BERWICK BANK WIND FARM
ONSHORE ENVIRONMENTAL IMPACT ASSESSMENT REPORT

Chapter 9: Noise & Vibration

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9. NOISE

9.1. INTRODUCTION

1. This chapter presents the assessment of the likely significant effects (as per the "EIA Regulations 2017") on the environment of the Berwick Bank Wind Farm onshore transmission works (OnTW) (the Proposed Development) due to noise and vibration. Specifically, this chapter considers the potential impact of the Proposed Development landward of Mean Low Water Springs (MLWS) during the construction, operational and maintenance, and decommissioning phases.

2. This assessment is informed by the following technical chapter:

- Chapter 12, Traffic and Transport.

3. This chapter summarises information contained within Volume 4, Appendix 9.1: Baseline Noise Survey.

4. This chapter refers to 'substation' as opposed to 'Electricity Transmission Buildings' or 'substation/converter station'. However, the assessment considers both the substation (HVAC) and converter station (HVDC) options. The source levels associated with both the substation (HVAC) and converter station (HVDC) are presented in the Maximum Design Scenario section and the predicted levels, secondary mitigation and residual effects of both designs are presented in the Assessment of Significance section. This ensures that the EIA assesses both design scenarios.

9.2. PURPOSE OF THIS CHAPTER

5. This chapter:

- Presents the existing environmental baseline established from desk studies, site-specific surveys and consultation with stakeholders;
- Identifies any assumptions and limitations encountered in compiling the environmental information;
- Presents the potential environmental impacts due to noise and vibration arising from the Proposed Development, and reaches a conclusion on the likely significant effects of noise and vibration based on the information gathered and the analysis and assessments carried out; and
- Highlights any necessary monitoring and/or mitigation measures recommended to prevent, minimise, reduce or offset the likely significant adverse environmental effects of the Proposed Development due to noise and vibration.

9.3. STUDY AREA

6. The noise and vibration study area, in relation to the extent of the onshore Proposed Development area, is shown in Volume 2, Figure 9.1. The noise and vibration study area includes the following elements of infrastructure:

- Cable landfall;
- Onshore cable corridor; and
- Onshore substation.

7. The spatial scope of the construction noise assessment includes the following geographic coverage:

- Up to 300 m from any construction activities;
- Along the onshore development area where activities have the potential to cause likely significant effects on identified Noise Sensitive Receptors (NSRs); and

- Traffic routes and routes subject to significant changes in traffic flows (and / or percentage of Heavy Goods Vehicle (HGV)) associated with construction.

8. 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 Volume 1, Chapter 12.

9. The noise and vibration 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.

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

11. The noise and vibration assessment draws on the information provided within Volume 1, Chapter 5 in order to define a maximum design scenario, which is subsequently assessed in this chapter.

Noise Sensitive Receptors

12. Table 9.1 describes the NSRs included within this assessment, and shown on Volume 2, Figure 9.2. The NSRs have been chosen based on their proximity to the cable landfall, the onshore cable corridor, and the onshore substation and are either individual residential properties or are considered representative of groups of residential properties.

Table 9.1: Identified Noise Sensitive Receptors

Receptor Identifier	Address	Coordinates		Classification
		X	Y	
CCR1	Castledene, Innerwick	373345	673497	Residential
CCR2	Fouracres, Innerwick	373361	673592	Residential
LFR1	Links Cottage, Skateraw	373706	675581	Residential
LFR2	Orchard House/Skateraw House, Skateraw	373450	675131	Residential
SSR1	Lawfield Cottage	375087	672993	Residential
SSR2	Railway Cottage	373565	674743	Residential
SSR3	Crowhill Farm Cottages	373637	674105	Residential
SSR4	Thornton Mill	374154	674095	Residential
SSR5	Blackberry Farm, 6 Thorntonloch Holdings	374075	673738	Residential
SSR6	12 Thorntonloch Holdings	374341	673712	Residential
SSR7	Innerwick Primary School/Dwellings in Innerwick	372251	674129	Educational/Residential

9.4. POLICY AND LEGISLATIVE CONTEXT

13. A summary of the policy provisions relevant to noise and vibration are provided in Table 9.2 below. A summary of the legislative provisions relevant to noise and vibration are provided in Table 9.3 below.

Table 9.2: Summary of Policy Provisions Relevant to Noise and Vibration

Relevant Policy	Summary of Relevant Policy Framework	How and Where Considered in the Onshore EIA Report
Planning Advice Note 1/2011: Planning and Noise (2011)	PAN 1/2011 provides general guidance and advice on the role of the planning system in helping to prevent and limit the adverse effects of noise.	The recommendations of PAN 1/2011 are considered within Section 9.9 Methodology.

Relevant Policy	Summary of Relevant Policy Framework	How and Where Considered in the Onshore EIA Report
Technical Advice Note (TAN): Assessment of Noise (2011)	TAN provides guidance for the assessment of significance in relation to noise effects.	The recommendations of the TAN are considered within Section 9.9 Methodology.
East Lothian Council Local Development Plan 2018, Policy NH13 Noise	Provides a requirement for noise generating developments to be subject to a noise impact assessment.	Considered throughout this chapter.

Table 9.3: Summary of Legislative Provisions Relevant to Noise and Vibration

Relevant Legislation	Summary of Relevant Legislative Framework	How and Where Considered in the Onshore EIA Report
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 (Scotland) Regulations 2006, and the Environment (EU Exit) (Scotland) (Amendment etc.) (No. 2) Regulations 2019	Provides a framework for the assessment and management of noise from transportation and other sources.	Considered throughout this chapter
The Control of Pollution Act 1974	Section 60 of the Act provides powers to Local 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 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.	Section 9.9, 9.10, 9.11, 9.12.

9.5. CONSULTATION

14. A summary of the key issues raised during consultation activities carried out to date specific to noise and vibration is presented in Table 9.4 below, together with how these issues have been considered in the production of this chapter. Further detail is presented within Volume 1, Chapter 2 and the Pre-Application Consultation (PAC) Report.

Table 9.4: Summary of Key Consultation Carried Out for the Proposed Development Relevant to Noise and Vibration

Date	Consultee and Type of Consultation	Issue(s) Raised	Response to Issue Raised and/or Where Considered in this Chapter
Consultation on the Proposed Development: Scoping Opinion			
October 2020	ELC Scoping Opinion	Agree that population and human health is scoped in - potential for noise at nearby residential properties.	Agreed
October 2020	ELC Scoping Opinion	The proposed hours of working during construction are Mon-Sun 0700-1900 hours with any noisy work required to be undertaken outwith these hours subject to prior agreement with the Planning Authority. The planning authority is likely to seek that standard working hours be amended to Mon-Fri 0700-1900 hours and Sat 0800-1300 hours as mitigation	Section 9.8, 9.11
October 2020	ELC Scoping Opinion	Standards and methodology is satisfactory.	Agreed
October 2020	ELC Scoping Opinion	Agreed that all potentially significant sources of noise and vibration and human health have been identified	Agreed
Relevant Consultation Undertaken to Date			
May 2021	ELC Environmental Health Officer (EHO), email consultation	Proposed monitoring locations, duration and monitoring methodology for the baseline noise survey	ELC EHO confirmed acceptance of the proposed baseline survey details
May 2021	ELC EHO, meeting	Discussion of proposed methodology for the assessment including requirements for noise and vibration surveys	ELC EHO confirmed acceptance of the proposed methodology

9.6. METHODOLOGY TO INFORM BASELINE

15. 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 NSRs and noise sources present within the noise and vibration study area for use in the assessment.

16. 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 Proposed Development.

17. Full details of the baseline noise surveys are discussed in Volume 4, Technical Appendix 9.1. The noise surveys confirmed the initial desk-based assessment that the

noise environment is influenced by the A1 trunk road and the East Coast Main Line (ECML) but is generally quiet and rural in nature in areas away from the major transport noise sources.

18. Noise monitoring survey locations were discussed and agreed with ELC's Environmental Health Officer prior to survey work commencing and are shown in Volume 2, Figure 9.2 and Table 9.1 above.

19. The surveys were carried out between May and November 2021 (with the findings used to inform the assessment presented within this EIA Report). Noise measurements were conducted in accordance with BS 7445-1:2003 (BSI 2003) and BS 4142:2014+A1:2019 (BSI 2019). A baseline vibration survey was not deemed necessary as vibration impacts do not relate to baseline vibration levels, with this approach being agreed during discussion with ELC's Environmental Health Officer through the EIA Scoping process.

9.6.1. DESKTOP STUDY

20. Information on noise and vibration within the noise and vibration study area was collected through a detailed desktop review of existing studies and datasets. These are summarised in Table 9.5 below.

Table 9.5: Summary of Key Desktop Studies & Datasets

Title	Source	Year	Author
Location of noise and vibration sensitive receptors and existing noise and vibration sources within the noise and vibration study area.	Google Maps Aerial Photography	2022	Google Maps
	Local Authority Local Plans	2022	East Lothian Council
	Ordnance Survey maps	2022	Ordnance Survey
	Construction Phasing Plans	2022	SSE Renewables
	Information from other projects within the area	2022	various
	Residential and commercial address data within defined study areas from Ordnance Survey "AddressBase Plus" data.	2022	Ordnance Survey

9.6.2. SITE-SPECIFIC SURVEYS

21. To inform the noise and vibration impact assessment, site-specific surveys were carried out, as agreed with East Lothian Council. A summary of the surveys carried out to inform the assessment of effects is outlined in Table 9.6 below.

Table 9.6: Summary of Site-Specific Survey Data

Title	Extent of Survey	Overview of Survey	Survey Contractor	Date	Reference to Further Information
Baseline Noise Survey	NSRs within the Noise and Vibration Study Area	Long term (>1 week) measurement of baseline noise levels and concurrent weather conditions	ITPEnergised	May, June, July and November 2021	Appendix 9.1

9.7. BASELINE ENVIRONMENT

9.7.1. OVERVIEW OF BASELINE ENVIRONMENT

22. In order to characterise the existing acoustic environment within the noise and vibration study area a baseline noise survey was conducted at locations representative of the NSRs as agreed with ELC, detailed in Table 9.1. Measurements were conducted between May

and November 2021. Details of the baseline noise survey are contained within Volume 4, Appendix 9.1.

23. Table 9.7 provides a summary of the measured baseline noise data at the landfall and along the cable route.

Table 9.7: Baseline Noise Data, Landfall and Cable Route, Daytime free-field, decibel (dB)

Noise Monitoring Location	Date	$L_{Aeq,1hr}$ (dB)	$L_{A90,1hr}$ (dB)
LFR1	November 2021	49.6	40.2
CCR1	November 2021	57.6	42.4
CCR2	November 2021	43.8	32.2

24. Table 9.8 and Table 9.9 provide a summary of the measured baseline noise data at NSRs in proximity to the onshore substation location during both the daytime and night-time surveys respectively as logarithmic averages over the monitoring period. The $L_{A90,T}$ values are considered in Table 9.10.

Table 9.8: Baseline Noise Data, Onshore Substation, Daytime free-field, dB

Noise Monitoring Location	Date	$L_{Aeq,16hr}$ (dB)
SSR1	June/July 2021	49.9
SSR2	June/July 2021	60.6
SSR3	June/July 2021	46.0
SSR4	June/July 2021	51.4
SSR5	June/July 2021	54.8
SSR6	May 2021	47.1

Table 9.9: Baseline Noise Data, Onshore Substation, Night-time free-field, dB

Noise Monitoring Location	Date	$L_{Aeq,8hr}$ (dB)
SSR1	June/July 2021	45.6
SSR2	June/July 2021	54.6
SSR3	June/July 2021	39.6
SSR4	June/July 2021	48.9
SSR5	June/July 2021	42.1
SSR6	May 2021	40.3

25. Surveyor observations at SSR1 during the installation and decommissioning of equipment noted that the acoustic environment was affected predominantly by natural sounds such as wind rustling vegetation and bird calls. Activities at the farm adjacent to the property (such as farm vehicle movements) were occasional contributors, as were infrequent vehicles passing on the road to the northwest.

26. Surveyor observations at SSR2 noted that the acoustic environment was affected predominantly by continuous road traffic on the A1 and intermittent train passes on the ECML adjacent to the property. Natural sounds, such as bird calls and barking dogs, were occasional contributors.

27. Surveyor observations at SSR3 noted that the acoustic environment was affected predominantly by continuous, distant road traffic on the A1 and intermittent train passes on ECML. Natural sounds, such as wind rustling vegetation, were also contributors. Lesser contributions came from nearby residential premises and infrequent vehicles passing through the village.

28. Surveyor observations at SSR4 noted that the acoustic environment within the garden/external amenity area was affected predominantly by continuous noise from the watercourse/burn to the edge of the garden. Lesser contributions came from wind-blown vegetation, distant road traffic on the A1 and intermittent train passes on the ECML. Aircraft were noted passing overhead during the survey set-up.

29. Surveyor observations at SSR5 noted that the acoustic environment was affected predominantly by natural sounds such as wind rustling vegetation, bird calls, barking dogs and noise from livestock (hens) at the farm. Lesser contributions came from distant road traffic on the A1 and intermittent train passes on the ECML.

30. Surveyor observations at SSR6 noted that the acoustic environment was affected predominantly by natural sounds such as wind rustling vegetation. Lesser contributions came from distant road traffic on the A1 and intermittent train passes on the ECML.

Deriving Background Sound Levels

31. Statistical analysis has been carried out on the measured background sound levels[1], $L_{A90,T}$, at the onshore noise and vibration study area during the night-time (as the constraining time period). The mean, mode and standard deviation are presented in Table 9.10 to show the variability of background sound at each location. Statistical analysis is carried out to ascertain a representative background sound level and is detailed within Volume 4, Appendix 9.1.

Table 9.10: Background Sound Level Statistical Analysis, Substation, Night-time free-field, dB

Receptor Identifier	Average $L_{A90,15min}$ (dB)	Mode $L_{A90,15min}$ (dB)	Standard Deviation (dB)	Determined Representative $L_{A90,T}$ (dB)
SSR1	32	32	5.0	30
SSR2	35	31	5.6	30
SSR3	29	31	3.4	28
SSR4	45	44	2.4	44
SSR5	31	31	4.8	28
SSR6	34	35	4.0	33

9.7.2. FUTURE BASELINE SCENARIO

32. The Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017, require that "*a description of the relevant aspects of the current state of the environment (baseline scenario) and an outline of the likely evolution thereof without development as far as natural changes from the baseline scenario can be assessed with*

[1] BS4142 uses the term 'sound' rather than 'noise' but this chapter adopts the use of the term 'noise' where relevant for consistency.

reasonable effort, on the basis of the availability of environmental information and scientific knowledge" is included within the Onshore EIA Report.

33. In order to ensure that the Proposed Development is assessed against a realistic baseline scenario, i.e. what the baseline conditions are likely to be once the Proposed Development is operational, a description of the likely future baseline conditions is provided within this section.

34. The baseline noise monitoring survey provides a clear representation of the existing acoustic environment within the noise and vibration study area of the Proposed Development.

35. Noise is managed and driven by 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 maintenance and improvement of the noise environment across the UK, which is reflected in national planning policies within Scotland (PAN 1 2011). 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.

36. Potential adverse impacts to the prevailing acoustic environment should be minimised or mitigated to suitable levels (in accordance with current legislation, policy and guidance), preventing and limiting adverse impact, where possible.

37. The acoustic environment in the noise and vibration study area is largely influenced by road traffic noise from the A1. Even with a predicted future movement towards electric vehicles the speed limit on the A1 is such that aerodynamic and tyre noise is more dominant than engine noise. In areas away from the influence of the A1 natural sounds such as wind and birdsong dominate, Consequently, in relation to the Proposed Development and its immediate receiving environment it is reasonable to predict a general steady baseline acoustic environment would be maintained.

9.7.3. DATA ASSUMPTIONS AND LIMITATIONS

38. 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 noise and vibration study area, data were collected over two weeks to allow for day to day variability and reduce uncertainty associated with the characterisation of the baseline environment.

39. The key data limitation with operational noise predictions is the source level data. Due to the stage of the design process, warranted source level information is not available. In place of site-specific data, worst case assumptions have been made on source levels based on historic data. As a result, there is also a lack of site-specific detailed information regarding the potential tonality. To manage this, and in a conservative and robust approach, 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. Measures to minimise noise levels will be considered, where possible, as part of the design process, further managing this limitation prior to energisation of the Proposed Development.

9.8. KEY PARAMETERS FOR ASSESSMENT

9.8.1. MAXIMUM DESIGN SCENARIO

40. The maximum design scenario(s) summarised here have been selected as those having the potential to result in the greatest effect on an identified receptor or receptor group. These scenarios have been selected from the details provided in Volume 1, Chapter 5. Effects of greater adverse significance are not predicted to arise should any other

development scenario, based on details within the Project Design Envelope (e.g. different infrastructure layout) to that assessed here, be taken forward in the final design scheme.

41. 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 9.11 and Table 9.12 give the parameters for construction and operation respectively.

Table 9.11: Parameters for Construction Impacts on Noise and Vibration

Impact and Phase	Parameters				
	Construction Equipment	Source	Number	Sound Power Level, dB(A)	Ontime (%)
Temporary Noise and Vibration from Enabling Works	Excavator	BS 5228-2009 C.2 No.14	2	107.0	50
	Dump truck	BS 5228-2009 C.1 No.11	2	108.2	50
	Bulldozer	BS 5228-2009 C.2 No.11	1	107.0	50
	Generator	BS 5228-2009 C.4 No.84	1	101.7	50
	Mobile crane	BS 5228-2009 C.4 No.39	1	104.6	50
Temporary Noise and Vibration from Trenchless Technique (e.g. Horizontal Directional Drilling (HDD)) at Landfall	Dump truck	BS 5228-2009 C.1 No.11	1	108.2	15
	Excavator	BS 5228-2009 C.2 No.14	1	107.0	15
	Drilling Rig	BS 5228-2009 C.2 No.44	2 at any one time	105.0	100
	Cement truck discharging	BS 5228-2009 C.4 No.18	1	103.1	15
	Generator	BS 5228-2009 C.4 No.84	3	101.7	100
	Mud pump	BS 5228-2009 C.2 No.45	1	88.0	100
	Concrete pump	BS 5228-2009 C.4 No.29	1	107.8	30
	Drilling fluid recovery system	BS 5228-2009 C.4 No.29	1	114.0	100
Temporary Noise and Vibration from Trenchless Technique (e.g. HDD) along the Cable Corridor	Dump truck	BS 5228-2009 C.1 No.11	1	108.2	15
	Excavator	BS 5228-2009 C.2 No.14	1	107.0	15
	Drilling Rig	BS 5228-2009 C.2 No.44	1	105.0	100
	Cement truck discharging	BS 5228-2009 C.4 No.18	1	103.1	15
	Generator	BS 5228-2009 C.4 No.84	3	101.7	100
	Mud pump	BS 5228-2009 C.2 No.11	1	88.0	100
	Concrete pump	BS 5228-2009 C.4 No.29	1	107.8	30
	Drilling fluid recovery system	BS 5228-2009 C.4 No.29	1	114.0	100
Temporary Noise and Vibration from Jointing Bay Construction	Dump truck	BS 5228-2009 C.1 No.11	2	108.2	15
	Excavator	BS 5228-2009 C.2 No.14	3	107.0	15
	Bulldozer	BS 5228-2009 C.2 No.12	1	108.7	100
	Cement truck discharging	BS 5228-2009 C.4 No.18	1	103.1	15

Impact and Phase	Parameters				
	Construction Equipment	Source	Number	Sound Power Level, dB(A)	Ontime (%)
	Lorry	BS 5228-2009 C.2 No.34	1	108.1	100
	Water pump	BS 5228-2009 C.2 No.11	1	88.0	100
	Concrete pump	BS 5228-2009 C.4 No.29	1	107.8	30
Temporary Noise and Vibration from Open Trenching	Excavator	BS 5228-2009 C.2 No.14	2	107.0	50
	Bulldozer	BS 5228-2009 C.2 No.11	1	107.0	50
	Wheeled loader	BS 5228-2009 C.2 No.28	1	104.1	50
	Generator	BS 5228-2009 C.4 No.84	1	101.7	100
	Dump truck	BS 5228-2009 C.1 No.11	2	108.2	50
Temporary Noise and Vibration from Cable Pulling	Dump truck	BS 5228-2009 C.1 No.11	1	108.2	15
	Excavator	BS 5228-2009 C.2 No.14	1	107.0	50
	Conveyor roller	BS 5228-2009 C.10 No.23	2	71.0	100
	Water pump	BS 5228-2009 C.2 No.11	1	88.0	100
	Generator	BS 5228-2009 C.4 No.84	1	101.7	100
	Conveyor drive unit	BS 5228-2009 C.10 No.20	1	95.0	100
	Winch	BS 5228-2009 C.10 No.20	1	110.0	100
Temporary Noise and Vibration from construction of the Onshore Substation	Excavator	BS 5228-2009 C.2 No.14	6	107.0	75
	Wheeled loader	BS 5228-2009 C.2 No.28	4	104.1	75
	Bulldozer	BS 5228-2009 C.2 No.11	4	107.0	75
	Dumper	BS 5228-2009 C.1 No.11	8	108.2	75
	Mobile crane	BS 5228-2009 C.4 No.39	4	104.6	75
	Cement mixer truck discharging	BS 5228-2009 C.4 No.18	2	103.1	50
	Cement truck pump and boom arm	BS 5228-2009 C.4 No.29	2	107.8	50
	Generator	BS 5228-2009 C.4 No.84	3	101.7	100
	Hydraulic Hammer Piling Rig	BS 5228-2009 C.3 No.3	1	116.5	15

42. The majority of construction activities will take place during daytime only. Some plant, such as generators for site security and pumps to maintain water levels, will run overnight. The night-time predicted noise levels for the scenarios detailed in Table 9.11 (excluding trenchless technology (e.g. HDD)) reflect this.

43. For the trenchless technology (e.g. HDD) scenarios where working occurs outside of the hours of Monday to Sunday 7am to 7pm the maximum design scenario includes only the drilling rig and associated drilling fluid recovery system, pumps and generators (i.e. no mobile heavy plant such as excavators or bulldozers).

44. Table 9.12 gives the parameters for operational impacts. Due to the stage of the design process warranted source level information is not available. In place of site-specific data, worst case assumptions have been made on source levels based on historic data.

45. Sources within buildings are calculated based on worst case sound power levels for internal plant and take into account the building dimensions. It is assumed that buildings will be constructed of single sheet profiled steel. Details of the buildings, including louvred openings and vents, will be clarified at detailed design stage The levels are rounded to the nearest dB.

46. The parameters detail a high voltage alternating current (HVAC) and high voltage direct current (HVDC) Option. This will be refined through the design process.

Table 9.12: Parameters for Operation Impacts on Noise and Vibration

Impact and Phase	Parameters			
Impact	Substation Equipment	Source Type	Number	Sound Power Level, dB(A)
Noise from the operational Onshore Substation (HVAC Option)	Transformer	3D Area Source	6 (+2 Spare)	113
	Auxiliary Transformer	Point	2	75
	400kV Harmonic Filter Building	Area/Radiating Building	2	79*
	220kV Large Harmonic Filter Building	Area/Radiating Building	2	79*
	220kV Small Harmonic Filter Building	Area/Radiating Building	2	84*
	220kV Shunt Reactor Building	Area/Radiating Building	4	75*
	33kV Statcom Building	Area/Radiating Building	2	66*
Noise from the operational Onshore Substation (HVDC Option)	400kV Harmonic Filter Building	Area/Radiating Building	2	79*
	Reactor Building	Area/Radiating Building	2	77*
	Transformer	3D Area Source	6 (+2 spare)	113
	Cooling fan bank	Area	4	92
	Auxiliary Transformer	Point	2	75

* - internal reverberant sound level within buildings

47. For each impact phase all works have been assessed as occurring simultaneously at each location (e.g. at each jointing bay, each trenchless technology compound in the respective scenarios) along the onshore cable corridor. It is noted that, given the potential spatial extent and programme for the Enabling Works it is unlikely that all aspects of the Enabling Works will be undertaken simultaneously, however, this is considered a conservative approach.

48. Trenchless technology (e.g. HDD) has been assumed to be in operation at the landfall trenchless technology location and where trenchless technology occurs under the railway line and the A1 Trunk Road for 24 hours a day and assessed accordingly. For all other construction activities at the landfall, onshore cable corridor and onshore substation the assessment is based on construction between the hours of 07:00 to 19:00 Monday to Sunday.

49. 24 hour operations will not happen for the trenchless technology (e.g. HDD) at the Scheduled Monument (SM5849) close to Castledene and Four Acres and it has been agreed that drilling would occur at the western compound which is the furthest from residential properties.

50. Trenchless technology (e.g. HDD) activities at other locations along the onshore cable corridor would be planned to occur during working hours; trenchless technology would only occur outside of these hours should an unforeseen overrun occur.

9.8.2. IMPACTS SCOPED OUT OF THE ASSESSMENT

51. Impacts scoped out of the assessment were agreed with key stakeholders through consultation. These, together with a justification, are presented in Table 9.13.

Table 9.13: Impacts Scoped Out of the Assessment for Noise and Vibration

Potential Impact	Phase[2]			Justification
	C	O	D	
Operational road traffic noise		✓		Traffic generation associated with the operational phase is limited to infrequent visits for maintenance and is unlikely to give rise to any significant noise and vibration impacts
Operational vibration		✓		No significant sources of vibration will be present within the onshore substation
Landfall and cable corridor operational noise and vibration		✓		No significant sources of noise or vibration will be present at landfall or within the cable corridor
Decommissioning noise and vibration			✓	Decommissioning noise and vibration will be no higher than construction noise and vibration.

9.9. METHODOLOGY FOR ASSESSMENT OF EFFECTS

9.9.1. OVERVIEW

52. The Noise and Vibration assessment of effects has followed the methodology set out within Volume 1, Chapter 2. Specific to the assessment of noise and vibration, the following guidance documents have also been considered:

- **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 control relating to construction and open sites where work activities/operations generate significant noise levels. The legislative background to noise 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 5228-2:2009+A1:2014 Code of Practice for Noise and Vibration Control on Construction and Open Sites – Part 2: Vibration** Part 2 gives recommendations

[2] C = Construction, O = Operational and maintenance, D = Decommissioning

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.

- **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 ($L_{Aeq,T}$). 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 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.
- **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.

9.9.2. IMPACT ASSESSMENT CRITERIA / METHOD

53. Determining the significance involves firstly defining the magnitude of the potential impacts and the sensitivity of the receptors before an assessment is made on the likely significant effects of the predicted impacts. This section describes the criteria applied in this chapter to assign values to the magnitude of potential impacts and the sensitivity of the receptors. The terms used to define magnitude and sensitivity are based on those which are described in further detail in Volume 1, Chapter 2.

Construction Phase Noise Impact Magnitude

54. Following the methodology contained in DMRB LA 111, (Highways England, 2020) an initial screening assessment was carried out to assess the potential for an increase in baseline noise level of 1dB(A) or more as a result of the addition of construction traffic to existing traffic levels. Any road links with a predicted increase in traffic volume of 25% were identified. Such changes in traffic volume would correspond to a 1 dB(A) change in noise level at the relevant road link. Traffic flows on the roads (links) surrounding the Proposed

Development site were provided by the traffic consultants (Pell Frischmann) as Average Daily Traffic (ADT) for the following scenarios:

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

55. Predictions of the $L_{A10,18hour}$ noise index were carried out in accordance with the method provided in CRTN within noise prediction software CadnaA, using the projected traffic flows and HGV composition converted to Annual Average Weekday Traffic (AAWT).

56. Construction phase change in road traffic noise at NSRs was assessed using the impact magnitude criteria in Table 9.14. 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 Development.

Table 9.14: 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
1.0 – 2.9	Low
3.0 – 4.9	Medium
5.0+	High

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

58. The assessment approach utilised in this EIA Report 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.

59. The predicted construction noise levels are assessed against noise limits derived from advice within Annex E of BS 5228-1:2009+A1:2014 (BSI 2014). Table 9.15, 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 Table 9.16, Table 9.17, and Table 9.18).

Table 9.15: Construction Noise Threshold Levels Based on the ABC Method (BS 5228-1:2009+A1:2014)

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.			

60. 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 thresholds presented above.

61. 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."

62. 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.

63. All identified NSRs at landfall, along the onshore cable corridor and at the onshore substation, are considered to fall into Category A, based on the measured noise levels at these receptors and will hence be subject to the most stringent noise limits (see Table 9.15).

64. 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.

65. Construction noise impacts were assessed using the impact magnitude presented in Table 9.16 for the daytime period, Table 9.17 for the evening and weekend periods, and Table 9.18 for the night-time.

Table 9.16: Day time Construction Noise Impact Magnitude Criteria

Impact Magnitude	Construction Noise Level, dB, $L_{Aeq,T}$
Negligible	<55
Low	>55 - <65
Medium	>65 - <70
High	>70

Table 9.17: Evening and Weekends Construction Noise Impact Magnitude Criteria

Impact Magnitude	Construction Noise Level, dB, $L_{Aeq,T}$
Negligible	<45
Low	>45 - <55
Medium	>55 - <60
High	>60

Table 9.18: Night-time Construction Noise Impact Magnitude Criteria

Impact Magnitude	Construction Noise Level, dB, $L_{Aeq,T}$
Negligible	<35
Low	>35 - <45
Medium	>45 - <50
High	>50

Construction Phase Vibration Impact Magnitude

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

67. *"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"

68. Construction traffic vibration is, therefore, not assessed.

69. 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.

70. 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 drilling in trenchless technology (e.g. HDD) which will be required at landfall and along the cable route.

71. 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.

72. 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.

73. 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".

74. However, these calculation methods rely on detailed information, including the type and number of plant 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.

75. 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 maximum design scenario assumptions in order to determine set-back distances at which adverse impacts from vibration levels may occur.

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 9.19 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. The onset of structural damage will occur only at magnitudes four times greater than those in Table 9.19.

Table 9.19: 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

76. Table 9.20 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 9.20: 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

77. Vibration associated with typical trenchless technology (e.g. HDD) is discussed in more detail within Section 9.11.

78. Table 9.21 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 9.21: 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

79. For construction vibration from sources other than blasting, the vibration level and effects presented in Table 9.22 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 9.22: 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
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

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

81. 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;*..."

82. This standard is the nationally accepted standard for the assessment of operational noise 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*."

83. The standard incorporates a requirement for the assessment of uncertainty in environmental sound 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.

84. The standard applies to industrial/commercial and background sound 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. Whilst the standard does not address non-residential receptors, such as Innerwick School (SSR7), adopting this standard for non-residential receptors does present a worst case assessment for these receptors and is considered a conservative approach.

85. Assessment is carried out by subtracting the measured background sound level from the rating level; the greater this difference, the greater the magnitude of the impact.

86. 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".*

Context

87. The standard also makes the following comments:

"*Where the initial estimate of the impact needs to be modified due to the context, take all pertinent factors into consideration, including the following.*

- *The absolute level of sound. For a given difference between the rating level and the background sound level, the magnitude of the overall impact might be greater for an acoustic environment where the residual sound level is high than for an acoustic environment where the residual sound level is low.*
- *Where background sound levels and rating levels are low, absolute levels might be as, or more, relevant than the margin by which the rating level exceeds the background. This is especially true at night.*
- *Where residual sound levels are very high, the residual sound might itself result in adverse impacts or significant adverse impacts, and the margin by which the rating level exceeds the background might simply be an indication of the extent to which the specific sound source is likely to make those impacts worse.*
- *The character and level of the residual sound compared to the character and level of the specific sound. Consider whether it would be beneficial to compare the frequency spectrum and temporal variation of the specific sound with that of the ambient or residual sound to assess the degree to which the specific sound source is likely to be distinguishable and will represent an incongruous sound by comparison to the acoustic environment that would occur in the absence of the specific sound. Any sound parameters, sampling periods and averaging time periods used to undertake character comparisons should reflect the way in which sound of an industrial and/ or commercial nature is likely to be perceived and how people react to it.*
- *The sensitivity of the receptor and whether dwellings or other premises used for residential purposes will already incorporate design measures that secure good internal and/or outdoor acoustic conditions, such as:*
- *facade insulation treatment;*
- *ventilation and/or cooling that will reduce the need to have windows open so as to provide rapid or purge ventilation; and*
- *acoustic screening*."

88. Whilst the latest revision of BS 4142 does not provide definition of low or very low background and rating levels the previous (1997) version considered that background levels of 30dB(A) and rating levels of 35dB(A) could be considered low. Numerous studies, such as those by Moorhouse for the Health Protection Agency and Berry and Flindell for Defra (referenced within the Further Reading Section of BS 4142), as well as the recent Association of Noise Consultants Working Group report on BS4142 application conclude that impacts at rating levels below 35 dB(A) are unlikely. At night, particularly, where potential sleep disturbance is the key issue, a rating level of below 35 dB(A) results in internal levels significantly below the BS8233 guideline values.

89. When assessing the noise from a source, which is classified as the Rating Level, it is necessary to have regard to the acoustic features that may be present. 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."*

90. These penalty corrections are added based on perceptibility at the receptor location.

91. An operational assessment in accordance with BS 4142:2014+A1:2019 has been carried out for the onshore substation as it is the only noise source associated with the operational phase. Due to the separation distance, existing acoustic environment and a detailed screening of the onshore substation plant and equipment, no penalty corrections for intermittency or impulsivity are required.

92. 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.

93. There are no items of fixed electrical plant with impulsive characteristics under typical operating conditions.

94. 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, this tonal characteristic may also be masked by other noise from the substation (e.g. cooling equipment). This will be understood in more detail at the detailed design stage post consent.

95. Therefore, as a precautionary approach it is considered that the maximum +6 dB penalty for tonality would be appropriate. The potential for tonality to be present in the sound emissions from the substation will be revisited at detailed design stage, when more detailed information regarding levels of tonal sound will be sought from the substation equipment provider and designer.

96. The specific sound level is measured or predicted 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).

97. To predict the noise from the operational aspects of the onshore substation, CadnaA noise modelling software was utilised. 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.

98. The calculation algorithm described in ISO 9613-2:1996 (ISO, 1996) was used in the operational noise propagation modelling exercise.

99. 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 and TAN, is summarised in Table 9.23.

100. TAN states

- "*In deciding if a significant impact occurs in regard to the assessment of industrial noise, or noise of an industrial nature, using the methodology of BS 4142 (where appropriate); the Scottish Government consider impacts are normally not significant (in a quantitative* *sense only) [where] the difference between the Rating and background noise levels is less than 5 dB(A), and that usually the threshold of minor significant impacts is when the difference between the Rating and background noise levels is at least 5 dB(A); and commonly do not become sufficiently significant to warrant mitigation until the difference between the Rating and background noise levels is more than 10 dB(A)*".

101. Using this principle, a difference in sound level of between +5 dB(A) to +10 dB(A) is detailed as a low magnitude of change.

Table 9.23: Substation Operational Noise Impact Magnitude Criteria

Difference Between Rating Level ($L_{Ar, Tr}$ dB) and Background (L_{A90})	Impact Magnitude
+ 5dB (and, where background sound levels are at or below 30dBA, a rating level of ≤35dB(A))	Negligible
+ 5 dB to +10 dB	Low
+ 10 dB to +12 dB	Medium
+ ≥12 dB	High

<u>Uncertainty</u>

102. A consideration of uncertainty is required by BS 4142:2014+A1:2019.

103. The baseline noise survey was carried out in appropriate conditions, over a significant period of time and hence uncertainty regarding the measured baseline and background sound levels at the receptors has been minimised.

104. The main source of uncertainty within the assessment is the sound power data provided and/or derived for the main items of substation electrical plant. A precautionary approach has been taken with respect to source levels. With regard to the potential for acoustic characteristics such as tonality, the effect of uncertainty has been minimised by applying an appropriate and precautionary tonality penalty to the predicted levels.

105. Some uncertainty also exists for the construction noise and vibration assessment whereby likely construction scenarios and assemblages of plant have been assessed. Uncertainty was minimised by consultation and liaison with project engineers with experience of the construction processes involved in the construction of the onshore elements of offshore wind farms.

Sensitivity

106. 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 9.24 presents the definitions used relating to the sensitivity of the receptor, with reference to the guidance contained within TAN.

Table 9.24: Sensitivity Levels for Receptors

Sensitivity	Definition	Examples
High	Receptors where people or operations are particularly susceptible to noise	Noise and Vibration Receptors have been categorised as high sensitivity where noise and vibration may be detrimental to receptors. Such receptors include residential properties and schools (during the daytime)
Medium	Receptors moderately sensitive to noise,	There are no NSRs that would be classed as medium sensitivity

Sensitivity	Definition	Examples
	where it may cause some distraction or disturbance	
Low	Receptors where distraction or disturbance from noise is minimal	There are no NSRs that would be classed as low sensitivity

107. All receptors considered within this assessment are of high sensitivity.

108. The significance of the effect is determined by correlating the magnitude of the impact and the sensitivity of the receptor, as outlined in Table 9.25 below.

9.9.3. IMPACT SIGNIFICANCE MATRIX

Table 9.25: Matrix Used for the Assessment of the Significance of the Effect

Sensitivity of Receptor	Magnitude of Impact				
		High	**Medium**	**Low**	**Negligible**
	Low	Minor to Moderate	Minor	Negligible to Minor	Negligible
	Medium	Moderate to Major	Moderate	Minor	Negligible
	High	Major	Moderate	Minor	Negligible

9.10. PRIMARY & TERTIARY MITIGATION

109. As part of the Proposed Development design process, a number of measures have been proposed to reduce the potential for impacts due to noise and vibration (see Table 9.26). These include measures which have been incorporated as part of the Proposed Development's design (referred to as 'primary mitigation') and measures which will be implemented regardless of the impact assessment (referred to as 'tertiary mitigation'). As there is a commitment to implementing these measures, they are considered inherently part of the design of the Proposed Development and have therefore been considered in the assessment presented in Section 9.11 below (i.e. the determination of magnitude and therefore significance assumes implementation of these measures). These measures are considered standard industry practice for this type of development.

Table 9.26: Measure Adopted as Part of the Proposed Development (Primary & Tertiary Mitigation)

Measures Adopted as Part of the Proposed Development (Primary & Tertiary Mitigation)	Justification
A Construction Environmental Management Plan (CEMP) will be prepared and implemented during the construction and decommissioning phases of the Proposed Development. The CEMP will include Proposed Development mitigation/monitoring measures and commitments and detail standard construction industry practice to reduce noise emissions during construction.	Measures will be adopted to ensure that the potential for disturbance from construction activities is minimised. The mitigation measures will include the provision of localised noise barriers to specific items of construction plant where necessary, likely to include Drilling Rigs, Drilling Fluid Recovery System and Generators/Static Pumps.

9.11. ASSESSMENT OF SIGNIFICANCE

110. An assessment of the likely significance of the effects of the Proposed Development on noise and vibration sensitive receptors caused by each identified impact is given below.

INCREASES IN ROAD TRAFFIC NOISE

111. Increases in road traffic, including HGV traffic, due to construction vehicles accessing sites during the construction period has the potential to increase noise levels at nearby NSRs.

Construction phase

Magnitude of impact

112. The road links identified by the transport assessment as carrying construction traffic are presented below in Table 9.27 and shown in Figure 12.1 and Figure 12.4.

Table 9.27: Development Impact on Daily Traffic Flows

Highway Link/ Automated Traffic Count Location	2026 Base Traffic Flow	2026 Base + Development	Percentage Increase
Skateraw	179	500	*179.6*
C122 (near Thurston Doggy Daycare)	1893	2208	*16.6*
Unnamed Road North of Barns Ness Terrace	141	363	*157.6*
C121 (north of Border Belles)	131	131	0
C124 (near Blackberry Farm Paddocks)	147	147	0
C121 (Barns Ness Terrace)	141	141	0
A1(T) Thorntonloch	12078	12078	0
A1(T) west of Innerwick Junction	12078	12747	5.*5*

113. The highway links at Skateraw and the unnamed road north of Barnes Terrace are 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 noise and vibration study area were carried out in accordance with the method provided in CRTN within noise prediction software CadnaA, using the projected traffic flows and HGV composition. Where roads have low flows (<1000 vehicles per day) a further calculation, using a moving point line source, was undertaken to validate the predicted noise level change.

114. The predicted noise levels arising due to road traffic at each of the identified NSRs are provided in Table 9.28.

Table 9.28: Predicted Construction Road Traffic Noise

NSR	2026 Base $L_{A10,18hour}$, dB	2026 Base + Development $L_{A10,18hour}$, dB	Change, dB
CCR1	42.0	41.9	0
CCR2	43.5	43.4	0
LFR1	38.8	38.9	+0.1
LFR2	45.8	46.6	+0.8
SSR1	36.2	36.2	0
SSR2	53.8	53.8	0
SSR3	41.6	41.5	0
SSR4	36.4	36.5	+0.1
SSR5	34.8	34.8	0
SSR6	34.8	34.8	0
SSR7	42.8	43.2	+0.3

115. Road traffic noise from the A1 is dominant at many of the receptors and therefore the influence of noise from other roads is diminished.

116. Predicted increases in road traffic noise and the resultant impact magnitude, with reference to Table 9.18, are negligible at all identified NSRs.

117. The impact is predicted to be of local spatial extent, medium term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore considered to be negligible.

Sensitivity of the receptor

118. As noted above, all receptors considered within the Noise and Vibration Chapter are of high sensitivity.

Significance of the effect

119. Overall, the magnitude of the impact is deemed to be negligible and the sensitivity of the receptor is considered to be high. The effect will, therefore, be of **negligible** adverse significance, which is not significant in EIA terms.

Secondary mitigation and residual effect

120. No secondary mitigation is considered necessary because the likely effect in the absence of secondary mitigation is not significant in EIA terms. The residual effect will, therefore, be of **negligible** significance.

VIBRATION AT SENSITIVE RECEPTORS

121. Operation of construction plant and equipment, both static and mobile, has the potential to transmit perceptible vibration to NSRs.

Construction phase

Magnitude of impact

122. Operation of drilling rigs and ancillary equipment is expected to produce the greatest vibration impacts, due to the proximity of trenchless technology (e.g. HDD) works to receptors and is therefore taken forward as the worst-case for the vibration assessment.

123. Vibration levels decay very rapidly with distance from a source (BS 5228-2:2009+A1:2014). A representative example of trenchless technology 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.

124. Research carried out 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 drilling through Lucan Formation rock overlain by Dublin Boulder Clay.

125. Given the distances between sources of vibration during the construction works and the NSRs (a minimum of 10 m) PPV levels would be below the criteria outlined in Table 9.22 at the NSRs along the Proposed Development area.

126. The impact is predicted to be of local spatial extent, medium term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore considered to be negligible.

127. It is not currently known whether piling or significant ground improvement works will be required at the onshore substation. However, with reference to Table 9.20 and Table 9.22 and the distances of the nearest receptors to the onshore substation (approximately 300 m) it is anticipated that vibration impacts from potential piling at the onshore substation would be of negligible magnitude.

128. Vibration impacts from construction works would therefore be of negligible magnitude.

Sensitivity of the receptor

129. As noted above, all receptors considered within the Noise and Vibration Chapter are of high sensitivity.

Significance of the effect

130. Overall, the magnitude of the impact is deemed to be negligible, and the sensitivity of the receptor is considered to be high. The effect will, therefore, be of **negligible** adverse significance, which is not significant in EIA terms.

Secondary mitigation and residual effect

131. No secondary mitigation is considered necessary because the likely effects in the absence of secondary mitigation is not significant in EIA terms. The residual effect will, therefore, be of **negligible** significance.

NOISE AT SENSITIVE RECEPTORS

132. Operation of construction plant and equipment has the potential to increase noise levels at NSRs.

Construction phase

Magnitude of impact

133. Table 9.29 to Table 9.36 show the predicted impacts due to noise during construction, under the Maximum Design Scenario (MDS). Noise levels are predicted only at those receptors close to the proposed construction activities. For all scenarios, except trenchless technology (e.g. HDD) at landfall and along the cable corridor, night-time impacts are based on equipment such as generators running overnight, in order to allow for site security, rather than construction activities being undertaken overnight. The predicted daytime noise level encompasses the proposed standard construction hours of 07:00 to 19:00 which includes periods that BS5228 defines as "Evening and Weekend".

Table 9.29: Enabling Works Construction Noise, Predicted Impacts

Receptor	Predicted Receptor Noise Level $L_{Aeq,T}$, day dB(A)	Predicted Receptor Noise Level $L_{Aeq,T}$, dB(A), night-time	Impact Magnitude Daytime	Impact Magnitude, Evening/Weekend	Impact Magnitude, Night-time
CCR1	67.2	49.7	Medium	High	Medium
CCR2	60.7	47.3	Low	High	Medium
LFR1	48.3	39.7	Negligible	Low	Low
LFR2	55.3	43.2	Low	Medium	Low

Table 9.30: Trenchless Technology Landfall Construction Noise, Predicted Impacts

Receptor	Predicted Receptor Noise Level $L_{Aeq,T}$, dB(A), daytime	Predicted Receptor Noise Level $L_{Aeq,T}$, dB(A), night-time	Impact Magnitude Daytime	Impact Magnitude, Evening & Weekend	Impact Magnitude, Night-time
LFR1	53.4	53.0	Negligible	Low	High
LFR2	34.2	33.8	Negligible	Negligible	Negligible

Table 9.31: Trenchless Technology Cable Corridor Construction Noise, Predicted Impacts

Receptor	Predicted Receptor Noise Level $L_{Aeq,T}$, dB(A), daytime	Predicted Receptor Noise Level $L_{Aeq,T}$, dB(A), night-time*	Impact Magnitude Daytime	Impact Magnitude Evening and Weekend	Impact Magnitude, Night-time
CCR1	64.1	50.0	Low	High	Medium/High
CCR2	64.0	50.8	Low	High	High
LFR2	58.6	58.1	Low	Medium	High
SSR2	54.9	54.3	Negligible	Low	High
SSR3	50.4	37.4	Negligible	Low	Low
SSR7	48.7	47.6	Negligible	Low	Medium

* - see Maximum Design Scenario in Section 9.8.1

Table 9.32: Jointing Bay Construction Noise, Predicted Impacts

Receptor	Predicted Receptor Noise Level $L_{Aeq,T}$, dB(A), daytime	Predicted Receptor Noise Level $L_{Aeq,T}$, dB(A), night-time	Impact Magnitude Daytime	Impact Magnitude, Evening & Weekend	Impact Magnitude, Night-time
CCR1	58.8	34.6	Low	Medium	Negligible
CCR2	56.0	31.3	Low	Medium	Negligible
LFR1	47.9	22.8	Negligible	Low	Negligible
LFR2	50.6	25.6	Negligible	Low	Negligible

Table 9.33: Open Trenching Construction Noise, Predicted Impacts

Receptor	Predicted Receptor Noise Level $L_{Aeq,T}$, dB(A), daytime	Predicted Receptor Noise Level $L_{Aeq,T}$, dB(A), night-time	Impact Magnitude Daytime	Impact Magnitude, Evening & Weekend	Impact Magnitude, Night-time
CCR1	54.4	40.8	Negligible	Low	Low

Receptor	Predicted Receptor Noise Level $L_{Aeq,T}$, dB(A), daytime	Predicted Receptor Noise Level $L_{Aeq,T}$, dB(A), night-time	Impact Magnitude Daytime	Impact Magnitude, Evening & Weekend	Impact Magnitude, Night-time
CCR2	53.2	39.9	Negligible	Low	Low
LFR1	53.2	40.3	Negligible	Low	Low
LFR2	54.4	35.3	Negligible	Negligible	Low

Table 9.34: Cable Pulling Construction Noise, Predicted Impacts

Receptor	Predicted Receptor Noise Level $L_{Aeq,T}$, dB(A), daytime	Predicted Receptor Noise Level $L_{Aeq,T}$, dB(A), night-time	Impact Magnitude Daytime	Impact Magnitude, Evening & Weekend	Impact Magnitude, Night-time
CCR1	57.1	43.1	Low	Medium	Low
CCR2	54.7	41.8	Negligible	Low	Low
LFR1	48.4	35.2	Negligible	Low	Low
LFR2	50.0	38.5	Negligible	Low	Low

Table 9.35: Onshore Substation Construction Noise, Predicted Impacts

Receptor	Predicted Receptor Noise Level $L_{Aeq,T}$, dB(A), daytime	Predicted Receptor Noise Level $L_{Aeq,T}$, dB(A), night-time	Impact Magnitude Daytime	Impact Magnitude, Evening & Weekend	Impact Magnitude, Night-time
CCR1	40.2	27.8	Negligible	Negligible	Negligible
CCR2	40.5	28.2	Negligible	Negligible	Negligible
LFR2	52.1	39.7	Negligible	Low	Low
SSR2	53.8	42.8	Negligible	Low	Low
SSR3	42.4	28.2	Negligible	Negligible	Negligible
SSR7	42.9	29.3	Negligible	Negligible	Negligible

Table 9.36: Open Trenching and Jointing Bay (Concurrent) Construction Noise, Predicted Impacts

Receptor	Predicted Receptor Noise Level $L_{Aeq,T}$, dB(A), daytime	Predicted Receptor Noise Level $L_{Aeq,T}$, dB(A), night-time	Impact Magnitude Daytime	Impact Magnitude, Evening & Weekend	Impact Magnitude, Night-time
CCR1	59.3	45.1	Low	Medium	Medium
CCR2	57.1	44.0	Low	Medium	Low
LFR1	54.5	41.4	Negligible	Low	Low
LFR2	52.0	40.2	Negligible	Low	Low

134. Impacts are of local spatial extent, medium term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude of impacts, with reference to Table 9.16, during the daytime, ranges from negligible to medium at all identified NSRs.

135. During the evening, weekend and night-time, impact magnitudes range from negligible to high.

Sensitivity of the receptor

136. All receptors considered within the Noise and Vibration Chapter are of high sensitivity.

Significance of the effect

137. At the majority of receptors except for CCR1, the magnitude of the impacts, during the daytime, is deemed to be negligible to low and the sensitivity of the receptors is considered to be high. The effect will, therefore, be of **negligible to minor** adverse significance, which is not significant in EIA terms.

138. At CCR1 the magnitude of impact during the daytime (during Enabling Works) is predicted to be medium and the sensitivity of the receptor is considered to be high. The effect will, therefore, be of **moderate** adverse significance, which is **significant** in EIA terms.

139. During the evening and weekend the magnitude of impact ranges from negligible to high and the sensitivity of the receptors is considered to be high. The effect will, therefore, be of **negligible to major** adverse significance, which is **significant** in EIA terms.

140. During the night-time the magnitude of impact again ranges from negligible to high and the sensitivity of the receptors is considered to be high. The effect will, therefore, be of **negligible to major** adverse significance, which is **significant** in EIA terms.

Secondary mitigation and residual effect

141. During open trenching, cable pulling works and construction of the onshore substation noise impacts from construction works will generally be of negligible to low magnitude.

142. For all other construction scenarios a number of receptors will experience impacts of medium or high magnitude during either daytime, weekend or night-time.

143. Secondary mitigation is, therefore, considered necessary.

144. Example mitigation, in the form of temporarily located noise barriers to individual plant items and/or to the boundary of the compounds during construction and the limiting of active plant numbers during the weekend hours, has been modelled and the results presented in Table 9.37 to Table 9.41.

Table 9.37: Enabling Works Construction Noise Mitigated, Predicted Impacts

Receptor	Predicted Receptor Noise Level $L_{Aeq,T}$, day dB(A)	Predicted Receptor Noise Level $L_{Aeq,T}$, dB(A), night-time	Impact Magnitude Daytime	Impact Magnitude, Evening/Weekend	Impact Magnitude, Night-time
CCR1	54.6	40.3	Negligible	Low	Low
CCR2	54.7	42.1	Negligible	Low	Low
LFR1	50.4	39.7	Negligible	Low	Low
LFR2	48.3	32.6	Negligible	Low	Negligible

Table 9.38: Trenchless Technology Landfall Construction Noise Mitigated, Predicted Impacts

Receptor	Predicted Receptor Noise Level $L_{Aeq,T}$, dB(A), daytime	Predicted Receptor Noise Level $L_{Aeq,T}$, dB(A), night-time	Impact Magnitude Daytime	Impact Magnitude, Evening & Weekend	Impact Magnitude, Night-time
LFR1	46.1	44.9	Negligible	Low	Low
LFR2	32.3	31.8	Negligible	Negligible	Negligible

Table 9.39: Trenchless Technology Cable Corridor Construction Noise Mitigated, Predicted Impacts

Receptor	Predicted Receptor Noise Level $L_{Aeq,T}$, dB(A), daytime	Predicted Receptor Noise Level $L_{Aeq,T}$, dB(A), night-time	Impact Magnitude Daytime	Impact Magnitude Evening and Weekend	Impact Magnitude, Night-time
CCR1	52.3	39.9	Negligible	Low	Low
CCR2	54.6	40.4	Negligible	Low	Low

Receptor	Predicted Receptor Noise Level $L_{Aeq,T}$, dB(A), daytime	Predicted Receptor Noise Level $L_{Aeq,T}$, dB(A), night-time	Impact Magnitude Daytime	Impact Magnitude Evening and Weekend	Impact Magnitude, Night-time
LFR2	49.8	44.2	Negligible	Low	Low
SSR2	46.5	41.1	Negligible	Low	Low
SSR3	44.2	37.1	Negligible	Negligible	Low
SSR7	44.7	41.3	Negligible	Negligible	Low

Table 9.40: Jointing Bay Construction Noise Mitigated, Predicted Impacts

Receptor	Predicted Receptor Noise Level $L_{Aeq,T}$, dB(A), daytime	Predicted Receptor Noise Level $L_{Aeq,T}$, dB(A), night-time	Impact Magnitude Daytime	Impact Magnitude, Evening & Weekend	Impact Magnitude, Night-time
CCR1	52.0	23.7	Negligible	Low	Negligible
CCR2	53.0	21.3	Negligible	Low	Negligible

Table 9.41: Open Trenching and Jointing Bay (Concurrent) Construction Noise Mitigated, Predicted Impacts

Receptor	Predicted Receptor Noise Level $L_{Aeq,T}$, dB(A), daytime	Predicted Receptor Noise Level $L_{Aeq,T}$, dB(A), night-time	Impact Magnitude Daytime	Impact Magnitude, Evening & Weekend	Impact Magnitude, Night-time
CCR1	54.5	44.9	Negligible	Low	Low
CCR2	53.2	44	Negligible	Low	Low
LFR1	54.5	41.4	Negligible	Low	Low
LFR2	51.9	40.2	Negligible	Low	Low

145. Overall, following mitigation, the magnitude of the impact is deemed to be negligible to low at most and the sensitivity of the receptor is considered to be high. The effect will, therefore, be of **negligible to minor** significance, which is not significant in EIA terms.

Operation and maintenance phase

Magnitude of impact

146. The impact assessment has been carried out using the unmitigated noise level for the various potential onshore noise and vibration study area components.

147. Operations at the onshore substation would be 24 hours a day. A detailed CadnaA noise model was created to assess noise levels comprising the plant items set out in Table 9.11. 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).

148. Calculated operational rating levels have been compared with the background sound levels at each receptor, which have been derived from the measured baseline noise data contained within Table 9.8 and Table 9.9.

149. The impact of the predicted noise levels from the onshore noise and vibration study area at surrounding residential receptors are presented in Table 9.42. 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 specific sound level. Noise from the onshore substation is neither intermittent nor impulsive in character, therefore no penalties for intermittency or impulsivity have been added.

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

151. Table 9.42 and Table 9.43 show the maximum operational noise impact (i.e. during the night).

Table 9.42: Onshore Substation Operational Noise, Predicted Impacts, HVAC

Receptor	Representative Background Sound Level, dB(A)	Predicted Rating Level, $L_{Ar,Tr}$	Difference	Impact Magnitude	Reduction to achieve 5 dB above background
CCR1	28	46	18	High	13
CCR2	28	46	18	High	13
LFR1	30	42	12	High	7
LFR2	30	50	20	High	15
SSR1	30	36	6	Low	1
SSR2	30	48	18	High	13

Receptor	Representative Background Sound Level, dB(A)	Predicted Rating Level, $L_{Ar,Tr}$	Difference	Impact Magnitude	Reduction to achieve 5 dB above background
SSR3	28	49	21	High	16
SSR4	44	42	-2	Negligible	N/A
SSR5	28	44	16	High	11
SSR6	33	42	9	Medium	4
SSR7	28	51	23	High	18

Table 9.43: Onshore Substation Operational Noise, Predicted Impacts, HVDC

Receptor	Representative Background Sound Level, dB(A)	Predicted Rating Level, $L_{Ar,Tr}$	Difference	Impact Magnitude	Reduction to achieve 5 dB above background
CCR1	28	48	20	High	15
CCR2	28	49	21	High	16
LFR1	30	42	12	High	7
LFR2	30	49	19	High	14
SSR1	30	35	5	Low	0
SSR2	30	52	22	High	17
SSR3	28	48	20	High	15
SSR4	44	42	-2	Negligible	N/A
SSR5	28	43	15	High	10
SSR6	33	42	9	High	4
SSR7	28	49	21	High	16

152. The impact is predicted to be of local spatial extent, long term duration, continuous and low reversibility. It is predicted that the impact will affect the receptor(s) directly.

153. Of the 11 receptors assessed under the HVAC scenario, one is predicted to have negligible, one a low, one a medium and eight a high magnitude.

154. Of the 11 receptors assessed under the HVDC scenario, one is predicted to have negligible, one a low and nine a high magnitude.

155. Analysis of the individual source contributions at each receptor indicates that the Transformers are the dominant noise source in each of the scenarios with cooler being of secondary dominance in the HVDC scenario.

Sensitivity of the receptor

156. All receptors considered within the Noise and Vibration Chapter are of high sensitivity.

Significance of the effect

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

Secondary mitigation and residual effect

158. The Proposed Development will commit to limiting operational noise from the onshore substation to a noise rating level (in accordance with BS4142:2014+A1:2019) of no greater than 5 dB above the representative background detailed within Table 9.42, $L_{Ar,Tr}$ (15 minutes) at any time at the NSRs limited to no less than 35dB $L_{Ar,Tr}$ (15 minutes) where background is considered low. Table 9.44 shows the suggested rating levels.

Table 9.44: Onshore Substation Operational Noise, Suggested Rating Level Limits

Receptor	Representative Background sound Level, dB(A)	Suggested Rating Level Limit, $L_{Ar,Tr}$
CCR1	28	35
CCR2	28	35
LFR1	30	35
LFR2	30	35
SSR1	30	35
SSR2	30	35
SSR3	28	35
SSR4	44	49
SSR5	28	35
SSR6	33	38
SSR7	28	35

159. The allowance for a rating level up to 5 dB above the representative background, or an absolute rating level of 35dB(A) was derived from consideration of the context of the existing environment (low background sound levels at many receptors) and the proposed

onshore infrastructure in accordance with BS 4142:2014+A1:2019. No further contextual factors were considered relevant.

160. Therefore, it is considered that the operational rating limit (in accordance with BS 4142:2014+A1:2019) is appropriate as this represents a limit of less than +5 dB(A) (minor adverse) above the representative background sound level (subject to a lower cut-off value of 35dB(A)) derived from measured levels.

161. The commitment to limit operational noise from the onshore substation to a maximum rating level up to 5 dB(A) above the representative background (subject to a lower cut-off value of 35dB(A)) at any NSR ensures that impacts are reduced to, at most, **minor** adverse, which is not significant.

162. During detailed design of the onshore substation, mitigation strategies, such as 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.

163. As an example mitigation measure, enclosures around the transformers and attenuation to the coolers (for the HVDC scenario) were included in residual operational noise models. Enclosures are highly effective noise mitigation methods, typically achieving reductions in noise emissions of greater than 18dB.

164. Table 9.45 and Table 9.46 show the maximum operational noise impact following mitigation by enclosure of the transformers (i.e. during the night). In a highly conservative approach, a +6dB penalty for tonality has been added. With predicted levels at or far below background, perceptible tonality at the receptors is unlikely.

Table 9.45: Onshore Substation Operational Noise, Predicted Residual Impacts, HVAC

Receptor	Representative Background sound Level, dB(A)	Predicted Rating Level, $L_{Ar,Tr}$	Difference	BS 4142 Impact Magnitude
CCR1	28	24	-4	Negligible
CCR2	28	28	0	Negligible
LFR1	30	21	-9	Negligible
LFR2	30	33	3	Negligible
SSR1	30	19	-11	Negligible
SSR2	30	32	2	Negligible
SSR3	28	31	3	Negligible
SSR4	44	22	-22	Negligible
SSR5	28	21	-7	Negligible

Receptor	Representative Background sound Level, dB(A)	Predicted Rating Level, $L_{Ar,Tr}$	Difference	BS 4142 Impact Magnitude
SSR6	33	21	-12	Negligible
SSR7	28	32	4	Negligible

Table 9.46: Onshore Substation Operational Noise, Predicted Residual Impacts, HVDC

Receptor	Representative Background Sound Level, dB(A)	Predicted Rating Level, $L_{Ar,Tr}$	Difference	BS 4142 Impact Magnitude
CCR1	28	24	-4	Negligible
CCR2	28	31	3	Negligible
LFR1	30	19	-11	Negligible
LFR2	30	32	2	Negligible
SSR1	30	18	-12	Negligible
SSR2	30	35	5	Negligible
SSR3	28	31	3	Negligible
SSR4	44	21	-23	Negligible
SSR5	28	20	-8	Negligible
SSR6	33	20	-13	Negligible
SSR7	28	30	2	Negligible

165. Overall, following mitigation, the magnitude of the impact is deemed to be negligible and the sensitivity of the receptor is considered to be high. The residual effects will, therefore, be of **negligible** significance, which is not significant in EIA terms.

9.11.1. PROPOSED MONITORING/FURTHER ASSESSMENT

166. Proposed monitoring measures are outlined in Table 9.47 below.

Table 9.47: Monitoring Commitments for Noise and Vibration

Potential Environmental Effect	Monitoring Commitment	Means of Implementation
Operational noise due to the substation	A further detailed noise impact assessment prior to commissioning of the onshore substation	Planning condition
Cumulative Effects during Construction	A further detailed noise assessment to consider the potential for cumulative construction noise effects	Planning condition

9.12. CUMULATIVE EFFECTS ASSESSMENT

9.12.1. METHODOLOGY

167. The Cumulative Effects Assessment (CEA) takes into account the impact associated with the Proposed Development together with other relevant plans, projects and activities. Cumulative effects are therefore the combined effect of the Proposed Development in combination with the effects from a number of different projects, on the same receptor or resource. Please see Volume 1, Chapter 2 of the Onshore EIA Report for detail on CEA methodology.

168. The projects and plans selected as relevant to the CEA presented within this chapter are based upon the results of a screening exercise (see Volume 4, Appendix 2.4). Each project or plan has been considered on a case by case basis for screening in or out of this chapter's assessment based upon data confidence, effect-receptor pathways and the spatial/temporal scales involved.

169. The specific projects scoped into the CEA for Noise and Vibration, are outlined in Table 9.48.

Table 9.48: List of Other Projects Considered Within the CEA for Noise and Vibration

Project/Plan	Status [i.e. Application, Consented, Under Construction, Operational]	Distance from Study Area (km)	Description of Project/Plan	Dates of Construction (If Applicable)	Dates of Operation (If Applicable)	Overlap with the Proposed Development
Tier 1						
N/A – considered to be no likely significant effects with Berwick Bank offshore infrastructure.						
Tier 2						
SPEN Eastern Link Project - Branxton Grid Substation	Application	<1km	Construction of a 400 kilovolt (kV) gas insulated switchgear (GIS) substation and associated works	2023 – 2026	2025	Potential exists for construction phases to overlap.
SPEN Eastern Link Project – Converter Station & Cable Route	Application	<1km	New 525kV electricity converter station underground cables and associated works	2024-2027	2026	Potential exists for construction phases to overlap.

9.12.2. MAXIMUM DESIGN SCENARIO

170. The maximum design scenario(s) summarised here have been selected as those having the potential to result in the greatest effect on an identified receptor or receptor group. The cumulative effects presented and assessed in this section have been selected from the details provided in Volume 1, Chapter 5 of the Onshore EIA Report as well as the information available on other projects and plans, to inform 'maximum design scenarios'. Effects of greater adverse significance are not predicted to arise should any other development scenario, based on details within the Project Design Envelope, to that assessed here, be taken forward in the final design scheme.

171. The maximum design scenario, derived from the proposed construction programmes for the SP Energy Networks (SPEN) Eastern Link – Branxton Grid Substation and Eastern Link - Converter Station and Cables Route projects and the Proposed Development, would be the concurrent construction works during Cable Pulling for the Proposed Development, Substation Site Preparation and Earthworks for the Eastern Link – Branxton Grid Substation project and Site Preparation Works along the cable corridor for the Eastern Link -Converter Station and Cable Route project. Under this maximum design scenario, the most affected receptor (common to the Proposed Development and both of the Eastern Link developments) would be CCR1 Castledene.

9.12.3. CUMULATIVE EFFECTS ASSESSMENT

172. An assessment description of the likely significance of the cumulative effects of the Proposed Development upon noise and vibration receptors arising from each identified impact is given below.

CUMULATIVE NOISE

Tier 2

Construction phase

Magnitude of impact

173. There is potential that the proposed construction phase of the Proposed Development, the SPEN Eastern Link – Branxton Grid Substation, and the SPEN Eastern Link - Converter Station and Cable Route may overlap and hence there is potential for cumulative noise impacts to occur.

174. The Noise and Vibration Chapter of the EIA Reports for both of the SPEN Eastern Link works (Eastern Link 1 Northern Point of Connection Substation EIA Report, Chapter 11, Noise and Vibration, December 2021 and Eastern Link 1 Northern Point of Connection Converter and Cables EIA Report, Chapter 11, Noise and Vibration, July 2022) provide details of the expected noise level at the closest receptor to both the Proposed Development works (during Cable Pulling) and works associated with both Eastern Link projects (CCR1 Castledene) and predicts a noise level during Substation Site Preparation and Earthworks of 59 dB(A) and during Site Preparation along the cable corridor of 63dB(A). With reference to Table 9.35 the predicted noise level from the Proposed Development works during Cable Pulling is a maximum of 57.1 dB(A).

175. Addition of these results in a predicted cumulative noise level of 65.2 dB(A) which, with reference to Table 9.16 and Table 9.17, is of medium magnitude should these activities

occur during daytime and of high magnitude should these activities occur during the weekend period.

176. The cumulative effect is predicted to be of local spatial extent, short term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be medium to high.

Sensitivity of receptor

177. All receptors within the Noise and Vibration assessment are considered to be of high sensitivity.

Significance of effect

178. Overall, the magnitude of the cumulative effect is deemed to be medium to high and the sensitivity of the receptor is considered to be high. The cumulative effect will, therefore, be of **moderate to major** adverse significance, which is **significant** in EIA terms.

Secondary mitigation and residual effect

179. The assessment of cumulative effects has considered a worst case scenario whereby the noisiest activities and highest impacts at the most affected receptor were considered. The assessment, in the absence of detailed information regarding the construction programme for the Eastern Link projects, assumed that these activities would occur simultaneously.

180. Secondary mitigation is considered necessary because the likely effect in the absence of secondary mitigation is significant in EIA terms. Secondary mitigation will involve the detailed planning of the timing of these potentially concurrent activities in order to prevent significant cumulative impacts occurring. Should the temporal separation of these activities not be feasible then additional secondary mitigation, such as temporarily located noise barriers to individual plant items and/or to the boundary of the compounds during construction and the limiting of active plant numbers, will be provided.

181. The mitigation measures will ensure that the magnitude of impact will be reduced to low, at most.

182. The residual effect will, therefore, be **minor**, which is not significant in EIA terms.

Operational phase

183. The Noise and Vibration Chapter of the EIA Report for the SPEN Eastern Link – Branxton Grid Substation works scoped out the assessment of operational noise stating:

> *"Operational noise effects associated with the proposed substation equipment installations, on the basis that there are no transformers or other significant noise emitting equipment intended to be installed"*

184. On this basis cumulative impacts of the Proposed Development and the SPEN Eastern Link – Branxton Grid Substation are not predicted.

185. The Noise and Vibration Chapter of the EIA Report for the SPEN Eastern Link - Branxton Grid Substation reported a "fair weather" L_{50} of 3dB(A) for corona noise from overhead lines. Corona noise occurs predominantly in damp or wet conditions, during which a BS 4142:2014+A1:2019 assessment (such as that undertaken for the Proposed Development) is invalid.

186. Given the fair weather predicted L_{50} of 3dB(A) it is considered highly unlikely that cumulative operational impacts will occur.

187. The Noise and Vibration Chapter of the EIA Report for the SPEN Eastern Link - Converter Station and Cables reported a predicted specific noise level ($L_{Aeq,Tr}$) of 26dB(A) at North Lodge (the closest NSR assessed for Eastern Link - Converter Station to the Proposed Development). Predicted noise levels due to the Proposed Development at North Lodge are a maximum of 14dB(A). When two noise levels are more than 10dB different, the lower

of the two levels is taken to have no influence on the higher, hence noise from the Proposed Development in operation will not increase the noise level at this receptor and no significant cumulative impacts are predicted.

9.13. INTER-RELATED EFFECTS

188. A description of the likely inter-related effects arising from the Proposed Development on noise and vibration is provided in Volume 4, Appendix 15.2 of the Onshore EIA Report.

9.14. SUMMARY OF IMPACTS, MITIGATION MEASURES, LIKELY SIGNIFICANT EFFECTS AND MONITORING

189. Information on noise and vibration within the noise and vibration study area was collected through desktop review, site surveys and consultation.

190. Table 9.49 presents a summary of the potential impacts, mitigation measures and the conclusion of likely significant effects in EIA terms in respect to noise and vibration. The impacts assessed include increases in road traffic noise, vibration at sensitive receptors and noise at sensitive receptors. Overall, it is concluded that there will be no likely significant residual effects arising from the Proposed Development during the construction, operational and maintenance or decommissioning phases.

191. Primary, Tertiary, and Secondary mitigation measures, during both construction and operation, have been proposed. Mitigation during construction will be largely secured within the CEMP and with the provision of specific mitigation such as site boundary temporary barriers. Mitigation measures for operational noise from the substation will be developed through the detailed design post consent phase and may include such measures as enclosure of specific equipment.

192. A further detailed noise impact assessment is proposed, prior to commissioning of the substation.

193. Table 9.50 presents a summary of the potential cumulative impacts, mitigation measures and the conclusion of likely significant effects in respect to noise and vibration in EIA terms. The cumulative effects assessed include noise at sensitive receptors. Overall, it is concluded that there will be no likely significant cumulative effects from the Proposed Development alongside other projects/plans.

Table 9.49: Summary of Likely Significant Environmental Effects, Mitigation and Monitoring

Description of Impact	Phase C	Phase O	Phase D	Magnitude of Impact	Sensitivity of Receptor	Significance of Effect	Secondary Mitigation	Residual Effect	Proposed Monitoring
Increases in road traffic noise	✓		✓	Negligible	High	Negligible	None	Negligible	None
Vibration at sensitive receptors	✓		✓	Negligible	High	Negligible	None	Negligible	None
Noise at sensitive receptors	✓	✓	✓	High	High	Major	Construction - General measures to be included within the CEMP and specific measures such as site boundary temporary barriers. Operation – measures to be developed during the detailed design post consent phase and may include enclosures to specific equipment items.	Minor	Further detailed NIA prior to commissioning of the substation

Table 9.50: Summary of Likely Significant Cumulative Environment Effects, Mitigation and Monitoring

Description of Impact	Phase			Cumulative Impact Assessment Tier	Magnitude of Impact	Sensitivity of Receptor	Significance of Effect	Secondary Mitigation	Residual Effect	Proposed Monitoring
	C	O	D							
Increases in noise at sensitive receptors	✓			Tier 2	High	High	Major	Construction programme planning and localised mitigation measures	Minor	Further detailed NIA prior to commencement of construction

9.15. REFERENCES

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