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Proposed Residential Development Land at Hemingfield Road, Hemingfield, Barnsley, S73 0PZ

Noise Impact Assessment

For:
Ptarmigan Land North Ltd

7th February 2024

Ref: NIA-11108-24-11392-v4 Hemingfield Road
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Contents

1 Introduction

1.1 Overview

Environmental Noise Solutions Ltd (ENS) has been commissioned by Ptarmigan Land North Ltd to undertake a noise impact assessment for a proposed residential development on land at Hemingfield Road, Hemingfield, Barnsley, S73 0PZ (hereafter referred to as 'the site').

The objectives of the noise impact assessment were to:

- Assess external noise levels at the site
- Assess the potential impact of the external noise climate on the proposed residential development with reference to relevant guidelines
- Provide outline recommendations for noise mitigation measures to provide suitable residential amenity

This report details the methodology and results of the assessment and provides outline recommendations as appropriate. It has been prepared to accompany a Planning Application to be submitted to Barnsley Metropolitan Borough Council.

The report has been prepared for Ptarmigan Land North Ltd 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 Ptarmigan Land North Ltd 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 1.

1.2 Site Description and Development Proposals

The site is located to the north of the residential settlement of Hemingfield on the south-eastern fringe of Barnsley centred on grid reference: 439213,401757. The site is bounded by the A6195 Dearne Valley Parkway to the north, Hemingfield Road to the south with existing residential dwellings beyond, open farmland to the east and Hemingfield Road to the west.

The topography of the site varies from north to south, with the northern boundary of the site lying between 10 to 15m lower than the land height of the A6195. Ground heights at the southern site boundary are also approximately 10 to 15m above ground heights at the northern site boundary.

See Figure 1.1 for site location.

Figure 1.1: Location of Proposed Development

The development proposals comprise an application for outline planning permission for the demolition of existing structures and the erection of residential dwellings with associated infrastructure and open space. All matters reserved except for means of access to, but not within, the site.

2 Policy Context and Assessment Guidance

2.1 National Planning Policy Framework

The National Planning Policy Framework (NPPF)[1] was updated in December 2023 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 180 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 191 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:

a) mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life,

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

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

2.2 Noise Policy Statement for England

The Noise Policy Statement for England[2] (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:

- 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

1 National Planning Policy Framework. Ministry of Housing, Communities and Local Government (2023)
2 Government Department for Environment, Food and Rural Affairs. Noise Policy Statement for England. March 2010.

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

Planning Practice Guidance[3] (PPG) is an online resource which provides 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'.

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'.

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. The following guidance documents provide some meaningful context.

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

2.4 British Standard 8233:2014 - Guidance on Sound Insulation and Noise Reduction for Buildings

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 residential 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 2.1.

Table 2.1: 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.'

Whilst BS 8233 is primarily concerned with noise within dwellings, the following guidance is also provided for external amenity areas:

"For traditional external areas that are used for amenity space, such as gardens or patios it is desirable that the external noise level does not exceed 50 dB $L_{Aeq,T}$, with an upper guideline value of 55 dB $L_{Aeq,T}$ which would be acceptable in noisier environments. However, it is also recognised that these guideline values are not achievable in all circumstances where development might be desirable. In higher noise areas, such as city centres or urban areas adjoining the strategic transport network, a compromise between elevated noise levels and other factors, such as the convenience of living in these locations or making efficient use of land resources to ensure development needs can be met, might be warranted. In such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces, but should not be prohibited".

2.5 ProPG Planning and Noise: New Residential Development

ProPG Planning and Noise: New Residential Development (ProPG)5 recommends compliance with indoor noise level targets in residential dwellings based on the guidance contained in BS8233 (see Table 2.1). Additionally, with regard to individual noise events, ProPG states:

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

[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)

'*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. However, where it is not reasonably practicable to achieve this guideline, then the judgement of acceptability will depend not only on the maximum noise levels but also factors such as the source, number, distribution, predictability and regularity of the noise events."*

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).'

3 Noise Survey

3.1 Overview

A noise survey was undertaken at the site on Tuesday 7th November and the early hours of Wednesday 8th November 2023. Additional monitoring was undertaken on 17th November to further quantify noise from the A6195.

The adopted noise monitoring positions are illustrated in Appendix B and were as follows:

- 1 – Along the western boundary at circa 5 metres from Hemingfield Road at 4 metres above ground level (AGL)
- 2 – approximately 10 metres from the A6195 (20 metres to centre) to the east of the site

Noise measurement position 2 was chosen as representative of noise from the A6195 as suitable measurement positions were inaccessible in the area immediately adjacent to the site due to the steep embankment and undergrowth.

Noise measurements were undertaken in free field conditions at 4 metres above ground level using Bruel & Kjaer 2250 and NTI XL3 Type 1 integrating sound level meters. The meters were connected to a windshield covered microphone positioned at the locations detailed above.

The measurement system calibration was verified immediately before and after the 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 band data.

The noted weather conditions during the surveys were dry with wind speeds < 5 m/s. Weather conditions were therefore considered appropriate for noise monitoring.

3.2 Summary

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	L_{Aeq} (dB)	L_{A90} (dB)	L_{A10} (dB)	Comment
1	07/11/2023	12:15–13:00	66	53	72	Road traffic on Hemingfield Road (typically 73 dB L_{AFMax} during the night-time due to vehicle passes)
		13:00–14:00	66	53	73	
		14:00–15:00	66	53	73	
	08/11/2023	06:00-07:00	61	49	64	
2	17/11/2023	12:34-15:34	79	71	83	Road traffic from A6195 dominant

Noise levels across the site were controlled by road traffic noise from both the A6195 and Hemingfield Road.

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 and 17:00 hours. Using $L_{A10\ (3\ hour)}$ as the arithmetic mean of the three consecutive values of hourly L_{A10}, the $L_{A10\ (18\ hour)}$ can be calculated from the equation:

$$L_{A10\ (18\ hour)} = L_{A10\ (3\ hour)} - 1\ dB$$

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 daytime $L_{Aeq\ (0700\text{-}2300)}$ and night time $L_{Aeq\ (2300\text{-}0700)}$ ambient noise levels based on the $L_{A10\ (18\ hour)}$ noise levels, as follows:

$$L_{Aeq\ (0700\text{-}2300)} = \frac{10 * \log ([(10^{((0.95 * L_{A10\ (18\ hour)} + 1.44)/10)} * 12] + [10^{((0.97 * L_{A10\ (18\ hour)} - 2.87)/10)} * 4])}{16}$$

$$L_{Aeq\ (2300\text{-}0700)} = 0.90 * L_{A10,\ 18\ hour} - 3.77$$

Based on the above formulae, the daytime and night-time ambient noise levels at MP2 are calculated at **78 dB $L_{Aeq\ (0700–2300)}$** and **70 dB $L_{Aeq\ (2300–0700)}$** respectively. Whilst noise from the A6195 was not measured during the night time, analysis of the daytime maximum noise levels indicates that typical individual events would not be expected to exceed **90 dB L_{AFMax}** more than 10 to 15 times during the night time period (23:00-07:00).

Maximum noise levels at monitoring position 1 were ≤ **81 dB L_{AFMax}** during the night-time, with levels typically ≤ **78 dB L_{AFMax}.**

4 Noise Assessment

4.1 Acoustic Modelling

Noise levels across the site have been predicted using a three-dimensional Cadna-A noise model. The model was constructed using topographical survey data and mapping from Ordnance Survey, in conjunction with drawings and information supplied by the client. Noise propagation is calculated in spectral terms according to BS EN ISO 1963: 1996, with 2nd order reflections considered. All buildings within the model have an assumed height of 8m above ground level, and are assumed to be reflective.

The following assumptions were used in the model:

- Ground absorption set to G = 0.5 for mixed ground
- Meteorological conditions: Temp. 10 °C, Relative Humidity 70%
- Foliage/woodland areas not considered to provide any reduction
- Reflections: set to two orders of reflection
- Absorption coefficient of buildings set to 0.2

Noise emission from roads in the vicinity of the site has been calculated in spectral terms (1/1 octave) based on the noise levels summarised in Section 3, including the calculated road noise levels for the A6195.

Noise levels across the site, and at the façade of the proposed residential dwellings have been calculated, based on the current illustrative masterplan (drawing reference: Illustrative Masterplan 2344:01 dated December 2023).

The results are presented as façade noise level and noise contour plots presented in Appendix C.

4.2 Site Noise Levels

Due to the topography of the site, road traffic noise is not significantly reduced for properties set back from the northern site boundary by the building massing of intervening properties based on the layout shown on the indicative masterplan.

With reference to Figure C1 and C2, the most noise affected façades are those dwellings fronting on to Hemingfield Road, with noise levels of ≤ 69 dB $L_{Aeq,16hr}$ predicted during the daytime, and up to 61 dB $L_{Aeq,8hr}$ predicted during the night time.

Noise levels at the north-western site boundary are predicted to be 61 to 64 dB $L_{Aeq,16hr}$. Similar noise levels are predicted for the second and third rows of properties, with levels decreasing by ≤ 2 dB in the most shielded areas.

At the western site boundary, whilst the first rows of dwellings shown on the indicative masterplan are set back from the northern site boundary by approximately 60m, their northern façades are predicted to be exposed to noise levels of 64 to 66 dB $L_{Aeq,16hr}$ due to the reduction in relative height between the A6195 and the site, which results in an increase in noise exposure within this area.

4.3 Internal Noise Levels

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'.

With reference to the day and night time façade noise levels presented as Figure C1 and C2, façades across the majority of the site are predicted to be exposed to noise levels above that which would allow for passive ventilation via partially open windows or simple façade openings.

On this basis, it is not recommended that permanently open windows are relied upon as the primary means of ventilation for proposed habitable rooms in these areas.

A scheme of sound insulation will be required with acoustically attenuated ventilation such that the minimum ventilation rates specified in Approved Document Part F can be achieved with windows closed. Typically, this would take the form of acoustic trickle ventilators or through wall ventilators.

The assessment assumes 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 exceeding the noise criteria; however, this would be on a temporary basis.

Scheme of Mitigation

Calculations have been performed to determine the configuration of glazing and ventilation required to satisfy the internal noise criteria with closed windows for the most noise affected areas of the site. The calculations incorporate the measured external noise level data summarised in Section 3 in conjunction with the results of the noise model discussed in Section 4 and are based on the noise ingress calculation methodology outlined in Annex G.2 of BS8233:2014. Building footprints are based on the current indicative masterplan, drawing reference: (Illustrative Masterplan 2344.01). The scheme of mitigation which follows should be considered indicative pending a final layout and details of the building massing.

In addition to satisfying the requirements of BS 8233, the scheme of sound insulation presented below is expected to control individual noise events in line with the ProPG requirement to not exceed 45 dB $L_{Amax,F}$ internally more than 10 to 15 times per night, as set out in Section 2.

The following has been assumed for assessment purposes:

Room and façade element dimensions have been estimated based on typical residential rooms (9m² floor area/24m³ volume)

Reverberation time of 0.5 seconds for habitable areas

Typical masonry external wall construction (e.g. 100mm brick / 100mm cavity / 100mm block)

Up to 3m² of glazing per room

Minimum sound reduction values for the glazing and ventilation elements are presented in Table 4.1, based on commonly available ventilation and glazing products. The calculations assume one ventilator per bedroom, and two for all other habitable rooms.

Table 4.1 should be read in conjunction with the site wide mark-up, indicating the distribution of glazing and mitigation measures required presented as Figure C4 in Appendix C.

Table 4.1: Required Sound Reduction of Façade Elements

Element	Required Sound Reduction (dB)						Indicative Specification
	125 Hz	250 Hz	500 Hz	1kHz	2kHz	Weighted R_w ($R_w + C_{tr}$) / $D_{n,e,w}$ ($D_{n,e,w} + C_{tr}$)	
Specification 1							
Glazing	20	20	30	39	35	**33 (28)**	6/16/6 Thermal double glazing
Ventilation	42	37	37	43	57	**43 (41)** *(open position)*	Ryton AAC125HP wall ventilator
Specification 2							
Glazing	20	20	30	39	35	**33 (28)**	6/16/6 Thermal double glazing
Ventilation	40	37	35	37	44	**39 (38)**	Invisivent EVO AK High acoustic trickle vent
Specification 3							
Glazing	20	20	30	39	35	**33 (28)**	6/16/6 Thermal double glazing
Ventilation	37	35	32	33	37	**34 (33)**	Standard Trickle Ventilator Invisivent EVO AK Basic acoustic trickle vent

Alternative solutions to the indicative specifications shown in Table 4.1 may be considered if sound reduction performances are equivalent to (or greater than) those stipulated.

The glazing recommendations apply to the window within a sealed unit. It is the responsibility of the window supplier to ensure that the window frame does not compromise the performance of the glazing. Calculations assume each habitable room is supplied with two trickle vents.

The opening and free area of the proposed ventilation units should be checked by mechanical services engineer before designs are finalised. Should the equivalent open area be insufficient to meet the minimum requirements of Part F of the Building Regulations, it may be necessary to increase the number of units per habitable room. Where this applies, the required sound reduction of the ventilation units should be increased accordingly (3 dB per doubling of required no. of vent units). Calculations assume one ventilator for bedrooms and two ventilators for all other habitable rooms.

The scheme of mitigation set out above is typical for a residential development of this type which is subject to road traffic noise.

4.4 External Noise Levels

With reference to the noise survey results summarised in Section 3 and the daytime noise contour plot presented as Figure C3, external noise levels across the site are predicted to be ≥ 55 dB $L_{Aeq,16hr}$, excepting a small area to the south-eastern corner of the site where noise levels are <55 dB $L_{Aeq,16hr}$.

With reference to the BS 8233 guidance summarised in Section 2, where external noise levels are predicted to exceed 50 dB $L_{Aeq,16hr}$, mitigation is recommended to reduce noise levels as far as practicably possible. On this basis, all gardens should be provided with solid garden fences to a minimum height of 1.8m above ground level. Fences should be imperforate with a minimum superficial mass per unit area of 10 kg/m^2.

An effective barrier can be composed of a solid masonry wall, close boarded fencing or a combination of types. Where timber fencing is used, a concrete gravel board is recommended to ensure that there are no gaps underneath the barrier. Alternatively, a proprietary specialist barrier may be used. Provision of localised screening is a typical and effective means of reducing noise levels in gardens and can be considered to represent the best practicable means for mitigation.

5 Summary and Conclusions

A noise impact assessment has been undertaken for the proposed (outline) residential development at land at Hemingfield Road, Hemingfield, Barnsley, S73 0PZ.

A noise survey was undertaken at the site on Tuesday 7th November and the early hours of Wednesday 8th November 2023. Additional monitoring was undertaken on 17th November to further quantify noise from the A6195.

Section 4 of this report sets out proposals for a scheme of sound insulation which is considered to achieve suitable residential amenity for the proposed new dwellings. Recommendations are also made for mitigating noise as far as practicably possible in external amenity areas.

The scheme of mitigation presented is considered typical for a development of this type, and is representative of the best practicable means. A good level of residential amenity can be achieved for all dwellings within the site, and on this basis noise is not considered to be an impediment to the development.

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:

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

Where L_p = sound pressure level in dB; p = rms sound pressure in Pa; and p_o = 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.

$L_{AF\ max}$
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 Layout and Noise Measurement Positions

Appendix C – Noise Contour and Façade Plots

Figure C1: Daytime façade levels – First floor

Figure C2: Night time façade levels – First floor

Figure C3: Daytime noise contour plot at 1.5m above ground level

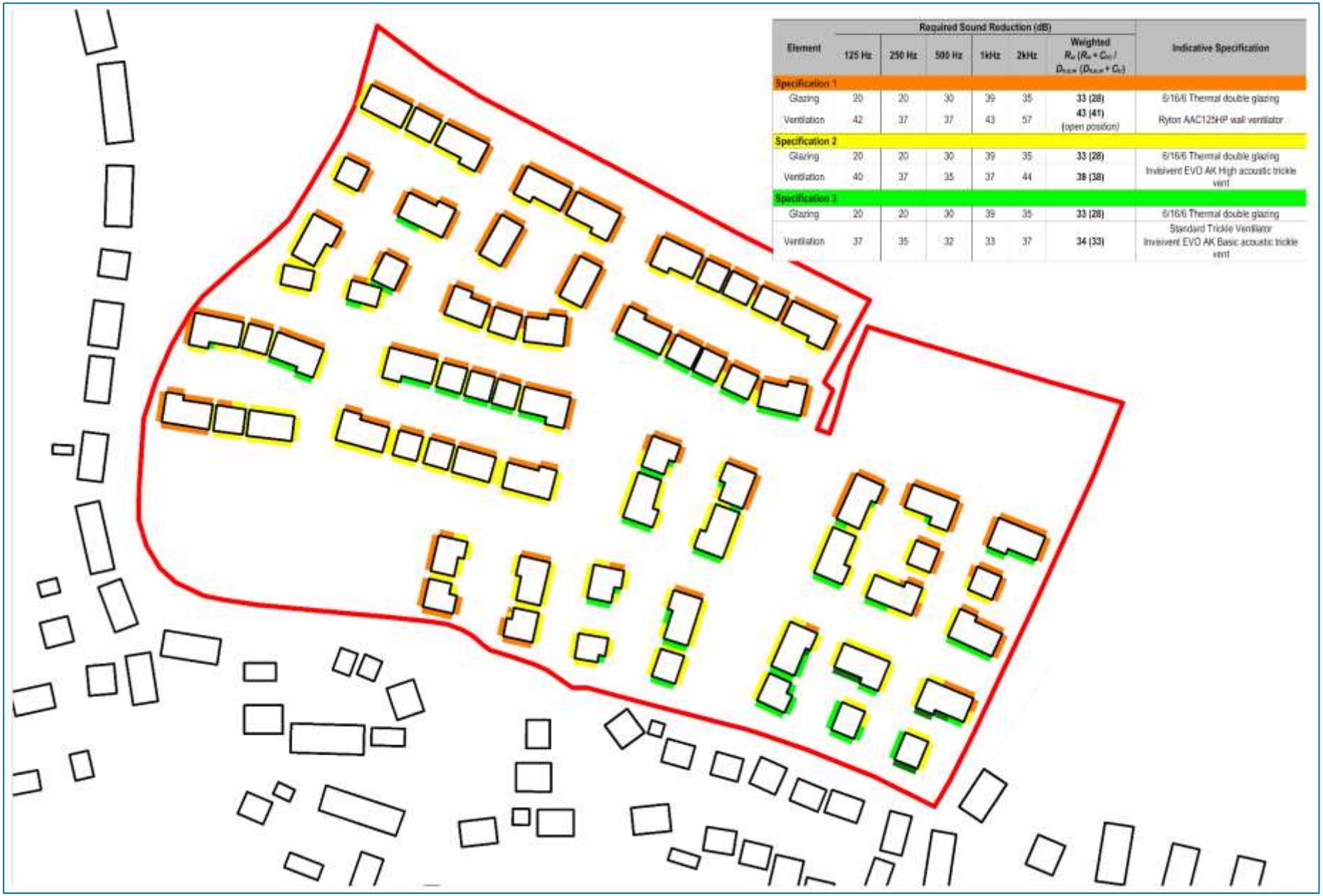

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Figure C4: Mitigation requirements