Environmental Noise Assessment

Project No: PA114

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Land Adjacent to Tenford Lane, Tean, Staffordshire

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1. Summary

1.1. Proposal

It is proposed to develop residential dwellings on land adjacent to Tenford Lane, Tean, Staffordshire, close to Tenford Dog Kennels

1.2. Reason for Assessment

The local planning authority has requested a noise assessment due to the site being within proximity of dog kennels.

1.3. Planning Conditions & Criteria

For desirable internal and external noise levels to be maintained, given in BS8233:2014 as:

- 35dB L_{Aeq} within living rooms (07:00 – 23:00)
- 30dB L_{Aeq} within bedrooms (23:00 – 07:00)
- 45dB L_{Amax} should not be regularly exceeded within bedrooms (23:00 – 07:00)
- <55dB $L_{Aeq,16hr}$ within external amenity spaces

1.4. Assessment Standards & Justification

'BS8233:2014 – Guidance on sound insulation and noise reduction for buildings' is a recognised standard for noise sensitive developments within proximity of aircraft noise. The standard gives a rigorous calculation method for determining interior noise levels based on measured environmental noise levels and typical façade specifications.

'WHO Guidelines for Community Noise, 1999' gives recommended internal noise level and gives comment on guideline noise levels based on annoyance, speech ineligibility, disturbance of information extraction, sleep disturbance and hearing impairment.

'BS EN 12354-3:2000 – Estimation of acoustic performance in buildings from the performance of elements. Airborne sound insulation against outdoor sound' allows internal noise levels to be derived from point sources situated externally from the building façade. The noise emitting from the Golf Club would emanate from a point source.

1.5. Measurements

In order to assess noise emissions, attended noise measurements were undertaken over a 3-hour daytime period on 6th October 2016 between 13:31-16:21 and a 1-hour night-time period on 7th October between 1:06-2:02.

Noise Measurement Summary				
Measurement	**Date**	**Period**	**LAeq (dB)**	**LAFmax (dB)**
M1	6th October 2016	Day (3hr)	**55.8**	**77.3**
M2	7th October 2016	Night (1hr)	**47.4**	**68.5**

1.6. Noise Assessment Outcome

It is determined that by using the mitigation as specified below for the building façade, the outcome summarised in the following table is achieved. This is based on the assumption that all windows are closed and auxiliary methods of ventilation are used:

Internal Space	Noise Parameter	Internal Noise Level	Within Desired Criteria
Living Room	Daytime $L_{Aeq, 16hr}$	27.7	Yes
Bedroom	Night-time $L_{Aeq, 8hr}$	19.9	Yes
Bedroom	Night-time L_{AFmax}	28.5	Yes
External Space	**Noise Parameter**	**External Noise Level**	**Within Desired Criteria**
Amenity Space	Daytime $L_{Aeq, 16hr}$	47.0	Yes

1.7. Mitigation Recommendations

1.7.1. Façade Specifications

Living Rooms and Bedrooms – 4/12/4mm glazing and hit & miss trickle ventilators

1.8. Site & Measurement Location

Measurement Location

Site Location

2. Environmental Noise Survey

2.1. Source Under Investigation

Primary noise sources identified onsite were from dogs barking from Tenford Kennels to the West and vehicle traffic from Tenford Lane to the South. Secondary noise sources were from birdsong and light aircraft.

Daytime and night-time noise measurements have been carried out on 6th and 7th October 2016

3.1. Measurement location

Noise levels were measured at the Western extent of the site, as close as possible to Tenford kennels

3.2. Weather Conditions

Weather conditions were deemed acceptable for environmental noise measurements; detailed weather conditions are given in **Appendix C**.

3.3. Measurement Equipment

Measurement equipment used complies with accuracy requirements for common environmental noise measurement standards. A detailed equipment list is given in **Appendix B** with calibration information in **Appendix D**.

3.4. Measurement Results

The results from the measurement intervals are summarised in the tables below. Full measurement details and information can be found in **Appendix E**.

3.4.1. Measurement Results

Measurements were taken in October which is not representative of peak times of operation for the dog kennels. It was difficult to assess the number of dogs currently housed in kennels however it can be assumed that the kennels will most likely be close to full capacity during the summer months. Assuming the worst-case scenario of the kennels having the capacity to double the number of dogs during peak months a 3dB penalty correction can be applied to all noise levels measured.

Results of measurements are as follows:

Measured Noise Levels 6th-7th October 2016

	$L_{Aeq,\ T}$ (dB)	L_{AFmax} (dB)
Daytime (M1)	**55.8**	**77.3**
Night-time (M2)	**47.4**	**68.5**
Capacity Correction (M1)	**58.8**	**80.3**
Capacity Correction (M2)	**50.4**	**71.5**

4. BS8233:2014 Noise Assessment

4.1. Criteria

The target outcome for the assessment is for desirable internal and external noise levels to be maintained, given in BS8233:2014 as:

- 35dB L_{Aeq} within living rooms (07:00 – 23:00)
- 30dB L_{Aeq} within bedrooms (23:00 – 07:00)
- 45dB L_{Amax} should not be regularly exceeded within living rooms (23:00 – 07:00)
- <55dB $L_{Aeq,16hr}$ within external amenity spaces

4.2. External Noise Analysis

Measured noise levels are shown graphically in **Appendix E.** Both day and night-time measurements are dominated by noise emanating from the adjacent kennels as L_{Aeq} and L_{Afmax} levels follow a similar pattern. The dogs were asleep during night-time measurements until approximately 01:45 when they were woken, accounting for the sudden increase in measured L_{Aeq} and L_{Afmax} levels. During day-time measurements dogs were barking consistently throughout measurements.

4.4. Internal Noise Levels – Assumed Insulation

Internal noise levels have been calculated in order to demonstrate that the proposed development can achieve suitable internal noise levels inside rooms, when appropriate glazing and ventilation systems are used.

In order to describe the likely internal exposure to environmental noise at the site, Peak Acoustics, Ltd. use suggested data from BS8233:2014 on standard construction. This will include all elements of the exposed living room and bedroom façades closest to the noise sources

A summary of assumed construction details is provided within **Appendix F.**

4.5. Daytime Internal Noise Levels

Considering the insulation with the addition of 4/12/4mm glazing and hit & miss trickle ventilation, daytime environmental noise would be reduced from 58.8 dB $L_{Aeq,\ 3hr}$ to interior levels of **27.7 dB $L_{Aeq,\ 16hr}$.**

The desirable limit of BS8233:2014 suggests a guideline of 35dB $L_{Aeq,\ 16hr}$ for resting conditions, and up to 40dB considered acceptable for necessary developments.

The assumed standard of construction would place the internal levels in living rooms as below 35dB $L_{Aeq,\ 16hr}$, therefore within the desirable criteria.

4.6. Night-time Internal Noise Levels

Considering the insulation with the addition of 4/12/4mm glazing and hit & miss trickle ventilators, night-time environmental noise in bedrooms would be reduced from 50.4 dB $L_{Aeq,\ 1hr}$ to interior levels of **19.9dB $L_{Aeq,\ 8hr}$**

BS8233:2014 suggests a desirable guideline of 30dB $L_{Aeq,\ 8hr}$ for sleeping conditions, with an acceptable limit of 35dB $L_{Aeq,\ 8hr}$.

The above standard of construction would place the internal continuous levels in bedrooms as below 30dB $L_{Aeq, 16hr}$

4.7. Maximum internal Noise Levels

Internal noise levels will be calculated in accordance with BS EN 12354:-3:2000 based on measured maxima. Calculations of internal maxima levels are calculated within the sound insulation modelling software Insul™ (Marshall Day Acoustics) see **Appendix H** for full details (note: calculated room sound level is subject to a +3dB capacity correction). The measured maxima (dogs barking) are line source distance corrected (line source is used to take into account a worst case scenario) to the nearest proposed residential façade 90m away by a factor of 10*log(90/6) = 11.8dB.

Considering the insulation with the addition of 4/12/4mm glazing and hit & miss trickle ventilators, daytime maximum individual noise events due to dogs barking will be reduced from 68.5 dB L_{Afmax} to **28.5dB L_{Afmax}**

For night-time maximum individual noise events due to dogs barking, internal levels will be reduced from 59.7dB L_{Afmax} to **20.6dB $L_{Afmax.}$**

The desirable limit of BS8233:2014 suggests Individual noise events (Measured with fast time-weighted Maximum) should not normally exceed 45dB L_{AFmax} (as in BS8233:1999).

The above standard of construction would place internal maximum noise level as below 45dB L_{AFmax}, therefore in the desirable category when considering both daytime and night-time maxima.

4.8. Assessment of Internal Noise Impact

4.8.1. Impact of dog barking intermittency

Due to the cyclic nature of measurements resulting from dogs barking intermittently calculations will be made for night-time noise break-in during periods where the dogs are quiet. This will be compared to the break-in due to dog noise levels in attempt to assess the impact of intermittent dog barking.

Noise levels during periods when the dogs in the kennels were quiet were measured between 14:35-15:25 in the day-time and 01:08-01:31 at night.

The following table shows the difference in noise levels from periods where dogs are barking to periods to where they are quiet. Calculations are made assuming all windows are shut:

	Overall Internal Noise Levels 90m from Kennels	Internal Noise Level when dogs quiet	Difference
Day, dB L_{Aeq}	15.9	16.0	-0.1
Night, dB L_{Aeq}	8.1	8.2	-0.1
Max (Night), dB L_{Afmax}	20.6	23.0	-2.4

The internal noise due to dogs barking will be reduced via line source distance attenuation by a factor of 10*log(90/6) = 11.8dB. This leaves only the resultant noise equivalent to when the dogs are quiet. The difference in internal noise levels between when the dogs are barking and when they are quiet will therefore be 0dB, there will be minimal difference.

Internal noise levels are within desirable criteria as stated in BS8233:2014.

4.8.2. Effect of Open Windows

BS8233:2014 states that a 15dB attenuation can be applied to measured noise levels to represent internal noise levels when windows are open, however this is assuming road traffic noise. The attenuation due to road traffic noise is based upon the assumption that the noise is emanating from a line source, in the case of this report the noise emanating from dogs barking is more likely to have a more severe impact on susceptibility, therefore a 12dB attenuation is assumed.

The following table shows the levels internal noise will be when windows are open:

	Open Window Corrected Measurements	Difference from BS8233 criteria
Day, dB L_{Aeq}	35.0	0
Night, dB L_{Aeq}	26.6	-3.4
Max (Night), dB L_{Afmax}	47.7	2.7

With the windows open, internal noise levels would therefore be within BS8233 criteria during both day and night-time however max noise level events would be 2.7dB above the desired criteria.

Although the maxima criteria is exceeded, it is exceeded by a minimal margin and is within a 3dB difference. A 3dB difference in noise levels is when the human ear can clearly distinguish a change in noise level, therefore it is likely that the difference from the desired criteria and the received maxima noise levels will be negligible.

4.9. Further Mitigation

4.9.1 Bedroom Window Locations

Where possible, and most importantly on dwellings situated closest to the kennels, bedroom windows should not face west and should ideally be easterly facing. This will obscure the line of sight between the bedroom windows and kennels, thus providing a further attenuation of noise emissions from the dog kennels.

4.10. External Amenity Space Noise Levels

BS8233:2014 provides a desirable guideline of 50dB $L_{Aeq,16hr}$ for external amenity spaces and an acceptable guideline of 55dB $L_{Aeq,16hr}$.

External noise levels across the full daytime period (07:00 – 23:00) were measured as **58.8 dB $L_{Aeq,16hr}$**. This is distance corrected to the nearest external amenity space using line source distance correction as in section 4.7 (10*log(90/6) = 11.8dB) resulting in a daytime noise level of 47.0dB, 3.0dB within the desirable criteria.

5. BS8233:2014 Effect Level and Exposure Outcomes

A summary of internal noise levels and their respective BS8233 classifications can be found below:

Internal Space	**Noise Parameter**	**Internal Noise Level**	**BS8233 Classification**
Living Room	Daytime $L_{Aeq, 16hr}$	27.7	'Desirable'
Bedroom	Night-time $L_{Aeq, 8hr}$	19.9	'Desirable'
Bedroom	Night-time L_{AFmax}	28.5	'Desirable'
External Space	**Noise Parameter**	**External Noise Level**	**BS8233 Classification**
Amenity Area	Daytime $L_{Aeq, 16hr}$	47.0	'Desirable'

APPENDIX A - Measurement Details

Measurement	Kit	Start Date	Start Time	End Date	End Time
M1	A3	06/10/16	13:31	06/10/16	16:21
M2	A3	07/10/16	01:06	07/10/16	02:02

APPENDIX B - Equipment Details

Kit	Equipment	Make	Model	Class	Serial Number
A3	Sound Meter	Svantek	958	1	40305
A3	Pre-Amp	Svantek	SV12L	1	41651
A3	Calibrator	Svantek	SV31	1	32507

APPENDIX C - Meteorology Details

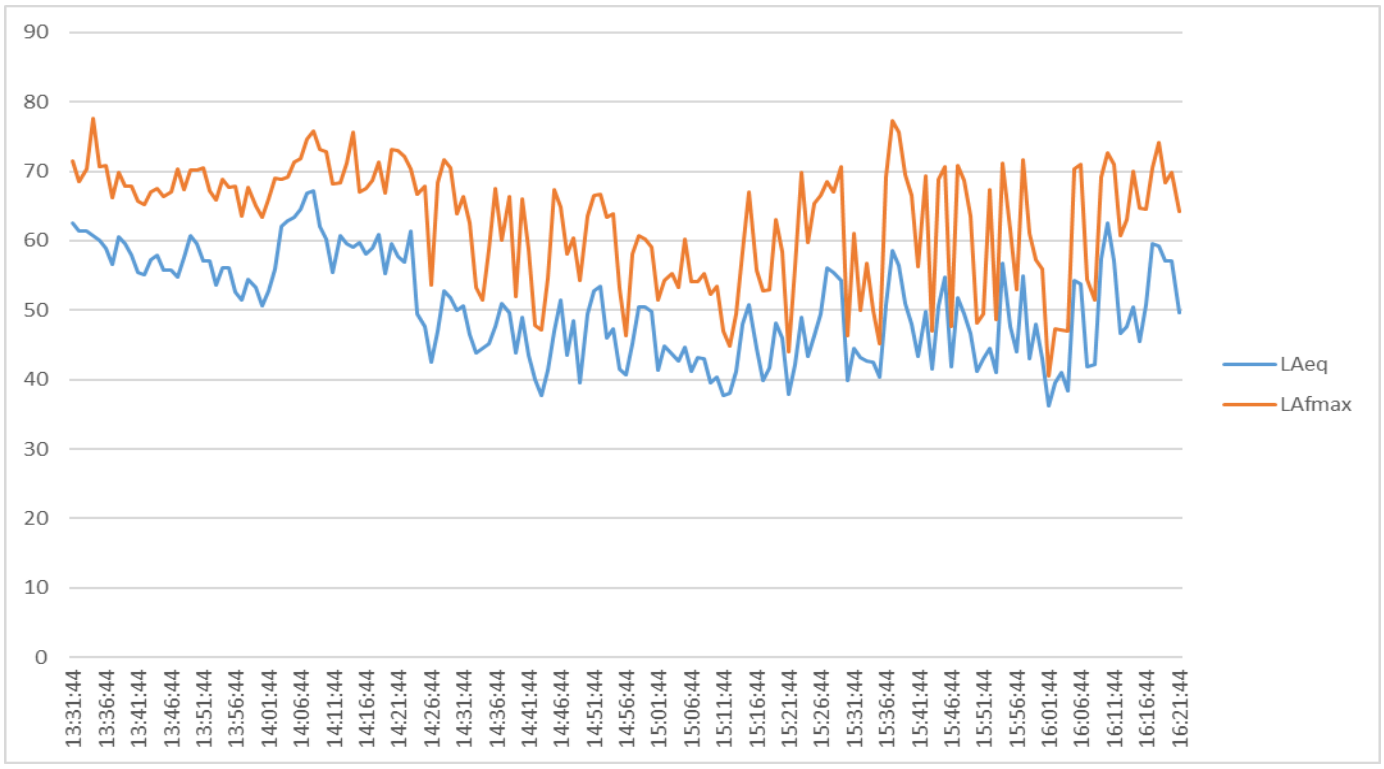
Measurement	Temp C	Wind Speed m/s	Wind Direction	Humidity %	Precipitation mm	Cloud Cover (Oktas)
M1	14	4.8	ENE	58	0.0	2/8
M2	10	3.3	N	79	0.0	Unidentifiable

APPENDIX D - Calibration Details

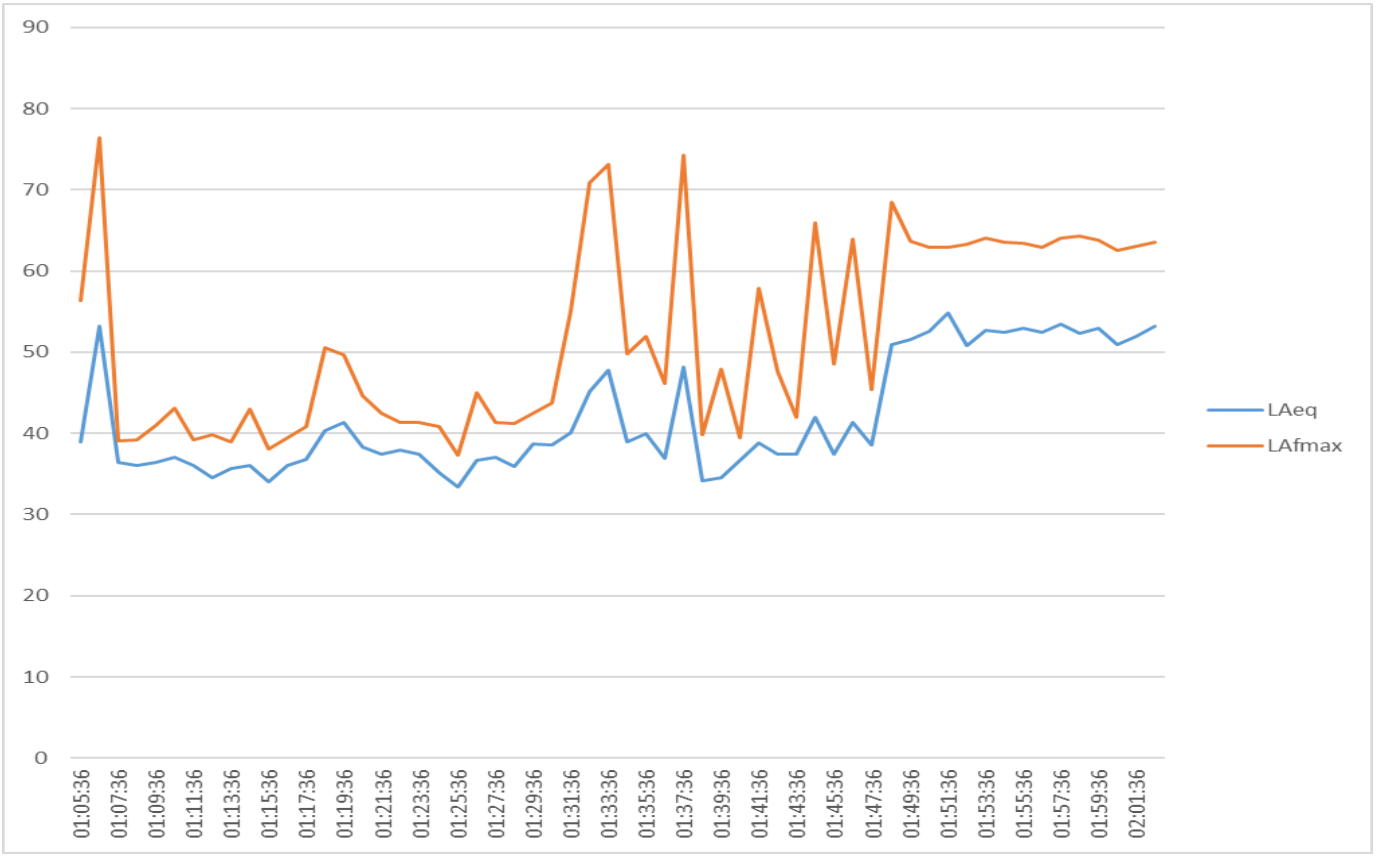
Measurement	Calibrator Ref Level (dB)	Level Before (dB)	Deviation Before (dB)	Level After (dB)	Deviation After (dB)
M1	114.0	113.53	0.47	113.44	0.56
M2	114.0	113.44	0.56	113.44	0.56

APPENDIX E – Noise Survey Results

Day-time environmental noise measurements, 6th October 2016



Night-time environmental noise measurements, 7th October 2016



APPENDIX F – Assumed Construction Details

Values are given according to two key areas covered by BS8233:2014, which are listed as the following:

- Living rooms between hours of 07:00 and 23:00;
- Bedrooms between hours of 23:00 and 07:00.

For the purposes of this assessment, daytime levels are assessed in living room spaces, night-time levels are assessed in bedrooms. Typical room sizes are taken from BS8233 as:

- Living room 5m x 4m x 2.4m
- Bedroom 3m x 4m x 2.4m

The building envelope is assumed as having standard construction, with façade materials and elements, such as:

- External wall, concrete block & brickwork leaves with >75mm cavity
- Pitched roof with mineral wool and plaster ceiling
- Hit & Miss Trickle Ventilators
- 4/12/4mm double glazing

The following are Sound Reduction Indices of the specifications identified previously:

Sound Reduction Index of the external wall, dB (R_w)

Frequency Band (Hz)	125	250	500	1000	2000
R_w of External wall	41	45	45	54	58

Sound Reduction Index of the roof, dB (R_w)

Frequency Band (Hz)	125	250	500	1000	2000
R_w of Roof	27	37	43	48	52

Sound Reduction Index of 4/12/4mm glazing, dB (R_w)

Frequency Band (Hz)	125	250	500	1000	2000
R_w of Glazing	24	20	25	34	37

Level Difference ($D_{n,e}$), dB of hit & miss trickle ventilators

Frequency Band (Hz)	125	250	500	1000	2000
$D_{n,e}$ of Ventilation	34	27	37	35	34

This report determines values based on the assumption that ventilation is **NOT from open windows**, but from auxiliary methods of external ventilation. Summary calculations are made following the BS8233:2014 Rigorous Design Calculation shown in **Appendix G**.

APPENDIX G – Attenuation Calculation Sheets

BS8233 Rigorous Design Calculation – Internal Daytime Noise

	125	250	500	1000	2000
Leq1	50.3	46.6	57.7	55.7	48.3
Dne	34	27	37	35	34
Rwi	24	20	25	34	37
Rew	41	45	45	54	58
Rrr	27	37	43	48	52
A	16	16	16	16	16
Sf	9.6		S	10	
Sw1	1.8		A0	10	
Sew	7.8				
Srr	20.0				

	125	250	500	1000	2000
A	50	47	58	56	48
B	0.00041	0.00208	0.00021	0.00033	0.00041
C	0.00075	0.00188	0.00059	0.00007	0.00004
D	0.00006	0.00003	0.00003	0.00000	0.00000
E	0.00017	0.00007	0.00007	0.00001	0.00000
F	-28.56620	-23.93084	-30.49469	-33.81348	-33.40373
G	-2.12188	-2.12188	-2.12188	-2.12188	-2.12188
leq2	22.6	23.5	28.1	22.8	15.8
A weight	-16	-9	-3	0	1
LAeq2	6.6	14.5	25.1	22.8	16.8
Leq2 (SN)	31.1				
LAeq2 (SN)	27.7				

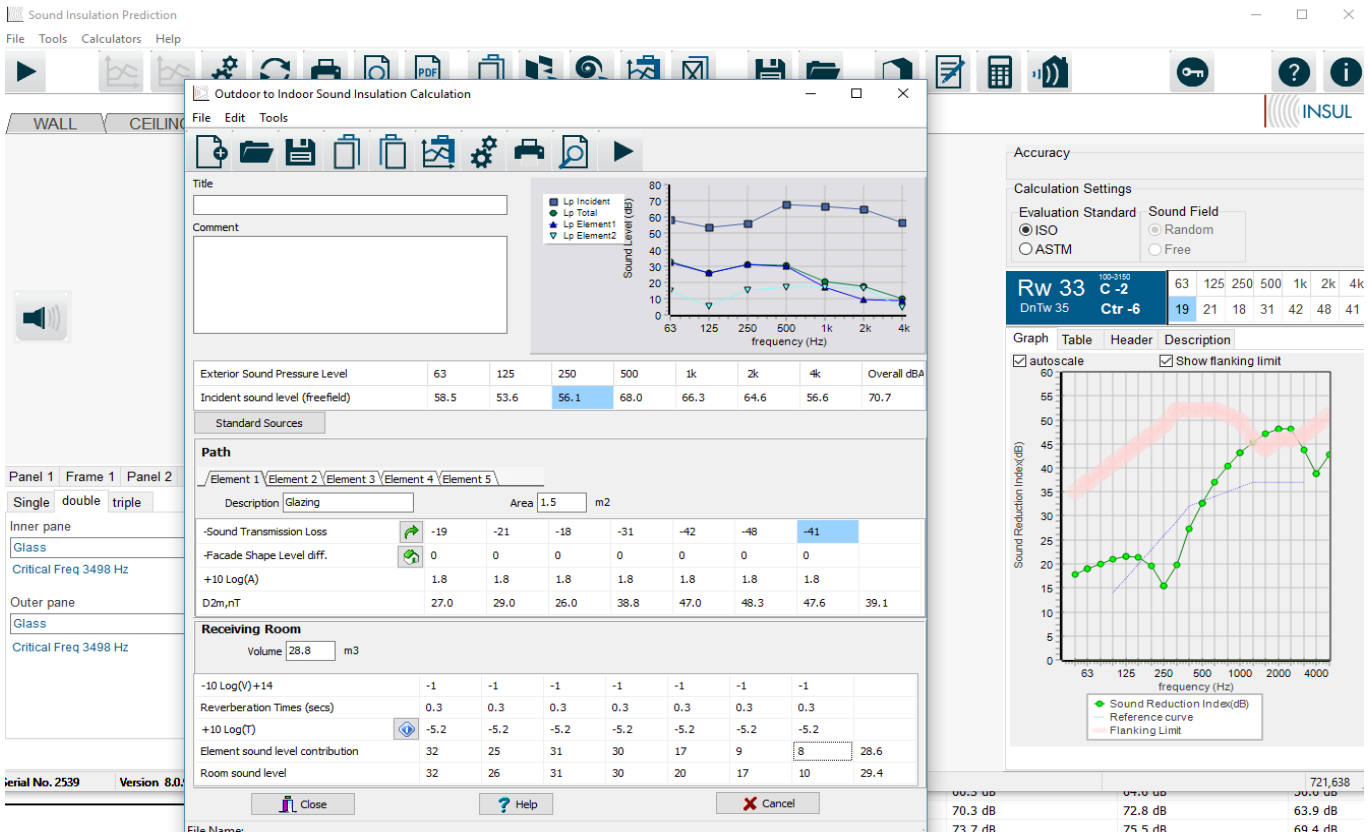
BS8233 Rigorous Design Calculation – Internal Night-time Noise

	125	250	500	1000	2000
Leq1	40.4	41.6	51.4	46.6	35.9
Dne	34	27	37	35	34
Rwi	24	20	25	34	37
Rew	41	45	45	54	58
Rrr	27	37	43	48	52
A	16	16	16	16	16
Sf	9.6		S	10	
Sw1	1.5		A0	10	
Sew	8.1				
Srr	12.0				

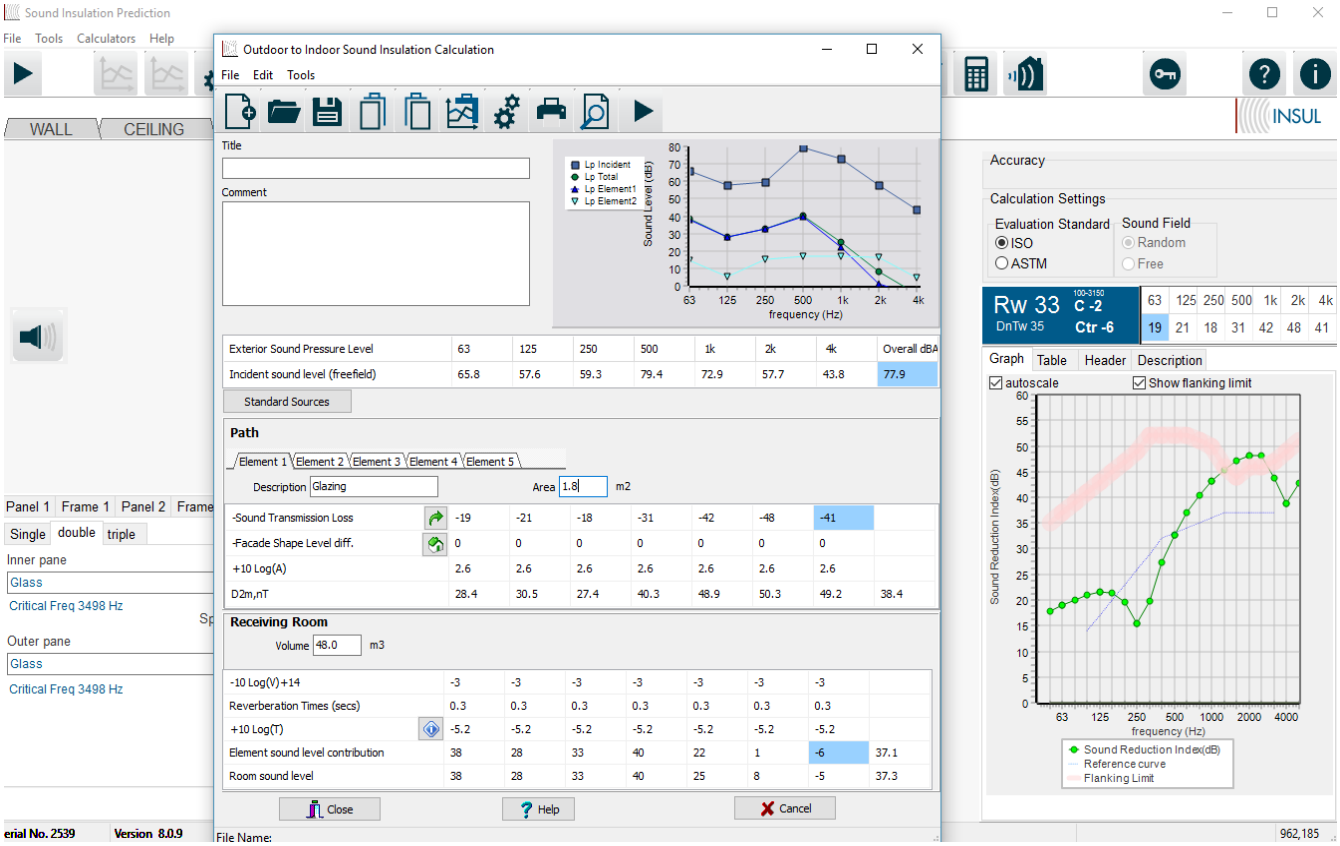
	125	250	500	1000	2000
A	40	42	51	47	36
B	0.00041	0.00208	0.00021	0.00033	0.00041
C	0.00062	0.00156	0.00049	0.00006	0.00003
D	0.00007	0.00003	0.00003	0.00000	0.00000
E	0.00010	0.00004	0.00004	0.00000	0.00000
F	-29.19716	-24.30965	-31.14551	-33.98001	-33.47571
G	-2.12188	-2.12188	-2.12188	-2.12188	-2.12188
leq2	12.1	18.2	21.1	13.5	3.3
A weight	-16	-9	-3	0	1
LAeq2	-3.9	9.2	18.1	13.5	4.3
Leq2 (SN)	23.7				
LAeq2 (SN)	19.9				

APPENDIX H – Insul™ Calculations of internal maxima levels

Night-time maxima



Day-time maxima



Appendix I – Proposed development plan