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Proposed Mixed-Use Development Barnsley West - Land to the South of Barugh Green Road, Barnsley

Noise Impact Assessment

**For:
Strata Sterling Barnsley West Limited**

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1 Introduction

1.1 Overview

Environmental Noise Solutions Ltd (ENS) has been commissioned by Strata Sterling Barnsley West Limited to undertake a noise impact assessment for a proposed mixed-use development (known as 'Barnsley West') on land to the south of Barugh Green Road in Barnsley (hereafter referred to as 'the site').

This report details:

- The methodology and results of a baseline noise survey conducted at the site and at locations representative of nearest noise sensitive receptors (NSRs) to the site
- The assessment of potential impact with regard to existing and future local noise sources that may affect the proposed development
- Recommendations for building envelope design (fenestration and ventilation) at key locations within the proposed development
- The assessment of potential noise impact, associated with the proposals, upon nearby NSRs

The report has been prepared for Strata Sterling Barnsley West Limited for the sole purpose described above and no extended duty of care to any third party is implied or offered. Third parties referring to the report should consult Strata Sterling Barnsley West Limited and ENS as to the extent to which the findings may be appropriate for their use.

A glossary of acoustic terms used in the main body of the text is contained in Appendix A.

1.2 Site Description

The site is located to the south of Barugh Green Road (A635) in the Higham / Barugh Green area, approximately 2 km to the north-west of Barnsley town centre, as shown in Appendix B.

The site is bound by:

- Barugh Green Road (A635) to the north with Claycliffe Business Park further beyond
- Higham village (residential area) to the west
- Gawber village (residential area) to the east
- M1 motorway to the south

The proposed development comprises:

- Area A – proposed housing (plus a school and a small area of commercial use) in the northern area of the site
- Area B – proposed housing in the central area of the site
- Areas C and D – proposed commercial use in the southern area of the site

2 Policy Context and Assessment Guidance

2.1 National Planning Policy Framework

The National Planning Policy Framework (NPPF)¹ was updated in February 2019 and sets out the Government's planning policies for England and how these are expected to be applied.

Where issues of noise impact are concerned the NPPF provides brief guidance in paragraph 170 where it states that planning policies and decisions should contribute to and enhance the natural and local environment by:

'preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of.....noise pollution'.

Paragraph 180 advises that:

'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.....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'.

The NPPF also refers to the 2010 DEFRA publication, the Noise Policy Statement for England (NPSE) which reinforces and supplements the NPPF.

Paragraph 182 states that:

'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.'

2.2 Noise Policy Statement for England

The Noise Policy Statement for England² (NPSE) sets out the long-term vision of promoting good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development. This long-term vision is supported by the following aims:

- Avoid significant adverse impacts on health and quality of life
- Mitigate and minimise adverse impacts on health and quality of life
- Where possible, contribute to the improvement of health and quality of life

The NPSE describes the following levels at which noise impacts may be identified:

¹ National Planning Policy Framework. Ministry of Housing, Communities and Local Government (2019)

² Noise Policy Statement for England. Government Department for Environment, Food and Rural Affairs (2010)

- 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
- SOAEL – Significant Observed Adverse Effect Level. This is the level above which significant adverse effects on health and quality of life occur

According to the explanatory notes in the statement, where a noise level falls between the lowest observable adverse effect level (LOAEL) and a level which represents a significant observable adverse effect level (SOAEL):

‘...all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life whilst also taking into consideration the guiding principles of sustainable development. This does not mean that such effects cannot occur.’

2.3 Planning Practice Guidance on Noise

In December 2014, Planning Practice Guidance³ (PPG) was updated online to provide additional guidance and elaboration on the NPPF. It advises that the Local Planning Authority should consider the acoustic environment in relation to:

- Whether or not a significant adverse effect is occurring or likely to occur
- Whether or not an adverse effect is occurring or likely to occur
- Whether or not a good standard of amenity can be achieved

In line with the Explanatory Note of the NPSE, the PPG references the LOAEL and SOAEL in relation to noise impact. It also provides examples of outcomes that could be expected for a given perception level of noise, plus actions that may be required to bring about a desired outcome. However, in line with the NPSE, no objective noise levels are provided for LOAEL or SOAEL although the PPG acknowledges that:

‘...the subjective nature of noise means that there is not a simple relationship between noise levels and the impact on those affected. This will depend on how various factors combine in any particular situation’.

Table 2.1 summarises the PPG noise exposure hierarchy.

³ Planning Practice Guidance on Noise, 2014: <http://planningguidance.planningportal.gov.uk/blog/guidance/noise/>

Table 2.1: PPG Noise Exposure Hierarchy

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

The PPG also provides general advice on the typical options available for mitigating noise, suggesting that Local Plans may include noise standards applicable to proposed developments within the Local Authority's administrative boundary, although it states that:

'Care should be taken, however, to avoid these being implemented as fixed thresholds as specific circumstances may justify some variation being allowed'.

With regard to the mitigation of extant environmental noise at a proposed residential development, the guidance states that:

'... consideration should also be given to whether adverse internal effects can be completely removed by closing windows and, in the case of new residential development, if the proposed mitigation relies on windows being kept closed most of the time. In both cases a suitable alternative means of ventilation is likely to be necessary. Further information on ventilation can be found in the Building Regulations'.

2.4 Assessment Guidance

British Standard 8233:2014

British Standard 8233:2014 'Guidance on Sound Insulation and Noise Reduction for Buildings' (BS8233)⁴ provides recommendations for the control of noise both in and around buildings and suggests criteria and limits appropriate to their function. For dwellings, the main considerations are:

- Bedrooms - the effect of noise upon sleep
- Other habitable rooms - the effect of noise upon resting, listening and communicating

It is desirable that the internal ambient noise level does not exceed the guideline values as replicated in Table 2.2.

⁴ British Standard 8233:2014 Guidance on sound insulation and noise reduction for buildings. BSI

Table 2.2: Indoor Ambient Noise Levels for Dwellings - BS8233:2014

Activity	Location	07:00 – 23:00	23:00 – 07:00
Resting	Living room	35 dB $L_{Aeq,16hour}$	-
Dining	Dining room/area	40 dB $L_{Aeq,16hour}$	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,16hour}$	30 dB $L_{Aeq,8hour}$

BS8233 states:

'If relying on closed windows to meet the guide values, there needs to be appropriate alternative ventilation 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.'

For traditional external areas that are used for amenity space, such as gardens, BS8233 states that:

'.....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.'

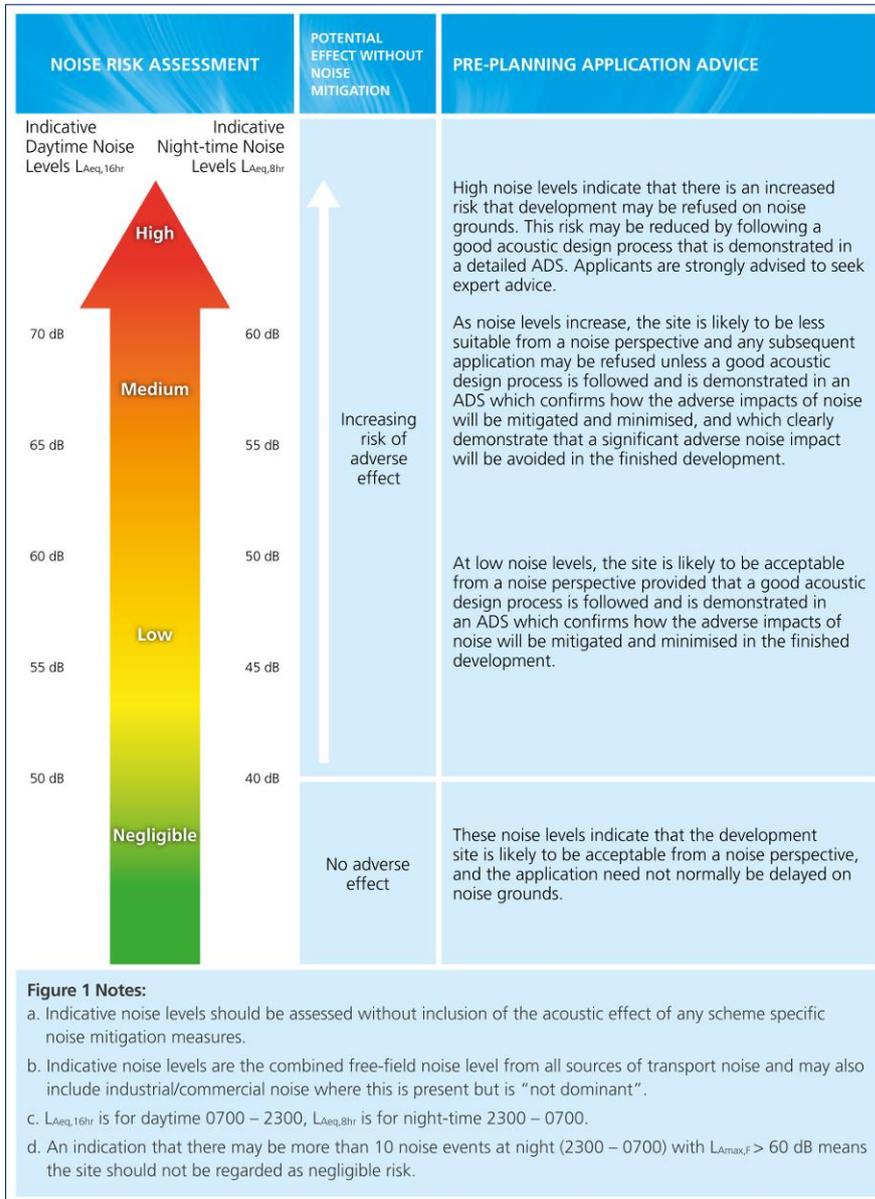
ProPG Planning and Noise: New Residential Development

ProPG Planning and Noise: New Residential Development (ProPG)⁵ promotes a systematic two-stage, risk-based approach to noise assessments that inform planning applications for new residential developments.

The 'Stage 1 Initial Site Noise Risk Assessment' should be conducted, at the proposed development site, at the earliest opportunity, before any planning application is submitted. The noise risk assessment should provide an indication of the likely risk of adverse effects from noise were no subsequent mitigation to be included as part of the development proposal. It should indicate whether the proposed site is considered to pose a negligible, low, medium or high risk from a noise perspective. Figure 2.1 summarises the initial noise risk assessment and demonstrates how measured site noise levels relate to potential adverse effects from noise.

⁵ 'ProPG Planning and Noise: New Residential Development (ProPG)', 2017. Association of Noise Consultants (ANC), Institute of Acoustics (IOA) and the Chartered Institute of Environmental Health (CIEH)

Figure 2.1: ProPG Stage 1 – Initial Site Noise Risk Assessment



ProPG recommends compliance with indoor noise level targets in residential dwellings based on the guidance contained in BS8233 (see Table 2.2). Additionally, with regard to individual noise events, ProPG states:

‘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. In most circumstances in noise sensitive rooms at night (e.g. bedrooms) good acoustic design can be used so that individual noise events do not normally exceed 45dB $L_{Amax,F}$ more than 10 times a night.’

ProPG acknowledges that the internal target noise levels may only be practically achieved with windows closed in certain areas (e.g. in urban areas or sites adjacent to transportation noise sources) and states that:

In such circumstances, internal noise levels can be assessed with windows closed but with any façade openings used to provide ‘whole dwelling ventilation’ in accordance with Building Regulations Approved Document F (e.g. trickle ventilators in the open position).

It should also be noted that the internal noise level guidelines are generally not applicable under ‘purge ventilation’ conditions as defined by Building Regulations Approved Document F, as this should only occur occasionally (e.g. to remove odour from painting and decorating or from burnt food).’

ProPG also considers compliance with ambient noise level targets for external amenity areas in line with the recommendation of BS8233. On this issue, ProPG states that:

‘Where, despite following a good acoustic design process, significant adverse noise impacts remain on any private external amenity space (e.g. garden or balcony) then that impact may be partially off-set if the residents are provided, through the design of the development or the planning process, with access to:

- a relatively quiet facade (containing openable windows to habitable rooms) or a relatively quiet externally ventilated space (i.e. an enclosed balcony) as part of their dwelling; and/or*
- a relatively quiet alternative or additional external amenity space for sole use by a household, (e.g. a garden, roof garden or large open balcony in a different, protected, location); and/or*
- a relatively quiet, protected, nearby, external amenity space for sole use by a limited group of residents as part of the amenity of their dwellings; and/or*
- a relatively quiet, protected, publicly accessible, external amenity space (e.g. a public park or a local green space designated because of its tranquillity) that is nearby (e.g. within a 5 minutes walking distance). The local planning authority could link such provision to the definition and management of Quiet Areas under the Environmental Noise Regulations.’*

Building Regulations - Approved Document F

Building Regulations Approved Document F ‘Ventilation’ (2010 version incorporating 2013 amendments)⁶ states:

‘For mainly naturally ventilated buildings, it is common to use a combination of ventilators (e. g. for dwellings it is common to use intermittent extract fans for extract ventilation, trickle ventilators for whole dwelling ventilation and windows for purge ventilation). ... Purge ventilation throughout the building to aid the removal of high concentrations pollutants and water vapour released from occasional activities such as painting and decorating and or accidental releases such as smoke and burnt food or spillage of water. Purge ventilation is intermittent i.e. required only when such activities occur. Purge ventilation provisions may also be used to improve thermal comfort, although this is not controlled under Building Regulations.’

It is therefore evident that, whilst ventilation may also provide a means to aid thermal comfort, this is not controlled under Building Regulations.

Building Bulletin 93 – Acoustic Design of Schools

Section 1 (Performance Standards) of Building Bulletin 93 ‘Acoustic Design of Schools: Performance Standards’ (BB93)⁷ was updated in February 2015. The overall objectives of the BB93 performance standards are to provide acoustic conditions in schools that:

⁶ The Building Regulations 2010 Approved Document F ‘Ventilation’ (amended 2013) (ADF)

⁷ ‘Building Bulletin 93 - Acoustic Design of Schools: Performance Standards’, 2015. Department for Education (DfE).

- Facilitate clear communication of speech between teachers and students
- Do not interfere with study activities

BB93 specifies maximum Indoor Ambient Noise Levels (IANLs) for all teaching and ancillary spaces. These are ‘overall’ target noise levels, comprising the sum of building services noise, external noise break-in and any other noise sources present within the unoccupied, fully operational building.

Where a natural ventilation strategy is to be employed, the IANL limits can be relaxed by 5 dB $L_{Aeq,30min}$ where the ‘normal condition’ is achieved. However, this does not apply to spaces with an indoor ambient noise limit of 45 dB $L_{Aeq,30min}$ or higher. For hybrid ventilation systems, the mechanical system noise component must comply with the limits set out in Table 1 of BB93, however the overall noise limit can also be relaxed by 5 dB $L_{Aeq,30min}$ if the ‘normal condition’ is achieved.

BB93 states that:

‘The normal condition for a natural or hybrid ventilation mode is defined as when the system is operating to limit the daily average carbon dioxide concentration to no more than 1,500ppm with the maximum concentration not exceeding 2,000ppm for more than 20 consecutive minutes on any day. This would normally equate to a minimum ventilation rate of approximately 5l/s per person.

The mid-season design condition can be used in simple ventilation calculations and is defined as an outside temperature of 11 °C and an internal air temperature of 20 °C with no external wind effect....

... Where there is a hybrid system, any mechanical system components should meet the IANL limits from Table 1. The total noise level including external noise ingress may exceed the IANL limit from Table 1 by up to 5 dB.’

Typically, the most onerous indoor ambient noise level requirement given within BB93 is 35 dB $L_{Aeq,30min}$ (or 40 dB $L_{Aeq,30min}$ if naturally ventilated) which applies to most teaching spaces. However, where a teaching space is ‘intended specifically for students with special hearing and communication needs’, a lower IANL requirement of 30 dB $L_{Aeq,30min}$ (or 35 dB $L_{Aeq,30min}$ if naturally ventilated) is required.

BB93 also sets a maximum noise level of 60 dB $L_{A1,30min}$ in teaching spaces and is used to assess short transient noise levels associated with aircraft, railways and other similar sources. This is achieved by default for spaces with indoor ambient noise levels up to 40 dB $L_{Aeq,30min}$, but requires assessment in spaces with indoor ambient noise level targets of 45 dB $L_{Aeq,30min}$ or above.

British Standard 4142:2014

BS4142:2014⁸ presents methods for rating and assessing the potential impact of commercial and industrial sound upon noise sensitive receptors.

The scope of BS4142 specifically includes sound from industrial and manufacturing processes, sound from fixed plant, sound from loading and unloading of goods at industrial and commercial sites and mobile plant forming an intrinsic part of the overall sound from a premises or process.

A rating penalty can be applied to account for the character of the noise, namely tonality, impulsivity and intermittency. All of these corrections can be added together in linear fashion where appropriate.

Tonality can be determined objectively (using adjacent third octave band analysis / the Joint Nordic method) or subjectively as listed below:

⁸ British Standard 4142:2014+A1:2019 Methods for rating and assessing industrial and commercial sound, BSI (2019)

- +2 dB penalty: Just perceptible
- +4 dB penalty: Clearly perceptible
- +6 dB penalty: Highly perceptible

Impulsivity (the rapidity of the change in sound level) can be determined objectively (using Fast Fourier Transform analysis) or subjectively as listed below:

- +3 dB penalty: Just perceptible
- +6 dB penalty: Clearly perceptible
- +9 dB penalty: Highly perceptible

Where intermittency is present (i.e. when the specific noise has identifiable on/off conditions) a +3 dB penalty can be applied.

Where the specific sound feature characteristics are neither tonal nor impulsive, but are distinguishable against the residual noise, a +3 dB penalty can be applied.

In order to assess the impact, the 'Rating level' of the new noise source is compared with the existing 'Background level' and the following analysis made:

- Typically, the greater this difference, the greater the magnitude of the impact
- A difference of +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context
- A difference of +5 dB is likely to be an indication of an adverse impact, depending on the context
- Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context

BS4142 requires separate analysis for day and night time periods, evaluating the Rating level over an appropriate reference time interval (T_r) of:

- 1 hr during the day (between 07:00 - 23:00 hrs)
- 15 min during the night (between 23:00 - 07:00 hrs)

Artificial Grass Pitch (AGP) Acoustics – Planning Implications

Sport England's 'Artificial Grass Pitch (AGP) – Planning Implications: New Guidance for 2015'⁹ provides guidance to assess the noise impact of new artificial grass pitches on noise sensitive receptors. The following two assessment methodologies are considered the most appropriate in this case:

- Absolute Assessment Method: This method refers to the World Health Organisation (WHO) 'Guidelines for Community Noise' (1999) recommending that noise levels at 1 metre from the façades of living spaces should not exceed 50 dB $L_{Aeq,16hr}$ during the day.
- Comparative Assessment Method: This method makes comparison of external sports activity noise against the existing noise climate. Reference is made to the IOA/IEMA Working Party Consultation Draft 2002, superseded by Guidelines for Environmental Noise Impact, providing the impact of change in noise levels. Sport England recommends the introduction of a new pitch should not result in an increase of the existing noise climate by more than 3 dB, which is the 'minimum perceptible under normal conditions'.

⁹ 'Artificial Grass Pitch (AGP) Acoustics – Planning Implications: New Guidance for 2015 August Revision 001', 2015. Sport England

Typical AGP noise levels are presented in the document, based on noise levels measured during nine sports sessions on three separate AGPs. The sessions included football, hockey and rugby and participation by men, women and children. Noise level measurements were taken at a distance of 10 metres behind the mid-way points along goal lines and side-lines. The most significant noise source from typical AGP sports sessions was found to be that from voices.

From the measurement data, a typical free-field noise level of 58 dB $L_{Aeq,1hr}$ at a distance of 10 metres from the side-line halfway marking has been determined as representative for noise from AGPs.

Calculation of Road Traffic Noise (CRTN)

The 'Calculation of Road Traffic Noise' (CRTN)¹⁰ sets out standard procedures for calculating noise levels from road traffic. These procedures are necessary to determine entitlement under the Noise Insulation Regulations but they also provide guidance appropriate to the calculation of traffic noise for more general applications e.g. environmental appraisal of road schemes, highway design and land use planning.

The calculation methods use a number of input variables, including traffic flow volume, average vehicle speed, percentage of heavy goods vehicles, type of road surface, site geometry and the presence of noise barriers or acoustically absorbent ground. CRTN predicts the $L_{A10,18hr}$ noise level (the level exceeded for 10% of any 18-hour period between 06:00 – 24:00 hrs) for any receptor point at a given distance, up to 300 metres, from the road.

¹⁰ Calculation of Road Traffic Noise, 1988. Department of Transport and the Welsh Office.

3 Noise Survey and Results

3.1 Overview

In order to quantify the level of external noise affecting the site and local vicinity, noise monitoring was carried out between Monday 7th October 2019 and Wednesday 9th October 2019.

The adopted noise monitoring positions (shown in Appendix B) were as follows:

- 1 – Northern boundary of the site, at a position representative of the nearest proposed dwellings to the Barugh Green Road (at a distance of approximately 18 metres from nearside kerb)
- 2 – South-eastern boundary of the site, at a position representative of the southern-most proposed dwellings (i.e. closest to the M1 motorway); this position is also representative of the nearest existing noise sensitive receptors (NSRs) to the proposed commercial use at the south-east area of the development
- 3 – North-western boundary of the site, at a position representative of the proposed school (i.e. similar distance from Barugh Green Road); this position is also representative of the nearest existing NSRs to the north-west area (including proposed school and commercial use) of the development
- 4 – Western boundary of the site, representative of the nearest existing NSRs to the western area of the development (construction phase)
- 5 – South-western boundary, representative of the nearest existing NSRs to the proposed commercial use at the south-west area of the development
- 6 – Central part of the site, representative of proposed dwellings adjacent to Hermit Lane
- 7 – North-eastern boundary of the site, representative of the nearest existing NSRs to the eastern area of the development (construction phase)

3.2 Equipment

Noise measurements were undertaken using a Bruel & Kjaer 2250 Type 1 integrating sound level meter. The meter was connected to a windshield covered microphone positioned at a height of 1.5 metres above ground in free-field conditions at the locations detailed in the foregoing Section 3.1.

The measurement system calibration was verified immediately before and after each survey period using a Bruel & Kjaer Type 4231 calibrator. No drift in calibration levels greater than 0.5 dB was noted.

Measurements consisted of A-weighted broadband parameters including L_{Aeq} , L_{A10} , L_{A90} and L_{AFmax} together with linear octave and third octave band data.

3.3 Weather

The noted weather conditions during the survey were generally dry / slightly damp, mild and calm (with average wind speeds ≤ 5 m/s). Weather conditions were therefore considered appropriate for noise monitoring.

3.4 Summary of Results

Table 3.1 presents a summary of the noise data for each measurement session, at each measurement position, rounded to the nearest decibel.

Table 3.1: Summary of Noise Measurement Data

Position	Date	Time (hh:mm)	L _{Aeq} (dB)	L _{AFmax} (dB)	L _{A10} (dB)	L _{A90,15min} Range (dB)	Comment
1	07/10/2019	10:02 – 11:02	60	79	63	52 – 53	Road traffic on Barugh Green Road (A635)
		11:02 – 12:02	59	74	62	51	
		12:02 – 13:02	59	73	62	51 – 53	
		23:01 – 23:16	55	79	58	47	
	08/10/2019	00:04 – 00:19	50	64	53	45	
		23:00 – 23:15	56	74	59	50	
09/10/2019	00:00 – 00:16	51	64	54	45		
2	07/10/2019	13:16 – 14:16	50	70	52	48 – 49	Distant road traffic on M1 Motorway
		14:16 – 15:16	51	69	52	48 – 49	
		15:16 – 16:16	52	62	54	47 – 51	
		23:42 – 23:57	48	55	49	46	
	08/10/2019	23:20 – 23:35	49	67	51	46	
09/10/2019	00:22 – 00:37	48	64	50	45		
3	08/10/2019	01:20 – 01:35	46	59	48	43	Distant road traffic on M1 Motorway
		01:35 – 01:50	45	53	48	42	
		11:17 – 11:32	53	65	54	50	
		11:32 – 11:47	53	73	56	49	
	09/10/2019	01:39 – 01:54	48	58	50	45	
		01:54 – 02:09	48	61	50	43	
		11:23 – 11:38	49	61	52	45	
11:38 – 11:53	47	55	49	46			
4	08/10/2019	12:01 – 12:16	53	62	54	51	Distant road traffic on M1 Motorway
		12:16 – 12:31	53	62	55	51	
	09/10/2019	11:56 – 12:11	51	57	52	49	
		12:11 – 12:26	50	61	52	48	
5	08/10/2019	00:43 – 00:58	52	63	54	49	Distant road traffic on M1 Motorway
		00:58 – 01:13	52	69	54	48	Distant road traffic on M1 Motorway and road traffic on Higham Road
		12:38 – 12:53	59	66	61	57	Distant road traffic on M1 Motorway and road traffic on Higham Road
		12:53 – 13:08	59	67	61	57	Distant road traffic on M1 Motorway and road traffic on Higham Road
	09/10/2019	01:01 – 01:16	51	59	53	47	Distant road traffic on M1 Motorway
		01:16 – 01:31	52	62	55	49	Distant road traffic on M1 Motorway
		12:31 – 12:46	57	70	59	52	Distant road traffic on M1 Motorway and road traffic on Higham Road
12:46 – 13:01	56	70	59	51	Distant road traffic on M1 Motorway and road traffic on Higham Road		
6	07/10/2019	23:22 – 23:37	51	73	50	43	Distant road traffic on M1 Motorway
	08/10/2019	00:25 – 00:40	47	68	47	43	Distant road traffic on M1 Motorway
		13:12 – 13:27	57	75	59	47	Distant road traffic on M1 Motorway and occasional vehicles on Hermit Lane
		13:27 – 13:42	60	82	63	47	
		23:40 – 23:55	48	69	48	42	Distant road traffic on M1 Motorway
	09/10/2019	00:42 – 00:57	49	71	51	44	Distant road traffic on M1 Motorway
		13:08 – 13:23	57	77	57	43	Distant road traffic on M1 Motorway and occasional vehicles on Hermit Lane
13:23 – 13:38		59	82	61	43		
7	08/10/2019	13:55 – 14:10	54	66	57	50	Road traffic on A635 (Barugh Green Road and Wilthorpe Road)
		14:10 – 14:25	51	67	53	49	
	09/10/2019	13:44 – 13:59	52	65	54	50	
		13:59 – 14:14	52	66	54	50	

3.5 Analysis

Northern Boundary

At Position 1, the dominant noise source was observed to be due to road traffic on Barugh Green Road (A635). No contributions from the existing nearby commercial premises (to the north) were observed at any time during the noise survey.

For the prediction of daytime road traffic noise, the Department of Transport's Memorandum on the Calculation of Road Traffic Noise (CRTN) explains that the following shortened measurement procedure may be used. Measurements of L_{A10} are made over any three consecutive hours between 10:00 - 17:00 hrs.

Using $L_{A10, 3hr}$ as the arithmetic mean of the three consecutive values of hourly L_{A10} , the $L_{A10, 18hr}$ can be calculated from the equation:

$$(i) \quad L_{A10, 18hr} = L_{A10, 3hr} - 1 \text{ dB}$$

$$(ii) \quad L_{Aeq, 16hr} \approx L_{A10, 18hr} - 2 \text{ dB}$$

Substituting (ii) into (i) gives the following approximation:

$$(iii) \quad L_{Aeq, 16hr} \approx L_{A10, 3hr} - 3 \text{ dB}$$

Based on the above formula, the 16-hr daytime ambient noise level is calculated to be 59 dB $L_{Aeq, 16hr}$.

A study prepared by TRL Limited on behalf of the Department for Environment, Food and Rural Affairs (DEFRA) entitled 'Converting the UK Traffic Noise Index L_{A10} (18 hour) to EU Noise Indices for Noise Mapping' presents a methodology for calculating night-time road traffic noise levels, based on daytime road traffic noise levels, using the following formulae:

$$(iv) \quad L_{Aeq, 8hr} \approx 0.9 \times L_{A10, 18hr} - 3.77 \text{ (for non-motorway roads)}$$

$$(v) \quad L_{Aeq, 8hr} \approx 0.87 \times L_{A10, 18hr} + 4.24 \text{ (for motorways)}$$

Based on the above formula (iv) for non-motorway roads, the 8-hr night-time ambient noise level is calculated to be 51 dB $L_{Aeq, 8hr}$.

Maximum noise levels were due to passing vehicle movements and were ≤ 79 dB L_{AFmax} at night.

South-Eastern Boundary

At Position 2, the dominant noise source was observed to be due to distant road traffic on the M1 Motorway.

Using the CRTN formula (iii) presented in the foregoing subsection, the 16-hr daytime ambient noise level is calculated to be 50 dB $L_{Aeq, 16hr}$.

Based on the TRL formula (v) for motorways, the 8-hr night-time ambient noise level is calculated to be 49 dB $L_{Aeq, 8hr}$.

Maximum noise levels were ≤ 67 dB L_{AFmax} at night.

Background noise levels ranged from 47 – 51 dB $L_{A90, 15min}$ during the day and 45 – 46 dB $L_{A90, 15min}$ at night. Typical background noise levels were around:

- 49 dB $L_{A90,15min}$ during the day
- 46 dB $L_{A90,15min}$ at night

North-Western Boundary

At Position 3, the dominant noise source was observed to be due to distant road traffic on the M1 Motorway. Daytime ambient noise levels were around 47 – 53 dB $L_{Aeq,T}$ and night-time ambient noise levels were around 45 – 48 dB $L_{Aeq,T}$. Maximum noise levels were \leq 61 dB L_{AFmax} at night.

Background noise levels ranged from 45 – 50 dB $L_{A90,15min}$ during the day and 42 – 45 dB $L_{A90,15min}$ at night. Typical background noise levels were around:

- 48 dB $L_{A90,15min}$ during the day
- 43 dB $L_{A90,15min}$ at night

Western Boundary

At Position 4, the dominant noise source was observed to be due to distant road traffic on the M1 Motorway with daytime ambient noise levels of around 50 – 53 dB $L_{Aeq,T}$.

South-Western Boundary

At Position 5, the dominant noise source was observed to be due to distant road traffic on the M1 Motorway, particularly at night. During the daytime, additional contributions were also noted from Higham Road.

Daytime ambient noise levels were around 56 – 59 dB $L_{Aeq,T}$ and night-time ambient noise levels were around 51 – 52 dB $L_{Aeq,T}$. Maximum noise levels were \leq 69 dB L_{AFmax} at night.

Background noise levels ranged from 51 – 57 dB $L_{A90,15min}$ during the day and 47 – 49 dB $L_{A90,15min}$ at night. Typical background noise levels were around:

- 57 dB $L_{A90,15min}$ during the day
- 49 dB $L_{A90,15min}$ at night

Central Area

At Position 6, the dominant noise source was observed to be due to distant road traffic on the M1 Motorway and occasional vehicle movements on Hermit Lane. Daytime ambient noise levels were around 57 – 60 dB $L_{Aeq,T}$ and night-time ambient noise levels were around 47 – 51 dB $L_{Aeq,T}$. Maximum noise levels were \leq 73 dB L_{AFmax} at night.

Background noise levels ranged from 43 – 47 dB $L_{A90,15min}$ during the day and 42 – 44 dB $L_{A90,15min}$ at night. Typical background noise levels were around:

- 47 dB $L_{A90,15min}$ during the day
- 43 dB $L_{A90,15min}$ at night

North-Eastern Boundary

At Position 7, the dominant noise source was observed to be due to road traffic on the A635 (Barugh Green Road and Wilthorpe Road) with daytime ambient noise levels of around 51 – 54 dB $L_{Aeq,T}$.

4 Noise Ingress Assessment – Existing Sources

4.1 Initial Site Noise Risk Assessment

Assessment of the measured/calculated ambient noise level data, using the ProPG initial site noise risk assessment diagram shown in Section 2, has determined that the residential areas of the development would be categorised as shown in Table 4.1 in terms of adverse effects from existing noise.

Table 4.1: Risk of Adverse Effects from Noise

Location	Period	External Noise Levels (dB LAeq)	Risk
Northern Boundary	Day (07:00–23:00)	59	Low
	Night (23:00–07:00)	51	Low
South-Eastern Boundary	Day (07:00–23:00)	52	Low
	Night (23:00–07:00)	49	Low
North-Western Boundary	Day (07:00–23:00)	53	Low
	Night (23:00–07:00)	48	Low
Central Area	Day (07:00–23:00)	60	Low
	Night (23:00–07:00)	51	Low

It can be seen that proposed dwellings will experience a low risk of adverse effects from road traffic noise. At low risk sites, ProPG advises that the site is likely to be acceptable from a noise perspective provided that a good acoustic design process is followed.

4.2 Noise Mitigation Strategy - Residential

Feasibility of Open Windows

With regard to internal noise levels when windows are open, the World Health Organisation (WHO) Guidelines for Community Noise (1999) states:

‘the noise reduction from outside to inside with the window partly open is 15 decibels’.

On this basis, internal noise levels with dwelling windows open have been calculated, as set out in Table 4.2.

Table 4.2: Internal Noise Levels in Residential Units – Windows Open

Location	Period	External Noise Levels	Resultant Internal Noise Level	Criteria	Criteria Satisfied?
Northern Boundary	Day (07:00–23:00)	59 dB LAeq	44 dB LAeq	35 dB LAeq	No
		51 dB LAeq	36 dB LAeq	30 dB LAeq	No
	Night (23:00–07:00)	79 dB LAfmax	64 dB LAfmax	45 dB LAfmax	No
South-Eastern Boundary	Day (07:00–23:00)	52 dB LAeq	37 dB LAeq	35 dB LAeq	No
		49 dB LAeq	34 dB LAeq	30 dB LAeq	No
	Night (23:00–07:00)	67 dB LAfmax	52 dB LAfmax	45 dB LAfmax	No
North-Western Boundary	Day (07:00–23:00)	53 dB LAeq	38 dB LAeq	35 dB LAeq	No
		48 dB LAeq	33 dB LAeq	30 dB LAeq	No
	Night (23:00–07:00)	61 dB LAfmax	46 dB LAfmax	45 dB LAfmax	No
Central Area	Day (07:00–23:00)	60 dB LAeq	45 dB LAeq	35 dB LAeq	No
		51 dB LAeq	36 dB LAeq	30 dB LAeq	No
	Night (23:00–07:00)	73 dB LAfmax	58 dB LAfmax	45 dB LAfmax	No

It can be seen that internal noise levels would exceed the criteria with open windows. On this basis, it is not recommended that permanently open windows are relied upon as the primary means of ventilation for proposed dwellings.

The assessment has therefore assumed that windows will be closed, as part of the noise mitigation strategy for the site. Windows can be opened for temporary purge ventilation (to enable discretionary rapid air changing) with resultant internal levels as per the values shown in Table 4.2; however, this would be on a temporary basis.

Closed Windows

External and internal noise measurements undertaken by ENS at other sites have determined that a standard double-glazed window with standard trickle vents in a building façade will provide at least 27 dB(A) sound insulation from a free-field external noise level. On this basis, internal noise levels with dwelling windows closed (and ventilation provided via standard trickle vents) have been calculated, as set out in Table 4.3.

Table 4.3: Internal Noise Levels in Residential Units – Windows Closed (Ventilation via Standard Trickle Vents)

Location	Period	External Noise Levels	Resultant Internal Noise Level	Criteria	Criteria Satisfied?
Northern Boundary	Day (07:00–23:00)	59 dB L _{Aeq}	33 dB L _{Aeq}	35 dB L _{Aeq}	Yes
	Night (23:00–07:00)	56 dB L _{Aeq}	29 dB L _{Aeq}	30 dB L _{Aeq}	No
79 dB L _{AFmax}		52 dB L _{AFmax}	45 dB L _{AFmax}		
South-Eastern Boundary	Day (07:00–23:00)	52 dB L _{Aeq}	25 dB L _{Aeq}	35 dB L _{Aeq}	Yes
	Night (23:00–07:00)	49 dB L _{Aeq}	22 dB L _{Aeq}	30 dB L _{Aeq}	Yes
67 dB L _{AFmax}		40 dB L _{AFmax}	45 dB L _{AFmax}		
North-Western Boundary	Day (07:00–23:00)	53 dB L _{Aeq}	26 dB L _{Aeq}	35 dB L _{Aeq}	Yes
	Night (23:00–07:00)	48 dB L _{Aeq}	21 dB L _{Aeq}	30 dB L _{Aeq}	Yes
61 dB L _{AFmax}		34 dB L _{AFmax}	45 dB L _{AFmax}		
Central Area	Day (07:00–23:00)	60 dB L _{Aeq}	33 dB L _{Aeq}	35 dB L _{Aeq}	Yes
	Night (23:00–07:00)	51 dB L _{Aeq}	24 dB L _{Aeq}	30 dB L _{Aeq}	No
73 dB L _{AFmax}		46 dB L _{AFmax}	45 dB L _{AFmax}		

It can be seen that, in most instances, internal noise levels would satisfy the criteria with closed windows (and a basic configuration of standard double glazing and trickle ventilation).

At the northern boundary and in the central area, the anticipated non-compliances (due to L_{AFmax} levels at night) occur where proposed dwellings would be in close proximity to passing vehicles on a local road (e.g. Barugh Green Road on the northern boundary and Hermit Lane in the central area of the site). Acoustic trickle vents (coupled with standard double glazing) would therefore be required for the most exposed dwelling facades in those areas.

External Amenity

In Section 3 of this report, it was established that the highest measured daytime free-field external noise levels were around 60 dB L_{Aeq,T} at the positions of dwellings proposed along the northern boundary and those adjacent to Hermit Lane in the centre of the site.

In order to mitigate external noise levels, to satisfy the criteria for external amenity areas as recommended by BS8233 / ProPG, it is recommended that proposed gardens at the northern boundary are either self-screened from Barugh Green Road (by positioning houses between the road and the gardens) or are protected with a solid acoustic barrier (e.g. imperforate close-boarded timber fencing or solid masonry wall with a mass per unit area $\geq 10\text{kg/m}^2$). The height of the barrier should be at least 1.8m above ground level in order to interrupt propagation of noise from the road to the gardens.

The above mitigation strategy is also recommended for proposed dwellings adjacent to Hermit Lane in the centre of the site.

For the rest of the site, external noise levels are just above the desirable threshold of 50 dB $L_{Aeq,T}$, as recommended by BS8233/ProPG and are therefore expected to satisfy the criteria once the scheme is complete due to shielding from the built form of the development, therefore no additional mitigation works would be expected for these areas.

4.3 Noise Mitigation Strategy - School

In Section 2 it was established that typically, the most onerous Indoor Ambient Noise Level (IANL) requirement within BB93 is 35 dB $L_{Aeq,30min}$ (or 40 dB $L_{Aeq,30min}$ if naturally ventilated) which applies to most teaching spaces. However, where a teaching space is 'intended specifically for students with special hearing and communication needs', a lower IANL requirement of 30 dB $L_{Aeq,30min}$ (or 35 dB $L_{Aeq,30min}$ if naturally ventilated) is required.

It is considered that an appropriate design criterion would be 40 dB $L_{Aeq,30min}$ based on the assumption that the proposed school would have a preference of natural ventilation. However, if the proposed school will cater for students with special hearing and communication needs, the criteria should be reduced accordingly by 5 dB.

In Section 3 it was determined that average daytime external noise levels affecting the location of the proposed school were around 47 – 53 dB $L_{Aeq,T}$. On this basis, IANLs in school teaching spaces with windows open have been calculated, as set out in Table 4.4.

Table 4.4: IANLs in Teaching Spaces – Windows Open

Period	External Noise Levels	Resultant Internal Noise Level	Criteria	Criterion Satisfied?
Typical School Day	≤ 53 dB L_{Aeq}	38 dB L_{Aeq}	≤ 40 dB L_{Aeq}	Yes

It can be seen that IANLs in school teaching spaces are expected to be satisfied using open windows as a means of natural ventilation. The BB93 maximum internal noise level of 60 dB $L_{A1,30min}$ will be achieved by default as IANLs are expected to be below 40 dB $L_{Aeq,30min}$.

5 Noise Ingress Assessment – Potential Future Scenario

5.1 Overview

In addition to the assessment of the existing noise environment affecting the proposed development, it is considered prudent to consider the potential additional noise contribution from the site access road that will run through the site. This road has the potential to be extended to create a link between two roundabouts at the northern and southern boundaries of the site.

Projected traffic data, associated with the site access road, have been provided by Fore Consulting Limited, the transport consultants for the project. 18hr Annual Average Weekday Traffic (AAWT) data has been provided for the forecast year of completion (2033). The data is replicated in Table 5.1.

Table 5.1: Forecast Site Access Road Traffic Data – 2033

Link / Road Name	18hr AAWT With Development and Other Committed Developments	% HGV
Site Access Road	13423	1

The above traffic flow data has been used, along with the methodology outlined in CRTN to calculate road traffic noise from the new link across the site for up to 300 metres distance. Calculations have incorporated the following assumptions:

- Vehicle speeds of ≤ 30 mph (48 km/h)¹¹
- Generally neutral gradient
- Impervious / bituminous road surface (if a pervious macadam surface is to be used then a correction of $- 2.5$ dB can be applied to calculated noise levels)
- Unobstructed propagation from road to receiver position (where the road is not expected to be visible due to proposed barriers or topographical shielding then additional corrections to the calculated noise levels may be appropriate)
- Hard / reflective intervening ground cover between the road and dwellings

Using the guidance set out in CRTN, along with the assumptions listed above, a basic noise level of 67 dB $L_{A10,18hr}$ has been determined at a distance of 10 metres from the nearest kerb.

Using the CRTN and TRL formulae detailed in Section 3, the 16-hr daytime and 8-hr night-time L_{Aeq} values have been calculated, as shown in Table 5.2.

Table 5.2: Calculated Road Traffic Noise Levels at Various Distances from Site Access Road

Distance from Site Access Road (m)	Calculated Road Traffic Noise Levels		
	$L_{A10,18hr}$ (dB)	Daytime $L_{Aeq,16hr}$ (dB)	Night $L_{Aeq,8hr}$ (dB)
10	67	65	57
20	65	63	54
30	63	61	53
40	62	60	52
50	61	59	51
100	58	56	49
200	55	53	46
300	54	52	44

¹¹ As advised by James Brierley, Fore Consulting Limited on 25/10/2019 (via email)

5.2 Noise Mitigation Strategy - Residential Development

External Amenity

With regard to external noise levels during the day, it can be seen that unmitigated noise levels in proposed garden areas are not expected to satisfy the lower 'desirable' guideline value of ≤ 50 dB $L_{Aeq,T}$ for external amenity areas, as recommended by BS8233 / ProPG, for distances within 300 metres from the proposed site access road.

In order to mitigate external noise levels, to satisfy the lower 'desirable' criterion of ≤ 50 dB $L_{Aeq,T}$ for external amenity areas, it is recommended that either:

- Proposed gardens are self-screened from the site access road (by positioning houses between the road and the gardens); or
- Proposed gardens that back on to the site access road are protected with a solid acoustic barrier¹²

Internal Noise Levels

With regard to habitable rooms with direct exposure to the site access road, internal noise levels with windows open have been calculated, as set out in Table 5.3.

Table 5.3: Internal Noise Levels in Habitable Rooms Facing Site Access Road – Windows Open

Distance from Site Access Road (m)	Period	External Noise Levels (dB L_{Aeq})	Resultant Internal Noise Level (dB L_{Aeq})	Criteria	Criteria Satisfied?
10	Day (07:00–23:00)	65	50	35 dB L_{Aeq}	No
	Night (23:00–07:00)	57	42	30 dB L_{Aeq}	No
20	Day (07:00–23:00)	63	48	35 dB L_{Aeq}	No
	Night (23:00–07:00)	54	39	30 dB L_{Aeq}	No
30	Day (07:00–23:00)	61	46	35 dB L_{Aeq}	No
	Night (23:00–07:00)	53	38	30 dB L_{Aeq}	No
40	Day (07:00–23:00)	60	45	35 dB L_{Aeq}	No
	Night (23:00–07:00)	52	37	30 dB L_{Aeq}	No
50	Day (07:00–23:00)	59	44	35 dB L_{Aeq}	No
	Night (23:00–07:00)	51	36	30 dB L_{Aeq}	No
100	Day (07:00–23:00)	56	41	35 dB L_{Aeq}	No
	Night (23:00–07:00)	49	34	30 dB L_{Aeq}	No
200	Day (07:00–23:00)	53	38	35 dB L_{Aeq}	No
	Night (23:00–07:00)	46	31	30 dB L_{Aeq}	No
300	Day (07:00–23:00)	52	37	35 dB L_{Aeq}	No
	Night (23:00–07:00)	44	29	30 dB L_{Aeq}	Yes

Table 5.3 shows that the internal noise criteria cannot be satisfied, in habitable rooms of dwellings within 300m distance, and with direct exposure to, the site access road, when open windows are relied upon as the primary source of background ventilation.

The assessment has therefore assumed that windows will be closed, as part of the noise mitigation strategy for habitable rooms with direct exposure to the new access road. Windows can be opened for temporary purge ventilation (to enable discretionary rapid air changing) with resultant internal levels as per the values shown in Table 5.3; however, this would be on a temporary basis.

¹² e.g. imperforate close-boarded timber fencing or solid masonry wall with a mass per unit area $\geq 10\text{kg/m}^2$). The height of the barrier should be at least 1.8m above ground level in order to interrupt propagation from the new road to the proposed gardens.

With regard to habitable rooms with direct exposure to the site access road, internal noise levels when windows are closed (with ventilation provided via standard trickle vents) have been calculated, as set out in Table 5.4.

Table 5.4: Internal Noise Levels in Habitable Rooms Facing Site Access Road – Windows Closed (Ventilation via Standard Trickle Vents)

Distance from Site Access Road (m)	Period	External Noise Levels (dB L _{Aeq})	Resultant Internal Noise Level (dB L _{Aeq})	Criteria	Criteria Satisfied?
10	Day (07:00–23:00)	65	38	35 dB L _{Aeq}	No
	Night (23:00–07:00)	57	30	30 dB L _{Aeq}	Yes
20	Day (07:00–23:00)	63	36	35 dB L _{Aeq}	No
	Night (23:00–07:00)	54	27	30 dB L _{Aeq}	Yes
30	Day (07:00–23:00)	61	34	35 dB L _{Aeq}	Yes
	Night (23:00–07:00)	53	26	30 dB L _{Aeq}	Yes
40	Day (07:00–23:00)	60	33	35 dB L _{Aeq}	Yes
	Night (23:00–07:00)	52	25	30 dB L _{Aeq}	Yes
50	Day (07:00–23:00)	59	32	35 dB L _{Aeq}	Yes
	Night (23:00–07:00)	51	24	30 dB L _{Aeq}	Yes
100	Day (07:00–23:00)	56	29	35 dB L _{Aeq}	Yes
	Night (23:00–07:00)	49	22	30 dB L _{Aeq}	Yes
200	Day (07:00–23:00)	53	26	35 dB L _{Aeq}	Yes
	Night (23:00–07:00)	46	19	30 dB L _{Aeq}	Yes
300	Day (07:00–23:00)	52	25	35 dB L _{Aeq}	Yes
	Night (23:00–07:00)	44	17	30 dB L _{Aeq}	Yes

Calculations have determined that internal day and night noise criteria would be satisfied, in habitable rooms with direct exposure to the site access road and with windows closed (and ventilation provided by standard trickle vents), for dwellings beyond 30m distance from the new access road.

Acoustic trickle vents (coupled with standard double glazing) would therefore be required for habitable rooms with direct exposure to the site access road, at 10 - 30 metre distance.

5.3 School

The masterplan shows the position of the school at a distance of approximately 65 metres from the proposed site access road. On this basis, a road traffic noise level of 59 dB L_{A10,18hr} has been calculated using the CRTN methodology. This equates to a daytime external noise level of 57 dB L_{Aeq,16hr} which is assumed to be the typical ambient noise level, L_{Aeq,30min}, affecting the location of the proposed school. On this basis, IANLs in school teaching spaces with windows open have been calculated, as set out in Table 5.5.

Table 5.5: IANLs in Teaching Spaces – Windows Open

Period	External Noise Levels	Resultant Internal Noise Level	Criteria	Criterion Satisfied?
Typical School Day	57 dB L _{Aeq}	42 dB L _{Aeq}	≤ 40 dB L _{Aeq}	No

Table 5.5 shows that the internal noise criteria cannot be satisfied, in classrooms with direct exposure to the proposed site access road, when open windows are relied upon as the primary source of background ventilation for the school. The assessment has therefore assumed that windows will be closed, as part of the noise mitigation strategy for the school.

A typical standard double-glazed unit will offer around 29 dB R_w (or 28 dB $R_w + C$). Annex G.1 of BS8233:2014 suggests one method for determining indoor ambient noise levels using a basic approach of subtracting the sound reduction value from the external ambient noise levels whilst allowing for a potential underestimation of around 5 dB. On this basis, internal noise levels with windows closed have been calculated for teaching spaces, as set out in Table 5.6.

Table 5.6: IANLs in Teaching Spaces – Windows Closed

Period	External Noise Levels	Resultant Internal Noise Level	Criteria	Criterion Satisfied?
Typical School Day	57 dB L_{Aeq}	34 dB L_{Aeq}	≤ 40 dB L_{Aeq}	Yes

Table 5.6 shows that IANL criteria will be achieved if windows are closed using a basic configuration of standard double glazing. However, the following should be noted:

- The criterion assumes passive ventilation as a preference. Therefore, the passive ventilation system must be designed such that the overall sound insulation performance (assumed to be dictated by the window) is not compromised by the passive ventilation system. Where this is not possible, a mechanical ventilation system may be required
- Where a mechanical ventilation system is used, the criterion shown in Table 5.6 would be reduced by 5 dB (i.e. 35 dB L_{Aeq})
- If the proposed school is to cater for students with special hearing and communication needs, a lower IANL requirement of 30 dB $L_{Aeq,30min}$ (or 35 dB $L_{Aeq,30min}$ if naturally ventilated) may be required. In such circumstances, a higher specification of glazing / ventilation may be required in specific areas of the school

6 Noise Criteria for Mixed-Use Development

6.1 Plant Noise Limits for Industrial / Commercial Use

Detailed information regarding the proposed nature of operation of industrial / commercial use and any item(s) of external plant associated with the proposals was not available at the time of writing. However, this section has been included to aid in the specification of any external plant and/or the control of noise impact from the proposed industrial / commercial units.

Proposed industrial / commercial units and any associated external plant / operations should be designed so that rating levels (as determined using the guidance of BS4142:2014) do not exceed the existing background noise level at the nearest existing NSRs in order to avoid an adverse impact.

Table 6.1 provides the highest permissible free-field rating noise levels from proposals when measured at the nearest existing or proposed receptors. These are based on the measured background noise levels presented in Section 3.

Table 6.1: Limiting Rating Noise Levels from Proposed Industrial / Commercial Units and Plant

Receptor	Limiting Rating Noise Level [$L_{A,r,Tr}$ (dB)] at NSR	
	Day	Night
Dwellings (existing or proposed) near to south-eastern boundary of site	49	46
Dwellings (existing or proposed) near to north-western boundary of site	48	43
Dwellings (existing or proposed) near to south-western boundary of site	57	49
Dwellings (existing or proposed) near to the centre of site	47	43

It should be noted that the limits presented in Table 5.1 are rating levels i.e. industrial / commercial noise levels when appropriate acoustic feature corrections have been applied, in accordance with the penalties described in Section 2 of this report. It should also be noted that the noise limits are the highest allowable noise levels from all proposed units / plant. Care should be taken to see that these limits are met with all units / plant in operation simultaneously and with appropriate acoustic feature correction penalties applied.

In order to maximise the potential for unrestricted operations, it is recommended that proposed industrial / commercial units are positioned / orientated between associated service yards and existing / proposed dwellings to the north, north-west and east. This would provide barrier attenuation by way of 'self-screening' from the built form of the industrial / commercial units.

6.2 Impact of School Sports Facilities

The 'typical' noise level of 58 dB $L_{Aeq,1hour}$ at 10 metres from the side-line halfway marking of a sports court has been used based on the guidance offered by Sport England's 'Artificial Grass Pitch (AGP) Acoustics – Planning Implications' detailed in Section 2 of this report.

The nearest existing noise sensitive receptor (NSR) is considered to be proposed dwellings circa 15 metres to the east of the proposed sports field. Using a basic noise propagation calculation incorporating distance attenuation, the noise level due to activity on the school sport field has been calculated at 55 dB $L_{Aeq,1hour}$ at the nearest proposed dwelling. With reference to the baseline noise data presented in Section 3, the calculated sports field noise level is around 4 dB higher than the existing average daytime ambient noise levels measured at Position 3. It follows that ambient noise levels at the nearest proposed dwellings would increase by more than 3 dB during the use of the sports field resulting in an adverse impact.

Based on the above, it is recommended that the distance between proposed dwellings and the school sports field is increased to 35 metres. This would result in a sports field noise level of 50 dB $L_{Aeq,1hour}$ which:

- Satisfies the 50 dB L_{Aeq} threshold set out in the Sport England 'Absolute Assessment Method'
- Satisfies the criterion set out in the Sport England 'Comparative Assessment Method' (≤ 3 dB increase of cumulative above prevailing ambient noise levels) as the logarithmic sum of existing average daytime ambient noise level (51 dB $L_{Aeq,T}$) plus the additional sports pitch contribution (50 dB $L_{Aeq,T}$) would result in a total ambient noise level of 53 dB $L_{Aeq,T}$; thus raising the ambient noise level by 2 dB.

7 Employment Area – Noise Impact

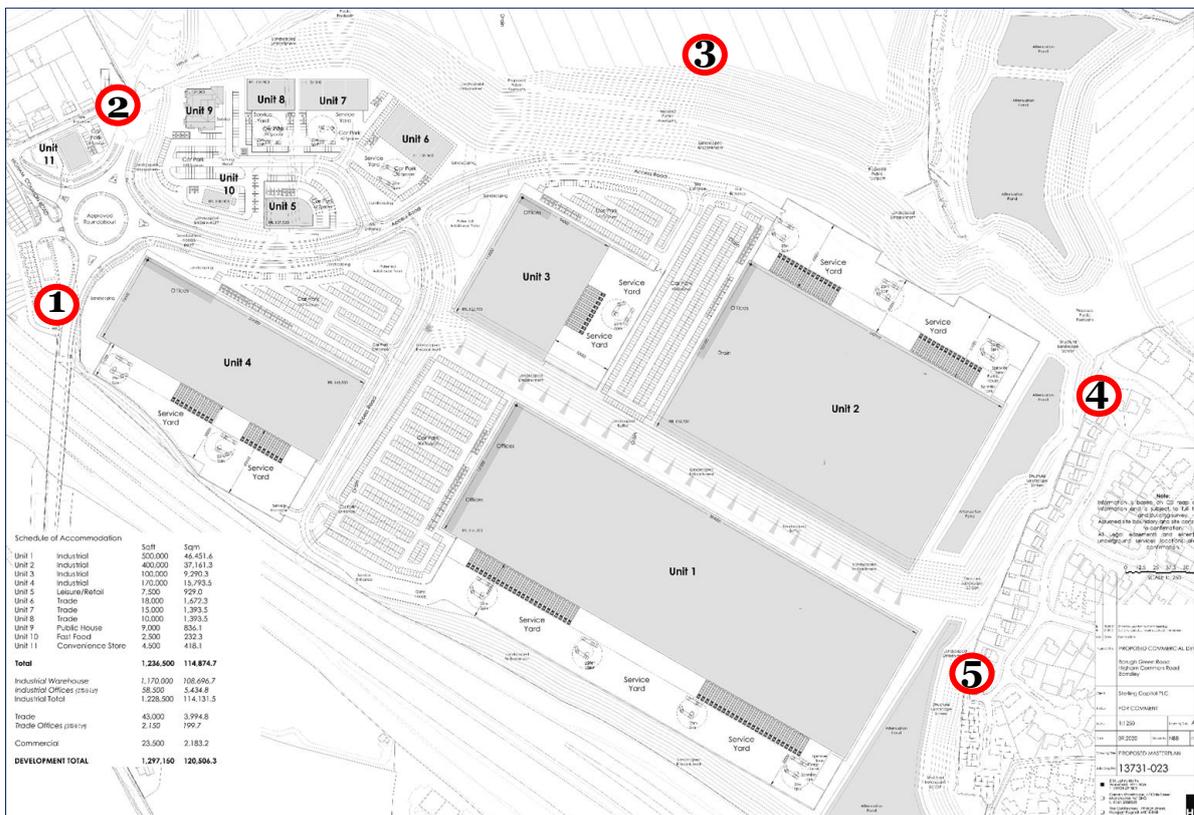
7.1 Receptors

The proposed site layout drawing¹³ shows four units proposed in the employment area at the southern end of the site.

The nearest noise sensitive receptors (NSRs) to the units have been identified as:

- NSR1 – Existing dwelling on Higham Common Road, approximately 51 metres to the north-west of Unit 4
- NSR2 – Existing dwelling on Hermit Lane, approximately 134 metres to the north-west of Unit 4
- NSR3 – Location of nearest proposed dwellings to the north of the employment area, approximately 170 metres to the north-east of Unit 3
- NSR4 – Existing dwelling on Harden Close, approximately 76 metres to the east of Unit 2
- NSR5 – Existing dwelling on Drury Farm Court, approximately 58 metres to the east of Unit 1

Figure 7.1: Noise Sensitive Receptors



¹³ Drawing No: 13731-023 Rev B issued by The Harris Partnership

7.2 Internal Noise Break-Out

Overview

Table 7.1 presents the distances between each NSR and the nearest façade (mid-point) of each unit.

Table 7.1: Distances between NSRs and Nearest Façade of Each Unit

Receptor	Distance to Nearest Unit Façade (m)			
	Unit 1	Unit 2	Unit 3	Unit 4
NSR1	383	549	371	62
NSR2	436	542	347	159
NSR3	384	235	170	446
NSR4	304	141	450	639
NSR5	82	159	454	568

Source Noise Levels

At the time of writing, the final occupants of the proposed units are to be determined; therefore, it is not possible to predict a precise internal noise levels for the proposed units. However, for assessment purposes, a relatively high internal reverberant noise level of 80 dB $L_{Aeq,T}$ has been robustly adopted, for use in noise break-out calculations, based on the following:

- Reverberant internal noise levels of up to 80 dB $L_{Aeq,T}$ have been measured previously by ENS inside a fabricators unit (B2)
- Reverberant internal noise levels of 68 – 72 dB $L_{Aeq,T}$ have been measured previously by ENS inside a busy distribution unit (B8)

Propagation

Noise propagation to each NSR, from the nearest façade of each unit, has been calculated using the following equation:

$$SPL_2 = SPL_1 - R + 10 \log S - 20 \log r - 14$$

Where:

SPL_2 = Sound pressure level at the NSR, dB(A)

SPL_1 = Assumed internal sound pressure level in each unit, dB(A)

R = Composite sound reduction performance of unit façade, dB R_w

S = Surface area of nearest façade of each unit, m^2

r = Distance from NSR to nearest façade of each unit, m

With regard to façade surface area, the façade length/width has been determined using supplied plan drawing. The proposed units are understood to be 19 metres high.

For the purpose of the calculations, the sound reduction performance of the building envelope is assumed to be ≥ 25 dB R_w based on the sound reduction performance of standard single-skin insulated cladding.

Calculations assume that the sound insulation of the façade will not be compromised by weaker elements (e.g. rooflights) or penetrations such as louvres or doors. Where any louvres, roof lights or doors are proposed for any of the units, they should therefore be designed with a sound insulation performance of ≥ 25 dB R_w .

Noise break-out levels, associated with internal operations within the units, have been determined at the nearest NSRs using a basic propagation calculation incorporating a distance attenuation correction. Where appropriate (i.e. where there is a break in the line of sight between a service area and NSR) calculations also incorporate a barrier attenuation correction. For a robust assessment, it is assumed that each unit will operate with an internal noise level of 80 dB $L_{Aeq,T}$ continuously and throughout the assessment period.

The calculated site noise levels are presented in Table 7.2.

Table 7.2: Calculated Unit Break-Out Levels at NSRs

Receptor	Unit Noise Break-Out Level (dB $L_{Aeq,T}$)				
	Unit 1	Unit 2	Unit 3	Unit 4	Cumulative
NSR1	13	11	13	37	37
NSR2	22	11	23	29	30
NSR3	28	30	28	24	34
NSR4	25	33	11	6	33
NSR5	36	32	11	8	38

Impact Assessment

The calculated unit noise break-out levels have been assessed in accordance with BS4142. At this stage, the exact nature of commercial / industrial operation within the proposed units is not known; therefore, it is not possible to determine whether or not the site noise will be tonal or impulsive in nature. For the purpose of assessment, a 3 dB penalty has been applied on the assumption that the noise emission from the units may be distinguishable against the residual acoustic environment.

The results of the BS4142 assessment are presented in Tables 7.3 and 7.4 for day and night periods respectively.

Table 7.3: BS4142 Assessment of Unit Noise Break Out – Daytime

Parameter	NSR1	NSR2	NSR3	NSR4	NSR5
Typical daytime background sound level ($L_{A90,15min}$)	57 dB	57 dB	47 dB	49 dB	49 dB
Specific noise level ($L_{Aeq,1hr}$) (See Table 7.2 – no corrections for % on time deemed necessary)	37 dB	30 dB	34 dB	33 dB	38 dB
Acoustic feature correction	+ 3 dB				
Rating level ($L_{Ar,1hr}$)	40 dB	33 dB	37 dB	36 dB	41 dB
Excess of rating level over background sound level	- 17 dB	- 24 dB	- 10 dB	- 13 dB	- 8 dB
Assessment (depending on context)	Low impact				

Table 7.4: BS4142 Assessment of Unit Noise Break Out – Night

Parameter	NSR1	NSR2	NSR3	NSR4	NSR5
Typical night background sound level ($L_{A90,15min}$)	49 dB	49 dB	43 dB	46 dB	46 dB
Specific noise level ($L_{Aeq,15min}$) (See Table 7.2 – no corrections for % on time deemed necessary)	37 dB	30 dB	34 dB	33 dB	38 dB
Acoustic feature correction	+ 3 dB				
Rating level ($L_{Ar,15min}$)	40 dB	33 dB	37 dB	36 dB	41 dB
Excess of rating level over background sound level	- 9 dB	- 16 dB	- 6 dB	- 10 dB	- 5 dB
Assessment (depending on context)	Low impact				

The BS4142 assessment of noise break-out from the units indicates a low impact at all assessed receptors during day and night periods.

7.3 Service Area Operations

Overview

The proposed site layout drawing shows that each unit has one or two associated service areas immediately adjacent to the building.

Table 7.5 presents the distances between each NSR and a position roughly central to the loading area of each service area.

Table 7.5: Distances between NSRs and Proposed Service Areas

Receptor	Distance to Proposed Service Area (m)						
	Unit 1a	Unit 1b	Unit 2a	Unit 2b	Unit 3	Unit 4a	Unit 4b
NSR1	460	680	630	747	442	147	215
NSR2	537	747	604	736	441	262	319
NSR3	471	564	218	341	229	497	474
NSR4	501	382	271	135	436	752	692
NSR5	383	189	360	264	445	686	623

It is assumed that activity within the service yards will consist of intermittent Heavy Goods Vehicle (HGV) movements and Forklift Truck (FLT) movements associated with loading/unloading operations.

Source Noise Levels

In order to assess the impact of HGV and FLT movements within the service areas, the Single Event Level / Sound Exposure Level (SEL) has been used. The SEL of a single discrete noise event is the level which if maintained constant for a period of one second would contain as much A-weighted sound energy as is contained in the actual noise event.

The SEL of HGV movements at low speed has previously been measured by ENS at circa 78 dB(A) at 10 metres. The SEL of a FLT loading operation has previously been measured at approximately 67 dB(A) at 10 metres. Associated maxima were around 75 dB L_{AFmax} and 79 dB L_{AFmax} (at 10 metres distance) respectively.

At this stage, the exact hours of operation of the proposed units are to be determined. For the purpose of assessment, it is assumed that HGV and FLT activity in the external service areas could potentially occur during the day or night.

In lieu of detailed delivery / collection schedule information, it is assumed that each service area could accommodate 4 no. HGV deliveries / collections per hour (i.e. 1 no. every 15-minutes). This equates to 8 no. HGV movements and 4 no. events of FLT loading / unloading activity per hour in each service yard during the day.

The following formula may be used for calculating the $L_{Aeq,T}$ level from the SEL:

$$L_{Aeq,T} = 10 \times \log_{10} [(n \times 10^{SEL/10}) / T]$$

where:

SEL = the Single Event Level / Sound Exposure Level

n = number of event occurrences

T = reference time period, in seconds

Processing the above, the calculated source noise levels ($L_{Aeq,T}$), at a reference distance of 10 metres, are presented in Table 7.6 and 7.7 for day and night periods respectively.

Table 7.6: Calculated HGV and FLT Noise Levels at 10 metre distance - Day

Source	SEL at 10m	No. of Events per ref. Period (Hour)	Reference Time (s)	Source Noise Level $L_{Aeq,1hr}$ at 10m
HGV	78 dB(A)	8	3600	52 dB
FLT	67 dB(A)	4	3600	38 dB

Table 7.7: Calculated HGV and FLT Noise Levels at 10 metre distance - Night

Source	SEL at 10m	No. of Events per ref. Period (15 min)	Reference Time (s)	Source Noise Level $L_{Aeq,15min}$ at 10m
HGV	78 dB(A)	2	900	52 dB
FLT	67 dB(A)	1	900	38 dB

Noise Propagation

Noise levels associated with HGV and FLT movements have been determined at the nearest NSRs using a basic propagation calculation incorporating a distance attenuation correction. Where appropriate (i.e. where there is a break in the line of sight between a service area and NSR) calculations also incorporate a barrier attenuation correction.

The calculated service area noise levels are presented in Table 7.8.

Table 7.8: Calculated Service Area Noise Levels at NSRs

Receptor	Source	Service Area Noise Levels (dB $L_{Aeq,T}$)							Cumulative
		Unit 1a	Unit 1b	Unit 2a	Unit 2b	Unit 3	Unit 4a	Unit 4b	
NSR1	HGV	18	15	<10	<10	<10	<10	28	30
	FLT	<10	<10	<10	<10	<10	<10	14	
NSR2	HGV	<10	<10	<10	<10	<10	<10	13	18
	FLT	<10	<10	<10	<10	<10	<10	<10	
NSR3	HGV	<10	<10	25	21	21	24	<10	29
	FLT	<10	<10	11	<10	<10	10	<10	
NSR4	HGV	<10	10	23	29	29	<10	<10	30
	FLT	<10	<10	<10	15	15	<10	<10	
NSR5	HGV	10	16	10	13	13	<10	<10	20
	FLT	<10	<10	<10	<10	<10	<10	<10	

Impact Assessment

For the purpose of assessment, a 6 dB penalty has been applied on the robust assumption that the noise emission from the service areas could be perceived as clearly impulsive.

The results of the BS4142 assessment are presented for daytime and night periods in Tables 7.9 and 7.10, respectively.

Table 7.9: BS4142 Assessment of Service Yard Operations – Daytime

Parameter	NSR1	NSR2	NSR3	NSR4	NSR5
Typical daytime background sound level ($L_{A90,15min}$)	57 dB	57 dB	47 dB	49 dB	49 dB
Specific noise level ($L_{Aeq,1hr}$) (See Table 7.8 – no corrections for % on time deemed necessary)	30 dB	18 dB	29 dB	30 dB	20 dB
Acoustic feature correction	+ 6 dB				
Rating level ($L_{Ar,1hr}$)	36 dB	24 dB	35 dB	36 dB	26 dB
Excess of rating level over background sound level	- 21 dB	- 33 dB	- 12 dB	- 13 dB	- 23 dB
Assessment (depending on context)	Low impact				

Table 7.10: BS4142 Assessment of Service Yard Operations – Night

Parameter	NSR1	NSR2	NSR3	NSR4	NSR5
Typical night background sound level ($L_{A90,15min}$)	49 dB	49 dB	43 dB	46 dB	46 dB
Specific noise level ($L_{Aeq,15min}$) (See Table 7.2 – no corrections for % on time deemed necessary)	30 dB	18 dB	29 dB	30 dB	20 dB
Acoustic feature correction	+ 6 dB				
Rating level ($L_{Ar,15min}$)	36 dB	24 dB	35 dB	36 dB	26 dB
Excess of rating level over background sound level	- 13 dB	- 25 dB	- 8 dB	- 10 dB	- 20 dB
Assessment (depending on context)	Low impact				

The BS4142 assessment of service yard operations indicate a low impact at all assessed receptors during day and night periods.

With regard to service yard maxima at night, noise levels are calculated at or below the following at the NSRs:

- 56 dB L_{AFmax} at NSR1
- 41 dB L_{AFmax} at NSR2
- 52 dB L_{AFmax} at NSR3
- 56 dB L_{AFmax} at NSR4
- 43 dB L_{AFmax} at NSR5

The above levels are all below the World Health Organisation upper limit of 60 dB L_{AFmax} to avoid sleep disturbance due to noise ingress through a partly open window.

8 Summary and Conclusions

A noise survey and assessment has been performed for a proposed mixed-use development on land to the south of Barugh Green Road in Barnsley.

Noise monitoring was carried out between Monday 7th October 2019 and Wednesday 9th October 2019 to quantify the level of external noise affecting the site and local vicinity. The results of the baseline noise survey are presented in Section 3.

Section 4 presents an initial site noise risk assessment using ProPG guidance. Proposed dwellings will experience a low risk of adverse effects from road traffic noise.

Section 4 also presents recommendations for a noise mitigation strategy to protect potential future residential development at the site from the existing noise climate using relevant criteria and guidance including BS8233 / ProPG.

Section 5 considers the additional noise contribution from the proposed site access road and presents recommendations for a noise mitigation strategy to protect potential future residential development at the site from this additional noise source using relevant criteria and guidance including BS8233 / ProPG.

Section 6 considers the potential noise impact of the proposed industrial / commercial units and plant upon noise sensitive receptors (NSRs). In order to avoid adverse impacts (as defined by BS4142:2014), maximum permissible free-field rating noise levels, from proposed industrial/commercial units and plant, are recommended at existing and proposed NSRs. These are based on the measured background noise levels presented in Section 3. Section 6 also considers the potential noise impact due to the use of the proposed sports fields at the school along with recommendations to avoid an adverse impact.

Appendix A - Abbreviations and Definitions

Sound Pressure Level (L_p)

The basic unit of sound measurement is the sound pressure level. As the pressures to which the human ear responds can range from 20 μPa to 200 Pa, a linear measurement of sound levels would involve many orders of magnitude. Consequently, the pressures are converted to a logarithmic scale and expressed in decibels (dB) as follows:

$$L_p = 20 \log_{10}(p/p_0)$$

Where L_p = sound pressure level in dB; p = rms sound pressure in Pa; and p_0 = reference sound pressure (20 μPa).

A-weighting

A frequency filtering system in a sound level meter, which approximates under defined conditions the frequency response of the human ear. The A-weighted sound pressure level, expressed in dB(A), has been shown to correlate well with subjective response to noise.

Equivalent continuous A-weighted sound pressure level, $L_{Aeq, T}$

The value of the A-weighted sound pressure level in decibels of continuous steady sound that within a specified time interval, T, has the same mean-square sound pressure as a sound that varies with time. $L_{Aeq, 16h}$ (07:00 to 23:00 hours) and $L_{Aeq, 8h}$ (23:00 to 07:00 hours) are used to qualify daytime and night time noise levels.

$L_{A10, T}$

The A-weighted sound pressure level in decibels exceeded for 10% of the measurement period, T. $L_{A10, 18h}$ is the arithmetic mean of the 18 hourly values from 06:00 to 24:00 hours.

$L_{A90, T}$

The A-weighted sound pressure level of the residual noise in decibels exceeded 90% of a given time interval, T. L_{A90} is typically taken as representative of background noise.

L_{AFmax}

The maximum A-weighted noise level recorded during the measurement period. The subscript 'F' denotes fast time weighting, slow time weighting 'S' is also used.

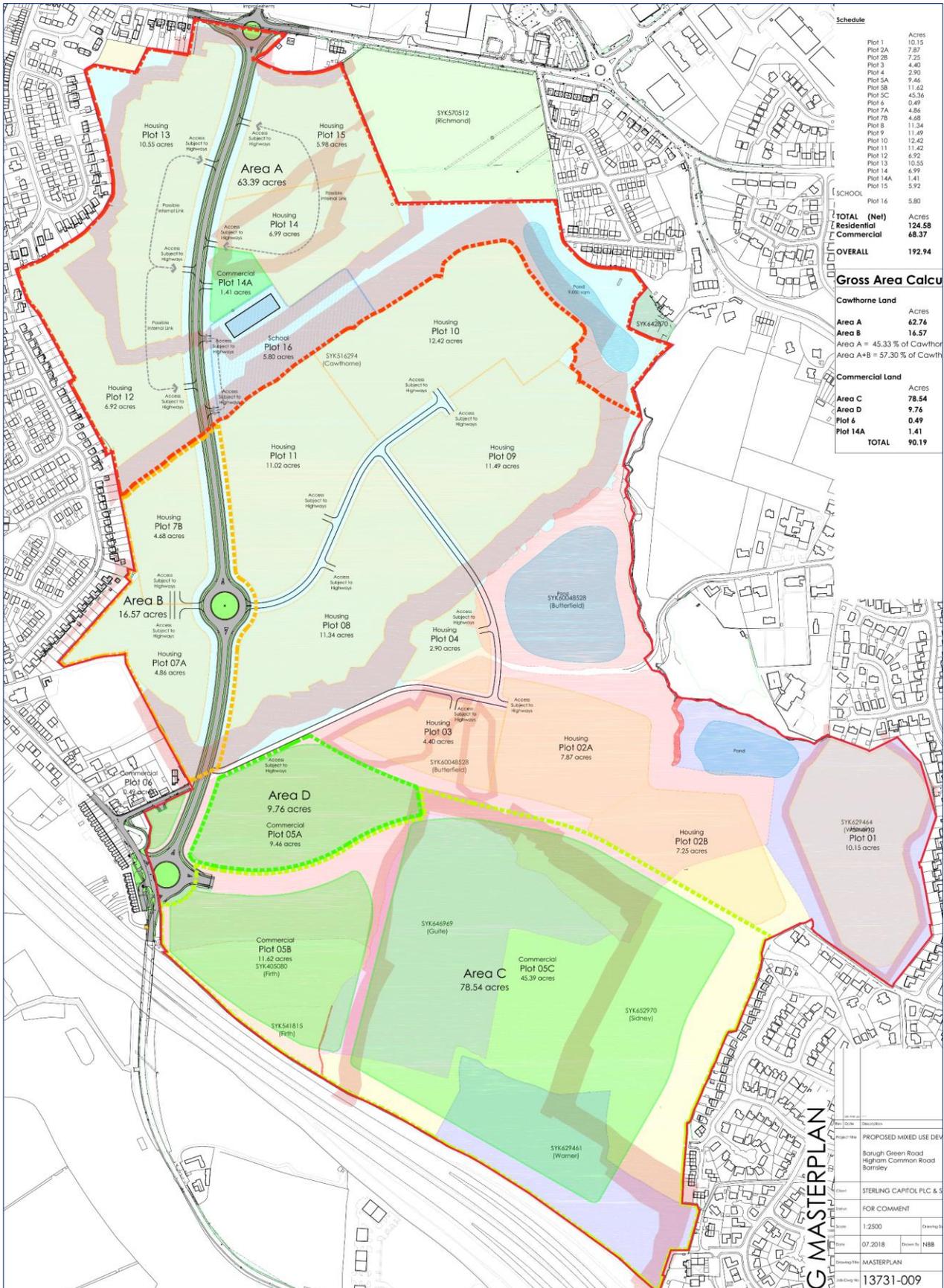
Single Event Level / Sound Exposure Level (SEL or L_{AE})

The energy produced by a discrete noise event averaged over one second, regardless of the event duration. This allows for comparison between different noise events which occur over different lengths of time.

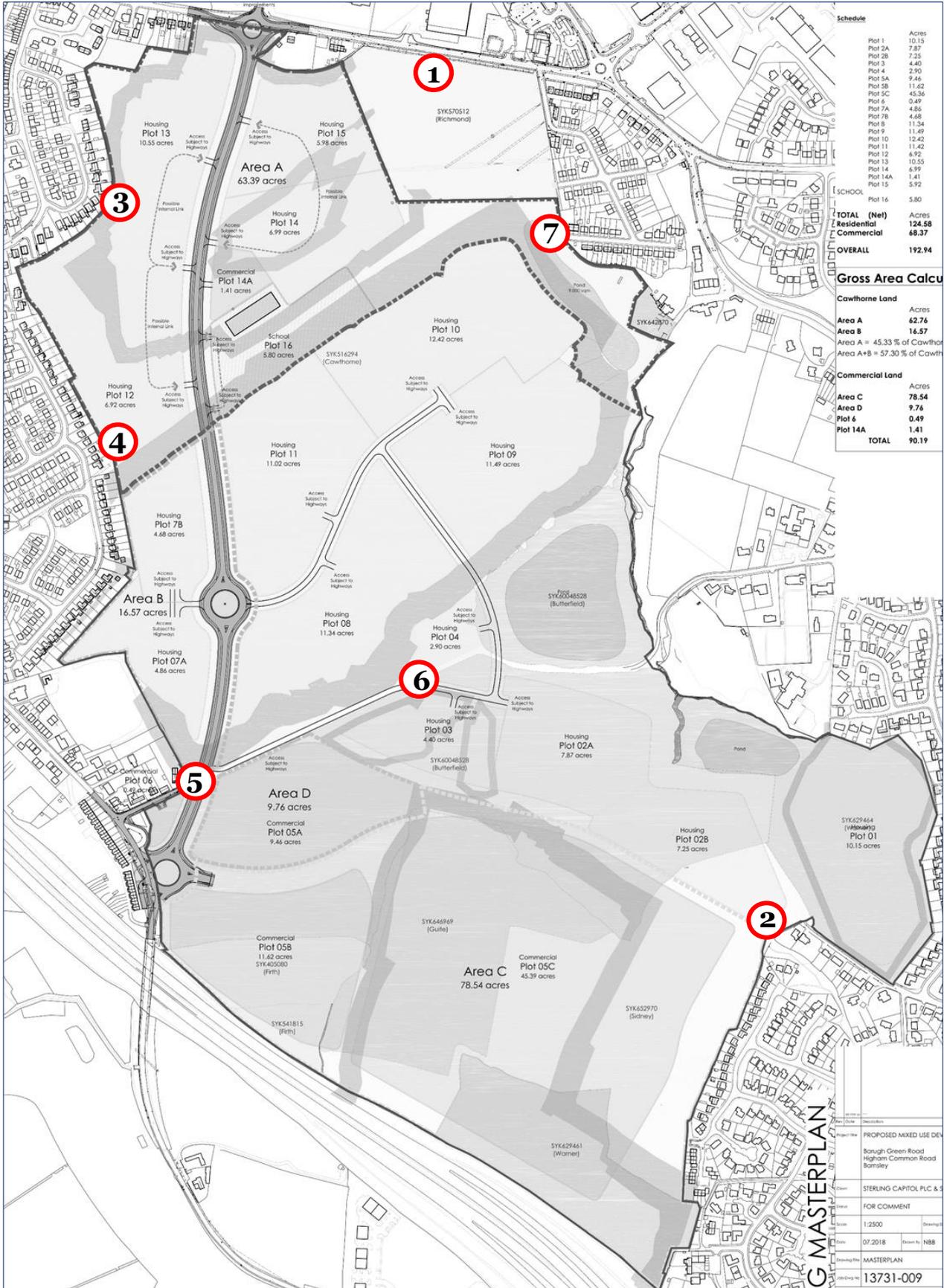
Weighted Sound Reduction Index (R_w)

Single number quantity which characterises the airborne sound insulation properties of a material or building element over a defined range of frequencies (R_w is used to characterise the insulation of a material or product that has been measured in a laboratory).

Appendix B – Site Location Plan



Appendix C – Noise Measurement Positions



Schedule	Acres
Plot 1	10.15
Plot 2A	7.87
Plot 2B	7.25
Plot 3	4.60
Plot 4	2.90
Plot 5A	9.46
Plot 5B	11.42
Plot 5C	45.36
Plot 6	0.49
Plot 7A	4.86
Plot 7B	4.68
Plot 8	11.34
Plot 9	11.49
Plot 10	12.42
Plot 11	11.42
Plot 12	6.92
Plot 13	10.55
Plot 14	6.99
Plot 14A	1.41
Plot 15	5.92
Plot 16	5.80
TOTAL (Net)	124.58
Residential	68.37
Commercial	56.21
OVERALL	192.94

Gross Area Calculations	
Cowhorse Land	
Area A	62.76
Area B	16.57
Area A = 45.33% of Cowhorse	
Area A+B = 57.30% of Cowhorse	
Commercial Land	
Area C	78.54
Area D	9.76
Plot 6	0.49
Plot 14A	1.41
TOTAL	90.19