Our ref: NIA/10213/22/10320/v4 Burringham Road

31st May 2023

Mr. Garry Peace
Senior Engineer
Keepmoat
The Waterfront
Lakeside Boulevard
Doncaster
DN4 5PL

Sent by email only: garry.peace@keepmoat.com

Dear Sir

**NOISE IMPACT ASSESSMENT FOR PROPOSED RESIDENTIAL DEVELOPMENT LINCOLNSHIRE LAKES, LAND EAST OF M181 AND NORTH OF BURRINGHAM ROAD, SCUNTHORPE**

## 1.00 INTRODUCTION

1.01 Environmental Noise Solutions Limited (ENS) has been commissioned by Keepmoat to carry out a noise impact assessment for the development of 599no. dwellings and lake, along with associated infrastructure, including landscaping, public open space and play area, pedestrian and cycle links, pumping station and sub-station at Lincolnshire Lakes, land east of M181 and north of Burringham Road, Scunthorpe (hereafter referred to as the application site).

1.02 The objectives of the noise impact assessment were to:

- Determine the ambient noise climate at the application site during representative periods of the daytime and night-time
- Assess the potential impact of the ambient noise climate on the proposed residential development with reference to pertinent guidance
- Provide recommendations for a scheme of sound attenuation works, as necessary, to ensure that the future occupants of the proposed residential development do not experience any unacceptable loss of amenity due to noise

1.03 This report details the methodology and results of the assessment. It has been prepared to accompany a planning application to be submitted to North Lincolnshire Council (NLC) for the development of the application site.

1.04 This report has been prepared for Keepmoat for the sole purpose described above and no extended duty of care to any third party is implied or offered. Third parties making reference to the report should consult Keepmoat and ENS as to the extent to which the findings may be appropriate for their use.

1.05 A glossary of acoustic terms used in the main body of the text is contained in Appendix 1.

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## 2.00 APPLICATION SITE SETTING AND PROPOSED RESIDENTIAL DEVELOPMENT

2.01 The application site is located on land to the east of the M181 motorway and to the north of the B1450 Burringham Road, Scunthorpe (a site location plan is contained in Appendix 2 for reference). It is bound by:

- Open fields to the north
- The B1450 Burringham Road to the south
- Open fields and existing residential dwellings (Carisbrooke Manor) to the east
- Open fields to the west with the M181 motorway further west

2.02 The proposed development consists of 599 no. dwellings with associated access roads, landscaping and car parking.

2.03 For reference, outline planning permission (Reference: PA/2015/0396) for the wider Lincolnshire Lakes development was granted by NLC in August 2021. It is evident that the principle of residential development at the application site has been established.

2.04 As part of the wider development, a new terminating junction is to be provided to the M181, and the existing B1450 Burringham Road will be realigned.

2.05 A planning layout (drawing ref: N1720_008) indicates that the residential development footprint is located circa **140 metres** from the M181 motorway, and at least **10 metres** from the nearside kerb of the existing/realigned B1450 Burringham Road (with the majority of dwellings set back at least 20 metres).

2.06 The ambient noise climate at the application site is formed by road traffic noise from the M181 motorway and (in close proximity to the road) the B1450 Burringham Road.

## 3.00 BASELINE NOISE SURVEY

3.01 In order to establish the ambient noise levels at the application site, baseline noise surveys were undertaken on Thursday 11th April through to Friday 12th April 2019, and on Tuesday 8th February through to Wednesday 9th February 2022.

3.02 For the purpose of the assessment the following measurement positions (MPs) were adopted (the approximate location of the measurement positions is reproduced in Appendix 2 for reference):

- MP1 was located along the western boundary of the application site, at circa 140 metres from the M181 motorway (representative of the western development footprint).

- MP1A was located towards the centre of the application site, at circa 280 metres from the M181 motorway

- MP2 was located at the southern boundary of the application site, at circa 20 metres from the nearside kerb of Burringham Road (representative of the southern development footprint)

- MP2A was located to the west of the application site boundary, at 10 metres to the north of the B1450 Burringham Road (adopted for Plots 150–156)

- MP3 was located midway along the eastern boundary of the application site

3.03 Noise measurements were undertaken in free field conditions, at a height of 4.0 metres above ground level, with Bruel & Kjaer 2250 Type 1 integrating sound level meters. A windshield was fitted for all measurements. The measurement system calibration was verified immediately before the commencement of the measurement sessions and again at the end, using a Bruel & Kjaer Type 4231 calibrator. No drift in calibration level was noted. Weather conditions throughout the survey were appropriate for monitoring.

Continued from page 2

3.04 Measurements consisted of A–weighted broadband parameters, together with linear octave band $L_{eq}$ levels. Table 3.1 contains a summary of the measurement data for each measurement session, at each measurement position, rounded to the nearest decibel.

**Table 3.1 – Summary of Noise Measurement Data**

| Position | Date | Time | $L_{Aeq}$ (dB) | $L_{A90}$ (dB) | $L_{A10}$ (dB) | $L_{A1}$ (dB) | Comment |
|---|---|---|---|---|---|---|---|
| MP1 | 08/02/22 | 1008–1108 | 59 | 56 | 61 | 64 | M181 motorway dominant<br>Maximum noise levels up to 68 dB $L_{AFMax}$ at night |
| | | 1108–1208 | 60 | 57 | 63 | 65 | |
| | | 1208–1308 | 59 | 56 | 61 | 63 | |
| | | 2301–0000 | 55 | 48 | 58 | 61 | |
| | 09/02/22 | 0000–0053 | 52 | 44 | 56 | 59 | |
| **Daytime noise level 59 dB $L_{Aeq\ (0700\text{-}2300)}$ based on CRTN methodology<br>Night-time noise level 51 dB $L_{Aeq\ (2300\text{-}0700)}$ based on TRL methodology (M181 acts as an A-road, not a motorway)<br>Maximum noise level up to 68 dB $L_{AFMax}$ during the night-time** | | | | | | | |
| MP1A | 08/02/22 | 1018–1033 | 56 | 53 | 58 | 61 | M181 motorway dominant |
| **Daytime noise level circa 56 dB $L_{Aeq,\ T}$** | | | | | | | |
| MP2 | 08/02/22 | 1100–1200 | 60 | 52 | 64 | 68 | Road traffic on B1450 dominant, distant M181<br>Maximum noise levels up to 73 dB $L_{AFMax}$ at night |
| | | 1200–1300 | 60 | 52 | 64 | 68 | |
| | | 1300–1400 | 61 | 53 | 65 | 68 | |
| | | 2343–0102 | 53 | 43 | 56 | 65 | |
| **Daytime ambient noise level 61 dB $L_{Aeq\ (0700\text{-}2300)}$ based on CRTN methodology<br>Night-time noise level 53 dB $L_{Aeq\ (2300\text{-}0700)}$ based on TRL methodology<br>Maximum noise level up to 73 dB $L_{AFMax}$ during the night-time** | | | | | | | |
| MP2A | 11/04/19 | 1422–1500 | 66 | 51 | 71 | 78 | Road traffic on B1450 dominant, distant M181<br>Maximum noise levels up to 78 dB $L_{AFMax}$ at night |
| | 11/04/19 | 1500–1530 | 66 | 51 | 71 | 77 | |
| | 12/04/19 | 1312–1345 | 65 | 51 | 69 | 76 | |
| | 12/04/19 | 0025–0120 | 54 | 41 | 52 | 66 | |
| **Daytime ambient noise level 66 dB $L_{Aeq\ (0700\text{-}2300)}$ based on CRTN methodology<br>Night-time noise level 58 dB $L_{Aeq\ (2300\text{-}0700)}$ based on TRL methodology<br>Maximum noise level up to 78 dB $L_{AFMax}$ during the night-time** | | | | | | | |
| MP3 | 08/02/22 | 1040–1055 | 52 | 51 | 54 | 56 | Distant M181 dominant |
| **Daytime ambient noise level circa 52 dB $L_{Aeq,\ T}$** | | | | | | | |

3.05 The principal noise source at the application site is the M181 motorway and (in close proximity to the road) the B1450 Burringham Road. The night-time noise measurement data illustrates that, as expected, the M181 (dual carriageway) acts as an A-road rather than a motorway.

3.06 For the prediction of daytime road traffic noise, the Department of Transport's Memorandum on the Calculation of Road Traffic Noise (CRTN) explains that the following shortened measurement procedure may be used. Measurements of $L_{A10}$ are made over any three consecutive hours between 10:00 and 17:00 hours. Using $L_{A10\ (3\ hour)}$ as the arithmetic mean of the three consecutive values of hourly $L_{A10}$, the $L_{A10\ (18\ hour)}$ can be calculated from the equation:

$$L_{A10\ (18\ hour)} = L_{A10\ (3\ hour)} - 1\ dB$$

Continued from page 3

3.07 A study prepared by TRL Limited on behalf of the Department for Environment, Food and Rural Affairs (DEFRA) entitled 'Converting the UK Traffic Noise Index $L_{A10\ (18\ hour)}$ to EU Noise Indices for Noise Mapping' presents a methodology for calculating daytime $L_{Aeq\ (0700\text{-}2300)}$ and night-time $L_{Aeq\ (2300\text{-}0700)}$ ambient noise levels based on the $L_{A10\ (18\ hour)}$ noise levels, as follows:

$$L_{Aeq\ (0700\text{-}2300)} = \frac{10 * \log ([(10^{((0.95 * L_{A10\ (18\ hour)} + 1.44)/10)*12] + [10^{((0.97 * L_{A10\ (18\ hour)} - 2.87)/10)*4])}}{16}$$

$$L_{Aeq\ (2300\text{-}0700)} = 0.90 * L_{A10,\ 18\ hour} - 3.77$$

3.08 Based on the above formulae, the daytime and night-time ambient noise levels at MP1 are measured / calculated at **59 dB $L_{Aeq\ (0700–2300)}$** and **51 dB $L_{Aeq\ (2300–0700)}$** respectively. Maximum noise levels at MP1 were measured at up to **68 dB $L_{AFMax}$** during the night-time.

3.09 Daytime and night-time ambient noise levels at MP2 are measured / calculated at **61 dB $L_{Aeq\ (0700–2300)}$** and **53 dB $L_{Aeq\ (2300–0700)}$** respectively. Maximum noise levels at MP2 were measured at up to **73 dB $L_{AFMax}$** during the night-time.

3.10 Daytime and night-time ambient noise levels at MP2A are measured / calculated at **66 dB $L_{Aeq\ (0700–2300)}$** and **58 dB $L_{Aeq\ (2300–0700)}$** respectively. Maximum noise levels at MP2 were measured at up to **78 dB $L_{AFMax}$** during the night-time.

## 4.00 NATIONAL PLANNING POLICY FRAMEWORK AND OTHER RELEVANT GUIDANCE

National Planning Policy Framework

4.01 The National Planning Policy Framework (NPPF) was updated in July 2021 and sets out the Government's planning policies for England and how these are expected to be applied.

4.02 Where issues of noise impact are concerned the NPPF provides brief guidance in paragraph 174 where it states that planning policies and decisions should contribute to and enhance the natural and local environment by:

*'preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of…..noise pollution'*.

4.03 Paragraph 185 advises that:

*'Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should…..mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life'*.

4.04 The NPPF also refers to the 2010 DEFRA publication, the Noise Policy Statement for England (NPSE) which reinforces and supplements the NPPF.

Noise Policy Statement for England

4.05 The Noise Policy Statement for England (NPSE) sets out the long-term vision of promoting good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development. This long-term vision is supported by the following aims:

- Avoid significant adverse impacts on health and quality of life.
- Mitigate and minimise adverse impacts on health and quality of life.
- Where possible, contribute to the improvement of health and quality of life.

4.06 NPSE describes the following levels at which noise impacts may be identified:

- NOEL – No Observed Effect Level. This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise.
- LOAEL – Lowest Observed Adverse Effect Level. This is the level above which adverse effects on health and quality of life can be detected.
- SOAEL – Significant Observed Adverse Effect Level. This is the level above which significant adverse effects on health and quality of life occur.

Planning Practice Guidance – Noise

4.07 Planning Practice Guidance (PPG) is an online resource (last updated 2019) which provides additional guidance and elaboration on the NPPF. It advises that the Local Planning Authority should consider the acoustic environment in relation to:

- Whether or not a significant adverse effect is occurring or likely to occur.
- Whether or not an adverse effect is occurring or likely to occur.
- Whether or not a good standard of amenity can be achieved.

4.08 In line with the Explanatory Note of the NPSE, the PPG references the LOAEL and SOAEL in relation to noise impact. It also provides examples of outcomes that could be expected for a given perception level of noise, plus actions that may be required to bring about a desired outcome. However, in line with the NPSE, no objective noise levels are provided for LOAEL or SOAEL although the PPG acknowledges that:

*'…the subjective nature of noise means that there is not a simple relationship between noise levels and the impact on those affected. This will depend on how various factors combine in any particular situation'*.

4.09 The PPG also provides general advice on the typical options available for mitigating noise. It goes on to suggest that Local Plans may include noise standards applicable to proposed developments within the Local Authority's administrative boundary, although it states that:

*'Care should be taken, however, to avoid these being implemented as fixed thresholds as specific circumstances may justify some variation being allowed'*.

ProPG Planning and Noise: New Residential Development

4.10 ProPG Planning and Noise: New Residential Development (ProPG) was published in May 2017 by the Association of Noise Consultants, Institute of Acoustics and the Chartered Institute of Environmental Health.

4.11 Stage 2: Element 2 of ProPG sets indoor ambient noise levels for residential dwellings based on the guidance contained in British Standard 8233:2014 'Guidance on Sound Insulation and Noise Reduction for Buildings' (BS 8233) (see table below).

**Table 4.1 – Indoor Ambient Noise Levels in Dwellings**

| Activity | Location | Good Indoor Ambient Noise Levels | |
|---|---|---|---|
| Resting | Living Room | 35 dB $L_{Aeq\ (0700–2300)}$ | - |
| Dining | Dining Room/Area | 40 dB $L_{Aeq\ (0700–2300)}$ | - |
| Sleeping (daytime resting) | Bedroom | 35 dB $L_{Aeq\ (0700–2300)}$ | 30 dB $L_{Aeq\ (2300–0700)}$<br>45 dB $L_{AFMax\ (2300–0700)}$ |

4.12 Note 4 to the above table states: *''A guideline value may be set in terms of SEL or $L_{Amax,F}$, depending on the character and number of events per night. Sporadic noise events could require separate values. In most circumstances in noise sensitive rooms at night (e.g. bedrooms) good acoustic design can be used so that individual noise events do not normally exceed 45dB $L_{Amax,F}$ more than 10 times a night.'*

4.13 Note 5 to the above table states: *'Where it is not possible to meet internal target levels with windows open, internal noise levels can be assessed with windows closed, however any façade openings used to provide whole dwelling ventilation (e.g. trickle ventilators) should be assessed in the "open" position and, in this scenario, the internal $L_{Aeq}$ target levels should not normally be exceeded, subject to the further advice in Note 7'*.

4.14 This is consistent with the guidance contained within the PPG, which states that:

*'… consideration should also be given to whether adverse internal effects can be completely removed by closing windows and, in the case of new residential development, if the proposed mitigation relies on windows being kept closed most of the time. In both cases a suitable alternative means of ventilation is likely to be necessary. Further information on ventilation can be found in the Building Regulations'*.

4.15 On the basis of the above, the following criteria (with windows closed and an alternative means of ventilation provided) are considered appropriate for the proposed residential development and considered to represent good resting and sleeping conditions:

- ≤ 35 dB $L_{Aeq\ (0700-2300)}$ during the daytime
- ≤ 30 dB $L_{Aeq\ (2300-0700)}$ during the night-time
- 45 dB $L_{AFMax}$ not regularly exceeded during the night-time

4.16 With respect to external amenity, ProPG reflects the advice contained in BS 8233, which states:

*'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 $L_{Aeq,T}$, with an upper guideline value of 55 dB $L_{Aeq,T}$ 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*.'

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## 5.00 SOUND ATTENUATION SCHEME PROPOSALS

5.01 The design noise levels at Plots 150–156 (in the south-eastern corner and circa 10 metres from Burringham Road) are as follows:

- ≤ 66 dB $L_{Aeq\ (0700\text{-}2300)}$ during the daytime
- ≤ 59 dB $L_{Aeq\ (2300\text{-}0700)}$ and ≤ 78 dB $L_{AFMax}$ during the night-time

5.02 The design noise levels at the façades of remaining dwellings fronting towards Burringham Road (set back at least 20 metres from the road) are as follows:

- ≤ 61 dB $L_{Aeq\ (0700\text{-}2300)}$ during the daytime
- ≤ 53 dB $L_{Aeq\ (2300\text{-}0700)}$ and ≤ 73 dB $L_{AFMax}$ during the night-time

5.03 The design noise levels at the façades of dwellings fronting towards the M181 are as follows:

- ≤ 59 dB $L_{Aeq\ (0700\text{-}2300)}$ during the daytime
- ≤ 51 dB $L_{Aeq\ (2300\text{-}0700)}$ and ≤ 68 dB $L_{AFMax}$ during the night-time

5.04 In order to calculate the sound insulation performance of the building envelope, the Building Research Establishment (BRE) building envelope insulation calculation spreadsheet was used. This spreadsheet is based on the calculation methodology advocated in BS 8233. The spreadsheet allows input of external noise levels, typical room dimensions and reverberation time together with parameters for the various elements of the building envelope and calculates the internal noise level in terms of the external noise level metric ($L_{Aeq}$ and $L_{AFMax}$ in this case).

5.05 Due to the proximity of Burringham Road, it is recommended that Plots 150–156 are provided with a mechanical ventilation strategy. Appropriate ventilation solutions include:

- A fully ducted mechanical ventilation system with heat recovery (MVHR)
- A System 3 mechanical extract ventilation (MEV) system
- A whole house positive input ventilation (PIV) system (e.g. Nuaire Drimaster 365)

5.06 In dwellings where the air permeability is tighter than (<) 5m$^3$/(h.m$^2$), 5000 mm$^2$ EA background ventilators may be required where MEV or PIV systems are proposed. In order to maintain the sound insulation properties of the façade, any trickle vents should be rated at least **42 dB $D_{n,e,w}$+C** per 5000 mm$^2$ EA (vent open), such as the Renson AK Ultra over-frame vent, or equivalent. Trickle vents are not required where an MVHR system is used.

5.07 Road-fronting habitable rooms of Plots 150–156 should be fitted with enhanced laminated glazing rated at least **38 dB $R_w$+C** (such as 6 mm glass / 6-20 Argon / 8.8 mm Optiphon).

5.08 Habitable rooms of Plots 150–156 which face away from the road may be fitted with standard glazing rated at least **28 dB $R_w$+C** (such as 4 mm glass / 6-20 cavity / 4 mm glass).

5.09 Remaining habitable rooms directly fronting towards Burringham Road should be fitted with enhanced glazing rated at least **32 dB $R_w$+C** (such as 8 mm glass / 12 mm cavity / 4 mm glass) in conjunction with acoustic trickle vents rated at least **39 dB $D_{n,e,w}$** per 5000 mm$^2$ EA (vent open), such as the Greenwood 5000EAW.AC1 or equivalent (2 no. vents per habitable room).

5.10 The rears of these plots may be fitted with standard double glazing rated at least **28 dB $R_w$+C** (such as 4 mm glass / 12 mm cavity / 4 mm glass) in conjunction with standard trickle vents rated at least **33 dB $D_{n,e,w}$** per 5000 mm$^2$ EA (vent open), such as the Greenwood 5000EA or equivalent (2 no. vents per habitable room).

5.11 Habitable rooms directly fronting towards the M181 should be fitted with standard double glazing rated at least **28 dB $R_w$+C** in conjunction with standard trickle vents rated at least **33 dB $D_{n,e,w}$** per 5000 mm$^2$ EA (vent open).

5.12 Standard thermal double glazing and standard trickle vents are considered appropriate for the remainder of the development, which is set back from the surrounding road network and will be screened by the first row of dwellings.

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5.13 See Appendix 3.1 and 3.2 for annotated glazing/ventilation markups, and Appendix 4 for selected BRE Calculation Spreadsheets.

5.14 The following points should be noted:

- The glazing recommendations apply to the window within a sealed unit. It is the responsibility of the window supplier to ensure that the window frame does not compromise the performance of the glazing.

- When selecting a glazing system to satisfy the requirements outlined above, it is important to ensure that the $R_w$+C value is achieved (rather than simply the $R_w$ value). Published $R_w$ values tend to be higher than corresponding $R_w$+C values; therefore, incorrect selection could result in an overestimation of sound reduction performance which in turn could result in higher internal noise levels.

- The opening and free area of the ventilation units should be checked by a mechanical service engineer before designs are finalised. Should the equivalent open area be insufficient to meet the minimum requirements of ADF, it may be necessary to increase the number of units per habitable room. Where this applies, ENS should be notified in order to advise whether the required sound reduction of the ventilation units should be increased.

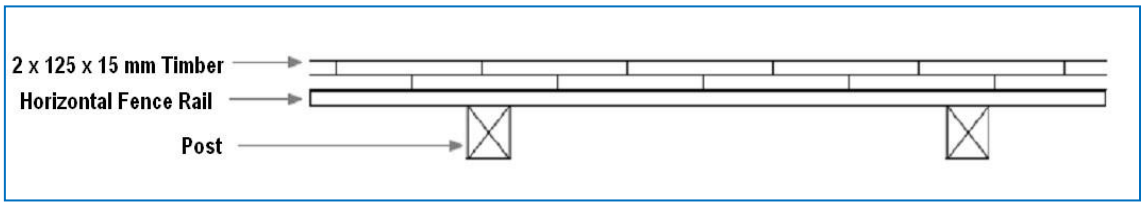
- Internal noise levels due to mechanical ventilation plant should not exceed 26 dB $L_{Aeq}$ in bedrooms and 30 dB $L_{Aeq}$ in living rooms

5.15 The site layout indicates that the majority of dwellings along the western and southern boundaries of the application site will 'front onto' the road network, such that gardens of these plots will be screened by the dwellings themselves.

5.16 Where gardens are not situated to the rear, it is recommended that they are provided with circa 2.0-metre-high solid timber fences or brick walls (see Appendix 3.1 and 3.2 for locations of barriers).

5.17 A brick wall of any construction is appropriate, providing there are no gaps in the construction.

5.18 If solid timber fences are installed, then it should be ensured that they have a mass per unit area of ≥ 10 kg/m2, are fully sealed to the ground and are fitted with cover strips to prevent gaps forming over time. An indicative acoustic fence detail is illustrated below. The double-thickness solid timber construction is considered robust and appropriate.



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## 6.00 CONCLUSIONS

6.01 A noise impact assessment has been undertaken for the development of 599no. dwellings and lake, along with associated infrastructure, including landscaping, public open space and play area, pedestrian and cycle links, pumping station and sub-station at Lincolnshire Lakes, land east of M181 and north of Burringham Road, Scunthorpe.

6.02 The ambient noise climate at the application site is formed by road traffic noise from the M181 motorway and (in close proximity to the road) the B1450 Burringham Road.

6.03 A scheme of sound insulation works has been developed to protect the proposed residential development from the ambient noise climate.

I trust the foregoing is sufficient for your needs. Should you have any queries regarding the above, please do not hesitate to contact me.

Yours sincerely

Simon Jefferson
AMIOA, Diploma in Acoustics & Noise Control
For Environmental Noise Solutions Limited

cc File

## Appendix 1
## Glossary of Acoustic Terms

### Sound Pressure Level ($L_p$)

The basic unit of sound measurement is the sound pressure level. As the pressures to which the human ear responds can range from 20 µPa to 200 Pa, a linear measurement of sound levels would involve many orders of magnitude. Consequently, the pressures are converted to a logarithmic scale and expressed in decibels (dB) as follows:

$$L_p = 20 \log_{10}(p/p_0)$$

Where $L_p$ = sound pressure level in dB; p = rms sound pressure in Pa; and $p_0$ = reference sound pressure (20 µPa).

### A-weighting Network

A frequency filtering system in a sound level meter, which approximates under defined conditions the frequency response of the human ear. The A-weighted sound pressure level, expressed in dB(A), has been shown to correlate well with subjective response to noise.

### Equivalent continuous A-weighted sound pressure level, $L_{Aeq, T}$

The value of the A-weighted sound pressure level in decibels of continuous steady sound that within a specified time interval, T, has the same mean-square sound pressure as a sound that varies with time. $L_{Aeq, 16h}$ (07:00 to 23:00 hours) and $L_{Aeq, 8h}$ (23:00 to 07:00 hours) are used to qualify daytime and night-time noise levels.

#### $L_{A10, T}$

The A-weighted sound pressure level in decibels exceeded for 10% of the measurement period, T. $L_{A10, 18h}$ is the arithmetic mean of the 18 hourly values from 06:00 to 24:00 hours.

#### $L_{A90, T}$

The A-weighted sound pressure level of the residual noise in decibels exceeded 90% of a given time interval, T. $L_{A90}$ is typically taken as representative of background noise.

#### $L_{AF\ max}$

The maximum A-weighted noise level recorded during the measurement period. The subscript ‘F’ denotes fast time weighting, slow time weighting ‘S’ is also used.

### Sound Exposure Level (SEL or $L_{AE}$)

The energy produced by a discrete noise event averaged over one second, no matter how long the event actually took. This allows for comparison between different noise events which occur over different lengths of time.

### Weighted Sound Reduction Index ($R_W$)

Single number quantity which characterises the airborne sound insulation properties of a material or building element over a defined range of frequencies ($R_W$ is used to characterise the insulation of a material or product that has been measured in a laboratory).

**Appendix 2**
**Drawings (Site Plan / Noise Monitoring Positions)**

**Appendix 3.1**
**Drawings (Scheme of Sound Attenuation, Southern Boundary)**

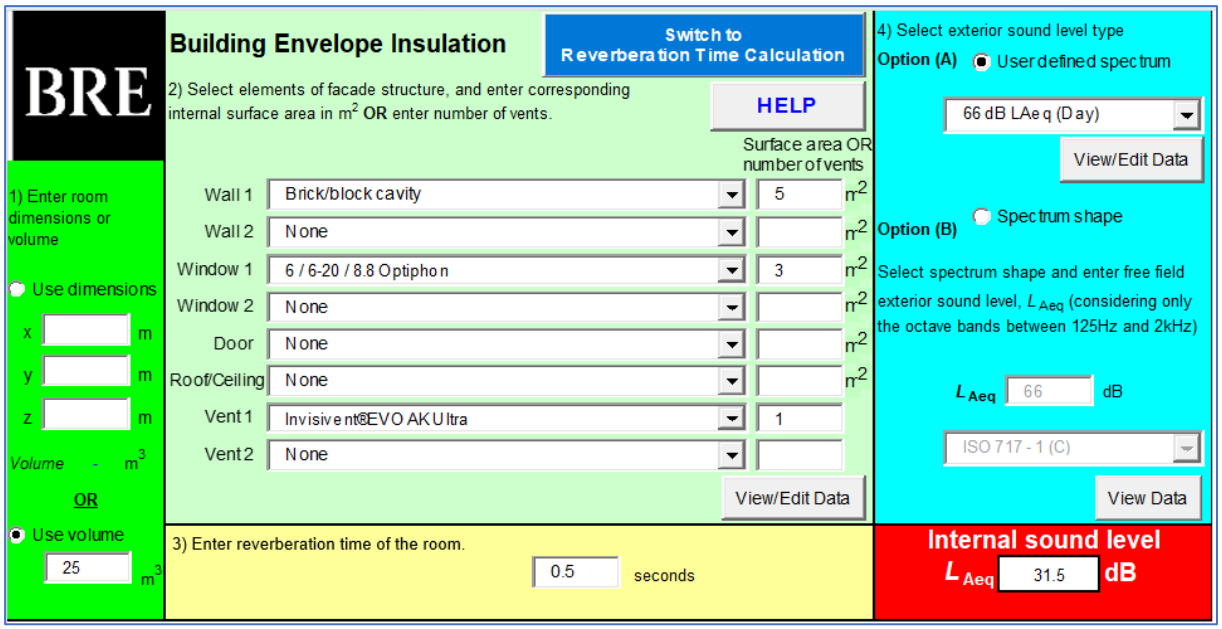

| |
|---|
| Enhanced glazing rated at 38 dB Rw+C with acoustic trickle vents rated at least 42 dB Dn,e,w per 5000 mm2 (vent open) |
| Enhanced glazing rated at 32 dB Rw+C with acoustic trickle vents rated at least 39 dB Dn,e,w per 5000 mm2 (vent open) |
| 2.0-metre-high brick wall / close boarded timber fence |
| Mechanical Ventilation |

**Appendix 3.2**
**Drawings (Scheme of Sound Attenuation, Western Boundary)**

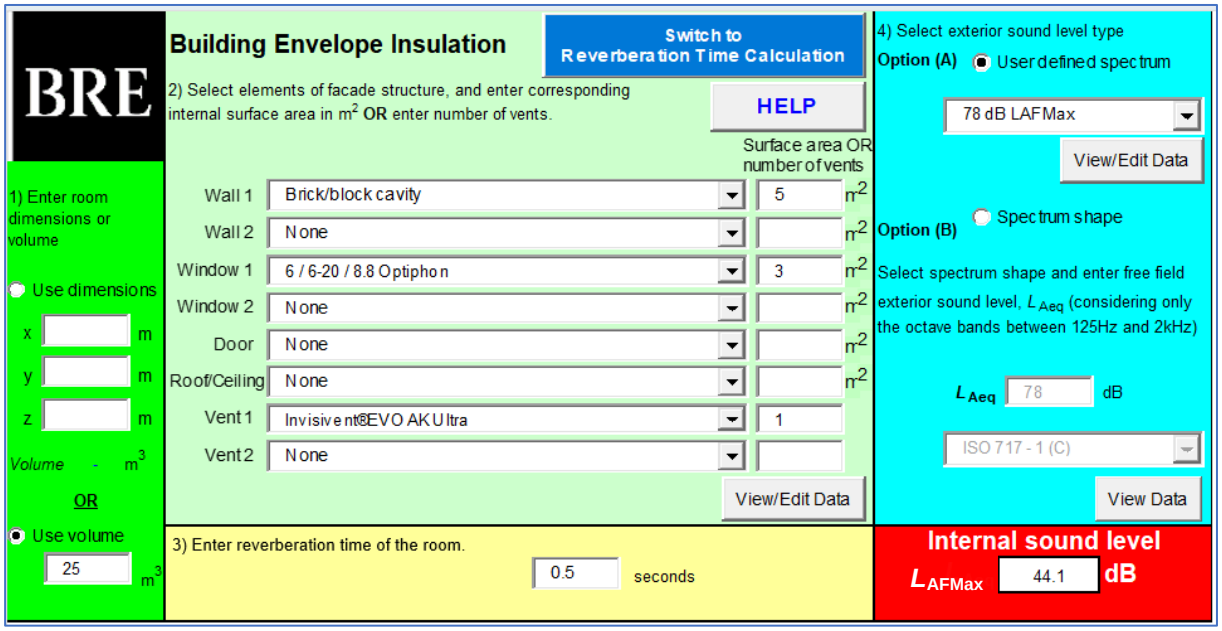

2.0-metre-high brick wall / close boarded timber fence

**Appendix 4**
**BRE Calculation Spreadsheets**

Daytime Ambient Noise Levels – Road-fronting habitable rooms of Plots 150–156

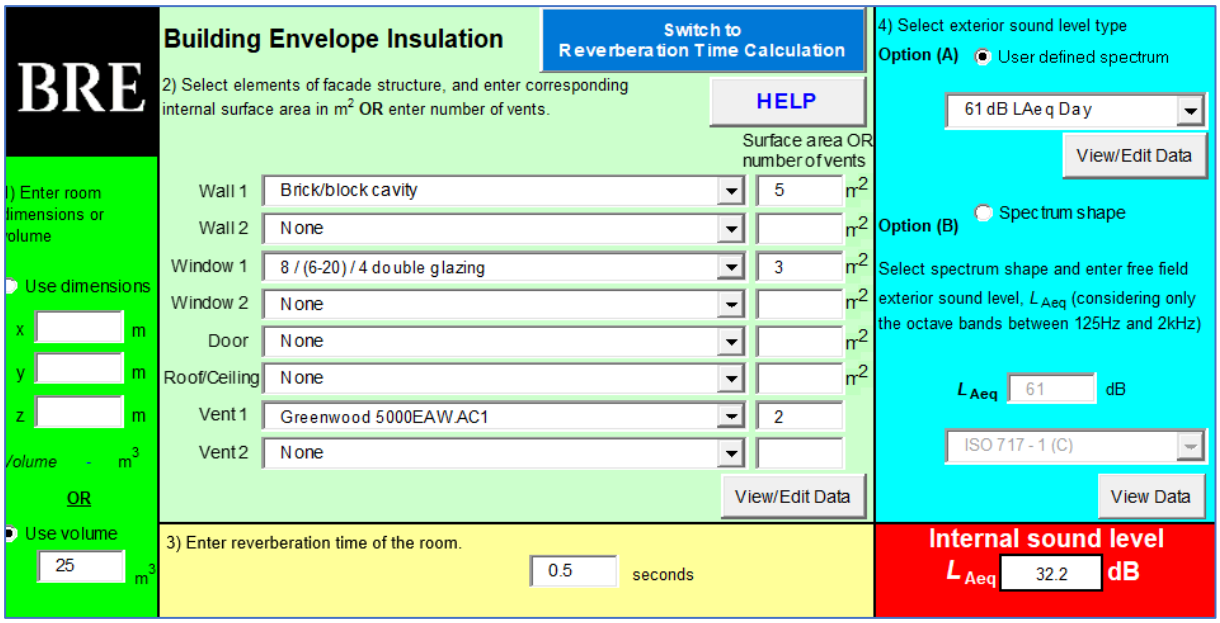



Night-time Maximum Noise Levels – Road-fronting bedrooms of Plots 150–156

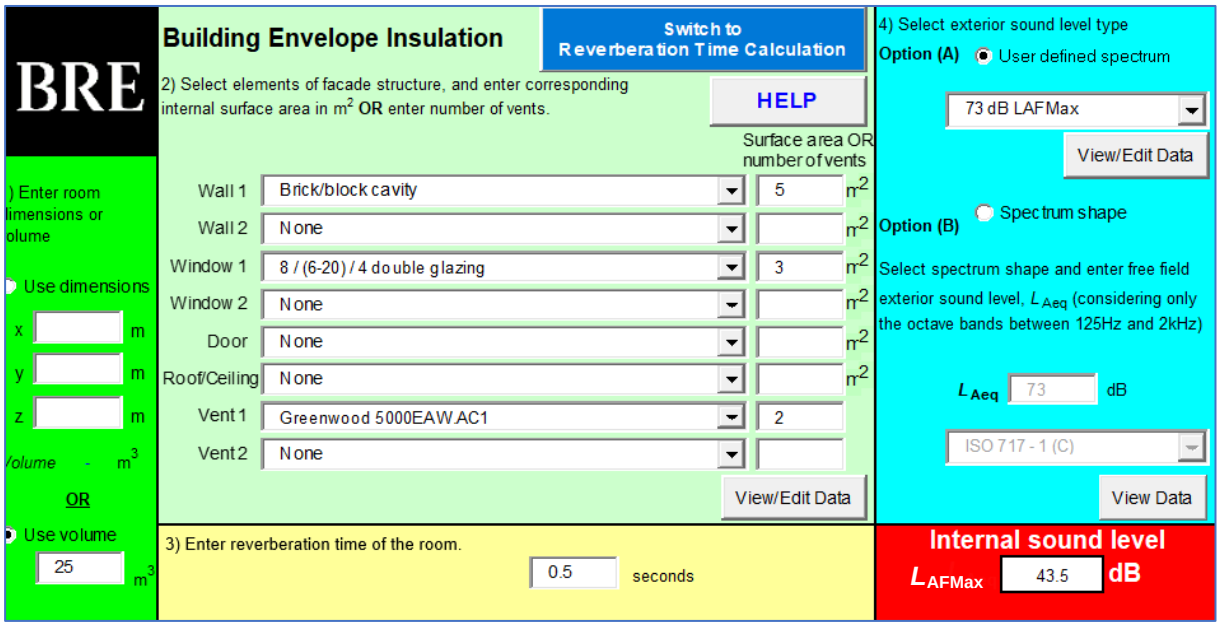


**Appendix 4**
**BRE Calculation Spreadsheets**

Daytime Ambient Noise Levels – Remaining habitable rooms fronting towards Burringham Road

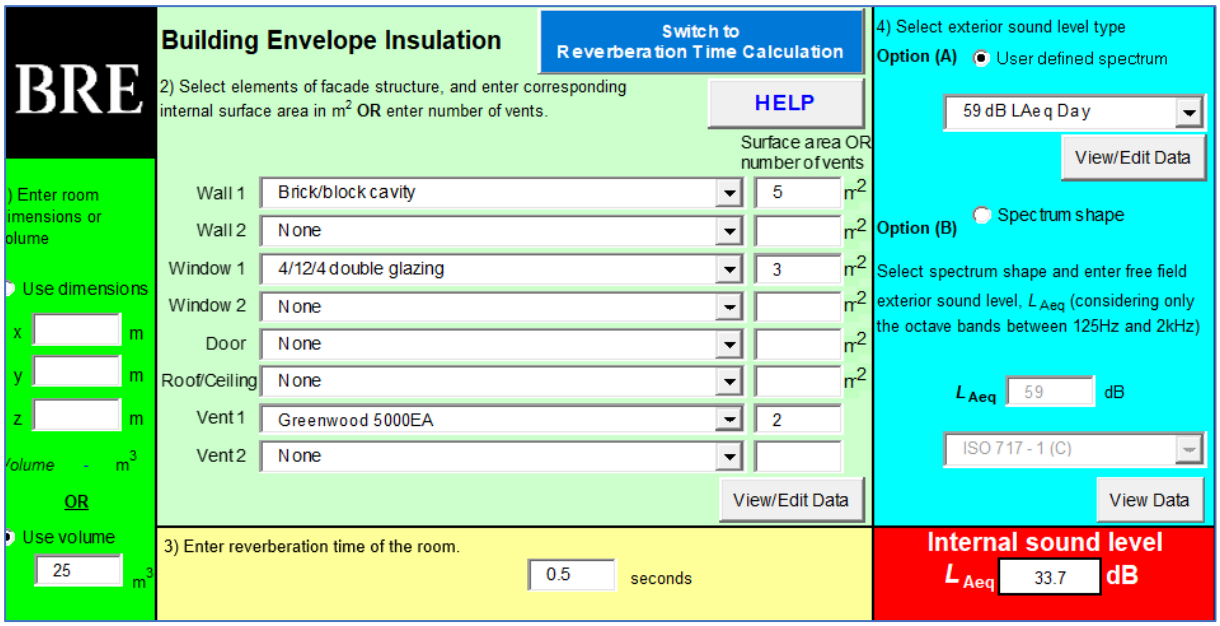



Night-time Maximum Noise Levels – Remaining bedrooms fronting towards Burringham Road



**Appendix 4**
**BRE Calculation Spreadsheets**

Daytime Ambient Noise Levels – Habitable rooms fronting towards the M181




Night-time Maximum Noise Levels – Bedrooms fronting towards the M181