



Acoustic Associates

P E T E R B O R O U G H

**Environmental Noise Assessment for
Proposed Residential Development Site at
Kirk Gate / Cross Street, Whaplode, Spalding**

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SUMMARY

An environmental noise assessment has been carried out in support of the planning application for the proposed residential development on land adjacent to Kirk Gate and Cross Street, Whaplode, Spalding, Lincolnshire, on behalf of D. Brown Building Contractors Ltd.

The assessment has taken account of industrial noise emissions from Lincolnshire Field Products (LFP) Ltd, industrial noise emissions from Tointons Motors, and noise emissions from road traffic on High Road (A151), Kirk Gate and Church Gate. The assessment was carried out in accordance with the National Planning Policy Framework (NPPF), British Standard 4142 and other relevant noise standards and guidance.

The assessment shows that provided recommended noise mitigation measures are implemented, the noise impact on the proposed residential dwellings is likely to be an Observed Adverse Effect when assessed in accordance with National Policy Planning Guidance (NPPG).

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1 OBJECTIVES

- 1.1 To carry out an environmental *noise assessment in support of the planning application for the proposed residential development on land adjacent to Kirk Gate and Cross Street, Whaplode, Spalding, Lincolnshire, in accordance with the National Policy Planning Framework (NPPF - Reference 4), the Noise Policy Statement for England (NPSE - Reference 6), British Standard 4142 (Reference 1) and World Health Organisation (WHO) Guidance (Reference 8).
- 1.2 Document the results and findings from the assessment in a technical report, including recommendations for suitable noise mitigation measures where necessary.

2 CONCLUSIONS

- 2.1 Overall using terminology from the National Policy Planning Guidance (NPPG – Reference 5), the assessment carried out has shown that the noise impact on the proposed dwellings is likely to be an “*Observed Adverse Effect*”, provided recommendations in this report are implemented.
- 2.2 Acceptable daytime noise levels below the threshold for “*moderate annoyance*” given in World Health Organisation (WHO) guidance values can be achieved within living rooms to all proposed dwellings provided recommendations in this report are implemented.
- 2.3 Acceptable night-time noise levels below the threshold for “*sleep disturbance*” given in WHO guidance can be achieved within bedrooms to all proposed dwellings provided recommendations in this report are implemented.
- 2.4 Acceptable daytime noise levels below the threshold for “*serious annoyance*” given in WHO guidance can be achieved within outdoor amenity areas to Plots 5-8, and below the threshold for “*moderate annoyance*” to Plots 1-4, when considering noise emissions from Lincolnshire Field Products (LFP) Ltd, Tointons Motors and road traffic.
- 2.5 The assessment in accordance with BS 4142 when assessed outside bedrooms of the worst affected dwellings (Plots 6-8) during the night-time period, ranges between -1 to +18 dB. This is indicative of the specific sound source (operation and movement of agricultural vehicles on the LFP site) being between a low impact and a significant adverse impact. Mitigation measures are therefore proposed.
- 2.6 The assessment in accordance with BS 4142 when assessed within outdoor amenity areas and outside living rooms of the worst affected dwellings (Plots 6-8) during the daytime period, ranges between +5 to +13 dB. This is indicative of the specific sound sources (operation and movement of agricultural vehicles on the LFP site, and maintenance activities associated with Tointons Motors) being between an adverse impact and a significant adverse impact. Mitigation measures are therefore proposed.

*** 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 fronting Kirk Gate / Cross Street, Whaplode, Spalding.
- 3.2 It is assumed that 1.8m high close boarded fences will be constructed to the side and rear boundaries to dwellings where shown in the Site Plan Proposals (Amended Scheme) drawing supplied. (Reference 12).
- 3.3 It is also assumed that 2m high acoustic fencing will be used to begin the northern boundary line separating the northern side of Plot 7 from existing industrial premises as illustrated in Figure 2.
- 3.4 3.5m⁽¹⁾ high acoustic fencing should be used to continue the northern boundary fence line adjacent to the position of Tointons Motors building (as shown in Figure 2).
- 3.5 It should be assumed that bedroom and living room windows are to be kept closed to prevent excessive impulsive noise emissions from the LFP site (daytime and night-time) and from Tointons Motors (daytime only).
- 3.6 Bedrooms and living rooms marked with a red dotted line in Figure 2, Must have a glazing specification R_w of 39 dB or higher.
- 3.7 Bedrooms and living rooms marked with a blue dotted line in Figure 2, Must have a glazing specification R_w of 30 dB or higher.
- 3.8 Any ventilation installed in the west façade facing bedrooms to Plots 7 & 8 (indicated with a yellow triangle in Figure 2) must have a ventilation specification $D_{n,e,w}$ of 43 dB or higher. For all other bedrooms and living rooms standard trickle vents with a ventilation specification $D_{n,e,w}$ of 31 dB or higher will suffice.
- 3.9 Any ventilation installed should comply with Noise Insulation Regulations 1975 (Reference 10) and the Approved Document F (Reference 11). Alternatively, a 'whole house' ventilation system could be used.

(1) In order to comply with WHO guidance values within the worst affected outdoor amenity areas a 3.5m high acoustic fence would be deemed necessary. However, predictions within this report have shown that if a 3m high acoustic fence was used noise levels within these areas would be no more than 1 dB higher.

4 BACKGROUND

D. Brown Building Contractors Ltd wish to develop 8 new residential dwellings on land adjacent to Kirk Gate and Cross Street in Whaplode, Spalding, Lincolnshire. The site is situated adjacent to existing agricultural industry to the west in the form of Lincolnshire Field Products (LFP) Ltd. To the north of the site is an existing motor vehicle service and repair centre in the form of Tointons Motors. The development site is located with High Road (A151) just north of the site, Kirk Gate to the west, Cross Street to the south and Church Gate to the east. Acoustic Associates (Peterborough) were asked to undertake an environmental noise assessment of the proposed residential development site and this report documents the results of that assessment. The location of the site is shown in Figure 1 along with photographs taken of the monitoring locations in Figure 3.

5 POLICY, GUIDANCE AND STANDARDS

5.1 National Policy Planning Framework

The National Policy Planning Framework (Reference 4) 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 tranquillity 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 6) 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 5) 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 8). 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 vehicle movements, WHO states *“For a good night 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 4142:2014

5.4.1 BS 4142 (Reference 1) 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.

5.4.2 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”*.

6 NOISE ASSESSMENT

6.1 Noise Sources

The proposed residential development site is subjected to noise from the following sources:

- Industrial noise from the LFP site, principally agricultural vehicle movements. This is of most concern during the early morning period. Other sources are audible during the daytime associated with vehicle maintenance.
- Industrial noise from Tointons Motors, associated with the maintenance and repair of cars and motorcycles during the daytime period only. (Operational hours are restricted to 8am – 6pm Monday – Saturday, and closed on Sunday).
- Traffic noise due to local traffic movements during the daytime and night-time, on Kirk Gate, High Road (A151) and Church Gate.

6.2 Noise Measurements

6.2.1 Ambient and Background Noise Measurements

Attended daytime measurements of existing ambient and background noise levels were taken on the proposed site between 10:40 – 13:20 hours on Tuesday 22nd March 2016 at Monitoring Location 4 (see Figure 1), at a distance of approximately 23m from the roadside to Kirk Gate and 14m from the northern boundary fence alongside the rear of Tointons Motors. Short term specific noise measurements were also taken during this site visit to quantify specific noise emissions associated with operational activities from the Tointons Motors site (shown in Appendix 6).

In addition to the above measurements from an environmental noise assessment previously carried out by Acoustic Associates (Reference 13), associated with a separate residential development have been used to quantify noise emissions from the LFP site. Measurements of existing ambient and background noise levels were taken between 13:10 – 15:40 hours on Thursday 15th October 2015 at Monitoring Location 1 (see Figure 1), at a distance of 17m from the site boundary north of the site, 38m from the site boundary to the east, 30m from the site boundary to the south and approximately 40m from the façade to one of LFP's agricultural buildings to the west.

Attended night-time measurements of existing ambient and background noise levels were also taken at Monitoring Location 1 between 05:16 – 07:16 hours on Friday 24th July 2015.

Short-term measurements were also taken on 15th October 2015 between 15:43 – 16:20 hours at Measurement Locations 2 & 3, associated with road traffic noise from High Road (A151) and Church Gate at a distance of approximately 1m from the roadsides and at a height of 1.5m above ground level.

Weather conditions during the 24th July 2015 were dry, overcast, approximately 13-14°C, with calm to light air wind speeds of between 0.4 – 0.9 m/s from the east. Conditions on the 15th October 2015 were dry with damp patches from light rain showers earlier, light cloud cover with few sunny spells, approximately 12°C and with an occasional gentle breeze of between 3.6 – 4.5 m/s from NNE direction. Conditions on the 22nd March 2016 were dry, cloudy with occasional sunny intervals, approximately 8 – 10°C with typical wind speeds of 1 – 1.5 m/s. Appendix 2 gives details of the noise instrumentation used.

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 7) which uses the methods given in ISO 9613 – 2 (Reference 3) to calculate noise levels given a topographical model of the site. The model was calibrated using the noise measurements taken on site of industrial noise. Although it has not been possible during this assessment to measure internal noise levels of typical maintenance activities inside Tointons Motors, Acoustic Associates (Peterborough) have

previously carried out similar assessments associated with motor vehicle service and repair centres where internal noise levels were measured, shown in Appendix 7 (see Reference 14). These measurements are considered to be representative of the likely internal noise levels associated with maintenance activities inside Tointons Motors and have been used within the noise model.

7 RESULTS

7.1 Measured Noise Levels

The results from the attended daytime ambient and background noise monitoring are documented in Appendices 3 & 5, for Measurement Locations 1 & 4 respectively. The table shows the 'energy average' ambient noise level ($L_{Aeq,T}$), the background noise level ($L_{A90,T}$) and the maximum noise level ($L_{Amax,T}$) taken during 5 minute periods. The results from the attended night-time ambient and background noise monitoring are shown in graphical form in Appendix 4. The graph illustrates the ambient, background and maximum noise levels during 1 minute periods. A breakdown of the most significant noise related events associated with the operation and movement of agricultural vehicles on the LFP site during the night-time period are documented in Appendix 8.

7.2 Background Noise Levels

Background noise levels ($L_{A90,T}$) were measured at locations deemed to be representative of the proposed residential development site, while excluding industrial emissions from the LFP and Tointon Motors sites. Statistical analysis of the background noise levels measured were estimated to be $L_{A90,T}$ 49 dB(A) during the daytime period, and $L_{A90,T}$ 43 dB(A) during the night-time period. These levels have been used for the assessment in accordance with BS 4142.

7.3 BS 4142 Assessment

The predicted specific noise levels from adjacent industrial premises (LFP and Tointons Motors) at the locations of the proposed dwellings have been assessed using the 'subjective method' for rating noise emissions. Noise associated with the operation and movement of agricultural vehicles / HGV's on the LFP site, and from motor vehicle maintenance activities at Tointons Motors are impulsive in character and clearly perceptible at the locations of the worst affected proposed dwellings. For impulsive characteristics of noise BS 4142 states:

"A correction of up to +9 dB can be applied for sound that is highly impulsive, considering both the rapidity of the change in sound level and the overall change in sound level. Subjectively, this can be converted to a penalty of 3 dB for impulsivity which is just perceptible at the noise receptor, 6 dB where it is clearly perceptible, and 9 dB where it is highly perceptible."

Taking the above into account, the assessment level is the difference between the background noise level and the rated noise level. For this BS 4142 states:

“A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.”

“A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context.”

Tables 3 & 4 document the assessment results in accordance with BS 4142 for the daytime and night-time periods respectively, and include mitigation with a 3.5m high acoustic fence (discussed in Section 8.2):

Location	Predicted Specific Noise Level $L_{Aeq,T}$ dB(A)	Predicted Specific Noise Level $L_{Aeq,T}$ dB(A) (with penalty rating of +6 dB for impulsivity)	Background ($L_{A90,T}$) Sound Level dB(A)	Rating Over Background Sound Level (dB)
Outdoor amenity areas of worst affected dwellings (Plots 6-8)	48 - 54	54 - 60	49	+5 to +11
Outside living rooms of worst affected dwellings (Plots 6-8)	50 - 56	56 - 62	49	+7 to +13

Table 3. – Daytime Assessment Results in Accordance with BS 4142

Location	Predicted Specific Noise Level $L_{Aeq,T}$ dB(A)	Predicted Specific Noise Level $L_{Aeq,T}$ dB(A) (with penalty rating of +3 dB for impulsivity)	Background ($L_{A90,T}$) Sound Level dB(A)	Rating Over Background Sound Level (dB)
Outside bedrooms of worst affected dwellings (Plots 6-8)	39 - 58	42 - 61 ⁽¹⁾	43	-1 to +18

Table 4. – Night-time Assessment Results in Accordance with BS 4142

- (1) Due to the noise emissions from LFP being from traffic related sources which are similar to the residual acoustic environment, a penalty rating for noise impulsivity being just perceptible (+3 dB) has been applied.

The daytime BS 4142 assessment (see Table 3) when assessed within outdoor amenity areas and outside living rooms shows that the rating level exceeds the background sound level between +5 dB to +13 dB. This is likely to be an indication of the specific sound source being between an adverse impact and a significant adverse impact during the daytime period. It is therefore recommended that additional noise mitigation measures (discussed in Section 8.1)

are implemented to reduce the impact of noise emissions on the proposed residential dwellings. (See Figure 4 for a map of industrial noise contours during the daytime period).

When considering the assessment during the night-time (see Table 4) outside bedrooms, the excess of the rating level over the background sound level ranges between -1 to +18 dB. This is likely to be an indication of the specific sound source being between a low impact and a significant adverse impact during the night-time period. Additional mitigation measures are therefore proposed in Section 8.1. (See Figure 5 for a map of industrial noise contours during the night-time period).

7.4 Calculated Noise Levels within Outdoor Amenity Areas of the Proposed Dwellings

Predictions have been carried out to determine noise levels within outdoor amenity areas at 3.5m from the facades of the proposed dwellings and at a height of 1.5m above ground level. The results of the computer predictions are given in Table 5.

Locations	Predicted Day-time Noise Level dB(A)	Predicted Day-time Noise Level dB(A) with Mitigation Measures Implemented
Outdoor amenity areas of worst affected dwellings (Plots 6-8)	53 – 57	52 - 55
Outdoor amenity areas of least affected dwellings (Plots 1-5)	47 – 51	47 – 51

Table 5. – Predicted Noise Levels within Amenity Areas

It is shown in Table 5 that with mitigation measures (see Section 8) implemented noise levels within outdoor amenity areas to the worst affected dwellings are predicted to be at or below the threshold for “serious annoyance” given in World Health Organisation (WHO) guidance values.

7.5 Calculated Noise Levels within Living Rooms of the Proposed Dwellings

Predictions have been carried out to determine noise levels outside living rooms at 1m from the façades of the proposed dwellings at a height of 1.5m above ground level. The results of the computer predictions are given in Table 6. Also included in the table are the predicted noise levels inside living rooms assuming a 13 dB reduction for partially open windows.

Location	Predicted Daytime Façade Noise Level dB(A)	Predicted Noise Level dB(A) within Living Rooms (Assuming Partially Open Windows)
West facing living rooms	51 - 59	38 - 46
East Facing living rooms	52 - 59	39 - 46
North facing living rooms	61	48
South facing living rooms	47 - 54	34 - 41

Table 6. – Predicted Noise Levels within Living Rooms

It is shown in Table 6 that predicted noise levels within living rooms to all dwellings exceed the value of 35 dB(A) given in WHO guidance for “moderate annoyance” inside living rooms during the daytime. Mitigation measures are therefore proposed in Section 8.

7.6 Calculated Noise Levels within Bedrooms of the Proposed Dwellings

Predictions have been carried out to determine the noise levels outside bedrooms at 1m from the façades of the proposed dwellings at a height of 1.5m above ground level for the single storey bungalows (Plots 3-6), and at a height of 4.5m above ground level for the two storey houses (Plots 1, 2, 7 & 8). The results of the computer predictions are given in Table 7. Also included in the table are the predicted noise levels inside bedrooms assuming a 13 dB reduction for partially open windows.

Location	Predicted Night-time Façade Noise Level dB(A)	Predicted Noise Level dB(A) within Bedrooms (Assuming Partially Open Windows)
West facing bedrooms	45 - 58	32 – 45
East Facing bedrooms	44 - 46	31 - 33
North facing bedrooms	42 - 44	29 - 31
South facing bedrooms	44	31

Table 7. – Predicted Noise Levels within Bedrooms

It is shown in Table 7 that predicted noise levels within bedrooms to the vast majority of dwellings exceed the value of 30 dB(A) given in WHO guidance for “sleep disturbance” inside bedrooms during the night-time. Mitigation measures are therefore proposed.

When proposing mitigation it is necessary to ensure that residents do not suffer sleep disturbance due to impulsive noise from passing vehicles (see Section 5.3.2). Given the results shown in Appendix 8, mitigation should protect against maximum noise levels of L_{Amax} 80 dB(A) outside bedroom windows.

7.7 Noise Policy Statement for England Assessment

Using the noise impact criteria from the Noise Policy Statement for England, the noise impact from the surrounding noise sources is likely to be above the “*Lowest Observed Adverse Effect Level*” but below the “*Significant Observed Adverse Effect Level*” when assessed at the worst affected dwellings with mitigation implemented.

8 **NOISE MITIGATION**

In order to reduce noise emissions to the proposed dwellings a variety of potential noise control measures have been explored. These control measures are discussed below.

8.1 **Mitigating noise emissions inside of dwellings**

Predictions within this report on noise levels inside of dwellings are based on the following assumptions:

- The external walls were assumed to be brick/block cavity walls.
- Double glazing with compression seals fitted was used as standard.
- Room volumes to plots 1 & 2 were assumed to be 28m³ in bedrooms and 38m³ in living rooms.
- The position of bedroom and living room windows to plots 1 & 2 were assumed to be either north or south facing.

The noise levels inside living rooms and bedrooms were calculated using a method approved by the Buildings Research Establishment. The calculations were carried out for partially open windows and for closed windows in cases where satisfactory levels could not be achieved with windows open. The results for representative dwellings are shown in Table 8.

Location	Room	Noise level dB(A) outside window at 1m from the façade	Specification	Internal ambient noise level dB(A)	Compliance with WHO Guidance
Plot 7	Bedroom 1 (facing west)	58.1	Double glazed window, closed, Acoustic through wall vent	25.6	Yes
	Bedroom 3 (facing east)	46.2	Double glazed window, closed, Trickle vent with indirect air path	19.8	Yes
	Lounge (facing west)	59.0	Double glazed window, closed, Trickle vent with indirect air path	29.2	Yes
	Dining room (facing east)	57.4	Double glazed window, closed, Trickle vent with indirect air path	31.5	Yes
Plot 8	Lounge (facing east)	52.3	Double glazed window, closed, Trickle vent with indirect air path	17.0	Yes
Plot 5	Bedroom 1 (facing west)	45.2	Double glazed window, closed, Trickle vent with indirect air path	18.5	Yes
	Lounge (facing east)	52.1	Double glazed window, closed, Trickle vent with indirect air path	27.5	Yes
Plot 1	Bedroom 1 (facing south)	46.3	Double glazed window, closed, Trickle vent with indirect air path	19.9	Yes

Table 8. - Ambient noise levels in representative plots including mitigation.

It can be seen in Table 8 that windows must be kept closed to achieve acceptable internal noise levels complying with the WHO guidance values. See Figure 2 for recommended glazing and ventilation specifications.

8.2 Mitigating noise emissions outside of dwellings

Predictions within this report on noise levels outside of dwellings are based on the following assumptions:

- 1.8m high close boarded fences will be constructed to the side and rear boundaries to dwellings where shown in the Site Plan Proposals (Amended Scheme) drawing supplied (Reference 12).
- 2m high acoustic fences⁽¹⁾ will be used to begin the northern boundary line separating the northern side to Plot 7 from existing industry as illustrated in Figure 2.
- 3.5m⁽²⁾ high acoustic fences⁽¹⁾ should be used to continue the northern boundary fence line adjacent to the position of Tointons Motors building (also shown in Figure 2).

(1) A specification design for the acoustic fences to be used is given in Figure 6 of this report.

(2) Predictions have shown that while a 3.5m high acoustic barrier fence would be deemed necessary to keep noise levels within the worst affected outdoor amenity areas below the threshold for "serious annoyance" when considering WHO guidance values. Consideration could be given to using a 3m high acoustic barrier fence. Predictions of this scenario have shown that although noise levels within the worst affected outdoor amenity areas would exceed the WHO guidance value, the overall increase in noise to these areas would be no more than 1 dB and considered to be insignificant.

REFERENCES

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13. *Acoustic Associates (Peterborough) – Environmental Noise Assessment for Proposed Residential Development Site at Kirk Gate, Whaplode, Spalding, Lincolnshire - Reported By: Darren Marshall – Report No: DLM/J3013/15749-1 – Date: November 2015.*
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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 (L_p)	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.
D_{n,e,w}	The weighted element normalised level difference
R_w	The weighted sound reduction index
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 Criteria

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 Rating Level L_{Ar,T_r}	The dB L_{Aeq,T_r} of the noise sources being assessed at a site. 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

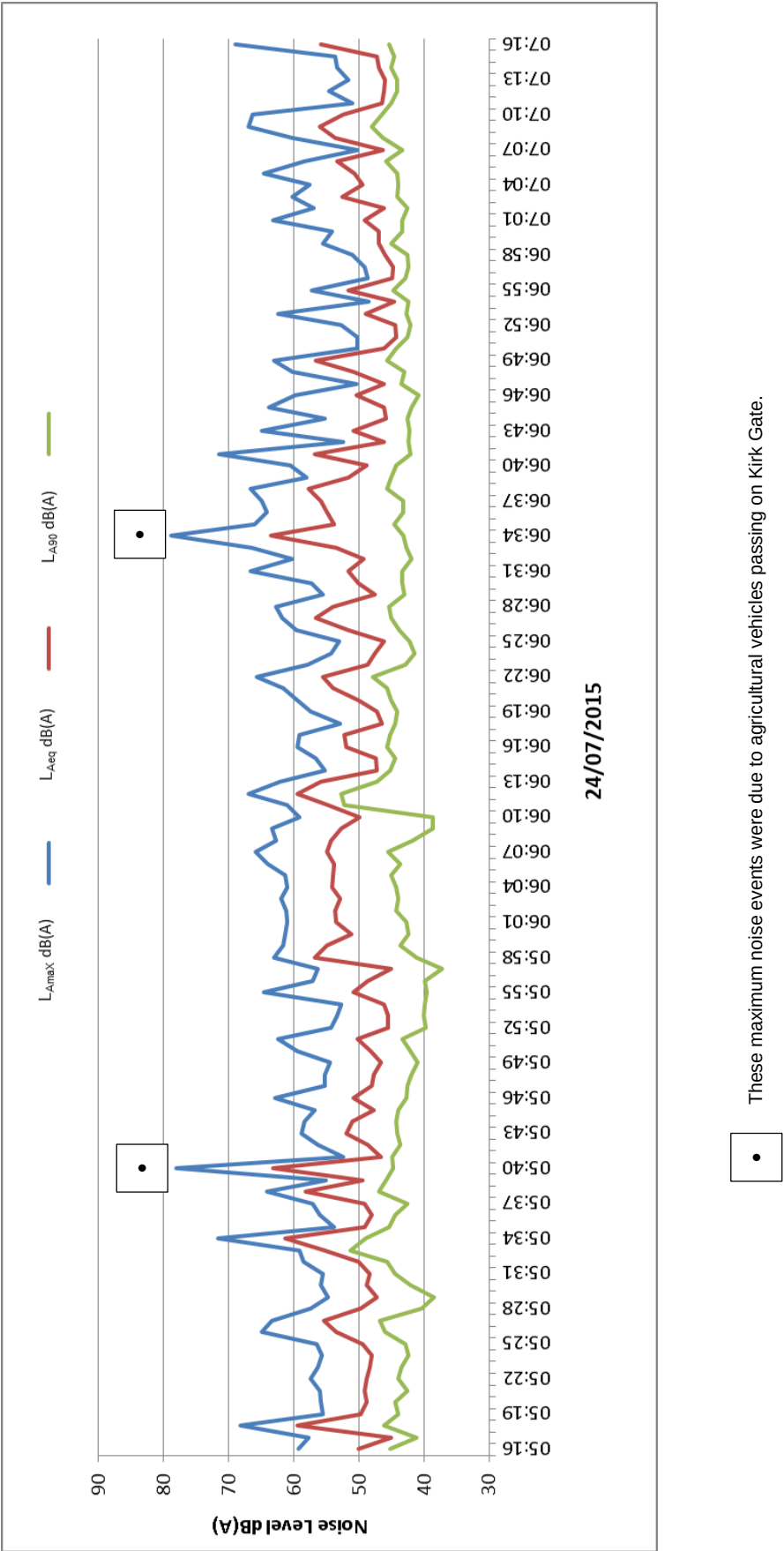
Type	Manufacturer	Description	Serial number	Last Calibration Date	Calibration Certificate No.
Svan 957	Svantek	Sound Level Meter	27517	03/02/2016	159050
GA 607	Castle	Sound Level Calibrator	039873	03/02/2016	159049
Svan 957	Svantek	Sound Level Meter	27591	10/06/2014	148881
GA 607	Castle	Sound Level Calibrator	043194	10/06/2014	148879

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

Appendix 3 – Daytime noise measurement results at Monitoring Location 1

Date	Time (Hours)	Ambient Noise Level ($L_{Aeq,5min}$) dB(A)	Background Noise Level ($L_{A90,5min}$) dB(A)	Maximum Noise Level ($L_{Amax,5min}$) dB(A)	Comments
15/10/2015	13:10 – 13:15	53.8	47.9	67.3	Frequent agricultural traffic movement from incoming/outgoing tractor type vehicles towing trailers and occasional HGV's entering/exiting the Lincolnshire Field Products (LFP) site to the west. Frequent distant road traffic from High Road (A151) to the north. Occasional passing road traffic on Church Gate and Kirk Gate to the east and west of the development site. Distant military aircraft briefly audible at 13:17 & 13:23 hours. Occasional faint rustling of trees/leaves during quietest periods with no traffic. Intermittent banging/drilling (quite loud on several occasions) from adjacent LFP site building possibly from tractor maintenance taking place within building. Occasional movement of sliding shutter doors to LFP building audible at 13:54 hours. Two tractors park with engines idling approximately 45m away between 13:34-13:38 hours. Distant raised voices from LFP site at 13:50 hours.
	13:15 – 13:20	59.1	47.1	77.3	
	13:20 – 13:25	57.1	50.2	67.6	
	13:25 – 13:30	58.6	49.3	74.1	
	13:30 – 13:35	53.7	49.2	70.0	
	13:35 – 13:40	56.4	48.4	66.8	
	13:40 – 13:45	55.7	46.3	72.4	
	13:45 – 13:50	54.8	48.8	72.7	
	13:50 – 13:55	56.4	48.8	72.3	
	13:55 – 14:00	57.0	49.4	67.7	
	14:00 – 14:05	50.7	47.5	60.5	Low flying military aircraft passes overhead at 14:07 hours.
	14:05 – 14:10	68.9	47.3	90.4	
	14:10 – 14:15	52.2	49.1	63.2	Frequent agricultural traffic movement from incoming/outgoing tractor vehicles and occasional HGV's entering/exiting the LFP site. Frequent distant road traffic from High Road (A151). Occasional passing road traffic on Church Gate and Kirk Gate. Intermittent banging/drilling from within LFP building audible at times. Occasional movement of sliding shutter doors to LFP building audible at 14:11 & 14:41 hours. Distant light aircraft briefly audible at 14:49 hours.
	14:15 – 14:20	58.5	50.2	74.4	
	14:20 – 14:25	56.4	49.7	67.7	
	14:25 – 14:30	56.7	48.1	67.0	
	14:30 – 14:35	54.7	48.9	68.0	
	14:35 – 14:40	53.4	49.2	64.7	
	14:40 – 14:45	54.0	49.4	66.7	
	14:45 – 14:50	55.2	48.0	64.9	
	14:50 – 14:55	59.2	48.5	69.7	Monitoring temporarily aborted due to brief light rain shower.
	14:55 – 15:00	-	-	-	
	15:00 – 15:05	55.3	48.9	71.2	Frequent agricultural traffic movement from incoming/outgoing tractors and occasional HGV's entering/exiting the LFP site. Frequent distant road traffic from High Road (A151). Occasional passing road traffic on Church Gate and Kirk Gate. Intermittent banging/drilling from within LFP building audible at times. Distant light aircraft audible at 15:00 hours. Sliding of shutter doors to LFP building audible at 15:08 hours. Tractor parks approximately 50m away with engine idling between 15:12 – 15:15 hours.
	15:05 – 15:10	54.4	47.1	69.9	
	15:10 – 15:15	58.1	50.8	79.8	
	15:15 – 15:20	59.4	49.1	73.1	
	15:20 – 15:25	58.9	48.4	72.1	
	15:25 – 15:30	51.6	48.2	67.6	
	15:30 – 15:35	55.1	49.2	65.2	
	15:35 – 15:40	48.6	44.0	58.4	

Appendix 4 – Night-time noise measurement results at Monitoring Location 1



Appendix 5 – Daytime noise measurement results at Monitoring Location 4

Date	Time (Hours)	Ambient Noise Level (L _{Aeq,5min}) dB(A)	Background Noise Level (L _{A90,5min}) dB(A)	Maximum Noise Level (L _{Amax,5min}) dB(A)	Comments
22 nd March 2016	10:40 – 10:45	50.4	43.2	58.2	Frequent road traffic passing on High Road (A151) audible throughout monitoring, occasional road traffic passing on Kirk Gate. Intermittent banging audible from Lincolnshire Field Products (LFP) site on few occasions. Distant military aircraft briefly audible at 10:58 hours. Tractor exits LFP site and heads south passing along Kirk Gate at 10:59 hours.
	10:45 – 10:50	50.6	44.4	67.2	
	10:50 – 10:55	52.2	44.6	66.4	
	10:55 – 11:00	51.4	43.5	64.5	
	11:00 – 11:05	54.4	44.8	66.8	Distant church bell chimes audible at 11:00 hours. Tractor passes on LFP site and exits onto High Road at 11:01 hours. Intermittent distant military aircraft audible on few occasions. Tractor exits LFP site and passes along Kirk Gate at 11:03 hours. One Tractor enters LFP site at 11:05 & 11:09 hours, another tractor exits site at 11:07 hours. HGV enters LFP site at 11:12 hours. Distant light aircraft audible at 11:16 hours. Few light taps/bangs audible from within Tointon Motors building at 11:19 hours.
	11:05 – 11:10	54.6	47.2	68.9	
	11:10 – 11:15	51.8	44.1	61.9	
	11:15 – 11:20	51.5	45.0	59.6	
	11:20 – 11:25	53.2	46.7	62.7	Distant light aircraft audible at 11:20 hours. LGV passes on Kirk Gate at 11:21 hours. HGV (without trailer) enters LFP site at 11:25 hours.
	11:25 – 11:30	57.7	46.7	72.1	Two tractors and two vans pass on Kirk Gate and enter LFP site at 11:28 hours. Faint whirring audible briefly from Tointons Motors at 11:30 hours and brief air hose audible at 11:32 hours. Two vans exit LFP site at 11:31 hours. HGV enters LFP site at 11:32 hours. Two tractors exit LFP site and pass along Kirk Gate at 11:33 hours. Distant vehicle movement on LFP site at 11:37 hours. Distant grinding noise audible on LFP site intermittently between 11:39-11:42 hours and again between 11:45-11:48 hours.
	11:30 – 11:35	56.6	46.2	71.7	
	11:35 – 11:40	50.4	44.9	60.1	
	11:40 – 11:45	50.9	44.5	60.0	
	11:45 – 11:50	50.3	44.5	59.1	
	11:50 – 11:55	53.1	45.2	66.9	
	11:55 – 12:00	54.2	44.4	65.6	
	12:00 – 12:05	52.1	44.4	64.0	
	12:05 – 12:10	55.3	48.3	65.2	One crop sprayer vehicle enters LFP at 12:07 hours and parks idling adjacent to entrance until 12:10 hours. One tractor exits LFP at 12:09 hours. One tractor exits LFP at 12:15 hours, another enters at 12:17 hours.
	12:10 – 12:15	52.8	46.2	63.8	
	12:15 – 12:20	61.1	45.0	78.8	

This table is continued overleaf

Appendix 5 – Daytime noise measurement results at Monitoring Location 4 (Continued)

Date	Time (Hours)	Ambient Noise Level ($L_{Aeq,5min}$) dB(A)	Background Noise Level ($L_{A90,5min}$) dB(A)	Maximum Noise Level ($L_{Amax,5min}$) dB(A)	Comments
22 nd March 2016	12:20 – 12:25	57.8	46.5	74.5	Extraction fan noise coming from exhaust pipe/vent to rear of Tointons Motors building at 12:20 hours. Intermittent motorcycle revving audible through exhaust/vent to Tointons Motors between 12:20-12:22 hours. Motorcycle idling ticking over audible between 12:22-12:37 hours. One HGV exits LFP at 12:23 hours. Two tractors exits LFP at 12:28 hours. Light aircraft audible briefly at 12:30 hours. One tractor exits LFP at 12:35 hours. Brief intermittent hammering/banging audible from within rear of Tointons Motors building at 12:39 hours.
	12:25 – 12:30	58.0	44.3	73.9	
	12:30 – 12:35	52.1	44.5	63.4	
	12:35 – 12:40	53.7	45.4	74.5	
	12:40 – 12:45	49.2	43.1	59.6	Light aircraft briefly audible at 12:45 hours and passes flying low overhead at 12:47 & 12:48 hours. One tractor passes on Kirk Gate at 12:50 hours.
	12:45 – 12:50	58.6	46.8	76.5	
	12:50 – 12:55	54.3	46.3	66.3	One tractor passes on Kirk Gate at 12:52 hours. One tractor exits LFP at 12:53 hours, another enters at 13:04 hours. Extraction fan noise from Tointons Motors exhaust/vent ceases at 13:04 hours.
	12:55 – 13:00	51.4	44.0	62.4	
	13:00 – 13:05	52.7	45.3	66.1	
	13:05 – 13:10	52.8	45.1	66.6	Brief intermittent hammering/banging, grinding and nut runner in use audible on a couple of occasions from within Tointons Motors between 13:05-13:06 hours.
	13:10 – 13:15	54.1	47.5	64.7	Distant ride-on lawn mower passes along Kirk Gate at 13:11 hours. Brief intermittent hammering/banging, grinding and nut runner in use audible on a couple of occasions from within Tointons Motors at 13:15 hours. One tractor exits LFP at 13:18 hours. Ride-on lawn mower in use in the distance and audible between 13:15-13:20 hours.
	13:15 – 13:20	54.3	49.4	66.2	

Appendix 6 – Daytime specific noise measurements of activities at Tointons Motors**(Taken on 22nd March 2016)**

Measurement	Time	Measured Octave Band Data (Hz)								L _{Aeq,T} dB(A)	L _{A90,T} dB(A)	L _{Amax,T} dB(A)	Comments
		63	125	250	500	1000	2000	4000	8000				
Motorcycle revving audible through exhaust/vent taken at 8m away	12:20 (8 secs)	32.0	51.9	68.8	72.4	73.4	66.1	51.2	39.9	77.0	60.5	87.1	Minimal contribution from other sources.
Motorcycle idling audible through exhaust/vent taken at 8m away	12:25 (6 secs)	30.2	32.2	36.5	34.9	40.3	38.7	34.9	26.9	44.9	44.1	49.2	
Extraction fan noise audible through exhaust/vent taken at 8m away	12:35 (6 secs)	26.3	27.5	33	35.4	39.2	38.1	34.3	27.2	43.8	42.8	45.0	
Intermittent hammering audible from within Tointons Motors taken at 8m away	13:06 (3 secs)	34	42.4	49.3	54.8	55.7	56.8	52.6	38.3	61.5	43.0	72.4	Includes some contribution from road traffic.

Appendix 7 – Representative internal noise levels taken within an Auto Service Centre

A summary of the internal noise levels taken during 5 minute intervals over a 1 hour and 15 minute period within an auto service & repair centre (see Reference 14) similar to Tointons Motors is given below.

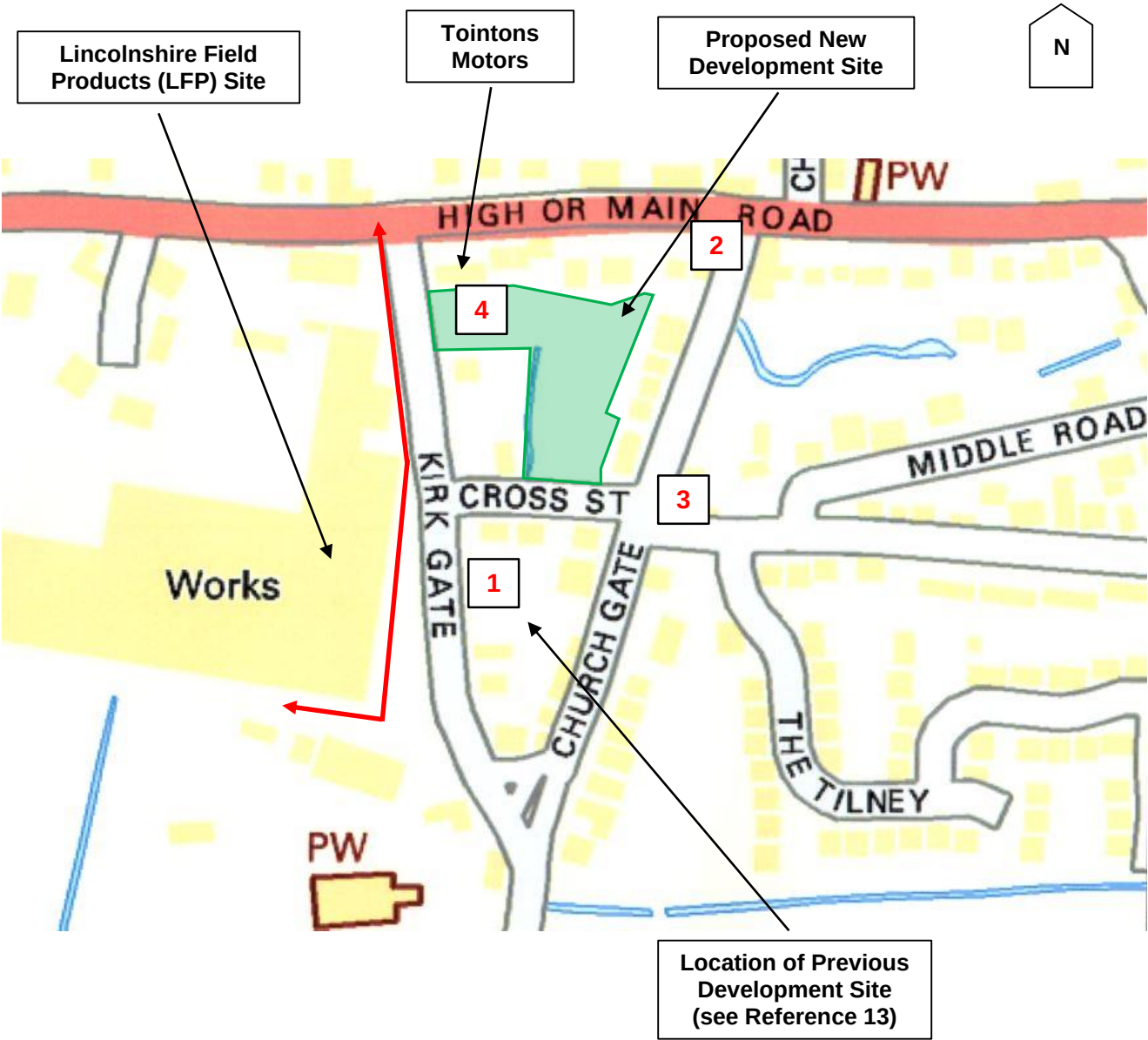
Measurement	Measured Octave Band Data (Hz)								L _{Aeq,T} dB(A)	Comments
	63	125	250	500	1000	2000	4000	8000		
Reverberant noise level taken inside the auto service centre	48.3	51.5	59.2	64.0	67.4	70.1	70.5	69.6	76.1	Activities include fitting tyres, exhausts, batteries, occasional compressor use, occasional driving of vehicles in/out of the service bays.

Appendix 8 – Breakdown of key night-time noise related events at Monitoring Location 1

Given below is a breakdown of the key night-time noise related events associated with the movement of incoming/outgoing agricultural vehicles operating on the Lincolnshire Field Products (LFP) site, from observations made during attended night-time noise monitoring at Monitoring Location 1.

Date	Time (Hours)	Agricultural vehicle passing on LFP site ramp access	Ambient Noise Level (L _{Aeq,1min}) dB(A)	Background Noise Level (L _{A90,1min}) dB(A)	Maximum Noise Level (L _{Amax,1min}) dB(A)	Comments
24/07/2015	05:15	Masey Ferguson 5455 Tractor	50.0	45.2	59.3	-
	05:18	Fendt 716 Tractor	59.5	46.1	68.2	-
	05:25	Agrifac Crop Sprayer	49.4	42.9	56.5	-
	05:26	JCB 3200 Tractor	53.5	46.0	65.0	Towing tanker
	05:32	John Deere 6320 651 Tractor	50.1	45.7	58.6	Towing loaded trailer
	05:33	Masey Ferguson 5460 Tractor	55.2	51.4	59.2	-
	05:34	White Transit Van	61.3	49.0	71.7	-
	05:38	Masey Ferguson 5455 Tractor	58.2	47.0	64.2	-
	05:40	John Deere Tractor	63.2	44.7	78.1	Non-site driving along Kirk Gate road towing large trailer
	05:42	Red Transit Van & White Car	48.6	43.7	56.3	-
	05:43	New Holland J6030 Tractor	52.0	44.1	58.8	-
	05:58	Fendt 724 Tractor & two Agrifac Crop Sprayers	48.6	43.7	56.3	Tractor towing tanker
	06:11	Fendt 724 Tractor	54.7	52.3	61.1	-
	06:12	Challenger MT765E Tractor & New Holland T6080 Tractor	59.5	52.7	66.9	-
	06:16	Fendt 716 Tractor	52.0	45.7	59.4	Tractor positioned with engine idling to south-east corner of site
	06:21	Fendt 724 Tractor & New Holland T6080 Tractor	54.0	45.7	61.6	-
	06:26	Passing car	51.7	43.8	59.6	-
	06:28	Fendt 716 Tractor	54.0	45.4	62.7	-
	06:34	John Deere 6215R Tractor	63.5	43.2	78.9	Non-site driving along Kirk Gate road towing large trailer
	06:38	John Deere 6320 653 Tractor & Fendt 716 Tractor	57.8	45.7	66.6	-
	06:55	Fendt 716 Tractor	51.7	44.8	57.3	-
	07:06	JCB Fast Trac 3200 Tractor	53.3	45.8	58.3	-
	07:08	Challenger MT765D Tractor	53.7	46.4	60.3	-

Figure 1 – Site location plan



Key:-



= Proposed new development site



= Route taken by incoming/outgoing agricultural vehicles & HGV's on LFP Site



= Monitoring Locations 1 - 4

Figure 2 – Proposed site layout showing glazing and ventilation specifications

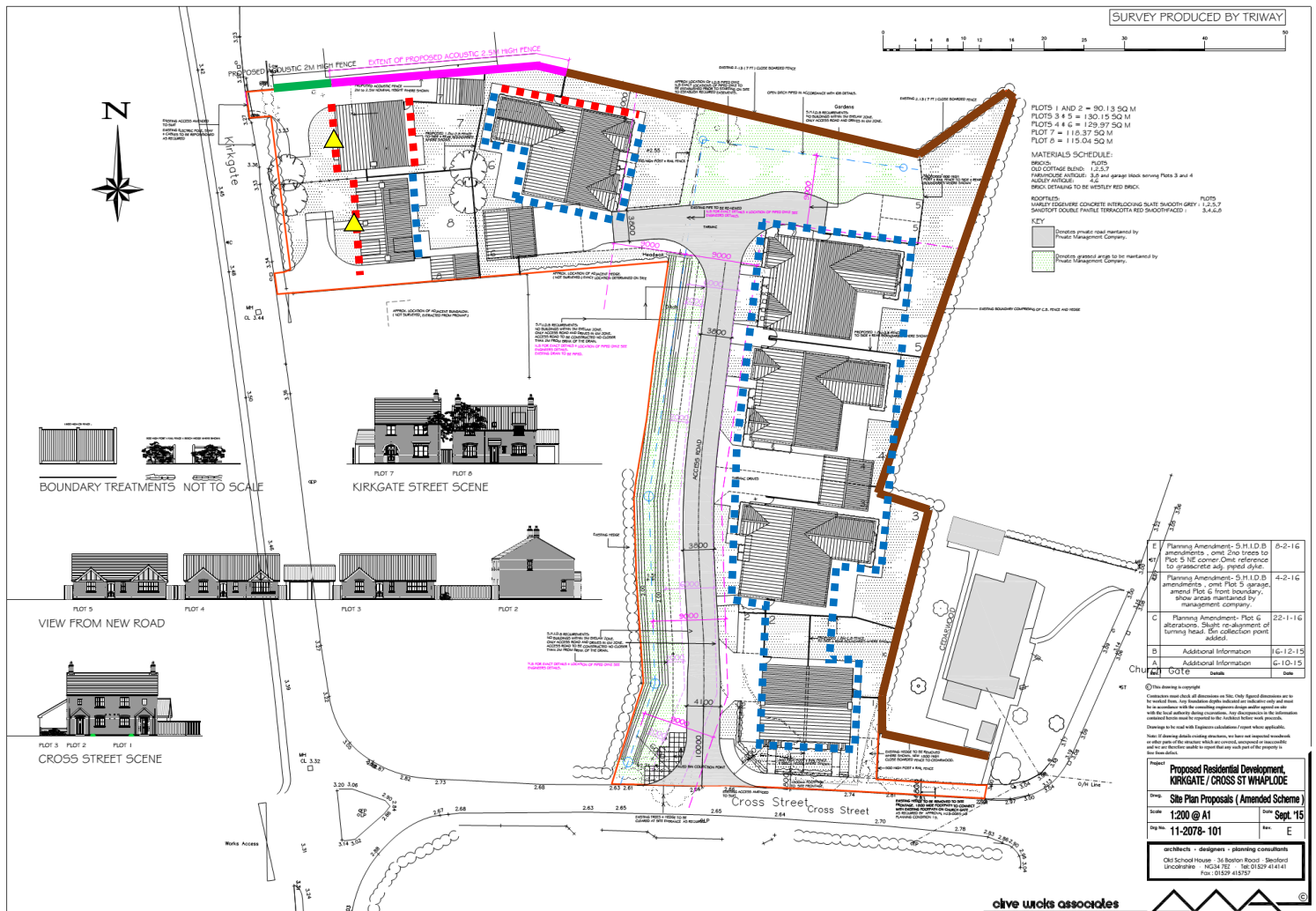


Figure 3 - Photographs of Monitoring Locations 1 - 4

Monitoring Location 1 (on previous development site)



Monitoring Location 2 (adjacent to High Road)



Figure 3 – Photographs of Monitoring Locations 1 – 4 (Continued)

Monitoring Location 3 (adjacent to Church Gate)



Monitoring Location 4 (on proposed development site)



Figure 4 – Daytime Noise Contours (from industrial sources only)

Includes mitigation with a 3.5m high acoustic fence



Figure 5 – Night-time Noise Contours (from industrial sources only)

Includes mitigation with a 3.5m high acoustic fence



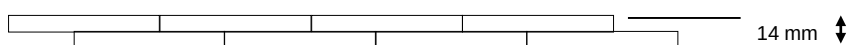
Figure 6 – Specification for a close-boarded acoustic barrier fence

Any acoustic barrier should comprise of an impervious material, e.g. close-boarded timber and have a mass per unit area of at least 10 kg/m².

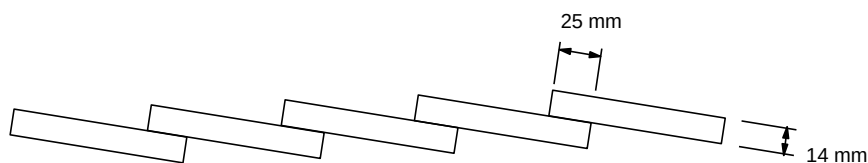
Any material can be used to construct the acoustic barrier, with a minimum surface density of 10 kg/m². This will give noise attenuation up to 20 dB.

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 barrier.