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GLEESON LAND

PROPOSED RESIDENTIAL DEVELOPMENT LAND EAST OF KNOWLE LANE, CRANLEIGH

NOISE ASSESSMENT

JANUARY 2023

the journey is the reward

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LAND EAST OF KNOWLE LANE, CRANLEIGH

NOISE ASSESSMENT

JANUARY 2023

Project Code:	**26283 - GLKnowleLane(N).9**
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PROPOSED RESIDENTIAL DEVELOPMENT
LAND EAST OF KNOWLE LANE, CRANLEIGH
NOISE ASSESSMENT

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1 Introduction

1.1 Mayer Brown Ltd has been appointed by Gleeson Land to prepare this Noise Assessment which accompanies an outline planning application for a proposed residential development at Land East of Knowle Lane, Cranleigh.

1.2 The outline application seeks to deliver up to 162 residential dwellings, with all matters reserved apart from access.

1.3 This noise impact assessment is structured as follows:

- **Section 2** describes the location of the site in relation to the existing transport infrastructure and neighbouring land uses;
- **Section 3** outlines the development proposals;
- **Section 4** discusses national and local planning policy and 'industry standard' design guidance relevant to noise;
- **Section 5** presents the results of environmental noise monitoring at the site to determine existing noise levels;
- **Section 6** assesses the suitability of the site for the proposed development, in line with ProPG Stage 1 guidance;
- **Section 7** discusses the design implications and mitigation options;
- Conclusions are presented in **Section 8.**

1.4 A glossary of the acoustic terminology used in this report is present at **Appendix A**.

2 Site Location

2.1 The location of the proposed development in relation to the local transport infrastructure is shown in **Figure 2.1** below:

Figure 2.1: Site in Relation to the Local Highway Network

2.2 The site comprises several field parcels located to the southwest of the settlement of Cranleigh between Knowle Lane to the west and, to the east, the former Horsham and Guildford Line which is now the Downs Link footpath.

2.3 The land lies adjacent to the south-eastern portion of the village of Cranleigh (approximately 1km from its centre). It is centred around Coldharbour Farm, surrounding the farm to the north and south, with access gained from Knowle Lane to the west.

2.4 The surrounding area has a mixed character, largely due to the divide between Cranleigh and the countryside. To the north is the village of Cranleigh, hosting the majority of nearby services. To the east, the majority of Cranleigh's residential area is located, separated by a row of trees. To the south and west and beyond is countryside. The western boundary of the site abuts Knowle Lane, which provides the main access to Cranleigh and its centre. To the south, Knowle Lane links the site to the villages of Alford and Rudgwick, and further beyond to Broadbridge Heath and Horsham.

2.5 A site location plan showing the boundaries of the site relative to existing land uses is presented in **Figure 2.2** below.

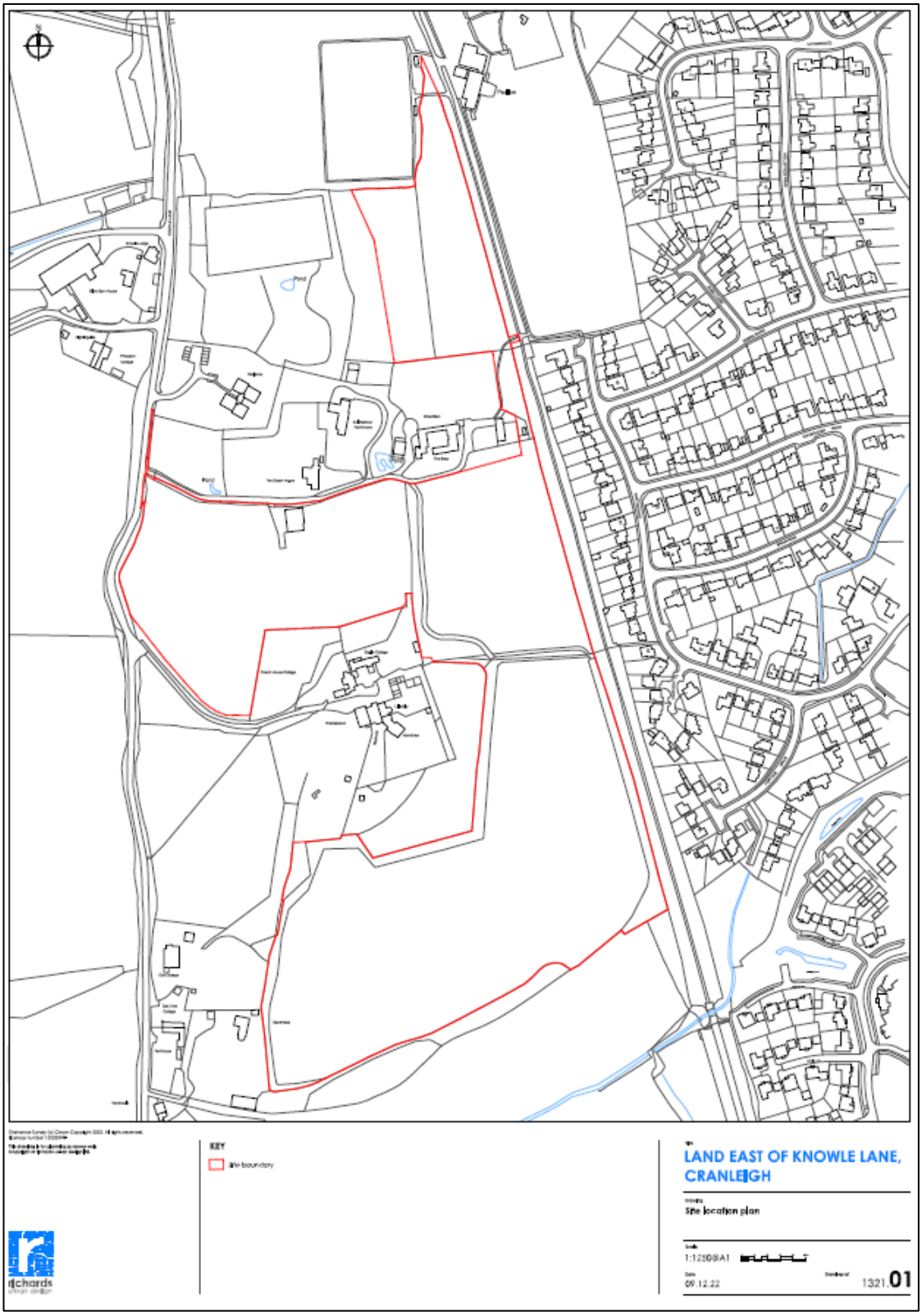


Figure 2.2: Site Location Plan

3 Proposed Development

3.1 Outline planning application (with all matters reserved except means of access) for up to 3 phases of residential development of up to 162 dwellings (including 30% affordable dwellings) including the creation of new vehicular access, pedestrian and cycle accesses, parking spaces, public open space, biodiversity enhancement, landscape planting, surface water attenuation, associated infrastructure and other associated works

3.2 An illustrative masterplan for the proposed development is shown in **Figure 3.1** below.

Figure 3.1: Illustrative Masterplan

4 Planning Policy Context

National Planning Policy

National Planning Policy Framework

4.1 Current governmental guidance for the determination of planning applications is given in the *"National Planning Policy Framework"* (NPPF), published in July 2021.

4.2 Paragraph 174 of the NPPF advises:

> *"Planning policies and decisions should contribute to and enhance the natural and local environment by:*
>
> *….. e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability.*

4.3 With specific regard to noise, paragraph 185 of the NPPF states:

> *"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; and*
>
> *c) limit the impact of light pollution from artificial light on local amenity, intrinsically dark landscapes and nature conservation.*

4.4 Paragraph 187 of the NPPF draw specific attention to the need to ensure that new development is compatible with existing businesses and community facilities and introduces and "agent of change" principle:

> *"Planning policies and decisions should ensure that new development can be integrated effectively with existing businesses and community facilities (such as*

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

4.5 With regard to *'adverse'* impacts and *'significant adverse'* impacts, the NPPF directs the reader to the advice contained in DEFRA's *"Noise Policy Statement for England"* (NPSE). This Policy Statement introduces the concept of a *"Significant Observed Adverse Effect Level"* (SOAEL), *"Lowest Observed Adverse Effect Level"* (LOAEL) and *"No Observed Adverse Effect Level"* (NOAEL). These are concepts aligned with toxicology outcomes derived from guidance given by the World Health Organisation.

Noise Policy Statement for England

4.6 Whilst the intent of the NPSE in relation to the NPPF is clear, the NPSE does not provide any quantitative threshold values for each identified level of *"effect"*. Indeed, the NPSE carefully highlights that:

"It is not possible to have a single objective noise-based measure that defines SOAEL that is applicable to all sources of noise in all situations. Consequently, the SOAEL is likely to be different for different noise sources, for different receptors and at different times. It is acknowledged that further research is required to increase our understanding of what may constitute a significant adverse impact on health and quality of life from noise. However, not having specific SOAEL values in the NPSE provides the necessary policy flexibility until further evidence and suitable guidance is available."

National Planning Practice Guidance

4.7 The application of national planning is amplified in the government's *"National Planning Practice Guidance"* (NPPG). This seeks to help clarify understanding the perception of noise effects, outcomes and actions that should be taken to align decision making with the NPPF. In line with the NPPF concept of basing decision making on the identification of "significant" or "other" impacts on health and quality of life, the NPPG aligns its guidance with the NPSE.

The table below summarises this guidance:

Perception	Examples of Outcomes	Increasing Effect Level	Action
Not noticeable	No Effect	No Observed Effect	**No specific measures required**
No Observed Adverse Effect Level (NOAEL)			
Present not intrusive	Noise can be heard, but does not cause any change in behaviour, attitude or other physiological response. 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 (LOAEL)			
Present and intrusive	Noise can be heard and causes small changes in behaviour, attitude or other physiological response, 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 small actual or perceived change in the quality of life.	Observed Adverse Effect	**Mitigate and reduce to a minimum**
Significant Observed Adverse Effect Level (SOAEL)			
Present and disruptive	The noise causes a material change in behaviour, attitude or other physiological response, 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 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**
Present and very disruptive	Extensive and regular changes in behaviour, attitude or other physiological response and/or an inability to mitigate effect of noise leading to psychological stress or physiological stress, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory	Unacceptable Adverse Effect	**Prevent**

Table 4.1: NPSE Guidance

4.8 Whilst the NPPF and associated planning practice guidance sets out stringent imperatives to ensure the satisfactory development of land in relation to possible noise impacts, this policy and guidance does not provide any specific technical guidance defining what may be considered to constitute an *"adverse"* or *"significant adverse"* impact. The guidance does, however, make reference to a number of *'industry standard'* guidance documents. Where available, technical noise standards supporting local planning policies can also be used to inform the assessment of potential noise effects.

4.9 Paragraph 010 (Ref. ID 30-010-20190722) provides the following guidance about how planning can address the adverse effects of noise sources, including where the 'agent of change' needs to put mitigation in place:

4.10 *"This will depend on the type of development being considered the type of noise involved and the nature of the proposed location. In general, for developments that are likely to generate noise, there are 4 broad types of mitigation:*

- *engineering: reducing the noise generated at source and/or containing the noise generated;*
- *layout: where possible, optimising the distance between the source and noise-sensitive receptors and/or incorporating good design to minimise noise transmission through the use of screening by natural or purpose built barriers, or other buildings;*
- *using planning conditions/obligations to restrict activities allowed on the site at certain times and/or specifying permissible noise levels differentiating as appropriate between different times of day, such as evenings and late at night, and;*
- *mitigating the impact on areas likely to be affected by noise including through noise insulation when the impact is on a building.*

4.11 *For noise sensitive developments, mitigation measures can include avoiding noisy locations in the first place; designing the development to reduce the impact of noise from adjoining activities or the local environment; incorporating noise barriers; and optimising the sound insulation provided by the building envelope. It may also be possible to work with the owners/operators of existing businesses or other activities in the vicinity, to explore whether potential adverse effects could be mitigated at source. Where this is the case, it may be necessary to ensure that these source-control measures are in place prior to the occupation / operation of the new development. Where multiple development sites would benefit from such source control measures, developers are encouraged to work collaboratively to spread this cost. Examples of source control measures could include increased sound proofing on a building (e.g. a*

music venue) or enclosing an outdoor activity (e.g. waste sorting) within a building to contain emissions.

4.12 *Care should be taken when considering mitigation to ensure the envisaged measures do not make for an unsatisfactory development."*

4.13 Paragraph 011 (Ref. ID 30-011-20190722) provides the following additional guidance about how adverse noise impacts may be off-set:

4.14 *"Noise impacts may be partially offset if residents have access to one or more of:*

- *a relatively quiet facade (containing windows to habitable rooms) as part of their dwelling;*
- *a relatively quiet external amenity space for their sole use, (e.g. a garden or balcony). Although the existence of a garden or balcony is generally desirable, the intended benefits will be reduced if this area is exposed to noise levels that result in significant adverse effects;*
- *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, external publically accessible 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 minute walking distance)."*

Local Planning Policy – Waverley Borough Council

4.15 In considering any planning application for development, the planning authority will be mindful of the framework set by government policy, in this instance the NPPF, by current Development Plan Policy and by other material considerations.

4.16 The Local Plan 2002 was adopted in 2002 and is in the process of being replaced by Waverley's New Local Plan (Part 1 and Part 2). Local Plan Part 1 (LPP1) replaces a number of policies from Local Plan 2002. Some of the Local Plan 2002 policies have been retained until the adoption of Local Plan Part 2 (LLP2).

4.17 LLP2 is expected to be adopted in October 2022, therefore is a material consideration.

Waverley Borough Council's "Local Plan (2002).

4.18 Polices D1 and D2 are relevant to the proposed development with regard to noise.

POLICY D1 – Environmental Implications of Development

"The Council will have regard to the environmental implications of development and will promote and encourage enhancement of the environment. Development

will not be permitted where it would result in material detriment to the environment by virtue of:-

(a) loss or damage to important environmental assets, such as buildings of historical or architectural interest, local watercourses, important archaeological sites and monuments and areas of conservation, ecological or landscape value;

(b) harm to the visual character and distinctiveness of a locality, particularly in respect of the design and scale of the development and its relationship to its surroundings;

(c) loss of general amenity, including material loss of natural light and privacy enjoyed by neighbours and disturbance resulting from the emission of noise, light or vibration;

(d) levels of traffic which are incompatible with the local highway network or cause significant environmental harm by virtue of noise and disturbance;

(e) potential pollution of air, land or water, including that arising from light pollution and from the storage and use of hazardous substances;

The Council will seek, as part of a development proposal, to resolve or limit environmental impacts. This may include the submission of a flood-risk/run-off assessment to determine the potential flood risk to the development, the likely effects of the development on flood risk to others, whether mitigation is necessary, and if so, whether it is likely to be effective and acceptable. The Council will also seek remedial measures to deal with existing problems such as land contamination."

POLICY D2 – Compatibility of Uses

"The Council will seek to ensure that proposed and existing land uses are compatible. In particular:-

(a) development which may have a materially detrimental impact on sensitive uses with regard to environmental disturbance or pollution will not be permitted;

(b) Uses such as housing or schools which are sensitive to disturbance or pollution will not be permitted near existing premises which generate significant disturbance or pollution, or which handle hazardous substances;

c) the Council will encourage redevelopment of a site with a more appropriate use where an existing permitted or lawful use is causing material detriment to the

character and amenities of the area and its loss or relocation is acceptable having regard to other policies of the Plan;"

4.19 It is noted that the explanatory text accompanying Policies D1 and D2 refer the reader to the guidance of PPG24.

4.20 The historic guidance of PPG24 introduced the concept of *"Noise Exposure Categories"* (NEC's) for determining the suitability of the site for residential development.

4.21 The NEC of a site is determined by considering the type of noise source affecting the site; daytime noise level (expressed as the $L_{Aeq,16hour}$ value between 07.00 to 23.00 hours); night-time noise level (expressed as the $L_{Aeq,8hour}$ value between 23.00 to 07.00 hours) and the magnitude and frequency of night-time noise events.

4.22 This classification of NEC's is summarised in **Table 4.2** below:

Noise Source	Time (Hours)	Noise Exposure Category			
		A	B	C	D
Road Traffic	(0700-2300)	<55	55-63	63-72	>72
	(2300-0700) [1]	<45	45-57	57-66	>66
Rail Traffic	(0700-2300)	<55	55-66	66-74	>74
	(2300-0700) [1]	<45	45-59	59-66	>66
Air Traffic [2]	(0700-2300)	<57	57-66	66-72	>72
	(2300-0700) [1]	<48	48-57	57-66	>66
Mixed Sources [3]	(0700-2300)	<55	55-66	66-74	>74
	(2300-0700) [1]	<45	45-59	59-66	>66

Table 4.2: PPG 24 Classification of Noise Exposure Categories

4.23 The NEC classification table is accompanied by the following explanatory notes:

[0] Noise levels: the noise level(s) ($L_{Aeq,T}$) used when deciding the NEC of a site should be representative of typical conditions

[1] Night-time noise levels (23.00 - 07.00): sites where individual noise events regularly exceed 82 dB L_{Amax} (S time weighting) several times in any hour should be treated as being in NEC C, regardless of the $L_{Aeq,8h}$ (except where the $L_{Aeq,8h}$ already puts the site in NEC D).

[2] Aircraft noise: daytime values accord with the contour values adopted by the Department for Transport which relate to levels measured 1.2m above open ground. For the same amount of noise energy, contour values can be up to 2 dB(A) higher than those of other sources because of ground reflection effects.

[3] *Mixed sources: this refers to any combination of road, rail, air and industrial noise sources. The "mixed source" values are based on the lowest numerical values of the single source limits in the table. The "mixed source" NECs should only be used where no individual noise source is dominant.*

4.24 It should be noted that PPG24 was withdrawn and replaced by the NPPF in March 2012. More contemporary guidance relating to the assessment of noise ("*ProPG: Professional Practice Guidance on Planning and Noise*" published by the Institute of Acoustics, Association of Noise Consultants and Chartered Institute of Environmental Health in 2017) is referenced in the Government's current Planning Practice Guidance[1].

Local Plan Part 1: Strategic Policies and Sites (adopted February 2018)

4.25 In respect to the LLP1, the following policies are relevant to noise:

Policy CC2 – Sustainable Construction and Design

"The Council will seek to promote sustainable patterns of development and reduce the level of greenhouse gas emissions by:

1. ensuring all new development, including residential extensions, include measures to minimise energy and water use through its design, layout, landscape and orientation;

2. encouraging the use of natural lighting and ventilation;

…"

Policy CC3 - Renewable Energy Development

"Renewable energy development should be located and designed to avoid significant adverse impacts on landscape, wildlife, heritage assets and amenity. Appropriate steps should be taken to mitigate any adverse impacts, such as noise nuisance, flood risk, shadow flicker and interference with telecommunications, through careful consideration of location, scale, design and other measures. The Council particularly encourages applications from community-led projects.

Development in the Green Belt will be considered in accordance with advice in the NPPF."

[1] https://www.gov.uk/guidance/noise--2 at Paragraph: 015 Reference IS : 30-015-20190722.

Local Plan Part 2: Site Allocations and Development Management Polices (Pre-Submission Document 2020)

4.26 The Draft Local Plan Part 2, the 'Pre-Submission Plan', provides the more detailed 'Development Management' policies.

4.27 Chapter 2 of the LPP2 mentions that many of the LLP2 policies carry forward the basis of policies in the Waverley Local Plan 2002. These policies have been updated among other things to comply with national policy.

4.28 In respect to the LLP2, the following policies are relevant to noise:

DM1: Environmental Implications of Development

"Development should:

a) Avoid harm to the health or amenity of occupants of nearby land and buildings, and future occupants of the development, including by way of an unacceptable increase in pollution, light, noise, dust, vibration, and odour, or an increase in flood risk;

b) …"

4.29 Policies DM5 (Safeguarding Amenity) requires that development *"should avoid harm to the amenity of future occupants and existing occupants of nearby land, buildings and residences"*. Whilst noise impacts are not explicitly referenced in the policy, the amenity requirements of this policy directly align with the imperatives created by paragraphs 185 and 187 of the NPPF.

Design Guidance

BS 8233: 2014; Sound Insulation and Noise Reduction for Buildings

4.30 BS 8233: 2014 *"Sound Insulation and Noise Reduction for Buildings"* is referenced in Paragraph 015 (Reference ID: 30-015-20190722) of the Government's Planning Practice Guidance. The standard offers the following design guidance for indoor ambient noise levels within dwellings:

Activity	Location	07.00 to 23.00 hours	23.00 t0 07.00 hours
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 $L_{Aeq,8hour}$

Table 4.3: BS 8233 Indoor Ambient Noise Level Design Guidance

4.31 A note accompanying the above Table 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."*

4.32 Despite identifying that maximum values *'may'* be set, guidance values for differing types of noise/frequency of events is not given. It can, however, be noted that the recommendations of BS8233 are aligned with guidance set out in the World Health Organisation's *"Guidelines for Community Noise"*. On that basis, it would seem appropriate to seek to limit night-time noise intrusion such that maximum noise levels do not normally exceed a maximum internal value of 45 dB $L_{Amax,fast}$. Section 3.4 of the WHO guidelines implies that *'not normally'* would be an occurrence of more than 10-15 times per night.

4.33 A further note to the above Table indicates that where *"development is considered necessary or desirable*", the above guideline values can be relaxed by 5 dB and "reasonable" internal conditions still be achieved.

4.34 With regard to external amenity spaces, Section 7.7.3.2 of BS 8233: 2014 states:

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

ProPG: Professional Practice Guidance on Planning and Noise

4.35 ProPG: Planning & Noise is also referenced the Government's PPG. The guidance was authored by representatives from the Chartered Institute of Environmental Health (CIEH), Institute of Acoustics (IOA) and Association of Noise Consultants (ANC) and seeks to consolidate and standardise existing industry good practice in order to expedite the planning process with regard to the consideration of noise.

The ProPG document promotes a two stage methodology for the acoustic assessment of a proposed residential development. Stage 1 involves an *"Initial Site Risk Assessment"*, to identify the likely risk of adverse effects from noise, were no subsequent mitigation to be included as part of the development proposal. The categorisation of potential risk is presented in Figure 1 of the guidance which is reproduced in **Figure 4.1** below:

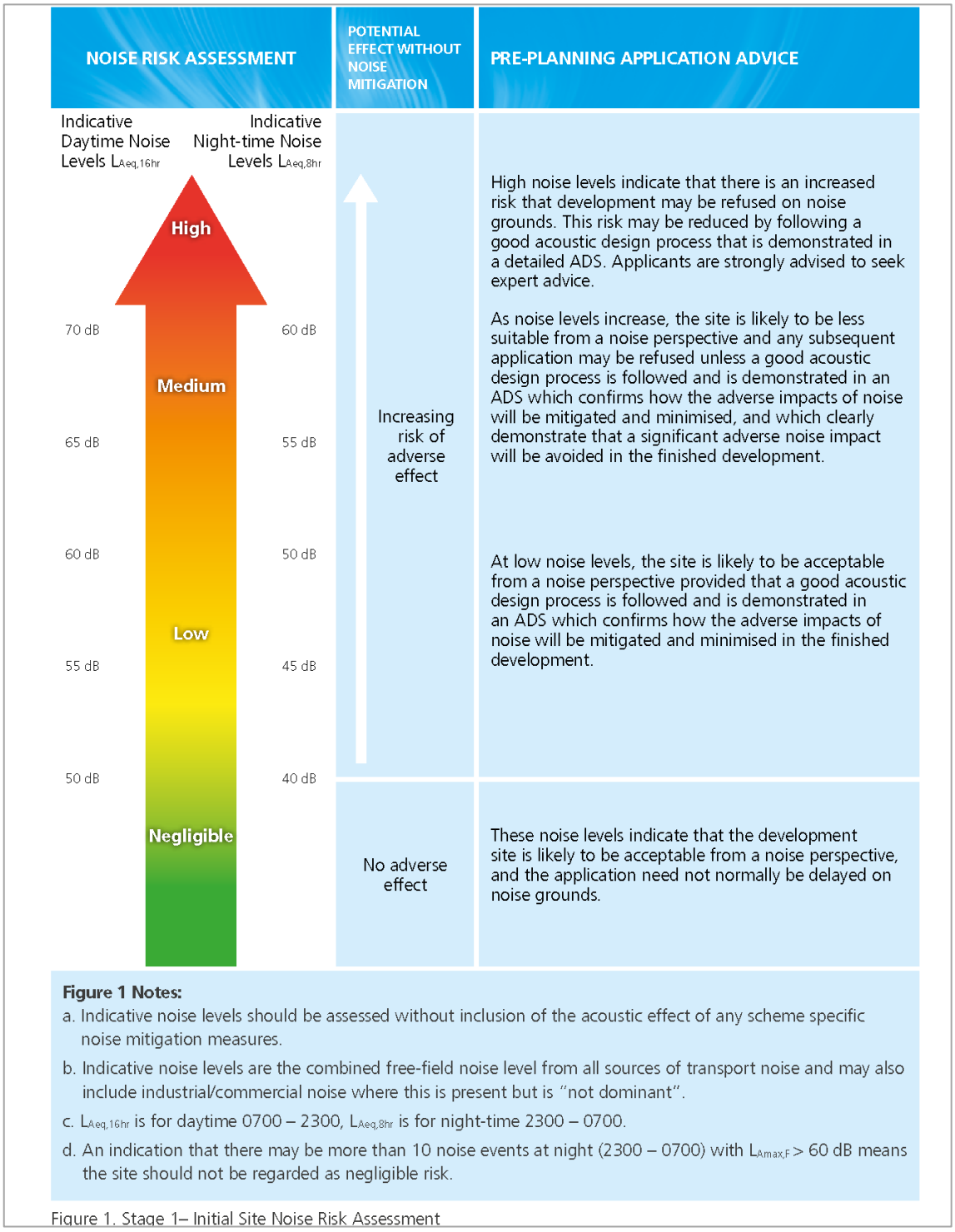


Figure 4.1: ProPG Initial Site Noise Risk Assessment

4.36 Where the Stage 1 assessment indicates that there is a potential for adverse effect, a Stage 2 "Full Assessment" should then be undertaken. This requires four "elements" to be considered:

- ***Element 1**: **Good Acoustic Design*** – demonstrating that the design implements appropriate design features which seek to mitigate noise impacts on future residents;
- ***Element 2: Internal Noise Level Guidelines*** – demonstrating that noise intrusion into internal areas of a development can be controlled in accordance with recommended noise levels;
- ***Element 3**: **External Amenity Area Noise Assessment*** – demonstrating how noise levels in external amenity areas will be controlled and minimised; and
- ***Element 4: Assessment of Other Relevant Issues*** – considering how the scheme complies with relevant national and local planning policy; the magnitude and extent of compliance with ProPG; whether the future occupants of the development are likely to have an increased sensitivity to noise; whether noise mitigation may lead to any unintended adverse consequences and any implication that the acoustic design may bring to the wider planning objectives for the locality.

4.37 Once the above elements have been considered, the acoustics practitioner should be able to make one of the following four recommendations to the decision maker in line with NPPF policy objectives:

A. Planning consent may be granted without any need for noise conditions;

B. Planning consent may be granted subject to the inclusion of suitable noise conditions;

C. Planning consent should be refused on noise grounds in order to avoid significant adverse effects ("avoid"); or

D. Planning consent should be refused on noise grounds in order to prevent unacceptable adverse effects ("prevent").

5 Existing Noise Environment

5.1 Existing noise levels at the site have been established using a combination of automated and attended noise surveys.

Noise Monitoring Locations and Instrumentation

5.2 Automated noise measurements were made over a notional six-day period between 22 and 28 of September 2022. Noise measurements were made at two locations (A1 to A2 shown in **Figure 5.1** below), with attended measurements made at four additional locations (M1 to M4, shown in **Figure 5.1** below).

5.3

5.4 d

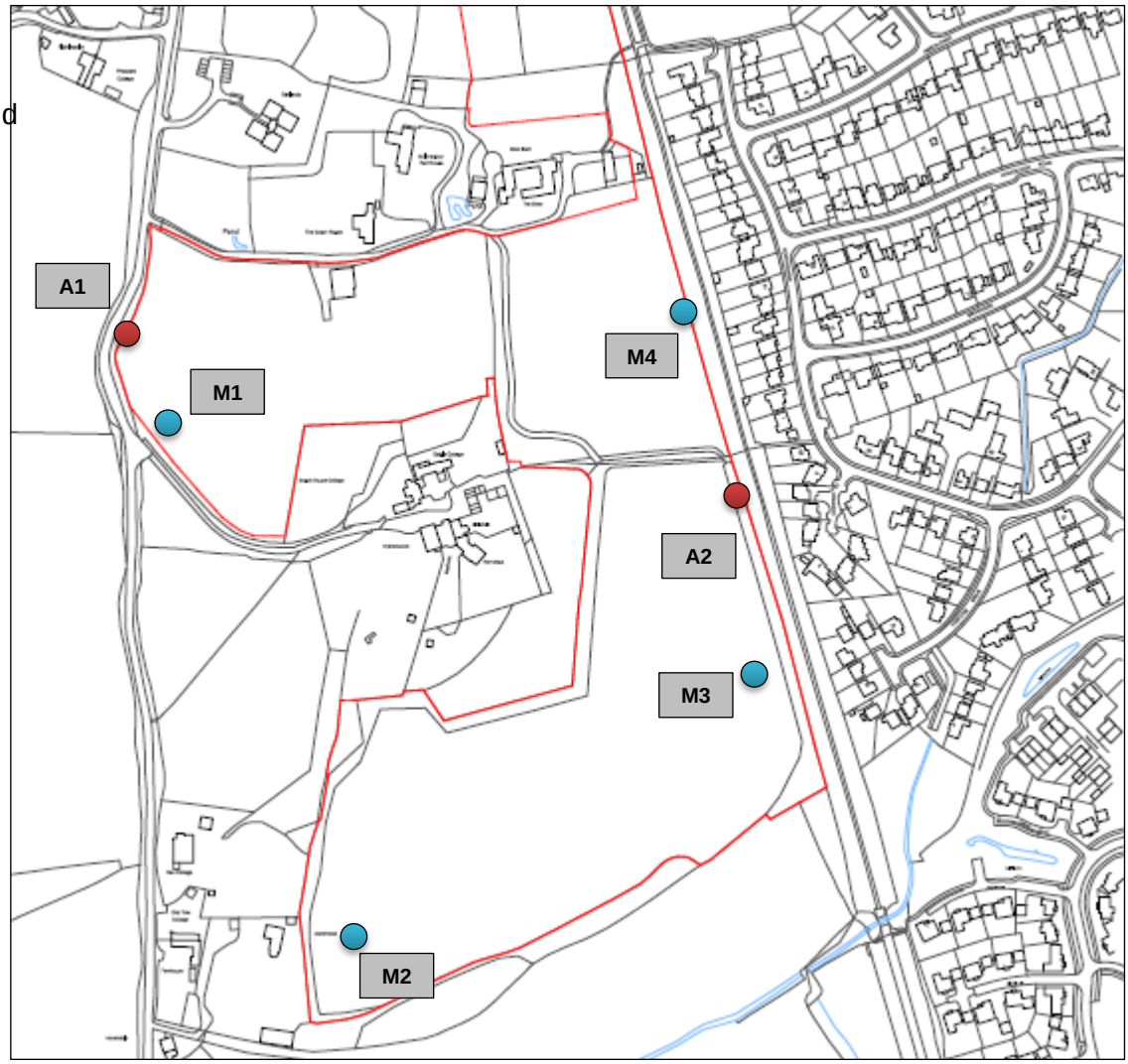


Figure 5.1: Noise Monitoring Locations

5.5 A more detailed description of measurement locations is given in **Table 5.1** below

Location	Description
A1	Along the western boundary of the site the measurement microphone was fixed on a pole approximately 3.5m over the ground level, in free field conditions. The microphone had a direct line of site to Knowle Lane. The manufactures windshield was attached to the microphone for the duration of the measurement period.
A2	Along the eastern boundary of the site the measurement microphone was fixed on a pole approximately 2.5m over the ground level, in free field conditions. The manufactures windshield was attached to the microphone for the duration of the measurement period.
M1-M4	Site boundary. The measurement microphone was positioned approximately 1.2m above ground level in broadly free field conditions

Table 5.1: Automated Noise Survey Locations

Instrumentation

5.6 The following instrumentation was used for the surveys:

Location	Description	Manufacturer	Model	Serial No.
A1	Sound Level Meter	Svantek	Svantek	121166
	Microphone		ACO Pacific	81976
	Preamplifier		Svantek	122199
	Outdoor Mic. Kit		Svantek	--
A2	Sound Level Logger	Convergence Instruments	NSRT_MK3	CnvcrdU4UXUVijngx+jxlD
M1-M4	Sound Level Meter	Svantek	Svantek	72535
	Microphone		ACO Pacific	68261
	Preamplifier		Svantek	72232
	Outdoor Mic. Kit		Svantek	--
All	Calibrator	Bruel & Kjaer	Type 2231	2513115

Table 5.2: Measurement Instrumentation

Automated Survey

Automated Survey Procedure

5.7 The monitoring equipment at Position A1 was configured to record the L_{A90}, $L_{Aeq,}$ and $L_{Amax,fast}$ sound pressure levels over consecutive 15 minute periods to provide a detailed time history profile showing fluctuations in noise levels. The meters were also configured to undertake higher resolution (1 second) logging to assist with the identification and discrimination of noise events.

5.8 The sound level analyser positioned at A2, was configured to continuously log "fast" A-weighted sound pressure levels at a resolution of 1 second. The data has been post-processed using Convergence Instruments "NSRT-AutoCalc" software to determine 15 minute $L_{Aeq,15min}$ and L_{Amax} noise metrics

5.9 The sound level analysers were calibrated before the survey and checked upon completion. No drift in calibration was observed.

Automated Noise Monitoring Results.

5.10 The results of the automated noise monitoring are presented in **Figures 5.2** below and **Figure 5.3** overleaf.

5.11 Higher resolution copies of these time history graphs are also attached at **Appendix B.**

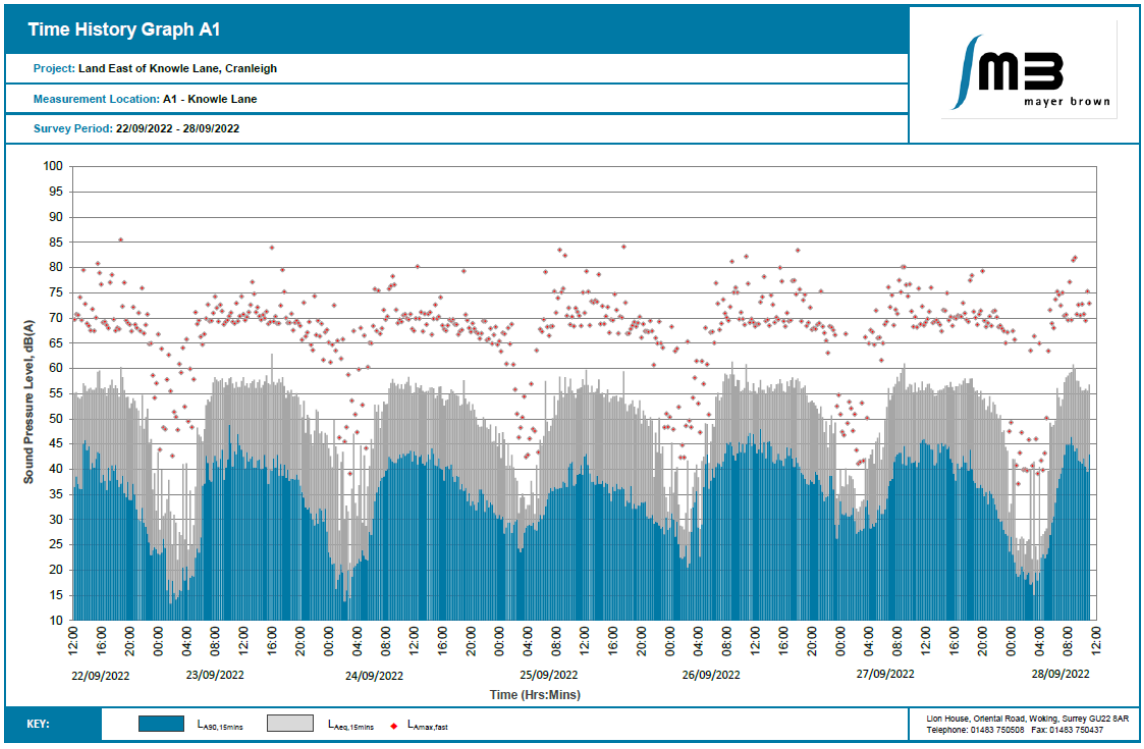


Figure 5.2: Time History Profile for Position A1

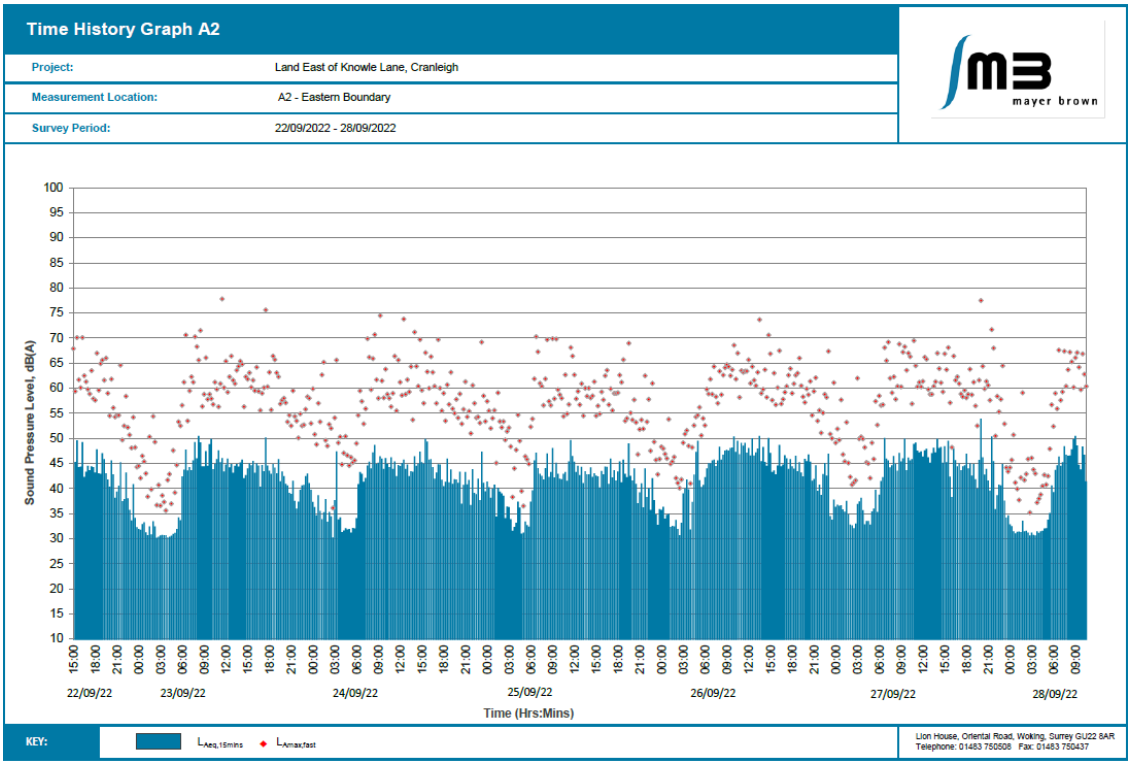


Figure 5.3: Time History Profile for Position A2

5.12 The measurement data has been processed to determine typical daytime ($L_{Aeq,16hour}$), night-time ($L_{Aeq,8hour}$) and L_{AFmax} night-time values (based on the available data for the relevant period. The results of the analysis are presented in **Table 5.3** and **5.4**.

Location	Date	Day-time $L_{Aeq,16hr}$ (dB)	Night-Time $L_{Aeq,8hr}$ (dB)	Typical Night-time $L_{Amax,fast}$[2] (dB)
A1	22/09/2022	56*	43	67
	23/09/2022	56	45	68
	24/09/2022	55	46	68
	25/09/2022	55	46	68
	26/09/2022	56	46	69
	27/09/2022	56	46	68
	28/09/2022	58*	--	
* Data is average for available time period				

Table 5.3: Summary of Automated Noise Monitoring Results – A1.

[2] The typical night-time L_{max} sound level has been determine through a statistical analysis of the survey data resolved to one minute survey periods, in accordance with good practice recommendations set out in paragraph 3.17 of the AVOG guidance (which includes reference to a paper published in Acoustics 2019, IOA Proceedings Volume 41 titled "Assessing Lmax for residential developments: the AVO Guide Approach" (authored by Paxton, Conlan, Harvie-Clark, Chilton and Trew)). The typical L_{max} value presented represents the 10th highest individual vent value determined from the 1-minute dataset.

Location	Date	Day-time $L_{Aeq,16hr}$ (dB)	Night-Time $L_{Aeq,8hr}$ (dB)	Typical Night-time $L_{Amax,fast}$[1] (dB)
A2	22/09/2022	44*	37	55
	23/09/2022	45	39	57
	24/09/2022	44	40	59
	25/09/2022	44	41	55
	26/09/2022	46	40	59
	27/09/2022	46	38	57
	28/09/2022	47*	--	
* Data is average for available time period				

Table 5.4: Summary of Automated Noise Monitoring Results – A2

Weather

5.13 Weather conditions were not actively measured during the survey, however, observations during site attendances and publicly available meteorological data indicates that weather conditions were typically characterised as set out in **Table 5.5** below:

Date	Temperature (°C)		Pressure (mb)		Avg. Wind Speed (kph)	Wind Direction	Cumulative Rainfall (mm)
	Max.	Min.	Max.	Min.			
22nd	19	8	1,011	1,004	3	SW	0
23rd	18	12	1,004	1,001	4	W	0
24th	17	8	1,007	1,002	7	NE	0
25th	15	7	1,008	999	7	NNE	0
26th	15	9	999	988	12	NW	0
27th	14	7	992	987	11	-	0
28th	15	3			4	N	0

Table 5.5: Weather Conditions during Survey

Attended Survey

Attended Survey Procedure

5.14 Attended noise measurements were undertaken in general accordance with the *'shortened measurement procedure'* of the *"Calculation of Road Traffic Noise"* [3]. The measurements covered a three hour period between 12.00 to 16.00 hours on 22 September 2022.

5.15 Attended noise measurements were undertaken at two locations (M1 – M2) around the site on 22 September 2022, to provide information regarding noise levels generated by road traffic noise from surrounding roads. The sound level analyser was configured to measure the L_{A90}, L_{A10}, L_{Aeq} and $L_{Amax,fast}$ noise indices over a notional 15 minute time period. The measured value is taken to be representative of the hour in which the measurement was taken.

5.16 In addition, two spot measurements (M3 to M4) were undertaken to provide additional, comparative measurements of noise propagation across the site.

Attended Noise Monitoring Results

5.17 The results of the attended measurements are presented in **Table 5.6** below and **Table 5.7** overleaf.

5.18 Data shown on positions M1 and M2 excludes aircraft noise.

Location	Time	$L_{A90,15mins}$	$L_{Aeq,15mins}$	$L_{A10,15mins}$	$L_{Amax,fast}$
M1	12:00-13:00	38	46	50	57
	13:00-14:00	38	46	50	59
	14:00-15.00	39	47	51	57
M2	13:00-14:00	36	40	42	48
	14:00-15.00	36	40	43	49
	15.00-16:00	37	41	43	48

Table 5.6: Attended Noise Measurement Results – Road Traffic Noise

[3] Department of Transport. (1998) Calculation of Road Traffic Noise (CRTN). HMSO. London.

Location	Time	$L_{A90,15mins}$	$L_{Aeq,15mins}$	$L_{A10,15mins}$	$L_{Amax,fast}$
M3	13:40-13:55	35	46	49	64
M4	13:00-13:15	36	44	48	62
	13:15-13.30	34	42	44	60
	14.15-14:30	38	44	47	58

Table 5.7: Attended Noise Measurement Results – General Noise

Observations and Discussions

5.19 Noise levels across the development site are dominated by aircraft noise with some contribution of local traffic from Knowle Lane. Road traffic noise becomes the dominant source towards the northwest of the site where Knowle Lane adjoins the boundary. However, terrain provides a noticeable screening in this area and road noise levels reduce with increasing distance from the road.

5.20 Distance road traffic was just intermittently audible across the eastern boundary of the site and does not contribute significantly to the overall noise levels. Measured noise levels at automated position A2 represent the aircraft noise levels contributions that could be expected to be experienced across the site.

5.21 Attended measurement positions M1 and M2 provide information regarding noise levels generated by road traffic noise from Knowle lane at different distances. Aircraft noise contributions at this location has been excluded of the measured data.

5.22 Attended measurement positions M3 to M5 data includes all sources and provides additional, comparative measurements of noise propagation across the site.

Analysis of the data

5.23 The measurement data has been processed to determine typical daytime ($L_{Aeq,16hour}$) and night-time ($L_{Aeq,8hour}$) values.

5.24 For positions A1 and A2, values have been calculated for each complete day/night-time period during the automated monitoring and averaged to provide typical daytime and night-time values.

5.25 For Position M1 and M2, daytime and night-time values have been estimated in accordance with the shortened measurement procedure of CRTN[4]. This analysis yields

[4] Department of Transport. (1988) *"Calculation of Road Traffic Noise"*. HMSO, London.

a predicted $L_{A10,18hour}$ value from which the $L_{Aeq,16hour}$ and $L_{Aeq,8hour}$ values have been estimated using the procedures developed by TRL/Casella Stanger for DEFRA[5].

5.26 Estimated road noise values at these positions M1 and M2 are summarised in **Table 5.8** below.

Location	Day-time $L_{Aeq,16hr}$ (dB) (07:00 – 23:00)	Night-Time $L_{Aeq,8hr}$ (dB) (23:00 – 07:00)
M1	47	41
M2	40	34

Table 5.8: Estimated Road Traffic Noise Daytime and Night-time $L_{Aeq,T}$ values

5.27 In order to represent the aircraft contribution at position M1-M2, typical daytime ($L_{Aeq,16hour}$) and night-time ($L_{Aeq,8hour}$) values calculated at position A2 have been added to the values show in **Table 5.8** above.

5.28 Estimated values are summarised on **Table 5.9** below.

Location	Day-time $L_{Aeq,16hr}$ (dB) (07:00 – 23:00)	Night-Time $L_{Aeq,8hr}$ (dB) (23:00 – 07:00)
A1	56	46
A2	45	39
M1	49	43
M2	46	40

Table 5.9: Estimated Combined Daytime and Night-time $L_{Aeq,T}$ values

[5] TRL/Casella Stanger (2006) for DEFRA. Method for Converting the UK Road Traffic Noise Index $L_{A10,18h}$ to the EU Noise Indices for Road Noise Mapping.

6 Site Suitability – ProPG Stage 1 Assessment

6.1 In order to consider the suitability of the site for residential development, noise levels determined for Positions A1, A2, M1 and M2 have assessed in accordance with the ProPG[6] *"Stage 1 Initial Site Noise Risk Assessment" guidance.*

6.2 An initial risk assessments of daytime noise levels is shown in **Figure 6.1** below.

Figure 6.1: ProPG Initial Site Noise Risk Assessment – Daytime

6.3 The initial daytime risk assessment indicates a "negligible" risk at Position A2 and M2, increasing to a "negligible" to "low" risk at Positions A1 and M1 (which are closer to Knowle Lane).

6.4 An initial risk assessments of daytime noise levels is shown in **Figure 6.2** overleaf.

[6]ProPG: Professional Practice Guidance on Planning and Noise: New Residential Development. (2017)

Figure 6.2: ProPG Initial Site Noise Risk Assessment – Night-time

6.5 The initial night-time risk assessment again indicates a broadly "negligible" risk at Position A2 and M2, increasing to a "negligible" to "low" risk at Positions A1 and M1 (which are closer to Knowle Lane).

6.6 It is clear from the above, that greatest noise risk is indicated at Position A1 at the western boundary of the site adjoining Knowle Lane. It is, however, also clear from the illustrative masterplan for the site that the proposed boundary of the residential development area is to be set back from Knowle Lane (by a distance of approximately 25m). The obvious corollary of this is the "actual" noise level experienced at even the closest dwellings to Knowle Lane will be lower than measured at Position A1 and the noise risk will therefore be moderated.

6.7 Guidance set out in the Department of Transport (Welsh Office) publication *"Calculation of Road Traffic Noise"* requires that roads are treated as a "line source", with the effective source positioned at a distance of 3.5m from the nearside carriageway edge and at a height of 0.5m.

6.8 The reduction in traffic noise at different distances can then be calculated from the equation:

$$SPL_2 = SPL_1 - 10\ \log_{10}(\frac{r_2}{r_1})$$

where:

SPL_1 is the sound pressure level at a "slant" distance of r_1 from the road line source; and

SPL_2 is the sound pressure level at a "slant" distance of r_2 from the road line source;

6.9 Using the above, the expected reduction in road traffic noise from 4 to 25 m from the nearside curb is calculated to be 6dB.

6.10 Applying the above correction to the results of the noise monitoring would give a "worst case" estimate of noise levels at the most noise residential development boundary of around 51 dB $L_{Aeq,16hour}$ (daytime) and 42 dB $L_{Aeq,8hour}$ (night-time).

6.11 **Figure 6.3** below presents a ProPG Stage 1 initial noise risk assessment of these likely worst case levels.

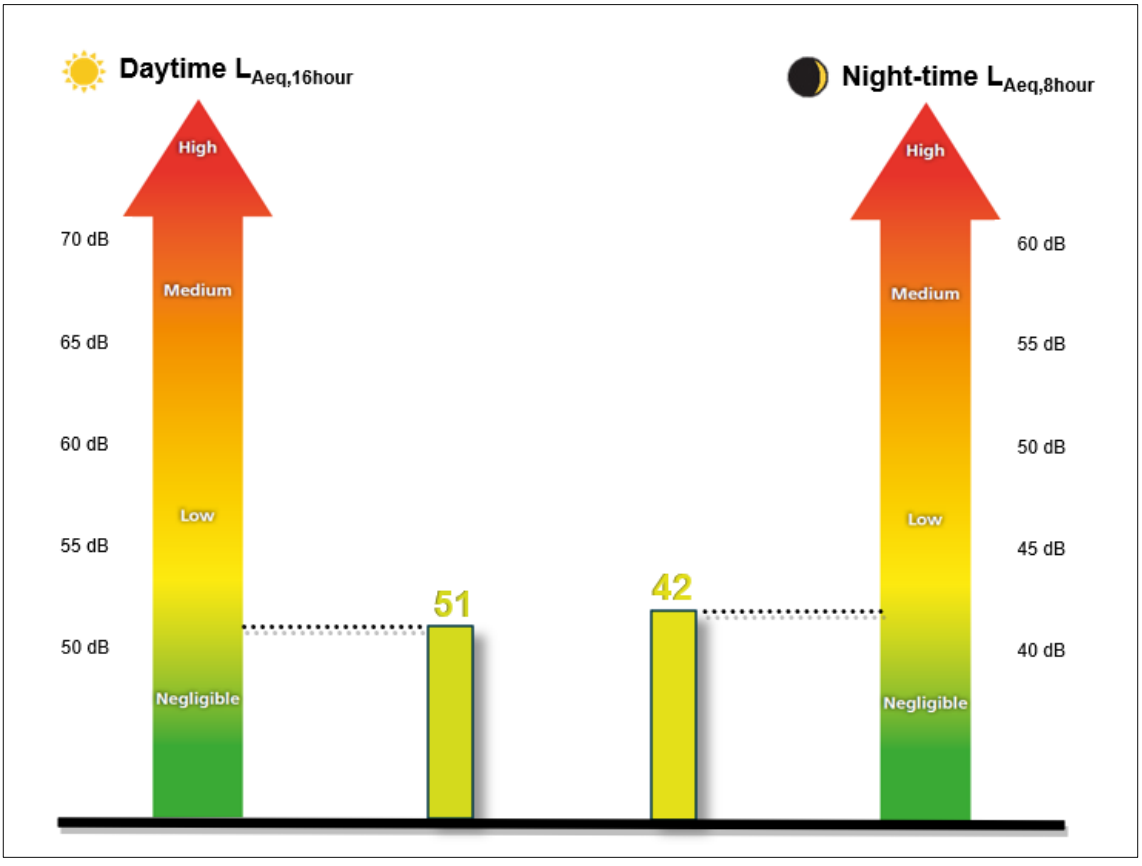


Figure 6.3: ProPG Initial Site Noise Risk Assessment – Daytime/Night-time

6.12 The above figure shows that during both the daytime and night-time hours, the "worst case" noise risk is assessed to be *"negligible"* to *"low"* only.

6.13 For *"negligible"* sites, ProPG states

> *These noise levels indicate that the development site is likely to be acceptable form a nose perspective and the application need not normally be delayed on noise grounds.*

6.14 For *"low"* risk sites, ProPG states:

> *At low noise levels, the site is likely to be acceptable from a noise perspective provided that a good acoustic design process is followed and is demonstrated in an ADS which confirms how the adverse impacts of noise will be mitigated and minimised in the finished development.*

6.15 In light of the above, it is concluded that the site should be suitable for residential development. The later sections of this report further explain how noise impacts can be further minimised through an intelligent, design-led masterplanning response and noise mitigation that will be intrinsically embedded within the detailed design proposals to satisfy other regulatory regimes (e.g. Building Regulations).

Compliance with Local Planning Policy

6.16 As noted in Section 4, explanatory text accompanying Local Policies D1 and D2 of the current adopted Local Plan refer the reader to the guidance of PPG24.

6.17 The historic guidance of PPG24 introduced the concept of *"Noise Exposure Categories"* (NEC's) for determining the suitability of the site for residential development.

6.18 The NEC of a site is determined by considering the type of noise source affecting the site; daytime noise level (expressed as the $L_{Aeq,16hour}$ value between 07.00 to 23.00 hours); night-time noise level (expressed as the $L_{Aeq,8hour}$ value between 23.00 to 07.00 hours) and the magnitude and frequency of night-time noise events.

6.19 In accordance with the PPG 24 classification of NEC's (please refer to **Table 4.2** in Section 4 above), the development will fall in the "NEC A".

6.20 The guidance set out in PPG24 for sites falling within NEC A:

> *"Noise need not be considered as a determining factor in granting planning permission, although the noise level at the high end of the category should not be regarded as a desirable level."*

6.21 Based on the above assessments, existing ambient noise levels at the site are considered to be wholly compatible with the development of new residential dwellings. Such a conclusion is further reinforced by the good practice guidance and mitigation that

can be provided by an intelligent design-led approach to the masterplanning of the development and mitigation that will be inherently embedded within the scheme design proposals, as explained in the following section.

7 Acoustic Design Statement

7.1 The following sections provide a more detailed consideration of the elements required by a ProPG Stage 2 “Full Assessment”.

Element 1 - Good Acoustic Design

7.2 As noted earlier, the highest noise levels characterising the site are experienced along its western boundary, where noise levels are influenced by intermittent vehicular traffic on Knowle Lane.

7.3 The proposed illustrative masterplan embeds good acoustic design principles including:

- The incorporation of a buffer zone along the western boundary of the site which helps to maximise the separation between Knowle Land and proposed dwellings, as shown in **Figure 7.1** below:

Figure 7.1. Masterplan Good Acoustic Design – Buffer Zone.

- Dwellings closest to the western boundary can be arranged to such that face “towards” Knowle Lane. This orientation will enable building to provide inherent acoustic screening to the rear elevations and rear gardens of the dwellings,

optimising opportunities for providing passive ventilation and minimising noise levels in external amenity areas.

Figure 7.2: Use of Double Aspect Units

Element 2 – Internal Noise Level Guidelines

7.4 In relation to Element 2 (Internal Noise Design Targets), Figure 2 of ProPG makes the following design recommendations:

ACTIVITY	LOCATION	07:00 – 23:00 HRS	23:00 – 07:00 HRS
Resting	Living room	35 dB $L_{Aeq,16\ hr}$	-
Dining	Dining room/area	40 dB $L_{Aeq,16\ hr}$	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,16\ hr}$	30 dB $L_{Aeq,8\ hr}$ 45 dB $L_{Amax,F}$ (Note 4)

Figure 7.3: ProPG Internal Noise Level Design Guidance

7.5 The above recommendations are accompanied by a number of notes. Of particular relevance are:

- **Note 2 –** which states *"The internal LAeq target levels shown in the Table are based on the existing guidelines issued by the WHO and assume normal diurnal fluctuations in external noise. In cases where local conditions do not follow a typical*

diurnal pattern, for example on a road serving a port with high levels of traffic at certain times of the night, an appropriate alternative period, e.g. 1 hour, may be used, but the level should be selected to ensure consistency with the internal L_{Aeq} target levels recommended in the Table."

- **Note 4** – which clarifies that the recommended $L_{Amax,fast}$ value should not normally be exceeded 10 times per night; and
- **Note 5** – which states *"Where it is not possible to meet internal target levels with windows open, internal noise levels can be assessed with windows closed, however any façade openings used to provide whole dwelling ventilation (e.g. trickle ventilators) should be assessed in the "open" position and, in this scenario, the internal L_{Aeq} target levels should not normally be exceeded…."*.

Façade Sound Insulation

7.6 The proposed development will, as a matter of course, include the use of thermal double glazing (to comply with the statutory thermal requirements of Approved Document L1 of the Building Regulations 2010, as amended) and an appropriate scheme of ventilation (to comply with the statutory requirements of Approved Document F1 of the Building Regulations 2010, as amended).

7.7 The use of standard thermal double glazing and non-acoustic ventilators will typically provide adequate sound insulation to control noise intrusion into building at daytime sound levels up to around 56dB $L_{Aeq,16hour}$ and night-time sound levels of around 510dB $L_{Aeq,8hour}$ [7].

7.8 It follows that even the "worst case" traffic noise level characterising the site should be readily controlled by the mitigation that will be inherently embedded within the scheme design control proposals (i.e. use of standard thermal double glazing and ADF compliant scheme of ventilation).

7.9 It is, therefore, concluded that the proposed development can readily provide acceptable indoor noise levels for future residents.

Purge of Ventilation

7.10 Approved Document F also requires that adequate provision is made for purge ventilation. Purge ventilation is the process of removing high concentrations of pollutants and water vapour released from occasional activities (such as painting and decorating) or accidental releases (such as smoke from burnt food or spillage of water). Since the

[7] See Table B-3 of IOA/ANC publication *"Acoustics Ventilation and Overheating: Residential Design Guide"* (January 2020)

need for purge ventilation is by its definition "occasional", this is normally achieved by giving residents the ability to open their windows. Whilst noise intrusion may increase as a result of windows being open, the occasional and temporary occurrence of such a situation can be readily accepted, particularly since occupants are *"in control"* of both the timing and duration of purge ventilation being required. Given the modest noise levels characterising the site, providing purge ventilation by means of opening windows is considered an appropriate and in line with ProPG guidance.

Thermal Comfort

7.11 Overheating (including acoustic considerations) is now a matter statutorily controlled through Approved Document O of the Building Regulations 2010 (as amended).

7.12 Guidance on how to address the potential conflict between acoustics, noise and ventilation is set out in the Association of Noise Consultants/Institute of Acoustics publication *"Acoustics Ventilation and Overheating: Residential Design Guide"* (January 2020). Table 3.2 of the guidance provides a means of assessing the initial noise risk of the site based on a consideration of the daytime and night-time noise levels.

7.13 **Figure 7.4** shows how the *"worst case"* noise levels determined from the noise monitoring would be assessed in accordance with this guidance.

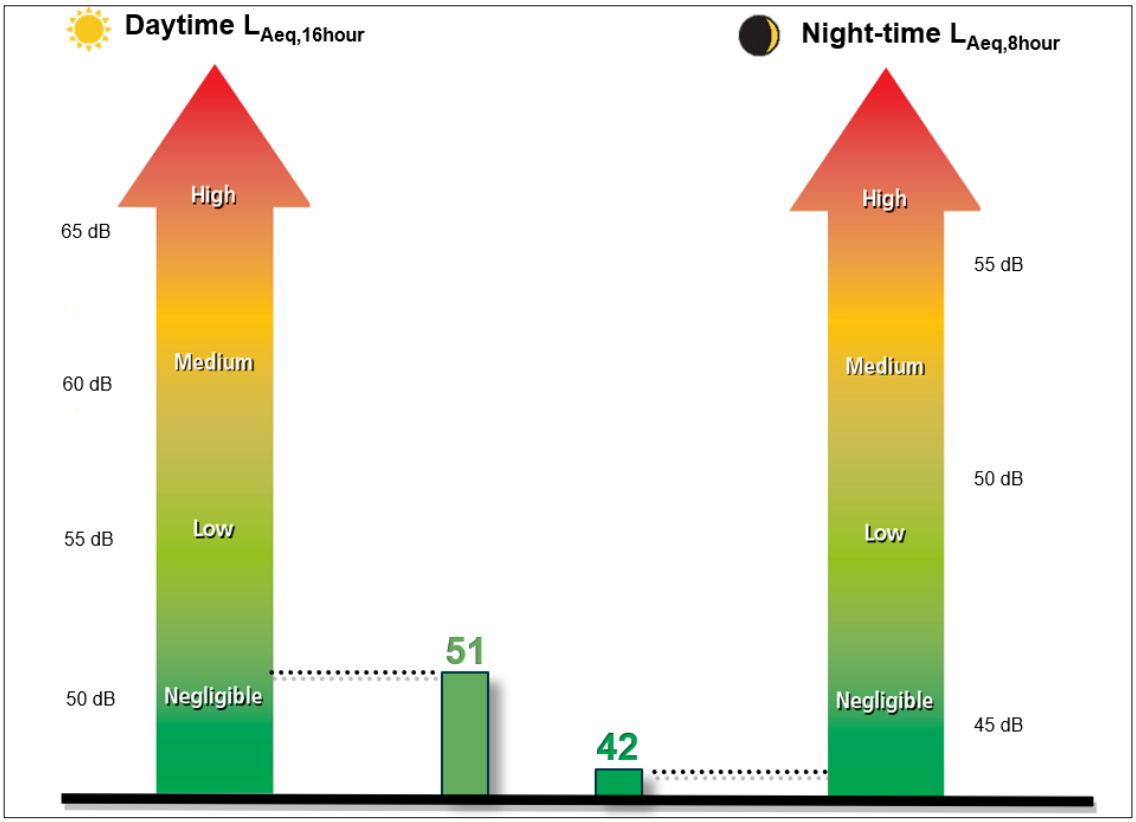


Figure 7.4: Level 1 AVOG Assessment

7.14 The above initial assessment shows that existing noise levels characterising the site are fully compatible with future dwellings relying on passive ventilation (by means of openable windows) to provide thermal comfort over their homes to address any overheating risk.

7.15 Approved Document O (ADO) of the Building Regulations also requires that reasonable provision is made to limit unwanted solar gains and provide adequate means to remove heat from the indoor environment – taking due account of internal noise levels. Reliance of the use of openable windows to provide thermal control may not be possible if indoor noise levels are likely to exceed night-time sound levels of 40dB $L_{Aeq.8hours}$. Given that the "worst case" **external** night-time sound level characterising future dwellings is estimated to be around 42dB(A), compliance with Approved Document O should be readily achievable by enabling residents to open their windows to provide ventilative cooling.

Element 3 - External Amenity

7.16 ProPG guidance recommends:

> *"If external amenity spaces are an intrinsic part of the overall design, the acoustic environment of those spaces should be considered so that they can be enjoyed as intended".*
>
> *The acoustic environment of external amenity areas that are an intrinsic part of the overall design should always be assessed and noise levels should ideally not be above the range 50 – 55 dB $L_{Aeq,16hr}$."*

7.17 The results of the noise monitoring indicate that the closest/most exposed houses on the site would be exposed to a "worst-case" daytime sound level of around 51dB $L_{Aeq,16hour}$. This is the existing "free-field" sound level and will be further reduced by the presence of the proposed buildings on the site and fencing around gardens, etc.

7.18 It can therefore be comfortably concluded that noise levels in external amenity areas provided by the development will be controlled comfortably in line with ProPG guidance (particularly with the additional mitigation that can be embedded within the developed masterplan).

Element 4 – Assessment of Other Relevant Issues

7.19 The assessments presented in preceding sections conclude that the proposed scheme complies with relevant national and local planning policy.

7.20 The magnitude and extent of compliance with ProPG guidance is considered to be full addressed in preceding sections, i.e. the development implements "good acoustic

design"; internal noise levels are adequately controlled and external amenity spaces noise levels comfortably controlled.

7.21 There are no commercial uses close to the development site, therefore the proposed development does not raise any agent of change obligations.

7.22 Section 3 of ProPG identifies that following the Stage 1 and 2 guidance, will lead to one of four possible recommendations from the noise practitioner to the decision maker:

A. Planning consent may be granted without any need for noise conditions;

B. Planning consent may be granted subject to the inclusion of suitable noise conditions;

C. Planning consent should be refused on noise grounds in order to avoid significant adverse effects ("avoid"); or

D. Planning consent should be refused on noise grounds in order to prevent unacceptable adverse effects ("prevent").

7.23 ProPG Stage 1 assessment process clearly demonstrates that the Site has a "negligible" noise risk at the majority of the site; towards the north-western boundary levels are in between "negligible" and "low". It is concluded that the site should be suitable for residential development, subject to the implementation of a good acoustic design process. This is demonstrated through the acoustic design statement.

7.24 Given that the satisfactory delivery of the scheme is only dependent on the implementation of a good acoustic design process, that has been demonstrated, the appropriate recommendation to the decision maker is that:

"Planning consent may be granted without any need for noise conditions"

8 Conclusions

Existing Noise Environment

8.1 Environmental noise monitoring has been undertaken to determine the existing environmental noise climate at the site. The majority of site is dominated by aircraft noise associated with aircraft movements to/from Gatwick airport with traffic noise from Knowle Lane becoming dominant at the western site boundary.

Planning Policy Context and Design Guidance

8.2 The requirements of national and local planning policy relevant to the proposed scheme are discussed.

8.3 Reference has also been made to industry standard design guidance, in particular ProPG: Planning and Noise, recently published by the Institute of Acoustic, Association of Noise Consultants and Chartered Institute of Environmental Health.

Site Suitability - Residential

8.4 The potential risk of the site for residential development has been assessed in line with a ProPG Initial Site Noise Risk Assessment. This concludes that the site is classified as a “negligible”/”low” risk for the daytime and night-time periods.

ProPG

8.5 With particular regard to the considerations required by ProPG, it is concluded that:

- The proposed illustrative masterplan implements a good acoustic design process;
- Internal noise levels can be adequately controlled through inherent mitigation (e.g. provision of secondary glazing and scheme of ventilation compliant with Approved Document F of the Buildings Regulation);
- Noise levels characterising the site are also fully compatible with enabling future residents to provide thermal control within their properties by means of passive ventilation (openable windows);
- Noise levels in external amenity spaces are already compliant with the guidance of BS 8233/ProPG but can be further reduced by boundary treatments (e.g. garden fencing) developed during the finalisation of the reserved matters planning; and
- Future residents will have access to public external amenity spaces, compliant with the aspirational noise levels indicated in WHO/BS8233 guidance;

Conclusion

8.6 It is concluded that an appropriate and intelligent design led approach to the development of the site can deliver high quality and sustainable buildings and places, in line with the requirements of the NPSE , NPPF, supporting planning practice guidance, local planning policy and industry standard good practice relating to noise.

APPENDIX A - Glossary of Acoustic Terminology

GLOSSARY OF ACOUSTIC TERMINOLOGY

General

A vibrating surface or turbulent fluid flow will cause pressure fluctuations in the surrounding air. These pressure fluctuations are perceived by the human ear as “sound”.

Measurement Units

The human ear can detect sound pressures as low as about 20 µPa, and can tolerate (for short periods) sound pressures as high as 200 Pa, an amplitude range of 10 million times. To take account of this huge amplitude range, sound pressure levels (often written in “acoustic shorthand” as SPL or Lp) are quantified using a logarithmic scale, the decibel (dB) scale. This is based on a reference pressure of 20µPa, thus a sound pressure of 20µPa would equate to 0dB and a pressure of 200Pa would equate to 140dB.

Frequency (Pitch) Characteristics

The sound received at any particular location is not solely influenced by the sound pressure level, the frequency characteristics (pitch) of the noise is also an important factor. Noise audible to a human (with “normal” hearing), typically covers the frequency range 20 Hertz to 20,000 Hertz. Hertz (Hz) are defined as the number of times the sound pressure fluctuates in one second. “Low” pitched sounds fluctuate less times per second than “high” pitched sounds. Whilst humans are capable of detecting a wide range of frequencies, the ear is not equally sensitive to all frequencies – the ear is most sensitive at frequencies towards the middle of the audible range and less sensitive to the lower and higher frequencies.

To take account of this frequency response, sound pressure fluctuations are normally quantified by applying a frequency-weighting network or filter which simulates the frequency response of the ear. In essence, this means that more significance is given to the frequencies at which the ear is most sensitive and less significance to those at which the ear is less sensitive. Noise measurements relating to human reaction are generally made using an “A-weighting” network. These measurements are reported as A-weighted decibels or dB(A). The A-weighted sound pressure level is written in “acoustic shorthand” as L_A.

Variation of Sound with Time

It will be appreciated that the sound pressure level of most noise sources will fluctuate with time. In order to take account of the way in which the human ear perceives noise, it is normal for the sound pressure level to be quantified using a time weighting network, to mimic the speed of response of the human ear. The standardised setting for most types of noise is a “Fast” time weighting.

The manner in which sound fluctuates with time can also influence the subjective manner in which noise is perceived. Noise can be continuous (showing no significant variation with time as in the case of a fan), intermittent (i.e. the noise is transient in it’s nature, such as a train pass-by) or impulsive (i.e. there is a sudden build up of noise - this can range from “clanking” types sounds as might be experienced next to railway goods yard or a high energy discharge such as an explosion)

Measurement of Sound

Sound pressure levels are measured using equipment comprising a pressure-sensitive microphone, associated amplifier, frequency weighting network, time weighted network and output indicator. In its simplest form this is a small hand-held instrument called a sound level meter. More sophisticated instrumentation (a sound level analyser) is also available which allows the real-time output of the frequency characteristics of the sound to be quantified.

Comparison of Sound Levels

To put the significance of noise measurement into context, the following Table presents the A-weighted sound pressure level of some typical sources:

Sound Pressure Level, dB(A)	Typical Noise Source . Activity
160	Saturn Rocket Taking Off
140	Military Jet Taking Off at 30m
100	Nightclub
90	Heavy goods vehicle driving past at 7m
80	Busy urban road
70	Domestic vacuum cleaner at 3m
60	Busy office environment
55	Normal speech at 1m
40	Whispered conversation at 2m
30	Bedroom at night (BS 8233: 1999)
20	Remote country location
0	Threshold of hearing – a very eery silence

Addition of Sound Levels

It is important to note that the use of a logarithmic scale to describe noise does not allow normal arithmetic addition. This means that two noise sources each generating a level of, say, 60dB(A) will not generate a combined sound level of 120dB(A). The values must be added logarithmically, which would actually yield a combined sound level of 63dB(A) in this example.

Subjective Perception of Sound Levels Changes

With regard to the human perception of sound level changes, the human ear:

- Cannot generally perceive a sound level difference of less than 3dB(A)
- Will perceive a sound level difference of 4-5dB(A) as “noticeable”
- Will perceive a sound level difference of 10dB(A) as a doubling (or halving) of loudness.

Acoustic Terminology

As stated previously, most sources of noise will fluctuate with time. In order to characterize such noise, it is therefore normal to represent the noise climate using a variety of noise parameters and statistical indices. The most commonly adopted noise parameters are described below:

$L_{Aeq,T}$ This is the equivalent continuous A-weighted sound level measured over a specified time period "T". This is the notional continuous sound level which, over the time T, contains the same amount of energy as the actual fluctuating sound being measured. This parameter is widely accepted as being the most appropriate noise descriptor for most environmental noise and the effects of noise on humans.

$L_{Amax,fast}$ This is maximum A-weighted sound pressure measured with a fast frequency response recorded during the stated measurement period. It is typically used to characterise the highest sound level caused during a noise event.

$L_{A90,T}$ This is the A-weighted sound pressure level exceeded for 90% of the specified time period "T". It is normally used to describe the underlying background noise level of an environment since it inherently excludes the effects of transient noise sources.

Noise Rating (NR) Level

When describing noise from building services installations, it is common to express noise levels in terms of a Noise Rating (NR) Level. The NR level is determined by plotting the measured frequency spectrum of a noise against a series of reference curves, which roughly approximate to equal loudness values. This method permits higher sound levels at low frequencies corresponding to the sensitivity of the human ear. The NR level is defined as the value of the highest curve "touched" by the plotted frequency spectrum. For typical sources of building services noise, the overall A-weighted sound level is numerically around 5-6dB higher than the NR level of the noise.

Airborne Sound Insulation Measurement Parameters

The ability of a building element to reduce airborne noise can be described by a number of different parameters relevant to both laboratory and on-site performance evaluation. In general, the higher these values, the better the resistance of the construction to the transmission of airborne sound. The most commonly used parameters include:

R_w The **"Weighted Sound Reduction Index"** (R_w) is a single value measure of the intrinsic sound reduction capabilities of a construction, as measured in an acoustic laboratory. Measurement values are determined in accordance with the BS EN ISO 10140 series of standards and weighted in accordance with BS EN ISO 717-1: 2013.

R'_w The **"Weighted Apparent Sound Reduction Index"** (R'_w) is a single value measure of the apparent sound reduction capabilities of a construction, when installed on-site (which will normally be some way lower than the laboratory value due to less favourable installation conditions, the quality of workmanship, etc.). Measurement values are determined in accordance with the BS EN ISO 10140 series of standards and weighted in accordance with BS EN ISO 717-1: 2013. In practice, the R'_w of a construction can only be reliably determined if "direct" sound transfer through the partition can confidently be taken as the dominant noise transfer path (i.e. there is no "flanking" sound transmission.

D_w The **"Weighted Sound Level Difference"** (D_w) is a single value measure of the on-site sound reduction between two rooms. This value inherently includes "direct" sound transmission through any separating construction and "flanking" transmission through other building elements. Measurement values are determined in accordance with BS EN ISO 140-4: 1998 (for Building Regulations compliance purposes) or BS EN ISO 16283-1: 2014 and weighted in accordance with BS EN ISO 717-1: 2013.

$D_{n,fw}$ The "**Weighted Normalised Flanking Level Difference**" ($D_{nf,w}$) is a single figure measure of the sound reduction between two rooms solely due to sound transmission through a specified flanking path. This parameter is frequently used to provide an indication of the sound reduction capabilities of suspended ceiling and raised access floor constructions where there is common void between adjacent rooms or as a measure of sound that may be transmitted between rooms through external curtain walling. Measurements are undertaken in accordance with BS EN ISO 10848-2: 2017 and weighted in accordance with BS EN ISO 717-1: 2013.

Impact Sound Insulation Measurement Parameters

Some building elements also have the potential to generate "impact" noise, for example due to human "footfall" on floor structures, or the impact of rainfall on lightweight roofing components. A variety of parameters are again available to define the amount of noise likely to be generated. In general, the lower these values, the less sound the construction will generate as a result of impacts. Typical measurements parameters include:

$L_{nT,w}$ The "**Standardised Impact Sound Pressure Level**" is a "single number" rating describing the intrinsic impact sound insulation capabilities of a construction (such as a floor system) as measured in an acoustics laboratory. Values are determined in a vertical sound transmission suite by locating a "tapping machine" in the upper room of the suite and measuring the amount of sound radiated by the floor in the room below. Measurement values are determined in accordance with the BS EN ISO 10140 series of standards and weighted in accordance with BS EN ISO 717-2: 2013.

$L_{nf,w}$ The "**Normalised Flanking Impact Sound Pressure Level**" is a "single number" rating describing the amount of flanking sound that would be transmitted to an adjoining space (separated by a partition) due to impacts on the test sample. It is, for example, used to indicate the amount of noise that may be generated due to footfall noise on a raised access floor system. Values are determined in a horizontal sound transmission suite by locating a "tapping machine" one side of a separating partition built off the test sample and measuring the amount of noise radiated by the floor in the adjoining space on the other side of the partition. Measurement values are determined in accordance with BS EN ISO 10848-2: 2017 and weighted in accordance with BS EN ISO 717-2: 2013.

Room Acoustic Measurements

T The "**Reverberation Time**" (T) of a room is defined as the time taken for the sound energy produced by a source Time (RT)to decay by 60 dB after the source has been switched off. The reverberation time of a space can be calculated by considering the volume of the room and the areas and sound absorption qualities of room surface finishes. Small, "soft" rooms tend to give low reverberation times, whilst large, "hard" rooms tend to give long reverberation times.

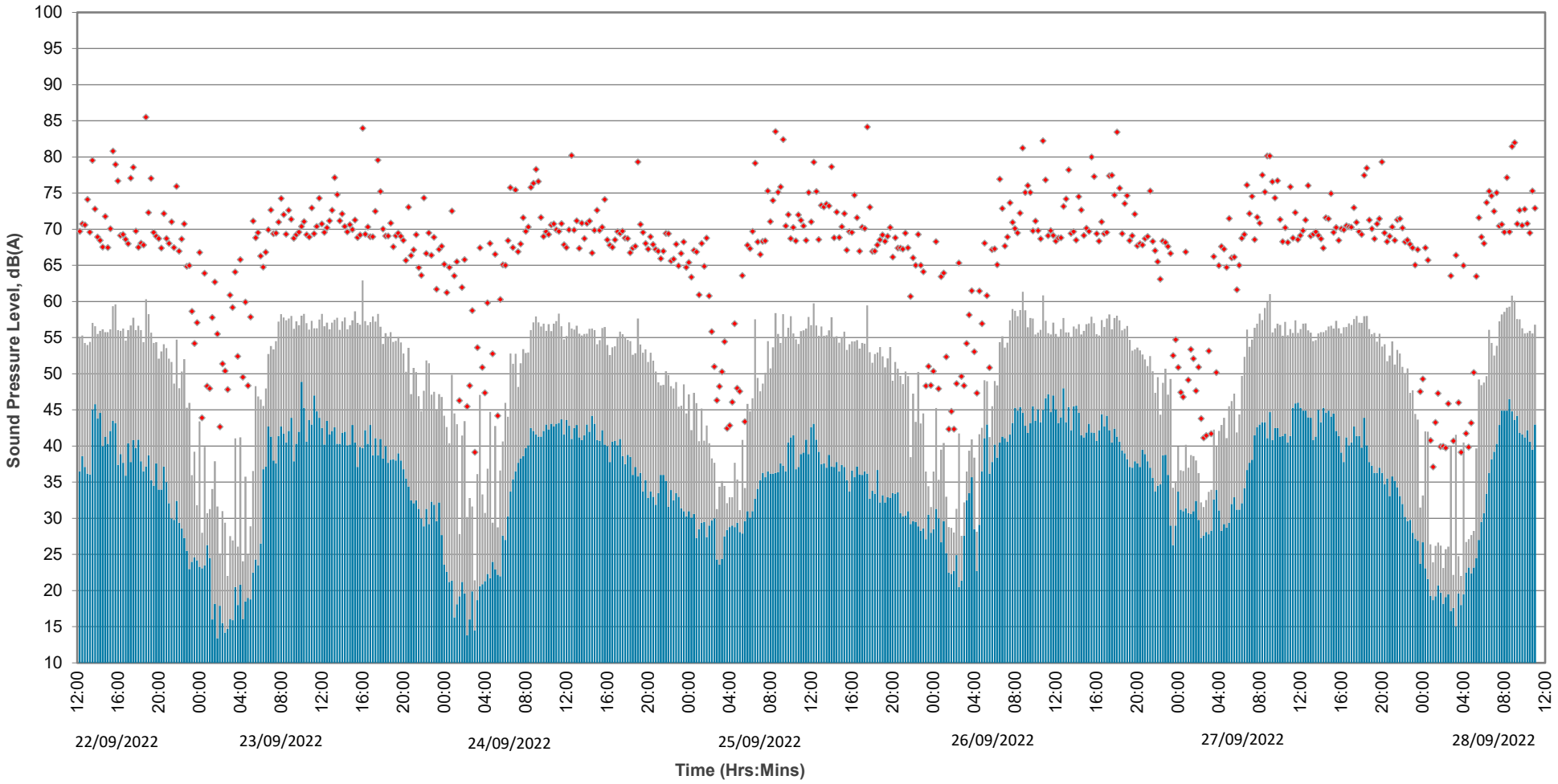
α_p The "**Practical Acoustic Absorption Coefficient**" (α_p) is a measure of how much sound energy is absorbed by a building element at a particular frequency, as measured in accordance with BS EN ISO 354: 2003.

α_w The "**Weighted Absorption Coefficient**" (α_w) is a single figure measure of the overall sound absorption capabilities of a building element determined in accordance with BS EN ISO 11654: 1997.

APPENDIX B – Noise Monitoring Results

Time History Graph A1

Project:	Land East of Knowle Lane, Cranleigh
Measurement Location:	A1 - Knowle Lane
Survey Period:	22/09/2022 - 28/09/2022



KEY: $L_{A90,15mins}$ $L_{Aeq,15mins}$ $L_{Amax,fast}$

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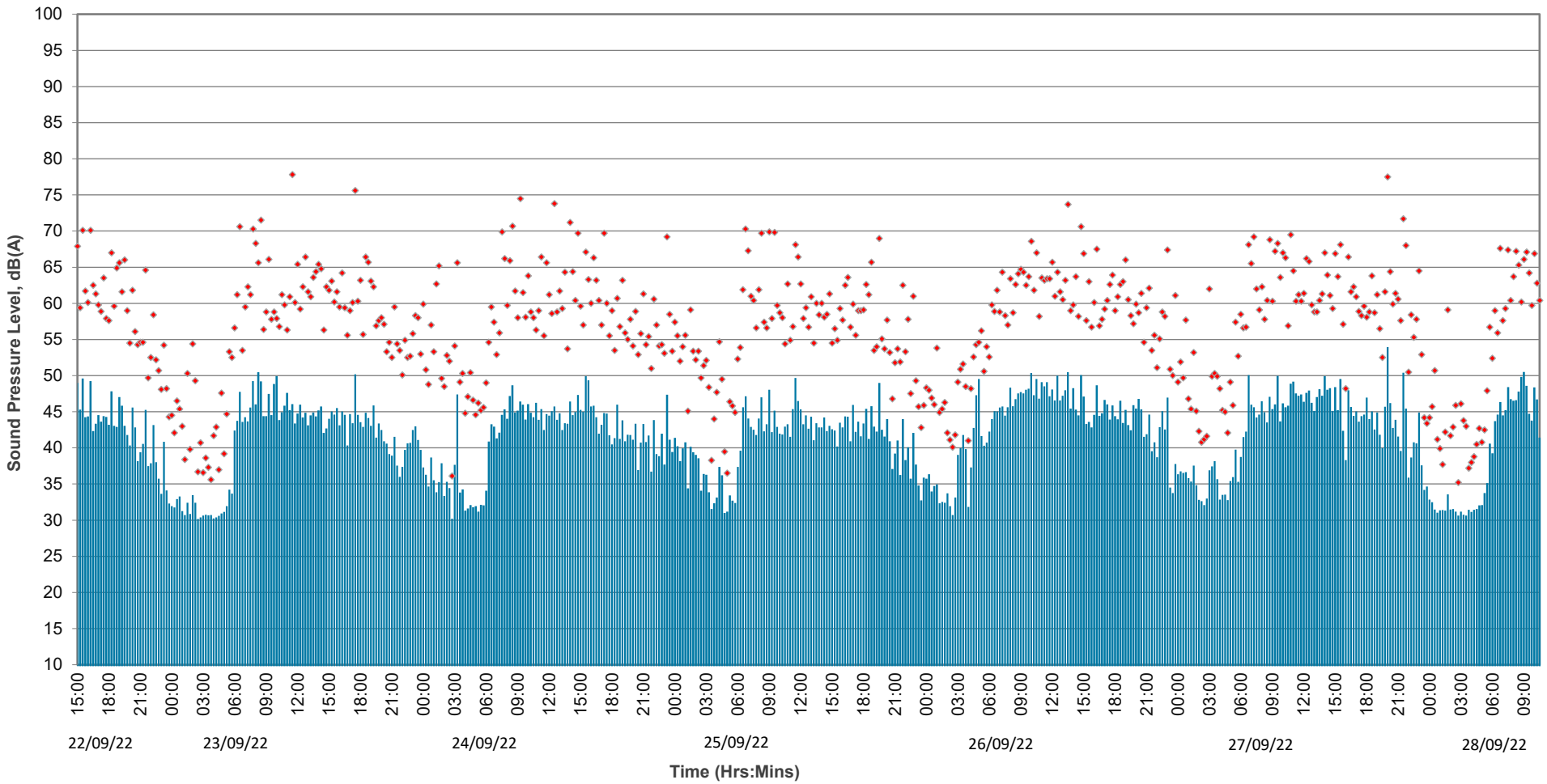
Time History Graph A2

Project:	Land East of Knowle Lane, Cranleigh
Measurement Location:	A2 - Eastern Boundary
Survey Period:	22/09/2022 - 28/09/2022



KEY: $L_{Aeq,15mins}$ $L_{Amax,fast}$

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