

Report VA6321.260413.NIA

Windsor Road, Trowbridge

Noise Impact Assessment

17 April 2026

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Report Version	Author	Approved	Changes	Date
NIA1	Steven Liddell	Ben Alexander	-	17/04/2026

The interpretations and conclusions summarised in this report represent Venta Acoustics' best technical interpretation of the data available to us at the time of assessment. Any information provided by third parties and referred to in this report has not been checked or verified by Venta Acoustics, unless otherwise expressly stated in the document. Venta Acoustics cannot accept any liability for the correctness or validity of the information provided. Due to a degree of uncertainty inherent in the prediction of all parameters, we cannot, and do not guarantee the accuracy or correctness of any interpretation and we shall not, except in the case of gross or wilful negligence on our part, be liable for any loss, cost, damages or expenses incurred or sustained by anyone resulting from any interpretations, predictions or conclusions made by the company or employees. The findings and conclusions are relevant to the period of the site survey works, and should not be relied upon to represent site conditions at later dates. Where additional information becomes available which may affect the findings of our assessment, the author reserves the right to review the information, reassess the findings and modify the conclusions accordingly.

1. Introduction

It is proposed to develop a new care home on land at Windsor Road, Trowbridge. Venta Acoustics has been commissioned by LNT Care Developments to undertake a noise impact assessment in support of a planning application for the proposed development.

An environmental noise survey has been undertaken to establish the prevailing noise climate at the site. The measured data has been used to assess the suitability of the site for the proposed use, the likely internal noise conditions within the development, and the potential impact of the proposed standard LNT plant items at the nearest residential receptors, with reference to relevant standards and guidance.

Outline mitigation measures are identified and the likely sound insulation performance required of the building envelope is set out.

2. Guidance and Legislation

2.1 The National Planning Policy Framework (2024)

The revised *National Planning Policy Framework* (NPPF), published in December 2024, sets out the Government's planning policies for England, superseding all previous planning policy statements and guidance.

In respect of noise, the NPPF states that the planning system should contribute to and enhance the natural and local environment by preventing both new and existing developments from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of noise pollution.

Hence, Paragraph 198 states that *planning policies and decisions should also ensure 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 impacts 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*

In regards to the term adverse impact, reference is made to the Noise Policy for England:

2.2 Noise Policy Statement for England (2010)

The Noise Policy Statement for England (NPSE) sets out the long term vision of Government noise policy: 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.

This vision is supported by the following aims:

- *avoid significant adverse impacts on health and quality of life;*
- *mitigate and minimise adverse impacts on health and quality of life; and*
- *where possible, contribute to the improvement of health and quality of life.*

The terms “significant adverse” and “adverse” are related to the following concepts:

No Observed Effect Level (NOEL) - *the level below which no effect on health and quality of life can be detected.*

Lowest Observed Adverse Effect Level (LOAEL) - *the level above which adverse effects on health and quality of life can be detected.*

Significant Observed Adverse Effect Level (SOAEL) - *the level above which significant adverse effects on health and quality of life occur.*

The guidance acknowledges that 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, but will be different for different noise sources, receptors and times.

In order to enable assessment of impacts in line with these requirements, reference should be made to other currently available guidance.

2.3 WHO Guidelines for Community Noise (1999)

The guidance in this document details suitable noise levels for various activities within residential and commercial buildings.

The relevant sections of this document are shown in Table 2.1.

Criterion	Environment	Design range $L_{Aeq,T}$ dB
Maintain speech intelligibility and avoid moderate annoyance, daytime and evening	Living Room	35 dB
Prevent sleep disturbance, night time	Bedrooms	30 dB

Table 2.1 – Excerpt from WHO

[dB ref. 20µPa]

This guidance also states:

For a good sleep, it is believed that indoor sound pressure levels should not exceed approximately 45dB L_{Amax} more than 10-15 times a night (Vallet & Vernet 1991).

For outdoor living areas, it is stated that:

To protect the majority of people from being seriously annoyed during the daytime, the outdoor sound level from steady, continuous noise should not exceed 55dB L_{Aeq} on balconies, terraces and in outdoor living areas. To protect the majority of people from being moderately annoyed during the daytime, the outdoor sound level should not exceed 50dB L_{Aeq} . Where it is practical and feasible, the lower outdoor sound level should be considered the maximum desirable sound level for new development.

For sleep disturbance, i.e. in bedrooms at night, the NOEL can, therefore, be taken as anything below 30dB(A), whilst the onset of the LOAEL occurs at 30dB(A) and above. The SOAEL cannot be inferred from this information.

During daytime periods, for avoidance of annoyance, the NOEL relates to anything up to 50dB(A) (typically applied to external areas, such as gardens), whilst the onset of the LOAEL occurs at 50dB(A) and above.

2.4 BS8233:2014

BS8233 *Guidance on sound insulation and noise reduction for buildings* provides guidance as to desirable internal ambient noise levels for different areas within residential buildings.

The relevant section of the standard is shown below in Table 2.2.

Activity	Location	07:00 to 23:00	23:00 to 07:00
Resting	Living Room	35 dB $L_{Aeq, 16 \text{ hour}}$	-
Dining	Dining Room	40 dB $L_{Aeq, 16 \text{ hour}}$	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq, 16 \text{ hour}}$	30 dB $L_{Aeq, 8 \text{ hour}}$

Table 2.2 – Excerpt from BS8233:2014 - Indoor ambient noise levels for dwellings

[dB ref. 20μPa]

For external areas the standard states the following:

For traditional external areas that are used for amenity space, such as gardens and patios, it is desirable that the external noise level does not exceed 50 dB $L_{Aeq,T}$, with an upper guideline value of 55 dB $L_{Aeq,T}$ which would be acceptable in noisier environments.

However, it is also recognized that these guideline values are not achievable in all circumstances where development might be desirable. In higher noise areas, such as city centres or urban areas adjoining the strategic transport network, a compromise between elevated noise levels and other factors, such as the convenience of living in these locations or making efficient use of land resources to ensure development needs can be met, might be warranted. In such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces, but should not be prohibited.

2.5 BS4142:2014+A1:2019

British Standard BS4142:2014+A1:2019 *Methods for rating and assessing industrial and commercial sound* describes a method for rating and assessing sound of an industrial and/or commercial nature, which includes sound from fixed installations comprising mechanical and/or electrical plant and equipment;

The assessment methodology considers the Specific Sound Level, as measured or calculated at a potential noise sensitive receptor, due to the source under investigation. A correction factor is added to this level to account for the acoustic character of the sound as follows:

Tonality – A correction of up to 6dB depending on the prominence of tones;

Impulsivity - A correction of up to 9dB depending on the prominence of impulsivity;

Other sound characteristics - A 3dB correction may be applied where a distinctive acoustic character is present that is neither tonal nor impulsive;

Intermittency - A 3dB correction may be applied where the specific sound has identifiable on/off conditions.

An estimate of the impact of the source is obtained by subtracting the typical background noise level from the corrected Specific Sound Level.

- Typically, the greater this difference, the greater the magnitude of the impact.
- A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.
- A difference of around +5 dB could be an indication of an adverse impact, depending on the context.
- The lower the rating level is relative to the measured background sound level, the less likely it is that there will be an adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound having a low impact, depending on the context.

3. Site Description

As shown on the attached site plan VA6321/SP1, the application site comprises a disused carpark situated to the south of Bradley Road, Trowbridge.

The proposed development comprises a new L-shaped care home with associated car parking and vehicular access taken from the southeast. The building is set back approximately 38 metres from Bradley Road. A natural bund is present between Bradley Road and the site, which is expected to provide a degree of acoustic screening from road traffic noise.

The surrounding area is mixed in character. Immediately to the east of the site are the Pavilion Court office buildings, while open agricultural land lies to the west. To the north is Bradley Road, beyond which is the White Horse Business Park. A new residential development is currently under construction to the northwest of the site, on the opposite side of Bradley Road, which is understood to represent the nearest noise-sensitive receptor in relation to the plant noise assessment.

The dominant noise source affecting the site is expected to be road traffic on Bradley Road. During the night-time period, background sound levels may also be influenced by existing commercial plant operating within the wider area.

4. Environmental Noise Survey

4.1 Survey Procedure & Equipment

In order to establish the existing noise levels at the site, a survey was carried out between Monday 23rd and Thursday 26th March 2026 at the location shown in site plan VA6321/SP1. The monitoring position was located within the site at a height of approximately 4 m above ground level and around 27 m from the nearside edge of Bradley Road. This location was chosen to be representative of the noise level affecting the proposed development and of the surrounding receptor environment.

Continuous 5-minute samples of the L_{Aeq} , L_{Amax} , L_{A10} and L_{A90} sound pressure levels were undertaken at the measurement location, together with one-third octave band spectral data.

The weather during the survey period had periods of elevated wind which were excluded from analysis. The periods for which data was used were considered suitable for environmental noise assessment.

Measurements were made generally in accordance with ISO 1996-2:2017 *Acoustics - Description, measurement and assessment of environmental noise - Part 2: Determination of sound pressure levels*.

The following equipment was used in the course of the survey:

Manufacturer	Model Type	Serial No	Calibration	
			Certificate No.	Date
Svantek Class 1 SLM	971A	143563	00002984-1	19/9/24
Larson Davis calibrator	CAL200	13049	1512828-2	16/7/25

Table 4.1 – Equipment used for the survey

The calibration of the sound level meter was verified before and after use with no significant calibration drift observed.

4.2 Results

The measured sound levels are shown as time-history plots on the attached charts VA6321/TH1-3. The site is primarily affected by road traffic noise from Bradley Road. Review of the time history and spectral data indicates that the night-time background sound level may also include a contribution from existing commercial plant operating within the wider area. Some elevated energy is evident in the 250 Hz to 315 Hz bands, although the precise source has not been confirmed.

The average ambient and representative background sound levels measured during the survey period are summarised below:

Monitoring Period	L _{Aeq, T}	Typical ¹ L _{A90,5min}
07:00 – 23:00	66 dB	49 dB
23:00 – 07:00	59 dB	43 dB
Kitchen Operational Period (08:30-17:30)	66 dB	56 dB

Table 4.2 – Average ambient and typical background noise levels

¹ The typical L_{A90} value is taken as the 10th percentile of all L_{A90} values measured during the relevant period.

The typical night-time maximum noise events generated by vehicle pass-bys on Bradley Road were in the order of L_{Amax} 74 dB.

5. Noise Impact on Proposed Development

5.1 Noise Propagation Model

To determine sound propagation across the proposed development, a 3D computer noise model was built using CadnaA software. The model incorporates the proposed site layout, the site topography (sloping upwards to the north), and the surrounding built environment.

The noise emission levels from the local road network were calibrated against the measured data from the environmental noise survey. Noise propagation was calculated in accordance with ISO 9613-2:1996 *Acoustics - Attenuation of sound during propagation outdoors*.

Account has also been taken of the natural bund between Bradley Road and the site, together with the building orientation. On this basis, the north facade is expected to be the principal noise-exposed facade, while the east, south and west facades are more sheltered.

The predicted noise levels at the proposed building façades are illustrated in the attached noise maps and summarized below.

The predicted noise levels at the proposed building façades are summarised below.

Façade Orientation	Dominant Source	Daytime L _{Aeq,16hr}	Night-time L _{Aeq,8hr}	Night-time L _{Amax}
North	Road Traffic	66 dB	58 dB	73 dB
West	Road Traffic	58 – 62 dB	50 – 54 dB	<69 dB
South and East (sheltered)	Road Traffic	50 – 53 dB	42 – 45 dB	<60 dB

Table 5.1 Predicted Façade Sound Levels

5.2 Internal Noise Assessment

The adopted façade levels have been assessed with reference to BS8233:2014 in order to determine the likely internal noise climate within the proposed care home. Bedrooms are the critical receptor in this assessment, particularly during the night-time period.

The assessment indicates that the north façade is subject to the highest noise levels. The east, south and west façades are materially more sheltered and are subject to lower incident noise levels.

On the basis of the adopted façade levels, acceptable internal noise conditions are expected to be achievable throughout the development, subject to an appropriate glazing and ventilation strategy.

5.3 Building Envelope Mitigation Strategy

A review of the scheme has been undertaken to specify the sound insulation performance required to achieve the internal noise criteria of BS8233:2014 and WHO 1999.

5.3.1 Sound Reduction Performances of Building Elements

It has been assumed that all the non-glazed elements, i.e. walls and roof systems, will be capable of providing the following minimum sound insulation performance, when tested in accordance with BS EN ISO 10140-2:2021 *Acoustics - Laboratory measurement of sound insulation of building elements – Part 2: Measurement of airborne sound insulation*.

Building Element	Single figure weighted sound reduction index, dB
Roof	R_w 45
Masonry	R_w 51

Table 5.2 – Assumed sound reductions performances of non-glazed elements

5.4 Glazing and Ventilation Specification

The monitoring data along with the architectural drawings have been used to calculate the required sound insulation performance for the windowsets (glazing and frame combination) and open ventilators for the building. These are summarised in 0 below.

Zone	Location	Required Glazing $R_w(+C_{tr})$	Ventilator $D_{n,e,w}(+C_{tr})$
Option A	North façades	35 (-4) dB	39 (-2) dB
Option B	East, South and West façades	27 (0) dB	31 (-2) dB

Table 5.3 – Required minimum sound reduction indices for glazing and ventilators

The standard LNT enhanced façade specification is understood to comprise a 4 mm / 17 mm / 6 mm insulating glazing unit with a sound reduction performance of approximately $R_w(+C_{tr})$ 35(-5) dB, together with up to two Greenwood 5000EAW.AC1 ventilators per room providing a performance of $D_{n,e,w}(+C_{tr})$ 39(-2) dB. On this basis, the performance requirements for the north façade would be achieved. Standard glazing and trickle ventilators are expected to be sufficient for the east, south and west façades.

With this glazing and ventilator spec achieved, internal noise levels are expected to be as follows:

	Predicted Sound Level	Target Sound Level	Target Met?
North bedrooms	Daytime L_{Aeq} 34 dB	$\leq L_{Aeq}$ 35	Pass
	Night time L_{Aeq} 26 dB	$\leq L_{Aeq}$ 30	Pass
	Night time L_{Amax} 41 dB	$\leq L_{Amax}$ 45	Pass
Other bedrooms	Daytime L_{Aeq} 33 dB	$\leq L_{Aeq}$ 35	Pass
	Night time L_{Aeq} 25 dB	$\leq L_{Aeq}$ 30	Pass
	Night time L_{Amax} 42 dB	$\leq L_{Amax}$ 45	Pass

Table 5.4 – predicted internal noise levels against the relevant criteria

5.5 Ventilation

In addition to BS8233, reference can be made to the Approved Document O Draft Noise Guide in considering the acoustic implications of the overheating strategy. For moderate risk locations, the simplified method is generally considered suitable where external noise levels do not exceed 50 dB $L_{Aeq,8hr}$ at night and where 65 dB L_{Amax} is not exceeded more than 10 times during the night.

Due to the elevated noise levels at the north façade, the BS8233 internal noise criteria are not expected to be achieved with windows open. Accordingly, opening of windows on this façade should not form part of the background ventilation or overheating strategy, and acoustically attenuated ventilation or an equivalent mechanical means of ventilation will be required.

The west façade is less exposed than the north façade and is expected to achieve the BS8233 internal criteria with the glazing and ventilation package identified above. However, external noise levels at this façade remain above those typically associated with the simplified Approved Document O guidance for moderate risk locations, and it should not therefore be assumed that open windows can form part of the overheating strategy without further consideration.

The south and east façades are more sheltered and are expected to achieve the internal criteria with the standard glazing and trickle ventilator combination. These façades are also more consistent with the simplified external noise guidance for Approved Document O.

Where acoustically attenuated background ventilators are used, the performance shown in O will be required. The figures allow for 2 vents per room. If additional vents are required, then the performance requirement shown in O should be increased by $10\log(N/2)$, with N being the total number of vents serving the room.

5.6 Areas of External Amenity

External amenity areas within the site are generally below 55 dB L_{Aeq} and are therefore considered to achieve the upper guideline values of BS8233. More sheltered areas within the site approach the desirable 50 dB level.

5.7 Other Noise Sources

In addition to road traffic noise, the survey data indicates a modest contribution to the night-time background sound level from existing commercial plant within the wider area. This contribution, at around 43dBA is materially lower than the prevailing road traffic noise levels affecting the more exposed façades and does not govern the façade design requirements for the development. The enhanced glazing and attenuated ventilation required to control road traffic noise at the north façade would also provide more than sufficient control of this lower-level commercial sound, such that it would not be expected to give rise to adverse internal effects.

Reasonable internal conditions would be expected even with partially open windows. A low impact is therefore expected.

6. Plant Noise Assessment

The potential noise impact from the proposed equipment associated with the care home on the nearest residential properties has been assessed in accordance with BS 4142:2014+A1:2019.

The nearest residential receptors are the new dwellings under construction to the northwest of the site, at a distance of approximately 150 metres from the proposed plant locations.

6.1 Proposed plant

The plant assessment has been based on standard LNT plant arrangements typically adopted for care home developments. The source noise data used in the assessment is derived from precedent measurements of comparable systems. Any final plant selections should be acoustically no worse than those assumed in this assessment.

Plant Item	Quantity	Proposed Model	Notes
Kitchen Extract Fan	1	Systemair K450 (CA1-450S4-1A)	Fan and motor located within the kitchen, with the discharge ducted via a louvre on the southern façade of the building. Standard LNT source level of 55dB @ 3m (normal speed).
PV Battery Storage	1	Xpelair GX12	Standard LNT source level of up to 60dB @ 1m

Table 6.1 – Advised plant selections used for this assessment.

6.2 Predicted Noise Levels

6.2.1 Kitchen Extract Fan

The proposed plant for this scheme includes a single kitchen extract fan. On the basis of typical LNT care home operation, the kitchen is expected to operate between 08:30 and 17:30 hours. During this period, the representative background sound level at the site was L_{A90} 56 dB.

Measurements of the noise emissions from this system specification have been undertaken outside the discharge louvre at other sites operated by the same developer.

Measurement	Result
Full Speed @ 3m	<68 dB
Normal operating Speed @ 3m	55 dB

Table 6.2 – Measured specific sound Levels due to extract

It is understood that the fan would typically operate at between 50% and 75% speeds for most periods (noise levels generated within the kitchen at full speed would interfere with communication between staff).

The most affected receivers are expected to be the new residential dwellings to the northwest, at a distance of approximately 150 metres from the proposed discharge location of the kitchen extract.

The frequency spectrum and subjective observations of sound from the fan during previous measurements do not highlight any tonal elements, and the equipment is not considered intermittent or impulsive during operation. However, the sound is identifiable as a fan and therefore the “other characteristics” penalty of 3dB stated in BS4142 will be applied.

Results	Dwellings to North-West	Relevant Clause	Commentary
Extract Fan	L _{Aeq} 55 dB @ 3m		Normal operating speed
Distance loss	-34 dB (150m)		
Screening	-10 dB		Screening by the building itself
Specific Sound Level	11 dB		
Acoustic feature correction	+3 dB	9.2	+3dB for other sound characteristics
Rating level	L _{Ar} 14 dB	9.2	
Background sound level	L _{A90} 56 dB	8	During Operational Hours
Excess of rating over background sound level	-42 dB	11	
Assessment indicates a low impact		11	Depending on context
Context	The sound level is predicted to be well below the existing background sound level at the nearest residential receptors.		

Table 6.3 – BS4142 Assessment – Kitchen Extract Fan

Measurements of the standard LNT kitchen extract arrangement have also been undertaken within occupant bedrooms at operational care homes developed by the same client. Those measurements indicated no measurable self-noise within bedrooms with windows on the standard LNT opening limiters, and the kitchen extract was not distinguishable from the prevailing external acoustic environment. On that basis, material internal self-noise effects associated with the standard extract arrangement are not expected.

6.2.2 PV Battery Storage

The PV battery ventilation fan is expected to operate during the daytime only.

The assessment has therefore been undertaken against the representative daytime background sound level of L_{A90} 49 dB. The nearest receptors are the new residential dwellings to the northwest at a distance of approximately 150 metres.

The fan sound was broadband with no acoustic character, making it inconspicuous against the local background sound levels. No acoustic character correction is applied.

Results	Dwellings to North-West	Relevant Clause	Commentary
PV Battery Storage	L_{Aeq} 60dB @ 1m		Measured at a similar site
Distance loss	-44 dB (150m)		
Screening	-10 dB		Screening by the building itself
Specific Sound Level	6 dB		
Acoustic feature correction	+0 dB	9.2	Not characterful
Rating level	L_{Ar} 6 dB	9.2	
Background sound level	L_{A90} 49 dB	8	Daytime background
Excess of rating over background sound level	-43 dB	11	
Assessment indicates a low impact		11	Depending on context
Context	The predicted rating level is well below the existing Daytime background sound level at the nearest residential receptors. The absolute noise level is low and is unlikely to be perceptible at the receptor. A low impact is expected.		

Table 6.4 - BS4142 Assessment – PV Battery Storage

6.3 Uncertainty

Noise predictions are subject to the usual uncertainty associated with environmental noise surveys, propagation calculations and the use of precedent source data.

- All survey instrumentation comprised Type 1 sound level meters, with field calibration checks carried out before and after the survey period in accordance with standard practice.
- The assessment methodologies were undertaken in general accordance with recognised British Standards and established guidance, including BS8233 and BS4142.
- The environmental noise survey was conducted over a period of several days, providing a robust dataset representative of typical conditions at the site.
- Source noise data for the proposed plant has been based on precedent measurements of standard LNT systems, with propagation to the nearest receptors assessed on a conservative distance-attenuation basis.
- On that basis, the predicted plant noise levels remain materially below the representative background sound levels, and the assessment outcome is not considered sensitive to normal day-to-day variation.

It is acknowledged that there would be day-to-day variations in the background noise level and source noise levels. However, given the nature of the survey and the margins of compliance within

the assessment, such variations are not expected to be sufficient to compromise the findings of this report.

7. Conclusion

A baseline environmental noise survey has been undertaken by Venta Acoustics to establish the prevailing noise climate at Windsor Road, Trowbridge in support of the proposed care home.

The measured levels have been assessed with reference to the National Planning Policy Framework, BS8233:2014 and BS4142:2014+A1:2019, including the likely effect of the proposed kitchen extract and PV battery plant at the nearest residential receptors.

The assessment indicates that the north façade is the controlling elevation in respect of internal noise. Subject to the detailed design adopting enhanced glazing and attenuated ventilation to this façade, and appropriate glazing and ventilation measures to the remaining façades in accordance with the recommendations set out in this report, acceptable internal conditions are expected to be achieved. Noise levels in principal external amenity areas on the sheltered sides of the building are also expected to be acceptable.

Noise levels from the proposed plant items are predicted to remain well below the representative background sound levels at the nearest residential receptors.

On that basis, and subject to the recommendations set out in this report being incorporated into the detailed design, the proposed development is considered capable of providing an acceptable acoustic environment and significant adverse noise effects are not expected.

Steven Liddell MIOA



VA6321 /SP1 Site Plan showing measurement locations

VA6321 Windsor Road, Trowbridge

Windsor Road, Trowbridge

Environmental Noise Time History: 1

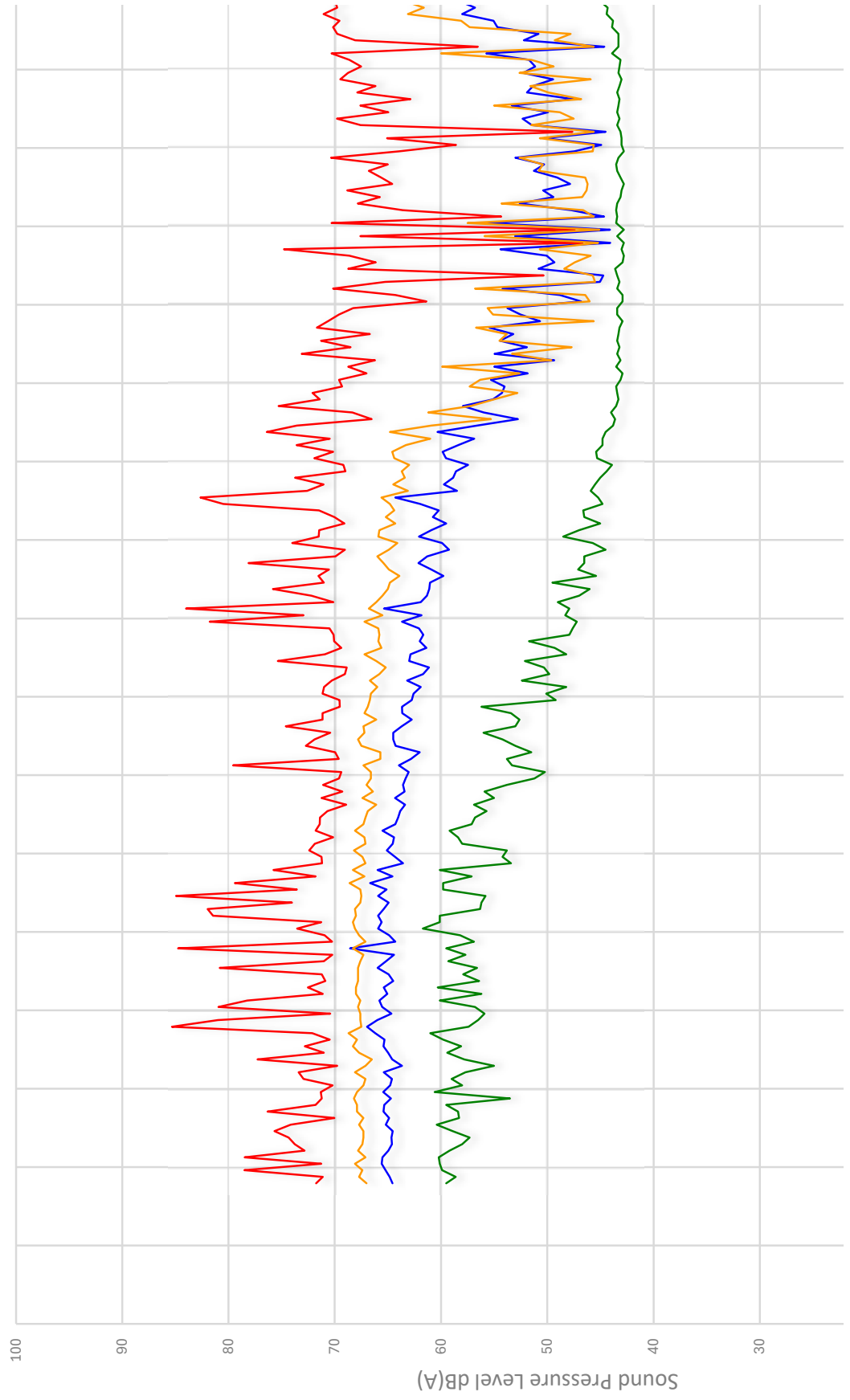


Figure VA6321/TH2

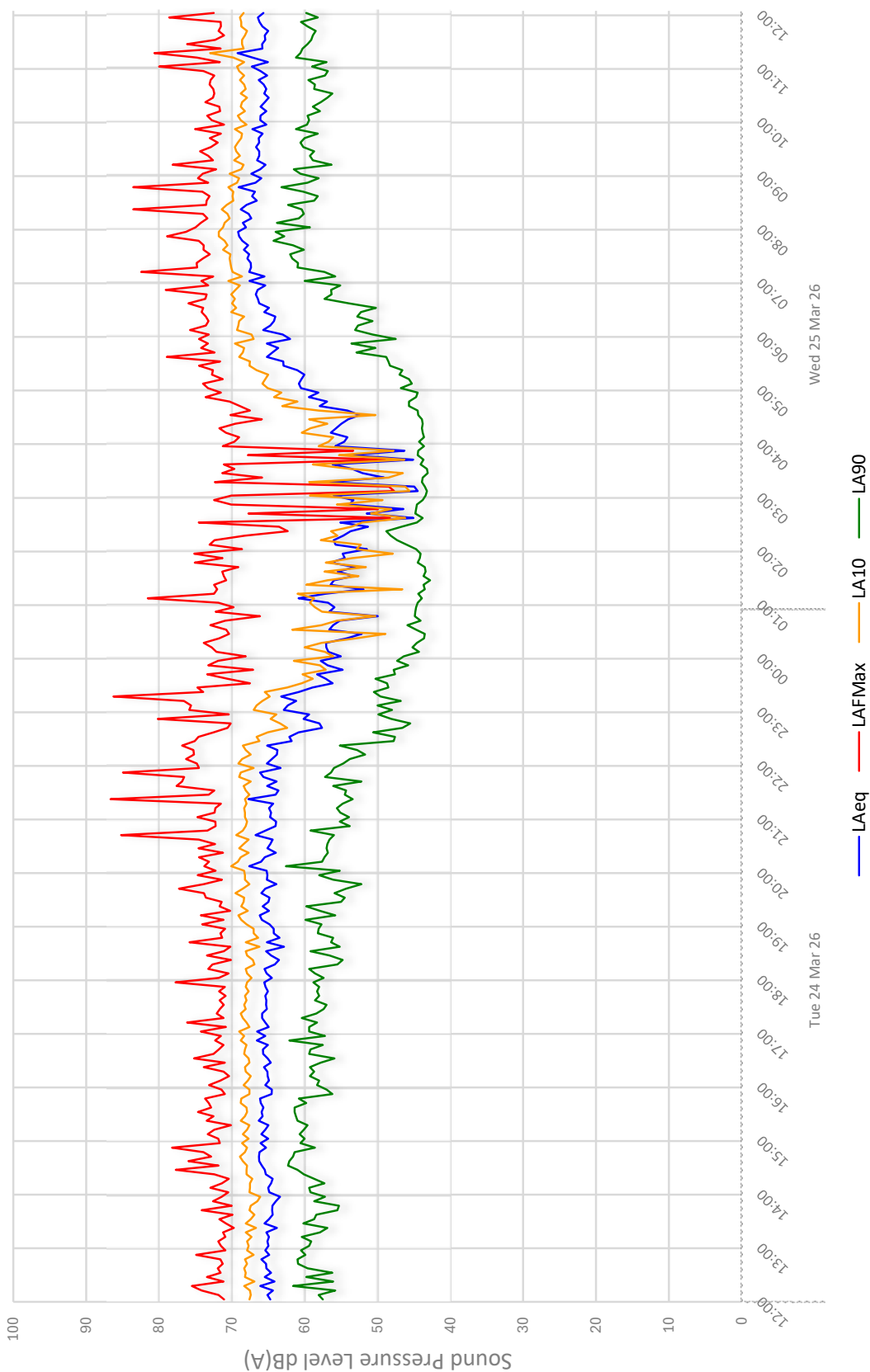
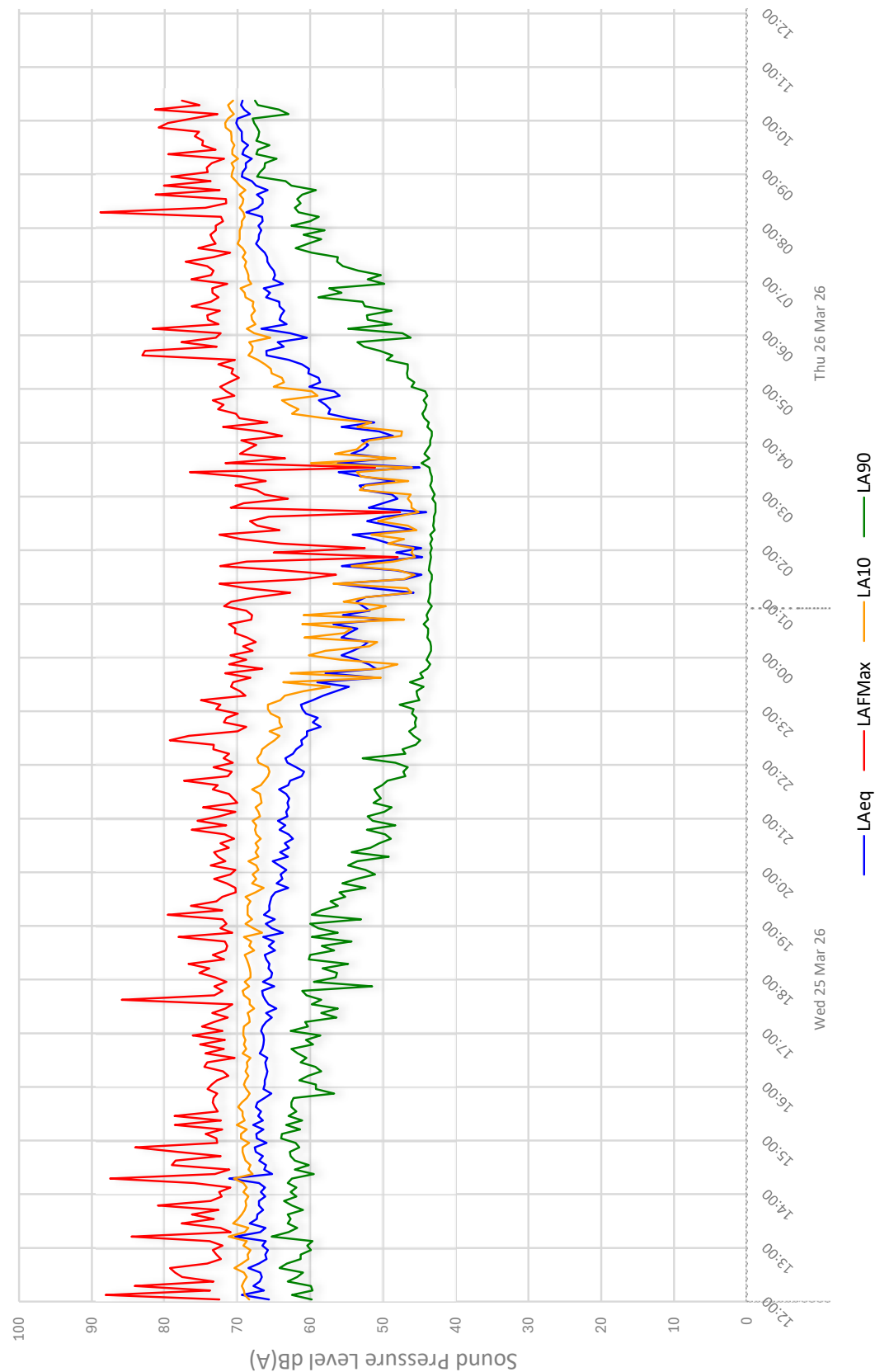
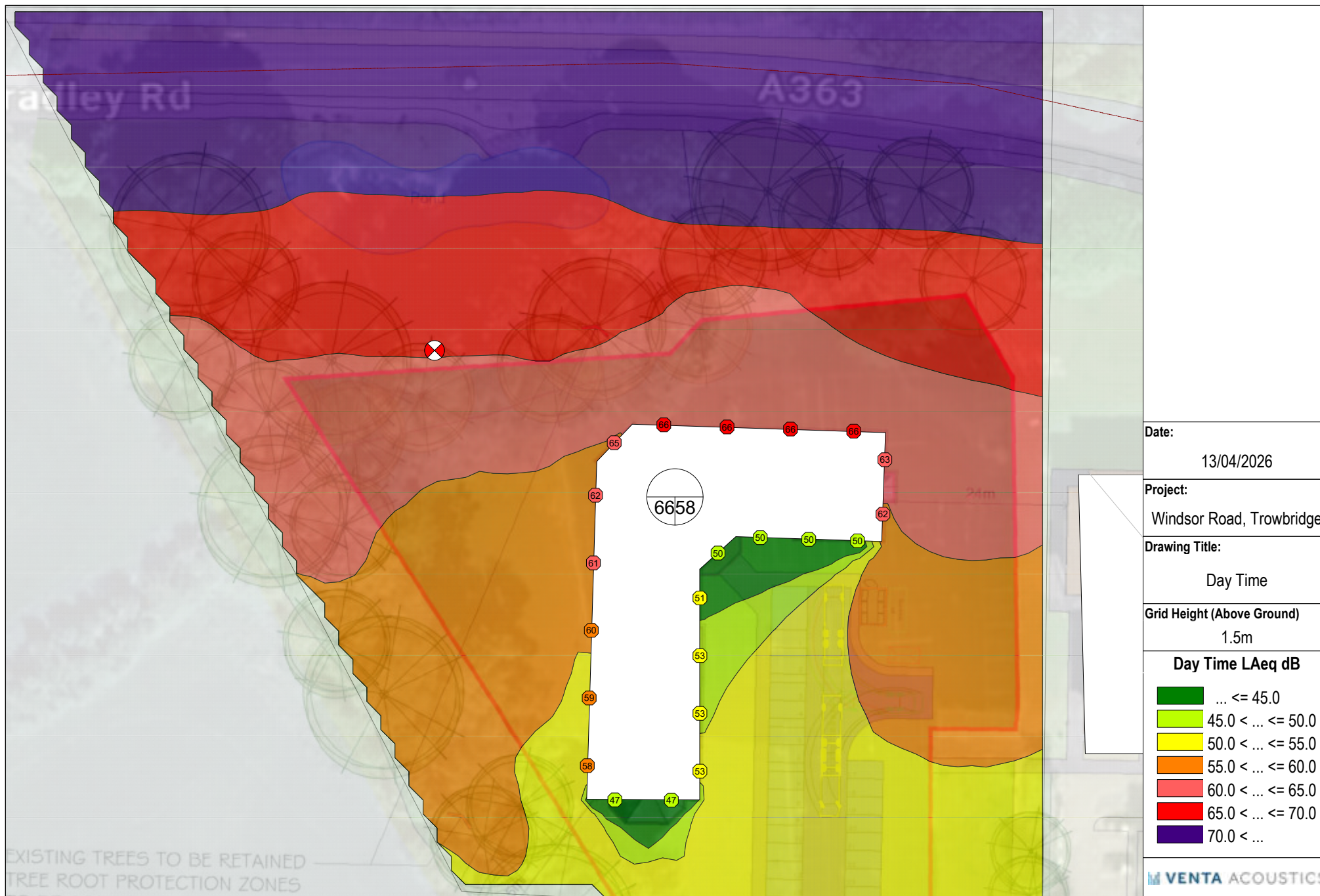
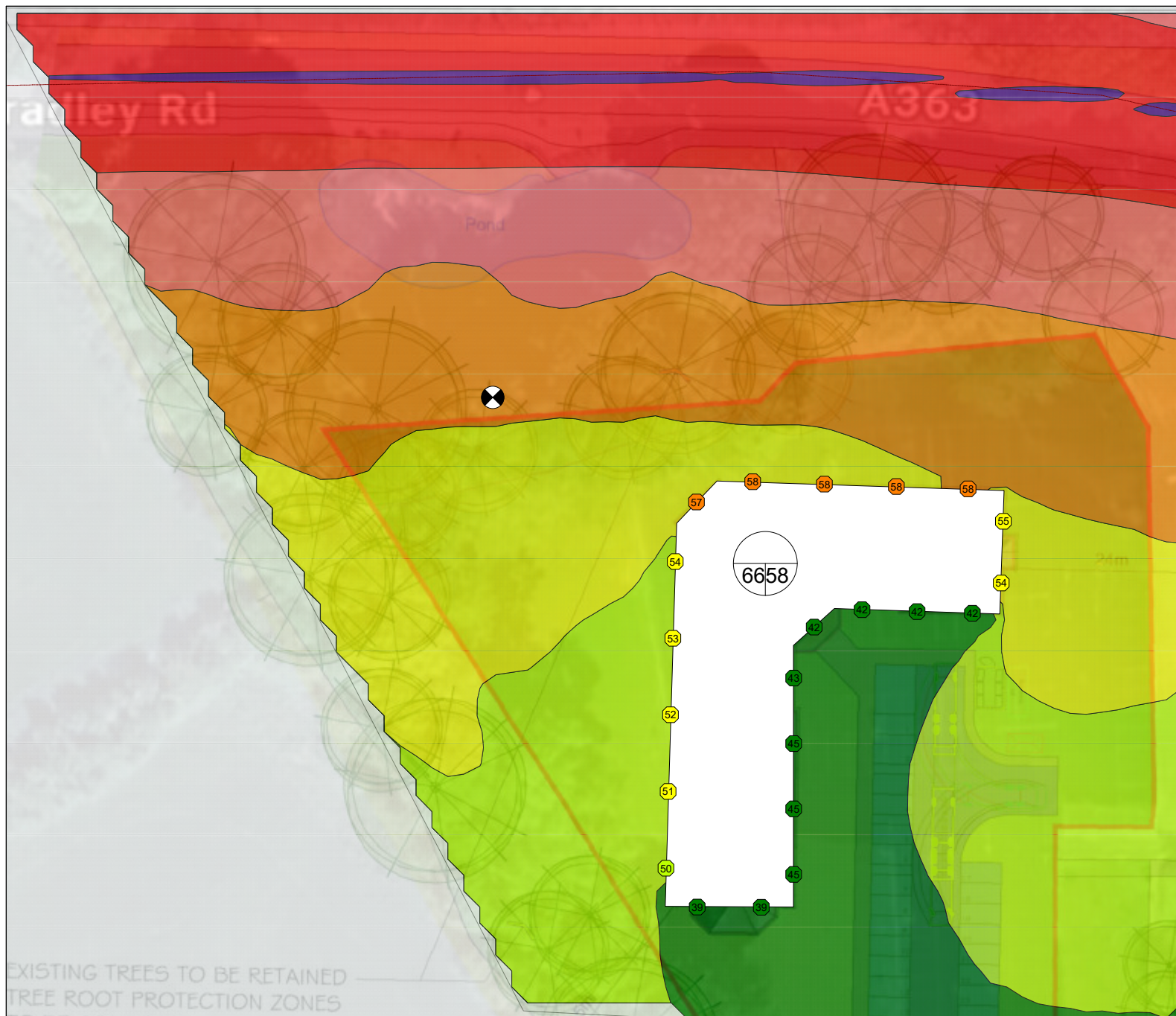


Figure VA6321/TH3







Date:

13/04/2026

Project:

Windsor Road, Trowbridge

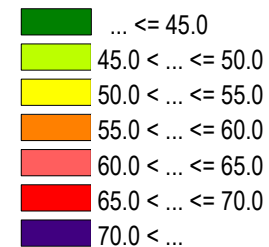
Drawing Title:

Night Time

Grid Height (Above Ground)

1.5m

Night Time LAeq dB



VENTA ACOUSTICS

APPENDIX A

Acoustic Terminology & Human Response to Broadband Sound

1.1 Acoustic Terminology

The human impact of sounds is dependent upon many complex interrelated factors such as 'loudness', its frequency (or pitch) and variation in level. In order to have some objective measure of the annoyance, scales have been derived to allow for these subjective factors.

Sound	Vibrations propagating through a medium (air, water, etc.) that are detectable by the auditory system.
Noise	Sound that is unwanted by or disturbing to the perceiver.
Frequency	The rate per second of vibration constituting a wave, measured in Hertz (Hz), where 1Hz = 1 vibration cycle per second. The human hearing can generally detect sound having frequencies in the range 20Hz to 20kHz. Frequency corresponds to the perception of 'pitch', with low frequencies producing low 'notes' and higher frequencies producing high 'notes'.
dB(A):	Human hearing is more susceptible to mid-frequency sounds than those at high and low frequencies. To take account of this in measurements and predictions, the 'A' weighting scale is used so that the level of sound corresponds roughly to the level as it is typically discerned by humans. The measured or calculated 'A' weighted sound level is designated as dB(A) or L_A . A notional steady sound level which, over a stated period of time, would contain the same amount of acoustical energy as the actual, fluctuating sound measured over that period (e.g. 8 hour, 1 hour, etc).
L_{eq} :	The concept of L_{eq} (equivalent continuous sound level) has primarily been used in assessing noise from industry, although its use is becoming more widespread in defining many other types of sounds, such as from amplified music and environmental sources such as aircraft and construction. Because L_{eq} is effectively a summation of a number of events, it does not in itself limit the magnitude of any individual event, and this is frequently used in conjunction with an absolute sound limit.
L_{10} & L_{90} :	Statistical L_n indices are used to describe the level and the degree of fluctuation of non-steady sound. The term refers to the level exceeded for n% of the time. Hence, L_{10} is the level exceeded for 10% of the time and as such can be regarded as a typical maximum level. Similarly, L_{90} is the typical minimum level and is often used to describe background noise. It is common practice to use the L_{10} index to describe noise from traffic as, being a high average, it takes into account the increased annoyance that results from the non-steady nature of traffic flow.
L_{max} :	The maximum sound pressure level recorded over a given period. L_{max} is sometimes used in assessing environmental noise, where occasional loud events occur which might not be adequately represented by a time-averaged L_{eq} value.
D_{nT}	<i>Weighted Standardised Level Difference.</i> As defined in BS EN ISO 717-1, representing the <i>Weighted Level Difference</i> , when standardised for reference receiving room reverberant characteristics.
$D_{n,e}$	Normalised sound insulation of small building elements of fixed dimensions, such as vents, measured in an accredited laboratory test suite in accordance with the procedures laid down in BS EN ISO 10140-2:2010.
$D_{n,f}$	Flanking sound insulation of lightweight elements, such as curtain wall mullions, measured in an accredited laboratory test suite in accordance with the procedures laid down in ISO 10848-2:2006

1.2 Octave Band Frequencies

In order to determine the way in which the energy of sound is distributed across the frequency range, the International Standards Organisation has agreed on "preferred" bands of frequency for sound measurement and analysis. The widest and most commonly used band for frequency measurement and analysis is the Octave Band. In these bands, the upper frequency limit is twice the lower frequency limit, with the band being described by its "centre frequency" which is the

APPENDIX A

Acoustic Terminology & Human Response to Broadband Sound

average (geometric mean) of the upper and lower limits, e.g. 250 Hz octave band extends from 176 Hz to 353 Hz. The most commonly used octave bands are:

Octave Band Centre Frequency Hz | 63 | 125 | 250 | 500 | 1000 | 2000 | 4000 | 8000

1.3 Human Perception of Broadband Noise

Because of the logarithmic nature of the decibel scale, it should be borne in mind that sound levels in dB(A) do not have a simple linear relationship. For example, 100dB(A) sound level is not twice as loud as 50dB(A). It has been found experimentally that changes in the average level of fluctuating sound, such as from traffic, need to be of the order of 3dB before becoming definitely perceptible to the human ear. Data from other experiments have indicated that a change in sound level of 10dB is perceived by the average listener as a doubling or halving of loudness. Using this information, a guide to the subjective interpretation of changes in environmental sound level can be given.

Change in Sound Level dB	Subjective Impression	Human Response
0 to 2	Imperceptible change in loudness	Marginal
3 to 5	Perceptible change in loudness	Noticeable
6 to 10	Up to a doubling or halving of loudness	Significant
11 to 15	More than a doubling or halving of loudness	Substantial
16 to 20	Up to a quadrupling or quartering of loudness	Substantial
21 or more	More than a quadrupling or quartering of loudness	Very Substantial

1.4 Earth Bunds and Barriers - Effective Screen Height

When considering the reduction in sound level of a source provided by a barrier, it is necessary to establish the "effective screen height". For example if a tall barrier exists between a sound source and a listener, with the barrier close to the listener, the listener will perceive the sound as being louder if he climbs up a ladder (and is closer to the top of the barrier) than if he were standing at ground level. Equally if he sat on the ground the sound would seem quieter than if he were standing. This is explained by the fact that the "effective screen height" is changing with the three cases above. In general, the greater the effective screen height, the greater the perceived reduction in sound level.

Similarly, the attenuation provided by a barrier will be greater where it is aligned close to either the source or the listener than where the barrier is midway between the two.