



**LAND AT PAGHAM SOUTH,
WEST SUSSEX**

Noise and Air Quality Assessment

December 2016

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AcousticAir
Noise, Vibration & Air Quality Services

**LAND AT PAGHAM SOUTH,
WEST SUSSEX**

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for
Hanbury Properties

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1. INTRODUCTION

- 1.1 AcousticAir have been commissioned by Hanbury Properties to undertake a noise and air quality assessment for proposed residential development on land at Pagham South, West Sussex. The principal sources of noise and emissions affecting the site will be local road traffic. Figure 1 shows the site location relative to the potential emission sources.
- 1.2 The assessments presented in this report respond to the Local Planning Authority's (LPA) scoping opinion for the development, which stated that full noise and air quality assessments would not be required for an Environmental Statement (ES), but that the cumulative impacts of the development and other schemes in terms of noise, vibration, air quality and dust would need to be covered. The various local schemes that have been considered by this assessment are described in Table 1.1. The assessments take account of the traffic contributions due to developments and, in terms of construction effects, the distances between each of the sites.

Table 1.1: Committed and Proposed Developments

Approved but uncompleted projects		
Scheme	Location	Details/Status
251 Pagham Road & Land R/O Pagham PO21 3QB (P/125/14/PL)	Approx. 600m to the north of Pagham South	Demolition of existing dwelling & ancillary buildings & erection of 40 no. dwellings with associated access, car parking, cycle & refuse storage, hard & soft landscaping & amenity space. (Application approved June 2016).
Land at Summer Lane Pagham PO21 4NG (P/58/15/OUT)	Adjacent to sites northern boundary.	Outline application with some matters reserved for the erection of 90 No. dwellings with associated access & open space (approved September 2016).
Plans and projects which are reasonably foreseeable.		
Scheme	Location	Details/Status
Land West of Hook Lane, Pagham	Approx. 1.3km to the north-east of the site	Up to 300 new homes, an 80 bed care home (C2), a 2form entry primary school (D1), a day nursery (D1), formation of new vehicular access onto Hook Lane and Pagham Road, new pedestrian and cycle linkages, green infrastructure, drainage infrastructure and ancillary infrastructure.
Land North of Sefter Road	Approx. 2km to north-east of the site	Up to 280 dwellings, provision of land for a replacement scout hut, land for

		an Ambulance Community Response Post facility and land for a 1FE Primary school.
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- 1.3 In addition, the Environmental Health Department commented that an assessment of the potential noise impacts from existing noise sources on future residents would need to be assessed, taking into account road noise and other noise sources. The pre-application response from The LPA also included the following request:

Assessment of any noise which may impact future residents - in particular the residential units above the retail outlets (deliveries/type of retail outlet/hours of operation etc), but also including any times of use of the proposed recreation area.

- 1.4 Due to the outline nature of the planning application, much of the information needed to complete the requested assessments is not yet available, and such matters are normally controlled by routine planning conditions, as discussed later.
- 1.5 Following the Secretary of State's Screening Direction highlighting that an ES is not required for the development, this technical report provides the information requested by the LPA, namely, a noise assessment covering the impacts of road traffic and other local sources on new residents, and secondly, the cumulative noise and air quality impacts of Pagham South development in conjunction with other proposed developments. The latter have been undertaken using traffic data provided for relevant baseline and with development scenarios.
- 1.6 Section 2 of this report provides details of relevant national guidance on traffic noise, which is the principal source of noise affecting the site. The noise criteria applicable to cumulative noise effects, e.g. covering construction noise and traffic noise change, are also presented in Section 2. Section 3 presents the results of noise surveys undertaken for the site, and the assessment of noise on the proposed residential development is considered in Section 4 together with our recommendations for mitigation. Cumulative construction noise and traffic effects are also presented in Section 4.
- 1.7 The scope of the studies for the cumulative air quality assessment includes a dust risk assessment to define appropriate mitigation measures, and appropriate screening modelling of air pollutants with and without development traffic. Regard has also been given to the LPA's query as to whether the sewage treatment works (STW) to the northwest of the site is likely to affect the site by way of odours, as set out within the pre-application response letter.
- 1.8 Air quality standards are summarised in Section 5 and the air quality assessments for the proposed/cumulative developments is presented in Section 6. Overall conclusions for noise and air quality are presented in Section 7.

2. NOISE CRITERIA

Noise Terms and Units

- 2.1 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 I.
- 2.2 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.
- 2.3 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

- 2.4 The National Planning Policy Framework (NPPF), issued by the Department for Communities and Local Government in March 2012, 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.
- 2.5 With a key emphasis on sustainable development, the NPPF identifies those planning guidance documents that have been revoked and replaced by the Framework, and, in relation to environmental emissions, these include, amongst others, Planning Policy Statement 23: Planning and Pollution Control (2004) and Planning Policy Guidance 24: Planning and Noise (1994).
- 2.6 The NPPF's new guidance with respect to noise and emissions is that planning policies and decisions should aim to:
- Avoid noise from giving rise to significant adverse impacts on health and quality of life as a result of new development;
 - Mitigate and reduce to a minimum other adverse impacts on health and quality of life arising from noise from new development, including through the use of conditions;

- Recognise that development will often create some noise and existing businesses wanting to develop in continuance of their business should not have unreasonable restrictions put on them because of changes in nearby land uses since they were established; and
 - Identify and protect areas of tranquility, which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason.
- 2.7 In drawing up their Local Plans to implement the NPPF, Local Planning Authorities are advised that significant adverse impacts on any of the three key dimensions of sustainable development (economic, social and environmental) should be avoided and, wherever possible, alternative options which reduce or eliminate such impacts should be pursued. Where adverse impacts are unavoidable, measures to mitigate the impact should be considered, and where adequate mitigation measures are not possible, compensatory measures may be appropriate.
- 2.8 An important part of the guidance is that planning authorities are advised to focus on (i) whether the development itself is an acceptable use of the land, and (ii) the impact of the use, rather than the control of processes or emissions themselves where these are subject to approval under pollution control regimes. Local planning authorities should assume that these regimes will operate effectively. Equally, where a planning decision has been made on a particular development, the planning issues should not be revisited through the permitting regimes operated by pollution control authorities. Therefore, the NPPF guidance is that where some noise and/or emissions may be present, there are properly adequate forms of legislation, such as the Control of Pollution Act and the Environmental Protection Act etc., that can be readily employed to deal with such matters.
- 2.9 In addition, for the purposes of decision-taking, policies in existing Local Plans should not be considered out-of-date simply because they were adopted prior to the publication of the Framework.

Planning Practice Guidance

- 2.10 In March 2014 the Department for Communities & Local Government updated its on-line planning guidance to assist with interpretation of the NPPF. 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 2.1: 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 intrusive	Noise can be heard, but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.	No Observed Adverse Effect	No specific measures required
Lowest Observed Adverse Effect Level			
Noticeable and intrusive	Noise can be heard and causes small changes in behaviour and/or attitude, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
Significant Observed Adverse Effect Level			
Noticeable and disruptive	The noise causes a material change in behaviour and/or attitude, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.	Significant Observed Adverse Effect	Avoid
Noticeable and very disruptive	Extensive and regular changes in behaviour and/or an inability to mitigate effect of noise leading to psychological stress or physiological effects, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory	Unacceptable Adverse Effect	Prevent

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

- 2.11 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 2.2.

Table 2.2: 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 2.2 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 2.2 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 2.2.*

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.*

2.12 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 $L_{Aeq,T}$.”

2.13 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

- 2.14 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.
- 2.15 The WHO noise criteria for dwellings are summarised in Table 2.3 together with the desirable noise levels for outdoor living areas, which are likewise equal to those referenced in BS8233.

Table 2.3: 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

- 2.16 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.

- 2.17 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."

- 2.18 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.

- 2.19 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.

Road Traffic

- 2.20 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).

- 2.21 For comparison with the L_{A10} (18 hour) traffic noise index, it is important to note that design guidance such as BS8233 and the WHO guidelines uses 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.
- 2.22 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.

Traffic Noise Change

- 2.23 With regard to the potential noise change due to traffic generated by development, the previous definitions in PPG24 stated "A change of 3 dB(A) is the minimum perceptible under normal conditions". Para 3.42 of the latest DMRB (Appendix II of DMRB) likewise states "A change of 1 dB(A) in the short-term (e.g. when a project is opened) is the smallest that is considered perceptible. In the long-term, a 3 dB(A) change is considered perceptible, and such an increase should be mitigated if possible." Therefore, for broadband environmental noises such as road traffic, 3 dB(A) has historically been used as a threshold to denote perceptible noise effects.
- 2.24 For environmental assessment purposes, noise change bands can be used to establish the degree of impact on sensitive dwellings. The significance criteria assigned by DMRB to short term noise changes are shown in Table 2.4 and those applied to long term changes are shown in Table 2.5.

Table 2.4: Classification of Magnitude of Noise Impacts in the Short Term

Noise Change Band, L_{A10} (18-hour)	Significance Criteria
0	No change
0 - 0.9	Negligible
1 - 2.9	Minor
3 - 4.9	Moderate
5 +	Major

Table 2.5: Classification of Magnitude of Noise Impacts in the Long Term

Noise Change Band, L_{A10} (18-hour)	Significance Criteria
0	No change
0.1 - 2.9	Negligible
3 - 4.9	Minor
5 – 9.9	Moderate
10 +	Major

Construction Noise and Vibration

- 2.25 Noise and vibration impacts during the construction phase are temporary effects that occur between the start of the works and the end of the project's construction period. Where materials need to be transported to or from the works, the effects of the haulage traffic long local roads may need to be considered, although impacts will depend on the baseline traffic volumes and the number of additional haulage vehicles per day.
- 2.26 In addition to airborne noise that may be audible to local residents, ground-borne vibrations caused either by the movement of heavy construction plant over road surface irregularities or by imparting high-energy impulsive forces into the ground, e.g. during piling, may be perceptible in and around dwellings and may cause nuisance or annoyance to local residents. In this case, people may be concerned that vibrations are causing structural damage to their property. However, the threshold of perception for vibration is much lower than the levels that could initiate structural damage or exacerbate existing damage.
- 2.27 The Design Manual for Roads and Bridges (DMRB) provides general guidance on ambient levels of vibration in peak particle velocity (ppv), stating that for traffic vibration a ppv of 0.3 mm/s measured on a floor in the vertical direction is perceptible. PPVs in the structure of buildings close to heavily trafficked roads are reported as rarely exceeding 2 mm/s and are typically below 1 mm/s. The DMRB also indicates that there is no firm evidence that structural damage to buildings can occur below 10 mm/s. BS5228 similarly indicates that for people in dwellings the threshold of perception is typically in the ppv range of 0.14 to 0.3 mm/s at frequencies between 8 and 80 Hz. (Further descriptions of vibration units are provided in Appendix I.)
- 2.28 For both noise and vibration, the levels experienced at sensitive receptors such as dwellings are strongly dependent on the level generated by the source and the separation distance between the source and the receptor, although mitigation measures such as noise and vibration controls applied to the source, or, in the case of noise, barriers along the noise pathway, can substantially reduce the exposure levels. However, in all cases, the adverse impacts of construction nuisance diminish fairly rapidly with distance.
- 2.29 In addition to the direct effects of noise or vibration from the construction sites, ancillary effects can be associated with temporary diversion routes, designated

haulage routes, or, for on-line projects, road traffic speed restrictions adjacent to construction works.

- 2.30 DMRB advises that, with regard to the assessment of the noise impact associated with construction traffic on the local road network and/or from temporary diversion routes during the construction phases, the classification of the magnitude of the noise change should use the descriptors set out above in Table 2.4 for short term noise change.

Construction Assessment Methodology

- 2.31 The latest methods for evaluating the significance of construction noise and vibration are those within BS 5228-1:2009+A1:2014: 'Code of practice for noise and vibration control on construction and open sites'.
- 2.32 In the case of vibration, DMRB advises that if the level of vibration at a sensitive receptor is predicted to rise to above a level of 0.3 mm/s, or an existing level above 0.3 mm/s is predicted to increase, then this should be classed as an adverse impact from vibration.
- 2.33 With regard to neighbourhood nuisance due to construction works, BS 5228 identifies the key factors affecting community reaction as follows:
- a) Site location – the closer noise sensitive premises (NSP) are to the works the greater will be the need for noise controls;
 - b) Existing ambient noise levels – the likelihood of complain increases as the ambient/background noise levels decrease;
 - c) Duration of site operations – in general, the longer the duration of works then the greater the adverse response from any affected NSPs;
 - d) Hours of work – the periods when people are getting to sleep and just before they wake are particularly sensitive. Site activity outside normal weekday and Saturday morning working hours need special consideration, and noise need control targets will need to be stricter for works during evening and night-time periods;
 - e) Attitude to the site operator – noise from a site will tend to be accepted more readily by local residents if they consider that the contractor is taking all possible measures to avoid unnecessary noise. Good community liaison is important; and
 - f) Noise characteristics – the presence of regular or loud tonal or impulsive noise characteristics can make the noise less acceptable than normal.
- 2.34 Example criteria for the assessment of the potential significance of noise effects are given in Annex E of BS 5228. The guidance provides three methods for assessing significance, one based upon fixed noise limits and two based upon noise change. Further thresholds are suggested to determine eligibility for noise insulation or temporary rehousing in situations where noise exposures are

deemed to be high and to deal with construction works involving long-term substantial earth moving, although these would only apply to works similar in scale to large highway schemes or surface mineral extraction works and are not considered further here.

Significance Based on Fixed Noise Limits

- 2.35 The older and more simplistic approach is based upon exceedance of fixed noise limits. Although there have been no formal noise limits applicable to construction noise within any planning policy guidance, criteria that have been commonly applied to large civil engineering contracts (such as national road and rail projects, and urban development projects) often tend to be in the region of 70-75 dB L_{Aeq} (1 or 12 hour) for daytime construction activities, reducing to about 65 dB(A) in the evening and about 50 dB(A) at night. Similar limits were promoted by an earlier Department of the Environment Advisory Leaflet (AL) 72 'Noise Control on Building Sites'.

- 2.36 The wording within AL72 is referenced in BS 5228 as follows:

Noise from construction and demolition sites should not exceed the level at which conversation in the nearest building would be difficult with the windows shut. The noise can be measured with a simple sound level meter, as we hear it, in A-weighted decibels (dB(A)) – see note below. Noise levels, between say 07.00 and 19.00 hours, outside the nearest window of the occupied room closest to the site boundary should not exceed:

- *70 decibels (dBA) in rural, suburban and urban areas away from main road traffic and industrial noise;*
- *75 decibels (dBA) in urban areas near main roads in heavy industrial areas.*

These limits are for daytime working outside living rooms and offices. In noise-sensitive situations, for example, near hospitals and educational establishments – and when working outside the normal hours say between 19.00 and 22.00 hours – the allowable noise levels from building sites will be less: such as the reduced values given in the contract specification or as advised by the Environmental Health Officer (a reduction of 10 dB(A) may often be appropriate). Noisy work likely to cause annoyance locally should not be permitted between 22.00 hours and 07.00 hours.

- 2.37 The above principles have historically been developed into a range of noise levels covering different periods of the day or week that take account of the varying sensitivity of receptors at different times of the day or week, and the most frequently used criteria are those shown in Table 2.7 following the section that deals with significance using noise change.

Significance Based on Noise Change

Method 1 – The ABC Method

- 2.38 The ABC method involves rounding the existing ambient noise levels to the nearest 5dB for the appropriate time period (night, evening/weekends or day) and then using this information to establish a threshold of potential significant effects at dwellings. The site noise level due to construction is rounded to the nearest decibel and compared to the ambient noise level. If the site noise level exceeds the appropriate category value then a significant effect is deemed to have occurred. The assessment categories and equivalent noise thresholds for different time periods are shown in Table 2.6.

Table 2.6: Threshold of Potential Significant Effect at Dwellings from Construction Noise

Assessment Category and Threshold Value Period	Threshold Value, dB $L_{Aeq,T}$		
	Category A ^{A)}	Category B ^{B)}	Category C ^{C)}
Night-time (23:00 – 07:00)	45	50	55
Evenings and weekends ^{D)}	55	60	65
Daytime (07:00 – 19:00) and Saturdays (07:00 – 13:00)	65	70	75
^{A)} Category A is the threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are less than these values. ^{B)} Category B is the threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are the same as Category A values. ^{C)} Category C is the threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are higher than Category A values. ^{D)} 19.00-23.00 weekdays, 13.00-23.00 Saturdays and 07.00-23.00 Sundays.			

- 2.39 If the $L_{Aeq,T}$ noise level arising from the site exceeds the threshold values presented in Table 2.6 for the appropriate ambient noise level, then a potential significant effect is indicated. If the ambient noise level exceeds the Category C threshold values then a potential significant effect is indicated if the total $L_{Aeq,T}$ noise level for the period increases by more than 3 dB due to construction activity. The ABC method should only apply to residential receptors.

Method 2 – 5 dB(A) Change

- 2.40 Under this method, noise levels generated by site activities are deemed to be potentially significant if the total noise (pre-construction ambient plus site noise) exceeds the pre-construction ambient noise by 5 dB or more, subject to lower

cut-off values of 65 dB, 55 dB and 45 dB $L_{Aeq,T}$ from site noise alone, for the daytime, evening and night-time periods respectively; coupled with a duration of one month or more, unless works of a shorter duration are likely to result in significant effect.

2.41 The above criteria are applicable to the following types of receptor:

- residential buildings;
- hotels and hostels;
- buildings in religious use;
- buildings in educational use; and
- buildings in health and/or community use.

2.42 For public open space, the method assumes an impact might be deemed to cause significant effects if the total noise exceeds the ambient noise ($L_{Aeq,T}$) by 5 dB or more for a period of one month or more. However, the extent of the area impacted relative to the total available area of the resource also needs to be taken into account in determining whether the impact causes a significant effect.

Thresholds for Noise Insulation and Temporary Relhousing

2.43 In those scenarios where, after a contractor has taken all reasonable measures to reduce noise levels, serious annoyance to residents is considered to arise for a substantial period of time (either continuously or sporadically), the need for noise insulation and/or temporary rehousing can be considered using thresholds such as those set out in Table 2.7.

Table 2.7: Examples of Time Periods, Averaging Times and Noise Levels Associated with the Determination of Eligibility for Noise insulation

Day	Time Period	Averaging time, T	Noise insulation trigger level dB $L_{Aeq,T}$
Monday to Friday	07.00-08.00	1 hr	70
	08.00-18.00	10 hr	75
	18.00-19.00	1 hr	70
	19.00-22.00	3 hr	65
	22.00-07.00	1 hr	55
Saturday	07.00-08.00	1 hr	70
	08.00-13.00	5 hr	75
	13.00-14.00	1 hr	70
	14.00-22.00	3 hr	65
	22.00-07.00	1 hr	55
Sunday and Public Holidays	07.00-21.00	1 hr	65
	21.00-07.00	1 hr	55

All noise levels are predicted or measured at a point 1m in front of the most exposed of any windows and doors in any façade of any eligible dwelling.
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- 2.44 Noise insulation, or the reasonable costs thereof, has historically been offered to owners or occupiers where the construction works causes a measured or predicted noise level that either exceeds one of the thresholds in Table 2.7 or is 5 dB or more above the existing pre-construction ambient noise level for the corresponding times of day, whichever is the higher. The 'exceedance' needs to be present for a period of 10 or more days of working in any 15 consecutive days or for a total number of days exceeding 40 in any 6 consecutive months.
- 2.45 The threshold for temporary housing equates to a noise level 10 dB above any of the trigger noise levels in Table 2.7 above for the corresponding times of the day, or a noise level 10 dB above the pre-construction ambient noise level for the corresponding times of the day, whichever is the higher. As for eligibility for noise insulation, the thresholds need to be exceeded for a period of 10 or more days of working in any 15 consecutive days or for a total number of days exceeding 40 in any 6 consecutive months.

3. NOISE SURVEY

- 3.1 Ambient noise levels affecting the site during the day and night-time were monitored during Thursday 8th and Friday 9th September 2016. Road traffic noise levels from Pagham Road were measured in accordance with the shortened measurement procedures of the Calculation of Road Traffic Noise (CRTN) at 7m from the carriageway edge (Position 1) at a section of Pagham Road where traffic noise levels were highest. 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 southern corner of the site, again at 7m from the carriageway edge of Pagham Road (Position 2), but south of its junction with Sea Way. The noise monitoring positions are identified in Figure 2.
- 3.2 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; and
Larson Davies CA200 acoustic calibrator.
- 3.3 The microphone was positioned at a height of 1.2 m in a free-field location, i.e. excluding the effect of reflections from buildings or structures. The weather conditions were clear and cool, with southerly winds of up to 3 m/s during the night, and hot and overcast, again with southerly winds of up to 3 m/s during the day.
- 3.4 During the survey periods the predominant noise for the site was at all times road traffic using Pagham Road. As a consequence, there was no significant noise from the neighbouring farms or any other commercial premises near to the site, and certainly no dominant noise that would warrant assessment using BS 4142:2014 Methods for rating and assessing industrial and commercial sound.
- 3.5 The measured noise levels are presented in Appendix II and are summarised below in Table 3.1.

Table 3.1: Measured Noise Levels at 7m from Pagham Road, Free-field dB(A)

Noise Level, dB	
L _{A10} 3-hour	65.2
Correction for 18-hour L _{A10}	-1
Correction for 16-hour L _{Aeq}	-2
L_{Aeq} 16-hour	62.2
L_{Aeq} 8-hour⁽¹⁾	52.2

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.

- 3.6 The derived daytime L_{Aeq} (16 hour) monitored at 7m from the carriageway edge of Pagham Road was 62 dB (rounding to the nearest whole number for assessment purposes).
- 3.7 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 Pagham Road, the measured difference between the day and night L_{Aeq} was 13 dB, therefore, using DMRB's quoted 10 dB difference as a worst case value results in a night-time L_{Aeq} of 52 dB.
- 3.8 At a distance of 7m from Pagham Road, analysis of the L_{Amax} noise levels shows that the individual road traffic noise events during the day typically fall below 75 dB, but with some occasional peaks due to loud vehicles causing peaks between 75-83 dB. Analysis of the night-time L_{Amax} noise levels shows that the individual road traffic noise events all fall below 75 dB. Therefore, for night-time assessment purposes it has been assumed that L_{Amax} noise events due to vehicles will typically be 75 dB or less at 7m from Pagham Road.
- 3.9 The sample measurements undertaken at Position 2 at the southern end of the site were lower, and show a daytime L_{Aeq} of 57 dB at 7m from the carriageway edge of Pagham Road south of its junction with Sea Way. The lower noise level indicates lower traffic flows along the southern section of Pagham Road.

4. NOISE IMPACT ASSESSMENT

- 4.1 The noise levels affecting the site are not particularly high, with a day and night-time L_{Aeq} at Position 1 of 62 dB and 52 dB respectively. None of the noise levels are considered to be high, and they were all lower than levels that are commonly encountered at approved developments adjacent to transportation routes. Consequently, acceptable noise standards will be readily achieved using practicable forms of noise mitigation as discussed below.
- 4.2 External and internal noise levels for new residential units closest to Pagham Road would be as shown in Table 4.1. The distance from the proposed retirement home block to the edge of Pagham Road is approximately 17m, whereas the distance to the road from the nearest residential block is 24m. Therefore, Table 1 shows the worst case noise exposures at 17m. The Table also shows the outdoor-to-indoor level difference (L_A) 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} 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).

- 4.3 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 L_A 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 III, however, window manufacturers will be able to provide test certificates showing precisely which of their designs are capable of achieving the minimum requirements.
- 4.4 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 4.1: External and Internal Noise Levels at 17m from Pagham 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			
61	28	46	26	19	Yes	47	51	18	36	21	14	Yes
							Night L_{Amax}					
							70	37	55	25	18	Yes

- Notes:
1. Facade noise level includes +3 dB correction for facade reflection effects.
 2. Internal noise level with windows closed assumes 33 dB(A) reduction for thermal double glazed windows against traffic noise as per old PPG24.
 3. Internal noise level with windows partly open assumes 15 dB(A) reduction as per WHO guidelines.
 4. The required sound reduction L_A is derived from the facade noise level minus the internal noise limit, i.e. 35 dB L_{Aeq} for living rooms and 30 dB L_{Aeq} for bedrooms.
 5. The need for ventilation is determined by whether the internal noise level can be met with windows partly open for ventilation.

4.5 At a distance of 17m from Pagham Road, Table 4.1 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 19 dB R_{TRA} . Normal thermal double glazing having a configuration of 4/12/4 or 4/16/4, 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, typically provides a sound reduction of 25 dB R_{TRA} as indicated by the data in Appendix III, which would be more than sufficient to enable all internal noise standards to be met.

4.6 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 the road. These would enable occupiers to obtain natural ventilation with windows closed, without any loss of amenity due to noise intrusion.

4.7 For the assessment in Table 4.1, it has been assumed that dwellings will face the road at a distance of 17m, with private gardens used for amenity purposes

located behind new dwellings, 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 47 dB L_{Aeq} for garden areas, which would satisfy the BS8233/WHO outdoor criterion of 55 dB.

- 4.8 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 traffic noise impacts. This would typically provide an attenuation of 7 dB(A) and would minimise the impact of traffic noise in accordance with the guidance of BS8233.
- 4.9 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 Pagham 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.
- 4.10 The noise assessment demonstrates that acceptable external and internal noise levels will be achieved for residents subject to appropriate noise mitigation, which is a matter that can be dealt with by way of planning conditions. For example, conditions can require a scheme for protecting the proposed residential development from road traffic noise to be submitted and approved by the local planning authority, and for all works that form part of the scheme to be completed before any part of the development is occupied. If required, specific noise standards to be achieved inside dwellings can be specified within a planning condition, and these would be attained by way of appropriate window designs. With relevant noise standards met, the proposed development would satisfy the requirements of the NPPF.

Noise from Retail Units

- 4.11 At this stage of the application it is not possible to define the types of retail uses and hence the levels of noise that will be generated. However, the measures to control noise generated internally and transmitted within the buildings, or generated externally by either mechanical/electrical service plant or service/delivery operations, are common to most mixed-use developments and are regularly implemented by way of routine planning conditions.
- 4.12 The requirements for the sound insulation to be provided by walls and floors between dwellings are governed by Approved Document E 'Resistance to the passage of sound', of the Building Regulations 2000, as amended. In the Secretary of State's view the normal way of satisfying Requirement E1 will be to build separating walls, separating floors and stairs that have a separating function, together with the associated flanking construction, in such a way that they achieve the sound insulation values for dwelling-houses and flats set out in

the Regulations. These sound insulation performance standards relate to airborne noise through walls and floors and impact noise through floors.

- 4.13 The above performance standards are appropriate for walls, floors and stairs that separate spaces used for normal domestic purposes. Approved Document E suggests that a higher standard of sound insulation may be required between spaces used for normal domestic purposes and communal and non-domestic purposes, e.g. any retail units that may be constructed at ground floor level beneath residential units. In these situations the appropriate level of sound insulation will depend on the noise generated in the non-domestic space.
- 4.14 Appropriate regard to the potential for noise from mechanical/electrical service plant would be given during the detailed design of the development and appropriate noise control measures would be incorporated where necessary to ensure that operational noise levels remain within the criteria of British Standard 4142:2014 Methods for rating and assessing industrial and commercial sound. The design would take account of the background noise levels at nearest noise-sensitive receptors to ensure that no tonal or impulsive acoustic characteristics associated with the plant's operation would give rise to complaints from new dwellings within the development.
- 4.15 Planning conditions are regularly employed to control noise from the above types of noise sources and there is no reason why they cannot be applied to the outline application.

Cumulative Noise Assessments

Traffic Noise Change

- 4.16 Annual Average Weekday Traffic (AAWT) flows for the local roads with and without development traffic have been prepared by the project's traffic engineers (Highgate Transportation Limited, in conjunction with the consultant teams of other strategic sites being considered for the cumulative assessments) and the flows, % heavy goods vehicle (HGV) compositions and average speeds with and without development are presented in Appendix IV.
- 4.17 A road's basic noise level (BNL) represents the free-field noise level at a distance of 10m from the carriageway edge based on the traffic flow, the percentage heavy vehicle composition and the average vehicle speeds. Where other factors such as screening or distance between buildings and the road remain constant between each situation under consideration, the difference between the BNLs reflects the actual noise change at any receptor adjacent to the road. Therefore, calculation of the BNLs for each road around the development area will provide an indication of the noise level changes due to traffic flow changes associated with the development.
- 4.18 The calculated BNLs and noise change are also presented in Appendix IV. For all existing receptors adjacent to local roads, the noise changes from 2016 to

2021 due to committed development traffic are 0.7 dB or less. Therefore, utilising the significance criteria in Tables 2.4 and 2.5, committed developments would have a negligible impact upon existing dwellings.

- 4.19 The greatest noise changes between 2021 with committed developments to 2021 with the proposed development at Pagham South amount to 1.1 and 1.5 dB respectively along Pagham Road south of Nyetimber Lane, and along Nyetimber Lane west, which amount to minor effects short term and negligible long term. All other roads would experience changes of 0.9 dB or less, which amount to negligible effects at all times.
- 4.20 If one considers the total noise change from 2016 to 2021 with all developments, then the greatest changes increase slightly to 1.7 and 2.1 dB respectively along Pagham Road south of Nyetimber Lane, and along Nyetimber Lane west, with additional changes of 1.2 to 1.4 dB along other sections of Pagham Road and also Hook Lane west. Once again, these amount to minor effects short term and negligible long term. Noise changes along all other roads would again be 0.9 dB or less, which amount to negligible effects at all times.
- 4.21 There is no defined relationship between the significance bands in Tables 2.4 and 2.5 and the LOAEL and SOAEL terms in Table 2.1, however, since a SOAEL requires a material change in behaviour and/or attitude, which is unlikely to occur when levels of noise change are not perceptible, changes of 3 dB or more can be taken to reflect the onset of SOAEL, whereas values between 1 to <3 dB(A) would be equivalent to a LOAEL.
- 4.22 Maximum noise changes of 2.1 dB or less would not cause any change in behaviour or attitude, nor would they significantly affect the acoustic character of the area such that there is a perceived change in the quality of life. Consequently, traffic generated by cumulative developments would have no observed adverse effect and there would be no requirement for specific mitigation measures.
- 4.23 Using traffic noise as a surrogate for traffic vibration, since there are no significant or perceptible noise changes with either committed or the proposed development, vibration is similarly not expected to have any significant impacts.

Construction Noise

- 4.24 Details of the types of construction methods and plant likely to be used during the construction phases have yet to be formulated and at this stage in the scheme's design it is not possible to state precisely where plant will operate and for how long during the working day. Therefore, indicative construction noise levels have been calculated using source noise data for construction plant that is normally used for this type of development, and noise levels have been calculated for a maximum worst case situation over 1 hour assuming that plant will operate at its closest point to each receptor in the absence of mitigation. In

practice, noise levels would tend to be lower due to greater separation distances and screening effects, and they would also tend to reduce over a 12 hour working day due to periods of plant inactivity.

- 4.25 The main construction phases on site will include site levelling/clearance, ground excavation, concreting, building construction and new internal road construction, alongside which there will be the movement of some construction vehicles during each stage on the local road network. The building construction phase, and the servicing and fitting out of new buildings, especially small dwelling houses, is normally not a significant source of noise for local receptors.
- 4.26 During the development of the site, some construction works would be present close to already occupied new dwellings. However, this situation is no different to circumstances on many large development sites where on-going construction works take place adjacent to occupied residential units. In fact, the same circumstances apply to the majority of new housing developments throughout the UK where completed units are sold and become occupied whilst the remainder of the site is being built. Once the preliminary ground preparation works are complete, the majority of the works associated with the construction of new dwellings involves manual labour and the use of hand-tools, which will reduce the noise emitted from the site.
- 4.27 Details of typical construction plant noise levels at the standard reference distance of 10m provided by BS5228 in the absence of noise controls such as screening and operational constraints are given below in Table 4.2. Highest noise levels tend to be associated with plant that will be employed during earthmoving and concreting. In the absence of specific details on the phasing and siting of construction activities, this information has been used to derive indicative noise levels at selected distance bands from the site boundary using the data and procedures of BS 5228, and the results are presented in Table 4.3.
- 4.28 Any plant operating along the site boundary would have the ability to generate noise levels above the typical daytime construction noise limit of 75 dB L_{Aeq} over distances of approximately 30m from the boundary, and the significance criterion of 65 dB L_{Aeq} would be reached out to 100m from the site boundary in the case of earthmoving and concreting works in the absence of any screening.

Table 4.2: Typical Construction Plant Noise Levels

Plant	Typical L_{Aeq} at 10m
Earth moving	85
Supply vehicles	80
Truck concrete mixer	80
Poker vibrators	84
Crane	74
Vibratory roller	76
Asphalt spreader/chip	80

spreader/roller/lorry	
Wheeled loader	76
Compressors	74
Welding Generators	42

Table 4.3: Predicted Indicative Construction Noise Levels, L_{Aeq} (1-hour) dB

Predicted Indicative Construction Noise Levels, L_{Aeq} (1-hour) dB							
Distance from site (metres)	10	15	20	30	40	50	100
Activity							
Earthmoving	85	81	79	75	73	71	65
Concreting	86	82	80	76	74	72	66
Road pavement	80	76	74	70	68	66	60

- 4.29 Dwellings adjacent to the eastern boundary of the site are approximately 15m or more from the site boundary and would normally be approximately 30m or more from the closest construction works, which indicates that the normal daytime limit of 75 dB L_{Aeq} is unlikely to be exceeded but that exceedence of the significance criterion of 65 dB L_{Aeq} is possible, subject to the overall time when plant is operating in close proximity to the eastern boundary.
- 4.30 However, the majority of dwellings to the east of the site are separated from the site by the existing traffic noise source along Pagham Road, which will increase the ambient noise levels and reduce the risk of annoyance due to construction activities. The redline boundary of the site is presented in Figure 1 and shows that apart from a few dwellings towards the southern end of the site, which are still separated from the site boundary by distances of 20-30m, the majority of the site boundary does not present to sensitive aspects of existing development. The Development Framework Plan in Figure 3 similarly shows how the actual areas of development where construction activities will be present relate mainly to the edge of Pagham Road, so that traffic noise will be present between the dwellings and the site.
- 4.31 Consequently the main area for noise control will apply to works close to the eastern boundary of the site, although the sensitive areas are limited in extent and occur mainly at the southern corner of the site. The time that plant is operated within this area should be restricted as much as possible and plant should not be left idling within this area when not in use.
- 4.32 Therefore, construction plant operating on the site will have the potential to affect a few noise-sensitive dwellings located immediately adjacent to the site. However, in practice, the main construction activities such as ground excavation works and new build construction will tend to take place slightly further into the site, or only affect a very limited number of dwellings for a short period of time at any given moment. Plant will only have to progress a relatively short distance

away from each existing receptor before noise levels fall below the typical construction noise criterion. There would also be no works during the most sensitive evening and night-time periods, other than any emergency operations agreed with the Local Planning Authority in advance.

- 4.33 In any event, the construction activities would be no different to those that regularly take place during the phased development of residential sites, when some construction work is present close to already occupied new dwellings. In fact, these circumstances apply to the majority of new housing developments throughout the UK where completed units are sold and become occupied whilst the remainder of the site is being built. In addition, the majority of the works associated with the construction of new dwellings involves manual labour and the use of hand-tools, which will reduce the noise emitted from the site. Therefore, apart from the initial earthmoving/concreting phases, there is no likelihood of any significant long-term noise impact upon existing dwellings during the routine works associated with the construction of the new dwellings. Nevertheless, appropriate controls and mitigation would be implemented.
- 4.34 With respect to potential vibration impacts on sensitive uses adjacent to the works, the construction of new residential development is not normally seen to be a significant source of vibration since impulsive operations such as piling are not required, and other routine ground works does not involve the application of impulsive forces directly into the ground.

Cumulative Construction Noise

- 4.35 Three of the four sites being considered for cumulative effects are 600m to approximately 2km to the north of the Pagham South site. Therefore, given the distances associated with significant effects from construction effects, e.g. see Tables 2.6 and 4.3, no cumulative noise effects are to be expected with these sites. The approved development on land at Summer Lane lies adjacent to the site's northern boundary, which means that construction works on that site could have cumulative effects if it occurred simultaneously with construction work at the northern end of the Pagham South site.
- 4.36 However, there are few dwellings close to both sites, and, given the earlier approval of the Summer Lane application and the smaller scale of this development, significant cumulative impacts are considered unlikely. The types of construction activities associated with house construction on both sites would be similar, therefore, even if the works were to take place concurrently, the total construction noise contributions would not increase by more than 3 dB, which would fall within the normal margin of error expected for construction noise predictions.
- 4.37 The routine noise mitigation measures for construction would be capable of dealing with the noise levels from either or both neighbouring construction sites should they take place at the same time.

Construction Mitigation

- 4.38 In accordance with modern working practices, the principles of the “best practicable means” (BPM), as defined in the Control of Pollution Act 1974 would be used to reduce emissions throughout the construction period. This would incorporate the use of measures to control noise and vibration that do not unreasonably inhibit the work, and the use of working methods that result in minimum effects compatible with normal working practices.
- 4.39 Appropriate contract conditions to minimise noise and vibration would be imposed upon the Contractor, who would also be required to liaise with the Local Authority's Environmental Health Department (EHD) to minimise impacts at all times. Control measures routinely applied in this way would include the following:
- Selecting inherently quiet plant;
 - The use, where necessary and practicable, of enclosures and screens around noisy fixed plant;
 - Limiting site work where possible to daytime hours; and
 - Adherence to relevant British Standards.
- 4.40 The above range of noise controls represents the measures that are regularly and successfully applied to large scale construction projects in order to minimise noise effects on local communities. The application of similar control measures during the construction of this development will likewise ensure that the works proceed with the minimum disturbance to local residents.

5. AIR QUALITY STANDARDS

- 5.1 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.
- 5.2 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.
- 5.3 Under the Environment Act 1995, Local Authorities must review and document local air quality within their areas by way of a staged appraisal and respond accordingly, with the aim of meeting the air quality objectives by the years defined in the Regulations. Where the objectives of the Regulations are not likely to be achieved by the objective year, an authority is required to designate an Air Quality Management Area (AQMA). For each AQMA the local authority is required to draw up an Air Quality Action Plan (AQAP) to secure improvements in air quality and show how it will try to meet air quality standards in future.
- 5.4 The Air Quality Strategy is an ongoing mechanism that will be regularly reviewed and updated to take account of evolving European Union (EU) legislation, technical and policy developments and the latest research on health effects of air pollution.
- 5.5 The Strategy's objectives for particles (PM₁₀), benzene and carbon monoxide were reviewed in 2000/2001 and in February 2003, in the light of more recent scientific knowledge and policy changes, the Government updated the Air Quality Strategy (AQS) by way of an Addendum. The revisions provide alterations or extensions to four of the eight existing pollutant objectives, and the addition of a ninth pollutant, polycyclic aromatic hydrocarbons (PAHs). Further revisions to the objectives were promulgated in the 2007 version of the AQR and the current air quality objectives for the protection of human health are summarised in Table 5.1 below. Definitions of units and terms used to quantify air pollutant concentrations are provided in Appendix IV.

Table 5.1: UK Air Quality Objectives for Protection of Human Health

Pollutant	Concentration	Measured as *	Objective Date
Benzene			
All authorities	16.25 µg/m ³	Running annual mean	31/12/2003
England and Wales only	5 µg/m ³	Annual mean	31/12/2010
Scotland and N. Ireland	3.25 µg/m ³	Running annual mean	31/12/2010
1,3 Butadiene	2.25 µg/m ³	Running annual mean	31/12/2003
Carbon Monoxide			
England, Wales and N. Ireland	10 mg/m ³	Maximum daily running 8-hour mean	31/12/2003
Scotland only	10 mg/m ³	Running 8-hour mean	31/12/2003
Lead	0.5 µg/m ³	Annual mean	31/12/2004
	0.25 µg/m ³	Annual mean	31/12/2008
Nitrogen dioxide	200 µg/m ³	1 hour mean not to be exceeded more than 18 times per year	31/12/2005
	40 µg/m ³	Annual mean	31/12/2005
Particles (PM₁₀ gravimetric)			
All authorities	50 µg/m ³	Daily mean not to be exceeded more than 35 times a year	31/12/2004
	40 µg/m ³	Annual mean	31/12/2004
Scotland only	50 µg/m ³	Daily mean not to be exceeded more than 7 times a year	31/12/2010
	18 µg/m ³	Annual mean	31/12/2010
Particles (PM_{2.5} gravimetric)	25 µg/m ³ (target)	Annual mean	2020
All authorities	15% cut in urban background exposure	Annual mean	2010-2020
Scotland only	12 µg/m ³ (limit)	Annual mean	2010

Sulphur dioxide	350 µg/m ³	1-hour mean not to be exceeded more than 24 times a year	31/12/2004
	125 µg/m ³	24-hour mean not to be exceeded more than 3 times a year	31/12/2004
	266 µg/m ³	15-minute mean not to be exceeded more than 35 times a year	31/12/2005
Objectives not yet Prescribed in Regulations for the Purposes of Local Air Quality Management			
Polycyclic aromatic hydrocarbons	0.25 ng/m ³	Annual mean	31/12/2010
Ozone	100 µg/m ³	8 hourly running or hourly mean, not to be exceeded more than 10 times a year	31/12/2005

Notes: * how the objectives are to be measured is set out in the UK Air Quality (England) Regulations (2000 and 2002)

5.6 The EU has also set NO₂ objectives for 2010 that must be met by all member states, although these 2010 EU NO₂ objectives are equal to the UK Air Quality Strategy NO₂ 2005 objectives.

5.7 Of the pollutants mentioned above, the majority of the UK SO₂ emissions derive from stationary combustion plant rather than traffic emissions. Therefore, this pollutant is not significant for this assessment. Similarly, the concentration of lead in vehicle fuels has been reduced to negligible levels in the past 10 to 15 years, particularly since the introduction of unleaded fuel, and this pollutant is also no longer of concern for this study. Of the remaining pollutants, the standards for carbon monoxide, benzene and 1,3 butadiene are generally met in urban areas. The pollutants of most concern to planning authorities in urban areas, due to the high concentrations presently encountered (of which local road traffic makes a large contribution) are NO₂ and PM₁₀.

London Councils Air Quality and Planning Guidance, January 2007

5.8 This guidance updates and replaces the Association of London Government's Planning Technical Guidance issued on 20th March 2001 and Circular TEC 01/03, and aims to help reduce exposure to air pollution across the whole of London. The technical guidance was produced by the APPLE (Air Pollution Planning and the Local Environment) working group and provides useful guidance for assessing the significance of air quality issues at other sites throughout the UK.

5.9 In determining both the significance of exposure to air pollution and the levels of mitigation required, the guidance recommends that consideration should be given to the Air Pollution Exposure Criteria (APEC) as presented in Table 5.2:

Table 5.2: Air Pollution Exposure Criteria

	Applicable Range Nitrogen Dioxide Annual Mean	Applicable Range PM₁₀	Recommendation
APEC – A	> 5% below national objective	Annual Mean: > 5% below national objective 24 hr: > 1-day less than national objective	No air quality grounds for refusal; however mitigation of any emissions should be considered.
APEC – B	Between 5% below or above national objective	Annual Mean: Between 5% above or below national objective 24 hr: Between 1-day above or below national objective.	May not be sufficient air quality grounds for refusal, however appropriate mitigation must be considered e.g., Maximise distance from pollutant source, proven ventilation systems, parking considerations, winter gardens, internal layout considered and internal pollutant emissions minimised.
APEC – C	> 5% above national objective	Annual Mean: > 5% above national objective 24 hr: > 1-day more than national objective.	Refusal on air quality grounds should be anticipated, unless the Local Authority has a specific policy enabling such land use and ensure best endeavours to reduce exposure are incorporated. Worker exposure in commercial/industrial land uses should be considered further. Mitigation measures must be presented with air quality assessment, detailing anticipated outcomes of mitigation measures.

Notes: * Applicable ranges assume downward pollutant trend has been established.

5.10 The London Councils' guidance also provides a diagram for assisting in determining whether an application is significant in terms of air quality, and the flow chart is reproduced in Appendix V. The matter of significance is based on

the professional judgement of the Local Authority officer, and it is advised that even where air quality is deemed not to be a significant consideration, mitigation measures may still be required.

National Planning Policy Framework

- 5.11 The National Planning Policy Framework (NPPF), issued by the Department for Communities and Local Government in March 2012, 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.
- 5.12 With a key emphasis on sustainable development, the NPPF identifies those planning guidance documents that have been revoked and replaced by the Framework, and, in relation to environmental emissions, these include, amongst others, Planning Policy Statement 23: Planning and Pollution Control (2004).
- 5.13 With regard to air quality, the NPPF guidance is that planning policies should sustain compliance with and contribute towards EU limit values or national objectives for pollutants, taking into account the presence of Air Quality Management Areas and the cumulative impacts of air quality from individual sites in local areas. Planning decisions should ensure that any new development in Air Quality Management Areas is consistent with the local air quality action plan.
- 5.14 In drawing up their Local Plans to implement the NPPF, Local Planning Authorities are advised that significant adverse impacts on any of the three key dimensions of sustainable development (economic, social and environmental) should be avoided and, wherever possible, alternative options which reduce or eliminate such impacts should be pursued. Where adverse impacts are unavoidable, measures to mitigate the impact should be considered, and where adequate mitigation measures are not possible, compensatory measures may be appropriate.

Planning Practice Guidance

- 5.15 In March 2014 the Department for Communities & Local Government updated its on-line planning guidance to assist with interpretation of the NPPF. The guidance covers general matters such as relevance of air quality issues, role of the Local Plan, information sources, assessment approaches and mitigation. How considerations about air quality fit into the development management process is summarised by the guidance in a flowchart, which is included here in Appendix V with other relevant flow charts.

Environmental Protection UK (EPUK) and the Institute of Air Quality Management (IAQM) – Land-Use Planning & Development Control: Planning For Air Quality 2015

- 5.16 Environmental Protection UK (EPUK) and the Institute of Air Quality Management (IAQM) have produced this guidance to ensure that air quality is adequately considered in the land-use planning and development control processes.
- 5.17 The guidance clarifies when an air quality assessment is required and what it should contain. It sets out how impacts should be described and assessed. Importantly it sets out a recommended approach that can be used to assess the significance of the air quality impacts, taking account of the advice issued by IAQM. An important focus of this guidance is on minimising the air quality impacts of all developments for which air quality assessments have been requested by the planning authority; this will be through good design and application of appropriate mitigation measures.
- 5.18 Stage 1 of the assessment in the local area seeks to screen out smaller development and/or developments where impacts can be considered to have insignificant effects. The Stage 1 criteria are set out in Table 5.3 and require any of the criteria in row A, coupled with any of the criteria in row B, to apply before an assessment proceeds to Stage 2. If none of the criteria are met then the impacts can be considered to be insignificant and there is no requirement to carry out an air quality assessment.

Table 5.3: Stage 1 Criteria

Criteria to Proceed to Stage 2	
A.	If any of the following apply: • 10 or more residential units or a site of more than 0.5 ha • more than 1,000 m² of floor space for all other uses or a site area greater than 1 ha
B.	Coupled with any of the following: • the development has more than 10 parking spaces • the development will have a centralised energy facility or other centralised combustion process
Note: Consideration should still be given to the potential impacts of neighbouring sources on the site, even if an assessment of impacts of the development on the surrounding area is screened out.	

- 5.19 The criteria in Table 5.4 provide more specific guidance as to when an air quality assessment is likely to be required to assess the impacts of the proposed development on the local area.

Table 5.4: Indicative Criteria for Requiring an Air Quality Assessment

The development will:	Indicative Criteria to Proceed to an Air Quality Assessment
1. Cause a significant change in Light Duty Vehicle (LDV) traffic flows on local roads with relevant receptors. (LDV = cars and small vans < 3.5t gross vehicle weight)	A change of LDV flows of: - more than 100 AADT within or adjacent to an AQMA - more than 500 AADT elsewhere
2. Cause a significant change in Heavy Duty Vehicle (HDV) flows on local roads with relevant receptors. (HDV = goods vehicles + buses > 3.5t gross vehicle weight)	A change of HDV flows of: - more than 25 AADT within or adjacent to an AQMA - more than 100 AADT elsewhere
3. Realign roads, i.e. changing the proximity of receptors to traffic lanes.	Where the change is 5m or more and the road is within an AQMA.
4. Introduce a new junction or remove an existing junction near to relevant receptors.	Applies to junctions that cause traffic to significantly change vehicle accelerate/decelerate, e.g. traffic lights, or roundabouts.
5. Introduce or change a bus station.	Where bus flows will change by: - more than 25 AADT within or adjacent to an AQMA - more than 100 AADT elsewhere.
6. Have an underground car park with extraction system.	The ventilation extract for the car park will be within 20m of a relevant receptor Coupled with the car park having more than 100 movements per day (total in and out)
7. Have one or more substantial combustion processes.	Where the combustion unit is: - any centralised plant using bio fuel - any combustion plant with single or combined thermal input > 300kW - a standby emergency generator associated with a centralised energy centre (if likely to be tested/used > 18 hours a year)
8. Have a combustion process of any size.	Where the pollutants are exhausted from a vent or stack in a location and at a height that may give rise to impacts at receptors through insufficient dispersion. This criterion is intended to address those situations where a new development may be close to other buildings that could be residential and/or which could adversely affect the plume's dispersion by way of their size and/or height.

5.20 Where an air quality assessment is identified as being required, this may be either a Simple or a Detailed Assessment. A Simple Assessment is one relying on already published information and without quantification of impacts, in contrast to a Detailed Assessment that is completed with the aid of a predictive technique, such as a dispersion model. Passing a criterion in Table 5.4 does not automatically lead to the requirement for a Detailed Assessment. Once again,

where none of the criteria are met the impacts can be considered to be insignificant and there is no requirement to carry out an air quality assessment.

- 5.21 The purpose of the air quality assessment is to define the likely quantitative or qualitative changes in air quality or exposure to air pollution as a result of the proposed development.
- 5.22 The suggested framework for describing the impacts on the basis set out above is set out in Table 5.5. The term Air Quality Assessment Level (AQAL) is used to include air quality objectives or limit values, where these exist. The Table is only intended to be used with annual mean concentrations, and all % changes are rounded up or down to whole numbers. At exposures less than 75% of the AQAL, the degree of harm is described as likely to be small. As the exposure encroaches and exceeds the AQAL the degree of harm increases, and the change becomes more important when the result is an exposure that is approximately equal to or greater than the AQAL.

Table 5.5: 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

- 5.23 In the case of combustion sources (including road traffic), it is recommended that PM_{2.5} is used to assess impacts rather than PM₁₀. The AQAL for PM_{2.5} is much lower on the basis of the air quality objective and EU limit value and this therefore represents a more conservative approach. If, however, PM₁₀ is assessed, then Table 3 should be applied using the limit value of 40 µg/m³ as an annual mean, or alternatively a derived value for the annual mean based on exceeding 50 µg/m³ for more than 35 days in a year (the equation in LAQM.TGO9 shows an annual mean of 32 µg/m³ equating to 35 days at or above 50 µg/m³).
- 5.24 A judgement of the significance of the impacts is to be made by a competent professional who is suitably qualified, and the reasons for reaching the conclusions should be transparent and set out logically. Whilst the starting point for the assessment of significance is the degree of impact, as defined by Table 5.5, this should be seen as only one of the factors for consideration, not least because the outcome of this assessment procedure applies to a receptor and not the overall impact of the scheme on the locality.
- 5.25 The guidance also makes it clear that the presence of an AQMA should not halt all development, but where development is permitted, the planning system

should ensure that any impacts are minimised as far as is practicable. Even where developments are proposed outside of AQMAs, and where pollutant concentrations are predicted to be below the objectives/limit values, it remains important that the proposed development incorporates good design principles and best practice measures and that emissions are fully minimised.

Construction Dust Nuisance

- 5.26 There is no specific guidance relating to the assessment of construction dust nuisance within Government documents such as the DMRB. Consequently, guidance from relevant national bodies provides the best advice for establishing the potential impacts from dust. Research carried out by the Buildings Research Establishment (BRE) indicates that the likelihood of complaints concerning dust nuisance is related to the distance of receptors from a construction site and the duration of dust raising activities. This relationship is shown in Table 5.6.

Table 5.6: Likelihood of Dust Complaints by Distance

Duration of dust raising activity onsite	Distance from site			
	< 20 m	20 – 50 m	50 – 100 m	100 – 150 m
	Likelihood of complaint			
> 12 months	Very Likely	Very Likely	Likely	Potential Likelihood
6 – 12 months	Very Likely	Likely	Likely	Potential Likelihood
< 6 months	Very Likely	Likely	Potential Likelihood	Not Likely

Note: Beyond 150 m dust nuisance is considered largely unlikely (Upton & Kukadia, 2002, Measurements of PM₁₀ from a Construction Site: A Case Study, prepared by BRE Environment for National Society for Clean Air).

- 5.27 Further empirically derived measures of the maximum distance from a source of airborne dust within which significant adverse effects are likely to be observed, are presented in Table 5.7. These values reflect qualitative estimates derived from historical data presented within environmental assessment reports and expert evidence.

Table 5.7: Qualitative Construction Dust Assessment Criteria

Source Descriptors		Zone for Potentially Significant Effects (Distance from Source)	
Source	Duration	Soiling	PM ₁₀ [*]
Large construction sites	1 year or more	100 m	25-50 m
Moderate sized construction sites	Months	50 m	15-30 m
Minor construction sites	Weeks	25 m	10-20 m

* Based on 35 permitted exceedences of 50 µg/m³ in a year, as defined in The Air Quality (England) Regulations.

Source: Adapted from Thames Gateway Bridge – Environmental Statement (Laxen, 2004)

Risk Assessment

- 5.28 The Institute of Air Quality Management (IAQM) Guidance on the assessment of dust from demolition and construction, February 2014, provides a framework for the assessment of risk.
- 5.29 The guidance divides activities on construction sites into four types to reflect their different potential impacts. These are:
- Demolition;
 - Earthworks;
 - Construction; and
 - Trackout
- 5.30 The assessment methodology considers the following three separate dust effects, with account being taken of the distance of the receptors that may experience these effects.
- Annoyance due to dust soiling;
 - Harm to ecological receptors; and
 - The risk of health effects due to a significant increase in exposure to PM₁₀,
- 5.31 The assessment procedures and risk categories for each of the four phases of construction where the potential for dust is high, i.e. those listed above, are summarised in Appendix VII.
- 5.32 Step 1 establishes that an assessment will normally be required where there are dwellings within 350m of the site boundary.

6. AIR QUALITY ASSESSMENT

- 6.1 The number of new dwellings within the proposed developments exceeds the threshold of 10 in the EPUK/IAQM guidance (Table 5.3), therefore, the assessment proceeds to Stage 2, which considers the number of vehicles generated by development.

Cumulative Traffic Data

- 6.2 Annual Average Weekday Traffic (AAWT) flows for the local roads with and without development traffic have been prepared by the project's traffic engineers (Highgate Transportation Limited, in conjunction with the consultant teams of other strategic sites being considered for the cumulative assessments) and the flows, % heavy goods vehicle (HGV) compositions and average speeds with and without developments are presented in Appendix VIII.
- 6.3 In order to establish whether there is a risk of exceeding air quality objectives adjacent to a road, Local Air Quality Management Technical Guidance (LAQM TG(09)) uses a threshold of 10,000 vehicles/day (vpd) to determine whether further assessment is required. For roads with daily traffic flows below 10,000, there is no risk of air quality objectives being exceeded and the impact from road traffic can be ignored. However, at junctions where the combined flow may be >10,000 vpd the impact should be assessed.
- 6.4 The traffic data demonstrates that a large number of the roads carrying traffic adjacent to the development site will have maximum flows below 10,000 vpd, therefore, development will have no adverse impacts upon existing dwellings within these roads. Nevertheless, further assessment of air quality relative to these roads, along with all other roads has been undertaken as discussed below.
- 6.5 The traffic flows have been used to calculate ambient concentrations of air pollution, using the DMRB screening method in accordance with LAQM TG(09), at indicative receptors representing existing dwellings closest to each road, which local mapping shows to be at distances between 4 to 14m from the road centrelines.
- 6.6 For determining compliance with air quality objectives, it is important that the contribution of emissions from baseline traffic is added to background concentrations already present in the area, or that which will be present in future years, and these are defined in the following section.

Background Air Quality

- 6.7 There are no automatic monitoring sites in the immediate vicinity of the development site from which background concentrations can be obtained. Therefore, suitable estimates of background air quality have been derived in accordance with LAQM.TG(09) using the air pollution background concentration maps published by Defra. The maps are updated by Defra periodically to reflect changes to underlying data including emissions factors. In recent years there have been annual updates due to new information on NO_x emissions from diesel vehicles, and fleet and vehicle activity data have also been updated. Average background pollutant concentrations for local 1 x 1 km grid squares are available for all future years, and Table 6.2 shows the background concentrations that were used in this assessment. Background values for NO_x are presented, as they are required in the conversion of modelled NO_x concentrations to total NO₂. Only those pollutants of real concern to the local authority, namely NO₂ and PM₁₀, are considered.

Table 6.2: Background Concentrations of Air Pollution, Annual Mean $\mu\text{g}/\text{m}^3$

Year	NO _x $\mu\text{g}/\text{m}^3$	NO ₂ $\mu\text{g}/\text{m}^3$	PM ₁₀ $\mu\text{g}/\text{m}^3$
2016	11.43	9.04	15.2
2021	9.85	7.87	14.68

Impact Assessment

- 6.8 The above information relating to traffic flows and background concentrations has been input to the DMRB screening model along with the distance representing the shortest distance between the centreline of the road and dwellings closest to the road. The results of the DMRB assessment are presented in Appendix IX.
- 6.9 The results indicate that for a baseline traffic situation in 2016, receptors adjacent to local roads have values below the current annual mean air quality objectives for NO₂ and PM₁₀, which is consistent with the LPA's air quality review and assessments.
- 6.10 With traffic generated by all committed developments plus the proposed Pagham South development, the absolute concentrations still remain below the air quality objectives. The level of change due to traffic generated by just the proposed Pagham South development would be small, with the maximum change being 0.5 $\mu\text{g}/\text{m}^3$ or less to annual mean concentrations of NO₂ and PM₁₀, which would not have a significant impact upon local air quality.

- 6.11 The total change from 2016 with all committed developments plus the proposed Pagham South development, is also shown in Appendix IX. Due to projected decreases to future background concentrations (see Table 6.2) future concentrations of NO₂ and PM₁₀ are calculated to reduce in 2021, even with committed developments and the proposed Pagham South development. Therefore, the committed and proposed developments would not have an adverse cumulative impact upon ambient air quality.
- 6.12 The ambient concentrations of local traffic emissions are predicted to be 75% or less of the Air Quality Assessment Level (AQAL) (see Table 5.5), and the % change in concentration relative to the AQAL due to development traffic is calculated to be less than 1%. On this basis, the development's impact on local air quality will be negligible.
- 6.13 If one considers the air quality effects against the London Councils guidance, the local air pollution exposure as a consequence of the proposals would fall within the category APEC-A, for which there would be no air quality grounds for refusal. Likewise, using the significance flowcharts in Appendix VI, the developments would not contribute to air quality exceedences or lead to the designation of a new AQMA, nor would they significantly increase emissions or lead to new exposure to emissions considered to be significant. Therefore, air quality for the proposed development is not deemed to be a significant consideration.
- 6.14 Therefore, since the air quality assessment indicates that annual mean air quality objectives will be met at the most exposed receptor locations, and since the actual changes due to traffic generated by developments are small and insignificant, it can be concluded that the air quality over the site is acceptable for residential development and that baseline plus development traffic will not have any adverse impacts on ambient air quality for existing dwellings. The results do not indicate a requirement for more detailed dispersion modelling.

Construction Dust

- 6.15 It is estimated that the construction process will take in excess of 12 months to complete and whilst this increases the likelihood of complaint (see Table 5.6), nuisance dust impacts are likely to be temporary and episodic (most noticeable during dry windy conditions) and would not persist beyond completion of construction. Where dust raising activities are present for 6-12 months or more, a potential likelihood for complaints can be found for receptors within 100-150 of the works, i.e. primarily for those dwellings located to the northeast of the site, but beyond 150 m dust nuisance is considered largely unlikely. Therefore, for those areas of earthworks close to these locations, a potential likelihood for complaints would exist without mitigation.

- 6.16 The qualitative dust assessment criteria in Table 5.7 likewise indicate that some receptors primarily to the east of the site on the opposite side of Pagham Road lie within the zone for potentially significant effects for soiling.
- 6.17 Applying the IAQM risk assessment procedures as set out in Appendix VII requires an assessment where there are sensitive receptors within 350m of the site boundary of the works and/or within 100m of the routes used by construction vehicles on the public highway up to 500m from the site entrance. Existing dwellings fall within the 350m zone, which triggers the initial screening criterion.
- 6.18 The overall risk assessment for dust from the construction works is presented in Table 6.3. The conclusions are based upon the classifications for a 'medium' construction site because, although the total site area is estimated to exceed 100,000m² and fall within the large category, not all of the site would require intensive earthworks nor would it require large numbers of plant or significant amounts of spoil removal, nor are the types of construction work or soil conditions likely to lead to anything more than being 'moderately dusty'. There are no demolition requirements on site. Distances from the main dust generating areas to the closest dwellings are approximately 30m or more, and generally more than 100m for all other dwellings. There are no known ecological areas within 50m of the works.

Table 6.3: Summary Risk Effects Table With No Mitigation

Source	Dust Soiling Effects	Ecological Effects	PM ₁₀ Effects
Demolition	N/A	N/A	N/A
Earthworks	Medium Risk Site	Negligible	Medium Risk Site
Construction	Low Risk Site	Negligible	Low Risk Site
Trackout	Low Risk Site	Negligible	Low Risk Site

- 6.19 With regard to dust soiling and PM₁₀ effects, the risk assessment indicates that on the basis of no mitigation being present, the earthworks would present a medium risk of dust annoyance, and building construction and trackout sources would each present a low risk of dust annoyance.
- 6.20 Guidance on the mitigation measures needed to deal with low, medium or high risk effects is set out in 'Guidance on the assessment of dust from demolition and construction', February 2014, prepared by the Institute of Air Quality Management. Those measures are presented here in Appendix X and are considered appropriate for the control of dust emissions from all sites.
- 6.21 The relevant mitigation measures presented in Appendix X appropriate for a medium and low risk site should be routinely included in the site's dust

management plan. Key measures known to minimise dust emissions and represent good practice guidance are summarised in Table 6.4.

Table 6.4: Key Dust Mitigation Measures

Aspect	Mitigation Measures
Site Planning	No bonfires
	Plan site layout - machinery and dust causing activities should be located away from sensitive receptors
Construction Traffic	All vehicles should switch off engines when not in active use – no idling vehicles
	Wash or clean all vehicles effectively before leaving the site if close to sensitive receptors
	All loads entering and leaving site to be covered
	No site runoff of water or mud
	All non road mobile machinery (NRMM) to use ultra low sulphur tax-exempt diesel (ULSD) where available
Demolition Works	Use water as dust suppressant
	Cutting equipment to use water as suppressant or suitable local exhaust ventilation systems
	Securely cover skips and minimize drop heights
Site Activities	To employ best practicable means in the control of dust
	Minimise dust generation activities
	Use water as dust suppressant where possible
	Keep stockpiles for the shortest possible times
Site Management	Appointment of a site agent whose contact details are provided to the LPA's Environmental Health Department and local residents prior to construction works starting.
	Agent to provide immediate response to any complaints by logging details of complaint and investigating source of complaint to establish whether routine mitigation measures have been properly implemented. If necessary, appropriate steps to be taken to mitigate against any adverse effects, and details of actions to be logged.

Cumulative Construction Dust

- 6.22 Three of the four sites being considered for cumulative effects are 600m to approximately 2km to the north of the Pagham South site. Therefore, given the distances associated with significant effects from construction effects, e.g. see Tables 5.6 and 5.7, no cumulative dust effects are to be expected with these sites. The approved development on land at Summer Lane lies adjacent to the

site's northern boundary, which means that construction works on that site could have cumulative effects if it occurred simultaneously with construction work at the northern end of the Pagham South site.

- 6.23 However, there are few dwellings close to both sites, and, given the earlier approval of the Summer Lane application and the smaller scale of this development, significant cumulative impacts are considered unlikely. The types of construction activities associated with house construction on both sites would be similar, therefore, even if the works were to take place concurrently, the total dust emissions would only increase if no mitigation measures were to be implemented at either site.
- 6.24 The routine dust mitigation measures for construction would be capable of dealing with dust emissions from either or both neighbouring construction sites should they take place at the same time, therefore, the use of appropriate planning conditions to implement such measures would be sufficient to deal with any cumulative effects.

Odour

- 6.25 The LPA has expressed concern regarding the potential for the sewage treatment works (STW) located to the northwest of the site to cause odours that might adversely affect residential amenity. The STW is identified on Figure 2 and is at least 482m from the closest boundary of the site. Existing dwellings in Millfarm Estate to the east of the STW are closer at approximately 300m.
- 6.26 Water Authorities generally seek to achieve a minimum separation distance of 400m between their works and new sensitive development, as beyond this there is little evidence of significant odours capable of exceeding odour thresholds. The site is 482m and more from the STW, which provides a strong indication that the STW would have no significant impacts upon residential amenity over the site.
- 6.27 It is also relevant that exposure to odour for planning assessment purposes is commonly assessed in terms of a percentile of hourly averages over the course of a year, which prevents results being skewed by infrequent meteorological conditions or infrequent operational conditions. This approach acknowledges that some occasional odours, e.g. detected on calm/foggy days, is unlikely to cause long-term annoyance. As a consequence, assessments do not focus upon worst case hourly concentrations but instead use a threshold expressed as a 98th percentile (C₉₈) of hourly averages, i.e. a concentration not exceeded for 98% of the year. This allows 2% of the year (175 hours) when the exposure may be above the criterion. The overall term for the concentration is C_{98, 1-hour} ou_E/m³.
- 6.28 The prevailing wind direction will, therefore, have a significant bearing upon potential exceedance of the C_{98,1-hour} threshold. Over the UK, the prevailing wind direction is from the southwest, which means that should odours be released

from the STW they would, for the majority of the year, be blown away from the development site.

- 6.29 Given the relative location to the STW, and the significant separation between the two, the site is unlikely to be exposed to odours that would exceed normal odour thresholds or cause complaint.

7. CONCLUSIONS

Traffic Noise

- 7.1 During the noise survey the predominant noise for the site was at all times road traffic using Pagham Road.
- 7.2 None of the noise levels were considered to be high, and they were all lower than levels that are commonly encountered at approved developments adjacent to transportation routes. Consequently, acceptable noise standards will be readily achieved using practicable forms of noise mitigation as discussed below.
- 7.3 For new dwellings and residential buildings facing Pagham Road at a distance of 17m or more from the carriageway edge, windows facing the road will need to provide a minimum sound reduction (R_{TRA}) of no more than 19 dB in order to achieve BS8233's internal L_{Aeq} and L_{Amax} noise levels. Normal thermal double glazing having a configuration of 4/12/4 or 4/16/4, 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, typically provides a sound reduction of 25 dB R_{TRA} , which would be more than sufficient to enable all internal noise standards to be met.
- 7.4 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 the road. These would enable occupiers to obtain natural ventilation with windows closed, without any loss of amenity due to noise intrusion.
- 7.5 It has been assumed that dwellings will face the road at a distance of 17m, with private gardens used for amenity purposes located behind new dwellings, 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 47 dB L_{Aeq} for garden areas, which would satisfy the BS8233/WHO outdoor criterion of 55 dB.
- 7.6 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. This would typically provide an attenuation of 7 dB(A) and would minimise the impact of traffic noise in accordance with the guidance of BS8233.

- 7.7 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 Pagham 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.
- 7.8 In conclusion, the noise assessment demonstrates that acceptable external and internal noise levels will be achieved for residents subject to appropriate noise mitigation, which is a matter that can be dealt with by way of planning conditions. For example, conditions can require a scheme for protecting the proposed residential development from road traffic noise to be submitted and approved by the local planning authority, and for all works that form part of the scheme to be completed before any part of the development is occupied. If required, specific noise standards to be achieved inside dwellings can be specified within a planning condition, and these would be attained by way of appropriate window designs. With relevant noise standards met, the proposed development would satisfy the requirements of the NPPF.
- 7.9 Planning conditions are regularly employed to control noise from ancillary noise sources such as retail units, service/delivery areas and mechanical/electrical service plant, and there is no reason why they cannot be applied to the outline application.

Cumulative Traffic Noise Effects

- 7.10 For all existing receptors adjacent to local roads, the noise changes from 2016 to 2021 due to committed development traffic are 0.7 dB or less. Therefore, committed developments would have a negligible impact upon existing dwellings.
- 7.11 The greatest noise changes between the situation with committed developments to the situation with all proposed developments amount to 1.1 and 1.5 dB respectively along Pagham Road south of Nyetimber Lane, and along Nyetimber Lane west, which amount to minor effects short term and negligible long term. All other roads would experience changes of 0.9 dB or less, which amount to negligible effects at all times.
- 7.12 If one considers the total noise change from 2016 to the situation with all developments, then the greatest changes increase slightly to 1.7 and 2.1 dB respectively along Pagham Road south of Nyetimber Lane, and along Nyetimber Lane west, with additional changes of 1.2 to 1.4 dB along other sections of Pagham Road and also Hook Lane west. Once again, these amount to minor effects short term and negligible long term. Noise changes along all other roads would again be 0.9 dB or less, which amount to negligible effects at all times.
- 7.13 Maximum noise changes of 2.1 dB or less would not cause any change in behaviour or attitude, nor would they significantly affect the acoustic character

of the area such that there is a perceived change in the quality of life. Consequently, traffic generated by cumulative developments would have no observed adverse effect and there would be no requirement for specific mitigation measures.

- 7.14 Using traffic noise as a surrogate for traffic vibration, since there are no significant or perceptible noise changes with either committed or the proposed development, vibration is similarly not expected to have any significant impacts.

Construction Noise Impacts

- 7.15 Dwellings adjacent to the eastern boundary of the site are approximately 15m or more from the site boundary and would normally be approximately 30m or more from the closest construction works, which indicates that the normal daytime limit of 75 dB L_{Aeq} is unlikely to be exceeded but that exceedence of the significance criterion of 65 dB L_{Aeq} is possible, subject to the overall time when plant is operating in close proximity to the eastern boundary.
- 7.16 However, the majority of dwellings to the east of the site are separated from the site by the existing traffic noise source along Pagham Road, which will increase the ambient noise levels and reduce the risk of annoyance due to construction activities. Apart from a few dwellings towards the southern end of the site, which are still separated from the site boundary by distances of 20-30m, the majority of the site boundary does directly abut sensitive aspects of existing development.
- 7.17 The main area for noise control will apply to works close to the eastern boundary of the site, although the sensitive areas are limited in extent and occur mainly at the southern corner of the site. The time that plant is operated within this area should be restricted as much as possible and plant should not be left idling within this area when not in use.
- 7.18 With respect to potential vibration impacts on sensitive uses adjacent to the works, the construction of new residential development is not normally seen to be a significant source of vibration since impulsive operations such as piling are not required, and other routine ground works does not involve the application of impulsive forces directly into the ground.
- 7.19 Due to the significant separation distances between the site and three of the four sites being considered for cumulative effects, no cumulative noise effects are to be expected with these sites. Only the approved development on land at Summer Lane, which lies adjacent to the site's northern boundary, would have the potential to cause cumulative construction noise effects if it occurred simultaneously with construction work at the northern end of the Pagham South site.

- 7.20 However, there are few dwellings close to both sites, and, given the earlier approval of the Summer Lane application and the smaller scale of this development, significant cumulative impacts are considered unlikely. The types of construction activities associated with house construction on both sites would be similar, therefore, even if the works were to take place concurrently, the total construction noise contributions would not increase by more than 3 dB, which would fall within the normal margin of error expected for construction noise predictions.
- 7.21 The routine noise mitigation measures for construction would be capable of dealing with the noise levels from either or both neighbouring construction sites should they take place at the same time.

Cumulative Traffic Emissions

- 7.22 The air quality assessment indicates that for a baseline traffic situation in 2016, receptors adjacent to local roads have values below the current annual mean air quality objectives for NO₂ and PM₁₀.
- 7.23 With traffic generated by all committed developments plus the proposed Pagham South development in 2021, the absolute concentrations still remain below the air quality objectives. The level of change due to traffic generated by just the proposed Pagham South development would be small, with the maximum change being 0.5 µg/m³ or less to annual mean concentrations of NO₂ and PM₁₀, which would not have a significant impact upon local air quality.
- 7.24 Due to projected decreases to future background concentrations, future concentrations of NO₂ and PM₁₀ are calculated to reduce in 2021, even with committed developments and the proposed Pagham South development. Therefore, the committed and proposed developments would not have an adverse cumulative impact upon ambient air quality.
- 7.25 The ambient concentrations of local traffic emissions are predicted to be 75% or less of the Air Quality Assessment Level (AQAL), and the % change in concentration relative to the AQAL due to development traffic is calculated to be less than 1%. On this basis, the development's impact on local air quality will be negligible.
- 7.26 Therefore, since the air quality assessment indicates that annual mean air quality objectives will be met at the most exposed receptor locations, and since the actual changes due to traffic generated by developments are small and insignificant, it can be concluded that the air quality over the site is acceptable for residential development and that baseline plus development traffic will not have any adverse impacts on ambient air quality for existing dwellings. The results do not indicate a requirement for more detailed dispersion modelling. Therefore, the air quality issues for the proposed development are not deemed to be a significant consideration.

Construction Dust

- 7.27 With regard to dust soiling and PM₁₀ effects, the risk assessment indicates that on the basis of no mitigation being present, the earthworks would present a medium risk of dust annoyance, and building construction and trackout sources would each present a low risk of dust annoyance.
- 7.28 Due to the significant separation distances between the site and three of the four sites being considered for cumulative effects, no cumulative dust effects are to be expected with these sites. Only the approved development on land at Summer Lane, which lies adjacent to the site's northern boundary, would have the potential to cause cumulative construction dust effects if it occurred simultaneously with construction work at the northern end of the Pagham South site. However, the total dust emissions would only increase if no mitigation measures were to be implemented at either site.
- 7.29 The routine dust mitigation measures for construction would be capable of dealing with dust emissions from either or both neighbouring construction sites should they take place at the same time, therefore, the use of appropriate planning conditions to implement such measures would be sufficient to deal with any cumulative effects.
- 7.30 Guidance on the mitigation measures needed to deal with low, medium or high risk effects is set out in 'Guidance on the assessment of dust from demolition and construction', February 2014, prepared by the Institute of Air Quality Management, and is considered appropriate for the control of dust emissions from all sites.

Odour

- 7.31 The STW is at least 482m from the closest boundary of the site, whereas existing dwellings in Millfarm Estate to the east of the STW are closer at approximately 300m.
- 7.32 Water Authorities generally seek to achieve a minimum separation distance of 400m between their works and new sensitive development, as beyond this there is little evidence of significant odours capable of exceeding odour thresholds. The site is 482m and more from the STW, which provides a strong indication that the STW would have no significant impacts upon residential amenity over the site.
- 7.33 It is also relevant that exposure to odour for planning assessment purposes is commonly assessed in terms of a percentile of hourly averages over the course of a year, which prevents results being skewed by infrequent meteorological conditions or infrequent operational conditions. The prevailing wind direction will, therefore, have a significant bearing upon potential exceedance of the odour threshold. Over the UK, the prevailing wind direction is from the southwest,

which means that should odours be released from the STW they would, for the majority of the year, be blown away from the development site.

- 7.34 Consequently, given the relative location of the site to the STW, and the significant separation between the two, the site is unlikely to be exposed to odours that would exceed normal odour thresholds or cause complaint.

Figure 1
Site Location Plan



Figure 2

Noise Monitoring Positions



Development Framework Plan



APPENDIX I

DESCRIPTION OF NOISE AND VIBRATION UNITS

DESCRIPTION OF NOISE AND VIBRATION UNITS

Noise

- 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/m²) to the highest that can be withstood without physical pain (about 10 watts/m²). 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-hour) noise index. The L_{A10} is the A-weighted sound level exceeded for 10% of the time, and the L_{A10} (18-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.

Vibration

- Vibrating sources, such as motor vehicle engines or the movement of vehicles over road surface irregularities, can produce not only displacement of the air molecules which we perceive as noise, but also displacement within the material components of the source or materials in contact with the source. These energy waves can travel through the ground in a similar manner to air pressure waves through the atmosphere and, dependent on the amount of energy being transmitted, be perceived as vibration.
- Vibration can produce three effects:
 - at levels above the threshold of perception it may cause human annoyance;
 - at extreme levels (above those commonly associated with road traffic) it may cause building damage; and

- it may be re-radiated as audible noise.
- Vibration can be defined as an oscillating motion about a fixed reference position. The number of times that a complete oscillation takes place during one second is called the 'frequency' measured in hertz (Hz) or cycles/second. The movement of an oscillating body can be described in terms of its displacement, velocity or acceleration.
- For a simple oscillating signal, the peak-to-peak value measures the maximum excursion of the vibration about the stable reference position, it is particularly useful for measuring the vibratory displacement of machine parts. The peak value is the highest positive excursion from the stable reference position and is used to measure the energy level of short duration shocks; these are commonly measured as peak particle velocity (ppv) in mm/s.
- For a complex vibration signal, the peak measures described above will not take account of the fluctuations that occur with time; this is called the signal's 'time history'. The RMS or 'root mean square' value is the most appropriate unit for measuring either the destructive abilities of a vibration or its potential for causing human annoyance because it takes account of the full time history of the signal and provides an amplitude value which is directly related to the energy content. Values are commonly measured as rms accelerations in m/s^2 .
- For a symmetrical signal the positive and negative excursions are equal, therefore, if the signal were to be averaged a 'zero' value would be obtained. This effect can be countered by first squaring the signal values before taking a mean. (The square of a negative value produces a positive value.) This squaring action will of course overestimate the vibrational energy and needs to be countered in turn by finally taking a square root of the mean, hence the term 'root mean square'.
- The probability of adverse comment due to a given vibration time history can be determined by using the rms frequency weighted acceleration and the duration of exposure to calculate a Vibration Dose Value (VDV). The VDV has 'fourth power' time dependency, therefore, unlike the rms value (which uses the square root of a squared value) the VDV is derived from the fourth root of the integral of the fourth power of the acceleration, in units of $\text{m/s}^{1.75}$. It provides a time dependent and frequency weighted unit of vibration that correlates with human response.

APPENDIX II

NOISE MEASUREMENTS

Date	LAeq	LAmaz	LAF,01	LAF,10	LAF,90
Position 1 Night					
(2016/09/08 23:00:00.00)	45.4	62.1	58	46.7	37.9
(2016/09/08 23:05:01.00)	51.3	68.6	64.5	51.2	39.2
(2016/09/08 23:10:01.00)	49.8	67.7	63.7	47.8	34.1
(2016/09/08 23:15:01.00)	46.8	68.1	62	41.5	30.7
(2016/09/08 23:20:01.00)	55.5	72	67.6	58.4	36.4
(2016/09/08 23:25:02.00)	53.9	71.4	68.1	51.8	35.6
(2016/09/08 23:30:02.00)	50.8	71.2	64.3	49.5	37.6
(2016/09/08 23:35:02.00)	45	61.9	57.9	46.8	34.8
(2016/09/08 23:40:02.00)	56.5	74.3	70.2	56.1	37.3
(2016/09/08 23:45:03.00)	48.6	63.2	58.8	52.1	41.5
(2016/09/08 23:50:03.00)	42.5	55.6	50.1	45.6	36.5
(2016/09/08 23:55:03.00)	51.4	69.8	64.2	50.6	38.5
(2016/09/09 00:00:03.00)	45.1	59.1	51.8	47.5	39.9
Average	49.4	66.5	61.6	49.7	36.9
Maximum	56.5	74.3	70.2	58.4	41.5
Position 1 Day					
(2016/09/09 11:16:58.00)	60.2	83.2	70	64.6	44.5
(2016/09/09 11:21:58.00)	63	71.8	70	66.8	49.3
(2016/09/09 11:26:59.00)	61.4	71.3	69.1	66.2	45.9
(2016/09/09 11:31:59.00)	61.3	78.3	71.8	65.5	45.2
(2016/09/09 11:36:59.00)	61.8	74.3	71.5	66.3	47.6
(2016/09/09 11:41:59.00)	60.4	73.8	70.5	65.6	46
(2016/09/09 11:47:00.00)	59.7	72.3	68.7	64.6	46.2
(2016/09/09 11:52:00.00)	59.1	72.3	68.9	64.2	44.4
(2016/09/09 11:57:00.00)	61.8	76.2	71.4	66.9	44.2
(2016/09/09 12:02:01.00)	59.2	72.4	69.4	63.5	45.9
(2016/09/09 12:07:01.00)	60.2	74.3	70.1	65	46.1
(2016/09/09 12:12:01.00)	59.2	70.2	68.5	64.2	44
(2016/09/09 12:17:02.00)	60.2	72.1	70.4	65.2	45.6
(2016/09/09 12:22:02.00)	60.9	73.2	70.8	65.7	45.3
(2016/09/09 12:27:02.00)	61.9	73.6	69.8	66.9	47.3
(2016/09/09 12:32:02.00)	59.6	71.7	69.4	65	43.7
(2016/09/09 12:37:03.00)	59.7	72.7	68.8	65	45.4
(2016/09/09 12:42:03.00)	60.1	72.6	69.6	65.2	44.9
(2016/09/09 12:47:03.00)	60.8	72.3	70.6	66.3	45.6
(2016/09/09 12:52:04.00)	60.2	73.1	70	65.3	45.4
(2016/09/09 12:57:04.00)	61	81.4	69.7	64.9	44.9
(2016/09/09 13:02:04.00)	61.8	77.7	72.2	66.2	46.1
(2016/09/09 13:07:05.00)	59.1	73.4	71.1	63.9	43.5
(2016/09/09 13:12:05.00)	58.6	69.1	67	63.7	47.8
(2016/09/09 13:17:05.00)	58.4	71.3	68	63.5	45.3
(2016/09/09 13:22:05.00)	60	71.2	69.5	65	47.1
(2016/09/09 13:27:06.00)	58.7	69.4	68.1	64	45.4
(2016/09/09 13:32:06.00)	59.8	73.2	69.9	64.6	46
(2016/09/09 13:37:07.00)	61.5	75.9	70.6	65.8	45.8

(2016/09/09 13:42:07.00)	61.8	78.9	75.1	65	47.2
(2016/09/09 13:47:07.00)	60.3	73.2	70	65	46.3
(2016/09/09 13:52:08.00)	60.8	74.3	71.9	65.3	45.4
(2016/09/09 13:57:08.00)	59.5	72.9	70	64.5	42.5
(2016/09/09 14:02:08.00)	60.6	74.7	71.8	65.6	43.3
(2016/09/09 14:07:09.00)	59.3	70.7	69.4	64.4	44.5
(2016/09/09 14:12:09.00)	64.5	81.7	75.2	68.4	45
(2016/09/09 14:17:09.00)	58.2	72.8	68.7	62.9	42.1
Average	60.4	73.9	70.2	65.2	45.4
Maximum	64.5	83.2	75.2	68.4	49.3
Position 2 Day					
(2016/09/09 14:31:10.00)	57.2	69.3	66.5	62.6	44.6
(2016/09/09 14:36:10.00)	55.7	66.2	64.9	61.2	44.6
(2016/09/09 14:41:10.00)	56.2	68.1	66	61	41.1
(2016/09/09 14:46:11.00)	55.8	68.9	65.8	61	42.2
(2016/09/09 14:51:11.00)	56.5	68.3	66.3	62	40.3
(2016/09/09 14:56:12.00)	57	69.7	67.4	61.9	41.3
(2016/09/09 15:01:12.00)	57.7	68.5	67.2	62.7	42.2
Average	56.6	68.4	66.3	61.8	42.3
Maximum	57.7	69.7	67.4	62.7	44.6

APPENDIX III

INDICATIVE SOUND INSULATION PERFORMANCE OF WINDOWS

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 IV

AAWT TRAFFIC FLOWS AND BASIC NOISE LEVELS

Road	Base 2016			2021+Com			%Change	BNL 18hr			
	%HGV	Speed kph	18-hr Flow	%HGV	Speed kph	18-hr Flow		Base	With dev	Change	
Pagham Road south of Nyetimber Lane	3.62	48	7956	3.30	48	9449	18.8	66.5	67.1	0.6	
Nyetimber Lane west	1.45	48	2434	1.24	48	2846	16.9	60.5	61.1	0.6	
Pagham Road north of Nyetimber Lane	3.63	48	7932	3.31	48	9414	18.7	66.5	67.1	0.6	
Pagham Road south of Hook Lane	3.74	48	7080	3.47	48	8297	17.2	66	66.6	0.6	
Hook Lane west	1.79	48	3940	1.57	48	4486	13.9	62.8	63.2	0.4	
Pagham Road north of Hook Lane	3.84	48	4904	3.80	48	5727	16.8	64.4	65.1	0.7	
Pagham Road south of Sefter Road	3.96	48	4904	3.80	48	5721	16.7	64.5	65.1	0.6	
Sefter Road	2.36	48	4492	2.17	48	4880	8.6	63.5	63.8	0.3	
Pagham Road north of Sefter Road	3.15	48	9149	3.01	48	10343	13	66.9	67.4	0.5	
Sefter Road west of Hook Lane	2.88	48	4492	2.77	48	4880	8.6	63.7	64.1	0.4	
Hook Lane east	2.20	48	4533	1.96	48	5092	12.3	63.5	63.9	0.4	
Sefter Road east of Hook Lane	1.90	48	8355	1.78	48	9249	10.7	66.1	66.5	0.4	
Gossamer Lane north	2.67	48	9014	2.65	48	9967	10.6	66.7	67.1	0.4	
Nyetimber Lane east	3.88	48	7279	3.13	48	8079	11	66.2	66.4	0.2	
Grosvenor Gardens	1.43	48	5339	1.30	48	5892	10.4	63.9	64.3	0.4	
Rose Green Road (eastbound only)	2.34	48	2264	2.15	48	2464	8.8	60.6	60.9	0.3	
Gossamer Lane south	2.50	48	10837	2.49	48	11807	9	67.4	67.8	0.4	
Aldwick Road west	4.24	48	6803	4.21	48	7397	8.7	66	66.3	0.3	
Aldwick Street	2.45	48	7432	2.47	48	8091	8.9	65.8	66.1	0.3	
Barrack Lane	3.62	48	3575	3.48	48	3887	8.7	63	63.3	0.3	

Pagham Road south of Lower Bognor Road	2.86	48	8855	2.70	48	10025	13.2	66.7	67.2	0.5	
Lower Bognor Road	0.95	48	7391	0.88	48	8038	8.8	65.2	65.5	0.3	
Pagham Road north of Lower Bognor Road	1.93	48	16176	1.86	48	17993	11.2	69	69.4	0.4	
B2166 Lagness Road east of Vinnetrow Road	3.39	48	16834	3.26	48	19134	13.7	69.6	70.2	0.6	
Vinnetrow Road	3.75	48	7062	3.78	48	7785	10.2	66	66.4	0.4	
B2166 Lagness Road west of Vinnetrow Road	3.54	48	15764	3.50	48	17452	10.7	69.4	69.8	0.4	
Mill Lane	0.68	48	864	0.63	48	941	8.8	55.7	56.1	0.4	
Aldwick Road j/w Lower Bognor Road	2.76	48	11931	2.73	48	13130	10.1	67.9	68.3	0.4	
B2166 jw B2145	3.73	48	24561	3.69	48	27072	10.2	71.4	71.8	0.4	
B2145 jw A27 - Whyke Roundabout	7.25	48	50145	7.20	48	54214	8.1	75.5	75.8	0.3	
Bognor Road jw A27 - Bognor Road Roundabout	5.68	48	51779	5.67	48	55678	7.5	75.2	75.5	0.3	
Road	2021+Com			2021+Com+Dev			%Change	BNL 18hr			Total change from 2016
	%HGV	Speed kph	18-hr Flow	%HGV	Speed kph	18-hr Flow		Base	With dev	Change	
Pagham Road south of Nyetimber Lane	3.30	48	9449	2.38	48	13083	38.5	67.1	68.2	1.1	1.7
Nyetimber Lane west	1.24	48	2846	0.85	48	4169	46.5	61.1	62.6	1.5	2.1
Pagham Road north of Nyetimber Lane	3.31	48	9414	2.66	48	11725	24.5	67.1	67.8	0.7	1.3
Pagham Road south of Hook Lane	3.47	48	8297	2.71	48	10613	27.9	66.6	67.4	0.8	1.4
Hook Lane west	1.57	48	4486	1.26	48	5604	24.9	63.2	64.1	0.9	1.3
Pagham Road north of Hook Lane	3.80	48	5727	3.14	48	6921	20.8	65.1	65.7	0.6	1.3
Pagham Road south of Sefter Road	3.80	48	5721	3.15	48	6915	20.9	65.1	65.7	0.6	1.2
Sefter Road	2.17	48	4880	2.17	48	4880	0	63.8	63.8	0	0.3
Pagham Road north of Sefter Road	3.01	48	10343	2.70	48	11537	11.5	67.4	67.8	0.4	0.9

Sefter Road west of Hook Lane	2.77	48	4880	2.77	48	4880	0	64.1	64.1	0	0.4
Hook Lane east	1.96	48	5092	1.71	48	5833	14.5	63.9	64.4	0.5	0.9
Sefter Road east of Hook Lane	1.78	48	9249	1.65	48	9990	8	66.5	66.8	0.3	0.7
Gossamer Lane north	2.65	48	9967	2.47	48	10702	7.4	67.1	67.4	0.3	0.7
Nyetimber Lane east	3.13	48	8079	2.87	48	8814	9.1	66.4	66.7	0.3	0.5
Grosvenor Gardens	1.30	48	5892	1.30	48	5892	0	64.3	64.3	0	0.4
Rose Green Road (eastbound only)	2.15	48	2464	2.15	48	2464	0	60.9	60.9	0	0.3
Gossamer Lane south	2.49	48	11807	2.38	48	12336	4.5	67.8	67.9	0.1	0.5
Aldwick Road west	4.21	48	7397	3.99	48	7815	5.6	66.3	66.5	0.2	0.5
Aldwick Street	2.47	48	8091	2.45	48	8144	0.7	66.1	66.2	0.1	0.4
Barrack Lane	3.48	48	3887	3.48	48	3887	0	63.3	63.3	0	0.3
Pagham Road south of Lower Bognor Road	2.70	48	10025	2.41	48	11219	11.9	67.2	67.5	0.3	0.8
Lower Bognor Road	0.88	48	8038	0.88	48	8038	0	65.5	65.5	0	0.3
Pagham Road north of Lower Bognor Road	1.86	48	17993	1.75	48	19186	6.6	69.4	69.6	0.2	0.6
B2166 Lagness Road east of Vinnetrow Road	3.26	48	19134	3.07	48	20327	6.2	70.2	70.4	0.2	0.8
Vinnetrow Road	3.78	48	7785	3.61	48	8138	4.5	66.4	66.6	0.2	0.6
B2166 Lagness Road west of Vinnetrow Road	3.50	48	17452	3.34	48	18334	5.1	69.8	70	0.2	0.6
Mill Lane	0.63	48	941	0.63	48	941	0	56.1	56.1	0	0.4
Aldwick Road j/w Lower Bognor Road	2.73	48	13130	2.64	48	13606	3.6	68.3	68.5	0.2	0.6
B2166 jw B2145	3.69	48	27072	3.58	48	27954	3.3	71.8	71.9	0.1	0.5
B2145 jw A27 - Whyke Roundabout	7.20	48	54214	7.09	48	55096	1.6	75.8	75.9	0.1	0.4
Bognor Road jw A27 - Bognor Road Roundabout	5.67	48	55678	5.64	48	56031	0.6	75.5	75.6	0.1	0.4

APPENDIX V

DESCRIPTION OF AIR QUALITY TERMS AND UNITS

DEFINITION OF AIR QUALITY TERMS AND UNITS

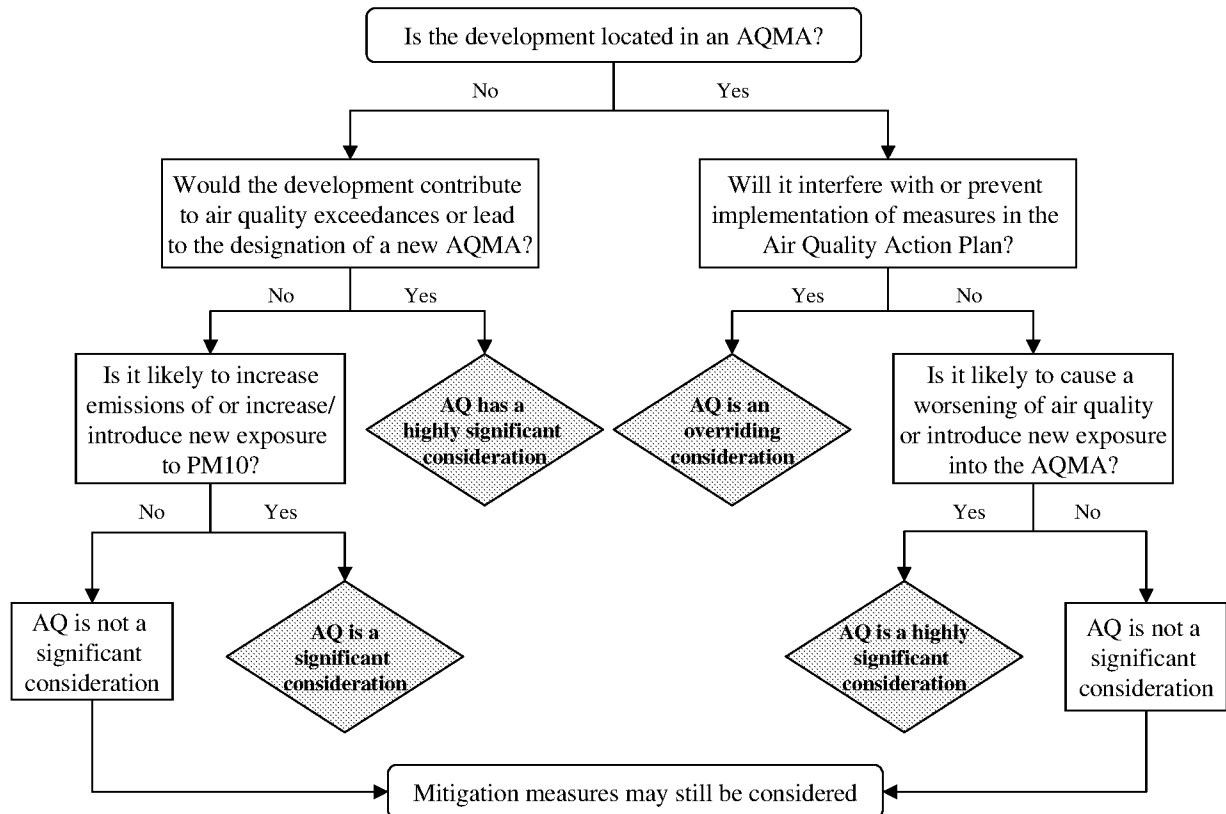
ppm	parts per million - defines the units of pollution in every million (10^6) units of air.
ppb	parts per billion - defines the units of pollution in every billion (10^9) units of air.
$\mu\text{g}/\text{m}^3$	microgrammes per cubic metre - one microgramme is one millionth of a gram.
ng/m^3	nanogrammes 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 90 th 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 VI

SIGNIFICANCE FLOW CHARTS

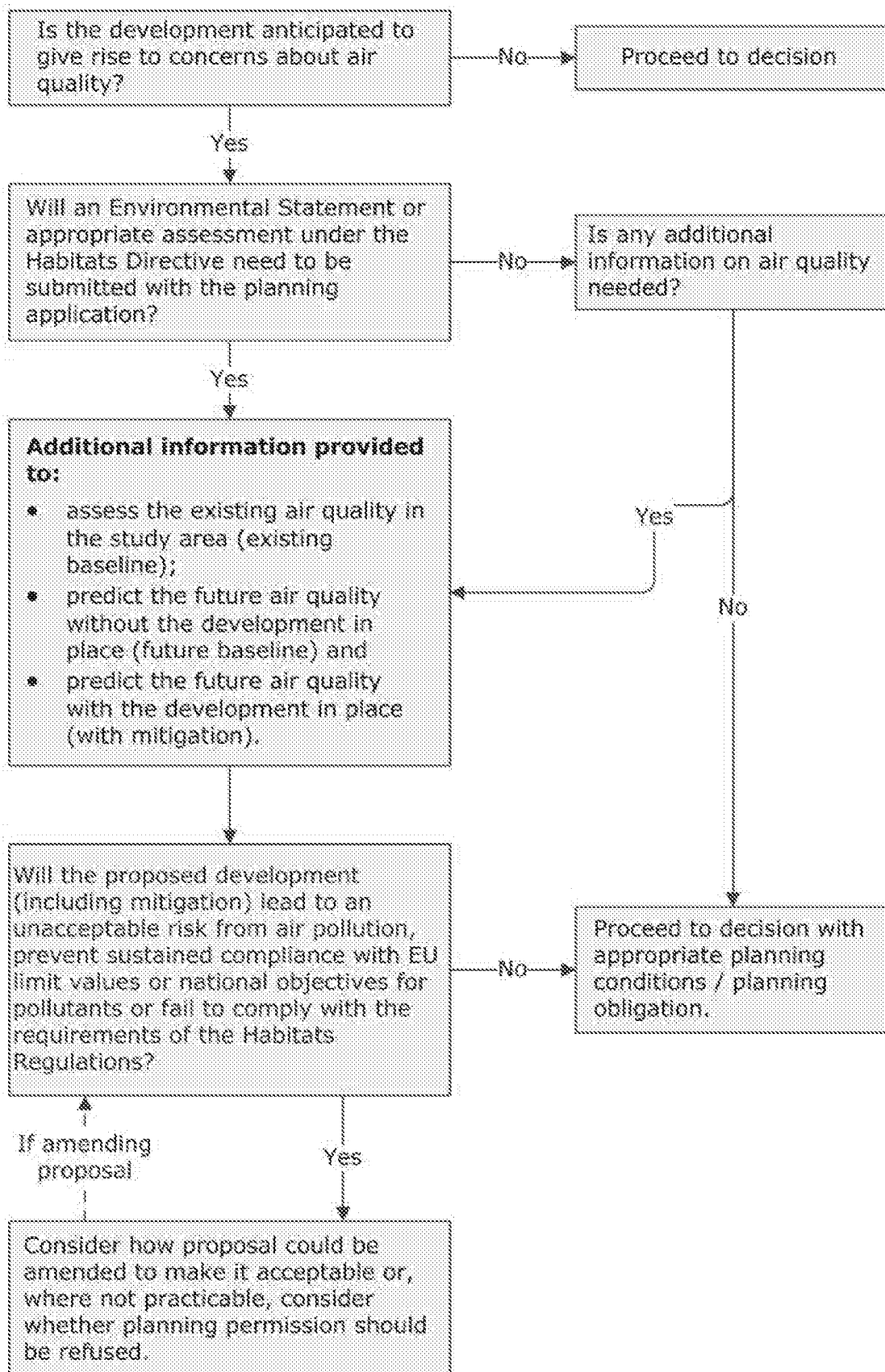
London Councils' Guidance

Determining significant impacts on air quality



Note: Where **significant** is used, it will be based on the professional judgement of the Local Authority officer.

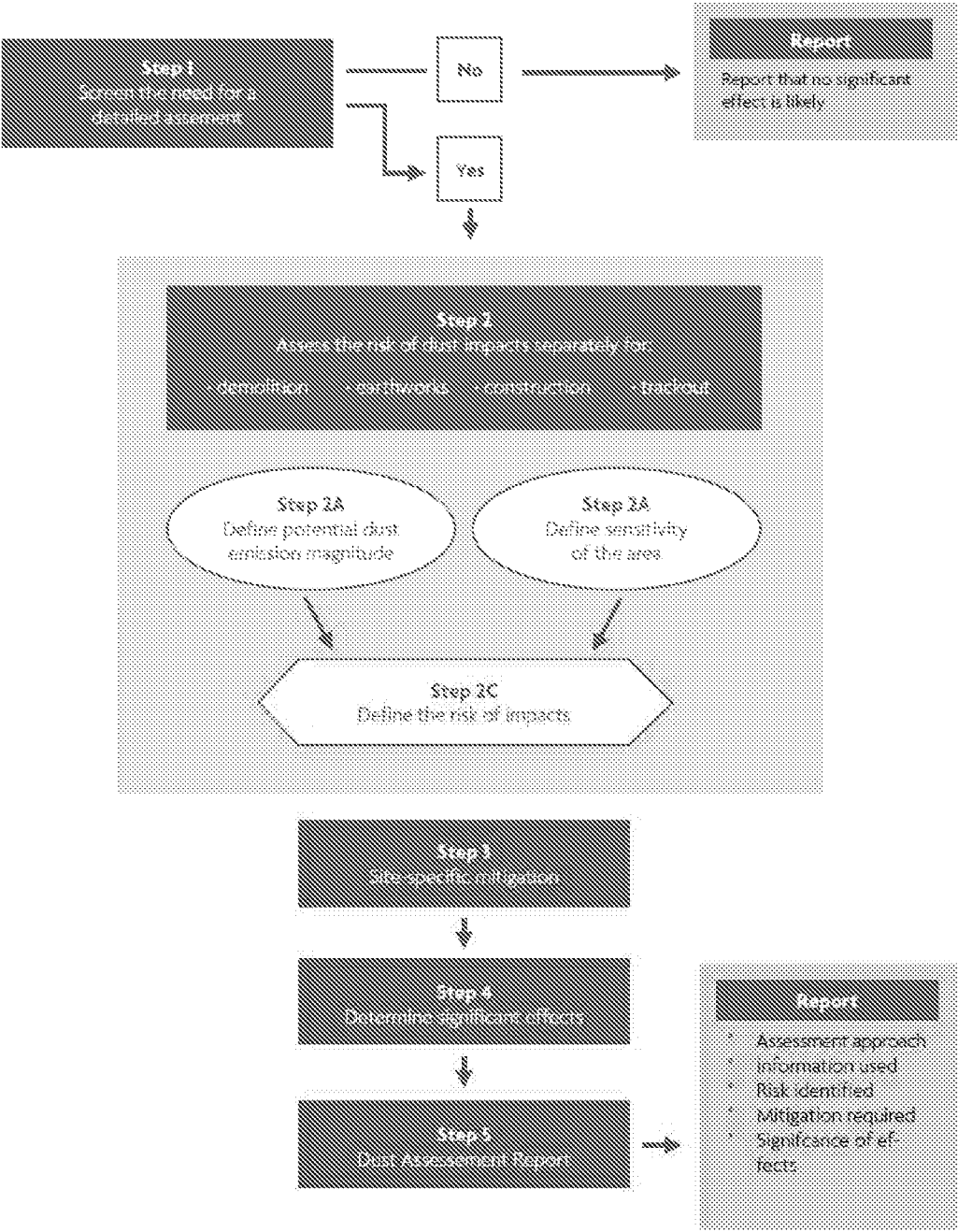
Planning Practice Guidance



APPENDIX VII

DUST RISK ASSESSMENT PROCEDURES

Figure 1: Steps to Perform a Dust Assessment



Demolition

Examples:

- **Large:** Total building volume >50 000 m³, potentially dusty construction material (e.g. concrete), on-site crushing and screening, demolition activities >20 m above ground level;
- **Medium:** Total building volume 20 000 m³ – 50 000m³, potentially dusty construction material, demolition activities 10-20 m above ground level; and
- **Small:** Total building volume <20 000 m³, construction material with low potential for dust release (e.g. metal cladding or timber), demolition activities <10m above ground, demolition during wetter months.

Earthworks

Examples:

- **Large:** Total site area >10 000 m², potentially dusty soil type (e.g. clay, which will be prone to suspension when dry due to small particle size), >10 heavy earth moving vehicles active at any one time, formation of bunds >8 m in height, total material moved >100 000 tonnes;
- **Medium:** Total site area 2 500 m² – 10 000 m², moderately dusty soil type (e.g. silt), 5-10 heavy earth moving vehicles active at any one time, formation of bunds 4 m - 8 m in height, total material moved 20 000 tonnes – 100 000 tonnes; and
- **Small:** Total site area <2 500 m², soil type with large grain size (e.g. sand), <5 heavy earth moving vehicles active at any one time, formation of bunds <4 m in height, total material moved <10 000 tonnes, earthworks during wetter months.

Construction

Examples:

- **Large:** Total building volume >100 000 m³, piling, on site concrete batching; sandblasting
- **Medium:** Total building volume 25 000 m³ – 100 000 m³, potentially dusty construction material (e.g. concrete), piling, on site concrete batching; and
- **Small:** Total building volume <25 000 m³, construction material with low potential for dust release (e.g. metal cladding or timber).

Trackout

Examples:

- **Large:** >50 HDV (>3.5t) outward movements in any one day, potentially dusty surface material (e.g. high clay content), unpaved road length >100m;
- **Medium:** 10-50 HDV (>3.5t) outward movements in any one day, moderately dusty surface material (e.g. high clay content), unpaved road lengths 50m-100m;
- **Small:** <10 HDV (>3.5t) outward movements in any one day, surface material with low potential for dust release, unpaved road length <50m.

These numbers are for vehicles that leave the site after moving over unpaved ground, where they will accumulate mud and dirt that can be tracked out onto the public highway.

Table 2: Sensitivity of the Area to Dust Soiling Effects on People and Property ^{a,b}

Receptor Sensitivity	Number of Receptors	Distance from the Source (m) ^c			
		<20	<50	<100	<150
High	>100	High	High	Medium	Low
	10-100	High	Medium	Low	Low
	1-10	Medium	Low	Low	Low
Medium	>1	Medium	Low	Low	Low
Low	>1	Low	Low	Low	Low

^a The sensitivity of the area should be derived for each of the four activities: demolition, construction, earthworks and trackout. See STEP 2B, Box 6 and Box 9.

^b Estimate the total number of receptors within the stated distance. Only the highest level of area sensitivity from the table needs to be considered. For example, if there are 7 high sensitivity receptors < 20m of the source and 95 high sensitivity receptors between 20 and 50 m, then the total of number of receptors < 50 m is 102. The sensitivity of the area in this case would be high.

^c For trackout, the distances should be measured from the side of the roads used by construction traffic. Without site-specific mitigation, trackout may occur from roads up to 500 m from large sites, 200 m from medium sites and 50 m from small sites, as measured from the site exit. The impact declines with distance from the site, and it is only necessary to consider trackout impacts up to 50m from the edge of the road.

Table 3: Sensitivity of the Area to Human Health Impacts ^{a,b}

Receptor Sensitivity	Annual Mean PM ₁₀ concentration ^c	Number of Receptors ^d	Distance from the Source (m) ^e				
			<20	<50	<100	<200	<350
High	>32 µg/m ³ (>18 µg/m ³ in Scotland)	>100	High	High	High	Medium	Low
		10-100	High	High	Medium	Low	Low
		1-10	High	Medium	Low	Low	Low
	28-32 µg/m ³ (16-18 µg/m ³ in Scotland)	>100	High	High	Medium	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	High	Medium	Low	Low	Low
	24-28 µg/m ³ (14-16 µg/m ³ in Scotland)	>100	High	Medium	Low	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	>24 µg/m ³ (>14 µg/m ³ in Scotland)	>100	Medium	Low	Low	Low	Low
		10-100	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Medium	-	>10	High	Medium	Low	Low	Low
	-	1-10	Medium	Low	Low	Low	Low
Low	-	>1	Low	Low	Low	Low	Low

^a The sensitivity of the area should be derived for each of the four activities: demolition, construction, earthworks and trackout. See STEP 2B, Box 7 and Box 9.

^b Estimate the total within the stated distance (e.g. the total within 350m and not the number between 300 and 350m), noting that only the highest level of area sensitivity from the table needs to be considered. For example, if there are 7 high sensitivity receptors < 20m of the source and 95 high sensitivity receptors between 20 and 50 m, then the total of number of receptors < 50 m is 102. If the annual mean PM₁₀ concentration is 29µg/m³, the sensitivity of the area would be high.

^c Most straightforwardly taken from the national background maps, but should also take account of local sources. The values are based on 32µg/m³ being the annual mean concentration at which an exceedance of the 24-hour objective is likely in England, Wales and Northern Ireland. In Scotland there is an annual mean objective of 18µg/m³.

^d In the case of high sensitivity receptors with high occupancy (such as schools or hospitals) approximate the number of people likely to be present. In the case of residential dwellings, just include the number of properties.

^e For trackout, the distances should be measured from the side of the roads used by construction traffic. Without site-specific mitigation, trackout may occur from roads up to 500 m from large sites, 200 m from medium sites and 50 m from small sites, as measured from the site exit. The impact declines with distance from the site, and it is only necessary to consider trackout impacts up to 50 m from the edge of the road.

Table 4: Sensitivity of the Area to Ecological Impacts ^{a b}

Receptor Sensitivity	Distance from the Source (m) ^c	
	<20	>50
High	High	Medium
Medium	Medium	Low
Low	Low	Low

^a The sensitivity of the area should be derived for each of the four activities: demolition, construction, earthworks and trackout and for each designated site. See **STEP 2B, Box 8** and **Box 9**.

^b Only the highest level of area sensitivity from the table needs to be considered.

^c For trackout, the distances should be measured from the side of the roads used by construction traffic. Without site-specific mitigation, trackout may occur from roads up to 500 m from large sites, 200 m from medium sites and 50 m from small sites, as measured from the site exit. The impact declines with distance from the site.

APPENDIX VIII

ANNUAL AVERAGE DAYTIME TRAFFIC DATA

Annual Average Daytime Traffic Flows

Road	2016 Base	2016 %HGV	2021 Base+Com.	2021 %HGV	2021 Base+Com+Dev	2021 %HGV
Pagham Road south of Nyetimber Lane	8118	3.6	9642	3.3	13350	2.4
Nyetimber Lane west	2484	1.4	2904	1.2	4254	0.8
Pagham Road north of Nyetimber Lane	8094	3.6	9606	3.3	11964	2.7
Pagham Road south of Hook Lane	7224	3.7	8466	3.5	10830	2.7
Hook Lane west	4020	1.8	4578	1.6	5718	1.3
Pagham Road north of Hook Lane	5004	3.8	5844	3.8	7062	3.1
Pagham Road south of Sefter Road	5004	4.0	5838	3.8	7056	3.1
Sefter Road	4584	2.4	4980	2.2	4980	2.2
Pagham Road north of Sefter Road	9336	3.1	10554	3.0	11772	2.7
Sefter Road west of Hook Lane	4584	2.9	4980	2.8	4980	2.8
Hook Lane east	4626	2.2	5196	2.0	5952	1.7
Sefter Road east of Hook Lane	8526	1.9	9438	1.8	10194	1.6
Gossamer Lane north	9198	2.7	10170	2.7	10920	2.5
Nyetimber Lane east	7428	3.9	8244	3.1	8994	2.9
Grosvenor Gardens	5448	1.4	6012	1.3	6012	1.3
Rose Green Road (eastbound only)	2310	2.3	2514	2.1	2514	2.1
Gossamer Lane south	11058	2.5	12048	2.5	12588	2.4
Aldwick Road west	6942	4.2	7548	4.2	7974	4.0
Aldwick Street	7584	2.5	8256	2.5	8310	2.5
Barrack Lane	3648	3.6	3966	3.5	3966	3.5
Pagham Road south of Lower Bognor Road	9036	2.9	10230	2.7	11448	2.4
Lower Bognor Road	7542	1.0	8202	0.9	8202	0.9
Pagham Road north of Lower Bognor Road	16506	1.9	18360	1.9	19578	1.7
B2166 Lagness Road east of Vinnetrow Road	17178	3.4	19524	3.3	20742	3.1
Vinnetrow Road	7206	3.7	7944	3.8	8304	3.6
B2166 Lagness Road west of Vinnetrow Road	16086	3.5	17808	3.5	18708	3.3
Mill Lane	882	0.7	960	0.6	960	0.6

APPENDIX IX

FORECAST CONCENTRATIONS OF AIR POLLUTION

Forecast Concentrations of Air Pollution

Name	Year	NO _x	NO ₂	PM ₁₀	
		Annual mean µg/m ³	Annual mean µg/m ³	Annual mean µg/m ³	Days >50µg/m ³
Pagham Road (s of Nyetimber) Base	2016	16.68	10.81	15.78	0.25
Pagham Road (s of Nyetimber) Base+Com.	2021	15.59	9.83	15.34	0.16
Pagham Road (s of Nyetimber) Base+Com+Dev.	2021	17.19	10.33	15.57	0.20
Change due to development		1.59	0.50	0.23	0.04
Total change from 2016		0.51	-0.48	-0.21	-0.05
Nyetimber Ln (west) Base	2016	12.82	9.53	15.38	0.17
Nyetimber Ln (west) Base+Com.	2021	11.37	8.42	14.88	0.00
Nyetimber Ln (west) Base+Com+Dev.	2021	11.99	8.64	14.97	0.00
Change due to development		0.61	0.22	0.09	0.00
Total change from 2016		-0.83	-0.89	-0.41	-0.17
Pagham Rd (n of Nyetimber) Base	2016	17.20	10.97	15.78	0.25
Pagham Rd (n of Nyetimber) Base+Com.	2021	16.18	10.02	15.34	0.16
Pagham Rd (n of Nyetimber) Base+Com+Dev.	2021	17.35	10.38	15.49	0.19
Change due to development		1.17	0.36	0.15	0.02
Total change from 2016		0.16	-0.59	-0.29	-0.06
Pagham Rd (s of Hook) Base	2016	16.12	10.63	15.67	0.22
Pagham Rd (s of Hook) Base+Com.	2021	14.97	9.63	15.21	0.15
Pagham Rd (s of Hook) Base+Com+Dev.	2021	15.98	9.96	15.34	0.16
Change due to development		1.01	0.32	0.13	0.02
Total change from 2016		-0.14	-0.68	-0.33	-0.06
Hook Ln (west) Base	2016	13.49	9.77	15.45	0.18
Hook Ln (west) Base+Com.	2021	12.05	8.66	14.96	0.00
Hook Ln (west) Base+Com+Dev.	2021	12.52	8.82	15.03	0.13
Change due to development		0.47	0.16	0.07	0.13
Total change from 2016		-0.98	-0.94	-0.43	-0.05
Pagham Rd (n of Hook) Base	2016	14.89	10.24	15.58	0.21
Pagham Rd (n of Hook) Base+Com.	2021	13.67	9.21	15.11	0.14
Pagham Rd (n of Hook) Base+Com+Dev.	2021	14.20	9.38	15.18	0.14
Change due to development		0.53	0.17	0.08	0.01
Total change from 2016		-0.70	-0.85	-0.39	-0.06
Pagham Rd (s of Sefter) Base	2016	14.52	10.11	15.53	0.20
Pagham Rd (s of Sefter) Base+Com.	2021	13.19	9.05	15.05	0.13
Pagham Rd (s of Sefter) Base+Com+Dev.	2021	13.65	9.20	15.12	0.14
Change due to development		0.46	0.15	0.07	0.01

Total change from 2016		-0.86	-0.91	-0.41	-0.06
Pagham Rd (n of Sefter) Base	2016	17.98	11.22	16.07	0.34
Pagham Rd (n of Sefter) Base+Com.	2021	16.87	10.23	15.64	0.22
Pagham Rd (n of Sefter) Base+Com+Dev.	2021	17.51	10.43	15.75	0.24
Change due to development		0.65	0.20	0.11	0.02
Total change from 2016		-0.47	-0.79	-0.32	-0.09
Hook Ln (east) Base	2016	14.05	9.95	15.51	0.19
Hook Ln (east) Base+Com.	2021	12.60	8.85	15.02	0.13
Hook Ln (east) Base+Com+Dev.	2021	12.91	8.95	15.07	0.13
Change due to development		0.31	0.10	0.05	0.00
Total change from 2016		-1.14	-1.00	-0.45	-0.06
Sefter Rd (e of Hook) Base	2016	16.35	10.71	15.80	0.26
Sefter Rd (e of Hook) Base+Com.	2021	15.00	9.64	15.33	0.16
Sefter Rd (e of Hook) Base+Com+Dev.	2021	15.30	9.74	15.37	0.17
Change due to development		0.30	0.10	0.05	0.01
Total change from 2016		-1.04	-0.96	-0.43	-0.09
Gossamer Ln (north) Base	2016	16.32	10.70	15.77	0.25
Gossamer Ln (north) Base+Com.	2021	14.99	9.64	15.29	0.16
Gossamer Ln (north) Base+Com+Dev.	2021	15.27	9.73	15.33	0.16
Change due to development		0.28	0.09	0.04	0.01
Total change from 2016		-1.05	-0.97	-0.44	-0.09
Nyetimber Ln (east) Base	2016	16.10	10.63	15.71	0.23
Nyetimber Ln (east) Base+Com.	2021	14.42	9.46	15.21	0.15
Nyetimber Ln (east) Base+Com+Dev.	2021	14.75	9.56	15.26	0.15
Change due to development		0.33	0.11	0.04	0.01
Total change from 2016		-1.35	-1.06	-0.45	-0.08
Gossamer Ln (south) Base	2016	17.20	10.97	15.88	0.28
Gossamer Ln (south) Base+Com.	2021	15.83	9.91	15.40	0.17
Gossamer Ln (south) Base+Com+Dev.	2021	16.04	9.97	15.43	0.18
Change due to development		0.21	0.07	0.03	0.00
Total change from 2016		-1.16	-1.00	-0.45	-0.10
Aldwick Rd (west) Base	2016	15.91	10.56	15.68	0.23
Aldwick Rd (west) Base+Com.	2021	14.44	9.46	15.18	0.14
Aldwick Rd (west) Base+Com+Dev.	2021	14.62	9.52	15.21	0.15
Change due to development		0.18	0.06	0.03	0.00
Total change from 2016		-1.29	-1.04	-0.47	-0.08
Aldwick St Base	2016	16.27	10.68	15.77	0.25
Aldwick St Base+Com.	2021	14.86	9.60	15.28	0.15
Aldwick St Base+Com+Dev.	2021	14.90	9.61	15.29	0.16

Change due to development		0.03	0.01	0.00	0.00
Total change from 2016		-1.37	-1.07	-0.48	-0.09
Pagham Rd (s of L Bonor) Base	2016	16.61	10.79	15.74	0.24
Pagham Rd (s of L Bonor) Base+Com.	2021	15.33	9.75	15.27	0.15
Pagham Rd (s of L Bonor) Base+Com+Dev.	2021	15.83	9.91	15.33	0.16
Change due to development		0.50	0.16	0.06	0.01
Total change from 2016		-0.78	-0.88	-0.41	-0.08
Pagham Rd (n of L Bonor) Base	2016	19.56	11.69	16.10	0.34
Pagham Rd (n of L Bonor) Base+Com.	2021	17.97	10.57	15.59	0.21
Pagham Rd (n of L Bonor) Base+Com+Dev.	2021	18.03	10.59	15.61	0.21
Change due to development		0.06	0.02	0.02	0.00
Total change from 2016		-1.53	-1.11	-0.49	-0.13
B2166 Lagness Rd (e of Vinnetrow) Base	2016	19.85	11.78	16.03	0.32
B2166 Lagness Rd (e of Vinnetrow) Base+Com.	2021	18.11	10.61	15.52	0.19
B2166 Lagness Rd (e of Vinnetrow) Base+Com+Dev.	2021	18.20	10.64	15.54	0.20
Change due to development		0.09	0.03	0.02	0.00
Total change from 2016		-1.65	-1.14	-0.50	-0.13
Vinnetrow Rd Base	2016	16.13	10.64	15.72	0.24
Vinnetrow Rd Base+Com.	2021	14.79	9.58	15.23	0.15
Vinnetrow Rd Base+Com+Dev.	2021	14.92	9.62	15.25	0.15
Change due to development		0.14	0.04	0.02	0.00
Total change from 2016		-1.21	-1.02	-0.46	-0.09
B2166 Lagness Rd (w of Vinnetrow) Base	2016	21.14	12.16	16.15	0.36
B2166 Lagness Rd (w of Vinnetrow) Base+Com.	2021	19.33	10.97	15.63	0.22
B2166 Lagness Rd (w of Vinnetrow) Base+Com+Dev.	2021	19.40	10.99	15.65	0.22
Change due to development		0.06	0.02	0.01	0.00
Total change from 2016		-1.75	-1.17	-0.51	-0.14

Note: The NO₂ criteria are defined in terms of both the annual mean of 40 µg/m³, and the number of exceedances of a 1-hour mean of 200 µg/m³. Whilst the annual mean NO₂ value is calculated, the number of exceedances of the hourly standard cannot be calculated from the annual mean with a high degree of confidence. Therefore, only the annual mean NO₂ value is reported.

APPENDIX X

AIR QUALITY CONTROL MEASURES FOR LOW, MEDIUM AND HIGH RISK SITES

Mitigation for all sites: Communications

Mitigation measure	Low Risk	Medium Risk	High Risk
1. Develop and implement a stakeholder communications plan that includes community engagement before work commences on site.	N	H	H
2. Display the name and contact details of person(s) accountable for air quality and dust issues on the site boundary. This may be the environment manager/engineer or the site manager.	H	H	H
3. Display the head or regional office contact information.	H	H	H

Mitigation for all sites: Dust Management

Mitigation measure	Low Risk	Medium Risk	High Risk
4. Develop and implement a Dust Management Plan (DMP), which may include measures to control other emissions, approved by the Local Authority. The level of detail will depend on the risk, and should include as a minimum the highly recommended measures in this document. The desirable measures should be included as appropriate for the site. In London additional measures may be required to ensure compliance with the Mayor of London's guidance. The DMP may include monitoring of dust deposition, dust flux, real-time PM10 continuous monitoring and/or visual inspections.	D	H	H
Site Management			
5. Record all dust and air quality complaints, identify cause(s), take appropriate measures to reduce emissions in a timely manner, and record the measures taken.	H	H	H
6. Make the complaints log available to the local authority when asked.	H	H	H
7. Record any exceptional incidents that cause dust and/or air emissions, either on- or off-site, and the action taken to resolve the situation in the log book.	H	H	H
8. Hold regular liaison meetings with other high risk construction sites within 500m of the site boundary, to ensure plans are co-ordinated and dust and particulate matter emissions are minimised. It is important to understand the interactions of the off-site transport/deliveries which might be using the same strategic road network routes.	N	H	H
Monitoring			
9. Undertake daily on-site and off-site inspection, where receptors (including roads) are nearby, to monitor dust, record inspection results, and make the log available to the local authority when asked. This should include regular dust soiling checks of surfaces such as street furniture, cars and window sills within 100m of site boundary, with cleaning to be provided if necessary.	D	D	H
10. Carry out regular site inspections to monitor compliance with the DMP, record inspection results, and make an inspection log available to the local authority when asked.	H	H	H
11. Increase the frequency of site inspections by the person accountable for air quality and dust issues on site when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions.	H	H	H
12. Agree dust deposition, dust flux, or real-time PM ₁₀ continuous monitoring locations with the Local Authority. Where possible commence baseline monitoring at least three months before work commences on site or, if it is a large site, before work on a phase commences. Further guidance is provided by IAQM on monitoring during demolition, earthworks and construction.	N	H	H
Preparing and maintaining the site			
13. Plan site layout so that machinery and dust causing activities are located away from receptors, as far as is possible.	H	H	H
14. Erect solid screens or barriers around dusty activities or the site boundary that are at least as high as any stockpiles on site.	H	H	H
15. Fully enclose site or specific operations where there is a high potential for dust production and the site is active for an extensive period.	D	H	H
16. Avoid site runoff of water or mud.	H	H	H
17. Keep site fencing, barriers and scaffolding clean using wet methods.	D	H	H

Mitigation measure	Low Risk	Medium Risk	High Risk
18. Remove materials that have a potential to produce dust from site as soon as possible, unless being re-used on site. If they are being re-used on-site cover as described below.	D	H	H
19. Cover seed or fence stockpiles to prevent wind whipping	D	H	H
Operating vehicle/machinery and sustainable travel			
20. Ensure all on-road vehicles comply with the requirements of the London Low Emission Zone and the London NPM standards, where applicable	H	H	H
21. Ensure all vehicles switch off engines when stationary – no idling vehicles	H	H	H
22. Avoid the use of diesel or petrol powered generators and use mains electricity or battery powered equipment where practicable	H	H	H
23. Impose and signpost a maximum speed limit of 15 mph on surfaced and 10 mph on unsurfaced haul roads and work areas (if long haul routes are required these speeds may be increased with suitable additional control measures provided, subject to the approval of the nominated undertaker and with the agreement of the local authority, where appropriate)	D	D	H
24. Produce a Construction Logistics Plan to manage the sustainable delivery of goods and materials	N	H	H
25. Implement a Travel Plan that supports and encourages sustainable travel (public transport, cycling, walking, and car-sharing)	N	D	H
Operations			
26. Only use cutting, grinding or sawing equipment fitted or in conjunction with suitable dust suppression techniques such as water sprays or local extraction, e.g. suitable local exhaust ventilation systems.	H	H	H
27. Ensure an adequate water supply on the site for effective dust/particulate matter suppression/mitigation, using non-potable water where possible and appropriate.	H	H	H
28. Use enclosed chutes and conveyors and covered skips.	H	H	H
29. Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on such equipment wherever appropriate.	H	H	H
30. Ensure equipment is readily available on site to clean any dry spillages, and clean up spillages as soon as reasonably practicable after the event using wet cleaning methods.	D	H	H
Waste management			
31. Avoid bonfires and burning of waste materials.	H	H	H

Measures specific to demolition

Mitigation measure	Low Risk	Medium Risk	High Risk
32. Soft strip inside buildings before demolition (retaining walls and windows in the rest of the building where possible, to provide a screen against dust).	D	D	H
33. Ensure effective water suppression is used during demolition operations. Hand held sprays are more effective than hoses attached to equipment as the water can be directed to where it is needed. In addition high volume water suppression systems, manually controlled, can produce fine water droplets that effectively bring the dust particles to the ground.	H	H	H
34. Avoid explosive blasting, using appropriate manual or mechanical alternatives.	H	H	H
35. Bag and remove any biological debris or damp down such material before demolition.	H	H	H

Measures specific to earthworks

Mitigation measure	Low Risk	Medium Risk	High Risk
36. Re-vegetate earthworks and exposed areas/soil stockpiles to stabilise surfaces as soon as practicable.	N	D	H
37. Use Hessian, mulches or trackifiers where it is not possible to re-vegetate or cover with topsoil, as soon as practicable.	N	D	H
38. Only remove the cover in small areas during work and not all at once.	N	D	H

Measures specific to construction

Mitigation measure	Low Risk	Medium Risk	High Risk
39. Avoid scabbling (roughening of concrete surfaces) if possible.	D	D	H
40. Ensure sand and other aggregates are stored in bunded areas and are not allowed to dry out, unless this is required for a particular process, in which case ensure that appropriate additional control measures are in place.	D	H	H
41. Ensure bulk cement and other fine powder materials are delivered in enclosed tankers and stored in silos with suitable emission control systems to prevent escape of material and overfilling during delivery.	N	D	H
42. For smaller supplies of fine powder materials ensure bags are sealed after use and stored appropriately to prevent dust.	N	D	D

Measures specific to trackout

Mitigation measure	Low Risk	Medium Risk	High Risk
43. Use water-assisted dust sweeper(s) on the access and local roads, to remove as necessary, any material tracked out of the site. This may require the sweeper being continuously in use.	D	H	H
44. Avoid dry sweeping of large areas.	D	H	H
45. Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport.	D	H	H
46. Inspect on-site haul routes for integrity and instigate necessary repairs to the surface as soon as reasonably practicable.	N	H	H
47. Record all inspections of haul routes and any subsequent action in a site log book.	D	H	H
48. Install hard surfaced haul routes, which are regularly damped down with fixed or mobile sprinkler systems, or mobile water bowzers and regularly cleaned.	N	H	H
49. Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable).	D	H	H
50. Ensure there is an adequate area of hard surfaced road between the wheel wash facility and the site exit, wherever site size and layout permits.	N	H	H
51. Access gates to be located at least 10m from receptors where possible.	N	H	H

Key to Tables:

H	Highly recommended
D	Desirable
N	Not required