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MOLE VALLEY DISTRICT COUNCIL

STRATEGIC M25 NOISE ASSESSMENT PROJECT

ASSESSMENT OF TRAFFIC NOISE

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REVIEW AND AUTHORISATION			
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1. INTRODUCTION

1.1.1 Southdowns Environmental Consultants Ltd was commissioned in September 2016 by Mole Valley District Council (MVDC) to undertake an assessment of noise from road traffic on major roads, within three specified zones adjacent to the M25.

1.1.2 The purpose of the assessment is to identify the extent to which road noise originating from the M25 and adjacent major roads acts as a strategic constraint on development. In particular, MVDC requested identification of areas so significantly impacted by road noise that residential development should be ruled out as a matter of principle and to identify those areas which may be acceptable with mitigation.

1.1.3 The noise levels, policy, guidance and criteria normally adopted for assessments of this kind are summarised in Section 2 of this report. The extent of the study area is detailed in Section 3. The sample noise monitoring data is described in Section 4. The noise modelling procedure is detailed in Section 5, with the modelling results presented in Section 6. Assessment of the results is presented in Section 7 with generic mitigation options outlined in Section 8. The conclusions of this assessment are summarised in Section 9.

1.1.4 The report has been produced by Stuart Berry (MIOA), with support and advice from Matthew Weston (MIOA). Calculations have been prepared by Roger Tompsett of NoiseMap Ltd. (MIOA). Stuart is experienced in the production of noise impact assessments following the methodology provided in BS 8233, undertaking the calculations to produce the assessments, and checking the calculations of other assessments relating to environmental noise.

2. NOISE LEVELS, POLICY AND CRITERIA

2.1 Noise Levels

2.1.1 Sound is measured on a logarithmic scale in decibels (dB) because of the ears' sensitivity to a wide range of pressure changes. The sound pressure level (SPL) of a signal is denoted by the symbol L_p and defined by the equation $L_p = 10 \log (p/p_o)^2$ where p is the root mean square pressure of the signal and p_o is the reference sound pressure (2×10^{-5} Pa).

2.1.2 The human auditory system is capable of detecting sounds over a frequency range of 20 Hz to 20 kHz. Because the ear is most sensitive to sounds with frequencies between 1 and 5 kHz an A-weighting network is used to reflect the differential sensitivity of human hearing to sounds of different frequency. The A-weighting sound pressure level, L_{pA}, is measured on a scale defined by the dB(A).

2.1.3 Community response to environmental noise sources is dependent on both acoustic and non-acoustic factors. The acoustic factors include absolute sound level, changes or exceedances of background or ambient sound levels as well as the characteristics, time, duration and frequency of the noise. National and local planning guidelines for noise assessment are set out below.

2.1.4 The dB(A) level is commonly used for the measurement and assessment of environmental noise due to the relationship between the subjective impression of the auditory strength of a sound, otherwise known as loudness, and the A-weighted sound pressure level of that sound. A change in 3 dB is the minimum perceptible change in event sound levels under normal everyday listening conditions, whilst a 10 dB increase or decrease in the sound pressure level of a steady sound generally corresponds to a perceived doubling or halving of loudness.

2.1.5 An indication of the range of sound pressure levels commonly found in the environment is given below:

Location	L_p dB(A)
Normal threshold of hearing	-10 to 20
Music halls and theatres	20 to 30
Living rooms and offices	30 to 50
Inside motor vehicles	50 to 70
Industrial premises	70 to 100
Burglar alarms at 1 m	100 to 110
Jet aircraft on take-off	110 to 130
Threshold of pain	130 to 140

2.1.6 The $L_{A90,T}$ *background* sound level is defined by the A-weighted sound pressure level of the ambient noise exceeded for 90% of a given time interval, T. This provides a measure of the lower levels of a fluctuating sound and is normally defined separately for day and night-time periods. Other percentiles are also sometimes used to describe the levels of ambient sound exceeded for different periods of time. The $L_{A50,T}$ and $L_{A10,T}$ sound levels denote the level of ambient sound exceeded for 50 and 10% of the time T respectively, whilst the $L_{Amax,F}$ sound level denotes the maximum instantaneous sound level in any given period of time obtained using the FAST time weighting (125 milliseconds).

2.1.7 The equivalent continuous sound pressure level is denoted by the symbol $L_{Aeq,T}$ and is defined as the notional steady sound which, at a given position over a defined period of time, T, has the same A-weighted acoustic energy as the actual fluctuating sound. This average sound level is used in the UK for the measurement of noise from most sources (including industry,

construction, railways and aircraft) and is widely used for the measurement of *ambient* sound, which comprises sound from all sources in the environment.

2.2 National Noise Policy and Planning Policy Framework

Noise Policy Statement for England (NPSE)

2.2.1 The Noise Policy Statement for England (March 2010) [1], sets out the long term vision of Government noise policy.

2.2.2 The vision of the NPSE is to 'Promote good health and a good quality of life through the effective management and control of noise within the context of Government policy on sustainable development'. This vision is supported by three key aims:

- avoid significant adverse impacts on health and quality of life;
- mitigate and reduce to a minimum other adverse impacts on health and quality of life; and
- where possible, contribute to the improvement of health and quality of life.

2.2.3 The NPSE applies to most forms of noise, including environmental noise, neighbour noise and neighbourhood noise, but not occupational noise in the workplace.

2.2.4 The NPSE has adopted the following concepts to help consider whether noise is likely to have a 'significant adverse' or 'adverse' impact on health and quality of life:

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 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.

2.2.5 The NPSE goes on to state 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 Policy Framework

2.2.6 The Government's National Planning Policy Framework (NPPF) came into force in March 2012 [2] and sets out the Government's planning policy for England and how it should be applied. The NPPF replaced a number of planning policy guidance documents, including the now archived Planning Policy Guidance 24: Planning and Noise.

2.2.7 The NPPF defines the Government's planning policy for England and sets out the framework within which local authorities should prepare their local and neighbourhood plans, reflecting the needs and priorities of their communities.

2.2.8 The main references to noise in the NPPF are found in paragraphs 109 and 123, where it states that:

" 109. The planning system should contribute to and enhance the natural and local environment by:…

- *preventing both new and existing development from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of soil, air, water or noise pollution or land instability;…*

123. Planning policies and decisions should aim to:

- *avoid noise from giving rise to significant adverse impacts on health and quality of life as a result of new development;*
- *mitigate and reduce to a minimum other adverse impacts on health and quality of life arising from noise from new development, including through the use of conditions;*
- *recognise that development will often create some noise and existing businesses wanting to develop in continuance of their business should not have unreasonable restrictions put on them because of changes in nearby land uses since they were established; and*
- *identify and protect areas of tranquillity which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason."*

2.2.9 In the preparation of local plans, the NPPF specifies that local planning authorities should:

"set out environmental criteria, in line with the policies in this Framework, against which planning applications will be assessed so as to ensure that permitted operations do not have unacceptable adverse impacts on the natural and historic environment or human health, including from noise, dust, visual intrusion…"

2.3 British Standard 8233

2.3.1 Recommendations for the control of noise in and around buildings are presented in BS 8233:2014 *Guidance on Sound Insulation and Noise Reduction for Buildings* [3]. The Standard suggests appropriate criteria and limits for different situations to guide the design of new or refurbished buildings undergoing a change of use.

2.3.2 Desirable upper noise levels inside residential habitable rooms are specified in the Standard and are reproduced below in Table 2.1.

Activity	Room	Ambient Indoor Noise Level 07:00 to 23:00 hrs, dB $L_{Aeq,16\ hr}$	Ambient Indoor Noise Level 23:00 to 07:00 hrs, dB $L_{Aeq,8\ hr}$
Resting	Living Room	35	-
Dining	Dining room/ area	40	-
Sleeping (daytime resting)	Bedroom	35	30

TABLE 2.1: BS 8233:2014 GUIDELINE INDOOR AMBIENT NOISE LEVELS FOR DWELLINGS

Notes:

1. *The table provides recommended levels for overall noise in the design of a building. These are the sum total of structure-borne and airborne noise sources. Groundborne noise is assessed separately and is not included as part of these targets, as human response to groundborne noise varies with many factors such as level, character, timing, occupant expectation and sensitivity.*
2. *The levels shown 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 levels recommended.*
3. *These levels are based on annual average data and do not have to be achieved in all circumstances. For example, it is normal to exclude occasional events, such as fireworks night or New Year's Eve.*
4. *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.*
5. *If relying on closed windows to meet the guide values, there needs to be an appropriate alternative ventilation strategy that does not compromise the façade insulation or the resulting internal noise level.*
6. *If applicable, any room should have adequate ventilation (e.g. trickle ventilators should be open) during assessment.*
7. *Attention is drawn to the Building Regulations.*
8. *Where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal target levels may be relaxed by up to 5 dB and reasonable internal conditions still achieved.*

2.3.3 BS 8233:2014 states that the guideline values are for "anonymous noise" as occupants are usually more tolerant of noise without a specific character and the guideline values should only be considered for noise without character.

2.3.4 In external amenity spaces, such as private gardens and patios, BS 8233:2014 indicates that it is desirable that the external noise level in these areas does not exceed 50 dB $L_{Aeq,T}$ with an upper guideline value of 55 dB $L_{Aeq,T}$ in noisier environments.

2.4 World Health Organisation, Guidelines for Community Noise

2.4.1 Guideline values for community noise in specific environments are presented in the World Health Organisation (WHO) Guidelines for Community Noise [4] document and the guideline values pertinent to this noise assessment are summarised in Table 2.2.

Specific Environment	Critical Health Effect(s)	dB $L_{Aeq,T}$	Time Base hours	dB $L_{Amax,F}$
Outdoor living area	Serious annoyance, daytime and evening	55	16	-
	Moderate annoyance, daytime and evening	50	16	-
Dwelling indoors	Speech intelligibility and moderate annoyance, daytime and evening	35	16	-
Inside bedrooms	Sleep disturbance, night-time	30	8	45

TABLE 2.2: WHO GUIDELINE NOISE VALUES

2.4.2 The guidelines presented in the World Health Organisation (WHO) document reflect conclusions drawn up after consideration of the most recent international research evidence on the health effects of exposure to noise. The guidelines define the goal of noise management as 'to maintain low noise exposures such that human health and well-being are protected', with 'specific objectives to develop criteria for the maximum safe exposure levels and to promote noise assessment and control as part of environmental health programmes'.

2.4.3 The guideline values presented for outdoor living areas indicate that few people may be moderately or seriously annoyed below the criteria levels of 50 dB $L_{Aeq,T}$ and 55 dB $L_{Aeq,T}$ respectively.

2.4.4 The guideline value of 30 dB $L_{Aeq,8hr}$ inside rooms is the continuous level at which measurable effects on sleep start, in particular for sensitive groups. Sleep disturbance from intermittent noise events increases with the maximum level, $L_{Amax,F}$. Therefore, to avoid sleep disturbance, guidelines for community noise should be expressed in terms of the equivalent sound level of the noise, as well as in terms of maximum noise levels, and the number of noise events.

2.1 Local Authority Noise Criteria

2.1.1 Within tender documentation MVDC has provided the following clarification with regard to the preferred criteria levels to be achieved:

> *"The minimum standard required is that proposals should meet the WHO amenity space standards of the open spaces and the habitable room standards of BS8233 with an open window. Forced ventilation systems should generally be avoided and at the very least minimised in the worst adverse circumstances."*

2.1.2 Where mitigation is required to make development acceptable, the report should indicate suitable design approach(s) for lower and/or higher density residential development within each zone and density.

3. STUDY AREA

3.1 Aim of the Project

3.1.1 The project aim is to identify the extent to which road noise originating from the M25 and adjacent major roads acts as a strategic constraint on development. The Council wished to identify:

- Any areas which are so significantly impacted by road noise that residential development should be ruled out as a matter of principle.
- Where there is an unacceptable level of noise, but it is possible to mitigate noise impact, suggest potential design solutions so that residential development becomes acceptable.

3.2 Study Area

3.2.1 The study covers three zones within the stretch of the M25 in the north of Mole Valley District, between the A245 to Pebble Lane. The section has been divided into three zones. The extent of the study is presented in Figure A1 of Appendix A. The three specific zones of interest are presented in Figure A2 to Figure A4 of Appendix A.

3.2.2 Zone 1 is representative of the topography within a 500m stretch of land to the north west of Leatherhead, east of the A245 and south of the M25. This zone required lower density residential modelling only as defined in section 3.3.

3.2.3 Zone 2 is representative of the topography within a 1.25km stretch of land between Ashtead and Leatherhead, between the northern and southern roundabouts of Junction 9. Higher and lower density residential options were considered for modelling in this zone.

3.2.4 Zone 3 is representative of the topography within a 1.2km stretch of land south east of the A24/A243 roundabout, taking in land between Leatherhead and Ashtead. This zone required the modelling of lower density residential development only.

3.3 Higher and Lower Density Development Definitions

3.3.1 The MVDC noise brief defines lower density development as follows:

- development at a density not exceeding 30 dwellings per hectare;
- housing aimed at families, including gardens and of a character appropriate to a suburban area;
- maximum two storeys; and
- no flats.

3.3.2 The MVDC noise brief defines higher density development as follows:

- development at a density of between 30-50 dwellings per hectare;
- housing of mixed sizes, but including smaller dwellings of one or two bedrooms;
- maximum of three storeys; and
- Can include flats.

3.3.3 MVDC supplied sample higher and lower density developments to be adopted for the strategic assessment, based on housing layouts which have historically been approved in the vicinity of the study area.

3.3.4 The acoustic benefit afforded by barriers of varying heights was also considered within the strategic assessment. The barrier locations considered are presented in Figure A5 of Appendix A.

4. SAMPLE NOISE MONITORING

4.1 Attended Noise Monitoring Survey

4.1.1 An attended noise survey was conducted on 21st September 2016 at sample locations of the study area in order to obtain sample noise measurements to understand the variation in noise levels arising from the M25 and provide validation to the noise model.

4.1.2 Attended short measurements were obtained at nine locations, labelled as ST1 to ST9 on Figure A6 to Figure A8.

4.1.3 The attended measurements were obtained using a Rion NL-52 precision integrating sound level meter fitted with a windshield.

4.1.4 The attended noise measurements were obtained using the 'F' time weighting and A-weighting frequency network.

4.1.5 The sound level meter was calibrated before and after the survey period using a Rion NC-74 Class 1 Acoustic Calibrator to generate a calibration level of 94.0 dB at 1 kHz. No drift in calibration was observed during the survey.

4.1.6 All measurements were obtained in free-field conditions with the microphone positioned c. 1.2 m above local ground.

4.1.7 Continuous 5 minute $L_{Amax,F}$, $L_{Aeq,T}$ and $L_{A90,T,}$ sound levels were measured at each of the attended monitoring locations.

4.1.8 During the survey the weather conditions were calm and clear. Mean measured wind speeds remained below 1 ms^{-1} with the temperature measured to be 20°c and a relatively humidity of 65%.

4.2 Measurement Results

4.2.1 A summary of the results of the noise monitoring survey are presented in Table 4.1. The full measurement results, as well as notes on the position and barrier observations, is presented in Table B1 of Appendix B.

Measurement Zone	Location ID	Measured Free-Field Sound Pressure Level, dB re. 2 x 10^{-5} Pa.		
		$L_{Aeq, 15min}$	$L_{Amax,F}$	$L_{A90,15min}$
Zone 3	ST1	61.5	77.0	60.2
	ST2	66.6	77.3	64.9
	ST3	81.6	85.6	79.2
	ST4	65.6	69.3	64.2
Zone 2	ST5	58.3	63.6	56.9
	ST6	59.3	73.8	57.0
	ST7	77.0	82.8	75.3
Zone 1	ST8	68.1	71.2	66.7
	ST9	70.1	84.5	62.1

TABLE 4.1: ATTENDED NOISE MONITORING RESULTS

5. NOISE MODELLING PROCEDURE

5.1 Overview

5.1.1 Road traffic data for the M25 and adjacent major roads has been provided by MVDC for use in the noise model. A summary of the data provided is presented in Table B2 of Appendix B.

5.1.2 A three dimensional NoiseMap model was built using a Digital Terrain Model (DTM) to create a ground model into which road alignments were imported. Noise barriers were entered manually, locations being taken from the measurement location report, but then refined by reference to Google Maps.

5.1.3 Traffic flows were taken from the traffic count datasets provided, which refer to the 18-hour Annual Average Weekday Traffic as required by Calculation of Road Traffic Noise [5] (CRTN). Speeds were taken as the 'Prescribed Speeds' from CRTN.

5.1.4 NoiseMap calculates the L_{A10} (18-hour) level with other parameters such as the $L_{Aeq16hour}$ and $L_{Aeq8hour}$ are computed from this.

5.1.5 Calculation receptors have been defined for selected locations indicative of varying positions across each zone. Calculation receptor locations are presented in Figure A9 to Figure A12 for Zones 1 – 3.

5.2 Calculation Assumptions

5.2.1 Road traffic noise levels have been calculated using the methodology presented in CRTN.

5.2.2 Road traffic counts have been provided by MVDC. The existing traffic flows associated with the road section of road are presented in Table B2.

5.2.3 The traffic flows have been incorporated into a NoiseMap Five noise calculation model. This software enables the calculation of road traffic noise levels to the CRTN methodology, as well as presentation of noise contour plots.

5.3 Calculation Scenarios

5.3.1 For Zones 1-3 a baseline scenario of the existing zones has been calculated without the inclusion of any development or mitigation.

5.3.2 Typical lower and higher density development layouts have been modelled in order to understand the propagation of noise with the influence from the layout. The adopted layouts for the lower and higher density developments have been provided by MVDC.

5.3.3 The development layouts have been positioned across each site in a manner that best employs any potential screening benefit from properties within the development. In the case of Zone 1, property blocks were relocated to increase the barrier effect from properties closest to the road in order to screen noise from those further back.

5.3.4 A modified barrier layout has been assumed to best understand the possible benefit of any additional mitigation. The barriers have been extended to a layout agreed with MVDC. The new layout has then been calculated for barriers of 2m, 3m and 4m in height. The agreed barrier layout is presented in Figure A5 of Appendix A.

6. NOISE MODELLING RESULTS

6.1 Contour Plots

6.1.1 Noise contour plots have been generated for daytime and night-time $L_{Aeq,T}$ noise levels across each zone in the scope of this survey. For the existing zone layouts, i.e. without development, contour plots have been generated for ground floor height (1.5 m). Lower density contour plots have been calculated at 1.5 m and 4 m heights to represent ground and first floor levels. The higher density plot for zone 2 has been calculated at heights of 1.5 m, 4 m and 6.5 m heights to represent ground, first and second floor levels.

6.1.2 The contour plots are presented in Figures A13 to A90 of Appendix A.

6.2 Noise Model Calculation Results

6.2.1 To illustrate calculated road noise levels 24 receptors have been positioned across each site. A full list of the results of the noise model calculations for each receptor are presented in Table B3 to Table B6 of Appendix B.

6.2.2 As part of the BS 8233 assessment internal noise levels have been calculated assuming a reduction of 33 dB in the free-field noise level with windows closed and 15 dB reduction in the free-field level with windows partially open. The resulting noise levels with windows partially open are presented in Table B7 to Table B10 of Appendix B. The noise levels with windows closed are presented in Table B11 to Table B14.

6.2.3 Using the noise levels measured during the attended survey an estimated difference between $L_{Aeq,T}$ and $L_{Amax,F}$ levels has been derived. The difference at each short term attended monitoring location has been applied across each site using the most representative monitoring location to obtain a level difference. The resulting noise levels are presented in Table B15 to Table B18 of Appendix B.

7. ASSESSMENT

7.1 Zone 1

Low Density Development

7.1.1 With windows partially open, the calculated noise levels across Zone 1 show little acoustic benefit from the addition of barriers in comparison to the existing barrier arrangements. There is no change in assessment across all scenarios with windows partially open.

7.1.2 With windows partially open, BS 8233 noise criteria is not achieved at any of the receivers considered during night-time periods. During daytime periods, in the vast majority of cases, either the living room, dining area or bedroom BS 8233 noise criteria is not achieved.

7.1.3 With closed windows, properties tend to achieve the daytime and night-time BS 8233 noise criteria with the exception of those properties closest to and facing towards the motorway. The introduction of 3 and 4 meter barriers allows some failing properties to meet the BS 8233 noise criteria, but not at all upper floor levels.

7.1.4 With windows closed all facades that do not directly overlook the motorway meet the BS 8233 resting, dining and sleeping criteria for daytime and night-time periods.

7.1.5 At approximately 100m from the M25 calculated external amenity noise levels achieve the upper guideline value of 55 dB $L_{Aeq,T}$. Whilst these are above the desirable guideline value of 50 dB $L_{Aeq,T}$ BS 8233 advises that for noisier environments the 55 dB $L_{Aeq,T}$ is acceptable. It is also noted that BS 8233 states:

> *"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."*

7.1.6 It is noted that there is an acoustic shadow from many of the buildings, including to the rear of buildings that directly overlook the motorway. This could be used to provide screened areas, following sufficient consideration in the design phase.

7.2 Zone 2

Low Density Development

7.2.1 With windows partially open calculated internal noise levels do not achieve the BS 8233 night-time noise criteria at any of the receptor locations considered. The adoption of additional noise barriers does not reduce noise levels to the extent that the night-time criterion is achieved.

7.2.2 During daytime periods, with windows partially open, none of the receptor locations considered achieves the living room or bedroom noise criteria of 35 dB $L_{Aeq,16\ hour}$. Only those receptors most distant from the M25 achieve dining area noise criterion of 40 dB $L_{Aeq,16\ hour}$. The introduction of noise barriers does not alter any of the assessment findings.

7.2.3 With windows closed those properties closest to and facing the M25 and A243 generally do not achieve the BS 8233 night-time noise criterion level of 30 dB $L_{Aeq,8hour}$, however, those properties facing away from the road noise sources tend to achieve the criterion. The

introduction of noise barriers does provide some assessment improvement but only at ground and first floor levels.

7.2.4 As with the night-time assessment those properties closest to and facing the road traffic noise sources tend to fail either the 35 of 40 dB $L_{Aeq,16hour}$ daytime criterion noised levels, whilst those on the sheltered sides of the buildings do achieve the daytime BS8233 noise criteria. The use of noise barriers does allow some ground and first floor receptors facing the road noise sources to achieve the daytime BS8233 noise criteria.

7.2.5 For the southern side of the lower density development within zone 2 there are few areas that achieve the upper guideline BS 8233 value of 55 dB $L_{Aeq,T.}$ The areas that meet the upper guideline value are those that are screened by modelled buildings.

7.2.6 To the north of the site the screening benefit from the modelled layout results in the upper guideline value being achieved at distances of at least 100 m from the motorway.

High Density Development

7.2.7 With windows partially open calculated internal noise levels do not achieve the BS 8233 night-time noise criteria level of 30 dB $L_{Aeq,8hours}$ at any of the receptor locations considered. The adoption of additional noise barriers does not reduce noise levels to the extent that the night-time criterion is achieved.

7.2.8 During daytime periods with windows partially open the majority of receptor locations considered no not achieve the living room or bedroom noise criteria of 35 dB $L_{Aeq,16\ hour}$. Only a single receptor achieved both the 35 and 40 dB $L_{Aeq,16}$ noise criterion. This receptor location was on the sheltered side of a modelled building. The introduction of noise barriers does not alter any of the assessment findings.

7.2.9 Generally, with windows closed the properties closest to and facing the M25 and A243 road traffic noise sources fail to achieve both the night-time criterion noise level of 30 dB $L_{Aeq,8hours}$ and the daytime noise criteria levels of 35 and 40 dB $L_{Aeq,16hours}$. The use of noise barriers does provide sufficient noise attenuation at some ground and first floor receptor locations for them to move from a fail to a pass, however, 2nd floor receptors do not gain sufficient benefit.

7.2.10 Similar to the lower density development the BS 8233 upper guideline value for external amenity areas is achieved in few locations in the higher density model within the south of zone 2 and at locations over 100 m north of the M25, where screening benefit from the proposed layout can be employed.

7.3 Zone 3

Low Density Development

7.3.1 With windows partially open calculated internal noise levels do not achieve the BS 8233 night-time noise criterion at any of the receptor locations considered. The adoption of additional noise barriers does not reduce noise levels to the extent that the night-time criterion is achieved.

7.3.2 During daytime periods with windows partially open none of the receptor locations achieves the living room or bedroom noise criteria of 35 dB $L_{Aeq,16\ hour}$. Only those receptors facing away from the M25 noise source achieve the living room and bedroom resting criterion level of 40 dB $L_{Aeq,16}$. The introduction of noise barriers does not sufficiently attenuate road traffic noise to the extent that the living and bedroom noise criteria of 35 dB $L_{Aeq,16\ hour}$ is met.

7.3.3 With windows closed those properties closest to and facing the M25 and A243 generally do not achieve the BS 8233 night-time noise criterion level of 30 dB $L_{Aeq,8hour}$, however, those

properties facing away from the road noise sources tend to achieve the criterion. The introduction of noise barriers does provide some assessment improvement but only at some ground and first floor levels.

7.3.4 Those properties closest to and facing the road traffic noise sources tend to fail either the 35 or 40 dB $L_{Aeq,16hour}$ daytime criterion noised levels, whilst those on the sheltered sides of the buildings do achieve the daytime BS 8233 noise criteria. The use of noise barriers does allow some ground and first floor receptors facing the road noise sources to achieve the daytime BS8233 noise criteria.

7.3.5 Across zone 3 the extension to the existing barriers offers the most benefit to the southern area of the site, with the central area achieving approximately 5 dB reduction with the introduction of the barrier.

7.3.6 For properties on the southern side of the development within zone 3 the upper guideline BS 8233 value for amenity areas of 55 dB $L_{Aeq,T}$ is met at properties at least approximately 70m from the M25.

7.3.7 To the north of the site the modelled layout results in the upper guideline value being achieved at distances of at least 100 m from the motorway.

7.4 World Health Organisation

7.4.1 WHO guideline noise criteria indicate an internal sleep disturbance noise limit of 45 dB $L_{Amax,F}$ for the onset of critical health effects.

7.4.2 BS 8233:2014 suggests a -33 dB correction can be applied from free-field outdoor to indoor noise levels assuming that windows are closed and -15 dB can be applied for a partially open window.

7.4.3 Using the derived $L_{Amax,F}$ noise levels for each zone the WHO sleep disturbance limit has been considered.

7.4.4 Maximum night-time $L_{Amax,F}$ noise levels representative of the modelled road traffic, with an assumed sound reduction of 15 dB R_w due to partially open windows, are presented in Table B19 to Table B22 of Appendix B.

7.4.5 Maximum night-time $L_{Amax,F}$ noise levels assuming a sound reduction of 33 dB R_w due to closed windows are presented in Table B23 to Table B26 of Appendix B.

7.4.6 Across zone 1 properties closest to and those facing the M25 fail to achieve the WHO guideline noise level of 45 dB $L_{Amax,F}$ criterion noised level with partially open windows. The use of noise barriers allows for only one of the failing receptors to meet the criteria and only with an increase to 4m in height.

7.4.7 For both lower and higher density developments, with partially open windows, maximum night-time $L_{Amax,F}$ noise levels across the majority of Zone 2 do not achieve the WHO sleep disturbance noise criteria. The introduction of additional noise barriers does not show any change in assessment across zone 2.

7.4.8 Calculated $L_{Amax,F}$ noise levels across zone 3 do not meet the WHO guideline noise criteria of 45 dB $L_{Amax,F}$ at the majority of the properties considered. Addition of noise barriers reduces calculated noise levels to meet the criteria at few receptors with no benefit from increasing the height of these.

7.4.9 Maximum night-time $L_{Amax,F}$ noise levels representative of the modelled road traffic, with an assumed sound reduction of 33 dB R_w due to closed windows, achieve the WHO sleep

disturbance noise limit at all zones for both higher and lower density layouts with the exception of just two of the receptors considered.

8. GENERIC NOISE MITIGATION OPTIONS

8.1.1 The results of the assessment show that with windows partially open, the majority of the development does not achieve the BS 8233 desirable guideline levels for internal noise levels in habitable rooms.

8.1.2 The noise calculations indicate that with closed windows (with an assumed 33 dB Rw façade reduction) internal noise levels, across the whole development, for facades that do not overlook the M25 or a major road, achieve BS 8233:2014 desirable guideline noise levels for dining rooms / areas, living rooms and bedrooms. Windows are therefore required to remain closed to achieve acceptable guideline levels. Alternative ventilation provision may need to be considered to ensure adequate air flow, whilst achieving BS 8233 internal guideline noise criteria.

8.1.3 Such ventilation options may include:

- trickle vents installed in the window;
- acoustics air bricks installed in the façade; and/or
- passive or mechanical silenced ventilation (whole house or individual).

8.1.4 Any selected ventilation system for habitable rooms would need to have sufficient sound insulation performance so that it does not compromise the internal noise environment inside the living rooms, dining rooms and bedrooms.

8.1.5 For those properties closest to and facing M25 and other major road noise sources which do not achieve BS 8233 noise criterion levels, enhanced glazing systems with greater dB Rw values may be considered.

8.1.6 Additionally, internal property layouts could be configured such that bedrooms, which are more sensitive and susceptible to noise, should be orientated away from the major road traffic noise sources.

8.1.7 The calculated receiver noise levels show little acoustic benefit due to an increase of the considered barriers. Whilst barriers in excess of 4 m may provide some additional benefit there may be structural or planning limitations to barriers of such height which could require consideration.

8.1.8 For all boundaries overlooking the M25 or a major road, additional barriers could be considered. Acoustic fencing or bunds could also be located along the boundary in order to further mitigate noise levels.

8.1.9 Review of the noise contour plots indicates that potential development properties generate “acoustic shadows” and produce acoustic benefit to properties and open areas centrally located within the development which are more remote from the major road noise sources.

8.1.10 The design and layout of a development should be designed to benefit from these acoustic shadows, with properties bordering the M25 positioned to create a near continuous façade.

8.1.11 Given that the noise levels reduce as distance from the road traffic noise sources increases the introduction of larger “buffer” zones between roads and development boundaries may be considered.

8.1.12 With regard to specifying mitigation it is recommended that further noise assessment calculations be made for consideration of any proposed development. It is also recommended that mitigation such as ventilation options and noise barriers be specified.

8.1.13 Based on the observed screening benefit of the modelled layouts it is deemed suitable that the design of any potential development could employ ‘courtyard’ areas in order to create enclosed amenity areas that might achieve the upper guideline noise level of 55 dB $L_{Aeq,T}$. In order to understand the benefit of ‘courtyard’ type layouts it is advised that further modelling be undertaken following, or in accordance with, the design phase of a proposed development.

8.1.14 Similarly, future developments may benefit from incorporating long façades and/or dedicated barriers in order to provide a screened area that could be used as a designated amenity area. It is again considered prudent that further calculations are undertaken in order to further understand the potential benefit of such design choices.

9. SUMMARY

9.1.1 Southdowns Environmental Consultants Ltd has undertaken an assessment to consider the potential for noise impact from road traffic on major roads on future developments that may be permissible on land surrounding a section of the M25 in Leatherhead, Surrey.

9.1.2 Attended sample noise measurements have been obtained in order to understand the existing sound levels across the section and to understand the variation between differing locations, for noise model validation.

9.1.3 A computer noise model has been generated and used to calculate road traffic noise levels for low density and high density developments. Typical high and low density layouts have been based on information provided by MVDC.

9.1.4 The layout of existing noise barriers along the M25 has been modelled based on site observations and online sources. Extensions to the existing barrier layout have been considered in order to assess the acoustical benefits of additional barriers of varying heights.

9.1.5 Based on typical façade reductions, noise calculations show that internal noise levels across the development generally do not achieve the BS 8233 criteria for daytime resting and dining areas with windows partially open.

9.1.6 Assuming a sound reduction of 15 dB Rw for windows partially open internal noise levels are not calculated to achieve the night-time criteria for bedrooms across all sites.

9.1.7 Generally, with conventional thermally glazed windows closed those properties closest to and facing the major road traffic noise sources do not achieve the daytime or night time criterion noise levels. This group of properties should therefore have internal layouts which avoid bedrooms in these facades or adopt enhanced glazing specifications.

9.1.8 The WHO night-time sleep disturbance criterion of 45 dB $L_{Amax,F}$ is generally not achieved with windows partially open across the three potential development zones. However, with closed thermally glazed windows the criterion of 45 dB $L_{Amax,F}$ is achieved with the exception of some properties closest to and overlooking the main road traffic noise sources. This group of properties should therefore have internal layouts which avoid bedrooms in these facades or adopt enhanced glazing specifications.

9.1.9 Generally, use of the barrier arrangements and heights considered to mitigate criteria exceedances is only effective in a relatively small proportion of the receptors considered and would need to be used in conjunction with other mitigation methods to achieve all the noise criteria considered.

9.1.10 Several examples of generic noise mitigation options have been provided for any dwelling where alternative forms of ventilation are required. These options ensure adequate air flow, whilst maintaining a desirable noise environment.

9.1.11 The design of a proposed development can be considered to allow for ‘courtyard’ areas and dedicated amenity areas that are deliberately positioned with the aim to provide specific areas of lower noise levels. It is advised that for any proposed development that further calculations are undertaken in order to understand any potential benefit from such layouts.

10. REFERENCES

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

2. Department for Communities and Local Government (2012). *National Planning Policy Framework*. London: House of Commons.

3. British Standards Institution (2014). *BS 8233:2014. Guidance on Sound Insulation and Noise Reduction for Buildings*. 2014. Standards Policy and Strategy Committee.

4. World Health Organization (1999). *Guidelines for Community Noise*. World Health Organization.

5. Department for Transport (1988). *Calculation of Road Traffic Noise*. Department for Transport, HMSO, London.