Proposed Residential Development
Harvester Way, Crowland

Application for Approval of Reserved Matters
Planning Noise Assessment

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Issued to
Wheatley Homes

Prepared by
Martin Hamilton BA MEng
Principal Consultant

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1. INTRODUCTION

Wheatley Homes Ltd has outline permission for a residential development at Harvester Way, Crowland granted on Appeal by The Planning Inspectorate in Decision APP/A2525/W/17/3171837. Condition 17 of this Decision states that "*a further [noise] assessment shall be submitted when application is made to the local planning authority for approval of reserved matters. This assessment will demonstrate how the interrelationship between the proposed dwellings and existing commercial businesses and allocated employment land to the west has been taken into account in the design and layout of the development. This will ensure that any impact on existing businesses and future occupants of the proposed dwellings is minimised and clear mitigation measures are outlined.*"

This report sets out the relevant policies and technical guidance that should be followed by the LPA when considering the scheme with regard to Condition 17. It uses survey data that was collected as part of the submission to the appeal process described above, and draws conclusions over the potential impact of noise on new residents with clear mitigation measures in place as described in Section 6, so that the condition can be discharged.

2. SITE AND ACTIVITY DESCRIPTION

The site and the arrangement of existing buildings are shown on the site location plan and site plans in Appendix A. The site for which outline permission has been granted is currently undeveloped. The site plan shows that the proposed housing is to the west of existing housing off Harvester Way and to the east of the existing commercial businesses and allocated employment land (currently undeveloped) which is referred to in Condition 17. The existing commercial businesses nearest to the site include Crowland Cranes and The Stone Library.

The proposed housing nearest the existing commercial businesses and allocated employment land is set back from the edge of the site which adjoins Crease Drove.

The Crowland Cranes site includes office, workshop and parking space. The workshop activities include service, repair and re-finishing. As part of the re-finishing there is a shot-blasting facility. Hours of operation on the Crowland Cranes site are understood to be 07:00 to 18:00 Monday to Saturday. A crane test area is located to the North of the site. Crowland Cranes also operate a crane hire business and self-propelled cranes (essentially HGVs) periodically leave the site and return. Observations have shown that they can leave the site as early as 06:00. The Stone Library operates out of a unit next to Crowland Cranes to the South and carries out stone cutting and preparation for kitchen worktops.

3. CONDITIONS AND CRITERIA FOR ACCEPTABILITY

3.1 PLANNING GUIDELINES

3.1.1 National Planning Policy Framework (NPPF)

The NPPF states that:

"The planning system should contribute to and enhance the natural and local environment by preventing both new and existing development from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of soil, air, water or noise pollution or land instability" (Para 109)"

Paragraph 123 of the NPPF advises that planning 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;*
- *identify and protect areas of tranquillity which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason.*

For advice on the assessment of impacts, the NPPF refers to the Noise Policy Statement for England (NPSE).

3.1.2 Noise Policy Statement for England (NPSE)

The NPPF refers to the Noise Policy Statement for England (NPSE) which sets out the long term vision of Government noise policy to be to *promote good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development.*

The NPSE notes (para. 2.7) that the application of the NPSE should enable noise to be considered alongside other relevant issues and not be considered in isolation.

The NPSE aims to clarify the principles and aims in existing policy documents, legislation and guidance that relate to noise. Through the effective management and control of environmental, neighbour and neighbourhood noise it aims to:

- *avoid significant adverse impacts on health and quality of life;*
- *mitigate and minimise adverse impacts on health and quality of life;*
- *where possible, contribute to the improvement of health and quality of life.*

These aims are developed by reference to the concepts of NOEL (No Observed Effect Level), LOAEL (Lowest Observed Adverse Effect Level – adverse effects on health and quality of life can be detected) and SOAEL (Significant Observed Adverse Effect Level – adverse effects on health and quality of life occur).

It recognises that there is no universally applicable objective threshold for these concepts. Consequently, the NOEL, LOAEL and SOAEL are likely to be different for different noise sources and receptors and at different times. Even so, significant effects should be avoided, taking account of sustainability aims.

Situations of significant adverse effect (SOAEL) should be avoided. Where the impact is between LOAEL and SOAEL reasonable steps should be taken to minimise and mitigate adverse effects on health and quality of life, but does not mean that such adverse effects cannot occur. It is implied that situations of NOEL would be acceptable in noise terms.

3.1.3 Planning Practice Guidance – Noise (PPG)

The PPG sets out government guidance on the role of noise in the planning process. This provides advice on issues such as when noise is relevant to planning, how to determine noise impact, discussion on the context of noise and how the impact of noise can be mitigated.

Of relevance to this scheme, it advises that *"Noise needs to be considered when …new developments would be sensitive to the prevailing acoustic environment."* Whilst it does advise that noise can override other planning concerns, it states that as with the NPSE and the NPPF it does not expect noise to be considered in isolation from other economic, social and environmental dimensions of a proposed development.

It asks an LPA to consider

- *whether or not a significant impact is occurring or likely to occur;*
- *whether or not an adverse effect is occurring or likely to occur;*
- *whether or not a good standard of amenity can be achieved.*

This includes identifying whether the noise exposure is above or below SOAEL or LOAEL.

The PPG talks about "impact" and "effect". This is an important part of the context discussion, as a noise may have a significant impact for brief period of time, but because the impact is only brief, the overall "effect" in not significant, as it does not materially affect behaviour.

The PPG summarises examples of the perception of noise, with the outcome and the effect level:

- No observed effect: Noise is not noticeable, and no specific measures are required. This would correlate to NOEL of the NPSE;
- No observed adverse effect: Noise is noticeable and not intrusive, does not cause any change in behaviour or attitude, can affect the acoustic character of an area but not such that there is a perceived change in the quality of life. No specific measures are required;

- Observed adverse effect: Noise causes small changes in behaviour (eg closing windows for some of the time because of the noise), potential for some sleep disturbance, and there is a perceived change in the quality of life. In this case noise should be mitigated and reduced to a minimum as it represents the onset of the LOAEL as defined in the NPSE;

- Significant observed adverse effect: Noise causes a material change in behaviour and attitude (eg avoiding certain activities during periods of intrusion, or having to keep windows closed most of the time because of the noise where there is no alternative ventilation), potential for difficulty getting back to sleep, quality of life diminished. This correlates to a SOAEL as defined by the NPSE and should be avoided.

- Unacceptable adverse effect: Extensive and regular changes in behaviour and/or an inability to mitigate effects, leading to psychological stress and physiological effects (eg regular sleep deprivation, medically definable harm). This, the PPG advises, should be prevented.

It is of note that the examples given in the PPG relate to changes of behaviour, and changes to quality of life and changes in the character of an area. In the case of this development, residents would be moving into an existing situation, so behaviours would not change, as no pattern of behaviour is already established.

This is reflected formally in paragraph 007 of the PPG. This paragraph helps the LPA consider the balance between planning and statutory nuisance (Environmental Protection Act 1990). It states that *"When assessing whether a statutory nuisance exists, local authorities will consider a number of relevant factors including the noise level, its duration, how often it occurs, the time of day or night that it occurs and the 'character of the locality'. The factors influencing the 'character of the locality' may include long-established sources of noise in the vicinity, for example church bells, industrial premises, music premises or public houses'."*

As stated in the NPSE, there is no simple relationship between noise levels and the effect of those noise levels. The NPSE lists a number of factors as relevant, and the following are those that apply to this scheme:

- Source and level of noise;

- Number of noise events, how often they occur, and the pattern;

- The spectral content of the noise and its character;

- Whether noise effects can be mitigated by closing windows, allowing for alternative ventilation to be provided;

- The acoustic environment in external amenity spaces where they are an intrinsic part of the overall design;

- The effect on a nearby existing business.

3.2 CRITERIA FOR ASSESSMENT

Neither the NPPF, the NPSE nor the PPG give objective quantified limits to define the NOEL, LOAEL and SOAEL categories.

Therefore, advice is taken from a series of British Standards and International Guidance, to inform an assessment and assist the decision maker in determining an application.

3.2.1 BS4142:2014 Methods for rating and assessing industrial and commercial sound

BS4142 provides a method for rating and assessing sound of a commercial nature, and is applicable when assessing sound at new dwellings. It uses the outdoor sound level to assess the likely effects on people who may be inside or outside a dwelling. The standard is not intended to be applied to the assessment of indoor sound levels.

It uses the concept of a 'Rating Level', which is based on the 'Specific' sound from the existing commercial site, (measured in terms of L_{Aeq} at the defined assessment position), with corrections applied to account for any tonal or impulsive characteristics (as these can increase the likelihood of an adverse impact). The assessment level is obtained by comparing the Rating Level with the existing Background Sound Level (measured in terms of L_{A90} at the assessment position).

The Background Sound Level is established by measuring the sound when the commercial noise (the "Specific Noise") is not present. This is called the Residual Sound. The Background Sound Level is then the sound pressure level that is exceed for 90% off the time, denoted $L_{A90,T}$.

The Standard is clear the "lowest" assessment should not necessarily be used, but a typical level should be quantified. For example, the Guidelines for Environmental Noise Impact Assessment, (IEMA 2014) recommends use of the mode average (the most commonly occurring sound level), or, if a weighting towards the worst case is preferred, the mean average minus one standard deviation.

The Specific Sound Level is a measurement of the sound level whilst the commercial activity occurs. This then is corrected to take account of the residual sound level (the level that would be measured if the commercial activity were not occurring), corrected to take account of particular acoustical characteristics (eg tone, impulse or other distinguishing characteristic), to determine a Rating Level, for comparison to the Background Sound Level. For daytime activity, a 1 hour time period is used. At night, a 15 minute period is used, and the sound level is an average over that time period (denoted $L_{Aeq,T}$). The same time periods are to be used when considering the Background Sound Level.

The standard advises that, where the Rating Level exceeds the Background Sound Level by around +10 dB or more this is likely to indicate a significant adverse impact. A difference of around +5 dB is likely to be an indication of an adverse impact. The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact.

In all cases, the Standard states that the assessment is dependent on the particular context in which the sound occurs. In particular, the following factors must be considered:

- The absolute level of the sound;

- The character and level of the residual sound;

- The sensitivity of the receptor and whether dwellings will incorporate design measures that secure good internal and/or outdoor acoustic conditions, such as facade insulation, ventilation and/or cooling that reduces the need to open windows and acoustic screening.

Whilst BS4142 talks about "impact", the NPSE talks about "effect". This is an important part of the context discussion, as a noise may have a significant impact for brief period of time, and because the impact is only brief, the overall "effect" is not significant, as it does not materially affect behaviour.

It is therefore important that any assessment of sound in accordance with BS4142 takes these additional factors into consideration, and BS8233 and WHO can assist in such a process.

3.2.2 BS 8233:2014 Guidance on sound insulation and noise reduction for buildings

BS8233 provides guidance for the control of noise in and around buildings. It is applicable to the design of new buildings.

Where commercial noise affects residential areas, the methods for rating the noise in BS 4142 should be applied. This is discussed above in section 3.2.1.

For dwellings, the standard advises the main considerations are the acoustic effect on sleep in bedrooms, and the acoustic effect on resting, listening and communicating in other rooms.

Inside Dwellings

BS8233 gives guidelines values, and states that for steady external noise sources, it is desirable that the indoor ambient noise level does not exceed the guidelines values given below in table 1.

Activity	Location	0700-2300	2300-0700
Resting	Living room	35 dB $L_{Aeq,16\ hour}$	-
Dining	Dining room/area	40 dB $L_{Aeq,16\ hour}$	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,16\ hour}$	30 dB $L_{Aeq,8\ hour}$

Table 1: Indoor ambient noise levels for dwellings

The standard also advises that *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_{AFmax} depending on the character and number of events per night. Sporadic noise events could require separate values.* It does not give guidance on what might constitute a guideline value.

It advises that *If relying on closed windows to meet the guide values, there needs to be an appropriate alternative ventilation that does not compromise the facade insulation or the resulting noise level. If applicable, any room should have adequate ventilation (eg trickle ventilators should be open) during assessment.* This therefore recognises that it is a normal mitigation practice to close windows, though in such circumstances the method of ventilation must also be considered.

Where development is considered necessary or desirable, the standard says that the internal target levels may be relaxed by up to 5 dB and reasonable conditions still achieved.

Outside Dwellings

BS8233 also suggests guidelines for noise levels in external spaces that are used for amenity space, such as gardens and patios. "*It is desirable that the external noise level does not exceed 50 dB $L_{Aeq,T}$ with an upper guideline of 55 dB $L_{Aeq,T}$, which would be acceptable in noisier environments. However, it is recognised that these guideline values are not achievable in all circumstances where development might be desirable…In such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces, but should not be prohibited.*"

3.2.3 World Health Organisation – Guidelines for community noise (WHO)

The WHO give guideline noise values for community noise in specific environments. The guideline levels of BS8233 (see section 4.2.1 above) are a reflection of those set out in WHO.

The preface to *Guidelines for Community Noise* – World Health Organization, 1999 (WHO) states that community noise includes road, rail and air traffic, industries, construction and public work, and the neighbourhood. WHO does not make the distinction that the guideline noise values apply to steady noise only. The limits it recommends are defined as limits for "community noise" which it specifically defines as including industries.

Inside Dwellings

WHO guideline values for community noise inside dwellings are $L_{Aeq,8hr}$ 30 dB for bedrooms at night, and $L_{Aeq,16hr}$ 35 dB for living-rooms. Outside bedrooms at night it suggests $L_{Aeq,8hr}$ 45 dB, which represents typically a 15 dB reduction that would be achieved between the external and internal noise level if a window was open.

Whilst BS8233 did not give guidance on noise levels in terms of maximum noise (short term noise level form a sporadic event), WHO suggests L_{AFmax} 45 dB should not be exceeded inside a bedroom (L_{AFmax} 60 dB outside) more than 10-15 times per night.

These guideline levels correspond to the lowest effect level for general populations. This would suggest that these guideline values represent the boundary between NOEL and LOAEL.

Outside Dwellings

WHO guideline values for community noise in outdoor living areas are $L_{Aeq,16hr}$ 50-55 dB. $L_{Aeq,16hr}$ 50 dB represents a noise level below which few people would be moderately annoyed, and so again, this seems to represent the LOAEL. $L_{Aeq,16hr}$ 55 dB is the level below which few people would be seriously annoyed. However, no guidance is provided as to a guideline value that could be interpreted as representing the onset of a SOAEL.

3.3 LOCAL PLANNING AUTHORITY'S APPROACH

The approach adopted in the previous assessment report was to assess against a requirement of a Rating Level as described in BS4142 of less than +5 dB(A) compared to the relevant Background Sound Level at the façade of the residential properties. This was informed by a non-site specific conversation with the LPA and is understood to be a typical requirement.

As background information, the Crowland Cranes Test Area to the North of their main workshops received Planning Permission on 5th July 2012 with a noise condition stating that fixed plant and machinery noise on this site should not exceed + 5dB(A) $L_{Aeq,5\ min}$ above background noise levels at a height of 1.5 m on any residential boundary outside the applicant's control.

4. NOISE MEASUREMENT SURVEYS

Specified locations at which measurements were taken and noise sources reported are shown on the site Plan in Appendix A. These locations are identified as follows.

Location	Description
1	At a point on the northern edge of the site 55 m from Crease Drove
2	Location of the automated gate alarm.
3	Location of containerised diesel generator set
4	Noise logger location in the garden at 6 Beccelm Drive
5	Spot noise measurement location at 12 m from automated gate alarm
6	Spot noise measurement location at 23 m from automated gate alarm

Table 2: Specified survey locations

4.1 DECEMBER 2016 SURVEY : MONDAY 12TH TO FRIDAY 16TH DECEMBER 2016

The noise logger was located in a compound on the subject site a Location 1 as shown on the plan in Appendix A. The context of this within the proposed development is also presented in Appendix A. Photographs of the equipment on location and details of the measurement kits used are presented in Appendix B.

Weather conditions as recorded at the nearest local meteorological station at Wittering were good for noise measurement with wind speed at 10 m height ranging between 1 and 4.5 m/s mainly from the South. High humidity with mist at times was a characteristic with temperatures ranging between 2 and 11 deg C. A table of weather conditions is presented in Appendix B.

4.1.1 Observations from attendance at site

The general noise environment affecting the site was observed during the attendance at site.

Observations were that traffic noise from the A16 which runs approximately 500 m to the south east of the site centre (site location plan in Appendix A) was dominant in terms of background and continuous noise levels. Traffic noise from intermittent movements of vehicles along the public roads around the site was the next most significant source and gave higher transient noise levels. This included vehicles accessing all the commercial areas including cranes arriving and leaving the Crowland Cranes site. Other extraneous noises included bird scarers, aircraft and building activity from a house building site located near to Harvester Way.

Noise of a commercial nature (apart from the building site off Harvester Way) was not observed from any of the sites except Crowland Cranes during times of attendance at site.

The most significant noise from the Crowland Cranes site was an automatic gate alarm and a diesel generator set both located at the corner of the Crowland Cranes site (Locations 2 and 3 respectively) closest to the noise meter at Location 1. These were observed as highly intrusive noises when on site on Wednesday 14th December (gate alarm) and Friday 16th December (gate alarm and diesel generator set). Apart from these highly intrusive noise sources the main noise generating activity on the Crowland Cranes site was vehicle movement and not significantly different from the vehicle movement noise on the public roads. It was possible to discern some banging and sawing activities on the site but at a very low level.

4.1.2 Site gate alarm information

A Facebook post from a local councillor received on Wednesday 14h December informing residents of the installation of a gate alarm during the period of the noise survey was provided by the client and is presented in Appendix C.

4.1.3 Observations from noise survey record

Appendix C provides details of the noise survey record. Logging has been carried out in 15-minute periods and also reported as hourly periods which is the reference time interval for BS4142 daytime assessment. The 15-minute periods are better able to show high intensity short period sound levels.

The noise survey record shows a typical diurnal variation in background and ambient sound levels. It also shows a number of maximum noise events which have been listened to for further analysis.

Crowland Cranes automated gate alarm

The noise survey record shows that on Tuesday between 14:00 and 18:00 extremely high noise levels were recorded with L_{AFmax} > 90 dB and $L_{Aeq,15\ min}$ > 80 at Location 1 which is 60 m from the gate. These noises are consistent with the installation of the automated gate alarm at Location 2 (Appendix A). The record also shows that some lesser high intensity events occurred from Monday 12th at 10:30 am onwards which sounded like trials of the gate alarm. On Wednesday starting at 05:00 the piercing tonal alarm continued intermittently until about 12:00 after which it changed to become a warbling and lower intensity alarm as observed also when attending site.

The intensity of the gate alarm appears to have been reduced further later on in the week.

Crowland Cranes' diesel generator set

Since the survey for the initial planning application carried out in May 2015, Crowland Cranes had located a containerised diesel generator set at Location 3 next to the automated gate. This location is the closest on the Crowland Cranes site to the noise survey Location 1. The container also had doors that could be opened, which open towards the noise survey Location 1. This generator set was witnessed operating on Friday 16th for a period of 11 minutes and examining the noise record was also operated for the first time on Thursday 14th at around 16:00, between 09:19 and 09:53 on Friday and around 13:00 on the same day.

The diesel generator generates very high noise levels and typically shows up as a period with $L_{A90,15\ min}$ very close to $L_{Aeq,15\ min}$ which is characteristic of a sustained single dominant noise source. It generates a $L_{Aeq,15\ min}$ = 67 and $L_{A90,15\ min}$ = 66 at Location 1 which is 60 m from the source.

4.1.4 Results

Graphical presentation of the results from the fixed noise monitor at Location 1 is provided in Appendix C. BS4142 determines that the reference time interval during the day is a 1 hour period. However, the logging was carried out in both 15 minute periods and 1 hour periods and the 15 minute periods provide more information about the short term events at the site which raise the noise levels.

As discussed in Section 4.1.1, we know that the main steady ambient noise source is traffic on the A16 and local roads.

Detailed analysis of period to Tuesday 13th at 14:00

As discussed in Section 4.1.3 and shown on the annotated 15 minute record in Appendix C the dominant events raising noise levels from the normal ambient levels at the measurement location are the automated gate alarm and the containerised generator set both located at Location 2 which is the closest position on the Crowland Cranes Site to the noise monitor location. In order to identify any significant noise events other than these a more detailed analysis of the noise record has been carried out for the period Monday 12th at 07:00 to Tuesday 13th at 14:00 where there has been less impact from these two noise sources.

This more detailed analysis has been done by listening to the noise record, in particular considering the highest L_{AFmax} events and periods where the $L_{Aeq,15min}$ is raised significantly above the $L_{A90,15min}$. It is in these periods that any significant commercial noise events would be expected to show up. The following table lists the events identified from this more detailed analysis.

Day	Period	L_{A90} dB	L_{Aeq} dB	L_{Afmax} dB	Event Time	Description
Monday	10:00 – 10:15	51	55	83	10:07	Crow squawking
12-12-2016	10:30 – 10:45	49	55	81	10:30	Short single tone alarm x 3
	11:00 – 11:15	50	67	89	11:13	Long single tone alarm
	12:45 – 13:00	51	64	78	12:58	Jet plane
	13:00 – 13:15	51	63	79	13:00	Jet plane x 2
	15:45 – 16:00	52	54	76	15:47	Loud single bang
Tuesday	06:45 – 07:00	53	60	79	06:50	HGV passing x 2 on road
13-12-2016	07:30 – 07:45	54	56	76	07:43	Bang - probably bird scarer
	13:00 – 13:15	51	56	73	13:05	Jet plane and HGVs
	14:00 – 14:15	52	71	91	14:14	Long single tone alarms

Table 3: Summary of detailed analysis of noise record at Location 1 for period to Tuesday 14:15

The table shows that even this period has been affected by alarms from the Crowland Cranes site. It is speculated that these events were trials for the later implementation on Tuesday afternoon.

Apart from these events, the main identified sources raising the $L_{Aeq,15min}$ significantly (> 5 dB) above the $L_{A90,15min}$ are jet planes and HGV's moving along the roads. This is significant because without the alarms the only event which has been found which is probably from the Crowland Cranes site was the single bang at 15:47 on Monday and in this case it was only the L_{AFmax} which was significant and not the raised level of $L_{Aeq,15min}$.

1 hour period analysis of daytime working hours period to Tuesday 13th at 14:00

An hourly analysis of the period noise levels between Monday 12th at 07:00 to Tuesday 13th at 14:00 including the hours 07:00 to 18:00 has been carried out to identify representative ambient and background noise levels **excluding the period 10:00 to 11:59 on Monday** which is affected by what is believed to be testing of the gate alarm. This period is shown graphically in Appendix C and numerically in the table below.

Day	Start time	Duration h	L_{A90} dB	L_{Aeq} dB
Monday	07:00	1	54	56
12-12-2016	08:00	1	54	57
	09:00	1	53	57
	12:00	1	52	58
	13:00	1	51	56
	14:00	1	51	54
	15:00	1	51	54
	16:00	1	52	54
	17:00	1	51	54
Tuesday	07:00	1	54	57
13-12-2016	08:00	1	52	55
	09:00	1	50	54
	10:00	1	49	53
	11:00	1	52	54
	12:00	1	51	54
	13:00	1	51	55

Table 4: Summary of period analysis of noise record at Location 1 for period to Tuesday 14:00

From this table the following values are relevant for an assessment of the impact on the proposed housing:

- Average Daytime Ambient sound level at Location 1 = 55 $L_{Aeq,1h}$

  This period data has also been used to provide octave band noise levels for calculation of indoor ambient noise level in habitable rooms in the daytime period. These external octave band noise levels are as presented in Appendix C.

- Background sound level at Location 1 = 51 $L_{A90,1h}$

Night-time period 23:00 – 07:00 on Monday 12th to Friday 16th

In order to provide a night-time average ambient sound level for assessment of indoor ambient noise level within bedrooms the detailed noise record shown in Appendix C has been referred to. From this it is established that 3 night-time 8 hour periods can be used as representative with the Tuesday night period excluded due to alarm testing very early on Wednesday morning.

Day	Start time	Duration h	L_{Aeq} dB
Monday 12-12-2016	23:00 – 07:00	8	50
Wednesday 13-12-2016	23:00 – 07:00	8	50
Thursday 14-12-2016	23:00 - 07:00	8	51

Table 5: Summary of period analysis of noise record at Location 1 for period to Tuesday 14:00

From this table the following values are relevant for an assessment of the impact on the proposed housing:

- Average Night-Time Ambient sound level at Location 1 = 51 $L_{Aeq,8h}$

  This period data has also been used to provide octave band noise levels for calculation of indoor ambient noise level in habitable rooms in the night-time period. These external octave band noise levels are as presented in Appendix C.

15 min period analysis of period 06:00 to 07:00 on Tuesday 13th to Friday 16th

A 15 minute analysis of the period noise levels between 06:00 to 07:00 on Tuesday 13th to Friday 16th has been carried out to identify representative background noise levels that can be used to assess gate alarm noise level subsequently measured in March. These levels are included numerically in the table below. Although the $L_{Aeq,}$ levels were high on Wednesday 13th owing to the gate alarm, nevertheless these noises were intermittent and not continuous and so the background noise levels remain representative data for this morning period.

Day	Start time	Duration hh:mm	L_{A90} dB	L_{Aeq} dB
Tuesday	6:00	00:15	50	53
13-12-2016	6:15	00:15	51	54
	6:30	00:15	52	56
	6:45	00:15	53	60
Wednesday	6:00	00:15	48	80
13-12-2016	6:15	00:15	48	78
	6:30	00:15	49	81
	6:45	00:15	48	83
Thursday	6:00	00:15	51	55
13-12-2016	6:15	00:15	51	54
	6:30	00:15	53	55
	6:45	00:15	53	55
Friday	6:00	00:15	51	54
13-12-2016	6:15	00:15	52	55
	6:30	00:15	53	57
	6:45	00:15	53	57

Table 6: Summary of period analysis of noise record at Location 1 for 06:00 to 07:00

From this table the following values are relevant for an assessment of the impact on the proposed housing:

- Representative minimum background sound level (period 06:00 to 07:00) = 48 $L_{A90,\ 15min.}$

4.2 FEBRUARY 2017 SURVEY: TUESDAY 14TH FEBRUARY TO MONDAY 20TH FEBRUARY 2017

The noise logger was located at a height of approximately 4m in the garden at 6 Beccelm Drive with effectively unscreened exposure to the Crowland Cranes site although there is some vegetation which prevents a direct sightline. This is Location 4 as shown on the plan in Appendix A and is approximately 350 m from the Crowland Cranes automated gate. Photographs of the equipment on location and details of the measurement kit used are presented in Appendix D.

Weather conditions as recorded at the nearest local meteorological station at Wittering were acceptable for these noise measurements with wind speed at 10 m height ranging between 1.4 and 7.7 m/s ranging from South East to West. Temperatures ranged between 5 and 11 deg C. A table of weather conditions is presented in Appendix D.

4.2.1 Observations from noise survey record

Appendix D provides details of the noise survey record. Logging has been reported in 15-minute periods

The noise survey record shows a typical diurnal variation in background and ambient sound levels. It also shows a number of maximum noise events which have been listened to for further analysis. No events recorded could be identified specifically as being generated from the Crowland Cranes site. Ambient noise levels are typically somewhat lower than in the December survey which is expected to be because of greater screening or distance from the major roads.

Crowland Cranes automated gate alarm

The automated gate alarm at Location 2 could not be identified in the noise record despite detailed listening at a time when it was known to have operated at 15:39 on Tuesday 14th February.

Crowland Cranes' diesel generator set

The characteristic sound of the diesel generator set at Location 3 could not be identified in the record. Based on measurements from the December survey reported in Section 4.1.3 this source would be expected to generate an $L_{Aeq,15\ min}$ = 52 and $L_{A90,15\ min}$ = 51 at Location 4. Events with closely spaced $L_{Aeq,15\ min}$ and $L_{A90,15\ min}$ at these values are not observed in the record.

4.3 MARCH 2017 SURVEY: THURSDAY 2ND MARCH 2017

An attended survey was carried out to quantify the sound power of the automated gate alarm at Crowland Cranes. Spot measurements of operation of the automated gate alarm were carried out at Locations 5 and 6 as shown on the site plans in Appendix A.

Observations of activity of the gate alarm were also recorded and are presented in Appendix E together with details of the recorded spot measurements.

Weather conditions as recorded at the nearest local meteorological station at Wittering were a wind speed at 10 m height of 8 m/s mainly from the West. Although this is higher than would normally be used for noise measurement the wind speed at ground level will be lower than this and the spot measurements taken close in to the source were able to be carried out when wind effects were not significant for the purpose of determining the gate alarm sound power.

Crowland Cranes automated gate alarm

The gate operation was measured to take 80 seconds. Typically the gate opens over about 80 seconds and then shortly afterwards closes over a further 80 seconds. The accompanying alarm was observed to be a two-tone warbling amounting to 160 seconds over a 3-4 minute period.

The earliest observed operation of the alarm was at 6:05 with a frequency of 1-3 operations over each 15 minute period between 06:00 and 07:00. Between 07:00 and 08:00 there were 3 operations in total.

5. DISCUSSION OF SITE SURVEYS

The purpose of the site surveys carried out that are presented in this report was to address concerns over the suitability of the site for housing following the initial refusal of planning permission. However, there has been no significant development in the local area since the time of the surveys and so the information can now be used to draw conclusions over the potential effect of noise on new residents now that a detailed layout has been prepared with noise mitigation measures included.

5.1 DECEMBER 2016 SURVEY

This 5 day site survey was significantly affected by what was believed to be a response by the operators of the Crowland Cranes site to the presence of the noise survey equipment. This is substantiated by the fact of the Facebook post copied in Appendix C and strongly suggested by the location of new noise sources (the gate alarm and the containerised diesel generator set) which were as close to the noise survey location as possible whilst still on the Crowland Cranes site.

In the worst case during the December survey, the noise levels recorded from these sources were projected to be as follows at the nearest existing houses which are approximately 200 m distant.

Automated gate alarm

$L_{Aeq,15min}$ 82 measured at the survey location 1
$L_{Aeq,15min}$ 72 predicted at the existing housing
$L_{A90,1h}$ 51 estimated at existing housing

This is an exceedance of 21 dB(A) at the existing housing compared with the typical requirement of no more than 5 dB(A).

Containerised diesel generator set

$L_{Aeq,15min}$ 67 measured at the survey location 1
$L_{Aeq,15min}$ 57 predicted at the existing housing
$L_{A90,1h}$ 51 estimated at existing housing

This is an exceedance of 6 dB(A) at the existing housing compared with the typical requirement of no more than 5 dB(A).

From this analysis, these noise sources were at a level which could be expected to generate complaints at the existing housing and are therefore not considered in this assessment, an approach supported by the fact that the Planning Inspectorate agreed that the site was suitable for housing development an could not have come to that conclusion if they believed that these noise sources were part of the normal noise environment.

A detailed examination of the period of 1.5 days before the main interference of the gate alarm has shown that when what are believed to be alarm operations are removed, only one potential commercial-site-based noise event has shown up in the record. This single isolated event although audible and with a relatively high L_{AFmax} would not merit a consideration in a BS1442 assessment because the rating level would be so low relative to background sound level.

HGV operations were evident but these do not fall within a BS4142 assessment because the noise is almost entirely from movement on public roads. Nevertheless these operations should be considered as part of the ambient environment used to determine façade sound insulation requirements and provide assurance of acceptable internal noise levels in accordance with BS8233.

When the ambient noise (including the dominant traffic noise from the A16, jet planes and movement of vehicles including HGVs on local roads and but excluding automated gate alarm noise) is assessed as described in Section 4 a set of underlying ambient noise data has been established which is used in the Assessment section of this report to check façade sound insulation requirements for the proposed housing.

5.2 FEBRUARY 2017 SURVEY

The February survey established that the noise level of the automated gate alarm had been reduced to a level which was not even audible at the logger location at 6 Beccelm Drive (Location 4). It also established that the use of the containerised diesel generator (Location 3) at the level operated in December was not a part of normal operations at the Crowland Cranes site.

5.3 MARCH 2017 SURVEY

The March survey collected data for a detailed assessment of the impact of the automated gate alarm now operating at much reduced noise level. The noise measurements from this survey together with a noise propagation prediction model enable the impact of this key noise source to be predicted across the site. When combined with representative background noise data at Location 1 collected during the December survey a BS4142 assessment calculation can be carried out.

6. DESIGN, LAYOUT AND MITIGATION MEASURES

Condition 17 requires that this assessment shows how *"the interrelationship between the proposed dwellings and existing commercial businesses and allocated employment land to the west has been taken into account in the design and layout of the development".*

The method used to achieve this is to outline the principal features that have been used in the layout and design and then provide an assessment based on that information and the criteria for assessment in Section 3 which provides the evidence needed to discharge the condition.

Site surveying has found that the overall noise environment is not particularly quiet. Indeed, day-time and night-time average ambient noise levels due to steady environmental noise are at level where the closing of windows is required to achieve the desirable indoor ambient noise levels specified in BS8233. This is normal mitigation practice as described in Section 3.2.2 and means that the specification of appropriate ventilation is required for when windows are closed.

The existing commercial businesses have not been found to operate normally in a way that generates any significant addition to these steady environmental noise levels and so the noise environment is dominated by transportation noise on local and more distant roads.

In this section the features of the design and layout in the context of the environment above are discussed.

6.1 SEPARATION

Instead of locating houses and gardens right up against Crease Drove, a strip of land incorporating grass, parking and driveways has been left on this boundary to increase separation of housing and gardens from existing and potential future commercial businesses to the west of Crease Drove. As distance increases the rate at which noise reduction occurs reduces and so there is a law of diminishing returns which limits the utility of increasing separation distance. Therefore this is only one of the measures that has been adopted. The other measures are described below.

6.2 ORIENTATION OF GARDENS

The first row of dwellings adjacent to Crease Drove is a mixture of houses and bungalows. These are arranged with their enclosed gardens to the rear facing away from Crease Drove and benefiting from the barrier effect of the dwellings shielding these gardens from the existing and potential future businesses.

6.3 ORIENTATION OF BEDROOMS

Although night-time commercial noise (apart from the automated gate alarm) is not a normally a feature of the existing operations of the businesses to the west of Crease Drove, nevertheless it is a feature of the room layouts of the first row of dwellings adjacent to Crease Drove that their bedrooms have been located facing away from Crease Drove. Therefore any contributions from the commercial area to the noise levels external to the bedrooms will be reduced by the barrier effect of the dwellings themselves. This is relevant to both night-time sleeping and daytime resting activities in the bedrooms.

6.4 SPECIFICATION OF FAÇADE INSULATION

The façade design of the dwellings, including glazing and background ventilation throughout the proposed development will be sufficient to provide indoor ambient noise level in habitable rooms which are significantly better than the desirable guideline values.

Whilst this does not assist when it comes to a numerical assessment of the impact of directly attributable commercial noise in accordance with BS4142 it is nevertheless a mitigation measure which is relevant to the overall effect of such a commercial noise impact. This is because a suitable façade and ventilation design will be in place to allow residents to choose to close windows if they wish and achieve much reduced noise levels.

7. PREDICTION OF SOUND LEVEL FROM EXISTING COMMERCIAL BUSINESSES AND ALLOCATED EMPLOYMENT LAND

7.1 PREDICTION BASED ON EXAMPLE COMMERCIAL ACTIVITY

In this section an example commercial activity noise is considered together with a prediction model to generate predicted example sound levels at a number of identified locations in the proposed development.

As discussed above, it has not been possible to identify any significant typical activities generating sound levels which can be assessed apart from the automated gate alarm at Crowland Cranes which is discussed later. Otherwise the existing typical commercial activities have been found to be insignificant with regard to noise impact. Movement of HGVs on local roads does not constitute a relevant commercial noise but is considered within the general environmental noise. As far as the potential development of the allocated employment land is concerned, again it is not possible to consider any specific noise sources as the nature of any development is uncertain.

Therefore the example commercial activity that is considered here is the operation of a fork lift truck with a sound power level of L_{wA} 87 dB. This data is taken from actual sound power measurements made by Spectrum of fork lift truck activity from a fork lift truck used for HGV deliveries to a site.

Frequency [Hz]	63	125	250	500	1000	2000	4000	8000	Total
Lw [dB(A)]	55.00	62.00	67.00	84.00	79.00	80.00	77.00	66.00	86.92

Figure 1: Fork Lift Truck Octave Band Sound Power Values (A weighted)

The particular prediction model that has been used for this analysis is Bruel & Kjaer's Type 7810 'Predictor' software. This acoustic model implements the procedures set out in ISO 9613-2:1996 "Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation to determine noise levels". The Predictor model takes account of the following features in its calculation procedure:

- Source sound power level (for point, line and area sources)
- Reflection from nearby structures and source directivity
- Distance from noise source (geometric spreading)
- Atmospheric absorption
- Acoustic screening of intervening structures and topography
- Ground absorption
- Ground effects (which includes the height of ground relative to the noise source)

Detailed calculations are then computed to predict sound levels at receptor locations across the site and generate indicative sound level contours.

The existing on-site buildings and the proposed dwellings have been modelled as solid bodies, around which sound can diffract. The intervening ground areas have been modelled with a ground factor of 0.1 over the employment zone and 0.7 elsewhere to represent grass land, according to the ISO 9613 method. Appendix F includes views of the noise prediction model with the proposed housing development layout in accordance with Drawing 17239/1007 Draft 05/06/18.

Appendix F shows the layout of the noise model with respect to sources and receptors

In this prediction the Fork Lift Truck sound source described above is located sequentially at points A, B, C and D in the Commercial Area to the west of Crease Drove. Since it is a point source the propagation of the sound is roughly hemispherical. No mitigation (other than existing buildings) has been placed in the model on the commercial area.

The results of the sound level prediction modelling are presented in Appendix G in the form of tables and contour diagrams overlaid on the site plan. It can be seen on the contour diagrams that as the example source moves from A to D the most affected residential receptor locations change. A full set of results for each of the source locations is presented in the Appendix.

From this full set of results a summary of the example commercial activity sound levels at the most affected parts of the proposed housing layout is presented below. Note that these sound levels are examples only and are for continuous operation of the example source at one location which is not a typical activity pattern for the existing businesses and not expected to be typical for future businesses. The assessment which follows in Section 8.4 takes into account all the other factors necessary to consider impact and effect.

External Receptor Location (At window for room or centre of garden)	Maximum Sound Level dB(A)
Plot 1 Kitchen / Dining	40
Plot 1 First floor bedroom	30
Plot 1 Garden	31
Plot 3 Living	42
Plot 3 Ground Floor Bedroom	27
Plot 4 Living	42
Plot 5 Living	40
Plot 5 Garden	34
Plot 12 First floor bedroom	36
Plot 12 Garden	32
Plot 68 Living	41
Plot 68 Ground Floor Bedroom	20
Plot 68 Garden	35
Plot 69 First floor bedroom	35
Plot 98 First floor bedroom	39
Plot 99 Living	41
Plot 99 Ground Floor Bedroom	23
Plot 99 Garden	34
Plot 100 Living	41

Table 7: Summary results of predicted maximum sound levels from example commercial activity at a sample of most affected locations

From these results the maximum external sound levels for each category of receptor are as follows.

- Predicted maximum sound level at any Living Room = 42 L_{Aeq} (Plots 3 and 4)
- Predicted maximum sound level at any Bedroom = 39 L_{Aeq} (Plot 98)

- Predicted maximum sound level in any Garden = 35 L_{Aeq} (Plot 68)

The predicted external sound level value of 42 L_{Aeq} for the living room is the maximum and will be used in the assessment in Section 8.4.

7.2 PREDICTION OF SOUND LEVEL FROM CROWLAND CRANES AUTOMATED GATE ALARM

Measurements of the automated gate alarm (Location 2) were carried out in the March 2017 survey. These have been used in a numerical noise model of the existing site arrangement to calibrate the sound power of this source and subsequently predict the sound levels across the site.

The narrow band analysis of the automated gate alarm reported in Appendix E shows it to have components with 1/3 octave band centre frequencies at 2 and 3.15 kHz. These have been isolated to characterise this source and discount the residual sound from other sources. The sound power level of the source in the model is calibrated by setting it to give the average of the top two measurement results at the respective measurement points in the model.

The results of the sound level prediction modelling are presented in Appendix G in the form of tables and contour diagrams overlaid on the site plan. A summary of the gate alarm sound levels at the most affected parts of the proposed housing layout is presented below. The assessment which follows in Section 8.4 takes into account all the other factors necessary to consider impact and effect.

External Receptor Location (At window for room or centre of garden)	Maximum Sound Level dB(A)
Plot 1 Kitchen / Dining	45
Plot 1 Garden	39
Plot 3 Living	43
Plot 12 First floor bedroom	41
Plot 12 Garden	39

Table 8: Summary results of predicted sound levels from automated gate alarm

From these results the maximum external sound levels for each category of receptor are as follows.

- Predicted maximum sound level at any Living Room = 45 L_{Aeq} (Plots 1)
- Predicted maximum sound level at any Bedroom = 41 L_{Aeq} (Plot 12)
- Predicted maximum sound level in any Garden = 39 L_{Aeq} (Plot 1/12)

The predicted external sound level value of 45 L_{Aeq} for the Living Room is the maximum for the daytime analysis and will be used in the assessment in Section 8.4. The predicted external sound level value of 41 L_{Aeq} for the Bedroom is the maximum applicable for the night-time analysis and will be used in the assessment in Section 8.4.

8. ASSESSMENT

8.1 EXTERNAL AMBIENT NOISE LEVELS

Section 4.1.4 gives representative average external ambient sound levels for the daytime period 07:00 to 18:00 and the night-time period 23:00 to 07:00 for use in comparison with BS 8233 guidelines as described in Section 3.2.2. Although these are derived by measurement at Location 1 they can be used throughout the development as conservative values.

- Average Daytime Ambient sound level = 55 $L_{Aeq,1h}$
- Average Night-Time Ambient sound level = 51 $L_{Aeq,8h}$

Full 16 hour average daytime levels will be lower than this but this value is acceptable as a conservative value.

This conservative ambient daytime sound level meets the upper guideline of *55 dB* $L_{Aeq,T}$ for gardens and patios.

8.2 INTERNAL NOISE

Calculations of the noise intrusion into a sample of house type rooms have been carried out using the method set out in BS 8233.

External noise levels used are the overall ambient levels above with the measured octave band data for the daytime and night-time periods as detailed in Appendix C.

It is understood that all dwellings will have brick and block external walls. Sound insulation data for the external walls has been taken from BS 8233:1999. Sound insulation data for windows and ventilation systems has been taken from manufacturers' data. Two trickle vents have been assumed per bedroom and four per living/dining room. The trickle vents should provide the required level of ventilation to the dwellings with windows closed which the client should check. Any additional ventilation provided to kitchen areas should meet or exceed the sound insulation performance of the relevant trickle vents.

The calculations assume typical internal finishes for habitable rooms, based on reverberation times that Spectrum have measured in a range of occupied dwellings at other sites, and on the room geometry and volumes taken from the floor plans and elevation drawings in Appendix H. The bedroom that will be subject to the highest internal ambient noise level has been used to calculate noise ingress.

The detailed calculations are presented in Appendix J and summarised in Table 9.

Sample room	External sound levels (dB) Incident L_{Aeq}	Internal noise levels (dB) L_{Aeq}	BS8233 guideline desirable maximum
Plot 99			
Living/kitchen/dining (day)	55	27	35
Bedroom (day)	55	24	35
Bedroom (night)	51	19	30
Plot 1			
Living/kitchen/dining (day)	55	27	35
Bedroom (day)	55	24	35
Bedroom (night)	51	19	30
Plot 19			
Living/kitchen/dining (day)	55	28	35
Bedroom (day)	55	27	35
Bedroom (night)	51	22	30

Table 9: Calculated indoor ambient noise levels

The results show that the criteria for reasonable sleeping and resting conditions, as set out in BS 8233 can be achieved at this site with a significant margin.

8.3 SCHEME OF MITIGATION TO FACADES

Glazing is specified using the weighted sound reduction index corrected for traffic noise, R_w+C_{tr}. Vents are specified using the normalised element weighted sound level difference corrected for traffic noise, $D_{n,e,w}+C_{tr}$. To ensure acceptable levels are achieved, both glazing and vent acoustic ratings should be achieved with and without the correction for traffic noise, C_{tr} (e.g. for glazing, the specified values for both R_w and R_w+C_{tr} should be met). Where doorsets (including French doors) open directly into habitable rooms they should be specified with overall R_w and R_w+C_{tr} values which are greater than or equal to the glazing specification.

Example façade elements that meet the specifications in each case are also given in Table 9. It should be noted, however, that it is the numerical values that are specified. The products shown are given by way of example only.

	Glazing (and doorsets to habitable rooms)		Trickle vents	
	R_w / R_w+C_{tr} (dB)	Example unit	$D_{n,e,w}$ / $D_{n,e,w}$+C_{tr} (dB)	Example unit
Suitable for all plots				
Living/kitchen/dining	29 / 25	Glazing - Pilkington 4/12/4 Doorset – Check with supplier	44 / 42	Greenwood EHA574 (Acoustic trickle)
Bedroom	29 / 25	Glazing - Pilkington 4/12/4 Doorset – Check with supplier	44 / 42	Greenwood EHA574 (Acoustic trickle)

Table 10: Scheme of acoustic mitigation to facades

With the above mitigation in place, good overall average noise levels inside dwellings at the proposed development site will be achieved by some margin. Note however, that the following section deals with the assessment for requirements for sound of a commercial nature.

8.4 BS4142 ASSESSMENT

In this section the predicted sound levels from the numerical noise modelling presented in Section 7 are assessed in accordance with the BS4142 methodology. It should be noted that none of these predicted sound levels in themselves are sufficient to raise overall average sound levels at the proposed housing significantly.

As regards uncertainty, although Background Sound Levels could be lower at times depending on weather conditions, the representative night-time background sound level was taken as the lowest 15 minute value over 4 days in the relevant time period which is a conservative approach to the data. The daytime background sound level was taken as the lowest 1 hour value from the data in Table 4 which again is conservative.

8.4.1 Example commercial activity – Fork Lift Truck operation

Section 7.1 describes the assumptions behind the predicted sound level at the most affected locations and the assessment below derives a Rating Level for that sound.

Result	Value outside window of Plot3 Living Room	Commentary
Predicted Sound Level of example commercial activity	L_{Aeq} = 42 dB	Determined by measurement close to example source and then predicted using the numerical noise model. (Section 7)
On-time correction	-6 dB	15 minutes maximum in 60 minute period
Acoustic feature correction	+9 dB	A penalty of + 6 dB has been applied for the tonal nature of any reversing alarm and a further 3 dB for intermittency. This is believed to be conservative.
Rating Level	(42 – 6 + 9) dB = 45 dB	
Assessed Background Sound Level	51 dB	Determined by measurement at Location 1. (Section 4.1.4)
Excess of Rating Level over Background Sound Level	(45 – 51) dB = -6 dB	This is a significantly negative result and is an indicator of low impact.

Table 11: BS4142 assessment external to Living Room at Plot 3

8.4.2 Existing commercial activity – Automated gate alarm operation

It has been described in the Section 7.2 how predicted sound levels from the automated gate alarm at Location 2 have been established at the most affected locations in the proposed housing layout. In this section, two BS4142 Rating Level assessments are presented for daytime and night-time periods. The most exposed bedroom is considered for the night-time period and the most exposed living room for the daytime period.

Assessment at most exposed bedroom for the night-time period

The table below summarises the key values in the assessment showing how the Specific Sound Level of the automated gate alarm and the Acoustic Feature Correction give the Rating Level at Plot 12, First Floor Bedroom 1 which is then compared with the assessed Background Sound Level.

Result	Value outside window of Plot 12, First Floor Bedroom 1	Commentary
Predicted Sound Level of automated gate alarm	L_{Aeq} = 41 dB	Determined by measurement close to source and then predicted using the numerical noise model. (Section 7)
On-time correction	-3 dB	480 seconds in 15 minute period (Section 4.3)
Acoustic feature correction	+9 dB	A penalty of + 6 dB has been applied for the tonal nature of the alarm and a further 3 dB for intermittency. This is believed to be conservative.
Rating Level	(41 – 3 + 9) dB = 47 dB	
Assessed Background Sound Level	48 dB	Determined by measurement at Location 1 and assessed for the most noise sensitive period when the source was found to be in operation. (Section 4.1)
Excess of Rating Level over Background Sound Level	(47 – 48) dB = -1 dB	This is below 0 dB and is an indicator of low impact.

Table 12: BS4142 assessment at Plot 12, First Floor Bedroom 1.

Assessment at most exposed living room for the daytime period

The table below summarises the key values in the assessment showing how the Specific Sound Level of the automated gate alarm and the Acoustic Feature Correction give the Rating Level at Plot 1,Kitchen / Dining Room which is then compared with the assessed Background Sound Level.

Result	Value outside window of Plot 1,Kitchen / Dining Room	Commentary
Predicted Sound Level of automated gate alarm	L_{Aeq} = 45 dB	Determined by measurement close to source and then predicted using the numerical noise model. (Section 7)
On-time correction	-9 dB	480 seconds in 60 minute period (Section 4.3)
Acoustic feature correction	+9 dB	A penalty of + 6 dB has been applied for the tonal nature of the alarm and a further 3 dB for intermittency. This is believed to be conservative.
Rating Level	(45 – 9 + 9) dB = 45 dB	
Assessed Background Sound Level	51 dB	Determined by measurement at Location 1 and assessed for the daytime hours 07:00 to 18:00. (Section 4.1)
Excess of Rating Level over Background Sound Level	(45 – 51) dB = -6 dB	This is below 0 dB and is an indicator of low impact.

Table 13: BS4142 assessment at Plot 1, Kitchen / Dining room.

8.4.3 Conclusions from BS4142 assessments

All three BS4142 assessments here find that the Rating Level is below the relevant Background Sound Level. In the case of the example commercial activity and the daytime assessment of the automated gate alarm the assessment finds that the Rating Level is 6 dB below the assessed Background Sound Level. The Rating Level rises to 1 dB below the assessed Background Sound Level for the night-time case of the automated gate alarm.

Therefore in all cases considered, with the design, layout and mitigation arrangements of Section 6 incorporated into the proposal in place, the outcome of the BS4142 assessments is that the commercial sound sources will have a low impact on future residents.

In addition to this the design measures for glazing and ventilation demonstrate by calculation that good internal acoustic conditions will be provided as standard when residents choose to close windows.

Further to this, because of the design, layout and mitigation measures in place and the fact that residents will be moving into an area with a commercial presence already in place, the low impact also means that the level of the commercial sound in terms of its likelihood of creating material changes in behaviour will be at or below the LOAEL as described in the PPG (Noise). This demonstrates that the impact on existing businesses and future occupants is minimised as required by Condition 17.

9. CONCLUSION

The proposed housing development at Harvester Way, Crowland is located between existing housing and a commercial area. Wheatley Homes Ltd has outline permission for the development granted on Appeal by The Planning Inspectorate. This report has been prepared for submission with the application for approval of reserved matters and deals with the requirements of Condition 17 on noise.

This report has set out the relevant policies and technical guidance that should be followed by the LPA when considering the scheme. It details the acoustic surveys completed which provide the data for the assessments, describes the range of acoustic considerations that have been incorporated into the scheme and concludes that the impact of noise on new residents with these measures in place will be low so that the condition can be discharged.

The results of the calculations for the proposed façade mitigation scheme show that good overall average noise levels inside dwellings at the proposed development site will be achieved by some margin. This meets the requirements of BS8233 as shown in Sections 8.2 and 8.3.

The results of the assessment of existing and potential commercial noise show how the layout and design of the proposed housing results in a low impact in accordance with BS4142 as shown in Section 8.4.

The report has considered not only the existing acoustic environment dominated by transportation noise rather than commercial noise but also the existing commercial operations and potential future commercial operations to demonstrate that a good standard of amenity can be achieved for the residents with sound levels at or below the LOAEL.

The report does not say that any potential future commercial operations will be at this level, because that would be unreasonable, but it does show that future commercial operations will not be unreasonably restricted by the presence of the proposed housing development.