night	60.7	53.4	46.2	43.1	46.9	50.9	31.1
3	GF	Day	68.6	60.8	53.5	50.3	54.5	58.8	38.9
3	GF	Lmax	73	63.7	58.3	55	59.4	63.7	42.3
3	GF	Night	59	54.4	42.9	40.1	43.5	47.6	31.8
3	1.FI	Day	69.6	61.3	54.8	51.6	55.8	60	39.7
3	1.FI	Lmax	74.3	65	59.6	56.3	60.6	64.9	43.6
3	1.FI	Night	59.5	53.7	44	41	44.6	48.7	31.5
3	2.FI	Day	70.8	62.4	56.5	53.2	57.2	61.4	40.6
3	2.FI	Lmax	75.5	66.6	61.3	58	62.1	66.3	45
3	2.FI	Night	60.2	53.7	45.4	42.2	45.9	50	31.5
3	3.FI	Day	71.5	63	57.3	54	58	62	40.9
3	3.FI	Lmax	76.3	67.4	62.1	58.9	62.9	66.9	45.5
3	3.FI	Night	60.6	53.8	46.1	42.9	46.7	50.6	31.2
4	GF	Day	67.9	59.6	50.2	46.8	51.6	54.9	35.9
4	GF	Lmax	72.3	61.8	54.9	51.2	56.4	59.8	37.4
4	GF	Night	58.7	53.9	40.3	37.5	40.9	43.9	30.7
4	1.FI	Day	68.6	59.6	51.1	47.6	52.3	55.6	35.8

4	1.FI	Lmax	73.2	62.7	55.7	52.1	57.1	60.5	38.1
4	1.FI	Night	58.9	53.1	40.9	38	41.4	44.5	30
4	2.FI	Day	69.6	60.5	52.7	48.7	53.3	56.5	35.9
4	2.FI	Lmax	74.2	64.2	57.5	53.4	58.1	61.3	38.9
4	2.FI	Night	59.3	53	42.1	38.5	42.2	45.2	29.3
5	GF	Day	68	58.8	50.2	47.7	52.3	55.6	35.3
5	GF	Lmax	72.6	62	55	52.4	57.1	60.5	38.4
5	GF	Night	58	52	39.4	37.1	41.2	44.4	28.8
5	1.FI	Day	68.8	59.3	51.2	48.5	53.1	56.4	35.8
5	1.FI	Lmax	73.5	63	55.9	53.3	57.9	61.3	39.1
5	1.FI	Night	58.6	51.7	40.5	38	42	45.2	28.8
5	2.FI	Day	69.7	60.4	53	49.9	54.1	57.3	36.3
5	2.FI	Lmax	74.5	64.4	57.8	54.7	58.9	62.2	39.9
5	2.FI	Night	59.2	52.2	42.1	39.1	42.9	46	28.8
6	GF	Day	68.4	59.9	49.9	49.5	52.7	56	36.8
6	GF	Lmax	72.8	61.9	54.4	54.1	57.5	60.8	38.8
6	GF	Night	59.2	54.5	40.1	39.4	41.9	44.9	31.2
6	1.FI	Day	69.3	60.1	50.9	50.3	53.5	56.8	36.9
6	1.FI	Lmax	73.8	63	55.5	55	58.3	61.6	39.6
6	1.FI	Night	59.6	53.8	41	40.1	42.6	45.6	30.8
6	2.FI	Day	70.4	61.2	53.1	51.6	54.6	57.7	37.1
6	2.FI	Lmax	75	64.8	57.8	56.3	59.4	62.6	40.4
6	2.FI	Night	60.1	53.8	42.5	40.9	43.5	46.5	30.2
6	3.FI	Day	72	62.9	55.6	52.9	55.5	58.3	37.3
6	3.FI	Lmax	76.8	67	60.4	57.7	60.4	63.2	40.7
6	3.FI	Night	61.4	54.5	44.7	42.1	44.4	47.1	30.2
6	4.FI	Day	72.8	63.7	56.9	53.4	55.8	58.2	36.6
6	4.FI	Lmax	77.6	68	61.7	58.2	60.7	63.1	39.9
6	4.FI	Night	62	54.8	45.8	42.4	44.6	46.9	29.7

10 APPENDIX C – UNCERTAINTY BUDGET

Sources of Uncertainty	Uncertainty Notes	Commentary	Value (half Width)	Convert to Same Units (dB)	Distribution Divisor			Standard Uncertainty (u) dB
					Normal	Rectangular	Other	
Measurement Position	Choice of position, ,	1m in 10m		0.2		rect($\sqrt{3}$)		0.13
	microphone orientation	Type 1 0 - 30deg	0.4		Normal			0.50
Instrumentation	Calibration	Calibration Drift	0.1		Normal			0.10
	Accuracy and precision (type 1)	Type 1 practical	1.9			rect($\sqrt{3}$)		0.50
Background Noise Level	Timing of Measurement							
Background Noise Level	Modal Analysis Day	Calculated Standard Deviation	4.1				s/ $\sqrt{n}$	0.41
Background Noise Level	Modal Analysis Night	Calculated Standard Deviation	3.2				s/ $\sqrt{n}$	0.32
Combined Uncertainty (root sum of squares)								1.96
Expanded Uncertainty U = Kuc (95% Confidence K =2)								3.92
Final Answer Expressed as Value +/- U dB with a confidence Level of 95%								
REFERENCE: Uncertainty Budget Calculated in line with M3003: The Expression of Uncertainty and Confidence in Measurement Edition 3, November 2012 and A Good Practice Guide on the Sources and Magnitude of Uncertainty Arising in the Practical Measurement of Environmental Noise N J Craven, G Kerry Edition 1a – May 2007.								

##End of Report##