8. NOISE AND VIBRATION

8.1 INTRODUCTION

8.1.1 Terms of Reference of this Chapter

This chapter presents an assessment of the likely significant effects due to noise and vibration from construction, operation and decommissioning of the Keadby II project (henceforth the 'Proposed Development'). The baseline acoustic environment around the Proposed Development site is described, potential effects identified, proposed mitigation measures listed and an assessment of the significance of residual effects is made.

Potential effects of the Proposed Development on noise sensitive receptors include the following:

- noise from construction plant during the various phases of site preparation and installation of equipment and structures;
- construction traffic on the wider road network; and
- 24 hour, year round operation of the facility.

Vibration is not considered further in this assessment because the major construction plant will be over 100 m from the nearest sensitive receiver and, as noted in the Scoping Report, significant vibration effects are not expected.

8.1.2 Basis of Assessment Including Realistic Worst Case Scenario

Construction

Construction plant items have not been specified in detail at this stage, and only approximate numbers of construction items are available. The locations at which the plant will operate have also not been established. Therefore, the assessment is based on an even spread of construction sources around the site, except for driven piling to form the supporting foundations of the main turbine buildings that has been located at those locations. This is thought to be a more realistic distribution than adopting a worst-case view assuming all the plant operates, for instance, at the site boundary. No mitigation has been assumed for construction plant in the predictions.

Construction Traffic

Road traffic flows have been forecast during construction and as reported in the Transport and Travel Technical report. It is expected that the traffic flows to and from the site will vary during the construction period based on experience of similar projects. As reported in Chapter 11, the peak in construction traffic is expected to generate 20 additional HGVs during daytime hours (0800 and 1800), and 100 cars as worker shifts change between 0600 and 0700 hours and between 1900 and 2000 hours. The increase in road traffic noise created by these flows over the base flows on the A18 route to the
site are assessed. After construction traffic leaves the A18 at Pilfrey Farm it will follow the access route over open farmland where there are no noise-sensitive receivers.

*Plant Operating Assumptions*

The proposed plant has the potential to increase noise levels at residential properties nearby and to create significant noise effects. The extent of the noise increases not only on the levels of noise emitted by the plant but also on the baseline noise conditions at the time of operation. The baseline was measured in summer 2015 as part of this assessment, while the Keadby I plant was not in operation. The baseline was then re-measured in January 2016 following recommencement of Keadby I operations in December 2015.

Noise levels have been predicted based on an outline plant design, as discussed in Section 8.2 for the multi-shaft option which would include more noise sources and produce overall higher noise levels than the single shaft option. All plant are assumed to operate 24 hours a day.

It has been estimated that 18 additional members of staff will be required to operate the development and these could travel to the site in single occupancy cars, arriving in two shifts each day. The additional noise generated by 9 cars twice a day will not give rise to significant noise effects.

### 8.1.3 Consultation

SSE is carrying out various consultation activities as part of the S36 variation application.

Consultation to date on the topic of noise and vibration has included discussions with North Lincolnshire Council on Noise Sensitive Receivers and the scope of the baseline noise survey and assessment methodologies. North Lincolnshire Council also provided comments on the Scoping Report. These comments are given in Table 8.1 with a response indicating how they have been addressed in this assessment.
Table 8.1 Scoping Report Comments on Noise and Vibration

<table>
<thead>
<tr>
<th>Consultee Comment</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>The EIA Scoping Report refers to the assessment of Baseline Conditions. I have also received a draft Baseline Noise Monitoring Methodology (copy attached) that outlines the scope and methods for assessment of the baseline conditions.</td>
<td>See Section 8.1.4. WHO guidelines give guidance as to the onset of health effects. The relevant UK planning guidance and standards used in this assessment are set in this context. The NPPF, PPG, and BS8233 are discussed in Section 8.1.4 and used in this assessment.</td>
</tr>
<tr>
<td>1.1 Policy and guidance In addition to the guidance listed in the applicant’s Overview, I recommend that the assessment of noise and vibration should be carried out with reference to the following: • NPPF and Planning Practice Guidance for Noise. • World Health Organisation Guidelines for Community Noise (1999) • World Health Organisation Night Noise Guidelines for Europe (2009) • BS8233:2014 Guidance on sound insulation and noise reduction for buildings</td>
<td>Noted. As a result a thorough baseline noise survey has been completed and agreed assessment locations clearly identified.</td>
</tr>
<tr>
<td>1.2 Potentially noise sensitive receptors The relevant noise sensitive receptors to be assessed are residential locations. I am not aware of any sensitive public amenity areas or other relevant sensitive receptors close to the proposed development. Figure 5.3 shows proposed noise monitoring locations. There has been an amendment to this figure (see attached amended that is labelled as Fig 3.1). The amended figure shows eight proposed locations. I agree with the proposed assessment locations and have discussed the proposed monitoring periods and methods with the applicant’s noise consultant, Rod Linnett of Environmental Resources Management.</td>
<td></td>
</tr>
<tr>
<td>1.3 Baseline conditions Section 5.4.2 of the scoping report refers to Keadby Phase 1 and the assessment of what contribution this makes to the existing acoustic environment. I recommend that the assessment of noise for Keadby Phase 2 should consider the cumulative impact of the Keadby generating site as a whole so that the contribution of both Phase 1 and Phase 2 should be assessed against the baseline background noise conditions without the site operating.</td>
<td>Whilst it is not the function of this noise assessment to consider the impact of Keadby I, the cumulative effect of the Proposed Development is considered against the baseline either with or without Keadby I in operation.</td>
</tr>
<tr>
<td>1.4 Establishing significance - Construction, demolition and site clearance. I understand that the control of noise and vibration will be addressed through a Construction Environmental Management Plan (CEMP). The EIA will need to include sufficient information to enable suitable limits to be established to help in drafting appropriate control measures for the CEMP. I recommend that the significant effects of construction noise should be assessed to take account of acoustic characteristics, rather than just making reference to the overall “average” levels listed in Table 5.2 of the EIA Scoping report. For example, impact noise may be significant for some activities so it may be appropriate to consider noise measured as LAm. The EIA Scoping report states that vibration has been “scoped out” of the EIA. I am concerned that there is insufficient information available at this stage to leave out assessment of vibration. I would expect the EIA to at least include outline information concerning methods and the likely vibration effect, so as to demonstrate that a full detailed assessment is not necessary.</td>
<td>Construction noise levels are predicted and assessed in Section 8.4 on the basis of typical construction methods for plants of this type. The method uses the Leq noise metric, as required by BS5228, and because it is sensitive to peaks in the varying noise levels that are characteristic of construction sites. Vibration from the typical methods used to construct this type of facility are not likely to lead to significant effects in this case because the nearest sensitive receiver is over 100m from the site.</td>
</tr>
<tr>
<td>1.5 Establishing significance – operational When considering the significance of operational noise, I would expect the EIA assessment to be carried out in the context of the policy and guidance listed above (para 1.1) in addition to that listed in the EIA scoping documents.</td>
<td>Noted and adopted.</td>
</tr>
</tbody>
</table>
8.1.4 Policy, Legislation and Guidance

Planning Policy

The Noise Policy Statement for England (NPSE), 2010 sets out the highest level of national noise policy in England, as summarised in Box 8.1.


<table>
<thead>
<tr>
<th>Noise Policy Aims</th>
</tr>
</thead>
<tbody>
<tr>
<td>Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development:</td>
</tr>
<tr>
<td>• avoid significant adverse impacts on health and quality of life;</td>
</tr>
<tr>
<td>• mitigate and minimise adverse impacts on health and quality of life; and</td>
</tr>
<tr>
<td>• where possible, contribute to the improvement of health and quality of life.</td>
</tr>
</tbody>
</table>

Government's guiding principles of sustainable development include: ensuring a strong, healthy and just society; using sound science responsibly; living within environmental limits; achieving a sustainable economy; and promoting good governance.

The first two aims of the NPSE follow established concepts from toxicology that are applied to noise impacts, for example, by the World Health Organisation. They are:

- **NOEL** – No Observed Effect Level - the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise; and

- **LOAEL** – Lowest Observed Adverse Effect Level - the level above which adverse effects on health and quality of life can be detected.

The NPSE extends these to the concept of a Significant Observed Adverse Effect Level:

- **SOAEL** – The level above which significant adverse effects on health and quality of life occur.

The NPSE notes “It is not possible to have a single objective noise-based measure that defines SOAEL that is applicable to all sources of noise in all situations. Consequently, the SOAEL is likely to be different for different noise sources, for different receptors and at different times”.

National Planning Policy Framework (2012) took on board the aims of the NPSE and at paragraph 109 added that the planning system should contribute to and enhance the natural and local environment by: preventing both new and existing development from contributing to or being put at unacceptable
risk from, or being adversely affected by unacceptable levels of noise pollution.

Government’s Planning Practice Guidance on noise (PPG) 2014, provides guidance on the effects of noise exposure, relating these to people’s perception of noise, and linking them to the NOEL and, as exposure increases, the LOAEL and SOAEL.

The LOAEL is described in PPG as the level above which "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."

PPG identifies the SOAEL as the level above which "noise causes a material change in behaviour and/or attitude, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area."

The PPG advises that as noise exposure increases above the LOAEL, the noise begins to have an adverse effect and consideration needs to be given to mitigating and minimising those effects, taking account of the economic and social benefits being derived from the activity causing the noise. As the noise exposure increases, it will then at some point cross the SOAEL boundary. If the exposure is above SOAEL the planning process should be used to avoid this effect occurring, by use of appropriate mitigation such as by altering the design and layout. Again, such decisions must be made taking account of the economic and social benefit of the activity causing the noise, but it is undesirable for such exposure to be caused. At the highest extreme, noise exposure causes extensive and sustained changes in behaviour without an ability to mitigate the effect of noise. The impacts on health and quality of life are such that regardless of the benefits of the activity causing the noise, this represents an unacceptable adverse effect and these situations should be prevented from occurring.

**BS4142 Methods for Rating and Assessing Industrial and Commercial Sound**

The guidance used for the assessment of sound of an industrial and/or commercial nature is BS 4142:2014 Methods for Rating and Assessing Industrial and Commercial Sound, British Standards Institute. The current version of the standard is applicable to investigating complaints; assessing sound from proposed, new, modified or additional sources of sound and for assessing sound at proposed new dwellings or premises used for residential purposes.

The methods described in BS 4142 use outdoor sound levels to assess the likely effects of sound on people who might be inside or outside a dwelling used for residential purposes.
BS 4142 is applicable for the determination of the following levels:

- Rating Levels of an industrial and/or commercial sounds;
- Ambient, Background and Residual sound levels, for the purposes of investigating complaints;
  - assessing sound from proposed, new, modified or additional source(s) of sound of an industrial and/or commercial nature;
  - assessing sound at proposed new dwellings or premises used for residential purposes.

The principal terms used in BS 4142 are broadly defined as follows:

- **Ambient Sound** – the overall sound level from all sources.
- **Specific Sound Level**, $L_s = L_{Aeq,Tr}$ – the noise source under consideration.
- **Rating Level**, $L_{Ar,Tr}$ – Residual noise corrected to allow for certain distinctive acoustic features.
- **Residual Sound Level**, $L_r = L_{Aeq,T}$ - the noise remaining when the specific noise is sufficiently suppressed so as not to contribute to the ambient noise level.
- **Background Sound Level**, $L_{A90,T}$ – the measured $L_{90}$ level of the residual noise.

The method requires the measurement or prediction of equipment or plant noise (Specific Sound Level) plus a correction for its acoustic character. A comparison is then made between the Rating Level and the Background Sound Level in consideration of the following overall guiding assessment values to provide an understanding of the potential for, and significance of impact(s):

- Typically, the greater this difference, the greater the magnitude of the impact.
- A difference of around +10 dB or more is likely to be an indication of significant adverse impact, depending on the context.
- A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context.
- The lower the rating level is relative to the measured background sound level, it is less likely that the specific sound source 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 on the context.

The Rating Level of the source is the A-weighted $L_{eq}$ taking into consideration the following characteristics of the sound source; tonality, impulsiveness; intermittency, time of occurrence, duration of event, and any other characteristics of the sound source that are likely to be distinctive in the environment. In this case planning conditions for the operating plant require it to have no tonal content, so there are no corrections to be added to the Specific Sound levels to arrive at the Rating Level.
BS4142 requires an initial estimate of the Specific Sound to be carried out which may later be modified by further consideration of the context. The standard differs from the previous (1997) version in several ways, and the consideration of context of one of the most important. A series of examples are given in which the initial numerical estimate is interpreted for a given context to arrive at the assessment of significance.

Where the initial estimate of the impact needs to be modified due to the context, the following factors need to be considered:

- the absolute level of sound where background sound levels and rating levels are low;
- where residual sound levels are very high and the residual sound might itself might result in noise impacts;
- the character and level of the residual sound compared to the character and level of the specific sound;
- evidence on likely human response to sound including references given in BS 4142; and
- the sensitivity of the receptor including façade insulation, acoustic ventilation or screening which will secure good acoustic conditions and reduce receptor sensitivity.

As in the previous (1997) version, the current version of BS 4142 makes reference to BS8233 for consideration of absolute (or benchmark) standards for noise which, as indicated in the examples, it recommends for the assessment of impacts when noise levels are low.


Benchmark noise criteria for various building uses are provided in BS 8233 (1). The British Standard gives guidelines for avoiding disturbance at night which includes 30 dB L_Aeq at night between 2300 and 0700 inside residential buildings. The external noise levels that are equivalent to this value are typically 10 to 15 dB higher with windows open so that a reasonable benchmark would vary between 40 and 45 dB L_Aeq (free-field 2300-0700 hours). These noise targets, which apply outside a building, are based on preserving good standards for sleep within the building. The night-time criterion does not aim primarily to preserve residential amenity outside the buildings and is less stringent than BS 4142 initial estimate criteria in areas where baseline noise levels are low. BS 8233 recommends the use of BS 4142 for the purposes of assessing noise changes, noting that noise changes should be considered in the context of the absolute levels of noise.

An external criterion of 50 to 55 dB L_Aeq (free-field 0700-2300 hours) has been proposed for more typical daytime activities. External areas such as gardens should also meet a desirable level of 50 dB L_Aeq where practicable.

The derived standards assume that buildings are not fitted with noise insulation, so higher external noise levels could be acceptable to residents if

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noise insulation and ventilation were provided which resulted in suitable internal noise levels.

8.1.5 Planning History

The September 1993 deemed planning permission included conditions addressing the following noise issues:

- During construction there shall be no pile driving during evening, night or weekends (condition 20)

- During construction, noise monitoring is required at the nearest residential properties in Chapel Lane, Trentside and the Mariners Arms, Keadby. A 'Programme' to be agreed to define methodology and noise limits (condition 22)

- A Scheme for the noise insulation of the Development should be submitted before commissioning of the development, including specifications for noise attenuation measures (condition 25)

- A scheme to determine the ambient noise levels (at nearest residential properties) to be submitted before commissioning, to specify equipment and sampling techniques (condition 26)

- Noise generated during operation to be monitored by company – the noise monitoring 'Programme' will define the maximum permissible noise level at each measurement location, and make provision for continuous noise monitoring over an approved period (condition 27)

- Condition 28)

  28) Notwithstanding the noise levels approved by the Borough Council pursuant to Condition (27) the noise levels when measured at one metre in front of the nearest residential properties in Chapel Lane, Trentside and the Mariners Arms, Keadby shall be within 5 dB (A) of the ambient noise levels approved pursuant to Condition (25) as assessed by British Standard 4142 and exhibit no tonal content.

In summary, baseline noise levels were to be measured to an agreed methodology and noise levels for the plant were to be no more than 5dB above the ambient noise levels in accordance with BS4142, and noise should exhibit no tonal content.

Keadby Blackstart

- The approval of the Keadby Blackstart scheme (an upgrade to the Keadby I power station including an additional gas turbine) in 1999 included the following noise conditions:

- Noise shall not exceed 45 dB(A) between the hours 1800 and 0700 during normal operation when the unaffected background noise level is at or
below 40 dB(A). Hence, the noise from the Development excluding the background noise shall not exceed 45 minus 40 dB(A), i.e. 43.3 dB(A). No tones or impulse content.

Similarly noise shall not exceed 49 dB(A) between 0700 and 1800, when background at or below 44 dB(A), i.e. 47.3 dB(A).

These conditions are based on assumed background noise levels of 40dB at night and 44dB in the daytime.

8.1.6 Supporting Information for this Chapter

Information on the results of baseline surveys is provided in Annex F which has three appendices:

Appendix A – Glossary of Acoustic Terminology;
Appendix B – Details of Attended Noise Monitoring Results; and
Appendix C - Details of Unattended Noise Monitoring Results.

8.2 ASSESSMENT METHODOLOGY

8.2.1 Methodology for Baseline Surveys for the EIA

A comprehensive baseline noise survey has been carried out, following the guidance in BS4142 (2014), and reported in Annex F.

8.2.2 Construction Noise Prediction

Temporary construction laydown areas will be located within the Proposed Development boundary to the west of the proposed buildings.

Noise sources during the first stage of construction will be site preparation, and concrete base formation. Piling for foundations will follow and will be undertaken during day time only. The power plant buildings and structures will be installed on reinforced concrete foundations. Driven pile foundations are likely to be required for larger heavier equipment such as the gas turbines, steam turbines and generators.

Once foundations are completed, super-structure construction will commence with the provision of steel and/or concrete frames, cladding and other general building works.

Construction noise has been predicted based on an understanding of other similar projects of the types and numbers of construction plant that will be used. For the purpose of noise assessment, the construction work has been divided into two main phases:

- site preparation;
- piling foundations; and
- building construction and installation.
Sound power levels were calculated to be 118 dB, 117 dB and 112dB respectively for each of the above phases. The plant during these phases has been predicted as being evenly distributed around the site which is realistic for this type of construction except for percussive piling for the foundations phase modelling that has been located at the building foundations.

Noise levels have been predicted using the methods set out in British Standard 5228 (1). This standard provides guidance on construction plant noise levels and on the threshold of significant noise effects on dwellings. Predicted noise levels are compared with the noise criteria in Table 8.2. In this case ambient noise levels mean that the NSRs are all Category A and the most stringent criteria are applied.

Table 8.2  
Threshold of Significant Effects of Construction (and Decommissioning)  
Noise at Dwellings

<table>
<thead>
<tr>
<th>Threshold of Significant Effect of Construction Noise at Dwellings</th>
<th>Threshold Value, dB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Night-time (23.00 – 07.00)</td>
<td>45</td>
</tr>
<tr>
<td>Evenings and weekends [a]</td>
<td>55</td>
</tr>
<tr>
<td>Daytime (07.00 – 19.00) and Saturdays</td>
<td>65</td>
</tr>
</tbody>
</table>

**Note 1:** All sound levels are defined at the façade of the receptor.

**Note 2:** If the ambient noise level exceeds the threshold values given in the table (i.e. the ambient noise level is higher than the above values), then a significant effect is deemed to occur if the total $L_{Aeq}$ noise level for the period increases by more than 3 dB due to construction activity.

**Note 3:**
(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 the category A values.
(d) 19.00 – 23.00 weekdays, 13.00 – 23.00 Saturdays and 07.00 – 23.00 Sundays.

8.2.3  
Construction Traffic Noise Prediction

Changes in road traffic noise levels resulting from construction (and decommissioning) of the Proposed Development are calculated using the Calculation of Road Traffic Noise (CRTN) methodology. Noise changes of greater than 3 dB(A) will be identified as a significant effect. This corresponds to the smallest noise change that is audible under normal conditions.

In cases where the existing traffic noise is very low, the absolute levels of noise are also taken into account when establishing significance of road noise effect. The significance of effect will also depend on the duration over which the change will take place.

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(1) BS 5228: 1997 ‘Noise and vibration control on construction and open sites’, BSI, 1997
8.2.4 Operational Noise Prediction

North Lincolnshire Council has indicated that the assessment should consider the cumulative noise impact of the Keadby I plant and the Proposed Development. The assessment has responded to this by measuring baseline noise levels both before and during Keadby I operations and by assessing cumulative noise levels based on the levels measured and predicted noise levels for the Proposed Development.

At this stage the Proposed Development is at an early outline design stage and supplier noise data are not available. The data used within this assessment are based on plant specifications supplied by SSE and noise emissions data provide by Siemens for the single and multi-shaft options. To address the worst case, noise modelling has been carried out for the multi-shaft option because it includes more noise sources. The noise emissions assumed in the noise model are summarised as follows.

<table>
<thead>
<tr>
<th>ID</th>
<th>Sources</th>
<th>Sound Power dB(A)</th>
<th>Noise Model Assumptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>10UMA</td>
<td>Steam Turbine Building 10UMA / Basis / Steady-state</td>
<td>100</td>
<td>Assume inside building</td>
</tr>
<tr>
<td>10UBX</td>
<td>Transformers 10UBx / Basis</td>
<td>80</td>
<td>Assumed to be contained - 10 dB reduction</td>
</tr>
<tr>
<td>10UBAXX</td>
<td>PCCs 10UBAxx</td>
<td>94</td>
<td>Assumed to be contained - 10 dB reduction</td>
</tr>
<tr>
<td>10UMY</td>
<td>Steam Pipes 10UMY / Basis / Steady-state</td>
<td>98</td>
<td>Assumed in Building/cladding</td>
</tr>
<tr>
<td>11UMB</td>
<td>Gas Turbine Building 11UMB / Basis / Steady-state</td>
<td>98</td>
<td>Modelled inside building</td>
</tr>
<tr>
<td></td>
<td>Gas Turbine Filter House Unit 11 / Basis</td>
<td>106</td>
<td>air intake - SSE to confirm size - northern side</td>
</tr>
<tr>
<td>10UMX</td>
<td>Gas Turbine Diffuser Extension Duct 10UMX / OUTDOOR Basis</td>
<td>114</td>
<td>Assumed inside building</td>
</tr>
<tr>
<td>10UHA</td>
<td>HRSG stehend 10UHA / OUTDOOR Basis / Steady-state</td>
<td>104</td>
<td>Assumed inside building</td>
</tr>
<tr>
<td>11UHX</td>
<td>HRSG Stack 11UHx / Basis</td>
<td>98</td>
<td>Modelled at top of stack</td>
</tr>
<tr>
<td>10UBF</td>
<td>Transformers CT variant/Basis* 10UBF/GT Generator Transformer (BAT)</td>
<td>104</td>
<td>Assumed inside building</td>
</tr>
<tr>
<td>10UBE</td>
<td>Transformers CT variant/Basis* 10UBE/Unit Aux. Transformer (BBT)</td>
<td>93</td>
<td>Assumed inside building</td>
</tr>
<tr>
<td>10UBD</td>
<td>Transformers CT variant/Basis* 10UBD/LV Power Transformer (BFT)</td>
<td>88</td>
<td>Assumed to be contained - 10 dB reduction</td>
</tr>
<tr>
<td>10UBX</td>
<td>Transformers CT variant/Basis* 10UBx / Static excitation transformer</td>
<td>91</td>
<td>Assumed to be contained - 10 dB reduction</td>
</tr>
<tr>
<td>10UBG</td>
<td>Transformers CT variant/Basis* 10UBG/ Start up transformer</td>
<td>98</td>
<td>Assumed to be contained - 10 dB reduction</td>
</tr>
<tr>
<td>near 10URL</td>
<td>Cooling Water Pumps / Basis</td>
<td>106</td>
<td>Assumed to be one and contained - 10 dB reduction</td>
</tr>
<tr>
<td>10ULA</td>
<td>Feed Water Pump Area / OUTDOOR Basis</td>
<td>112</td>
<td>Modelled inside building</td>
</tr>
<tr>
<td>USB</td>
<td>Space Heating System / Basis</td>
<td>90</td>
<td>Modelled externally</td>
</tr>
<tr>
<td>UGJ</td>
<td>Cooling Tower Make-up Water Treatment Plant / Basis</td>
<td>96</td>
<td>Assumed inside building</td>
</tr>
<tr>
<td>00UBD</td>
<td>Transformers / Basis 00UBD/LV Power Transformer (BFT)</td>
<td>82</td>
<td>Assumed to be contained - 10 dB reduction</td>
</tr>
</tbody>
</table>
Initial modelling showed standard cooling towers to be the predominant noise source, so low noise options were researched. The noise levels given above are for a low noise hybrid cooling tower with low noise fans, fan silencers and acoustic attenuators on air intakes leading to significantly lower sound power levels.

Brüel & Kjær’s Predictor 7810 (Version 10) noise modelling software package has been used to calculate noise levels using the ISO 9613.1 industrial noise propagation algorithms in octave bands.

### 8.3 Baseline Conditions

#### 8.3.1 Summary of Data Collected

The baseline noise study consisted of a series of continuous unattended noise measurements (UANMs) and operator attended noise measurements (OANMs) within the vicinity of Keadby Power Station, during the months June, July and August 2015 to measure ambient noise conditions within the study area. Keadby I was not operational in this period. A further survey was undertaken in January 2016 when the plant was operating.

Prior to the survey the Noise Monitoring Locations (NMLs) were discussed and agreed with Lincolnshire council. Seven NMLs were chosen at the seven Noise Sensitive Receivers representing all the receivers that could be affected by noise from the site. Of these, four were chosen for long term unattended monitoring. The UANM and OANM sites are shown in Figure 8.1.
Figure 8.1
Noise Monitoring Locations
Catchments and Measurement locations

Site Boundary
- Attended Noise Sensitive Location
- Unattended Noise Sensitive Receptor

SCALE: See Scale Bar
VERSION: A01
DRAWN: GB
CHECKED: SM
APPROVED: KM

SOURCE: © Getmapping plc © 2016 GeoEye © 2016 Intermap Earthstar
Geographics SID © 2016 Microsoft Corporation

Path: P:\Projects\0280278_Keadby\GB\KMMAP\EIA\08_Noise\0280278_Noise_A02.mxd
The baseline noise monitoring survey consisted of:

- continuous UANM at four sites, for a period to provide at least 5 days of noise data inclusive of the weekend period; measuring $L_{Aeq}$, $L_{A\text{Max}}$, $L_{A1}$, $L_{A5}$, $L_{A10}$, $L_{A50}$, $L_{A90}$, $L_{A95}$, $L_{A99}$ and $L_{A\text{min}}$, statistical noise parameters;
- OANM (during the daytime and night time) at nearest seven potential noise sensitive receptor locations to quantify and characterise noise emissions from all noise sources in the area; and
- deployment of a meteorological station to measure wind speed data for the purpose of excluding noise measurements affected by periods of high winds and/or rain.

Details of the survey methods and results are provided in Annex F which includes three appendices, giving a glossary and definitions of abbreviations, and detailed results of the noise levels measured in the unattended and attended surveys.

### 8.3.2 Discussion of Data

The attended measurements corresponded well with the unattended measurements in both surveys. This provided confidence that the unattended surveys captured samples of noise conditions that were typical and representative of the noise climate at each NML.

An equipment failure at the Trent Side NML reduced the number of long term unattended sites from four to three in the first survey. However, the sites are affected by similar noise sources and the attended levels at this site agreed well with those at NML4 so the full attended site data were taken to be representative of both sites.

The attended levels at NML2 Red House were similar (within 1-2dB) to those at the nearby location NML3 Hawthorn House where long term unattended levels were measured, so the long term data from NML3 were used for NML2.

Similarly, the attended levels at NML5 Mariners Arms Flats, NML6 Trent Side and NML7 South Bank were similar to those at the NML4 Keadby Village where long term unattended levels were measured, so the long term data from NML4 were used for NML5, 6 and 7.

In order to follow the assessment guidance in BS4142, 2014 the Representative Sound Levels are taken as the levels that are typical and most commonly occurring in each time period; day and night. To establish a Representative Sound Level for each NSR, the method from Section 8 of BS4142 has been used. The unattended noise monitoring results (ambient $L_{Aeq}$ and background $L_{A90}$) for each receptor were divided into day (0700-2300 hours) and night (2300-0700 hours) period, and measurements during bad weather were excluded. This gave 850-950 15 minute samples for the summer 2015 survey and 170-180 15 minutes samples for the winter 2016 survey. These are plotted as a series of level distribution graphs in Annex F. The Representative Sound Levels obtained from the BS4142 methodology can be used to summarise the summer 2015 and winter 2016 survey results, as follows.
### Table 8.3  Summary of Representative Sound Levels at NSRs Summer 2015/ Winter 2016

<table>
<thead>
<tr>
<th>NSR</th>
<th>Daytime L₉₀, 15 minutes dB</th>
<th>Night-time L₉₀, 15 minutes dB</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Vazon Bridge</td>
<td>37/ 39</td>
<td>39/ 39 periods without trains</td>
</tr>
<tr>
<td></td>
<td>59/ 58</td>
<td>59/ 60 periods with trains</td>
</tr>
<tr>
<td>2 Red House</td>
<td>37/ 39</td>
<td>45/ 45</td>
</tr>
<tr>
<td>3 Hawthorne House</td>
<td>37/ 39</td>
<td>45/ 45</td>
</tr>
<tr>
<td>4 Keadby Village</td>
<td>35/ 39</td>
<td>45/ 44</td>
</tr>
<tr>
<td>5 Mariners Arms</td>
<td>35/ 39</td>
<td>45/ 44</td>
</tr>
<tr>
<td>6 Trent Side</td>
<td>35/ 39</td>
<td>45/ 44</td>
</tr>
<tr>
<td>7 South Bank</td>
<td>35/ 39</td>
<td>45/ 44</td>
</tr>
</tbody>
</table>

The table shows that the measured L₉₀ and Lₑq were higher in the 2016 survey except at Vazon Bridge. Observations in 2016 indicated that Keadby I was audible and contributing to noise levels to the north of the site (NML 2, 3 and 4 in particular) but other industrial noise sources including the nearby wind turbines and electrical sub-station were also present, so the increase in levels may not be due solely to Keadby I.

The representative L₉₀ at all locations increased in the 2016 survey.

At Vazon Bridge measured Lₑq,15 minute noise levels were above these limits, but L₉₀, 15 minute levels day and night were below 40dB indicating that noise from the plant (that is constant and would control the L₉₀ if present) is well within the planning limits.

The noise climate at each NSR is discussed briefly below. Further details are provided in Annex F.

**Vazon Bridge NSR1.** Passing trains exhibit high levels of noise for a short period with Lₐₘₐₓ levels in the range 75-85dB, but they have little effect on the background L₉₀ levels. Consequently during the day the noise climate at Vazon Bridge House is dynamic, with Lₑq levels approximately 59dB and L₉₀ levels 37dB. This pattern continues at night except between about 0100 and 0400 at weekends and on some weekdays when there are no trains and Lₑq noise levels drop.

This dynamic noise environment is important to the noise assessment because it influences the way in which new noise from the power station will be perceived. Importantly the railway lies between the house and the power plant site, so the rooms that will experience new noise from the extended power station are the same rooms that currently experience train noise levels of Lₐₘₐₓ 75-85dB at least four times an hour, 21 hours a day. It is reasonable
to assume that the occupiers of the house cope with these levels of train noise day and night, and as a consequence are considerably less likely to be affected by an increase in background noise than if there was no train noise present.

**Red House NSR2** is situated on the northeast corner of Chapel Lane. Noise from trains is also audible here with industrial noise sources and some noise from wind turbines creating a less dynamic noise climate than NSR1. During the January 2016 survey, noise from Keadby I operating was audible and contributing to the noise levels.

**Hawthorne House NSR3** is on Chapel Lane. The noise climate is similar to Red House.

**Keadby Village NSR4** is 45A Chapel Lane, approximately 30 metres northeast of Keadby water tower. During the day, noise from people in the village elevates $L_{eq}$ levels above background but at night these sources drop away to a less dynamic environment. During the January 2016 survey noise from Keadby I operating was audible and contributing to the noise levels.

**Mariners Arms Flats NSR 5** is Mariners Arms Flats terrace. The noise climate in this location is similar to NML4, both being near Keadby Village.

**Trent Side NSR6 and South Bank NSR7** are located on the roads Trent Side and South Bank respectively. The noise levels are similar to those at Keadby Village and Mariners Arms Flats.

### 8.4 ASSESSMENT OF EFFECTS

#### 8.4.1 Introduction

This assessment compares modelled noise levels from the Proposed Development with appropriate criteria which are informed by baseline survey work. Once noise impacts leading to likely significant effects were identified from initial modelling, discussions with the design engineers took place to develop mitigation for various plant items resulting in the predicted levels reported below. The purposes of the following three sections are to assess the likely significant noise effects with Section 8.5 outlining the mitigation that has been included in the assessment to date.

#### 8.4.2 Assessment of Effects during Construction

The predicted levels of noise during the three main phases of noisy construction activity (Site Preparation/Foundations/Construction) for each NSR are summarised in Table 8.4.
Table 8.4  Table 8.4 Construction Noise Levels (facade) and Likely Impacts

<table>
<thead>
<tr>
<th>NSR</th>
<th>Predicted Noise Levels</th>
<th>Exceedance of Assessment Criterion</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$L_{eq}$ dB</td>
<td>Day 65dB</td>
</tr>
<tr>
<td>Assessing Criterion</td>
<td>Site Preparation/Foundations/Construction</td>
<td></td>
</tr>
<tr>
<td>1 Vazon Bridge</td>
<td>64/58/58</td>
<td>-</td>
</tr>
<tr>
<td>2 Red House</td>
<td>60/55/54</td>
<td>-</td>
</tr>
<tr>
<td>3 Hawthorne House</td>
<td>54/50/48</td>
<td>-</td>
</tr>
<tr>
<td>4 Keadby Village</td>
<td>49/43/44</td>
<td>-</td>
</tr>
<tr>
<td>5 Mariners Arms</td>
<td>46/38/40</td>
<td>-</td>
</tr>
<tr>
<td>6 Trent Side</td>
<td>49/41/43</td>
<td>-</td>
</tr>
<tr>
<td>7 South Bank</td>
<td>49/40/43</td>
<td>-</td>
</tr>
</tbody>
</table>

Note: piling foundations is limited to daytime.

Predicted daytime levels are within the daytime impact assessment criterion at all NSRs indicating construction noise impacts are unlikely. However, during the evening and at night there is significant risk of noise impacts. Mitigation is discussed below.

8.4.3  Assessment of Effects due to Construction Traffic

Criteria

Noise changes of greater than 3 dB(A) will be identified as a significant effect. This corresponds to the smallest noise change that is audible under normal conditions. In cases where the existing traffic noise is very low, the absolute level of noise is also taken into account when establishing significance of a road noise change of greater than 3dB. The significance of effect will also depend on the duration over which the change will take place.

Predicted Impacts

Using the construction traffic flows given in Tables 11.14 to 11.17 to identify the numbers of HGVs and cars expected on the A18 and A161 the corresponding hourly noise changes in peak construction traffic hours have been predicted. The greatest increases in hourly noise levels are 0.5dB on the A18 west of the site and the A161 in the peak HGV hours due to 20 additional HGVs/hour, and 1.2dB on the A18 East of the site in the peak staff shift change hours due to 100 additional cars/hour. These are not significant noise increases for temporary traffic. Once construction traffic leaves the A18 to approach the site it will travel on the site access route where there are no noise sensitive receivers. Hence no significant effects from traffic noise impacts are predicted.

8.4.4  Assessment of Effects during Operation

Initial Estimates of Impacts

The criteria used to assess noise impacts are discussed in Section 8.2. First an initial estimate of the impact is made using the BS4142 method. Then the
context of that estimate is considered for each NSR in turn using the guidance in BS4142 to determine the effect significance.

*Figure 8.2* shows the predicted noise levels around the proposed development based on the level of noise mitigation described in *Section 8.2*.

*Table 8.5* summarises the baseline noise levels and gives an initial estimate of impacts at each of the 7 NSRs. Levels are free-field and at first floor window level. Noise levels at ground floor level are slightly lower (typically 1dB) due to greater ground absorption. *Table 8.5* also summarises the planning limits for reference, when discussing the context of the predicted noise change and its significance for each NSR in the sections below.
Figure 8.2 Predicted Noise Levels During Operation
Table 8.5  Initial Estimate of Noise Impacts (Free-field, 1\textsuperscript{st} Floor Level)

<table>
<thead>
<tr>
<th>NSR</th>
<th>Predicted Noise Level</th>
<th>Baseline\textsuperscript{(1)}</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Baseline\textsuperscript{(1)}</td>
</tr>
<tr>
<td></td>
<td></td>
<td>L\textsubscript{90}, 15 minutes dB</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Daytime</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Day dB</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Day dB</td>
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<td>Day dB</td>
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<td></td>
<td></td>
<td>Day dB</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Day dB</td>
</tr>
<tr>
<td></td>
<td>Planning Condition Limits</td>
<td>47.3</td>
</tr>
<tr>
<td>1 Vazon Bridge</td>
<td>50</td>
<td>37/39</td>
</tr>
<tr>
<td>2 Red House</td>
<td>43</td>
<td>37/39</td>
</tr>
<tr>
<td>3 Hawthorne House</td>
<td>39</td>
<td>37/39</td>
</tr>
<tr>
<td>4 Keadby Village</td>
<td>34</td>
<td>35/39</td>
</tr>
<tr>
<td>5 Mariners Arms</td>
<td>31</td>
<td>35/39</td>
</tr>
<tr>
<td>6 Trent Side</td>
<td>33</td>
<td>35/39</td>
</tr>
<tr>
<td>7 South Bank</td>
<td>33</td>
<td>35/39</td>
</tr>
</tbody>
</table>

\textsuperscript{(1)} Summer 2015 without Keadby I operating / winter 2016 with Keadby I operating.

\textsuperscript{(2)} Trains stop between approximately 0100 and 0400 hours on some nights including weekends.
Context Considerations Common to All NSRs

The background noise levels in the area in 2015 are characterised by representative background L₉₀ noise levels in the range 30 to 36dB at night and 35-37dB in the day. BS4142 guidance indicates that because these are low, it is relevant to consider absolute levels in addition to noise change. This is because a noise change above a low background could be created but with absolute levels still within standards (such as the BS8233 sleep disturbance standard of 40-45dB with open windows) and hence acceptable conditions could result even with a significant increase in noise levels. This is relevant here at all NSRs.

The characteristics of the residual sound in the area (i.e. the sound without the Proposed Development) includes noise from the windfarm and the substation and associated equipment. The new noise from the Proposed Development would not be the only form of industrial noise heard at NSRs, and to some extent this common character will lessen how obtrusive it is and hence its impact.

NSR1 Vazon Bridge

The Vazon Bridge NSR represents a single house next to the railway line.

At Vazon Bridge the predicted Rating Level of 50dB is 13-14dB above the 2015 baseline (without Keadby I operating) indicating an initial estimate of a significant impact during the day and night. The main context is an unusually dynamic noise environment due to the close proximity to the railway with noise from trains affecting the same side of the property and outside space as noise from the Proposed Development. Background noise levels between trains are low, L₉₀ 36-38dB day and night. Peak train noise levels are in the range Lₘₐₓ 75 to 85dB usually at least every 15 minutes all day every day and most of the night except 0100 and 0400 hours on some nights including weekends. Train noise severely compromises the low background noise environment with Lₑq levels in the range 58-59dB, above those preferred for outside space (Lₑq 50dB) and sufficiently high to cause sleep disturbance with windows open (40-45dB). Peak noise levels are high enough to cause sleep disturbance.

The occupiers of the property will have adjusted in some ways to train noise, so as to use the internal space and to sleep through the noise and to make appropriate use of the outside space. BS4142 refers to this as a context consideration as follows:

- the sensitivity of the receptor including façade insulation, acoustic ventilation or screening which will secure good acoustic conditions and reduce receptor sensitivity.

This will lessen the effect of noise from the Proposed Development. The predicted noise level of 50dB is on the northern side of the house facing the site. On the southern side the predicted noise level is 38dB.

The predicted noise level from the Proposed Development is Lₑq 50dB on the northern side facing the site. The cumulative noise level from both Keadby I and the Proposed Development is also 50dB. During the day this would
increase background noise levels in the garden, but still within the recommended standards and below levels of train noise ($L_{eq}$ 59-60dB). The daytime noise impact is therefore not considered significant.

At night, the predicted noise level of $L_{eq}$ 50dB, from Keadby I and the Proposed Development, will also increase background noise levels between trains, but on most nights train noise will be approximately 10dB higher. Whilst the predicted level of noise is above sleep disturbance thresholds with windows open, it is unlikely the plant would cause sleep disturbance because the occupants are already exposed to considerably higher levels of train noise ($L_{eq}$ 60dB and $L_{max}$ 75-85dB). It is therefore unlikely that the impact of noise from the Proposed Development at night will be significant.

**NSR2 Red House**

The Red House NSR represents a single one storey house south of Chapel Lane located 200m from Keadby I with a number of farm buildings to its south. These buildings may provide some acoustics screening to the residential property, which has not been accounted for in detail in predicting the noise levels used in this assessment, and they could be sources of noise themselves. There is currently work taking place at Red House but it is understood that the property will remain a dwelling.

At Red House the predicted Rating Level of 43dB is 6-10dB above the 2015 baseline (without Keadby I operating) indicating an initial estimated impact between adverse (5dB) and significant (10dB). The increase over the 2016 baseline is 3-4dB which would be rated as adverse. It is therefore necessary to consider the context of these predicted levels.

As with other NSRs the increase is above a low base and the new noise would not be of a new character to the area. The predicted Proposed Development noise level of 43dB is within the planning limit. The total night-time noise level for the baseline, Keadby I and the Proposed Development is up to $L_{eq}$ 45dB (the predicted level from the Proposed Development plus the $L_{eq}$ 41dB measured in January 2016 with Keadby I running). This is within the planning limit and BS 8233 standards for sleep disturbance with open windows. Similarly predicted total daytime levels are within the planning limits and BS8233 standard for inside and outside areas.

The noise climate in the area is quite varied with wind farm noise increasing levels above those used in this assessment at times. This is also a single dwelling. Given the above context, the predicted impact is not considered to be significant.

**NSR3 Hawthorne House**

The Hawthorne House NSR represents two semi-detached two-storey houses south of Chapel Lane located 140m from Keadby I.

At Hawthorne House the predicted Rating Level of 39dB is 4-6dB above the 2015 baseline (without Keadby I operating) indicating an initial estimate of an adverse impact. The predicted noise level is lower than at Red House because this NSR is further from the main noise source, the cooling towers.
The predicted total noise level from Keadby I and the Proposed Development is up to 43dB.

The predicted uplift in baseline gives a noise level below the existing (2015 without Keadby I) daytime ambient $L_{eq}$ level. It would meet the daytime benchmark of 50dB for outside space and the night-time sleep disturbance benchmark of 40-45dB.

As with other NSRs the increase is above a low base and the new noise would not be of a new character to the area. The predicted level is within the planning noise limits.

As a result the predicted noise impact at Hawthorn House is not considered to be significant.

**NSR4 Keadby Village**

The Keadby Village NSR represents the group of houses in the north of the village on Chapel Lane located 500m or more from the site of the Proposed Development. The existing Keadby I power station lies between the Proposed Development site and these houses.

At Keadby Village the predicted Rating Level of 34dB is 1dB below the daytime 2015 baseline (without Keadby I operating). At night the predicted Rating Level is 4dB above the same baseline indicating an initial estimate below an adverse impact.

The predicted total noise level from Keadby I and the Proposed Development is up to 40dB.

During the day the predicted level is below the ambient $L_{eq}$ level and within daytime benchmark levels for outside space. At night the predicted level is within the sleep disturbance benchmark of 40-45dB. As with other NSRs the increase is above a low base and the new noise would not be of a new character to the area. The predicted level is also within the consented planning limits.

As a result predicted noise impact is not considered significant.

**NSR5 Mariners Arms**

The Mariners Arms NSR represents the group of houses in the south of the village located 700m from the site of the Proposed Development. The existing Keadby I power station lies between the Proposed Development site and these houses.

In the Mariners Arms area the predicted Rating Level of 31dB is below the daytime baseline noise level. At night the predicted Rating Level is 1 dB above the 2015 baseline (without Keadby I operating) indicating an initial estimate below an adverse impact.

The context of this initial assessment is similar to that for the rest of the village, and because the predicted levels are lower and all benchmark
standards and planning limits would be met, as elsewhere in the village, the predicted noise level is considered less than the adverse level described in BS4142. Significant impacts are not predicted.

**NSR6 Trent Side and NSR7 South Bank**

The Trent Side and South Bank NSRs represent the larger group of houses to the south upwards of 500m from the site of the Proposed Development. The existing Keadby I power station lies partly between the Proposed Development site and these houses.

At Trent Side and South Bank the predicted Rating Level of 33dB is below the daytime 2015 baseline (without Keadby I operating) indicating an initial estimate of less than an adverse impact. At night the predicted Rating Level is 3dB above the same baseline indicating an initial estimate of less than an adverse impact.

The context of this initial assessment is similar to that for the rest of the village, and because the predicted levels are lower and all benchmark standards and planning limits would be met, as elsewhere in the village, the predicted noise level is considered less than the adverse level described in BS4142.

### 8.4.5 Assessment of Effects during Decommissioning

The main source of noise from decommissioning is likely to be demolition of the main structures on the site. Noise levels from this activity will be similar to those during construction. Provided work proceeds with equivalent mitigation measured, in particular no noisy night work, and no new noise sensitive receivers have been built closer to the site, significant effects should not arise.

### 8.4.6 Cumulative Effects

The cumulative effect of noise from the Proposed Development above the consented and operational Keadby I plant has been discussed in Section 8.4.4 above. Both plants could operate together, and their additive effect has been considered in arriving at conclusions of the likely impacts at each noise sensitive receiver.

### 8.4.7 Uncertainty and Key Assumptions

Construction noise predictions are necessarily approximate. However, the BS5228 method is conservative so that a realistic worst case assessment has been undertaken.

To assess operational noise in accordance with BS4142 it is necessary to establish representative baseline sound levels. Environmental noise levels vary over time as weather changes and local noise sources such as road traffic varies. In this case the adjacent wind farm also creates varying noise levels. To address this two considerable baseline noise surveys were undertaken generating over 250 hours of noise samples in suitable weather conditions which have been statistically analysed using the BS4142 method. Wind speeds were monitored throughout so the surveys included sufficient
periods of low wind and hence low wind farm noise contributions. The survey method was also agreed in advance with the local authority.

The prediction of noise from the operating plant relies on design information for the major noise sources. A conservative approach has been used based initially on standard plant, to which noise mitigation has subsequently been applied. This process enabled a focus on the main noise source, the cooling towers, and detailed consideration of low noise options to minimise total noise levels. This ensured a high level of mitigation but within a realistic design envelope.

8.5 Mitigation

8.5.1 Introduction

The following sections describe the mitigation measures included in the Proposed Development to minimise impacts.

8.5.2 Summary of Mitigation

Construction

Construction noise from daytime working is not predicted to give rise to significant noise impacts. The predicted levels are below the assessment criterion of $\text{Leq, period} = 65 \, \text{dB}$ at all NSRs and noise levels will be monitored as required by the planning conditions to ensure impacts are not created. There are various ways to reduce levels of noise emitted from construction sites that will be used if necessary to reduce construction noise; most of these are standard good practice that would likely be adopted anyway for the wellbeing of the workforce. These including the following:

- use of models of compressors, generators and pumps fitted with properly lined and sealed acoustic covers or enclosures, which will be kept closed whenever the machines are in use;
- fitting of mufflers or silencers of the type recommended by manufacturers;
- shutting down of machines in intermittent periods between work, or throttling down to a minimum;
- housing of stationary noise emitting equipment which is required to run continuously in suitable acoustic enclosures;
- maintenance of plant in good working condition to minimise extraneous noises arising from mechanical vibration; and
- siting noisy plant and equipment as far away as possible from noise sensitive receptors, and use of barriers (eg site huts, acoustic sheds or partitions) to reduce the level of construction noise at receptors wherever possible.

In accordance with the planning conditions, piling will only take place in daytime hours (0800-1800 hours).

Some work may be required in the evening (1900-2300 hours). This will be limited to minor works that are not major sources of noise so that levels at
NSRs are kept below $L_{eq,\text{period}}$ 55dB. Noise levels will be monitored as required by the planning conditions to ensure impacts are not created.

There will be no work at night unless it is essential and demonstrated that noise levels will not exceed the night-time assessment criterion of $L_{eq,\text{period}}$ 45dB at the nearest properties.

**Operation**

The Proposed Development is at an intermediate stage in design but a number of noise mitigation measures have been identified and factored into the equipment sound power levels used to predict noise levels at receptors as discussed in Section 8.2.4. Particular attention has been paid to the cooling towers which emerged as a major noise source. Low noise options were considered and will be taken forward in the design of the plant. This may involve low noise fans, motor attenuation, baffling of inlets, pump enclosures or operational controls such as reducing fan speed (rather than cutting out units) in cooler conditions including at night.

Other items of the plant will also require careful acoustic design as the Proposed Development progresses. The target of this design will be to reduce noise levels as far as practicable using the best available techniques. This design will also ensure that the plant has no discernible tonal or other character at affected NSRs.

**8.6 Conclusions**

Comprehensive baseline noise surveys have been undertaken of conditions in 2015 with the Keadby I plant not in operation and in January 2016 with the Keadby I plant operating. The planning history that consented the plant includes conditions allowing noise levels of up to 47dB in the day and 43dB at night at the nearest Noise Sensitive Receivers (NSRs).

The baseline survey in 2016 with Keadby I running showed baseline noise levels higher than in 2015 at the noise sensitive receivers to the north of the site but below the consented levels. Vazon Bridge, the closest NSR1, has a very dynamic noise environment with low background noise levels interspersed with train noise levels of up to $L_{\text{max}}$ 75-85dB during the day and most nights. This lessens its sensitivity to noise from the Proposed Development.

During construction, daytime work is not likely to give rise to significant noise impacts. The construction access route is away from NSRs so no impacts from construction traffic are expected. Work on site in the evening or at night will be limited to quiet activities in order to avoid disturbance, with noise levels monitored to ensure appropriate noise limits are not breached.

Mitigation measures have been incorporated in to the noise modelling based on the current outline design available, including low noise options for the cooling towers. This will be considered further as the design progresses.

Other items of the plant have been identified that will also require careful acoustic design as the Proposed Development progresses. The target of this
design will be to reduce noise levels as far as practicable using the best available techniques. Noise modelling of the Proposed Development has shown that noise levels in the main residential area of Keadby Village will not cause significant effects. Similarly cumulative noise levels from both Keadby I and the Proposed Development will not give rise to noise impacts.

Predicted noise levels are more marginal at the three individual houses nearest the site: Vazon Cottage to the south and Red House and Hawthorn House to the north. The assessment has looked closely at likely changes in noise levels with the Keadby I and the Proposed Development, as well as the context of that change at each NSR, in accordance with the latest guidance given in BS4142, 2014. The main two contextual features are as follows.

- Firstly, background noise levels are low, so the assessment has also considered the direct effects of noise likely inside buildings and in gardens.
- Secondly, the area already has industrial noise from the wind turbines and substations and electrical equipment.

At Vazon Cottage, operation of the Proposed Development will increase background noise levels in the day and at night. However, the noise environment here is dominated by train noise and the predicted increase in background noise is not considered significant.

At Red House and Hawthorne House, noise increases are predicted, but because these are above low baseline levels, absolute noise standards are relevant and these will be met in the day and at night and, given the context, significant impacts are not predicted. The predicted levels from Keadby I and the Proposed Development meet the planning condition limits.

8.7 COMPARISON BETWEEN THE LIKELY SIGNIFICANT EFFECTS OF THE CONSENTED DEVELOPMENT AND PROPOSED DEVELOPMENT

This ES is required to present the main respects in which it is considered that the likely significant effects on the environment of the Proposed Development would differ from those described in the Environmental Assessment (EA) that was prepared for the Consented Development. The table below makes a comparison between the findings of this EIA for the Proposed Development and those of the 1992 EA to the extent possible.

Planning conditions attached to the 1993 consent included noise conditions and noise limits for the operating plant, as reported above. The 1998 planning consent added to these limits.

The various planning conditions relating to limiting construction noise are still relevant and will be met. Hence noise and vibration impacts will be no worse than consented.

The assessment reported herein has measured noise levels both before and during the operation of the Keadby I plant and has predicted noise levels from the operating of the Proposed Development. The design of the Proposed
Development includes various acoustic attenuation measures and low noise cooling towers. Consequently the noise levels predicted from the plant are lower than the noise limits set in the planning consents. Accordingly the impact of the plant should no worse than envisaged in 1993.

<table>
<thead>
<tr>
<th>Topic</th>
<th>Comparison</th>
<th>Result of Variation between Proposed Development and Consented Development</th>
</tr>
</thead>
</table>
| Construction activity on site | - The EA for the Consented Development concludes that only rarely would construction noise levels approach the assessment criterion and so it is assumed effects could be assessed as not significant.  
- The ELA concludes that construction noise levels are within the daytime assessment criteria. Limitations will be required on the nature of works undertaken at night. Effects are assessed as not significant. | O |
| Construction traffic          | - The EA for the Consented Development did not specifically assess noise from construction traffic but the numbers of movement were in the same order as for the Proposed Development.  
- The assessment of construction traffic noise for the Proposed Development concludes there will be no significant effects on roadside receptors.  
- In as much as the Consented Development and the Proposed Development both have similar construction traffic volumes it is reasonable to conclude that effects for both would be broadly similar and not significant. | O |
| Operational noise             | - For the Consented Development noise was assessed in terms of compliance with a suggested consent condition that would be based in part on that for Keadby I, taking account of the presence of Keadby I in the noise baseline.  
- For the Proposed Development noise levels have been assessed against current criteria and the assessment concludes that operational noise will not lead to significant effects on people at the nearest sensitive receptors.  
- In as much as the Consented Development and the Proposed Development noise effects at receptors can be compared it is reasonable to conclude that effects for both would be broadly similar and not significant. However it is worth noting that the Proposed Development will benefit from noise attenuation (e.g. designed in to the cooling towers) that may not have been available to the Consented Development and as a result the noise levels predicted for the Proposed Development are lower than the noise limits set in the planning consents for the Consented Development. | O |