Acoustic Associates
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ENVIRONMENTAL NOISE ASSESSMENT FOR A PROPOSED RESIDENTIAL DEVELOPMENT ON LAND OFF CREASE DROVE, CROWLAND (WOODROFFE SITE)

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SUMMARY

An environmental noise assessment has been carried out for a proposed residential development on land off Crease Drove, Crowland (Woodroffe Site), on behalf of Ashwood Homes. The assessment was carried out in accordance with the ProPG Planning and Noise Guidance, the National Planning Policy Framework (NPPF) and other relevant noise standards and guidance.

It includes attended noise monitoring, predictive noise modelling, assessment of the results and consideration of potential mitigation measures, where required.

The NPPF assessment carried out shows that, the noise impact on the worst affected dwellings is at the “Lowest Observed Adverse Effect Level”. Should the mitigation measures recommended within this report be adopted, then an acceptable noise situation should occur.

The ProPG initial noise risk assessment for the site shows that noise emissions across the proposed site are likely to be indicative of a “*Negligible – Low / Medium Risk”* during the daytime and a *“Low - Medium Risk”* during the night-time period. Implementation of a good acoustic design process have therefore been considered to demonstrate that an acceptable noise situation can occur for the future residents of the proposed residential premises.

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1 OBJECTIVES

1.1 To carry out an environmental *noise assessment for the proposed residential development on land off Crease Drove, Crowland (Woodroffe site - see Figures 1 & 2), in accordance with the ProPG Planning and Noise Guidance (ProPG – Reference 7), the National Planning Policy Framework (NPPF – Reference 1) the Noise Policy Statement for England (NPSE – Reference 2), the National Policy Planning Guidance (NPPG - Reference 3), British Standard (BS) 4142 (Reference 10), the World Health Organisation Guidance (WHO – Reference 5) and British Standard (BS) 8233 (Reference 6).

1.2 To recommend solutions to any problems identified by the assessment.

2 CONCLUSIONS

2.1 Using terminology from the ProPG, noise levels across the site are likely to be indicative of a "*Negligible risk"* for the majority of the site during the daytime, however the plots closest to Crease Drove are likely to fall into the "Low – Medium" risk category during this period. Noise levels across the site would be indicative of a *"Low - Medium"* risk during the night-time period. A good acoustic design process and methods for mitigation measures for the sections of the site closest to Crease Drove and along the southern site boundary (facing the Crowland Cranes site) are therefore recommended.

2.2 The assessment in accordance with BS 4142 shows that noise emissions from the adjacent Crowland Cranes industrial premises are likely to be at a level whereby a "significant adverse impact" could occur during the daytime and night-time period. Mitigation measures are therefore recommended within this report to protect future residents from industrial noise emissions.

2.3 Acceptable noise levels below the threshold for *"moderate annoyance, daytime and evening"* given in the WHO guidelines can be achieved within all outdoor amenity areas to the proposed dwellings provided recommendations within this report are implemented.

2.4 Acceptable noise levels below the threshold for *"speech intelligibility and moderate annoyance, daytime and evening"* given in the WHO guidelines can be achieved inside living rooms provided recommendations within this report are implemented.

2.5 Acceptable noise levels below the threshold for *"sleep disturbance, night-time"* given in the WHO guidelines can be achieved inside bedrooms provided recommendations within this report are implemented.

2.6 Using the noise impact criteria from the Noise Policy Statement for England the assessment carried out shows that with the proposed mitigation measures installed, the noise impact on the proposed residential development is likely to be at the "Lowest Observed Adverse Effect Level", this is deemed to be an acceptable noise situation.

*** see Appendix 1 for a Glossary of Terms**

3 RECOMMENDATIONS

3.1 This report should be used in support of the Planning Application for the proposed residential development on land off Crease Drove, Crowland (Woodroffe Site).

3.2 The following noise mitigation measures are required for the proposed dwellings:

- Double glazing fitted with compression seals should be built into all living rooms, dining rooms and bedrooms. Glazing specifications are given below for ground floor windows (representative of living rooms) and first floor windows (representative of bedrooms) which should achieve satisfactory internal noise levels.

Location	Minimum R dB at frequency (Hz) for glazing				
	125	250	500	1000	2000
All Bedrooms, Living Rooms and Dining Rooms	22	21	27	38	46

This is likely to be achieved using a minimum specification of 4/20/4 double glazing with compression seals. Guardian Glass 4/20/4 glazing has been proposed for all plots on the proposed site by the client. This glazing meets the specification detailed above and is therefore deemed to be suitable.

- Within the bedrooms of Plots 3 – 65 and 91 - 98, acceptable internal noise levels are likely to be achieved, even under circumstances where windows are partially opened to provide ventilation and therefore any form of ventilation system can be used for these dwellings.
- Internal noise levels within the following plots may be excessive if bedroom windows are opened:
    - Eastern facing bedrooms of Plot 1
    - Southern and Eastern facing bedrooms of Plot 2
    - Southern facing bedrooms of Plots 66 – 90
    - Northern and Eastern facing bedrooms of Plot 99
    - Eastern facing bedrooms of Plots 100 – 106
    - Eastern and Western facing bedrooms of Plots 107 – 108

Alternative ventilation must therefore be installed for these bedrooms. Any ventilation attached to the walls must achieve the following sound insulation values when in the open position.

Location	Minimum D_{ne} dB at frequency (Hz) for Ventilation				
	125	250	500	1000	2000
Bedrooms of Plots 1, 2, 66 – 90 and 99 - 108	37	36	47	46	47

The specification detailed above is likely to be achieved using a single acoustic through wall vent in each bedroom (e.g: Passivent fresh TLFdB acoustic through wall vent, or equivalent). The bedroom façades requiring acoustic through wall vents are shown in **GREEN** in Figure 2

- Within the living rooms of Plots 3 – 98 and dining rooms of Plots 3 – 98 and 100 – 108 acceptable internal noise levels are likely to be achieved, even under circumstances where windows are partially opened to provide ventilation and therefore any form of ventilation system can be used for these dwellings.
- Internal noise levels within the living rooms of Plots 1 – 2 and 99 – 108 and the dining rooms of Plots 1, 2 and 99 may be excessive if windows are opened. Alternative ventilation must therefore be installed. Any ventilation attached to the walls must achieve the following sound insulation values when in the open position.

Location	Minimum D_{ne} dB at frequency (Hz) for Ventilation				
	125	250	500	1000	2000
Living Rooms of Plots 1 – 2 and 99 - 108 / Dining Rooms of Plots 1, 2 and 99	30	33	38	37	36

The specification detailed above is likely to be achieved using acoustic trickle vents. The living room and dining room façades requiring acoustic trickle vents are shown in **BLUE** in Figure 2.

- If rooms are mechanically ventilated then the system chosen must comply with the Approved Document F (Reference 4). Alternatively, a 'whole house' ventilation system could be used.
- The predicted noise levels assume that the worst affected outdoor amenity areas serving Plots 66 – 90 will be surrounded by 1.8m high closed boarded fencing. It is recommended that fencing of this nature is installed and should have a mass per unit area of ≥10 kg/m^2 (see Figure 5). The location of the proposed 1.8m high fencing is indicated in **ORANGE** in Figure 2.

4 BACKGROUND

Ashwood Homes wish to apply for planning permission for the proposed residential development on land off Crease Drove, Crowland (Woodroffe Site). The site is alongside Crease Drove to the East and the neighbouring Crowland Cranes industrial site to the South. The A16 is also located approximately 800m to the South-East of the proposed development. Acoustic Associates (Peterborough) were asked to undertake an environmental noise assessment of the proposed development and this report documents the results of that assessment. The location of the site is shown in Figure 1 and the proposed plot layout is shown in Figure 2. Note: Acoustic Associates have previously carried out similar assessments for Ashwood Homes on the western side of Crease Drove and have also worked directly for Crowland Cranes.

5 POLICY, GUIDANCE AND STANDARDS

5.1 National Policy Planning Framework

The National Policy Planning Framework (Reference 1) states the following with respect to noise (para 123).

"Planning policies and decisions should aim to:

avoid noise from giving rise to significant adverse impacts (27) on health and quality of life as a result of new development;

mitigate and reduce to a minimum other adverse impacts (27) 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."

The footnote 27 in the first two bullet points refers to the Noise Policy Statement for England (NPSE – Reference 2) in order to explain what it means by "adverse impact".

5.2 Noise Policy Statement for England and National Policy Planning Guidance

The NPSE has stated that the impact of noise be classified according to an "effect level" (shown in column 3 below). The National Policy Planning Guidance (NPPG - Reference 3) has clarified what this effect level below means in terms of its perception by people at receptors and what action should be taken (columns 1 and 4 in Table 1 below).

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

Table 1 - National Policy Planning Guidance noise exposure hierarchy

5.3 World Health Organisation Guidance

5.3.1 The World Health Organisation (WHO) has published guidelines for community noise, as shown in Table 2 (Reference 5). This WHO document gives guidance for the levels of noise both inside and outside of dwellings.

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

Note: The 'daytime' and 'night-time' periods are generally referred to as 0700 to 2300 and 2300 to 0700 hours respectively.

Table 2 - World Health Organisation Noise Guidance Levels

5.3.2 For impulsive noise, such as that associated with rail movements, WHO states *"For a good sleep, it is believed that indoor sound pressure levels should not exceed approximately 45 dB L_{Amax} more than 10–15 times per night".*

5.4 British Standard (BS) 8233:2014

BS 8233:2014 (Reference 6) also gives guidance on indoor ambient noise levels, as shown in Table 3.

Activity	Location	Noise criteria	
		07:00 to 23:00	23:00 to 07:00
Resting	Living room	35 dB $L_{Aeq,16hour}$	-
Dining	Dining room/area	40 dB $L_{Aeq,16hour}$	-
Sleeping	Bedroom	35 dB $L_{Aeq,16hour}$	30 dB $L_{Aeq,8hour}$

Table 3 - BS 8233: 2014 guidance indoor ambient noise levels for dwellings.

5.5 British Standard BS 4142:2014

5.5.1 BS 4142 (Reference 10) is a standard which describes a method for assessing whether the 'specific noise' from an industrial source is likely to give rise to complaints from residents of the adjacent dwellings. The 'specific noise' levels are determined outside dwellings. The specific noise level is determined for reference time periods of 1-hour for the daytime (7am to 11pm) and 15 minutes for the night time. Tonal or impulsive characteristics of a noise are likely to increase the scope for complaints and this is taken into account by adding a value to the specific noise source level to obtain the 'rating level'. The value may be between 0 and 15 dB depending on objective and subjective measures detailed in the standard. The following table

detail the values added for the subjective method (which is the method used in this assessment).

Characteristics of noise	Noise at receptor	Value to add to specific noise level for rating level
Noise has tonal characteristics	Just perceptible	+2 dB
	Clearly perceptible	+4 dB
	Highly perceptible	+6 dB
Noise has impulsive characteristics	Just perceptible	+3 dB
	Clearly perceptible	+6 dB
	Highly perceptible	+9 dB
Other - characteristics that are neither tonal nor impulsive but are readily distinctive against the residual acoustic environment,	-	+ 3 dB
Intermittency	If intermittency is readily distinctive in the residual acoustic environment	+3 dB

Table 4 – BS 4142 – Corrections to noise to calculate rating level – subjective method

5.5.2 BS 4142 requires that the rating Level of a noise is compared with the existing background noise ($L_{A90,T}$). Guidance given in the standard states the following regarding the difference between the rating Level and the background noise.

- A difference of 0 dB is indicative of a *"minor impact*";
- A difference of +5 dB is indicative of an *"adverse impact";*
- A difference of +10 dB is indicative of a *"significant adverse impact"* .

5.6 ProPG: Professional Practice Guidance on Planning & Noise

The Professional Practice Guidance on Planning and Noise (ProPG) (Reference 7) has been produced to provide practitioners with guidance on a recommended approach to the management of noise within the planning system in England.

The National Planning Policy Framework (NPPF) encourages improved standards of design. The CIEH, IOA and ANC have worked together to produce this guidance which encourages better acoustic design for new residential development and aims to protect people from the harmful effects of noise.

The ProPG advocates a risk based, 2 stage approach encouraging early consideration of noise issues, facilitates straightforward accelerated decision making for lower risk sites, and assists proper consideration of noise issues where the acoustic environment is challenging. It is

envisaged that following the guidance contained in ProPG there will be an increase in the likelihood of success of planning applications for new residential development, yet it also provides a clear basis for recommending refusal of new housing development on noise grounds where necessary.

The two sequential stages of the overall approach are:

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

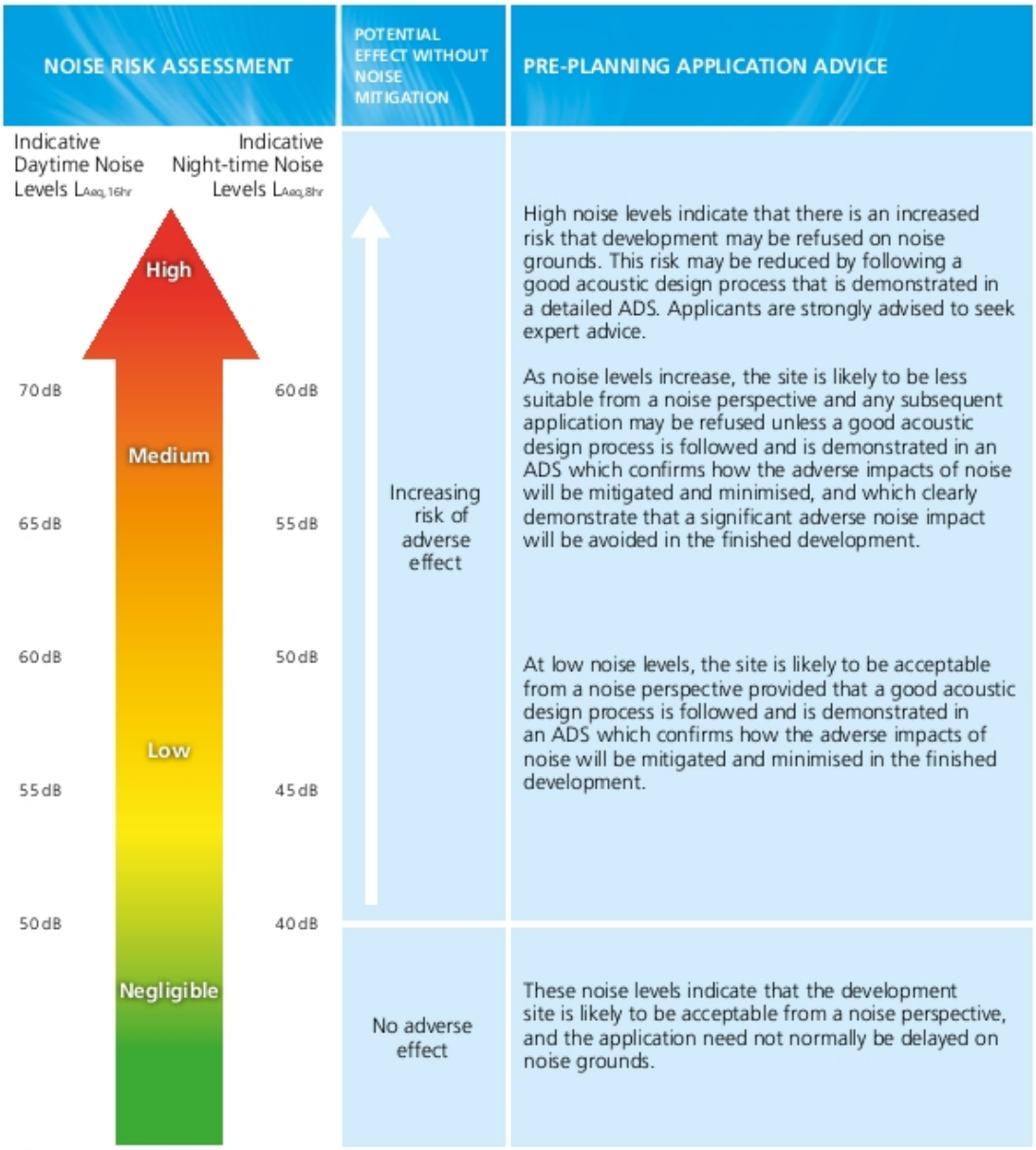
The four key elements to be undertaken in parallel during Stage 2 of the recommended approach are:

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

The approach is underpinned by the preparation and delivery of an "Acoustic Design Statement" (ADS). An ADS for a site assessed as high risk should be more detailed than for a site assessed as low risk. An ADS should not be necessary for a site assessed as negligible risk.

Having followed this approach to its end, it is envisaged that noise practitioners will then have a choice of one of four possible recommendations to present to the decision maker. In simple terms the choice of recommendation is as follows: "grant without conditions", "grant with conditions", "avoid" or "prevent".

The image below (excerpt 1 from ProPG) summarises the Stage 1 Initial Site Noise Risk Assessment and illustrates how an initial noise risk assessment is linked with an increasing risk of adverse effect from noise and how this in turn is broadly associated with indicative noise levels derived from current guidance and experience. The indicative noise levels are intended to provide a sense of the noise challenge at a potential residential development site and should be interpreted flexibly having regard to the locality, the project and the wider context. In the final column, the initial noise risk assessment is aligned with pre-planning application guidance that highlights the increasing importance of good acoustic design as the noise risk increases.



ProPG Excerpt 1: Initial Site Noise Risk Assessment

It is important that the assessment of noise risk at a proposed residential development site is not the basis for the eventual recommendation to the decision maker. The recommended approach is intended to give the developer, the noise practitioner, and the decision maker an early indication of the likely initial suitability of the site for new residential development from a noise perspective and the extent of the acoustic issues that would be faced.

Stage 2 of the assessment involves the aforementioned four key elements that are covered in greater detail below:

Element 1 - Good Acoustic Design Process

Provide an integrated solution whereby development avoids "unreasonable" and prevents "unacceptable" acoustic conditions. In particular the following should be considered:-

- Check the feasibility of relocating, or reducing noise levels from relevant sources.
- Consider options for planning the site or building layout.
- Consider the orientation of proposed building(s).
- Select construction types and methods for meeting building performance requirements.
- Examine the effects of noise control measures on ventilation, fire regulation, health and safety, cost, CDM (construction, design and management) etc.
- Assess the viability of alternative solutions.
- Assess external amenity area noise.

Element 2 – Internal Noise Level Guidelines

The applicant should seek to achieve recommended noise levels inside noise sensitive rooms in new residential development. These internal noise levels are based around the BS 8233:2014 criteria (Reference 7), with a number of additions.

Element 3 – External Amenity Area Noise Assessment

The acoustic environment of external amenity areas that are an intrinsic part of the overall design assessment should always be assessed and noise levels should ideally not be above the range 50-55 dB $L_{Aeq,16hours}$.

Element 4 – Assessment of Other Relevant Issues

At this stage the following should be addressed:

- compliance with relevant national and local policy
- magnitude and extent of compliance with ProPG
- likely occupants of the development
- acoustic design v unintended adverse consequences
- acoustic design v wider planning objectives

5.7 Criteria for this assessment

ProPG Stage 1 guidance has been used to carry out an initial noise risk assessment. The assessment then uses ProPG Stage 2 guidance to carry out a systematic approach taking

account of the four key elements given in the guidance. ProPG, BS 8233 and WHO Guidance is used to assess noise inside dwellings and within outdoor amenity areas. The impact of Industrial noise is also assessed in accordance with BS 4142. The overall noise impact with mitigation measures in place is classified according to criteria given in the NPSE and NPPG.

6 NOISE ASSESSMENT

6.1 Ambient and Background Noise

Attended noise monitoring was carried out at Monitoring Locations A – D (see Figure 1) during May and June 2018. Daytime measurements were taken on Thursday 17th May 2018 between 09:02 – 10:17 hours at Monitoring Locations A and B. Daytime measurements were also taken on Friday 18th May 2018 between 08:50 – 11:54 hours at Monitoring Locations A – D. The site was also visited during the night-time (early morning period) on Wednesday 6th June 2018 where attended measurements were taken at Monitoring Locations A and C between 04:30 – 06:45 hours. The noise monitoring locations used were in free-field conditions at a height of approximately 1.2 metres above ground level. Locations A and B were approximately 16m from the roadside of Crease Drove, Location C was approximately 6m from the roadside of Crease Drove and Location D was approximately 290m from the nearest section of the A16. The weather conditions during the monitoring period on 17th May were dry, partial cloud cover, approximately 11°C, with wind speeds averaging between 2.5 – 4.5m/s. The weather conditions during the monitoring period on 18th May were dry, partial cloud cover, approximately 11 - 12°C, with typical wind speeds of 1m/s. The weather conditions during the monitoring period on 6th June were dry, partial cloud cover, approximately 8 - 9°C, with typical wind speeds of 1m/s. Appendix 2 gives details of the noise instrumentation used and Figure 1 shows the monitoring locations.

6.2 Specific Noise

The worst affected plots (nearest to Crease Drove and Crowland Cranes) are exposed to a mixture of road traffic and Industrial / commercial noise. Noise measurements of passing road traffic were taken to allow their contribution to be determined. Specific noise measurements were also taken associated with the noisiest operations witnessed on the Crowland Cranes site. These were associated with loading and unloading activities in the open area to the north-east section of the Crowland Cranes site (witnessed during the daytime period), HGV's loaded with cranes leaving the site during the early morning (witnessed during the night-time period between 06:00 – 07:00) and also a siren that sounds during periods when both the gated site entrance opens and closes at the south-east corner of the Crowland Cranes site (witnessed during both the daytime and night-time periods).

6.3 Computer noise model of the site and surrounding area

A computer noise model of the site and surrounding area was generated using Wolfel IMMI Computer Noise Modelling Software (Reference 9) which uses the methods given in ISO 9613 – 2 (Reference 10) to calculate noise levels across the site. The model was calibrated using the noise measurements taken on site. An area source has been used to model the loading / unloading processes on the Crowland Cranes site, whilst a point source has been used to represent the gate siren on the site.

7 RESULTS

7.1 Measured noise levels

The results from the attended ambient and background noise monitoring at Monitoring Locations A – D are shown below in Table 5 - 8. The tables show the 'energy average' noise levels ($L_{Aeq,T}$), maximum sound pressure levels ($L_{Amax,T}$) and background noise levels ($L_{A90,T}$).

Date	Time (Hours)	Ambient Noise Level ($L_{Aeq,T}$) dB(A)	Background Noise Level ($L_{A90,T}$) dB(A)	Maximum Noise Level ($L_{Amax,T}$) dB(A)	Comments
17th May 2018	09:02 – 09:17	50.5	44.4	69.0	Road traffic on Crease Drove / Harvester Way ranging from 5 – 8 vehicles per 15 minute period. A tractor with a trailer also travelled along the road during the 09:17 – 09:32 period and a HGV travelled along the road during the 10:02 – 10:16 period. Some activity took place within the workshops on the Crowland Cranes sites but were not dominant. Gate opening closing sirens also occurred on the Crowland Cranes site during both periods between 09:02 – 09:32.
	09:17 – 09:32	52.4	44.6	71.5	
	09:32 – 09:47	49.8	44.2	66.4	
	09:47 – 10:02	49.1	44.0	64.0	
	10:02 – 10:16	51.6	44.0	72.2	
18th May 2018	08:50 – 09:05	52.9	41.8	75.1	Road traffic on Crease Drove / Harvester Way ranging from 2 – 15 vehicles per 15 minute period. Some activity took place within the workshops on the Crowland Cranes sites but were not dominant. Gate opening closing sirens also occurred on the Crowland Cranes site during both periods between 10:20 – 10:50. Between 10:05 – 10:20, 4 x HGV's entered the Crowland Cranes Site and were loaded / unloaded in the yard area on the north western section of the site throughout the rest of the monitoring period.
	09:05 – 09:20	59.6	42.7	92.8	
	09:20 – 09:35	52.9	38.5	75.2	
	09:35 – 09:50	46.0	36.8	63.4	
	09:50 – 10:05	42.7	35.3	62.2	
	10:05 – 10:20	53.0	37.0	77.7	
	10:20 – 10:35	51.8	44.3	69.9	
	10:35 – 10:50	51.5	43.8	70.2	
	10:50 – 11:05	52.3	43.9	67.8	
	11:05 – 11:20	49.6	42.0	64.4	
6th June 2018	04:30 – 04:45	45.9	40.6	64.5	Road traffic on Crease Drove / Harvester Way ranging from 0 – 7 vehicles per 15 minute period. Gate opening closing sirens also occurred on the Crowland Cranes site during the 06:15 – 06:30 period. 3 x HGV's loader with Cranes started up and drove across then off the Crowland Cranes site during the 06:15 – 06:30 period.
	04:45 – 05:00	45.0	40.2	61.8	
	05:00 – 05:15	46.4	40.8	65.4	
	05:15 – 05:30	43.3	39.0	61.9	
	05:30 – 05:45	46.5	37.9	66.9	
	05:45 – 06:00	49.3	39.0	69.4	
	06:00 – 06:15	45.8	39.0	63.5	
	06:15 – 06:30	51.4	40.1	68.7	
	06:30 – 06:45	43.9	39.4	62.6	

Table 5 – Measured noise levels at Monitoring Location A

Date	Time (Hours)	Ambient Noise Level ($L_{Aeq,T}$) dB(A)	Background Noise Level ($L_{A90,T}$) dB(A)	Maximum Noise Level ($L_{Amax,T}$) dB(A)	Comments
17th May 2018	09:17 – 09:32	55.1	46.3	72.6	Road traffic on Crease Drove / Harvester Way ranging from 5 – 8 vehicles per 15 minute period. A tractor with a trailer also travelled along the road during the 09:17 – 09:32 period and a HGV travelled along the road during the 10:02 – 10:16 period. Some activity took place within the workshops on the Crowland Cranes sites but were not dominant. Gate opening closing sirens also occurred on the Crowland Cranes site during both periods between 09:02 – 09:32.
	09:32 – 09:47	50.1	45.7	63.2	
	09:47 – 10:02	49.9	45.3	63.6	
	10:02 – 10:15	52.0	45.4	71.9	
18th May 2018	09:05 – 09:20	54.6	42.2	82.5	Road traffic on Crease Drove / Harvester Way ranging from 2 – 15 vehicles per 15 minute period. Some activity took place within the workshops on the Crowland Cranes sites but were not dominant. Gate opening closing sirens also occurred on the Crowland Cranes site during both periods between 10:20 – 10:50. Between 10:05 – 10:20, 4 x HGV's entered the Crowland Cranes Site and were loaded / unloaded in the yard area on the north western section of the site throughout the rest of the monitoring period.
	09:20 – 09:35	53.2	41.6	73.0	
	09:35 – 09:50	47.8	39.2	65.7	
	09:50 – 10:05	45.8	38.1	66.9	
	10:05 – 10:20	57.4	39.0	86.9	
	10:20 – 10:35	53.7	43.1	69.0	
	10:35 – 10:50	53.0	41.3	74.3	
	10:50 – 11:05	50.9	41.7	65.6	
	11:05 – 11:20	47.5	40.4	64.3	

Table 6 – Measured noise levels at Monitoring Location B

Date	Time (Hours)	Ambient Noise Level ($L_{Aeq,T}$) dB(A)	Background Noise Level ($L_{A90,T}$) dB(A)	Maximum Noise Level ($L_{Amax,T}$) dB(A)	Comments
18th May 2018	09:21 – 09:36	61.1	39.0	89.0	Road traffic on Crease Drove / Harvester Way ranging from 2 – 15 vehicles per 15 minute period. Some activity took place within the workshops on the Crowland Cranes sites but were not dominant. Gate opening closing sirens also occurred on the Crowland Cranes site during both periods between 10:20 – 10:50. Between 10:05 – 10:20 4 x HGV's entered the Crowland Cranes Site and were loaded / unloaded in the yard area on the north western section of the site throughout the rest of the monitoring period.
	09:36 – 09:51	52.8	37.8	74.9	
	09:51 – 10:06	48.4	37.3	73.4	
	10:06 – 10:21	60.0	39.2	87.3	
	10:21 – 10:36	54.4	39.1	82.0	
	10:36 – 10:51	60.0	41.9	85.9	
	10:51 – 11:06	55.4	41.8	75.2	
	11:06 – 11:21	54.0	41.5	79.1	
6th June 2018	04:45 – 05:00	43.4	38.9	58.5	Road traffic on Crease Drove / Harvester Way ranging from 0 – 7 vehicles per 15 minute period. Gate opening closing sirens also occurred on the Crowland Cranes site during the 06:15 – 06:30 period. 3 x HGV's loader with Cranes started up and drove across then off the Crowland Cranes site during the 06:15 – 06:30 period.
	05:00 – 05:15	47.9	38.4	73.7	
	05:15 – 05:30	43.7	37.1	62.5	
	05:30 – 05:45	50.9	36.4	74.9	
	05:45 – 06:00	54.4	38.0	79.1	
	06:00 – 06:15	47.8	37.8	72.1	
	06:15 – 06:30	52.3	39.3	74.7	
	06:30 – 06:45	44.8	38.3	69.5	

Table 7 – Measured noise levels at Monitoring Location C

Date	Time (Hours)	Ambient Noise Level ($L_{Aeq,T}$) dB(A)	Background Noise Level ($L_{A90,T}$) dB(A)	Maximum Noise Level ($L_{Amax,T}$) dB(A)	Comments
18th May 2018	11:44 – 11:53	40.5	36.7	54.4	Noise levels were dominated by distant contributions from the A16.

Table 8 – Measured noise levels at Monitoring Location D

7.2 ProPG Stage 1 – Initial noise risk assessment

The measured noise data was input into a computer model of the site. The predicted output from this software model is shown as noise contours across the proposed development site and has been colour coded in accordance with the indicative daytime and night-time noise level colour coding scheme given in excerpt 1 of the Pro-PG Stage 1 assessment criteria (See Figures 3 & 4 for noise contour maps). It is shown in Figure 3 that the proposed site is likely to be indicative of a "*Negligible risk"* for the majority of the site during the daytime, however the plots closest to Crease Drove and the Crowland Cranes site are likely to fall into the "Low – Medium" risk category during this period. Figure 4 shows the proposed site is likely to be indicative of a "Low – Medium risk" during the night-time period.

The following should be noted in order for a planning application to be successful:

- Dwellings located on the eastern boundary of the site (closest to Crease Drove) are regarded as “Low - Medium Risk” during the daytime and night-time periods according to the indicative ProPG scale (see Section 5.6). Good acoustic design is therefore essential for these areas.

7.3 British Standard (BS) 4142 Assessment

During the daytime monitoring periods and also for a small section of the night-time monitoring period (06:00 – 07:00 hours) noise emissions associated with the neighbouring Crowland Cranes Industrial site were present and were included within the noise measurements. The presence of these industrial noise contributions have been assessed in accordance with BS 4142. The daytime Assessment Location is within the outdoor amenity area of the worst affected plot (Plot 85 – See Figure 2), whilst the night-time Assessment Location is 1m from the first floor façade (4.5m above the ground) of the worst affected plot (Plot 90). The results of these daytime and night-time assessments are shown below in Tables 9 and 10 respectively.

Daytime BS 4142 Assessment		Comments
Predicted specific sound level within the worst affected outdoor amenity area of Plot 85 (1.5m above the ground)	$L_{Aeq,T}$ = 48 dB(A)	Predicted sound level calculated using the computer noise model (Industrial Noise sources associated with Crowland Cranes only – Including "gate opening / closing warning sirens" in use and flatbed HGV's being loaded by fork lift trucks in the north-eastern section of the site).
Background sound level	$L_{A90,T}$ = 42 dB(A)	The "modal" background sound level measured during the daytime periods at Monitoring Locations A - C.
Assessment made during the daytime, so the reference time interval is 1 hour	-	The gate opening / closing warning siren has been assumed to operate for 20 minutes in any 1 hour daytime reference period which from observations is based on worst case operations. The loading operations have been assumed to take place continuously throughout the entire 1 hour reference period.
Acoustic feature correction	+5 dB	The tonality of noise emission from the industrial noise sources are likely to be "just perceptible" within the worst affected gardens (+2dB correction) They could also generate impulsive noise emissions that are "just perceptible" within the worst affected gardens, therefore a +3dB correction has been applied for impulsivity.
Rating Level	(48 + 5) = 53 dB	Acoustic feature correction added to the specific sound level.
Excess of rating level over the background sound level	53 – 42 = +11 dB	The predicted "rating level" ($L_{Ar,Tr}$) is 11 dB(A) above the background sound level, which is likely to result in a level where a "significant adverse impact" could occur for the residents of the worst affected proposed plots. Noise mitigation measures need to be introduced to ensure noise levels within living rooms during the daytime achieve acceptable levels.
Assessment when taking account of context	-	Calculations have been based on worst case assumptions and are therefore likely to be overestimates of noise emissions for large portions of the daytime period. The predicted noise levels within living rooms and within outdoor amenity areas (with the proposed mitigation measures installed) achieve the ProPG and WHO guidance levels and therefore taking this into account an acceptable noise situation is deemed to occur for the future residents of the proposed residential premises.
Uncertainty of the assessment	-	Calculations have been based on worst case assumptions and are therefore likely to be overestimates of noise emissions for large portions of the daytime. The background sound levels and the specific noise levels were taken over three separate site visits, therefore the uncertainties of the assessment are deemed to be low. The uncertainties relating to the use of predictive modelling are assumed to be ± 3 dB(A).

Table 9 – Daytime BS 4142 Assessment

Night-Time BS 4142 Assessment		Comments
Predicted specific sound level 1m from the worst affected first floor façade of Plot 90 (4.5m above the ground)	$L_{Aeq,T}$ = 47 dB(A)	Predicted sound level calculated using the computer noise model (Industrial Noise sources associated with Crowland Cranes only – Including "gate opening / closing warning sirens" in use and HGV crane vehicles starting up and leaving the site.
Background sound level	$L_{A90,T}$ = 39 dB(A)	The "modal" background sound level measured during the night-time periods at Monitoring Locations A & C.
Assessment made during the night-time, so the reference time interval is 15 minutes	-	The gate opening / closing warning siren has been assumed to operate for 5 minutes in any 15 minute night-time reference period which from observations is based on worst case operations. Based on worst case observations 3 x HGV crane vehicles are assumed to leave the site during the 15 minute reference period.
Acoustic feature correction	+5 dB	The tonality of noise emission from the industrial noise sources are likely to be "just perceptible" at the worst affected residential receptor (+2dB correction) They could also generate impulsive noise emissions that are "just perceptible" at the worst affected residential receptor, therefore a +3dB correction has been applied for impulsivity.
Rating Level	(47 + 5) = 52 dB	Acoustic feature correction added to the specific sound level.
Excess of rating level over the background sound level	52 – 39 = +13 dB	The predicted "rating level" ($L_{Ar,Tr}$) is 13 dB(A) above the background sound level, which is likely to result in a level where a "significant adverse impact" could occur for the residents of the worst affected proposed plots. Noise mitigation measures need to be introduced to ensure noise levels within bedrooms at night achieve acceptable levels.
Assessment when taking account of context	-	Calculations have been based on worst case assumptions and are therefore likely to be overestimates of noise emissions for large portions of the night-time period. During the attended night-time period, the only activity witnessed on the Crowland Cranes site (with the exception of the occasional car arriving on site from 06:00 hours onwards) all occurred between the 15 minute period between 06:15 – 06:30. The predicted noise levels within bedrooms (with the proposed mitigation measures installed) achieve the ProPG and WHO guidance levels and therefore taking this into account an acceptable noise situation is deemed to occur for the future residents of the proposed residential premises.
Uncertainty of the assessment	-	Calculations have been based on worst case assumptions and are therefore likely to be overestimates of noise emissions for large portions of the night-time. The background sound levels and the specific noise levels were taken over three separate site visits, therefore the uncertainties of the assessment are deemed to be low. The uncertainties relating to the use of predictive modelling are assumed to be ± 3 dB(A).

Table 10 – Night-Time BS 4142 Assessment

7.3 ProPG Stage 2 – Full assessment of the four key elements

7.3.1 Element 1 – Good acoustic design process

The following measures should be considered to protect residential amenity inside and outside dwellings:

Orientation of buildings and outdoor amenity areas

From the proposed layout plan (shown in Figure 2), the orientation of buildings show consideration for good acoustic design, whereby proposed plots 1 – 2 and 99 – 108 nearest to Crease Drove have buildings acting as partial noise barriers to protect outdoor amenity areas.

Orientation of rooms within buildings

Internal room layouts to dwellings should ideally be orientated so that living rooms and as many bedrooms as possible are located in the acoustic shadow of Crease Drove and Crowland Cranes and that kitchens / stairwells and bathrooms etc are facing towards this site. If this is not possible, then the layout should where possible have at least one window of habitable rooms that can be opened in the acoustic shadow of the road to potentially allow for the option of natural ventilation. Plots 66 – 90 have been effectively designed with living rooms facing away from the Crowland Cranes site. Plots 1, 2 and 99 – 108 have living room windows facing onto Crease Drove, therefore upgraded ventilation specifications have been considered below to ensure that acceptable internal noise levels within these rooms can be achieved.

7.3.2 Element 2 – Internal noise level guidelines

Based on the proposed plot layout, external noise levels have been predicted at 1m away from the worst affected plot façades (Plot 2) at heights of 1.5m (daytime) and 4.5m (night-time) above ground and are representative of locations just outside of where living room and bedroom windows will be located. Table 11 summarises these predictions. Also included in the table are predicted internal noise levels allowing for a 15 dB(A) reduction for partially open windows.

Assessment Location	Predicted Noise Level Outside the Façade dB(A)		Predicted Internal Noise Level with partially open windows dB(A)		Compliance with ProPG / WHO / BS 8233 Guidance
	$L_{Aeq,16hour}$ Daytime	$L_{Aeq,8hour}$ Night time	$L_{Aeq,16hour}$ Daytime	$L_{Aeq,8hour}$ Night time	
Plots 2 Façade	62	54	47	39	NO

Table 11 – Internal noise level predictions with partially opened windows

Ventilation and glazing

Site layouts should be designed so that the internal target ambient noise levels can be achieved with open windows in as many properties / façades as possible to demonstrate good acoustic design. Where it is not possible to achieve reasonable internal noise levels with open windows (i.e. the nearest plot façades facing towards Crease Drove), then alternative means for suitably ventilating properties will be required.

The WHO gives guidance on indoor noise levels above which critical health effects occur: 35 dB(A) – speech intelligibility disturbance and 30 dB(A) – sleep disturbance. BS 8233 also implies that an internal night-time level of <30 dB(A) is suitable for bedrooms and an internal daytime level of <35 dB(A) is suitable for living rooms.

Noise can enter a building through many paths, e.g: windows, walls, roof, etc. However, in most cases windows and vents provide the main path and it is important to ensure that their insulation is specified correctly. Table 12 shows the predicted internal noise levels within the living rooms and bedrooms of the worst affected residential premises (Plot 2). The predicted internal noise levels are based upon the assumption that all windows fitted will be double glazed units meeting the minimum specification discussed in Section 3.2 and will be kept closed, therefore alternative ventilation arrangements will be required. Glazed areas of $2m^2$ have been assumed for each room assessed. For the purposes of this assessment two acoustic trickle vents have been assumed to provide ventilation to living rooms and dining rooms of the worst affected plots and a single through wall vent has been assumed to provide ventilation to bedrooms of the worst affected plots (any vents installed will need to achieve the minimum D_{new} values specified in Section 3.2 when in the open position). Living room volumes have been assumed to be $38.4m^3$, whilst bedroom volumes are assumed to be $28.8m^3$.

Assessment Location	Predicted Noise Level Outside the Façade dB(A)		Predicted Internal Noise Level dB(A)		Compliance with ProPG / WHO / BS 8233 Guidance
	$L_{Aeq,16hour}$ Daytime	$L_{Aeq,8hour}$ Night time	$L_{Aeq,16hour}$ Daytime	$L_{Aeq,8hour}$ Night time	
Plot 2 Façade	62	54	33	20	YES

Table 12 – Predicted worst case Internal noise levels (with proposed glazing / ventilation Installed and windows closed)

It can be seen that with windows on the worst living room and bedroom façades closed and ventilation (meeting the minimum specification in Section 3.2) installed and open, the proposed development should meet the ProPG, WHO and BS 8233 internal noise criteria within all plots. Any ventilation system installed must comply with the Approved Document F (Reference 4). This is deemed to be an acceptable noise situation.

Consideration of Maximum (L_{Amax}) noise levels during the night-time period

Analysis of maximum (L_{Amax}) noise levels associated with road traffic movements on Crease Drove measured during the night-time period, are predicted to be around 79 dB(A) outside of bedroom windows to the worst affected plot (Plot 2) and could occur regularly during the night-time due to the close proximity of the road traffic. However, with windows kept closed and the proposed glazing and ventilation fitted, the predicted internal (L_{Amax}) noise level within the worst affected bedrooms is predicted to be 45 dB(A), which meets the acceptable internal levels specified within the ProPG and WHO Guidance.

7.3.3 Element 3 – External amenity area noise assessment

Protection of outdoor amenity areas (Plots 1 – 2 and 91 – 108)

The proposed outdoor amenity areas of the worst affected plots (Plots 1 – 2 and 91 – 108) have been effectively designed so that they are shielded from the major noise source (Crease Drove) by the buildings themselves. Based on the proposed plot layout, noise levels within outdoor amenity areas have been predicted at a height of 1.5m above ground and 3.5m from the building façade, giving predicted ($L_{Aeq,T}$) outdoor amenity area noise levels in the worst affected plots of ≤48 dB(A). These levels are below the level of 50 dB(A) which is regarded as the threshold for *"moderate annoyance, daytime and evening"* given in the WHO guidelines. This is deemed to be an acceptable noise situation.

Protection of outdoor amenity areas (Plots 66 - 90)

The proposed outdoor amenity areas of Plots 66 - 90 face directly towards the Crowland Cranes site. Closed boarded fencing should be installed along the southern boundary of these gardens (at the location shown in **ORANGE** in Figure 2). Any barrier should comprise of an impervious material e.g. close-boarded timber and have a mass per unit area of ≥10 kg/m^2 (see Figure 5) and be at least 1.8 metres in height. Based on the proposed plot layout, noise levels within outdoor amenity areas have been predicted at a height of 1.5m above ground and at least 3.5m from the building façade, giving predicted ($L_{Aeq,T}$) outdoor amenity area noise levels in the worst affected plots of ≤50 dB(A). These levels do not exceed the level of 50 dB(A) which is regarded as the threshold for *"moderate annoyance, daytime and evening"* given in the WHO guidelines. This is deemed to be an acceptable noise situation.

7.3.4 Element 4 – Assessment of Other Relevant Issues

Using the noise impact criteria from the Noise Policy Statement for England (NPSE) and the NPPG the assessment carried out shows that, the noise impact on the proposed residential dwellings is likely to be at a level where the "Lowest Observed Adverse Effect" could occur.

There are no other relevant issues likely to affect this assessment as detailed in Element 4 of the ProPG Stage 2 Assessment.

7.4 ProPG Stage 2 – Recommendation to the decision maker

It is recommended that the mitigation measures proposed within the recommendations section of this report are implemented as part of the development and the recommendation to the decision maker is that Planning Permission should be awarded, subject to these conditions.

8 UNCERTAINTIES

The main uncertainties relating to assessments of this type relate to:

- Measured noise levels used
- Sources of noise that have been assumed
- Predictive computer modelling

Uncertainties relating to the daytime and night-time measured noise levels associated with road traffic and specific noise emissions from the Crowland Cranes site are minimal due to the regular flow of traffic on the A16 and noise emissions from the other sources being assessed during three separate site visits.

Specific measurements associated with industrial noise sources on the Crowland Cranes site have been based upon worst case scenarios (e.g: the noisiest scenarios witnessed have been used for predictions).

As a worst case noise scenario, with regard to industrial / commercial noise emissions has been assumed, the predictions are likely to be an overestimate of noise levels during parts of the daytime period and the majority of the night-time period.

The uncertainties relating to the use of predictive modelling are likely to be ± 3 dB(A).

These uncertainties are unlikely to affect the conclusions of this report.

REFERENCES

1. *National Policy Planning Framework;* DCLG, 2012.
2. *Noise Policy Statement for England;* DEFRA, 2010.
3. *National Policy Planning Guidance, 2014, DEFRA*.
4. *Document F Ventilation Regulations;* thenbs, 2010.
5. *World Health Organisation Guidance, Guidelines for Community Noise;* WHO, 1999.
6. *British Standard BS 8233, Guidance on sound insulation and noise reduction for buildings;* BSI, 2014.
7. *Professional Practice Guidance on Planning & Noise: New Residential Development;* ProPG, 2017.
8. *Wolfel IMMI Computer Noise Modelling Software.*
9. *ISO 9613-2 Acoustics of sound during propagation outdoors, Part 2: General method of calculation;* ISO, 1996.
10. *British Standard BS 4142:2014, Methods of rating and assessing industrial and commercial sound;* BSI, 2014.
11. NWK Design Drawing No: 1250-004, Revision G, dated February 2019

Appendix 1 – Glossary of terms

Sound Pressure	The variation of ambient pressure that is detected by the ear as sound.
Noise	Unwanted sound
deciBel (dB)	Ten times the logarithm of the square of the ratio of the Sound Pressure to a reference pressure (20 micro-Pascal's).
Sound Pressure Level (Lp)	The decibel version of the Sound Pressure.
A-Weighting	A frequency weighting which simulates the response of the ear. An A-Weighted Sound Pressure Level is denoted by L_{pA} and has units of dB(A)
$L_{Aeq,T}$	The value of the A-weighted sound pressure level, in decibels [dB(A)], of a continuous steady sound that within a specified time interval (T), for example 16 hours, has the same mean-square sound pressure as a sound that varies with time. Therefore, the average over a 16 hour period would be denoted as $L_{Aeq,16h}$
$L_{Amax,T}$	The maximum A-Weighted sound pressure level that was encountered during the measurement period.
$L_{A90,T}$	The A-Weighted sound pressure level that is exceeded for 90% of the time (T). This is usually used a measure of background noise.
Free Field	Where noise can propagate freely without any reflections from buildings etc.
Octave Band	A band of frequencies the upper limit of which is twice the lower limit. They are known by their centre frequency, e.g., 63, 125, 250, 500, 1000, 2000
NPSE Critera	
NOEL	No Observed Effect Level
LOAEL	Lowest Observed Adverse Effect Level
SOAEL	Significant Observed Adverse Effect Level

BS 4142 Terms

T_r	The reference time interval over which an equivalent continuous A-weighted sound pressure is determined. Day time = 1 hour Night-time = 15 minutes
T_m	The measurement time interval over which measurements are taken.
Ambient Noise	Total sound in a given situation at a given time.
Residual Noise	The ambient noise remaining at a given position in a given situation when the specific noise is suppressed to a degree such that it does not contribute to the ambient noise.
Specific Noise Level	The dB $L_{Aeq,Tr}$ of the noise sources being assessed at a site.
Rating Level $L_{Ar,Tr}$	The specific noise level plus any correction (+5 dB) for the character of the noise, known as the Rating Level.
Assessment Level	Difference between Rating Level ($L_{Ar,T}$) and Background Noise ($L_{A90,T}$)
Sound Power Level (L_{WA})	The noise level from the source in terms of sound power, in dB(A).

Appendix 2 – Noise instrumentation

Type	Manufacturer	Description	Serial Number	Last Calibration Date	Calibration Certificate No.
Svan 957	Svantek	Sound level meter	23893	25/10/2017	171631
Svan 957	Svantek	Sound level meter	27591	21/07/2016	67857
Svan 957	Svantek	Sound level meter	27517	07/02/2018	174163
GA 607	Castle	Sound level calibrator	039873	07/02/2018	174162
GA 607	Castle	Sound level calibrator	043186	25/10/2017	171632

The calibration of the instrumentation was checked at the start and end of the tests and there was no significant drift.

Figure 1 - Location Plan

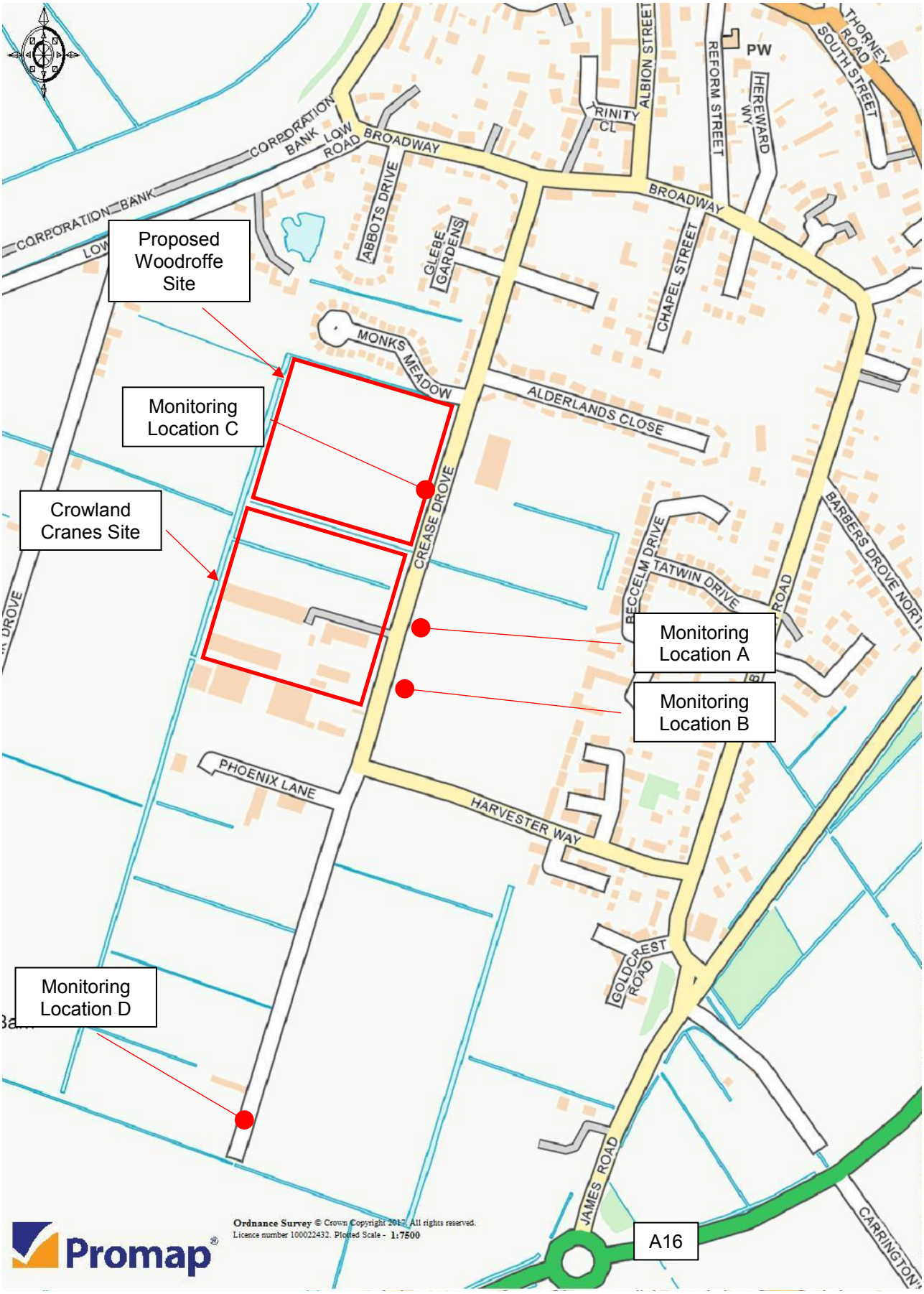


Figure 2 – Proposed Woodroffe Site Layout and Façade Treatment Required

Key:

- Living Rooms and Dining Rooms requiring Acoustic Trickle Vents (see Section 3.2 for minimum acoustic specification)
- Bedrooms requiring Through Wall Vents (see Section 3.2 for minimum acoustic specification)
- Proposed Location of 1.8m high closed boarded fencing (see Section 3.2 and Figure 5 for minimum specification)

Figure 3 – Daytime noise contours at 1.5m above ground level

Acoustic Associates PETERBOROUGH

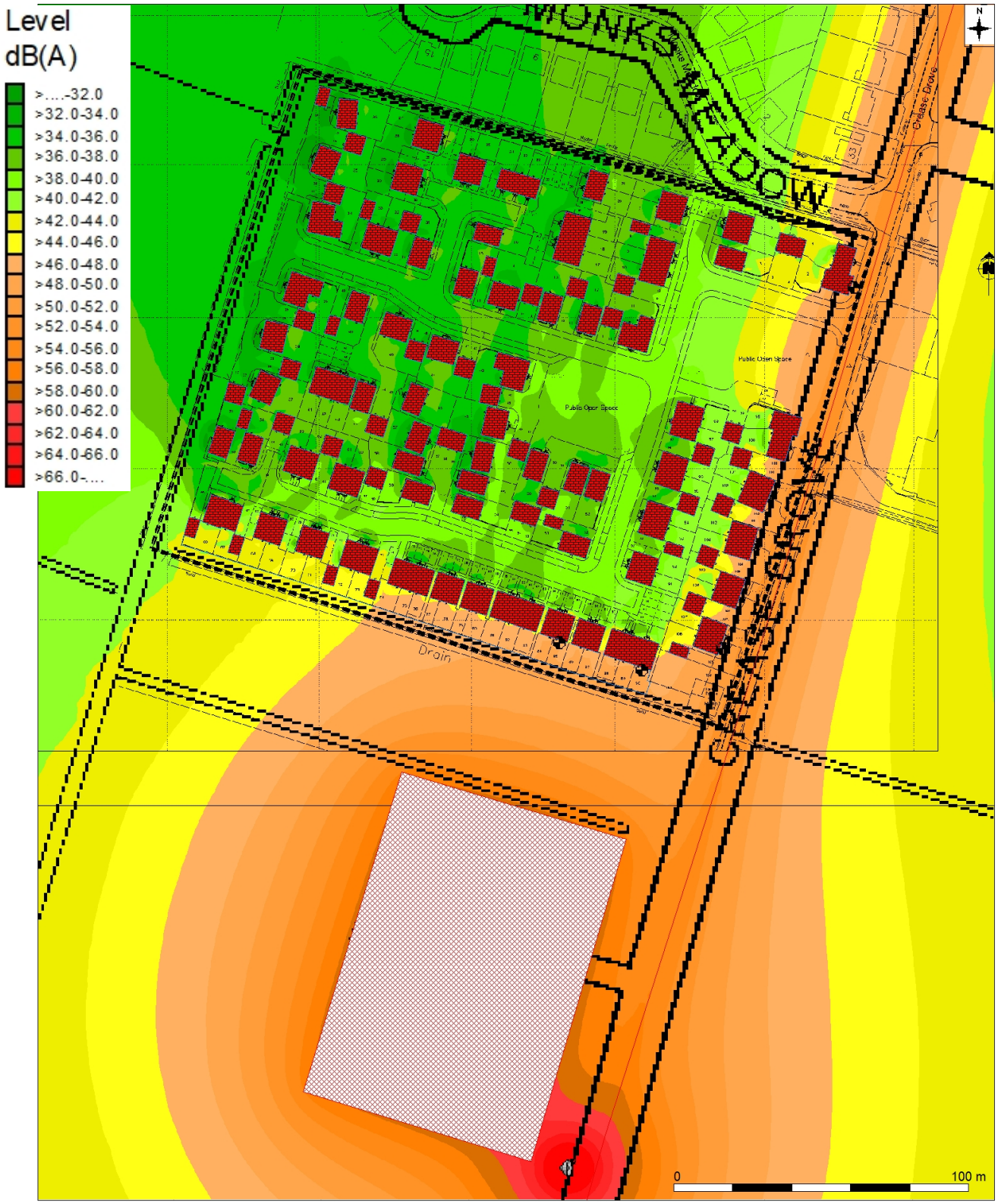
Client: Ashwood Homes

Handled by: Stephen Marshall MIOA, MIDiagE

Project: Proposed Residential Development, Crease Drove, Crowland (Woodroffe Site)

Noise contours for illustrative purposes only

Figure 4 – Night-time noise contours at 4.5m above ground level



Acoustic Associates PETERBOROUGH

Client: Ashwood Homes

Handled by: Stephen Marshall MIOA, MIDiagE

Project: Proposed Residential Development, Crease Drove, Crowland (Woodroffe Site)

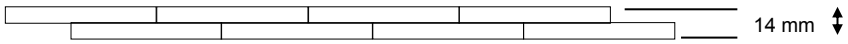
Noise contours for illustrative purposes only

Figure 5 – Acoustic Barrier Guidance

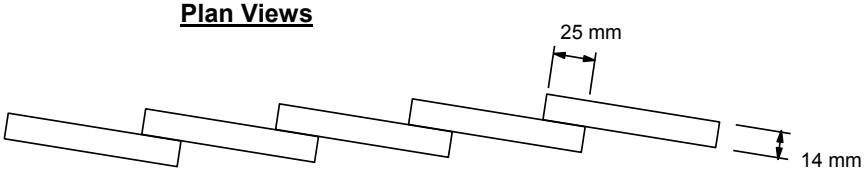
Any material can be used to construct the acoustic barriers, with a minimum surface density of 10 kg/m². This will give noise attenuation up to 20 dB.

It is advised that the minimum thickness of a wooden fence is at least 14mm and is overlapped as shown below.

Suitable Wooden Fence Configurations:



Plan Views



Note: All gaps should be sealed, including the area between the ground and bottom of the fence.