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TABLES

8.0 NOISE AND VIBRATION

8.1 Introduction

8.1.1 This chapter of the ES presents an assessment of the likely significant effects of the construction, operation and maintenance, and decommissioning of the Proposed Development with respect to noise and vibration. This chapter also describes the methods used to assess the effects; the baseline conditions currently existing at the Site and surrounding area; the measures required to prevent, reduce or offset any significant negative effects; and the likely residual effects after these measures have been adopted.

8.1.2 This chapter is supported by Figure 8.1 in ES Volume II and Appendices 8A-8D in ES Volume III.

8.2 Legislation and Planning Policy Context

Legislation

Environmental Protection Act 1990

8.2.1 The Environmental Protection Act 1990 (EPA) Part 3 prescribes noise (and vibration) emitted from premises (including land) so as to be prejudicial to health or a nuisance as a statutory nuisance.

8.2.2 Local Authorities are required to investigate any public complaints of noise and if they are satisfied that a statutory nuisance exists, or is likely to occur or recur, they may serve a noise abatement notice. A notice is served on the person responsible for the nuisance. It can require the abatement of the nuisance; works to abate the nuisance to be carried out; or prohibition restriction of the activity. Contravention of a notice without reasonable excuse is an offence.

8.2.3 In determining if a noise complaint amounts to a statutory nuisance the Local Authority can take account of various guidance documents and existing case law; no statutory noise limits exist. Demonstrating the use of 'Best Practicable Means' (BPM) to minimise noise levels is a defence in relation to the contravention of a noise abatement notice.

Control of Pollution Act 1974

8.2.4 Sections 60 and 61 of the Control of Pollution Act 1974 (CoPA) provide the main legislation regarding demolition and construction site noise and vibration. If noise complaints are received, a Section 60 notice may be issued by the local planning authority with instructions to cease work until specific conditions to reduce noise have been adopted.

8.2.5 Section 61 of the CoPA provides a means for applying for prior consent to carry out noise generating activities during construction. Once prior consent has been agreed under Section 61, a Section 60 notice cannot be served provided the agreed conditions are maintained on-site.

8.2.6 CoPA requires that BPM (as defined in Section 72 of CoPA) be adopted for construction noise on any given site. CoPA makes reference to British Standard (BS) 5228 (British Standards Institute (BSI), 2014a and b) as BPM.

Environmental Permitting Regulations 2016

8.2.7 The Environmental Permitting (England and Wales) Regulations 2016 require the application of Best Available Techniques (BAT) to activities performed within installations regulated by the legislation in order to manage the impact of these

operations on the surrounding environment. This therefore applies only to the operational period, not construction.

8.2.8 In terms of noise specifically, the selection of BAT is considered and balanced with releases to different environmental media (air, land and water) and due consideration is given to issues such as usage of energy and raw materials. Noise, therefore, cannot be considered in isolation from other impacts on the environment.

8.2.9 The definition of pollution includes "emissions which may be harmful to human health or the quality of the environment, cause offence to human senses or impair or interfere with amenities and other legitimate uses of the environment". BAT is therefore likely to be similar, in practice, to the requirements of the Statutory Nuisance legislation which requires the use of BPM to prevent or minimise noise nuisance. In the case of noise, "offence of any human senses" may be judged by the likelihood of complaints. However, the lack of complaint should not necessarily imply the absence of a noise problem. In some cases it may be possible, and desirable, to reduce noise emissions still further at reasonable costs and this may therefore be BAT for noise emissions. Consequently, the aim of BAT should be to ensure that there is no reasonable cause for annoyance to persons beyond the installation boundary.

8.2.10 Guidance regarding Environmental Permitting and noise is available in the Environment Agency's Integrated Pollution Prevention and Control (IPPC) H3 document 'Horizontal Guidance for Noise Part 2 - Noise assessment and Control' (Environment Agency, 2002a). 'Horizontal Guidance for Noise Part 1 – Regulation and Permitting' (Environment Agency, 2002b), which provided guidance relating to noise limits from industrial installations in terms of absolute rating levels and rating levels relative to background noise levels (as defined in BS 4142:1997 (now superseded)) was withdrawn in February 2016. Therefore industry wide noise limits no longer apply.

National Planning Policy

National Planning Policy Framework (2018)

8.2.11 The National Planning Policy Framework (NPPF) was introduced in March 2012 and updated in 2018 (Ministry of Housing, Communities & Local Government (MHCLG), 2018). The document sets out the Government's planning policies for England and how these are expected to be applied.

8.2.12 The planning system is required to contribute to and enhance the natural and local environment. Consequently, the aim is to prevent both new and existing development from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of noise pollution.

8.2.13 The NPPF states that planning policies and decisions should aim to:

- "mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise from giving rise to significant adverse impacts on health and quality of life; 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".

8.2.14 With regards to 'adverse effects' and 'significant adverse effects' the NPPF (2018) refers to the Noise Policy Statement for England Explanatory Note (NPSE) (Department for Environment, Food and Rural Affairs (Defra), 2010), which is described below.

Noise Policy Statement for England

8.2.15 The Noise Policy Statement for England (NPSE) (Defra, 2010) seeks to clarify the underlying principles and aims in existing policy documents, legislation and guidance

that relate to noise. The NPSE applies to all forms of noise, including environmental noise, neighbour noise and neighbourhood noise.

8.2.16 The NPSE sets out the long term vision of the government's noise policy, which is to:

"promote good health and a good quality of life through the effective management of noise within the context of policy on sustainable development".

8.2.17 This long term vision is supported by three aims:

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

8.2.18 The long term policy vision and aims are designed to enable decisions to be made regarding what is an acceptable noise burden to place on society.

8.2.19 The 'Explanatory Note' within the NPSE provides further guidance on defining 'significant adverse effects' and 'adverse effects' using the concepts:

- No Observed Effect Level (NOEL) - the level below which no effect can be detected. Below this level no detectable effect on health and quality of life due to noise can be established;
- Lowest Observable Adverse Effect Level (LOAEL) - the level above which adverse effects on health and quality of life can be detected; and
- Significant Observed Adverse Effect Level (SOAEL) - the level above which significant adverse effects on health and quality of life occur.

8.2.20 The three aims can therefore be interpreted as follows:

- the first aim is to avoid noise levels above the SOAEL;
- the second aim considers situations where noise levels are between the LOAEL and SOAEL. In such circumstances, all reasonable steps should be taken to mitigate and minimise the effects. However, this does not mean that such adverse effects cannot occur; and
- the third aim seeks, where possible, to positively improve the health and quality of life through the pro-active management of noise whilst also taking account of the guiding principles of sustainable development. The Explanatory Note considers that the protection of quiet places and quiet times as well as the enhancement of the acoustic environment will assist with delivering this aim.

8.2.21 The NPSE recognises that it is not possible to have single objective noise-based measures that define the SOAEL, LOAEL and NOEL that are applicable to all sources of noise in all situations. The levels are likely to be different for different noise sources, receptors and at different times of the day.

Planning Practice Guidance

8.2.22 In March 2014, DCLG released its Planning Practice Guidance (PPG) web-based resource to support the NPPF (DCLG, 2014). The guidance at paragraph 003 (revision date 6 March 2014) advises that local planning authorities should consider:

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

8.2.23 This guidance introduced the additional concepts of NOAEL (No Observed Adverse Effect Level), and UAEL (Unacceptable Adverse Effect Level). Full details of the PPG on effects are provided in Table 8.1.

8.2.24 Factors to be considered in determining if noise is a concern are identified including the absolute noise level of the source, the existing ambient noise climate, time of day, frequency of occurrence, duration, character of the noise and cumulative impacts.

8.2.25 With particular regard to mitigating noise impacts on residential development the guidance highlights that impacts may be partially off-set if residents have access to a relatively quiet façade as part of their dwelling or a relatively quiet amenity space (private, shared or public).

Table 8.1: Planning Practice Guidance on Noise Exposure Hierarchy (Paragraph 005, revision date 6 March 2014)

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	Significant Observed Adverse Effect	Avoid

PERCEPTION	EXAMPLES OF OUTCOMES	INCREASING EFFECT LEVEL	ACTION
	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.		
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

Local Planning Policy

8.2.26 The North East Lincolnshire Local Plan 2013-2032 was adopted in March 2018 (North East Lincolnshire Council (NELC), 2018). The following policies from the Local Plan are considered relevant to the assessment of noise and vibration from the construction and operation of the Proposed Development:

- Policy 5 – Development boundaries; and
- Policy 47 – Future requirements for waste facilities.

Other Guidance

British Standard 7445-1:2003 and 7445-2:1991

8.2.27 BS 7445 'Description and measurement of environmental noise' (BSI, 1991 and 2003) defines parameters, procedures and instrumentation required for noise measurement and analysis.

British Standard 5228:2009+A1:2014

8.2.28 BS 5228-1 'Code of practice for noise and vibration control on construction and open sites. Noise' (BSI, 2014a) provides a 'best practice' guide for noise control, and includes Sound Power Level (Lw) data for individual plant as well as a calculation method for noise from construction activities. BS 5228-2 'Code of practice for noise and vibration control on construction and open sites. Vibration' (BSI, 2014b) provides comparable 'best practice' for vibration control, including guidance on the human response to vibration.

British Standard 7385:1993

8.2.29 BS 7385-2 'Evaluation and measurement for vibration in buildings. Guide to damage levels from groundborne vibration' (BSI, 1993) presents guide values for transient and continuous vibration, above which there is a likelihood of cosmetic damage. The standard establishes the basic principles for carrying out vibration measurements and processing the data, with regard to evaluating vibration effects on buildings.

British Standard 4142:2014

8.2.30 BS 4142 'Methods for rating and assessing industrial and commercial sound' (BSI, 2014) can be used for assessing the effect of noise of an industrial nature, including

mechanical services plant noise. The method is based on a comparison between the 'rating level' of the industrial noise and the 'background level' at the receptor position.

World Health Organisation

8.2.31 The World Health Organisation's (WHO) 'Guidelines for Community Noise' (WHO, 1999) recommend external daytime and evening environmental noise limits, and internal night-time limits to avoid sleep disturbance.

8.2.32 The WHO 'Night Noise Guidelines for Europe' (WHO, 2009) recommend updated guidelines on night-time noise limits to avoid sleep disturbance.

Calculation of Road Traffic Noise

8.2.33 CRTN (DfT/ Welsh Office, 1988) describes procedures for traffic noise calculation, and is suitable for environmental assessments of schemes where road traffic noise may have an effect.

Design Manual for Road and Bridges

8.2.34 DMRB Volume 11 Section 3 Part 7 HD213/11 (Revision 1) Traffic Noise and Vibration (Highways Agency, 2011) provides guidance on the appropriate level of assessment to be used when assessing the noise and vibration effects arising from all road projects, including new construction, improvements and maintenance. The guidance can also be used for assessing changes in traffic noise levels as a result of non-road projects.

8.3 Assessment Methodology and Significance Criteria

Consultation

8.3.1 Consultation was carried out with the Environmental Health Department at NELC (both directly and through the formal EIA Scoping process) to agree the measurement and assessment methodologies. The following was agreed:

- noise measurement locations and methodology;
- that a BS 4142 assessment should be undertaken and the Rating Level from noise from the operation of the Proposed Development should be no greater than 5 dB above the typical measured background noise level for daytime and night-time periods; and
- that an assessment of noise impacts from the increase in road traffic flows on public roads as a result of the construction and operation of Proposed Development be undertaken using the methodologies given in the Calculation of Road Traffic Noise (CRTN) (Department for Transport (DfT)/ Welsh Office, 1998) and the Design Manual for Roads and Bridges (DMRB) (Highways Agency, 2011).

Determining Baseline Conditions and Noise Sensitive Receptors

Noise Monitoring Locations and Protocol

8.3.2 The location of potential noise sensitive receptors (NSRs) in proximity to the Site has been considered when assessing the effects associated with noise and vibration levels from the construction and operational phases of the Proposed Development.

8.3.3 Key NSR locations have been selected which are considered to be representative of the nearest and potentially most sensitive existing receptors to the Site.

8.3.4 Long-term unattended ambient noise measurements has been undertaken at three locations and attended short-term monitoring at two further locations representative of residential NSR locations close to the Site and the Humber Estuary as an important ecological receptor located to the east. The noise monitoring locations and protocol

were discussed in advance with NELC. The locations are given in Table 8.2 and are shown on Figure 8.1 in ES Volume II.

Table 8.2: Monitoring locations

MONITORING LOCATION	ADDRESS	DETAILS
LT1	Poplar Farm, South Marsh Road	Located in the paddock to the north of Poplar Farm, approximately 1.35 km from the boundary of the Main Development Area.
LT2	Cress Cottage, Stallingborough	Located in corner of the garden to the north of Cress Cottage, approximately 1.52 km from the boundary of the Main Development Area. Representative of Cress Cottage, Field Cottage and Primrose Cottage.
LT3	South-eastern site boundary	Located along the south-eastern boundary of the Main Development Area, approximately 390 m from the existing South Humber Bank Power Station and 150 m from the existing cooling water pumping station.
ST1	Estuary edge	Along the wall bordering the Humber Estuary (Site of Special Scientific Interest (SSSI), Special Area of Conservation SAC, Special Protection Area (SPA), Ramsar site).
ST2	Mauxhall Farm, Immingham	Located to the north of the residential property at Mauxhall Farm, approximately 440 m from the A1173 and 380 m from the A180.

8.3.5 The long-term noise measurements were undertaken continuously between Wednesday 25th July and Wednesday 1st August 2018. Short-term attended noise measurements were undertaken during the day on Wednesday 25th July 2018. Noise measurements were undertaken using the methodology given in BS 7445-1: 2003. Further details relating to the noise monitoring are given in Appendix 8B in ES Volume III.

Weather Conditions

8.3.6 Weather conditions during the long-term surveys were generally dry with low wind speeds. There were some periods of rain and thunderstorms. The data collected during these periods has been omitted from the monitoring results.

Impact Assessment and Significance Criteria

8.3.7 Effects are classified based on the magnitude of the impact and the sensitivity or value of the affected receptor. The criteria for assigning the magnitude of impacts are outlined below for the various potential impacts during construction and operation.

Development Scenarios

8.3.8 As described in Chapter 4: The Proposed Development, there are a number of possible development scenarios – a single stream plant, a two stream plant built in a single phase, or a two stream plant built in two phases.

8.3.9 The assessment of noise and vibration impacts during construction considers different types of construction activity that would be required for the construction of any of the development scenarios, so the assessment is relevant to all development scenarios.

8.3.10 The assessment of noise and vibration impacts during operation considers the impacts of the two stream plant in operation as this development scenario would have the greatest impact (including the maximum predicted traffic volumes).

Estimated Construction Noise Impacts

8.3.11 Before the appointment of a construction contractor, site specific details on the construction activities, programme and number or type of construction plant are not available. Indicative construction noise predictions have been undertaken using the calculation methods set out in BS 5228:2009+A1:2014 'Code of practice for noise and vibration control on construction and open sites' (BSI, 2014a), based upon information for similar construction projects.

8.3.12 The calculation method provided in BS 5228 (BSI, 2014a) takes account of factors including the number and types of equipment operating, their associated Sound Power Levels (SWLs), their modes of operation (% on-times within the working period), the distance to NSRs, and the effects of any intervening ground cover or barrier/ topographical screening. This allows prediction of the magnitude of impact.

8.3.13 The subsequent assessment of construction noise 'effects' at residential NSRs (described in Section 8.5) is based on the guidance in 'example method 1 – the ABC method' as defined in BS 5228-1:2009+A1:2014 (BSI, 2014a). Table 8.3 (reproduced from BS 5228) provides guidance in terms of appropriate threshold values for residential NSRs, based upon existing ambient noise levels.

Table 8.3: Construction noise thresholds at residential dwellings

ASSESSMENT CATEGORY AND THRESHOLD VALUE PERIOD	THRESHOLD VALUE $L_{Aeq,T}$ DB(A) – FREE-FIELD		
	CATEGORY A (a)	CATEGORY B (b)	CATEGORY C (c)
Night-time (23:00 – 07:00)	45	50	55
Evenings and weekends (d)	55	60	65
Daytime (07:00 – 19:00) and Saturdays (07:00 – 13:00)	65	70	75
NOTE 1: A potential significant effect is indicated if the $L_{Aeq,T}$ noise level arising from the site exceeds the threshold level for the category appropriate to the ambient noise level. NOTE 2 If the ambient noise level exceeds the Category C threshold values given in the table (i.e. the ambient noise level is higher than the above values), then a potential significant effect is indicated if the total $L_{Aeq,T}$ noise level for the period increases by more than 3 dB due to site noise. NOTE 3: Applies to residential receptors only.			
(a) Category A: Threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are less than these values. (b) Category B: Threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are the same as Category A values. (c) Category C: Threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are higher than Category A values. (d) 19:00 – 23:00 weekdays, 13:00 – 23:00 Saturdays, 07:00 – 23:00 Sundays.			

8.3.14 For the appropriate period (day, evening, night, weekend etc.), the ambient noise level is determined and rounded to the nearest 5 dB and the appropriate Threshold Value is then derived. The predicted construction noise level is then compared with this Threshold Value. Based upon this BS 5228 ABC method (BSI, 2014a), the criterion adopted in this assessment for the determination of potentially significant effects is the exceedance of the $L_{Aeq,T}$ threshold level for the category appropriate to the ambient noise level at each NSR.

8.3.15 Based upon the above, the magnitude of the impact of construction noise is classified in accordance with the descriptors in Table 8.4.

Table 8.4: Magnitude of construction noise impacts

High	Exceedance of ABC Threshold Value by ≥5dB
Medium	Exceedance of ABC Threshold Value by up to 5dB
Low	Equal to or below the ABC Threshold Value by up to 5dB
Very Low	Below the ABC Threshold Value by ≥5dB

8.3.16 The criteria described above relate to impacts on human receptors. Impacts on ecological receptors cannot be assessed using the same criteria because ecological receptors have different responses to and effects from noise compared to humans. Therefore, whilst the noise impacts on ecological receptors are described in Section 8.6, the assessment of effects on ecological receptors is described in Chapter 10: Ecology and Nature Conservation and only summarised in this chapter.

Assessment of Construction Vibration Effects

8.3.17 Vibration due to construction activities has the potential to result in adverse impacts at nearby NSRs. The transmission of ground-borne vibration is highly dependent on the nature of the intervening ground between the source and receiver and the activities being undertaken. BS 5228-2: 2009+A1: 2014 'Code of Practice for Noise and Vibration Control on Construction and Open Sites - Vibration' (BSI, 2014b) provides data on measured levels of vibration for various construction works, with particular emphasis on piling. Impacts are considered for both damage to buildings and annoyance to occupiers.

8.3.18 With regards to annoyance, the magnitude of the impact of construction vibration from piling is classified with the descriptors in Table 8.5, taken from Table B.1 in BS 5228-2.

Table 8.5: Magnitude of construction vibration impacts

VIBRATION LEVEL PPV MMS^{-1}	EFFECT		MAGNITUDE OF IMPACT
10	Vibration is likely to be intolerable for any more than a brief exposure at this level.	Intolerable	High
1	It is likely that vibration of this level in residential environments will cause complaint but can be tolerated if prior warning and explanation has been given to residents.	Complaints likely	Medium
0.3	Vibration might just be perceptible in residential environments	Just perceptible	Low
0.14	Vibration may be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.	Complaints unlikely	Very Low

8.3.19 It has been assumed for the purposes of assessment that drop-hammer piling would be undertaken. This type of piling produces much higher levels of groundborne vibration than other piling methods, such as Continuous Flight Auger (CFA) piling.

8.3.20 Given the significant distance to residential receptors (>500 m), no significant vibration (medium or high magnitude impacts) is expected to result from the construction of the Proposed Development and therefore further assessment of vibration at residential receptors is scoped out.

8.3.21 Sensitive ecological receptors are located at the Humber Estuary and at fields located to the north and south of the Site, so vibration from piling works could affect ecological receptors. Vibration levels at the ecological areas have therefore also been reported.

Assessment of Operational Noise from the Proposed Development

8.3.22 Predicted operational noise levels will be assessed using the methodology given in BS 4142. A key aspect of the BS 4142 assessment procedure is a comparison between the Background Sound Level in the vicinity of residential locations and the Rating Level of the sound source under consideration. The relevant parameters in this instance are as follows:

- Background Sound Level – $L_{A90,T}$ – defined in the Standard as the ”A-weighted sound pressure level that is exceeded by the residual sound for 90% of a given time interval, T, measured using time weighting F and quoted to the nearest whole number of decibels”;
- Specific Sound Level – Ls ($L_{Aeq,Tr}$) – the “equivalent continuous A-weighted sound pressure level produced by the specific sound source at the assessment location over a given reference time interval, Tr”; and
- Rating Level – $L_{Ar,Tr}$ – the “specific sound level plus any adjustment made for the characteristic features of the sound”.

8.3.23 BS 4142: 2014 allows for corrections to be applied based upon the presence or expected presence of the following:

- *tonality*: up to +6 dB penalty;
- *impulsivity*: up to +9 dB penalty (this can be summed with tonality penalty); and
- *other sound characteristics* (neither tonal or impulsive but still distinctive): + 3 dB penalty.

8.3.24 Once any adjustments have been made, the background sound level and the rating level are compared. The standard states that:

- “typically, the greater the difference, the greater the magnitude of impact;
- a difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending upon the context; and
- a difference of around +5 dB is likely to be an indication of an adverse impact, depending upon the context.

8.3.25 The lower the rating level is to the measured background sound level, the less likely it is that the specific sound will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending upon the context.

8.3.26 Importantly, BS 4142:2014 (BSI, 2014) requires that the rating level of the noise source under assessment be considered in the context of the environment when defining the overall significance of the impact.

8.3.27 BS 4142:2014 (BSI, 2014) suggests that a one hour assessment period is considered during the day and a 15-minute assessment period at night.

8.3.28 Maintenance activities will be required periodically throughout the operational period, but as these are not part of the normal operation of the Proposed Development noise from maintenance activities is not specifically assessed in this Chapter. Similarly the predictions do not account for irregular emergency operations, such as boiler safety valves or steam turbine bypass valves in operation.

8.3.29 Table 8.6 gives the adopted magnitude of impact scale used in this assessment based upon the numerical level difference.

Table 8.6: Magnitude of impact for industrial noise including building services

MAGNITUDE OF IMPACT	BS 4142 DESCRIPTOR	RATING LEVEL – BACKGROUND SOUND LEVEL (B)
High	No BS 4142 descriptor for this magnitude level	>15
Medium	Indication of a significant adverse effect, depending upon context	+10 approx.
Low	Indication of an adverse effect, depending upon context	+5 approx.
Very Low	Indication of low impact, depending upon context	≤ 0

8.3.30 As described above in relation to construction noise, the criteria described above relate to impacts human receptors. Impacts on ecological receptors cannot be assessed using the same criteria because ecological receptors have different responses to and effects from noise compared to humans. Therefore, whilst the noise impacts on ecological receptors are described in Section 8.6, the assessment of effects on ecological receptors is described in Chapter 10: Ecology and Nature Conservation and only cross-referenced in this chapter.

Assessment of Operational Vibration

8.3.31 Based on experience of similar facilities, and due to the large distance between the Proposed Development and the closest residential NSRs (>1 km), the operation of the Proposed Development is unlikely to produce significant vibration levels at NSRs. Therefore further assessment of operational vibration is scoped out of this assessment.

Assessment of Road Traffic Noise during Construction and Operation

8.3.32 There is potential that the Proposed Development will have an impact on traffic flows on existing roads in the area surrounding the Site during construction and operation.

8.3.33 Forecast construction and operational traffic movements have been provided from the transport assessment (see Chapter 9: Traffic and Transport) in the format 18 hour AAWT data for the construction year of 2020 for the 'with' and 'without' construction scenarios, and the operational year of 2022 for the scenarios of 'with' and 'without' the Proposed Development in place.

8.3.34 The road traffic data has been inputted into the prediction models to determine the construction and operational noise impact of changes in road traffic noise as a result of the Proposed Development.

8.3.35 The criteria for the assessment of traffic noise changes arising from construction and operational road traffic have been taken from Table 3.1 of DMRB (Highways Agency, 2011) and are provided in Table 8.7 below.

Table 8.7: Traffic noise criteria

MAGNITUDE OF IMPACT	CHANGE IN TRAFFIC NOISE LEVEL LA10,18H DB
High	≥ 5

MAGNITUDE OF IMPACT	CHANGE IN TRAFFIC NOISE LEVEL LA10,18H DB
Medium	3 to <5
Low	1 to <3
Very Low	<1

8.3.36 The Humber Estuary SPA/SAC is approximately 385 m from the nearest road that will be used by Proposed Development traffic (i.e. the Site entrance) and therefore the assessment of road traffic impacts on ecological receptors has been scoped out.

Receptor Sensitivity

8.3.37 In accordance with the principles of environmental impact assessment, the sensitivity of existing receptors to noise (or vibration) impacts during either construction or operational phases has been defined in Table 8.8.

Table 8.8: Sensitivity of receptors

SENSITIVITY	DESCRIPTION	EXAMPLES OF RECEPTOR
High	Receptors where people or operations are particularly susceptible to noise or vibration. Sensitive ecological receptors known to be vulnerable to the effects of noise or vibration.	Residential. Quiet outdoor areas used for recreation. Schools/ educational facilities in the daytime. Hospitals/ residential care homes. Ecologically sensitive areas for example Special Protection Areas (SPAs), Special Areas of Conservation (SAC) etc.
Medium	Receptors moderately sensitive to noise or vibration where it may cause some distraction or disturbance.	Offices. Restaurants/ retail. Sports grounds when spectator or noise is not a normal part of the event and where quiet conditions are necessary (e.g. tennis, golf).
Low	Receptors where distraction or disturbance of people from noise or vibration is minimal.	Residences and other buildings not occupied during working hours. Factories and working environments with existing high noise levels. Sports grounds when spectator or noise is a normal part of the event.

Significance of Effects

8.3.38 The following terminology has been used in the assessment to define effects:

- adverse – detrimental or negative effects to an environmental resource or receptor;
- neutral – effects to an environmental resource or receptor that are neither adverse nor beneficial; or
- beneficial – advantageous or positive effect to an environmental resource or receptor.

8.3.39 The effect resulting from each individual potential impact type above is classified according to the magnitude of the impact and the sensitivity or value of the affected receptor using the matrix presented in Table 8.9 below, but where necessary also considering the context of the acoustic environment. This matrix is not the standard matrix set out in Chapter 2: Assessment Methodology because no receptors are classified as 'Very Low' sensitivity for the noise and vibration assessment.

Table 8.9: Classification of effects

SENSITIVITY OF RECEPTOR	MAGNITUDE OF IMPACT			
	HIGH	MEDIUM	LOW	VERY LOW
HIGH	Major	Moderate	Minor	Negligible
MEDIUM	Moderate	Minor	Negligible	Negligible
LOW	Minor	Negligible	Negligible	Negligible

8.3.40 Negligible and minor effects are considered to be not significant, whereas moderate and major effects are considered to be significant.

8.4 Baseline Conditions

Existing Baseline- Noise Survey Results

Long-term Monitoring Locations

8.4.1 The processed results from each noise survey position are provided in Tables 8.10 to 8.12 below. The L_{A90} values presented are the most frequently occurring 15-minute measurements within the specified time periods. Observations regarding the general baseline noise environment at each monitoring location are detailed after the tables. Further details on the noise monitoring are given in Appendix 8B.

Table 8.10: Measured noise level at LT1 – Poplar Farm

MONITORING LOCATION	DAY OF WEEK	TIME OF DAY	TIME PERIOD	$L_{Aeq,T}$ DB	TYPICAL $L_{A90,T}$ DB	L_{AFMAX} DB RANGE
LT1 – Poplar Farm	Monday - Friday	Day	07:00 – 23:00	54	47	51-87
		Day	09:00 – 10:00	53	48	56-82
		Night	23:00 – 07:00	52	41	49-88

MONITORING LOCATION	DAY OF WEEK	TIME OF DAY	TIME PERIOD	$L_{Aeq,T}$ DB	TYPICAL $L_{A90,T}$ DB	L_{AFMAX} DB RANGE
		Night	06:00 – 07:00	57	54	57-71
	Saturday - Sunday	Day	07:00 – 23:00	55	50	58-82
		Day	09:00 – 10:00	56	51	62-80
		Night	23:00 – 07:00	52	43	56-87
		Night	06:00 – 07:00	52	50	60-65

Table 8.11: Measured noise level at LT2 – Cress Cottage

MONITORING LOCATION	DAY OF WEEK	TIME OF DAY	TIME PERIOD	$L_{AEQ,T}$ DB	TYPICAL $L_{A90,T}$ DB	L_{AFMAX} DB RANGE
LT2 – Cress Cottage	Monday - Friday	Day	07:00 – 23:00	65	62	58-97
		Day	09:00 – 10:00	63	59	67-75
		Night	23:00 – 07:00	60	42	59-86
		Night	06:00 – 07:00	65	62	68-78
	Saturday - Sunday	Day	07:00 – 23:00	67	65	72-81
		Day	09:00 – 10:00	65	61	73-77
		Night	23:00 – 07:00	61	52	67-80
		Night	06:00 – 07:00	64	58	75-77

Table 8.12: Measured noise level at LT3 – South-eastern Site boundary

MONITORING LOCATION	DAY OF WEEK	TIME OF DAY	TIME PERIOD	$L_{AEQ,T}$ DB	TYPICAL $L_{A90,T}$ DB	L_{AFMAX} DB RANGE
LT3 – South-eastern Site Boundary (Humber Estuary)	Monday - Friday	Day	07:00 – 23:00	53	45	46-84
		Day	09:00 – 10:00	48	43	53-83
		Night	23:00 –	50	44	44-83

MONITORING LOCATION	DAY OF WEEK	TIME OF DAY	TIME PERIOD	$L_{AEQ,T}$ DB	TYPICAL $L_{A90,T}$ DB	L_{AFMAX} DB RANGE
			07:00			
		Night	06:00 – 07:00	50	48	51-81
	Saturday-Sunday	Day	07:00 – 23:00	51	48	47-77
		Day	09:00 – 10:00	51	45	53-72
		Night	23:00 – 07:00	49	45	49-69
		Night	06:00 – 07:00	47	45	50-65

Poplar Farm (LT1)

8.4.2 The dominant noise sources at this location during the daytime were noted to be distant road traffic noise from the A180 and traffic on local roads. Birdsong was also audible. At this location, noise from barking dogs close by occurred regularly. Whilst the existing South Humber Bank Power Station (SHBPS) was not audible, the background noise levels at this location will include the contribution of noise from the SHBPS.

Cress Cottage (LT2)

8.4.3 Noise within this area was observed to be dominated by road traffic noise from the A180. The background noise levels at this location include the contribution of noise from the SHBPS.

South-eastern Site Boundary (LT3)

8.4.4 Noise within this area was observed to be generally dominated by noise from the SHBPS, which was operating intermittently throughout the noise monitoring period. Noise from the pumping station associated with SHBPS and operations at the adjacent chemical plant (Synthomer) was also audible.

Estuary Edge (ST1)

8.4.5 The dominant noise source at the Estuary edge was waves breaking along the Estuary and birdsong. Distant broadband noise was also audible, possibly from the SHBPS pumping station or the neighbouring chemical plant. The background noise levels at this location include the contribution of noise from the SHBPS. A comparison of the measured levels at the Site boundary (LT3) and at the Estuary edge (ST1) has been undertaken in order to estimate likely daytime and night-time noise levels along the Estuary edge, and are given in Table 8.13.

Table 8.13: Measured noise level at ST1 – Estuary edge

TIME	PARAMETER	SOUTH-EASTERN SITE BOUNDARY	ESTUARY WALL	DIFFERENCE DB	OBSERVATIONS/ NOTES
14:45	$L_{Aeq,T}$ dB	44.0	54.4	10.4	Quad bike
15:00		44.7	48.8	4.1	
15:15		44.9	50.6	5.7	
15:30		45.2	54.5	9.3	Car turning 3 x motorbikes
14:45	$L_{A90,15min}$ dB	42.3	46.3	4	Quad bike
15:00		42.6	47.1	4.5	
15:15		42.9	48.4	5.5	
15:30		43.3	50.9	7.6	Car turning 3 x motorbikes
14:45	Highest $L_{AFmax,15min}$ dB	54.8	77.7	22.9	
15:00		51.3	61.2	9.9	Quad bike
15:15		53.1	62.7	9.6	
15:30		54.2	72.5	18.3	Car turning 3 x motorbikes

8.4.6 As indicated in Table 8.13, noise levels at the Estuary edge are higher than those at the Site boundary measurement location. Noise levels at the Estuary are regularly influenced by passing motor vehicles, in particular motorbikes. When there are no other additional noise sources influencing the noise climate at the Estuary edge, ambient and background levels are in the region of 5 dB higher at the Estuary edge than at the site boundary monitoring location (LT3). Therefore, to determine the daytime and night-time noise levels at the Estuary edge, the measured levels at the site boundary (LT3) have been increased by 5 dB. The resulting estimated ambient and background levels are given in Table 8.14.

Table 8.14: Estimated noise levels at Estuary edge

DAY OF WEEK	TIME OF DAY	TIME PERIOD	$L_{AEQ,T}$ AT SITE BOUNDARY DB	ESTIMATED $L_{AEQ,T}$ AT ESTUARY EDGE DB	TYPICAL $L_{A90,T}$ AT SITE BOUNDARY DB	ESTIMATE $L_{A90,T}$ AT ESTUARY EDGE DB
Monday - Friday	Day	07:00 – 23:00	53	58	57	62
	Day	09:00 – 10:00	48	53	43	48
	Night	23:00 – 07:00	50	55	45	50
	Night	06:00 – 07:00	50	55	48	53
Saturday- Sunday	Day	07:00 – 23:00	51	56	60	65
	Day	09:00 – 10:00	51	56	45	50
	Night	23:00 – 07:00	49	54	50	55
	Night	06:00 – 07;00	47	52	45	50

Mauxhall Farm (ST2)

8.4.7 There is the potential for increases in noise levels at Mauxhall Farm as a result of increases in road traffic flow once the Proposed Development is operational. Short-term attended noise monitoring was undertaken at Mauxhall Farm to determine the existing noise climate. Measured noise levels are given in Table 8.15.

Table 8.15: Measured noise level at ST2 – Mauxhall Farm

TIME OF DAY	TIME PERIOD	$L_{AEQ,T}$ DB	$L_{A90,15MIN}$ DB	HIGHEST $L_{AFMAX,15MIN}$ DB
Day	07:00 – 23:00	50	47	75

8.4.8 Road traffic on the A180 dominated the noise climate at Mauxhall Farm. Other noise sources included farm vehicles in nearby fields and birdsong.

8.5 Development Design and Impact Avoidance

Construction Noise

8.5.1 Measures to mitigate noise will be implemented during the construction phase of the Proposed Development in order to reduce impacts at local residential receptors, particularly with respect to activities required outside the proposed standard construction hours of 07:00 to 19.00 Monday to Saturday.

8.5.2 The construction contractor will follow Best Practicable Means to reduce the noise and vibration impacts to surrounding sensitive receptors. Best Practicable Means include the following (where practicable):

- all construction plant and equipment will comply with EU noise emission limits;
- proper use of plant with respect to minimising noise emissions – all vehicles and mechanical plant will be fitted with effective exhaust silencers and maintained in good efficient working order;
- selection of inherently quiet plant where appropriate – for example and where practicable major compressors will be 'sound reduced' models fitted with properly lined and sealed acoustic covers which will be kept closed whenever the machines are in use, and all ancillary pneumatic percussive tools will be fitted with mufflers or silencers of the type recommended by the manufacturers;
- machines in intermittent use will be shut down in the intervening periods between work or throttled down to a minimum;
- materials should be handled with care and be placed, not dropped. Materials should be delivered during standard working hours where possible;
- all ancillary plant such as generators, compressors and pumps will be positioned so as to cause minimum noise disturbance, i.e. furthest from receptors or behind close boarded noise barriers; if necessary, acoustic enclosures will be provided and/or acoustic shielding; and
- construction contractors will be obliged to adhere to the codes of practice for construction working and piling given in BS 5228 and the guidance given therein minimising noise emissions from the Site.

Operational Noise

8.5.3 The Proposed Development will be operated in accordance with an Environmental Permit, issued and regulated by the Environment Agency. This will require operational noise from the generating station within the Proposed Development to be controlled through the use of BAT, which will be determined and regulated through an Environmental Permit.

8.6 Likely Impacts and Effects

Identification and Evaluation of Significant Effects

Sensitive Receptors

8.6.1 The NSRs for the construction and operational assessments are given in Table 8.16 below, and are presented on Figure 8.1 in ES Volume II.

Table 8.16: Selected NSRs

RECEPTOR REFERENCE	DETAILS
R1	Poplar Farm, South Marsh Road
R2	Cress Cottage/ Field Cottage, Stallingborough
R3	Humber Estuary (SSSI, SAC, SPA, Ramsar)
R4	Field to the south of the site (non-statutory ecological receptor)
R5	Field to the north of the site (non-statutory ecological receptor)
R6	Mauxhall Farm, Immingham

Construction Noise and Vibration

8.6.2 This section discusses the potential noise and vibration effects on NSRs arising during the construction phase of the Proposed Development.

8.6.3 Noise levels experienced by NSRs during such works depend upon a number of variables, the most significant of which are:

- the noise generated by plant or equipment used on Site, generally expressed as Sound Power Levels (Lw) or the vibration generated by the plant;
- the periods of use of the plant on Site, known as its on-time;
- the distance between the noise/ vibration source and the NSR;
- the noise attenuation due to ground absorption, air absorption and barrier effects;
- in some instances, the reflection of noise due to the presence of hard surfaces such as the sides of buildings; and
- the time of day or night the works are undertaken.

8.6.4 Residential NSRs are located at distance to the west and south-west of the Site. The closest residential NSRs to the Site are Poplar Farm to the west and Field Cottage to the south-west. The Humber Estuary Ramsar, SAC, SPA and SSSI is located to the north-east, with further non-statutory wildlife areas to the immediate north and south of the Site. Due to the distance between the Site and Mauxhall Farm (>3 km), construction noise predictions have not been undertaken for this NSR.

8.6.5 It is anticipated that construction works will be undertaken during the period Monday to Saturday, 07:00 to 19:00.

Construction Noise Emission Criteria

8.6.6 Based upon the analysis and summary of the results of the existing free-field baseline ambient noise surveys undertaken for the Proposed Development, Table 8.17 sets out the BS 5228 ‘ABC’ noise threshold categories (BSI, 2014) at each NSR, as set out in Table 8.3.

Table 8.17: Measured free-field $L_{Aeq,T}$ noise levels and associated 'ABC' assessment category

RECEPTOR	DAYTIME 07:00 – 19:00		
	AMBIENT NOISE LEVEL $L_{AEQ,T}$ DB*	ABC CATEGORY	CONSTRUCTION NOISE LIMIT $L_{AEQ,T}$ DB (FREE-FIELD)
R1 – Poplar Farm	54	A	65
R2 – Cress Cottage/ Field Cottage	65	A	70
R3 – Humber Estuary	58	N/A	N/A
R4 – Field to the south of the Site	53*	N/A	N/A
R5 – Field to the north of the Site	53*	N/A	N/A

* The ambient noise level at these locations has been assumed to be the same as those measured at monitoring location LT3.

Predicted Construction Noise Levels

8.6.7 Predicted noise levels for construction of the Proposed Development have been based upon construction methods used for other similar developments. As a conservative approach, it is assumed that all plant and activities will be taking place at the closest approach to each NSR, whereas in reality this may not always be the case and, in any event, activities are unlikely to occur for any significant duration.

8.6.8 The predicted levels apply to normal weekday daytime (07:00 – 19:00) working. Full details on the noise prediction methodology, including a full list construction plant and associated sound power levels for each construction phase, are presented in Appendix 8C.

8.6.9 A summary of predicted noise levels at NSR locations around the Site are presented in Table 8.18. For residential receptors, free-field noise levels have been predicted to allow subsequent comparison with the ABC categories derived from free-field baseline ambient noise levels at NSRs. At Receptors R4 (field to the south of the Site) and R5 (field to the north of the Site) a range of predicted noise levels has been given to access impacts across these areas to inform the assessment of effects in Chapter 10: Ecology and Nature Conservation. Receptor R3 (Humber Estuary), Receptor R4 (field to south of the Site) and Receptor R5 (field to the north of the Site), are discussed after Table 8.20.

Table 8.18: Predicted construction noise levels

ACTIVITY	PREDICTED FREE-FIELD NOISE LEVEL FOR DAYTIME CONSTRUCTION ACTIVITY DB LAEQ,1H				
	R1	R2	R3	R4	R5
Site clearance	36	35	49	44-71	42-64
Earthworks	34	33	47	42-69	40-62
Drop hammer piling	48	48	62	55-71	54-74
Foundations	38	37	51	45-61	43-63
Slab construction	37	37	51	44-60	43-63
Building construction	37	36	50	43-60	42-62
Fitting out	35	35	49	42-58	41-61
Access roads & hardstanding	38	38	52	46-73	44-67

Construction Noise Effects

8.6.10 A comparison of the predicted noise levels at NSRs R1 and R2 with the threshold values is given in Table 8.19.

Table 8.19: Predicted construction noise level above threshold value

ACTIVITY	R1			R2		
	PREDICTED LAEQ,1H DB	CONSTRUCTION LIMIT	LEVEL ABOVE LIMIT	PREDICTED LAEQ,1H DB	CONSTRUCTION LIMIT	LEVEL ABOVE LIMIT
Site clearance	36	65	-29	35	70	-35
Earthworks	34	65	-31	33	70	-37
Drop hammer piling	48	65	-17	48	70	-22
Foundations	38	65	-27	37	70	-33
Slab construction	37	65	-28	37	70	-33
Building construction	37	65	-28	36	70	-34
Fitting out	35	65	-30	35	70	-35
Access roads & car parking	38	65	-27	38	70	-32

8.6.11 The effects of the predicted daytime construction noise levels on NSRs R1 and R2 have been classified by considering the daytime ABC noise threshold values in Tables 8.18

and 8.19, and using the semantic scales in Tables 8.8 and 8.9. These effects are summarised in Table 8.20 below.

Table 8.20: Daytime construction noise effects

CONSTRUCTION ACTIVITY	R1	R2
Site clearance	Negligible adverse	Negligible adverse
Earthworks	Negligible adverse	Negligible adverse
Drop hammer piling	Negligible adverse	Negligible adverse
Foundations	Negligible adverse	Negligible adverse
Slab construction	Negligible adverse	Negligible adverse
Building construction	Negligible adverse	Negligible adverse
Fitting out	Negligible adverse	Negligible adverse
Access roads & car parking	Negligible adverse	Negligible adverse

8.6.12 Noise effects at all residential receptors during construction of the Proposed Development are predicted to be negligible adverse (not significant) during all construction activities.

8.6.13 At Receptor R3 (Humber Estuary), predicted noise levels during all but one construction activity fall below the ambient noise level of 58 dB L_{Aeq} so no impact is predicted. During drop hammer piling works, noise levels at R3 are predicted to exceed the ambient noise level by up to 4 dB. In addition, the type of noise being emitted by drop hammer piling (regular impulsive high noise levels) may be considered as more disturbing to birds. Considering to the position of the birds (on mudflats behind the existing flood defence embankment), the ecological impact assessment considers the effect on birds to be minor adverse (not significant) (see Chapter 10: Ecology and Nature Conservation).

8.6.14 At the ecological Receptor areas R4 (field to the south of the Site) and R5 (field to the north of the Site), noise from construction works varies across each area depending on the proximity to the Site. At locations close to the Site, ambient noise levels are exceeded by up to 21 dB. At locations furthest from the Site, noise levels are predicted to fall below ambient noise levels. The greatest noise impact is predicted to occur during piling works. The ecological impact assessment in Chapter 10: Ecology and Nature Conservation concludes that the majority of waterbirds will be located towards the central and eastern parts of the southern field (R4) where the effect of piling noise on birds at R4 is assessed to be moderate adverse (significant) if piling takes place within the winter months when the highest aggregations of waterbirds are present in the field (September to March inclusive). Mitigation of this potential effect is discussed further in Section 8.7 and Chapter 10: Ecology and Nature Conservation. The ecological impact assessment concludes that the effect on waterbirds using the fields to the north of the Site (R5), where the predicted piling noise levels are lower, will be minor adverse (not significant) even if piling takes place within the winter months (see Chapter 10: Ecology and Nature Conservation).

Construction Traffic Noise

8.6.15 The predicted $L_{A10,18h}$ levels at the residential NSRs around the Site due to construction traffic on public roads are presented in Table 8.21.

Table 8.21: Road traffic noise - construction

RECEPTOR	FLOOR LEVEL	PREDICTED NOISE LEVELS FROM ROAD TRAFFIC $L_{A10,18H}$ DB		CHANGE IN $L_{A10,18H}$ AS A RESULT OF CONSTRUCTION TRAFFIC ON PUBLIC ROADS
		2020 BASE + COMMITTED	2020 BASE + COMMITTED + CONSTRUCTION	
R1 – Poplar Farm	Ground	53.0	53.1	+0.1
R2 - Cress Cottage/ Field Cottage	Ground	58.9	58.92	+0.0
	First	60.8	60.8	+0.0
R6 – Mauxhall Farm	Ground	57.0	57.1	+0.1
	First	58.2	58.3	+0.1

8.6.16 The significance of effect of changes in road traffic noise levels is given in Table 8.22.

Table 8.22: Changes in road traffic levels during construction – significance of effect

RECEPTOR	FLOOR LEVEL	CHANGE IN ROAD TRAFFIC NOISE DB	MAGNITUDE OF IMPACT	RECEPTOR SENSITIVITY	CLASSIFIC-ATION OF EFFECT
R1 – Poplar Farm	Ground	+0.1	Very low	High	Negligible adverse
R2 - Cress Cottage/ Field Cottage	Ground	+0.0	Very low	High	Negligible adverse
	First	+0.0	Very low	High	Negligible adverse
R6 – Mauxhall Farm	Ground	+0.1	Very low	High	Negligible adverse
	First	+0.1	Very low	High	Negligible adverse

8.6.17 As shown in Table 8.22, the change in road traffic noise levels as a result of construction traffic during construction of the Proposed Development will result in negligible effects (not significant) at the selected residential NSRs.

Construction Vibration

8.6.18 It has been assumed for the purposes of assessment that drop-hammer piling will be required. This type of piling produces much higher levels of groundborne vibration compared to other piling methods. However, given the significant distance to residential receptors (>500 m), no significant vibration (medium or high magnitude impacts) is expected to result from the proposed construction at residential receptors.

8.6.19 Sensitive receptors at the Humber Estuary and the fields located to the south and north of the Site may be adversely affected from vibration during piling. Estimated vibration levels at the Humber Estuary and ecological Receptor areas R4 (field south of the Site) and R5 (field north of the Site) are given in Table 8.23 below.

Table 8.23: Predicted Vibration Levels at Ecological Areas from Drop-Hammer Piling

RECEPTOR	DISTANCE FROM PILING WORKS (M)	ESTIMATED VIBRATION LEVEL PPV MMS^{-1}	MAGNITUDE OF IMPACT	RECEPTOR SENSITIVITY	CLASSIFIC-ATION OF EFFECT
R3 – Humber Estuary	500	0.34	Low	High	Minor adverse
R4 – field south of Site	100 - 615	<0.34 to 2.7	Low to Medium	High	Minor to moderate adverse
R5 – field north of Site	75 to 490	<0.34 to 4.3	Low to Medium	High	Minor to moderate adverse

8.6.20 The classification of vibration effects described in Table 8.23 above and discussed below is based on standards and guidance for human receptors in the absence of standards or guidance for assessment of vibration effects on ecological receptors.

8.6.21 The estimated vibration levels at the Humber Estuary are predicted to result in a low magnitude of impact, resulting in a minor adverse (not significant) effect. Although vibration levels may just be perceptible, vibration will be caused along the Estuary from the breaking of waves and will likely mask vibration incident along the Humber Estuary.

8.6.22 At Receptors R4 (field south of the Site) and R5 (field north of the Site), vibration levels at the closest part of the field to the piling works are estimated to result in a moderate adverse (significant) effect, and at locations further from the construction works, the significance of effect is estimated to be minor adverse (not significant). The effects of vibration from piling on birds using these fields will be the same as described for piling noise in paragraphs 8.6.13 and 8.6.14 above, and the mitigation is the same (see Section 8.7 and Chapter 10: Ecology and Nature Conservation).

Operational Noise

Operation of the Proposed Development

8.6.23 A noise propagation model has been developed in the SoundPLAN suite of programs to assess the effects of the Proposed Development. SoundPLAN implements the noise prediction method ISO 9613-2: 1996 'Attenuation of sound during propagation outdoors' (ISO, 1996), which has been employed to calculate noise levels at surrounding NSRs due to noise breakout from the proposed buildings and plant at the Proposed Development and also HGVs on Site during operation of the Proposed Development. The model consists of a detailed three-dimensional representation of the Proposed Development and surroundings, including existing buildings, residential receptors, topography and ground conditions.

8.6.24 Operational noise modelling has been undertaken for the Proposed Development for a number of scenarios, depending on operational traffic. These scenarios are:

- Scenario 1: worst-case hour during the day (09:00 – 10:00);
- Scenario 2: worst-case hour at night including HGVs (06:00 – 07:00); and
- Scenario 3: typical one-hour at night – no HGVs (23:00 – 06:00)

8.6.25 Details of the settings used in the noise modelling software and information of the sound data and building fabric assumed are presented in Appendix 8D.

Operational Noise Levels at Residential Receptors

8.6.26 The predicted $L_{Aeq,1h}$ levels at the residential NSRs around the Site as a result of the operation of the Proposed Development are presented in Table 8.24.

Table 8.24: Predicted operational noise levels

RECEPTOR	FLOOR LEVEL	PREDICTED NOISE LEVELS FROM OPERATION $L_{AEQ,1H}$ DB		
		SCENARIO 1: WORST-CASE HOUR – DAY (09:00 – 10:00)	SCENARIO 2: WORST-CASE HOUR – NIGHT (06:00 – 07:00)	SCENARIO 3: TYPICAL HOUR - NIGHT (NO HGVS) (23:00 – 06:00)
R1 – Poplar Farm	Ground	35	35	34
R2 – Cress Cottage/ Field Cottage	Ground	34	-	-
	First	-	35	34

8.6.27 The BS 4142 assessments for NSRs R1 and R2 are presented in Table 8.25 for the closest residential receptors during the worst-case hour during the day (Scenario 1). A penalty of 3 dB has been added to the specific sound level to determine the Rating Level to account for intermittency as a result of HGV arrivals and departures.

8.6.28 In addition, the magnitude of impact and effect classification has been included based upon the BS 4142 assessment outcomes, with reference to the semantic scales in Tables 8.7 and 8.8. The representative background sound levels used are those

presented in Tables 8.10 and 8.11, to present an assessment against existing baseline conditions.

Table 8.25: BS 4142 assessment - Scenario 1: worst-case hour daytime 09:00-10:00

RECEPTOR	R1 – POPLAR FARM	R2 – CRESS COTTAGE/ FIELD COTTAGE
Specific Sound Level Ls ($L_{Aeq,Tr}$), dB	35	34
Acoustic feature correction, dB	+3	+3
Rating Level ($L_{Ar,Tr}$), dB	38	37
Representative Background Sound Level ($L_{A90,T}$), dB	48	59
Excess of rating level over background sound level ($L_{Ar,Tr}$ - $L_{A90,T}$), dB	-10	-22
BS 4142:2014 assessment outcome	Low impact	Low impact
Magnitude of impact	Very low	Very low
Classification of effect	Negligible adverse	Negligible adverse

8.6.29 During the worst-case hour during the daytime, effects are categorised as negligible adverse (not significant) for both NSRs, with no specifically designed mitigation in place.

8.6.30 The BS 4142 assessment for the worst-case hour at night (Scenario 2) is presented in Table 8.24. A penalty of 3 dB has been added to the specific sound level to determine the Rating Level to account for intermittency as a result of HGV arrivals and departures.

Table 8.26: BS 4142 assessment - Scenario 2: worst-case hour night-time 06:00-07:00

RECEPTOR	R1 – POPLAR FARM	R2 – CRESS COTTAGE/ FIELD COTTAGE
Specific Sound Level Ls ($L_{Aeq,Tr}$), dB	35	35
Acoustic feature correction, dB	+3	+3
Rating Level ($L_{Ar,Tr}$), dB	38	38
Representative Background Sound Level ($L_{A90,T}$), dB	50	58
Excess of rating level over background sound level ($L_{Ar,Tr}$ - $L_{A90,T}$), dB	-12	-20
BS 4142:2014 assessment outcome	Low impact	Low impact
Magnitude of impact	Very low	Very low
Classification of effect	Negligible adverse	Negligible adverse

8.6.31 During the worst-case hour at night (06:00 – 07:00), effects are categorised as negligible adverse (not significant) for both NSRs, with no specifically designed mitigation in place.

8.6.32 The BS 4142 assessment for a typical hour at night with no HGV movements (Scenario 3) is presented in Table 8.27. No penalty has been added to the specific noise level.

Table 8.27: BS 4142 assessment - Scenario 3: typical hour night-time no HGVs 23:00-06:00

RECEPTOR	R1 – POPLAR FARM	R2 – CRESS COTTAGE/ FIELD COTTAGE
Specific Sound Level Ls ($L_{Aeq,Tr}$), dB	34	34
Acoustic feature correction, dB	0	0
Rating Level ($L_{Ar,Tr}$), dB	34	34
Representative Background Sound Level ($L_{A90,T}$), dB	41	42
Excess of rating level over background sound level ($L_{Ar,Tr}$ - $L_{A90,T}$), dB	-7	-8
BS 4142:2014 assessment outcome	Low impact	Low impact
Magnitude of impact	Very low	Very low
Classification of effect	Negligible adverse	Negligible adverse

8.6.33 During the night-time period when there will be no deliveries of waste (23:00 – 06:00), effects are categorised as negligible adverse (not significant) for both NSRs, with no specifically designed mitigation in place.

8.6.34 Given that operation of the Proposed Development will be 24 hours, provided that noise levels are acceptable during the worst-case night-time hour of 06:00 – 07:00 (when the Proposed Development is fully operational and there is the greatest predicted number of HGV movements), they will be acceptable during the daytime period when existing ambient noise levels are higher.

Operational Noise Levels at Ecological Sites

8.6.35 Predicted operational noise levels at ecological sites close to the Proposed Development during the three operational scenarios are given in Tables 8.28 to 8.30. A noise contour map illustrating predicted noise levels at the Humber Estuary and the fields to the north and south of the Site during the worst-case night-time hour of 06:00 – 07:00 are given in Figure 8.2 in ES Volume II.

Table 8.28: Predicted operational noise levels: R3 – Humber Estuary

RECEPTOR	PREDICTED NOISE LEVELS FROM OPERATION $L_{AEQ,1H}$ DB		
	SCENARIO 1: WORST-CASE HOUR – DAY (09:00 – 10:00)	SCENARIO 2: WORST-CASE HOUR – NIGHT (06:00 – 07:00)	SCENARIO 3: TYPICAL-CASE HOUR – NIGHT (NO HGVS) (23:00 – 06:00)
Predicted noise level $L_{Aeq,T}$ dB	47	47	46
Ambient noise level $L_{Aeq,T}$ dB	53	52	54
Ambient + Predicted $L_{Aeq,T}$ dB	54	53	55
Increase in ambient dB	+1	+1	+1

Table 8.29: Predicted operational noise levels: R4 – Field to South

RECEPTOR	PREDICTED NOISE LEVELS FROM OPERATION $L_{AEQ,1H}$ DB		
	SCENARIO 1: WORST-CASE HOUR – DAY (09:00 – 10:00)	SCENARIO 2: WORST-CASE HOUR – NIGHT (06:00 – 07:00)	SCENARIO 3: TYPICAL-CASE HOUR – NIGHT (NO HGVS) (23:00 – 06:00)
Predicted noise level $L_{Aeq,T}$ dB	45-61	45-62	44-55
Ambient noise level $L_{Aeq,T}$ dB	48	50	50
Ambient + Predicted $L_{Aeq,T}$ dB	50-61	51-63	51-56
Increase in ambient dB	+2 to +13	+1 to +13	+1 to +6

Table 8.30: Predicted operational noise levels: R5 – Field to North

RECEPTOR	PREDICTED NOISE LEVELS FROM OPERATION $L_{AEQ,1H}$ DB		
	SCENARIO 1: WORST-CASE HOUR – DAY (09:00 – 10:00)	**SCENARIO 2: WORST-CASE HOUR – NIGHT (06:00 – 07:00)**	**SCENARIO 3: TYPICAL-CASE HOUR – NIGHT (NO HGVS) (23:00 – 06:00)**
Predicted noise level $L_{Aeq,T}$ dB	41-59	41-59	40-58
Ambient noise level $L_{Aeq,T}$ dB*	48	50	50
Ambient + Predicted $L_{Aeq,T}$ dB	49-59	51-60	50-59
Increase in ambient dB	+1 to +11	+1 to +10	0 to +9

* For a worst-case assessment, ambient noise levels at this Receptor are assumed to be the same as at R4.

8.6.36 At Receptor R3 (Humber Estuary), predicted noise levels are 5 dB below the weekend ambient noise level of 52 dB L_{Aeq} during the worst-case hour at night (06:00 – 07:00). This results in an increase in the ambient level of no more than 1 dB. The assessment in Chapter 10: Ecology and Nature Conservation therefore concludes that there will be no effect on Receptor R3.

8.6.37 At the closest parts of Receptors R4 (field south of the Site) and R5 (field north of the Site), noise impacts from the operation of the Proposed Development are predicted to be greater due to proximity. As expected, at locations closest to the Proposed Development, noise levels are higher than at locations located further away.

8.6.38 The increase in the ambient noise level across the fields to the south of the Site (R4) is predicted to be between 1 dB and 6 dB during the night (when there are no HGV movements) and between 2 dB and 13 dB during the day. During the worst-case night-time hour (06:00 – 07:00) when the number of HGVs entering and leaving the Site is predicted to be at its highest, the ambient noise level is predicted to increase from between 1 and 13 dB. As discussed in Chapter 10: Ecology and Nature Conservation, based on studies of the waterbird behaviour, waterbirds will tend to use parts of the field closest to the Estuary and away from field boundary features, which are further away from the Main Development Area; at these locations the noise levels will be similar to ambient levels, so the effect on waterbirds at R4 is considered to be neutral (not significant).

8.6.39 At Receptor R5 (the field north of the Site), noise from the operation of the Proposed Development is predicted to increase the ambient noise level between 1 and 9 dB during the night (when there are no HGV movements). During the day, and also during the hours of 06:00-07:00 (when there are HGV movements), ambient levels are expected to increase by between 1 and 11 dB. This is due to all vehicles entering and leaving the Site travelling along South Marsh Lane. As waterbirds will tend to use parts of the field away from field boundary features and therefore further away from the Main

Development Area (see paragraph 8.6.37 above and Chapter 10: Ecology and Nature Conservation), at these locations the noise impact will be similar to ambient levels, so the effect on waterbirds is assessed in Chapter 10: Ecology and Nature Conservation to be neutral (not significant).

8.6.40 With regards to L_{AFmax} levels during operation of the Proposed Development, it is not expected that significant L_{AFmax} events will occur at the Site which will be audible along the Humber Estuary or at the fields located to the north and south of the Site (Receptors R4 and R5). The activities that are likely to result in the highest L_{AFmax} levels are the tipping of waste into the bunker when it is delivered and the placing of waste into the shredder. As these activities are undertaken within the fuel reception hall and fuel bunker parts of the building, L_{AFmax} levels from these activities are unlikely to be audible at the Estuary but may be just perceptible at the ecological Receptor areas to the north and south of the Site (R4 and R5).

8.6.41 In summary, the ecological impact assessment (see Chapter 10: Ecology and Nature Conservation) concludes that operational noise effects on Receptors R3, R4 and R5 will be neutral (not significant).

Changes in Operational Road Traffic Noise

8.6.42 Noise modelling has been undertaken to determine the change in road traffic noise levels as a result of the operation of the Proposed Development.

8.6.43 Details of the settings used in the noise modelling software are presented within Appendix 8C in ES Volume III.

8.6.44 The predicted $L_{A10,18h}$ levels at the residential NSRs are presented in Table 8.31.

Table 8.31: Predicted noise levels with and without the Proposed Development

RECEPTOR	FLOOR LEVEL	PREDICTED NOISE LEVELS FROM ROAD TRAFFIC $L_{A10,18H}$ DB		CHANGE IN $L_{A10,18H}$ AS A RESULT OF THE OPERATION OF THE PROPOSED DEVELOPMENT
		2022 WITHOUT DEVELOPMENT	2022 WITH DEVELOPMENT	
R1 – Poplar Farm	Ground	53.1	53.3	+0.2
R2 - Cress Cottage/ Field Cottage	Ground	59.2	59.2	0
	First	61.0	61.1	+0.1
R6 – Mauxhall Farm	Ground	57.3	57.6	+0.3
	First	58.5	58.7	+0.2

8.6.45 The classification of effect as a result of changes in road traffic noise levels is given in Table 8.32.

Table 8.32: Changes in road traffic levels – classification of effect

RECEPTOR	FLOOR LEVEL	CHANGE IN ROAD TRAFFIC NOISE DB	MAGNI-TUDE OF IMPACT	RECEPTOR SENSITIVITY	CLASSIFIC-ATION OF EFFECT
R1 – Poplar Farm	Ground	+0.2	Very low	High	Negligible adverse
R2 - Cress Cottage/ Field Cottage	Ground	0	Very low	High	Negligible adverse
	First	+0.1	Very low	High	Negligible adverse
R6 – Mauxhall Farm	Ground	+0.3	Very low	High	Negligible adverse
	First	+0.2	Very low	High	Negligible adverse

8.6.46 As shown in Table 8.32, the change in road traffic noise levels as a result of the operation of the Proposed Development will result in negligible adverse (not significant) effects at the selected residential receptors.

Decommissioning

8.6.47 Noise and vibration during decommissioning would result in broadly similar levels of impacts and effects to those presented for the construction of the Proposed Development (with the exception of piling impacts). The potential impacts and effects would require further consideration at the decommissioning stage of the Proposed Development, but potential measures to ensure that appropriate mitigation is in place during the works have already been discussed in Section 8.5 Development Design and Impact Avoidance.

8.7 Mitigation and Enhancement Measures

Construction

8.7.1 As no significant noise effects are predicted to occur during construction activities at residential receptors (R1, R2, and R6), no additional mitigation is required.

8.7.2 The assessment has predicted that during piling works, noise levels at the Humber Estuary and at the ecological areas located to the north and south of the Site (R4 and R5) will be higher than the ambient noise levels however this will be temporary in duration. The ecological impact assessment (Chapter 10: Ecology and Nature Conservation) concludes that the effect on waterbirds using the field to the south of the Site is significant if piling takes place in the winter months (September to March inclusive).

8.7.3 Mitigation is therefore required to avoid significant adverse effects on waterbirds using the field to the south of the Site during piling activities. Alternative piling methods may be used to reduce the noise impact, e.g. Continuous Flight Auger (CFA) piling. At R4, the residual effect using CFA piling would reduce to 62 dB at the closest part of the field

to the Site (exceeding the ambient levels by up to 9 dB), and between 42 dB and 47 dB at locations further from the Site (below the ambient levels). In addition, the nature of the noise from CFA piling is less disturbing to birds as there is no impulsive noise.

8.7.4 Alternatively seasonal restrictions on piling activities may be used to avoid impacts by not using drop hammer piling for two hours either side of high tide between September and March (inclusive) (see Chapter 10: Ecology and Nature Conservation, Section 10.7).

8.7.5 At this stage, the piling noise mitigation measures to be employed have not been fixed to allow sufficient flexibility for the contractor to determine the best available technique for noise abatement during piling works, but a commitment for the contractor to implement appropriate mitigation is made and details will be agreed with North East Lincolnshire Council prior to piling works commencing.

Operation

8.7.6 A worst-case assessment has been undertaken and the resulting predicted levels fall well below background and ambient noise levels at NSRs and no significant noise or vibration effects are predicted to occur as a consequence of the operation of the Proposed Development. However, the following best practice methods to reduce noise impacts upon the closest NSRs will be considered during the detailed design of the Proposed Development, including:

- the selection of quiet plant to reduce noise emissions;
- the selection of external cladding that provides a minimum weighted sound reduction of 27 dB Rw;
- the selection of louvres/ baffles that provide a minimum weighted sound reduction of 11 dB Rw;
- the potential to design an acoustically treated stack – the stack is the dominant source contributor to the overall noise levels, therefore providing acoustic attenuation to the stack will help to reduce the overall predicted noise levels, particularly to the Humber Estuary and other ecological receptors; and
- the potential to design cladding, louvres/baffles, silencers and air inlets to reduce tonal noise from the Proposed Development during its operation.

8.8 Limitations or Difficulties

8.8.1 Detailed construction information is not yet available as the contractor has not yet been appointed and therefore this assessment draws upon the experience of assessments undertaken from similar developments.

8.8.2 Lists of assumptions made during the noise modelling and assessment of the Proposed Development are as presented within Appendix 8D in ES Volume III. It is considered that the assumptions made will have led to a conservative ('worst case') assessment. The detailed design stage will ensure that appropriate noise limits are achieved at NSRs, and this will be secured through the environmental permit and conditions attached to the planning permission.

8.9 Residual Effects and Conclusions

Construction

8.9.1 During the construction of the Proposed Development, noise levels at the closest residential NSRs are predicted to fall well below the ambient noise levels. No significant effects on residential properties are predicted.

8.9.2 The use of alternative piling methods e.g. CFA piling would reduce the noise to 50 dB $L_{Aeq,1h}$ to mitigate impacts on waterbirds in the fields to the south of the Site (R4). This is up to 8 dB below the ambient noise level measured at the Site boundary. In addition, the nature of the noise from CFA piling is less disturbing to birds as there is no impulsive noise. Alternatively seasonal restrictions on drop-hammer piling (piling restricted for two hours either side of high tide in the period September to March inclusive) could be used to avoid significant effects on waterbirds. Whilst the specific mitigation measures are not fixed at this stage to allow flexibility for the contractor, the commitment to implement appropriate mitigation reduces the moderate adverse (significant) effect at Receptor R4 before mitigation to a residual minor adverse effect (not significant) (see Chapter 10: Ecology and Nature Conservation).

8.9.3 Due to the distance to the nearest NSRs, vibration incident on residential properties from the construction of the Proposed Development has been scoped out. At the Humber Estuary, vibration levels are estimated to be just perceptible, resulting in a minor adverse effect which is not significant, particularly when considered in the context of existing sources of vibration within the Estuary, such as waves. At the ecological areas to the north and south of the Site (Receptors R4 and R5), vibration levels from piling are estimated to be significant at the closest parts of the fields to the Site, but reduce with distance. The effects on birds using these fields have been assessed by the consideration of piling noise effects, and the vibration effects will be the same. The use of alternative piling methods, such as CFA piling, would result in vibration levels of approximately 0.08 ppv mms^{-1}, reducing the residual effect to negligible adverse (not significant), or alternatively the effects could be mitigated by seasonal restrictions on drop-hammer piling activities.

Operation

8.9.4 During the operation of the Proposed Development, noise levels at the closest residential NSRs are predicted to fall well below the measured background noise levels. No significant noise effects are predicted.

8.9.5 At ecological receptors located along the Humber Estuary to the east, noise levels are predicted to fall below ambient noise levels during the operation of the Proposed Development and no significant effects are predicted.

8.9.6 At the ecological receptors located immediately north and south of the Proposed Development (R4 and R5), noise levels at the closest parts of the fields to the Site are predicted to exceed ambient noise levels during operation. The ecological impact assessment concludes that, as the majority of waterbirds will be located in the central and eastern parts of the fields to the south and central and northern parts of the fields to the north, the effects on waterbirds will be neutral (not significant).

8.9.7 Due to the distance to the nearest NSRs and the nature of the Proposed Development, vibration from the operation of the Proposed Development has been scoped out of the assessment.

Decommissioning

8.9.8 The nature of decommissioning works is likely to be similar to that of construction works (with the exception of piling). Therefore, noise levels at the closest NSRs are expected to fall below the ambient noise levels. No significant effects are predicted.

8.10 References

- British Standards Institute (1991) BS 7445-2 – Description and measurement of environmental noise. Guide to the acquisition of data pertinent to land use
- British Standards Institute (1993) BS 7385-2 – Evaluation and measurement for vibration in buildings. Guide to damage levels from groundborne vibration
- British Standards Institute (2003) BS 7445-1 – Description and measurement of environmental noise. Guide to quantities and procedures
- British Standards Institute (2008) BS 6472-1 – Guide to evaluation of human exposure to vibration in buildings. Vibration sources other than blasting
- British Standards Institute (2014a) BS 5228-1:2009+A1:2014 – Code of practice for noise and vibration control on construction and open sites. Part 1: Noise.
- British Standards Institute (2014b) BS 5228-2:2009+A1:2014 – Code of practice for noise and vibration control on construction and open sites. Part 2:Vibration
- British Standards Institute (2014c) BS 4142 – Methods for rating and assessing industrial and commercial sound
- Ministry for Communities, Housing and Local Government (2018) National Planning Policy Framework. MHCLG, London
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- Department of Transport/ Welsh Office (1998) Calculation of Road Traffic Noise (CRTN)
- Environment Agency (2002a) Integrated Pollution Prevention and Control (IPPC) H3 document Horizontal Guidance for Noise Part 2 - Noise assessment and Control
- Environment Agency (2002b) Integrated Pollution Prevention and Control (IPPC) H3 document Horizontal Guidance for Noise Part 1 – Regulation and Permitting
- Highways Agency (2011) Design Manual for Road and Bridges Volume 11 Section 3 Part 7 HD213/11 (Revision 1) Traffic Noise and Vibration
- North East Lincolnshire Council (2018) North East Lincolnshire Local Plan 2013 to 2032
- World Health Organisation (WHO) (1999) Guidelines for Community Noise
- World Health Organisation (WHO) (2009) Night Noise Guidelines for Europe