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UK Onshore Scheme

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Chapter 26

Noise & Vibration (Proposed Converter Station)

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Environmental Statement Volume 2			
ES Reference	**Chapter**	**Chapter Title**	
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ES-2-A.02	Ch02	Development of the UK Onshore Scheme	
ES-2-A.03	Ch03	The UK Onshore Scheme	
ES-2-A.04	Ch04	Environmental Impact Assessment Methods	
ES-2-B.01	Ch05	The Proposed Underground DC Cable	
ES-2-B.02	Ch06	Intertidal Zone	
ES-2-B.03	Ch07	Geology & Hydrogeology	
ES-2-B.04	Ch08	Water Resources & Hydrology	
ES-2-B.05	Ch09	Agriculture & Soils	
ES-2-B.06	Ch10	Ecology	
ES-2-B.07	Ch11	Landscape & Visual Amenity	
ES-2-B.08	Ch12	Archaeology & Cultural Heritage	
ES-2-B.09	Ch13	Socio-economics & Tourism	
ES-2-B.10	Ch14	Traffic & Transport	
ES-2-B.11	Ch15	Noise & Vibration	
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Glossary & Abbreviations

Glossary of Terms	
Term	**Meaning**
A-weighting/ A-weighted	Weighting of the audible frequencies designed to reflect the response of the human ear to sound. The ear is more sensitive to sound at frequencies in the middle of the audible range than it is to either very high or very low frequencies. Sound measurements are often A-weighted (using a dedicated filter) to compensate for the sensitivity of the ear.
Ambient sound level	BS 4142 (Ref 26-7) defines the ambient sound level as the: 'totally encompassing sound in a given situation at a given time, usually from many sources near and far.' It is sometimes used to mean an environmental noise level defined specifically in terms of the L_{Aeq} index. The terms 'ambient' and 'background' may be colloquially synonymous when describing environmental noise levels.
Anthropogenic noise	Noise from man-made sources or man's activities, i.e. noise from road, rail or farming activities.
Background sound level	BS 4142 (Ref 26-7) defines the background sound level $L_{A90,T}$ as the: '*A-weighted sound pressure level that is exceeded by the residual sound at the assessment location for 90% of a given time interval, T, measured using time weighting F and quoted to the nearest whole number of decibels*' (i.e. a sound level defined specifically in terms of the L_{A90} index). The ambient sound level is a measure of the residual sound and the specific sound when present. The terms 'ambient' and 'background' may be colloquially synonymous when describing environmental noise levels but this is not correct in formal terminology for acoustics terms. Horizontal Guidance H3 Part 2 Noise Assessment and Control (Environment Agency, 2002) describes the L_{A90} background noise level as: 'Whilst it is not the absolute lowest level measured in any of the short samples, it gives a clear indication of the underlying noise level, or the level that is almost always there in between intermittent noisy events'.
Baseline sound or noise levels/baseline sound or noise environment	The existing sound or noise levels before construction or operation of a development commences.
Broadband	A sound containing a wide range of frequencies (for example, a whooshing sound like a waterfall or an out of tune analogue radio).
Decibel (dB)	Units of sound measurement and noise exposure measurement.
Directivity	The uniform/non-uniform directional characteristics of a sound source (as sound may be emitted from the source in different directions with varying intensities and frequencies).

Glossary of Terms	
Term	**Meaning**
Equivalent continuous sound pressure level ($L_{Aeq,T}$)	Defined in BS 7445 (Ref 26-1) as the 'value of the A-weighted sound pressure level of a continuous, steady sound that, within a specified time interval, T, has the same mean square sound pressure as a sound under consideration whose level varies with time' i.e. it is a measure of the noise dose or exposure over a period. It is a unit commonly used to describe construction noise and noise from industrial premises and is the most suitable unit for the description of other forms of environmental noise. It is also the unit best suited to assessing community response.
Façade/Freefield	This applies to the positions for either measurement or prediction. A façade position is one that effectively represents sound levels at a building but is conventionally taken at a position 1 m from the building; this includes reflections from the building. A freefield position is one that is at least 3.5 m from a building where reflection effects are not significant. The difference between a sound level measured at a façade position and a freefield position, assuming that there is a specific sound source that causes reflections, is that levels are around 3 dB higher at the façade, due to the reflection effects.
Frequency	The pitch of the sound, measured in Hz. The tonal quality of a sound is described and measured in terms of the frequency content and is commonly expressed as octave or third octave bands, the latter being the division of the octave bands into three for finer analysis, across the frequency spectrum. The smaller the octave band or third octave band centre frequency number defined in terms of Hz, the lower the sound. For example, 63 Hz is lower than 500 Hz and is perceived as a deeper sound. The attenuation due to air absorption and natural barriers increases with frequency i.e. low frequencies are always the most difficult to control/mitigate. Frequency ranges for commonly occurring sounds include: · the low notes on a bass guitar are typically around 40 to 50 Hz; · the lowest string on a guitar is typically about 80 Hz; · Middle C is about 250 Hz; · the C above middle C is about 500 Hz; · cars in a residential area are generally around 250 and 500 Hz; · Greenwich Mean-time signal (pips) is around 1 kHz; · bird calls are generally around 2 to 5 kHz; and · a 'Shhh' sound made by the mouth is mostly around 4 kHz and above.
Harmonic	An oscillation (e.g. sound wave) that has a frequency that is an integral multiple of a fundamental frequency.
Hertz (Hz)	The unit of frequency in cycles per second.
Immission	The correlative of emission. Emissions are emitted by the sound source and immissions are received at the noise sensitive receptor.
$L_{Aeq,T}$	See "Equivalent continuous sound pressure level".
L_{Amax}	Maximum value of the A-weighted sound pressure level, measured using the fast (F) time weighting (in dBA).

Glossary of Terms	
Term	**Meaning**
L_{A90}	See “Background sound level”.
Loudness/Loud	The measure of the subjective impression of the magnitude or strength of a sound as perceived by the human ear.
Noise and Sound	Response to sound can be subjective and is affected by many factors, both acoustic and non-acoustic. The significance of its impact, for example, can depend on such factors as the margin by which a sound exceeds the background sound level, its absolute level, time of day and change in the acoustic environment, as well as local attitudes to the source of the sound and the character of the neighbourhood. Sound can be measured by a sound level meter or other measuring system. Noise is related to a human response and is routinely described as unwanted sound, or sound that is considered undesirable or disruptive.
Octave	The range between two frequencies whose ratio is 2:1.
Octave bands	Groups of frequencies defined by standards where the upper frequency of each band is equal to twice the lower frequency of the next higher band. Octave bands are usually named by their geometric centre frequency. For example, the octave band extending between 44.7 Hz and 89.1 Hz is called the 63 Hz octave band. The octave band extending between 89.1 Hz and 178 Hz is called the 125 Hz octave band. The full complement of octave bands in the audible frequency range is as follows: 31.5, 63, 125, 250, 500, 1,000, 2,000, 4,000, 8,000 and 16,000 Hz.
Point/Line/Area Source	Noise sources can be modelled as point, line or area sources. Noise attenuation due to geometric spreading, which is the effect of acoustic energy being spread over an increasing area with increasing distance from the source, can be different for the different types of source. Generally, when the distance from the source to the receptor is very much greater than the dimensions of the source, the attenuation due to geometric spreading from all source types is the same as for point sources.
Rating level, $L_{Ar,Tr}$	BS 4142:2014 (Ref 26-7) defines the rating level as ‘The specific noise level plus any adjustment for the characteristic features of the noise.’
Reflection	Sound can be reflected by hard surfaces and reflection effects can affect sound levels.
Slow/Fast Time Weighting	The response speed of the detector in a sound level meter. Slow response time is 1 second; fast response time is 1/8 second (0.125 seconds) and will detect changes in sound levels more rapidly than measurements made with Slow time-weighting.
Sound	See “Noise and Sound”.
Sound Power Level (SWL, L_W)	A sound power level is a measure of the total power radiated as sound by a source in all directions. It is a property of the source and is essentially independent of the measuring environment. The sound power level of a source is expressed in decibels (dB) and is equal to 10 times the logarithm to the base 10 of the ratio of the sound power of the source to a reference sound power. The reference sound power in air is normally taken to be 10^{-12} watt.

Glossary of Terms	
Term	**Meaning**
SoundPLANÒ	A computer software package that uses a ray-tracing numerical modelling approach to predict acoustic propagation from industrial and/or transport sound sources. The prediction methodologies follow national and international standards.
Sound Pressure Level (SPL)	Sound pressure is the dynamic variation of the static pressure of air and is measured in force per unit area. Sound pressure is normally represented on a logarithmic amplitude scale, which gives a better relationship to the human perception of hearing. The sound pressure level is expressed in decibels (dB) and is equal to 20 times the logarithm to the base 10 of the ratio of the sound pressure at the measurement location to a reference sound pressure. The reference sound pressure in air is normally taken to be 20 µPa, which roughly corresponds to the threshold of human hearing.
Sound spectrum	A sound represented by its frequency components.
Soundscape	The acoustic environment as perceived and understood by people in context.
Source term	The acoustic properties of a source defined as a sound power level or as a sound pressure level under specific measurement conditions. Source terms are sometimes provided as a spectrum.
Specific sound level, $L_{Aeq,Tr}$	BS 4142 (Ref 26-7) defines the specific sound level as the 'equivalent continuous A-weighted sound pressure level produced by the specific sound source over a given reference time interval'.
Third-octave bands	Frequency ranges where each octave is divided into one-third octaves.
Tonal	Sound sources sometimes contain audible or measurable components that can be identified as hums, whistles etc. The presence of these tonal components is sometimes considered to add an extra, annoying quality to the sound.
µPa	Symbol for micropascal.

List of Abbreviation	
Abbreviation	**Meaning**
BBC	Boston Borough Council
BS	British Standard
BSi	British Standards Institution
CoCP or CEMP	Code of Construction Practice/Construction Environmental Management Plan
CS	Converter Station
dBA	Decibels A-weighted
DCLG	Department for Communities and Local Government
DCO	Development Consent Order
DMRB	Design Manual for Roads and Bridges
EIA	Environmental Impact Assessment

List of Abbreviation	
Abbreviation	**Meaning**
ELDC	East Lindsey District Council
EPO	Environmental Protection Officer
ES	Environmental Statement
HDD	Horizontal Directional Drilling (a Trenchless Technology)
HVAC	High Voltage Alternating Current
HVDC	High Voltage Direct Current
Hz	Hertz
IPC	Infrastructure Planning Commission
LOAEL	Lowest Observed Adverse Effect Level
NKDC	North Kesteven District Council
NOEL	No Observed Effect Level
NPPF	National Planning Policy Framework (Ref 26-10)
NPPGN	National Planning Practice Guidance – Noise (Ref 26-11)
NPSE	Noise Policy Statement for England (Ref 26-9)
NVSR	Noise and Vibration Sensitive Receptor
OS	Ordnance Survey
PINS	Planning Inspectorate
PPV	Peak Particle Velocity
PRoW	Public Right of Way
SHDC	South Holland District Council
SOAEL	Significant Observed Adverse Effect Level
SRI	Sound Reduction Index
TT	Trenchless Technology (including HDD, thrust boring and auger boring).

1 Introduction

1.1 Introduction

1.1.1 This chapter has been prepared by RPS. It reports the results of baseline studies and the assessment of the potential impacts of the proposed converter station (including the proposed Alternating Current (AC) cable route and proposed permanent access road) on Noise and Vibration Sensitive Receptors (NVSRs). Table 26.1 below sets out the structure of the Environmental Statement (ES) with respect to noise and vibration.

1.1.2 Noise and vibration effects are interrelated with impacts on ecological receptors; an assessment of the impact of noise on ecological receptors is reported in ES-2-C.05 Chapter 21, Ecology. Reference should also be made to ES-2-C.09 Chapter 25, Traffic & Transport, upon which the assessment of transport noise depends.

Table 26.1 Environmental Statement: Noise & Vibration

ES Reference	ES Volume	ES Chapter	Content
ES-2-B.11	2	15	Main Report: Proposed Underground DC Cable
ES-2-C.10	**2**	**26**	**Main Report: Proposed Converter Station**
ES-3-B.01	3	15	Figures: Proposed Underground DC Cable
ES-3-C.01	3	26	Figures: Proposed Converter Station
ES-4-B.11	4	15	Technical Appendices: Proposed Underground DC Cable
ES-4-C.10	4	26	Technical Appendices: Proposed Converter Station

1.2 Chapter Structure

1.2.1 The remainder of this chapter is structured as follows:

- Section 2. Approach to Assessment. Sets out the discipline specific approach to the assessment in accordance with relevant guidance.
- Section 3. Basis of Assessment. Sets out the key assumptions which have been made in undertaking the impact assessment.
- Section 4. Planning Policy and Legislative Considerations. Provides a summary of the key points of planning policy and legislation which have been considered as part of the assessment.

- Section 5. Baseline Conditions. Reports the results of desktop and field studies undertaken to establish existing conditions.
- Section 6. Potential Impacts. Identifies the potential impacts on NVSRs which may occur as result of construction and operation.
- Section 7. Mitigation. Identifies the mitigation which is proposed including measures which are incorporated into the siting, design and construction of the proposed converter station.
- Section 8. Residual Effects. Reports the residual effects which remain taking into account proposed mitigation and identifies whether these are significant or not.
- Section 9. Monitoring. Outlines potential monitoring requirements during the construction and operational phases of the Scheme.
- Section 10. Cumulative Effects. Identifies the inter-project cumulative effects which may occur in combination with other developments.
- Section 11. Summary of Assessment. Provides a summary of the key findings of the impact assessment.
- Section 12. References.

2 Approach to Assessment

2.1 Introduction

2.1.1 This section describes the discipline specific approach in accordance with relevant guidance relating to noise and vibration.

2.2 Summary of Consultation

Scoping Opinion Review

2.2.1 Table 26.2 summarises the issues raised in the scoping opinion in relation to noise and vibration and outlines how and where these have been addressed in the subsequent assessment. A copy of the Scoping Opinion is included in Appendix 4.1.

Table 26.2 Scoping Opinion (Noise & Vibration)

Consultee	Summary of Comment	How and where addressed
Boston Borough Council (BBC)	The Councils consider that all residential receptors should be classed as being of high sensitivity whereas RPS had classed individual properties or small groups of properties as medium sensitivity and conglomerations of six or more properties as high sensitivity.	RPS considers that the classification should remain as stated to allow for more sensitive receptors which would otherwise require a change to the matrix to add a very high sensitivity. Following further consideration, the designation of six or more properties as being of high sensitivity has been revised. These are now considered to be of medium sensitivity as for individual properties.

2.3 Scope of Assessment

Aspects to be assessed

2.3.1 The key aspects with regards to noise and vibration for the Scheme are considered to be:

- Construction Effects: any adverse noise and/or vibration effects arising from the construction of the Scheme on NVSRs; this includes the construction of the converter station and new access road and the installation of the underground alternating current (AC) cables between the proposed converter station and the Bicker Fen NGET Substation.
- Construction Traffic Effects: any adverse noise effects arising from construction traffic associated with the Scheme both on the public highway and on the temporary access road off the public highway to the construction areas/compounds. Assuming all roads will be well maintained, vibration effects have been scoped out.

- Operational Effects: any adverse noise effects arising from the operation of the proposed converter station on NVSRs; traffic associated with the maintenance of the proposed converter station will be minimal and significant effects are most unlikely. On this basis, this aspect is scoped out. Also scoped out are any operational noise effects associated with the AC cable route and vibration effects associated with both the operation of the converter station and the AC cable.

2.3.2 For the proposed converter station, the most significant sources of operational noise emissions are (not in order of likely significance):

- the facades of the converter station buildings (due to their large size but only where they have significant internal noise levels);
- ventilation louvres within the converter station facades; and
- external noise sources, including any external fixed plant including significant items such as transformers.

2.3.3 With regard to overlaps with other disciplines, the main area is ecology where noise or vibration levels may interfere with species breeding, communicating etc. This aspect is considered in ES-2-C.05, Volume 2, Chapter 21, Ecology and in ES-2-D.01, Volume 2, Chapter 29, Cumulative Effects.

2.4 Spatial Scope

2.4.1 The spatial scope of the study area covers the area of land 1 km around the proposed converter station and 500 m either side of the centre of the proposed AC cable route. It should however be noted that, should the cable be laid towards the edge of the LoD, the edge of the study area will be 420m from the cable. These areas establish the Zone of Influence (ZoI) in which NVSRs are present and baseline surveys have been focused.

2.5 Temporal Scope

2.5.1 The assessment of noise and vibration effects is limited to those times when the noise or vibration is being generated. Once the source of noise or vibration is removed, any associated impact or effect will cease. For the assessment of noise and vibration effects arising during the construction phase, the temporal scope is the duration of the construction works.

2.5.2 Whilst construction of the converter station could occur for 3 to 4 years, activities would usually be undertaken during daytime periods although there would be some essential activities, such as concrete pours, where 24 hour working will be required.

2.5.3 The operation of the converter station will generate noise of much lower level than during construction but will occur for its lifetime. Whilst noise levels may vary depending on load or ambient temperature, the assessment is made against the highest expected noise emissions during normal operation. Noise emissions during exceptional conditions may exceed these; where exceptional conditions are under the control of the operator, such as testing, these will be limited to the daytime where possible. Unexpected exceptional conditions, such as emergency

alarms for example, might occur at any time (albeit infrequently) and exceed the normal operational noise levels but for very short durations.

2.6 Identification of Baseline Studies

Desk Studies

2.6.1 OS mapping and project information have been used to identify potential NVSRs in the area surrounding the proposed converter station and proposed AC cable route.

2.6.2 Reviews have been undertaken of the baseline sections of the ESs for other infrastructure projects in the area, including the substation which forms part of the Triton Knoll Offshore Wind Farm Electrical System and for Bicker Fen Wind Farm. From these, the descriptions of the baseline environment and data have been reviewed as have their predicted contribution to the existing and future soundscape of the area. However, the latter does not form part of the current baseline.

2.6.3 Baseline conditions around the proposed converter station site, AC cable route and access road have informed the assessment of both the construction and operation of the facility.

Field Studies

2.6.4 Noise surveys have provided baseline sound survey data at representative locations along the length of the Scheme including the proposed converter station, AC cable route and access road. The focus of these was at the proposed converter station, being essential for the operational noise assessment. Measurements of the baseline sound environment around the proposed converter station were undertaken in October and November 2016 and are reported in Technical Appendix Volume 4 Parts C Noise & Vibration (Baseline Sound Monitoring Report – Converter Station).

2.6.5 The measurements were carried out in accordance with BS 7445-1:2003 Description and measurement of environmental noise. Guide to quantities and procedures (Ref 26-1) and BS 7445-2:1991. Description and measurement of environmental noise. Guide to the acquisition of data pertinent to land use (Ref 26-2).

2.6.6 The surveys primarily focused on establishing the existing baseline noise level in the environment around the proposed converter station site where baseline levels have informed the identification of acoustic design mitigation in order to prevent significant effects from both the operation of the proposed converter station alone and cumulatively with other current and consented infrastructure. However, surveys were also included to consider effects for the AC cable route and the access road.

2.6.7 With regards to construction, it is recognised that the acoustic environments at the proposed converter station and along the proposed AC cable route and site access road are generally quiet. Consequently, the construction noise assessment criteria will likely be set to the lower thresholds given for Example Method 2 of Annex E 3.3 of BS 5228-1:2009+A1:2014 (Ref 26-3).

Meteorological measurements have also been taken in parallel with noise measurements, to verify that appropriate conditions prevailed during the surveys.

2.6.8 The noise surveys around the proposed converter station and along the proposed AC cable route have comprised long term (LT) surveys carried out over multiple days; supplemented by short-term (ST) surveys carried out over three one-hour consecutive periods. The average daytime $L_{Aeq,16hr}$ and $L_{A90,16hr}$ and night-time daytime $L_{Aeq,8hr}$ and $L_{A90,8hr}$ can be determined directly from the LT survey data. The exact number and location of surveys were determined through the survey selection process in consultation with the various statutory consultees (BBC, ELDC, NKDC, SHDC and Lincolnshire County Council (LCC)) for agreement prior to the surveys commencing.

2.7 Assessment Criteria

2.7.1 Criteria for the noise and vibration assessment, for the construction and operational phases, are set out below in the following paragraphs and in ES-2-A.04 Chapter 04 Environmental Impact Assessment Methods.

Construction Noise

2.7.2 The magnitude of impacts from construction noise has been determined in accordance with one example contained within Annex E of BS 5228-1:2009+A1:2014 (Ref 26-3). The significance criteria for assessing noise impact from construction works have been based on Example Method 2 contained within Annex E.3.3 of the above standard, as referred to above; this indicates that:

'Noise levels generated by site activities are deemed to be potentially significant if the total noise (pre-construction ambient plus site noise) exceeds the pre-construction ambient noise by 5 dB or more, subject to lower cut-off values of 65 dB, 55 dB and 45 dB $L_{Aeq,Period}$, from site noise alone, for the daytime, evening and night-time periods, respectively; and a duration of one month or more, unless works of a shorter duration are likely to result in significant effect.'

2.7.3 Table 26.3 summarises the criteria that have been used for the assessment of construction noise effects for residential dwellings and other NVSRs of Medium and High sensitivity. The guidance in BS 5228-1:2009+A1:2014 applies to residential dwellings only (deemed to be of medium sensitivity); therefore, for NVSRs that have low or high sensitivity, professional judgement has been applied to determine the overall level of effect.

Table 26.3 Construction Noise Levels Lower Cut-off Values which Might Result in Various Probabilities of Adverse Impact at Residential Building Facades					
Assessment category and threshold value period (L_{Aeq})	Threshold value[1], in decibels (dB)				
	No/ Negligible	Low	Median line for receptors of medium sensitivity	Moderate	Major
Night-time (23.00 to 07.00 hours)	<40	40 - 45		45 – 55	>55
Evenings (19.00 to 23.00 hours weekdays). Weekends (13.00 to 23.00 hours Saturdays and 07.00 to 23.00 hours Sundays)	<50	50 - 55		55 – 65	>65
Daytime (07.00 to 19.00 hours) weekdays and Saturdays (07.00 to 13.00 hours)	<60	60 - 65		65 - 75	>75

[1] Subject to duration criteria and where ambient noise levels are low.

2.7.4 The calculation method of BS 5228-1:2009+A1:2014 takes account of the duration of an activity per hour, the 'on-time'; and the attenuation of sound due to the effects of distance, ground attenuation and barrier effects. The assessment has been based on reasonably expected construction phases, plant items and on-times based on the information provided within BS 5228-1:2009+A1:2014.

2.7.5 Where predicted construction noise levels are up to 5 dB below the level criteria given in paragraph 2.7.2 above or of short duration (less than 1 month), this is considered to be a 'no change' or negligible adverse magnitude of impact. For works of significant duration (of one month or more, unless works of a shorter duration are likely to result in a significant effect: where levels are between -5 dB below and equal to the criteria above (to the left of the median line), this is considered to be a low adverse impact; where the criteria are exceeded by up to 10 dB (to the right of the median line), this is considered to be a moderate adverse impact. Noise levels greater than 10 dB above the criteria (median line of 45, 55 and 65 dB for night, evening and day) are considered a major adverse impact depending on the context and duration of the works.

2.7.6 For the majority of NVSRs, noise levels are likely to result in the criteria set within the lower cut-off levels given in Table 26.3 above, the most stringent limits.

2.7.7 The noise changes identified below have been used in the assessment of noise impacts associated with additional construction traffic on the local road network, the effects of temporary diversion routes necessary as a result of the construction of the Scheme and/or from any other

associated traffic changes. These are based on the guidance in the Design Manual for Roads and Bridges (DMRB) Volume 11, Section 3, Part 7 'Noise and Vibration' (Ref 26-4) for the classification of magnitude of noise impacts in the long term. Although construction works have their effects in the short-term, the temporary nature of the works decreases the rating of impacts.

2.7.8 Construction noise levels have been predicted using SoundPLAN noise modelling software implementing BS 5228-1:2009+A1:2014 (Ref 26-3) based on an assumed plant list and source terms contained within the Standard. The model input data and results of the assessments are provided in Technical Appendix 26.1 Annex 2: Construction Noise Assessment Calculations.

2.7.9 This noise change methodology has only been used for the assessment of changes in traffic flows on the public highway.

Table 26.4 Classification of Magnitude of Temporary Traffic Noise Impacts

Noise Change, $L_{A10,18h}$	Magnitude of Impact
0	No change
0.1– 2.9	Negligible
3 – 4.9	Low
5 – 9.9	Medium
10+	High

Construction Vibration

2.7.10 Criteria for assessing the significance of construction vibration are provided in BS 5228-2:2009+A1:2014 (Ref 26-5). Table 26.5 below details potential vibration levels measured in terms of Peak Particle Velocity (PPV) based on the guidance in BS 5228-2:2009+A1:2014 and provides a semantic scale for construction vibration effects on human receptors.

Table 26.5 Guidance on Effects of Vibration Levels

Peak Particle Velocity	Description	Magnitude of Impact
0.14 mm/s	Vibration might just be perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.	Negligible
0.3 mm/s	Vibration might just be perceptible in residential environments.	Low
1.0 mm/s	It is likely that vibration of this level in residential environments	Medium

Table 26.5 Guidance on Effects of Vibration Levels		
Peak Particle Velocity	**Description**	**Magnitude of Impact**
	will cause complaint but can be tolerated if prior warning and explanation has been given to residents.	
10 mm/s	Vibration is likely to be intolerable for any more than a brief exposure to this level.	High

2.7.11 Vibration from construction activities may impact on adjacent buildings. The criteria used in this assessment relate to the potential for cosmetic damage, not structural damage. Table 26.6 below provides the vibration limits contained within BS 5228-2:2009+A1:2014 above which cosmetic damage could occur. Minor damage is possible at vibration magnitudes that are greater than twice those given in Table 26.6 and major damage to a structure may occur at values greater than four times the tabulated values. The limits are the same as those in BS 7385-2:1993 'Evaluation and measurement of vibration in buildings - Part 1: Guide for measurement of vibrations and evaluation of their effects on buildings' (Ref 26-6) which would be applicable for effects beyond the construction phase.

Table 26.6 Threshold Vibration Values for the Evaluation of Cosmetic Building Damage			
Building Classification	**Frequency of Range of Vibration (Hz)**	**PPV mm/s [1]**	
		Transient Vibration	**Continuous Vibration**
Unreinforced or light framed structures[2] Residential or light commercial type buildings[2]	4 Hz to 15 Hz	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	7.5 mm/s at 4 Hz increasing to 10 mm/s at 15 Hz
	15 Hz and above	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above	10 mm/s at 15 Hz increasing to 25 mm/s at 40 Hz and above
Reinforced or framed structures Industrial and heavy commercial buildings	4 Hz and above	50	25

1. Values relate to the base of the building.
2. For lightweight structures, at frequencies below 4 Hz, a maximum displacement of 0.6 mm (zero to peak) is not to be exceeded.

Operational Noise

2.7.12 The significance of the noise effects associated with the operation of the converter station has been determined based upon the general methodology contained within BS 4142:2014 (Ref 26-7) as described below. This has been carried out based upon an indicative outline design taken from another National Grid project where a converter station was also required:

1. determination and characterisation of the baseline sound environment to derive a representative background sound level for the periods of interest;
2. development of a noise model for the indicative plant design that includes the significant sound generating items of plant and activities (either based on manufactures' data or representative noise source levels) ; this model predicts noise levels at the NVSRs included within the model – this provides the specific noise level at each NVSR (a SoundPLAN noise model has been developed which utilises the prediction methodology contained within International Standard (ISO) 9613-2:1996 'Acoustics: Attenuation of sound during propagation outdoors. Part 2: General method of calculation' (Ref 26-8));
3. specification of any character corrections as required and described in Section 9 of BS 4142:2014 including those for tonality, impulsivity, other sound characteristics and intermittency – when any corrections are made to the Specific Noise Level, this then becomes the Rating Level, L_{ArTr} (if no corrections are made, the level is still termed the Rating Level); and then
4. determine the difference at each NVSR between the L_{ArTr} from 3 above and the background noise level from 1 above. The difference determines the impact which can be described in accordance with Section 11 of BS 4142:2014 but this also requires consideration of the context.

2.7.13 The location of NVSRs may affect where plant can be located on site (i.e. locating sound sources as far away from receptors and/or using the proposed building as a sound attenuation screen).

2.7.14 A plant noise specification has also been provided to tenderers for the operational equipment. Whilst this is subject to confirmation, it provides a second assessment of steps 2 and 3 above, to ensure a robust appraisal is made within the ES.

2.7.15 From the above, and following the guidance in BS 4142:2014, Table 26.7 can be used to define the magnitude of effects.

Table 26.7 Operational Noise - Determination of Magnitude of Effect		
Difference between Rating Level and Background Noise Level	**BS 4142 Semantic Description**	**Magnitude of Effect**
> 7.5 dB	A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.	High
0 to 7.5 dB	A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context.	Medium
-10 to 0 dB	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.	Low
< -10 dB	-	Negligible

2.7.16 It is not appropriate, however, to solely ascribe numerical rating and background level differences to a BS 4142:2014 assessment, because this fails to consider the context of the sound which is a key requirement of the Standard. BS 4142:2014 requires that the significance of the effect of the noise in question (i.e. the magnitude of effect) should be determined both on the basis of the initial estimate of impact significance from the BS 4142:2014 assessment and with reference to the context of the sound, for example by referring to the examples of outcomes described within the PPGN.

2.7.17 With regard to context, it is necessary to consider all pertinent factors, including:

- the absolute level of the sound;
- the character and level of the residual sound compared to the character and level of the specific sound; and
- the sensitivity of the receptor and whether dwellings or other premises used for residential purposes will already incorporate design measures that secure good internal and/or outdoor acoustic conditions.

2.7.18 These considerations comprise the context of any potential impact identified and will inform the overall outcome of the assessment.

2.7.19 In addition, the LPAs (SHDC, BBC and NKDC) have stipulated a cumulative rating level ($L_{Ar,Tr}$) at receptors in accordance with BS 4142:2014 of 35 dB(A) from all existing and proposed

infrastructure in the area, primarily the Triton Knoll windfarm onshore infrastructure and the Bicker Fen Windfarm and the 400 kV National Grid Electricity Transmission (NGET) Substation. Noise emissions from the Bicker Fen Wind Farm turbines vary with wind speed; at medium to high wind speeds, noise from the windfarm will dominate noise immissions at some receptors and therefore it is considered that noise from the windfarm should not form part of the cumulative noise assessment.

2.7.20 Notwithstanding the above, with the specification set at paragraph 2.7.16 above, assuming noise from the proposed converter station does not exceed 25 dB $L_{Ar,Tr}$ at any NVSR, then the noise contribution from the proposed converter station at any NVSR will never exceed or increase the cumulative rating level limit.

Sensitivity of Receptors

2.7.21 Residential properties have been considered as being of 'Medium' sensitivity in accordance with other National Grid projects and common practice for EIA noise assessments.

2.7.22 Users of PRoWs, other permitted recreational trails and users of recreational facilities where the purpose of that recreation is enjoyment of the countryside have been treated as being of low sensitivity due to their temporary exposure and option to use other routes.

2.7.23 Other sensitive receptors (such as schools, nursing homes, hospitals etc.) have been treated as being of 'high' sensitivity, unless particular circumstances indicate otherwise. The sensitivity of impacts and effects upon important ecological sites or areas have been assessed by the ecologists and reported in the ecology chapters, as appropriate.

2.7.24 Table 26.8 describes the sensitivity and value criteria applied for various classes of receptor.

Table 26.8 Receptor Sensitivity (Noise & Vibration)

Sensitivity	Receptor types	Notes
Very High	As particular circumstances indicate. None identified	Unless particular circumstances indicate otherwise
High	Other sensitive receptors (such as schools, nursing homes, hospitals etc). None identified	Unless particular circumstances indicate otherwise
Medium	Residential properties	Unless particular circumstances indicate otherwise
Low	PRoW, other permitted recreational trails and users of recreational facilities where the purpose of that recreation is enjoyment of the countryside	Unless particular circumstances indicate otherwise

Table 26.8 Receptor Sensitivity (Noise & Vibration)		
Sensitivity	**Receptor types**	**Notes**
Negligible	Effects of noise on receptors of negligible sensitivity to noise are scoped out of the assessment	Unless particular circumstances indicate otherwise
Other	Ecological receptors.	As reported within the Ecological sections of the ES. See ES-2-C.05, Volume 2, Chapter 21, Ecology.

2.7.25 No receptors of Very High or High sensitivity have been identified. Effects of noise on receptors of negligible sensitivity to noise are scoped out of the assessment.

Magnitude of Impacts

2.7.26 As a guiding principle, the magnitude of potential impacts has been ranked none, negligible or low for effects within current guidelines; medium for effects marginally exceeding current guidelines; and high for effects significantly exceeding current guidelines.

Table 26.9 Magnitude of Impacts (Noise & Vibration)		
Magnitude of Impacts	**Description**	**Notes**
High	Effects significantly exceeding current guidelines	Threshold between marginal and significant exceedance will be specific to the aspect being considered
Medium	Effects marginally exceeding current guidelines	
Low	Effects within current guidelines	-
Negligible		-
None		-

Assessing the Significance of Effects

2.7.27 The following assessment of significance matrix has been used, with moderate or major effects being classed as a significant effect based upon effects at individual NVSRs.

Table 26.10 Assessment of Significance (Noise & Vibration)					
Magnitude of Impact	Sensitivity or Value of Receptor				
	Very High	High	Medium	Low	Negligible
High	Major	Major	Moderate	Moderate	Minor
Medium	Major	Moderate	Moderate	Minor	Negligible
Low	Moderate	Moderate	Minor	Negligible	Negligible
Negligible	Minor	Minor	Negligible	Negligible	Negligible

3 Basis of Assessment

3.1 Introduction

3.1.1 This section sets out the design assumptions and supporting information which inform the assessment. The assessment is based on the description of the construction and operation of the converter station, permanent access road and AC cable route connection to the Bicker Fen NGET Substation provided in ES-2-C.01 Chapter 17 The Proposed Converter Station. Assumptions for the noise and vibration assessment are provided in the various annexes contained within Appendix 26.1.

3.2 Converter Station

3.2.1 The converter station sits within the area of SHDC; the boundary with NKDC lies approximately 700 m to the west of the converter station site.

3.2.2 Key assumptions for the construction and operational assessments of the converter station, as provided in Annexes 3, 5, 9, 10 and 11 of Appendix 26.1, which underpin the assessment need to ensure that realistic worst case scenarios are considered for each aspect e.g.:

- For operational noise, that the converter station is operating at full load with all plant and equipment etc in operation but that noise immissions (noise reaching the nearest NVSRs) will not exceed the required specification (noise limit) achieved through mitigation by design.
- For construction, that representative plant type and numbers, including construction traffic, activities and works locations are assessed with regards to NVSRs in the area but that works will be carried out in accordance with Best Practicable Means implementing the control and mitigation measures outlined in BS 5228-1/2:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Part 1: Noise and Part 2: Vibration (Refs 28-3 and 28-5). Typical mitigation measures are outlined in ES-2-C-11 Chapter 7 Mitigation and will feature within the draft and final CEMPs.
- The assessment has considered the following example scenarios to enable a quantitative assessment to be undertaken:
  - site clearance and ground works using 360° tracked excavators/dozers;
  - piling (4-tonne hydraulic vibratory hammer inserting tubular steel piles);
  - foundation formation using 24-hour concrete pour; and
  - equipment installation using lorries and mobile tracked-cranes.

3.2.3 At the time of the assessment, the detailed acoustic specification of the equipment to be installed within the converter station is not known. However, the following specification has been issued to

potential contractors; this protects the cumulative limit required by the LPAs as described in paragraph 2.7.14 above:

"The rating level of noise emitted from the converter station buildings and any external plant shall not exceed 25 dB $L_{Ar,Tr}$ when determined at a freefield location representative of any surrounding dwelling or premises in residential use. The noise rating level shall be determined in accordance with BS 4142:2014, including any appropriate acoustic feature correction."

3.2.4 It is considered that this is achievable through appropriate design and this control can be regulated through inclusion of the above wording as a condition attached to the consent. This specification forms part of the embedded design mitigation. This specification provides sufficient information for an indicative design to be modelled and assessed. However, in addition to modelling and assessing effects based upon this limit, noise emissions from an example NGET converter station have also been modelled to evaluate the feasibility of achieving the maximum rating level above.

3.2.5 On the basis of the above, the assessment is predicated on the following:

- the LPAs cumulative limit of 35 dB $L_{Ar,Tr}$ from all infrastructure in the area applicable to any NVSR;
- the Project's suggested limit of the rating level of noise emitted from the converter station buildings and any external plant shall not exceed 25 dB $L_{Ar,Tr}$ at any NVSR to ensure that the 35 dB $L_{Ar,Tr}$ overall cumulative limit cannot be exceeded by noise from the converter station alone;
- a specification provided to potential contractors based on the not to exceed 25 dB $L_{Ar,Tr}$ at the nearest NVSR; and
- test modelling using source terms from a likely similar plant to determine whether the specification is achievable.

3.3 Access Road

3.3.1 The permanent access road sits within the area of SHDC. The assessment considers both the construction of this road and its subsequent use during the construction phase. Assumptions for its construction are included in Annex 4 of Appendix 26.1 and for its use in Annex 7 of Appendix 26.1 which is based on a peak month of vehicle movements.

3.4 AC Underground Cable

3.4.1 The AC cable route runs within the LPA boundaries of both SHDC (1.21 km length) and BBC (1.13 km length). The assumptions for its construction are provided in Annex 2 of Appendix 26.1. It will not have any operational noise effects although there will be a decommissioning phase.

3.5 Offsite/Public Highway Traffic

3.5.1 The noise changes associated with traffic generated during the construction phase on the local road network have been assessed for additional traffic on the local road network, the effects of temporary diversion routes necessary as a result of the construction of the Scheme and/or from any other associated traffic changes.

3.5.2 Traffic flow changes and assumptions for affected road links and the consequential noise predictions and changes are provided in Annex 8 of Appendix 26.1.

4 Planning Policy and Legislative Considerations

4.1 Introduction

4.1.1 This section summarises the key points of planning policy and legislation which have been considered as part of the assessment. A full description and analysis of planning policy and legislation will be dealt with in detail in a separate Planning Statement.

4.1.2 NGVL and their appointed contractors will comply with legislation.

4.2 Planning Policy and Guidance

4.2.1 Relevant guidance and national planning policy is contained within the Noise Policy Statement for England (NPSE) (Ref 26-9), the National Planning Policy Framework (NPPF) (Ref 26-10) and published Planning Practice Guidance on Noise (PPGN) (Ref 26-11). These documents do not contain guidance in terms of numerical noise levels. Guidance is provided descriptively, which may be transposed to numerical noise levels for site-specific situations, using the methods contained within British Standards (BSs). However, there is no specific guidance on this; the research that Defra promoted has apparently been inconclusive and is likely to vary by source.

Noise Policy Statement for England

4.2.2 The noise element of the assessment is based on the definition of 'noise' and the reference to 'sound' contained within the Noise Policy Statement for England (NPSE), which states:

"For the purposes of the NPSE, 'noise' includes:

- *'environmental noise' which includes noise from transportation sources;*
- *'neighbour noise' which includes noise from inside and outside people's homes; and*
- *'neighbourhood noise' which includes noise arising from within the community such as industrial and entertainment premises, trade and business premises, construction sites and noise in the street.*

Furthermore, sound only becomes noise (often defined as 'unwanted sound') when it exists in the wrong place or at the wrong time such that it causes or contributes to some harmful or otherwise unwanted effect, like annoyance or sleep disturbance. Unlike many other pollutants, noise pollution depends not just on the physical aspects of the sound itself, but also the human reaction to it."

4.2.3 On this basis, the assessment determines the significance of noise effects on the basis of measured and predicted levels of sound taking into account the context of the levels received at the noise sensitive receptors (NVSRs) as described in the NPSE.

4.2.4 The NPSE aims to provide clarity regarding current policies and practices to enable noise management decisions to be made within the wider context, at the most appropriate level, in a cost-effective manner and in a timely fashion.

4.2.5 Paragraph 1.6 of the NPSE sets out the long-term vision and aims of Government noise policy:

"Noise Policy Vision

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

"Noise Policy Aims

Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development:

- *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 improvement of health and quality of life."*

4.2.6 The aims require that all reasonable steps should be taken to avoid, mitigate and minimise adverse effects on health and quality of life whilst also taking into account the guiding principles of sustainable development, which include social, economic, environmental and health considerations.

4.2.7 With regard to the terms 'significant adverse' and 'adverse' included in the 'Noise Policy Aims', these are explained further in the 'Explanatory Note' as relating to established concepts from toxicology that are currently being applied to noise impacts, for example, by the World Health Organisation which are:

'NOEL – No Observed Effect Level

This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on human health and quality of life due to noise.

LOAEL – Lowest Observed Adverse Effect Level

This is the level above which adverse effects on health and quality of life can be detected.'

4.2.8 Defra has then extended these concepts for the purpose of the NPSE to introduce the concept of:

'SOAEL – Significant Observed Adverse Effect Level

This is the level above which significant adverse effects on health and quality of life occur.'

4.2.9 The accompanying explanation states:

'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. It is acknowledged that further research is required to increase our understanding of what may constitute a significant adverse impact on health and quality of life from noise. However, not having specific SOAEL values in the NPSE provides the necessary policy flexibility until further evidence and suitable guidance is available'.

4.2.10 With regard to 'further evidence', Defra has commissioned research to try and identify the levels at which the above effects occur but this is not yet in the public domain. However, early indications are that this research has been largely inconclusive. On this basis, and until further guidance becomes available, and given that there is no specific guidance in the NPPF on noise, there is no justification to vary assessment methods and criteria from those previously adopted from British Standards etc.

National Planning Policy Framework

4.2.11 The National Planning Policy Framework (NPPF) (Ref 26-10), published in March 2012, sets out the Government's planning policies for England. The document does not contain any specific noise policy, or noise limits but it provides a framework for local people and local authorities to produce their own local and neighbourhood plans, which reflect the needs and priorities of their communities.

4.2.12 In Section 11 of the NPPF, 'Conserving and enhancing the natural environment', paragraph 123 relates to noise and states:

'123. Planning policies and decisions should aim to:

- *avoid noise from giving rise to significant adverse impacts[27] on health and quality of life as a result of new development;*
- *mitigate and reduce to a minimum other adverse impacts[27] on health and quality of life arising from noise from new development, including through the use of conditions;*
- *recognise that development will often create some noise and existing businesses wanting to develop in continuance of their business should not have unreasonable restrictions put on them because of changes in nearby land uses since they were established;[28] 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*.'

[27] See Explanatory Note to the Noise Policy Statement for England (Department for the Environment, Food and Rural Affairs).

[28] Subject to the provisions of the Environmental Protection Act 1990 and other relevant law.'

4.2.13 The first bullet point refers to 'significant adverse impacts' which relates to the 'significant observed adverse effect level' (SOAEL) in the Noise Policy Statement for England (NPSE), though the term 'effect' is used instead of the term 'impact' although these have been deemed to be interchangeable in this context. Therefore, given the comments above on the NPSE with regard to assessment methods and criteria, the current content of the NPPF does not require any change in previously adopted approaches.

Planning Practice Guidance on Noise

4.2.14 The Government has published Planning Practice Guidance on a range of subjects including noise (Ref 26-11).The guidance forms part of the NPPF and provides advice on how to deliver its

policies. The PPGN reiterates general guidance on noise policy and assessment methods provided in the NPPF, NPSE and British Standards (BSs) and contains examples of acoustic environments commensurate with various effect levels. Paragraph 006 of the PPGN explains that:

'The subjective nature of noise means that there is not a simple relationship between noise levels and the impact on those affected. This will depend on how various factors combine in any particular situation.'

4.2.15 According to the PPGN, factors that can influence whether noise could be of concern include:

- the source and absolute level of the noise together with the time of day it occurs;
- for non-continuous sources of noise, the number of noise events, and the frequency and pattern of occurrence of the noise;
- the spectral content and the general character of the noise;
- the local topology and topography along with the existing and, where appropriate, the planned character of the area.
- where applicable, the cumulative impacts of more than one source should be taken into account along with the extent to which the source of noise is intermittent and of limited duration;
- whether adverse internal effects can be completely removed by closing windows and, in the case of new residential development, if the proposed mitigation relies on windows being kept closed most of the time;
- in cases where existing noise sensitive locations already experience high noise levels, a development that is expected to cause even a small increase in the overall noise level may result in a significant adverse effect occurring even though little to no change in behaviour would be likely to occur;
- where relevant, Noise Action Plans, and, in particular the Important Areas identified through the process associated with the Environmental Noise Directive and corresponding regulations;
- the effect of noise on wildlife;
- if external amenity spaces are an intrinsic part of the overall design, the acoustic environment of those spaces; and
- the potential effect of a new residential development being located close to an existing business that gives rise to noise should be carefully considered. This is because existing noise levels from the business even if intermittent (for example, a live music venue) may be regarded as unacceptable by the new residents and subject to enforcement action. To help avoid such instances, appropriate mitigation should be considered, including optimising the sound insulation provided by the new development's building envelope. In the case of an established business, the policy set out in the third bullet of paragraph 123 of the NPPF should be followed.

4.2.16 Relevant experience and professional judgment are fundamental to all stages of the assessment that leads to the determination of the significance of a noise effect. The non-numeric guidance

contained within the PPGN, based upon the initial advice in the NPSE, is summarised in Table 26.11 below.

Table 26.11 Summary of Guidance from NPSE and PPGN

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 (LOAEL)			
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 (SOAEL)			
Noticeable and disruptive	The noise causes a material change in behaviour and/or attitude, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.	Significant Observed Adverse Effect	Avoid
Unacceptable Adverse Effect Level (UAEL)			
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

4.2.17 The descriptions and examples of outcomes within the NPSE and PPGN can be used to inform the assessment of context, as required within BS 4142:2014.

4.2.18 The PPGN provides further information on the adverse effects of noise and how it can be mitigated. For noise sensitive development, mitigation measures can include: avoiding noisy locations; designing the development to reduce the impact of noise from the local environment, including noise barriers; and optimising the sound insulation provided by the building envelope including through noise insulation.

4.3 Legislation

Control of Pollution Act, 1974

4.3.1 Part III of the Control of Pollution Act 1974 (CoPA) (Ref 26-12) is specifically concerned with pollution. With regards to noise it covers construction sites; noise in the street; noise abatement zones; codes of practice and best practicable means (BPM).

4.3.2 Section 60, Part III of the CoPA refers to the control of noise on construction sites. It provides legislation by which local authorities can control noise from construction sites to prevent noise disturbance occurring. The Control of Noise (Code of Practice for Construction and Open Sites) (England) Order 2015 (Ref 26-13) approved British Standard (BS) 5228-1:2009+A1:2014 (Ref 26-3) and BS 5228-2:2009+A1:2014 (Ref 26-5) for the purpose of giving guidance on appropriate methods for minimising noise from construction and open sites in exercise of the powers conferred on the Secretary of State by sections 71(1)(b), (2) and (3) of the CoPA.

4.3.3 The CoPA enables the local authority, in whose area work is going to be undertaken, or is being undertaken, the power to serve a notice imposing requirements as to the way in which construction works are to be carried out. This notice can specify, the plant or machinery that is or is not to be used, the hours during which the construction work can be carried out, the level of noise and vibration that can be emitted from the premises in question or at any specified point on these premises or that can be emitted during specified hours, or for any change of circumstances.

4.3.4 Section 61, Part III of the CoPA refers to prior consent for work on construction sites. It provides a method by which a contractor can apply for consent to undertake construction works in advance. If consent is given, and the stated method and hours of work are complied with, then the local authority cannot take action under Section 60.

4.3.5 Section 71, Part III of the CoPA refers to the preparation and approval of codes of practice for minimising noise.

4.3.6 Section 72, Part III of the CoPA refers to BPM, which is defined as:

'reasonably practicable, having regards among other things to local conditions and circumstances, to the current state of technical knowledge and to the financial implications'. Whilst 'Means' includes 'the design, installation, maintenance and manner and periods of

operation of plant and machinery, and the design, construction and maintenance of buildings and acoustic structures'.

4.3.7 If BPM is applied, then it can provide a defence against prosecution by the local authority.

Environmental Protection Act 1990, Part lll (EPA)

4.3.8 The Environmental Protection Act 1990 (EPA) (Ref 26-14) deals with statutory nuisance, including noise.

4.3.9 Section 79, Part III of the EPA, 'Statutory nuisances and inspections therefor', places a duty on local authorities to regularly inspect their areas to detect whether a statutory nuisances exists. This section also considers and defines the concept of 'Best Practicable Means' (BPM) which originates from Section 72, Part III of the Control of Pollution Act (CoPA), where BPM is defined as:

'reasonably practicable having regard, among other things, to local conditions and circumstances, to the current state of technical knowledge and to the financial implications'.

4.3.10 Where the local authority is satisfied that a statutory nuisance does exist, or is likely to occur or recur, it must serve an abatement notice. Section 80, Part III of the EPA, 'Summary proceedings for statutory nuisances', provides local authorities with the power to serve an abatement notice requiring the abatement of the nuisance or prohibiting or restricting its occurrence or recurrence; and/or carrying out such works or other action necessary to abate the nuisance.

4.3.11 Section 82, Part III of the EPA, 'Summary proceedings by persons aggrieved by statutory nuisances', allows a Magistrates' court to act on a complaint made by any person on the grounds that he is aggrieved by a statutory nuisance, such as noise.

4.3.12 The procedures for appeals against abatement notices are detailed in the Statutory Nuisance (Appeals) Regulations 1995 (Ref 26-15).

5 Baseline Conditions

5.1 Study Area

5.1.1 This section provides a brief description of baseline conditions present in the study area (including the converter station, permanent access road and AC cable route to the Bicker Fen Substation). This corresponds to the geographic scope of assessment described in section 2.4 of this chapter. The full results and survey details are provided in Technical Appendix 26.1 Baseline Sound Monitoring Report – Converter Station.

5.1.2 For construction and operation (and future decommissioning), the noise and vibration assessment has considered NVSRs and Public Rights of Way (PRoWs) within approximately 1 km of the converter station site and 500 m either side of the AC cable route centreline to the Bicker Fen Substation. Some baseline noise surveys fell just outside this study distance, as did some NVSRs assessed to ensure appropriate and full coverage of those NVSRs may be affected.

5.1.3 These areas establish the Zone of Influence (ZoI) in which NVSRs are present and baseline surveys have been focused.

5.1.4 Noise effects resulting from construction traffic are considered on roads outside of the ZoI where it is considered that there is the potential for a significant effect to occur.

5.1.5 Vibration effects are likely to be insignificant at lesser distances than noise effects so this approach is precautionary.

5.2 Baseline Noise Conditions

5.2.1 Baseline noise levels have been determined by means of survey, both of attended and unattended sound level measurement, in the vicinity of the proposed converter station, permanent access road and AC cable route.

5.2.2 Baseline sound level monitoring was undertaken over a 15 day period between Wednesday 26th October 2016 and Thursday 10th November 2016. Six partially attended, 15-day continuous surveys were completed. Attendance and observations in the general survey area (north, east, south and west of the proposed site) were made during the evening and night-time periods, around 19:00 hours and 02:00 hours respectively, on two separate evenings/nights. In addition, four fully attended short-term surveys, consisting of three 1-hour discontinuous periods, were completed during the daytime period (10:00 to 17:00 hours).

5.2.3 Survey locations were selected to be representative of a range of acoustic environments within the converter station study area and agreed with the LPAs (BBC, ELDC and NKDC) in advance. These locations were representative of residential receptors, nature conservation areas, recreational uses and otherwise noise sensitive locations.

5.2.4 Survey locations are shown in Figure 3.1 of Technical Appendix 26.2 and full details of the survey procedure, locations and results are also provided in Technical Appendix 26.2, Baseline Sound Monitoring Report – Converter Station. The locations of NVSRs in the vicinity of the converter station are in Annex 13 of Technical Appendix 26.1 which includes the converter station site. There appear to be two PRoW in the area, a bridleway that runs down the eastern side of the South Forty Foot Drain to the west of the site and a footpath that runs near the road at Northorpe to the east of the site. Neither of these lie within a distance where users of these PRoW would be adversely affected by noise from the converter station in operation.

5.2.5 The site and area surrounding the proposed converter station site is in use as agricultural land and sound sources such as agricultural machinery in the fields and roads were present; these were audible at the majority of the survey locations including during the evening attended observations. However, whilst agricultural activity was noted at all locations (except on Park Lane, Donington), it was transient and not continuous in nature. It is considered that the surveys were representative of typical conditions.

5.2.6 Other notable sound sources included occasional traffic movements on the local road network close to the survey locations and regular low level aircraft (one to two per hour), considered likely to be associated with RAF Coningsby, located approximately 20 km to the north.

5.2.7 Other sources of sound included distant road traffic on the A17 and A52 roads (mainly audible during quiet periods), occasional train movements on the railway to the south of the site, turbulent sound when close to the wind farm north of the site, bird calls and some wind rustle of trees and other foliage etc.

5.2.8 Table 26.12 below provides a summary of representative baseline sound levels to be used for the assessment. For the purposes of the assessment, representative levels have been placed into two groups, with each group based on the proximity to the proposed converter station. The quieter group reflect the expected noise levels at rural properties away from major roads, with the higher levels being representative of those properties nearer conglomerations and transport infrastructure.

Table 26.12 Summary of Representative Baseline Sound Levels at Nearby NVSRs

Group	Period	Representative Ambient Level $L_{Aeq,T}$ (dB)	Representative Background Level $L_{A90,T}$ (dB)
The Old Barn and Bank Farm House, North Ing Drove, Northorpe House, Northorpe Road and Eau End Farm	Day	51	29
	Evening	35	24
	Night	38	22
1 Ing Road, properties on Northorpe Road, properties on Days Lane, properties on Cowbridge Road and	Day	50	35
	Evening	37	30
	Night	38	26

Table 26.12 Summary of Representative Baseline Sound Levels at Nearby NVSRs			
Group	**Period**	**Representative Ambient Level $L_{Aeq,T}$ (dB)**	**Representative Background Level $L_{A90,T}$ (dB)**
properties on Park Lane			
Note: Ambient representative sound level excludes data from 05/11/2016 and 06/11/2016.			

5.2.9 It is noted that the night-time L_{Aeq} level is higher than that for the evening. It is considered that this is due to the contribution from the dawn chorus. For the purpose of assessment, the lower of the evening/night levels has been used for the night period.

5.3 Baseline Vibration Conditions

5.3.1 No existing significant sources of vibration relevant to the UK Onshore Scheme have been identified; any assessment of vibration will not be made in relation to existing vibration levels. It is therefore not necessary for any baseline vibration measurements to have been undertaken.

6 Potential Impacts

6.1 Overview of Potential Impacts

6.1.1 The assessment of the potential operational noise impacts takes into consideration design mitigation measures in relation to noise and vibration, i.e. the integral design of the converter station that will achieve the accepted noise limit at the nearest NVSRs. This limit will ensure that noise immissions will not result in an acoustic environment exceeding an unacceptable adverse effect level (UAEL as discussed in Table 26.11) at any surrounding residential receptors. This is further considered in Sections 3 and 7 with residual effects being considered in Section 8.

6.1.2 Mitigation measures for construction are also considered in Sections 3 and Section 7. These include the application of Best Practicable Means (Ref 26-13, Control of Pollution Act 1974, Chapter 40, Part III, Section 72) to reduce noise emissions and adherence to an appropriate CEMP.

6.2 Construction Impacts

6.2.1 For the purposes of this EIA, construction effects are typically temporary or short to medium term occurring during the construction phase only. Given the scale of the converter station, and hence the longevity of the programme, construction might be considered to be of medium term duration. The effects will include those resulting from construction of the converter station, the access road and the AC cable route. Sources would include construction traffic, construction plant and machinery or other temporary effects associated with access or the construction compounds.

Construction of the Converter Station

6.2.2 The assessment of the noise effects during the construction of the converter station has considered the activities likely to give rise to the greatest noise immissions and the duration of construction activities. At this stage of the project, precise quanta and type of plant and working methods cannot be specified but an assessment has been undertaken based on typical construction activities for this type of infrastructure.

Magnitude of impact

6.2.3 The assessment indicates that the predicted daytime construction noise levels from the construction of the converter station are likely to range between 37 dB $L_{Aeq,T}$ and 47 dB $L_{Aeq,T}$ at the nearest NVSRs. Most works will be daytime only but exceptional, short-term activities may require 24 hour working to facilitate activities like concrete pours for main slabs which have to be continuous from start to completion.

6.2.4 In terms of noise immissions, the results of the assessments indicate that the magnitude of impact from the construction of the converter station site would be **negligible** during the daytime and evening, and **negligible to medium** for works during the night-time. However, due to the long duration of the construction activity, the semantics should become **low to negligible** during the daytime (low at the start reducing to negligible as major works lessen) and **medium** for any evening or night-time works.

Sensitivity of receptor

6.2.5 The residential properties are of **medium** sensitivity.

Significance of effect

6.2.6 Based upon the above, the significance of effects becomes **minor to negligible adverse** during the day and **moderate adverse** for any evening or night-time works.

Construction of the AC Cable Route

6.2.7 An approximate alignment of the AC cable route has been modelled. The alignment is remote from any residential receptors (greater than 500 m from the centre line of the cable route assuming that the cable route is positioned at the centre of the LoD), and a maximum construction noise level of 33 dB L_{Aeq} is predicted at any receptor. This is a low level and would not alter greatly if the alignment was to swing away from the centre of the LoD.

Magnitude of impact

6.2.8 Construction of the AC cable route would be **negligible** at any time in terms of both noise immissions and the duration of activities.

Sensitivity of receptor

6.2.9 The residential properties are of **medium** sensitivity.

Significance of effect

6.2.10 Based upon the above, there would be a **negligible** significance of effect.

Construction of the Access Road

6.2.11 The access road from the A52 is closest to residential properties where it joins the A52. Properties near larger roads will generally be experiencing a higher ambient noise environment compared to properties remote from roads; however, the lower cut-offs for construction noise as discussed in paragraph 2.7.2 above remain appropriate.

Magnitude of impact

6.2.12 For the nearest residential properties, across the A52 within Donington, at approximately 100 m distance and beyond, a maximum construction noise level of 44 dB L_{Aeq} is predicted at any receptor. Given that works should only be required during the daytime, the results of the assessments indicate that the magnitude of impact from the construction of the access road would be **negligible** in terms of both noise immissions and the duration of activities.

Sensitivity of receptor

6.2.13 The residential properties are of **medium** sensitivity.

Significance of effect

6.2.14 Based upon the above, there would be a **negligible** significance of effect.

Effects upon PRoW

6.2.15 There are a number of PRoWs within the 1 km study area of the proposed converter station site. The magnitude of impact on users of the PRoWs from construction of the proposed converter station is considered to be **negligible to medium**. However, users of PRoWs are transitory, where exposure is temporary as the user passes a particular point or moves through an area.

6.2.16 The sensitivity of the PRoWs is considered to be **low** and hence the significance of effect is **negligible** due to the short duration of any exposure.

Vibration from Construction of the Proposed Converter Station, Access Road and AC Cable

6.2.17 Vibration from construction will be minimised as far as is reasonably practicable. No blasting or impact piling is anticipated. As far as is reasonably practicable, all piling will be undertaken by non-impact methods, such as continuous flight auger (CFA). As such, construction vibration would be unlikely to be significant beyond the immediate site/construction areas, i.e. less than 1.0 mm/s. Off-site vibration would be a **negligible adverse** impact at all NVSR locations, i.e. less than 0.3 mm/s.

6.2.18 Construction vibration would be of **negligible adverse** significance, which is not significant.

Construction Vehicles on the Permanent Access Road

Magnitude of impact

6.2.19 Assessment is made on the basis of construction traffic data issued 13th April 2017. Detail of the data and construction traffic profile can be found in ES-2-C.09 Chapter 25, Traffic & Transport. As the construction progresses, changes to the predicted traffic flows are expected. Other than those arising from a major change in construction programming, however, the noise assessment

is robust to most changes that arise. Furthermore, a 20% uplift prediction is also assessed, to allow for variation in prediction.

6.2.20 Allowing for a 20% uplift, predicted two-way daily traffic flows of circa 226 vehicles are predicted in the peak month. Of these, 133 would be heavy goods vehicles (HGV) with the remainder being cars or light delivery vehicles (LDV). The traffic consultant reports that the client indicates that few vehicle movements would occur at night.

6.2.21 The assessment indicates that the predicted noise levels from vehicles on the proposed converter station construction site access road are likely to be 61 dB L_{Aeq} at 50 m, 58 dB L_{Aeq} at 100 m and 54 dB L_{Aeq} at 250 m during times of peak flow.

6.2.22 For some properties on North Ing Road, at approximately 250 m from the permanent access road, levels of 54 dB L_{Aeq} would be expected. Where the permanent access road joins the A52, properties on Park Lane lie approximately 100 m from its terminus and levels of 58 dB L_{Aeq} are predicted.

6.2.23 The impact at the nearest NVSRs is predicted to be local, short to medium term duration, intermittent and temporary. Where the peak traffic flow is limited to the daytime period, the magnitude of impact from traffic generation on the converter station construction access is considered to be **negligible**. If peak flow occurs within the evening or night-time, then impact magnitudes of **low/medium** may occur. The traffic assessment, however, indicates that there will be minimal HGV movements during either the evening or night periods. This aspect will be covered in the CEMP but night-time traffic movements may only be required for exceptional activities required over 24 hours such as concrete pours. This is unless batching occurs on site and all deliveries are made during the day.

6.2.24 There are two PRoWs within the construction study area which cross or run along the permanent access road. Users of PRoWs are transitory and hence exposure is temporary as the user passes a particular point or moves through an area or exposure can be avoided by choosing a different route. The magnitude of impact on PRoWs from construction traffic generation on the converter station permanent access road is **negligible to low.**

6.2.25 Access roads will be well maintained during the construction phase and kept free of potholes. As such, construction vehicles will not generate significant vibration away from the immediate carriageway.

Sensitivity of receptor

6.2.26 The proposed permanent converter station site access road is located within a rural area but with the potential to affect only a few individual residential receptors. However, the eastern extent of the access road will be close to (i.e. within 300 m) the edges of Donington and individual dwellings.

6.2.27 The sensitivity of the residential receptors along the existing road network and adjacent to the new road is considered to be **medium**.

Significance of effect

6.2.28 The effect on NVSRs including users of the PRoWs will, therefore, be of **negligible** significance, which is not significant.

Construction Vehicles on the Public Highway

Magnitude of impact

6.2.29 Noise change has been predicted based on the two-way 18-hour flows, percentage of HGVs and speed data for 17 existing and unaltered road links for both a summer and winter weekday which are likely to be used by construction traffic. Full details of the traffic forecasting methodology and assumptions are provided in ES-2-C.09 Chapter 25 Traffic & Transport. The assessment only takes into account data for the road links identified in chapter 25 only. A figure identifying the road traffic links is provided in ES-2-C.09 Chapter 25 Traffic & Transport.

6.2.30 The percentage traffic increases have been considered for the following scenarios (for summer and winter periods):

- Base 2019 + Construction
- Base 2022 + Construction
- Base 2019 + Construction (+20% Uplift)
- Base 2022 + Construction (+20% Uplift)

6.2.31 The AAWT flows provided are based on surveyed traffic flows captured over a week during a summer and winter month.

6.2.32 In summary, none of the links experience an increase in total traffic of >10% with the construction traffic added, and only one link has an increase in HGV traffic of >10% (the A52 (Bicker) with 12.9% increase in HGV traffic). Consequently, any noise change due to additional construction traffic is likely to be less than a 1 dB increase. For the purposes of the assessment, the traffic consultant indicates that night traffic will be minimal, with deliveries occurring during the daytime.

6.2.33 For the year 2019, the 18-hour assessment indicates that a noise increase of less than 1 dB is predicted for both summer and winter weekdays for all 17 links. A maximum noise increase of 0.4 dB is predicted for the A52 (Bicker). Similarly, for the year 2022, the assessment also indicates that a maximum noise increase of 0.4 dB is predicted for the A52 (Bicker).

6.2.34 A summary of the predicted changes are given in Table 26.13. Full calculations are provided in Appendix 26.1 Annex 8.

Table 26.13 Predicted Construction Traffic Noise Change (dB) on Existing Road Links					
Locations	ATC Site	Year 2019 Without to with construction		Year 2022 Without to with construction	
		Summer	Winter	Summer	Winter
A17 (Swineshead)	57	0.1	0.1	0.0	0.1
A52 (Bicker)	60	0.4	0.4	0.4	0.4
A52 (Swaton)	63	0.2	0.2	0.2	0.2
A15 (Swarby)	64	0.1	0.1	0.1	0.1
A17 (Kirkby la Thorpe)	55	0.0	0.0	0.0	0.0
A17 (Swineshead Bridge)	56	0.0	0.0	0.0	0.0
A1121 (Hubbert's Bridge)	58	0.0	0.0	0.0	0.0
A17 (Wigtoft)	59	0.0	0.0	0.0	0.0
A16 (Kirton)	61	0.0	0.0	0.0	0.0
A16 (Algarkirk)	62	0.0	0.0	0.0	0.0
A16 (Hilldyke)	25	0.1	0.1	0.1	0.1
A52 (Haltoft End)	24	0.0	0.0	0.0	0.0
A15 (Folkingham)	65	0.1	0.1	0.1	0.1
A52 (Dembleby)	68	0.0	0.1	0.0	0.1
A17 (Holbeach Clough)	81	0.0	0.0	0.0	0.0
A17 (Long Sutton)	80	0.0	0.0	0.0	0.0
B1992 (Langrick)	99	0.0	0.0	0.0	0.0

6.2.35 When allowing for a 20% uplift: for the year 2019, the 18-hour assessment indicates that a noise increase of less than 1 dB is predicted for both summer and winter weekdays for all 17 links. A maximum noise increase of 0.5 dB is predicted for the A52 (Bicker). Similarly, for the year 2022, the assessment also indicates that a maximum noise increase of 0.5 dB is predicted for the A52 (Bicker).

6.2.36 A summary of the predicted changes are given in Table 26.14. Full calculations are provided in Appendix 26.1 Annex 8.

Table 26.14 Predicted Construction Traffic (with 20% uplift) Noise Change (dB) on Existing Road Links					
Locations	ATC Site	Year 2019 Without to with construction		Year 2022 Without to with construction	
		Summer	Winter	Summer	Winter
A17 (Swineshead)	57	0.1	0.1	0.1	0.1
A52 (Bicker)	60	0.5	0.5	0.5	0.5
A52 (Swaton)	63	0.2	0.2	0.2	0.2
A15 (Swarby)	64	0.1	0.1	0.1	0.1
A17 (Kirkby la Thorpe)	55	0.0	0.0	0.0	0.0
A17 (Swineshead Bridge)	56	0.0	0.1	0.0	0.1
A1121 (Hubbert's Bridge)	58	0.0	0.0	0.0	0.0
A17 (Wigtoft)	59	0.0	0.0	0.0	0.0
A16 (Kirton)	61	0.0	0.0	0.0	0.0
A16 (Algarkirk)	62	0.0	0.0	0.0	0.0
A16 (Hilldyke)	25	0.1	0.1	0.1	0.1
A52 (Haltoft End)	24	0.0	0.0	0.0	0.0
A15 (Folkingham)	65	0.1	0.1	0.1	0.1
A52 (Dembleby)	68	0.1	0.1	0.1	0.1
A17 (Holbeach Clough)	81	0.0	0.0	0.0	0.0
A17 (Long Sutton)	80	0.0	0.0	0.0	0.0
B1992 (Langrick)	99	0.0	0.0	0.0	0.0

6.2.37 Changes in vibration, arising from construction traffic on the public highway, will be proportional to the changes in noise. As such, the assessment of impacts relates to the effects of both noise and vibration. The impact at the NVSRs on or close to the local road network is predicted to be local, short to medium-term, continuous and temporary. The results of the assessment indicate that significance criteria are not exceeded at any NVSRs; the magnitude of impact from traffic generation on the local road network is, therefore, considered to be **negligible**.

6.2.38 The effect on users of the PRoWs will be no different than those already experienced from existing traffic movements on the local road network. Vibration effects should be minimal assuming all roads are suitably maintained and hence this aspect has been scoped out.

Sensitivity of receptor

6.2.39 The number of NVSRs on each road link varies; however, traffic generation on the local road network has the potential to affect only a few individual residential receptors at a time. These

residential receptors are considered as **medium** sensitivity. The sensitivity of the PRoWs in the vicinity of existing road links is considered to be **low.**

Significance of effect

6.2.40 The effect on NVSRs, including any PRoW, will, therefore, be of **negligible** significance, which is not significant.

Converter Station Decommissioning

6.2.41 The future decommissioning of the proposed converter station has the potential to result in adverse effects. Noise and vibration emissions would be controlled by future best practice, and are likely to be similar and no worse than, or less than those that arose during construction.

6.2.42 With appropriate best practice, it is not anticipated that decommissioning of the proposed converter station will result in any adverse impact greater than **low** or **negligible**.

6.2.43 The effect on NVSRs will, therefore, be of **minor** or **negligible** significance, which is not significant.

6.3 Operational, Longer Term and Permanent Impacts

6.3.1 For the purposes of this EIA, operational, longer term and permanent effects are those which would occur as a result of the Scheme's land take or as a result of its operation.

Noise from Permanent Operation of the Converter Station

6.3.2 Operational noise emissions from the proposed converter station are primarily controlled by means of the specification of plant performance issued to the potential contractors.

6.3.3 The following specification has been issued to potential contractors:

"*The rating level of noise emitted from the converter station buildings and any external plant shall not exceed a rating level of 25 dB $L_{Ar,Tr}$ when determined at a freefield location representative of any surrounding dwelling or premises in residential use. The noise rating level shall be determined in accordance with BS 4142:2014, including any appropriate acoustic feature correction."*

6.3.4 It is considered that this is achievable through the converter station design and is demonstrated to be achievable, with a slight increase in mitigation, by the modelling undertaken and reported below. A figure providing a contour plot is provided in Annex 14 of Technical Appendix 26.1. Therefore, for the purpose of this assessment, it has been assumed that noise from the operation of the proposed converter station will not exceed 25 dB $L_{A,Tr}$ (as defined in BS 4142:2014) at any residential NVSR.

6.3.5 Noise from the operational converter station will generally be steady in nature. It has been assumed that there will be no significant difference in noise emissions during the day, evening or night periods.

6.3.6 To demonstrate the practicality of the contractor requirement, operational noise immissions from the proposed converter station have been predicted using SoundPLAN noise modelling software implementing ISO 9613-2 based on source term data for a typical/similar converter station previously developed by National Grid.

6.3.7 An example layout has been assessed. Generic spectral shapes have been adopted for each sound source to enable a spectral assessment to be undertaken and tonality of noise emissions to be considered. The assessment uses four spectral shapes as set out in Technical Appendix 26.1, Annex 11 – Converter Station Site Layout and Noise Assumptions.

6.3.8 The sound reduction index (SRI) and absorption coefficient of the walls and roof of the converter station buildings have been obtained from the SoundPLAN library for a cladding panel providing attenuation of 28 dB Rw. The absorption coefficient for the separating walls between transformers has also been obtained from the SoundPLAN library.

6.3.9 The noise model input data and results of the noise assessment are provided in Technical Appendix 26.1 Annex 15 which includes a table chart of predicted third-octave noise immission levels at the closest NVSRs, 'The Old Barn', from the noise model prediction. This indicates that the noise immission would be low-frequency (i.e. 50 to 250 Hz) and likely to be tonal (i.e. a noise containing a wide range of frequencies). As an indication, BS 7445-2 states that: "a prominent tonal component may be detected in one-third octave spectra if the level of a one-third octave band exceeds the level of the adjacent bands by 5 dB or more." More detail as to the determination of tonality is given in Annexes C and D of BS 4142:2014.

6.3.10 This assessment considers only noise arising from the converter station and does not include any masking effects from other non-site-related noise sources. Given the possible character of the noise immission at the nearest NVSRs, however, it is appropriate to apply a +6 dB character correction to the specific sound level to give the rating level.

6.3.11 The results of the test model indicate a maximum L_{Aeq} level of 20 dB at two properties: River Farm and Bank Farm House. With the tonality correction of +6 dB this equates to a rating level of 26 dB $L_{Ar,Tr}$. Noting that this prediction is based on non-site specific plant noise source levels, it is considered that the 1 dB margin of exceedance of the 25 dB $L_{Ar,Tr}$ limit within the plant specification could readily be achieved by the equipment providers. Consequently, it is considered that the specification provided to the equipment providers is achievable. The following assessment of operational noise is made against the specification level of 25 dB $L_{Ar,Tr.}$

Magnitude of impact

6.3.12 The magnitude of impact is assessed against the criteria given in Table 26.7; this is based on BS 4142:2014.

6.3.13 Representative background noise levels are given in Table 26.12 of this chapter. For the receptors closest to the proposed converter station site, representative background levels of 29 dB L_{A90} day, 24 dB L_{A90} evening and 22 dB L_{A90} night-time were determined.

6.3.14 At the nearest receptors, where a rating level of 25 dB $L_{Ar,Tr}$ has been specified, this gives a noise rating difference of:

- -4 dB during the daytime;
- +1 dB during the evening and
- +3 dB during the night.

6.3.15 This corresponds to a **low adverse** magnitude of effect during the day; and a **medium adverse** magnitude of effect during the evening and night-time. However, BS 4142 indicates that sleep disturbance should also be considered at night. With the attenuation of a partially open window providing up to -15 dB attenuation, an internal level of 10 dB(A) would occur at the nearest residential NVSRs. This is an exceptionally low level which would be of **negligible** impact in practice, when considering the context of the noise, as required by BS 4142.

6.3.16 Furthermore, if the noise levels from the proposed converter station are considered in conjunction with the existing ambient levels, which is what would occur in reality, the levels from the proposed converter station would be 10 dB below the lowest representative existing levels (35 dB L_{Aeq} from Table 26.12) and if the two levels were added together, an insignificant increase of less than 1 dB would occur at all residences.

6.3.17 Given the context of the noise arising from the converter station, discussed in the previous two paragraphs, the nearest NVSR receptors comprise nine properties at Whichways, Engine Drove; Bank Farm, Engine Drove; River Farm, Engine Drove; Eau End Farm, North Drove (2 properties identifed); Northorpe House, Northorpe Road; The Northings, Northorpe; and Northorpe Farm, Northorpe. These are considered to experience a **low adverse** magnitude of impact. Properties beyond these would also experience a **low adverse** impact during the evening and night, to a distance of circa 2 km (for properties in quieter rural areas), being **negligible** beyond due to the greater attenuation with distance and/or higher baseline levels if the NVSRs are near main roads etc.

6.3.18 The assessment of noise effects on ecological NVSRs is provided in ES-2-C.05 Chapter 21 Ecology, based on the model predictions described in this chapter.

6.3.19 There are a number of PRoWs within the study area, as previously mentioned, but at greater distance than the nearest residential NVSR. The magnitude of impact on users of the PRoWs from the operation of the proposed converter station is, therefore, considered to be low. Furthermore, users of PRoWs are transitory and so exposure is temporary as the user passes a particular point or moves through an area.

Sensitivity of receptor

6.3.20 There are approximately sixteen relatively isolated residential dwellings within 1 km of the proposed converter station site as detailed in Technical Appendix 26.1, Annex 13. The sensitivity of residential receptors is considered to be **medium** and the sensitivity of the PRoWs is considered to be **low**.

Significance of effect

6.3.21 From the above, residential properties near the proposed site around North Ing Drove, River Farm, Engine Drove and Eau End Farm would experience a **minor adverse** effect due to operational noise from the converter station. This is not significant.

6.3.22 Beyond these properties, isolated properties within approximately 2 km of the converter station would experience a **minor adverse** effect which is not significant.

6.3.23 All other effects would be of **negligible adverse** significance.

6.3.24 The effect on residential NVSRs will, therefore, be of **minor to negligible adverse** significance, which is not significant. The effect on users of the PRoWs will be of **minor to negligible** significance, which is not significant.

Further Discussion

6.3.25 The local planning authorities potentially affected by noise from the proposed converter station have indicated that the maximum cumulative noise level from all industrial type development in the area should not exceed 35 dB $L_{Ar,Tr}$ at NVSRs, i.e. this would include the proposed converter station, the Bicker Fen 400 kV Substation, the Bicker Fen Windfarm and the recently consented Triton Knoll Substation. The specification of a rating level limit of 25 dB $L_{Ar,Tr}$ for the proposed Viking converter station will ensure that the cumulative 35 dB $L_{Ar,Tr}$ level cannot be compromised by noise immissions from the converter station at any NVSR. This specification is now a contractual specification passed to potential contractors.

Vibration from Permanent Operation of the Converter Station

6.3.26 Operational vibration will be controlled by design at source as this is essential for the longevity of the plant. Any low levels of vibration would be most unlikely to be perceptible beyond the immediate structure of the buildings and would be below the thresholds of significance for vibration. Off-site vibration would be a **negligible** impact at all locations.

6.3.27 Operational vibration would be of **negligible** significance, which is not significant.

7 Mitigation

7.1.1 This section outlines what mitigation measures have been assumed in the basic noise and vibration assessment but also considers what additional mitigation may be required beyond what has been assumed would normally be applied to schemes of this type and which has been assumed for the primary assessment. This mitigation falls into three main areas; design mitigation which applies to the fundamental design of the plant which is this case is required to not exceed a specified limit at NVSRs; mitigation applied during construction which will demonstrate Best Practicable Means; and finally, for the operational plant, whether any additional mitigation or control measures are required. These aspects are discussed below.

7.2 Design Mitigation

7.2.1 As a guiding practice, noise emissions and overall effects have been minimised as far as is reasonably practicable through a combination of site selection and the future design of the proposed converter station which will be guaranteed through a plant noise specification provided to the contractors. All such, design mitigation is identified in ES-2-C.01 Chapter 17 The Proposed Converter Station. This specification will ensure that the cumulative criterion specified by the local planning authorities will not be exceeded under normal conditions, i.e. low wind speeds affecting the wind turbines.

7.2.2 Mitigation measures will be incorporated into the Scheme by design and include consideration of noise during selection of the convertor station (rating the acoustic merits of the different converter station sites, as documented in ES-2-A.02 Chapter 02 Development of the UK Onshore Scheme (Alternatives), equipment specification and layout, including a preference for equipment to be enclosed internally. Any design will reflect the parameters and the expected condition that will be included within any planning permission.

7.2.3 The equipment specification issued effectively incentivises the contractors to minimise any noise of tonal or impulsive character (as described under BS 4142:2014) emitted from the converter station; these being acoustic characteristics which may increase the intrusiveness of any sound emitted. With the design meeting the specification which is set to ensure the LPA criterion is not exceeded, no further mitigation will be required.

7.3 Construction Mitigation

7.3.1 These measures are incorporated into how the proposed converter station, permanent access road and AC underground cable will be constructed.

7.3.2 Construction will be undertaken in accordance with a Construction Environmental Management Plan (CEMP) which will include mitigation measures with respect to reducing the impact of construction related noise and vibration.

7.3.3 Best Practicable Means (BPM) will be applied and will include, but not be limited to:

- the use of quieter alternative methods, plant and/or equipment, where reasonably practicable;
- the use of site hoardings, enclosures, acoustic barriers, portable screens and/or screening nosier items of plant; and
- maintaining and operating all vehicles, plant and equipment in an appropriate manner, to ensure that extraneous sound from mechanical vibration, creaking and squeaking is kept to a minimum.

7.3.4 Examples of construction BPM for noise are provided in BS 5228-1:2009+A1:2014.

7.3.5 To minimise adverse vibration as far as is reasonably practicable, the following mitigation measures have been assumed to be applied:

- low vibration working methods will be employed; plant will be carefully selected to minimise the potential for vibration;
- vibration will be controlled at source and the spread of vibration will be limited;
- where processes could potentially give rise to significant levels of vibration, on-site vibration levels will be monitored regularly by a suitably qualified person appointed specifically for the purpose; and
- plant and/or methods of working likely to cause significant levels of vibration at sensitive receptors will be replaced by other less intrusive plant and/or methods of working.

7.3.6 Examples of construction BPM for vibration are provided in BS 5228-2:2009+A1:2014.

7.3.7 A written scheme for noise management measures will be agreed with the local planning authorities prior to the start of construction and incorporated into the CEMP.

7.4 Operational Mitigation

7.4.1 Other than included within the design mitigation, no other mitigation measures have been identified as being required.

8 Residual Effects

8.1 Construction Effects

8.1.1 Residual construction effects remain unchanged from those identified in Section 6 above.

8.1.2 Noise and vibration effects from the construction of the converter station will be of **minor to negligible adverse** significance during the day and **moderate adverse** significance, where works are required at night. For the AC cable and the permanent access road, effects will be of **negligible adverse** significance to residential NVSRs and of **negligible** significance to users of PRoWs in the immediate vicinity of the worksites.

8.2 Operational, Longer Term and Permanent Effects

8.2.1 Operational, longer term and permanent effects remain unchanged from those identified in Section 6 above.

8.2.2 Operational noise at nine properties: Whichways, Engine Drove; Bank Farm, Engine Drove; River Farm, Engine Drove; Eau End Farm, North Drove (2 properties); Northorpe House, Northorpe Road; The Northings, Northorpe; and Northorpe Farm, Northorpe, will experience an effect of **minor adverse** significance on residential NVSRs and **minor or negligible adverse** magnitude on residential properties beyond and on users of PRoWs in the immediate vicinity of the worksites.

9 Monitoring

9.1 Proposed Monitoring

9.1.1 Monitoring of noise and vibration for the purpose of evaluating noise emissions to the environment and environmental protection may be undertaken, and are described below.

9.1.2 In addition, but falling outside the scope of the environmental assessment, any commissioning tests or monitoring as required by the LPAs under the Control of Noise at Work Regulations, for the protection the workforce, will be undertaken as required.

Construction Phase

9.1.3 Construction noise monitoring, as a minimum, will be undertaken at the request of the LPA, where the contractor or NGVL receive substantiated complaint or where construction activities are anticipated to result in noise levels exceeding the thresholds set out in Section 2.

9.1.4 Monitoring of construction vibration will be undertaken where construction works may result in significant vibration effects at existing vibration-sensitive infrastructure/property. However, with the separation distance to NVSRs from the converter station site and the AC cable route, and assuming the permanent access road is well maintained, this need is considered most unlikely.

Operational Phase

9.1.5 Operational noise monitoring, as a minimum, will be undertaken at the request of the LPA, where the contractor or NGVL receive substantiated complaint.

9.1.6 Noise monitoring to demonstrate compliance with the acoustic specification is likely to be required as part of any site commissioning tests, but does not form part of the ES proposals. However, this is likely to form a requirement of the contract for the contractor to demonstrate that that the specification has been met. This would generally be carried out during the commissioning phase and within 6 months of normal operational conditions being achieved.

9.1.7 Operational vibration monitoring will not be undertaken, unless required by the LPA or operator.

10 Cumulative Effects

10.1.1 This section considers inter-project cumulative effects only. The cumulative assessment chapter (ES-2-D.01 Chapter 28 Cumulative Effects) considers intra-project cumulative effects, also identifying the cumulative external projects considered within the assessment.

10.2 Scope of Cumulative Assessment

10.2.1 Inter-relationships are considered to be the impacts and associated effects of different projects on the same NVSRs.

10.2.2 Cumulative noise effects associated with the operation of the converter station will be controlled by means of the restriction agreed with the local planning authorities; that is a cumulative target rating level for all developments at Bicker Fen not to exceed 35 dB(A) including character penalty (BS 4142:2014). However, this necessarily excludes noise from the Bicker Fen Wind Farm at elevated wind speeds when this source will dominate.

10.2.3 As part of the converter station site selection, cumulative effects considering noise levels from Triton Knoll and Bicker Fen Substations have been included using information from their published Environmental Statements. The modelling also considers noise from the Bicker Fen Wind Farm for a range of wind-speeds, to allow its contribution to be assessed in context.

10.3 Cumulative Effects

Construction Noise and Vibration Effects

10.3.1 The temporary effects, although quite long term, of converter station construction may affect receptors sensitive to noise or vibration in conjunction with consecutive or parallel cumulative construction works of other project. The worst case scenario, for noise, would occur as a result of an overlap of construction programmes, resulting in the greatest potential for cumulative construction noise impacts on NVSRs. Due to the short distances over which any vibration levels attenuate to baseline, there would be no cumulative vibration effects.

10.3.2 The combined effects of construction works for different projects tend not to be greater than the effects associated with each project individually unless they are very close, i.e. it is most unlikely that any additional NVSRs will be subject to a significant adverse effect due to the cumulative works, above those NVSRs already identified for an adverse effect due to each work individually. Nor would NVSRs predicted to experience an impact from the development alone be likely to experience an increased impact due to the cumulative developments.

10.3.3 Similarly, intra-project effects as a result of the cumulation of DC/AC cable and converter station construction works are unlikely to result in effects greater than reported in each separate assessment.

10.3.4 Consequently, the cumulative effects due to construction works overlapping with other Projects would be unlikely to be greater than for the Project alone.

Operational Noise and Vibration Effects

10.3.5 The specification for operational noise emissions from the converter station has been set 10 dB below the cumulative target level for all developments at Bicker Fen as described below.

10.3.6 The LPAs whose administrative areas are potentially affected by noise from the proposed converter station have indicated that the maximum cumulative noise level from all industrial type development in the area should not exceed 35 dB $L_{Ar,Tr}$ at NVSRs, i.e. this would include the converter station, the Bicker Fen 400 kV Substation, the Bicker Fen Windfarm and the recently consented Triton Knoll Substation. The specification of a rating level limit of 25 dB $L_{Ar,Tr}$ given to the contractor was chosen, in part, to ensure that the operation of the converter station would not significantly contribute to the cumulative noise levels in the area.

10.3.7 Intra-project noise effects as a result of the accumulation of DC cable and converter station operation would not result in any increase above those identified within the converter station assessment. The DC cable will emit no noise, and consequently no cumulative effect would occur.

10.3.8 As such, the converter station will have no significant contribution to the permitted operational noise limit for the area, and consequently no increase in cumulative effects above those identified for other projects will occur.

10.3.9 The converter station is unlikely to submit any levels of vibration and hence no cumulative effects would occur.

11 Summary of Assessment

11.1 Summary

Overview of Baseline Conditions

11.1.1 The area surrounding the proposed converter station, AC cable route and permanent access road is generally quiet and rural. Away from the larger roads and conglomerations of houses, representative background noise levels are generally below 30 dB L_{A90}, falling to 22 dB L_{A90} at night. At the more urban fringes and nearer main roads, levels are higher but still relatively low, ranging from 35 dB L_{A90} during the day, falling to 26 dB L_{A90} at night.

11.1.2 A summary of residual effects is provided in Table 26.15.

Overview of Residual Effects

11.1.3 For the construction of the converter station, noise effects are of **minor adverse to negligible** significance during the day and **moderate adverse** at night should night works be required. However, few NVSRs are affected. Vibration effects are **negligible**.

11.1.4 For construction of the AC cable and the permanent access road, vehicles on the access road and on the public highway, decommissioning and effects from vibration, are all of **negligible** significance as are any effects on users of PRoW.

11.1.5 During operation, residential properties within approximately 2 km of the proposed converter station would experience a **minor to negligible adverse** effect which is not significant.

11.1.6 Other effects would be of **negligible** significance which is not significant.

Residual Effects in South Holland District Council

11.1.7 For the construction of the converter station, noise effects are of **minor adverse to negligible** significance during the day and **moderate adverse** at night should night works be required. However, few NVSRs are affected. Vibration effects are **negligible**.

11.1.8 For construction of the AC cable and the permanent access road, vehicles on the access road and on the public highway, decommissioning and effects from vibration, are all of **negligible** significance as are any effects on users of PRoW.

11.1.9 During operation, residential properties within approximately 2 km of the proposed converter station would experience a **minor to negligible adverse** effect which is not significant.

11.1.10 Other effects would be of **negligible** significance which is not significant.

Residual Effects in Boston Borough Council

11.1.11 For the construction of the converter station noise effects are of **minor adverse to negligible** significance during the day and **moderate** at night should night works be required. However, very few NVSRs are affected. Vibration effects are **negligible**.

11.1.12 For construction of the AC cable and the permanent access road, vehicles on the access road and on the public highway, decommissioning and effects from vibration, are all of **negligible** significance as are any effects on users of PRoW.

11.1.13 During operation, residential properties within approximately 2 km of the proposed converter station would experience a **minor to negligible adverse** effect which is not significant.

11.1.14 Other effects would be of **negligible** significance which is not significant.

Residual Effects in North Kesteven District Council

11.1.15 For the construction of the converter station, noise effects are of **minor adverse to negligible** significance during the day and **moderate** at night should night works be required. However, few NVSRs are affected. Vibration effects are **negligible**.

11.1.16 For construction of the AC cable and the permanent access road, vehicles on the access road and on the public highway, decommissioning and effects from vibration, are all of **negligible** significance as are any effects on users of PRoW.

11.1.17 During operation, residential properties within approximately 2 km of the proposed converter station would experience a **minor to negligible adverse** effect which is not significant.

11.1.18 Other effects would be of **negligible** significance which is not significant.

Table 26.15 Summary of Assessment: Noise & Vibration (Converter Station)				
Description of Receptor	**Value/ Sensitivity**	**Description of Residual Effect**	**Significance**	**Significant**
Residential Receptors	Medium	Construction Noise	Adverse Minor to Negligible	Yes
Residential Receptors	Medium	Construction Traffic	Adverse Negligible	No
Residential Receptors	Medium	Construction Vibration	Adverse Negligible	No
Residential Receptors – nine properties at Whichways, Engine Drove; Bank Farm, Engine Drove; River Farm, Engine Drove; Eau End Farm, North Drove (x2); Northorpe House, Northorpe Road; The Northings, Northorpe; and Northorpe Farm, Northorpe.	Medium	Operational Noise	Adverse Minor to Negligible	No
Residential Receptors (other than above), within circa 2 km of the converter station	Medium	Operational Noise	Adverse Minor to Negligible	No
Receptors beyond circa 2 km of the converter station	Medium	Operational Noise	Adverse Negligible	No
Residential Receptors	Medium	Operational Vibration	-	No
Users of the PRoW (where crossing or running parallel to the permanent access road	Low	Construction Noise	Adverse Negligible	No
Users of the PRoW	Low	Operational Noise/Vibration	Adverse Negligible	No

12 References

Ref 26-1 British Standards Institution (BSI) (2003). BS 7445-1:2003 Description and measurement of environmental noise. Guide to quantities and procedures.

Ref 26-2 British Standards Institution (BSI) (1991). BS 7445-2:1991. Description and measurement of environmental noise. Guide to the acquisition of data pertinent to land use.

Ref 26-3 British Standards Institution (BSI) (2014). BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites - Part 1: Noise

Ref 26-4 The Highways Agency (2011). Design Manual for Roads and Bridges (DMRB), Volume 11, Section 3, Part 7 'Noise and Vibration'

Ref 26-5 British Standards Institution (BSI) (2014). BS 5228-2:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites - Part 2: Vibration

Ref 26-6 British Standards Institution (BSI) (1993). BS 7385-2:1993 'Evaluation and measurement of vibration in buildings - Part 1: Guide for measurement of vibrations and evaluation of their effects on buildings

Ref 26-7. British Standards Institution (BSI) (2014). British Standard 4142: Methods for rating and assessing industrial and commercial sound.

Ref 26-8. International Organization for Standardization (ISO) (1996). International Standard ISO 9613-2:1996. Acoustics - Attenuation of sound during propagation outdoors - Part 2: General method of calculation.

Ref 26-9. Department for Environment (Food and Rural Affairs) (Defra) (2010). Noise Policy Statement for England.

Ref 26-10. Department for Communities and Local Government (DCLG) (2012). National Planning Policy Framework.

Ref 26-11. Department for Communities and Local Government (DCLG) (2014). National Planning Practice Guidance - Noise.

Ref 26-12. The Stationery Office Limited (HMSO) (1974). Control of Pollution Act, Chapter 40, Part III.

Ref 26-13. The Stationery Office Limited (HSMO) (2015). Statutory Instruments. No. 227. The Control of Noise (Code of Practice for Construction and Open Sites) (England) Order 2015

Ref 26-14. The Stationery Office Limited (HMSO) (1990). Environmental Protection Act, Chapter 43, Part III.

Ref 26-15. The Stationery Office Limited (HMSO) (1995). Statutory Nuisance (Appeals) Regulations 1995

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