Trumpington South

Noise Assessment - Feasibility Study

0044912

24 February 2020

Revision 03

Revision	Description	Issued by	Date	Checked
00	For issue	DB	07-02-2020	DP
01	Updated to architectural massing option	DB	19-02-2020	BFB
02	Incorporating GD comments	DB	20-02-2020	BFB
03	Incorporating GD comments	DB	24-02-2020	BFB

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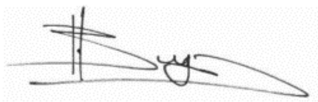
signature	
date	**24-02-2020**

Contents

Table of Tables

Table of Figures

Glossary

Term	Definition
$L_{Aeq,T}$	Equivalent continuous sound pressure level (A-weighted) over a period of time, T.
$L_{AFmax,T}$	The maximum sound pressure level measured during the measurement period T using the fast time constant.
Decibel, dB	Commonly used unit used for the comparison of the powers of levels sound. Abbreviation dB. Is the unit of level derived from the logarithm of the ratio between the value of a quantity and a reference value For sound pressure level (L_p) the reference quantity is $2x10^{-5}$ N/m^2. The sound pressure level existing when microphone measured pressure is $2x10^{-5}$ N/m^2 is 0 dB, the threshold of hearing.
L_{eq} (& L_{Aeq})- Equivalent continuous noise level of a time-varying noise	Steady noise level (usually in dB(A)) which, over the period of time under consideration, contains the same amount of sound energy as the time-varying noise over the same period of time.
L_p - sound pressure level	Sound pressure level, in decibels, of a sound is 20 times the logarithm to the base of 10 of the ratio of the sound pressure to the reference pressure. The reference pressure shall be explicitly stated and is defined by standard.
Frequency (Hz)	Number of cycles per second, measured in hertz (Hz), related to sound pitch.
Weightings (as defined in IEC 61672:2003):	A-Weighting: Frequency weighting devised to attempt to consider the fact that human response to sound is not equally sensitive to all frequencies; it consists of an electronic filter in a sound level meter, which attempts to build in this variability into the indicated noise level reading so that it will correlate, approximately, with human response.). C-Weighting: One of the frequency weightings corresponding to the 100-phon contour and the closest to the linear or un-weighted value.

1 Executive Summary

- The proposed development of Trumpington South is considered suitable for residential development;
- This Feasibility Study demonstrates that noise should not form a barrier to residential development at the site and can achieve the requirements of the Greater Cambridge Supplementary Planning Document, as:
  - Target internal ambient noise levels can be achieved; and
  - Target external ambient noise levels can be achieved.
- It has been demonstrated that:
  - The proposed massing screens external amenity areas, resulting in suitable external ambient noise levels; and
  - Passive mitigation measures can be installed to provide suitable internal ambient noise levels.
- Detailed design mitigation measures will be developed as the detailed design of the Trumpington South site progresses.

2 Introduction

2.1 Overview

BuroHappold (BH) have been appointed by Grosvenor Britain and Ireland to carry out a Noise Impact Assessment for the proposed Trumpington South development located on the border of South Cambridgeshire District Council (SCDC) and Cambridge City Council (CCC). This feasibility assessment is prepared to support the proposed residential-led development of the site.

1.2 Scope

The assessment details the potential noise impact of the existing noise climate upon proposed massing, with this information provided by Terence O'Rourke . The assessment also looks at how the development's massing could impact the success of the acoustic design. In summary, the assessment includes the following:

- Required performance criteria for residential amenity, based on Local Planning Authority guidelines;
- External noise levels (from the survey);
- Results of a 3D computer noise model considering a possible site layout, with a bund located along the site boundary (southern) with the M11;
- Commentary on building layouts; and
- Indicative façade acoustic performance and ventilation treatments.

Recommendations within this report are in line with relevant Standards and pertinent Planning Policy, both national and local. The Local Planning Authority (LPA) is the South Cambridge District Council (SCDC).

3 Acoustic Design Criteria

3.1 Introduction

In order to provide suitable acoustic design advice in relation to massing options, the following acoustic design information is considered.

3.2 Relevant Guidance Documentation

This report is informed by the following standards and guidelines:

Primary Guidance / Policy:

- The National Planning Policy Framework, 2019 (NPPF);
- The Noise Policy Statement for England, 2010 (NPSE); and
- Greater Cambridge Sustainable Design and Construction Supplementary Planning Document.

Secondary Guidance / Policy:

- ProPG: *Planning and Noise – Professional Practice Guidance on Planning and Noise – New Residential Development,* May 2017;
- British Standard (BS) 8233:2014 - *Guidance on sound insulation and noise reduction for buildings*; and
- World Health Organisation (WHO) – *Guidelines for community noise*.

3.3 English Planning Policy on Noise Impact – The NPPF and NPSE

The NPPF is the overarching Planning Policy document that applies to all new developments in England. The guidance and assessment criteria given (or referred to) in this document is relevant to other standards in terms of assessing the suitability of granting Planning Permission with respect to noise impact.

The NPPF states that planning policies and decisions should aim to:

"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; and

identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason."

With specific reference to noise impact, the NPPF document refers to the Noise Policy Statement for England (NPSE). The NPSE provides guidance, which enables decisions to be made regarding the acceptable noise burden to place on society, using three key phrases – the No Observed Effect Level (NOEL), the Lowest Observed Adverse Effect Level (LOAEL) and the Significant Observed Adverse Effect Level (SOAEL).

In order to provide a consistent frame of reference (and to allow a view to be taken on the suitability of an application with reference to the relevant planning guidance), the levels or criteria given in other relevant documents used in the assessment will be re-framed as shown in Table 3—1.

Table 3—1 NOAEL, LOAEL and SOAEL

Effect Level	Description
NOEL	The NOEL is the level of noise impact below which no effect can be detected, and there would be no discernible negative effect on health or quality of life.
LOAEL	The LOAEL is the lowest level of noise impact above which adverse effects on health or quality of life can be detected. Designing noise impacts to be equal-to-or-less-than, the LOAEL should see that any adverse effects on health or quality of life are negligible.
SOAEL	The SOAEL is the level above which significant adverse effects on health and quality of life occur. Designs should always seek to avoid a noise impact, which would be categorised as a SOAEL.

3.4 Greater Cambridge Sustainable Design and Construction Supplementary Planning Document

3.4.1 Introduction

Key points which form the Greater Cambridge Supplementary Planning Document (SPD) are included in the sub-sections below.

3.4.2 Reference to the NPPF

The NPPF is referred to within Para 3.6.64 of the SPD, and has been modified to establish a noise assessment process, this process is shown in Figure 3—1.

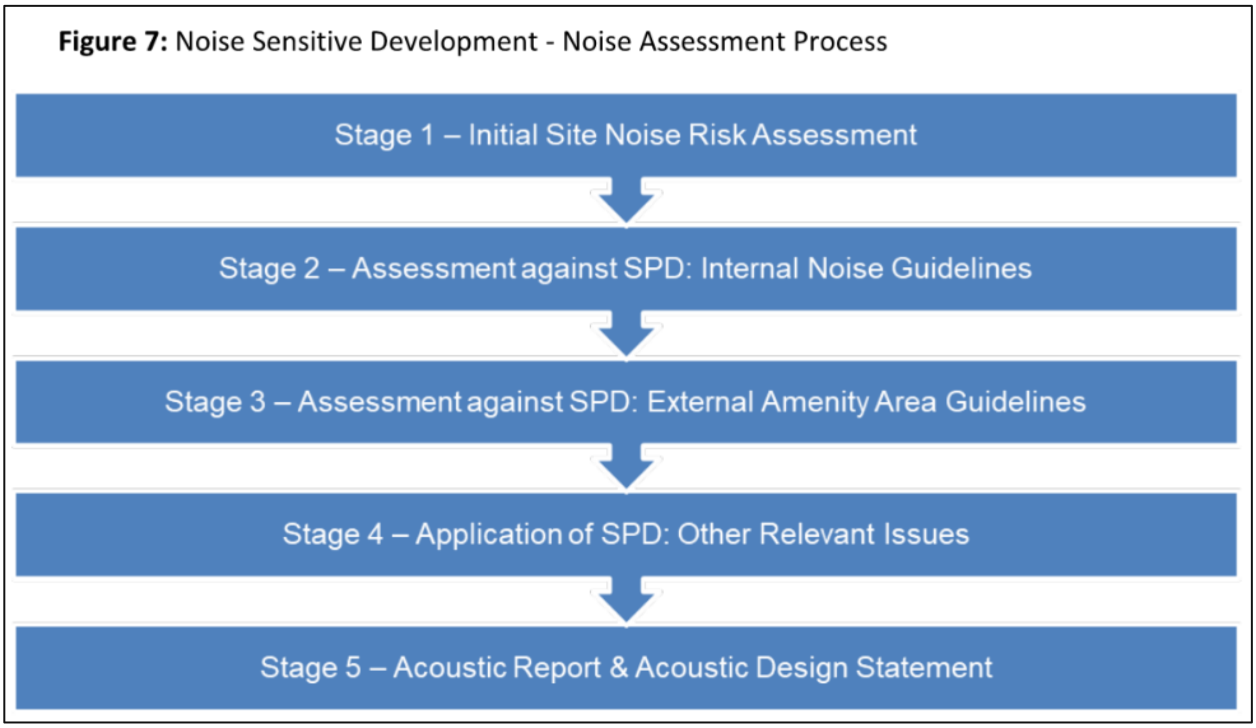


Figure 3—1 Noise sensitive development – Noise assessment process (Greater Cambridge SPD)

3.4.3 Stage 1 Assessment – An overview of the site noise levels

A Stage 1 assessment should follow the information as laid out within Figure 1 of ProPG, this is reproduced in Figure 3—2.

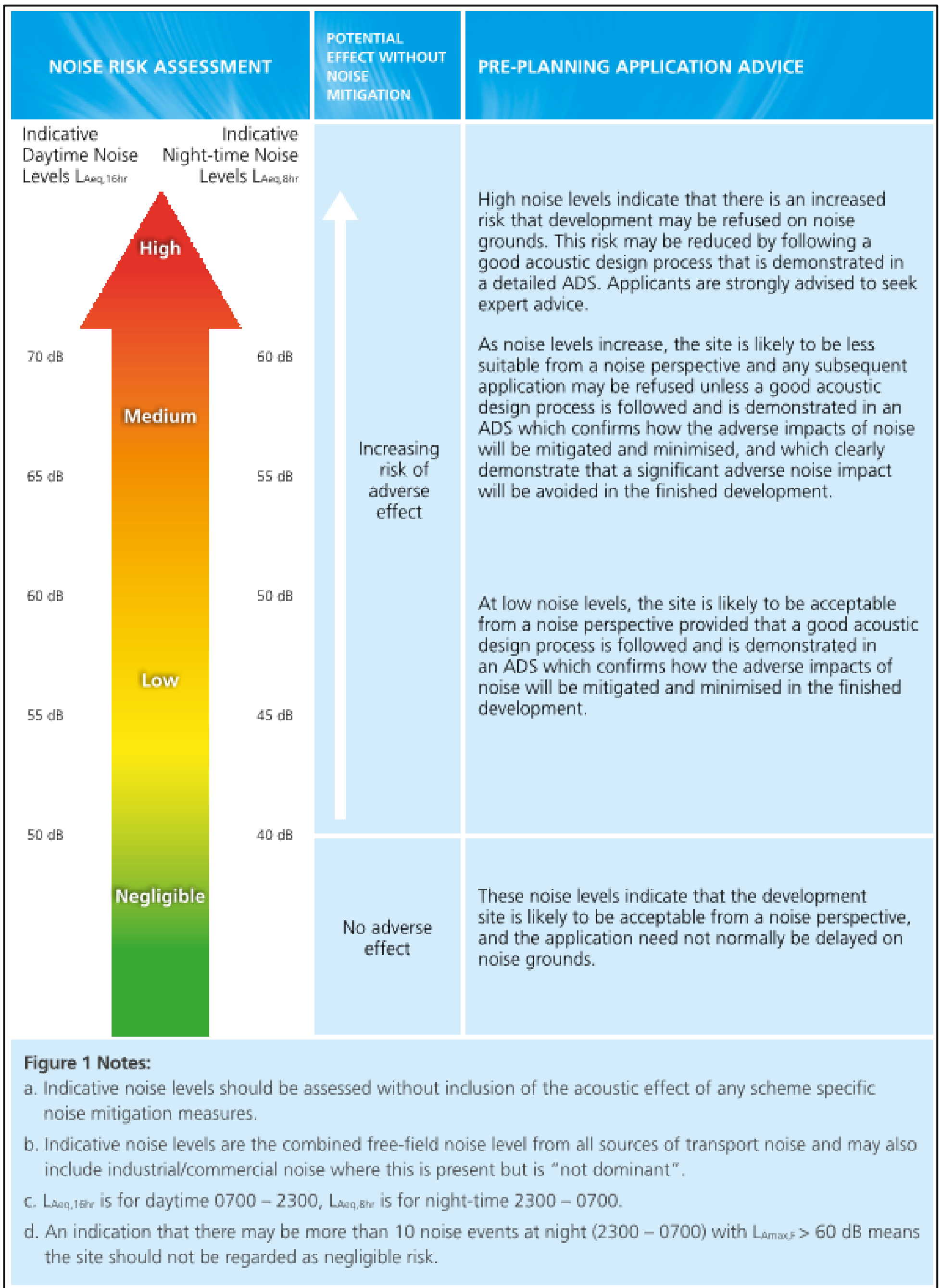


Figure 1. Stage 1– Initial Site Noise Risk Assessment

Figure 3—2 Stage 1 – Initial site noise risk assessment (Figure.1 ProPG, 2017)

It is considered that the level of detail provided as part of this Feasibility Study is appropriate in forming the requirements of a Level 1 assessment.

3.4.4 Stage 2 assessment – Internal design noise levels

BS 8233:2014 guidance is referred to within Para 3.6.74 of the SPD. A table of target internal noise limits for residential developments is also displayed and this is reproduced in Figure 3—3. These target noise levels guide the information provided in this Feasibility Statement and should be used as definitive design criteria as part of a noise impact assessment for planning.

Situation / Activity	Location	07:00 – 23:00 hrs.	23:00 – 07:00 hrs.
Resting, listening and communicating	Living room	35 dB LAeq,16 hour	
Dining	Dining room/area	40 dB LAeq, 16 hour	
Sleeping (daytime resting)	Bedroom	35 dB LAeq,16 hour	30 dB LAeq, 8 hour
Sleeping	Bedroom		45 dB LAMax (several times in any one hour)

Figure 3—3 Target internal noise limits for residential development (Greater Cambridge SPD)

A key footnote to the internal residential noise limits is shown in Figure 3—4. This is considered as part of the modelling exercises completed as part of this Feasibility Study.

(v) If relying on closed windows to meet the guide values, there needs to be appropriate alternative ventilation provision that does not compromise the façade insulation or the resulting noise level. If applicable, any room should have adequate ventilation (e.g. trickle ventilators should be open) during assessment. If there is noise from a mechanical ventilation system, the internal ambient noise levels should be reported separately with the system operating and with it switched off.

Figure 3—4 Footnote v – “Internal Ambient Noise Levels for Dwellings” (Greater Cambridge SPD)

Note 7 of BS 8233:2014 is referenced within the SPD document to provide a level of flexibility to the target noise limits shown in Figure 3—3. A summary of this flexibility is shown in Figure 3—5 with Note 7 shown in Figure 3—6.

(vi)Where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal target levels may be relaxed by up to 5 dB and reasonable internal conditions still achieved. The more often internal LAeq levels start to exceed the internal LAeq target levels by more than 5 dB, the more that most people are likely to regard them as “unreasonable”. Where such exceedances are predicted, applicants should be required to show how the relevant number of rooms affected has been kept to a minimum. Once internal LAeq levels exceed the target levels by more than 10 dB, they are highly likely to be regarded as “unacceptable” by most people, particularly if such levels occur more than occasionally. Every effort should be made to avoid relevant rooms experiencing “unacceptable” noise levels at all and where such levels are likely to occur frequently, the development should be prevented in its proposed form

Figure 3—5 WHO guideline internal noise levels

NOTE 7 Where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal target levels may be relaxed by up to 5 dB and reasonable internal conditions still achieved.

Figure 3—6 Note 7 of BS 8233:2014 (Page 25)

3.4.5 Stage 3 assessment – Design noise levels for external amenity spaces

Although this is not referenced, the SPD targets are the same as those contained within WHO and BS 8233:2014 guidelines. The advice and targets from the SPD are reproduced in Figure 3—7. This information has been considered as the target noise level range as part of this Feasibility Assessment.

Stage 3 – Design Noise Levels for External Amenity Spaces

3.6.76 The sound level within a residential building is not the only consideration and most residents will also expect a reasonable degree of peaceful enjoyment of their gardens or balcony and adjacent amenity areas. The acoustic environment of external amenity areas shall always be assessed and noise levels should ideally not be above the range 50 to 55 dB LAeq, 16hr for "anonymous noise". It may be necessary to carefully locate and design amenity areas and/or to provide acoustic screening in order to meet this aim.

3.6.77 Developers are encouraged to enter into pre application discussion where noise levels in proposed amenity spaces are likely to be above 55 dB LAeq,16hr. In such cases development should be designed to achieve the lowest practicable levels in these external amenity spaces and the availability of reasonable access to an outdoor recreational area away from but close to the development site, that meets the above target external levels will be taken into account in deciding whether the scheme is acceptable in noise terms. Soundscape management techniques, including psychological masking, may also help to provide a suitable outdoor acoustic environment in otherwise noisy locations. It is accepted that, in some circumstances it may be appropriate to vary, or not to apply, these goals in order to meet wider planning objectives.

Figure 3—7 Design noise levels for external amenity spaces

It is considered that the level of detail provided as part of this Feasibility Study is appropriate in forming the requirements of a Level 2 assessment.

3.4.6 Stage 4 assessment – Assessment of other relevant issues

The Stage 4 assessment goes beyond the scope of this master planning exercise; however, these considerations should be addressed as the design progresses. This may include specific elevational treatments to individual plots (once the masterplan has been finalised and frozen) and/or consideration of alternative strategies (e.g. to control noise break-out) if other uses than residential dwellings are ultimately included in the final proposals. These can easily be dealt with in later design stages with suitable calculation and specification.

3.4.7 Ventilation and cooling

Ventilation and cooling forms part of the SPD. This issue is not covered in detail as part of this Feasibility Study, however, acoustics, ventilation and cooling is becoming a key planning and design consideration, often being requested by Environmental Health Officers (EHOs).

The recently released Acoustics, Ventilation and Overheating (AVO guide – January 2020) has been produced to address this key design crossover.

Ventilation and cooling should be considered as two separate design items.

The ventilation systems used in the development should be capable of providing the background ventilation rates given in Part F of the Building Regulations. Although opening windows should not be necessary in order to provide background ventilation, the windows may still be operable for purge ventilation as defined in Part F (for example following painting or accidental burning of food) or at the occupant's choice.

In this instance of purge ventilation, internal ambient noise levels may exceed BS 8233:2014 guideline levels. However, this would be considered acceptable due to the short duration and infrequent occurrence of this situation, where the requirement to purge airborne toxins temporarily takes precedence over low internal ambient noise levels.

Overheating should be considered separately in tandem with a TM 59[1] assessment (by others), typically completed by a sustainability consultant. Overheating is referenced within the Cambridge SPD; however, a detailed overheating assessment goes beyond the scope of this feasibility exercise, again, this should be considered as the design progresses.

[1] CIBSE TM59: Design methodology for the assessment of overheating risk in homes (2017).

3.4.8 Planning recommendations

It is recommended that the information identified in Figure 3—8 is submitted for the site when applying for outline Planning Permission. This information is provided as part of the Greater Cambridge SPD, and reiterates information contained within the Noise Policy Statement for England (NPSE).

This information is qualitative, and highlight three levels of impact that can be applied to quantitative design targets as described in the sections above. The information below is included for reference to highlight this approach.

This approach is considered as part of this assessment and should be fully referenced when providing the Outline Planning Application.

> 3.6.87 Details submitted as part of an outline application for NSD must be treated by the LPA as forming part of any subsequent "full" application. If material planning considerations, conditions cannot be used to reserve consideration of these details for subsequent approval unless the applicant has made it clear that they were only illustrative. It is therefore recommended that an initial site noise risk assessment should be undertaken and that LPAs should not grant outline planning permission for new residential developments at sites considered to pose a medium or high noise risk (LOAEL to SOAEL) without first being satisfied with a reasonable degree of confidence that good acoustic design can be secured to overcome the acoustic challenges.

> 3.6.88 In particular, where a site is considered medium or high risk (LOAEL to SOAEL) following an **initial site noise risk assessment,** it is recommended that the examination of acoustically critical design issues such as site layout, building heights, materials, landform contouring, detailed design and landscaping, the location of vehicle and pedestrian access, boundary treatments, amenity spaces etc. should not be left for agreement at a later stage as these are important fundamental design issues. Any changes in acoustically critical issues following grant of outline consent should be fully assessed in an updated **noise assessment** and **acoustic design statement**.

Figure 3—8 Outline Planning Permission for Noise Sensitive Developments (Source: Greater Cambridge SPD)

3.5 Summary of Guidance Documentation

Based on a review of the guidance documentation above, the targets shown in Table 3—2 have been adopted for the purposes of this feasibility study.

Table 3—2 Feasibility study design targets

Activity	Location	Daytime (07:00 – 23:00)	Night-time (23:00 – 07:00)
Resting	Living Room	$L_{Aeq,\ 16\ hours}$ 35 dB(A)	-
Dining	Dining room/area	$L_{Aeq,\ 16\ hours}$ 40 dB(A)	-
Resting	External amenity areas	$L_{Aeq,\ 16\ hour}$ 50-55 dB(A)[2]	-
Sleeping (daytime resting)	Bedroom	$L_{Aeq,\ 16\ hour}$ 35 dB(A)	$L_{Aeq,\ 8\ hour}$ 30 dB(A)
Sleeping (sleep disturbance)	Bedroom	-	$L_{AF,max}$ 45 dB(A)[3]

Where the above target noise values are achieved, this is considered to represent a level of noise impact on the site that falls below the Lowest Observed Adverse Effect Level (LOAEL) based on the wider planning context.

[2] Subject to the context of the space, may not be achievable in all areas and a balanced view on this should be taken.
[3] Several times in any one hour.

4 Site Description and External Noise Survey Results

4.1 Site Description

The proposed site is located to the south of Trumpington, on the outskirts of Cambridge. The site is bounded by the following, an annotated aerial site image is included in Figure 4—1.

- **North** – proposed residential dwellings (Barratt Homes), with other uses beyond;
- **East** – The A1309 "Hauxton Road" to the east with fields opposite;
- **South** – The M11 with fields opposite; and
- **West** – Fields to the west.

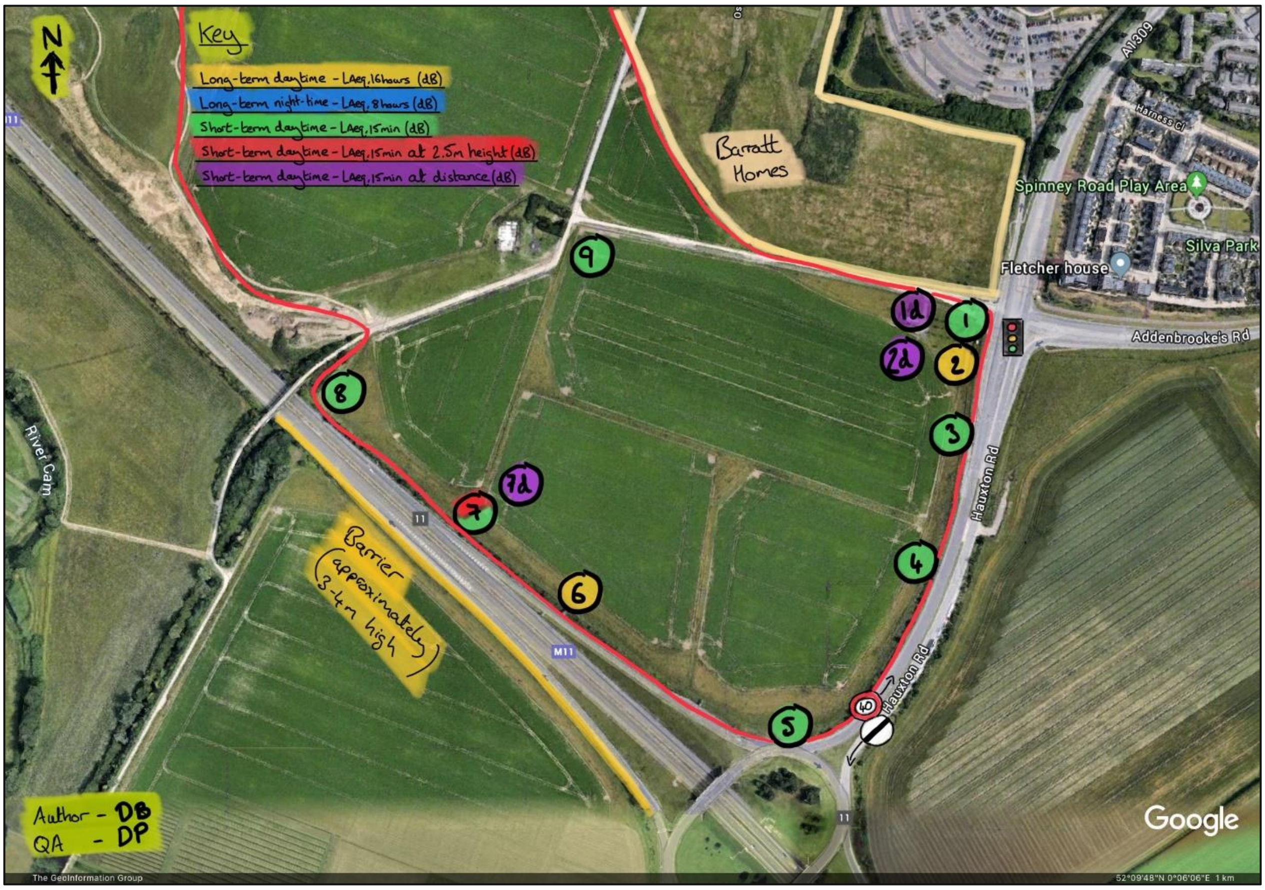


Figure 4—1 Annotated aerial site image (Source: Google. (n.d.). Trumpington, Cambridge. Retrieved from: https://www.google.com/maps/place/Trumpington,+Cambridge/@52.1640667,0.0965205,1097m/data=!3m1!1e3!4m5!3m4!1s0x47d87a113ca7aceb:0x8cd1661cc58c8ae!8m2!3d52.173673!4d0.110348)

The local sound environment is dominated by road traffic noise from the M11 to the south which can be heard as a constant noise source across the site. The A1309 "Hauxton Road" that runs along the eastern boundary is also audible, however, its noise impact is more localised in nature within proximity of the road.

4.2 Noise Survey

4.2.1 Introduction

A noise survey was carried out on the following dates:

- **Long-term (automated)** – over a period between Friday 10 January 2020 and Tuesday 14 January 2020; and
- **Short-term (manned)** – on Friday 10 January 2020.

The survey work has been undertaken to capture the noise impact from surrounding environmental noise sources (e.g. roads, aircraft) on assumed residential massing. This allows the assessment of external building envelope attenuation (i.e. glazing and ventilation) to see that internal ambient noise levels within residential rooms can be compliant with pertinent criteria (as a minimum).

4.2.2 Survey locations and durations

The noise survey methodology demonstrates how noise levels change around the site throughout various times of the daytime (07:00-23:00 hours) and night-time (23:00-07:00 hours).

All measurements were undertaken at heights relative to the local ground level which varied across the site. The measurement height relative to the ground level is included in Figure 4—2. Measurements were undertaken in free-field environments with wind speeds ≤ 5 m/s. Weather conditions were considered appropriate for both the short and long-term monitoring.

Measurement locations are detailed below and marked on the annotated aerial image in Figure 4—1.

4.2.3 Equipment

The equipment used during the environmental noise survey is detailed in Table 4—1.

Table 4—1 Equipment used during the environmental noise survey

Equipment	Manufacturer & Part No.	Serial Number
Sound level meter	RION NL-52	620867
Sound level Meter	RION NL-52	1265411
Sound level Meter	Bruel & Kjaer 2250	3008216
Pre-amplifier	Bruel & Kjaer ZC 0032	22669
Microphone	Bruel & Kjaer 4189	2983647
Calibrator	Bruel & Kjaer 4231	2438725

4.2.4 Results

The sound level meters were calibrated before and after measurements, with no significant drift recorded. An accredited laboratory calibrated the equipment not more than two years prior to the measurements being made, with the exception of the calibrator, which had been calibrated not more than one year prior to the survey.

The explanation of the measurement indices are as follows:

- **$L_{Aeq,T}$** – the average A-weighted sound pressure level within a measurement period. Typically thought of as the average ambient noise level at a particular time and likely to be due to a combination of various noise sources, near and far, for short-term, levels displayed are the unadjusted measurement values. For long-term measurements, the values displayed are a logarithmic average of the 15-minute measurement values; and

- **$L_{AF,max}$** – the maximum instantaneous A-weighted sound pressure level measured during the measurement time period. Typically corresponding to a short-duration event with a very high sound pressure level (SPL), for example, motorbike passing by, car horn etc.. Only long-term maximum values are displayed, these values are the 75th percentile of measured $L_{AF,max}$ values, sampled over 15-minute periods between 23:00 hours and 07:00 hours. The 75th percentile of the dataset is considered the representative value due to the consistency of measurement results throughout the night-time period. This statistical value is considered representative and in-line with the criteria displayed in Figure 3—3.

The time / history plot for each long-term measurement location is shown in Appendix A.

Table 4—2 Measurement summary

Location	Height relative to ground level (m)	Start time (HH:MM)	Duration (HH:MM)	Distance to centre of road (m)	Co-ordinates (east, north)	Ambient noise level ($L_{Aeq,T}$ dB(A))	Maximum noise level night-time ($L_{AF,max}$ dB(A))
1	1.5	06:31	00:15	23	52.1647192, 0.1066393	64	-
1d	1.5	06:13	00:15	55	52.1647946, 0.1061675	60	-
2	1.5	07:00	See below[4]	23	52.1645622, 0.1065789	64 daytime / 59 night-time	71
2d	1.5	07:56	00:15	46	52.1645720, 0.1063204	59	-
3	1.5	08:13	00:15	20	52.163718, 0.106319	65	-
4	1.5	08:30	00:15	20	52.1627856, 0.1059281	67	-
5	1.5	08:48	00:15	17	52.1612203, 0.1043715	67	-
6	1.5	07:00	See below[5]	42	52.162449, 0.099482	76 daytime / 71 night-time	81
7	1.5	09:07	15	37	52.1622861, 0.1006164	78	-
7h	2.5	09:23	02:22	37	52.1622861, 0.1006164	80	-
7d	1.5	09:27	15:00	73	52.1625102, 0.1009781	71	-
8	1.5	10:02	00:15	35	52.1639184, 0.0976099	72	-
9	1.5	10:30	00:15	410 to Hauxton 315 to M11	52.1654454, 0.1010298	57	-

Notes

- **Short-term measurement**
- **Long-term measurement**
- **Measurements, referencing another at increased distance from the road centre (to show distance attenuation characteristics)**
- **Measurements, referencing another at increased height**

4.2.5 Measurement summary

A summary of the measurement ambient noise levels recorded during the survey are shown in Figure 4—2.

[4] Long-term measurement location undertaken over daytime and night-time periods, to establish 16 hour (07:00-23:00) and 8 hour (23:00-07:00) noise levels.
[5] Long-term measurement location undertaken over daytime and night-time periods, to establish 16 hour (07:00-23:00) and 8 hour (23:00-07:00) noise levels.

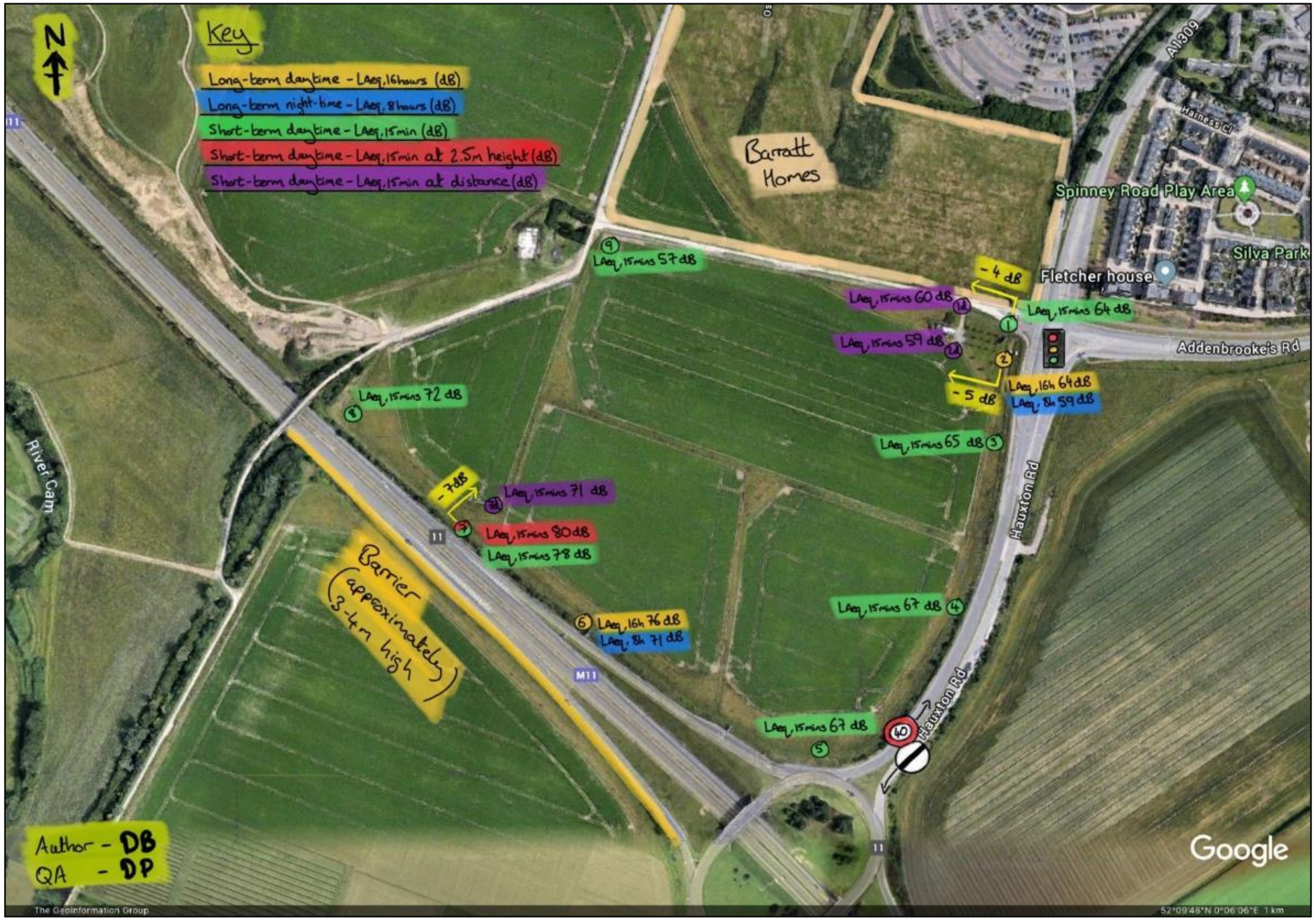


Figure 4—2 Measurement noise levels (Source: Google. (n.d.). Trumpington, Cambridge. Retrieved from: https://www.google.com/maps/place/Trumpington,+Cambridge/@52.1640667,0.0965205,1097m/data=!3m1!1e3!4m5!3m4!1s0x47d87a113ca7aceb:0x8cd1661cc58c8ae!8m2!3d52.173673!4d0.110348

4.2.6 Discussion

A summary of the key measurement information is included in the bullet points below:

- Noise levels across the eastern boundary are consistent, ranging between $L_{Aeq,T}$ 64 and 67 dB(A).
- Both long-term noise measurements identified a 5 dB decrease from daytime to night-time ambient noise levels.
- The ambient noise level decreased traveling north along Hauxton Road, this was noted by the survey engineer as being due to decreasing vehicle speeds as they approach the traffic lights at the north-eastern corner of the site (see Figure 4—3).

Figure 4—3 Slow-moving traffic at the north-eastern corner of the site

- The relative site level is approximately 2 – 3 m below the level of Hauxton Road, becoming less steep with travel north along the road. This provides some level of screening to the road surface (see Figure 4—4).

Figure 4—4 Embankment up to road level along the eastern boundary, Hauxton Road

- Noise levels across the southern boundary:
    - Increase with height (+ 2 dB from 1.5 m to 2.5 m height) due to the angle of view to the M11 increasing; and
    - Decrease with distance (-7 dB with a doubling of distance to the road centre), due to a combination of air / ground absorption and screening afforded by an existing bund. (See Figure 4—5 for a sketch summary of the scenario).

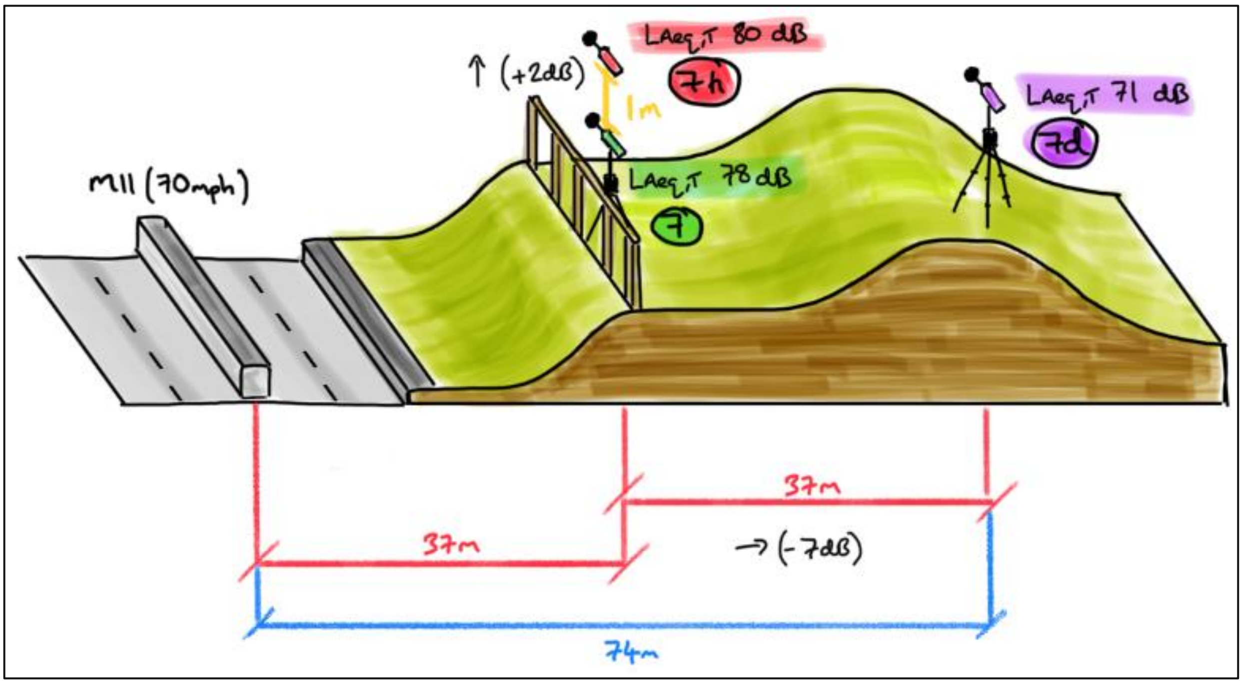


Figure 4—5 Sketch of measurement noise levels demonstrating change in noise level with height and distance overlooking the M11

- A solid barrier is located along the opposite (westbound) carriageway of the M11 (see Figure 4—6).

Figure 4—6 Existing M11 barrier

- Towards the south-western corner of the site, the noise level decreases, this is due to screening provided by the earth bunds supporting the existing motorway bridge (see Figure 4—7).

Figure 4—7 Motorway bridge at the south-western corner of the site

5 Environmental Noise Modelling

5.1 Introduction

A noise modelling exercise has been undertaken to predict the likely noise levels across the proposed development at Trumpington South, and also to demonstrate the noise levels impacting upon the assumed façades of the development. The results of the acoustic model allow for the different stages of assessment to be undertaken in line with the requirements of the LPA and to aid in the assessment of the façade build-up design in terms of its sound insulation properties and the protection of external amenity. In doing this, it can be demonstrated whether internal and external acoustic conditions at site are suitable for the proposed development. Other features that have been included include the site topography, measurement heights, screening, barrier reflections and traffic flows / speed.

5.2 Methodology

In order to determine noise propagation across the development site, a 3D environmental noise model has been produced in CadnaA 2019 modelling software. The noise model has been constructed based on detailed Google Earth mapping data. Local roads were added into the model to simulate noise sources that were measured during the on-site noise surveys.

The model predicts and maps the noise impacts as follows:

- As a grid set at a height of 1.5 m above the relative ground level, this is to demonstrate external amenity noise levels within garden spaces; and
- As points on the outline massing so that a façade sound insulation analysis can be undertaken.

Both prediction methods consider factors such as distance attenuation, natural and man-made barrier attenuation, reflections and source directivity.

It has been established that the dominant, continuous noise source affecting the site during both daytime and night-time periods is local road traffic to the south and east. The noise model has therefore been calibrated, based upon the results obtained from these noise sources during the surveys to represent the noise climate as closely as possible to the current conditions on-site.

The following massing information has been included in the model:

- Architectural massing option provided by the architects with the following drawing reference:

Development edge
Landscape strategy
173614/LA/SK02
Scale 1:5000 @ A2
January 2020

TERENCE O ROURKE

- 15 m building height;

Receiver points on the building massing are:

- 10 m apart horizontally; and
- 3 m apart vertically (representing different floor levels over 5 no. storeys).

5.3 Bund

It is understood that a 3m high earth bund is consented along the south western edge of the site, running adjacent to the M11, as part of the Trumpington Meadows development to the north of the site. The construction of Trumpington Meadows is underway (anticipated completion in 2022/23) and the earth bund is expected to be built out in full over the course of the development. The earth bund will therefore be implemented ahead of any development at Trumpington South, and has been included in the noise model.

5.4 Limitations

The assessment has been based on the results produced through a noise modelling exercise, which provides predictions on the likely future noise levels. In order to increase the reliability of the results, the models have been calibrated to the noise levels measured on-site during worst-case time periods, as shown in Figure 4—2. However, this does not guarantee the full accuracy of the predicted noise levels. Typically, an uncertainty within a range of approximately +/- 3 dB could be expected from computer noise modelling software. It should be noted that, this uncertainty has been controlled as far as practicable by cross-referencing the levels of predicted noise impact against the spot measurements captured on site.

5.5 Results

Figure 5—1 shows the predicted noise levels incident on the façades of the development during the daytime. The model also shows a grid noise map at a height of 1.5 m above ground level, which is considered representative of the noise level expected in external garden amenity areas. Night-time noise levels are expected to be 5 dB lower than daytime noise levels, as indicated by the noise measurement data.

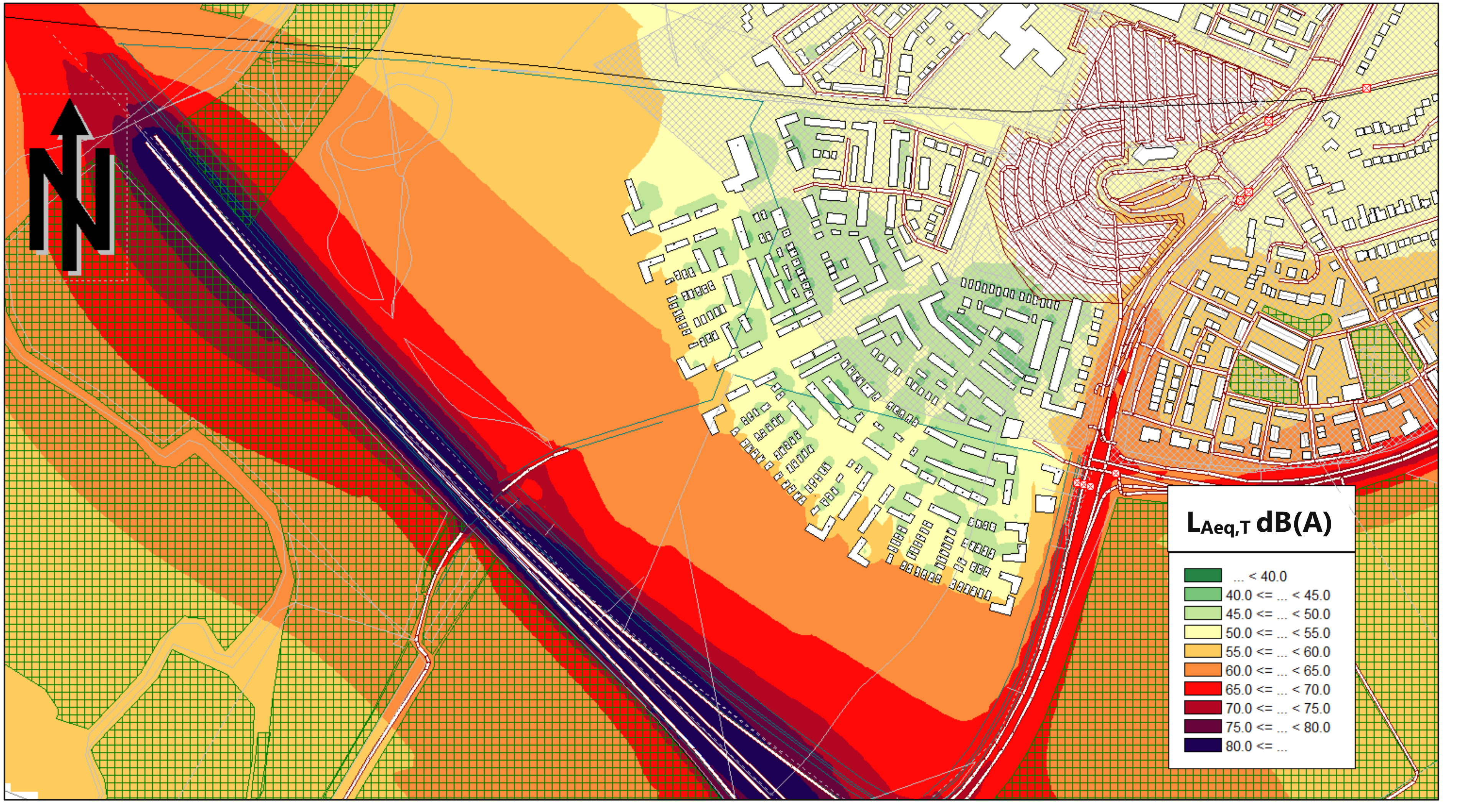


Figure 5—1 Highest predicted daytime façade noise levels $L_{Aeq(07:00-23:00)}$ dB(A)

5.5.1 Discussion

Figure 5—1 demonstrate noise levels across the site. Key points are shown below:

- With the bund, noise levels across the western boundary attenuate more rapidly, moving away (north) from the M11, providing a benefit to plots towards the north-eastern corner;
- Noise modelling predictions demonstrate that noise levels at the southernly plots, closest to the M11 are subject to noise levels of approximately $L_{Aeq,T}$ 65 dB(A);
- Noise modelling predictions demonstrate that noise levels to the rear of the most southernly plots closest to the M11, are typically below $L_{Aeq,T}$ 55 dB(A) due to the additional screening. These noise levels fall within the Cambridge SPD design range of $L_{Aeq,T}$ 50 – 55 dB(A) and are therefore considered to be acceptable for the development of residential units at the site; and
- Building massing along the eastern elevation has proven to be effective at protecting external amenity moving westwards into the site. The same approach could be utilised along the western site boundary.

5.6 Noise Risk Category (ProPG) – Night-Time Only

Daytime and night-time noise levels have been measured as having a 5 dB difference (reducing during the night-time period). On the basis of this reduction, the night-time noise levels are considered to represent the most stringent condition for consideration under the ProPG risk assessment method, this is because the ProPG assessment criteria is 10 dB more stringent during the night-time period.

The night-time model, with the key adjusted to reflect the risk categories is displayed in Figure 5—2.

A "zoomed-in" view of the south-eastern corner of the site is shown in these figures. This is considered to be the area of the site which is most exposed to traffic noise.

The night-time $L_{Aeq,T}$ dB(A) ranges are taken as follows:

- **High** – ≥ 60;
- **Medium** – 50 – 59;
- **Low** – 45 – 49; and
- **Negligible** - ≤ 44.

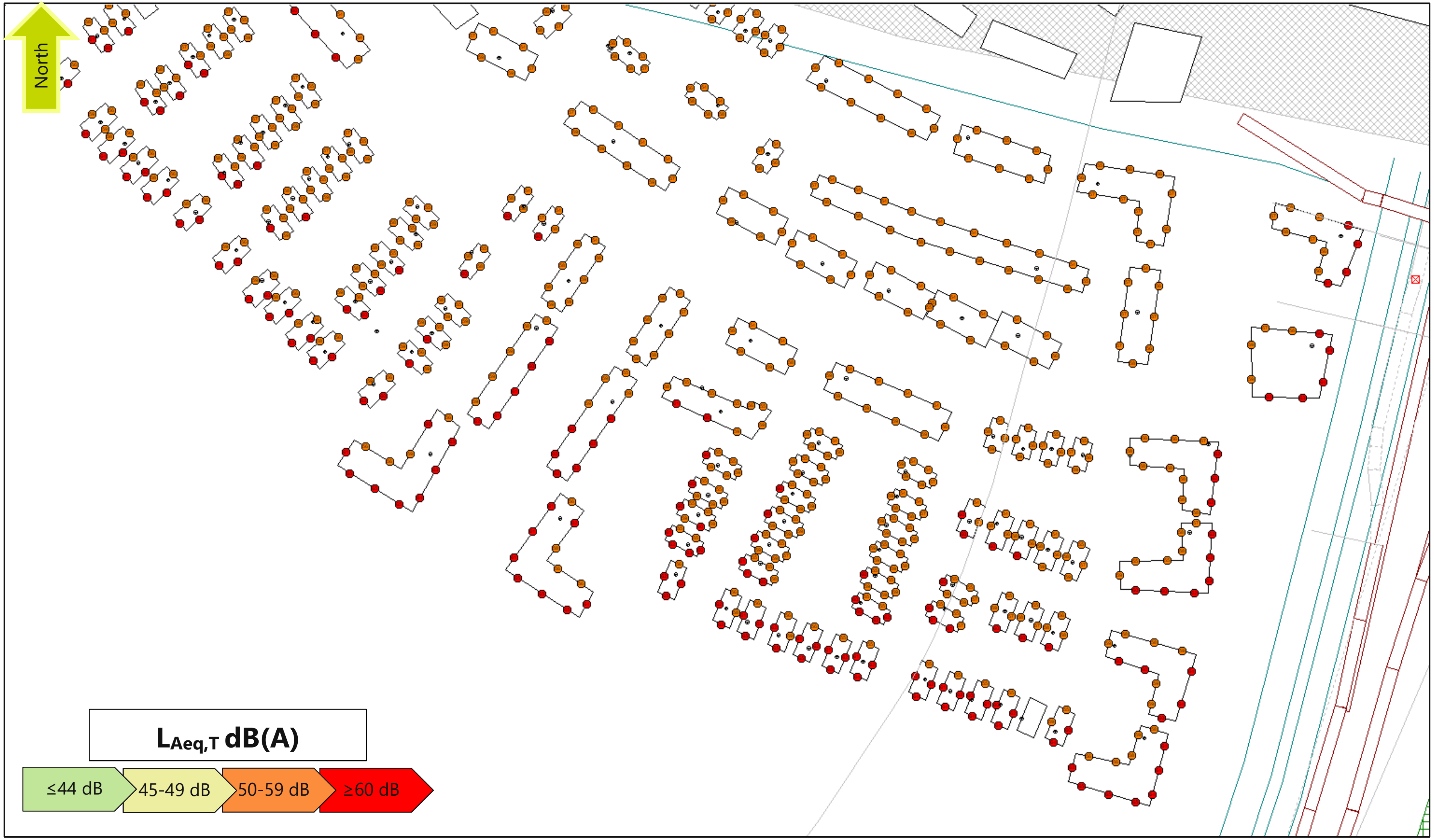


Figure 5—2 ProPG night-time assessment

5.6.1 Discussion

The models above demonstrate that ambient noise levels across the proposed development are highest adjacent to roads. Lower noise levels are predicted across the façades situated away from the roads.

Figure 5—2 demonstrates that the majority of plots fall into Pro PG Medium band, with a small number of plots falling into the Pro PG High band (although these can be simply mitigated to control internal and external noise levels sufficiently).

The risk categories are for illustrative purposes in line with the SPD guidelines. It should be noted that:

- Section 4 above identifies that suitable external ambient noise levels can be achieved at the site; and
- Section 6 below highlights that suitable internal ambient noise levels can be achieved at the site.

Based on the above, noise is not considered to form a barrier to residential development at the site.

6 Noise Break-in

6.1 Introduction

A façade noise break-in assessment is undertaken within this section, this has been completed to demonstrate the sorts of mitigation measures (including different types of ventilation and glazing) that could be suitable at Trumpington South based on the site layout. These measures would be incorporated into the detailed design stages of the proposed development, ahead of any future outline planning application.

6.2 Building Envelope Requirements

Within the vast majority of traditionally-built façades (which include masonry external walls and slate or tile roofs, the weakest elements of the external elevation are the glazing and ventilation systems.

The façade sound insulation requirements have been calculated using the noise modelling output, the acceptable indoor noise criteria identified in Table 3—2 and typical bedroom dimensions.

Bedroom dimensions are taken as:

- 10 m^2 façade area;
- 3 m^2 glazing;
- Room dimensions – 4.0 m x 4.0 m x 2.5 m = 40 m^3;
- 0.5 second reverberation time; and
- The top end of the night-time noise level bands as shown in Table 6—2.

The façade design should consider how the external noise levels can be reduced to provide suitable internal noise conditions for the end users. To aid in calculations, measurement spectra are shown in Table 6—1.

Table 6—1 Typical measurement spectra

Noise source	Measurement location	Octave-band centre frequency noise level (dB Hz)						Broadband noise level (dB(A))
		125	250	500	1K	2k	4k	
M11 road traffic (ambient, $L_{Aeq,T}$)	7	71	68	72	76	70	58	78
M11 road traffic (maximum $L_{AF,max}$)	6	78	81	78	79	74	62	81

It is considered suitable that the above measurement spectrum can be adjusted by adding or subtracting equal values from each octave-band, to result in a representative broadband noise level.

The façade acoustic requirements are given in terms of $R_w + C_{tr}$, which are described as:

Weighted Sound Reduction Index, R_w – it is a single figure value which describes the standardised performance of partitions when measured in a laboratory; and

Correction Traffic, C_{tr} – it is a single correction value applied which considers the urban traffic noise spectrum.

Calculation procedures follow the "more rigorous calculation method" outlined in BS 8233:2014, based on the following equation:

$$L_{eq,2} = L_{eq,ff} + 10\log_{10}\left(\frac{A_0}{S}10^{\frac{-D_{n,e}}{10}} + \frac{S_{wi}}{S}10^{\frac{-R_{wi}}{10}} + \frac{S_{ew}}{S}10^{\frac{-R_{ew}}{10}} + \frac{S_{rr}}{S}10^{\frac{-R_{rr}}{10}}\right) + 10\log_{10}\left(\frac{S}{A}\right) + 3$$

$L_{eq,ff}$	*is the equivalent continuous sound pressure level outside the room elements under consideration*[6]
A_0	*is a reference absorption area of 10 m² and is independent of frequency*
S_f	*is the total façade area in square metres (m²) of the room in question*
S_{wi}	*is the area in square metres (m²) of the windows of the room*
S_{ew}	*is the area in square metres (m²) of the external wall of the room*
S_{rr}	*is the area is square metres (m²) of the ceiling of the room*
S	*is the total area in square metres (m²) of elements through which sound enters the room, i.e.* $S_f + S_{rr}$
$D_{n,e}$	*is the insulation of the trickle ventilator measured according to BS EN ISO 10140*
R_{wi}	*is the sound reduction index (octave band value) of the window*
R_{ew}	*is the sound reduction index (octave band value) of the external wall*
R_{rr}	*is the sound reduction index (octave band value) of the roof/ceiling*
A	*is the equivalent absorption area of the receiving room being considered*
3	*is a correction factor*

[6] It is the free-field sound level (i.e. in the absence of the façade), measured or estimated at the intended position of the element under consideration. It is related to the level $L_{eq,1}$ measured within a few millimetres of the actual façade by the relation $L_{eq,ff} \approx L_{eq,1} - 6$, and to the level $L_{eq,2m}$ measured 2 m away from the façade by the relation $L_{eq,ff} \approx L_{eq,2m} - 3$

6.3 Indicative Glazing Calculations

Four sets of glazing calculations have been undertaken for the Trumpington South masterplan to identify four glazing "conditions" which should reduce the external façade incident noise levels to "good" internal ambient noise levels, in-line with the SPD guidance. A further, fifth "natural ventilation" condition is included in pink. Noise levels below these values could be suitably mitigated by the reduction in noise level provided from noise transmission from the outside to inside via an open window[7].

Table 6—2 Glazing conditions

Condition	Descriptor	Noise level ($L_{Aeq,T}$ dB(A)	Likely mitigation measures required
1	$L_{Aeq(07:00-23:00)}$	76 - 84	Enhanced glazing with mechanical ventilation
	$L_{Aeq(23:00-07:00)}$	71 - 79	
	$L_{AF,max}$	81 is the highest measured on site	
2	$L_{Aeq(07:00-23:00)}$	71 - 75	Enhanced glazing with acoustic trickle ventilators
	$L_{Aeq(23:00-07:00)}$	66 - 70	
	$L_{AF,max}$	81 is the highest measured on site	
3	$L_{Aeq(07:00-23:00)}$	61 - 70	Enhanced glazing with acoustic trickle ventilators
	$L_{Aeq(23:00-07:00)}$	56 - 65	
	$L_{AF,max}$	82	
4	$L_{Aeq(07:00-23:00)}$	48 - 60	Standard double glazing with hit-and-miss trickle vents.
	$L_{Aeq(23:00-07:00)}$	43 - 55	
	$L_{AF,max}$	71	
5	$L_{Aeq(07:00-23:00)}$	≤ 47	Natural ventilation via open windows
	$L_{Aeq(23:00-07:00)}$	≤ 42	
	$L_{AF,max}$	≤ 57	

Maps of the indicative glazing conditions are shown in Figure 6—1.

[7] - 12 dB attenuation from outside to inside through an open window. Stated in the AVO Guide (2020).

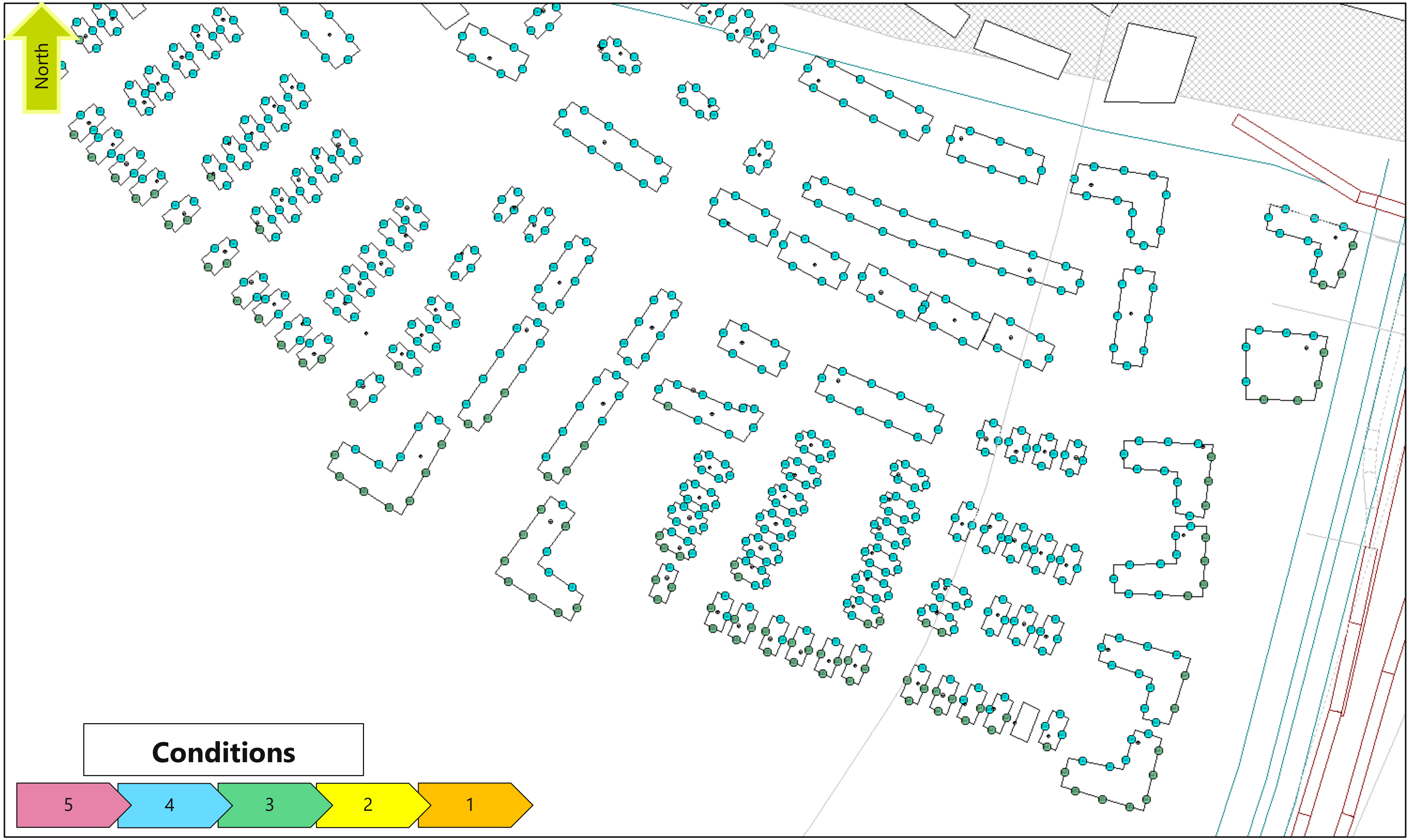


Figure 6—1 Glazing condition map - With bund – South-eastern corner of the site

6.4 Discussion

The models above demonstrate that:

- **Condition 3 (Enhanced glazing with acoustic trickle ventilators)** should be suitable for plots located across the boundaries of the site, adjacent to roads; and
- **Condition 4 (Standard double glazing and trickle ventilators)** may be suitable to the remainder of the site.

Figure 6—1 demonstrates that two mitigation conditions could be suitable at the site, both using passive ventilation strategies

It can be seen that the plots closest to the road would require Condition 3. These external plots could be considered in the wider site context as acting as a barrier to noise for the remainder of the site, with the majority of the site then suitable for standard glazing and ventilation options.

7 Assessment Summary

Table 7—1 identifies what steps have been completed as part of this Feasibility Study for the proposed development at Trumpington South and which steps should be completed in the detailed design stages in the lead-up to any future planning application.

In summary, the site is considered suitable for residential development and noise should not been seen as a barrier to development. This is due to demonstrating that suitable internal and external acoustic conditions at Trumpington South can be met in terms of the relevant Planning Policy. The massing of the plots is paramount to the successful use of the site, with current proposals considered appropriate in unlocking the site's full potential for development in terms of providing suitable levels of noise amenity.

Table 7—1 Assessment summary

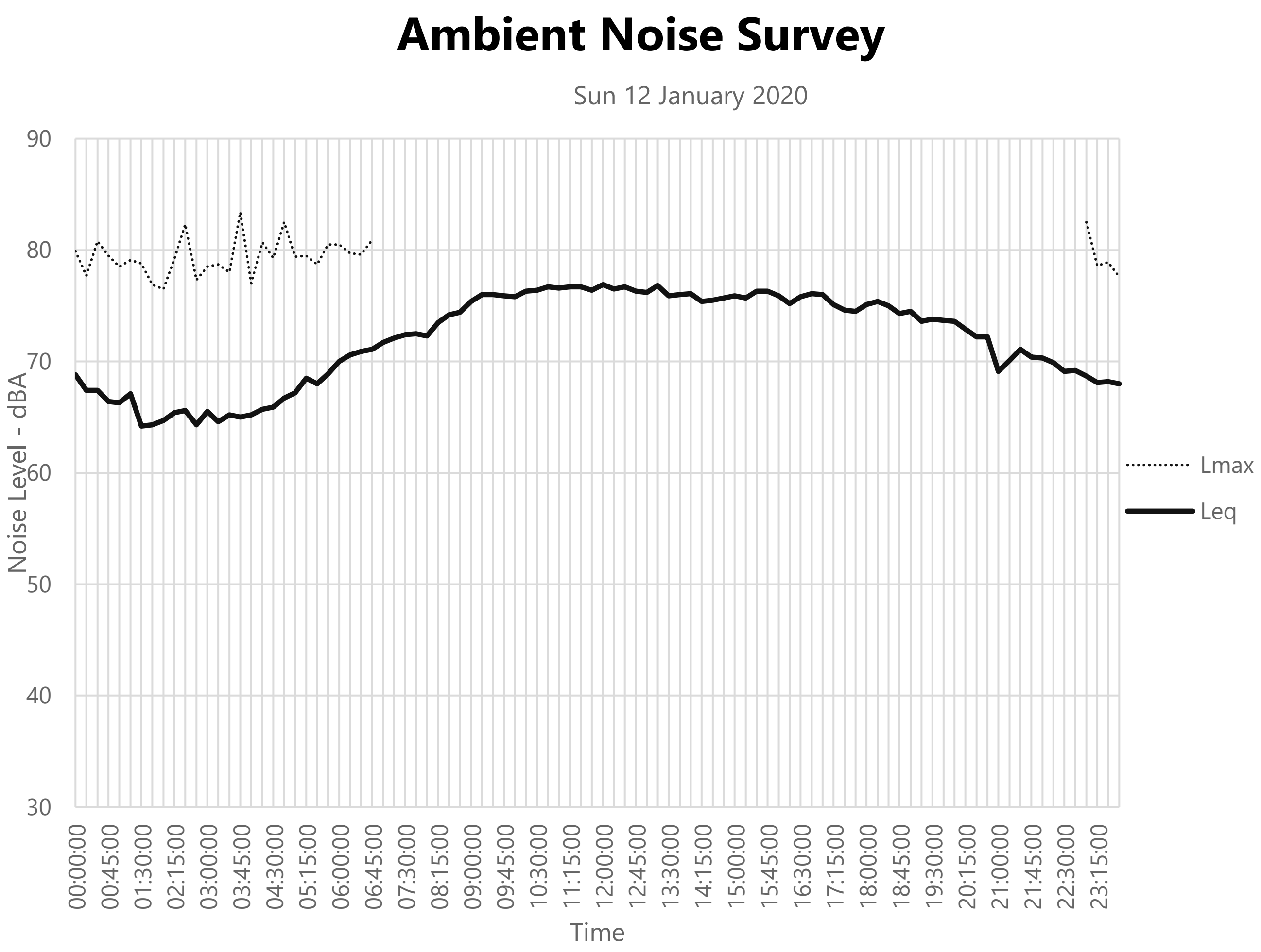
Stage	Completed (Y/N)	Notes
Stage 1 Assessment	Y	• Noise survey undertaken • Site assessed and found to be in the following risk categories: • **High** – along the road boundaries; • **Medium** – towards the centre of the site; and • **Low** – moving north-west away from roads.
Stage 2 Assessment	Y	This feasibility study has shown that: • Suitable internal ambient noise levels are possible at the site, with the use of: • Suitably rated acoustic trickle ventilators and enhanced double glazing for plots closest to the surrounding road network. • Standard double glazing and hit and miss trickle vents for plots located moving north-west in site.
Stage 3 Assessment	Y	This study has shown, based on the type of massing selected that: • Target external amenity noise levels are achievable at the site. • Target external amenity noise levels may not be achievable where gardens/balconied are proposed with a direct line of sight to the surrounding road network.
Application of SPD	N	• These factors should consider the wider planning policy as the design progresses.
Acoustic Report/Design Statement	N	• Once plans have been finalised, an acoustic report/design statement could be produced. This could be based on the existing noise survey information contained within this feasibility study.
Overheating / Cooling	N	• An overheating assessment could be undertaken in line with the requirements of TM 59 (by others, a service BuroHappold Provides). Acoustic input can be provided to feed into this assessment in a more joined-up way when done in-house.

8 Conclusions

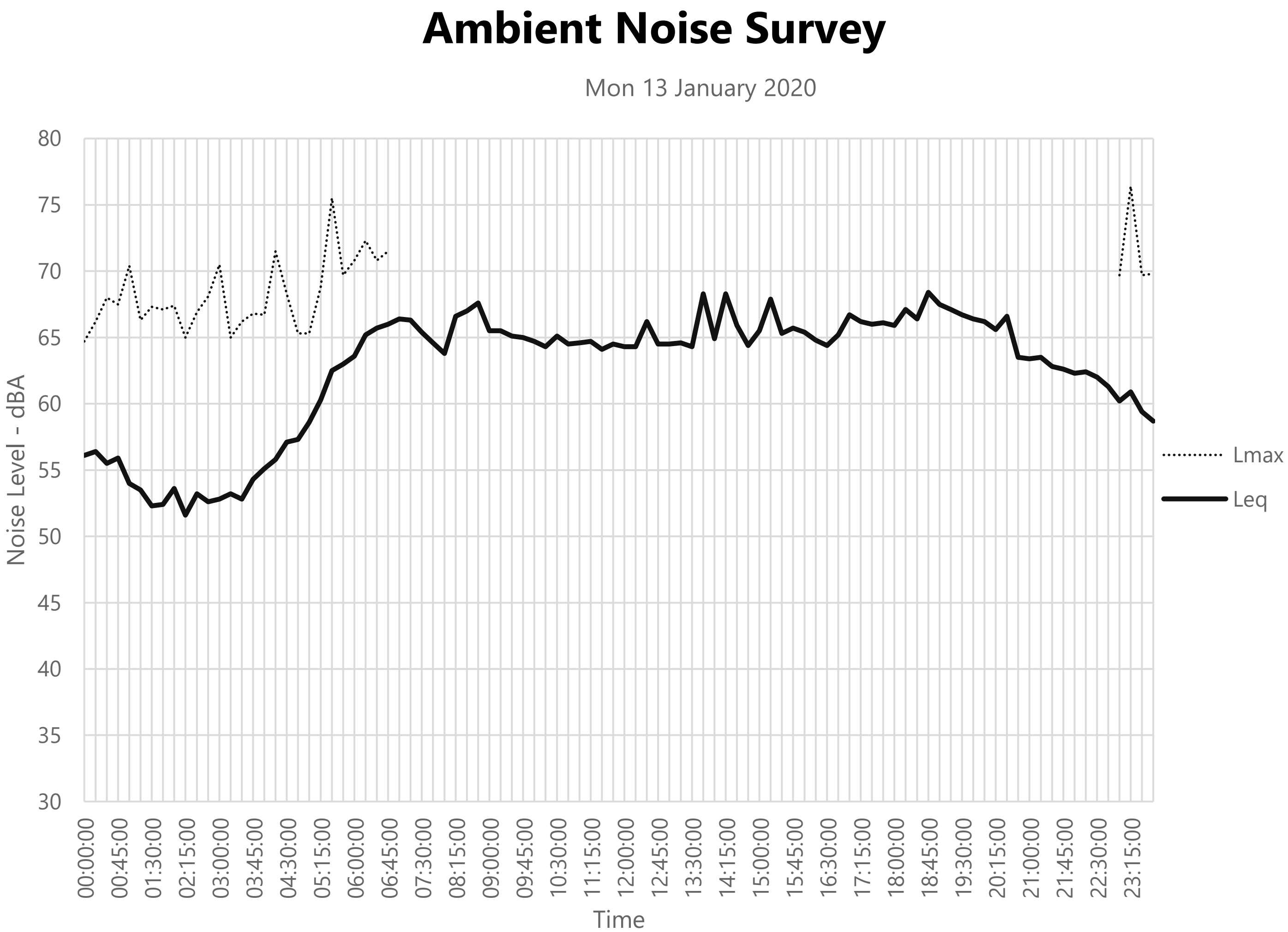
- The proposed development of Trumpington South is considered suitable for residential development;
- This Feasibility Study demonstrates that noise should not form a barrier to residential development at the site and can achieve the requirements of achieve the requirements of the Greater Cambridge Supplementary Planning Document, as:
    - Target internal ambient noise levels can be achieved; and
    - Target external ambient noise levels can be achieved.
- It has been demonstrated that:
    - The proposed massing screens external amenity areas, providing suitable external ambient noise levels; and
    - Passive mitigation measures can be installed to provide suitable internal ambient noise levels.

Appendix A Noise Level Time/History Plots

A.1 Time / history plot – Location 6 – Long-term – M11



A.2 Time/history plot – Location 2 – Long-term – Hauxton Road



Appendix B Indicative Glazing Calculations

B.1 Condition 1

FAÇADE BREAK-IN CALCULATION	
Project Name	Trumpington South
Room or space	Condition 1
Date	201027

ROOM CONSTANT & FAÇADE AREA			
Façade area (incl. window)	10.0 m2		
Area of the louver	0.0 m2	Area of the external wall	7 m2
Area of the windows	3.0 m2		
Area of the roof/ceiling	16.0 m2	Area of exposed envelope	26 m2
Room Depth (x)	4.0 m		
Room Width (y)	4.0 m	Room Volume	40 m3
Ceiling height (z)	2.5 m		

Room reverberation time (s)						
Tmf	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz
0.5	0.5	0.5	0.5	0.5	0.5	0.5

DISTANCE ATTENUATION CALCULATION			
Distance correction	No	Calculated Distance Attenuation	-
Type of distance correction	Line source		
Distance from source to microphone	-		
Distance from source to receiver	-		

FREE FIELD LEVELS AT 1m FROM THE NOISE SENSITIVE FAÇADE								
LAeq		dB(A)	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz
	Free Field Leq in octave bands (dB)	79	72	69	73	77	71	59
	Resultant Free-Field Leq with distance attenuation (dB(A))	79	72	69	73	77	71	59
LAmax (if applicable)		dB(A)	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz
	Free Field Lfmax in octave bands	82	78	81	78	79	74	62
	Resultant Free-Field LAmax with distance	82	78	81	78	79	74	62

SOUND REDUCTION PROPERTIES OF BUILDING ELEMENTS									
		125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	R_w	R_w+C_{Tr} (dB)
Window (R_w)	*Rw+Ctr 46dB SGG 12 PVB interlayer (2no.)/24/14 PVB interlayer (2no.)*	38	41	46	51	53	57	50	46
Louver (Rw)	*No Louver*	0	0	0	0	0	0	0	0
External wall Construction (Rw)	*Typical external wall construction*	46	44	46	54	62	67	52	49
Roof Construction (Rw)	*Typical roof construction*	99	99	99	99	99	99	99	99

			125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	$D_{n,e,w}$ (dB)
Trickle Vent ($D_{n,e,w}$)	*No Vent*	1 Units	200	200	200	200	200	200	-

CALCULATED INTERNAL LAeq AND LAF,max LEVELS						
	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz
Calculated LAeq in the receiver room (dB)	32	28	29	26	16	-1
Calculated LAFmax in the receiver room (dB)	35	37	31	25	16	-1

L_{Aeq} (125-4000Hz)	L_{Amax} (125-4000Hz)
30 dB(A)	**32 dB(A)**

B.2 Condition 2

FAÇADE BREAK-IN CALCULATION	
Project Name	Trumpington South
Room or space	Condition 2
Date	201027

ROOM CONSTANT & FAÇADE AREA			
Façade area (incl. window)	10.0 m2		
Area of the louver	0.0 m2	Area of the external wall	7 m2
Area of the windows	3.0 m2		
Area of the roof/ceiling	16.0 m2	Area of exposed envelope	26 m2
Room Depth (x)	4.0 m		
Room Width (y)	4.0 m	Room Volume	40 m3
Ceiling height (z)	2.5 m		

Room reverberation time (s)						
Tmf	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz
0.5	0.5	0.5	0.5	0.5	0.5	0.5

DISTANCE ATTENUATION CALCULATION			
Distance correction	No	Calculated Distance Attenuation	-
Type of distance correction	Line source		
Distance from source to microphone	-		
Distance from source to receiver	-		

FREE FIELD LEVELS AT 1m FROM THE NOISE SENSITIVE FAÇADE								
LAeq		dB(A)	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz
	Free Field Leq in octave bands (dB)	70	63	60	64	68	62	50
	Resultant Free-Field Leq with distance attenuation (dB(A))	70	63	60	64	68	62	50
LAmax (if applicable)		dB(A)	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz
	Free Field Lfmax in octave bands	82	78	81	78	79	74	62
	Resultant Free-Field LAmax with distance	82	78	81	78	79	74	62

SOUND REDUCTION PROPERTIES OF BUILDING ELEMENTS									
		125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	R_w	R_w+C_{Tr} (dB)
Window (R_w)	*Rw+Ctr 41dB SGG 10/24/8 PVB interlayer (1no.)*	28	38	46	48	51	56	47	41
Louver (Rw)	*No Louver*	0	0	0	0	0	0	0	0
External wall Construction (Rw)	*Typical external wall construction*	46	44	46	54	62	67	52	49
Roof Construction (Rw)	*Typical roof construction*	99	99	99	99	99	99	99	99

			125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	$D_{n,e,w}$ (dB)
Trickle Vent ($D_{n,e,w}$)	*Dne,w 42 Passivent TVALdB 800*	1 Units	46	44	38	43	43	50	42

CALCULATED INTERNAL LAeq AND LAF,max LEVELS						
	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz
Calculated LAeq in the receiver room (dB)	32	23	29	27	21	3
Calculated LAFmax in the receiver room (dB)	44	41	40	35	30	12

L_{Aeq} (125-4000Hz)	L_{Amax} (125-4000Hz)
30 dB(A)	**40 dB(A)**

B.3 Condition 3

FAÇADE BREAK-IN CALCULATION	
Project Name	Trumpington South
Room or space	Condition 3
Date	201027

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ROOM CONSTANT & FAÇADE AREA			
Façade area (incl. window)	10.0 m2	Area of the external wall	7 m2
Area of the louver	0.0 m2		
Area of the windows	3.0 m2		
Area of the roof/ceiling	16.0 m2	Area of exposed envelope	26 m2
Room Depth (x)	4.0 m		
Room Width (y)	4.0 m	Room Volume	40 m3
Ceiling height (z)	2.5 m		

Room reverberation time (s)						
Tmf	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz
0.5	0.5	0.5	0.5	0.5	0.5	0.5

DISTANCE ATTENUATION CALCULATION			
Distance correction	No	Calculated Distance Attenuation	-
Type of distance correction	Line source		
Distance from source to microphone	-		
Distance from source to receiver	-		

FREE FIELD LEVELS AT 1m FROM THE NOISE SENSITIVE FAÇADE								
LAeq		dB(A)	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz
	Free Field Leq in octave bands (dB)	65	58	55	59	63	57	45
	Resultant Free-Field Leq with distance attenuation (dB(A))	65	58	55	59	63	57	45
LAmax (if applicable)		dB(A)	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz
	Free Field Lfmax in octave bands	82	78	81	78	79	74	62
	Resultant Free-Field LAmax with distance	82	78	81	78	79	74	62

SOUND REDUCTION PROPERTIES OF BUILDING ELEMENTS									
		125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	R_w	R_w+C_{tr} (dB)
Window (R_w)	Rw+Ctr 34dB SGG 8/6/6.4 (Stadip Silence)	26	28	31	40	44	50	38	34
Louver (Rw)	No Louver	0	0	0	0	0	0	0	0
External wall Construction (Rw)	Typical external wall construction	46	44	46	54	62	67	52	49
Roof Construction (Rw)	Typical roof construction	99	99	99	99	99	99	99	99
		125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	$D_{n,e,w}$ (dB)	
Trickle Vent ($D_{n,e,w}$)	Dne,w 39 Passivent TVES4dB — 1 Units	41	40	36	40	40	38	39	

CALCULATED INTERNAL LAeq AND LAF,max LEVELS						
	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz
Calculated LAeq in the receiver room (dB)	29	25	28	26	20	9
Calculated LAFmax in the receiver room (dB)	46	48	44	39	34	23

L_{Aeq} (125-4000Hz)	L_{Amax} (125-4000Hz)
30 dB(A)	45 dB(A)

B.4 Condition 4

FAÇADE BREAK-IN CALCULATION	
Project Name	Trumpington South
Room or space	Condition 4
Date	201027

BUROHAPPOLD ENGINEERING

ROOM CONSTANT & FAÇADE AREA			
Façade area (incl. window)	10.0 m2	Area of the external wall	7 m2
Area of the louver	0.0 m2		
Area of the windows	3.0 m2		
Area of the roof/ceiling	16.0 m2	Area of exposed envelope	26 m2
Room Depth (x)	4.0 m		
Room Width (y)	4.0 m	Room Volume	40 m3
Ceiling height (z)	2.5 m		

Room reverberation time (s)						
Tmf	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz
0.5	0.5	0.5	0.5	0.5	0.5	0.5

DISTANCE ATTENUATION CALCULATION			
Distance correction	No	Calculated Distance Attenuation	-
Type of distance correction	Line source		
Distance from source to microphone	-		
Distance from source to receiver	-		

FREE FIELD LEVELS AT 1m FROM THE NOISE SENSITIVE FAÇADE								
LAeq		dB(A)	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz
	Free Field Leq in octave bands (dB)	55	48	45	49	53	47	35
	Resultant Free-Field Leq with distance attenuation (dB(A))	55	48	45	49	53	47	35
LAmax (if applicable)		dB(A)	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz
	Free Field Lfmax in octave bands	71	67	70	67	68	63	51
	Resultant Free-Field LAmax with distance	71	67	70	67	68	63	51

SOUND REDUCTION PROPERTIES OF BUILDING ELEMENTS									
		125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	R_w	R_w+C_{tr} (dB)
Window (R_w)	Rw+Ctr 25dB BS12354 4/20/4	21	17	25	35	37	31	29	25
Louver (Rw)	No Louver	0	0	0	0	0	0	0	0
External wall Construction (Rw)	Typical external wall construction	46	44	46	54	62	67	52	49
Roof Construction (Rw)	Typical roof construction	99	99	99	99	99	99	99	99
		125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	$D_{n,e,w}$ (dB)	
Trickle Vent ($D_{n,e,w}$)	Non-acoustic trickle vent — 1 Units	27	27	27	27	27	27	-	

CALCULATED INTERNAL LAeq AND LAF,max LEVELS						
	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz
Calculated LAeq in the receiver room (dB)	26	26	26	28	22	10
Calculated LAFmax in the receiver room (dB)	42	48	41	40	35	23

L_{Aeq} (125-4000Hz)	L_{Amax} (125-4000Hz)
30 dB(A)	45 dB(A)

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