

Volume 2: Chapter 10 – Noise and Vibration

VOLUME 2, CHAPTER 10: NOISE AND VIBRATION

VOLUME 2, CHAPTER 10: NOISE AND VIBRATION	1
10. NOISE AND VIBRATION	2
10.1 Introduction	2
10.2 Scope of the Assessment	3
10.3 Assessment Methodology	4
10.4 Baseline Conditions	14
10.5 Mitigation and Monitoring	14
10.6 Assessment of Likely Significant Effects - Construction	16
10.7 Assessment of Likely Significant Effects - Operation	21
10.8 Assessment of Likely Significant Effects - Decommissioning	22
10.9 Assessment of Residual Cumulative Effects	22
10.10 Summary of Significant Effects	26

Figures (Volume 3 of this EIAR)

Figure 10.1 Noise Sensitive Receptors (NSRs)

Appendices (Volume 4 of this EIAR)

Appendix 10.1: Noise Sensitive Receptors (NSRs)

Appendix 10.2: Construction Activity

Appendix 10.3: Construction Noise Impact Assessment

Appendix 10.4: Operational Noise Impact Assessment

10. NOISE AND VIBRATION

10.1 Introduction

10.1.1 This Chapter considers the potential effects of the Proposed Development on noise and vibration. The evaluation of the baseline has been made through a combination of desk-based study, field survey and consultation.

10.1.2 The specific objectives of the study are as follows:

- identify the NSRs in the vicinity of the Proposed Development and the baseline noise environment;
- describe how consultation has informed the scope of the assessment;
- describe the assessment methodology and significance criteria used in the assessment;
- describe and define the baseline noise environment;
- identify the dominant sound sources associated with the operation and construction of the Proposed Development;
- calculate and assess the potential direct and indirect impacts on NSRs; and
- indicate any requirements for mitigation measures, if applicable, to provide sufficient levels of protection for all NSRs.

10.1.3 This chapter should be read in conjunction with **Volume 2, Chapter 3: Project Description** of the EIA Report for full details of the Proposed Development.

10.1.4 This Chapter was prepared and overseen by experienced acoustic consultants with appropriate memberships of the Institute of Acoustics (IOA), and experience of EIA in the context of wind farm, grid and mixed-use developments. Field surveys and data collection were undertaken by acousticians who had extensive experience and training in undertaking noise surveys for grid and renewable energy projects.

10.1.5 The following acoustic terminology is referred to throughout this Chapter:

Terminology	Definition
dB (decibel)	A unit of the noise level derived from the logarithm of the ratio between the value of a quantity and a reference value and the scale on which sound pressure level is expressed. Sound pressure level is defined as 20 times the logarithm of the ratio between the root-mean-square pressure of the sound field and a reference pressure (2×10^{-5} Pa).
dB(A)	A-weighted decibel. This is a measure of the overall level of sound across the audible spectrum with a frequency weighting (ie 'A' weighting) to compensate for the varying sensitivity of the human ear to sound at different frequencies.
$L_{Aeq,T}$	L_{Aeq} is defined as the notional steady sound level which, over a stated period of time (T), would contain the same amount of acoustical energy as the A-weighted fluctuating sound measured over that period.
L_{A10} & L_{A90}	If a non-steady noise is to be described it is necessary to know both its level and the degree of fluctuation. The L_n indices are used for this purpose, and the term refers to the level exceeded for n% of the time of the measurement. Hence L_{A10} is the A-weighted level exceeded for 10% of the time and as such can be regarded as the 'average maximum level'. Similarly, L_{A90} is the 'average minimum level' and is often used to describe the background noise. It is common practice to use the L_{A10} index to describe traffic noise.
Free-field Level	A sound field determined at a point away from reflective surfaces other than the ground with no significant contributions due to sound from other reflective surfaces. Generally as measured outside and away from buildings.
Ambient Noise Level	The all encompassing noise level measured in $L_{Aeq,T}$. The Ambient Noise Level incorporates background sounds as well as the noise source noise under consideration.
Residual Noise Level	The Ambient Noise Level in the absence of the noise source noise under consideration, measured in $L_{Aeq,T}$.
Specific Noise Level	The noise level measured in $L_{Aeq,T}$ attributed to the noise source under consideration alone.

Terminology	Definition
Background Noise Level	The noise level in the absence of the industrial source noise under consideration, measured in L_{A90} .
Noise Sensitive Receptor (NSR)	Any property where the presence of noise could significantly impact the occupants' well-being, activities, or health. These receptors typically include places such as residences, schools, hospitals, offices and other commercial properties.

- 10.1.6 An energised overhead line (OHL) can be the source of an audible phenomenon known as 'corona discharge'. This is a limited electrical breakdown of the air in the vicinity of the OHL conductors. While OHL conductors are designed and constructed to minimise corona discharge, surface irregularities such as damage, attached raindrops, insects and other types of contamination can increase local electric field strength beyond the inception level for local corona discharge at these sites. Such corona discharge can be the source of audible noise, a crackling sound accompanied sometimes by a low frequency hum.
- 10.1.7 The highest noise levels generated by an OHL usually occur during light rain when water droplets, collecting on the surface of the conductor, can initiate corona discharge. The number of droplets that collect, and hence the amount of noise, depends on the rate of rainfall. Mist or fog can also cause corona discharge from droplets condensing on and attaching to the conductor surface. Sometimes, after a prolonged spell of dry weather, conductors can become contaminated with accumulated dust particles and other materials on which corona discharge can occur and audible noise can be generated. Later rain showers have the effect of washing the conductors clean of such debris.
- 10.1.8 An OHL may also produce 'aeolian noise'. Aeolian noise is caused by wind blowing over a structure resulting in vibration that matches that of the natural frequency of the structure, or vortex shedding on the surface of a structure. It is difficult to assess aeolian noise and there is currently not a standardised method to predict this type of noise. This type of noise is usually infrequent and depends on wind velocity and direction. Embedded mitigation in **Table 10.13: Embedded Mitigation** details how these potential effects can be reduced.

10.2 Scope of the Assessment

Effects Assessed in Full

- 10.2.1 The EIA Scoping process, baseline conditions and professional judgement has identified the following direct, indirect and cumulative effects for detailed assessment:
- direct effects during construction from noise and vibration;
 - direct effects during operation from noise;
 - indirect effects during operation from noise;
 - cumulative effects during construction from noise and vibration; and
 - cumulative effects during operation on noise.
- 10.2.2 The assessment scenarios used in this assessment are the fully operational Proposed Development with both temporary and permanent alignments.

Effects Scoped Out

- 10.2.3 On the basis of the desk-based work undertaken, the professional judgement of the EIA team, experience from other relevant projects and policy guidance or standards, and feedback received from consultees, the following effects have been 'scoped out' of detailed assessment, as proposed in the EIA Scoping Report and confirmed in the Scoping Opinion issued by the Scottish Government's Energy Consents Unit (ECU), in consultation with Angus Council. The effects scoped out are summarised below, and a copy of the Scoping Opinion is provided in **Volume 4, Appendix 6.2 Scoping Opinion**.
- There are no sources of operational vibrational issues associated with the Proposed Development. Therefore, vibration due to operation is not expected to be perceptible or adversely impact receptors and has not been assessed further.

- Any operational maintenance works required will be short-term and intermittent and are not expected to give rise to Significant effects relating to noise and vibration. Therefore, noise from operational maintenance is not expected to adversely impact receptors and has not been assessed further.
- Traffic and Transport has been scoped out of the wider EIA. Therefore, noise effects due to traffic and transport has not been assessed further.

Study Area

10.2.4 The Study Area for the assessment of noise and vibration encompasses the area over which all desk-based data were gathered to inform the assessment presented in this Chapter. The Study Area comprises 32 nearby NSRs in proximity to the Proposed Development. NSRs were compiled from AddressBase data¹, detailed maps, and aerial photographs of the area surrounding the Proposed Development. These NSRs are all within 500 m of the nearest point to the Proposed Development. The reason 500 m was chosen was as it would allow all NSRs that could be impacted by the Proposed Development to be considered by the assessment.

10.3 Assessment Methodology

10.3.1 The following legislation, policy and guidance documents of relevance have been considered in undertaking the assessment of effects of noise and vibration from the Proposed Development:

Legislation

- The Control of Pollution Act, 1974² (COPA) - Section 60 of the Control of Pollution Act enables Local Authority officers to serve a notice in respect of noise nuisance from construction works, instructing the contractor to minimise nuisance to neighbouring properties through specific conditions. Section 61 of the Control of Pollution Act provides a method by which a contractor can apply to the Local Authority for prior consent to undertake construction works in advance of their commencement. If consent is given, the application is exempt from any enforcement action under Section 60 of the same act.
- The Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017³.

Policy

10.3.2 The following policies of relevance to the assessment have been considered:

- Planning Advice Note (PAN) 1/2011: 'Planning and Noise'⁴

10.3.3 Published in March 2011, PAN 1/2011 provides advice on the role of the planning system in helping to prevent and limit adverse effects of noise (Scottish Government, 2011). Information and advice on noise assessment methods are provided in the accompanying Technical Advice Note (TAN): Assessment of Noise. Included within the PAN document and the accompanying TAN are details of the legislation, technical standards, and codes of practice for specific noise issues.

10.3.4 Neither PAN 1/2011 nor the associated TAN provides specific guidance on the assessment of noise from fixed plant, but the TAN includes an example assessment scenario for 'New noisy development (incl. commercial and recreation) affecting a noise sensitive building', which is based on British Standard (BS) 4142:1997: Method for rating industrial noise affecting mixed residential and industrial areas. In 2014, BS4142:1997 was replaced with BS4142:2014 +A1:2019: Methods for rating and assessing industrial and commercial sound.

Standards and Guidance

10.3.5 This assessment is carried out in accordance with the principles contained within the following documents:

¹ Emapsite, n.d. *UK Mapping and Data*. [Online] Available at: <https://www.emapsite.com/>

² UK Government 1974. *Control of Pollution Act 1974* [Online] Available at: <https://www.legislation.gov.uk/ukpga/1974/40>

³ UK Government 2017. *The Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017* [Online] Available at: <https://www.legislation.gov.uk/ssi/2017/102/contents>

⁴ Planning Advice Note: Planning and noise (PAN 1/2011, The Scottish Government, 2011)

British Standard 5228-1:2009 +A1:2014 (BS5228), Code of Practice for Noise and Vibration Control on Construction and Open Sites⁵

- 10.3.6 Guidance on the prediction and assessment of noise and vibration from construction sites is provided in BS5228 2009 +A1:2014 Code of Practice for Noise and Vibration Control on Construction and Open Sites – Part 1: Noise. BS5228-1 provides recommended limits for noise from construction sites.
- 10.3.7 The construction noise impact assessment (CNIA) will be carried out according to the ABC method specified in Table E.1 of BS5228-1, in which NSRs are classified in categories A, B or C according to their measured or estimated background noise level (the threshold values and categories are shown in **Table 10.2: Construction Noise Impact Assessment Criteria**. If the site noise level exceeds the threshold value of the appropriate category, then a potential significant effect is indicated. For the purposes of this assessment NSRs will be classed as Category A, which is the most conservative, as background noise levels are estimated to be below 55 dB. If changes occur to the planned equipment an updated CNIA will be required.
- 10.3.8 A desk-based CNIA has been prepared for the purpose of assessing the effects of the works on NSRs within the Study Area. This assessment has been produced in line with British Standard 5228-1:2009 +A1:2014 (BS5228), Code of Practice for Noise and Vibration Control on Construction and Open Sites.
- 10.3.9 The construction time periods according to BS5228-1 are shown in **Table 10.1: Construction Noise Time Periods**.

Table 10.1: Construction Noise Time Periods

Assessment category	Definition
Night-time	23:00 to 07:00 everyday
Evenings and weekends	19:00 to 23:00 on weekdays 13:00 to 23:00 on Saturdays 07:00 to 23:00 on Sundays
Daytime and Saturdays	07:00 to 19:00 on weekdays 07:00 to 13:00 on Saturdays

- 10.3.10 To determine the threshold value and noise limit to which the construction noise is assessed against, the periods must be defined and categories identified.
- 10.3.11 Night-time is defined as between 23:00 and 07:00. This is also in line with the BS 4142 definition for night-time. Evenings and weekends are defined as 19:00 – 23:00 on weekdays, 13:00 – 23:00 on Saturdays and 07:00 – 23:00 on Sundays. Daytime is defined to be 07:00 – 19:00 on weekdays and 07:00 – 13:00 on Saturdays.
- 10.3.12 The noise criteria provided for the ABC method detailed in BS5228-1 are shown in **Table 10.2: Construction Noise Impact Assessment Criteria**. NSRs are classified in categories A, B or C according to their measured or estimated background noise level. If the site noise level exceeds the threshold value of the appropriate category, then a potential significant effect is indicated.

Table 10.2: Construction Noise Impact Assessment Criteria

Assessment category and threshold value period	Threshold value, LAeq (dB)		
	Category A	Category B	Category C
Night-time	45	50	55
Evenings and weekends	55	60	65
Daytime and Saturdays	65	70	75

- 10.3.13 The NSR is defined as Category A if the ambient noise levels (rounded to the nearest 5 dB) are less than those stated for Category A. This is true for the Study Area given the rural setting, and to ensure that the assessment is

⁵ British Standard 5228: Code of practice for noise and vibration control on construction and open sites (BS 5228), BSI, 2009, amended 2014

conservative, the Proposed Development will be assessed to Category A thresholds. Higher category thresholds are usually for more urbanised or industrial areas with high ambient noise levels.

10.3.14 Part 2: Vibration. BS5228-2 provides recommended limits for vibration from construction sites. The construction vibration impact assessment (CVIA) will be carried out against the guidance on effects of vibration levels specified in Table B.1 of BS5228-2. The level of vibration ranging from 0.14 mm.s^{-1} to 10 mm.s^{-1} indicates where vibration may be perceptible however acceptable, or intolerable.

10.3.15 Construction activities that induce vibration are likely to be limited to potential piling activities where required at foundations. As a worst-case assessment, all towers are assumed to require foundations works. The formulae for the prediction of groundborne vibration due to piling is taken from Table E.1 in BS5228-2.

TGN(E)322 – Operational Audible Noise Assessment Process for Overhead Lines

10.3.16 National Grid Electricity Transmission (NGET)⁶ has derived a procedure which is followed by Transmission Network Operators, including SSEN Transmission, to assess the impact of OHL noise in both dry and rainy conditions – TGN(E)322 – Operational Audible Noise Assessment Process for Overhead Lines. The guidance of the British Standard BS 4142:2014+A1:2019 can also be used to assess the impact of the noise from a specific industrial source at NSRs.

10.3.17 The procedure requires that a series of assessments are conducted in tiers. Tiers 1 and 2 determine the worst-case wet noise and combined dry and wet noise levels, for the purposes of screening out NSRs from further assessment. For NSRs that proceed to Tier 3, the procedure requires that the background noise at NSRs be measured during quiet night times and in dry conditions with little wind. The nature of the ground surface around the sensitive receptors is noted so that the contribution to background noise (BGN) of the surface noise attributable to the rainfall can be derived from empirically derived curves (Miller curves). The logarithmic sum of the measured BGN and the empirically derived contribution for rainfall is adopted as the BGN level, in wet conditions, against which to compare the predicted received noise from the OHL. Using the parameters provided in TGN(E)322 the likelihood of an adverse impact can be assessed.

10.3.18 The assessment procedure follows the process set out in TGN(E)322, which recommends that:

- the outcome of the Tier 1 assessment has determined whether the ‘worst case’ wet noise impact is predicted to be acceptable, or whether further assessment is required. Only the wet noise is assessed to a certain limit (34 dB(A) for residential receptors);
- the outcome of the Tier 2 assessment has determined whether the combined wet and dry noise impact is acceptable, or whether further assessment is required. Historical rain data in the region is used to calculate the mean annual wet hours and new criteria for a ‘combined’ wet and dry noise level. The mean annual wet hours is used to find the percentage of wet weather, which will determine how often wet noise occurs and conversely, the percentage of dry noise. Using the formula for combined wet and dry noise criteria in Appendix D of TGN(E)322, this results in a range for adverse impacts of **36.6 dB(A) to 46.6 dB(A)**. Where the combined wet/dry noise falls below 36.6 dB(A), the NSR will be assessed to experience ‘No Adverse Impacts’ and OHL noise is deemed acceptable, and no further action is necessary. Where the combined wet/dry noise is within this range, the NSRs falls into the Adverse Impacts category. TGN(E)322 suggests that NSRs in this category should be considered to proceed to Tier 3 given the scale and cost of noise mitigation associated with minimising the noise. If the combined wet/dry noise is above 46.7 dB(A), then the NSR falls into the Significant Adverse Impact category and must proceed to Tier 3;
- the outcome of the Tier 3 assessment has determined whether the noise impact is acceptable, whether the noise needs to be mitigated and minimised or whether the noise is unacceptable;
- the Tier 3 assessment takes account of existing background sound levels in the area and noise levels due to rainfall;

⁶ The Transmission Operator in England and Wales.

- the attended collection of night-time background noise levels at NSRs, or groups of such NSRs, within approximately 500 m of the centreline of the OHL during suitable dry weather conditions, before construction;
- allowance for the effects of rainfall on BGN (TGN(E)322 considers fog – an atypical condition – to produce lower noise levels than in rain but is still referred to as 'wet noise');
- prediction of contribution from conductors;
- determination of total excess at the most likely rain rate;
- in Tier 3, a 6 dB tonal penalty is added to the wet noise predicted in Tier 1 to determine a rating level. The excess wet figure is derived by comparing the total noise with penalty (rating) to the background noise level for the appropriate Miller Curve rating at each receptor at a rain rate of 1 mm/hr. Miller curve descriptions are provided in **Table 10.3: Miller Curve Description**. This rating level is then compared to the background noise level measured which must be adjusted for rainfall; and
- a dry noise rating is also determined by adding a tonal penalty of 3 dB to the dry noise level. The excess dry figure is compared to a background noise level in dry conditions.

Table 10.3: Miller Curve Description

Miller Curve	Description
R-1	Essentially bare, porous ground (that is ploughed field or snow-covered ground), no standing puddles or water. Relatively small-leaved ground cover vegetation, such as grass lawn, meadow, hayfield shortly after mowing, field of small-leaf plants.
R-2	Non-porous, hard, bare ground or pavement, falling raindrops splash on thin layers of puddles of collected water; or in or beside wooded area of deciduous trees without leaves or with only small leaves; or in or beside wooded area of coniferous trees or evergreens having needles rather than leaves; or thin-leaved ground cover of crop, such as hay, clover, or grain.
R-3	A few small, fully leafed deciduous trees 15 to 30 m or a few large, fully leafed trees 30 to 90 m distance.
R-4	Large area of fully leafed trees or large-leaved crops or vegetation, such as corn starting 15 to 30 m distance.
R-5	Large area of fully leafed trees or large-leaved crops or vegetation surrounding the area of interest.

British Standard 4142:2014+A1:2019: Methods for rating and assessing industrial and commercial sound (BS 4142)⁷

10.3.19 British Standard 4142 describes methods for rating and assessing the following:

- sound from industrial and manufacturing processes;
- sound from fixed installations which comprise mechanical and electrical plant and equipment;
- sound from the loading and unloading of goods and materials at industrial and/or commercial premises; and
- sound from mobile plant and vehicles that is an intrinsic part of the overall sound emanating from premises or processes, such as that from forklift trucks, or that from train movements on or around an industrial and/or commercial site.

10.3.20 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.

10.3.21 In accordance with the assessment methodology, the specific sound level ($L_{Aeq,T}$) of the noise source being assessed is corrected, by the application corrections for acoustic features, such as tonal qualities and/or distinct impulses, to give a "rating level" ($L_{Ar,Tr}$). The British Standard effectively compares and rates the difference between the rating level and the typical background sound level ($L_{A90,T}$) in the absence of the noise source being assessed.

⁷ British Standard 4142: Methods for rating and assessing industrial and commercial sound (BS 4142), BSI, 2014, Amended 2019

10.3.22 BS 4142 advises that the time interval ('T') of the background sound measurement should be sufficient to obtain a representative or typical value of the background sound level at the time(s) when the noise source in question is likely to operate or is proposed to operate in the future.

10.3.23 Comparing the rating level with the background sound level, BS 4142 states:

- "Typically, the greater this difference, the greater the magnitude of impact;
- a difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context;
- a difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context; and
- the lower the rating level is 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."

Consultation

10.3.24 In undertaking the assessment, consideration has been given to the consultation responses which has been undertaken as detailed in **Table 10.4: Summary of Consultation**.

Table 10.4: Summary of Consultation

Consultee and Date	Scoping/Other Consultation	Issue Raised	Response/Action Taken
Angus Council	Formal Scoping Consultation	Construction noise, construction vibration and operational noise are to be fully assessed. Cumulative noise with other OHL developments are also to be assessed.	The noise and vibration assessment of properties has been proposed in the Scoping Report and is being conducted in this Chapter. Construction noise and vibration is assessed to BS 5228-1 and BS 5228-2 respectively. Construction is proposed to take place from 07.00 to 19.00 during British Summer Time and 07.00 to 18.00 during Greenwich Mean Time seven days a week. Construction noise has been assessed to 55 dB limits to be in accordance with the Evening and Weekends limit, as per BS 5228-1. It has also been assessed to 65 dB limits to show impacts in the Daytime and Saturdays timeframe. Operational noise caused by corona discharge in wet conditions is assessed according to TGN(E)322.

Desk Based Research and Data Sources

10.3.25 The following data sources have informed the assessment:

- Ordnance Survey OS AddressBase.

Determining Sensitivity of Receptors

10.3.26 The sensitivity of the NSR is estimated in its current state prior to any change implied by the Proposed Development. The level of sensitivity is determined according to existing regulations and guidance, societal value, and vulnerability. The definition of receptor sensitivity is outlined in TGN(E)322. Prior to detailed assessment, all NSRs considered in this assessment are assumed to be residential in nature. Therefore, the sensitivity is assumed as medium unless otherwise specified.

Identification of Sensitive Receptors

10.3.27 Potential NSRs were processed from AddressBase data and cross-checked with the SSEN Transmission Land team and satellite imagery. All potential receptors from the AddressBase dataset that fall within 500 m of the centreline of the OHLs are considered in the construction noise and vibration assessment and operational noise assessment. This resulted in the identification of 32 NSRs.

10.3.28 For the operational noise assessment, according to the Electrical Power Research Institute (EPRI) method, recommended by the TGN(E)322, an OHL passes a Tier 1 assessment of TGN(E)322 if the wet noise falls below 34 dB(A) at that receptor, assuming a **Medium** sensitivity for residential receptors. No vulnerable subgroups of High sensitivity have been identified. The overhead lines associated with the Proposed Development use different conductors of varying rated voltage. The wet noise emissions from the proposed conductors are summarised in **Table 10.5: Conductor Noise Emissions**. For context, the distance at which these conductors produce this noise is included to show what NSRs would fail at Tier 1 and progress to Tier 2. This assumes L8 tower types as advised by the Applicant.

Table 10.5: Conductor Noise Emissions

Conductor Type	Rated Voltage (kV)	Associated OHL	Distance for 34 dB(A) (m)
Triple Upas	275 (single circuit)	East Emmock – Tealing Tie-back	0
Triple Upas	275 (double circuit)	Alyth – Tealing 275 kV OHL (existing and temporary diversion) West Emmock – Tealing Tie-back	0
Triple Upas	400 (double circuit)	Proposed reconductoring Alyth – Tealing OHL (275 kV to 400 kV)	313
Triple Oslo	400 (double circuit)	Proposed reconductoring Westfield – Tealing OHL (275 kV to 400 kV)	366

10.3.29 The 32 NSRs are detailed in **Volume 4, Appendix 10.1: Noise Sensitive Receptors (NSRs)** and shown in **Volume 3, Figure 10.1: Noise Sensitive Receptors (NSRs)**.

Determining Magnitude of Impact

10.3.30 The impact magnitude has been assessed for both the construction noise and vibration in addition to the operational noise. These methods to determine impact magnitude of either High, Medium, Low, or Negligible are described in the following sections.

Construction Noise

10.3.31 The proposed working hours of the construction activities are outlined in **Table 10.6: Construction Schedule**. Likely construction equipment has been identified with input from contractors and associated noise levels have been taken from Annex C of BS5228-1. At the time of writing, the exact start and end date of each activity is not known. Therefore, the sequence of activities is shown. The activity is analysed to determine the percentage of the construction time each piece of equipment is being used and how many are in use. Using this information, a total equivalent noise level is calculated. The dispersion of this total noise level is then modelled, accounting for distance and ground absorption.

Table 10.6: Construction Schedule

Contract Works	Proposed Working Hours
Felling (where required)	During British Summer Time (30 Mar to 26 Oct) Every day 07:00 – 19:00
Tower Assembly and Erection	
Foundations	During Greenwich Mean Time (26 Nov to 29 March) Every day 07:00 – 18:00
Civil Works	
Stringing of Conductor	

10.3.32 From the outlined construction schedule above, it is expected that the majority of construction works will occur during weekday daytime hours, however it is possible that some work is required to extend into Saturday afternoons and Sundays, hours as categorised in BS5228 and seen in **Table 10.1: Construction Noise Time Periods**.

10.3.33 To calculate the potential construction noise levels from the Proposed Development, information regarding the proposed construction activities is required. The Principal Contractors will be responsible for developing the detailed construction methodology and associated plant requirements following contract award, however, **Volume 4,**

Appendix 10.2: Construction Activities shows indicative plant activities, assumed plant items, their assumed quantities, their assumed utilisation, and associated noise levels at a distance of 10 m, taken from BS 5228 and based on estimated construction activities provided by contractors. By combining the items' noise levels ($L_{A,eq}$ at 10 m (dB)) with the amount of time each will be running (utilisation) and their quantity, the total equivalent noise can be calculated for each row. These are then logarithmically summed to give a total value for the construction noise at 10 m. To ensure a worst-case assessment, it has been assumed that all works within the phases will take place simultaneously for the indicated percentage of the working hours, despite this being unlikely in practice. The total equivalent noise level at 10 m for each activity can be used in a propagation calculation to find the specific noise at each receptor.

- 10.3.34 For the construction assessment, the distance to NSRs is determined from the address location to the nearest tower location of the proposed alignment (for all phases except felling and access). Noise from felling is calculated using the distance from the NSR to the nearest felling buffer associated with the operational corridor. Felling on access tracks was considered however did not contribute to significant areas in proximity to NSRs. Access track noise is calculated using the distance from the NSR to the nearest access track. The average activity over the working period will be at the geometric centre of the construction area, which is the tower itself, and therefore noise is calculated for each phase assuming the works take place at the tower location.
- 10.3.35 Attenuation has been calculated over mixed hard and soft ground to the F.2.3.2 method in BS 5228. Given the dominance of soft ground in the area surrounding the Proposed Development, this is slightly conservative. The effects of barriers or topographical screening have not been considered as a conservative approach.
- 10.3.36 In line with best practice (BS5228-1), a Construction Noise Management Plan (CNMP) will be developed by the Principal Contractors prior to starting construction works. The detail of the CNMP will be agreed with the Local Authority (LA) and is expected to be secured by an appropriately worded condition on the Section 37 Consent.
- 10.3.37 From the outlined construction schedule, work is expected 7 days a week. It is likely that the majority of construction works will occur during daytime periods, however, may extend into evening and weekends. It is not known what activities within each phase will take place at what times. Therefore, the 55 dB(A) limit has been adopted in this case to ensure a conservative assessment takes place. While work is expected to take place between 7am and 7pm every day, construction activity will take place within the hours of Daytime and Saturdays, therefore the noise is also assessed to a 65 dB limit in the case that noisier work is prioritised then rather than Saturday afternoons or Sundays.
- 10.3.38 With a noise limit of 55 dB(A) identified from BS5228-1, the following magnitude of impact at receptors can be determined from **Table 10.7: Construction Noise - Magnitude of Impact at Receptors**, which uses the threshold value periods described in **Table 10.2: Construction Noise Impact Assessment Criteria**.

Table 10.7: Construction Noise - Magnitude of Impact at Receptors

Magnitude of Impact	Construction Noise Level (dB(A))	
	Evenings and Weekends (55 dB Limit)	Daytime and Saturdays (65 dB Limit)
High	> 60	>70
Medium	56 to 60	66 to 70
Low	BGN to 55	BGN to 65
Negligible	< Background Noise Level	< BGN

- 10.3.39 Excess over the 55 dB criteria will result in **Medium** impact magnitude. Excess of 5 dB or more over the noise limit will result in **High** impact magnitude. For the daytime assessment the 55 dB(A) limit is replaced with 65 dB(A).

Construction Vibration

- 10.3.40 Vibrations, even of very low magnitude, can be perceptible to people and can interfere with the satisfactory conduct of certain activities, eg delicate procedures in hospital operating theatres, use of very sensitive laboratory weighing equipment. Vibration nuisance is frequently associated with the assumption that, if vibrations can be felt, then damage is inevitable; however, considerably greater levels of vibration are required to cause damage to buildings

and structures. Vibrations transmitted from site activities to the neighbourhood can, therefore, cause anxiety as well as annoyance, and can disturb sleep, work or leisure activities.

10.3.41 Criteria for construction vibration due to access tracks and foundation works are taken from Table B.1 in BS5228-2 and shown in **Table 10.8: Construction Vibration Impact Assessment Criteria (Table B.1 in BS5228-2)**. Vibration is measured as peak particle velocity (PPV).

Table 10.8: Construction Vibration Impact Assessment Criteria (Table B.1 in BS5228-2)

Impact Magnitude	Vibration Level, Peak Particle Velocity (PPV) $\text{mm}\cdot\text{s}^{-1}$	Impact
Negligible	<0.3	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.
Low	0.3 to 1.0	Vibration might be just perceptible in residential environments.
Medium	1.0 to 10	It is likely that vibration of this level in residential environments will cause complaints but can be tolerated if prior warning and explanation have been given to residents.
High	>10	Vibration is likely to be intolerable for any more than a very brief exposure to this level in most building environments.

10.3.42 Excess over the $10 \text{ mm}\cdot\text{s}^{-1}$ criteria will result in **High** impact magnitude. Construction vibration between the $1 \text{ mm}\cdot\text{s}^{-1}$ and $10 \text{ mm}\cdot\text{s}^{-1}$ threshold will result in **Medium** impact magnitude. Below $1 \text{ mm}\cdot\text{s}^{-1}$ will result in **Low** impact magnitude. Below $0.3 \text{ mm}\cdot\text{s}^{-1}$ is **Negligible**.

Operational Noise

10.3.43 The impact of operational noise is approached as a tiered assessment in TGN(E)322.

10.3.44 The outcome of the Tier 1 assessment will determine whether the 'worst case' wet noise impact is predicted to be acceptable, or whether further assessment is required. Predicted free field wet noise levels at the external façade of the NSR are compared against the Tier 1 noise criteria outlined in **Table 10.9: Operational Noise – Tier 1**.

Table 10.9: Operational Noise – Tier 1

Use	No Adverse Impact - Screened Out	Tier 2 Assessment Required
Vulnerable subgroups	< 29 dB(A)	> 29 dB(A)
Residential	< 34 dB(A)	> 34 dB(A)
Schools and Hotels	< 39 dB(A)	> 39 dB(A)

10.3.45 Where the predicted wet noise levels fall into the 'No Adverse Impact' category, the noise from the OHL is acceptable. Receptors falling into this category are screened out of further assessment and no further action or assessment is necessary, impact can be considered **Negligible**.

10.3.46 A Tier 2 Assessment shall be carried out where predicted Wet Noise levels exceed the 'No Adverse Impact' Category. A tier 2 assessment considers the combined dry and wet noise contribution through logarithmic calculation to determine new noise criteria. The combined noise criteria are presented in **Table 10.10: Operational Noise – Tier 2**.

Table 10.10: Operational Noise – Tier 2

Use	No Adverse Impact	Adverse Impact	Significant Adverse Impact
Vulnerable subgroups	< 31.6 dB(A)	31.6 - 41.6 dB(A)	> 41.6 dB(A)
Residential	< 36.6 dB(A)	36.6 - 46.6 dB(A)	> 46.6 dB(A)

Use	No Adverse Impact	Adverse Impact	Significant Adverse Impact
Schools and Hotels	< 41.6 dB(A)	41.6 - 51.6 dB(A)	> 51.6 dB(A)

10.3.47 Where the predicted combined wet/dry noise level falls into the 'No Adverse Impact' category in a Tier 2 assessment, impacts can be considered **Negligible**.

10.3.48 Where the predicted combined wet/dry noise level falls into the 'Significant Adverse Impact' category in a Tier 2 assessment, TGN(E)322 states a Tier 3 assessment will be necessary. Where the predicted noise levels fall into the 'Adverse Impact' category, mitigation should be considered or also considered to proceed to Tier 3.

10.3.49 The outcome of the Tier 3 assessment will determine whether the noise impact is acceptable, whether the noise needs to be mitigated and minimized or whether the noise is unacceptable. The Tier 3 assessment takes account of existing background sound levels in the area and noise levels due to rainfall. The Tier 3 Assessment requires the impact of Dry Noise and Wet Noise to be assessed separately using two different methods which are based on the principles of BS4142. The two methods differ in that the Dry Noise assessment requires the determination of the existing baseline sound level, whilst for the Wet Noise assessment, it is necessary to predict the increase in background sound levels due to rainfall.

10.3.50 The magnitude of a predicted noise impact at a given receptor can be interpreted as the degree of alteration that is undergone by the receptor as a consequence of the impact. Magnitude criteria can be quantitative using standards such as BS4142. As reported in the table below, the impact magnitude is worked out on a case-by-case basis for each NSR and classified as Negligible, Low, Medium, or High. Information from the rating level, the background sound level, and the stated impacts from a BS4142 assessment have been converted into representative impact magnitudes, detailed in **Table 10.11: BS4142 Impact Magnitude**.

Table 10.11: BS4142 Impact Magnitude

Impact Magnitude	Definition	Tier 1 Criteria for Magnitude of Impact	Tier 2 Criteria for Magnitude of Impact	TGN(E)322 Tier 3 Criteria for Magnitude of Impact (Difference between OHL Rating Noise Level and Background Sound Level)
Negligible	Impact to the receptor is immeasurable, undetectable or within the range of normal natural background variation.	<34 dB(A) wet noise	<36.7 dB(A) combined wet and dry noise	Low Impact ≤ 0 dB
Low	The lower the rating level is 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	>34 dB(A), further assessment required at Tier 2	>36.7 dB(A), further assessment required at Tier 3	Minor Impact 0 to 4 dB
Medium	A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context.			Adverse Impact 5 to 9 dB
High	A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.			Significant Adverse Impact ≥ 10 dB

10.3.51 A difference in the rating level at the NSR compared to background sound levels of +10dB or more is likely to be an indication of a **High** impact.

10.3.52 A difference of +5dB to +9dB is likely to be an indication of a **Medium** impact.

10.3.53 A difference of 0 to +4dB is an indication of **Low** impact.

10.3.54 If the level of noise from the OHL does not exceed the background sound level, this is an indication of noise from the OHL having a **Negligible** impact.

Determining Significance of Effect

10.3.55 After assessing the sensitivity of the NSR in its baseline state, and then the impact magnitude of the noise likely to affect the NSR, an estimate of the effect significance can be derived by applying a calculation matrix (**Table 10.12: Evaluation of the Effect Significance**).

10.3.56 The measure of significance is the key output of the impact assessment process and drives the requirement for mitigation measures to be applied during operation to offset or reduce potential project generated effects.

10.3.57 The evaluation of effect significance shall be performed based on the significance matrix presented in TGN(E)322 and based on professional judgement, considering both sensitivity and magnitude of change. Resulting effects of **Moderate** and **Major** impacts are considered **Significant** under the *EIA Regulations* and require mitigation to be considered.

Table 10.12: Evaluation of the Effect Significance

		Sensitivity of NSR			
		High	Medium	Low	Negligible
Magnitude of Change	High	Major	Major	Moderate	Negligible
	Medium	Major	Moderate	Minor	Negligible
	Low	Moderate	Minor	Minor	Negligible
	Negligible	Negligible	Negligible	Negligible	Negligible

Assessment Assumptions and Limitations

10.3.58 Estimated noise emissions from the Proposed Development's construction noise activities and plant items have been extracted from Annex C in BS 5228-1. Where equipment has been proposed, that cannot be extracted from BS 5228-1, information of source noise levels is taken from projects of a similar nature. This assessment considers conservative assumptions with the aim to produce a worst-case assessment. The assumptions include a direct path from source to receiver with no screening or change in terrain level. The ground factor is assumed as a mix of both hard and soft terrain. The assessment assumes equipment is producing the maximum sound power level for the entire time it is assumed as operational according to the construction schedule in **Volume 4, Appendix 10.2: Construction Activities**. In practice, noise levels during construction would be expected to be lower than the assessment details.

10.3.59 There will be periods just after rainfall or during mist conditions where there is some noise emission from the OHL, although these levels are less than those during rain according to TGN(E)322. Noise generated under these circumstances is referred to as 'wet noise'. These periods where background noise is less than those during periods of rainfall are not accounted for in the assessment as there is no standardised methodology or procedure. The number of droplets, and hence the noise level, will depend primarily on the rate of rainfall. Historical studies determined that hum inception typically occurs at a rainfall rate of approximately 1 mm/hr. Hum inception is the point at which during rainfall the low-frequency humming component of corona discharge noise becomes noticeable. This hum induces a tonal component of the noise, which is represented by a 6 dB tonal penalty at Tier 3 of a TGN(E)322 assessment.

10.3.60 There is a degree of uncertainty when conducting assessments on developments in the planning stage. Further assessments will be conducted if a change of design is likely to increase impacts from what is currently assessed. Assumptions include a flat terrain between OHL centreline and NSR, an uncertainty distance of 10 m has been included when determining distance from source to receiver. In Tier 1 and 2 of the TGN(E)322 assessment, no acoustic absorption due to the ground is included to ensure a worst-case assessment. The calculation for OHL

conductor noise uses the Electric Power Research Institute (EPRI)⁸ method of calculation which assumes a moderately aged conductor, which is appropriate for the assessment of the Proposed Development for the lifetime of its operation.

- 10.3.61 There is no method in advance of construction for reliably predicting potential aeolian noise impacts due to OHLs. Therefore, aeolian noise is not assessed within this chapter. However, the impacts of such noise should be anticipated and mitigated where possible in the design of the Proposed Development. If there are certain components used on operational OHLs that are known to produce aeolian noise, it is recommended to select appropriate OHL components and avoid those that are known to produce aeolian noise.
- 10.3.62 The assessments are based on information available at the time of publication, any changes to design or specification of the Proposed Development that may lead to increased adverse effects would require re-assessment.
- 10.3.63 The perception and impact of noise is subjective. However, the standard methodologies aim to assess noise objectively. Whilst some information is subject to change such as the construction activities and, it is considered that there is sufficient information to enable an informed decision to be taken in relation to the identification and assessment of likely **Significant** environmental effects on noise and vibration.

10.4 Baseline Conditions

Existing Baseline

- 10.4.1 As part of the TGN(E)322 operational noise impact assessment, BGN levels are required for Tier 3. BGN levels are ascertained by conducting free-field attended spot measurements at each noise sensitive receptor (in the Tier 3 assessment) using a Class 1 sound level meter.
- 10.4.2 A field survey was not required due to the outcome of the Tier 1 TGN(E)322 operational noise assessment. No NSRs proceed to Tier 3 and therefore background noise is not required. Background noise is not required for the construction noise impact assessment, using the ABC method of BS5228, and assuming all NSRs fall into the most conservative 'A' category.
- 10.4.3 Some field surveys were conducted in the early stages of the project, when the proposed alignment was not finalised, however the results of the final calculation found that these were not required and therefore baseline surveys were subsequently not used or have not been included in this EIA.

Future Baseline

- 10.4.4 It is likely that a steady increase in background noise levels can be assumed due to potential future expansion of settlements, even if small in scale, and potential increases of traffic movement. However, these changes are unpredictable, or irrelevant in the context of this assessment.

10.5 Mitigation and Monitoring

Embedded Mitigation

- 10.5.1 Topic specific embedded mitigation (mitigation achieved through design) is outlined below in **Table 10.13: Embedded Mitigation**.

Table 10.13: Embedded Mitigation

Mitigation Measure	Project Stage/Timing	Responsibility
NV1 – Permanent towers and conductors are not proposed to be located within 170 m of NSRs (nearest is NSR 5 - Seventeen Acres at 188 m), beyond this distance, the conductor produces relatively low noise. The purpose and key driver of the routeing is to avoid proximity to NSRs such as residential properties.	Detailed Design	Applicant
NV2 – Aeolian noise is caused by wind blowing through the conductors and/or structures. This type of noise is usually infrequent	Detailed Design	Applicant

⁸ EPRI AC Transmission Line Reference Book – 200 kV and Above, Third Edition, Final Report, 2005, Electrical Power Research Institute

Mitigation Measure	Project Stage/Timing	Responsibility
and depends on wind velocity and direction. Wind must blow steadily and perpendicular to the lines to set up an aeolian vibration, which can produce resonance if the frequency of the vibration matches the natural frequency of the line. Design of the conductors will implement best practice. Dampers can be attached to the lines to minimise aeolian vibration and therefore aeolian noise. It must be ensured that no components are used that have a known history to produce high aeolian noise.		

Applied Mitigation

10.5.2 Topic specific applied mitigation is outlined below in **Table 10.14: Applied Mitigation**.

Table 10.14: Applied Mitigation

Mitigation Measure	Project Stage/Timing	Responsibility
NV3 – Construction Noise Management Plan including, but not limited to, the following measures: Set out proactive strategies to manage and minimise the noise and vibration impacts generated by construction. Mitigation measures are recommended such as the control of the noise source levels, controlling the noise transmission path via noise barriers, time management and managing operational times of equipment when not in use. This will also include community engagement and stakeholder management plans to ensure legal compliance with Control of Pollution Act 1974. Updated detailed construction noise impact assessment and CNMP. Carry out identified high noise level activities during daytime defined hours 07:00 – 19:00 on weekdays and 07:00 – 13:00 on Saturdays. Construction noise monitoring utilising best available techniques (BAT).	Pre-Construction Phase	Principal Contractor

10.5.3 For its new infrastructure projects in recent years, the Applicant has developed and effectively implemented a suite of General Environmental Management Plans (GEMPs) which prescribe good environmental management practices. In addition, the Applicant has developed a Consents and Environment Specification which prescribes environmental management principles which the Principal Contractor are required to meet under the terms of the Principal Contract. The Specification includes management plans that the Principal Contractor is required to prepare and implement, including a Construction Environmental Management Plan (CEMP), and subsidiary plans including a construction noise management plan (CNMP) and a construction transport management plan (CTMP). In preparing these Plans, the Principal Contractor will be required to incorporate any additional management measures identified through the EIA as necessary to avoid or reduce significant residual effects (ie 'additional mitigation').

10.5.4 The CNMP will be carried out in accordance with the guidance, procedures and best practice outlined in BS5228-1. The CNMP will be embedded within the Construction Environmental Management Plan (CEMP) as the Applicant requires of the Principal Contractor through a condition of contract. The details of the CNMP will be agreed with Angus Council prior to the commencement of construction works and is expected to be secured by an appropriately worded planning condition. Procedures within the CNMP will include:

- minimising the noise as much as is reasonably practicable at source;
- attenuation of noise propagation (see paragraph 0);
- carrying out identified high noise level activities at a time when they are least likely to cause a nuisance to residents; and
- providing advance notice of unavoidable periods of high noise levels to Angus Council and residents likely to be impacted.

10.5.5 In order to maintain low impact on the noise environment, consideration will be given to attenuation of construction noise at source by means of the following:

- giving due consideration to the effect of noise, in selection of construction methods;

- avoidance of vehicles waiting or queuing, particularly on public highways or in residential areas with their engines running;
- scheduling of deliveries to arrive during daytime hours only. Care should be taken to minimise noise while unloading delivery vehicles;
- ensure plant and equipment are regularly and properly maintained;
- fit and maintain silencers to plant, machinery, and vehicles where appropriate and necessary;
- operate plant and equipment in modes of operation that minimise noise, and power down plant when not in use;
- use electrically powered plant rather than diesel or petrol driven, where this is practicable; and
- work typically not to take place outside of hours defined in the construction schedule.

10.5.6 Consideration will be given to the attenuation of construction noise in the transmission path by means of the following:

- locate plant and equipment liable to create noise as far from NSRs as is reasonably practicable or use natural land topography to reduce line of sight noise transmission;
- noise screens, hoardings and barriers should be erected where appropriate, necessary, and practicable to shield high-noise level activities; and
- provide lined acoustic enclosures for equipment such as static generators and, when applicable, portable generators, compressors and pumps.

10.5.7 As part of an overall construction noise management plan, it is recommended that the Principal Contractor informs all neighbouring residents who are likely to be affected of the proposed timescales and the intended site operations.

10.5.8 The CNMP is to be established and ensure that the noise limit thresholds of BS5228 are not exceeded at NSRs as defined in **Table 10.2: Construction Noise Impact Assessment Criteria**.

10.5.9 A noise monitoring programme will be established during construction works to ensure limits at nearby NSRs are maintained through the various phases of work.

10.6 Assessment of Likely Significant Effects - Construction

Construction Noise

10.6.1 A desk-based construction noise appraisal has been prepared for the purpose of assessing the effects of the works on any nearby NSRs. This appraisal has been produced in line with BS 5228-1:2009 +A1:2014 (BS5228), Code of Practice for Noise and Vibration Control on Construction and Open Sites.

10.6.2 Construction noise is assessed to a 55 dB limit in the case that work takes place during the Saturday afternoons or Sundays (defined as Evening and Weekends in **Paragraph 10.3.11**). Work will also take place in the during weekdays and Saturday mornings and therefore would be assessed to a 65 dB limit. Results have been included for both noise limits. The magnitude of change from each phase have been compared to the sensitivity of the NSRs and the resultant significance of effect has been evaluated. Where effects have been predicted to be significant, these are shown as detailed results shown in **Volume 4, Appendix 10.3: Construction Noise Impact Assessment**, a summary of results are presented in **Table 10.15: Summary of Construction Noise Results – Number of Predicted Receptors – Using Proposed Alignment for Distance to NSR**.

Table 10.15: Summary of Construction Noise Results – Number of Predicted Receptors – Using Proposed Alignment for Distance to NSR

Phase	Daytime and Saturday mornings (65 dB limit)		Evenings and Weekends (55 dB limit)	
	Medium Impacts (65 dB to 70 dB)	High Impacts (Above 70 dB)	Medium Impacts (55 dB to 60 dB)	High Impacts (Above 60 dB)
Vegetation Clearance and Felling	1	1	11	12
Access and Enabling	3	6	6	15
Piling	0	0	6	0

Phase	Daytime and Saturday mornings (65 dB limit)		Evenings and Weekends (55 dB limit)	
	Medium Impacts (65 dB to 70 dB)	High Impacts (Above 70 dB)	Medium Impacts (55 dB to 60 dB)	High Impacts (Above 60 dB)
Foundations	0	0	6	1
Tower Erection	0	0	0	0
Stringing	0	0	0	0
Dismantling	2	1	4	7

- 10.6.3 During vegetation clearance and felling, noise at 23 out of 32 NSRs are above the 55 dB noise limit, 12 NSRs result in High impact. If completed within the hours specified as the Daytime and Saturdays category, then the limit breaches are reduced to 2 NSRs. The distance is currently assumed to be from the edge of the nearest felling area to each receptor. Areas of management felling are not included in this assessment. Felling is expected to be very short term. It also includes small vegetation such as bushes and hedges, therefore, in practice, results are expected to be reduced
- 10.6.4 Noise at 21 of 32 NSRs are above the 55 dB limit during access and enabling works, with 15 NSRs rated as High impact. 9 NSRs would exceed the 65 dB limit if this phase were to take place during daytime hours, with 6 of these breaches being High impact. Access work is expected to be short term, however, equipment active operational time must be addressed in a CNMP to reduce impacts to Low.
- 10.6.5 Noise at 6 of 32 NSRs are above the 55 dB limit during piling, with no NSRs rated as High impact. No NSRs would exceed the 65 dB limit if this phase were to take place during daytime hours.
- 10.6.6 Noise at 7 of 32 NSRs are above the 55 dB limit during construction of the foundations, with one NSR rated as **High** impact. No NSRs would exceed the 65 dB limit if this phase were to take place during daytime hours.
- 10.6.7 No NSRs are above the 55 dB limit during tower erection and stringing, therefore, the construction noise due to this phase is assessed as with **Low** impact.
- 10.6.8 Noise at 11 of 32 NSRs are above the 55 dB limit during the dismantling, with 7 NSRs rated as High impact. Three NSRs would exceed the 65 dB limit if this phase were to take place during daytime hours, with one of these breaches being High impact. Dismantling is expected to be short term, however, equipment active operational time must be addressed in a CNMP to reduce impacts to **Low**.
- 10.6.9 Therefore, prior to the mitigation measures, construction noise is assessed as High impact, on a Medium sensitivity receptor, causing a **Major** effect which is **Significant** in EIA terms. This is due to the 55 dB limit breaches during felling, access and enabling, foundations and dismantling.

Construction Vibration

- 10.6.10A desk-based construction vibration appraisal has been prepared for the purpose of assessing the effects of the works on any nearby residents. This appraisal has been produced in line with BS 5228-2:2009 +A1:2014 (BS5228), *Code of Practice for Noise and Vibration Control on Construction and Open Sites*.
- 10.6.11 BS5228-2 provides recommended limits for vibration from construction sites. The CVIA has been carried out against the guidance on effects of vibration levels specified in Table B.1 of BS5228-2. The level of vibration ranging from 0.14 mm.s⁻¹ to 10 mm.s⁻¹ indicates where vibration may be perceptible however acceptable, or intolerable.
- 10.6.12 Construction activities that induce vibration are likely to be limited to potential piling activities where required at foundations. The formulae for the prediction of groundborne vibration due to piling is taken from Table E.1 in BS5228-2.
- 10.6.13 Construction vibration activities and parameters associated with equipment specified in **Volume 4, Appendix 10.2: Construction Activity** are largely unknown at time of writing, therefore, the worst-case parameters have been assumed for vibration due to foundation excavation and piling taking place at TE4. This tower is the closest to any NSR (NSR 5 Seventeen Acres at 217 m from nearest Tower TEG1 at Tealing Substation). If the assessment passes

at the closest receptor, it will pass at all others. The parameters that affect resultant vibration from piling, V_{res} , are shown in **Table 10.16: Groundborne Vibration Parameters from Mechanised Construction Works**.

Table 10.16: Groundborne Vibration Parameters from Mechanised Construction Works

Vibration Parameter	Range
Maximum amplitude of drum vibration, in millimetres (mm)	Between 0.4 and 1.72 mm
Pile toe depth, in metres (m)	Between 1 and 27 m
Vibrating roller drum width, in metres (m)	Between 0.75 and 2.2 m
Number of vibrating drums	1 or 2
Slope distance from the pile toe or tunnel crown, in metres (m)	Depends on distance between source and receiver and pile toe depth
Nominal hammer energy, in joules (J)	Between 1.5 and 85 kJ
Potential energy of a raised tamper, in joules (MJ)	Between 1 and 12 MJ
Distance measured along the ground surface, in m	217 m for closest NSR 5 Seventeen Acres

10.6.14 **Table 10.17: Groundborne Vibration Results from Foundation Works at Tower TE4 on NSR 5 Seventeen Acres** shows the worst-case results of the groundborne vibration due to piling. Vibratory compaction, percussive piling, and vibratory piling have been calculated in the case these activities will take place.

Table 10.17: Groundborne Vibration Results from Foundation Works at Tower TE4 on NSR 5 Seventeen Acres

Vibration Operation	Proposed Alignment	
	Resultant PPV (mms-1)	Magnitude of Impact
Vibratory Compaction (Steady State)	0.07	Negligible
Vibratory Compaction (Start Up and Run Down)	0.19	Negligible
Percussive Piling	0.04	Negligible
Vibratory Piling	0.09	Negligible
Dynamic Compaction	0.50	Low

10.6.15 All impacts, except for the potential dynamic compaction (**Low**), for potential vibration works have been assessed as **Negligible**. In the worst case, the **Negligible** vibration activities might be just perceptible in residential environments, therefore, the significance of effect for construction vibration is **Minor** and **Not Significant**.

Additional Mitigation

Table 10.18: Committed Additional Mitigation Construction

Mitigation Measure	Rationale	Project Stage/Timing	Responsibility
CNMP – to set out proactive strategies to manage and minimise the noise and vibration impacts generated by construction. Mitigation measures are recommended such as the control of the noise source levels, controlling the noise transmission path via noise barriers, time management and managing operational times of equipment when not in use. This will also include community engagement and stakeholder management plans to ensure legal compliance with Control of Pollution Act 1974.	Potential Significant noise effects	Prior to and during construction	Principal Contractors
Community Engagement - Communities would be informed of the programme of construction activities and a Community Liaison contact would be appointed to deal with any community queries or feedback. These would be detailed in the CNMP to be agreed with the relevant Local Authority.	Potential Significant noise effects	Prior to and during construction	Applicant

Mitigation Measure	Rationale	Project Stage/Timing	Responsibility
Equipment Curtailment - Where activities take place during Saturday afternoon and Sundays and construction noise is assessed to 55 dB, the applied mitigation in Paragraphs 10.5.4 to 10.5.7 and relevant measures in the CNMP are recommended to reduce noise impacts at nearby NSRs. The noisiest activities will be restricted to Daytime and Saturdays to allow assessment to the 65 dB limit. These restrictions will be detailed in the CNMP. In addition, noise compliance measurements would be implemented at any NSRs still assessed to be impacted to ensure noise emissions do not exceed limits in the noisiest activities. Active time of noisiest equipment during felling, access/enabling, and dismantling works should be reduced to a worst-case 65 dB at receptors. If noise levels at sites exceed acceptable thresholds during these phases, information will be given to Principal Contractors for specific mitigation to be included in the CNMP. This may focus on detailed scheduling the operation of the highest noise-generating equipment as breakers, saws, and other felling equipment at the locations identified in the tables of Volume 4, Appendix 10.3 Construction Noise Impact Assessment. For access, avoiding the use of the breakers and piling rigs during the Saturday afternoons and Sundays. By minimising the concurrent use of this equipment throughout the phase in the daytime and Saturdays threshold period, the equivalent sound pressure level can be reduced to 84 dB(A) at 10 m calculated in a BS 5228-1 assessment (by method of eliminating the concurrent use of this equipment, this reduces the overall impact of noise over the entire day to 84 dB(A)). This is predicted to cause Significant impact at NSRs 1, 9, 12, 20, 21, 23, 25, and 31. This assumes noise takes place at the point on the access track closest to the NSR for the entire day. In practice, the noise will be significantly less over the working day and overall be short-term. For dismantling, the noisiest equipment such as the breaker must be managed for the duration of total operational time by spreading out the activity over the course of the working day. At NSRs 9 and 25, reducing the concurrent use of the chain saw, the brush cutter and wood chipper will effectively reduce the equivalent sound pressure level at the receptors to a maximum of 65 dB(A). This mitigation measure will be included in the felling section of the CNMP. Felling is also expected to produce high noise levels at the nearby NSRs but is expected to be short-term and temporary. For felling, the noisiest equipment such as the chainsaws must be managed for the duration of total operational time by spreading out the activity over the course of the working day. At NSRs 17, 20, and 25, reducing the concurrent use of the breaker with other equipment will effectively reduce the equivalent sound pressure level at the receptors to a maximum of 65 dB(A). This mitigation measure will be included in the felling section of the CNMP. Curtailing of the above equipment will ensure noise impact can be effectively reduced from Moderate impact to Low impact. The residual construction noise effects can be reduced from High to Low and Not Significant.	Potential Significant noise effects	Prior to and during construction	Principal Contractors
Duration of Works – The construction noise in general will be very short-term, maintaining this duration will ensure construction noise impacts are minimised.	Potential Significant noise effects	Prior to and during construction	Principal Contractors

Residual Construction Effects

10.6.16 The information used in this assessment is accurate at time of writing. It is recommended that this assessment is reviewed and updated as necessary by the Principal Contractors if significant changes in equipment take place. It is expected that with the implementation of a CNMP, where activity near locations of significant impacts can be micrositied in terms of active operational time of equipment and increased community engagement to detail the

duration of works, any remaining impacts can be eliminated. Therefore, it is predicted that construction noise would result in **Minor** impact at worst and therefore is **Not Significant**.

10.7 Assessment of Likely Significant Effects - Operation

Predicted Operational Effects

- 10.7.1 There are differences in assessment methods for dry and wet conditions. Dry noise is assessed by indicating the excess of rating level over background. During wet conditions, the noise output from OHLs varies according to the number and size of rain droplets accumulated on the surface of the conductors. Therefore, there is a strong relationship between the rainfall rate and the noise output from an OHL. Background noise levels also increase with rainfall rate, such that during very heavy rain, OHL noise is generally inaudible. For these reasons, an alternative noise assessment method to deal with rain-induced noise is required. The external rain-induced noise levels are assessed using the methodology developed by National Grid and detailed in their Technical Guidance Note TGN(E)322.
- 10.7.2 The excess wet figure is derived by comparing the total noise to the background noise level for the appropriate Miller Curve rating at each receptor at a rain rate of 1 mm/hr.
- 10.7.3 The lower the rating level is 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.
- 10.7.4 Due to the lack of standardised quantitative prediction method for the assessment of potential aeolian noise impacts, a summary has been produced. While aeolian noise is possible under specific wind conditions, its occurrence is typically infrequent and it cannot be accurately assessed. Wind must be incident on the insulators or dampers of the OHL at certain direction and speed for the aeolian noise to be induced. If the wind is too low, there will be no noise induced. If the wind is too high, then background noise is raised and aeolian noise impacts are less likely to be Significant. While aeolian noise may be audible several hundred metres from a tower, these specific conditions of wind conditions are not likely to be frequent enough to cause adverse noise impacts. Therefore, the focus is on anticipating and mitigating potential aeolian noise through appropriate design measures for the Proposed Development (NV2 in **Table 10.13: Embedded Mitigation**).
- 10.7.5 The corona-induced audible noise of the OHL in rainfall has been calculated using the EPRI⁹ method as recommended in TGN(E)322. Noise emissions at distances up to 500 m of the conductors of each overhead line have been calculated. The external rain-induced noise levels have been assessed using the TGN(E)322 methodology developed by National Grid.
- 10.7.6 In the TGN(E)322 method, previously mentioned in **Section 10.3.18**, the tiered system screens out receptors of low enough wet noise in Tier 1. If the wet noise is above 34 dB(A), Tier 2 assesses the combined wet and dry noise. This stage assesses the proportion of time the area is raining or is dry and calculates a 'combined' wet and dry noise. Dry noise is assumed to be 25 dB less than wet noise. Table 2 of TGN(E)322 provides criteria on various rainfall. Historical rain data in the region has been used to calculate the mean annual wet hours from the period of 01 June 2014 to 01 December 2024. If combined noise is above 36.6 dB(A), NSRs proceed to a Tier 3 assessment. If Tier 3 is required, the total noise is assessed at a worst-case rain rate of 1 mm/hr to provide the excess above the wet background noise.
- 10.7.7 In a Tier 3 assessment, the excess wet figure is compared against a background noise level calculated through the addition of dry background noise levels and predicted noise due to rainfall according to the Miller curve value for that specific NSR. Miller curve descriptions are provided in **Table 10.3: Miller Curve Description**.
- 10.7.8 Two scenarios have been assessed. The first considers the total noise from temporary diversions and tie backs, the second considers the OHLs in their permanent location, once temporary diversions have been removed.
- 10.7.9 All receptors are of Medium sensitivity. As shown in **Volume 4, Appendix 10.4: Operational Noise Impact Assessment**, for the Tier 1 assessment, the wet noise at each location is predicted to be between 8.3 and 13.6 dB for the temporary scenario and between 12.9 dB and 37.2 dB for the permanent scenario. Also detailed is the distance from the NSRs to the nearest point on the nearest line associated with the proposed Development.

⁹ Electrical Power Research Institute, 2005. *EPRI AC Transmission Line Reference Book – 200 kV and Above*, Third Edition, Final Report, 2005, Electrical Power Research Institute.

10.7.10 Audible noise from the wet temporary and permanent Proposed Development falls below 34 dB for 29 out of the 32 receptors. This results in **Negligible** magnitude of impact at the 29 NSRs and therefore the effect is **Not Significant**.

10.7.11 For the permanent alignment, three NSRs (Wynton Works, North Balluderon Farm, and Dunian) are required to proceed to a Tier 2 assessment as total wet noise is predicted above 34 dB(A) at these NSRs. This stage assesses the proportion of time the area is raining or is dry and calculates a 'combined' wet and dry noise. Dry noise is assumed to be 25 dB less than wet noise. Table 2 and Appendix C of TGN(E)322 provide criteria on various rainfall. After evaluating historical rain data from June 2014 to December 2024 at the nearest weather station the Met Office has data for (Leuchars Weather Station), the average annual wet hours rain is 893 hours, or rain is expected to fall 10.2 % of the annual hours. If combined noise is predicted to be above 36.6 dB(A), NSRs will proceed to a Tier 3 assessment. The results of this assessment, for the permanent diversion are shown in **Volume 4, Appendix 10.4: Operational Noise Impact Assessment**. The new sections of Alyth - Tealing 275 kV OHL and Westfield - Tealing 275 kV OHL have been assessed as they are expected to be uprated to 400 kV Triple Upas and Triple Oslo conductor respectively. The results show that at a TGN(E)322 Tier 2 assessment at the three NSRs, the combined wet and dry noise falls below 36.6 dB(A). Therefore, this is deemed as **Not Significant**. The permanent realignment is assessed as **Negligible** and **Not Significant**.

Additional Mitigation

Table 10.19: Committed Additional Mitigation Operation

Mitigation Measure	Rationale	Project Stage/Timing	Responsibility
No additional mitigation is required for operational noise	n/a	n/a	n/a

Residual Operational Effects

10.7.12 No residual operational effects are predicted.

10.8 Assessment of Likely Significant Effects - Decommissioning

10.8.1 Due to the short-term nature of the works, dismantling is considered as part of the wider commissioning construction assessment. The noise and vibration impacts of decommissioning a tower of the Proposed Development will be comparable to the dismantling works phase and is not likely to be any more significant.

10.9 Assessment of Residual Cumulative Effects

10.9.1 A summary of cumulative project effects are presented in **Table 10.20: Assessment of Cumulative Effects**.

Table 10.20: Assessment of Cumulative Effects

Development Name	Construction Noise	Operational Noise
Emmock 400 kV substation SSEN Transmission Development	It has been concluded that there will be No Significant adverse effects upon NSRs during the construction of the Proposed Development with the application of Applied Mitigation. Predicted noise levels from construction activities related to the Proposed Development, Emmock 400 kV substation and Kintore to Tealing 400 kV OHL were logarithmically summed to assess the cumulative effects of construction noise. At NSRs 11, 29, and 32, there was the potential to push noise levels over the 55dB if the loudest phases of construction for each development occurred concurrently. If these works are due to occur concurrently then work should be done during Daytime and Saturday category hours (65dB limit). Therefore, cumulative construction effects would result in Negligible impact and Not Significant with the implementation of a CNMP.	The operational noise of Emmock substation is predicted to be below 5 dB excess above background noise in a BS4142 assessment and therefore Low impact and Not Significant. Emmock substation has assessed in dry conditions as a worst-case for lower background noise. The Proposed Development has been assessed in wet conditions, where the background noise is elevated. In these conditions, the background noise is raised due to rainfall. Therefore, in this scenario, operational noise from Emmock substation will be less prominent and likely to have a Negligible impact on NSRs when considered cumulatively with the operational noise from the Proposed Development. Any noise effects from Emmock substation are predicted to be Negligible in these conditions. The Proposed Development is assessed for worst-case noise in wet conditions. Receptors that are potentially impacted by both Emmock substation and the Proposed Development are unlikely to exceed wet background noise with contributions from both Emmock substation and the Proposed Development. The worst-case noise effects of Emmock substation are assessed in dry conditions, where noise from the Proposed Development is Negligible. The worst-case noise effects from the Proposed Development are assessed in wet conditions where noise from Emmock substation is no longer worst-case. Therefore, cumulative noise in dry and wet conditions is Not Significant.
Kintore to Tealing 400 kV OHL SSEN Transmission Development	It has been concluded that there will be No Significant adverse effects upon NSRs during the construction of the Proposed Development with the application of Applied Mitigation. Predicted noise levels from construction activities related to the Proposed Development, Emmock 400 kV substation and Kintore to Tealing 400 kV OHL were logarithmically summed to assess the cumulative effects of construction noise. At NSRs 11, 29, and 32, there was the potential to push noise levels over the 55dB if the loudest phases of construction for each development occurred concurrently. If these works are due to occur concurrently then work should be done during Daytime and Saturday category hours (65dB limit). Therefore, cumulative construction effects would result in Negligible impact and Not Significant with the implementation of a CNMP.	The operational noise from Kintore to Tealing OHL is predicted to be low with minor impact (not significant). The maximum wet noise from Kintore to Tealing OHL is predicted to be 25dB at NSR 20. This level will not contribute to an increase in impact at any NSR. Therefore cumulative operational impact from Kintore to Tealing OHL is Negligible and Not Significant.

Development Name	Construction Noise	Operational Noise
Alyth to Tealing 275 kV OHL Upgrade (to 400 kV) *	The construction phases of this project in the areas surrounding the Proposed Development have already been considered in this report and residual impacts have been assessed as Not Significant .	Operational noise from Alyth to Tealing OHL at 400 kV has already been accounted for in the operational assessment of the proposed development and shows no adverse impacts, therefore Not Significant .
Tealing to Westfield 275 kV OHL Upgrade (to 400 kV) *	Cumulative construction noise as above.	Operational noise from Tealing to Westfield OHL at 400 kV has already been accounted for in the operational assessment of the proposed development and shows no adverse impacts, therefore Not Significant .
Fithie Energy Park*	The construction of the cumulative development has the potential to have a cumulative noise impact due to the equipment and increased traffic. If the construction works are coincidental, once a contractor has been appointed, a detailed CNMP must be updated to include working times, activities and a schedule. There is the potential for activities that are associated with the construction of the cumulative development that take place concurrently to raise the noise above either the 65 dB daytime noise limit or the 55 dB evening and weekend limit at the Proposed Development NSRs. Therefore, it is possible for cumulative construction noise to result in Major effect which is Significant . Cumulative construction noise is required to be controlled through an updated assessment by the Principal Contractors, and a CNMP. Therefore, with the appropriate mitigation, in the form of reducing equivalent sound pressure level over the working day, residual effects are likely to be Minor and Not Significant .	The battery storage containers will be fitted with air conditioning units and the operation of the facility create noise. Other noise-producing equipment includes transformers and inverters. While recognising there are other noise generating uses in the vicinity of the Site, there are a small number of properties which may be adversely affected by noise from the Proposed Development. Worst-case results from the proposed BESS site will occur in dry conditions, which is where the OHL noise is at a minimum. In wet conditions, the OHL noise is elevated. In these conditions, the background noise is increased due to the rainfall, which would make the effects of the cumulative developments such as the BESS development less likely to have an impact on the relevant receptors. Therefore, cumulative impacts due to the BESS would be low and considered to have Negligible impact.
Balnuith Battery Energy Storage System (BESS)*	Cumulative construction noise as above.	Worst-case results from the proposed BESS site will occur in dry conditions, which is where the OHL noise is at a minimum. In wet conditions, the OHL noise is elevated. In these conditions, the background noise is increased due to the rainfall, which would make the effects of the cumulative developments such as the BESS development less likely to have an impact on the relevant receptors. Therefore, cumulative impacts due to the BESS would be low and considered to have Negligible impact.
Myreton Battery Energy Storage System (BESS)*	Cumulative construction noise as above.	Cumulative operational noise as above.
17 Acres Battery Energy Storage System (BESS)	Cumulative construction noise as above.	Cumulative operational noise as above.
Pitpointie Solar Proposal Application	Cumulative construction noise as above.	Cumulative operational noise as above.

TRANSMISSION

Development Name	Construction Noise	Operational Noise
Ark Hill Wind Farm Extension	Cumulative construction noise as above.	The Ark Hill Wind Farm Extension is approximately 3 km from the nearest Proposed Development NSR and deemed to have Negligible impact due to noise propagation over this distance (assuming this development meets its own noise limit criteria). Therefore, No Significant cumulative effects are predicted.

10.10 Summary of Significant Effects

10.10.1 **Table 10.21: Summary of Significant Effects** below summarises the predicted residual effects of the Proposed Development on Noise and Vibration prior to and following to application of additional mitigation.

Table 10.21: Summary of Significant Effects

Predicted Effects	Significance Prior to Additional Mitigation	Mitigation	Significance of Residual Effects Following Additional Mitigation
Construction	Significant	CNMP – Measures to include active time of noisiest equipment over the working hours, reduce quantity of simultaneous equipment, and prioritise noisiest activity in daytime and increase community engagement.	Not Significant
Operation	Not Significant	Not required	Not Significant
Cumulative	Significant	CNMP– Measures to include active time of noisiest equipment over the working hours, reduce quantity of simultaneous equipment, and prioritise noisiest activity in daytime. Awareness of simultaneous operations of cumulative developments so manage traffic effects.	Not Significant