M·EC
ACOUSTIC AIR

LAND OFF HOWLETT WAY, TRIMLEY ST MARTIN

NOISE & AIR QUALITY ASSESSMENT

JANUARY 2020

REPORT REF: 23637/10-18/6375 REV D






Noise, Vibration, Air Quality and Odour

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CLIENT: Trinity College Cambridge

ENGINEER: Mewies Engineering Consultants Ltd
The Old Chapel
Station Road
Hugglescote
Leicestershire
LE67 2GB

Tel: 01530 264 753
Email group@m-ec.co.uk

Report Prepared By:

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Neil S Forsdyke
Senior Noise & Air Quality Consultant

Report Checked By:

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Dr Michael Forsdyke BSc MSc PhD

REGISTRATION OF AMENDMENTS

REV	COMMENTS AND CHANGES
First Issue Oct 2018	Final issue for Planning
A Dec 2019	Updated Site Layout Plan
B Dec 2019	Addressing Client's Comments
C Dec 2019	Updated Site Layout Plan
D Jan 2020	Updated Site Layout Plan

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APPENDICES

1.0 INTRODUCTION

1.1 Mewies Engineering Consultants Ltd (M-EC AcousticAir) has been commissioned by Trinity College Cambridge, to prepare a noise and air quality assessment for a proposed residential development on land off Howlett Way, Trimley St Martin.

Assessment Scope

1.2 This report will have regard to the Government's latest planning policy guidance, i.e. the National Planning Policy Framework (NPPF) and the latest Professional Practice Guidance on Planning & Noise (ProPG), prepared jointly by the Association of Noise Consultants (ANC), the Institute of Acoustics (IOA) and the Chartered Institute of Environmental Health (CIEH), which seeks to secure good acoustic design for new residential development within England's planning system. The need for specific noise mitigation measures will be determined against relevant guidance such as BS8233:2014 'Guidance on sound insulation and noise reduction for buildings' and the World Health Organisation guidelines.

1.3 The need for an air quality assessment will be evaluated in accordance with Land-Use Planning and Development Control: Planning for Air Quality, 'Guidance from Environmental Protection UK and the Institute of Air Quality Management for the consideration of air quality within the land-use planning and development control processes', May 2015.

1.4 Due to the presence of significant road traffic corridors along three sides of the site, the air quality impacts due to traffic generated by development have been assessed by dispersion modelling.

1.5 A site description is provided in Section 2 of this report. Section 3 of this report provides details of relevant national guidance on traffic noise, which is the principal source of noise affecting the site. Section 4 presents the results of the noise surveys undertaken for the site, and the assessment of noise on the proposed residential development is considered in Section 5 together with our recommendations for mitigation.

1.6 Air quality standards are summarised in Section 6 of this report, and the methodology for the air quality assessment is presented in Section 7. The air quality results and assessment for the proposed development, i.e. taking account of traffic generated by development, is presented in Section 8, and our conclusions for both noise and air quality are presented in Section 9.

1.7 M-EC has completed this report for the benefit of the individuals referred to in paragraph 1.1 and any relevant statutory authority which may require reference in relation to approvals for the proposed development. Other third parties should not use or rely upon the contents of this report unless explicit written approval has been gained from M-EC.

1.8 M-EC accepts no responsibility or liability for:

a) The consequence of this documentation being used for any purpose or project other than that for which it was commissioned;
b) The issue of this document to any third party with whom approval for use has not been agreed.

2.0 SITE DESCRIPTION

Existing Site

2.1 The site is located on land off Howlett Way, Trimley St Martin. The principal sources of emissions affecting the site will be road traffic using the A14 to the east, along with its junction to Howlett Way, and Howlett Way itself that runs adjacent to the northern boundary of the site, and the junction between Howlett Way and the High Road at the northwest corner of the site.

2.2 A site location plan is included in Appendix A, and an illustrative site layout plan is included in Appendix B.

2.3 Development proposals are for approximately 340 residential dwellings subject to final design.

3.0 NOISE CRITERIA

Noise Terms and Units

3.1 Noise levels are measured and assessed using the decibel scale (dB), which provides a measure of the air pressure changes due to vibrating sources such as vehicle engines or machinery. Due to the vast range of air pressures that the human ear is capable of detecting, the decibel measurement uses a logarithmic scale that compresses the data into a more manageable scale for assessment purposes. A detailed explanation of the derivation of the decibel scale is presented in Appendix C.

3.2 Due to the logarithmic nature of the dB scale, the addition of two or more noise levels has to be done logarithmically rather than arithmetically. For example, two equal sound sources each producing 50 dB, when operated simultaneously, do not result in a noise level of 100 dB but instead produce a combined level of 53 dB, i.e. a rise of 3 dB for each doubling of sound energy. Subjectively, a 3 dB change does not represent a doubling or halving of loudness; to make a sound appear twice or half as loud requires a change of 10 dB.

3.3 The subjective loudness of noise can be measured by applying a filter or weighting that equates to the frequency response of the human ear. This is referred to as an A-weighting and when applied results in noise levels expressed as dB(A). dB(A) noise levels reflect the human perception of loudness.

National Planning Policy Framework

3.4 The latest National Planning Policy Framework (NPPF), issued by the Ministry of Housing, Communities and Local Government in July 2018, sets out the Government's planning policies for England and how these are to be expected to be applied. The NPPF must be taken into account in the preparation of local and neighbourhood plans, and is to be a material consideration in planning decisions.

3.5 Paragraph 170 of the NPPF advises that, with respect to noise, planning policies and decisions should contribute to and enhance the natural and local environment by *"...preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution ..."*.

3.6 Further, paragraph 180 advises that "Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:

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; and

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.

3.7 The NPPF's footnote to point a) above explicitly refers to the Explanatory Note to the *Noise Policy Statement for England* (Department for Environment, Food & Rural Affairs, 2010).

Noise Policy Statement for England

3.8 The guidance of the Noise Policy Statement for England (NPSE) applies to all forms of noise including environmental noise, neighbour noise and neighbourhood noise, but does not apply to noise in the workplace (occupational noise). It introduces the concepts of 'No Observed Effect Level' (NOEL), which is the level below which there is no detectable effect on health and quality of life due to the noise; the 'Lowest Observed Adverse Effect Level' (LOAEL), which is the level above which adverse effects on health and quality of life can be detected; and the 'Significant Observed Adverse Effect Level' (SOAEL), which is the level above which significant adverse effects on health and quality of life occur.

3.9 In March 2014 the Department for Communities & Local Government updated its on-line planning guidance to assist with interpretation of the original NPPF and the NPSE. The guidance covers general matters such as relevance of noise issues, noise concerns and factors, how to determine impacts, and mitigation. To assist with recognising when noise could be a concern, the guidance summarises the noise exposure hierarchy as follows, based on the likely average response.

Table 1: Noise Exposure Hierarchy Based on Likely Average Response

Perception	Examples of Outcomes	Increasing Effect Level	Action
Not noticeable	No Effect	No Observed Effect	No specific measures required
Noticeable and not	Noise can be heard, but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a	No Observed Adverse Effect	No specific measures required

intrusive	perceived change in the quality of life.		
Lowest Observed Adverse Effect Level			
Noticeable and intrusive	Noise can be heard and causes small changes in behaviour and/or attitude, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
Significant Observed Adverse Effect Level			
Noticeable and disruptive	The noise causes a material change in behaviour and/or attitude, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.	Significant Observed Adverse Effect	Avoid
Noticeable and very disruptive	Extensive and regular changes in behaviour and/or an inability to mitigate effect of noise leading to psychological stress or physiological effects, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory	Unacceptable Adverse Effect	Prevent

BS8233:2014 'Guidance on sound insulation and noise reduction for buildings'

3.10 For steady external noise sources, BS8233:2014 states that it is generally desirable that the internal ambient noise level does not exceed the guideline values in Table 2.

Table 2: Indoor ambient noise levels for dwellings

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

NOTE 1 *Table 2 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.*

NOTE 2 *The levels shown in Table 2 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 in Table 2.*

NOTE 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 Years Eve.*

NOTE 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 $L_{Amax,P}$ depending on the character and number of events per night. Sporadic noise events could require separate values.*

NOTE 5 *If relying on closed windows to meet the guide values, there needs to be an appropriate alternative ventilation that does not compromise the façade insulation or the resulting noise level.*

NOTE 6 *Attention is drawn to the building regulations (30, 31, 32).*

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

3.11 For traditional external areas that are used for amenity space, such as gardens and patios, the BS says it is desirable that "*the external noise does not exceed 50 dB $L_{Aeq,T}$, with an upper guideline value of 55dB $L_{Aeq,T}$.*"

3.12 However, due to the nationwide difficulty in satisfying an external noise criterion of 55 dB $L_{Aeq,T}$ in urban areas where transportation noise is prevalent, the BS provides an over-arching consideration of how to treat outdoor garden areas in the following way:

... 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.

Other locations, such as balconies, roof gardens and terraces, are also important in residential buildings where normal external amenity space might be limited or not available, i.e. in flats, apartment blocks, etc. In these locations, specification of noise limits is not necessarily appropriate. Small balconies may be included for uses such as drying washing or growing pot plants, and noise limits should not be necessary for these uses.

World Health Organisation Guidelines

3.13 The noise guidance from the World Health Organisation (Community Noise, WHO Vol. 2, Issue 1, 1995, and Guidelines for Community Noise, 2000) is that in order to avoid sleep disturbance the period noise level (L_{Aeq}) should not exceed 30 dB internally and individual noise events should not normally exceed 45 dB L_{Amax}. To preserve speech intelligibility during the daytime and evening, the recommended internal noise level for living rooms is 35 dB $L_{Aeq,T}$. These L_{Aeq} values are consistent with the latest guidance of BS8233.

3.14 The WHO noise criteria for dwellings are summarised in Table 3 together with the desirable noise levels for outdoor living areas, which are likewise equal to those referenced in BS8233.

Table 3: WHO Guideline Noise Levels for Dwellings

Location	Critical Health Effect(s)	L_{Aeq} dB	Time base	L_{Amax} fast dB
Outdoor living area	Serious annoyance, daytime and evening	55	16 hours	-
	Moderate annoyance, daytime and evening	50	16 hours	-
Dwelling, indoors	Speech intelligibility & moderate annoyance, daytime & evening	35	16 hours	
Inside bedrooms	Sleep disturbance, night-time	30	8 hours	45
Outside bedrooms	Sleep disturbance, window open (outdoor values)	45	8 hours	60

3.15 Section 3.4 of the WHO Guidelines states that for good sleep, indoor noise levels should not exceed approximately 45 dB L_{Amax} more than 10-15 times/night. On the basis of the WHO's 15 dB façade insulation for windows partly open, this equates to external L_{Amax} of 60 dB that should not be exceeded more than 10-15 times/night.

3.16 As for the comments in BS8233 relating to the ability to achieve the outdoor noise criterion in many locations, in considering the application of an outdoor criterion of 55 dB L_{Aeq} or less, it is again important to take account of the feasibility of achieving such a level. A review of 'Health effect-based noise assessment methods: A review and feasibility study' (NPL Report CMAM 16, 1998) reported the following:

"Perhaps the main weaknesses of both WHO-inspired documents is that they fail to consider the practicality of actually being able to achieve any of the stated guideline values. ...... We know from the most recent national survey of noise exposure carried out in England and Wales (Sargent 93) that around 56% of the population are exposed to daytime noise levels exceeding 55 L_{Aeq} and that around 65% are exposed to night-time noise levels exceeding 45 L_{Aeq} (as measured outside the house in each case). ..... The percentages exposed above the WHO guideline values could not be significantly reduced without drastic action to virtually eliminate road traffic noise and other forms of transportation noise (including public transport) from the vicinity of houses. The social and economic consequences of such action would be likely to be far greater than any environmental advantages of reducing the proportion of the population

annoyed by noise. In addition, there is no evidence that anything other than a small minority of the population exposed at such noise levels find them to be particularly onerous in the context of their daily lives."

3.17 The latest WHO guidelines (Night Noise Guidelines for Europe, 2009) are applicable to Member States of the European Region and represent an extension to, as well as an update of, the previous WHO Guidelines for Community Noise. Based on the scientific evidence on thresholds of night noise exposure indicated by $L_{night,outside}$ as defined in the Environmental Noise Directive (2002/49/EC), the latest WHO guidance recommends an $L_{night,outside}$ of 40 dB as a target for the night noise guideline (NNG) to protect the public, including the most vulnerable groups such as children, the chronically ill and the elderly. An $L_{night,outside}$ value of 55 dB is recommended as an interim target for countries where the NNG cannot be achieved in the short term for various reasons, and where policy-makers choose to adopt a stepwise approach.

3.18 The $L_{night,outside}$ is the A-weighted long-term average sound level determined over all nights of the year, where the night is the 8-hour period between 2300-0700 hours. The target noise level excludes sound reflected from a building façade, therefore, a 3 dB façade correction must also be allowed in the case of measurements or predictions at building facades. The receptor height is typically 3.8 to 4.2m above ground level, i.e. as applicable first floor bedrooms, but in the case of rural areas with single storey dwellings a height of not less than 1.5m is applicable.

Professional Practice Guidance on Planning & Noise, New Residential Development, May 2017

3.19 The Professional Practice Guidance on Planning & Noise (ProPG), prepared jointly by the Association of Noise Consultants (ANC), the Institute of Acoustics (IOA) and the Chartered Institute of Environmental Health (CIEH), seeks to secure good acoustic design for new residential development within England's planning system.

3.20 The guidance includes a framework to enable situations where noise is not an issue to be clearly determined, and to help identify the extent of risk at noisier sites. However, the guidance does not constitute an official government code of practice and neither replaces nor provides an authoritative interpretation of the law or government policy.

3.21 The scope of the guidance is also restricted to sites that are exposed predominantly to noise from transportation sources. Where industrial or commercial noise is present on the site but is "not dominant", its contribution may be included in the noise level used to establish the degree of risk. Where industrial or commercial noise is present on the site and is considered to be "dominant", then the risk assessment should not be applied to the industrial or commercial noise component and regard should be had to the guidance in BS4142:2014.

3.22 The ProPG advocates a 2-stage approach covering:

- Stage 1 – an initial noise risk assessment of the proposed development site;
- Stage 2 – a systematic consideration of four key elements.

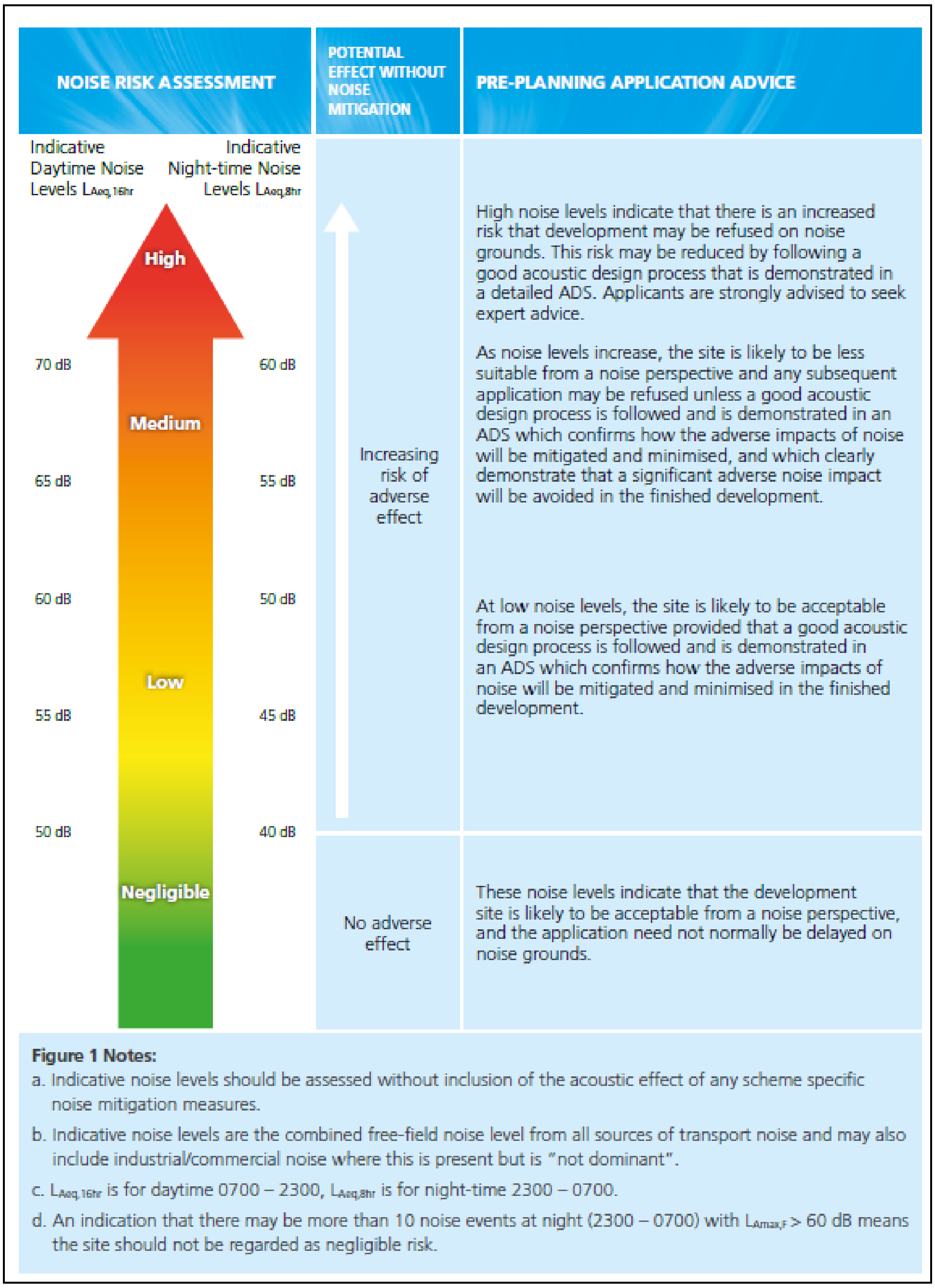
3.23 The four key elements to be undertaken in parallel during Stage 2 of the assessment are:

1. demonstrating a "Good Acoustic Design Process";
2. observing internal "Noise Level Guidelines";
3. undertaking an "External Amenity Area Noise Assessment"; and
4 consideration of "Other Relevant Issues".

3.24 The overall approach is underpinned by the preparation of an "Acoustic Design Statement" (ADS), for which guidance is contained in ProPG Supplementary Document 2, Good Acoustic Design. An ADS for a site assessed as high risk should be more detailed than for a site assessed as low risk, and an ADS should not be necessary for a site assessed as negligible risk. The ProPG's Supplementary Document 1, Planning & Noise Policy Guidance provides additional information regarding other planning guidance.

3.25 The process for the Initial Site Noise Risk Assessment is summarised in Figure 1. The site's day and night-time noise exposures are used to define whether the site falls into a negligible, low, medium or high risk noise category. A site considered as negligible risk is likely to be acceptable from a noise perspective and need not normally be delayed on noise grounds.

Figure 1: Initial Site Noise Risk Assessment



3.26 Elements 1 and 2 of the Stage 2 assessments utilise the noise levels at new dwellings to determine the good acoustic design to avoid 'unreasonable' acoustic conditions and prevent 'unacceptable' acoustic conditions. The internal noise level guidelines used by ProPG are largely those previously set out under BS8233:2014 (Table 2) but with some additional guidance intended to assist with the determination of 'unreasonable' and 'unacceptable' acoustic conditions, which, for clarity, are highlighted by the use of blue italic font in the notes to Table 4.

Table 4: ProPG Internal Noise Level Guidelines

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)

NOTE 1 The Table provides recommended internal L_{Aeq} target levels for overall noise in the design of a building. These are the sum total of structure-borne and airborne noise sources. Ground-borne noise is assessed separately and is not included as part of these targets, as human response to ground-borne noise varies with many factors such as level, character, timing, occupant expectation and sensitivity.

NOTE 2 The internal L_{Aeq} 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 3 These internal L_{Aeq} target 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.

NOTE 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. In most circumstances in noise-sensitive rooms at night (e.g. bedrooms) good acoustic design can be used so that individual noise events do not normally exceed 45dB $L_{Amax,F}$ more than 10 times a night. However, where it is not reasonably practicable to achieve this guideline then the judgement of acceptability will depend not only on the maximum noise levels but also on factors such as the source, number, distribution, predictability and regularity of noise events (see Appendix A).

NOTE 5 Designing the site layout and the dwellings so that the internal target levels can be achieved with open windows in as many properties as possible demonstrates good acoustic design. 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, subject to the further advice in Note 7.

NOTE 6 Attention is drawn to the requirements of the Building Regulations.

NOTE 7 Where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal L_{Aeq} target levels may be relaxed by up to 5 dB and reasonable internal conditions still achieved. The more often internal L_{Aeq} levels start to exceed the internal L_{Aeq} target levels by more than 5 dB, the more that most people are likely to regard them as "unreasonable". Where such exceedances are predicted, applicants should be required to show how the relevant number of rooms affected has been kept to a minimum. Once internal L_{Aeq} levels exceed the target levels by more than 10 dB, they are highly likely to be regarded as "unacceptable" by most people, particularly if such levels occur more than occasionally. Every effort should be made to avoid relevant rooms experiencing "unacceptable" noise levels at all and where such levels are likely to occur frequently, the development should be prevented in its proposed form **(see Section 3.D)**.

3.27 Element 3 of the ProPG's Stage 2 assessment applicable to External Amenity Area Noise Assessment similarly extends the current guidance applicable to outdoor areas in the following manner:

3(i) 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.

3(ii) 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 LAeq,16hr.

3(iii) *These guideline values may not be achievable in all circumstances where development might be desirable. In such a situation, development should be designed to achieve the lowest practicable noise levels in these external amenity spaces.*

3(iv) *Whether or not external amenity spaces are an intrinsic part of the overall design, consideration of the need to provide access to a quiet or relatively quiet external amenity space forms part of a good acoustic design process.*

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

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

3.28 The final element of Stage 2 is an assessment of other relevant issues, which may include the following matters:

4(i) *compliance with relevant national and local policy;*

4(ii) *magnitude and extent of compliance with ProPG;*

4(iii) *likely occupants of the development;*

4(iv) acoustic design v unintended adverse consequences;

4(v) acoustic design v wider planning objectives.

3.29 Upon completion of the ProPG's Stage 1 and 2 assessments, the findings should enable one of four possible recommendations to be presented to the decision maker, i.e. to the Local Planning Authority (LPA), namely to grant permission without conditions, grant with conditions, 'avoid' or 'prevent'.

Road Traffic

3.30 Road traffic noise levels, which have been determined to be the dominant source of noise for the site, are typically measured and predicted in units of $L_{A10\ (18\ hour)}$ dB in accordance with the Department of Transport's 'Calculation of Road Traffic Noise, 1988' (CRTN). The L_{A10} is the A-weighted sound level in decibels exceeded for 10% of the measurement period, which in this case is the 18 hour period between 0600 and 2400 hours. This noise index has been shown to correlate best with people's subjective annoyance due to road traffic noise. L_{A10} noise levels measured over any three hours between 1000-1700 hours are typically 1 dB(A) higher than the L_{A10} over the 18-hour period (CRTN paragraph 43).

3.31 For comparison with the $L_{A10\ (18\ hour)}$ traffic noise index, it is important to note that the noise index used by design guidance such as BS8233 and the WHO guidelines use the $L_{Aeq,T}$ dB noise index, which is a measure of the total sound energy present in a time period, T, expressed as an equivalent continuous noise level.

3.32 For environmental noise sources such as road traffic, the $L_{Aeq,T}$ noise level over the daytime assessment period of 16 hours used by planning guidance is typically, 2 dB lower than $L_{A10\ (18\ hour)}$ noise level. In addition, planning criteria are often expressed as free-field noise levels, i.e. away from the reflecting effects of building facades, whereas noise levels predicted at specific buildings by CRTN normally include a facade reflection factor. $L_{A10\ (18\ hour)}$ noise levels will be higher than equivalent free-field values by a further 3 dB(A) due to these reflection effects.

4.0 NOISE SURVEY

4.1 Ambient noise levels affecting the site during the day and night-time were monitored during Thursday 11th to Friday 12th January 2018. Road traffic noise levels from the A14, Howlett Way, and the Howlett Way/High Road roundabout junction were measured in accordance with the shortened measurement procedures of the Calculation of Road Traffic Noise (CRTN). Position 1 was at 40m from the carriageway edge of the A14 slip road embankment, which is approximately 7m high and screens the site from the main carriageway of the A14 located beyond. Position 2 was at 7m from the carriageway edge of Howlett Way, and Position 3 was at 14m from the carriageway edge of the Howlett Way/High Road roundabout junction. The short-term noise survey is endorsed and approved by central government guidance. Indeed, the latest Design Manual for Roads and Bridges (DMRB) provides analysis of data from the National Noise Survey carried out by the Building Research establishment in 2000 and confirms that the CRTN shortened measurement procedure is still a valid method for evaluating the $L_{A10\ (18\ hour)}$ (Annex 4: A4.44- A4.50, DMRB Vol 11, Section 3, Part 7 HD 213/11). Further sample measurements were undertaken in the northeast corner of the site, at 15m from the 4m high embankment of Howlett Way and the 5m high embankment of the A14 slip road, at approximately 30m from the carriageway edge of the Howlett Way/A14 roundabout junction (Position 4), and in the southern most corner of the site (Position 5). All noise monitoring positions are identified in Appendix A.

4.2 Noise levels were recorded using the following equipment, which was calibrated to a reference signal of 94 dB immediately prior to and after the survey and exhibited zero drift.

Norsonic 131	Sound level meter;
SVAN	Sound level meter; and
CEL-2835/3	Acoustic calibrator.

4.3 The microphone was positioned at a height of 1.2m in a free-field location, i.e. excluding the effect of reflections from buildings or structures. The weather conditions were overcast, with very light intermittent rain and northerly winds of up to 1.5 m/s during Thursday, cold and foggy, with damp roads and north westerly winds of 1 m/s overnight, and sunny and clear, with southerly winds of up to 2 m/s during Friday. The light rainfall and damp roads during the monitoring periods will have increased the noise exposure.

4.4 The main noise source affecting the site is road traffic using the surrounding roads. Overnight, the A14 was shut southbound affecting noise contributions from that section of road, and as a consequence, there was more traffic using Howlett Way and High Road and in particular, more HGV traffic using Howlett Way and High Road on route to the docks. Therefore, the measured noise levels for Howlett Way and the junction with High Road represent a worst-case scenario. For night-time noise levels adjacent to the A14, due to the logarithmic nature of the decibel scale, a suitable factor to reflect the night-time closure of the A14 southbound would be +3 dB.

4.5 The measured noise levels are presented in Appendix D and are summarised below in Table 5, Table 6, and Table 7.

Table 5: Measured Noise Levels at 40m from the A14 Slip Road, Free-field dB(A)

Noise Level, dB	
L_{A10} 3-hour	59.5
Correction for 18-hour L_{A10}	-1
Correction for 16-hour L_{Aeq}	-2
L_{Aeq} 16-hour	**56.5**
L_{Aeq} 8-hour$^{(1)}$	**46.5**

Note: (1) based either on difference between day and night-time L_{Aeq} measurements or DMRB's quoted 10 dB difference, whichever gives the greater noise level.

Table 6: Measured Noise Levels at 7m from Howlett Way, Free-field dB(A)

Noise Level, dB	
L_{A10} 3-hour	75.2
Correction for 18-hour L_{A10}	-1
Correction for 16-hour L_{Aeq}	-2
L_{Aeq} 16-hour	**72.2**
L_{Aeq} 8-hour$^{(1)}$	**62.2**

Table 7: Measured Noise Levels at 14m from Howlett Way/High Road Roundabout Junction, Free-field dB(A)

Noise Level, dB	
L_{A10} 3-hour	64.3
Correction for 18-hour L_{A10}	-1
Correction for 16-hour L_{Aeq}	-2
L_{Aeq} 16-hour	**61.3**
L_{Aeq} 8-hour$^{(1)}$	**62.8**

4.6 The derived daytime $L_{Aeq\ (16\ hour)}$ monitored at 40m from the carriageway edge of the A14 slip road and 7m from the carriageway edge of Howlett Way were 57 dB and 72 dB respectively (rounding to the nearest whole number for assessment purposes). The derived daytime $L_{Aeq\ (16\ hour)}$ monitored at 14m from the carriageway edge of the Howlett Way/High Road roundabout junction was 61 dB.

4.7 There is normally a reduction in traffic flows during the night-time period between 2300-0700 hours, which will in turn reduce the noise exposure. Volume 11 Section 3 Part 7 of the Design Manual for Roads and Bridges (DMRB) states that "*measurements of noise* *from roads indicate that on average night-time traffic noise (i.e. noise between 23:00 and 07:00 on the following day) is approximately 10 dB(A) less than daytime levels".* In the case of the measurements adjacent to the A14 slip road and Howlett Way, the measured differences between the day and night L_{Aeq} ranged between 11-14 dB, therefore, using DMRB's quoted 10 dB difference as a worst-case value results in a night-time $L_{Aeq\ (8\ hour)}$ of 47 dB at 40m from the A14 slip road, which, after applying a correction of +3 dB to reflect the closure of the southbound carriageway, results in a level of 50 dB at 40m from the A14 slip road, and 62 dB at 7m from Howlett Way.

4.8 Adjacent to the Howlett Way/High Road roundabout junction, the day and night L_{Aeq} were similar at 62 dB during the day and 63 dB at night. The similarity between the day and night time noise levels will in part, be due to the closure of the A14 southbound carriageway. Nevertheless, the higher night-time value will result in a worst-case night-time noise assessment.

4.9 Adjacent to the A14 slip road, analysis of the L_{Amax} noise levels shows that the individual road traffic noise events during the day typically fall below 66 dB, but with some occasional peaks due to loud vehicles causing peaks between 66-90 dB. Analysis of the night-time L_{Amax} noise levels shows that the individual road traffic noise events all fall below 79 dB. Therefore, for night-time assessment purposes L_{Amax} noise events due to vehicles will typically be 79 dB or less at 40m from the A14 slip road.

4.10 Adjacent to Howelett Way, analysis of the L_{Amax} noise levels shows that the individual road traffic noise events during the day typically fall below 84 dB, but with some occasional peaks due to loud vehicles causing peaks between 84-92 dB. Analysis of the night-time L_{Amax} noise levels shows that the individual road traffic noise events all fall below 84 dB. Therefore, for night-time assessment purposes L_{Amax} noise events due to vehicles will typically be 84 dB or less at 7m from Howlett Way.

4.11 Adjacent to the Howeltt Way/High Road roundabout junction, analysis of the L_{Amax} noise levels shows that the individual road traffic noise events during the day typically fall below 76 dB, but with some occasional peaks due to loud vehicles causing peaks between 76-86 dB. Analysis of the night-time L_{Amax} noise levels shows that the individual road traffic noise events all fall below 87 dB. Therefore, for night-time assessment purposes L_{Amax} noise events due to vehicles will typically be 87 dB or less at 14m from the Howlett Way/High Road roundabout junction.

4.12 The sample measurements undertaken at Positions 4 and 5 showed a daytime L_{Aeq} of 59 dB and 54 dB respectively.

5.0 NOISE IMPACT ASSESSMENT

5.1 The day and night-time L_{Aeq} monitored at 7m from the carriageway edge of Howlett Way were 72 dB and 61 dB respectively. The day and night-time L_{Aeq} monitored at 14m from the Howlett Way/High Road roundabout junction were 61 dB and 63 dB respectively. Away from the immediate effects of traffic on Howlett Way, the noise levels were not particularly high, with a day and night-time L_{Aeq} adjacent the boundary with the A14 slip road of 57 dB and 50 dB respectively, and a daytime L_{Aeq} at positions 4 and 5 of 59 dB and 54 dB respectively.

5.2 An Initial Site Noise Risk Assessment required by the ProPG is presented in Table 8. Based on the maximum noise exposure levels recorded on the site, the land immediately adjacent to Howlett Way falls within the category of High risk, for which the guidance is *"High noise levels indicate that there is an increased risk that development may be refused on noise grounds. This risk may be reduced by following a good acoustic design process that is demonstrated in a detailed ADS. Applicants are strongly advised to seek expert advise."* Away from the direct effect of traffic noise from Howlett Way, site noise levels represent a Low risk, for which the guidance indicates that "*At low noise levels, the site is less 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.*".

Table 8: Initial Site Noise Risk Assessment

Risk Category	**Negligible**		**Low**		**Medium**		**High**	
Period	Day	Night	Day	Night	Day	Night	Day	Night
ProPG L_{Aeq} threshold dB	<50	<40	50-60	40-50	60-70	50-60	>70	>60
Site Noise Level L_{Aeq} dB (Howlett Way)							72	63
Risk Assessment							**High**	
Site Noise Level L_{Aeq} dB (A14 slip road)			57	50				
Risk Assessment			**Low**					

5.3 The following sections deal with the mitigation measures required by an ADS, namely the acoustic design needed to achieve internal noise level guidelines and the consideration of any other relevant matters.

5.4 The traffic growth over a 15 year design period from 2018 to 2033 would amount to a noise increase of less than 1 dB(A) using the traffic growth forecasts provided by CRTN, which would be represented by only a small and insignificant shift in the noise exposure levels across the site. Therefore, essentially the same comments and noise bands relating to the noise measurements in 2018 can be applied to the site to account for future traffic growth by the year 2033.

5.5 External and internal noise levels for new dwellings facing Howlett Way and the A14 slip road at distances of 10m from the carriageway edge of Howlett Way and 60m from the carriageway edge of the A14 slip road, as shown on the Illustrative Site Layout Plan (Appendix B), would be as shown in Table 9 and Table 10. The Tables also show the outdoor-to-indoor level difference (LA) that windows to habitable rooms must provide in order to achieve BS8233's noise limits, e.g. an internal noise level of 35 dB L_{Aeq} during the day for living rooms and 30 dB L_{Aeq} and 45 dB LAmax during the night for bedrooms. The window's required sound reduction index (R) can be calculated from the following equation:

Sound reduction index, $R = L_1 - L_2 + 10\log(S/A)$

Where,	L_1	=	facade noise level;
	L_2	=	internal noise level, e.g. noise standard to be met;
	S	=	surface area of relevant portion of the building envelope, i.e. the window (m^2); and
	A	=	absorption in the room (m^2).

5.6 For a typical example of window area S = 2 m^2 and room absorption A = 10 m^2, and assuming these factors remain constant over the whole frequency range used for sound reduction purposes, the correction to be added to the level difference LA to derive the sound reduction index R (or R_{TRA} where this is specific to road traffic or other transportation noise) is –7 dB. The sound reduction index may also be presented in terms of the weighted sound reduction index R_W, which is typically between 3 to 7 (average 5) dB higher than R_{TRA}. Therefore, for design purposes, the R_{TRA} will be 7 dB lower than the L_A, and the R_W can be estimated by adding 5 dB to the calculated R_{TRA}. Indicative sound insulation performances of different window designs are presented in Appendix F, however, window manufacturers will be able to provide test certificates showing precisely which of their designs are capable of achieving the minimum requirements.

5.7 The above approach takes account of the sound reduction requirements needed to satisfy the internal noise standards within occupied dwellings, i.e. taking account of the window area and including the absorption that will be present from normal occupation, e.g. with carpets, curtains and furnishings etc. Any compliance monitoring that could take place prior to dwellings being occupied and furnished would need to take account of the loss of room absorption at this stage. That is to say, internal measurements within empty rooms would need to allow 7 dB to compensate for the lack of sound absorption and the reverberations from hard internal surfaces.

Table 9: External and Internal Noise Levels of New Dwellings at 10m from Howlett Way, dB

<table>
<tr><th colspan="7">Day L_{Aeq}</th><th colspan="6">Night L_{Aeq}</th></tr>
<tr><th rowspan="2">Facade</th><th colspan="2">Internal</th><th rowspan="2">L_A</th><th rowspan="2">R_{TRA}</th><th rowspan="2">Vent^n</th><th rowspan="2">Garden</th><th rowspan="2">Facade</th><th colspan="2">Internal</th><th rowspan="2">L_A</th><th rowspan="2">R_{TRA}</th><th rowspan="2">Vent^n</th></tr>
<tr><th>Windows Closed</th><th>Windows partly open</th><th>Windows closed</th><th>Windows partly open</th></tr>
<tr><td>73</td><td>40</td><td>58</td><td>38</td><td>31</td><td>Yes</td><td>58</td><td>63</td><td>30</td><td>48</td><td>33</td><td>26</td><td>Yes</td></tr>
<tr><td colspan="7"></td><th colspan="6">Night L_{Amax}</th></tr>
<tr><td colspan="7"></td><td>83</td><td>50</td><td>68</td><td>38</td><td>31</td><td>Yes</td></tr>
</table>

Notes:
1. Façade noise level includes +3 dB correction for façade reflection effects.
2. Internal noise level with windows closed assumes 33 dB(A) reduction for thermal double glazed windows as per old PPG24.
3. Internal noise level with windows partly open assumes 15 dB(A) reduction as per WHO guidelines.
4. The minimum required sound level difference L_A is derived from the façade noise level minus the internal noise limit, i.e. BS8233's noise levels.
5. The minimum required sound reduction index, R_{TRA} is derived from the level difference L_A minus 7.
6. The need for ventilation is determined by whether the internal noise level can be met with windows partly open for ventilation.

5.8 For new dwellings facing Howlett Way, Table 9 shows that in order to achieve BS8233's internal L_{Aeq} and L_{Amax} noise levels, windows facing the road will need to provide a minimum sound reduction (R_{TRA}) of no more than 31 dB R_{TRA}. Data for the sound insulation performance of different window configurations (Appendix E) indicates that an appropriate window design capable of providing a sound reduction of 31 dB would be 6/12/7 in acoustic laminate, where the information is presented in terms of the thickness of one pane of glass in mm, followed by the size of the air gap, followed by the thickness of the second pane of glass. Window manufacturers will be able to provide certification showing which of their window designs are capable of achieving the required sound reductions.

5.9 With regards to the new apartments facing Howlett Way, noise levels at higher floors can typically increase by 1 dB due to contributions coming from a greater angle of exposure. Therefore, for habitable rooms on the upper floors of new apartments facing Howlett Way, a slightly higher window specification is recommended, and a specification such as 10/12/6 would be capable of providing an overall sound reduction of 32 dB R_{TRA}, which would similarly enable all internal noise standards to be met

5.10 Opening windows for ventilation purposes would reduce the insulation provided by the building façade and internal noise levels would then exceed the design standards, although this situation is not unusual for residential areas within the urban environment where transportation noise is prevalent. Passive acoustic ventilators, such as acoustic trickle vents in the window frames or acoustic airbrick type vents within the walls, can be used for habitable rooms that have windows having an unscreened view towards Howlett Way. These would enable occupiers to obtain natural ventilation with windows closed, without any loss of amenity due to noise intrusion.

5.11 The ProPG recommends that "Where it is not possible to meet internal target levels with windows open, internal noise levels can be assessed with windows closed, however, any facade openings used to provide whole dwelling ventilation (e.g. trickle ventilators) should be assessed in the 'open' position and, in this scenario, the internal LAeq target levels should not normally be exceeded". This means that in the case of thermal double glazed windows providing a sound reduction of 31 dB and 32 dB R_{TRA}, the acoustic vent when 'open' should also provide a sound reduction no less than that provided by the window, or no less than that required by Table 9.

5.12 With regard to the sound reduction performance of the acoustic ventilator, which is commonly presented as a $D_{n,e,w}$ rating, it is not possible to give a direct conversion between the $D_{n,e,w}$ and R_{TRA} or R_w ratings applicable to windows because these will vary from one product to another and from one composite wall arrangement to another. The $D_{n,e,w}$ is the weighted average composite loss of a typical wall with the vent installed - the sound reduction (R) of the vent alone is likely to be less. Therefore, when selecting a vent based upon the $D_{n,e,w}$ value it is always necessary to go for one that gives a value higher than the R_{TRA} or R_w needed for the window. As a rough guide, the Rw can range from being 5 to 10 dB lower than the $D_{n,e,w}$ therefore, if the vent is selected with a $D_{n,e,w}$ at least 7 dB higher than the required R_w for the window then this should not lessen the sound reduction performance of the window.

5.13 For example, for a window providing an RTRA of 31 dB, which equates to an R_w of approximately 36 dB, the vent, when open, should be selected to at least provide 43 dB $D_{n,e,w}$, i.e. window R_{TRA} + 5 = R_w; R_w + 7 = required minimum $D_{n,e,w}$, whereas the equivalent acoustic vent for windows providing 32 dB R_{TRA} should be capable of providing at least 44 dB $D_{n,e,w}$ when open.

5.14 The illustrative Site Layout Plan (Appendix B) indicates dwelling frontages facing Howlett Way, with private gardens used for amenity purposes located behind and thereby experiencing additional distance attenuation as well as screening from the dwellings themselves. In this scenario, a conservative attenuation of 10 dB(A) would apply and, together with the additional distance attenuation, would result in an outdoor noise level of approximately 58 dB L_{Aeq} for garden areas, which would slightly exceed the BS8233/WHO outdoor criterion of 55 dB. However, this needs to be considered against the caveats expressed in paragraphs 3.12 and 3.16, namely that achievement of the WHO guideline values in urban areas would often require drastic action to virtually eliminate road traffic noise and other forms of transportation noise (including public transport) from the vicinity of houses, and that there is no evidence that anything other than a small minority of the population exposed at such noise levels find them to be particularly onerous in the context of their daily lives. The latest guidance from BS8233:2014 is that *"In such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces, but should not be prohibited."*

5.15 Any residual garden areas having a partial unscreened view to the road should have at least a 1.8m high close-boarded timber fence or equivalent structure along the garden boundary to minimise the noise impacts. This would typically provide an attenuation of 7 dB(A) and would minimise the impact of noise in accordance with the guidance of BS8233.

5.16 For new dwellings facing the A14 slip road, Table 10 shows that in order to achieve BS8233's internal L_{Aeq} and L_{Amax} noise levels, windows facing the road will need to provide a minimum sound reduction (R_{TRA}) of 15 dB for living rooms and 26 dB for bedrooms. Data for the sound insulation performance of different window configurations indicates that appropriate window designs capable of providing sound reductions of 15 dB and 26 dB are normal thermal double glazing having a configuration of 4/12/4 or 4/16/4 for living rooms and a configuration of 6/12/6 for bedrooms.

Table 10: External and Internal Noise Levels of New Dwellings at 60m from the A14 slip road, dB

Day L_{Aeq}							Night L_{Aeq}					
Facade	Internal		L_A	R_{TRA}	Vent^n	Garden	Facade	Internal		L_A	R_{TRA}	Vent^n
	Windows closed	Windows partly open						Windows closed	Windows partly open			
57	24	42	22	15	Yes	44	51	18	36	21	14	Yes
							Night L_{Amax}					
							78	45	63	33	26	Yes

5.17 Internal noise standards would again be exceeded with windows open for ventilation, therefore, passive acoustic ventilators are again recommended for habitable rooms overlooking the road in order to allow ventilation without noise intrusion. For window sound reductions of 25 dB and 26 dB R_{TRA}, the respective $D_{n,e,w}$ requirement for the acoustic ventilators, when open, would be 37 dB and 38 dB.

5.18 With private gardens used for amenity purposes located behind new dwellings, the screened outdoor noise level of approximately 44 dB L_{Aeq} for garden areas would satisfy the BS8233/WHO outdoor criterion of 55 dB.

5.19 Once again, any residual garden areas having a partial unscreened view to the road should have at least a 1.8m high close-boarded timber fence or equivalent structure along the garden boundary to minimise the traffic noise impacts.

5.20 Dwellings further into the site will experience lower noise levels due to the additional distance attenuation and the screening provided by dwellings located adjacent to Howlett Way and the A14 slip road. As a consequence, acceptable internal noise levels will be achieved using normal thermal double glazing, and the outdoor noise criterion will be met at all locations.

5.21 There are no other outstanding noise issues, therefore, the overall conclusion of the assessment is that the decision maker may grant planning permission with conditions where appropriate.

6.0 AIR QUALITY STANDARDS

6.1 The principal air quality standards applied within the UK are the standards and objectives that were initially formulated within the Air Quality (England) Regulations 2000 (AQR) as amended in 2002. These were enacted as part of the UK National Air Quality Strategy (AQS) under Section 80 of the Environment Act 1995, and implement relevant directives of the European Union (EU). The latest version of the UK AQS was published in 2007.

6.2 It is important to note the distinction between standards and objectives. Although the AQS standards define concentration levels that will avoid or minimise risks to health, they do not necessarily reflect levels that are presently technically feasible or economically efficient. In contrast, the AQS objectives have been set with regard to what is realistically achievable within a specified timetable. The approach adopted by the Strategy is to apply the objectives, where members of the public, in a non-occupational capacity and at locations close to ground level, are likely to be exposed over the averaging time of the objective, for example, over 1-hour, 24-hour or annual periods as appropriate.

National Policy

Environment Act 1995

6.3 Part IV of the Environment Act 1995 (the Act) requires UK government and devolved administrations to produce a national air quality strategy containing standards, objectives and measures for ameliorating ambient air quality and to continually review these policies.

6.4 The Act also provides a legislative framework for a system of Local Air Quality Management (LAQM). This system is an integral part of delivering the UK's air quality obligations.

6.5 Under the LAQM regime, responsible authorities are required to carry out a regular review and assessment (R&A) of air quality in their area against defined national objectives, which have been prescribed in regulations for the purposes of LAQM. Where it is found these objectives are unlikely to be met, responsible authorities must designate Air Quality Management Areas (AQMAs) and implement Air Quality Action Plans (AQAPs) to tackle the problems.

6.6 Provisions in the Act are largely enabling and allow responsible authorities the power to take forward local policies to suit their own needs. Local circumstance will also determine the content of the local air quality policy, designation of AQMAs and the content of AQAPs.

The National Air Quality Strategy

6.7 Due to the transboundary nature of air pollution, it is appropriate to have an overarching strategy with common aims covering all parts of the UK. For this reason, the National Air Quality Strategy (NAQS) is presented as a joint UK Government and devolved administrations document.

6.8 The most recent NAQS was published in July 2007 and established a framework for further air quality improvements across the UK. The NAQS sets out standards and objectives which have been established in order to measure the improvement of air quality.

6.9 The NAQS is a statement of policy intentions or policy targets and as such there is no legal requirement to meet these objectives except in so far as these mirror any equivalent legally binding 'limit values' in EU legislation.

6.10 With minimal exception, the objectives have been met across the UK for all pollutants except particulate matter (PM_{10}) and nitrogen dioxide (NO_2). These pollutants are directly related to road traffic pollution and many of the areas that breach the objectives (designated AQMAs) are located close to major road sources.

6.11 There are a wide range of terms and concepts used in international, national and local air quality policy and legislation and the NAQS discusses air quality in terms of Standards and Objectives. These terms are defined below:

6.12 Standards are the concentrations of pollutants in the atmosphere which can be broadly taken to achieve a certain level of environmental quality. The standards are based on assessment of the effects of each pollutant on human health including the effects on sensitive sub groups and ecosystems.

6.13 Objectives are policy targets often expressed as a maximum ambient concentration not to be exceeded either without exception or with a permitted number of exceedances within a given timescale.

National Planning Policy Framework

6.14 The latest National Planning Policy Framework (NPPF), issued by the Ministry of Housing, Communities and Local Government in July 2018, sets out the Government's planning policies for England and how these are to be expected to be applied. The NPPF must be taken into account in the preparation of local and neighbourhood plans, and is to be a material consideration in planning decisions.

6.15 Paragraph 170 of the NPPF advises that, with respect to noise, planning policies and decisions should contribute to and enhance the natural and local environment by *"…preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans"*.

6.16 Further, paragraph 181 advises that *"Planning policies and decisions should sustain and contribute towards compliance with relevant limit values or national objectives for pollutants, taking into account the presence of Air Quality Management Areas and Clean Air Zones, and the cumulative impacts from individual sites in local areas. Opportunities to improve air quality or mitigate impacts should be identified, such as through traffic and travel management, and green infrastructure provision and enhancement. So far as possible these opportunities should be considered at the plan-making stage, to ensure a strategic approach and limit the need for issues to be reconsidered when determining individual applications. Planning decisions should ensure that any new development in Air Quality Management Areas and Clean Air Zones is consistent with the local air quality action plan."*

National Planning Policy Guidance

6.17 The National Planning Practice Guidance (NPPG) provides guiding principles on how planning can take account of new development on air quality.

6.18 Whether or not air quality is relevant to a planning decision will depend on the proposed development and its location. Concerns may arise if the development is likely to generate an air quality impact in the area, or the development Is likely to adversely impact upon the implementation of air quality strategies and action plans, and/or lead to a breach of EU legislation.

6.19 When deciding whether air quality is relevant to a planning application, considerations include whether the development would:

- Significantly affect traffic in the immediate vicinity of the proposed development or further afield.
- Introduce new point sources of air pollution.
- Expose people to existing sources of air pollutants, for example building new homes.

- Give rise to potentially unacceptable impact (such as dust) during construction.
- Affect biodiversity.

Legislation

6.20 The NAQS Objectives are transposed into UK legislation by a series of Regulations including, for England, the Air Quality Regulations 2000, the Air Quality (England) Amendment Regulations 2002, and the Air Quality (England) Amendment Regulations 2004.

6.21 In addition, the UK has a legislative requirement to meet air quality limit values for key pollutants defined at a European level by European Council Directives:

- Directive 2008/50/EC on ambient air quality and cleaner air for Europe; and
- Directive 2004/107/EC relating to arsenic, cadmium, mercury, nickel and PAH.

6.22 These Directives are transposed into UK legislation by the Air Quality Standards Regulations 2010.

6.23 Table 11 summarises the national objectives and European 'limit value' obligations for PM_{10} and NO_2, the key transport-related pollutants of concern in the UK. Definitions of units and terms used to quantify air pollutant concentrations are provided in Appendix F.

Table 11: Summary of Air Quality Objectives

Pollutant	Air Quality Objectives	
	Concentration ($\mu g/m^3$)	**Averaging Period**
Nitrogen Dioxide (NO_2)	200	1-hour mean; not to be exceeded more than 18 times a year
	40	Annual mean
Particulate Matter with an aerodynamic diameter of less than 10 microns (PM_{10})	50	24-hour mean; not to be exceeded more than 35 times a year
	40	Annual mean

Local Air Quality Management

6.24 LAQM requires local authorities to undertake a regular Review and Assessment of air quality. Previous guidance (pre-2016) dictated three types of assessment a local authority could carry out.

6.25 The first was an Updating and Screening Assessment (USA), undertaken every three years. A USA considered the changes that had occurred in pollutant emissions and sources since the last round of Review and Assessment that may affect air quality. The USA was then followed by either a Detailed Assessment or a Progress Report.

6.26 A Detailed Assessment was required when the USA identifies a risk of exceeding an air quality objective at a location of relevant public exposure, and the objective is to determine whether it is necessary to declare an AQMA. If the USA does not identify any risk, then a Progress Report was prepared annually in the intervening years between USAs, to maintain continuity in the LAQM process.

6.27 The LAQM system changed in 2016, providing a more streamlined approach and a greater emphasis on action planning to bring forward improvements in air quality and to include local measures as part of EU reporting requirements. As part of the changes to LAQM, from 2016 Annual Status Reports (ASR) will replace all other reports, except Action Plans, to reduce the burden of the reporting cycle.

Local Air Quality

6.28 Suffolk Coastal District Council's (SCDC) most recently published 2018 ASR states that in 2017, SCDC operated 53 diffusion tubes and one automatic analyser. The 2017 monitoring results show only one receptor location where NO_2 was just above the annual mean objective at 41 μg/m^3, this is a new monitoring site on High Road, Trimley St. Martin.

6.29 SCDC operates four nitrogen dioxide diffusion tubes in close proximity to the development site. All four sites are classified as 'roadside' and their annual mean concentrations are summarised in Table 2. Although sites FLX17, FLX23 and FLX39 have been operational since at least 2013, the site at FLX40 only commenced in 2017.

Table 2: Annual Mean NO2 Concentrations, μg/m^3

ID	Type	Location	2013	2014	2015	2016	2017	Average
FLX17	Roadside	38 Spriteshall Lane	25	23	22	22	21	22.6
FLX23	Roadside	23 Heathgate Piece	28	27	26	26	22	25.8
FLX39	Roadside	424 High Road	21	28	23	22	23	23.4
FLX40	Roadside	216 High Road	-	-	-	-	41	41

6.30 With the exception of FLX40, the three remaining sites show concentrations well below the objective of 40 μg/m^3, with average values ranging from 23 to 26 μg/m^3. The single year of monitoring undertaken at FLX40 in 2017 shows an exceedance of the annual mean objective level at 41 μg/m^3. However, the 2018 ASR states that *"As this is our first reading using a single diffusion tube in this locality we have chosen not to declare a* *fast track AQMA. To improve the accuracy of our data collection in 2018 we now have a triplicate set of diffusion tubes at FLX 40, and have added 3 additional monitoring sites at other properties close by. In addition, we have added a number of monitoring locations along the Trimleys in order to assess concentrations at key sites. The readings obtained so far in 2018 at FLX 40 (January to April) are much reduced when compared with the same time frame in 2017, this may be due to very high readings seen across the whole district in early 2017 due to unusual weather conditions (fog and very still conditions) or to some more local influence. We will be monitoring results carefully over the year to see if this reduction continues."*

6.31 There were no measured annual mean NO_2 concentrations exceeding 60 µg/m^3, indicating that an exceedance of the 1-hour mean objective was unlikely.

7.0 AIR QUALITY ASSESSMENT METHODOLOGY

General

7.1 The assessment has been undertaken using the atmospheric dispersion modelling package ADMS-Roads Air Quality Management System Version 4.1.1, developed by Cambridge Environmental Research Consultants Ltd (CERC), to establish air pollutant concentrations at the proposed development.

7.2 The assessment has been undertaken with reference to guidance set out within Defra's LAQM.TG(16), the IAQM and EPUK's 'Guidance on Land-Use Planning and Development Control: Planning for Air Quality 2017 (v1.2)'

7.3 Specifically, ADMS-Roads has been used to disperse emissions of NO_x and PM_{10} from local road sources and derive resultant road contributions to the concentrations of these pollutants at specific existing receptor locations. When added to the background concentration, this provides an indication of the resulting air quality at each receptor location.

7.4 The ADMS-Roads model requires the input of background pollutant concentration data, hourly traffic flows, annual average vehicle speed, vehicle classification broken down into light and heavy duty vehicles (LDV/HDV), information on the type of road and meteorological data (model inputs are discussed in turn later).

7.5 Current guidance has led to some changes in the way in which NO_2 concentrations should be modelled. In accordance with LAQM.TG(16) the ADMS-Roads model has been used to derive road-based concentrations of NO_x at specific receptor locations. To convert the modelled road-based NO_x to annual NO_2 the 'NO_x to NO_2' calculator (Version 6.1) (available from https://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html#NOxNO2calc) has been applied to all modelled results.

Model Inputs

Assessment Scenarios

7.6 The assessment seeks to establish air pollutant concentrations at identified receptor locations as shown in Appendix G. The following scenarios (informed by available SCDC NO_2 monitoring data and the Transport Assessment work) have been included in the assessment:

- 2017 Base (for verification);
- 2023 'Do Nothing' (2023 DN) (i.e. base + growth + cumulative); and

- 2023 'Do Something' (2023 DS) (i.e. base + growth + cumulative + proposed development).

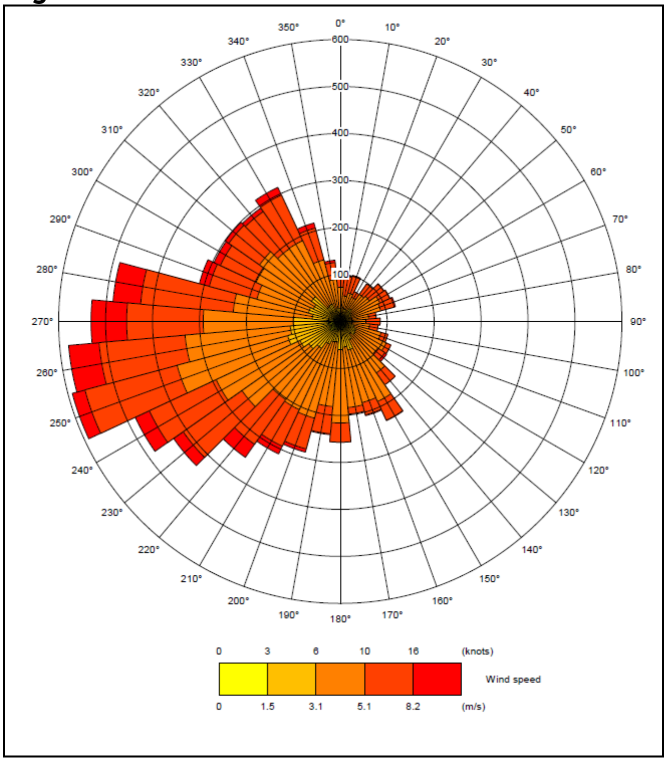
7.7 The 2023 future year scenario has been modelled using 2023 traffic flow data, together with 2018 background and emissions data, to account for current uncertainty in future year projections. Background concentrations and vehicle emission factors are projected to decrease year on year due to fleet composition and technological changes. Using 2018 data therefore provides a conservative case for the 2023 scenario.

Meteorology

7.8 Dispersion has been informed by an ADMS-Roads-compatible hourly sequential meteorological data file for the Wattisham weather station, for the year 2017. This has been used to approximate average weather conditions for all scenario years.

7.9 The windrose for Wattisham weather station is presented in Figure 2. The predominant wind direction is from the west-south-west and is associated with the highest wind speeds. There is a lower occurrence of wind from any other direction.

Figure 2: Windrose- Wattisham 2017



Local Road Network

7.10 Local road sources have been input into the model using the interface between ADMS-Roads and the ADMS-Roads mapper, which enables roads to be input according to their geographic location using OS base mapping of the local area. Road/carriageway widths have been informed from OS base and aerial mapping.

Traffic Data & Emissions

7.11 To inform emissions from each road source included within the model, traffic flows for the local road network have been provided by project's transport consultants Development Transport Planning Ltd.

7.12 Traffic flow data, % HGV and average speed assumptions for each road source and for each assessment scenario are provided in Appendix H for information.

7.13 Emission rates for each road source have been derived from traffic flow data using the Emission Factor Toolkit (EFT), Version 8.0.1, Published by Defra and the devolved administrations in November 2017. The EFT is incorporated within ADMS-Roads. The EFT allows users to calculate road vehicle pollutant emission rates for pollutants for a specified year, road type, and vehicle speed and vehicle fleet composition.

Receptor Locations

7.14 For the purpose of an Air Quality Assessment, sensitive receptors can be thought of as areas within 200m of the roadside where people may be subject to change in air quality. Beyond 200m from the roadside, atmospheric dispersion (and chemistry) effect render emissions from road traffic negligible.

7.15 The assessment has considered the potential impact of emissions from development-related traffic upon NO_2 and PM_{10} concentrations at individual receptor locations along High Road, High Street, Hawkes Lane, Ataka Road, Church Lane, Treetops, Fen Meadow, Faulkeners Way, Brick Kiln Close, St Martins Green, Ash Ground Close, the A14 and Howlett Way.

7.16 Receptor locations identified for the assessment have been selected due to proximity to road links. Receptor locations are listed in Table 3 and are shown on the Receptor Location Plan provided in Appendix G.

Table 3: Receptor Locations

Receptor ID	**Receptor Location**	**Grid Reference**	
		X	Y
1	High Road, Trimley St Martin	627490.6	237333.8
2	Reeve Lodge, High Road, Trimley St Martin	627513.7	237276.6
3	High Road, Trimley St	627551.9	237196.8

Receptor ID	Receptor Location	Grid Reference	
	Martin		
4	High Road, Trimley St Martin	627587.7	237135.9
5	206-208, High Road, Trimley St Martin	627617	237072.5
6	High Road, Trimley St Martin	627717.4	236890
7	High Road, Trimley St Martin	627722	236872.3
8	High Road, Trimley St Martin	627745.8	236813
9	High Road, Trimley St Martin	627792.3	236771.2
10	Trimley Lodge, High Road, Trimley St Martin	627899.5	236639.4
11	High Road, Trimley St Martin	627897.2	236614.7
12	High Road, Trimley St Martin	627943.5	236579.8
13	High Road, Trimley St Martin	627931.3	236556.8
14	High Road, Trimley St Martin	627952.5	236564.9
15	High Road, Trimley St Martin	628094.8	236410.6
16	High Road, Trimley St Martin	628103.7	236373.9
17	High Road, Trimley St Martin	628138.1	236370.2
18	High Road, Trimley St Martin	628166.3	236347.9
19	High Road, Trimley St Martin	628186.8	236311.1
20	High Road, Trimley St Martin	628220.7	236313.4
21	High Road, Trimley St Martin	628265.3	236266.6
22	High Road, Trimley St Martin	628284.8	236256.1
23	High Road, Trimley St Martin	628369.5	236231.9
24	High Road, Trimley St Martin	628502.1	236177.3
25	High Road, Trimley St Martin	628535.8	236164.1
26	High Road, Trimley St	628631.9	236121.1

Receptor ID	Receptor Location	Grid Reference	
	Martin		
27	High Road, Trimley St Martin	628763.4	236070.7
28	395 High Street	628835.3	236010.6
29	Hawkes Lane	628985.1	235952.8
30	High Street	629125.9	235875.8
31	High Street	629194.2	235857.1
32	High Street	629292.5	235789
33	High Street	629359.1	235749.3
34	High Street	629366.6	235719.1
35	272 High Strret	629421.5	235701.6
36	High Street	629395.4	235698
37	230 High Street	629486.8	235655.7
38	232 High Street	629483	235640.4
39	Ataka Road	629637.1	235890
40	Church Lane	629568.3	235923.6
41	Treetops	629325.8	236067.5
42	Fen Meadow	628312.3	236859.1
43	Faulkeners Way	628388	236750.2
44	High Road	627473.8	237405.2
45	Brick Kiln Close	627517	237433.4
46	St Martins, Green	627574.5	237468.4
47	Ash Ground Close	627711.2	237535.5
48	Ash Ground Close	627741.1	237549.6
49	A14	627975.5	237398.1
50	Howlett Way	627762.4	237504.4
51	Howlett Way	627698	237481
52	Howlett Way	627663.4	237466
53	Howlett Way	627571.9	237408.8

Background NO_2 and NO_x Concentrations

7.17 Background concentrations of NO_2, NO_x, and PM_{10} have been obtained from the 2015-based maps available on the Defra website (https://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html) which provide estimated background pollutant concentrations for each 1kmx1km grid square in the UK.

7.18 As the background maps provide data for individual pollutant sectors, those sectors relating to road traffic have been removed to avoid double counting of road emissions. As only total background concentrations are provided for NO_2, the NO_2 map has been adjusted using the online NO_2 Adjustment for NO_x Sector Removal Tool (Version 6.0), https://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html#NOxsector.

Verification

7.19 To determine how well the model is performing and to correct any over or under estimation of pollutant concentrations, LAQM.TG(16) recommends a verification process that should be applied. Verification involves a comparison between predicted and measured 'road traffic contributions' at one or more local sites and adjustment of the modelled concentrations if necessary.

7.20 Modelled pollutant concentrations have been verified against SCDC's 2017 NO_2 monitoring results, as shown in Table 4 below. Due to the uncertainties surrounding the monitoring results at the Council's monitoring location FLX40, this location has been removed from the verification process.

Table 4: SCDC Monitoring Data Used In Verification

SCDC Site ID	Type	Grid Reference	Annual Mean NO_2 ($\mu g/m^3$)			
			2014	**2015**	**2016**	**2017**
FLX40	Diffusion Tube	627618, 237092	-	-	-	41
FLX17	Diffusion Tube	622817, 236323	23	22	22	21
FLX23	Diffusion Tube	628542, 2365992	27	26	26	22
FLX39	Diffusion Tube	628760, 236071	28	23	22	23

7.21 The derived adjustment factor is 2.5, and has been applied to all modelled road contribution NOx and PM_{10}. Details of this verification process are included in Appendix I for information.

8.0 AIR QUALITY RESULTS AND ASSESSMENT

General

8.1 This section of the report outlines the findings of the assessment discussed in Section 4.0. Having established the likely change in pollutant concentrations arising from the 'do something' assessment scenarios, the potential local air quality impact of the proposed development has been described using the approach set out in the IAQM and EPUK 'Guidance on Land-Use Planning and Development Control: Planning for Air Quality 2017.

8.2 EPUK Guidance suggests a two stage process to be followed in the assessment:

- A qualitative or quantitative description of the impacts on local air quality arising from the development; and
- A judgement on the overall significance of the effects of any impacts.

8.3 For air quality impacts on the surrounding area (i.e. existing receptors), a practical way of assigning a meaningful description to the degree of an impact is to express the magnitude of incremental change as a proportion of the relevant assessment level and then to examine this change in the context of the new total concentration and its relationship with the assessment criterion. The suggested IAQM/EPUK framework for describing the impacts on the basis set out above is shown in Table 5 below.

Table 5: Impact Descriptors for Individual Receptors

Long term average concentration at receptor in assessment year	**% Change in concentration relative to Air Quality Assessment Level (AQAL*)**			
	1	**2-5**	**6-10**	**>10**
75% or less of AQAL	Negligible	Negligible	Slight	Moderate
76-94% of AQAL	Negligible	Slight	Moderate	Moderate
95-102% of AQAL	Slight	Moderate	Moderate	Substantial
103-109% of AQAL	Moderate	Moderate	Substantial	Substantial
110% or more of AQAL	Moderate	Substantial	Substantial	Substantial

*AQAL = Air Quality Assessment Level 40μg/m^3

Results

8.4 The findings of the assessment of pollutant concentrations at each of the receptor locations for the modelled scenarios are discussed in the tables and text below.

8.5 These results should be compared with the objectives listed in Table 5 and summarised as follows:

- NO_2 average annual mean not to exceed 40 µg/m^3; and
- PM_{10} average annual concentrations not to exceed 40 µg/m^3.

Nitrogen Dioxide (NO_2)

8.6 Table 6 below shows the modelled annual mean NO_2 concentrations and the incremental change at each receptor between 2023 DN and 2023 DS scenarios, resulting from traffic generated by the proposed development.

Table 6: Modelled Annual Mean NO_2 (µg/m^3)

Receptor ID	Annual Mean NO_2 (µg/m^3)		Incremental Change 2023 DS – 2023 DN
	2023 DN	2023 DS	
1	17.62	17.87	0.25
2	16.83	17.14	0.31
3	19.14	19.59	0.45
4	22.02	22.62	0.60
5	17.62	17.99	0.37
6	21.83	22.41	0.58
8	25.58	26.35	0.77
9	16.91	17.24	0.33
10	19.92	20.42	0.50
11	18.78	19.21	0.43
12	17.81	18.19	0.38
12	18.74	19.17	0.43
13	14.68	14.88	0.20
14	18.85	19.29	0.44
15	17.51	17.84	0.33
16	17.01	17.29	0.28
17	19.16	19.55	0.39
18	20.98	21.45	0.47
19	17.04	17.31	0.27
20	19.01	19.4	0.39
21	17.31	17.6	0.29
22	17.28	17.57	0.29
23	21.4	21.9	0.50
24	21.01	21.49	0.48
25	21.82	22.34	0.52
26	21.3	21.79	0.49
27	21.95	22.34	0.39

Receptor ID	Annual Mean NO_2 (µg/m^3)		Incremental Change 2023 DS – 2023 DN
	2023 DN	2023 DS	
28	19.45	19.74	0.29
29	17.78	18.16	0.38
30	19.92	20.36	0.44
31	20.39	20.88	0.49
32	22.15	22.74	0.59
33	23.08	23.72	0.64
34	19.48	19.92	0.44
35	22.12	22.71	0.59
36	19.06	19.48	0.42
37	22.6	23.21	0.61
38	18.86	19.26	0.40
39	18.04	20.68	2.64
40	17.58	19.78	2.20
41	17.38	19.06	1.68
42	22.82	22.87	0.05
43	21.62	21.68	0.06
44	14.19	14.21	0.02
45	14.23	14.27	0.04
46	14.8	14.87	0.07
47	15.67	16.24	0.57
48	15.24	15.79	0.55
49	14.2	14.29	0.09
50	14.84	15.45	0.61
51	15.46	17.78	2.32
52	15.55	18.33	2.78
53	15.29	15.36	0.07

Results from ADMS-Roads v4.1 with NO_x to NO_2 calculator used to derive annual mean NO_2.

8.7 The results in Table 6 indicate that annual mean NO_2 concentrations are predicted to remain below the objective for all receptor locations. The incremental change in annual mean concentrations due to traffic generated by the development is predicted to be small, ranging from 0.02 to 2.78 µg/m^3.

Particulate Matter (PM_{10})

8.8 Table 7 below shows the modelled annual mean PM_{10} concentrations and the incremental change at each receptor between 2023 DN and 2023 DS scenarios, resulting from traffic generated by the proposed development at each receptor.

Table 7: Modelled Annual Mean PM_{10} (µg/m^3)

Receptor ID	Annual Mean PM_{10} (µg/m^3)		Incremental Change 2023 DS – 2023 DN
	2023 DN	2023 DS	
1	17.78	17.83	0.05
2	17.78	17.83	0.05
3	18.18	18.26	0.08
4	18.67	18.78	0.11
5	17.93	17.99	0.06
6	18.41	18.51	0.09
8	18.96	19.09	0.13
9	17.90	17.97	0.06
10	18.49	18.59	0.10
11	18.23	18.31	0.08
12	17.94	18.01	0.06
12	18.12	18.20	0.08
13	17.47	17.51	0.04
14	18.24	18.33	0.08
15	17.10	17.16	0.06
16	16.92	16.97	0.05
17	17.27	17.34	0.07
18	17.35	17.42	0.08
19	16.85	16.90	0.05
20	17.27	17.34	0.07
21	16.97	17.03	0.05
22	16.97	17.02	0.05
23	17.44	17.52	0.08
24	17.42	17.50	0.08
25	17.49	17.57	0.08
26	17.61	17.70	0.09
27	17.80	17.87	0.07
28	17.35	17.40	0.05
29	17.00	17.06	0.06
30	16.58	16.66	0.07
31	16.67	16.75	0.08

Receptor ID	Annual Mean PM_{10} (μg/m^3)		Incremental Change 2023 DS – 2023 DN
	2023 DN	2023 DS	
32	16.97	17.07	0.10
33	16.93	17.03	0.10
34	16.48	16.55	0.07
35	17.06	17.17	0.11
36	16.47	16.54	0.07
37	17.17	17.28	0.11
38	16.45	16.52	0.07
39	16.17	16.51	0.34
40	16.11	16.39	0.28
41	16.08	16.30	0.21
42	17.24	17.24	0.01
43	17.00	17.00	0.01
44	17.30	17.32	0.01
45	17.37	17.38	0.01
46	17.49	17.51	0.01
47	17.62	17.65	0.03
48	17.57	17.64	0.06
49	17.41	17.43	0.01
50	17.50	17.57	0.07
51	17.52	17.78	0.26
52	17.56	17.87	0.32
53	17.56	17.58	0.02

8.9 The results in Table 7 indicate that annual mean PM_{10} concentrations are predicted to remain below the objective for all receptor locations. The incremental change in annual mean concentrations due to traffic generated by the development is predicted to be small, ranging from 0.01 to 0.34 μg/m^3.

Assessment

8.10 With reference to the impact descriptors for individual receptors set out in Table 5, modelled annual mean NO_2 and PM_{10} concentrations as a percentage of the AQAL are set within Table 8.

Table 8: Modelled Annual Mean NO_2 and PM_{10} Concentrations as a Percentage of the AQAL

Receptor ID	Annual Mean Percentage of the AQAL (40µg/m^3)			
	NO_2		PM_{10}	
	2026 DN	2026 DS	2026 DN	2026 DS
1	44.1%	44.7%	44.5%	44.6%
2	42.1%	42.9%	44.4%	44.6%
3	47.9%	49.0%	45.4%	45.6%
4	55.1%	56.6%	46.7%	47.0%
5	44.1%	45.0%	44.8%	45.0%
6	54.6%	56.0%	46.0%	46.3%
8	64.0%	65.9%	47.4%	47.7%
9	42.3%	43.1%	44.8%	44.9%
10	49.8%	51.1%	46.2%	46.5%
11	47.0%	48.0%	45.6%	45.8%
12	44.5%	45.5%	44.9%	45.0%
12	46.9%	47.9%	45.3%	45.5%
13	36.7%	37.2%	43.7%	43.8%
14	47.1%	48.2%	45.6%	45.8%
15	43.8%	44.6%	42.7%	42.9%
16	42.5%	43.2%	42.3%	42.4%
17	47.9%	48.9%	43.2%	43.3%
18	52.5%	53.6%	43.4%	43.6%
19	42.6%	43.3%	42.1%	42.3%
20	47.5%	48.5%	43.2%	43.4%
21	43.3%	44.0%	42.4%	42.6%
22	43.2%	43.9%	42.4%	42.5%
23	53.5%	54.8%	43.6%	43.8%
24	52.5%	53.7%	43.5%	43.7%
25	54.6%	55.9%	43.7%	43.9%
26	53.3%	54.5%	44.0%	44.3%
27	54.9%	55.9%	44.5%	44.7%
28	48.6%	49.4%	43.4%	43.5%
29	44.5%	45.4%	42.5%	42.6%
30	49.8%	50.9%	41.5%	41.6%
31	51.0%	52.2%	41.7%	41.9%
32	55.4%	56.9%	42.4%	42.7%
33	57.7%	59.3%	42.3%	42.6%
34	48.7%	49.8%	41.2%	41.4%

Receptor ID	Annual Mean Percentage of the AQAL (40µg/m³)			
	NO_2		PM_{10}	
	2026 DN	2026 DS	2026 DN	2026 DS
35	55.3%	56.8%	42.7%	42.9%
36	47.7%	48.7%	41.2%	41.3%
37	56.5%	58.0%	42.9%	43.2%
38	47.2%	48.2%	41.1%	41.3%
39	45.1%	51.7%	40.4%	41.3%
40	44.0%	49.5%	40.3%	41.0%
41	43.5%	47.7%	40.2%	40.7%
42	57.1%	57.2%	43.1%	43.1%
43	54.1%	54.2%	42.5%	42.5%
44	35.5%	35.5%	43.3%	43.3%
45	35.6%	35.7%	43.4%	43.5%
46	37.0%	37.2%	43.7%	43.8%
47	39.2%	40.6%	44.0%	44.1%
48	38.1%	39.5%	43.9%	44.1%
49	35.5%	35.7%	43.5%	43.6%
50	37.1%	38.6%	43.8%	43.9%
51	38.7%	44.5%	43.8%	44.4%
52	38.9%	45.8%	43.9%	44.7%
53	38.2%	38.4%	43.9%	43.9%

8.11 The percentage changes in annual mean NO_2 and PM_{10} concentrations resulting from development traffic relative to the AQALs are shown in Table 9. Impact descriptors for individual receptors have been determined using the framework shown in Table 5.

Table 9: Impact Descriptors for Individual Receptors

Receptor ID	NO_2		PM_{10}	
	% Change in NO_2 Annual Mean Concentration Relative to AQAL	Impact Descriptor	% Change in PM_{10} Annual Mean Concentration Relative to AQAL	Impact Descriptor
1	0.63%	Negligible	0.1%	Negligible
2	0.78%	Negligible	0.1%	Negligible
3	1.13%	Negligible	0.2%	Negligible
4	1.50%	Negligible	0.3%	Negligible
5	0.92%	Negligible	0.2%	Negligible
6	0.63%	Negligible	0.1%	Negligible
8	0.78%	Negligible	0.1%	Negligible
9	1.13%	Negligible	0.2%	Negligible

Receptor ID	NO_2		PM_{10}	
	% Change in NO_2 Annual Mean Concentration Relative to AQAL	**Impact Descriptor**	**% Change in PM_{10} Annual Mean Concentration Relative to AQAL**	**Impact Descriptor**
10	1.50%	Negligible	0.3%	Negligible
11	0.92%	Negligible	0.2%	Negligible
12	1.45%	Negligible	0.2%	Negligible
12	1.93%	Negligible	0.3%	Negligible
13	0.82%	Negligible	0.2%	Negligible
14	1.25%	Negligible	0.2%	Negligible
15	1.08%	Negligible	0.2%	Negligible
16	1.0%	Negligible	0.2%	Negligible
17	1.1%	Negligible	0.2%	Negligible
18	0.5%	Negligible	0.1%	Negligible
19	1.1%	Negligible	0.2%	Negligible
20	0.8%	Negligible	0.2%	Negligible
21	0.7%	Negligible	0.1%	Negligible
22	1.0%	Negligible	0.2%	Negligible
23	1.2%	Negligible	0.2%	Negligible
24	0.7%	Negligible	0.1%	Negligible
25	1.0%	Negligible	0.2%	Negligible
26	0.7%	Negligible	0.1%	Negligible
27	0.7%	Negligible	0.1%	Negligible
28	1.3%	Negligible	0.2%	Negligible
29	1.2%	Negligible	0.2%	Negligible
30	1.3%	Negligible	0.2%	Negligible
31	1.2%	Negligible	0.2%	Negligible
32	1.0%	Negligible	0.2%	Negligible
33	0.7%	Negligible	0.1%	Negligible
34	0.9%	Negligible	0.2%	Negligible
35	1.1%	Negligible	0.2%	Negligible
36	1.2%	Negligible	0.2%	Negligible
37	1.5%	Negligible	0.3%	Negligible
38	1.6%	Negligible	0.2%	Negligible
39	1.1%	Negligible	0.2%	Negligible
40	1.5%	Negligible	0.3%	Negligible
41	1.1%	Negligible	0.2%	Negligible
42	1.5%	Negligible	0.3%	Negligible
43	1.0%	Negligible	0.2%	Negligible

Receptor ID	NO_2		PM_{10}	
	% Change in NO_2 Annual Mean Concentration Relative to AQAL	**Impact Descriptor**	**% Change in PM_{10} Annual Mean Concentration Relative to AQAL**	**Impact Descriptor**
44	6.6%	Negligible	0.8%	Negligible
45	5.5%	Negligible	0.7%	Negligible
46	4.2%	Negligible	0.5%	Negligible
47	0.1%	Negligible	0.0%	Negligible
48	0.1%	Negligible	0.0%	Negligible
49	0.1%	Negligible	0.0%	Negligible
50	0.1%	Negligible	0.0%	Negligible
51	0.2%	Negligible	0.0%	Negligible
52	1.4%	Negligible	0.1%	Negligible
53	1.4%	Negligible	0.2%	Negligible

8.12 The results in Table 9 show that increases in pollutant concentrations as a result of development traffic are expected to lead to a 'Negligible' impact at all other assessed receptor locations.

8.13 With regard to the 1-hour mean objective LAQM.TG(16) advises that, *'previous research carried out on behalf of Defra and the Devolved Administrations identified a relationship between the annual mean and the 1-hour mean objective, such that exceedances of the latter were considered unlikely where the annual mean was below 60 $\mu g/m^3$'*. As the results in Table 6 indicate annual mean concentrations of NO_2 will remain well below 60 $\mu g/m^3$, it is considered that the NO_2 1-hour objective will not be exceeded at any receptor, for any development scenario.

8.14 It is noted that the 2023 future year has been modelled using 2023 traffic flow data, together with 2018 background and emissions data, to account for current uncertainty in future year projections. Background concentrations and vehicle emission factors are projected to decrease year on year, as new Euro standards and UK fleet turnover are assumed. Using 2018 data therefore provides a conservative case for 2023 scenarios. In reality, pollutant concentrations may be lower.

9.0 CONCLUSIONS

Noise

9.1 The main noise source affecting the site is road traffic using the surrounding roads. Overnight, the A14 was shut southbound affecting noise contributions from that section of road, and as a consequence, there was more traffic using Howlett Way and High Road and in particular, more HGV traffic using Howlett Way and High Road on route to the docks. Therefore, the measured noise levels for Howlett Way and the junction with High Road represent a worst-case scenario.

9.2 An Initial Site Noise Risk Assessment required by the ProPG shows that the land immediately adjacent to Howlett Way falls within the category of High risk during both the day and night, for which the guidance is *"High noise levels indicate that there is an increased risk that development may be refused on noise grounds. This risk may be reduced by following a good acoustic design process that is demonstrated in a detailed ADS. Applicants are strongly advised to seek expert advice."* The lower noise levels across the remainder of the site represents a low noise risk.

9.3 Windows facing Howlett Way will need to provide a minimum sound reduction (R_{TRA}) of no more than 31 dB R_{TRA} in order to achieve BS8233's internal L_{Aeq} and L_{Amax} noise levels. Data for the sound insulation performance of different window configurations indicates that an appropriate window design capable of providing a sound reduction of 31 dB would be 6/12/7 in acoustic laminate, where the information is presented in terms of the thickness of one pane of glass in mm, followed by the size of the air gap, followed by the thickness of the second pane of glass. Window manufacturers will be able to provide certification showing which of their window designs are capable of achieving the required sound reductions.

9.4 With regards to the new apartments facing Howlett Way, noise levels at higher floors can typically increase by 1 dB due to contributions coming from a greater angle of exposure. Therefore, for habitable rooms on the upper floors of new apartments facing Howlett Way, a slightly higher window specification is recommended, and a specification such as 10/12/6 would be capable of providing an overall sound reduction of 32 dB R_{TRA}, which would similarly enable all internal noise standards to be met.

9.5 Opening windows for ventilation purposes would reduce the insulation provided by the building façade and internal noise levels would then exceed the design standards, although this situation is not unusual for residential areas within the urban environment where transportation noise is prevalent. Passive acoustic ventilators, such as acoustic trickle vents in the window frames or acoustic airbrick type vents within the walls, can be used for habitable rooms that have windows having an unscreened view towards Howlett Way. These would enable occupiers to obtain natural ventilation with windows closed, without any loss of amenity due to noise intrusion.

9.6 For acoustic trickle vents in windows providing a sound reduction of 31 dB R_{TRA}, the vent, when open, should be selected to at least provide 43 dB $D_{n,e,w}$, whereas the equivalent acoustic vent for windows providing 32 dB should be capable of providing a value of at least 44 dB $D_{n,e,w}$ when open.

9.7 The illustrative Site Layout Plan indicates dwelling frontages facing Howlett Way, with private gardens used for amenity purposes located behind and thereby experiencing additional distance attenuation as well as screening from the dwellings themselves. In this scenario, a conservative attenuation of 10 dB(A) would apply and, together with the additional distance attenuation, would result in an outdoor noise level of approximately 58 dB L_{Aeq} for garden areas, which would slightly exceed the BS8233/WHO outdoor criterion of 55 dB. However, this needs to be considered against the expressed caveats, namely that achievement of the WHO guideline values in urban areas would often require drastic action to virtually eliminate road traffic noise and other forms of transportation noise (including public transport) from the vicinity of houses, and that there is no evidence that anything other than a small minority of the population exposed at such noise levels find them to be particularly onerous in the context of their daily lives. The latest guidance from BS8233:2014 is that *"In such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces, but should not be prohibited."*

9.8 Any residual garden areas having a partial unscreened view to the road should have at least a 1.8m high close-boarded timber fence or equivalent structure along the garden boundary to minimise the noise impacts. This would typically provide an attenuation of 7 dB(A) and would minimise the impact of noise in accordance with the guidance of BS8233.

9.9 For new dwellings facing the A14 slip road, windows facing the road will need to provide a minimum sound reduction (R_{TRA}) of 15 dB for living rooms and 26 dB for bedrooms in order to achieve BS8233's internal L_{Aeq} and L_{Amax} noise levels. Data for the sound insulation performance of different window configurations indicates that appropriate window designs capable of providing sound reductions of 15 dB and 26 dB are normal thermal double glazing having a configuration of 4/12/4 or 4/16/4 for living rooms and a configuration of 6/12/6 for bedrooms. Acoustic vents would need to provide respective sound reductions of at least 37 dB and 38 dB $D_{n,e,w}$ when open.

9.10 With private gardens used for amenity purposes located behind new dwellings, the screened outdoor noise level of approximately 44 dB L_{Aeq} for garden areas would satisfy the BS8233/WHO outdoor criterion of 55 dB.

9.11 Once again, any residual garden areas having a partial unscreened view to the road should have at least a 1.8m high close-boarded timber fence or equivalent structure along the garden boundary to minimise the traffic noise impacts.

9.12 Dwellings further into the site will experience lower noise levels due to the additional distance attenuation and the screening provided by dwellings located adjacent to Howlett Way and the A14 slip road. As a consequence, acceptable internal noise levels will be achieved using normal thermal double glazing, and the outdoor noise criterion will be met at all locations.

9.13 There are no other outstanding noise issues, therefore, the overall conclusion of the assessment is that the decision maker may grant planning permission with conditions where appropriate.

Air Quality

9.14 The assessment results indicate that annual mean NO_2 and PM_{10} concentrations are predicted to remain below the annual mean objective at all assessed receptor locations, and that the effects of traffic generated by development would be negligible.

9.15 Therefore, since the air quality assessment indicates that the annual mean air quality objective will be met at the most exposed receptor locations, and since the actual changes due to traffic generated by development are small and not significant, it can be concluded that the air quality at the proposed site is acceptable for development and development traffic will not lead to significant adverse impact upon existing air quality.

APPENDIX A

SITE LOCATION PLAN AND NOISE MONITORING POSITIONS

APPENDIX B

NORTH

NOTES

This drawing to be read in accordance with the specification/Bills of Quantities and related drawings.

No Dimensions to be scaled from this drawing. All stated dimensions to be verified on site and the Architect notified of any discrepancies.

0 100

Scale bar 100mm at 1:1

NOTE: TREES LOCATED IN PRIVATE PLOTS ARE SHOWN INDICATIVELY; TREES IN PUBLIC AREAS ARE PROPOSED.

KEY:

- FLATS
- HOUSES
- PROPOSED DRAINAGE BASINS
- PROPOSED ZEBRA CROSSING
- EXISTING MATURE TREES (UN-SURVEYED)
- EXISTING PUBLIC RIGHT OF WAY (SHOWN BLUE DOTTED)

FOR PLANNING

REV	DATE	NOTE	IN
A	01/20	UPDATES TO VILLAGE GREEN	JH

Project

TRIMLEY ST MARTIN
LAND OFF HOWLETT WAY
RESIDENTIAL DEVELOPMENT

Title

ILLUSTRATIVE SITE LAYOUT

Scale 1:1000 @A1

Date Dec 2019

Drawn SD

Checked AL

Drawing Number 7845/P101

Revision A

Saunders
Architecture + Urban Design

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APPENDIX C

DESCRIPTION OF NOISE UNITS

- The sounds that we hear are a result of successive air pressure changes. These air pressure changes are generated by vibrating sources, such as motor vehicle engines, and they travel to a receiver, i.e. the human ear, as air pressure waves.

- The human ear is capable of detecting a vast range of air pressures, from the lowest sound intensity that the normal ear can detect (about 10^{-12} watts/m^2) to the highest that can be withstood without physical pain (about 10 watts/m^2). If we were to use a linear scale to represent this range of human sensitivity it would encompass a billion units. Clearly this would be an unmanageable scale yielding unwieldy numbers.

- The scale can be compressed by converting it to a logarithmic or Bel scale, the number of Bels being the logarithm to the base 10 of one value to another (as applied by Alexander Graham Bell to measure the intensity of electric currents). The Bel scale gives a compressed range of 0 to 12 units which in practice is a little too compressed. A change of 1 Bel represents a doubling or halving of loudness to the average listener. A more practical operating range of 0 to 120 is obtained by multiplying by 10, i.e. 10 x Bel, which produces the scale units known as decibels or dB.

- Examples of typical sound intensity levels within the decibel range of 0 to 120 dB are listed below:

Four engine jet aircraft at 100m	120 dB
Riveting of steel plate at 10m	105 dB
Pneumatic drill at 10m	90 dB
Circular wood saw at 10m	80 dB
Heavy road traffic at 10m	75 dB
Telephone bell at 10m	65 dB
Male speech, average at 10m	50 dB
Whisper at 10m	25 dB
Threshold of hearing, 1000 Hz	0 dB

- Due to this logarithmic scale noise levels have to be combined logarithmically rather than arithmetically. For example, two equal sound sources of 70 dB each, when operated simultaneously, do not produce a combined level of 140 dB but instead result in a level of 73 dB, i.e. a rise of 3 dB for each doubling of sound intensity.

Subjectively, a 3 dB change does not represent a doubling or halving of loudness; to make a sound appear twice as loud requires an increase in sound pressure level of about 10 dB.

- The sensitivity of the human ear to different acoustic frequencies of sound can be taken into account when measuring or calculating noise by applying a filter or weighting which equates to the frequency response of the human ear. This is referred to as an A-weighting and when applied results in noise levels expressed as dB(A). dB(A) noise levels reflect the human perception of loudness.

- Due to the often broadband and variable nature of environmental noises such as traffic, people exposed to different levels of noise do not make consistently different judgements about the noise climate until the difference in average noise level is about 3 dB(A). This is equivalent to a doubling of sound energy or, for example, a doubling of traffic flow. However, individuals are able to detect much lesser changes in noise exposure in any given situation and under ideal conditions can detect differences of as little as 1dB.

- Noise levels that fluctuate over time can be measured using a variety of noise indices. One index that correlates fairly well with community annoyance due to road traffic noise is the $L_{A10\ (18\text{-hour})}$ noise index. The L_{A10} is the A-weighted sound level exceeded for 10% of the time, and the $L_{A10\ (18\text{-hour})}$ is the arithmetic mean of the 18 hourly L_{A10} values during the period 6am to midnight (0600 to 2400 hours).

- An alternative index used in the UK to characterise intermittent sources of noise such as railways or construction sites is the equivalent continuous noise level, L_{Aeq}. It is a measure of the total sound energy generated by a fluctuating sound signal within a given time period and can be derived by 'spreading' the total sound energy evenly over the same time period as the fluctuating signal, hence the term 'equivalent continuous noise level'.

- Other useful noise units include the L_{Amax}, which is the maximum A-weighted sound level often used to characterise single events, and the L_{A90} which is the level of noise exceeded for 90% of the time and is an indicator of the background noise levels in the absence of specific sources such as traffic.

APPENDIX D

Date	L_{Aeq}	L_{Amax}	L_{A01}	L_{A10}	L_{A90}
Position 1 Day					
(2018/01/11 12:16:10.00)	58.1	69.9	62.1	60.2	55.7
(2018/01/11 12:21:10.00)	57.7	64.4	62.8	60	55.1
(2018/01/11 12:26:10.00)	57.3	75.8	61.7	59.2	54.4
(2018/01/11 12:31:11.00)	58.3	62.1	61.2	60	56.5
(2018/01/11 12:36:11.00)	57.7	69.6	62.5	60	54.4
(2018/01/11 12:41:11.00)	57.8	65.3	62	60.2	54.9
(2018/01/11 12:46:11.00)	57.6	67.2	61.9	59.4	55.2
(2018/01/11 12:51:12.00)	57.1	68.1	61.8	58.7	54.8
(2018/01/11 12:56:12.00)	57.3	61.4	60.7	59.4	54.9
(2018/01/11 13:01:13.00)	58.1	65.9	61.9	59.7	55.9
(2018/01/11 13:06:13.00)	58.5	74.6	62.2	60.4	55.7
(2018/01/11 13:11:13.00)	58.1	62.8	61.5	60	55.8
(2018/01/11 13:16:14.00)	57.2	71.8	62.7	58.9	54
(2018/01/11 13:21:14.00)	57.3	62.6	61.2	59	55.4
(2018/01/11 13:26:14.00)	57.5	65.3	60.7	59.2	55.3
(2018/01/11 13:31:14.00)	57.2	62.6	61.2	59.5	54.5
(2018/01/11 13:36:15.00)	57.3	67.6	61.8	59.3	54.9
(2018/01/11 13:41:15.00)	58	62.8	61.8	60.2	55.3
(2018/01/11 13:46:15.00)	58.1	64.3	62.4	59.5	56
(2018/01/11 13:51:16.00)	57.7	62.9	62.1	59.5	55.4
(2018/01/11 13:56:16.00)	57.7	64	63.3	59.5	55.3
(2018/01/11 14:01:16.00)	56.9	62.1	60.9	58.5	54.6
(2018/01/11 14:06:17.00)	57.1	63.8	61.7	59	54.6
(2018/01/11 14:11:17.00)	57.3	63.2	62	59.7	54.4
(2018/01/11 14:16:17.00)	56.7	65.2	61.3	59.1	53.9
(2018/01/11 14:21:17.00)	56.1	62.5	61	58.2	52.9
(2018/01/11 14:26:18.00)	56.9	70.5	62.8	59	53.5
(2018/01/11 14:31:18.00)	56.9	65.8	62.1	59.2	54.4
(2018/01/11 14:36:19.00)	56.5	60.9	60.1	58.8	53.6
(2018/01/11 14:41:19.00)	68.6	90.1	84.3	60.6	53
(2018/01/11 14:46:19.00)	57.5	62.7	61.2	59.2	54.8
(2018/01/11 14:51:19.00)	58.1	64.3	61.8	59.8	56
(2018/01/11 14:56:20.00)	58.2	64	62.2	59.9	55.7
(2018/01/11 15:01:20.00)	58	62.6	61.5	59.4	55.8
(2018/01/11 15:06:21.00)	58.3	62.8	61.6	60.1	55.8
(2018/01/11 15:11:21.00)	57.9	63.5	62	59.8	55.4
Average	57.9	66	62.4	59.5	54.9
Maximum	68.6	90.1	84.3	60.6	56.5
Position 1 Night					
(2018/01/12 00:02:28.00)	49.1	79	56.2	49.9	35.6
(2018/01/12 00:07:29.00)	45.8	58.5	56.9	49.6	35.6
(2018/01/12 00:12:29.00)	43.4	53.6	52.7	47.3	35.5
(2018/01/12 00:17:29.00)	44.6	52.8	50.9	48.5	36.7
(2018/01/12 00:22:30.00)	48.6	63.2	61.8	49.6	34.5
(2018/01/12 00:27:30.00)	44.7	52.7	51.6	49.2	36.2
(2018/01/12 00:32:30.00)	45.5	58.2	56.9	48.7	37.8
(2018/01/12 00:37:31.00)	46	55.3	52.7	50.2	34.5
(2018/01/12 00:42:31.00)	44.5	51.8	51	48.7	35.8
(2018/01/12 00:47:31.00)	43.8	52.8	51.8	48.6	33
(2018/01/12 00:52:31.00)	43.9	52.5	51.3	47.9	35.5
(2018/01/12 00:57:32.00)	44.3	56.3	54.8	48.8	34.8
(2018/01/12 01:02:32.00)	44.5	55.6	53.9	48.6	35.4

(2018/01/12 01:07:32.00)	46.3	56	53	49.9	37.5
(2018/01/12 01:12:32.00)	44.6	55.8	53.3	48.1	38.2
Average	45.3	56.9	53.9	48.9	35.8
Maximum	49.1	79	61.8	50.2	38.2
Position 2 Day					
12/01/2018 11:21	69.6	80.3	78	74.7	56.2
12/01/2018 11:26	69.3	82.4	79.1	74.3	54.8
12/01/2018 11:31	68.7	80.7	78.5	74	55.3
12/01/2018 11:36	69.2	80.7	78.6	74.7	55.3
12/01/2018 11:41	68.5	79.8	78.2	73.8	53.2
12/01/2018 11:46	70.1	80.2	78.8	75	55.7
12/01/2018 11:51	69.2	83	79.5	74.2	54.2
12/01/2018 11:56	70.3	83.9	79.2	75.1	54.8
12/01/2018 12:01	70.7	83.5	79.7	75	55.3
12/01/2018 12:06	70.7	82.2	79.3	75.4	54.4
12/01/2018 12:11	71.2	83.3	79.6	75.7	55.6
12/01/2018 12:16	71.1	82.3	80	75.9	55.7
12/01/2018 12:21	71.5	84.6	79.7	76.4	54.8
12/01/2018 12:26	70.1	80.6	78	74.8	54.2
12/01/2018 12:31	69.8	83.4	79.6	75	53
12/01/2018 12:36	69.5	80.4	78.7	74.5	53.9
12/01/2018 12:41	69.7	82.7	79.2	74.7	52.5
12/01/2018 12:46	71	81.6	78.8	75.8	54.6
12/01/2018 12:51	70	81.7	78.6	75	53.4
12/01/2018 12:56	72.7	92.2	80.2	76.3	53.7
12/01/2018 13:01	71.5	83.5	80	76.1	55.4
12/01/2018 13:06	71.3	82.2	79.6	76.3	54.8
12/01/2018 13:11	72.3	84.1	79.9	77.1	55
12/01/2018 13:16	70.8	82.8	79.7	75.5	54.6
12/01/2018 13:21	71.2	84.2	79.7	76.1	53.2
12/01/2018 13:26	70	83.4	79.3	75	52.6
12/01/2018 13:31	71	82.7	79.5	75.7	53.8
12/01/2018 13:36	69.6	80.6	78.8	75	51.3
12/01/2018 13:41	69	80.8	78	73.8	52.3
12/01/2018 13:46	69.4	81	79.4	74.9	51.1
12/01/2018 13:51	71.7	83	80.7	76.4	53.3
12/01/2018 13:56	71.6	83.6	80	76	53
12/01/2018 14:01	69.5	80.8	78.6	75	49.6
12/01/2018 14:06	70.2	80.9	78.3	74.9	53.2
12/01/2018 14:11	69.6	80.5	78.1	74.5	53.9
12/01/2018 14:16	70.6	81.6	79.8	75.4	53.4
Average	70.3	82.4	79.2	75.2	53.9
Maximum	72.7	92.2	80.7	77.1	56.2
Position 2 Night					
12/01/2018 00:10	55.4	76.6	69	48.6	36.1
12/01/2018 00:15	57.4	78.1	72.3	49.5	37.2
12/01/2018 00:20	60.8	83.1	74.8	51.8	38.8
12/01/2018 00:25	65	82.3	79.8	64.3	36.3
12/01/2018 00:30	61.2	80.8	76.8	54.9	38
12/01/2018 00:35	59.4	79.6	74	56.1	38.8
12/01/2018 00:40	59.1	80.6	73	47.8	36.5
12/01/2018 00:45	61.2	82.4	75.4	47	33.8
12/01/2018 00:50	64.8	82.1	79.7	61	37.9
12/01/2018 00:55	59.8	82.8	72.6	45.7	35.2

12/01/2018 01:00	41.7	57.5	49.1	44.8	35.5
12/01/2018 01:05	58.7	80	72.7	48.8	36.2
Average	58.7	78.8	72.4	51.7	36.7
Maximum	65	83.1	79.8	64.3	38.8
Position 3 Day					
(2018/01/12 11:27:43.00)	60.4	75.2	65.9	63.3	53.7
(2018/01/12 11:32:43.00)	60.9	68.7	67.1	64.4	54.1
(2018/01/12 11:37:43.00)	61.7	72.9	70.2	64.3	55.4
(2018/01/12 11:42:44.00)	60.5	70.3	66.5	63.4	53.9
(2018/01/12 11:47:44.00)	61.3	70.9	67.2	64.7	54.5
(2018/01/12 11:52:44.00)	61.8	73.4	70.7	64.6	55.8
(2018/01/12 11:57:44.00)	62.4	77.1	72.1	64.6	54.6
(2018/01/12 12:02:45.00)	63.5	75.3	72	66.4	56.6
(2018/01/12 12:07:45.00)	62.5	74	71.7	65.2	55.4
(2018/01/12 12:12:46.00)	65.2	85.8	75.2	66.5	55.5
(2018/01/12 12:17:46.00)	61.7	70.3	67.2	65	55.5
(2018/01/12 12:22:47.00)	62.5	74.9	68.8	65.5	56.7
(2018/01/12 12:27:47.00)	61.9	72.1	68.1	64.8	55.1
(2018/01/12 12:32:48.00)	61.9	76.6	71	64.8	54.8
(2018/01/12 12:37:48.00)	60.9	69.8	67.8	64.4	54.1
(2018/01/12 12:42:49.00)	62.3	73.9	71	65.2	51.9
(2018/01/12 12:47:49.00)	61.7	77.2	69.5	64.7	52.7
(2018/01/12 12:52:49.00)	62.1	71.2	68.7	65.3	55.5
(2018/01/12 12:57:49.00)	64.3	80.8	77.4	65.2	55.6
(2018/01/12 13:02:50.00)	62.9	74	70.9	65.6	57.2
(2018/01/12 13:07:50.00)	62.4	70	68.3	65.2	57.4
(2018/01/12 13:12:50.00)	63.5	76.6	72.1	65.7	57.6
(2018/01/12 13:17:51.00)	62.9	77.7	73.1	64.9	55.3
(2018/01/12 13:22:51.00)	62.9	74.6	70.9	65.6	56.3
(2018/01/12 13:27:51.00)	61.4	74	69.6	64.3	54.1
(2018/01/12 13:32:52.00)	61.9	70.4	68.6	64.9	55.1
(2018/01/12 13:37:52.00)	61.8	73.7	70.8	64.8	53.7
(2018/01/12 13:42:52.00)	60	69.3	66.6	63.2	52.8
(2018/01/12 13:47:53.00)	61.4	67.9	66.9	64.9	54.3
(2018/01/12 13:52:53.00)	62.6	75	69.5	65.5	56.4
(2018/01/12 13:57:53.00)	62.1	71.4	69.5	64.9	56
(2018/01/12 14:02:54.00)	63.1	77.9	73.2	65.7	55.5
(2018/01/12 14:07:54.00)	61.7	75.6	71.5	64.4	53
(2018/01/12 14:12:54.00)	60.8	70.3	67.2	64.3	54.6
(2018/01/12 14:17:55.00)	62.6	79	69	65.6	55.3
(2018/01/12 14:22:55.00)	62.6	70.8	68.1	65.7	56.3
(2018/01/12 14:27:55.00)	63.1	64.7	-	64	61.6
(2018/01/12 14:35:53.00)	49.9	69.3	54.6	50.6	48.1
(2018/01/12 14:40:53.00)	51.8	61.5	58.7	54.6	48
Average	61.6	73.2	69.1	64.3	54.9
Maximum	65.2	85.8	77.4	66.5	61.6
Position 3 Night					
(2018/01/12 01:27:26.00)	63	78.9	73.1	68.1	41
(2018/01/12 01:32:26.00)	57.6	75.7	72.9	51.2	38.2
(2018/01/12 01:37:26.00)	63.7	76.4	73.5	69.2	41.2
(2018/01/12 01:42:26.00)	59.3	76.1	71.2	64	41.6
(2018/01/12 01:47:27.00)	63.2	83.3	74	67.3	40.5
(2018/01/12 01:52:27.00)	62.8	77.8	73.9	67.5	41.7
(2018/01/12 01:57:27.00)	65.1	79.9	74.7	70.9	41.4

(2018/01/12 02:02:27.00)	61.8	76.2	72.4	66.7	42.5
(2018/01/12 02:07:28.00)	61.9	78.2	72.3	68	42.5
(2018/01/12 02:12:28.00)	66	83.8	75	71.8	44.1
(2018/01/12 02:17:28.00)	64.7	81.4	75	70.3	43.8
(2018/01/12 02:22:28.00)	64.6	87	75.1	70.6	43.1
Average	62.8	79.6	73.6	67.1	41.8
Maximum	66	87	75.1	71.8	44.1
Position 4 Day					
(2018/01/11 15:22:04.00)	58.2	68.6	62.7	61	53.9
(2018/01/11 15:27:04.00)	58.6	65.2	63.1	60.8	54.6
(2018/01/11 15:32:04.00)	59	68.1	65.6	61	55.8
(2018/01/11 15:37:05.00)	58.3	62.9	61.6	60.5	55
(2018/01/11 15:42:05.00)	59.5	75.6	63	61.6	56
(2018/01/11 15:47:05.00)	59.5	64.1	63.1	61.6	56.1
(2018/01/11 15:52:05.00)	58.7	64	62.6	60.6	55.3
(2018/01/11 15:57:06.00)	58.7	74.6	62.6	60.6	56
(2018/01/11 16:02:06.00)	58.1	70.2	61.7	60.4	54.3
(2018/01/11 16:07:07.00)	58	62.7	61.6	60	54.6
(2018/01/11 16:12:07.00)	58.2	64.4	62.7	60.3	54.1
(2018/01/11 16:17:07.00)	58.2	73.4	62	60.2	54.9
Average	58.6	67.8	62.7	60.7	55.1
Maximum	59.5	75.6	65.6	61.6	56.1
Position 5 Day					
(2018/01/12 15:04:28.00)	51.7	61.6	55.6	53.2	49.9
(2018/01/12 15:09:29.00)	53.8	68.4	58	55.3	51.7
(2018/01/12 15:14:29.00)	53.3	62.3	56	54.7	51.5
(2018/01/12 15:19:29.00)	58.9	90.8	56.7	53.7	50.8
(2018/01/12 15:24:30.00)	52.6	59.4	56	54.1	51.1
(2018/01/12 15:29:30.00)	54	65.4	59.2	55.5	52
Average	54.1	68	56.9	54.4	51.2
Maximum	58.9	90.8	59.2	55.5	52

APPENDIX E

Indicative Sound Insulation Performance of Different Window Configurations

Third octave band centre frequency Hz	Sound Insulation (dB) for Glass Thickness (mm)																					
	4/16/4 or 4/12/4		6/12/6		6/12/6.4 PVB		10/12/4		10/12/6		10/12/6.4 PVB		Acoustic Laminate									
													6/12/7		6/12/11		10/12/16		13/12/13		16/12/16	
100	25		17		19		23		27		27		25		26		26		30		31	
125	24	24	26	20	24	21	28	25	27	26	28	27	27	26	25	26	28	27	27	28	34	32
160	23		22		21		26		24		26		26		25		26		27		33	
200	21		18		19		19		24		26		23		25		24		31		34	
250	21	20	18	19	19	20	23	22	29	27	30	29	24	25	28	28	28	27	38	34	38	37
315	19		24		24		26		31		32		28		32		31		39		39	
400	22		27		28		31		33		34		30		35		34		41		43	
500	25	25	29	29	32	31	33	33	34	34	36	36	34	33	39	38	38	37	44	44	46	45
630	30		33		34		36		37		40		37		43		41		48		48	
800	33		37		38		39		39		41		42		46		44		51		50	
1000	36	35	39	38	40	39	41	40	41	40	42	41	45	44	47	47	45	45	53	52	48	46
1250	38		39		40		41		41		41		46		47		46		52		43	
1600	40		39		39		41		39		41		46		46		44		49		43	
2000	41	38	34	36	35	37	45	43	37	38	42	42	45	46	43	43	42	44	45	47	46	46
2500	35		37		39		45		40		44		48		42		44		48		50	
3150	31		42		44		42		43		49		51		47		51		52		53	
4000	40	35	47	45	49	47	44	44	47	46	53	52	52	52	54	51	56	54	57	55	59	57
R_m dB	29		30		31		34		34		36		36		37		39		42		42	
R_w dB	31		33		34		36		38		40		38		41		42		45		46	
R_{TRA} dBA	25		26		27		29		32		34		31		33		37		38		41	

Notes:
1. The glass thickness is presented in terms of the thickness of one pane of glass, followed by the size of the air gap, followed by the thickness of the second pane of glass, all dimensions in millimetres.
2. 6.4mm PVB glass denotes a laminated glass consisting of a tough plastic interlayer made of polyvinyl butyral (PVB) bonded together between two panes of glass.

APPENDIX F

DEFINITION OF AIR QUALITY TERMS AND UNITS

ppm parts per million - defines the units of pollution in every million (10^6) units of air.

ppb parts per billion - defines the units of pollution in every billion (10^9) units of air.

$\mu g/m^3$ microgrammes per cubic metre - one microgramme is one millionth of a gram.

ng/m^3 nanogrammes per cubic metre – one nanogramme is one milliardth (i.e. one thousand millionth of a gram (10^{-9}))

Annual mean the average of the concentrations measured for one year.

1-hour mean the average of the concentrations measured for one hour.

24-hour mean the average of the concentrations measured for twenty four hours.

Running mean the mean or series of means calculated for overlapping time periods. For example, an 8-hour running mean is calculated every hour and averages the values for eight hours. The period of averaging is stepped forward by one hour for each subsequent value so that a degree of overlap exists between successive values. Non-running means are calculated for consecutive time periods so that there is no overlap.

Percentile a value that establishes a particular threshold in a collection of data. For example, the 90th percentile of yearly values is the value that 90% of all the data in the year fall below or equal.

Exceedance a period of time when the concentration of a pollutant is greater than, or equal to, the relevant air quality standard.

APPENDIX G

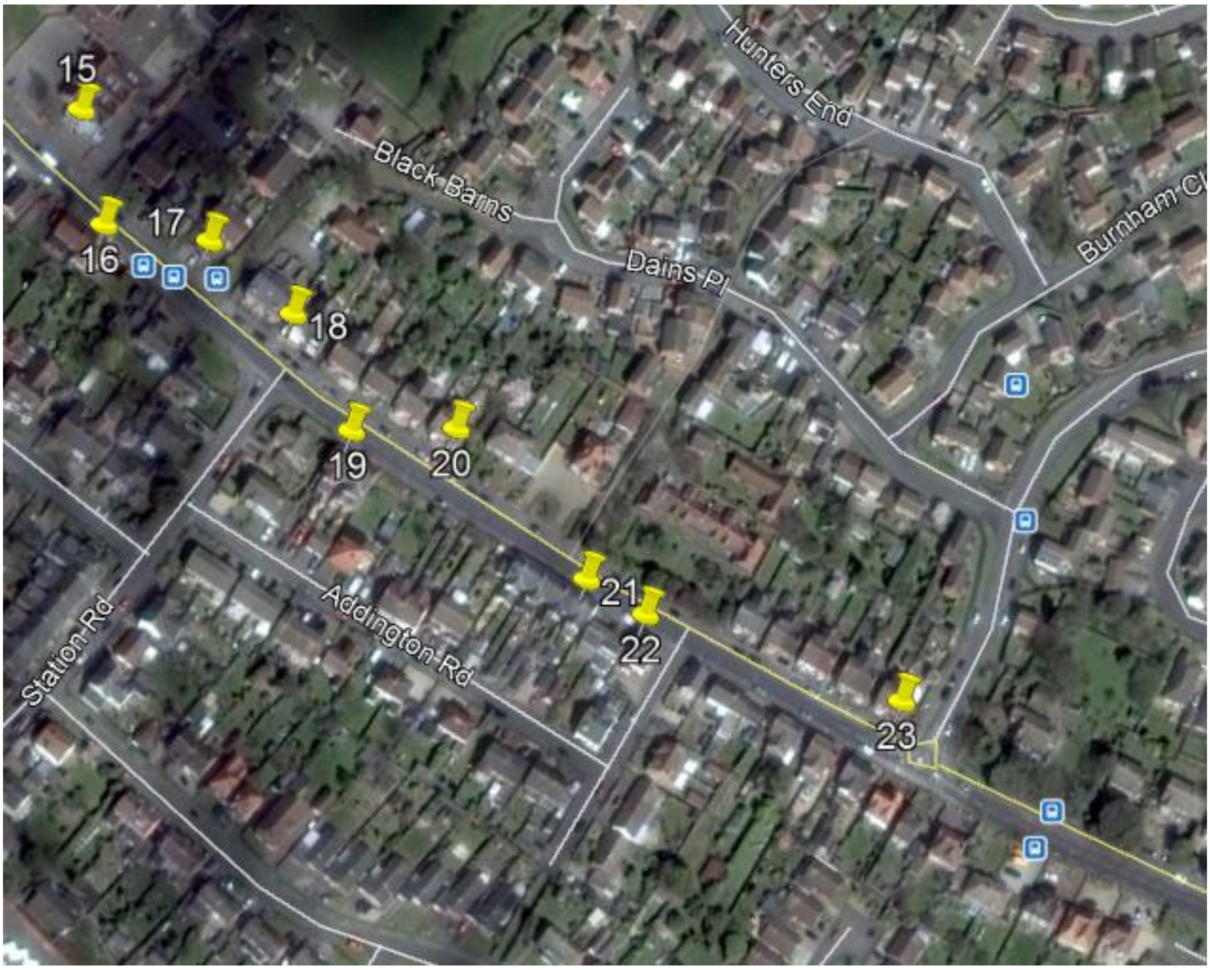
Verification

All Receptors

Receptors 1-5, 44-53

Receptors 6-14

Receptors 15-23

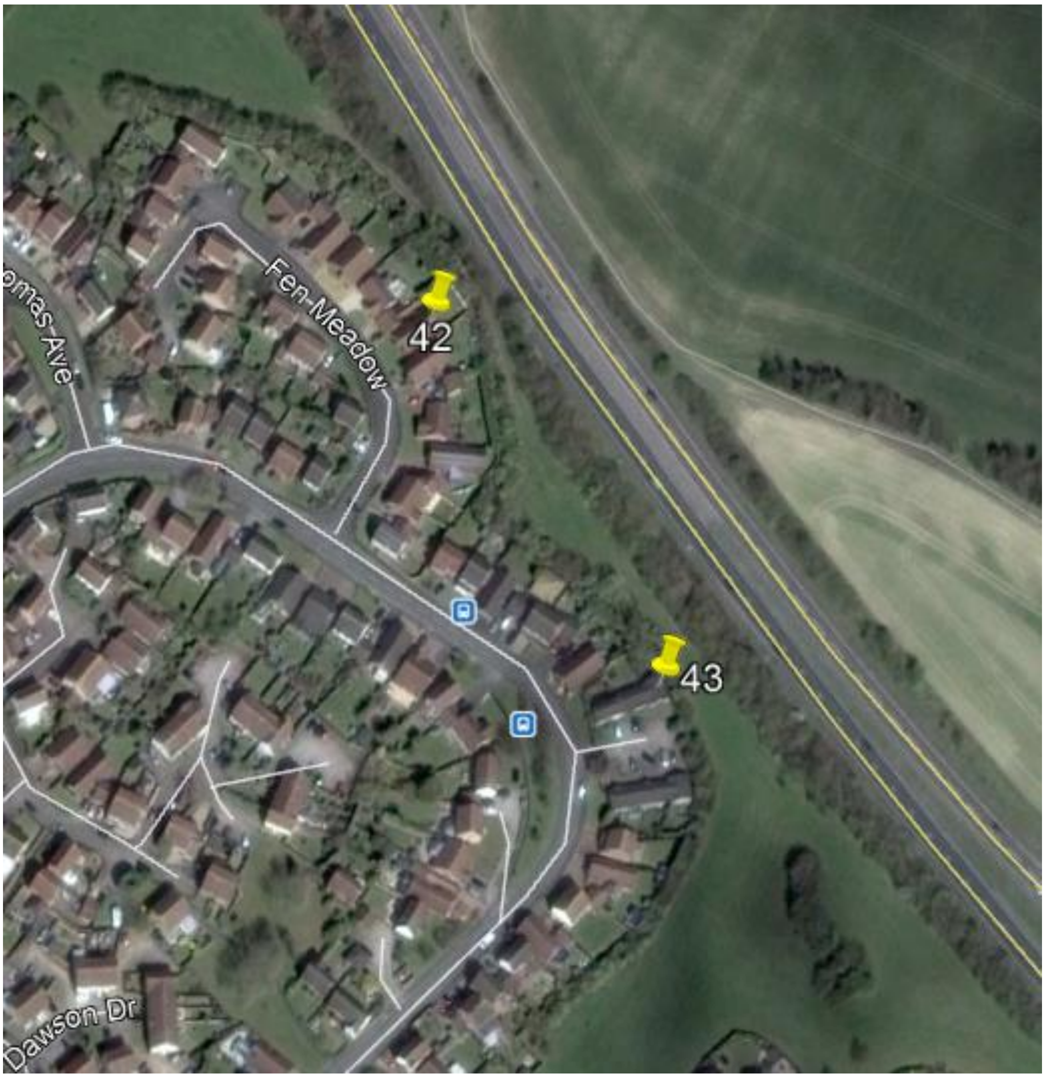


Receptors 24-29

Receptors 30-38

Receptors 39-41

Receptors 42-43



APPENDIX H

Verification

Link ID	Links	Speed (Kph)	Overall AADT	LDV AADT	Hourly	HGV	Hourly	Width (m)
1	Howlett Way A Northeast	20	8306	7768	324	538	22	6
2		50	8306	7768	324	538	22	6
3		20	8306	7768	324	538	22	6
4	Howlett Way B Southwest	20	8222	7657	319	565	24	6
5		50	8222	7657	319	565	24	6
6		20	8222	7657	319	565	24	6
7	Candlet Road C	20	18111	17224	718	887	37	8
8		117	18111	17224	718	887	37	8
9	High Road 1	20	9223	9020	376	203	8	6
10		50	9223	9020	376	203	8	6
11		20	9223	9020	376	203	8	6
12		20	9223	9020	376	203	8	6
13		50	9223	9020	376	203	8	6
14		20	9223	9020	376	203	8	6
15	High Road 2	20	8223	8032	335	191	8	6
16		50	8223	8032	335	191	8	6
17		20	8223	8032	335	191	8	6
18		20	8223	8032	335	191	8	6
19		50	8223	8032	335	191	8	6
20		20	8223	8032	335	191	8	6
21	High Road 3	20	9041	8856	369	185	8	6
22		50	9041	8856	369	185	8	6
23		20	9041	8856	369	185	8	6
24		50	9041	8856	369	185	8	6
25		20	9041	8856	369	185	8	6
26		50	9042	8857	369	185	8	6
27	A14 eastbound	117	18190	14625	609	3565	149	10
28		20	18190	14625	609	3565	149	6
29	A14 Westbound	117	17871	14511	605	3360	140	10
30		20	17871	14511	605	3360	140	6
31	A14 sliproad off westbound	90	2533	2492	104	41	2	6
32		20	2533	2492	104	41	2	6
33	A14	15	11881	8578	357	3303	138	25
34		100	11881	8578	357	3303	138	20

2023 Do Nothing

Link ID	Links	Speed (Kph)	Overall AADT	LDV AADT	Hourly	HGV	Hourly	Width (m)
1	Howlett Way A Northeast	20	8839	8266	344	573	24	6
2		50	8839	8266	344	573	24	6
3		20	8839	8266	344	573	24	6
4	Howlett Way B Southwest	20	8750	8385	349	365	15	6
5		50	8750	8385	349	365	15	6
6		20	8750	8385	349	365	15	6
7	Candlet Road C	20	19688	18724	780	964	40	8
8		117	19688	18724	780	964	40	8
9	High Road 1	20	9815	9599	400	216	9	6
10		50	9815	9599	400	216	9	6
11		20	9815	9599	400	216	9	6
12		20	9815	9599	400	216	9	6
13		50	9815	9599	400	216	9	6
14		20	9815	9599	400	216	9	6
15	High Road 2	20	8751	8548	356	203	8	6
16		50	8751	8548	356	203	8	6
17		20	8751	8548	356	203	8	6
18		20	8751	8554	356	203	8	6
19		50	8751	8554	356	203	8	6
20		20	8751	8554	356	203	8	6
21	High Road 3	20	9621	9424	393	197	8	6
22		50	9621	9424	393	197	8	6
23		20	9621	9424	393	197	8	6
24		50	9621	9424	393	197	8	6
25		20	9621	9424	393	197	8	6
26		50	9621	9424	393	197	8	6
27	A14 eastbound	117	19560	15727	655	3834	160	10
28		20	19560	15727	655	3834	160	6
29	A14 Westbound	117	19217	15604	650	3613	151	10
30		20	19217	15604	650	3613	151	6
31	A14 sliproad off westbound	90	2724	2680	112	44	2	6
32		20	2724	2680	112	44	2	6
33	A14	15	12661	9141	381	3520	147	25
34		100	12661	9141	381	3520	147	20

2023 Do Something

Link ID	Links	Speed (Kph)	Overall AADT	LDV AADT	Hourly	HGV	Hourly	Width (m)
1	Howlett Way A Northeast	20	9539	9142	381	397	17	9539
2		50	9539	9142	381	397	17	9539
3		20	9539	9142	381	397	17	9539
4	Howlett Way B Southwest	20	9443	8870	370	573	24	9443
5		50	9443	8870	370	573	24	9443
6		20	9443	8870	370	573	24	9443
7	Candlet Road C	20	24517	23553	981	964	40	24517
8		117	24517	23553	981	964	40	24517
9	High Road 1	20	10476	10260	428	216	9	10476
10		50	10476	10260	428	216	9	10476
11		20	10476	10260	428	216	9	10476
12		20	10476	10260	428	216	9	10476
13		50	10476	10260	428	216	9	10476
14		20	10476	10260	428	216	9	10476
15	High Road 2	20	9340	9137	381	203	8	9340
16		50	9340	9137	381	203	8	9340
17		20	9340	9137	381	203	8	9340
18		20	9340	9137	381	203	8	9340
19		50	9340	9137	381	203	8	9340
20		20	9340	9137	381	203	8	9340
21	High Road 3	20	10269	10072	420	197	8	10269
22		50	10269	10072	420	197	8	10269
23		20	10269	10072	420	197	8	10269
24		50	10269	10072	420	197	8	10269
25		20	10269	10072	420	197	8	10269
26		50	10269	10072	420	197	8	10269
27	A14 eastbound	117	19560	15727	655	3834	160	19560
28		20	19560	15727	655	3834	160	19560
29	A14 Westbound	117	19217	15604	650	3613	151	19217
30		20	19217	15604	650	3613	151	19217
31	A14 sliproad off westbound	90	2724	2680	112	44	2	2724
32		20	2724	2680	112	44	2	2724
33	A14	15	12661	9141	381	3520	147	12661
34		100	12661	9141	381	3520	147	12661

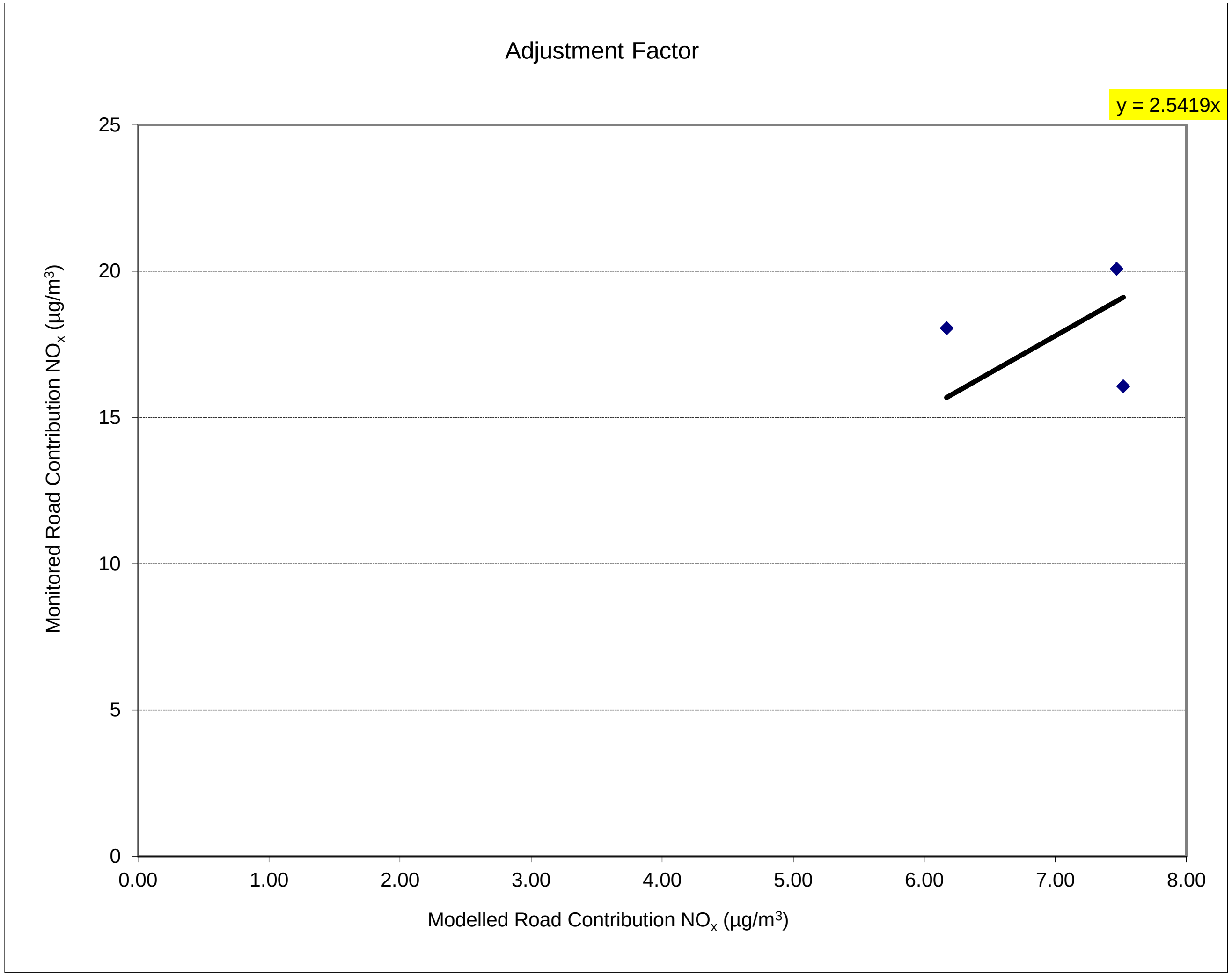
APPENDIX I

Verification (LAQM.TG 16)

	FLX40	FLC17/23/39
Background NO_2	11.40	12.59
Background NO_x	15.51	17.34

Site ID	Location		Modelled Road Contribution NO_x (ex-background)	Monitored Total NO_2	Monitored Road Contribution Nox*	Monitored Total NO_x	Ratio of Monitored Road Contribution NO_x / Modelled Road Contribution NO_x
	X (m)	Y (m)					
FLX17	628817	236323	7.52	21	16.07	33.41	2.1
FLX23	628542	236592	6.17	22	18.06	18.06	2.9
FLX39	628760	236071	7.47	23	20.08	20.08	2.7

Verification Factor	2.5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25
20
15
10
5
0
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
8.00
Monitored Road Contribution NO_x ($\mu g/m^3$)
Modelled Road Contribution NO_x ($\mu g/m^3$)

Civil Engineering

Transport

Road Safety

Flood Risk & Drainage

Structures

Geo-environmental

M-EC Acoustic Air

Utilities

M-EC Geomatics

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