



## Residential Noise Assessment

Site Address: Cornerfields, Nutts Lane, Hinckley, Leicestershire, LE10 3EG

Client Name: Sketchley Homes

Project Reference No: NP-009577

**Authorisation and Version Control**

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## 1. Introduction

UK Building Compliance has been commissioned to prepare a noise assessment for a new build residential development ('the Proposed Development') at Cornerfields, Nutts Lane, Hinckley, Leicestershire, LE10 3EG ('the Site'). The site is subject to noise from road traffic emissions and trains using the adjacent railway line.

A noise survey has been undertaken to establish the prevailing ambient sound levels incident on the Proposed Development Site. The findings have subsequently been used to assess the suitability of the site for residential use. Measures required to mitigate noise impacts for the proposed development have been assessed in accordance with the relevant performance standards, legislation, policy, and guidance.

This noise assessment is necessarily technical in nature; therefore, a glossary of terms is included in Appendix A to assist the reader.

### ***Standards, Legislation, Policy & Guidance***

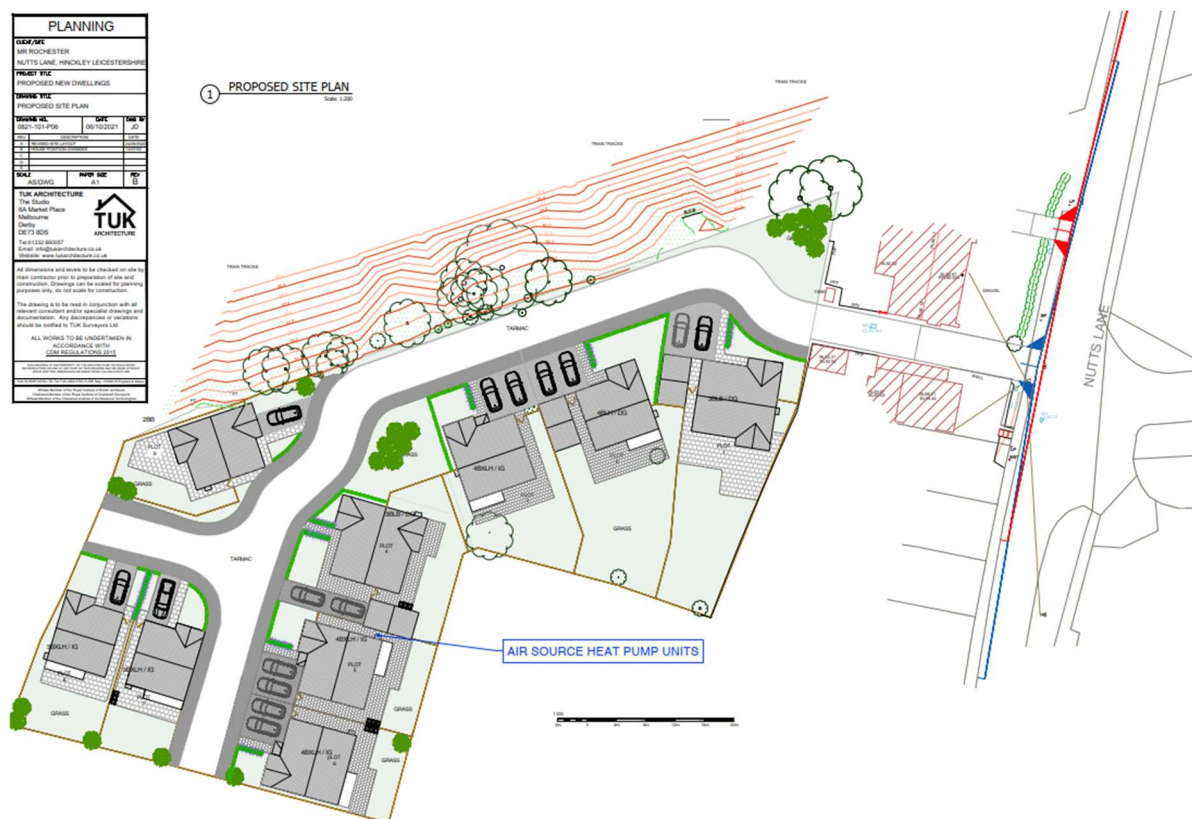
The following performance standards, legislation, policy, and guidance have been considered to ensure good acoustic design in the assessment:

- The Local Planning Authorities (LPA) conditional approval; specifically, 'Condition 5'.
- National Planning Policy Framework (2021)
- Noise Policy Statement for England (2010)
- British Standard BS8233:2014 – 'Guidance on sound insulation and noise reduction for buildings'
- ProPG: 'Planning and Noise 2017' (including supplementary documents 1 & 2).
- Approved Document O: Overheating (2021)
- Acoustics Ventilation Overheating: Residential Design Guide 2020' (AVO Guide)

Further information on the legislation can be found in Appendix B.

## Proposal Brief

The proposal is for the erection of 9no. new build residential dwellinghouses. The figure below shows the layout of the Proposed Development.



Drawing Ref No. 0821-101-P06 - B from 'TUK Architecture'

Figure 1 – Proposed Development Layout

## Local Planning Authority Guidance and Criteria

The LPA's conditional approval of the planning application has the following relevant condition:

20/01289/OUT – Residential development for up to 9 dwellings (outline - access only)

Condition 5:

'Development shall not begin until a scheme for protecting the proposed dwellings from noise from the adjacent railway track has been submitted to and approved by the Local Planning Authority and all works which form part of the scheme shall be completed before any of the permitted dwellings are first occupied. Reason: To ensure that the proposed use does not become a source of annoyance to nearby residents in accordance with Policy DM10 of the adopted Site Allocations and Development Management Policies Development Plan Document (2016).'

## 2. Environmental Noise Survey

### Measurement Methodology

The following table outlines the measurement dates and particulars.

| Location | Survey Dates            | Measurement Particulars                                                                   |
|----------|-------------------------|-------------------------------------------------------------------------------------------|
| MP1      | 03/07/2023 – 06/07/2023 | Equipment mounted on a lamppost at a height of 3.5m on Nutts Lane.                        |
| MP2      | 03/07/2023 – 06/07/2023 | Equipment mounted on a lamppost at a height of 3.5m on Nutts Lane close to Sansome Drive. |
| MP3      | 06/07/2023              | Spot noise and vibration measurements were taken on site, close to the railway line.      |

Table 1 – Measurement Methodology

The figure below outlines the site surroundings and measurement locations:

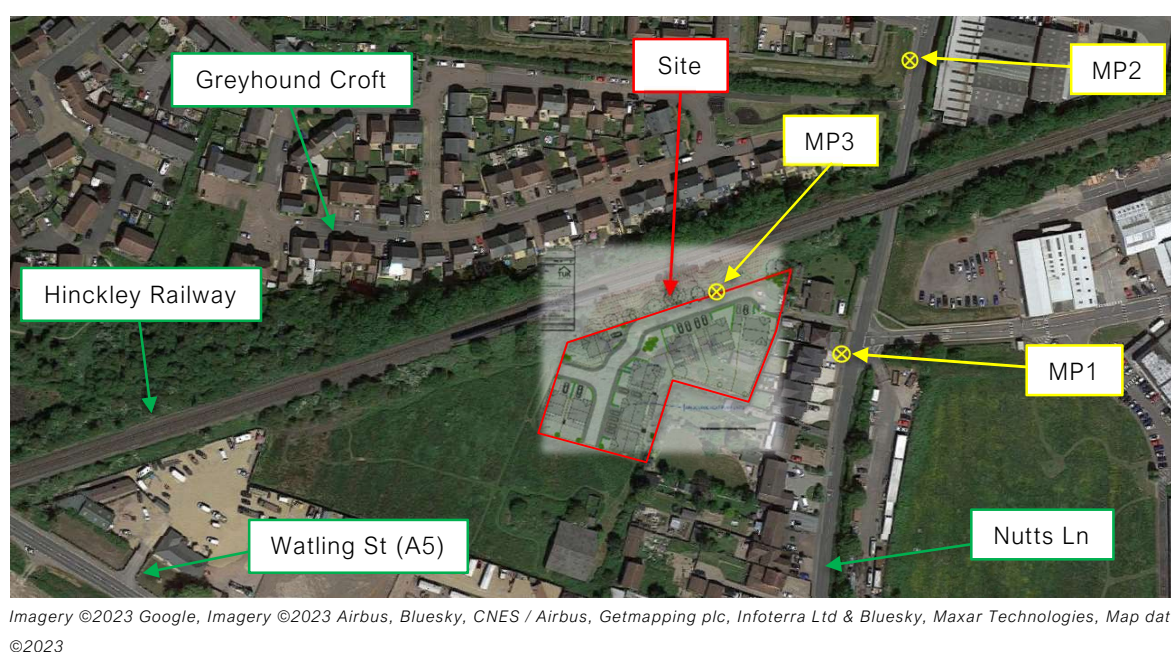


Figure 2 – Measurement Locations and Site Surroundings

### Context & Subjective Impression

The Proposed Development Site is located on vacant land off Nutts Lane in Hinckley, Leicestershire. The area surrounding the Site consists primarily of residential dwellings to the north and east with commercial / light industrial properties further afield. The area to the south of site appears to be a static caravan storage facility with open land in between.

The acoustic environment is deemed to be low to moderate in level and the noise profile is dominated by emissions from Nutts Lane to the east and Hinckley railway line, which bounds the northern perimeter of site. Watling Street (A5) is also audible but to a lesser extent. During the site visits, noise emissions from the commercial / light industrial properties located on the opposite side of Nutts Lane were not audible above the residual noise level. Due to distance attenuation, acoustic shielding from intervening properties and the nature of the businesses, commercial noise is not considered to be a concern.

## Environmental Noise Survey Results

The following section outlines the sound levels measured during the long-term survey. The time history results can be found in Appendix D.

| Location | Measurement Period ('T') | Octave Frequency Band (Hz, $L_{eq,T}$ dB) |     |     |    |    |    | $L_{Aeq,T}$ (dB) | $L_{AFmax,1min}$ (dB) |
|----------|--------------------------|-------------------------------------------|-----|-----|----|----|----|------------------|-----------------------|
|          |                          | 125                                       | 250 | 500 | 1k | 2k | 4k |                  |                       |
| MP1      | $L_{eq,16hr}$ (Day)      | 63                                        | 62  | 61  | 62 | 58 | 51 | 65               | --                    |
|          | $L_{eq,8hr}$ (Night)     | 59                                        | 57  | 57  | 58 | 54 | 46 | 61               | 80                    |
|          | $L_{eq,1hr}$ (Day)       | 67                                        | 66  | 64  | 65 | 62 | 57 | 68               | --                    |
|          | $L_{eq,1hr}$ (Night)     | 63                                        | 60  | 60  | 61 | 59 | 49 | 65               | 80                    |
| MP2      | $L_{eq,16hr}$ (Day)      | 63                                        | 61  | 60  | 63 | 61 | 55 | 67               | --                    |
|          | $L_{eq,8hr}$ (Night)     | 60                                        | 57  | 56  | 57 | 53 | 44 | 60               | 82                    |
|          | $L_{eq,1hr}$ (Day)       | 66                                        | 66  | 64  | 65 | 65 | 60 | 70               | --                    |
|          | $L_{eq,1hr}$ (Night)     | 63                                        | 61  | 59  | 62 | 58 | 48 | 65               | 82                    |

Table 2 – Sound Level Results Summary

## Short-Term Noise Survey

The following table outlines the short-term noise measurement recorded at Measurement Position 3 (MP3).

| Measurement Position MP3        |                                 |     |     |    |    |    |                  |                    |
|---------------------------------|---------------------------------|-----|-----|----|----|----|------------------|--------------------|
| Measurement Period ('t')        | Octave Band $L_{eq,t}$ (Hz, dB) |     |     |    |    |    | $L_{Aeq,t}$ (dB) | $L_{AFmax,t}$ (dB) |
|                                 | 125                             | 250 | 500 | 1k | 2k | 4k |                  |                    |
| 06/07/2023: 10.14 – 12:17 (Day) | 48                              | 48  | 48  | 47 | 43 | 40 | 51               | 85                 |

Table 3 – Short-Term Monitoring Results – MP3

## CRN Calculations

The following table shows the average S.E.L. measurement of the train pass-bys measured at MP3 on 06/07/23.

| Measurement Position | Description             | Average S.E.L. (dBA) |
|----------------------|-------------------------|----------------------|
| MP3                  | Passenger Train Pass-By | 79                   |
|                      | Freight Train Pass-By   | 88                   |

Table 4 – Average S.E.L. of Train Pass-Bys

The following table shows the calculated  $L_{Aeq,16hour}$  and  $L_{Aeq,8hour}$  values based on the shortened CRN Procedure. The number of train movements has been predicted using information gathered during attended measurements and the 'Real Time Trains' website.

| Description                                    | Day | Night |
|------------------------------------------------|-----|-------|
| Passenger Train S.E.L. (dBA)                   | 79  |       |
| Predicted Number of Train Movements Per Period | 65  | 5     |
| L <sub>Aeq,t</sub> at MP3 (dB)                 | 50  | 42    |
| Description                                    | Day | Night |
| Freight Train S.E.L. (dBA)                     | 88  |       |
| Predicted Number of Train Movements Per Period | 45  | 12    |
| L <sub>Aeq,t</sub> at MP3 (dB)                 | 57  | 54    |
| Total                                          |     |       |
| Cumulative L <sub>Aeq,t</sub> at MP3 (dB)      | 58  | 54    |

Table 5 – CRN Calculation

### 3. Noise Modelling

The long-term and short-term environmental noise surveys have allowed the sound levels at the Proposed Development to be modelled within SoundPlan 9.0. The modelling particulars are outlined in Appendix F. The sound maps showing the daytime  $L_{Aeq,t}$ , night-time  $L_{Aeq,t}$  and night-time  $L_{AFmax,1min}$  sound levels incident upon the Proposed Development can be seen in the figures below.

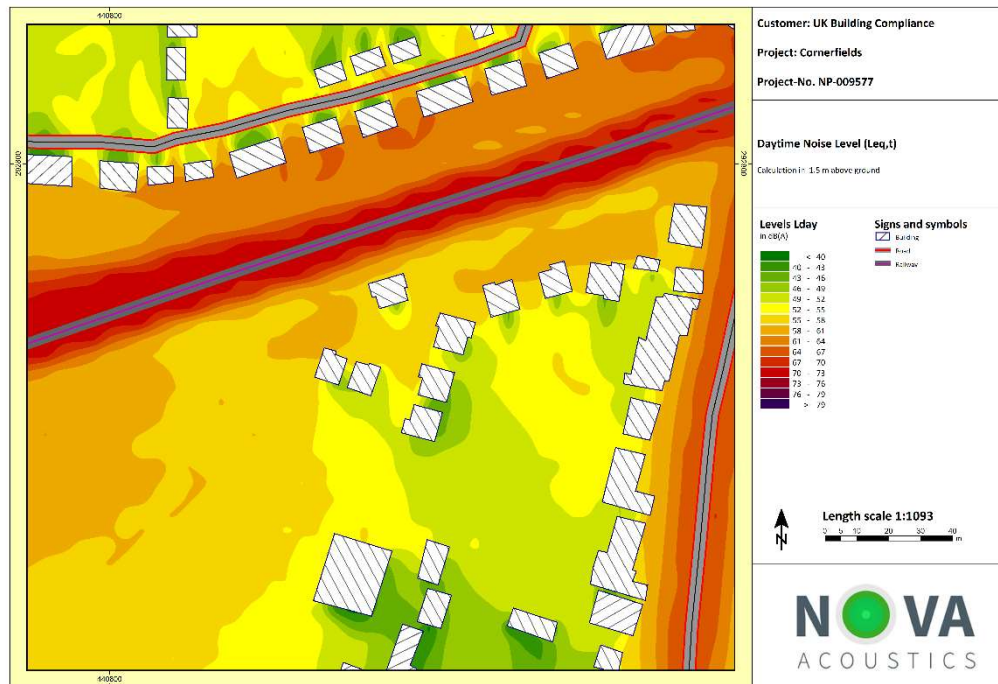


Figure 3 –  $L_{Aeq,16hr}$  Ambient Sound Map (1.5m Grid Map Height)

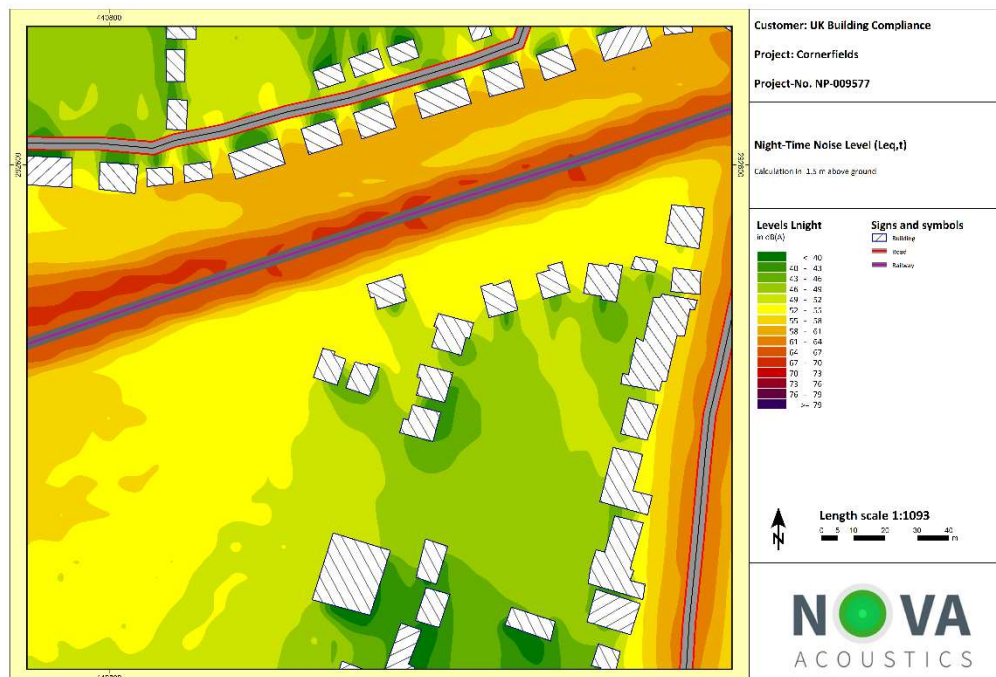


Figure 4 –  $L_{Aeq,8hr}$  Ambient Sound Map (1.5m Grid Map Height)

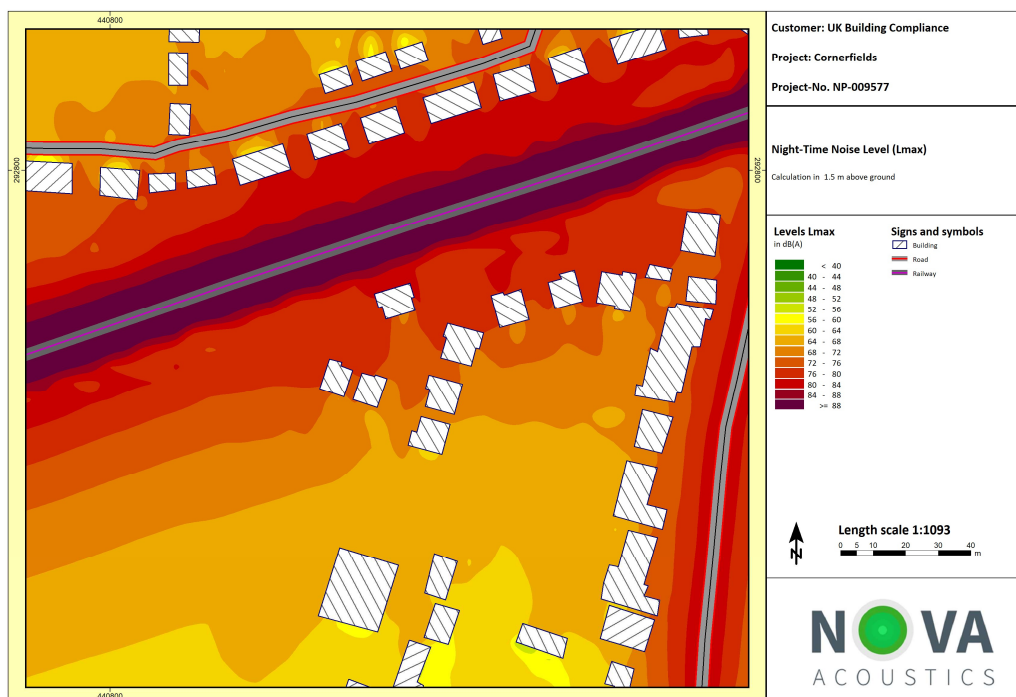


Figure 5 –  $L_{AFmax,1min}$  Sound Map (1.5m Grid Map Height)

## 4. Noise Break-in Assessment and Sound Insulation Scheme

### Internal Noise Level Criteria

The noise profile of the area is predominantly “anonymous” steady state noise sources e.g., transport. The following table outlines the internal and external acoustic design criteria used in the following assessment.

| Activity                      | Location         | Daytime<br>(07:00 – 23:00)  | Night-time<br>(23:00 – 07:00)                     |
|-------------------------------|------------------|-----------------------------|---------------------------------------------------|
| Resting                       | Living Room      | 35 dB $L_{Aeq,16hr}$ / NR30 | --                                                |
| Dining                        | Dining Room/Area | 40 dB $L_{Aeq,16hr}$ / NR35 | --                                                |
| Sleeping<br>(Daytime resting) | Bedroom          | 35 dB $L_{Aeq,16hr}$ / NR30 | 30 dB $L_{Aeq,8hr}$ / NR25<br>45 dB $L_{AFmax}$ * |

\*NOTE 1: The maximum criteria have been taken from the World Health Organisation (WHO) Guidelines for Community Noise.

\*NOTE 2: ProPG:2017 which is relevant to 'New Residential' states; "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. However, where it is not reasonably practicable to achieve this guideline then the judgement of acceptability will depend not only on the maximum noise levels but also on factors such as the source, number, distribution, predictability, and regularity of noise events".

Note 3: BS8233:2014 states: "Where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal target levels may be relaxed by up to 5 dB and reasonable internal conditions still achieved".

Note 4: BS8233:2014 states: "The levels shown in Table 4 (criteria shown above) are based on the existing guidelines issued by the WHO and assume normal diurnal fluctuations in external noise. In cases where local conditions do not follow a typical diurnal pattern, for example on a road serving a port with high levels of traffic at certain times of the night, an appropriate alternative period, e.g., 1 hour, may be used, but the level should be selected to ensure consistency with the levels recommended in Table 4.

Note 5: BS8233:2014 states: "If relying on closed windows to meet the guide values, there needs to be an appropriate alternative ventilation that does not compromise the façade insulation or the resulting noise level.

Table 6 – Acoustic Design Criteria

The measured sound levels at the proposed development are assessed against the relevant criteria and a sound insulation scheme is provided to achieve a good internal acoustic environment.



| Sound Insulation Scheme – Red Bedrooms                     |                                |     |     |     |    |    |    |                       |                                         |
|------------------------------------------------------------|--------------------------------|-----|-----|-----|----|----|----|-----------------------|-----------------------------------------|
| Description                                                | Octave Frequency Band (Hz, dB) |     |     |     |    |    |    | Overall (dB)          | Overall (dB)                            |
|                                                            | 63                             | 125 | 250 | 500 | 1k | 2k | 4k |                       |                                         |
| 6mm Glass / 16mm Air Cavity / 6.8mm Optiphon Glass (SRI)*  | 21                             | 21  | 28  | 37  | 48 | 48 | 54 | 39 (R <sub>w</sub> )  | 33 (R <sub>w</sub> + C <sub>tr</sub> )  |
| Greenwoods MA3051 (2 No. Through Wall) (D <sub>ne</sub> )* | 30                             | 46  | 45  | 50  | 55 | 65 | 67 | 55 (D <sub>ne</sub> ) | 52 (D <sub>ne</sub> + C <sub>tr</sub> ) |

Table 8 – Glazing Specification – Red Bedrooms

| Sound Insulation Scheme – Amber Bedrooms                      |                                |     |     |     |    |    |    |                       |                                         |
|---------------------------------------------------------------|--------------------------------|-----|-----|-----|----|----|----|-----------------------|-----------------------------------------|
| Description                                                   | Octave Frequency Band (Hz, dB) |     |     |     |    |    |    | Overall (dB)          | Overall (dB)                            |
|                                                               | 63                             | 125 | 250 | 500 | 1k | 2k | 4k |                       |                                         |
| 8mm Glass / 16mm Air Cavity / 4mm Glass (SRI)*                | 21                             | 22  | 21  | 28  | 38 | 40 | 47 | 33 (R <sub>w</sub> )  | 28 (R <sub>w</sub> + C <sub>tr</sub> )  |
| Titon Standard Vent + C75 (2 No. Trickle) (D <sub>ne</sub> )* | 28                             | 38  | 36  | 35  | 42 | 39 | 42 | 35 (D <sub>ne</sub> ) | 34 (D <sub>ne</sub> + C <sub>tr</sub> ) |

Table 9 – Glazing Specification – Amber Bedrooms

\*Any other window or ventilation specification capable of providing this attenuation will be suitable provided the glazing suppliers can provide an acoustic test report in accordance with BS EN ISO 10140-2:2010 or an evidence-based calculation.

## 5. Open Window Noise Break-In Assessment

### *Internal Noise Levels with Open Windows Criteria*

The AVO Guide advises that if windows are open regularly to provide higher rates of ventilation to mitigate overheating, this will lead to elevated internal noise levels which could lead to undesirable living conditions. If windows are opened rarely the occupants may be able to tolerate elevated noise levels due to the inherent benefits of natural ventilation. This assessment will firstly assess whether the internal noise level criteria can be achieved with open windows. The AVO Guide provides criteria for both daytime and night-time periods which shown below.

| Windows                | Daytime<br>(07:00 – 23:00) | Night-time<br>(23:00 – 07:00)                                      | AVO Guide Table 3-3<br>Example Outcomes                                                                                   | AVO Guide Table 3 – 2<br>Recommendation for<br>Level 2 Assessment |
|------------------------|----------------------------|--------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|
| Rarely<br>Open         | 50 dB $L_{Aeq,16hour}$     | 42 dB $L_{Aeq,8hour}$<br>Normally<br>Exceeds 65 dB<br>$L_{AF,max}$ | Noise causes a material<br>change in behaviour<br>e.g., having to keep<br>windows closed most of<br>the time              | Recommended                                                       |
| Increasing Noise Level |                            |                                                                    | Increasing likelihood of<br>impact on reliable<br>speech communication<br>during the day or sleep<br>disturbance at night | Optional                                                          |
| Often<br>Open          | 40 dB $L_{Aeq,16hour}$     | 35 dB $L_{Aeq,8hour}$<br>Normally<br>Exceeds 45 dB<br>$L_{AF,max}$ | Noise can be heard, but<br>does not cause any<br>change in behaviour                                                      | Not Required                                                      |

*Table 10 – AVO Guide Open Window Criteria*

To advise if openable windows can be used as the ventilation strategy (whilst maintaining reasonable internal noise levels), an open window assessment will be provided. The suitability of the internal noise levels will be based upon the internal noise criteria above and an open window providing 13 dB attenuation. If required, an alternative ventilation strategy compliant with Approved Document F will be proposed.

### Open Window Assessment

This assessment will firstly consider whether the internal noise level criteria from Table 3 – 3 of the AVO Guide can be achieved with open windows.

| Red Façades                     |                              |            |                               |            |
|---------------------------------|------------------------------|------------|-------------------------------|------------|
| External Noise Levels           | AVO Guide Windows Open Often | Exceedance | AVO Guide Windows Rarely Open | Exceedance |
| 62 L <sub>Aeq,16hr</sub> (Day)  | 53                           | +9         | 63                            | -1         |
| 59 L <sub>Aeq,8hr</sub> (Night) | 48                           | +11        | 55                            | +4         |
| 83 L <sub>AFmax</sub> (Night)   | 58                           | +25        | 78                            | +5         |
| Amber Façades                   |                              |            |                               |            |
| External Noise Levels           | AVO Guide Windows Open Often | Exceedance | AVO Guide Windows Rarely Open | Exceedance |
| 61 L <sub>Aeq,16hr</sub> (Day)  | 53                           | +8         | 63                            | -2         |
| 57 L <sub>Aeq,8hr</sub> (Night) | 48                           | +9         | 55                            | +2         |
| 76 L <sub>AFmax</sub> (Night)   | 58                           | +18        | 78                            | -2         |
| Green Façades                   |                              |            |                               |            |
| External Noise Levels           | AVO Guide Windows Open Often | Exceedance | AVO Guide Windows Rarely Open | Exceedance |
| 58 L <sub>Aeq,16hr</sub> (Day)  | 53                           | +5         | 63                            | -5         |
| 54 L <sub>Aeq,8hr</sub> (Night) | 48                           | +6         | 55                            | -1         |
| 73 L <sub>AFmax</sub> (Night)   | 58                           | +15        | 78                            | -5         |

Table 11 – Open Window Assessment

The external noise levels incident on the green façades exceed the AVO Guides 'Windows Open Often' criteria which means that windows being used for the primary means of ventilation (whilst maintaining reasonable internal noise levels) could vary dependent on the outcome of a TM59 overheating assessment. To assist in the design of the alternative ventilation strategy a TM59 overheating assessment should be undertaken to ascertain how frequently open windows will be required to mitigate overheating. The TM59 assessor should be provided with this report to base their study.

If a TM59 assessment is not undertaken, then a mechanical extract ventilation system should be installed to provide 'Whole Dwelling Ventilation' in accordance with Approved Document F. It is understood that continuous MEV extract fans installed in accordance with the specified trickle ventilators to allow the ingress of fresh air will be adequate. The ventilation system should be designed by an appropriately qualified person to ascertain compliance with the relevant Building Regulations. Special consideration should be given to 1.5 to 1.7 of Approved Document F to assist in the design of the ventilation system and to ensure the self-generated noise levels from the MEV extract fans to not exceed the specified criteria.

The noise levels incident on the red and amber façades exceed the AVO Guides 'Windows Rarely Open' criteria, which means that mechanical ventilation will be required for rooms with windows on these façades. Again, it is understood that continuous MEV extract fans installed in accordance with the specified trickle ventilators to allow the ingress of fresh air will be adequate.

## 6. External Noise Level Assessment

The following section analyses the external amenity area noise levels across the Proposed Development. The external amenity area sound levels are summarised in the table below.

| External Amenity Area Noise Level Assessment |                                        |                               |                 |
|----------------------------------------------|----------------------------------------|-------------------------------|-----------------|
| Plot No.                                     | L <sub>Aeq,16hr</sub> Noise Level (dB) | BS8233:2014 Criteria (dB)     | Exceedance (dB) |
| 1-8                                          | 42 - 54                                | 50 – 55 L <sub>Aeq,16hr</sub> | -1              |
| 9                                            | 58                                     |                               | +3              |

*Table 12 – BS8233:2014 External Amenity Area Noise Level Assessment*

As can be seen in the table above, the noise levels within the external amenity areas of Plots 1 – 8 are within the BS8233 criteria. As such, no further mitigation is deemed necessary in these areas.

The noise levels in the garden area of Plot 9 are expected to exceed the criteria by approximately 3 dB. Due to the nature of the site and the fact that the trainline is at a raised level, mitigation in the form of acoustic fencing is likely to be ineffective. As such, if it is deemed that the criteria must be achieved, then it is recommended that the layout of Plot 9 is reorientated so that the garden area is shielded from the trainline by building.

## 7. Ground-Borne Vibration Screening Assessment

Due to the proximity of the trainline, it is possible that the Site may be affected by ground borne vibration. For this reason, vibration measurements were taken on site, and the results are analysed in the following section.

### Ground-Borne Vibration Criteria

BS6472-1:2008 provides criteria for assessing ground-borne vibration in the form of the “likelihood of adverse comment” that might result from given Vibration Dose Values (VDV) within buildings. The following table outlines the criteria presented within BS6472-1:2008.

| Description              | VDV $\text{m.s}^{-1.75}$           |                          |                          |
|--------------------------|------------------------------------|--------------------------|--------------------------|
|                          | Low Probability of Adverse Comment | Adverse Comment Possible | Adverse Comment Probable |
| Residential 16-hour Day  | 0.2 – 0.4                          | 0.4 – 0.8                | 0.8 – 1.6                |
| Residential 8-hour Night | 0.1 – 0.2                          | 0.2 – 0.4                | 0.4 – 0.8                |

Table 13 – BS6472-1:2008 Ground-Borne Vibration Criteria Inside Dwellings

### Ground-Borne Vibration Measured Results

VDV measurements were taken using a Svantek SV958A Vibration Meter and Svantek SV84 accelerometer. The meter was set up at the boundary of site, closest to the trainline and measurements were taken across the relevant low-frequency range (1-80Hz) over a 2-hour period on 06/07/2023. The accelerometer was situated on the floor at the approximate location of the closest proposed residential dwelling.

The table below presents the maximum tri-axial vibration dose during train pass-bys.

| Description              | Max VDV Event $\text{m.s}^{-1.75}$ |                  |                  |
|--------------------------|------------------------------------|------------------|------------------|
|                          | X Axis ( $W_d$ )                   | Y Axis ( $W_d$ ) | Z Axis ( $W_b$ ) |
| 06/07/23 - 13:15 – 15:18 | 0.07                               | 0.09             | 0.04             |

Table 14 – Maximum Measured VDV Levels during Train Pass-bys

The table above shows that vibration levels were typically highest in the Y-axis (Horizontal).

The table below shows the number of trains for both the day and night-time period, taken from the Realtime Trains database.

| Day (07:00 – 23:00) | Night (23:00 – 07:00) |
|---------------------|-----------------------|
| 106                 | 17                    |

Table 15 – Number of Trains

The calculated day and night-time vibration dose values are detailed in the table below. The calculation method is taken from Example 1 in Appendix B of BS6472-1:2008

| Description  | Calculated VDV $\text{m.s}^{-1.75}$ |                  |                  |
|--------------|-------------------------------------|------------------|------------------|
|              | X Axis ( $W_d$ )                    | Y Axis ( $W_d$ ) | Z Axis ( $W_b$ ) |
| 16-hour Day  | 0.24                                | 0.28             | 0.13             |
| 8-hour Night | 0.15                                | 0.17             | 0.08             |

*Table 16 – Summary of Calculated VDV Levels*

### **Discussion**

With reference to the human response criteria in BS6472-1:2008, the calculated VDV's for the daytime and night-time periods correspond with the assessment outcome of "low probability of adverse comment". As such, it is thought that it is unlikely that vibration levels at the site will negatively affect the amenity of future residents.

## 8. BS4142 Noise Impact Assessment

### *External Fixed Plant Noise Limit Level*

It can be seen on the plans that air source heat pumps will be installed to service the development buildings, however, the makes and models of units have not yet been finalised. As such, plant noise limit levels have been defined to ensure that the noise emissions do not exceed the background sound levels at the closest NSRs. The limit levels are inclusive of any rating penalties that should be applied to account for audible characteristics of the noise which could be deemed to cause increased annoyance, such as intermittency, impulsivity, or tonality. The limit levels have been calculated for the daytime and night-time periods, depending on when the plant will be operational.

The calculated plant noise limit levels are shown in the table below.

| BS4142:2014 Plant Noise Limit Levels      |                                                                                                                     |                  |
|-------------------------------------------|---------------------------------------------------------------------------------------------------------------------|------------------|
| Description                               | Daytime (dBA)                                                                                                       | Night-time (dBA) |
| Background Sound Level*                   | 49                                                                                                                  | 39               |
| Cumulative Plant Noise Limit Level at NSR | 44                                                                                                                  | 34               |
| BS4142 Assessment Outcome                 | Assessment indicates 'Low Impact, dependent on context' in accordance with BS4142:2014.                             |                  |
| NPPF & NSPSE Outcome                      | The assessment outcome would be classed as 'No Observed Effect level ('NOEL') in accordance with the NPPF and NPSE. |                  |

*Table 17 – BS4142 Plant Noise Limit Levels*

*\*The background sound levels are the modal values for each period and have been selected considering the ranges and distributions of values.*

## 9. Conclusion and Action Plan

The proposed development has been assessed against the acoustic design criteria and a sound insulation scheme has been provided to ensure the criteria has been achieved.

The following 'Action Plan' is outlined to ensure the design considerations and specifications from this report are duly implemented:

1. The proposed glazing and background ventilation systems, or suitable alternatives, should be installed as shown in Section 4.
2. To assist in the design of the alternative ventilation strategy a TM59 overheating assessment should be undertaken to ascertain how frequently open windows will be required to mitigate overheating. The TM59 assessor should be provided with this report to base their study. It is highlighted that this report also presents an alternative ventilation strategy in Section 5 should a TM59 assessment not be undertaken.
3. Noise levels in the external amenity area of Plot 9 should be mitigated as described in Section 6.
4. Any external fixed plant that may be installed should not exceed the plant noise limit levels presented in Section 8. These are inclusive of any BS4142 acoustic feature corrections. Once the plant units are specified the noise emissions should be calculated by an appropriately qualified person to ensure that the limit levels are achieved.

The findings of this report will require written approval from the Local Authority prior to work commencing.

## Appendix A – Acoustic Terminology

|                                                                    |                                                                                                                                                                                                                                                   |
|--------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| A-weighted sound pressure level, $L_{pA}$                          | Quantity of A-weighted sound pressure given by the following formula in decibels (dBA). $L_{pA} = 10 \log_{10} (pA/p_0)^2$ . Where: $pA$ is the A-weighted sound pressure in pascals (Pa) and $p_0$ is the reference sound pressure (20 $\mu$ Pa) |
| Background Sound                                                   | Underlying level of sound over a period, $T$ , which might in part be an indication of relative quietness at a given location                                                                                                                     |
| Equivalent continuous A-weighted sound pressure level, $L_{Aeq,T}$ | Value of the A-weighted sound pressure level in decibels (dB) of a continuous, steady sound that, within a specified time interval, $T$ , has the same mean-squared sound pressure as the sound under consideration that varies with time         |
| Facade level                                                       | Sound pressure level 1 m in front of the facade                                                                                                                                                                                                   |
| Free-field level                                                   | Sound pressure level away from reflecting surfaces                                                                                                                                                                                                |
| Indoor ambient noise                                               | Noise in a given situation at a given time, usually composed of noise from many sources, inside and outside the building, but excluding noise from activities of the occupants                                                                    |
| Noise Criteria                                                     | Numerical indices used to define design goals in a given space                                                                                                                                                                                    |
| Noise Rating (NR)                                                  | Graphical method for rating a noise by comparing the noise spectrum with a family of noise rating curves                                                                                                                                          |
| Octave Band                                                        | Band of frequencies in which the upper limit of the band is twice the frequency of the lower limit                                                                                                                                                |
| Percentile Level, $L_{AN,T}$                                       | A-weighted sound pressure level obtained using time-weighting “F”, which is exceeded for $N\%$ of a specified time interval                                                                                                                       |
| Rating Level, $L_{Ar,Tr}$                                          | Equivalent continuous A-weighted sound pressure level of the noise, plus any adjustment for the characteristic features of the noise                                                                                                              |
| Reverberation time, $T$                                            | Time that would be required for the sound pressure level to decrease by 60 dB after the sound source has stopped                                                                                                                                  |
| Sound Pressure, $p$                                                | root-mean-square value of the variation in air pressure, measured in pascals (Pa) above and below atmospheric pressure, caused by the sound                                                                                                       |
| Sound Pressure Level, $L_p$                                        | Quantity of sound pressure, in decibels (dB), given by the formula: $L_p = 10 \log_{10}(p/p_0)^2$ . Where: $p$ is the root-mean-square sound pressure in pascals (Pa) and $p_0$ is the reference sound pressure (20 $\mu$ Pa)                     |
| Weighted sound reduction index, $R_w$                              | Single-number quantity which characterizes the airborne sound insulating properties of a material or building element over a range of frequencies                                                                                                 |

## Appendix B – Standards, Legislation, Policy, and Guidance

This report is to be primarily based on the following standards, legislation, policy, and guidance.

### ***B.1 – National Planning Policy Framework (2021)***

Government policy on noise is set out in the National Planning Policy Framework (NPPF), published in 2021. This replaced all earlier guidance on noise and places an emphasis on sustainability. In section 15, Conserving and enhancing the natural and local environment, paragraph 174e, it states:

*Preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans.*

Paragraph 185 states:

*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:*

- a) Mitigate and reduce to a minimum potential adverse impact resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life.*
- b) Identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason; and*
- c) Limit the impact of light pollution from artificial light on local amenity, intrinsically dark landscapes, and nature conservation.*

### ***B.2 – Noise Policy Statement for England (2010)***

Paragraph 185 of the NPPF also refers to advice on adverse effects of noise given in the Noise Policy Statement for England (NPSE). This document sets out a policy vision to:

Promote good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development.

To achieve this vision the Statement identifies the following three aims:

Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development:

- 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.

In achieving these aims the document introduces significance criteria as follows:

### **SOAEL – Significant Observed Adverse Effect Level**

This is the level above which significant adverse effects on health and quality of life occur. It is stated that “significant adverse effects on health and quality of life should be avoided while also considering the guiding principles of sustainable development”.

### **LOAEL – Lowest Observed Adverse Effect Level**

This is the level above which adverse effects on health and quality of life can be detected. It is stated that the second aim above lies somewhere between LOAEL and SOAEL and requires that: “all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life while also considering the guiding principles of sustainable development. This does not mean that such adverse effects cannot occur.”

### **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. This can be related to the third aim above, which seeks: “where possible, positively to improve health and quality of life through the pro-active management of noise while also considering the guiding principles of sustainable development, recognising that there will be opportunities for such measures to be taken and that they will deliver potential benefits to society. The protection of quiet places and quiet times as well as the enhancement of the acoustic environment will assist with delivering this aim.”

The NPSE recognises that it is not possible to have a single objective noise-based measure that is mandatory and applicable to all sources of noise in all situations and provides no guidance as to how these criteria should be interpreted. It is clear, however, that there is no requirement to achieve noise levels where there are no observable adverse impacts but that reasonable and practicable steps to reduce adverse noise impacts should be taken in the context of sustainable development and ensure a balance between noise sensitive and the need for noise generating developments.

Any scheme of noise mitigation outlined in this report will, therefore, aim to abide by the above principles of the NPPF and NPSE whilst recognizing the constraints of the site.

### ***B.3 – BS8233:2014 ‘Guidance on Sound insulation and noise reduction for buildings’***

BS8233 provides guidance on noise levels from sources without specific character in the built environment, based on the recommendations of the World Health Organization; specifically, ‘WHO Guidelines on Community Noise, 1999’. The Guidelines on Community Noise (1999) document defines community noise to include noise from “industries” and “construction”. The desirable criteria levels of steady state, “anonymous” noise in unoccupied spaces within dwellings, from sources such as road traffic, mechanical services and other continuously running plant, are tabulated below.

| BS8233:2014 Internal Ambient Noise Level Criteria |                  |                            |                                              |
|---------------------------------------------------|------------------|----------------------------|----------------------------------------------|
| Activity                                          | Location         | Daytime<br>(07:00 – 23:00) | Night-time<br>(23:00 – 07:00)                |
| Resting                                           | Living Room      | 35 dB $L_{Aeq,16hour}$     | --                                           |
| Dining                                            | Dining Room/Area | 40 dB $L_{Aeq,16hour}$     | --                                           |
| Sleeping<br>(Daytime resting)                     | Bedroom          | 35 dB $L_{Aeq,16hour}$     | 30 dB $L_{Aeq,8hour}$<br>45 dB $L_{AFmax}^*$ |

Table 18 – BS8233:2014 Internal Ambient Noise Level Criteria

*\*ProPG:2017 states that's good acoustic design can be used so that individual noise events do not normally exceed 45 dB  $L_{AFmax}$  more than 10 time a night within noise sensitive rooms such as bedrooms. However, where it is not reasonably practicable to achieve the guideline then the judgment of acceptability will depend not only on the maximum noise levels but also on factors such as the source, number distribution, predictability, and regularity of noise events.*

It is noted, however, that where development is considered necessary or desirable, despite external noise level above WHO guidelines, the above target levels may be relaxed by up to 5 dB.

General recommendations for mitigation to enable these targets to be achieved are provided, including the use of bunds and barriers to reduce external noise and space planning and sound insulation for the control of internal noise levels.

For this assessment, the above criteria are considered to be the 'LOAEL' as defined in the NPSE in Appendix B.

#### **B.4 – ProPG: Planning and Noise (2017)**

ProPG Planning and Noise published May 2017 by the Association of Noise Consultants (ANC) was produced to provide practitioners with guidance on a recommended approach to the management of noise within the planning system in England. ProPG aims to encourage better acoustic design of new residential developments promoting good health and wellbeing through the effective management of noise. It therefore outlines four key elements which should be considered in the assessment of noise:

- Element 1 – demonstrating a “Good Acoustic Design Process”.
- Element 2 – observing internal “Noise Level Guidelines”.
- Element 3 – undertaking an “External Amenity Area Noise Assessment”; and
- Element 4 – consideration of “Other Relevant Issues”.

The ProPG supplementary document 2 provides the following 'Good Acoustic Design' hierarchy of noise management measures which LPAs should encourage. These are shown below, In descending order of preference:

| Order of Preference | Noise Management Measure                                                                                                                                                                               |
|---------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1                   | Reduction of the noise generated at source by redesign, relocation, or containment. *                                                                                                                  |
| 2                   | Maximising the spatial separation of noise source(s) and receptor(s).                                                                                                                                  |
| 3                   | Using existing topography and existing structures (that are likely to last the expected life of the noise-sensitive scheme) to screen the proposed development site from significant sources of noise. |
| 4                   | Investigating the necessity and feasibility of reducing existing noise levels and relocating existing noise sources.                                                                                   |
| 5                   | Incorporating noise barriers as part of the scheme to screen the proposed development site from significant sources of noise.                                                                          |
| 6                   | Using the layout of the scheme to reduce noise propagation across the site.                                                                                                                            |
| 7                   | Using the orientation of buildings to reduce the noise exposure of noise sensitive rooms.                                                                                                              |
| 8                   | Using the building envelope to mitigate noise to acceptable levels.                                                                                                                                    |

Table 19 – Hierarchy of Noise Management Measures

\*Not from ProPG

### B.5 – Approved Document O: Overheating (2021)

Approved Document O states the following in relation to noise:

1. In locations where external noise may be an issue (for example, where the local planning authority considered external noise to be an issue at the planning stage), the overheating mitigation strategy should take account of the likelihood that windows will be closed during sleeping hours (11pm to 7am).
2. Windows are likely to be closed during sleeping hours if noise within bedrooms exceeds the following limits.
  - a. 40dB  $L_{Aeq,T}$ , averaged over 8 hours (between 11pm and 7am).
  - b. 55dB  $L_{AFmax}$ , more than 10 times a night (between 11pm and 7am).
3. Where in-situ noise measurements are used as evidence that these limits are not exceeded, measurements should be taken in accordance with the Association of Noise Consultants' Measurement of Sound Levels in Buildings with the overheating mitigation strategy in use.

**NOTE:** Guidance on reducing the passage of external noise into buildings can be found in the National Model Design Code: Part 2 – Guidance Notes (MHCLG, 2021) and the Association of Noise Consultants' Acoustics, Ventilation and Overheating: Residential Design Guide (2020).B.6 - Acoustics Ventilation and Overheating – Residential Design Guide 2020

### B.6 – Acoustics Ventilation and Overheating – Residential Design Guide 2020

It is suggested that the desirable internal noise criteria within BS8233:2014 should be achieved considering adequate ventilation as defined by Building Regulations 'Approved Document F' ('ADF') whole dwelling ventilation. However, for a whole dwelling ventilation system such as MVHR it is considered reasonable to allow higher levels of internal ambient noise from transport sources when higher rates of ventilation are required in relation to the overheating condition.

AVO 'Level 1' risk assessment criteria guide based on external free field ambient noise levels for dwellings relying on purge ventilation (e.g., opening windows) to prevent summertime overheating. AVO Guide Table 3-2 detailed in the figure below. To assess the possibility of overheating it is reasonable to relax the BS 8233:2014 internal ambient noise levels from opening a window by 5 decibels (5 dB). Also, it is assumed that a partially open window will provide a sound reduction of 13 dB. Therefore, to achieve internal noise levels in line with BS 8233:2014 the façade external noise levels should fall inside the levels shown in Table 3-2.

| Risk category for Level 1 assessment <sup>[Note 5]</sup>                                                                                                                                                                         | Potential Effect without Mitigation                                                                                | Recommendation for Level 2 assessment |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|---------------------------------------|
| <p>LAeq,T <sup>[Note 3]</sup> during 07:00 - 23:00</p> <p>LAeq,8hr during 23:00 - 07:00</p> <p>65 dB</p> <p>55 dB</p> <p>60 dB</p> <p>50 dB</p> <p>55 dB</p> <p>50 dB</p> <p>High</p> <p>Medium</p> <p>Low</p> <p>Negligible</p> | <p>Increasing risk of adverse effect</p>                                                                           | <p>Recommended</p> <p>Optional</p>    |
|                                                                                                                                                                                                                                  | <p>Use of opening windows as primary means of mitigating overheating is not likely to result in adverse effect</p> | <p>Not required</p>                   |

Figure 7 – AVO Guide Level 1 Risk Category

The AVO Guide (2020) seeks to determine the level of risk associated with overheating in a new residential development based on the existing noise climate. The AVO risk categories are detailed in the table below with clearer categorisation.

| AVO Guide (2020) Level 1 Risk Assessment |                               |                 |                                                                                                                                              |
|------------------------------------------|-------------------------------|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------|
| Daytime<br>(07:00 – 23:00)               | Night-time<br>(23:00 – 07:00) | Risk Category   | Mitigation                                                                                                                                   |
| $\geq 63$ dB $L_{Aeq,16hour}$            | $\geq 55$ dB $L_{Aeq,8hour}$  | High Risk       | Level 2 assessment recommended. Windows which are unopenable on grounds of noise will inevitably create issues for the overheating strategy. |
| 57 – 62 dB $L_{Aeq,16hour}$              | 52 – 54 dB $L_{Aeq,8hour}$    | Medium Risk     | Level 2 assessment optional to give more confidence regarding the suitability of internal noise conditions.                                  |
| 54 – 56 dB $L_{Aeq,16hour}$              | 49 – 51 dB $L_{Aeq,8hour}$    | Low Risk        |                                                                                                                                              |
| $\leq 53$ dB $L_{Aeq,16hour}$            | $\leq 48$ dB $L_{Aeq,8hour}$  | Negligible Risk | None required – openable windows suitable for ventilation                                                                                    |

Table 20 – AVO Guide (2020) Level 1 Risk Assessment

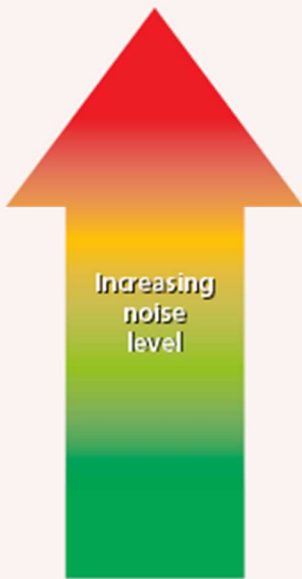
#### Level 2 Risk Assessment:

A 'Level 2' assessment of noise is recommended where a dwelling using purge ventilation (e.g., open windows) reaches Level 1 'High Risk' or 'Medium Risk'. The Level 2 assessment guidance comments that where internal ambient noise levels are  $>50$  dB  $L_{Aeq,16hr}$  (day) or  $>42$  dB  $L_{Aeq,8hr}$  (night) then the outcome might be that the noise causes a material change in behaviour, e.g., having to keep windows closed for the majority of the time, or there is the potential for sleep disturbance.

To conduct a Level 2 assessment, the following minimum information is required:

- Statement of the overheating criteria being applied.
- Description of the provisions for meeting the stated overheating criteria. This should include, where relevant, the area of façade opening.
- Details of the likely internal ambient noise levels whilst using provisions for mitigating overheating, and the method used to predict these.
- Estimation of how frequently and for what duration such provisions are required to mitigate overheating.
- Consideration of the effect of individual noise events.
- Assessment of the adverse effect on occupants.

The figure below outlines the AVO Guide (2020) guidance for a Level 2 assessment of noise from transport sources relating to the Overheating Condition.

| Internal ambient noise level [Note 2]                                              |                                      |                                                                                      | Examples of Outcomes [Note 5]                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|------------------------------------------------------------------------------------|--------------------------------------|--------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| $L_{Aeq,T}$ [Note 3]<br>during<br>07:00 – 23:00<br>[Note 6]                        | $L_{Aeq,8h}$ during<br>23:00 – 07:00 | Individual noise<br>events during<br>23:00 – 07:00<br>[Note 4]                       |                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| > 50 dB                                                                            | > 42 dB                              | Normally<br>exceeds 65 dB<br>$L_{A, Fmax}$                                           | Noise causes<br>a material<br>change in<br>behaviour<br>e.g. having to<br>keep windows<br>closed most<br>of the time                  | Avoiding certain activities during<br>periods of intrusion. Having to keep<br>windows closed most of the time<br>because of the noise. Potential<br>for sleep disturbance resulting<br>in difficulty in getting to sleep,<br>premature awakening and difficulty<br>in getting back to sleep. Quality<br>of life diminished due to change<br>in acoustic character of the area.                                                                                                                                                                                                                                                                                                                                                                                         |
|  |                                      |                                                                                      | Increasing<br>likelihood of<br>impact on<br>reliable speech<br>communication<br>during the<br>day or sleep<br>disturbance<br>at night | At higher noise levels, more<br>significant behavioural change<br>is expected and may only be<br>considered suitable if occurring<br>for limited periods.<br><br>As noise levels increase, small<br>behaviour changes are expected<br>e.g. turning up the volume on the<br>television; speaking a little more<br>loudly; having to close windows<br>for certain activities, for example<br>ones which require a high level of<br>concentration. Potential for some<br>reported sleep disturbance. Affects<br>the acoustic environment inside<br>the dwelling such that there is a<br>perceived change in quality of life.<br><br>At lower noise levels, limited<br>behavioural change is expected<br>unless conditions are prevalent<br>for most of the time. [Note 8] |
| ≤ 35 dB                                                                            | ≤ 30 dB                              | Do not<br>normally<br>exceed $L_{A, Fmax}$<br>45 dB more<br>than 10 times<br>a night | Noise can<br>be heard, but<br>does not cause<br>any change in<br>behaviour                                                            | Noise can be heard, but does not<br>cause any change in behaviour,<br>attitude, or other physiological<br>response [Note 9]. Can slightly affect the<br>acoustic character of the area but<br>not such that there is a perceived<br>change in the quality of life.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

**Note 1** The noise levels suggested in Tables 3-2 and 3-3 assume a steady road traffic noise source but may be adapted for other types of transport.

Table 3-3 of AVO Guide (2020)

Figure 8 – AVO Guide Level 2 Internal Ambient Noise Levels



## Appendix D – Environmental Survey

### D.1 – Time History Noise Data

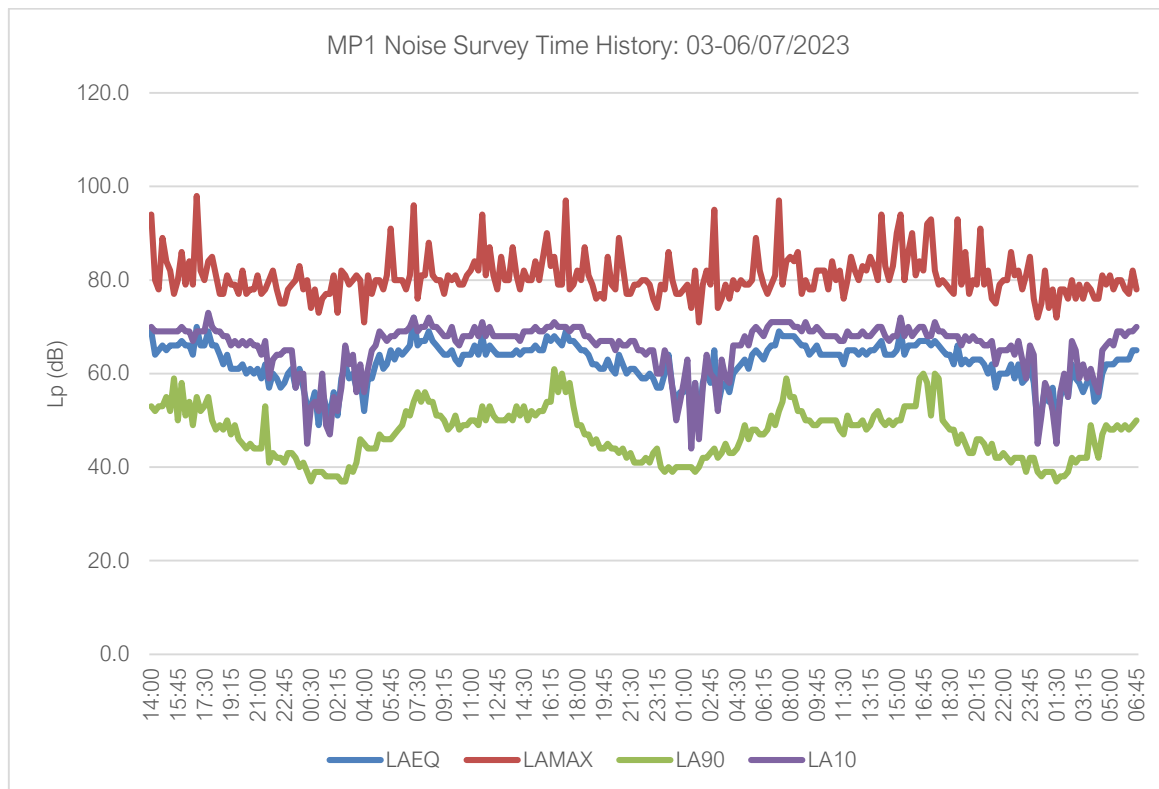


Figure 10 – MP1 Noise Survey Time History

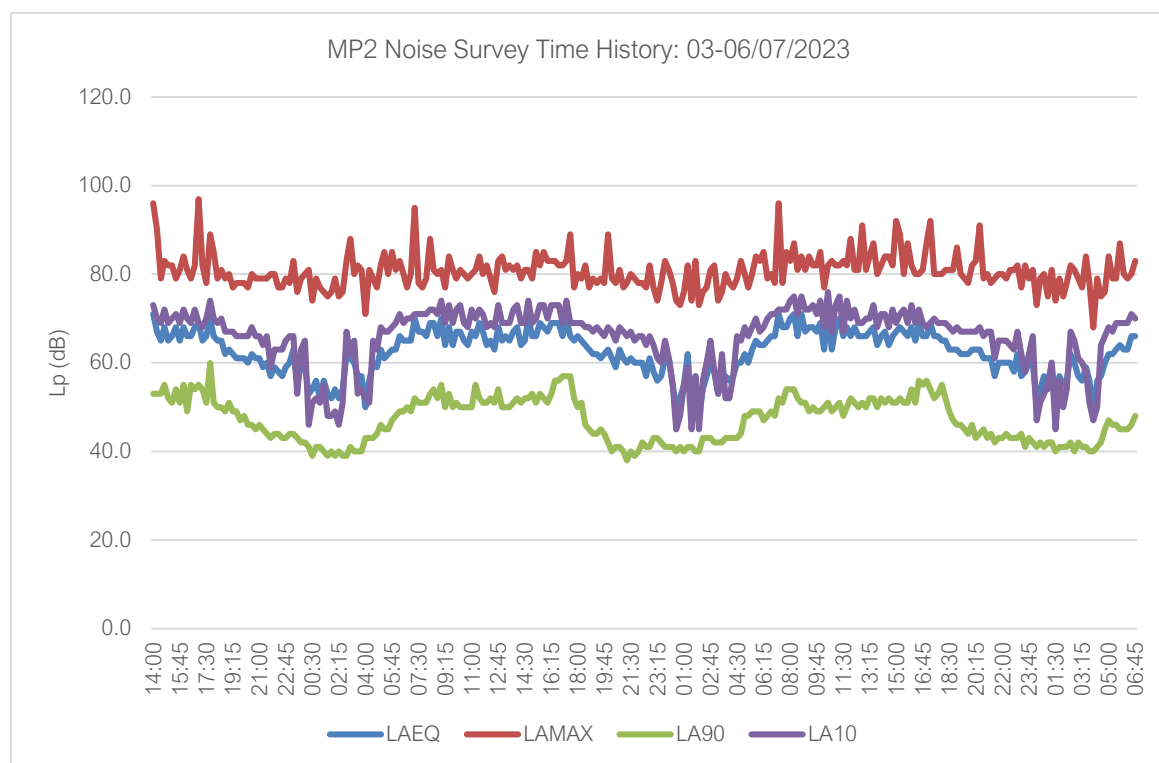


Figure 11 – MP2 Noise Survey Time History

## D.2 – Surveying Equipment

| Piece of Equipment                    | Serial No. | Calibration Deviation |
|---------------------------------------|------------|-----------------------|
| Svantek 977 Class 1 Sound Level Meter | 34826      | ≤0.2                  |
| Svantek SV33B Class 1 Calibrator      | 116639     |                       |
| Svantek 971 Class 1 Sound Level Meter | 77796      | ≤0.2                  |
| Svantek SV33B Class 1 Calibrator      | 116639     |                       |

Table 21 – Surveying Equipment

All equipment used during the survey was field calibrated at the start and end of the measurement period with a negligible deviation of ≤0.2 dB. All sound level meters are calibrated every 24 months and all calibrators are calibrated every 12 months, by a third-party calibration laboratory. All microphones were fitted with a protective windshield for the entire measurements period. Calibration certificates can be provided upon request.

## D.3 – Meteorological Conditions

As the environmental noise survey was carried out over a long un-manned period no localised records of weather conditions were taken. However, all measurements have been compared with met office weather data of the area, specifically the closest weather station, and the data from the weather station is outlined in the table below. When reviewing the time history of the noise measurements, any scenarios that were considered potentially to be affected by the local weather conditions have been omitted. The analysis of the noise data includes statistical and percentile analysis and review of minimum and maximum values, which aids in the preclusion of any periods of undesirable weather conditions. The weather conditions were deemed suitable for the measurement of environmental noise in accordance with BS7445 Description and Measurement of Environmental Noise. The table below presents the average temperature, wind speed and rainfall range for each 24-hour period during the entire measurement.

| Weather Conditions – Stoke Golding (Approx. 4.9km N of Site) |               |                 |                           |                  |
|--------------------------------------------------------------|---------------|-----------------|---------------------------|------------------|
| Time Period                                                  | Air Temp (°C) | Rainfall (mm/h) | Prevailing Wind Direction | Wind Speed (m/s) |
| 03/07/23 – 00:00 – 23:59                                     | 11.6 – 20.6   | 0.0             | SSW                       | 0.5 – 7.0        |
| 04/07/23 – 00:00 – 23:59                                     | 11.5 – 17.6   | 0.0             | SW                        | 0.0 – 4.8        |
| 05/07/23 – 00:00 – 23:59                                     | 9.3 – 20.8    | 0.0             | SSW                       | 0.0 – 3.9        |
| 06/07/23 – 00:00 – 23:59                                     | 10.2 – 22.3   | 0.0             | SSW                       | 0.0 – 5.7        |

Table 22 – Weather Conditions

## Appendix E – Noise Break-in Calculations

### *E.1 – Façades with Background Ventilation*

The façade sound reduction and predicted internal noise levels are calculated assuming the following:

- The calculation method for façade sound reduction is in accordance with BS8233:2014 and BS EN 12354-3.
- The frequency profile from MP3 has been used for all calculations.
- The second highest  $L_{AFmax}$  measurement recorded at MP3 has been used to calibrate the maximum noise emissions from the trainline.
- The reverberation time is typically 0.5 seconds across the relevant frequency range for a furnished living room in the UK. This value is used for both living rooms and bedrooms.
- Based on the technical drawings provided, window areas of 2-5m<sup>2</sup> and room volumes of 26-38m<sup>3</sup> are used in the calculations for bedrooms as a worst-case scenario. For living rooms, the calculations are based on a window area of 2.5-13.5m<sup>2</sup> and room volume of 27-84m<sup>3</sup> as a worst-case scenario.
- The acoustic performance of the façade elements is taken from the relevant manufacturers' technical information, or the sound reduction has been predicted using INSUL 9.0.
- For background trickle ventilation a total Equivalent Area of 5000mm<sup>2</sup> per habitable room has been used in the calculations, which equates to 2 No. trickle vents (2500mm<sup>2</sup> each).

## Living Room (Red) Day Time Leq

| Item / Description         | dB(A)     | 63        | 125       | 250       | 500       | 1k        | 2k        | 4k        |
|----------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Corrected Leq,T Spectrum   | 62        | 67        | 59        | 59        | 59        | 58        | 54        | 51        |
| Glazing Noise Ingress      | 30        | 43        | 33        | 35        | 28        | 15        | 13        | 7         |
| Ventilation Noise Ingress  | 28        |           | 25        | 28        | 28        | 20        | 20        | 13        |
| Wall Noise Ingress         | 4         | 23        | 10        | 8         | -2        | -4        | -8        | -11       |
| Roof Noise Ingress         |           |           |           |           |           |           |           |           |
| Room Absorption Correction |           | 0         | 0         | -1        | -1        | -1        | -2        | -3        |
| <b>Total Noise Ingress</b> | <b>34</b> | <b>46</b> | <b>37</b> | <b>38</b> | <b>33</b> | <b>24</b> | <b>22</b> | <b>15</b> |
| NR30                       | 35        | 59        | 48        | 39        | 33        | 30        | 26        | 24        |
| Exceedance of Criteria     | -1        | -13       | -11       | -1        | 0         | -6        | -4        | -9        |

## Bedroom (Red) Day Time Leq

| Item / Description         | dB(A)     | 63        | 125       | 250       | 500       | 1k       | 2k       | 4k        |
|----------------------------|-----------|-----------|-----------|-----------|-----------|----------|----------|-----------|
| Corrected Leq,T Spectrum   | 62        | 67        | 59        | 59        | 59        | 58       | 54       | 51        |
| Glazing Noise Ingress      | 24        | 43        | 35        | 28        | 19        | 7        | 3        | -6        |
| Ventilation Noise Ingress  | 17        | 40        | 16        | 17        | 12        | 6        | -8       | -13       |
| Wall Noise Ingress         | 3         | 22        | 8         | 7         | -4        | -5       | -9       | -13       |
| Roof Noise Ingress         |           |           |           |           |           |          |          |           |
| Room Absorption Correction |           | -2        | -2        | -3        | -3        | -3       | -4       | -5        |
| <b>Total Noise Ingress</b> | <b>25</b> | <b>46</b> | <b>35</b> | <b>29</b> | <b>19</b> | <b>9</b> | <b>3</b> | <b>-6</b> |
| NR30                       | 35        | 59        | 48        | 39        | 33        | 30       | 26       | 24        |
| Exceedance of Criteria     | -10       | -13       | -13       | -10       | -14       | -21      | -23      | -30       |

## Bedroom (Red) Night Time Leq

| Item / Description         | dB(A)     | 63        | 125       | 250       | 500       | 1k       | 2k       | 4k        |
|----------------------------|-----------|-----------|-----------|-----------|-----------|----------|----------|-----------|
| Corrected Leq,T Spectrum   | 59        | 64        | 56        | 56        | 56        | 55       | 51       | 48        |
| Glazing Noise Ingress      | 21        | 40        | 32        | 25        | 16        | 4        | 0        | -9        |
| Ventilation Noise Ingress  | 14        | 37        | 13        | 14        | 9         | 3        | -11      | -16       |
| Wall Noise Ingress         | 0         | 19        | 5         | 4         | -7        | -8       | -12      | -16       |
| Roof Noise Ingress         |           |           |           |           |           |          |          |           |
| Room Absorption Correction |           | -2        | -2        | -3        | -3        | -3       | -4       | -5        |
| <b>Total Noise Ingress</b> | <b>22</b> | <b>43</b> | <b>32</b> | <b>26</b> | <b>16</b> | <b>6</b> | <b>0</b> | <b>-9</b> |
| NR25                       | 30        | 55        | 43        | 35        | 28        | 25       | 21       | 19        |
| Exceedance of Criteria     | -8        | -12       | -11       | -9        | -12       | -19      | -21      | -28       |

## Bedroom (Red) Night Time Max

| Item / Description         | dB(A)     | 63        | 125       | 250       | 500       | 1k        | 2k        | 4k        |
|----------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Corrected Lmax Spectrum    | 82        | 87        | 79        | 79        | 79        | 78        | 74        | 71        |
| Glazing Noise Ingress      | 44        | 63        | 55        | 48        | 39        | 27        | 23        | 14        |
| Ventilation Noise Ingress  | 37        | 60        | 36        | 37        | 32        | 26        | 12        | 7         |
| Wall Noise Ingress         | 23        | 42        | 28        | 27        | 16        | 15        | 11        | 7         |
| Roof Noise Ingress         |           |           |           |           |           |           |           |           |
| Room Absorption Correction |           | -2        | -2        | -3        | -3        | -3        | -4        | -5        |
| <b>Total Noise Ingress</b> | <b>45</b> | <b>66</b> | <b>55</b> | <b>49</b> | <b>39</b> | <b>29</b> | <b>23</b> | <b>14</b> |
| NR40                       | 45        | 67        | 56        | 49        | 43        | 40        | 37        | 34        |
| Exceedance of Criteria     | 0         | -1        | -1        | 0         | -4        | -11       | -14       | -20       |

## Living Room (Amber) Day Time Leq

| Item / Description         | dB(A)     | 63        | 125       | 250       | 500       | 1k        | 2k        | 4k        |
|----------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Corrected Leq,T Spectrum   | 61        | 66        | 58        | 58        | 58        | 57        | 53        | 50        |
| Glazing Noise Ingress      | 31        | 44        | 35        | 36        | 30        | 17        | 14        | 9         |
| Ventilation Noise Ingress  | 22        |           | 19        | 22        | 22        | 15        | 14        | 7         |
| Wall Noise Ingress         | 1         | 20        | 6         | 5         | -6        | -8        | -11       | -15       |
| Roof Noise Ingress         |           |           |           |           |           |           |           |           |
| Room Absorption Correction |           | 0         | 0         | -1        | -1        | -1        | -2        | -3        |
| <b>Total Noise Ingress</b> | <b>34</b> | <b>47</b> | <b>37</b> | <b>39</b> | <b>32</b> | <b>21</b> | <b>19</b> | <b>12</b> |
| NR30                       | 35        | 59        | 48        | 39        | 33        | 30        | 26        | 24        |
| Exceedance of Criteria     | -1        | -12       | -11       | 0         | -1        | -9        | -7        | -12       |

## Bedroom (Amber) Day Time Leq

| Item / Description         | dB(A)     | 63        | 125       | 250       | 500       | 1k        | 2k        | 4k        |
|----------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Corrected Leq,T Spectrum   | 61        | 66        | 58        | 58        | 58        | 57        | 53        | 50        |
| Glazing Noise Ingress      | 26        | 40        | 30        | 32        | 24        | 14        | 8         | -2        |
| Ventilation Noise Ingress  | 28        |           | 24        | 27        | 27        | 20        | 19        | 13        |
| Wall Noise Ingress         | 4         | 23        | 9         | 8         | -3        | -5        | -8        | -12       |
| Roof Noise Ingress         |           |           |           |           |           |           |           |           |
| Room Absorption Correction |           | -2        | -2        | -3        | -3        | -3        | -4        | -5        |
| <b>Total Noise Ingress</b> | <b>30</b> | <b>41</b> | <b>32</b> | <b>33</b> | <b>29</b> | <b>20</b> | <b>19</b> | <b>11</b> |
| NR30                       | 35        | 59        | 48        | 39        | 33        | 30        | 26        | 24        |
| Exceedance of Criteria     | -5        | -18       | -16       | -6        | -4        | -10       | -7        | -13       |

## Bedroom (Amber) Night Time Leq

| Item / Description         | dB(A)     | 63        | 125       | 250       | 500       | 1k        | 2k        | 4k       |
|----------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|----------|
| Corrected Leq,T Spectrum   | 57        | 62        | 54        | 54        | 54        | 53        | 49        | 46       |
| Glazing Noise Ingress      | 22        | 36        | 26        | 28        | 20        | 10        | 4         | -6       |
| Ventilation Noise Ingress  | 24        |           | 20        | 23        | 23        | 16        | 15        | 9        |
| Wall Noise Ingress         | 0         | 19        | 5         | 4         | -7        | -9        | -12       | -16      |
| Roof Noise Ingress         |           |           |           |           |           |           |           |          |
| Room Absorption Correction |           | -2        | -2        | -3        | -3        | -3        | -4        | -5       |
| <b>Total Noise Ingress</b> | <b>26</b> | <b>37</b> | <b>28</b> | <b>29</b> | <b>25</b> | <b>16</b> | <b>15</b> | <b>7</b> |
| NR25                       | 30        | 55        | 43        | 35        | 28        | 25        | 21        | 19       |
| Exceedance of Criteria     | -4        | -18       | -15       | -6        | -3        | -9        | -6        | -12      |

## Bedroom (Amber) Night Time Max

| Item / Description         | dB(A)     | 63        | 125       | 250       | 500       | 1k        | 2k        | 4k        |
|----------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Corrected Lmax Spectrum    | 75        | 80        | 72        | 72        | 72        | 71        | 67        | 64        |
| Glazing Noise Ingress      | 40        | 54        | 44        | 46        | 38        | 28        | 22        | 12        |
| Ventilation Noise Ingress  | 42        |           | 38        | 41        | 41        | 34        | 33        | 27        |
| Wall Noise Ingress         | 18        | 37        | 23        | 22        | 11        | 9         | 6         | 2         |
| Roof Noise Ingress         |           |           |           |           |           |           |           |           |
| Room Absorption Correction |           | -2        | -2        | -3        | -3        | -3        | -4        | -5        |
| <b>Total Noise Ingress</b> | <b>44</b> | <b>55</b> | <b>46</b> | <b>47</b> | <b>43</b> | <b>34</b> | <b>33</b> | <b>25</b> |
| NR40                       | 45        | 67        | 56        | 49        | 43        | 40        | 37        | 34        |
| Exceedance of Criteria     | -1        | -12       | -10       | -2        | 0         | -6        | -4        | -9        |

## Living Room (Green) Day Time Leq

| Item / Description         | dB(A)     | 63        | 125       | 250       | 500       | 1k        | 2k        | 4k       |
|----------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|----------|
| Corrected Leq,T Spectrum   | 58        | 63        | 55        | 55        | 55        | 54        | 50        | 47       |
| Glazing Noise Ingress      | 28        | 41        | 32        | 33        | 27        | 14        | 11        | 6        |
| Ventilation Noise Ingress  | 19        | 16        | 19        | 19        | 12        | 11        | 4         |          |
| Wall Noise Ingress         | -2        | 17        | 3         | 2         | -9        | -11       | -14       | -18      |
| Roof Noise Ingress         |           |           |           |           |           |           |           |          |
| Room Absorption Correction |           | 0         | 0         | -1        | -1        | -1        | -2        | -3       |
| <b>Total Noise Ingress</b> | <b>31</b> | <b>44</b> | <b>34</b> | <b>36</b> | <b>29</b> | <b>18</b> | <b>16</b> | <b>9</b> |
| NR30                       | 35        | 59        | 48        | 39        | 33        | 30        | 26        | 24       |
| Exceedance of Criteria     | -4        | -15       | -14       | -3        | -4        | -12       | -10       | -15      |

## Bedroom (Green) Day Time Leq

| Item / Description         | dB(A)     | 63        | 125       | 250       | 500       | 1k        | 2k        | 4k       |
|----------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|----------|
| Corrected Leq,T Spectrum   | 58        | 63        | 55        | 55        | 55        | 54        | 50        | 47       |
| Glazing Noise Ingress      | 25        | 38        | 28        | 30        | 23        | 11        | 8         | 3        |
| Ventilation Noise Ingress  | 25        | 21        | 24        | 24        | 17        | 16        | 10        |          |
| Wall Noise Ingress         | 1         | 20        | 6         | 5         | -6        | -8        | -11       | -15      |
| Roof Noise Ingress         |           |           |           |           |           |           |           |          |
| Room Absorption Correction |           | -2        | -2        | -3        | -3        | -3        | -4        | -5       |
| <b>Total Noise Ingress</b> | <b>28</b> | <b>39</b> | <b>30</b> | <b>31</b> | <b>27</b> | <b>17</b> | <b>16</b> | <b>9</b> |
| NR30                       | 35        | 59        | 48        | 39        | 33        | 30        | 26        | 24       |
| Exceedance of Criteria     | -7        | -20       | -18       | -8        | -6        | -13       | -10       | -15      |

## Bedroom (Green) Night Time Leq

| Item / Description         | dB(A)     | 63        | 125       | 250       | 500       | 1k        | 2k        | 4k       |
|----------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|----------|
| Corrected Leq,T Spectrum   | 54        | 59        | 51        | 51        | 51        | 50        | 46        | 43       |
| Glazing Noise Ingress      | 21        | 34        | 24        | 26        | 19        | 7         | 4         | -1       |
| Ventilation Noise Ingress  | 21        | 17        | 20        | 20        | 13        | 12        | 6         |          |
| Wall Noise Ingress         | -3        | 16        | 2         | 1         | -10       | -12       | -15       | -19      |
| Roof Noise Ingress         |           |           |           |           |           |           |           |          |
| Room Absorption Correction |           | -2        | -2        | -3        | -3        | -3        | -4        | -5       |
| <b>Total Noise Ingress</b> | <b>24</b> | <b>35</b> | <b>26</b> | <b>27</b> | <b>23</b> | <b>13</b> | <b>12</b> | <b>5</b> |
| NR25                       | 30        | 55        | 43        | 35        | 28        | 25        | 21        | 19       |
| Exceedance of Criteria     | -6        | -20       | -17       | -8        | -5        | -12       | -9        | -14      |

## Bedroom (Green) Night Time Max

| Item / Description         | dB(A)     | 63        | 125       | 250       | 500       | 1k        | 2k        | 4k        |
|----------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Corrected Lmax Spectrum    | 73        | 78        | 70        | 70        | 70        | 69        | 65        | 62        |
| Glazing Noise Ingress      | 40        | 53        | 43        | 45        | 38        | 26        | 23        | 18        |
| Ventilation Noise Ingress  | 40        | 36        | 39        | 39        | 32        | 31        | 25        |           |
| Wall Noise Ingress         | 16        | 35        | 21        | 20        | 9         | 7         | 4         | 0         |
| Roof Noise Ingress         |           |           |           |           |           |           |           |           |
| Room Absorption Correction |           | -2        | -2        | -3        | -3        | -3        | -4        | -5        |
| <b>Total Noise Ingress</b> | <b>43</b> | <b>54</b> | <b>45</b> | <b>46</b> | <b>42</b> | <b>32</b> | <b>31</b> | <b>24</b> |
| NR40                       | 45        | 67        | 56        | 49        | 43        | 40        | 37        | 34        |
| Exceedance of Criteria     | -2        | -13       | -11       | -3        | -1        | -8        | -6        | -10       |

Figure 12 – Noise Break-In Calculations

## Appendix F – Noise Modelling Particulars

The SoundPlan 9.0 noise model has been setup with the following inputs and assumptions:

- To accurately model the land surrounding the development the topographical data has been taken from the EAs 'National LIDAR Programme' on the DEFRA Data Services Platform.
- For the purpose of the assessment, the ground between the source and receiver is considered to consist primarily of acoustically 'soft' surfaces.
- The sound map grid height has been set to 1.5m, however, the noise levels used in the assessment will be taken from the most exposed point on each NSR façade.
- All buildings and any intervening objects have been modelled according to the technical drawings provided by the applicant, and those provided by the LIDAR data.
- The noise levels presented in Table 2 have been used to calibrate the noise model.



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