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Residential development, Land off Windmill Lane, Gosberton Risegate

Noise and Vibration Assessment Report

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On behalf of
R. K. Wilson Builders Ltd

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1.0 INTRODUCTION

1.1 Blue Tree Acoustics has been appointed by R. K. Wilson Builders Ltd to carry out an assessment of existing noise and vibration levels for a proposed residential development on land off Windmill Lane, Gosberton Risegate.

1.2 The development site is situated in Gosberton Risegate. It is bounded by dwellings to the south and west, and by fields to the north. Future residential development is understood to be permitted, but currently not built, on land between the development site and the railway to the east. The Spalding to Sleaford railway line runs past the site at a distance of some 70m to the east.

1.3 The surrounding area is predominantly residential in character.

1.4 The noise and vibration impact assessment has included:

a) Inspection of the site and surroundings.

b) Noise and vibration monitoring surveys undertaken at locations on the site during daytime and nighttime.

c) Evaluation of the site in accordance with relevant planning policy guidance.

d) Consideration of noise control measures required to maintain acceptable noise levels within the proposed bedrooms and living rooms in accordance with *British Standard 8233: 2014, 'Guidance on sound insulation and noise reduction for buildings'* (BS8233:2014).

e) Evaluation of the site in accordance with *BS6472:2008 'Evaluation of Human Exposure to Vibration in Buildings (1 Hz to 80 Hz)'* (BS6472).

1.5 A glossary of technical terminology and parameters used in this report is provided in Appendix 1.

2.0 EXISTING NOISE SOURCES

Road traffic

2.1 Risegate Road connects Gosberton Risegate to the A17, and experiences regular passing traffic. Distant road traffic was also audible across the development site.

Railway line

2.2 Trains passing on the nearby railway line are the primary source of noise along the eastern boundary of the development site. The line is relatively busy with both passenger and freight train movements passing the site, and multiple train movements can occur within an hourly period.

3.0 NOISE AND VIBRATION SURVEYS

Noise surveys

3.1 Unattended noise surveys were undertaken by Blue Tree Acoustics between Tuesday 05/09/2023 and Tuesday 12/09/2023 to determine the existing ambient noise climate at the site during representative daytime and nighttime periods. The measurement location is indicated in Figure 1.

3.2 The instrument used for the noise monitoring was 1no Rion NL-52 Type 1/Class 1 integrating sound level meter. The meter was within a valid period of laboratory calibration. Calibration checks were carried out both before and after the measurements, with no variance observed. A proprietary environmental windshield was fitted to the microphone, and measurements were made with the microphone mounted on a tripod at approximately 1.5m height from local ground level.

3.3 Weather conditions throughout the survey periods were typically dry and relatively calm. Archival data from a nearby weather station is presented in in Appendix 4. Data collected during periods of rainfall and excessive wind have been excluded from the dataset.

3.4 The noise survey measurement results are detailed in Appendix 2 and summarised in the table below.

Table 1: Free-field external noise levels at Location 1 – Daytime and nighttime

Time period	dB $L_{Aeq,1min}$	dB $L_{Amax,1min}$	dB $L_{A10,1min}$	dB $L_{A90,1min}$
Daytime (0700-2300 hours)	22 - 81 (Average = 54)	26 - 89	23 - 86	21 - 75
Nighttime (2300-0700 hours)	18 - 71 (Average = 51)	19 - 80	18 - 75	17 - 52

3.5 Noise levels at Location 1 were measured over contiguous 1-minute periods to assess passing train movements during both day and night. The Location 1 measurement data contains multiple train passbys, including freight movements.

3.6 Average noise levels at Location 1 were 54dB L_{Aeq} during daytime, and 51dB L_{Aeq} during nighttime. Measured maximum noise levels were up to 89dB L_{Amax} in the day and 80dB L_{Amax} at night.

3.7 It is concluded that the measured sound levels are suitably representative of the noise climate at the development site for the purpose of this assessment.

Vibration survey

3.8 Unattended vibration surveys were undertaken by Blue Tree Acoustics between Tuesday 05/09/2023 and Tuesday 12/09/2023 to determine the existing vibration levels from passing trains at the site. The measurement location is indicated in Figure 1.

3.9 The instrument used for the vibration monitoring was 1no Svan 958A vibration level meter. The meter was fitted with its corresponding proprietary tri-axial transducer, which was positioned directly on the ground surface. The transducer was positioned with the X axis perpendicular to the railway line and the Y axis parallel to the railway line, with Z being the vertical axis. The meter was within a valid period of laboratory calibration.

3.10 Continuous logging measurements were taken of vibration levels, including vibration dose value (VDV). Internal frequency weightings were set to W_d weighting for horizontal vibration, and to W_b weighting for vertical vibration.

3.11 The vibration measurement results are detailed in Appendix 3. The passing trains can be clearly seen as discrete events in the Location 1 vibration charts presented in Appendix 3, and these align with corresponding spikes in the noise measurement data.

3.12 The highest measured individual VDV value was recorded at 1527 hours on Thursday 07/09/2023, being 0.028 $ms^{-1.75}$ VDV_z for a passing freight train.

4.0 NOISE ASSESSMENT CRITERIA

4.1 First published in March 2012, and most recently updated in July 2021, the *National Planning Policy Framework* (NPPF) sets out the Government's planning policies for England and how these are expected to be applied. Reference to noise is made at Paragraph 174 of the NPPF Section 15 'Conserving and enhancing the natural environment', stating that:

> *"174. Planning policies and decisions should contribute to and enhance the natural and local environment by:*
>
> *[…]*
>
> *(e) 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"*

4.2 Noise is also referenced within the ground conditions and pollution subsection within Section 15 of the NPPF at Paragraph 185, which states:

> *"185. 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 impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life [65],*
>
> *(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."*
>
> *[65] See Explanatory Note to the Noise Policy Statement for England (Department for the Environment, Food and Rural Affairs, 2010).*

4.3 Paragraph 187 of NPPF states:

> *"Planning policies and decisions should ensure that new development can be integrated effectively with existing businesses and community facilities (such as places of worship, pubs, music venues and sports clubs). Existing businesses and facilities should not have unreasonable restrictions placed on them as a result of development permitted after they were established. Where the operation of an existing business or community facility could have a significant adverse effect on new development (including changes of use) in its vicinity, the applicant (or 'agent of change') should be required to provide suitable mitigation before the development has been completed."*

4.4 Department for Environment, Food and Rural Affairs, Noise Policy Statement for England (NPSE), 2010 states:

Noise Policy Vision

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

Noise Policy 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; and**
- **where possible, contribute to the improvement of health and quality of life.**

Guiding principles of sustainable development

Ensuring a Strong Healthy and Just Society – Meeting the diverse needs of all people in existing and future communities, promoting personal wellbeing, social cohesion and inclusion, and creating equal opportunity for all.

Using Sound Science Responsibly – Ensuring policy is developed and implemented on the basis of strong scientific evidence, whilst taking into account scientific uncertainty (through the precautionary principle) as well as public attitudes and values.

Living Within Environmental Limits – Respecting the limits of the planet's environment, resources and biodiversity – to improve our environment and ensure that the natural resources needed for life are unimpaired and remain so for future generations.

Achieving a Sustainable Economy – Building a strong, stable and sustainable economy which provides prosperity and opportunities for all, and in which environmental and social costs fall on those who impose them (polluter pays), and efficient resource use is incentivised.

Promoting Good Governance – Actively promoting effective, participative systems of governance in all levels of society – engaging people's creativity, energy and diversity.

Source: Securing the future – delivering UK sustainable development strategy, HM Government, March 2005.

4.5 The Noise Policy Statement for England Explanatory note states that:

Noise is an inevitable consequence of a mature and vibrant society. For some the noise of city life provides a desirable sense of excitement and exhilaration, but for others noise is an unwanted intrusion that adversely impacts on their quality of life, affecting their health and well being.

The management of noise has developed over many years as the types and character of noise sources have altered and as people's attitude to noise has changed. The Noise Abatement Act came into law in 1960 and the Report from the Committee on the Problem of Noise was published in 1963 (the Wilson report). Since then, examples of noise management can be found in many areas including reducing noise at source; the use of the land use and transport planning systems, compensation measures, the statutory nuisance and licensing regimes and other related legislation.

Furthermore, the broad aim of noise management has been to separate noise sources from sensitive noise receivers and to 'minimise' noise. Of course, taken in isolation and to a literal extreme, noise minimisation would mean no noise at all. In reality, although it has not always been stated, the aim has tended to be to minimise noise as far as reasonably practical. This concept can be found in the Environmental Protection Act 1990, where, in some circumstances, there is a defence of 'best practicable means' in summary statutory nuisance proceedings.

By describing clear policy vision and aims the NPSE provides the necessary clarity and direction to enable decisions to be made regarding what is an acceptable noise burden to place on society.

The intention is that the NPSE should apply to all types of noise apart from noise in the workplace (occupational noise). For the purposes of the NPSE, "noise" includes:

- *"environmental noise" which includes noise from transportation sources;*
- *"neighbour noise" which includes noise from inside and outside people's homes;*

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

The application of the NPSE should mean that noise is properly taken into account at the appropriate time. In the past, the opportunity for the cost effective management of noise has often been missed because the noise implications of a particular policy, development or other activity have not been considered at an early enough stage.

In addition, the application of the NPSE should enable noise to be considered alongside other relevant issues and not to be considered in isolation. In the past, the wider benefits of a particular policy, development or other activity may not have been given adequate weight when assessing the noise implications.

In the longer term, the Government hopes that existing policies could be reviewed (on a prioritised basis), and revised if necessary, so that the policies and any noise management measures being adopted accord with the vision, aims and principles of the NPSE.

Noise management is a complex issue and at times requires complex solutions. Unlike air quality, there are currently no European or national noise limits which have to be met, although there can be specific local limits for specific developments. Furthermore, sound only becomes noise (often defined as 'unwanted sound') when it exists in the wrong place or at the wrong time such that it causes or contributes to some harmful or otherwise unwanted effect, like annoyance or sleep disturbance. Unlike many other pollutants, noise pollution depends not just on the physical aspects of the sound itself, but also the human reaction to it. Consequently, the NPSE provides a clear description of desired outcome from the noise management of a particular situation.

The guiding principles of Government policy on sustainable development should be used to assist in its implementation. The development of further principles specifically to underpin implementation of noise management policy will be kept under review as experience is gained from the application of the NPSE.

There are several key phrases within the NPSE vision and these are discussed below.

Health and quality of life

The World Health Organisation defines health as a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity, and recognises the enjoyment of the highest attainable standard of health as one of the fundamental rights of every human being.

It can be argued that quality of life contributes to our standard of health. However, in the NPSE it has been decided to make a distinction between 'quality of life' which is a subjective measure that refers to people's emotional, social and physical well being and 'health' which refers to physical and mental well being.

It is recognised that noise exposure can cause annoyance and sleep disturbance both of which impact on quality of life. It is also agreed by many experts that annoyance and sleep disturbance can give rise to adverse health effects. The distinction that has been made between 'quality of life' effects and 'health' effects recognises that there is emerging evidence that long term exposure to some types of transport noise can additionally cause an increased risk of direct health effects. The Government intends to keep research on the health effects of long term exposure to noise under review in accordance with the principles of the NPSE.

Promote good health and good quality of life

This statement expresses the long term desired policy outcome, but in the use of 'promote' and 'good' 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.

Effective management of noise

This concept confirms that the policy applies to all types of 'noise' (environmental, neighbour and neighbourhood) and that the solution could be more than simply minimising the noise.

Within the context of Government policy on sustainable development

Sustainable development is a core principle underpinning all government policy. For the UK Government the goal of sustainable development is being pursued in an integrated way through a sustainable, innovative and productive economy that delivers high levels of employment and a just society that promotes social inclusion, sustainable communities and personal wellbeing. The goal is pursued in ways that protect and enhance the physical and natural environment, and that use resources and energy as efficiently as possible.

There is a need to integrate consideration of the economic and social benefit of the activity or policy under examination with proper consideration of the adverse environmental effects, including the impact of noise on health and quality of life. This should avoid noise being treated in isolation in any particular situation, i.e. not focussing solely on the noise impact without taking into account other related factors.

There are several key phrases within the NPSE aims and these are discussed below.

"Significant adverse" and "adverse"

There are two established concepts from toxicology that are currently being applied to noise impacts, for example, by the World Health Organisation. They are:

NOEL . No Observed Effect Level

This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise.

LOAEL . Lowest Observed Adverse Effect Level

This is the level above which adverse effects on health and quality of life can be detected.

Extending these concepts for the purpose of this NPSE leads to the concept of a significant observed adverse effect level.

SOAEL . Significant Observed Adverse Effect Level

This is the level above which significant adverse effects on health and quality of life occur.

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.

The first aim of the Noise Policy Statement for England

Avoid significant adverse impacts on health and quality of life from environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development.

The first aim of the NPSE states that significant adverse effects on health and quality of life should be avoided while also taking into account the guiding principles of sustainable development.

The second aim of the Noise Policy Statement for England

Mitigate and minimise adverse impacts on health and quality of life from environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development.

The second aim of the NPSE refers to the situation where the impact lies somewhere between LOAEL and SOAEL. It requires that all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life while also taking into account the guiding principles of sustainable development. This does not mean that such adverse effects cannot occur.

The third aim of the Noise Policy Statement for England

Where possible, contribute to the improvement of health and quality of life through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development.

This aim seeks, where possible, positively to improve health and quality of life through the pro-active management of noise while also taking into account 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.

4.6 Unfortunately, the above guidance gives no objective, tangible standards or criteria that enable planning decisions to be made. In the absence of such guidance, quantification of noise impact in terms of guidance such as BS8233:2014, which present noise limits and criteria based on World Health Organisation recommendations, can be considered as appropriately assessing the potential noise impact with regard to toxicology concepts and hence in line with the principles of the NPPF and NPSE. Therefore, if a site meets the recommendations of BS8233:2014 and any associated Local Authority noise requirements, it can be considered as being below the level where there is no detectable adverse effect on health and quality of life due to noise, and this meets the NOEL (No Observed Effect Level) set out in the NPSE.

4.7 *British Standard 8233: 2014, 'Guidance on sound insulation and noise reduction for buildings'* (BS8233:2014) provides information on the design of internal acoustics in buildings. It deals with control of noise from outside the building, noise from plant and services within it, and room acoustics for non-critical situations.

4.8 BS8233:2014 provides guidance regarding indoor ambient noise criteria for residential accommodation, as presented below.

Table 2: BS8233:2014 Guidance criteria for indoor ambient noise levels

Activity	Location	0700-2300 hours	2300-0700 hours
Resting	Living rooms	35 dB $L_{Aeq\ (16\ hour)}$	-
Dining	Dining room/area	40 dB $L_{Aeq\ (16\ hour)}$	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq\ (16\ hour)}$	30 dB $L_{Aeq\ (8\ hour)}$

4.9 BS8233:2014 does not stipulate any criteria for maximum noise levels within rooms in terms of dB L_{Amax}, but does state that, *"Regular individual noise events (for example, scheduled aircraft or passing trains) can cause sleep disturbance. A guideline value may be set in terms of SEL or $L_{Amax,F}$, depending on the character and number of events per night. Sporadic noise events could require separate values."*

4.10 It is noted that BS8233:2014 also states that, where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal target levels may be relaxed by up to 5dB and reasonable internal conditions still achieved.

4.11 In addition, the BS8233:2014 guidance relating to gardens makes reference to external noise levels in gardens and balconies, etc., as follows:

> *"For traditional external areas that are used for amenity space, such as gardens and patios, it is desirable that the external noise level does not exceed 50 dB $L_{Aeq,T}$, 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.*

Other locations, such as balconies, roof gardens and terraces, are also important in residential buildings where normal external amenity space might be limited or not available, i.e. in flats, apartment blocks, etc. In these locations, specification of noise limits is not necessarily appropriate. Small balconies may be included for uses such as drying washing or growing pot plants, and noise limits should not be necessary for these uses. However, the general guidance on noise in amenity space is still appropriate for larger balconies, roof gardens and terraces, which might be intended to be used for relaxation. In high-noise areas, consideration should be given to protecting these areas by screening or building design to achieve the lowest practicable levels. Achieving levels of 55 dB $L_{Aeq,T}$ or less might not be possible at the outer edge of these areas, but should be achievable in some areas of the space."

4.12 The following general noise mitigation advice is based on achieving the BS8233:2014 indoor noise level criteria to ensure a suitable level of protection for the future occupants of the development. Noise ingress calculations have been carried out in accordance with BS8233:2014. Calculations have been undertaken to limit noise ingress to 45dB L_{Amax} within bedrooms at nighttime, as this is typically applied for control of rail traffic noise. Calculations are based on the typical noise events occurring at the site as presented herein; however, it must be acknowledged that there will always remain potential for atypical events, such as emergency sirens, police/ambulance helicopter, temporary works, etc., that could result in L_{Amax} noise levels exceeding 45dB within bedrooms. It is therefore not possible to determine with 100% accuracy which external noise levels will occur on any given day, nor is it possible to predict the maximum noise levels that may occur outside the dwellings in the future, and thus it is impossible to design and install a building envelope to ensure that an absolute maximum noise level criterion in a bedroom is never exceeded. The building envelope calculations are based on the typical noise events understood to occur at the site, and therefore provide a reasonable basis for appropriate acoustic design.

4.13 Published guidance on implementing limiting L_{Amax} criteria in bedrooms (e.g. *ProPG: Planning and Noise* and *WHO Community Noise Guidelines*) commonly advises that individual noise events should not normally exceed 45dB L_{Amax} more than 10no times per night, as this represents a threshold below which the effects of individual noise events on sleep can be regarded as negligible. Such an approach is commonly accepted by Local Authorities.

5.0 NOISE MITIGATION MEASURES

5.1 There are a variety of proportionate and reasonable techniques that could be introduced to mitigate the effects of noise, such as:

a) **Engineering:** reduction of noise at source (e.g. use of quiet machinery and working methods), containment of generated noise, and protection of noise-sensitive buildings (e.g. by sound insulation and/or screening them by purpose-built barriers);

b) **Layout:** adequate distance between source and noise-sensitive building; screening by natural barriers, other buildings or non-critical rooms in a building;

c) **Administrative:** limiting operating time of source, restricting activities onsite, specifying an acceptable noise limit.

Railway boundary line acoustic barrier

5.2 The survey data indicates that daytime noise levels within the site red line boundary are expected to not exceed the BS8233:2014 55dB L_{Aeq} upper limit for garden areas, with the average daytime value being measured as 54dB L_{Aeq}. Nonetheless, provision of enhanced acoustic fencing to protect private gardens would reduce noise levels and is desirable. The barrier design shall need to be verified as part of the Client's detailed design stage of the development, but an initial outline specification of 2m high acoustic fencing should provide suitable sound attenuation when installed along the eastern garden boundaries.

5.3 Acoustic fencing should be constructed of solid, weather-treated timber (or ply) of minimum 18mm thickness. All joints should be tight-butted with timber cover strips or tongue and groove boards to ensure that there are no airgaps in the structure or between the base of the fence and the ground beneath. Alternatively, acoustic barriers can be created from almost any solid material that can be made impermeable to air; for example, the barrier could be constructed from masonry, concrete, plastic, timber panels, etc., if desired. Proprietary acoustic fencing products are available from various suppliers, such as Jacksons Jakoustic® acoustic fencing. The manufacturer's guidance and installation instructions must be followed for all proprietary systems.

Dwelling protection

5.4 The design of the building envelope of the new dwellings can incorporate suitable sound insulation to satisfy the BS8233:2014 internal noise criteria set out above. Noise ingress calculations have been carried out in accordance with BS8233:2014 to determine appropriate sound insulation measures to satisfy the acoustic criteria set out above. The precise

requirements will depend on the external noise level experienced at the dwellings. The following outline sound insulation measures are recommended.

5.5 A traditional pitched tile/slate roof construction should provide suitable sound insulation. For dwellings situated along the site boundary with the railway, ceilings in bedrooms immediately below the roofspace should comprise minimum 2no layers solid gypsum-based board (total minimum mass per unit area 20kg/m^2), overlaid with mineral wool insulation of minimum 200mm thickness.

5.6 External walls should comprise dense masonry cavity construction (e.g. outer brickwork with inner blockwork leaf of minimum density 1000 kg/m^3). The external wall cavity should be minimum 100mm and insulated with mineral wool to the same thickness as the cavity depth.

5.7 Our calculations indicate that an enhanced acoustic specification for glazing and ventilation will likely be required for bedrooms in order that BS8233:2014 internal noise levels can be met. However, the BS8233:2014 criteria clearly can be met, and therefore suitable acoustic conditions for residential development are achievable.

5.8 The assumed nighttime 45dB L_{Amax} criterion in bedrooms is the most onerous performance requirement.

5.9 The specifications given in Table 3 below are based on the proposed site layout plan shown in Figure 2.

Table 3: Glazing minimum octave band sound reduction and ventilation

Elevations	Octave band minimum sound reduction indices (dB)						Vent ($D_{n,e,w}$)
	125	250	500	1k	2k	4k	
Bedrooms facing railway: 10mm glass / minimum 12mm airgap / 6.8mm acoustic laminate glass (nominal R_w 38dB)	22	27	28	36	45	53	42dB / 55dB *
All other bedrooms: 4mm glass / minimum 12mm airgap / 6mm glass (nominal R_w 33dB)	18	23	22	27	38	40	42dB
Living rooms and dining rooms: 4mm glass / minimum 12mm airgap / 6mm glass (nominal R_w 33dB)	18	23	22	27	38	40	35dB

* *See additional explanations given in the paragraphs below.*

5.10 Passive 42dB $D_{n,e,w}$ ventilators are available, such as the Titon V75 vent with C50 canopy, Greenwood 5000EAW.AC2 Acoustic, or Greenwood EAR42W.

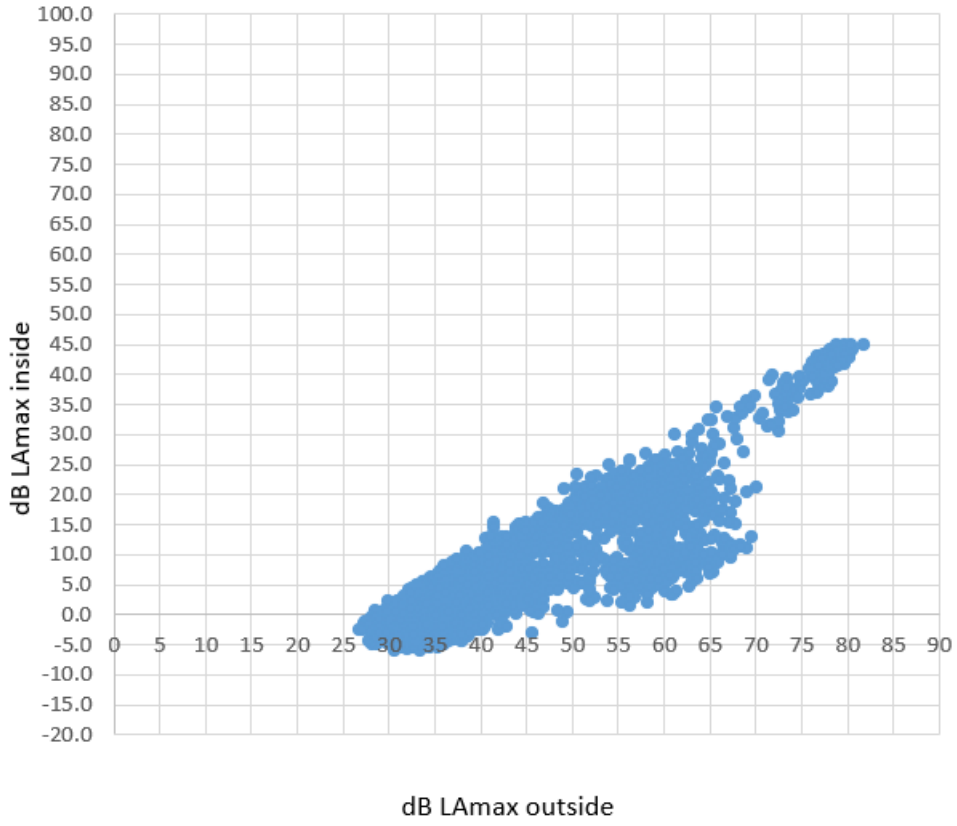
5.11 An example of a ventilator with 55dB $D_{n,e,w}$ performance is the Greenwood MA3051 wall vent. Alternatively, a mechanically assisted acoustic ventilator such as the Titon Sonair F+ or a ducted ventilation system designed with suitable acoustic attenuation to the ventilators may be used (e.g. PIV/MVHR/MEV). If feasible, air ducted from quieter elevations would require less attenuation, but care must be taken to ensure that the ducting does not transfer noise between dwellings.

5.12 Ventilators with a minimum sound insulation performance of 35dB $D_{n,e,w}$ can be sourced from manufacturers such as R.W. Simon, Titon, or Greenwood.

5.13 Glazing and ventilators to non-habitable rooms or spaces do not require special acoustic measures, and these spaces may have standard trickle ventilation. (For the purposes of noise assessment, separate kitchens, bathrooms, WCs, etc., are considered as non-habitable spaces.)

5.14 Nighttime bedroom maximum noise levels are most critical. The following chart shows the measured broadband external noise level compared to the calculated internal broadband noise level within worst-affected bedrooms at night in terms of L_{Amax} values. Note that the noise ingress calculations are undertaken in octave band analysis, but that overall broadband results are presented. Also note that, as maximum octave noise level values are measured over a 1-minute period as used in the calculation, the external broadband values calculated here are slightly higher than the true values are; in effect, the values assume that each octave band maximum occurred at the same time, when in reality it probably did not.

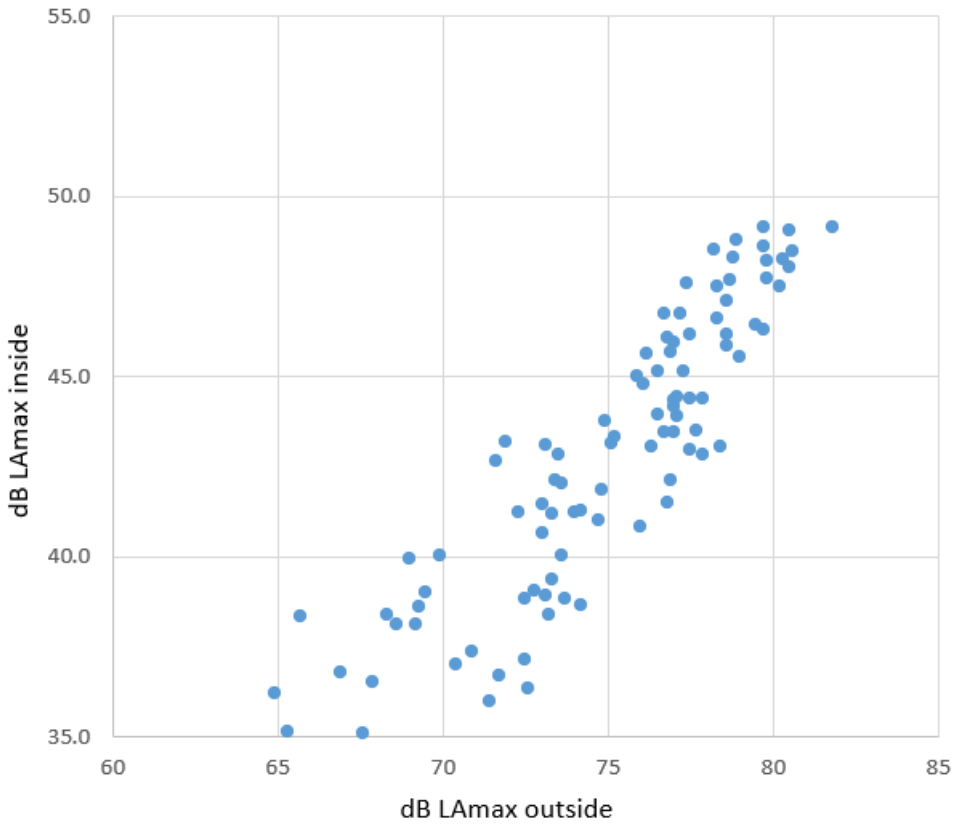
Chart 1: External dB L_{Amax} compared to calculated internal dB L_{Amax} for bedroom specification with 55dB $D_{n,e,w}$ vent



5.15 Across the noise level data collected, the above chart shows zero exceedances per night, whereas up to 10no exceedances per night would normally be permitted.

5.16 A 42dB $D_{n,e,w}$ vent rather than a 55dBdB $D_{n,e,w}$ vent would generate the data in the following chart.

Chart 2: External dB L_{Amax} compared to calculated internal dB L_{Amax} for bedroom specification with 42dB $D_{n,e,w}$ vent



5.17 The data in the chart above shows 33no exceedances across 7no nights, i.e. averaging to typically 5no exceedances per night, which would normally be acceptable. None of these exceedances result in predicted noise levels higher than 50dB L_{Amax} inside the bedroom. Furthermore, once the new permitted residential development to the east is built, it will provide this development site with additional acoustic protection from the railway, and the number of exceedances it experiences would reduce.

5.18 Provision of either a 42dB $D_{n,e,w}$ or 55dB $D_{n,e,w}$ vent is expected to provide suitable reduction in nighttime L_{Amax} sound levels inside bedrooms, and therefore either specification is suitable in terms of satisfying the applicable acoustic standards and typical planning requirements. However, provision of a 55dB $D_{n,e,w}$ vent will increase the margin of compliance and occupier comfort, and therefore may be the preferred option.

5.19 The specifications given above are suitable recommendations. Equivalent acoustic performance may be achieved by other materials or products, but acoustic performance data for all proposed systems should be submitted to a competent acoustic consultant for checking in order to ensure adequate acoustic performance will be achieved.

5.20 It should be acknowledged that careful design and close attention to detail, along with high standards of site supervision and workmanship, are essential in achieving the required acoustic performance, particularly in relation to controlling flanking sound transmission paths, airgaps, and use of suitable materials. Therefore, effective work management plans will be needed to ensure all contractors and tradesmen are aware of the acoustic performance requirements and details to ensure works are implemented to the necessary standard.

6.0 VIBRATION ASSESSMENT

6.1 Guidance on predicting human response to vibration in buildings is set out in *British Standard 6472: 2008 'Guide to the evaluation of human exposure to vibration in buildings'* (BS6472). The standard includes a section on intermittent vibrations and requires the vibration exposure to be determined in terms of 'vibration dose value' ('VDV'), which is determined from frequency-weighted vibration acceleration measurements to assess the probability of adverse comment from human beings experiencing vibration in buildings. Consideration is given to time of day and use of the space (e.g. residential, office, or workshop).

6.2 VDV takes into account the magnitude of the vibration and the duration of the exposure, and is defined as a cumulative measurement of the vibration level received over a given period; it is the integrated fourth power vibration value with units $ms^{-1.75}$, and it has the advantage of sensitivity to vibration peak levels.

6.3 The vibration dose summation procedure described in BS6472-1 allows comparison of all types of vibration exposure on a common basis, i.e. the severity of impulsive and/or intermittent vibration is evaluated on a basis applicable equally to continuous vibration.

6.4 Unless the direction of vibration having the dominant effect is known, the motion should be recorded in 3no orthogonal axes and evaluated for the single axis in which the magnitude of weighted acceleration is greatest. Vertical vibrations are generally more perceptible than horizontal vibrations.

6.5 BS6472-1 sets out the likely human response in terms of probability of adverse comment to VDV levels ($ms^{-1.75}$) for vertical and horizontal vibration in residential buildings in the table titled 'Vibration dose value ranges which might result in various probabilities of adverse comment within residential buildings', which is reproduced below:

Vibration dose value ranges which might result in various probabilities of adverse comment within residential buildings

Place and time	Low probability of adverse comment $m \cdot s^{-1.75}$ 1)	Adverse comment possible $m \cdot s^{-1.75}$	Adverse comment probable $m \cdot s^{-1.75}$ 2)
Residential buildings 16 h day	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential buildings 8 h night	0.1 to 0.2	0.2 to 0.4	0.4 to 0.8

6.6 As presented in Appendix 3, measurements of vibration were carried out at Location 1 during the same periods as the noise survey. The vibration survey gathered a series of contiguous 20-second VDV measurements in each of the 3no orthogonal directions. From these measurements, the 16-hour VDV or 8-hour VDV may be estimated. The total daytime VDV or nighttime VDV can be evaluated using the following relationship for (N) number of vibration episodes during the assessment period:

$$VDV = (\sum_{i=1-N} VDV_i^4)^{0.25}$$

6.7 There was no perceptible vibration experienced underfoot during the passage of trains, but the objective measurement is deemed more critical than the subjective assessment onsite. The greatest single VDV measurement was 0.028 $ms^{-1.75}$ VDV_z for a passing freight train. Assuming the vibration levels measured in the day occurred throughout the day from 0700-2300 hours, the 16-hour daytime VDV at Location 1 is calculated to be 0.208 $ms^{-1.75}$. The 8-hour nighttime VDV at Location 1 is calculated to be 0.146 $ms^{-1.75}$. This equates to vibration levels at the 'low probability of adverse comment' range defined in BS6472-1 assuming the worst event occurs constantly all day and all night. The values measured through each day and night period were no more than 0.059 $ms^{-1.75}$ in the day and 0.044 $ms^{-1.75}$ at night, which was well below the threshold values of BS6472-1. Vibration levels at the new dwellings are therefore expected to be within acceptable limits, and unlikely to result in adverse comment.

6.8 *British Standard 7385-2:1993 'Evaluation and measurement for vibration in Buildings – Part 2: Guide to damage levels from ground-borne vibration'* (BS7385-2) provides vibration criteria relating to building damage, and advice on acceptable levels of vibration in structures. The standard uses the PPV quantity as correlating best with recorded occurrences of vibration-induced damage. The BS6472-1 VDV vibration criteria are more sensitive than the BS7385-2 PPV limits for transient vibrations, and therefore assessment in terms of the more critical BS6472-1 standard is considered appropriate for this assessment. The highest measured PPV value was 2mm/s, whereas the most onerous value in the BS7385-2 criteria is 15mm/s. The site comfortably satisfies BS7385-2, and vibration effects are considered to be negligible.

7.0 SUMMARY AND CONCLUSIONS

7.1 A noise and vibration assessment has been carried out on behalf of R. K. Wilson Builders Ltd for a proposed residential development on land off Windmill Lane, Gosberton Risegate.

7.2 The assessment has included measurements of environmental noise levels at the site during representative daytime and nighttime periods. Rail traffic was found to be the dominant noise source at the development site. Measurements of vibration levels were also taken during the noise survey periods.

7.3 Calculations indicate that the stated BS8233:2014 noise criteria can be met, as enhanced acoustic specification of ventilation and glazing can provide sufficient sound attenuation.

7.4 The assessment has also considered the magnitude of vibration experienced on the site.

7.5 The measured vibration levels were found to be below the lower threshold of the 'low probability of adverse comment' range, and therefore within suitable limits for residential development.

7.6 The site may be considered suitable for residential development in planning and noise terms, as acceptable noise levels in accordance with BS8233:2014 can be achieved following the design and implementation of suitable noise mitigation measures.

7.7 In addition, the assessment has been undertaken with regard to the *National Planning Policy Framework* (NPPF) and the *Noise Policy Statement for England* (NPSE). Appropriate noise assessment and design targets for internal noise levels have been used to quantify noise impact and determine suitability for residential development with due regard to effects on health and quality of life as set out in the NPSE. On this basis, we consider that the noise assessment methodology and conclusions meet the principles set out in the NPPF and NPSE.

8.0 DISCLAIMER

8.1 This document is limited to addressing the specific acoustic issues contained herein, and its content is based on drawings and information provided to date by our Client/their Design Team.

8.2 All findings, comments, recommendations, etc., in this document are for acoustic purposes only; any and all other considerations and requirements, e.g. structural, airflow, thermal, fire safety, CDM compliance, determination of whether materials are dangerous, hazardous, deleterious, etc. (non-exhaustively), are the responsibility of other such suitably qualified specialists to check and advise on.

8.3 BTA's work may occasionally involve provision of acoustic performance advice and acoustic design recommendations that others may choose to regard as a "specification" under CDM 2015 (and thus others may occasionally choose to regard BTA to be a "Designer" under CDM 2015). Notwithstanding this, it is always the responsibility of others (Principal Designer) to approve/incorporate into their final design – or not – their final specification selections; although these may be based on BTA's acoustic performance advice, as BTA neither has control over how or whether BTA's acoustic advice is incorporated into the final design by others, nor any power to enforce that any such final specification selections made by others based on BTA's advice are appropriate in any regard beyond their acoustic performance qualities, it also remains the responsibility of others under CDM 2015 to ensure that any ancillary (non-acoustic) considerations in the course of selection, installation, maintenance, etc. of final specifications are advised upon by such relevantly qualified specialists (non-acoustic, and therefore non-BTA), and that any safety precautions identified in the course of their consideration by others are taken by others (the Principal Designer, Designers, Contractors, Client, etc.).

8.4 Products and materials that perform well acoustically tend to be heavier than standard products. Use of these products and materials may increase the weight of the element, and the CDM Principal Designer, Client, etc. must take care to ensure that this risk is mitigated as far as possible with appropriate changes to their design, and the Client, Principal Contractor, Contractor, Installer, Fitter, etc. must ensure that appropriate and safe lifting and installation techniques, maintenance, etc. are used to reduce any remaining risk. Wherever BTA advises that works such as acoustic barriers are desirable to attenuate noise, care must be taken by the CDM Principal Designer, Client, etc. to ensure that the risks associated with constructing and maintaining bunds, walls, fences, etc. are mitigated as far as possible with appropriate changes to their design, and the Client, Principal Contractor, Contractor, Installer, Fitter, etc. must ensure that appropriate and safe construction and installation techniques, maintenance, etc. are used to reduce any remaining risk.

8.5 This document has been prepared for the sole use, benefit, and information of our direct Client for the purposes agreed at the time of their formal instruction. The liability of BTA in respect of the information contained herein will not extend to any third party.

FIGURE 1 – SITE AERIAL VIEW AND APPROXIMATE MEASUREMENT LOCATION

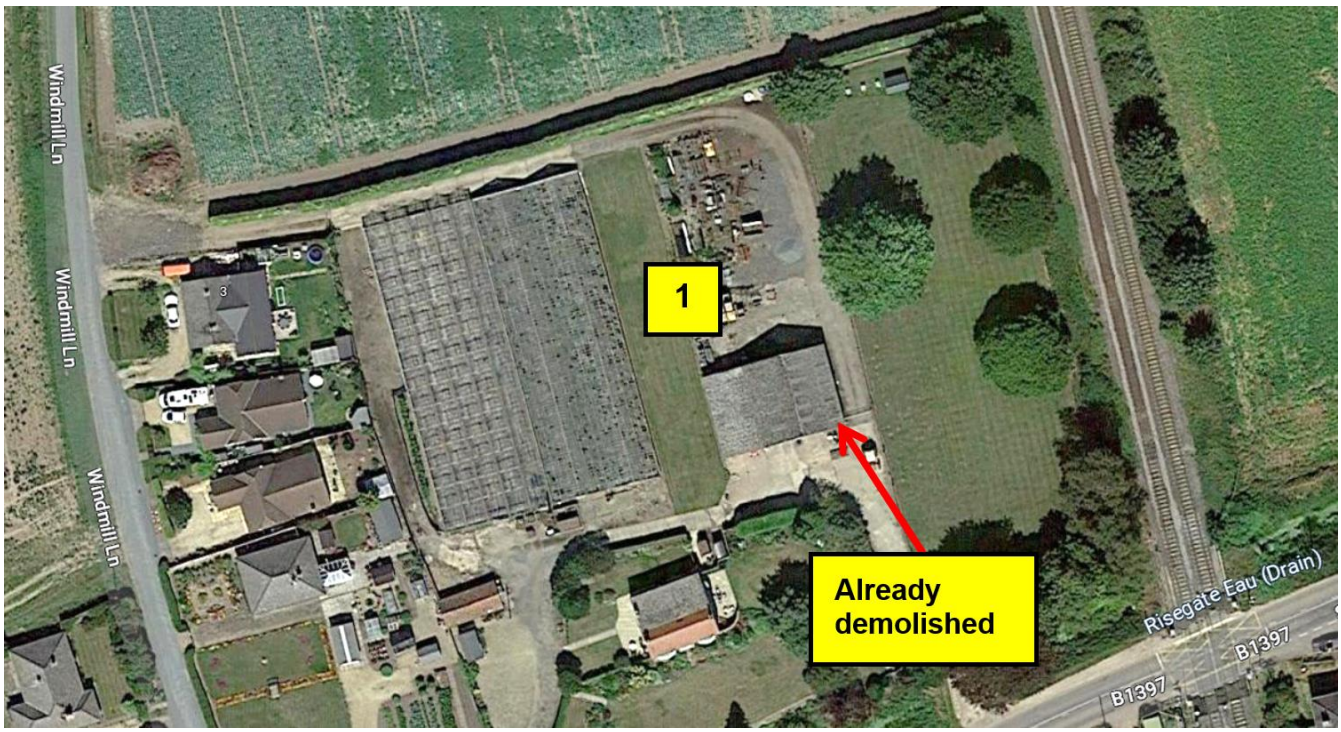


FIGURE 2 – SITE RED LINE AND INDICATIVE PROPOSED SITE LAYOUT PLAN



APPENDIX 1 – TECHNICAL UNITS AND INDICES

a) Sound Pressure Level and the decibel (dB)

A sound wave is a small fluctuation of pressure in air. The human ear responds to these variations in pressure, producing the sensation of hearing. The ear can detect a very wide range of pressure variations. Due to the wide range of pressure variations detectable by the ear, a logarithmic scale is used to convert the values into manageable numbers. The dB (decibel) is the logarithmic unit used to describe sound (or noise) levels. The usual range of sound pressure levels is from 0 dB (threshold of hearing) to 120 dB (threshold of pain).

b) Frequency and Hertz (Hz)

Frequency is a measure of the rate of fluctuation of a sound wave. The unit used is cycles per second, or Hertz (Hz). Sometimes large frequencies are often written as kilohertz (kHz), where 1kHz = 1000Hz.

Young people with normal hearing can hear frequencies in the range 20Hz to 20kHz. However, the upper frequency limit gradually reduces as a person gets older.

As the ear hears some frequencies better than others, the A-weighting scale is used to mimic human hearing. A-weighing applies a correction to the sound level at a given frequency depending on how well the ear hears that frequency.

c) Glossary of Terms

In order to describe noise where the level is continuously varying, a number of other indices, including statistical parameters, are used. The indices used in this report are described below.

L_{Aeq} This is the A-weighted equivalent continuous sound level which is an average of the total sound energy measured over a specified time period. In other words, L_{Aeq} is the level of a continuous noise which has the same total (A-weighted) energy as the real fluctuating noise, measured over the same time period.

L_{Amax} This is the maximum A-weighted sound level that was recorded during the monitoring period.

L_{A90} This is the A-weighted sound level exceeded for 90% of the time period. L_{A90} is used as a measure of background noise.

L_{A10} This is the A-weighted sound level exceeded for 10% of the time period and is often used in the assessment of road traffic noise.

SEL This is the Single Event Level or Sound Exposure Level. The SEL is the total energy measured over the event, compressed into 1 second. SEL= L_{Aeq}+10log(t), where t is time in seconds. Also L_{Aeq} = SEL - 10log(t) + 10log(n) where t is time in seconds and n is the number of events in the time period.

NR Measured noise levels in each octave band are compared to the NR curve reference values. The overall NR value is the lowest NR curve that has not been exceeded.

$D_{nT,w}$ Weighted standardised level difference, a single figure generated by comparing the D_{nT} with a reference curve. The reference curve is shifted in 1dB steps until the sum of adverse deviation of the test curve, compared to the reference curve, is as large as possible, but no more than 32.0 dB. The value of the shifted reference curve at 500Hz is taken as the $D_{nT,w}$. N.B. As $D_{nT,w}$ for airborne transmission represents a level difference, an improvement generates a larger figure – used in airborne tests.

R_w Similar to the $D_{nT,w}$ term, but a measure of the airborne sound insulation performance of a separating element, when tested in laboratory conditions. As such the build is essentially perfect, and has no flanking noise routes. $D_{nT,w}$ values measured onsite will always be of a significantly lower value than the R_w value for a structure.

VDV Vibration Dose Value: cumulative measurement of the vibration level received over a given period. It is the integrated fourth power vibration value with units $ms^{-1.75}$ and has the advantage of sensitivity to vibration peak levels.

PPV Peak Particle Velocity: Instantaneous maximum velocity reached by a vibrating element as it oscillates about its rest position.

APPENDIX 2 – NOISE SURVEY MEASUREMENT DATA

Measurement locations were 'free-field', i.e. suitably distant from acoustically reflecting surfaces and structures (other than the ground) to minimise the influence of reflections.

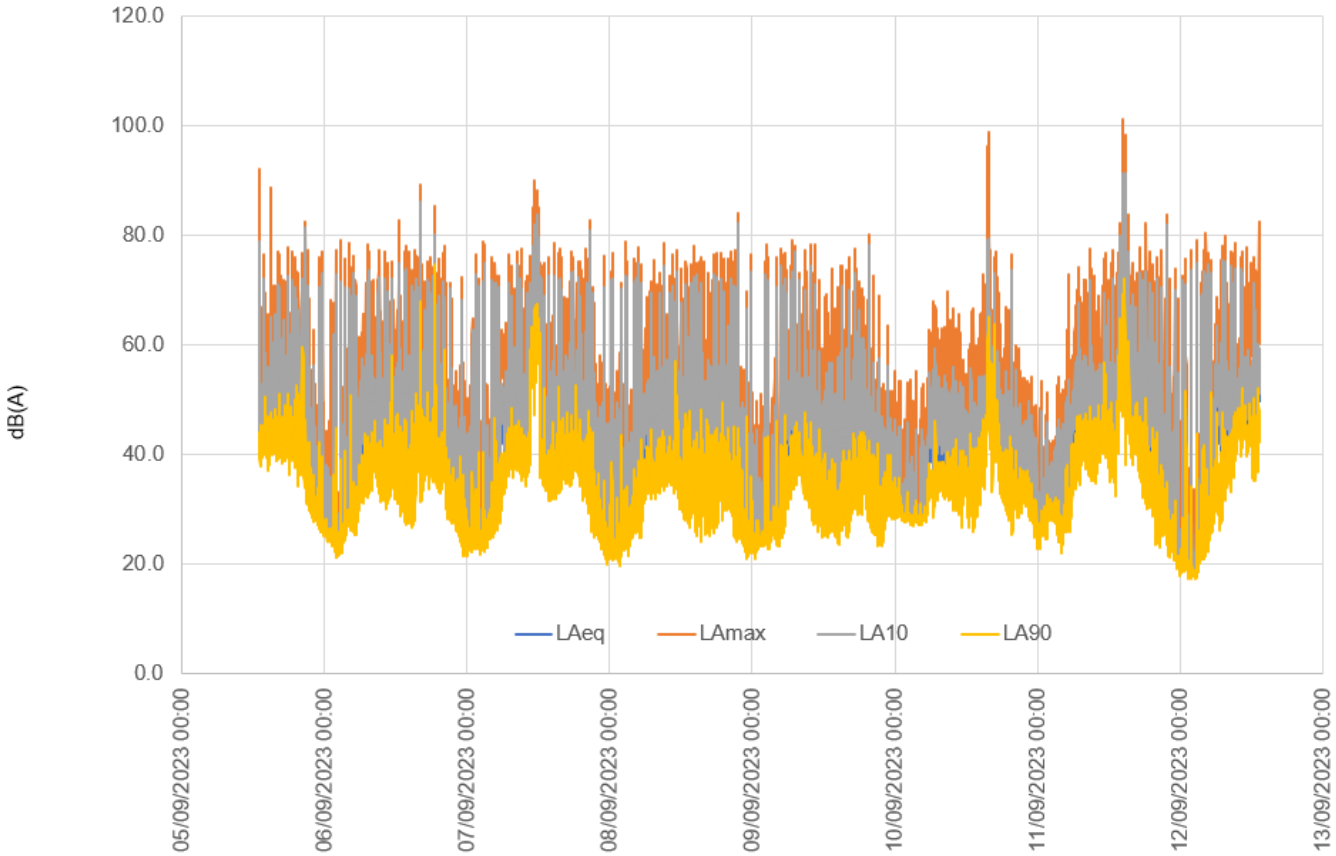
Location 1 – Eastern site boundary

Rion NL-52 sound level meter (S/N 01021309). All values dB(A), 1-minute measurement periods.

Passing trains are visible as distinct spikes in the L_{Amax} measurement data, although other sources generate the maximum values in any minute where there is no train event.

Passing trains are the dominant noise source at this location. Other observed sources of noise included distant traffic, wildlife/birdsong, and occasional distant aircraft.

Chart A1: Primary full dataset



The full dataset includes some measurements collected while the weather conditions were not agreeable, i.e. during rainfall or windspeeds >5m/s.

Work was also underway onsite to erect a marquee on Tuesday 12/09/2023, and grass-cutting additionally took place in close proximity to the microphone on 2no occasions during the installation period.

Removing these affected data measurement periods leaves the primary dataset L_{Aeq} and L_{Amax} values shown below.

Chart A2: Daytime data

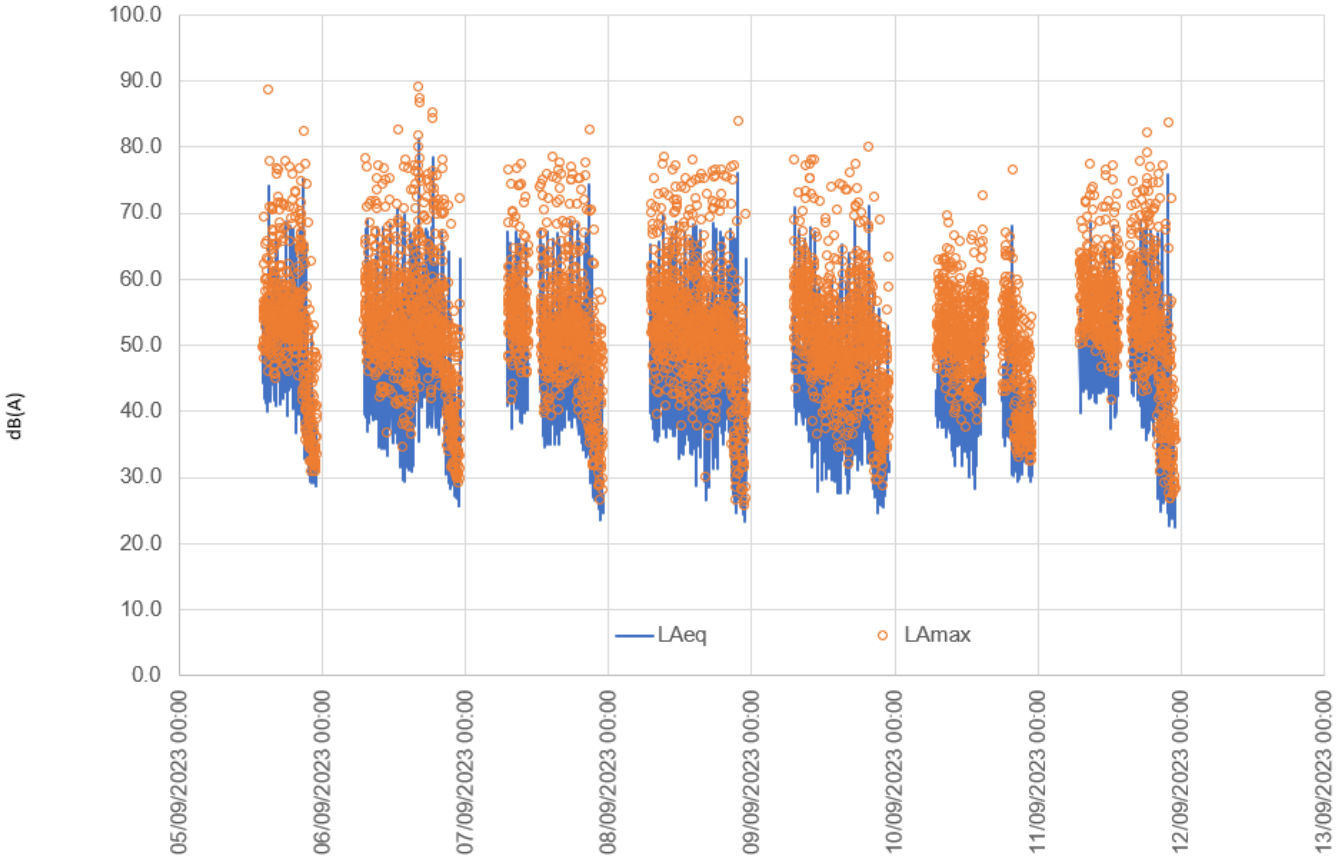


Chart A3: Nighttime data

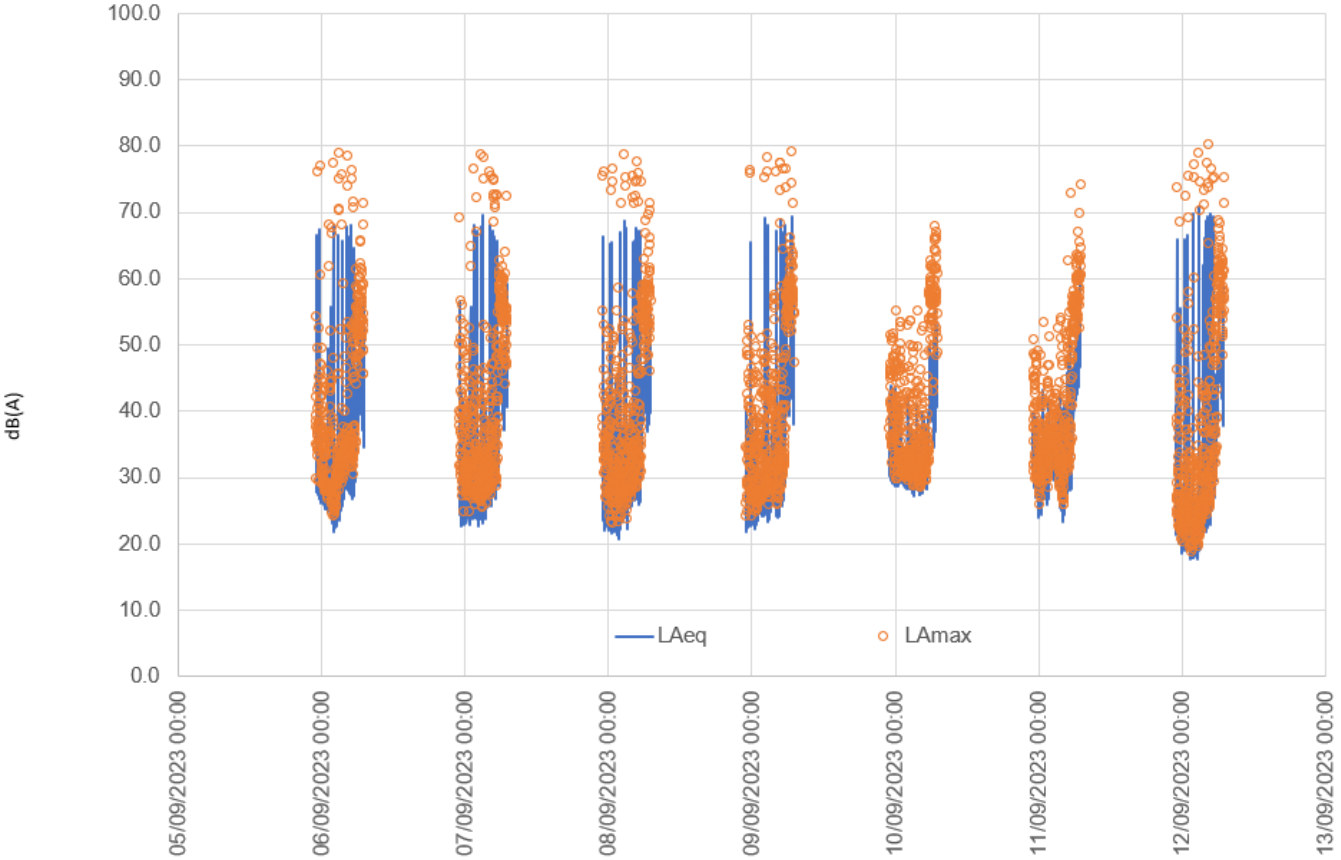
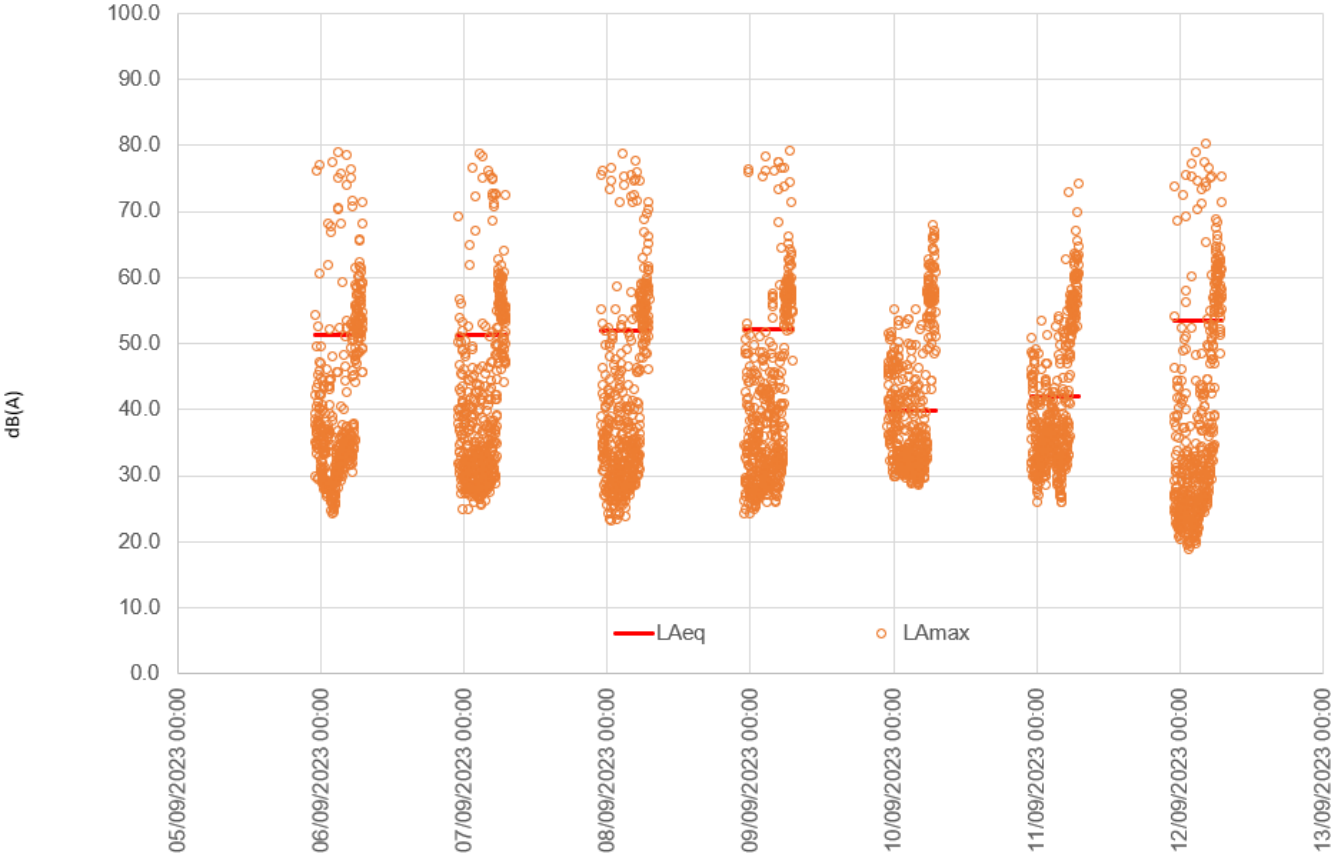


Chart A4: Daytime data with calculated 16-hour L_{Aeq} values



Daytime	16-hour dB L_{Aeq}	Highest dB L_{Amax}
06/09/2023	58.1	89.2
07/09/2023	53.4	82.7
08/09/2023	53.5	83.9
09/09/2023	50.5	80.1
10/09/2023	44.6	76.6
11/09/2023	53.4	83.7

Chart A5: Nighttime data with calculated 8-hour L_{Aeq} values



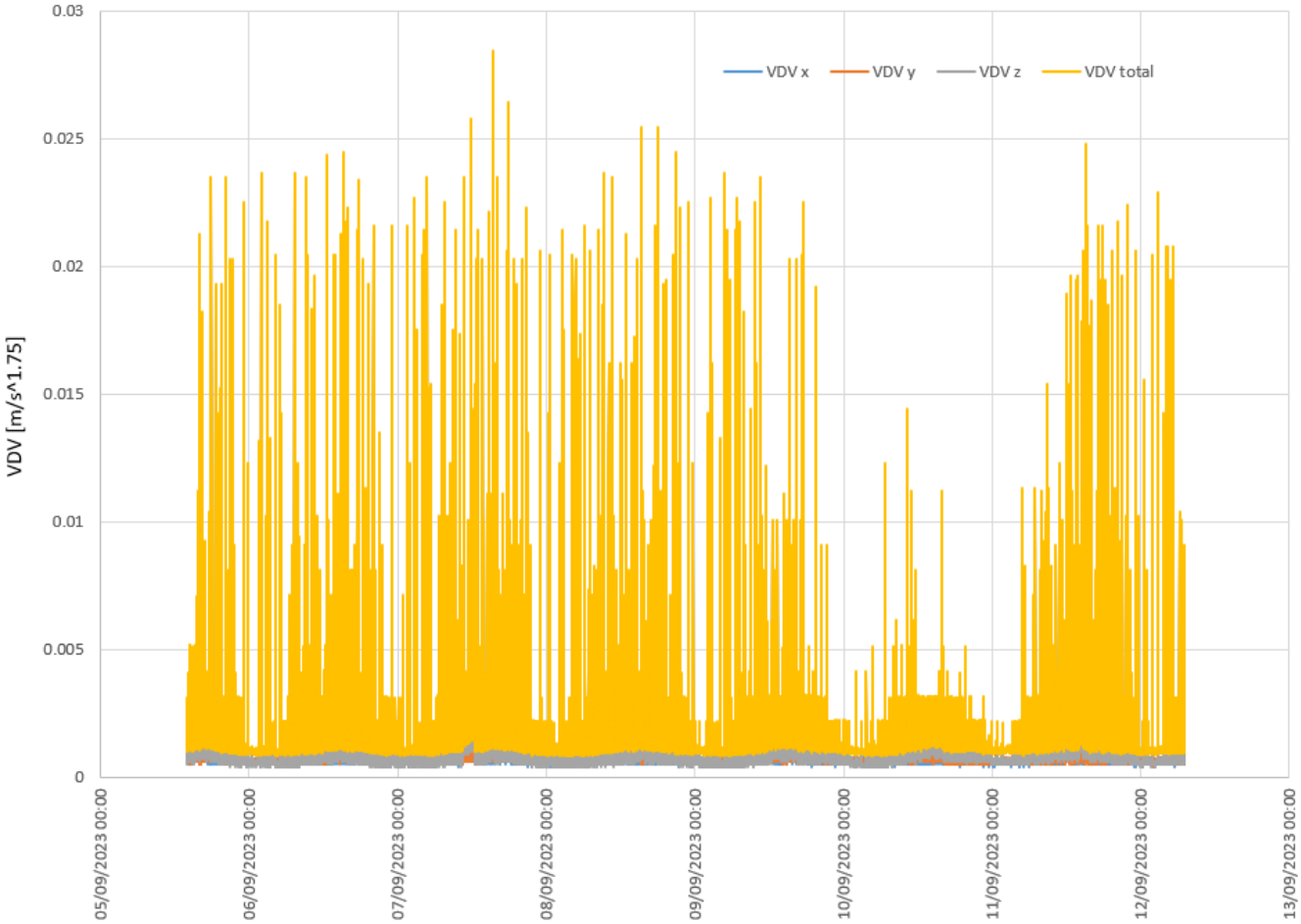
Nighttime	8-hour dB L_{Aeq}	Highest dB L_{Amax}
05/09/2023	51.3	79.0
06/09/2023	51.3	78.7
07/09/2023	52.0	78.8
08/09/2023	52.1	79.2
09/09/2023	39.9	67.9
10/09/2023	42.0	74.2
11/09/2023	53.5	80.3

APPENDIX 3 – VIBRATION SURVEY MEASUREMENT DATA

Location 1 – Eastern site boundary

Svan 958A vibration level meter (S/N 45582). All values in $ms^{-1.75}$, 20-second measurement periods.

Chart A6: VDV data



Daytime	16-hour VDV m/s$^{1.75}$
06/09/2023	0.0547
07/09/2023	0.0592
08/09/2023	0.0545
09/09/2023	0.0450
10/09/2023	0.0205
11/09/2023	0.0526

Nighttime	8-hour VDV m/s$^{1.75}$
05/09/2023	0.0395
06/09/2023	0.0415
07/09/2023	0.0444
08/09/2023	0.0439
09/09/2023	0.0150
10/09/2023	0.0170
11/09/2023	0.0414

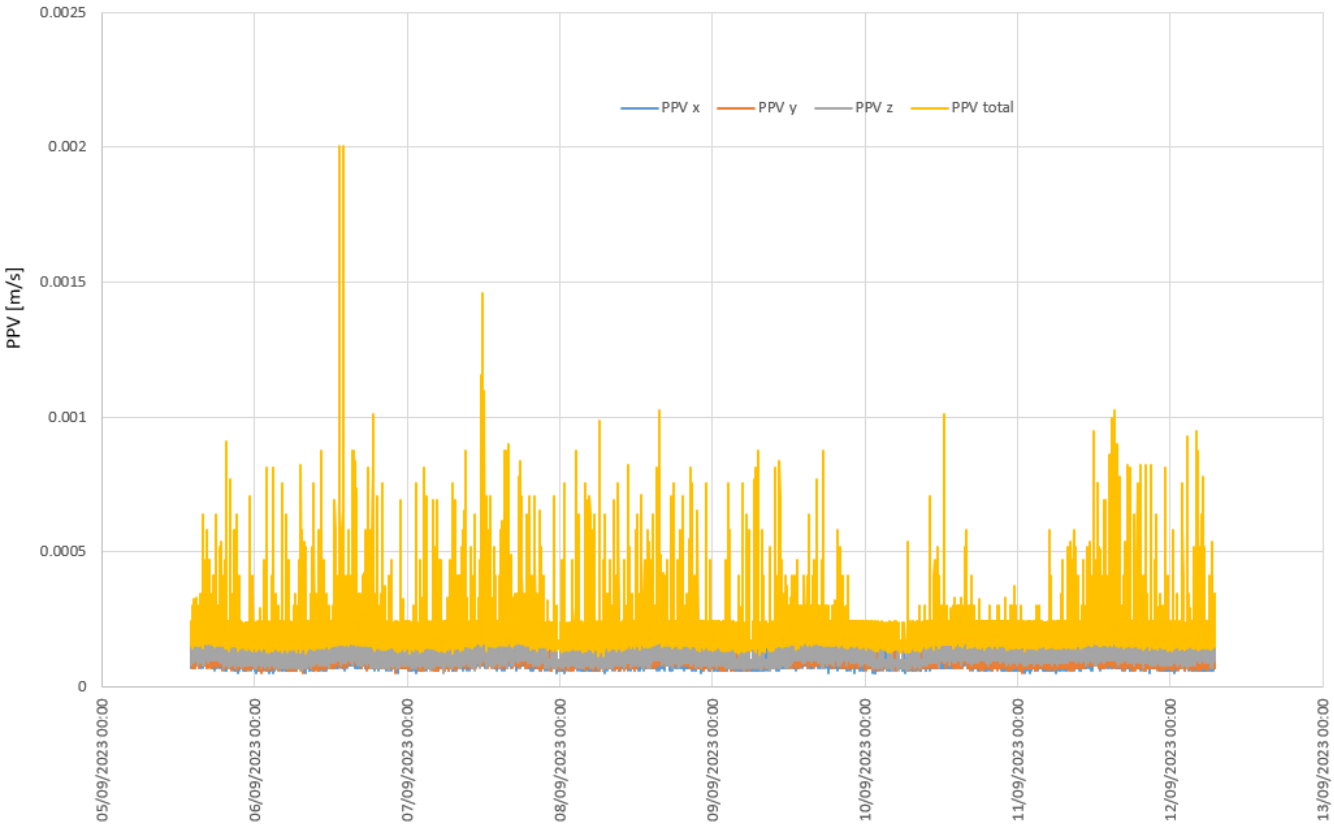
The highest of all of the above 16-hour or 8-hour VDV values is <0.1m/s$^{1.75}$, and therefore below the low probability of adverse comment threshold of BS6472-1.

The table titled 'Vibration dose value ranges which might result in various probabilities of adverse comment within residential buildings' is reproduced below for reference:

Vibration dose value ranges which might result in various probabilities of adverse comment within residential buildings

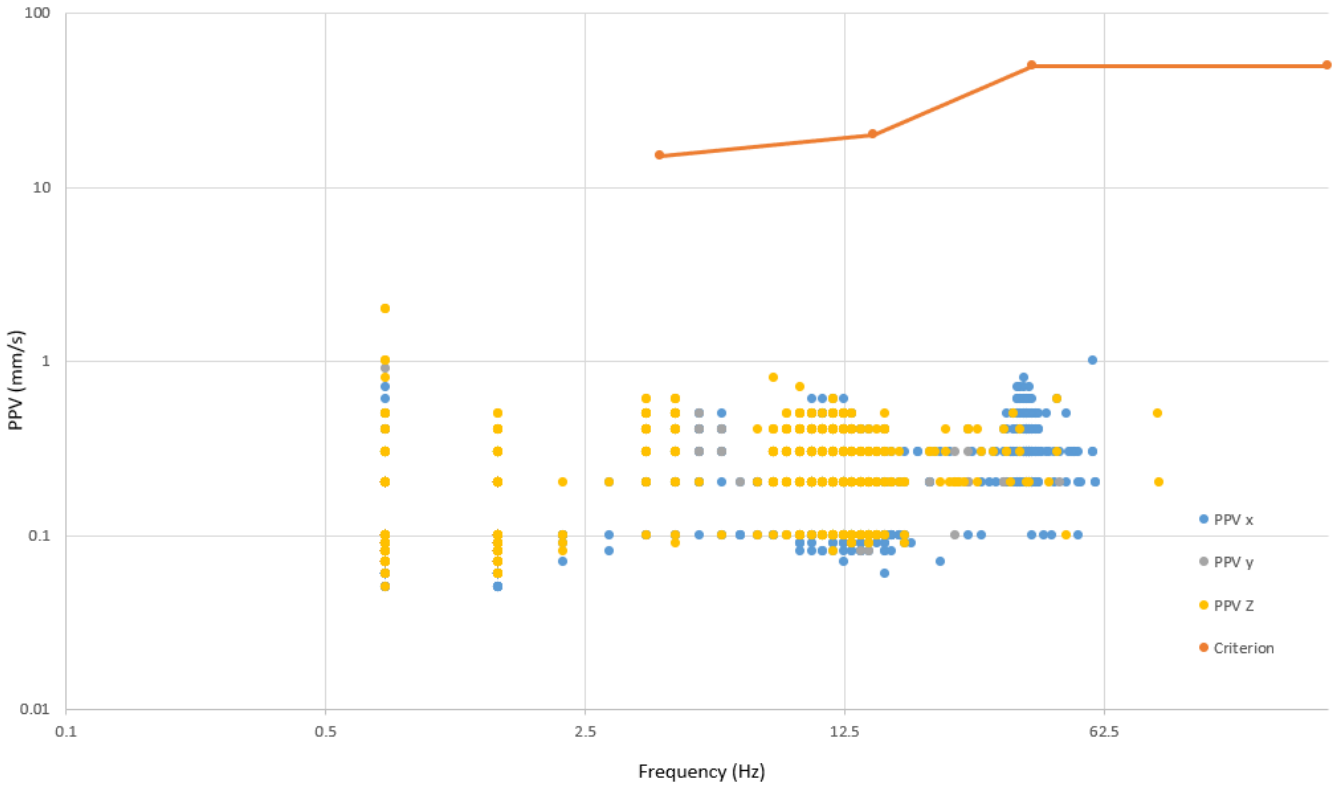
Place and time	Low probability of adverse comment $m \cdot s^{-1.75}$ 1)	Adverse comment possible $m \cdot s^{-1.75}$	Adverse comment probable $m \cdot s^{-1.75}$ 2)
Residential buildings 16 h day	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential buildings 8 h night	0.1 to 0.2	0.2 to 0.4	0.4 to 0.8

Chart A7: PPV data



The highest PPV value is 0.002005m/s = 2.05mm/s.

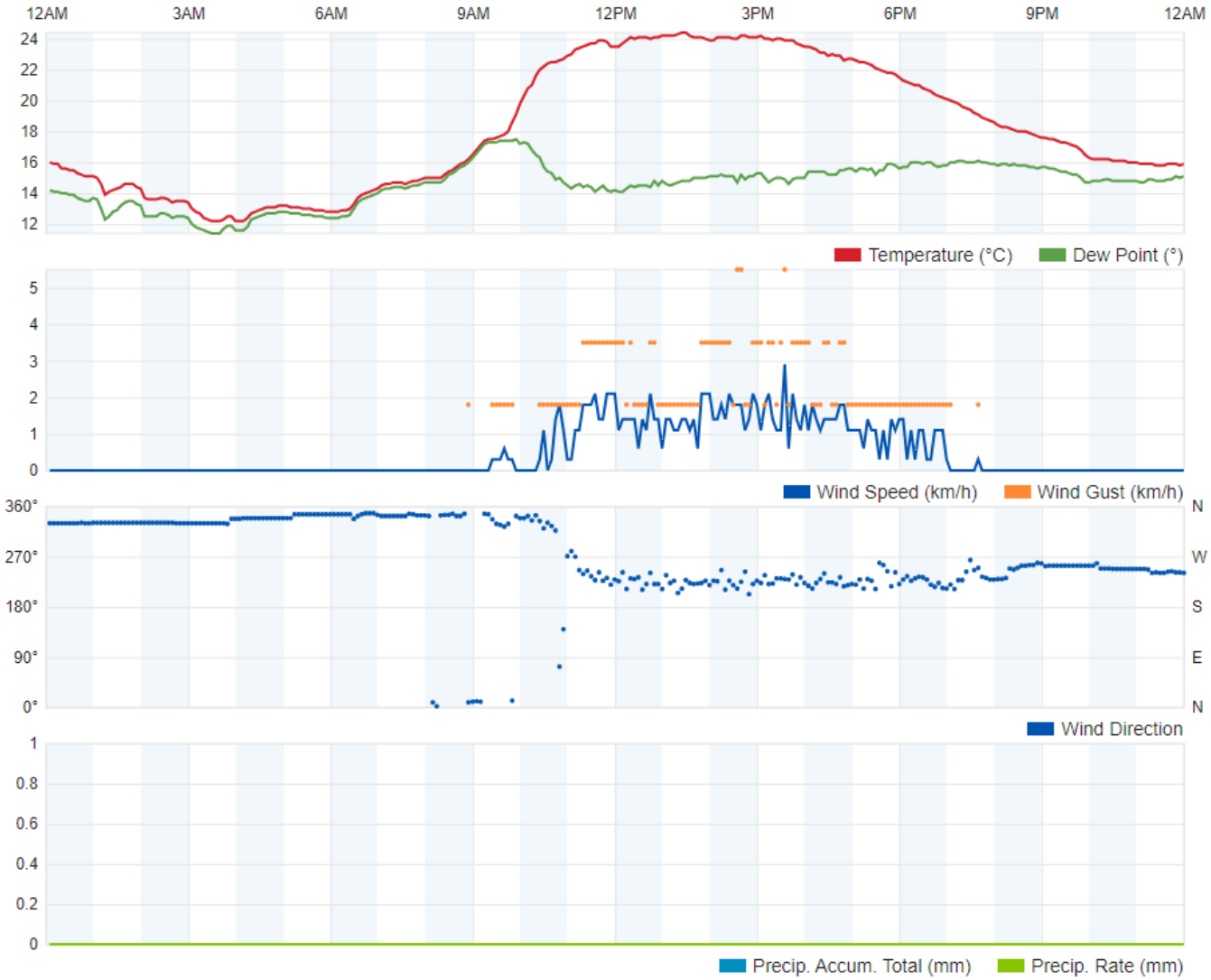
Chart A8: PPV data compared to BS7385-2 criteria



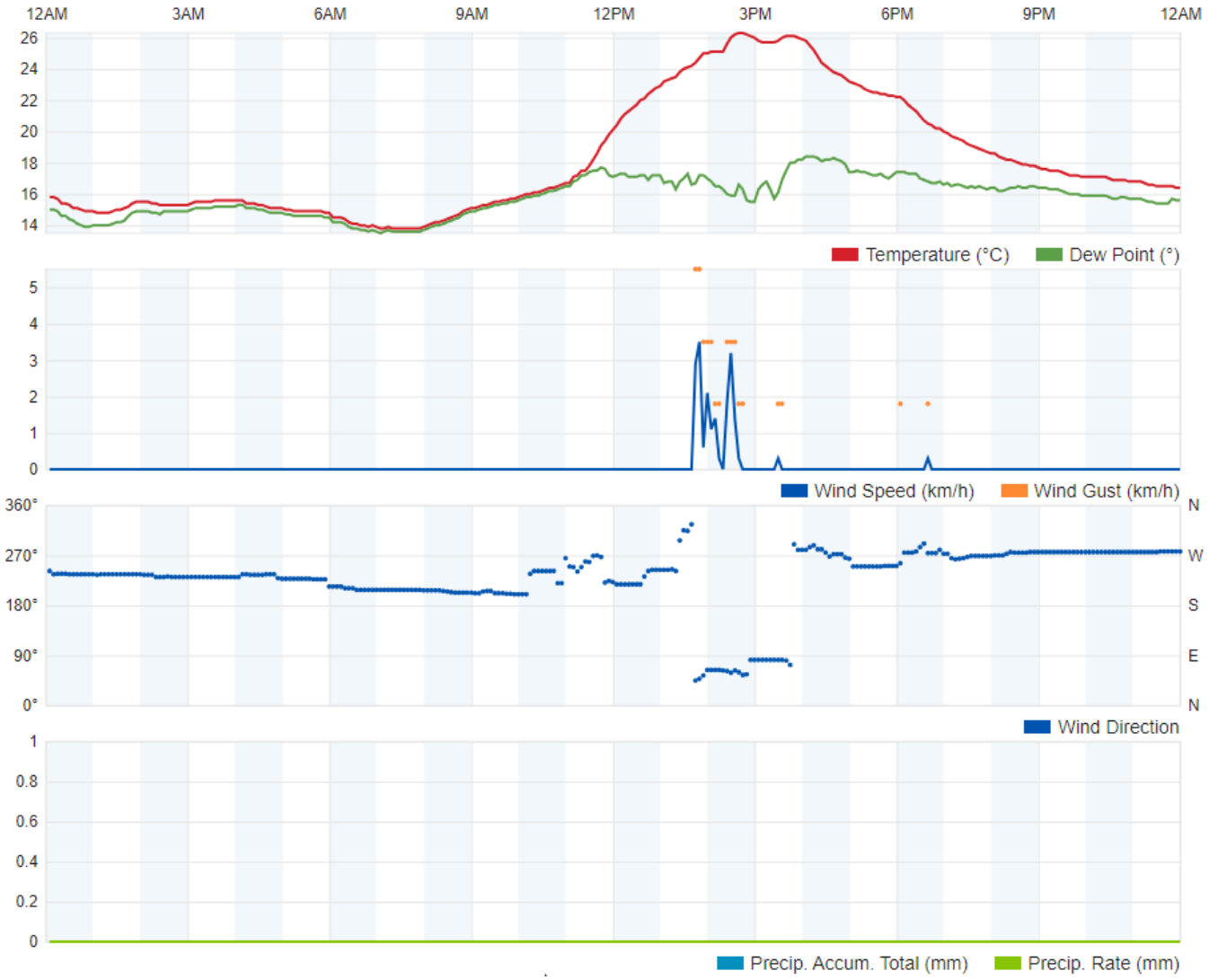
The lowest criteria value is 15mm/s. The highest measured value is 2mm/s.

APPENDIX 4 – WEATHER DATA

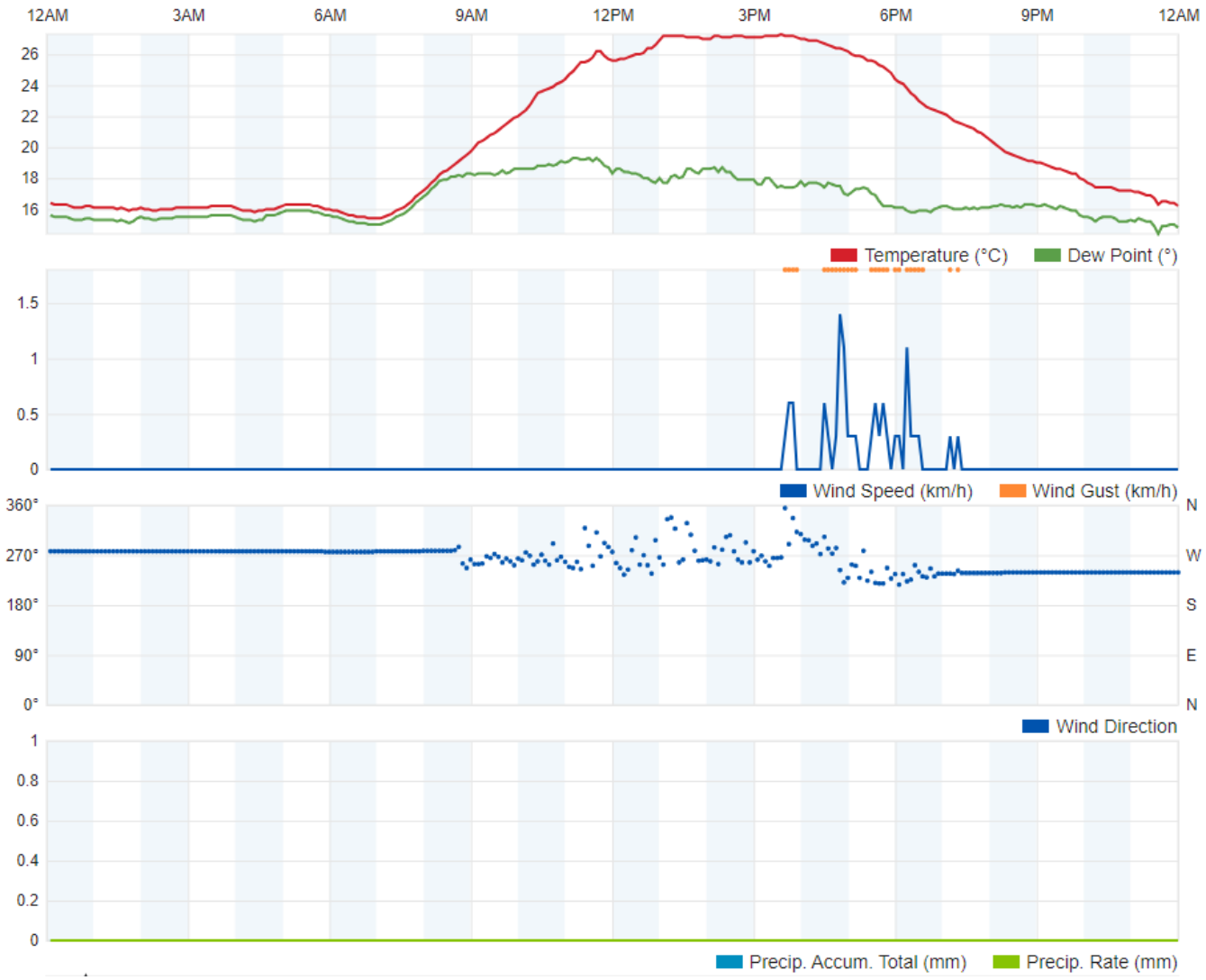
Tuesday 05/09/2023



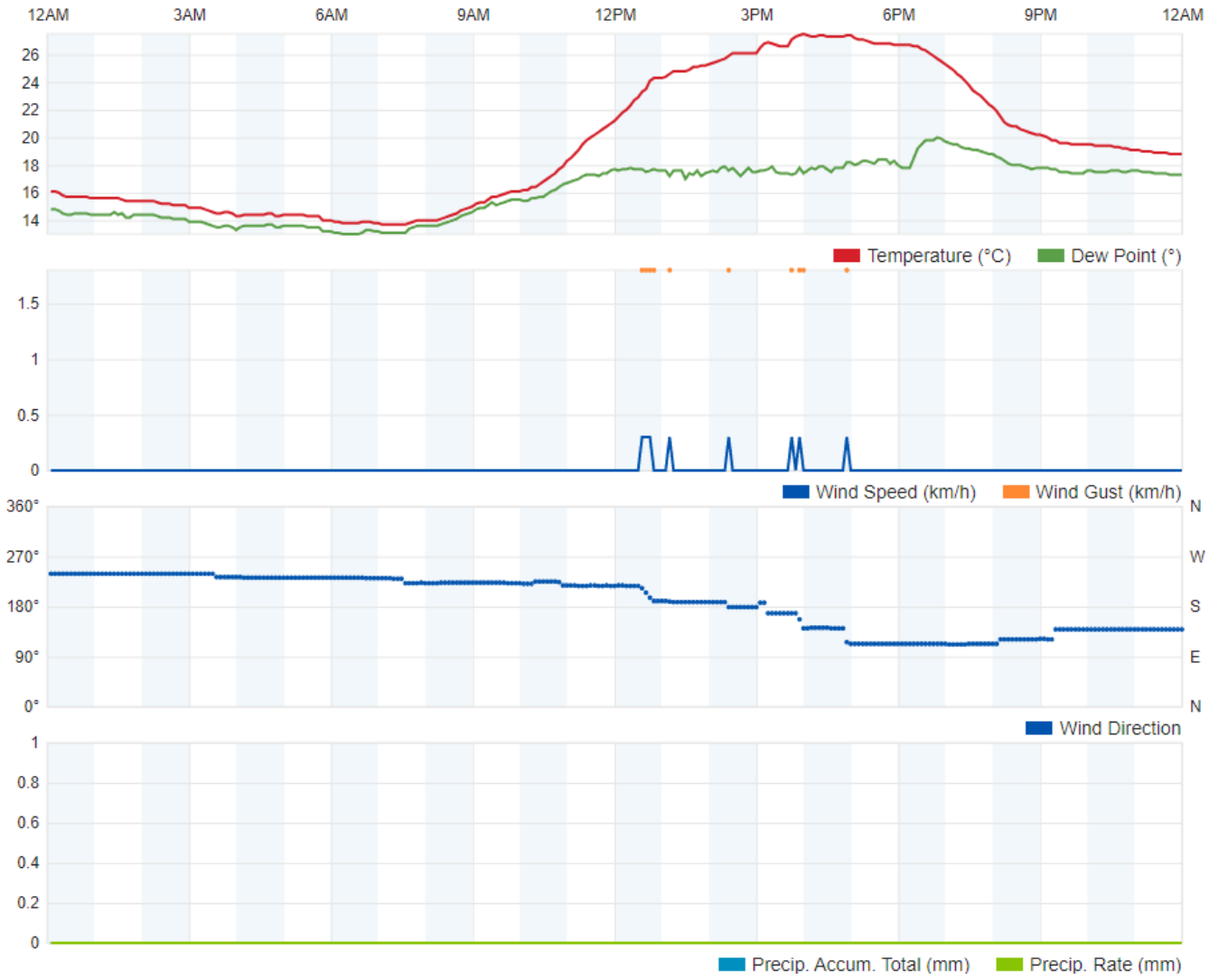
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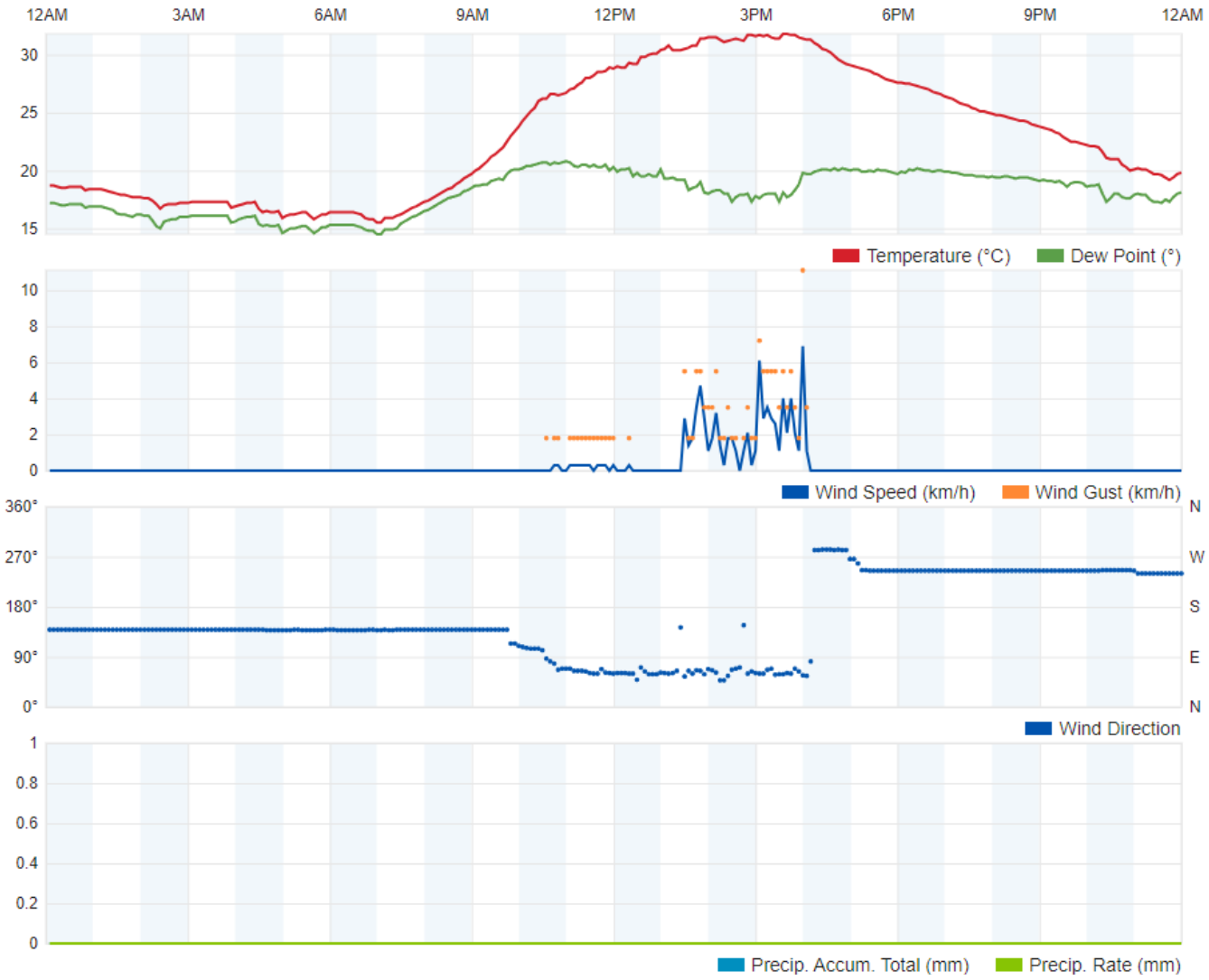
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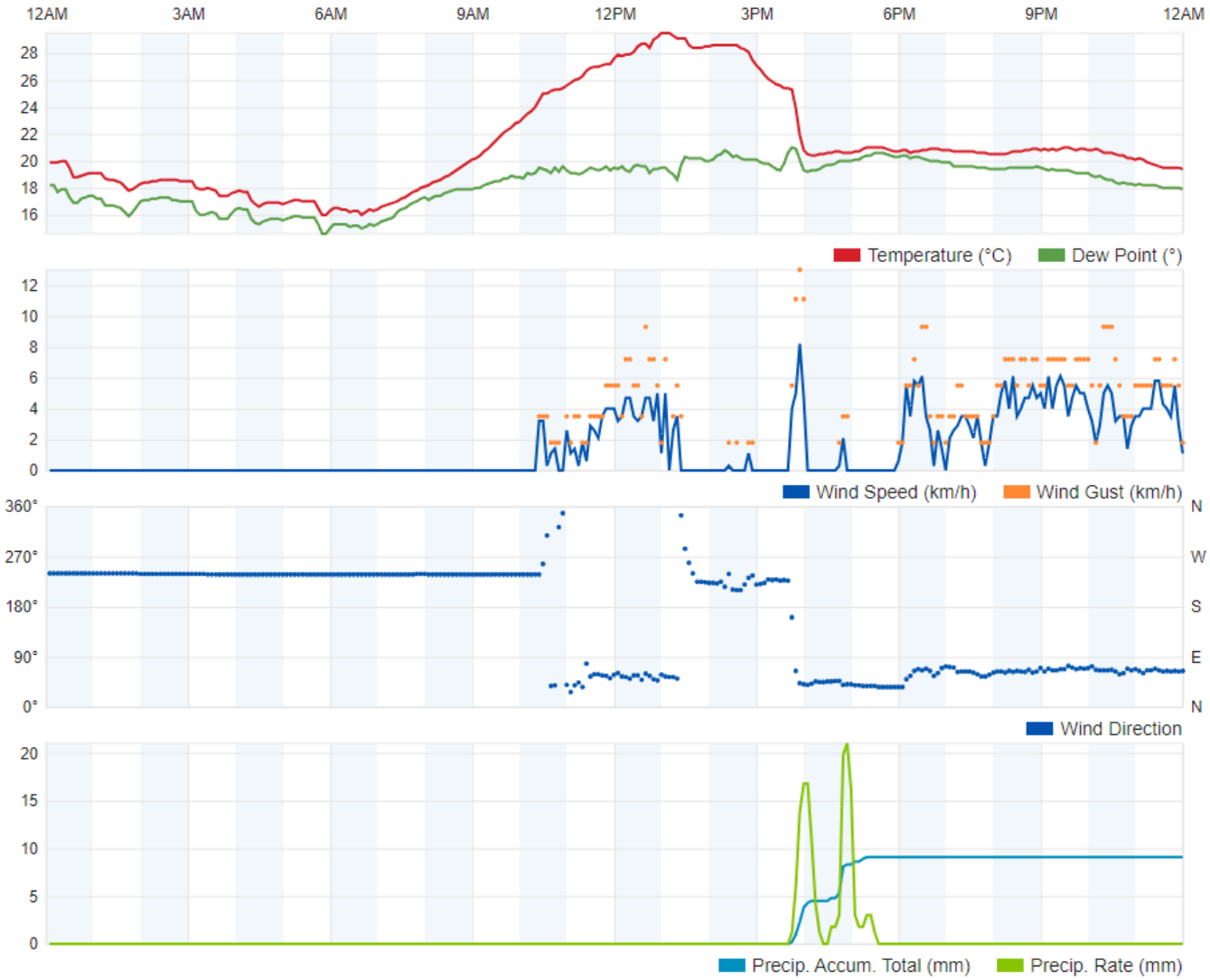
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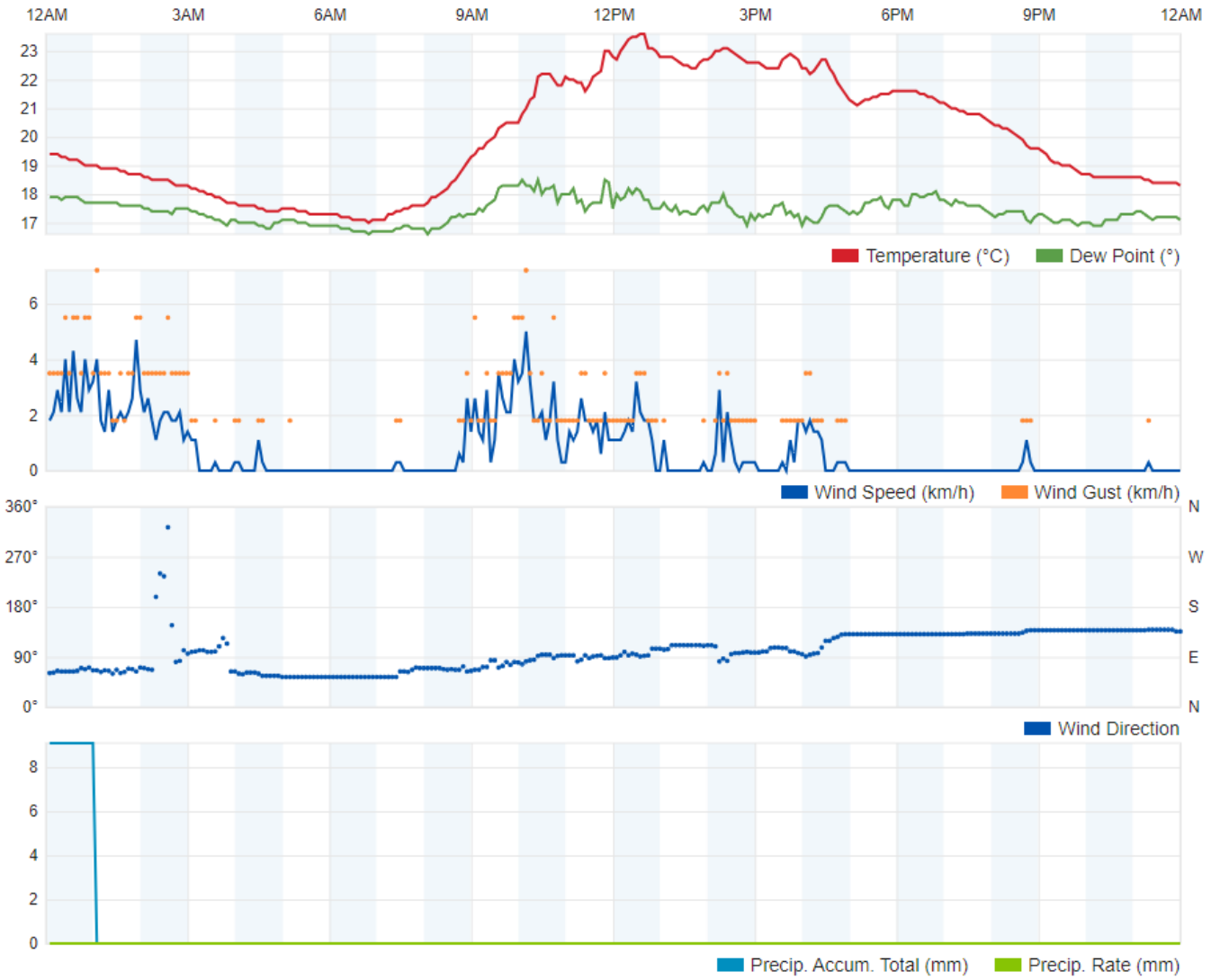
Saturday 09/09/2023



Sunday 10/09/2023



Monday 11/09/2023



Tuesday 12/09/2023

