

11.0 NOISE AND VIBRATION

11.1 Introduction

11.1.1 This chapter of the ES assesses the impact of the proposed development with regard to noise. It describes the methods used to assess the impacts, the baseline conditions currently existing at the site and the potentially affected noise sensitive receptors. The potential direct and indirect impacts arising from the proposed development and an example of mitigation measures required are also covered.

11.1.2 The assessment includes the consideration of:

- information on typical existing site noise climate;
- information on the noise impact on existing residential dwellings from site noise sources;
- information and predictions on noise from construction works;
- an example of noise mitigation measures to comply with current noise standards and guidance.

11.1.3 The above potential noise impacts are considered in the context of the existing background noise at the site, which is influenced by road traffic movements and intermittent rail traffic and farming activities.

11.1.4 Appendix 11.1 provides details of technical terms within this section, for ease of reference. There is also a chart showing typical everyday noise levels to assist in understanding the subjective level of noise in terms of decibels.

11.1.5 The areas of new plant relevant to the planning application relates to the following equipment (as shown on Figure 4.1):

Renewable Energy Plant

- (i) Turbine and Boiler Hall;
- (ii) Flue Gas Treatment & 62 metre Chimney Stack;
- (iii) Air Cooled Condenser;
- (iv) Wood Storage Building;

- (v) Straw Barn 1 & 2;
- (vi) Grab Cranes 1 & 2 (inside building);
- (vii) Conveyors (enclosed);
- (viii) Transformer;
- (ix) Pump House;
- (x) Radiator Coolers;
- (xi) Silos & Bottom Ash Storage & Disposal;
- (xii) HGV's;

11.1.6 It is intended that the Renewable Energy Plant (REP) facilities applicable to this assessment would operate 24 hours per day and 7 days per week. The hours proposed for delivery of fuel for the REP site would relate to daytime periods from 0700 hours up to 1900 hours on weekdays, with a half day of deliveries on Saturdays. The doors into the straw barn buildings would be kept closed except to allow delivery vehicles in and out.

11.1.7 The aim of the survey and assessment was to:

- (i) Identify plant equipment and its location;
- (ii) Identify the nearest noise sensitive receptors or sites;
- (iii) Determine likely source noise levels;
- (iv) Provide information on existing background and specific site noise levels at the nearest sensitive receptors;
- (v) Provide predictions of resultant noise levels at the nearest sensitive receptors;
- (vi) Provide an example of amelioration measures to reduce noise for the proposed development by applying Best Available Techniques ("BAT");

11.1.8 To establish the existence and locality of any significant site noise, the consultancy team methodology and approach includes the following:

- (i) Establish nearest noise sensitive sites;
- (ii) Evaluation of typical background and ambient noise levels;
- (iii) Evaluation of noise sources from an existing REP site in terms of typical LAeq levels and frequency analysis;
- (iv) Assessment of specific noise sources in relation to appropriate guidance and standards (e.g. BS4142 and WHO guidelines);

- (v) Where new noise sources have been identified as being significant or have the potential of causing a significant increase in existing noise levels, the consultancy team would provide an example of noise amelioration measures using BAT.

11.2 Planning Policy

- 11.2.1 Within the introduction of Planning Policy Guidance (“PPG”) 24, ‘Planning and Noise’ 1994, it states:

‘The aim of this guidance is to provide advice on how the planning system can be used to minimise the adverse impact of noise without placing unreasonable restrictions on development or adding unduly to the costs and administrative burdens of business.’

- 11.2.2 The guidance introduces the concept of Noise Exposure Categories (NEC), which has been derived to assist local planning authorities in their consideration of planning applications for residential development near transport related noise sources. The NEC procedure is only applicable for the introduction of a new residential development into an area with an existing noise source. Within Annex B, guidance is given for various types of noise sources, which include, for example, commercial developments, road traffic, construction sites, aircraft and railways.
- 11.2.3 For reference, the recommended noise exposure categories for new dwellings near existing sources are shown below in Table 11.1. Note that these noise categories are based on measurements taken in an open site (i.e. without any proposed noise attenuating features in place).

Table 11.1: Noise Exposure Categories (NECs) according to PPG24: 1994

Noise Levels Corresponding to the Noise Exposure Categories for New Dwellings L_{AeqT} dB				
Noise Source	Noise Exposure Category - $L_{Aeq, T}$ dB			
	A	B	C	D
Road Traffic (07:00-23:00)	< 55	55 – 63	63 – 72	72
(23:00-07:00)	< 45	45 – 57	57 – 66	> 66
Rail Traffic (07:00-23:00)	< 55	55 – 66	66 – 74	74
(23:00-07:00)	< 45	45 – 59	59 – 66	> 66
Air Traffic (07:00-23:00)	< 57	57 – 66	66 – 72	72
(23:00-07:00)	<48	48 – 57	57 – 66	> 66
Mixed Sources (07:00-23:00)	< 55	55 – 63	63 – 72	72
(23:00-07:00)	< 45	45 – 57	57 – 66	> 66

11.2.4 The level at the boundary of NEC A and NEC B is based on guidance provided by the World Health Organisation health criteria from 1980 that *‘general daytime outdoor noise levels of less than 55dB(A) LAeq are desirable to prevent any significant community annoyance’*.

11.2.5 The night-time noise level at the boundary of NEC A and NEC B is also based on the World Health Organisation health criteria, which states that *‘based on limited data available, a level of less than 35dB(A) [within the bedroom] is recommended to preserve the restorative process of sleep’*.

11.2.6 The following table gives an interpretation of the NEC categories in terms of granting planning permission.

Table 11.2: NEC Category description in terms of planning issues

NEC Category	Description
A	Noise need not be considered as a determining factor in granting planning permission, although the noise level at the high end of the category should not be regarded as desirable.
B	Noise should be taken into account when determining planning applications and, where appropriate, conditions imposed to ensure an adequate level of protection.
C	Planning permission should not normally be granted. Where it is considered that permission should be given, for example, because there are no alternative quieter sites available, conditions should be imposed to ensure a commensurate level of protection against noise.
D	Planning permission should normally be refused.

11.2.7 For noisy industrial development the guidance refers to BS4142 Method for rating industrial noise affecting mixed residential and industrial areas. It gives the comment that *“The likelihood of complaints about noise from industrial development can be assessed, where the Standard is appropriate, using guidance in BS4142: 1990.”* Further comment is made in respect of noise levels within buildings in that *“In addition, general guidance on acceptable noise levels within buildings can be found in BS8233: 1987.”*

Other Guidance

BS4142: 1997 'Method for rating industrial noise affecting mixed residential and industrial areas'

11.2.8 BS4142: 1997 'Method for rating industrial noise affecting mixed residential and industrial areas' is based on the measurement of background noise using LA90 noise measurements compared to source noise levels measured in LAeq measurements. The differential between the two measurements (once any corrections have been applied for source noise tonality, distinct impulses etc.) determines the likelihood of complaints. If a differential of +5dB(A) is resultant, then the standard says that the noise is of marginal significance; if the differential is +10dB(A) then complaints are likely. Any assessment of source noise has to be considered in context with the existing ambient noise level in terms of LAeq and therefore must be corrected for its influence before

applying any further tonal corrections and comparing with background noise data.

BS 8233:1999

11.2.9 The British Standard BS8233: 1999, 'Sound insulation and noise reduction for buildings – Code of Practice' provides additional guidance on noise levels within buildings. These are based on the WHO recommendations and the criteria given in the standard for unoccupied spaces within residential properties include the following:

Table 11.3: BS8233: 1999 Internal noise level guidance for dwellings

Criterion	Typical Situation	Design Range, LAeq, dB	
		Good	Reasonable
Reasonable conditions for work	Executive office	35	40
Reasonable conditions for sleeping and resting	Living Rooms	30	40
Reasonable conditions for sleeping and Resting	Bedrooms	30	35

For a reasonable standard in bedrooms at night, individual noise events (measured with the F time-weighting) should not normally exceed 45dB LAmax

World Health Organisation (WHO) Guidelines for Community Noise: April 1999

11.2.10 This document provides further updated information on noise and its affects on the community. Within the document for noise 'In Dwellings' it states that "The effects of noise in dwellings, typically, are sleep disturbance, annoyance and speech interference. For bedrooms the critical effect is sleep disturbance. Indoor guideline values for bedrooms are 30dB LAeq for continuous noise and 45dB LAmax for single sound events. Lower noise levels may be disturbing depending upon the nature of the noise source. At night-time, outside sound levels about 1 metre from facades of living spaces should not exceed 45dB LAeq, so that people may sleep with bedroom windows open. This value was obtained by assuming that the noise reduction from outside to inside with the window open is 15dB. To enable casual conversation indoors during daytime, the sound level of interfering noise should not exceed 35dB LAeq. To protect the majority of people from being seriously annoyed during the daytime, the outdoor sound level from steady, continuous noise should not exceed 55dB LAeq on balconies, terraces and in outdoor living areas. To protect the majority of people from being moderately annoyed during the daytime, the

outdoor sound level should not exceed 50dB LAeq. Where it is practical and feasible, the lower outdoor sound level should be considered the maximum desirable sound level for new development.”

11.3 Assessment Methodology

11.3.1 To establish the impact of the Proposed Development in relation to noise on existing residential areas it is necessary to consider the relevant noise guidance, standards and policy for an industrial development. The following information examines the guidance and establishes the methodology to be adopted for assessing noise impacts.

11.3.2 Information used in this assessment has been obtained from the following sources:

- Ordnance Survey maps of the local area;
- information relating to the general layout of the proposed site was provided by AXIS and Eco 2;
- Planning Policy Guidance (“PPG”) 24, ‘Planning and Noise’ – 1994;
- British Standards BS4142: 1997, BS5228: 1997, BS7445: 2003 & BS8233: 1999;
- World Health Organisation: ‘Guidelines for Community Noise’ - April 1999
- Department of Transport ‘Calculation of Road Traffic Noise’: 1988;
- Design Manual for Roads and Bridges, Volume 11, Environmental Assessment: 1999;
- University of Salford Prepared for Defra ‘Proposed criteria for the assessment of low frequency noise disturbance’: February 2005.

General

11.3.3 Noise has been defined as sound that is unwanted by the recipient. The effects of noise on the neighbourhood are varied and complicated, including such things as interference with speech communication, disturbance of work, leisure or sleep. A further complicating factor is that in any one neighbourhood some individuals would be more sensitive to noise than others.

Proposed Noise Criteria

- 11.3.4 Contact was made with North Lincolnshire Council Environmental Health Officer with regard to nearest sensitive receptors, proposed noise monitoring methodologies and appropriate noise criteria.
- 11.3.5 It was informally agreed that the appropriate noise criteria relevant to this proposed development would include, World Health Organisation guidance for sleep disturbance criteria, BS4142: 1997 'Method for rating industrial noise affecting mixed residential and industrial areas' for any fixed plant equipment relative to industrial noise. It was advised that the site should be assessed similar to an IPPC approach by applying BAT techniques for mitigation. For construction noise BS5228: Part 1 1997 'Noise and Vibration Control on Construction and Open Sites' is relevant.
- 11.3.6 For any fixed industrial noise relevant to the site then BS4142: 1997 is appropriate. The standard indicates then that if the level difference between the background noise and the specific noise is 10dB(A) or greater then complaints are likely. Therefore, to ensure that the 10dB(A) level difference is not reached, the design noise criteria should aim to be less than 5dB(A) above the background level [i.e. below LA90+5dB(A)]. The criteria would therefore vary according to the measured LA90 levels at each of the receptor positions.

Construction Noise

- 11.3.7 For construction noise British Standard BS 5228, Part 1 is the appropriate standard. This is an approved code of practice under the Control of Pollution Act and consequently there is a legal requirement for construction noise to be controlled according to the recommendations given in BS 5228. The standard does not give noise limits for construction sites, but emphasis is placed on ensuring that best practical means are adopted to control noise on site.
- 11.3.8 Noise emission levels emanating from the site due to associated construction works for the proposed development would vary from day to day. In order to give an indication of the probable noise levels generated by the works, the highest noise sources are considered at the closest approach. The procedures set out in British Standard, BS5228: Part 1 1997 'Noise and Vibration Control

on Construction and Open Sites', have been used to estimate construction noise levels at the nearest property.

11.3.9 The construction activities would include the movement of soils and construction of the new buildings and infrastructure. The unit used to assess construction noise is the Equivalent Continuous Sound Pressure Level, L_{Aeq} . For the purpose of establishing the 'worst case' scenario for construction noise, calculations have been based on the resultant noise at the nearest property.

11.3.10 It must be noted that Local Authorities have statutory powers to reduce or counteract the effects of noise from construction sites via the Control of Pollution Act 1974. The Local Authority would specify maximum noise levels.

Road Traffic Noise

11.3.11 From the results of the background noise survey and observations at the nearest residential receptors, it is clear that the noise climate is dominated by local and distant road traffic noise (i.e. along Brigg Road, A18 and the M180 Motorway), occasional train movements and local industrial activities.

11.3.12 As determined by the Traffic Impact Assessment (see Chapter 6.0) there is likely to be a total of approximately 136 vehicle movements per day (including staff vehicles) as a result of the development. Under a 'worst case' demand scenario, the maximum vehicle movements for opening year 2012 and 2022 is shown to be 240.

11.3.13 The percentage change in two way flow resulting from the development along Brigg Road and the A18 road is shown to vary between approximately 1.8% and 4.3% for 2012 opening year (this includes a 'worst case' traffic flow scenario). The resultant change in noise levels associated with the vehicle movements has been calculated using 'Calculation of Road Traffic Noise' (CRTN): 1988 and for low vehicle flows the prediction model found within BS5228: 1997. The results of the calculations in respect of road traffic noise at the nearest receptors are shown to produce a negligible effect. Further detail is provided later in this section.

Survey Techniques

11.3.14 The background noise survey would be carried out in accordance with BS4142: 1997. The monitoring of environmental noise level would also be in accordance with advice given in BS 7445:2003 'Description and measurement of environmental noise'.

11.4 Baseline Conditions

Site Noise Survey

11.4.1 A detailed environmental noise survey was carried out at the site to determine details of the noise climate at the nearest residential properties to provide typical background noise data. The site inspection was carried out on 4th April 2008 and a detailed noise survey was carried out on Sunday 13th April to Tuesday 15th April 2008. Static noise measurements were undertaken in the vicinity of the site to establish data on the existing noise climate.

11.4.2 The main source of existing noise affecting nearest receptor properties relates to the movement of traffic along local roads, occasional train movements and local industrial activities.

11.4.3 Following consultation with the Environmental Health Officer at North Lincolnshire Council, we examined the areas surrounding the site and established suitable locations for static noise monitoring, which are detailed below:

Position 1: Rear boundary of properties to the northwest off Brook Lane, which is located approximately 1.7 kilometres south west of Brigg town centre. The nearest sensitive receptor position relative to the REP site is at a distance of approximately 360 metres from the nearest building.

Position 2: This monitoring location is north of the REP site position on land at the end of Silverside Lane. The nearest residential dwellings are at a distance of approximately 340 metres to the nearest REP building.

Position 3: This position is to the north east at the nearest residential property off Mill Lane. The distance from the nearest REP building to nearest property is approximately 850 metres. At the end of Mill Lane is a cluster of industrial units and a caravan park. The industrial units are located directly in front of the caravan park providing a natural screen towards the REP site. The distance from the nearest REP site to the caravan site is approximately 770 metres.

Position 4: The final fixed monitoring position chosen was off Cadney Road south of the site. The nearest property is located south of the REP site at a distance of approximately 1050 metres.

- 11.4.4 The noise monitoring positions are indicated on Figure 11.1.
- 11.4.5 The fixed monitoring positions provide us with broadband noise data of the existing noise climate around the site at the nearest residential properties.
- 11.4.6 The noise monitoring exercise was carried out over a Sunday morning through to a Tuesday morning to establish the lowest likely ambient noise climate. Details of the instrumentation used for the survey are detailed in Appendix 11.2.

Noise Survey Results

Site Baseline Noise Survey

- 11.4.7 The results of average measurements taken at the fixed monitoring positions at site are presented below in Table 11.4 to 11.7 and detailed measurements in Appendix 11.3.

Table 11.4: Average Noise Levels during Sunday (i.e. from or about 0700 – 2300 hours)

Location	LAeq dB	LA10 dB	LA90 dB	LAmx dB
1. North west to off Brook Lane	50.8	50	43.6	70.3
2. North off Silverside Lane	49.6	50.2	44.1	69
3. North west off Mill Lane	49.7	49.8	42.5	66.8
4. South off Cadney Road	48.6	49.3	44	59

Table 11.5: Night-time (Sunday-Monday) average levels (i.e. 2300 – 0700 hours)

Location	LAeq dB	LA10 dB	LA90 dB	LAmx dB
1. North west to off Brook Lane	49.5	49.4	42.5	58
2. North off Silverside Lane	50.2	50.9	45.2	60.9
3. North west off Mill Lane	49.3	48.4	42.5	56.4
4. South off Cadney Road	46.4	48	39.2	50.6

Table 11.6: Average Noise Levels during Monday (i.e. 0700 – 2300 hours)

Location	LAeq dB	LA10 dB	LA90 dB	LAmx dB
1. North west to off Brook Lane	53.9	54.6	50.7	69.7
2. North off Silverside Lane	54.6	54.8	50.1	71.2
3. North west off Mill Lane	53.5	53.4	47.6	69.1
4. South off Cadney Road	49.8	51.2	44.8	60.4

Table 11.7: Night-time average levels (Monday-Tuesday i.e. 2300 – 0700 hours)

Location	LAeq dB	LA10 dB	LA90 dB	LAmx dB
1. North west to off Brook Lane	52.5	52.2	43.4	59.4
2. North off Silverside Lane	52.3	51.1	43.6	61.5
3. North west off Mill Lane	49.3	48.6	42.3	56.3
4. South off Cadney Road	46.7	48.1	38.8	50.7

11.4.8 Based on the results of the background noise survey, guidance provided within BS4142: 1997, WHO guidelines and advice from the Environmental Health Officer, the following noise criteria would be applicable to the nearest residential receptors:

Table 11.8: Proposed Noise Criteria at Nearest Residential Boundary based on lowest average noise levels

Position	Time Period	Existing LAeq (dB)	Existing LA90 (dB)	Proposed Maximum Site Noise Criteria LAeq (dB)
1. North west to off Brook Lane	0700-2300	50.8	43.6	48
	2300-0700	49.5	42.5	45
2. North off Silverside Lane	0700-2300	49.6	44.1	49
	2300-0700	50.2	43.6	45
3. North west off Mill Lane	0700-2300	49.7	42.5	48
	2300-0700	49.3	42.3	45
4. South off Cadney Road	0700-2300	48.6	44	49
	2300-0700	46.4	38.8	42

Existing Renewable Energy Plant Site Survey

11.4.9 Noise monitoring at a REP site in Cambridgeshire was undertaken in May 2007. The noise monitoring was carried out during a late night period when background noise levels were low and measurements at distances of between 50 metres and 500 metres were recorded. Details of the results of the noise monitoring are presented in Appendix 11.4. This includes broadband and one-third octave band frequency analysis. The results of the survey are summarised in Table 11.9.

11.4.10 Subjectively, the noise from the existing REP plant at close range distances (i.e. 50 metres to 150 metres) was audible but not significant. There was some low frequency noise content although influence of noise from an adjacent site was more distracting than that from the REP site. At a distance of 500 metres the noise from the plant was very low and only just audible but not deemed to be significant. At the 500 metre position, the actual noise contribution from the site is not fully known as the existing residual noise (i.e. noise not associated with the site) may have been a contributory factor. The results do however show that at this site the noise levels are not significant.

Table 11.9: Noise Results taken at Existing REP Site in Operation

Time	Distance to REP Buildings (metres)	LAeq dB	LA10 dB	LA90 dB	LAmx dB
23:28	50	58.9	59.8	57.7	61.1
23:30	100	53.9	54.7	53.1	57.5
23:08 to 23:26	150	48.5-53.7	49.4-54.3	45.9-52.4	53.8-59.7
23:34	170	50.8	51.9	49.9	53.7
23:44 & 23:46	500	38.6-40.9	39.2-41.6	37.9-38.7	39.7-53.8

Low Frequency Noise

11.4.11 Detailed frequency analysis of an existing REP site is provided within Appendix 11.4 and 11.5. We have compared the results of measured noise from the site (adjusted for distance) against the recently published 'proposed criteria for the assessment of low frequency noise disturbance', which was carried out by Salford University on behalf of Defra in 2004 and published in 2005. The results show that typical noise produced by sites of this type does not exceed the low frequency noise criteria.

11.5 Key Impacts and Likely Significant Effects

Identification of Impacts

11.5.1 Descriptives such as substantial, moderate, slight and negligible are used to assign the magnitude of the impact. The methodology adopted for assessing the scale of impact is shown below in Table 11.10

Table 11.10: Methodology for Assessing the Scale of Impact

Scale of Impact	Description
Substantial	Significant change in noise conditions causing breaches of statutory duties and/or guidance.
Moderate	Moderate change in noise levels without exceedance of statutory duties and/or guidance
Slight	Slight change in noise conditions
Negligible	No discernible change in noise conditions

11.5.2 To assess the significance we provide a scoring system, which relates to the nature of impact, as shown below in Table 11.11.

Table 11.11: Impact Significance Category

Nature of Impact	Score
Major beneficial (positive) effect	+3
Intermediate beneficial (positive) effect	+2
Minor beneficial (positive) effect	+1
Neutral effect	0
Minor adverse (negative) effect	-1
Intermediate adverse (negative) effect	-2
Major adverse (negative) effect	-3

Evaluation of Impact:

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11.5.3 The areas surrounding the site were examined to select noise-monitoring locations in the vicinity of the most sensitive residential dwelling positions. Background noise data obtained from these monitoring positions has enabled us to assess the impact of the proposed development site.

Road Traffic Noise:

11.5.4 The effects of any increase in road traffic movements have been assessed and are detailed in this assessment below. The results of the calculations show that there are no significant changes in road traffic flow as a result of the development. The assessment of impact from any increase in road traffic on site is likely to result in a negligible to slight effect (i.e. 0 to -1 impact score).

Operational Noise: Noise Level Predictions

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- 11.5.5 A measure that is in general use and is recommended internationally for the description of environmental noise is the equivalent continuous noise level or L_{Aeq} parameter.
- 11.5.6 In general, the level of noise in the local environs that arises from a development site would depend on a number of factors. The more significant of which are: -
- (a) The sound power or sound pressure levels (SWL's or SPL's) of the plant;
 - (b) The frequency content and characteristics of the noise source;
 - (c) The periods of operation of the plant on site;
 - (d) The distance between the source noise and the receiving position;
 - (e) The presence or absence of screening effects due to barriers, or ground absorption;
 - (f) Any reflection effects due to the facades of buildings etc;

Results of Noise Predictions

Road Traffic Noise

Calculation Methodology

- 11.5.7 To assess any likely impact on existing residential properties from any traffic noise generated by the development site, additional noise calculations have been undertaken using CRTN and BS5228 methodology and traffic flow information provided by the consultancy team. The results of these calculations are shown below in Tables 11.12 and 11.13.
- 11.5.8 The traffic flow for vehicle movements on and off the development site has been used to calculate the change in noise climate at the nearest sensitive properties.

11.5.9 The nearest dwellings are potentially affected by increased traffic flow onto Brigg Road (B1206) and the A18 road, which connects to the M180 Motorway.

11.5.10 Access to the REP site would be via the existing junction off Brigg Road (B1206). The traffic impact assessment (provided in Chapter 6.0) shows the proposed routing agreement, which would be onto Brigg Road and north via the A18 onto the M180 Motorway or A15.

11.5.11 The following tables provide details of the impact due to the increased traffic flow based on a development 'opening year' of 2012 and a 15 year future design horizon of 2022. The dwelling positions off the B1206 are the most sensitive receptors to any direct traffic flow increase along the B1206 and the A18 roads.

Table 11.12.: Predicted Road Traffic Noise Increase at Existing Residential Properties During Daytime (12 hour)

Position	Noise level 2012 (without REP site) LAeq12hour (dB)*/**/***	Noise level 2012 (with REP site) LAeq12hour (dB)*/**/***	Change in 2012 (with REP site) LAeq12hour (dB)	Change in 2022 (with REP site) LAeq12hour (dB)
1. Property at end of access road to site	60.5	61.4	+0.9	+0.9
2. Properties off Scawby Road (B1206)	59.4	60.1	+0.7	+0.7
3. Properties off A18 road	64.4	64.7	+0.3	+0.3

* 12hour flows converted to 18hr equivalent on a pro-rata basis to enable CRTN calculations to be undertaken

** Based on TEMPRO local growth factors

*** Conversion from LA10 to LAeq taken as -2dB(A) based on previous road traffic noise assessments

Table 11.13: Predicted Road Traffic Noise Increase at Existing Residential Properties During Daytime (am and pm peak hour)

Position	Noise level 2012 (without REP site) AM & PM ^{*/**} LAeq1hour (dB)	Noise level 2012 (with REP site) LAeq1hour (dB) ^{*/**}	Change in 2012 (with REP site) LAeq1hour (dB)	Change in 2022 (with REP site) LAeq1hour (dB)
1. Property at end of access road to site	61.5 & 64.9	62.9 & 66.1	+1.4 & +1.2	+1.4 & +1.0
2. Properties off Brigg Road (B1206)	59.2 & 61.1	60.1 & 61.9	+0.9 & +0.8	+0.6 & +0.7
3. Properties off A18 road	65.5 & 66.1	65.8 & 66.2	+0.3 & +0.1	+0.3 & +0.2

* Based on TEMPRO local growth factors

** Conversion from LA10 to LAeq taken as -2dB(A) based on previous road traffic noise assessments

11.5.12 The highest likely impact (i.e. during typical peak hour traffic movements) with and without the proposed development shows a small increase of noise level of +0.1dB(A) to +1.4dB(A). The increase at positions 2 to 3 is due to the change in road traffic along the B1206 and the A18. The increase at position 1 is due to the resultant change in traffic flow along the existing access road to the power station and traffic onto the B1206. The impact in 2022 will be similar as the development traffic will not increase and the background demand will only increase slightly.

11.5.13 If we consider the highest possible traffic flow (i.e. using the maximum number of vehicles that could be accommodated at the REP site at any one time), the results of the noise prediction calculations show that the maximum increase in noise level associated with road traffic movements would be +1.7dB(A). This increase is still not deemed to be significant according to Government advice.

11.5.14 In accordance with guidance given in the DETR 'Guidance on the new approach to appraisal': 1998 for road traffic assessment, paragraph 6.8 "*only those properties experiencing changes greater than 3dB(A) should be taken into account.*" The Transportation Assessment also states '*IEA guidance notes the following: In general, people are unable to perceive a change in noise nuisance for changes in noise levels of less than 3dB(A), such changes requires a "doubling or halving in the level of traffic".*'

11.5.15 In November 2006 the Department of Transport published a Transport Analysis Guidance (TAG unit 3.3.2) in which it states *“It should be recognised that, in many situations, relatively large changes in traffic flows are required to bring about significant changes in the response to noise levels in the longer term. For freely flowing traffic, a difference of about 3dB in noise level is required before there is a statistically significant change in the average assessment of nuisance.”* [ref. paragraph 1.15].

Fixed Noise Sources

Calculation Methodology

11.5.16 The calculation method used in this study is based upon ISO 9613: 2, noise propagation model, which takes into account source position, screening effects, distance and direction in relation to the nearest receptor.

11.5.17 The consultancy team have used the empirical field data taken at similar sites and plant in the UK to calculate the expected resultant noise contribution at the nearest property boundary locations during daytime and night-time operations.

Table 11.14: Predicted Noise Contribution from REP with the example of noise amelioration measures

Receptor Position	Noise contribution from REP Site Plant LAeq dB	Proposed Noise Criteria LAeq dB (day/night)
1. North west off Brook Lane	40 (day) 38 (night)	48 (day) 45 (night)
2. North off Silverside Lane	40 (day) 39 (night)	49 (day) 45 (night)
3. North west off Mill Lane	32 (day) 31 (night)	48 (day) 45 (night)
4. South off Cadney Road	31 (day) 29 (night)	49 (day) 42 (night)

Note: The above noise predictions assume all plant operating during the daytime and night-time period (i.e. 'worst case').

11.5.18 The above table indicates that there are no areas where the noise levels exceed the proposed noise criteria for day or night-time operations. This

assumes that the example of noise amelioration measures are implemented as detailed in section 11.6 and the plant noise levels are as provided within Appendix 11.7.

- 11.5.19 The predicted noise levels are for site attributable noise and do not include for any existing ambient noise that may affect the measured noise levels.
- 11.5.20 The assessment of impact concludes that a neutral to minor adverse effect is likely at the nearest dwellings in the vicinity of the new potential noise sources (i.e. 0/-1 impact score). In terms of worst case, the magnitude of the impact relates to a very slight or negligible change in noise conditions.
- 11.5.21 In respect of the effect of wind direction on noise levels we would refer to BS8233: 1999 'Sound Insulation and noise reduction for buildings – Code of practice' (paragraph 5.3 external noise sources – meteorological effects) in which it states 'The effects range from increasing the level by typically 2dB downwind, to reducing it by typically 10dB upwind'. Even when allowing for the 'worst case' scenario of downwind, the resultant noise level increase would still be below the noise criteria relevant to this development and would therefore not alter the conclusions above.

Construction Noise

- 11.5.22 Initial site preparation work is likely to involve demolition, the movement of soils and the construction of new buildings and infrastructure. It is considered that excavators, haulage lorries, piling rigs, cranes, dumpers, concrete mixers, diggers and paving machines would all, at some time during the construction programme, be operating on the site. In addition, ancillary equipment such as small generators and compressors may also be operating on occasions during the construction of the homes.
- 11.5.23 The above noise sources and their associated activities would vary from day to day and may be in use at different stages of the proposed development for relatively short durations. The noisiest activities are expected to be generated during soil movement and piling work during the initial stages of the development when excavators, piling rigs or similar may be in use.

11.5.24 No specific advice is provided at this stage of the development by the Local Authority. Below is a typical example of a Local Authority planning condition relating to construction noise:

'Noise generated by construction activities should be carried out in line with the 'Good Builders Guide' and BS 5228 Noise Control on Construction and Open Sites. All works and ancillary operations, which are audible at the site boundary or at such other place as, may be agreed with the Council.'

11.5.25 All work shall be carried out only between the hours of 07.00 and 19.00 on Monday to Fridays and between the hours of 08.00 and 16.00 on Saturdays and at no time on Sundays or Bank Holidays.'

Construction Noise Prediction

11.5.26 The actual noise level produced by construction work would vary at the nearest property boundary at any time depending upon a number of factors including the plant location, duration of operation, hours of operation, intervening topography and type of plant being used. It is therefore difficult to accurately determine the likely noise levels without knowing much greater detail.

11.5.27 Detailed below is an indication of the highest likely noise levels at the nearest receptors based on soil movement, infrastructure work and general site activities at the closest approach to existing residential areas.

11.5.28 The calculations use the calculation methodology given in BS 5228: Part 1, 1997. For this method the sound power level of the noise source is defined and the attenuation is calculated between its location and the selected receiver, taking account of distance, screening due to barriers, ground attenuation and the time that a noise source would be operating.

11.5.29 It is difficult to estimate how long the different types of activity would last, but typically in areas close to the site boundary (i.e. noisiest construction period assessed) this is normally completed in weeks rather than months.

11.5.30 The results of calculations for soil movement, piling, infrastructure work and general site activities are shown below in Table 11.15.

Table 11.15: Noise Predictions for Highest Likely Construction Noise

Position	Distance to receptor (m)	Activity	Noise Level, dB LAeq	Typical residual noise dB LAeq
1. North west off Brook Lane	360	Soil Movement Piling* General site activities Infrastructure	48-51 51-54 40-46 46-53	51-54
2. North off Silverside Lane	340	Soil Movement Piling* General site activities Infrastructure	49-52 51-54 41-47 47-54	50-55
3. North west off Mill Lane	850	Soil Movement Piling* General site activities Infrastructure	40-42 44-46 32-37 37-44	50-54
4. South off Cadney Road	1050	Soil Movement Piling* General site activities Infrastructure	38-40 43-45 30-34 34-42	48-50

*Piling noise based on auger piling, which is the likely type of piling, if it is required at all.

Note: Construction noise prediction levels given above do not allow for any proposed amelioration measures and plant equipment at close approach.

11.5.31 For the development, the highest community noise levels are likely to be created during piling, soil movements and the construction of the access roads, buildings and infrastructure when they are close to the boundary with properties adjacent to the north and eastern site boundaries. This would be within the level of noise normally found to be acceptable for an activity of this type and duration. The movement of soil may be part of the initial site preparation works and it is unlikely that any other significant sources of noise would be present on the site while these activities were being carried out.

11.5.32 The assessment of impact from construction noise concludes that a neutral to minor adverse effect is likely to occur (i.e. 0/-1 impact score) without further mitigation measures. In terms of worst case, the magnitude of the impact relates to a slight or negligible change in noise conditions.

Assessment of Significance

11.5.33 The methodology adopted for establishing the significance of the impact associated with the development is detailed previously.

11.5.34 The introduction of the example of amelioration measures detailed in section 11.6, in relation to site construction and operational noise at the nearest residential properties, has been assessed. Previous tables (i.e. 11.14 and 11.15) show the effect of the measures on the highest likely noise levels, Table 11.16 below shows the impact significance.

Table 11.16: Residual Impact at Nearest Receptor after Amelioration Measures

Noise Source	Time Period	Impact Significance	Impact Score
Construction	Daytime	Negligible/Slight Effect	0/-1
Road traffic noise	Daytime	Negligible/Slight Effect	0/-1
Industrial noise	Daytime	Negligible/Slight Effect	0/-1
	Night-time	Negligible/Slight Effect	0/-1

11.6 Mitigation and Enhancement

Construction Noise

11.6.1 In accordance with BS5228, best practical means would be employed to control the noise generation (e.g. using equipment that is regularly maintained, where practicable use equipment fitted with silencers or acoustic hoods).

11.6.2 In consideration of the likely highest levels of construction noise which would occur during short-term activities at the closest approach to nearest dwellings around the site, the following approach would be incorporated in the detailed design:

- Restriction of construction hours to non-sensitive times of day would normally form part of the planning consent conditions.
- Restriction on the types of plant being used relating to noise limits for specific operations.

- Sensible routing of the construction plant to avoid the nearest residential properties, where possible.
- Use of auger type piling rigs where practicable rather than drop-hammer

Road Traffic Noise

11.6.3 The results of noise calculations of the impact of road traffic noise show no significant increase at the receptor positions.

Industrial Noise

11.6.4 The Local Authority are able to set out planning consent conditions to ensure that the proposed noise criteria for daytime and night-time operations is achieved.

11.6.5 Whilst this can be achieved by mitigation it must be noted that this assessment considers only one method of treatment. There are a number of different ways in which the criteria can be achieved, for example, the use of noise control at source and/or the selection of different plant equipment which may be quieter can be investigated. When further detailed information is available on specific plant selection, it may be necessary to undertake a further noise assessment to check that the planning consent conditions would be achieved.

11.6.6 The predicted noise levels from the site have been calculated using the noise levels provided within Appendix 11.7. The noise levels are based on empirical test data and include the following example of mitigation measures. These measures may vary depending upon the detailed design and plant selection as explained above.

- a) Insulated clad buildings containing peak noise sources (i.e. turbine and boiler hall and straw barns);
- b) Air cooler condenser fitted with peripheral screen;
- c) External conveyor systems enclosed;
- d) Doors into peak noise areas formed from either insulated roller shutter doors or solid core fire access doors;
- e) Noise from ID fan stack limited to a noise level of 75dB(A) @ 1 metre.

Site Management:

11.6.7 Effective site management helps to ensure that peak noise emanating from the plant is minimised. This may include consideration of the following measures in the detailed design:

- (i) Where practicable, door openings kept closed during night-time periods. During the daytime, when plant is operating, the doors into the REP buildings would normally be in the closed position (where practicable) except for periods during the daytime for HGV access
- (ii) Daytime use of HGV reverse alarms can be minimised by the use of turning circles and a 'drive through' system within the straw barn offloading bays.
- (iii) During night-time periods site management procedures may be introduced to minimise HGV and mobile plant movements (where practicable).

11.7 Vibration Assessment

Review of Vibration Criteria

Vibration Damage Criteria

11.7.1 Most of the available data relating to the effects of ground vibration on buildings have been obtained during tests using explosives. From these studies, two regimes of building damage have evolved, those of structural damage involving major failures of whole or parts of buildings and architectural damage involving cracking plaster or other brittle materials. Architectural, sometimes called cosmetic, damage is thought to be more annoying than dangerous and would start to occur at lower levels of vibration than structural damage. International and British Standards [i.e. BS7385:1990 & ISO4866:1990(E)] define and categorise building damage under three main headings:

- a) Cosmetic - the formation of hairline cracks on drywall surfaces or the growth of existing cracks in plaster or drywall surfaces. In addition, the formation of hairline cracks in mortar joints of brick/concrete block construction.
- b) Minor - the formation of large cracks or loosening and falling of plaster or drywall surfaces, or cracks through bricks/concrete blocks.
- c) Major - damage to structural elements of the building, cracks in support columns, loosening of joints, splaying of masonry cracks, etc.

11.7.2 An investigation into the effects of induced vibration undertaken by the British Standards Institution has culminated in BS 7385:1993; Part 2, which gives guide values to prevent cosmetic damage to property of 15mms^{-1} to 20mms^{-1} between 4Hz and 15 Hz, whilst above 40 Hz the guide value is 50mms^{-1} . The BSI suggests reducing these figures by a factor of 50% for continuous vibration, for example from rail traffic, thus the values become $7.5\text{-}10\text{mms}^{-1}$ at 4-15 Hz, and 25.0mms^{-1} at 40 Hz and above.

11.7.3 These vibration criteria are comparable with those of the German Standard DIN 4150, Part 3 1986 which recommends continuous vibration magnitudes of 5.0 mms^{-1} at a frequency below 10 Hz, with $5.0\text{-}15.0\text{ mms}^{-1}$ at frequencies between 10 Hz and 50 Hz.

11.7.4 In France, the Ministry of Environment and Transport Regulations for mechanical vibration affecting buildings gives a guide value of 5.0mms^{-1} at frequencies between 10 Hz and 30 Hz, with $5.0\text{-}8.0\text{mms}^{-1}$ at frequencies between 30 Hz and 60 Hz.

11.7.5 With regard to the threshold of cosmetic damage, for continuous vibration such as road or rail traffic, levels below 5.0mms^{-1} are unlikely to be significant. For a given level of vibration the risk of damage decreases as the frequency of that vibration increases.

11.7.6 BS5228: Part 4: 1992 'Noise control on construction and open sites' states the following: *'It is recommended that, for soundly constructed residential property and similar structures, which are in generally good repair, a conservative threshold for minor or cosmetic (i.e. non-structural) damage should be taken as a peak particle velocity (p.p.v.) of 10mms^{-1} for intermittent*

vibration and 5 mm/s for continuous vibrations. Below these vibration magnitudes, minor damage is unlikely to occur.'

11.7.7 For the purposes of assessing the potential to cause structural damage the following criteria has been chosen:-

- a) A limiting value for continuous vibration of 5.0mms^{-1} .
- b) A limiting value for intermittent vibration of 10mms^{-1} .

11.7.8 To put this in perspective, a velocity of 0.3 mms^{-1} is quoted as the human threshold of vibration perception and a CONTINUOUS velocity of about 2.5 mms^{-1} is quoted as being annoying.

Vibration Nuisance Criteria

11.7.9 The fact that the human body is very sensitive to vibration can result in subjective concern being expressed at energy levels well below the threshold of damage.

11.7.10 Structural vibration in buildings can therefore be detected by the occupants and effect them in many ways. For example, their quality of life may be reduced and, if the building relates to a work place, working efficiency may also be affected.

11.7.11 Guidance on the human response to vibration in buildings may be found in British Standard BS 6472:1992. Weighting curves related to human response to vibration of buildings are presented within this document. Tentative guidance is given on the magnitudes of vibration at which adverse comment may begin to arise.

11.7.12 For the purposes of assessing the potential to cause nuisance the guidance in BS 6472:1992 has been referred to.

Local Planning Authority Vibration Criteria

11.7.13 We are not aware of any specific vibration limitations that are imposed by the Local Planning Authority for the site.

Vibration Measurements

11.7.14 Measurements of ground borne vibration were undertaken at an existing REP site. The methodology described below was employed during the vibration survey. Definitions of all vibration measurement parameters noted during the survey are presented in Appendix 11.9.

Measurement Technique

11.7.15 Vibration measurements were made, in the three mutually perpendicular axes, during the monitoring period. The Nomis seismograph was set to the 'continuous' setting (at a trigger level of 0.3 mms^{-1}) and was placed at a distance of approximately 50 metres of the site boundary.

11.7.16 The seismograph has monitored the ground borne vibration in terms of Peak Particle Velocity (PPV).

Results of Survey

11.7.17 During the vibration survey, the seismograph transducer did not trigger, indicating that the level of vibration was below the transducer sensitive threshold of 0.3 mms^{-1} .

11.8 Conclusions of Vibration Assessment

Structural and Cosmetic Damage

11.8.1 NVC consider that a limiting value for continuous vibration of 5.0 mms^{-1} , based on the criteria discussed in section 11.7 of this document is a satisfactory magnitude to protect buildings from damage of any description. For intermittent vibrations NVC considers that a limiting value of 10.0 mms^{-1} is a satisfactory magnitude to protect buildings from damage of any description.

11.8.2 A continuous vibration is one in which the cyclic variation in amplitude is repeated many times. An intermittent vibration is one in which a sequence (sometimes regular, sometimes irregular) of transient vibrations occurs with

sufficient interval between successive events to permit the amplitude to diminish to an insignificant level in interim periods.

- 11.8.3 The results of the vibration monitoring with the seismograph in continuous mode are shown below:

Table 11.17: Summary of Vibration Monitoring in Continuous Mode

Position	Vibration Source	Resultant Maximum PPV (mms^{-1})	Peak Frequency (Hz)
Access road (100m) (kerbside)	REP Plant	No trigger (0.3mms^{-1} background level)	-
50m boundary of site	REP Plant	No trigger (0.3mms^{-1} background level)	-

- 11.8.4 The results show that the seismograph did not trigger during the monitoring period as the level of vibration was too low and below the level of perceptibility. We therefore conclude that the level of vibration is significantly lower than limiting levels of vibration relating to structural or cosmetic damage.

Vibration Nuisance

- 11.8.5 British Standard BS6472: 1992 "*Evaluation of human exposure to vibration in buildings (1-80 Hz)*" discusses the possible effects that various types of vibration may have on the inhabitants of any building. Appendix 11-8 of this document describes methods for the evaluation of such vibration and indicates levels that might possibly give rise to adverse comment under a given range of circumstances.
- 11.8.6 The results show that the levels of vibration at the nearest residential properties would be well below a 'low probability of adverse comment' according to BS6472: 1992 and is therefore insignificant.

Vibration from Road Traffic

- 11.8.7 Based on other studies carried out by NVC of the vibration impact from HGVs on access roads, we conclude that the only situation likely to generate any measurable vibration would be when HGVs travel close to properties (i.e. within 10 metres) and are required to pass over speed 'humps'. The general

movement of HGVs on relatively smooth access roads (even at close distance) does not normally give rise to excessive ground borne vibration. Even in situations where the HGV does pass over a speed 'hump', the level of vibration is still relatively low and experience has shown that according to BS6472:1992 there is normally a 'low probability of adverse comment' indicating that nuisance conditions are unlikely.

11.9 Summary

Introduction

- 11.9.1 Noise levels have been considered and assessed during the construction and the operational phases of the proposed development. Relevant and appropriate noise guidance and standards have been used to determine the noise impact. Where appropriate, an example of mitigation measures is provided, to show that the noise sources would be reduced to achieve the criteria. This noise assessment has been undertaken to inform and guide the design of the development such that any likely noise impact on existing dwellings is minimised.
- 11.9.2 To establish any likely impact from noise it was necessary to establish the existing noise climate at the site. This information has helped determine any likely noise impact on nearest receptors to the site during the construction and operation of the proposed development.
- 11.9.3 The Environmental Health Officer of North Lincolnshire Council has been informally consulted for the assessment to seek approval for the noise survey methodology and confirmation of appropriate noise criteria.

Baseline Noise Conditions

- 11.9.4 In accordance with relevant planning policy guidance on noise the existing average background noise levels at the nearest receptors are shown to vary typically between 43dB(A) and 51dB(A) L90 [49dB(A) to 55dB(A) LAeq] during daytime. During night-time periods, the background noise climate falls to levels between 39dB(A) and 45dB(A) L90 [46dB(A) to 53dB(A) LAeq].

11.9.5 Subjective observations at nearest residential properties indicate that intermittent noise from local and distant road traffic, occasional train and industrial activity noise and birdsong form the general noise climate at the nearest receptors.

Likely Effects

11.9.6 During the construction phase of the development, there would be a variety of noise sources in use at different stages and their associated activities would vary from day to day. The highest noise levels relative to nearest receptors are likely to occur at the start of the construction in the particular working area during piling and soil movements and infrastructure development. These activities do not normally occur over long periods of time and best practical means would be employed to control the noise being generated. In general there would be negligible or slight effect likely to occur depending upon the type of plant being used.

11.9.7 During the operation of the site it is concluded in respect of the resultant residual impact that, with appropriate mitigation measures within the detailed design, there is likely to be a negligible or slight effect. The results of frequency analysis shows no significant effect from low frequency noise based on noise measured from an existing REP site and the design layout with mitigation.

11.9.8 The impact on existing residential areas from any increase in road traffic noise on local roads during the daytime periods would also have a negligible or slight effect.

11.9.9 In terms of ground borne vibration from the site or from HGVs, this will be below the level of perceptibility and therefore insignificant.

Mitigation

11.9.10 For construction noise, in accordance with appropriate standards, best practical means would be employed to control the noise generation (e.g. using equipment that is regularly maintained, where practicable use equipment fitted

with silencers or acoustic hoods). Other measures proposed include restriction on operating hours, types of plant and sensible routing of equipment to site.

11.9.11 For operational noise, the introduction of appropriate detailed design mitigation measures, would ensure that the resultant noise levels are within appropriate guidance and standards. The measures would be based on the employment of Best Available Techniques (BAT) to mitigate any potential peak noise sources.

11.9.12 In terms of the access road to the REP site, the use of speed 'humps' should be avoided in areas close to residential properties and the access road surface regularly maintained to ensure vibration from HGVs remains insignificant.

Conclusions

11.9.13 For the construction phase, the noise levels would vary from day to day depending upon a number of factors including type of plant being used, type of activity, distance from the site boundary, screening, duration of activity and nature of activity. For the assessment of impact for the construction phase it is concluded that by adopting the proposed mitigation measures, the impact would result in a negligible to slight adverse effect albeit a temporary noise source.

11.9.14 During the operational phase, the noise assessment considers an example of mitigation that could be implemented to control noise from the site to achieve the noise criteria. There are a number of different ways in which the criteria can be achieved, for example, the use of noise control at source and/or the selection of different plant equipment, which may be quieter, can be investigated (i.e. by applying BAT techniques). When further detailed information is available on specific plant selection, it may be necessary to undertake a further noise assessment to check that the planning consent conditions would be achieved. The provision of appropriate mitigation measures within the detailed design would assist in minimising any noise impact and the level of risk is anticipated to be low. The residual impact from noise is therefore deemed to have a negligible effect or at worst a slight effect on noise levels at the nearest residential dwellings.

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