



**24Acoustics**

Armstrong House  
3 Bassett Avenue  
Southampton  
SO16 7DP

T: 02380 555 000

**PROPOSED RESIDENTIAL DEVELOPMENT  
AT LOWER ROAD, BEDHAMPTON**

**NOISE AND VIBRATION IMPACT ASSESSMENT**

Technical Report: R6954-1 Rev 2

Date: 28th October 2020

For: Bargate Homes Ltd  
The New Barn,  
Vicarage Farm Business Park  
Winchester Road,  
Fair Oak  
SO50 7HD

## 24 Acoustics Document Control Sheet

**Project Title:** Proposed Residential Development at Lower Road, Bedhampton  
Noise and Vibration Impact Assessment

**Report Ref:** R6954-1 Rev 2

**Date:** 28th October 2020

|                                       | Name                                   | Position             | Signature | Date       |
|---------------------------------------|----------------------------------------|----------------------|-----------|------------|
| Prepared by                           | Reuben Peckham<br>BEng MPhil CEng MIOA | Principal Consultant |           | 28/10/2020 |
| Approved by                           | Stephen Gosling<br>BEng MIOA           | Principal Consultant |           | 28/10/2020 |
| For and on behalf of 24 Acoustics Ltd |                                        |                      |           |            |

## Document Status and Approval Schedule

| Revision | Description        | Prepared By    | Approved By     |
|----------|--------------------|----------------|-----------------|
| 0        | Approved for Issue | Jonathan Munns | Reuben Peckham  |
| 1        | Amended            | Jonathan Munns | Reuben Peckham  |
| 2        | Amended            | Reuben Peckham | Stephen Gosling |
|          |                    |                |                 |
|          |                    |                |                 |
|          |                    |                |                 |

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## **EXECUTIVE SUMMARY**

24 Acoustics Ltd has been instructed by Bargate Homes Ltd to undertake an updated noise and vibration assessment relating to a proposed development site at Lower Road in Bedhampton. A new planning application to develop the site for residential use is proposed.

Environmental noise and vibration measurements have been undertaken at the site to establish the prevailing ambient noise / vibration levels at the site.

The assessment has indicated that vibration on the area of the site proposed for development is insignificant.

External noise levels in private gardens within the developed site are generally predicted to be below 55 dB  $L_{Aeq, 16 \text{ hour}}$  in private gardens.

Glazing and ventilation specifications have been determined in outline to achieve a satisfactory internal acoustic environment in all habitable rooms.

On the above basis, it is considered that an appropriate acoustic environment can be provided to the proposed residential properties, both externally and internally, relative to the prevailing acoustic environment.

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## **1.0 INTRODUCTION**

- 1.1 24 Acoustics Ltd has been instructed by Bargate Homes Ltd to undertake a noise and vibration assessment at a proposed development site at Lower Road in Bedhampton. It is proposed to submit an updated planning application to develop the site for residential use.
- 1.2 This report has assessed the impact of noise and vibration from road and rail traffic and other sources of ambient noise. The A27 dual carriageway is close to the site to the west and south and the site is bounded by a railway to the south.
- 1.3 All noise levels in this report are quoted in dB relative to 20  $\mu$ Pa. A definition of noise and vibration parameters described in this report is provided in Appendix A.

## **2.0 SITE DESCRIPTION AND PROPOSED DEVELOPMENT**

- 2.1 The site is located to the south of Bedhampton. Vehicular access to the site is via Lower Road which links to Brookside Road. The site is bounded by existing residential and commercial properties to the north. There is agricultural land to the west, east and south, with a railway along the southern boundary. The A27 is located further away to the west and south.
- 2.2 An aerial image showing the location of the site is shown in Figure 1. The proposed development scheme is shown in Figure 2.
- 2.3 Planning consent is sought to develop the site to provide residential dwellings. There is potential for the new housing to be affected by noise from the railway and road traffic using the A27.

### 3.0 STANDARDS AND GUIDANCE

#### National Planning Policy

3.1 Paragraph 180 of the National Planning Policy Framework (NPPF) [Reference 1] states that planning policies and decisions 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;
- identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason.

3.2 The NPPF also refers to the Noise Policy Statement for England (NPSE) [Reference 3] which is intended to apply to all forms of noise, including environmental noise, neighbour noise and neighbourhood noise. The NPSE sets out the Government's long-term 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' which 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.

3.3 The NPSE defines the concept of a 'significant observed adverse effect level' (SOAEL) as 'the level above which significant adverse effects on health and quality of life occur'. The following guidance is provided within the NPSE:

*"It is not possible to have a single objective noise-based measure that defines SOAEL that is applicable to all sources of noise in all situations. Consequently, the SOAEL is likely to be different for different noise sources, for different receptors and at different times. It is acknowledged that further research is required to increase our understanding of what may constitute a significant adverse impact on health and quality of life from noise. However, not having specific SOAEL values in the NPSE provides the necessary policy flexibility until further evidence and suitable guidance is available."*

- 3.4 In March 2014 the Planning Practice Guidance (PPG) [Reference 4] was first published. This is written to support the NPPF with more specific planning guidance. The PPG reflects the NPSE and states that noise needs to be considered when new developments may create additional noise and when new developments would be sensitive to the prevailing acoustic environment. It also states that opportunities should be taken, where practicable, to achieve improvements to the acoustic environment. The PPG states that noise can over-ride other planning concerns but should not be considered in isolation from the other economic, social and environmental dimensions of the proposed development.
- 3.5 The PPG expands upon the concept of SOAEL (together with Lowest Observable Adverse Effect Level, LOAEL, and No Observed Effect Level, NOEL) as introduced in the NPSE and provides a table of noise exposure hierarchy for use in noise impact assessments in the planning system. Table 1 is reproduced from the PPG and summarises the noise exposure hierarchy, based on the likely average response.

| Perception                                               | Examples of Outcomes                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Increasing Effect Level             | Action                           |
|----------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|----------------------------------|
| Not noticeable                                           | No Effect                                                                                                                                                                                                                                                                                                                                                                                                                                                             | No Observed Effect                  | No specific measures required    |
| Noticeable and not intrusive                             | Noise can be heard, but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life                                                                                                                                                                                                                                                               | No Observed Adverse Effect          | No specific measures required    |
| <b>Lowest Observable Adverse Effect Level (LOAEL)</b>    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                     |                                  |
| Noticeable and intrusive                                 | Noise can be heard and causes small changes in behaviour and/ or attitude, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a perceived change in the quality of life                                                           | Observed Adverse Effect             | Mitigate and reduce to a minimum |
| <b>Significant Observed Adverse Effect Level (SOAEL)</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                     |                                  |
| Noticeable and disruptive                                | The noise causes a material change in behaviour and/ or attitude, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area. | Significant Observed Adverse Effect | Avoid                            |
| Noticeable and very disruptive                           | Extension and regular changes in behaviour and/ or an inability to mitigate effect of noise leading to psychological stress or physiological effects, e.g. regular sleep deprivation/ awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non auditory                                                                                                                                                                              | Unacceptable Adverse Effect         | Prevent                          |

**Table 1:** PPG Noise Exposure Hierarchy

- 3.6 In general terms it is considered that a noise impact with an effects level which is lower than SOAEL is acceptable (providing the effect is mitigated to a minimum). There is currently, however, a discontinuity between the above guidance and objective technical criteria for use in planning noise impact assessments.

### Internal Noise Levels

- 3.7 For residential developments 24 Acoustics considers that the spirit of the requirements of the NPPF, NPSE and PPG will be complied with if criteria from British Standard 8233:2014 [Reference 5] and World Health Organisation guidelines [Reference 6] are adopted for internal noise within dwellings.
- 3.8 BS 8233 provides desirable internal ambient noise levels for habitable rooms. Table 2 shows a summary of the levels recommended in BS 8233 for living rooms and bedrooms.

| Activity                   | Location    | Daytime<br>07:00 to 23:00 | Night-time<br>23:00 to 07:00 |
|----------------------------|-------------|---------------------------|------------------------------|
| Resting                    | Living Room | 35 dB $L_{Aeq,16hr}$      | --                           |
| Sleeping (daytime resting) | Bedroom     |                           | 30 dB $L_{Aeq,8hr}$          |

**Table 2:** Indoor Ambient Noise Levels as Recommended in BS 8233

- 3.9 The World Health Organisation provides guidance on desirable internal noise levels to minimise the risk of sleep disturbance. The WHO guidelines suggest internal noise levels not exceeding 30 dB  $L_{Aeq}$  or regularly exceeding 45 dB  $L_{Amax,f}$  for 'a good sleep'.

### External Noise Levels

- 3.10 The World Health Organisation provides guidance on the relationship between annoyance and noise levels in external amenity areas (gardens, terraces, balconies etc.). The guidance defines noise levels of 55 dB  $L_{Aeq, 16 \text{ hour}}$  as the onset of significant community annoyance for these areas during daytime hours (07:00 and 23:00 hours). It should be noted that these values are aspirational and BS 8233:2014 refers to these levels as 'not achievable in all circumstances where development might be desirable'. In such situations development should be designed to achieve the lowest levels practicable in external amenity spaces but development should not be prohibited.

### Vibration

- 3.11 The assessment of human response to vibration within buildings is guided by British Standard (BS) 6472 [Reference 7].

- 3.12 Where the vibration occurs as a series of events (as in the case of trains movements), BS 6472 indicates that Vibration Dose Values (VDVs) should be used. Human response to vibration in buildings is assessed in terms of VDVs defined over daytime and night-time periods. The standard defines values of VDV which are likely to cause varying degrees of adverse comment and these are summarised in Table 3.

| Place and Time                                         | Assessment Semantic and Vibration Dose Value $\text{m/s}^{1.75}$ |                          |                          |
|--------------------------------------------------------|------------------------------------------------------------------|--------------------------|--------------------------|
|                                                        | Low Probability Of Adverse Comment                               | Adverse Comment Possible | Adverse Comment Probable |
| Residential buildings<br>16hr day<br>(07:00 to 23:00)  | 0.2 to 0.4                                                       | 0.4 to 0.8               | 0.8 to 1.6               |
| Residential buildings<br>8hr night<br>(23:00 to 07:00) | 0.1 to 0.2                                                       | 0.2 to 0.4               | 0.4 to 0.8               |

**Table 3:** Vibration Dose Values ( $\text{ms}^{-1.75}$ ) above which various degrees of adverse comment may be expected in residential buildings

- 3.13 It is considered, within the spirit of the standard, that vibration levels falling within the 'low probability of adverse comment' range of BS 6472 would be acceptable both during the day and at night.

#### Summary of Proposed Criteria

- 3.14 Based upon the review of standards described above, noise and vibration has been assessed in accordance with the following approach:
- BS 8233 for recommended internal noise levels inside the properties. It is considered that an upper internal daytime level of 35 dB  $L_{Aeq,16hr}$  for lounges or living rooms and a night-time level for bedrooms of 30 dB  $L_{Aeq,8hr}$  should apply. Similarly, a maximum night-time internal level of 45 dB  $L_{Amax,f}$  should apply in bedrooms for regular events;
  - Noise levels in external amenity areas to be as low as practically possible given the constraints of the scheme.
  - BS 6472 for assessment of vibration within proposed dwellings. It is considered vibration should not exceed the 'low probability of adverse comment' range.

## 4.0 NOISE AND VIBRATION MEASUREMENTS

### Methodology

- 4.1 Environmental noise and vibration measurements have been undertaken at the undeveloped site in order to establish existing ambient noise levels across the site. Noise measurements were undertaken between 3rd and 15th August 2017, and vibration measurements on the 15th August 2017. The measurement locations were on the southern boundary for the noise monitoring, and approximately 60 m from the southern boundary at the location of the nearest proposed property for the vibration measurements, as shown in Figure 1.
- 4.2 Noise and vibration measurements were undertaken using the following equipment:
- |                                                   |            |
|---------------------------------------------------|------------|
| Rion class 1 sound level meter                    | Type NL52; |
| Svantek precision sound and vibration level meter | Type 958;  |
| Brüel and Kjær acoustic calibrator                | Type 4231. |
- 4.3 All noise measurements were undertaken at approximately 2.5 m above local grade level in free field conditions and with direct line of sight to the railway. Environmental windshields were fitted to the microphones and instrumentation was configured to measure and store overall A-weighted statistical parameters such as  $L_{Aeq}$ ,  $L_{Amax}$  and  $L_{A90}$  (all measured on fast response) in 5 minute intervals. Measurements were made in accordance with BS 7445: 1991 "Description and measurement of environmental noise Part 2 - Acquisition of data pertinent to land use" [Reference 8].
- 4.4 Vibration measurements were undertaken in each of the three orthogonal axes of motion to measure the frequency weighted Vibration Dose Value (using the  $W_d$  frequency weighting in the horizontal axes and the  $W_b$  weighting in the vertical axis in accordance with the requirements of BS 6472) of passing trains. The accelerometer was levelled and mounted directly in the ground via mounting plate. The accelerometer was well coupled with the ground in free field conditions. The orientation of the accelerometer was as follows: X-axis horizontal, perpendicular to the railway; Y-axis horizontal, parallel to the railway; Z-axis vertical.
- 4.5 The calibration of the instrumentation was checked before and after the tests and no signal variation occurred. Calibration of 24 Acoustics' equipment is traceable to National Standards.

- 4.6 Weather conditions during the survey period were mostly fine and dry with wind speeds typically lower than 5 m/s.

### Results

- 4.7 The noise survey results are shown graphically in Appendix B and are summarised below.

| Date               | Sound Pressure Level, dB(A) |               |                      |
|--------------------|-----------------------------|---------------|----------------------|
|                    | Daytime<br>$L_{Aeq,16hr}$   | Night-time    |                      |
|                    |                             | $L_{Aeq,8hr}$ | Typical $L_{Amax,f}$ |
| Thursday 3/8/2017  | 62                          | 55            | 74                   |
| Friday 4/8/2017    | 61                          | 53            | 75                   |
| Saturday 5/8/2017  | 59                          | 53            | 70                   |
| Sunday 6/8/2017    | 59                          | 54            | 73                   |
| Monday 7/8/2017    | 60                          | 53            | 74                   |
| Tuesday 8/8/2017   | 59                          | 53            | 74                   |
| Wednesday 9/8/2017 | 58                          | 54            | 74                   |
| Thursday 10/8/2017 | 58                          | 54            | 74                   |
| Friday 11/8/2017   | 62                          | 54            | 73                   |
| Saturday 12/8/2017 | 59                          | 51            | 67                   |
| Sunday 13/8/2017   | 58                          | 56            | 74                   |
| Monday 14/8/2017   | 60                          | 53            | 73                   |
| Tuesday 15/8/2017  | 58                          | -             | -                    |
| <b>Maximum</b>     | <b>62</b>                   | <b>56</b>     | <b>75</b>            |

**Table 4:** Summary of Noise Survey Results at Southern Site Boundary

- 4.8 The vibration measurement results are shown graphically in Appendix C. Calculations have been undertaken using vibration measurements to determine the 16 hour daytime and 8 hour night time estimated vibration dose values (eVDV) in accordance with the requirements of BS 6472.
- 4.9 VDV measurements of individual trains passing were made. The maximum measurement in each axis was used to calculate the eVDV based on an overestimate of 300 trains passing during the daytime, and 50 trains passing during the night-time. These overestimates of the number of trains have been made after consulting the train timetables. The results from the vibration calculations are summarised in Table 5.

| Estimated Vibration Dose Value, $m/s^{1.75}$ |        |        |                               |        |        |
|----------------------------------------------|--------|--------|-------------------------------|--------|--------|
| Daytime<br>(07:00 – 23:00)                   |        |        | Night-time<br>(23:00 – 07:00) |        |        |
| X axis                                       | Y axis | Z axis | X axis                        | Y axis | Z axis |
| 0.004                                        | 0.002  | 0.007  | 0.002                         | 0.001  | 0.005  |

**Table 5:** Summary of Vibration Calculation Results

- 4.10 Vibration was not perceptible at any location on the site and the survey results indicate that the vibration level recorded is insignificant/ below the level considered necessary to cause adverse comment.

#### Noise Propagation Model

- 4.11 Noise measurements have been used to calibrate an acoustic model of the site, using IMMI v2017 noise-mapping software, to determine the noise levels at the proposed site from the railway. This has used the propagation methodology of ISO 9613 [Reference 9] taking into account the effects of geometric divergence, atmospheric and ground absorption and acoustic screening. The following parameters were used in the model:
- Ambient temperature: 10 degrees centigrade;
  - Relative humidity: 70%;
  - Ground effects:  $G=0$  ('hard' ground);
  - Light downwind propagation conditions. 54
- 4.12 The acoustic model has considered the proposed site layout including topography of the site for receptor heights at both ground floor and first floor level (1.5 m and 4 m receptor heights) and takes into account the recessed nature of the railway in its cutting. The acoustic model results are shown as noise contours in Figures 3 and 4.

## 5.0 ASSESSMENT

- 5.1 This assessment has considered noise levels in proposed habitable rooms across the proposed development site as well as external noise levels in amenity spaces. As discussed above vibration on the site is insignificant and has not been considered further.

### External Noise Levels

- 5.2 Noise measurement and propagation model results (as shown in Figure 3) show that, based on proposed layout plans, external noise levels in private gardens will be no greater than 55 dB  $L_{Aeq, 16 \text{ hour}}$ .
- 5.3 On this basis it is considered that providing the relevant development needs can be met, the proposals, as presented, are acceptable on noise grounds.

### Internal Noise Levels

- 5.4 Calculations to determine internal noise levels have been undertaken for proposed properties at the site. Calculations have been undertaken in outline based on typical room volumes and elevations. These calculations should therefore be updated following confirmation and issue of final building layout plans and elevations.
- 5.5 The analysis given below has been based on 24 Acoustics' understanding of the envelope construction to be used for this scheme (based on a cavity masonry construction).
- 5.6 Calculations have been undertaken using measurement and acoustic model results as described in Section 4 to determine the glazing and ventilation requirements for the proposed residential scheme which will ensure that the noise levels inside the properties does not exceed 35 dB  $L_{Aeq, 16 \text{ hour}}$  during the day and 30 dB  $L_{Aeq, 8 \text{ hour}}$  at night (and also not regularly exceed 45 dB  $L_{Amax,f}$  at night).
- 5.7 The requirements are summarised in Table 6 below.

| Plots                  | Rooms                | Ventilator Type          |
|------------------------|----------------------|--------------------------|
| 2-15, 18-30, 47        | Lounges and bedrooms | Minimum 30 dB $D_{n,eW}$ |
| 1, 16-17, 31-46, 48-50 | Lounges              |                          |
| 1, 16-17, 31-46, 48-50 | Bedrooms             | Minimum 39 dB $D_{n,eW}$ |

**Table 6:** Ventilator Requirements

- 5.8 The ventilator should be specified to provide background ventilation in accordance with Part F of the building regulations at all times when windows are closed. Bargate Homes may be interested in systems such as the Titon Maxiglaze ventilator (<http://www.titon.co.uk/pages/window-door-hardware/ventilators/glazed-in-vents/maxiglaze.php>) which is capable of 30 dB  $D_{n,eW}$ , and Simon Acoustics EHAS (<http://www.rwsimon.co.uk/wp-content/uploads/2015/02/Simon-acoustic-NEW-STYLE-red.pdf>) which is capable of 39 dB  $D_{n,eW}$ . Alternatively, any background vent capable of comply with the specification in Table 6 will suffice and may be procured from the likes of Titon, Ryton and Passivent.

- 5.9 The acoustic specification for the glazing systems are shown below in Table 7.

| Octave Band Centre Frequency, Hz and Sound Reduction Index, dB |     |     |     |      |      |      |      |
|----------------------------------------------------------------|-----|-----|-----|------|------|------|------|
| 63                                                             | 125 | 250 | 500 | 1000 | 2000 | 4000 | 8000 |
| 20                                                             | 24  | 20  | 25  | 35   | 38   | 35   | 35   |

**Table 7:** Acoustic Specification for Glazing Systems

- 5.10 The glazing specifications (which apply to the window set as a whole, including the glass, frames and seals) should comply with the minimum specification shown in Table 7 in each octave band. In practice the following glazing type may be compliant with the above specification: 4 mm glass, 16 mm airgap, 4 mm glass (standard thermal double glazing).

## **6.0 CONCLUSIONS**

- 6.1 24 Acoustics Ltd has been instructed by Bargate Homes Ltd to undertake an updated noise and vibration assessment relating to a proposed development site at Lower Road in Bedhampton. A new planning application to develop the site for residential use is proposed.
- 6.2 Environmental noise and vibration measurements have been undertaken at the site to establish the prevailing ambient noise/ vibration levels at the site.
- 6.3 The assessment has indicated that vibration on the area of the site proposed for development is insignificant.
- 6.4 External noise levels in private gardens within the developed site are predicted to be at or below 55 dB  $L_{Aeq, 16 \text{ hour}}$ .
- 6.5 Glazing and ventilation specifications have been determined in outline to achieve a satisfactory internal environment in all habitable rooms.
- 6.6 On the above basis, it is considered that an appropriate acoustic environment can be provided to the proposed residential properties, both externally and internally relative to the prevailing acoustic environment.

## REFERENCES

1. Department for Communities and Local Government. National Planning Policy Framework, 2019.
2. DEFRA. Noise Policy Statement for England, 2010.
3. Department of Communities and Local Government. Planning Practice Guidance, March 2014.
4. British Standards Institution. British Standard 8233: Guidance on sound insulation and noise reduction for buildings, 2014.
5. World Health Organisation. Guidelines for Community Noise, 2000.
6. British Standards Institution. British Standard 6472: Guide to Evaluation of Human Exposure to Vibration in Buildings, Part 1: Vibration Sources Other than Blasting: 2008.
7. British Standards Institution. British Standard 7445: 1991 Description and measurement of environmental noise Part 2 - Acquisition of data pertinent to land use.
8. International Standards Organisation. ISO 9613, Acoustics - Attenuation of Sound During Propagation Outdoors, 1993.
9. Building Regulations. Approved Document F - Ventilation, 2010.



Vibration  
measurement

Noise  
measurement

|                                                       |                                                                              |                       |                                                                                                      |
|-------------------------------------------------------|------------------------------------------------------------------------------|-----------------------|------------------------------------------------------------------------------------------------------|
| <b>Project:</b><br>Land off Lower Road,<br>Bedhampton | <b>Title:</b><br>Site Location Plan/ Noise and Vibration Survey<br>Locations |                       | <br>24Acoustics |
| <b>DWG No:</b> Figure 1                               | <b>Scale:</b> N.T.S.                                                         | <b>Rev:</b> -         |                                                                                                      |
| <b>Date:</b> October 2020                             | <b>Drawn By:</b> RP                                                          | <b>Job No:</b> 6954-2 |                                                                                                      |





**Project:**  
Land off Lower Road,  
Bedhampton

**DWG No:** Figure 3

**Date:** October 2020

**Title:**  
Daytime Noise Contours, dB LAeq, 16 hour

**Scale:** N.T.S.

**Drawn By:** RP

**Rev:** -

**Job No:** 6954-2



**Project:**  
Land off Lower Road,  
Bedhampton

**DWG No:** Figure 4

**Date:** October 2020

**Title:**  
Night time noise contours, dB  $L_{Aeq}$ , 8 hour

**Scale:** N.T.S.

**Drawn By:** RP

**Rev:** -

**Job No:** 6954-2

## APPENDIX A: NOISE UNITS

### Noise

Noise is defined as unwanted sound. The range of audible sound is from 0 to 140 dB. The frequency response of the ear is usually taken to be around 18 Hz (number of oscillations per second) to 18000 Hz. The ear does not respond equally to different frequencies at the same level. It is more sensitive in the mid-frequency range than the lower and higher frequencies and because of this, the low and high frequency components of a sound are reduced in importance by applying a weighting (filtering) circuit to the noise measuring instrument. The weighting which is most widely used and which correlates best with subjective response to noise is the dB(A) weighting. This is an internationally accepted standard for noise measurements.

For variable sources, such as traffic, a difference of 3 dB(A) is just distinguishable. In addition, a doubling of traffic flow will increase the overall noise by 3 dB(A). The 'loudness' of a noise is a purely subjective parameter, but it is generally accepted that an increase/ decrease of 10 dB(A) corresponds to a doubling/ halving in perceived loudness.

External noise levels are rarely steady, but rise and fall according to activities within an area. In attempt to produce a figure that relates this variable noise level to subjective response, a number of noise indices have been developed. These include:

- i) The  $L_{Amax}$  noise level

This is the maximum noise level recorded over the measurement period.

- ii) The  $L_{Aeq}$  noise level

This is "equivalent continuous A-weighted sound pressure level, in decibels" and is defined in British Standard BS 7445 as the "value of the A-weighted sound pressure level of a continuous, steady sound that, within a specified time interval, T, has the same mean square sound pressure as a sound under consideration whose level varies with time".

It is a unit commonly used to describe construction noise and noise from industrial premises and is the most suitable unit for the description of other forms of environmental noise. In more straightforward terms, it is a measure of energy within the varying noise.

## Vibration

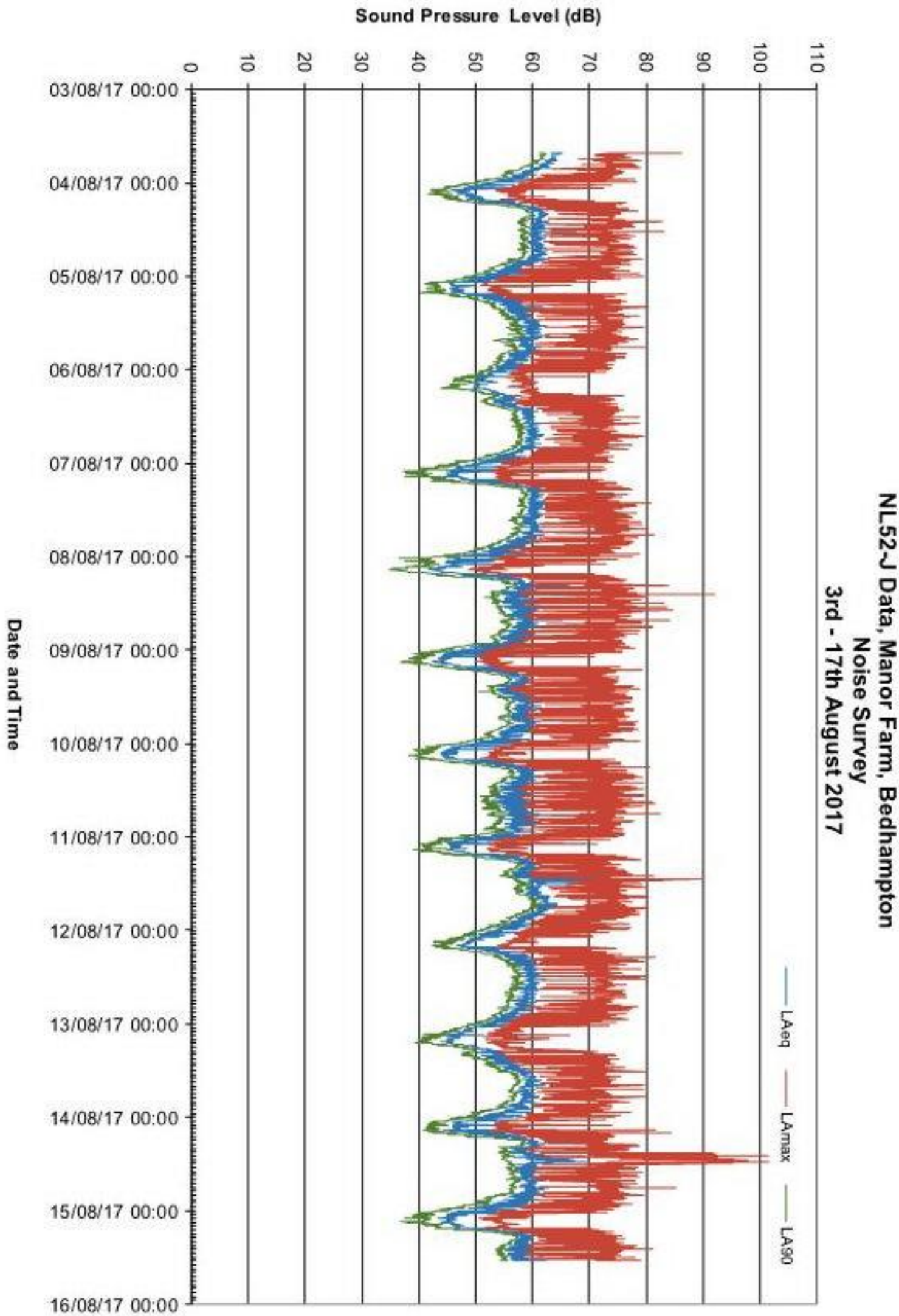
Vibration can be described as a mechanical isolation of a medium about an equilibrium point. Vibration may be periodic, such as the motion of a pendulum or random such as the response of ground to a force input on a construction or demolition site.

Vibration may be measured in terms of acceleration, velocity or displacement (most commonly acceleration or velocity) using either an accelerometer or a velocity transducer and suitable signal conditioning system.

The measured data may be analysed to identify frequency content and considered in terms of a number of different parameters, including the root mean square (rms), maximum or peak.

In the UK British Standard 6472 Parts 1 and 2 provides methodology for measuring and assessing human exposure to vibration in buildings. The standard states that vibration should be measured in the three orthogonal axes of motion, two lateral and one vertical (with respective frequency weighting curves  $w_d$  and  $w_b$ ), in terms of the vibration dose value (VDV) for overall daytime and night-time periods. Guidance is given on the relationship between daytime and night-time VDV exposures levels and the impacts on occupants.

APPENDIX B: AMBIENT NOISE MEASUREMENT RESULTS



**APPENDIX C: VIBRATION MEASUREMENT RESULTS**

| Time     | Measurement length (s) | X-axis | Y-axis | Z-axis |
|----------|------------------------|--------|--------|--------|
| 11:11:45 | 12                     | 0.0005 | 0.0003 | 0.0010 |
| 11:26:41 | 13                     | 0.0004 | 0.0004 | 0.0015 |
| 11:31:31 | 14                     | 0.0004 | 0.0005 | 0.0014 |
| 11:35:27 | 23                     | 0.0004 | 0.0004 | 0.0016 |
| 11:44:04 | 11                     | 0.0003 | 0.0003 | 0.0010 |
| 11:46:01 | 14                     | 0.0003 | 0.0004 | 0.0010 |
| 11:47:46 | 20                     | 0.0002 | 0.0003 | 0.0008 |
| 11:52:10 | 6                      | 0.0001 | 0.0002 | 0.0004 |
| 11:56:26 | 17                     | 0.0003 | 0.0004 | 0.0011 |
| 12:06:38 | 19                     | 0.0004 | 0.0004 | 0.0017 |
| 12:09:00 | 9                      | 0.0003 | 0.0003 | 0.0011 |
| 12:09:20 | 14                     | 0.0003 | 0.0004 | 0.0011 |
| 12:13:00 | 36                     | 0.0003 | 0.0003 | 0.0012 |
| 12:16:24 | 7                      | 0.0001 | 0.0002 | 0.0003 |
| 12:27:12 | 16                     | 0.0009 | 0.0005 | 0.0016 |
| 12:40:19 | 39                     | 0.0003 | 0.0004 | 0.0013 |
| 12:40:38 | 17                     | 0.0002 | 0.0003 | 0.0009 |
| 12:43:17 | 14                     | 0.0003 | 0.0003 | 0.0009 |
| 12:45:19 | 21                     | 0.0002 | 0.0003 | 0.0004 |
| 12:51:15 | 12                     | 0.0003 | 0.0003 | 0.0013 |
| 12:56:40 | 18                     | 0.0004 | 0.0004 | 0.0018 |

**Table 8:** Vibration Dose Values (ms-1.75) for measured events (i.e. trains passing) at the location shown in Figure 1