

THE SNELL & WILCOX LTD PENSION PLAN

**PROPOSED REDEVELOPMENT OF LAND AT
SOUTHLEIGH PARK HOUSE, EASTLEIGH ROAD,
HAVANT**

NOISE IMPACT ASSESSMENT

**REPORT REF. 160720-03B
PROJECT NO. 160720
JULY 2017**

**PROPOSED REDEVELOPMENT OF LAND AT SOUTHLEIGH PARK,
EASTLEIGH ROAD, HAVANT**

NOISE IMPACT ASSESSMENT

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DOCUMENT CONTROL SHEET

REV	ISSUE PURPOSE	AUTHOR	CHECKED	APPROVED	DATE
-	Draft for project team review	MNR	SJB	DRAFT ONLY	30/06/16
-	Final for submission	MNR	LL	MNR	04/04/17
A	Final for submission	HB	JC	SH	19/07/17
B	Final for submission	HB	JC <i>jec</i>	SH <i>SH</i>	25/07/17

1.0 INTRODUCTION

1.1 Ardent Consulting Engineers (ACE) is instructed by The Snell & Wilcox Limited Pension Plan to advise on the impact of ambient noise on the proposed redevelopment of Southleigh Park in Havant, for residential use to provide up to 90 dwellings.

1.2 The scheme involves: *"Hybrid application for up to 90 residential units in total, comprising:*

Full planning permission and listed building consent for the change of use, alterations to and extension of existing buildings to 20 residential units, (13 dwellings in the main house and 7 in other listed buildings) with associated landscaping, parking and amenity space.

Outline application (all matters reserved except means of access) for the demolition of 1983 office building and associated brick and glass corridor link and development of up to 70 residential units, associated landscaping, parking and infrastructure works."

1.3 This Noise Impact Assessment (NIA) has been produced to accompany the hybrid planning application submission to Havant Borough Council (HBC).

Location

1.4 The application site is located on the eastern side of Eastleigh Road, on the northeastern fringes of Havant. It is bordered by: Bartons Road to the north; Eastleigh Road to the west; Horndean Road (B2148) to the east; and open parkland that forms part of the Southleigh Park House grounds to the south. The site in the context of the local area is shown on the site location plan at **Plate 1**.

1.5 It is currently occupied by Southleigh Park House and associated buildings which are Grade 2 listed, plus a number of more modern

buildings which are in office use, although it is understood that occupancy of the buildings has been winding down from a peak of up to around 400 members of staff some 15 years ago with numbers dropping from around 250 in 2002 to around 70 in 2014. The existing floor area of buildings under B1 Office use at the site amounts to 4,350 sqm.



Plate 1: Site Location

Development Proposals

- 1.6 It is proposed to redevelop the site to provide up to 90 dwellings on the site, of which 20 will be provided within the existing Southleigh Park House and associated buildings, which are listed buildings that will be refurbished as part of the proposals. A total of 160 car parking spaces will be providing, which incorporates provision for use by visitors.

1.7 The indicative layout comprises 90 dwelling scheme comprise:

- 73 houses (27x2-bedroom, 32x3-bedroom, 2x3.5-bedroom and 12x4-bedroom); and
- 17 flats (10x1-bedroom, 6x2-bedroom and 1x3-bedroom).

1.8 An extract of the proposed illustrative master plan is included at **Plate 2** below:



Plate 2: Illustrative Masterplan (Extract)

2.0 RELEVANT POLICY AND GUIDANCE

National Planning Policy Framework (NPPF) – March 2012

2.1 Under the NPPF, with regard to environmental noise, planning policies and decisions should aim to: -

- avoid noise from giving rise to significant adverse impacts on health and quality of life as a result of new development;
- mitigate and reduce to a minimum other adverse impacts on health and quality of life arising from noise from new development, including through the use of conditions;
- recognise that development will often create some noise and existing businesses wanting to develop in continuance of their business should not have unreasonable restrictions put on them because of changes in nearby land uses since they were established; and
- identify and protect areas of tranquillity which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason.

Noise Policy Statement for England (NPSE)

2.2 To avoid and mitigate adverse noise effects on health arising from and impacting on new development, the NPPF makes reference to NPSE. The NPSE was published in March 2010 and covers all forms of noise, other than occupational noise. For the purposes of this report, "Neighbourhood Noise" is most relevant as NPSE defined at paragraph 2.5:

"neighbourhood noise which includes noise arising from within the community such as industrial and entertainment premises, trade and business premises, construction sites and noise in the street."

Calculation of Road Traffic Noise – 1988

- 2.3 For new developments, road traffic noise levels should be predicted in accordance with *CRTN*. This prediction method uses the traffic flow, vehicle speed, and percentage of heavy duty vehicles (HDVs, over 3.5 tonnes), road gradient and other factors to calculate noise levels at receptor points.

World Health Organisation – Guidance on Community Noise

- 2.4 The WHO document *Guidance on Community Noise* specifies additional information for noise affecting noise sensitive receptors and forms the basis of many noise limitations and design ranges for internal and external ambient noise levels, which are repeated specifically for developments within the United Kingdom in BS 8233: 2014 – Guidance on Sound Insulation and Noise Reduction for Buildings.

BS8233:2014 – Guidance on Sound Insulation and Noise Reduction for Buildings

- 2.5 Formerly a Code of Practice, the recent 2014 revision of BS8233 is now presented and intended as a guidance document. The standard is mainly concerned with building design from an acoustic standpoint. It does however, contain information relevant to environmental noise more specifically by stating guidance for desirable internal noise levels for dwellings and other buildings. An extract of Table 4 of the document relevant for residential development is reproduced in **Table 2.1** on the following page.

Activity	Location	07:00 to 23:00	23:00 to 07:00
Resting	Living room	35dB LAeq,(16hour)	-
Dining	Dining room / area	40dB LAeq,(16hour)	-
Sleeping (Daytime resting)	Bedroom	35dB LAeq,(16hour)	30dB LAeq,(8hour)

Table 2.1: Extract from Table 4 – Indoor ambient noise levels in dwellings

2.6 The latest revision of the document does not include a recommended maximum internal noise level. However, in order to provide a suitably robust assessment, the guidance of the previous document (1999 revision) will be used, which is based on WHO's recommendations.

2.7 BS8233:1999 stated that for reasonable standards in a bedroom at night, individual noise events should not normally exceed a maximum noise level LA_{max} of 45 dB(A).

2.8 The guidance of BS8233:2014 with regards to external amenity spaces is as follows:

"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 50 dB LAeq,T, with an upper guideline value of 55 dB LAeq,T which would be acceptable in noisier environments. However, it is also recognized that these guideline values are not achievable in all circumstances where development might be desirable. In higher noise areas, such as city centres or urban areas adjoining the strategic transport network, 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. In such a situation, development

should be designed to achieve the lowest practicable levels in these external amenity spaces, but should not be prohibited."

- 2.9 Further guidance on the recommended levels is given in the World Health Organisation (WHO) Guidelines for Community Noise. In this document it is stated that:

"To protect the majority of people from being seriously annoyed during the daytime, the outdoor sound level from steady, continuous noise should not exceed 55 dB LAeq on balconies, terraces and in outdoor living areas. To protect the majority of people from being moderately annoyed during the daytime, the outdoor sound level should not exceed 50 dB LAeq."

3.0 ENVIRONMENTAL NOISE SURVEY

3.1 Measured noise surveys were undertaken at the positions on shown in **Plate 3**. The locations were chosen in order to obtain representative baseline noise levels due to the main observed noise sources affecting the site:



Plate 3: Noise Monitoring Locations at the development site

- 3.2 Continuous automated monitoring was undertaken for the duration of the survey between 20th June 2016 and 22nd June 2016 at points, **TH1, TH2, TH3** and **TH4** as shown at **Plate 3** above.
- 3.3 Noise measurements presented as time histories can be found in **Appendix A** and are summarised in the relevant following paragraphs.

- 3.4 All measurements used within the calculations, mitigation recommendations and conclusions were taken during times of appropriate weather and representative conditions.

Measurement Procedures

- 3.5 To avoid the occurrence of instrument over or under-loading at the measurement point, noise levels were observed prior to measurement to determine the dynamic measurement range for the instrument.
- 3.6 The staff involved with the measurements and observations are fully competent with regard to the requirements of environmental noise measurement. Measurement procedures used within this assessment conformed to relevant guidance within *BS 7445* and *CRN*, where appropriate.

Instrumentation

- 3.7 The equipment used was as follows:
- Svantek Type 957 Class 1 Sound Level Meters
 - Norsonic Type 1251 Class 1 Calibrator
- 3.8 Measurements for background noise were taken at a height of 1.2m to 1.3m from the ground and would be considered free field where no sound reflections occurred.
- 3.9 All equipment used has been professionally calibrated. Field calibration of the sound level meters was undertaken before and after measurement to ensure no drifting of the calibration signal.

Observations

3.10 Over the course of the surveys, the most significant noise source affecting the site was road noise from Bartons Road, Horndean Road and Eastleigh Road. The noise sources affecting each measurement location are as follows:

- TH1: Traffic noise from Bartons Road and Horndean Road with occasional traffic from Eastleigh Road
- TH2: Traffic noise from Horndean Road and Bartons Road
- TH3: Traffic noise from Horndean Road
- TH4: Traffic Noise from Horndean Road with occasional traffic from Eastliegh Road

Results

3.11 The $L_{Aeq: 15min}$, $L_{Amax: 15min}$, $L_{A10: 15min}$ and $L_{A90: 15min}$ acoustic parameters were measured throughout the duration of the survey. Measured levels are shown as time histories in **Appendix A**.

3.12 **Table 3.1** on the following page provides a summary of the measured noise survey results.

*Typical $L_{AFmax,8hr}$ level not exceeded more than 10 - 15 times per night

		Ambient Noise Level $L_{Aeq,T}$ (dB)	Typical Maximum Noise Level* L_{Amax} (dB)
Point TH1	Daytime [07:00 - 23:00]	60.8	N/A
	Night-time [23:00 - 07:00]	53.2	74.7
Point TH2	Daytime [07:00 - 23:00]	67.4	N/A
	Night-time [23:00 - 07:00]	61.3	78.4
Point TH3	Daytime [07:00 - 23:00]	72.5	N/A
	Night-time [23:00 - 07:00]	63.8	87
Point TH4	Daytime [07:00 - 23:00]	56.1	N/A
	Night-time [23:00 - 07:00]	48.1	67

Table 3.1: Site average noise levels for daytime and night time

3.13 Provided satisfactory mitigation measures are put in place during the design and construction phase of a development, acceptable internal noise levels can be achieved. Outline mitigation measures are described in **Chapter 4** of this report.

3.14 Maximum noise levels shown in **Table 3.1** are deemed to be 'not normally exceeded' as required for maximum internal noise level specification purposes.

4.0 MITIGATION RECOMMENDATIONS

- 4.1 The measurements, resultant noise mapping and proposed layout were used to undertake calculations, presented in **Appendix C**, for suitable façade treatments, as outlined in the following paragraphs.

External Building Fabric - Non Glazed Elements

- 4.2 It is currently assumed that the non-glazed external building fabric elements of the proposed development would comprise blockwork. This would contribute towards a significant reduction of ambient noise levels in combination with a good quality double-glazed window configuration, as shown in **Table 4.2**.
- 4.3 All non-glazed elements of the building facades have been assumed to provide a sound reduction performance of at least the figures shown in **Table 4.1** when tested in accordance with BS EN ISO, 140-3:1995:

Element	Octave band centre frequency SRI, dB					
	125	250	500	1k	2k	4k
Non glazed element SRI	41	43	48	50	55	55

Table 4.1: Non-glazed elements assumed sound reduction performance

External Building Fabric - Specification of Glazed Units

- 4.4 Sound reduction performance calculations have been undertaken in order to specify the minimum performance required from glazed elements in order to achieve recommended internal noise levels shown in **Table 2.1** of **Chapter 2**.
- 4.5 Calculations have been based on habitable rooms with relatively higher ratios of glazing to masonry, in order to present a more onerous assessment. This specification therefore presents the most

robust assessment, for BS8233:2014 criteria for internal noise levels in all affected facades.

- 4.6 The glazing type for each building requiring special treatment is indicated on the noise mitigation plan in **Appendix D**. The required performances for each window type is shown in **Table 4.2** below. The performance is specified for the whole window unit, including the frame:

Glazing Type reference, description and typical dimensions(mm)	Sound Reduction Index RW / RW+Ctr		Octave band centre Frequency (Hz)					
			SRI (dB)					
			125	250	500	1000	2000	4000
Type 1 Thermal double 8/6-16/4	35/29	Sound reduction (dB)	22	21	28	38	40	47
Type 2 Acoustic double (Laminated) 10/16/9.1*	45/40		29	33	44	46	49	57

* Indicates laminated pane

Table 4.2: Minimum Glazing Specification

- 4.7 Areas requiring uprated glazing can be broadly defined as follows with the full extent shown in **Appendix D**:

- **Glazing type 1** is required for habitable rooms on façades to the north facing Horndean Road and Bartons Road as a result of day time L_{Aeq} noise levels.
- **Glazing type 2** is required for habitable rooms on the facades immediately adjacent to Horndean Road to the south of the development as a result of night time L_{Amax} events.

- 4.8 All other facades and non-habitable rooms can be fitted with standard thermal double glazing and achieve a “desirable” internal ambient noise levels defined within BS 8233.
- 4.9 It should be noted that there may be additional considerations for glazing requirements such as security and thermal performance, therefore the above specified glazing is merely guidance for how the acoustic criteria can be achieved. Alternative glazing could be used in place of the above specified units, assuming the minimum acoustic performance is met.
- 4.10 All major building elements should be tested in accordance with BS EN ISO 140-3:1995. Sole glass performance data would not necessarily demonstrate compliance with this specification. No further mitigation measures would be required to achieve the recommended internal noise levels.

Acoustic Attenuated Ventilation Specification

- 4.11 Acoustically attenuated air brick ventilation is required for habitable rooms adjacent to and facing Bartons Road and Horndean Road. Ventilation will need to meet (at minimum) the criteria of the Noise Insulation Regulations (NIR) 1975 Part 3, Clauses 6 and 7. **Table 4.3** on the following page, outlines the required acoustic performance of the ventilation system.

1/3 Octave Frequency Band centre (Hz)	Normalised sound pressure level difference (dB)
100	30
125	33
160	36
200	39
250	42
315	45
400	48
500	49
630	50
800	51
1000	52
1250	53
1600	53
2000	53
2500	53
3150	53

Table 4.3: Extract from NIR: Part 3, Table 2 – Minimum acoustic performance of ventilation

- 4.12 In addition to the requirements of **Table 4.3**, all other recommendations of NIR Part 3 Clause 6 and 7 are to be adhered to when specifying ventilation. Ventilation will need to be sized appropriately for the ventilation and cooling performance which will need to be considered during the detailed design stage.
- 4.13 Attenuated ventilation will be limited to habitable rooms on the most exposed facades such as those adjacent to New Road. The extent of uprated ventilation is shown in **Appendix D**.
- 4.14 It should be noted that there may be additional concerns affecting the selection of suitable ventilation such as air quality and thermal performance. The use of mechanical ventilation heat recovery (MVHR) would be an appropriate substitution for the acoustically attenuated ventilation, providing the requirements of **Table 4.3** can

be met and that the units themselves do not significantly contribute to internal ambient noise levels.

Gardens and Amenity Space

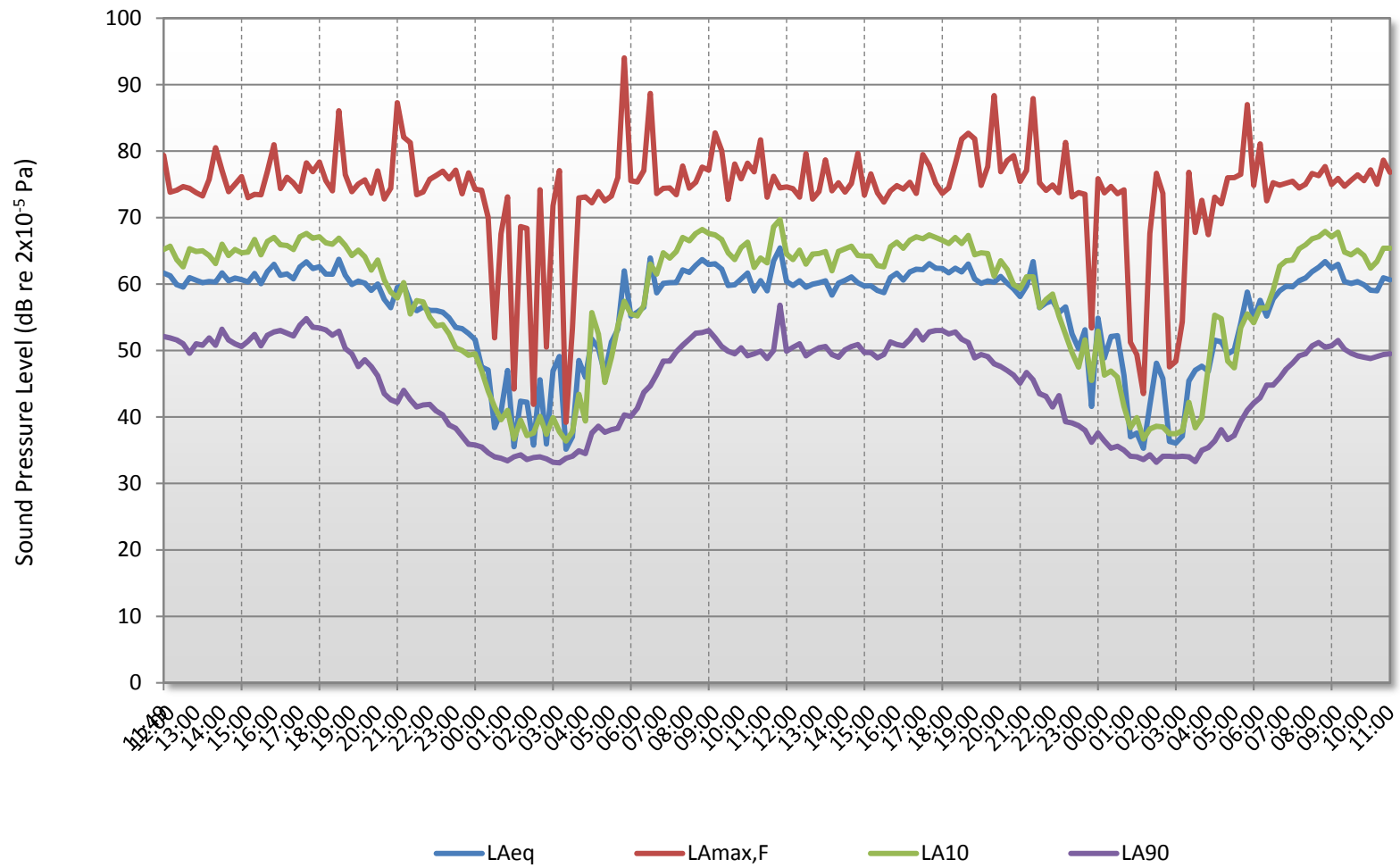
- 4.15 Gardens and shared amenity space will need to meet desirable ambient noise levels defined in WHO Guidelines and BS 8233. Some areas of the site require an uprated fence or boundary treatment specification to comply.
- 4.16 It has been found that the following gardens would require a minimum boundary treatment of 2m high double lapped close boarded fence in order to meet the required ambient noise levels. The areas requiring treatment are shown at **Appendix D**.

5.0 CONCLUSIONS

- 5.1 The proposed developed areas of the site would be within desirable noise levels both internally and externally, providing the recommendations set out within **Chapter 4** and demonstrated at **Appendix D** are implemented, we see no reason that planning permission should be refused on the grounds of noise.

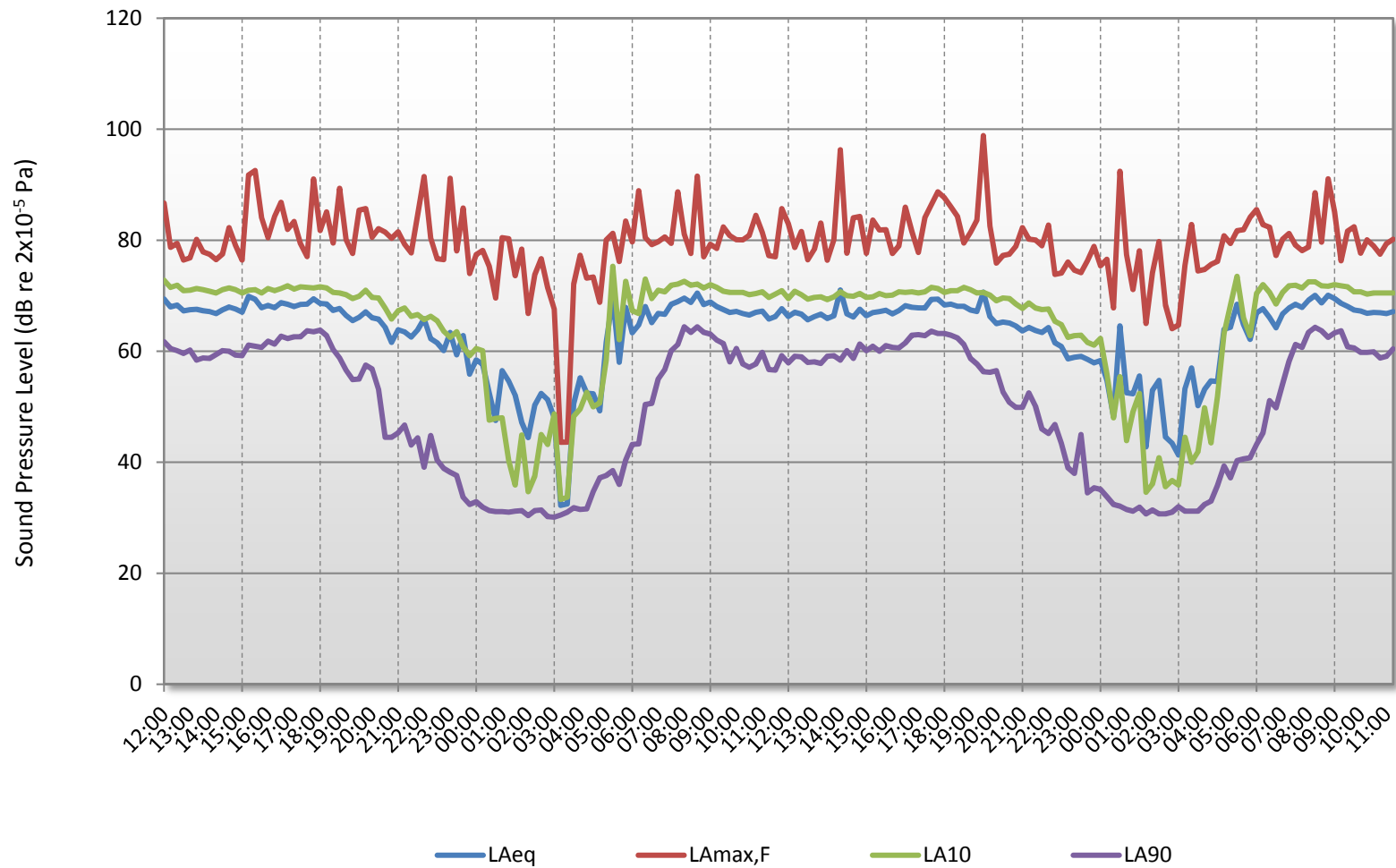
APPENDIX A MEASUREMENTS

Environmental Noise Time History - TH1
20 June to to 22 June 2016

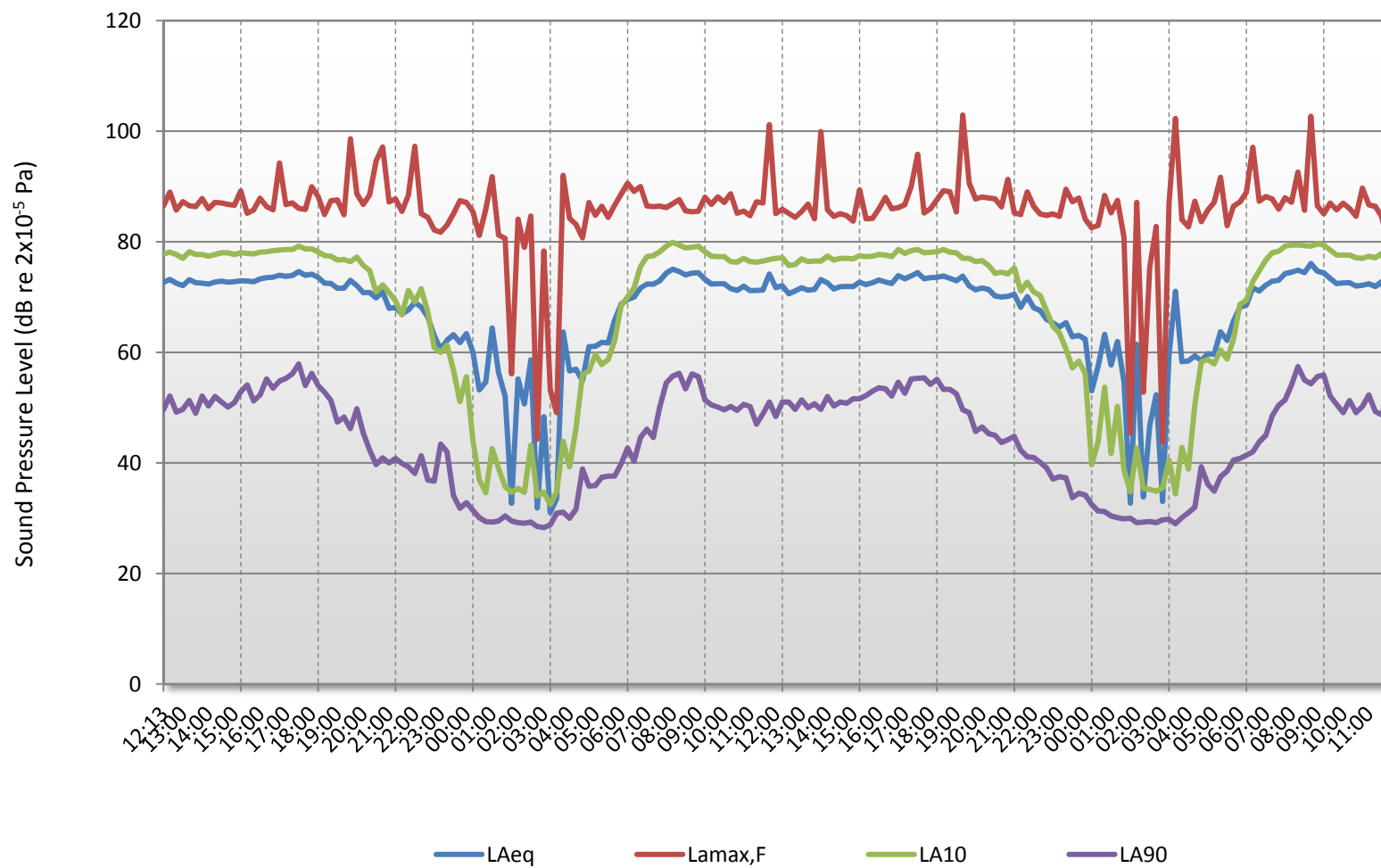


11337-TH1

Environmental Noise Time History - TH2
20 June to 22 June 2016

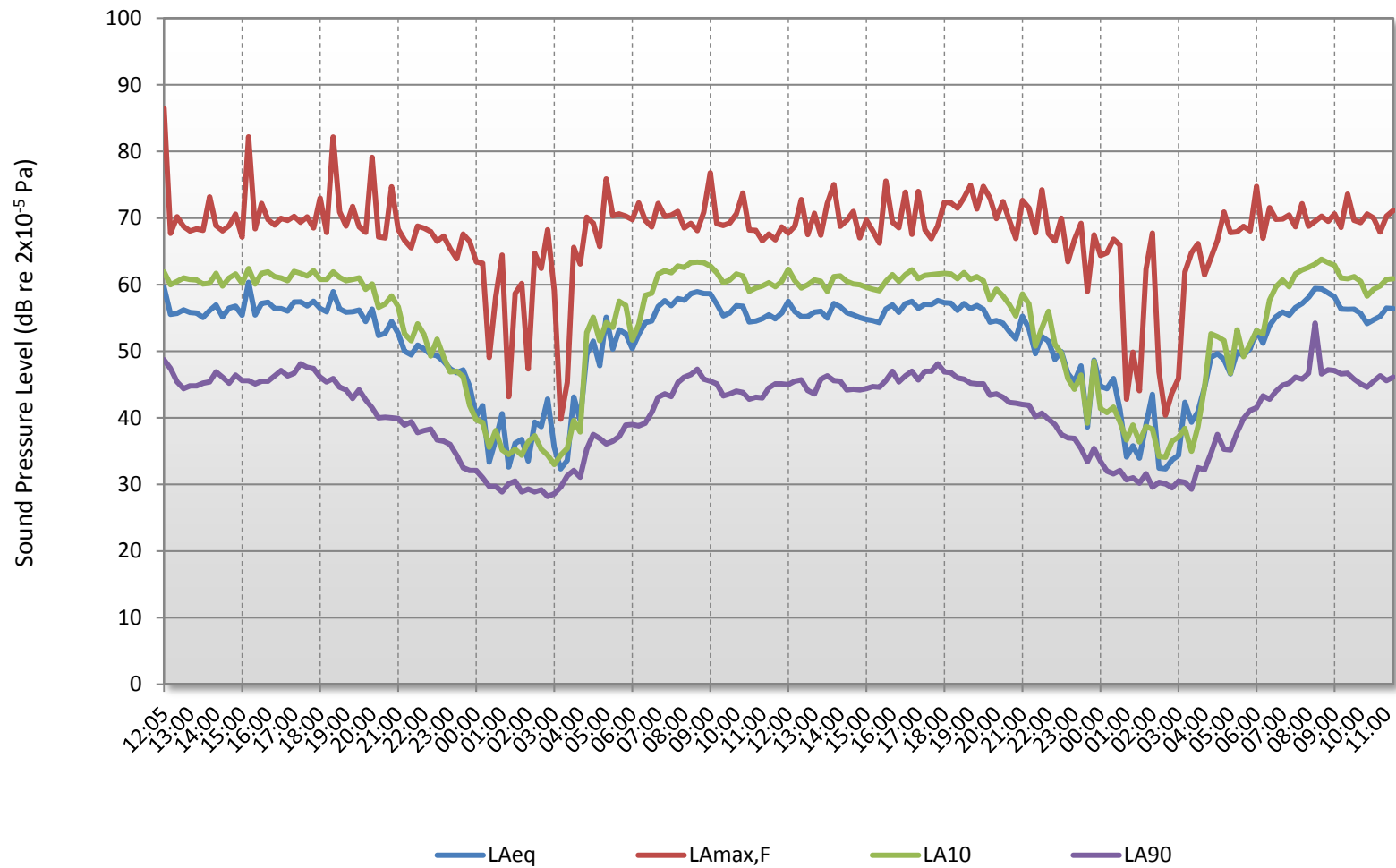


Environmental Noise Time History - TH3
20 June to 22 June 2016



11337-TH3

Environmental Noise Time History - TH4
20 June to 22 June 2016



11337-TH4

APPENDIX B

CALCULATIONS

Facade Acoustic Performance Calculations

The Average Sound Reduction index (R) is calculated using the following Formula

$$R_{AV} = 10 \log \left(\frac{1}{T_{AV}} \right)$$

Where;

R_{AV} = Average sound reduction index of the façade

T_{AV} = Average transmission per square meter of façade

In order to calculate the TAV a spreadsheet has been used. The spreadsheet uses the surface area of each of the façade components along with the component's sound reduction index and the transmission coefficient of the component.

The transmission coefficient is calculated using the following formula:

$$t = \left(\frac{1}{10^{R/10}} \right)$$

Where:

t = Transmission coefficient

R = Sound reduction index of component

Typical Living Room - Standard Glazing (TYPE 1)

Glazing type Thermal Double (8/16/4)

Glazing Rw + Ctr 29 dB

Façade Dimensions		Window Dimensions (total)		Remaining Wall
Length	4 m	Length	1.8 m	Area: 6.59 m ²
Height	2.3 m	Height	1.45 m	
Area:	9.2 m ²	Area:	2.61 m ²	

Sound Reduction Index

Windows 29 (dB) Rw + Ctr

Wall 43 (dB) Rw + Ctr

Façade Component	(s) Surface Area (m ²)	(R) Sound Reduction Index (dB)	(T) Transmission Coefficient	S x T
Windows	2.61	29	0.001258925	0.003285795
Wall	6.59	43	5.01187E-05	0.000330282
Total S	9.2		Total S x T	0.003616078

$$T_{AV} = \left(\frac{\sum S \times T}{\sum S} \right)$$

TAV = 0.00039

$$R_{AV} = 10 \log \left(\frac{1}{T_{AV}} \right)$$

RAV = 34.1 dB

Time (t)	Internal Target (LAeqt) (dB)	Outside Maximum (LAeqt) (dB)
Day (16hour)	35	69.1
Night (8 hour)	30	64.1

Facade Acoustic Performance Calculations

The Average Sound Reduction index (R) is calculated using the following Formula

$$R_{AV} = 10 \log \left(\frac{1}{T_{AV}} \right)$$

Where;

R_{AV} = Average sound reduction index of the façade

T_{AV} = Average transmission per square meter of façade

In order to calculate the TAV a spreadsheet has been used. The spreadsheet uses the surface area of each of the façade components along with the component's sound reduction index and the transmission coefficient of the component.

The transmission coefficient is calculated using the following formula:

$$t = \left(\frac{1}{10^{R/10}} \right)$$

Where:

t = Transmission coefficient

R = Sound reduction index of component

Typical Bedroom - Standard Glazing - (TYPE 1)

Glazing type Thermal Double (8/16/4)

Glazing Rw + Ctr 29 dB

Façade Dimensions		Window Dimensions (total)		Remaining Wall
Length	2.8 m	Length	1.45 m	Area: 4.7 m2
Height	2.3 m	Height	1.2 m	
Area:	6.44 m2	Area:	1.74 m2	

Sound Reduction Index

Windows 29 (dB) Rw + Ctr

Wall 43 (dB) Rw + Ctr

Façade Component	(s) Surface Area (m2)	(R) Sound Reduction Index (dB)	(T) Transmission Coefficient	S x T
Widows	1.74	29	0.001258925	0.00219053
Wall	6.44	43	5.01187E-05	0.000322765
Total S	8.18		Total S x T	0.002513295

$$T_{AV} = \left(\frac{\sum S \times T}{\sum S} \right)$$

TAV = 0.00031

$$R_{AV} = 10 \log \left(\frac{1}{T_{AV}} \right)$$

RAV = 35.1 dB

Time (t)	Internal Target (LAeqt) (dB)	Outside Maximum (LAeqt) (dB)	Internal Target (LAMaxt) (dB)	Outside Maximum (LAMaxt) (dB)
Day (16hour)	35	70.1		
Night (8 hour)	30	65.1	45	80.1

Facade Acoustic Performance Calculations

The Average Sound Reduction index (R) is calculated using the following Formula

$$R_{AV} = 10 \log \left(\frac{1}{T_{AV}} \right)$$

Where;

R_{AV} = Average sound reduction index of the façade

T_{AV} = Average transmission per square meter of façade

In order to calculate the TAV a spreadsheet has been used. The spreadsheet uses the surface area of each of the façade components along with the component's sound reduction index and the transmission coefficient of the component.

The transmission coefficient is calculated using the following formula:

$$t = \left(\frac{1}{10^{R/10}} \right)$$

Where:

t = Transmission coefficient

R = Sound reduction index of component

Typical Living Room -Acoustic Glazing - (TYPE 2)

Glazing type Acoustic Laminate (10/16/9.1*)

Glazing Rw + Ctr 40 dB

Façade Dimensions		Window Dimensions (total)		Remaining Wall
Length	4 m	Length	1.8 m	Area: 6.59 m2
Height	2.3 m	Height	1.45 m	
Area:	9.2 m2	Area:	2.61 m2	

Sound Reduction Index

Windows 40 (dB) Rw + Ctr

Wall 43 (dB) Rw + Ctr

Façade Component	(s) Surface Area (m2)	(R) Sound Reduction Index	(T) Transmission Coefficient	S x T
Widows	2.61	40	0.0001	0.000261
Wall	6.59	43	5.01187E-05	0.000330282
Total S	9.2		Total S x T	0.000591282

$$T_{AV} = \left(\frac{\sum S \times T}{\sum S} \right)$$

TAV = 6.4E-05

$$R_{AV} = 10 \log \left(\frac{1}{T_{AV}} \right)$$

RAV = 41.9 dB

Time (t)	Internal Target (LAeqt) (dB)	Outside Maximum (LAeqt) (dB)
Day (16hour)	35	76.9
Night (8 hour)	30	71.9

Facade Acoustic Performance Calculations

The Average Sound Reduction index (R) is calculated using the following Formula

$$R_{AV} = 10 \log \left(\frac{1}{T_{AV}} \right)$$

Where;

R_{AV} = Average sound reduction index of the façade

T_{AV} = Average transmission per square meter of façade

In order to calculate the TAV a spreadsheet has been used. The spreadsheet uses the surface area of each of the façade components along with the component's sound reduction index and the transmission coefficient of the component.

The transmission coefficient is calculated using the following formula:

$$t = \left(\frac{1}{10^{R/10}} \right)$$

Where:

t = Transmission coefficient

R = Sound reduction index of component

Typical Bedroom - Acoustic Glazing - (TYPE 2)

Glazing type Acoustic Laminate (10/16/9.1*)

Glazing Rw + Ctr 40 dB

Façade Dimensions		Window Dimensions (total)		Remaining Wall
Length	2.8 m	Length	1.45 m	Area: 4.7 m ²
Height	2.3 m	Height	1.2 m	
Area:	6.44 m ²	Area:	1.74 m ²	

Sound Reduction Index

Windows 40 (dB) Rw + Ctr

Wall 43 (dB) Rw + Ctr

Façade Component	(s) Surface Area (m ²)	(R) Sound Reduction Index	(T) Transmission Coefficient	S x T
Windows	1.74	40	0.0001	0.000174
Wall	4.7	43	5.01187E-05	0.000235558
Total S	6.44		Total S x T	0.000409558

$$T_{AV} = \left(\frac{\sum S \times T}{\sum S} \right)$$

TAV = 6.4E-05

$$R_{AV} = 10 \log \left(\frac{1}{T_{AV}} \right)$$

RAV = 42.0 dB

Time (t)	Internal Target (LAeqt) (dB)	Outside Maximum (LAeqt) (dB)	Internal Target (LAMaxt) (dB)	Outside Maximum (LAMaxt) (dB)
Day (16hour)	35	77.0		
Night (8 hour)	30	72.0	45	87.0

APPENDIX C
ACOUSTIC TERMINOLOGY

ACOUSTIC TERMINOLOGY

The effects of noise on human beings may be expressed in terms of physiological damage and annoyance. It is, however, only the annoyance impacts that need to be considered in detail when addressing environmental noise impacts. Annoyance also includes the immediate effects of activity interference, for example sleep disturbance and speech interference.

The practice has become to measure sound levels in decibels (dB). The decibel scale is logarithmic rather than linear and it is useful to bear in mind that a noise level change of 3dB would be equivalent to doubling the energy level (for example doubling the volume of traffic) and that an increase of 10 dB is perceived, subjectively, as a doubling of loudness. The human ear responds differently to sounds of different frequency. The ear perceives high frequency sound of a given sound pressure level more loudly than a low frequency sound at the same level. The A-weighted sound level, dB(A), takes this response into consideration and is commonly used for measurement of environmental noise in UK. It thus indicates the subjective human response to sound.

Environmental noise levels vary continuously from second to second, it is clearly impractical to specify the sound level continuously and thus time averaging is required. In practice human response has been related to various units which include allowance for the fluctuating nature of sound with time. For the purpose of this report these include:

$L_{Aeq,T}$ the equivalent A-weighted continuous sound level.

This unit relates to the equivalent level of continuous sound for a specific time period T , for example 16 hours for daytime noise. It contains all the sound energy of the varying sound levels over the same time period and expresses it as a continuous sound level over that period. The unit is used for assessing traffic and industrial noise for planning purposes and in particular for PPG24.

$L_{A10,T}$: the A-weighted level of sound exceeded for 10% of the time period T .

This unit is used for traffic noise measurement and is the preferred unit for prediction of traffic noise in the publication, 'Calculation of Road Traffic Noise',

$L_{A90,T}$: the A-weighted level of sound exceeded for 90% of the time period T.

This unit is commonly used to represent the background noise and is used in assessing the effects of industrial noise in UK.

L_{Amax} : the maximum A-weighted level of sound over a period of measurement.

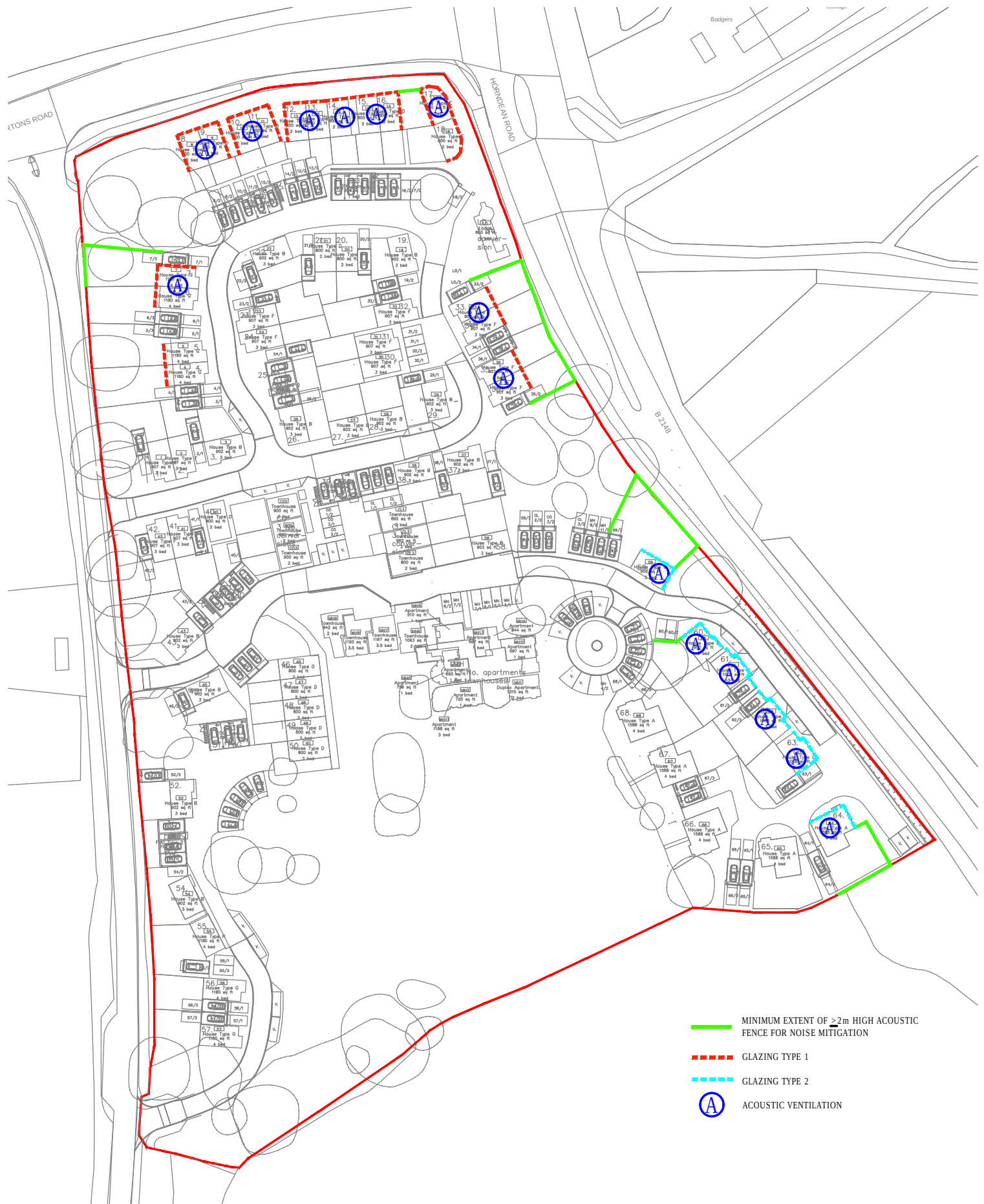
$L_{Ar,T}$ the rating level.

The specific Noise plus any adjustments for the characteristic features of the noise. Used for comparison between background levels with the noise source off.

S_{EL} the Sound Exposure Level.

Sound exposure level abbreviated as SEL and LAE, is the total noise energy produced from a single noise event condensed into a 1 second time period

APPENDIX D
NOISE MITIGATION PLAN



- MINIMUM EXTENT OF $\geq 2\text{m}$ HIGH ACOUSTIC FENCE FOR NOISE MITIGATION
- - - GLAZING TYPE 1
- - - GLAZING TYPE 2
- Ⓐ ACOUSTIC VENTILATION