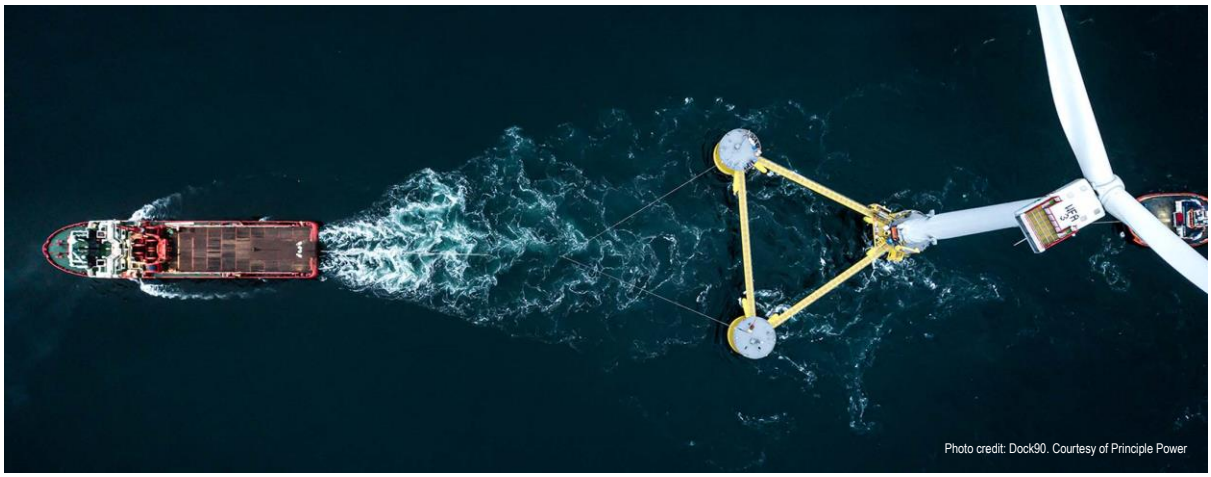


Project Erebus Environmental Statement
Chapter 22: Noise and Vibration

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Acronyms

Term	Definition
BNL	Basic Noise Level
BPM	Best Practicable Means
BS	British Standard
CoCP	Code of Construction Practice
CRTN	Calculation of Road Traffic Noise
DMRB	Design Manual for Roads and Bridges
DEFRA	Department for Environment, Food & Rural Affairs
EIA	Environmental Impact Assessment
EU	European Union
EPA	Environmental Protection Act
EPUK	Environmental Protection UK
eVDV	Estimated Vibration Dose Value
HDD	Horizontal Directional Drilling
ISO	International Standards Organisation
km	Kilometres
LDP	Local Development Plan
m	Metres
NSR	Noise Sensitive Receptor
O&M	Operation and Maintenance
PCC	Pembrokeshire County Council
PDE	Project Design Envelope
PPV	Peak Particle Velocity
PPW	Planning Policy Wales
SAC	Special Area of Conservation
SLM	Sound Level Meter
SSSI	Site of Special Scientific Interest
SPA	Special Protected Area

Term	Definition
TRL	Transport Research Laboratory
TRRL	Transport and Road Research Laboratory
VDV	Vibration Dose Value
WHO	World Health Organisation

Glossary

Term	Definition
Decibel (dB)	A unit of noise level derived from the logarithm of the ratio between the value of a quantity and a reference value. It is used to describe the level of many different quantities. For sound pressure level the reference quantity is 20 µPa, the threshold of normal hearing is 0dB, and 140dB is the threshold of pain. A change of 1dB is only perceptible under controlled conditions. Under normal conditions a change in noise level of 3dB(A) is the smallest perceptible change.
dB(A)	Decibels measured on a sound level meter incorporating a frequency weighting (A weighting) which differentiates between sounds of different frequency (pitch) in a similar way to the human ear. Measurements in dB(A) broadly agree with people's assessment of loudness. A change of 3 dB(A) is the minimum perceptible under normal conditions, and a change of 10 dB(A) corresponds roughly to halving or doubling the loudness of a sound. The background noise level in a living room may be about 30 dB(A); normal conversation about 60 dB(A) at 1 metre; heavy road traffic about 80 dB(A) at 10 metres; the level near a pneumatic drill about 100 dB(A).
dB(Z) (or previously Lleq)	Decibels measured on a sound level meter incorporating a flat frequency weighting (Z weighting) across the frequency range.
CadnaA	A noise modelling software package
$L_{A10, T}$	The A weighted noise level exceeded for 10% of the specified measurement period (T). L_{A10} is the index generally adopted to assess traffic noise.
$L_{A90, T}$	The A weighted noise level exceeded for 90% of the specified measurement period (T). In BS 4142:2014+A1:2019 it is used to define the 'background' noise level.
$L_{Aeq, T}$	The equivalent continuous sound level – the sound level of a notionally steady sound having the same energy as a fluctuating sound over a specified measurement period (T). $L_{Aeq,T}$ is used to describe many types of noise and can be measured directly with an integrating sound level meter.
L_{Amax}	The maximum A-weighted sound pressure level recorded during a measurement.
$L_{Ar,15min}$	Specific sound level plus any adjustment for the characteristic features of the sound including specified interval over which the specific sound level is determined.

Chapter 22 Noise and Vibration

22.1 Introduction

22.1.1.1 This chapter of the Environmental Statement (ES) considers the potential onshore airborne noise and vibration impacts of the Proposed Development. This chapter provides an overview of the baseline noise conditions where the onshore development area is proposed and identifies potentially sensitive receptors to noise and vibration. The chapter presents an assessment of the potential impacts and associated mitigation for the construction, operation and decommissioning of the Proposed Development as defined in Chapter 4: Proposed Development Description, from noise and vibration.

22.1.1.2 This chapter focusses on the potential impacts associated with the onshore component of the Project.

22.1.1.3 This chapter is supported by Volume 3 Technical Appendix 22.1. Figures which accompany this chapter are provided in Volume 2 Figures 22.1 to 22.3.

22.1.1.4 Potential impacts in relation to noise and vibration inter-relate with other technical topics as presented within other chapters of the ES. These are referenced within this chapter and consist of:

- Chapter 20 Terrestrial and Coastal Ecology;
- Chapter 25 Traffic and Transport;
- Chapter 27 Socio-Economics, Tourism and Recreation (including Human Health)

22.1.1.5 This assessment has been undertaken by ITPE (Energised Environments Limited trading as ITPEnergised). The chapter has been authored by Alasdair Baxter (BSc (Hons), MSc, MIOA) who has over 18 years of experience of environmental acoustics.

22.2 Legislation, Policy and Guidelines

22.2.1.1 The following legislation, planning policy and guidance documents have been considered in the preparation of this chapter:

22.2.2 Legislation

22.2.2.1 The following legislation, policy and guidance have been used to inform the scope and content of the noise and vibration assessment; assist in the identification of potential effects and mitigation; and influence the design of the Project to reduce the significance of effects.

22.2.3 European Legislation Transposed into Domestic Law

22.2.3.1 The EU Directive (2002/49/EC) on the Assessment and Management of Environmental Noise came into force in June 2002 (Council of the European Union, 2002). The Directive is transposed into UK Law by The Environmental Noise (Wales) Regulations 2006, as amended 2009, and The Environmental Noise (Wales) (Amendment) (EU Exit) Regulations 2019.

22.2.3.2 Relevant legislation and guidance documents have been reviewed and taken into account as part of this assessment. Of particular relevance are:

- Section 79 of the Environmental Protection Act 1990 (the EPA 1990) defines statutory nuisance with regard to noise and determines that Local Planning Authorities have a duty to detect such nuisances in their area. The EPA 1990 also defines the concept of 'Best Practicable Means' (BPM) as:
    - *"Practicable" means reasonably practicable having regard among other things to local conditions and circumstances, to the current state of technical knowledge and to the financial implications;*
    - *The means to be employed include the design, installation, maintenance and manner and periods of operation of plant and machinery, and the design, construction and maintenance of buildings and structures;*
    - *The test is to apply only so far as compatible with any duty imposed by law; and*
    - *The test is to apply only so far as compatible with safety and safe working conditions, and with the exigencies of any emergency or unforeseeable circumstances."*
- Section 80 of the EPA 1990 provides Local Planning Authorities with powers to serve an abatement notice requiring the abatement of a nuisance or requiring works to be executed to prevent their occurrence.
- Section 60 of the Control of Pollution Act 1974 provides powers to Local Planning Authority officers to serve an abatement notice in respect of noise nuisance from construction works.
- Section 61 provides a method by which a contractor can apply for 'prior consent' for construction activities before commencement of works. The 'prior consent' is agreed between the Local Planning Authority and the contractor and may contain a range of agreed working conditions, noise limits and control measures designed to minimise or prevent the occurrence of noise nuisance from construction activities. Application for a 'prior consent' is a commonly used control measure in respect of potential noise impacts from major construction works.
- Environmental Noise (Wales) (Amendment) (EU Exit) Regulations 2019. These regulations require the Welsh Government to produce strategic noise maps for road, rail and agglomerations, to determine likely population noise exposure scenarios and establish action plans to reduce noise levels where needed and preserve environmental noise quality where it is good.

22.2.4 Planning Policy Wales

22.2.4.1 The Planning Policy Wales (PPW) was last published in December 2018 (Welsh Government, 2018).

22.2.4.2 This document sets out the land use planning policies of the Welsh Government, forming a strategic framework to guide development. It acknowledges that noise can be a material planning consideration, sets an objective for noise policies to minimise noise emissions and reduce ambient noise levels to an acceptable standard, and recommends that development plan policies should ensure potentially noisy developments are located in areas where effects can be minimised.

22.2.4.3 More specifically related to noise, Section 6.7 of the PPW, states that:

"Clean air and an appropriate soundscape, contribute to a positive experience of place as well as being necessary for public health, amenity and well-being. They are indicators of local environmental quality and integral qualities of place which should be protected

through preventative or proactive action through the planning system. Conversely, air, noise and light pollution can have negative effects on people, biodiversity and the resilience of ecosystems and should be reduced as far as possible.

…..

In proposing new development, planning authorities and developers must, therefore:

- *address any implication arising as a result of its association with, or location within, air quality management areas, noise action planning priority areas or areas where there are sensitive receptors;*
- *not create areas of poor air quality or inappropriate soundscape; and*
- *seek to incorporate measures which reduce overall exposure to air and noise pollution and create appropriate soundscapes".*

22.2.5 National Planning Policy

National Policy Statements (NPS)

22.2.5.1 The assessment of potential impacts upon onshore noise and vibration receptors has been made with specific reference to the relevant NPS. These are the principal decision-making documents for Nationally Significant Infrastructure Projects (NSIP). Those relevant to the Project are:

- Overarching NPS for Energy (EN-1) (DECC 2011a);
- NPS for Renewable Energy Infrastructure (EN-3) (DECC 2011b); and
- NPS for Electricity Networks Infrastructure (EN-5) (DECC 2011c).

Table 22.1 – Summary of NPS Requirements

Legislation		Description
Where noise impacts are likely to arise, the applicant should include: • A description of the noise generating aspects of the development proposal leading to noise impacts including the identification of any distinctive tonal, impulsive or low frequency characteristics of the noise; • Identification of noise sensitive premises and noise sensitive areas that may be affected; • The characteristics of the existing noise environment; • A prediction of how the noise environment will change with the proposed development; • In the shorter term such as during the construction period;	EN-1, paragraph 5.11.4	Refer to Section 23.4 for the assessment methodology for assessing potential noise and vibration impacts, Section 23.5 for details on the existing noise environment including the identification of NSRs and Section 23.6 where any changes in noise levels as a result of the proposed Project Erebus are assessed, and any potential impacts and potential mitigation measures are identified.

Legislation		Description
• In the longer term during the operating life of the infrastructure; • At particular times of the day, evening and night as appropriate; • An assessment of the effect of predicted changes in the noise environment on any noise sensitive premises and noise sensitive areas; and • Measures to be employed in mitigating noise. The nature and extent of the noise assessment should be proportionate to the likely noise impact.		
The noise impact of ancillary activities associated with the development, such as increased road and rail traffic movements, or other forms of transportation, should also be considered.	EN-1, paragraph 5.11.5	Refer to Section 23.6 where any changes in noise levels as a result of the proposed Project Erebus from ancillary works, for example vehicle movements, are assessed and any potential impacts and potential mitigation measures are identified.
Operational noise, with respect to human receptors, should be assessed using the principles of the relevant British Standards and other guidance. Further information on assessment of particular noise sources may be contained in the technology-specific NPSs. In particular, for renewables (EN-3) and electricity networks (EN-5) there are assessment guidance for specific features of those technologies. For the prediction, assessment and management of construction noise, reference should be made to any relevant British Standards and other guidance which also give examples of mitigation strategies.	EN-1, paragraph 5.11.6	Any changes in noise levels as a result of the proposed Project Erebus are assessed in Section 23.6, and any potential impacts and potential mitigation measures are identified. Noise assessment described within EN-3 and EN-5 relates to the offshore environment. Those potential noise impacts are considered separately within Chapter 10 Fish and Shellfish Ecology and Chapter 11 Marine Mammals. The current relevant British Standards (BS) have been used within this assessment detailed within Section 23.2.
The applicant should consult EA and Natural England (NE), or the Countryside Council for Wales (CCW), as necessary and in particular with regard to assessment of noise on protected species or other wildlife. The results of any noise surveys and predictions may inform the ecological assessment. The seasonality of potentially	EN-1, paragraph 5.11.7	Noise impacts on terrestrial protected species or other wildlife is considered within Chapter 20 Terrestrial and Coastal Ecology and Onshore Ornithology.

Legislation		Description
affected species in nearby sites may also need to be taken into account.		
Where noise impacts are likely to arise, the applicant should include: • A description of the noise generating aspects of the development proposal leading to noise impacts including the identification of any distinctive tonal, impulsive or low frequency characteristics of the noise; • Identification of noise sensitive premises and noise sensitive areas that may be affected; • The characteristics of the existing noise environment; • A prediction of how the noise environment will change with the proposed development; • In the shorter term such as during the construction period; • In the longer term during the operating life of the infrastructure; • At particular times of the day, evening and night as appropriate; • An assessment of the effect of predicted changes in the noise environment on any noise sensitive premises and noise sensitive areas; and • Measures to be employed in mitigating noise. The nature and extent of the noise assessment should be proportionate to the likely noise impact.	EN-1, paragraph 5.11.4	Refer to Section 23.4 for the assessment methodology for assessing potential noise and vibration impacts, Section 23.5 for details on the existing noise environment including the identification of NSRs and Section 23.6 where any changes in noise levels as a result of the proposed Project Erebus are assessed, and any potential impacts and potential mitigation measures are identified.
The noise impact of ancillary activities associated with the development, such as increased road and rail traffic movements, or other forms of transportation, should also be considered.	EN-1, paragraph 5.11.5	Refer to Section 23.6 where any changes in noise levels as a result of the proposed Project Erebus from ancillary works, for example vehicle movements, are assessed and any potential impacts and potential mitigation measures are identified.

22.2.6 Local Planning Policy

22.2.6.1 The Pembrokeshire County Council (PCC) Local Development Plan (LDP) (Pembrokeshire County Council, 2013) has a number of policies related to air quality:

22.2.6.2 Policy GN.1 General Development policy states that:

"Development will be permitted where the following criteria are met:

2. It would not result in a significant detrimental impact on local amenity in terms of visual impact, loss of light or privacy, odours, smoke, fumes, dust, air quality or an increase in noise and vibration levels".

22.2.6.3 Under Policy GN.3 Infrastructure and New Development it is stated that:

"It is also important that provision is made for the mitigation of potential adverse impacts of new development upon biodiversity and cultural heritage. Adverse impacts might include……noise, …..".

22.2.6.4 The Pembrokeshire Coast National Park Authority (PCNPA) has a LDP (Pembrokeshire Coast National Park, 2020) which includes Policy 30, Amenity and Policy 33 Renewable and Low Carbon Energy:

Policy 30

"Development will not be permitted where it has an unacceptable adverse effect on amenity, particularly where:",

"the development leads to an increase in traffic or noise or odour or light which has a significant adverse effect;".

Policy 33

"Proposals for renewable and low carbon energy development…. will be permitted subject to the following criteria:

All renewable and low carbon energy development proposals will be required to demonstrate that:

…..

ii. There will be no unacceptable impacts on residential amenity;…"

22.2.6.5 Both statements are cross-referenced to PPW as discussed in Section 22.2.4.

Technical Advice Note 11 (TAN11), Noise (1997)

22.2.6.6 TAN11 provides advice on how the planning system can be used to minimise the adverse impact of noise without placing unreasonable restrictions on development or adding unduly to the costs and administrative burdens of business.

22.2.6.7 It outlines some of the main considerations which local planning authorities should take into account in drawing-up development plan policies and when determining planning applications for development which will either generate noise or be exposed to existing noise sources. TAN11 offers guidance to local authorities on the assessment of noise and its potential effect on noise-sensitive dwellings.

22.2.6.8 TAN 11 also "provides advice on how the planning system can be used to minimise the adverse effect of noise without placing unreasonable restrictions on development or adding unduly to the costs and administrative burdens of business."

22.2.6.9 Where the information with TAN11 references British Standards that have since been superseded, the current version of these standards will be used within this assessment. This include BS4142:2014, BS 5228-1:2009+A1 and BS 5228-2:2009+A1:2014

22.2.6.10 The likelihood of complaints about noise from industrial development can be assessed, where the Standard is appropriate, using guidance in BS 4142: 2014+A1:2019. Tonal or impulsive characteristics of the noise are likely to increase the scope for complaints and this is taken into account by the "rating sound level" defined in BS 4142.

22.2.6.11 Detailed guidance on assessing noise from construction sites can be found in BS 5228:2009+A1:2014. In particular, “Part 1 Noise" describes a method for predicting noise from construction sites as well as giving general advice.

A Noise Action Plan for Wales 2018-2023 (NAP)

22.2.6.12 The NAP explains how different sources of noise are being managed across Wales and by whom, and provides summaries of evidence to support noise policy, it gives examples of positive initiatives that have taken place in Wales.

22.2.6.13 Regarding industrial noise, Section 6.1 of the NAP states that: “There is a danger that if the acceptability of a new industrial noise source is assessed relative to the background sound level from all the existing noise sources, this may lead to an ever-increasing noise level where each new source to be added is allowed to be louder than the previous one, known as ’creeping background’. This is clearly inappropriate, because the total noise level has potential to cause harm to health and wellbeing regardless of whether individual components are noticeable.”

22.2.6.14 Noise Action Plans that aim to protect specific areas within Wales do not extend to the Development area.

22.2.7 Guidance

22.2.7.1 The guidance in Table 22.2 has been applied to the noise and vibration assessment.

Table 22.2 – Relevant Guidance

Document	Policy / guidance purpose
BS 4142:2014+A1:2019 – Method for Rating and Assessing Industrial and Commercial Sound	Describes a method for rating and assessing sound of an industrial and/or commercial nature. This method uses a Rating level to assess the likely effects from sound of an industrial or commercial nature on people using amenity space outside a dwelling or premises used for residential purposes upon which the sound is incident.
BS 5228-1:2009+A1:2014 Code of Practice for Noise and Vibration Control on Construction and Open Sites – Part 1: Noise	Part 1 provides recommendations for basic methods of noise and vibration control relating to construction and open sites where work activities/operations generate significant noise and/or vibration levels. The legislative background to noise and vibration control is described and recommendations are given regarding procedures for the establishment of effective liaison between developers, site operators and Local Planning Authorities. This BS provides guidance on methods of predicting and measuring noise and assessing its impact on those exposed to it.
BS 5228-1:2009+A1:2014 Code of Practice for Noise and Vibration Control on Construction and Open Sites – Part 2: Vibration	Part 2 gives recommendations for basic methods of vibration control relating to construction and open sites where work activities/operations generate significant vibration levels. The Standard includes tables of vibration levels measured during piling operations throughout the UK. It provides guidance concerning methods of mitigating vibration from construction, particularly with regard to percussive piling.

Document	Policy / guidance purpose
BS 6472-1:2008 – Guide to Evaluation of Human Exposure to Vibration in Buildings	Provides general guidance on human exposure to building vibration in the range of 1Hz to 80Hz and includes curves of equal annoyance for humans. It also outlines the measurement methodology to be employed. It introduces the concept of Vibration Dose Value (VDV) and estimated Vibration Dose Value (eVDV) for the basis of assessment of the severity of impulsive and intermittent vibration levels, such as those caused by a series of trains passing a given location.
BS 7445: Parts 1 and 2 – Description and Measurement of Environmental Noise	Provides details of the instrumentation and measurement techniques to be used when assessing environmental noise and defines the basic noise quantity as the continuous A-weighted sound pressure level (L_{Aeq}). Part 2 of BS 7445 replicates International Standards Organisation (ISO) 1996-2.
BS 8233:2014 – Guidance on Sound Insulation and Noise Reduction for Buildings	Provides a methodology to calculate the noise levels entering a building through facades and facade elements and provides details of appropriate measures for sound insulation between dwellings. It includes recommended internal noise levels which are provided for a variety of situations and are based on World Health Organisation (WHO) recommendations.
Calculation of Road Traffic Noise (CRTN) 1988	Provides a method for assessing noise from road traffic in the UK and a method of calculating noise levels from the Annual Average Weekday Traffic (AAWT) flows and from measured noise levels. Since publication in 1988 this document has been the nationally accepted standard in predicting noise levels from road traffic. The calculation methods provided include correction factors to take account of variables affecting the creation and propagation of road traffic noise, accounting for the percentage of heavy goods vehicles (HGV), different road surfacing, inclination, screening by barriers and relative height of source and receiver.
Design Manual for Roads and Bridges (DMRB), LA 111, 2020	LA 111 provides guidance on the environmental assessment of noise impacts from road schemes. It contains advice and information on transport-related noise and vibration, which has relevance with regard to the construction and operational traffic impacts affecting sensitive receptors adjacent to road networks. It also provides guideline significance criteria for assessing traffic related noise impacts.
ISO 3744	Specifies a method for measuring the sound pressure levels on a measurement surface enveloping a noise source, under essentially free field conditions near one or more reflecting planes, in order to calculate the sound power level produced by the noise source.
ISO 717	Defines single-number quantities for airborne sound insulation in buildings and of building elements such as walls, floors, doors, and windows.
ISO 9613-2	Specifies an engineering method for calculating the attenuation of sound during propagation outdoors in order to predict the levels of environmental noise at a distance from a noise source.

Document	Policy / guidance purpose
WHO (1999) Guidelines for Community Noise	These guidelines present health-based noise limits intended to protect the population from exposure to excess noise. They present guideline limit values at which the likelihood of particular effects, such as sleep disturbance or annoyance, may increase. The guideline values are 50 or 55dB L_{Aeq} during the day, related to annoyance, and 45dB L_{Aeq} or 60dB L_{Amax} at night, related to sleep disturbance.
WHO (2018) Environmental Noise Guidelines for the European Region	The guidance states: "The main purpose of these guidelines is to provide recommendations for protecting human health from exposure to environmental noise originating from various sources: transportation (road traffic, railway and aircraft) noise, wind turbine noise and leisure noise. They provide robust public health advice underpinned by evidence, which is essential to drive policy action that will protect communities from the adverse effects of noise."
WHO (2009) Night Noise Guidelines for Europe	An extension to the WHO Guidelines for Community Noise (1999). It concludes that: "Considering the scientific evidence on the thresholds of night noise exposure indicated by L_{night} outside as defined in the Environmental Noise Directive (2002148/EC), an L_{night} outside of 40dB should be the target of the night noise guideline (NNG) to protect the public, including the most vulnerable groups such as children, the chronically ill and the elderly. L_{night} outside value of 55dB is recommended as an interim target for those countries where the NNG cannot be achieved in the short term for various reasons, and where policy-makers choose to adopt a stepwise approach."
High Speed Two Phase One Information Paper E23: Control of Construction Noise and Vibration (2017)	Provides additional guidance for construction noise and vibration affecting residential premises and details noise and vibration levels above which significant effects are anticipated.

22.3 Consultation and Scoping

22.3.1.1 Consultation is a key feature of the EIA process, and continues throughout the lifecycle of a project, from its initial stages through to consent and post-consent. A summary of the consultation responses received as part of the EIA Scoping Opinion and additional consultation is provided in Table 22.3.

Table 22.3 – Summary of Scoping and Consultation Responses

Consultee	Response	Applicant Action
NRW (Scoping Opinion) January 2020	*"No comments were received from consultees in relation to Airborne Noise and Vibration and we have no comment to make on this section of the report (section 7.10). The ES should however include an assessment of impacts on Airborne Noise*	The Environmental Statement (ES) includes an Airborne Noise and Vibration Chapter.

Consultee	Response	Applicant Action
	and Vibration, as set out in the scoping report"	
PCC (phone meeting) July 2021	*Telephone meeting with PCC Environmental Health Officer with discussion of proposed scope and methodology, baseline survey duration and locations.*	The Airborne Noise and Vibration Chapter and baseline noise survey were undertaken in accordance with the agreed methodology.
PCC (confirmation email) July 2021	*Email confirmation that the proposed scope and methodology for the Airborne Noise and Vibration Impact Assessment is acceptable and appropriate, the baseline survey methodology, locations and durations are appropriate.*	The Airborne Noise and Vibration Chapter and baseline noise survey were undertaken in accordance with the agreed methodology.
Public Consultation Event July 2021	*Concerns were raised by the owner of Newton farm at the Public Event held at Angle on the 29th of July, however the farm is not located in proximity to either the substation or landfall.*	The Airborne Noise and Vibration Chapter addresses temporary noise impacts from construction along the cable route

22.4 Assessment Methodology and Significance Criteria

22.4.1.1 Chapter 2 Overview of EIA Methodology outlines the general assessment approach adopted in this EIA.

22.4.2 Study Area

22.4.2.1 The noise and vibration Study Area, defined as the extent of the onshore development area, is shown in Volume 2 Figure 22.1. The noise and vibration Study Area includes the following elements:

- Landfall;
- Onshore cable corridor; and
- Onshore substation.

22.4.3 Construction Phase

22.4.3.1 The spatial scope of the construction noise assessment included the following geographic coverage:

- Up to 300 m from any construction activities
- Along the onshore development area where significant activities could affect Noise Sensitive Receptors (NSRs); and
- Traffic routes and routes subject to significant changes in traffic flows (and / or percentage HGV) associated with construction.

22.4.3.2 The extent of the noise and vibration Study Area for the construction phase road traffic noise and vibration assessment was based on details provided in Chapter 25 Traffic and Transport.

22.4.3.3 The study areas are based on experience from recent major infrastructure projects including the Thames Tideway Tunnel, the A14 Cambridge to Huntingdon Improvement Scheme, High Speed 2 (Phases 1 and 2a) and Crossrail.

22.4.4 Operational Phase

22.4.4.1 The operational phase noise assessment study area is defined as up to 1 km from the onshore substation boundary.

22.4.4.2 The noise and vibration assessment draws on the information provided within Chapter 4 Proposed Development Description in order to define a worst-case scenario, which is subsequently assessed in this chapter.

22.4.4.3 Traffic generation associated with the operational phase is limited to infrequent visits for maintenance and unlikely to give rise to any significant noise and vibration impacts.

22.4.4.4 The effects of noise and vibration due to road traffic from the Proposed Development during the operational phase are scoped out of further assessment.

22.4.4.5 No significant sources of vibration will be present within the onshore substation.

22.4.4.6 The effects of vibration during the operational phase of the Proposed Development are scoped out of further assessment.

Noise Sensitive Receptors

22.4.4.7 Table 22.4 describe the Noise Sensitive Receptors included in this assessment while Figure 22.1 show their position in relation to the Proposed Development.

Table 22.4 – Noise Sensitive Receptors Included in Assessment

Receptor Identifier	Address	Coordinates		Distance to site boundary (m)	Classification	Sensitivity
		X	Y			
LFR1	The Beach House, Angle	185440	203089	75	Residential	Medium
LFR2	Woodfield, Angle	185435	203091	75	Residential	Medium
CCR1	North Studdock Cottage	185687	202692	10	Residential	Medium
CCR2	Burrows, Angle Road	188424	200999	50	Residential	Medium
CCR3	Neath Farm	190215	201168	105	Residential	Medium
SSR1	Lambeeth Farm, Pwllcrochan	193803	201663	110	Residential	Medium

Receptor Identifier	Address	Coordinates		Distance to site boundary (m)	Classification	Sensitivity
		X	Y			
SSR2	Moreston Cottage, Goldborough Road, Hundleton	193607	200982	280	Residential	Medium
SSR3	Goldborough Farm, Hundleton	194009	200870	575	Residential	Medium
SSR4	Sunnyridge, Wallaston Five Cross, Hundleton	192344	201258	160	Residential	Medium
SSR5	Moreston Farm, Goldborough Road, Hundleton	193611	200738	530	Residential	Medium
SSR6	The Stables, Lambeeth Farm	193813	201633	90	Residential	Medium
SSR7	Westwinds, Wallaston Five Cross, Hundleton	192328	201260	160	Residential	Medium

22.4.5 Decommissioning Phase

22.4.5.1 The Study Area for the decommissioning phase is the same as for the construction phase as shown in Volume 2 Figure 22.1.

22.4.6 Data Sources

22.4.6.1 Consideration of the surrounding environment was initially conducted using existing available geographical information including aerial and satellite photography and mapping data in order to determine the nearest Noise Sensitive Receptors (NSR) and noise sources present within the noise and vibration study area for use in the assessment.

22.4.6.2 The desk data sources used in the assessment and the confidence levels associated with them which informed the desk-based assessment are provided in Table 22.5.

Table 22.5 – Desk-Based Data Sources to Inform the Assessment

Data obtained	Year	Data source used	Coverage	Confidence[1]
Location of noise and vibration sensitive receptors within the noise and vibration study area.	*2021*	Google Maps Aerial Photography	Onshore Noise and Vibration study area	High
	2021	Local Authority Local Plans	Onshore Noise and Vibration study area	High
	2021	Ordnance Survey maps	Onshore Noise and Vibration study area	High
	2021	Construction Phasing Plans	Construction: • Landfall • Onshore Cable Route • Onshore Substation	High
	2021	Information from other projects within the area	Onshore Noise and Vibration study area	High
	2021	Residential and commercial address data within defined study areas from Ordnance Survey "AddressBase Plus" data.	Onshore Noise and Vibration study area	High

22.4.7 Site Visit / Surveys

22.4.7.1 Measurements of the existing ambient noise level were required to be taken at locations considered representative of the NSRs that had the potential to be affected by the construction and operation of the Project.

22.4.7.2 Full details of the baseline noise surveys are discussed in section 22.5 and in Volume 3 Technical Appendix 22.1. The noise surveys confirmed the initial desk based assessment that the noise environment is generally quiet and rural in nature.

[1] Confidence level based upon the organisation responsible for collating data source (high = regulatory, low = non-regulatory)

22.4.7.3 Noise monitoring survey locations were discussed and agreed with PCC's Environmental Health Officer prior to survey work commencing and are shown in Volume 2 Figure 22.2.

22.4.7.4 The surveys were undertaken between 7th July 2021 to 21st July 2021 (with the findings used to inform the assessment presented within this ES). Noise measurements were undertaken in accordance with BS 7445-1:2003 (BSI 2003) and BS 4142:2014+A1:2019 (BSI 2019). Following the consultation with PCC's Environmental Health Officer a baseline vibration survey was not deemed necessary.

Survey Practice

22.4.7.5 Baseline survey measurements were conducted in accordance with current guidance, including BS 4142:2014 Method for Rating and Assessing Industrial and Commercial Sound and BS 7445:2003 Description and measurement of environmental noise and the methodology used was agreed with relevant stakeholders during consultation.

22.4.7.6 Sound Level Meters (SLM) were fully calibrated, traceable to UKAS standards and satisfied the requirements of BS EN 61672-1:2013 for a 'Class 1'SLM. Calibration certificates are provided within Volume 3 Technical Appendix 22.1.

22.4.7.7 For all measurement locations during the noise survey, SLMs were set to record the following:

- L_{Aeq} – the equivalent continuous sound pressure level over the measurement period. This parameter was standardised as pertinent for land use within BS 7445:2003;
- L_{Amax} – the maximum sound pressure level occurring within the defined measurement period;
- L_{A90} – the sound pressure level exceeded for 90% of the measurement period and is indicative of the background noise level; and

22.4.7.8 The equivalent continuous sound pressure level (L_{Aeq}) is the conventional descriptor of environmental noise and is defined below:

$$L_{eq,T} = 10 \times \log\left[\frac{1}{T}\int \frac{\rho^2(t)\partial t}{\rho_0^2}\right] dB$$

22.4.7.9 Noise measurements are normally taken with an A-weighting (denoted by a subscript 'A') to approximate the frequency response of the human ear.

22.4.7.10 Noise measurements were conducted with the SLMs mounted on tripods at a height of between 1.2 m and 1.5 m above ground level and 3.5m away from any reflecting surface other than the ground, i.e. in free-field conditions. The instruments were calibrated before and after the survey using a portable calibrator. No significant deviation in the calibration level was observed.

22.4.7.11 A record of the meteorological conditions during the survey was made. Any measurements taken during periods of rain or when average wind speeds exceed 5m/s were screened from the results.

Predicted Future Baseline

22.4.7.12 The baseline noise monitoring survey provides a clear representation of the existing soundscape within the noise and vibration study area of the project.

22.4.7.13 Noise is managed and driven by EU, UK and local legislation and policies. The UK's noise strategy and standards are enacted through management actions at a local authority level. There is a policy trend towards the achievement and maintenance of the noise environment across the UK, which is reflected in national planning policies. Predicted noise levels due to a change in land use, new developments and associated vehicles are assessed as part of the development planning and consent process.

22.4.7.14 Potential impacts to the prevailing soundscape should be minimised, avoided, or mitigated to suitable levels (in accordance with current legislation, policy and guidance), avoiding an adverse impact, where possible. In addition to planning controls there is a clear trend for noise from vehicle, commercial and industrial sources to be driven down in compliance with stricter legislation and guidance. Consequently, in relation to the project and its immediate receiving environment it is reasonable to predict a general steady baseline soundscape would be maintained.

22.4.8 Assessment of Potential Effect Significance

Construction Phase Impact Magnitude

22.4.8.1 BS 5228-1:2009+A1:2014 (BSI 2014) describes several methods for assessing noise impacts during construction projects.

22.4.8.2 The assessment approach utilised in this ES is the threshold based "ABC" method. The method is detailed within BS 5228-1:2009+A1:2014 (BSI 2014), which specifies a construction noise limit based on the existing ambient noise level and for different periods of the day. The predicted construction noise levels were assessed against noise limits derived from advice within Annex E of BS 5228-1:2009+A1:2014 (BSI 2014). Table 22.6, reproduced from BS 5228-1:2009+A1:2014 (BSI 2014) Table E.1, presents the criteria for selection of a noise limit for a specific receptor location (which are adopted in the noise impact magnitude criteria in Tables 22.7 to 22.9).

Table 22.6 – Construction Noise Threshold Levels Based on the ABC Method (BS 5228:2009+A1:2014)

Assessment category and threshold value period (L_{Aeq})	**Threshold value, in decibels (dB)**	**Assessment category and threshold value period (L_{Aeq})**	**Threshold value, in decibels (dB)**
	Category A[A)]	**Category B[B)]**	**Category C[C)]**
Night time (23.00 – 07.00)	45	50	55
Evenings and weekends (D)	55	60	65
Daytime (07.00 – 19.00) and Saturday (07.00 – 13.00)	65	70	75
A) Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are less than these values.			
B) Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are the same as category A values.			
C) Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are higher than category A values.			
D) 19.00–23.00 weekdays, 13.00–23.00 Saturdays and 07.00–23.00 Sundays.			

22.4.8.3 The "ABC method" described in BS 5228-1:2009+A1:2014 and the guidance contained within the HS2 Information Paper E23: Control of Construction Noise and Vibration establishes that there is no significant impact below the three thresholds presented above.

22.4.8.4 BS 5228-1:2009+A1:2014 states:

> "*If the site noise level exceeds the appropriate category value, then a potential significant effect is indicated. The assessor then needs to consider other project-specific factors, such as the number of receptors affected and the duration and character of the impact, to determine if there is a significant effect."*

22.4.8.5 The CadnaA noise model used in this construction phase assessment incorporated noise sources located in the noise and vibration study area, nearby residential dwellings and other buildings, intervening ground cover and topographical information.

22.4.8.6 All identified noise sensitive receptors at landfall and at the onshore substation, are considered to fall into Category A, based on the measured noise levels at these receptors (Section 22.5). All noise sensitive receptors along the onshore cable corridor, in a conservative approach, are also considered to fall into Category A.

22.4.8.7 Noise levels for the construction phase were calculated using the methods and guidance in BS 5228-1:2009+A1:2014. This Standard provides methods for predicting receptor noise levels from construction works based on the number and type of construction plant and activities operating on site, with corrections to account for:

- The "on-time" of the plant, as a percentage of the assessment period
- Distance from source to receptor;
- Acoustic screening by barriers, buildings or topography; and
- Ground type.

22.4.8.8 Construction noise impacts were assessed (Section 22.6.2) using the impact magnitude presented in Table 22.7 for the daytime period, Table 22.8 for the evening and weekend periods, and Table 22.9 for the night time.

Table 22.7 – Day time (0700-1700 Mon-Fri and 0700-1900 Saturdays) Construction Noise Impact Magnitude Criteria

Impact magnitude	Construction noise level, dB, $L_{Aeq,T}$
Negligible	<65.9
Low	>66.0 - <67.9
Medium	>68.0 - <69.9
High	>70

Table 22.8 – Evening and Weekends Construction Noise Impact Magnitude Criteria

Impact magnitude	Construction noise level, dB, $L_{Aeq,T}$
Negligible	<55.9

Impact magnitude	Construction noise level, dB, $L_{Aeq,T}$
Low	>56.0 - <57.9
Medium	>58.0 - <59.9
High	>60

Table 22.9 – Night-time Construction Noise Impact Magnitude Criteria

Impact magnitude	Construction noise level, dB, $L_{Aeq,T}$
Negligible	<45.9
Low	>46.0 - <47.9
Medium	>48.0 - <49.9
High	>50

Construction Phase Traffic Noise Impact Magnitude

22.4.8.9 Following the methodology contained in DMRB LA 111, (Highways England, 2020) an initial screening assessment was undertaken to assess whether there would be any significant changes in traffic volume and composition on surrounding local roads as a result of the Proposed Development based on predicted traffic flows (Chapter 25 Traffic and Transport). Any road links with a predicted increase in traffic volume of 25% or a decrease of 20% were identified. Such changes in traffic volume would correspond to a 1 dBA change in noise level at the relevant road link. A change in noise level of less than 1 dBA is regarded as being imperceptible and, therefore, of negligible magnitude. If there are no increases greater than 25% or a decrease of 20% or greater, then the DMRB guidance indicates that no further assessment needs to be conducted.

22.4.8.10 Traffic flows on the roads (links) surrounding the proposed development site were provided by the traffic consultants (Cundall) as Annual Average Weekday Traffic (AAWT) for the following scenarios:

- 2026 – baseline traffic flow;
- 2026 – baseline traffic flow plus construction traffic;

22.4.8.11 Predictions of the $L_{A10,18hour}$ noise index were undertaken in accordance with the method provided in CRTN within noise prediction software CadnaA, using the projected traffic flows and Heavy Goods Vehicle (HGV) composition.

22.4.8.12 Construction phase receptor dB change was assessed using the impact magnitude criteria in Table 22.10. The thresholds for differentiating the criteria are taken from DMRB for short-term impacts and are an indication of the relative change in ambient noise as a result of the proposed Project Erebus.

Table 22.10 – Magnitude Criteria for Relative Change Due to Road Traffic (Short Term)

Change in noise level ($L_{A10\ (18\ hour)}$ dB)	**Impact magnitude**
Less than 1.0	Negligible Adverse
1.0 – 2.9	Minor Adverse
3.0 – 4.9	Moderate Adverse
5.0+	Major Adverse

22.4.8.13 Paragraph 3.32 of DMRB LA 111 (Highways England, 2020) states that:

- *"PPVs [peak particle velocity] in the structure of buildings close to heavily trafficked roads rarely exceed 2 mm/s and typically are below 1 mm/s. Normal use of a building such as closing doors, walking on suspended wooden floors and operating domestic appliances can generate similar levels of vibration to those from road traffic"*

Construction Phase Vibration Impact Magnitude

22.4.8.14 Ground-borne vibration can result from construction works and may lead to perceptible levels of vibration at nearby receptors, which at higher levels can cause annoyance to residents. In extreme cases, cosmetic or structural building damage can occur, however vibration levels have to be of a significant magnitude for this effect to be manifested and such cases are rare.

22.4.8.15 High vibration levels generally arise from 'heavy' construction works such as piling, deep excavation, or dynamic ground compaction. The use of piling during the construction of the onshore substation may be required as well as HDD could be required at landfall and along the cable route.

22.4.8.16 Annex E of BS 5228-2:2009+A1:2014 contains empirical formulae derived by Hiller and Crabb (2000) from field measurements relating to resultant peak particle velocity (PPV) with a number of other parameters for vibratory compaction, dynamic compaction, percussive and vibratory piling, the vibration of stone columns and tunnel boring operations. Use of these empirical formulae enables resultant PPV to be predicted and for some activities (vibratory compaction, vibratory piling and vibrated stone columns) they can provide an indicator of the probability of these levels of PPV being exceeded.

22.4.8.17 The empirical equations for predicting construction-related vibration provide estimates in terms of PPV. Therefore, the consequences of predicted levels in terms of human perception and disturbance can be established through direct comparison with the BS 5228-2:2009+A1:2014 guidance vibration levels.

22.4.8.18 Ground-borne vibration assessments may be drawn from the empirical methods detailed in BS 5228-2:2009+A1:2014, in the Transport and Road Research Laboratory (TRRL) 246: Traffic: Traffic induced vibrations in buildings, and within the Transport Research Laboratory (TRL) Report 429 (2000): Ground-borne vibration caused by mechanical construction works.

22.4.8.19 However, these calculation methods rely on detailed information, including the type and number of plants being used, their location and the length of time they are in operation. Given the mobile nature of much of the plant that has the potential to impart sufficient energy into the ground, and the varying ground conditions in the immediate vicinity of the construction works, it was considered that an accurate representation of vibration conditions using these predictive methods was not possible.

22.4.8.20 Consequently, a series of calculations, following the methodologies referred to above, were carried out based on typical construction activities that have the potential to impart sufficient energy into the ground, applying reasonable worst case assumptions in order to determine set-back distances at which critical vibration levels may occur.

22.4.8.21 Humans are very sensitive to vibration, which can result in concern being expressed at energy levels well below the threshold of damage. Guidance on the human response to vibration in buildings is found in BS 6472-1:2008 Guide to evaluation of human exposure to vibration in buildings, Part 1, Vibration sources other than blasting.

22.4.8.22 BS 6472 describes how to determine the VDV from frequency-weighted vibration measurements. VDV is defined by the following equation:

$$VDV_{b/d,\ day/night} = (\int_0^T a^4(t)dt)^{0.25}$$

22.4.8.23 The VDV is used to estimate the probability of adverse comment which might be expected from human beings experiencing vibration in buildings. Consideration is given to the time of day and use made of occupied space in buildings, whether residential, office or workshop.

22.4.8.24 BS 6472 states that in homes, adverse comment about building vibrations is likely when the vibration levels to which occupants are exposed are only slightly above thresholds of perception.

22.4.8.25 BS 6472 contains a methodology for assessing the human response to vibration in terms of either the VDV, or in terms of the acceleration or the peak velocity of the vibration, which is also referred to as PPV. The VDV is determined over a 16-hour daytime period or 8-hour night-time period.

22.4.8.26 The response of a building to ground-borne vibration is affected by the type of foundation, ground conditions, the building construction and the condition of the building. For construction vibration, the vibration level and effects detailed in Table 22.11 were adopted based on BS 5228-2:2009+A1:2014. Limits for transient vibration, above which cosmetic damage could occur, are given numerically in terms of PPV.

Table 22.11 – Transient Vibration Guide Values for Cosmetic Damage

Type of building	**Peak component particle velocity in frequency range of predominant pulse**	
	4 Hz to 15 Hz	**15 Hz and above**
Reinforced or framed structures Industrial and heavy commercial buildings	50 mms^{-1} at 4 Hz and above	
Un-reinforced or light framed structures Residential or light commercial type buildings	15 mms^{-1} at 4 Hz increasing to 20 mms^{-1} at 15 Hz	20 mms^{-1} at 15 Hz increasing to 50 mms^{-1} at 40 Hz and above

22.4.8.27 Table 22.12 lists the minimum set-back distances at which vibration levels of reportable significance for other typical construction activities may occur. BS 5228-2:2009+A1:2014 calculation methods were used to derive the set-back distances.

Table 22.12 – Predicted Distances at Which Vibration Levels May Occur

Name	Set-back distance at which vibration level (PPV) occurs			
	0.3 mm/s	1.0 mm/s	10 mm/s	15 mm/s
Vibratory Compaction (Start-up)	166 m	65 m	9 m	6 m
Vibratory Compaction (Steady State)	102 m	44 m	8 m	6 m
Percussive Piling	48 m	19 m	3 m	2 m

22.4.8.28 Table 22.13 reproduced from research (Rockhill et al. 2014) details minimum safe separation distance for piling activities from sensitive receptors to reduce the likelihood of cosmetic damage occurrence.

Table 22.13 – Receptor Proximity for Indicated Piling Methods

Building type (limits on vibrations from Eurocode 3)	Piling method		
	Press-in	25kJ drop hammer	170 kW 27Hz vibrohammer
Architectural merit	2.6m	29.6m	27.7m
Residential	0.5m	11.8m	13.8m
Light commercial	0.14m	5.9m	5.5m
Heavy industrial	0.06m	3.9m	3.7m
Buried services	0.03m	2.9m	2.2m

22.4.8.29 For construction vibration from sources other than blasting, the vibration level and effects presented in Table 22.14 were adopted based on Table B-1 of BS 5228-2:2009+A1:2014. These levels and effects are based on human perception of vibration in residential environments.

Table 22.14 – Construction Vibration - Impact Magnitude

Vibration limit PPV (mm/s)	Interpreted significance to humans	Impact magnitude
< 0.3	Vibration unlikely to be generally perceptible but might just be perceptible in the most sensitive situations for most vibration frequencies associated with construction	Negligible
0.3 to 1.0	Vibration might just be perceptible in residential environments	Low

Vibration limit PPV (mm/s)	Interpreted significance to humans	Impact magnitude
1.0 to ≤10.0	It is likely that vibration at this level in residential environments will cause complaint, but can be tolerated if prior warning and explanation has been given to residents	Medium
≥10.0	Vibration is likely to be intolerable for any more than a brief exposure to this level	High

Operational Phase Noise Impact Magnitude

22.4.8.30 Where there are noise sources such as fixed plant associated with onshore assets, the most appropriate assessment guidance is BS 4142:2014+A1:2019. The guidance describes a method of determining the level of noise of an industrial noise source and the existing background noise level.

22.4.8.31 BS 4142:2014+A1:2019 describes methods for rating and assessing sound of an industrial and/or commercial nature. The methods use outdoor sound levels to assess the likely effects of sound on people who might be inside or outside a dwelling or premises used for residential purposes upon which sound is incident, and combines procedures for assessing the impact in relation to:

- *Sound from fixed installations which comprise mechanical and electrical plant and equipment;*

22.4.8.32 This standard is confirmed as the appropriate standard for the assessment of operational noise in the Overarching National Policy Statement for Energy (EN-5), (DECC 2011) and is applicable to the determination of the following levels at outdoor locations:

- *"a) rating levels for sources of sound of an industrial and/or commercial nature; and*
- *b) ambient, background and residual sound levels, for the purposes of:*
  - *investigating complaints;*
  - *assessing sound from existing, proposed, new, modified or additional source(s) of sound of an industrial and/or commercial nature; and*
  - *assessing sound at proposed new dwellings or premises used for residential purposes."*

22.4.8.33 The standard is not intended to be applied to the assessment of indoor sound levels.

22.4.8.34 The standard incorporates a requirement for the assessment of uncertainty in environmental noise measurements and introduces the concepts of "significant adverse impact" rather than likelihood of complaints. Common principles with the previous edition are consideration of sound characteristics, time of day and frequency of occurrence.

22.4.8.35 The standard applies to industrial/commercial and background noise levels outside residential buildings and for assessing whether existing and new industrial/commercial noise sources are likely to give rise to significant adverse impacts on the occupants living in the vicinity.

22.4.8.36 Assessment is undertaken by subtracting the measured background noise level from the rating level; the greater this difference, the greater the magnitude of the impact.

22.4.8.37 BS 4142:2014 refers to the following:

- *"A difference of around +10dB or more is likely to be an indication of a significant adverse impact, depending on the context;*
- *A difference of around +5dB is likely to be an indication of an adverse impact, depending on the context; and*
- *The lower the rating level relative to the measured background sound level the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context".*

22.4.8.38 When assessing the noise from a source, which is classified as the Rated Noise Level, it is necessary to have regard to the acoustic features that may be present in the noise. Section 9.1 of BS 4142:2014+A1:2019 states:

- *"Certain acoustic features can increase the significance of impact over that expected from a basic comparison between the specific sound level and the background sound level. Where such features are present at the assessment location, add a character correction to the specific sound level to obtain the rating level."*

22.4.8.39 An operational assessment in accordance with BS 4142:2014+A1:2019 has been undertaken for the onshore substation as it is the only noise source associated with the operational phase. Due to the separation distance, existing ambient soundscape and a detailed screening of the onshore substation plant and equipment, no penalty corrections for intermittency or impulsivity are required. These acoustic features are added based on perceptibility at the receptor location.

22.4.8.40 In terms of intermittency, the onshore substation will typically operate for the full 24hrs each day, with no expected stops/starts to the fixed electrical plant. Therefore, no intermittency penalty correction is required. Where there may be air cooling fans that stop/start, this is not considered to be distinctively audible at the receptor, above baseline sound characteristics due to masking effects.

22.4.8.41 In terms of impulsivity, the onshore substation will typically operate for the full 24hrs each day, with no expected stops/starts to the fixed plant. There are no items of fixed electrical plant with impulsive characteristics under typical operating conditions.

22.4.8.42 Whilst it is known that the sound emissions (i.e. sound level emitted at source) from transformers typically contain a significant proportion of their acoustic energy at 100 Hz and harmonics, in order to determine perceptibility of tonality detailed information regarding the source noise levels (e.g. sound power levels in third octave bands are required for determination of tonality using Annex C of BS4142:2014+A1:2019) is generally required. This information will become available at detail design stage.

22.4.8.43 Therefore, an assumed spectral profile has been used and it is considered that a +6 dB penalty for tonality, applicable to tones which are 'clearly audible', would be appropriate where the predicted specific noise level is significantly above background, a +2dB penalty for tonality where the predicted specific noise level is close to the existing background and 0dB penalty where predicted specific noise is below background, or the predicted level is objectively low (and hence tonality is unlikely to be perceptible).

22.4.8.44 The specific sound level is measured in terms of the $L_{Aeq,T}$, where 'T' is a reference period of:

- 1 hour during daytime hours (07:00 to 23:00 hours); and
- 15 minutes during night-time hours (23:00 to 07:00 hours).

22.4.8.45 To predict the noise from the operational aspects of the onshore substation, CadnaA noise modelling software was utilised. The results of the modelling are detailed in Section 22.6.3. The model incorporated proposed buildings based on elevation drawings, proposed fixed plant and additional noise sources (such as temporary generating plant) associated with the onshore substation. The model also included nearby residential dwellings and other buildings in the onshore development area, intervening ground cover and topographical information.

22.4.8.46 The calculation algorithm described in ISO 9613 (ISO, 1996) was used in the operational noise propagation modelling exercise.

22.4.8.47 The magnitude of impact that will be applied to the operational assessment, based on a quantitative assessment of noise impact using BS 4142:2014+A1:2019 is summarised in Table 22.15.

22.4.8.48 It is considered and accepted that the smallest perceptible change in environmental noise is 3 dBA. Therefore, a difference in noise level above the background of up to +3 dBA is detailed as a negligible adverse impact magnitude.

22.4.8.49 BS4142:2014+A1:2019 states that *"a difference of around +5dB is likely to be an indication of an adverse impact, depending on the context "*. Using this principle, a difference in sound level of between +3 dBA to +5d BA is detailed as a minor adverse impact.

Table 22.15 – Substation Operational Noise Impact Magnitude Criteria

BS4142 Rating level ($L_{Ar, Tr}$ dB)	**Impact magnitude**
> up to L_{90} dBA + <3dB	Negligible
> L_{90} dBA + >3 dB to <5 dB	Low
> L_{90} dBA + >5 dB to 9.9 dB	Medium
L_{90} dBA + ≥10 dB	High

Sensitivity

22.4.8.50 Sensitive receptors, in the context of noise and vibration, are typically residential premises but can also include schools, places of worship and noise sensitive commercial premises. Table 22.16 presents the definitions used relating to the sensitivity of the receptor.

Table 22.16 – Sensitivity Levels for Receptors

Sensitivity	**Definition**	**Examples**
High	Receptor has very limited tolerance of effect	Noise Receptors have been categorised as high sensitivity where noise may be detrimental to vulnerable receptors. Such receptors include certain hospital wards (e.g. operating theatres or high dependency units) or care homes at night.

Sensitivity	Definition	Examples
		Vibration Receptors have been categorised as high sensitivity where the receptors are listed buildings or Scheduled Monuments.
Medium	Receptor has limited tolerance of effect	Noise Receptors have been categorised as medium sensitivity where noise may cause disturbance and a level of protection is required but a level of tolerance is expected. Such subgroups include residential accommodation, private gardens, hospital wards, care homes, schools, universities, research facilities, national parks, (during the day); and temporary holiday accommodation at all times. Vibration Receptors have been categorised as medium sensitivity where the structural integrity of the structure is limited but the receptor is not a listed building or Scheduled Monument.
Low	Receptor has some tolerance of effect	Noise Receptors have been categorised as low sensitivity where noise may cause short duration effects in a recreational setting although particularly high noise levels may cause a moderate effect. Such subgroups include offices, shops, outdoor amenity areas, long distance footpaths, doctor's surgeries, sports facilities and places of worship. Vibration Receptors have been categorised as low sensitivity where the structural integrity of the structure is expected to be high. The level of vibration required to cause damage is very high and such levels are not expected to be reached during the proposed Project Erebus.
Negligible	Receptor generally tolerant of effect.	Noise Receptors have been categorised as negligible sensitivity where noise is not expected to be detrimental. Such subgroups include warehouses, light industry, car parks, and agricultural land. Vibration Receptors have been categorised as negligible sensitivity where vibration is not expected to be detrimental.

22.4.8.51 All receptors considered within this assessment are of medium sensitivity.

Significance of Effect

22.4.8.52 The significance of the effect due to noise and vibration is determined by correlating the magnitude of the impact and the sensitivity of the receptor, as presented in Table 22.17. On this basis potential impacts are assessed as of negligible, minor, moderate and major significance (definitions are provided in Chapter 2: Overview of EIA Methodology).

22.4.8.53 For the purposes of this assessment, any effects with a significance level of major and/or moderate have been deemed significant in EIA terms, while those of minor or negligible are deemed non-significant.

Table 22.17 – Impact Significant Matrix

		Sensitivity			
		High	**Medium**	**Low**	**Negligible**
Magnitude	**High**	Major	Major	Moderate	Minor
	Medium	Major	Moderate	Minor	Minor
	Low	Moderate	Minor	Minor	Negligible
	Negligible	Minor	Minor	Negligible	Negligible

22.4.9 Standard Mitigation

22.4.9.1 A range of standard mitigation measures has already been applied to the Project as part of the over-arching site selection and iterative design process (see below and Chapter 3: Site Selection and Alternatives). These have been introduced in order to minimise potential impacts of the Project on any affected receptors.

22.4.9.2 Experience in the UK is that good site practice is capable of mitigating the impact of noise and vibration associated with construction activities effectively. In all but the most exceptional circumstances, impacts at receptors can be controlled to ensure effects are negligible to minor adverse and not significant.

22.4.9.3 Standard mitigation measures which the Project has already implemented, or is committed to in the future, in order to minimise potential impacts due to noise and vibration are listed below. These will be further defined in the Construction Environmental Management Plan (CEMP) and implemented during the construction phase by the successful Contractor. An Outline CEMP is included in Volume 3 Technical Appendix 4.1.

22.4.9.4 The precise mitigation measures to control noise from the works may require the agreement of the local authority prior to the works starting. Generic measures below are given to illustrate the range of techniques available.

22.4.9.5 The adoption of Best Practicable Means, as defined in the Control of Pollution Act 1974, is usually the most effective means of controlling noise from sites. Within the constraints of efficient site operations and the requirements of the relevant British Standards, the following is advisable:

- limit the use of particularly noise plant, i.e. do not use particularly noisy plant early in the morning where avoidable;
- limit the number of plant items in use at any one time;
- plant maintenance operations should be undertaken as far away from noise-sensitive receptors as possible;
- any compressors, generators etc. brought on to site should be silenced or sound reduced models fitted with acoustic enclosures;
- reduce the speed of vehicle movements;

- all pneumatic tools should be fitted with silencers or mufflers;
- ensure that operations are designed to be undertaken with any directional noise emissions pointing away from noise-sensitive receptors where practicable;
- when replacing older plant, ensure that the quietest plant available is considered wherever possible; any deliveries/waste removal vehicles should be programmed to arrive and depart during daytime hours only.
- drop heights must be minimised when loading vehicles with rubble.
- care should be taken when loading vehicles to minimise disturbance to local residents. Vehicles should be prohibited from waiting within the site with their engines running;
- all plant items should be properly maintained and operated according to the manufacturers' recommendations in such a manner as to avoid causing excessive noise. All plant should be sited so that the noise impact at nearby noise-sensitive properties is minimised;
- local hoarding, screens or barriers should be erected as necessary to shield particularly noisy activities; and
- any problems concerning noise from construction works can sometimes be avoided by taking a considerate and neighbourly approach to relations with local residents.

Training

22.4.9.6 The contractor's site induction programme and site rules must include good working practice instructions for site staff/managers and contractors to help minimise noise and vibration whilst working on the site.

22.4.9.7 Good working practice guidance/instructions should include, but not be limited to, the following points:

- avoid un-necessary revving of engines;
- plant used intermittently should be shut-down between operational periods;
- avoid reversing wherever possible;
- drive carefully and within the site speed limit at all times; and
- report any defective equipment/plant as soon as possible so that corrective maintenance can be taken.

Maintenance

22.4.9.8 A pre-commencement inspection of all plant shall be made to ensure that:

- any plant found to be requiring interim maintenance should be identified by the operator and repairs undertaken by a qualified engineer as soon as possible.
- regular and effective maintenance of plant can play an important part in keeping noise levels under control.
- always ensure that doors fitted to acoustic enclosures around fixed plant remain closed, the fitting of self-closing mechanisms is advisable.

Community Relations

22.4.9.9 It is essential to maintain good public relations with local residents in nearby noise-sensitive receptors. General measures to improve public relations are detailed below:

- endeavour to be good neighbours, i.e.:
- get to know the neighbours, be concerned about them and try to understand their problems, encourage them to know the site personnel, listen as well as talk,
- provide regular communications,
- create a good impression by running a tidy and efficient site,
- ensure lines of communication, e.g.:
- nominate a point of contact for issues relating to the site,
- support public consultation,
- give advance notice and explanation of activities that might cause complaint,
- keep systematic records of complaints and the remedial actions taken,
- follow up complaints with correspondence and action,
- ensure that site staff are environmentally aware and are trained to cope with issues,
- do not rely on the letter of the law where there are obvious problems, but culpability cannot be easily proved; be prepared to be flexible,
- try to co-operate and avoid being adversarial.

Action Plan

22.4.9.10 The following details the actions which should be undertaken following a complaint being received, namely:

- a complaints response system shall be maintained by the construction contractor for the site enabling any complaints regarding noise to be reported and appropriate action taken.
- an investigation shall be instigated as soon as possible following receipt of the complaint to identify the cause of the complaint.
- such an investigation may involve the identification and re-assessment of the activity or activities considered to be the cause of the complaint and/or the investigation of mitigation measures to reduce the noise emission levels from the activity or activities, for example the replacement of noisy plant with quieter alternatives and/or the use of temporary screening barriers.
- any deviation from agreed working practices shall be identified immediately and conformance to the working practice reinstated.

22.4.10 Assessment for Residual Effect Significance

22.4.10.1 The impact assessments and conclusions on significance of effect presented in Sections 22.6 and 22.7 assume that these standard mitigation measures listed above have been successfully implemented. Where significant environmental impacts remain even after these standard measures have been factored in, then project-specific mitigation measures are detailed and the residual significance of effect presented.

22.4.11 Limitations to Assessment

22.4.11.1 The key data limitation with the baseline data and their ability to materially influence the outcome of the EIA is the inherent variability of the noise environment. To manage this variability and provide representative noise data for the onshore study area, data were collected over two weeks to allow for day to day variability.

22.4.11.2 The key data limitation with operational noise predictions is the lack of detailed information regarding the potential tonality (third octave sound power levels for substation equipment). To manage this, an assumed spectral profile was used and appropriate penalties applied to the specific sound level to account for the likely perceptibility of tonality at receptors.

22.5 Baseline Conditions

22.5.1.1 In order to characterise the existing noise climate within the noise and vibration study area a baseline noise survey was undertaken at locations representative of the nearest sensitive receptors as agreed with the Local Planning Authority, detailed in Table 22.4 and shown in Volume 2 Figure 22.3. Measurements were conducted between 7th July 2021 to 21st July 2021. Details of the baseline noise survey are contained within Volume 3 Technical Appendix 22.1.

22.5.1.2 Table 22.18 and Table 22.19 provide a summary of the measured baseline noise data at the landfall during both the daytime and night-time surveys respectively.

Table 22.18 – Baseline Noise Data, Landfall, Daytime free-field, dB

Noise Monitoring Location	Date	L_{Aeq}	L_{Amax}	L_{A90}
LFR1/LFR2	7th July 2021	43.5	68.2	36.8

Table 22.19 – Baseline Noise Data, Landfall, Night-time free-field, dB

Noise Monitoring Location	Date	L_{Aeq}	L_{Amax}	L_{A90}
LFR1/LFR2	8th July 2021	35.3	62.9	31.7

22.5.1.3 Tables 22.20 and 22.21 provide a summary of the measured baseline noise data at the onshore substation location during both the daytime and night-time surveys respectively. The L_{A90} is considered in Table 22.22.

Table 22.20 – Baseline Noise Data, Substation, Daytime free-field, dB

Noise Monitoring Location	Date	L_{Aeq}	L_{Amax}
SSR1	7th to 21st July 2021	54.9	90.4
SSR2	7th to 21st July 2021	55.4	84.0*
SSR3	7th to 21st July 2021	46.7	92.0
SSR4	7th to 16th July 2021	43.3	82.3

Table 22.21 – Baseline Noise Data, Substation, Night-time free-field, dB

Noise Monitoring Location	Date	L_{Aeq}	L_{Amax}
SSR1	7th to 21st July 2021	49.6	76.7
SSR2	7th to 21st July 2021	38.4	72.7
SSR3	7th to 21st July 2021	41.9	76.4
SSR4	7th to 16th July 2021	40.8	69.1

Deriving Background Noise Levels

22.5.1.4 Statistical analysis has been undertaken of the measured background noise levels, L_{A90}, at the onshore study area during the night-time (as the constraining time period). The mean, mode and standard deviation are presented to show the variability of background noise at each location. Statistical analysis is undertaken to ascertain a representative background sound level and is detailed within Volume 3 Technical Appendix 22.1.

Table 22.22 – LA90 Statistical Analysis, Substation, Night-time free-field, dB

Noise Monitoring Location	Average $L_{A90,15min}$	Mode	Standard Deviation	Representative $L_{A90,15min}$	Receptor representing
SSR1	32	32	5.2	32	SSR1 & SSR6
SSR2	31	32	4.9	32	SSR2
SSR3	30	32	5.0	32	SSR3 & SSR5
SSR4	34	38	7.0	34	SSR4 & SSR7

22.6 Potential Environmental Effects

22.6.1.1 The potential effects at sensitive receptors associated with the Proposed Development are:

- adverse impacts on human health and quality of life due to noise and vibration during construction and decommissioning; and
- adverse effects on human health and quality of life due to noise from operation of the onshore substation.

22.6.1.2 This section describes the parameters on which the noise and vibration assessment has been based. These are the parameters which are judged to give rise to the maximum levels of effect on noise and vibration sensitive receptors.

Table 22.23 – Parameters for impacts on Noise and Vibration

Impact and Phase		**Parameters**			
Construction					
Impact	**Construction Equipment**	**Source**	**Number**	**Sound Power Level, dB(A)**	**Ontime (%)**
Temporary noise and vibration from HDD works and other trenchless technologies at landfall and along the cable route	Excavator	BS_5228_2009_C2_3	1	106	60
	Generators	BS_5228_2009_C4_84	3	101.7	100
	HDD Rig	Measured[1]	1	86	95
	Drill fluid recycling system	Measured[1]	1	114	95
	Mud Pump	Measured[1]	2	88	90
	Power Pack	Measured[1]	1	88	95
Temporary noise and vibration from open trench construction	Bulldozer	BS_5228_2009_C2_11	1	107	75
	Dump Truck	BS_5228_2009_C1_11	1	108	75
	Tracked Excavator	BS_5228_2009_C2_3	1	106	75
	Generator	BS5228:2009 C4:84	1	101.7	100
	Wheeled Loader	BS_5228_2009_C2_28		104	75
Temporary noise and vibration from construction of the onshore substation.	Tracked Excavator	BS_5228_2009_C2_3	2	106	75
	Wheeled Loader	BS_5228_2009_C2_28	2	104	75
	Bulldozer	BS_5228_2009_C2_11	2	107	75
	Dump Truck	BS_5228_2009_C1_11	2	108	75

Impact and Phase		Parameters			
Construction					
	Mobile Crane	BS_5228_2009_C4_39	2	105	75
	Truck Mounted Concrete Pump and Boom Arm	BS_5228_2009_C4_32	1	108	50
Operation					
Impact	**Substation Equipment**		**Number**	**Sound Power Level, dB(A)**	
Noise from the operational onshore substation	Grid Transformer		1	108	
	Statcom/SVC		3	81	
	Harmonic Filter		3	80	
	Harmonic Filter Capacitor Bank		3	78	

1 – Data provided in TECHNICAL NOTE PROJECT EREBUS HDD LANDFALL INPUTS FOR THE ENVIRONMENTAL IMPACT STATEMENT, reference ERE-CAB-OWC-TNT-ENV-0001 Rev A01, OWC 2021.

22.6.1.3 HDD has been assumed to be in operation at the HDD locations for 24 hours a day and assessed accordingly; for all other construction activities at the landfall, cable route corridor and onshore substation the assessment is based on construction between the hours of 07:00 to 19:00 Monday to Friday and 07:00 to 19:00 Saturday.

22.6.1.4 Whilst HDD activities have been assessed as operational 24 hours a day, along the cable route corridor this would be an extremely rare occurrence (if at all).

22.6.1.5 HDD activities along the cable route corridor would be planned to occur during working hours; HDD would only occur outside of these hours should an unforeseen overrun occur.

22.6.2 Construction Phase

22.6.2.1 The following sections describe sources of noise and vibration during construction sequentially and result of impact assessment.

Construction Traffic Noise

22.6.2.2 The road links identified by the transport assessment as carrying construction traffic are presented below in Table 22.24 and in Chapter 25: Traffic and Transport.

Table 22.24 – Development Impact on Daily Traffic Flows

Highway Link	2026 Base Traffic Flow	2026 Base + Development	Percentage Increase
B4320 East	3160	3210	1.58%
B4320 West	690	700	1.45%

Highway Link	2026 Base Traffic Flow	2026 Base + Development	Percentage Increase
C3101 between the B4320 and Goldborough Road	2551	2591	1.57%
Goldborough Road	36	76	111.11%

22.6.2.3 Table 22.25 summarises the impact on daily HGV movements generated by the Proposed Development.

Table 22.25 – Development Impact on Daily HGV Flows

Highway Link	2026 Base HGV Flow	2026 Base + Development	Percentage Increase
B4320 East	234	257	9.83%
B4320 West	38	43	13.17%
C3101 between the B4320 and Goldborough Road	199	222	11.56%
Goldborough Road	11	34	217.40%

22.6.2.4 Goldborough Road is predicted to experience an increase of more than 25% in road traffic flows during the construction period. Predictions of the $L_{A10,18hour}$ noise index in the vicinity of Goldborough Road (i.e. near to the proposed substation) were undertaken in accordance with the method provided in CRTN within noise prediction software CadnaA, using the projected traffic flows and Heavy Goods Vehicle (HGV) composition.

22.6.2.5 The predicted noise levels arising due to road traffic at each of the identified NSRs are provided in Table 22.26.

Table 22.26 – Predicted Construction Road Traffic Noise

NSR	2026 Base $L_{A10,18hour}$, dB	2026 Base + Development $L_{A10,18hour}$, dB	Change, dB
SSR1	34.4	34.7	0.3
SSR2	43.7	43.8	0.1
SSR3	39.7	40.0	0.3
SSR4	44.9	45.2	0.3
SSR5	39.8	40.1	0.3
SSR6	34.9	35.2	0.3
SSR7	44.4	44.7	0.3

22.6.2.6 Predicted increases in road traffic noise and the resultant impact magnitude, with reference to Table 22.10, are negligible at all identified NSRs.

22.6.2.7 The resultant significance of effect of road traffic noise arising due to the proposed development, with reference to the criteria provided in Table 22.10, is **minor adverse**, which is not significant in EIA terms.

Construction Vibration

22.6.2.8 Operation of HDD rigs and ancillary equipment is expected to produce the greatest vibration impacts and is therefore taken forward as the worst-case for the vibration assessment.

22.6.2.9 Vibration levels decay very rapidly with distance from a source (BS 5228-2:2009+A1:2014). A representative example of HDD given within BS 5228-2:2009+A1:2014 is for boring through silts overlying sandstone with a PPV of 8 mm/s at 4.5 m from the source, decreasing to a PPV of 2.7 mm/s at 7 m from the source and 1.8 mm/s at 12 m from the source.

22.6.2.10 Research undertaken by Reilly C. et al (Vibrations due to horizontal directional drilling in Lucan Formation rock and Dublin Boulder Clay, Conference Paper, Civil Engineering Research in Ireland, 2020) reported vibration levels of less than 1 mm/s PPV at distances of 9 m from HDD through Lucan Formation rock overlain by Dublin Boulder Clay.

22.6.2.11 Given the distances between sources of vibration during the construction works and the NSRs (see Table 22.4) it is clear that PPV levels would be below the criteria outlined in Table 22.14 at the NSRs along the proposed onshore development area. Vibration impacts from construction works would be of negligible magnitude. Therefore, no additional mitigation is required.

22.6.2.12 It is not currently known whether piling or significant ground improvement works will be required at the onshore substation, however, with reference to Table 22.12 and Table 22.14 and the distances of the nearest receptors to the substation (approximately 250 m) it is anticipated that vibration impacts from potential piling at the onshore substation would be of negligible magnitude.

22.6.2.13 Vibration impacts from construction works would be of negligible magnitude. The significance of the impact is **minor adverse**, which is not significant in EIA terms and is not considered further in this assessment.

Construction Noise

Table 22.27 – Landfall and Cable Route Construction Noise, Predicted Impacts HDD

Receptor	Worst Case Predicted Receptor Noise Level, dB(A)	Worst Case Impact Magnitude, Daytime	Worst Case Impact Magnitude, Evening & Weekend	Worst Case Impact Magnitude, Night-time	Maximum Duration
LFR1 & LFR2	58.7	Negligible	Medium	High	32 weeks[1]
CCR1	43.8	Negligible	Negligible	Negligible	1 week[2]
CCR2	59.9	Negligible	Medium	High	1 week

Receptor	Worst Case Predicted Receptor Noise Level, dB(A)	Worst Case Impact Magnitude, Daytime	Worst Case Impact Magnitude, Evening & Weekend	Worst Case Impact Magnitude, Night-time	Maximum Duration
CCR3	45.9	Negligible	Negligible	Negligible	1 week
SSR4	56.5	Negligible	Low	High	1 week

1 – Maximum duration for HDD at landfall is 32 weeks based on daytime only working hours, i.e. evening and weekend impacts will not occur if the duration is 32 weeks.
2 – Anticipated "pass-by" time of the moving work front passing residential receptors.

Table 22.28 – Cable Route Construction Noise, Predicted Impacts Open Trench, Daytime

Receptor	Worst Case Predicted Receptor Noise Level, dB(A)	Worst Case Impact Magnitude Daytime	Duration
CCR1	60.4	Negligible	1 week
CCR2	60.6	Negligible	1 week
CCR3	54.5	Negligible	1 week

Table 22.29 – Onshore Substation Construction Noise, Predicted Impacts, Daytime

Receptor	Worst Case Predicted Receptor Noise Level, dB(A)	Worst Case Impact Magnitude, Daytime	Duration
SSR1	44.8	Negligible	18 months
SSR2	44.2	Negligible	18 months
SSR3	37.1	Negligible	18 months
SSR4	31.0	Negligible	18 months
SSR5	40.7	Negligible	18 months
SSR6	46.4	Negligible	18 months
SSR7	30.8	Negligible	18 months

1 – the 18 month duration of onshore substation construction works represents the total period of construction – the predicted impacts are based on the maximum anticipated numbers of plant at any one time, all operating simultaneously and represents a worst-case which will occur for shorter periods during the 18 month construction duration.

22.6.2.14 When predicted noise levels are compared to the threshold criteria detailed within Table 22.6 it can be seen that, during the onshore cable route construction and onshore substation construction, predicted noise levels are below the threshold criteria. The impacts due to onshore cable route construction and onshore substation construction are predicted to be of local spatial extent, short term duration, intermittent and temporary. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be negligible during daytime. The significance of the impact is **minor adverse**, which is not significant in EIA terms and is not considered further in this assessment.

22.6.2.15 The impacts due to HDD at the landfall and along the cable route are predicted to be of local spatial extent, short term duration, intermittent and temporary. It is predicted that the impact will affect the receptor directly.

22.6.2.16 Predicted noise levels due to HDD works are below the threshold criteria during daytime and above the threshold during evenings, weekends and night-time at receptors at landfall and at one location along the cable route corridor. The magnitude is therefore, considered to be negligible during daytime, at most medium during evenings and weekends and, at most, high during night-time. The significance of the impact as defined in the assessment of significance matrix is **major adverse** during the night-time, which is significant in EIA terms and therefore additional mitigation is proposed for HDD.

22.6.3 Operational Phase

22.6.3.1 The impact assessment has been undertaken using the unmitigated noise level for the various potential onshore study area components.

22.6.3.2 Operations at the onshore study area would be 24 hours a day. A detailed CadnaA noise model was created to assess noise levels comprising of the plant items set out in Table 22.23. Ground absorption was incorporated into the CadnaA model using a coefficient of 0 within the substation compound (to represent hard, reflective ground) and 1 elsewhere (representing soft ground, i.e. agricultural land).

22.6.3.3 Calculated operational noise levels have been compared with the background noise levels at each receptor, which have been derived from the measured baseline noise data contained within Table 22.20 and Table 22.21.

22.6.3.4 The impact of the predicted noise levels from the onshore study area at surrounding residential receptors is presented in Table 22.30. The magnitude of effects has been assessed in accordance with BS 4142:2014+A1:2019. A tonality penalty of +6 dB(A) (for highly perceptible tonality) has been added to the predicted noise level at locations SSR1, SSR2, SSR5 and SSR6, +4 dB(A) (for clearly perceptible tonality) at location SSR3. At location SSR4 and SSR7 no penalty has been added as the predicted noise level is below the background noise level at this location therefore tonal elements would not be perceptible. Noise from the substation is neither intermittent nor impulsive in character, therefore no penalties for intermittency or impulsivity have been added.

22.6.3.5 The requirement for inclusion of tonality penalties will be developed and reviewed throughout the detailed substation design process and may therefore be removed at future stages.

22.6.3.6 Table 22.30 shows the maximum operational noise impact (i.e. during the night).

Table 22.30 – Operational Substation Noise, Predicted Impacts, Night-time

Receptor	Measured Background Noise Level, dB(A)	Predicted Rating Noise Level, $L_{Ar,Tr}$	Difference	BS 4142 Impact Magnitude	Reduction to achieve 5 dB above background
SSR1	32	45.2	+13.2	High	>13
SSR2	32	43.6	+11.6	High	>12
SSR3	32	37.0	+5.0	Low	>1
SSR4	34	29.0	-5.0	Negligible	n/a
SSR5	32	42.8	+10.8	High	>11
SSR6	32	46.6	+14.6	High	>15
SSR7	34	28.9	-5.1	Negligible	n/a

22.6.3.7 Analysis of the individual source contributions at each receptor indicates that the Transformer is the dominant noise source.

22.6.3.8 Overall, it is predicted that the sensitivity of the receptor is medium, and the magnitude, at its highest, is high. The effect is of **major adverse** significance, which is significant in EIA terms.

22.6.3.9 Of the seven receptors assessed, two are predicted to have negligible impact, one a low and four a high magnitude.

22.6.3.10 Additional mitigation is proposed.

22.6.4 Decommissioning Phase

22.6.4.1 It is recognised that industry best practice and legislation change over time and it is therefore not possible to confirm a decommissioning strategy at this time. It is likely that the substation equipment would be reused or recycled, with any hardstanding remaining undisturbed. It is likely that onshore cables would be removed from ducts and trenches and recycled with ducts left in place undisturbed.

22.6.4.2 A Decommissioning Management Plan will be developed and agreed with the regulator prior to commencement of decommissioning works. It is anticipated that the potential decommissioning impacts would be lesser in scale and nature to those of the construction phase and controlled through the measures identified in Section 22.4.9.

22.6.4.3 The effects of the decommissioning phase on human receptors are considered to be **negligible,** which is not significant in EIA terms.

22.7 Additional Mitigation

22.7.1 Construction

22.7.1.1 During the night at landfall and cable route receptors significant effects are predicted due to noise from HDD.

22.7.1.2 In order to ensure impacts are mitigated as far as reasonably possible at locations where a potential significant impact is identified, site-specific solutions such as the use of screening and temporary noise barriers will be applied.

22.7.1.3 As an example of the relative effectiveness of applying a temporary localised noise barrier BS 5228 states:

- *"as a working approximation, if there is a barrier or other topographic feature between the source and the receiving position, assume an approximate attenuation of 5 dB when the top of the plant is just visible to the receiver over the noise barrier, and of 10 dB when the noise screen completely hides the sources from the receiver. High topographical features and specifically designed and positioned noise barriers could provide greater attenuation.".*

22.7.1.4 Noise barriers, around the main items of equipment (HDD Drill Rig, Drill Fluid Recovery System etc.) were included within the noise model for HDD.

22.7.2 Operation

22.7.2.1 The Applicant will submit and agree with PCC (in writing) an operational noise assessment to demonstrate that operational noise from the onshore substation will not exceed a noise rating level (in accordance with BS4142:2014+A1:2019) of 36 dB $L_{Ar,15min}$ at any time at the nearest Noise Sensitive Receptors.

22.7.2.2 The operational noise assessment shall demonstrate, by monitoring or appropriate alternative means, compliance with the rating level detailed within para 22.7.2.1.

22.7.2.3 The allowance for up to 36 dBA rating level was derived from consideration of the context of the existing environment and the proposed onshore infrastructure in accordance with BS 4142:2014+A1:2019.

22.7.2.4 Therefore, it is considered that the operational noise rating limit (in accordance with BS 4142:2014+A1:2019) of 36 dBA is appropriate as this represents a limit of less than +5 dBA (minor adverse) above the representative background L_{A90} derived from measured sound levels during July 2021 (Section 22.5).

22.7.2.5 The commitment to limit operational noise from the onshore substation to a maximum rating level of 36 dB at any noise sensitive receptor ensures that impacts are reduced to, at most, minor adverse.

22.7.2.6 During detailed design of the onshore substation, mitigation strategies, including the use of landscaped bunds, equipment selection to reduce/eliminate tonality, provision of barriers and/or enclosures and to reduce overall noise level of each contributing item of equipment, will be developed to ensure the operational noise commitment will be met.

22.7.2.7 As an example of mitigation measure, a 6 m high barrier around the transformer was included in the operational noise model.

22.8 Residual Effects

22.8.1 Construction Phase

22.8.1.1 The residual effects after the additional mitigation measures have been applied are detailed in Table 22.31.

Table 22.31 – Landfall and Cable Route Construction Noise, Residual Impacts HDD

Receptor	Worst Case Predicted Receptor Noise Level, dB(A)	Worst Case Impact Magnitude, Daytime	Worst Case Impact Magnitude, Evening & Weekend	Worst Case Impact Magnitude, Night-time
LFR1 & LFR2	47.0	Negligible	Negligible	Low
CCR1	34.0	Negligible	Negligible	Negligible
CCR2	46.9	Negligible	Negligible	Low
CCR3	40.7	Negligible	Negligible	Negligible
SSR4	47.2	Negligible	Negligible	Low

22.8.1.2 The residual impacts due to HDD are predicted to be of local spatial extent, short term duration, intermittent and reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be negligible during daytime and evening and weekend and, at most, low during night-time. Irrespective of the sensitivity of the receptor, the significance of the impact is **minor adverse**, which is not significant in EIA terms and is not considered further in this assessment.

22.8.2 Operational Phase

22.8.2.1 The residual effects after the additional mitigation measures have been applied are detailed in Table 22.32.

Table 22.32 – Operational Substation Noise, Residual Impacts, Night-time

Receptor	Measured Background Noise Level, dB(A)	Predicted Rating Noise Level, $L_{Ar,Tr}$	Difference	BS 4142 Impact Magnitude	Reduction to achieve 5 dB above background
SSR1	32	29.6	-2.4	Negligible	n/a
SSR2	32	34.2	+2.2	Negligible	n/a
SSR3	32	28.6	-3.4	Negligible	n/a
SSR4	34	18.3	-15.7	Negligible	n/a
SSR5	32	31.1	-0.9	Negligible	n/a
SSR6	32	32.9	+0.9	Negligible	n/a
SSR7	34	18.1	-15.9	Negligible	n/a

22.8.2.2 The residual impacts due to operational substation noise are predicted to be of local spatial extent, short term duration, intermittent and reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be low at most. The impact is **negligible**, which is not significant in EIA terms and is not considered further in this assessment.

22.8.2.3 As the detailed design of the substation develops a full mitigation strategy, including detailed consideration of tonality, will be developed.

22.8.3 Decommissioning Phase

22.8.3.1 The residual effects of the decommissioning phase of the Proposed Development are concluded to be **negligible**, which is not significant in EIA terms.

22.9 Inter-Related Effects

22.9.1.1 Such inter-related effects include both:

- Project lifetime effects: i.e. those arising throughout more than one phase of the project (construction, operation, and decommissioning) to interact to potentially create a more significant effect on a receptor than if just one phase were assessed in isolation; and
- Receptor led effects: Assessment of the scope for all effects to interact, spatially and temporally, to create inter-related effects on a receptor (or group). Receptor-led effects might be short term, temporary or transient effects, or incorporate longer term effects.

Table 22.33 – Inter-related effects assessment for Noise and Vibration

Project phase(s)	Nature of inter-related effect	Assessment alone	Inter-related effects assessment
Project lifetime effects			
Construction, Operation and, decommissioning	Increases in noise and vibration as a result of construction, operation and decommissioning	Impacts at human receptors were not predicted to be significant for the construction or operational phase subject to appropriate mitigation. The decommissioning phase is not anticipated to give rise to impacts any greater in magnitude than those considered for construction.	Impacts associated with noise and vibration will only be experienced for the duration of each phase. The phases of the project cannot overlap temporally, therefore there is no potential for inter-related noise and vibration impacts to occur.
Receptor-led effects			
An inter-related effect due to the combination of noise, visual, air quality and traffic effects on human receptors		Due to concurrent multiple activities, the construction phase presents the most likely opportunity for receptor-led effects. A range of effective onshore construction phase mitigation is proposed as part of Project Erebus, which would be implemented through the CEMP. Given the effectiveness of the mitigation proposed, many effects during construction would be negligible to minor adverse and not significant. These are detailed in the respective chapters. Construction effects would be temporary. The proposed measures would control construction effects as far as reasonably practicable. On the basis of the assessment undertaken, with mitigation measures, construction noise effects are considered to be not significant. Overall, no inter-related effects across the project phases are anticipated.	

22.10 Cumulative Assessment

22.10.1.1 A Cumulative Effects Assessment (CEA) has been made based on existing and proposed developments in the Study Area (Chapter 30: Cumulative Effects Assessment). The approach to the CEA is described in Chapter 30: Cumulative Effects Assessment. Cumulative effects are defined as those effects on a receptor that may arise when the development is considered together with other reasonably foreseeable projects.

22.10.2 Construction

22.10.2.1 There are no identified concurrent construction projects in the Study Area which could result in cumulative effects due to noise and vibration. Notwithstanding, should any construction projects be identified, the Proposed Development would ensure that works are staged so as not to give rise to significant effects.

22.10.3 Operation

22.10.3.1 The proposed Greenlink converter station is within proximity to the onshore substation. No significant noise and vibration impacts were predicted for the Greenlink converter station (Greenlink Summary of Onshore and Offshore Effects, Greenlink Interconnector, September 2019) and no significant noise and vibration impacts are predicted, subject to appropriate mitigation, for the Project.

22.10.3.2 No significant cumulative effects, therefore, are predicted.

22.10.4 Decommissioning

22.10.4.1 It is not known whether there will be any other projects that could have noise and vibration impacts during the decommissioning phase for the Project. It is considered unlikely that there will be cumulative effects from noise and vibration in the decommissioning phase and any potential effects will be managed in accordance with guidelines and legislation applicable at the time of decommissioning.

22.11 Trans-boundary

22.11.1.1 There are no trans- boundary impacts predicted to result from the construction, operation and maintenance and decommissioning of the Project with respect to noise and vibration.

22.12 Summary

22.12.1.1 This chapter considers potential noise and vibration impacts upon human receptors within defined Study Area for the construction, operational and decommissioning phases of the Proposed Development.

22.12.1.2 The assessment has included a detailed baseline noise survey, prediction of construction and operational phase impacts, recommendations for mitigation and an assessment of residual impacts.

22.12.1.3 The assessment has concluded that, subject to appropriate specific mitigation, the effects of the construction and decommissioning phases on human receptors are temporary negligible adverse and not significant.

22.12.1.4 The assessment has concluded that with the inclusion of specific mitigation, the effects of the operational phase are negligible adverse at human receptors and are not significant.

22.12.1.5 Overall, it is concluded that the residual effect of the Proposed Development due to noise and vibration is not significant.

Table 22.34 – Summary of Effects on Human Receptors

Description of Effect	Significance of Potential Effect (assuming standard mitigation implemented)		Additional Mitigation Measure	Significance of Residual Effect	
	Significance	Beneficial/ Adverse		Significance	Beneficial/ Adverse
Construction					
Increased noise on residential receptors along the Study Area	Major	Adverse	Provision of targeted noise barriers to construction equipment	Minor	Adverse
Vibration disturbance along the Study Area	Negligible	-	n/a	Negligible	-
Operation					
Increased operational noise on residential from the onshore substation	Major	Adverse	Project Erebus onshore substation will restrict operational noise rating level to 36 dB(A). Best Practice Measures (BPM), use of quieter equipment, use of enclosures and localised screening.	Negligible	-
Decommissioning					
Increased noise on residential receptors along the Study Area	Negligible	-	n/a	Negligible	-

Table 22.35 – Summary of Cumulative Effects. – TBC after checking for simultaneous construction with other schemes

Receptor	Effect	Cumulative Developments	Significance of Cumulative Effect	
			Significance	Beneficial/ Adverse
NONE				

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