Environmental Impact Assessment (EIA) Report

LT384 Tealing to Westfield Overhead Line (OHL) 400 kV Upgrade

November 2024

VOLUME 2: CHAPTER 14 – NOISE AND VIBRATION

Figures (Volume 3 of this EIA Report)

There are no figures associated with this chapter.

Appendices (Volume 4 of this EIA Report)

- Appendix 14.1 – Acoustic Terminology;
- Appendix 14.2 – Calibration Certificates;
- Appendix 14.3 – Noise Sensitive Receptors;
- Appendix 14.4 – Construction Activity;
- Appendix 14.5 – Construction Noise Impact Assessment; and,
- Appendix 14.6 – Operational Noise Impact Assessment.

14. NOISE AND VIBRATION

14.1 Introduction

14.1.1 This chapter considers the potential effects, including cumulative effects, of the Proposed Development on noise and vibration during construction and operation. The methodology will primarily focus on assessment of effects on permanent residential receptors in the study area. Where likely significant effects are predicted, appropriate mitigation measures are proposed, and the significance of predicted residual effects are assessed. This chapter (and its associated Appendices) is not intended to be read as a standalone assessment and reference should be made to the introductory chapters of this EIA Report.

14.1.2 The objectives of this chapter are to:

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

14.1.3 An energised electrical overhead transmission 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. These noise levels are present in 275 kV OHLs and are more likely to be prominent in 400 kV OHLs, depending on the conductor type.

14.1.4 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.

14.1.5 An OHL may also produce ‘aeolian noise’. Aeolian noise is caused by wind blowing over a structure resulting in vibration that matches the natural frequency of the structure, or vortex shedding on the surface of a structure. There is currently not a standardised method to predict this type of noise, therefore it is difficult to assess. This type of noise is usually infrequent and depends on wind velocity and direction.

14.1.6 This chapter is necessarily technical in nature so to assist the reader, a glossary of acoustic terminology is included in Appendix 14.1: Acoustic Terminology (Volume 4).

14.1.7 Additional information which supports this chapter is presented in the following Appendices (Volume 4):

- Appendix 14.1 – Acoustic Terminology
- Appendix 14.2 – Calibration Certificates;
- Appendix 14.3 – Noise Sensitive Receptors (NSRs);
- Appendix 14.4 – Construction Activity;
- Appendix 14.5 – Construction Noise Impact Assessment; and.
- Appendix 14.6 – Operational Noise Impact Assessment.

14.2 Assessment Methodology and Significance Criteria

Scope of the Assessment

14.2.1 The scope of this assessment is to quantify the impact that may result from the construction and operational phases (including cumulative) of the Proposed Development.

14.2.2 The Proposed Development and methodology of assessment has been discussed with the Local Planning Authority Environmental Health Officer (LPA EHO).

14.2.3 The assessment of construction noise will comply with the following standards and guidance.

The Control of Pollution Act, 1974 (COPA) (Great Britain, 1974)

14.2.4 Section 60 of the 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 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.

British Standard 5228-1/2:2009 +A1:2014 (BS5228), Code of Practice for Noise and Vibration Control on Construction and Open Sites[1]

14.2.5 Guidance on the prediction and assessment of noise and vibration from construction sites is provided in British Standard (BS) 5228 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.

14.2.6 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 noise sensitive receptors (NSRs) are classified in categories A, B or C according to their measured or estimated background noise level.

14.2.7 In line with best practice (BS 5228-1), a Construction Noise Management Plan (CNMP) will be developed by the principal contractor prior to starting construction works. The details of the CNMP will be agreed with the LPA and is expected to be secured by an appropriately worded planning condition.

14.2.8 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.

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

Planning Advice Note (PAN) 1/2011: 'Planning and Noise'[2]

14.2.9 Published in March 2011, this document provides advice on the role of the planning system in helping to prevent and limit adverse effects of noise. 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.

14.2.10 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 (including commercial and recreation) affecting a noise sensitive building', which is based on BS 4142:1997: Method for rating industrial noise affecting mixed residential and industrial areas. This British Standard has been replaced with BS 4142:2014: Methods for rating and assessing industrial and commercial sound.

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

14.2.11 The National Grid has derived a procedure 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 can also be used to assess the impact of the noise from a specific industrial source at NSRs.

14.2.12 The procedure requires that a series of assessments are conducted in tiers. Tier 3 requires that the background noise (BGN) at NSRs within a set distance from the OHL (usually 200 m) 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 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 rainy 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.

14.2.13 The assessment procedure follows TGN(E)322, and has been conducted in the following stages:

- 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;
- the outcome of the Tier 2 assessment will determine whether the combined wet and dry noise impact is acceptable, or whether further assessment is required;
- 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 attended collection of night-time background noise levels at NSRs, or groups of such NSRs, within at least 280 m of the centreline of the OHL during suitable dry weather conditions, before construction;
- allowance for the effects of rainfall on BGN;
- prediction of contribution from conductors; and,
- determination of total excess at the most likely rain rate.

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

British Standard 4142:2014+A1:2019: Methods for rating and assessing industrial and commercial sound (BS 4142)[3]

14.2.14 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.

14.2.15 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.

14.2.16 In accordance with the assessment methodology, the specific sound level (LAeq,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" (LAr,Tr).The British Standard effectively compares and rates the difference between the rating level and the typical background sound level (LA90,T) in the absence of the noise source being assessed.

14.2.17 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.

14.2.18 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*."

BS8233:2014[4] *and Noise Rating Curves*[5]

14.2.19 British Standard 8233:2014: Guidance on sound insulation and noise reduction for buildings provides guidance for the control of noise in and around buildings. The guidance provided within the document is applicable to the design of new buildings, or refurbished buildings undergoing a change of use, but does not provide guidance on assessing the effects of changes in the external noise levels to occupants of an existing building.

14.2.20 The guidance provided includes appropriate internal and external noise level criteria which are applicable to dwellings exposed to steady-state external noise sources. It is stated in the British Standard that it is desirable

3 British Standard 4142: Methods for rating and assessing industrial and commercial sound (BS 4142), BSI, 2014, Amended 2019
4 British Standard 8233: Guidance on sound insulation and noise reduction for buildings (BS 8233), BSI, 2014
5 ISO 1996-2:2017: Acoustics — Description, measurement and assessment of environmental noise, (ISO 1996), ISO, 2017

for internal ambient noise level not to exceed the criteria set out in BS 8233:2014Error! Reference source not found.. A summary is provided in Table 14.1.

Table 14.1: Summary of Internal Ambient Noise Level Criteria for Dwellings from BS 8233:2014

Activity	Location	Period	Activity
		07:00 to 23:00 Hours, i.e. Daytime	23:00 to 07:00 Hours, i.e. Night-time
Resting	Living Room	35 dB LAeq,16 hour	-
Dining	Dining Room / Area	40 dB LAeq,16 hour	-
Sleeping (daytime resting)	Bedroom	35 dB LAeq,16 hour	30 dB LAeq,8 hour

14.2.21 The Noise Rating (NR curves) was developed by the International Organization for Standardization to determine the acceptable indoor environment for hearing preservation, speech communication and annoyance. The primary standards that reference NR curves include; ISO 1996-1:2016, ISO 717-1:2013, and BS 8233:2014.

14.2.22 The noise rating curves for different sound pressure levels are plotted as acceptable sound pressure levels at different frequencies. Acceptable sound pressure level varies with the room and the use of it. Different curves are obtained for each type of use. Each curve is referenced by a NR number is set out in Table 14.2.

Table 14.2: Noise Rating

Noise Rating	Application
NR 20	Quiet rural area for protection of amenity
NR 25	Concert halls, broadcasting and recording studios, churches
NR 30	Private dwellings, hospitals, theatres, cinemas, conference rooms
NR 35	Libraries, museums, court rooms, schools, hospitals operating theatres and wards, flats, hotels, executive offices
NR 40	Halls, corridors, cloakrooms, restaurants, night clubs, offices, shops
NR 45	Department stores, supermarkets, canteens, general offices
NR 50	Typing pools, offices with business machines
NR 60	Light engineering works
NR 70	Foundries, heavy engineering works

14.2.23 The noise rating curve NR20 equates to a similar total noise level of 30 dB(A), and therefore is an appropriate consideration in respect to indoor noise levels as specified in BS8233.

Extent of the Study Area

14.2.24 The Study Area encompasses the area over which all desk-based and field data were gathered to inform the assessment presented in this Chapter. The Study Area comprises 391 nearby NSRs in proximity to the Proposed Development. These NSRs are all within 280 m of the nearest point to the OHL. The distance of 280 m was chosen after a screening of the worst-case conductor type where any NSRs outside of 280 m would pass a Tier 1 assessment according to TGN(E)322. The main settlements within the vicinity of the OHL Route include North Dronley, Piperdam, Longforgan, St Madoes, and Abernethy. Smaller settlements, individual dwellings, and clusters of properties are also distributed along the length of the OHL Route.

Consultation Undertaken to Date

14.2.25 To inform the scope of the assessment for the Proposed Development, consultation was undertaken with the LPA. Table 14.3 summarises the responses relevant to this chapter and provides information on where and/or how points raised have been addressed in this assessment.

Table 14.3: Summary of Consultation Undertaken

Consultee	Type of consultation	Response	Action
Angus Council	Proposed methodology and assessment approach.	General agreement on methodology from involvement in the East Coast 400 kV upgrade. Noted that change to specific OHL methodology (now TGN(E)322). Expects for some consideration for internal noise impacts. Expects justification of 280 m separation distance. Notes there seems to be significant distance between some NSRs and the nearest background monitoring locations, and this should be justified.	An indoor assessment has been conducted against NR curve criteria, assuming a partially open window. Initial screening calculations show that past 280 m, noise levels are insignificant from the proposed conductor. Some properties initially identified were screened to be non-inhabited, and therefore have been removed from the assessment.
Perth and Kinross Council	Proposed methodology and assessment approach.	Generally happy with the proposed methodology, however, note that whilst previous assessments; North East 400 kV Reinforcement Works (Jan 2020) and East Coast 400 kV Upgrade (Dec 2020) have included NR Curves, there is no mention of this criteria in the proposed assessment.	An indoor assessment has been conducted against NR curve criteria, assuming a partially open window.
Fife Council	Proposed methodology and assessment approach.	Happy with proposal of methodology and assessment. Requests that the Old Lodge property (322949, 714335) is considered for measurement.	A background noise measurement at Old Lodge has been conducted and has been considered as an NSR for assessment.

Method of Baseline Data Collation

14.2.26 The field survey consists of free-field attended spot measurements at each noise sensitive receptor using a class-1 sound level meter. This is necessary to determine the existing noise environment and to obtain background noise (BGN) levels at each location. This background noise level is used as a baseline for the operational noise impact assessment for dry and wet conditions.

14.2.27 Measurements were conducted using Rion NL-52 sound level meters (serial numbers 01265436 and 00175536) which was spot calibrated with a Rion NC-74 calibrator (serial number 34178103), before and after the measurement campaign. Calibration certificates can be found in Appendix 14.2 (Volume 4). Where the acoustic environment was stable with no transient noise sources, a 5-minute measurement was conducted as this was representative of the location during this period. If transient noise sources were present, the measurement was extended to 15-minutes as recommended by BS4142.

14.2.28 Measured parameters include the following:

- L_{Aeq} (5-minutes);

- L_{Aeq} (5-minutes) one-third octave band spectrum;
- L_{A90} (5-minutes); and,
- L_{A90} (5-minutes) one-third octave band spectrum.

Assessment Modelling

Construction Noise

14.2.29 A desk-based construction noise 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 British Standard 5228-1:2009 +A1:2014 (BS5228), Code of Practice for Noise and Vibration Control on Construction and Open Sites.

14.2.30 The hours of the construction activities are outlined in Table 14.4, with likely construction equipment identified in Annex C of BS 5228-1. At the time of writing, it is not known the exact start and end date of each activity. 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 14.4: Construction Schedule

Contract Works	Proposed Working Hours
Felling (where required)	Summer (1st Mar to 31st Oct) Monday – Friday: 07:00 – 19:00 Saturday – Sunday: 07:00 – 17:00 Winter (1st Nov to 28th Feb) Every day 07:30 – 17:00 (or as daylight allows)
Dismantling and Removal of Conductor	
Foundations	
Stringing of Conductor	

Construction Vibration

14.2.31 A desk-based construction vibration appraisal has been prepared for the purpose of assessing the effects of the land levelling works on any nearby residents. This appraisal has been produced in line with British Standard 5228-2:2009 +A1:2014 (BS5228), Code of Practice for Noise and Vibration Control on Construction and Open Sites.

14.2.32 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.

14.2.33 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.

14.2.34 Potential of heavy goods vehicle (HGV) vibration on receptors along haul roads will be predicted using the procedures in Transport and Road Research Laboratory (TRL) Research Report 246 – Traffic Induced Vibrations in Buildings.

Operational Noise

14.2.35 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.

14.2.36 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.

14.2.37 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.

14.2.38 There is no method for the prediction or assessment of potential aeolian noise impacts. Therefore, aeolian noise is not assessed within this chapter, however, should be anticipated and mitigated in the design of the Proposed Development.

Determining Sensitivity of Receptors

14.2.39 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 for the change. By the combination of the assessed value of these three components, the NSRs' sensitivity can be classified as Low, Medium or High (Table 14.5). A negligible category is not included, as such a receptor would be an unoccupied or unused area, which is not a defined receptor.

Table 14.5: Evaluation of Receptor Sensitivity

Level of Sensitivity	Definition
Low	The receptor has minor societal value, low vulnerability for the change and no existing regulations and guidance. Even a receptor which has major or moderate societal value may have low sensitivity if it is not liable to be influenced by the Proposed Development. Area used primarily for leisure activities, including recreational routes, sites of historic or cultural importance.
Medium	The receptor has moderate value to society, its vulnerability for the change is medium, regulation may set reference values or recommendations, and it may be in a conservation program. Even a receptor which has major societal value may have medium sensitivity if it has low vulnerability, and vice versa.
High	Legislation strictly conserves the receptor, or it is very valuable to society, or very liable to be harmed by the Project development. Vulnerable subgroups including hospitals, pre-schools, care homes, and hospices.

14.2.40 Prior to detailed assessment, all NSRs considered in this assessment are assumed to be residential in nature with a quiet baseline noise environment. Therefore, the sensitivity is assumed as ***Medium*** unless otherwise specified.

Determining Magnitude of Impact

Construction

14.2.41 The noise criteria provided for the ABC method detailed in BS 5228-1 are shown in Table 14.6.

Table 14.6: 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

14.2.42 Night-time is defined as between 23:00 and 07:00. Evenings and weekends are defined as 19:00 to 23:00 on weekdays, 13:00 to 23:00 on Saturdays and 07:00 to 23:00 on Sundays. Daytime is defined as 07:00 to 19:00 on weekdays and 07:00 to 13:00 on Saturdays.

14.2.43 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 and therefore the Proposed Development will be assessed to Category A thresholds.

14.2.44 From the outlined construction schedule, work is expected seven days a week. It is likely that majority of construction works will occur during daytime periods, however, may extend into evening periods at weekends. It is not known what activities within each phase will take place at what times, therefore, all activities within each phase are assumed to take place in the evening. Therefore, the 55 dB(A) limit has been adopted in this case to ensure a conservative assessment takes place.

14.2.45 With a noise limit of 55 dB(A) identified from BS 5228-1, the following magnitude of impact at receptors can be determined from Table 14.7.

Table 14.7: Construction Noise - Magnitude of Impact at Receptors

Magnitude of Impact	Construction Noise Level (dB(A))
High	> 60
Medium	56 to 60
Low	BGN to 55
Negligible	< BGN

14.2.46 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.

14.2.47 Criteria for construction vibration due to access tracks and foundation works are taken from Table B.1 in BS5228-2 and shown in Table 14.8. Vibration is measured as peak particle velocity (PPV).

Table 14.8: Construction Vibration Impact Assessment Criteria

Impact Magnitude	Vibration Level, PPV	Effect
Negligible	0.13 mm·s^{-1}	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 mm·s^{-1}	Vibration might be just perceptible in residential environments.
Medium	>1.0 mm·s^{-1}	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 mm·s^{-1}	Vibration is likely to be intolerable for any more than a very brief exposure to this level in most building environments.

14.2.48 Excess over the 10 mm·s^{-1} criteria will result in ***High*** impact magnitude. Construction vibration between the 1 mm·s^{-1} and 10 mm·s^{-1} threshold will result in ***Medium*** impact magnitude. Below 1 mm·s^{-1} will result in ***Low*** impact magnitude.

Operational

14.2.49 The magnitude of an 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 BS 4142. 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**.

14.2.50 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 14.9:

Table 14.9: BS4142 Impact Magnitude

Impact Magnitude	Definition
Negligible	Impact to the receptor is immeasurable, undetectable or within the range of normal natural background variation.
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.
Medium	A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context.
High	A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.

Determining Significance of Effect

14.2.51 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 14.10).

14.2.52 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.

14.2.53 The evaluation of effect significance shall be performed by following a conservative approach to account for potential uncertainties affecting baseline data. Resulting effects of ***moderate*** and ***major*** impacts are considered ***significant*** under the EIA Regulations and require mitgation.

Table 14.10: Evaluation of the Effect Significance

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

Limitations and Assumptions

14.2.54 Estimated noise emissions from the Proposed Development's construction noise activities and plant items are based on previous 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 to be operational as according to the construction schedule in Appendix 14.4 (Volume 4). In practice, noise levels during construction would be expected to be lower than the assessment details.

14.2.55 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. These periods are not accounted for in the assessment. 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.

14.2.56 There is always a degree of uncertainty when conducting assessments on developments in the planning stage. These uncertainties occur in calculation, rounding, and baseline levels used. Assumptions include a flat terrain between OHL centreline and NSR. 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) 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.

14.2.57 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 reassessment.

14.2.58 The perception and impact of noise is subjective. As a result, there cannot be an absolute guarantee that complaints will not be received.

14.2.59 Whilst some information gaps have been identified, 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.

14.3 Sensitive Receptors

14.3.1 Potential noise sensitive receptors were processed from AddressBase data. In conducting calculations according to the EPRI method, recommended by the TGN(E)322, an overhead line passes a Tier 1 assessment of TGN(E)322 if the wet noise falls below 34 dB(A) at that receptor. At time of screening for NSRs, the conductor type was not known, only a choice of three conductors. It was calculated that the wet noise from the noisiest of three, Triple Oslo, is predicted to produce 34 dB(A) of wet noise up to a distance of 260 m. Adding a buffer of 20 m, for variances in property size, addresses up to 280 m of the proposed alignment were considered as receptors. Triple Upas and Triple Eagle were the other two conductors. Both are predicted to produce 34 dB(A) at 210 m. The conductor that has been selected for the Proposed Development is Triple Oslo.

14.3.2 There are 391 noise sensitive receptors identified within 280 m of the centreline of the existing overhead line. These are detailed in Appendix 14.3 (Volume 4).

14.3.3 In areas of a high concentration of receptors, measurement locations were selected which were deemed to be representative of the relevant surrounding area. These are often in residential areas with densely populated houses that have a shared acoustic environment. The background noise measurements are used in a Tier 3 assessment.

14.4 Baseline Conditions

14.4.1 Noise monitoring has been conducted in the vicinity of the Proposed Development to determine the existing prevailing noise environment. To determine the background noise (BGN) at each location, free field attended spot measurements were conducted at the nearby NSRs between 23:00 and 03:00 on the nights of 23rd April 2024, 24th April 2024, 1st May 2024, 2nd May 2024, 12th June 2024, and 17th June 2024.

14.4.2 In general, the BGN data is relatively low at night in areas far from busy roads such as the A90. The results of baseline noise survey show that NSRs in vicinity of the Proposed Development have a noise environment quantified between 17 – 39 dB L_{A90} during night periods. The noise environment of NSRs close to the A90 is dominated by traffic noise. Where this traffic noise is not audible, background noise levels drop to a considerably low level.

14.4.3 It is not expected that there will be a significant change to future baseline noise levels than those measured in this study.

14.5 Issues Scoped Out

14.5.1 There are no known vibrational issues associated with the operation of the Proposed Development at nearby NSRs. Therefore, vibration due to operation is scoped out of the EIA assessment.

14.5.2 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.

14.6 Assessment of Effects, Mitigation and Residual Effects

14.6.1 Potential significant effects that may result from the construction and operational phases (including cumulative) and of the Proposed Development include:

- effects of construction noise on the surrounding area and on NSRs including effects of static and quasi-static construction noise from construction plant, such as excavators, dump trucks and cranes; and,

- operational effects of noise from the Proposed Development on NSRs, mainly noise from corona discharge in wet conditions and the potential for aeolian noise in windy conditions.

Mitigation by Design

14.6.2 Aeolian noise is caused by wind blowing through the conductors and/or structures. This type of noise is usually infrequent 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. Dampers can be attached to the lines to minimise aeolian noise. It must be ensured that no components are used that have a known history to produce high aeolian noise.

Construction Phase

14.6.3 It is expected that construction works are likely to occur during the daytime and evening periods at weekends. It is not known what activities will take place during the daytime and evenings. It is therefore assumed all activities can take place in the evening to ensure a worst-case assessment. Therefore, the 55 dB limit has been adopted in this case to ensure a conservative assessment takes place. Excess over the 55 dB criteria will result in ***High*** impact magnitude. The 65 dB limit will also be assessed in case the majority of activities take place in the daytime.

14.6.4 At the time of writing, the equipment expected to be used has not been supplied. Equipment from projects of a similar nature have been assumed, in sequential construction phases.

14.6.5 To calculate the potential construction noise levels from the work sites for the Proposed Development, information about the proposed construction activities is needed. The Principal Contractor will be responsible for developing the detailed construction methodology and associated plant requirements following contract award, however, Appendix 14.4 (Volume 4) shows 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 worst case construction activities at a similar overhead line construction site (proposed Coire Glas 400 kV OHL). 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. The noise due to vehicle movements on access tracks has also been considered. The construction schedule states there is a maximum of eight vehicle movements (six light and two heavy) during construction. This has been averaged and rounded to assume there is an average of one vehicle on access tracks per hour during the proposed construction working hours. The Principal Contractor is also responsible for implementing a Construction Traffic Management Plan, especially in the case this average changes.

14.6.6 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.

14.6.7 This 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.

14.6.8 Detailed results are shown in Appendix 14.4 (Volume 4), and a summary of results are presented in Table 14.11.

Table 14.11 – Summary of Construction Noise Results

Phase	Receptors in excess (55 dB Limit)	Receptors in Excess (65 dB limit)
Felling	0	0
Dismantling and Removal of Conductor	228	9
Foundations	228	9
Stringing of Conductor	16	0

14.6.9 For the felling phase, noise at 0 out of 391 NSRs are above the 55 dB noise limit. The distance is considered to be the distance from the NSR property centre to the nearest felling buffer. Felling activities will vary in time spent, with some areas expected to be very short term. When a CNMP is created, the time expected to fell trees in each area should be specified to assess the severity of the construction noise.

14.6.10 Noise at 228 of 391 NSRs are above the 55 dB limit for the dismantling and removal of conductor phase, with 87 rated as ***High*** impact. If completed in the daytime, then there are 9 limit breaches.

14.6.11 For the foundations phase, it is predicted 228 of the 391 NSRs are above the 55 dB limit, with 87 resulting in ***High*** impact. If completed in the daytime, then construction noise at 9 NSRs is predicted to be above the 65 dB limit. The construction schedule indicates that foundations works will take place 'where required'. Therefore, when a detailed construction plan is written, it should be made clear which towers foundations works are necessary. The distance is currently assumed to be from the nearest tower to each receptor.

14.6.12 For the stringing, noise at 16 NSRs is predicted to be above the 55 dB limit, with 3 resulting in ***High*** impact. If stringing is done in the daytime, no breaches at any 5 NSRs are predicted.

14.6.13 Therefore, prior to the mitigation measures, construction noise is assessed as ***major*** and therefore ***significant*** due to the 55 dB limit breaches at the assumed phases.

14.6.14 Construction activities associated with vibration are largely unknown at time of writing, therefore, the worst case parameters will be assumed for vibration due to foundation excavation and piling taking place at Tower 140 and impacting the closest receptor to the tower (NSR 113 at 57 metres from the nearest tower). 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 14.12.

Table 14.12: 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

Vibration Parameter	Range
Nominal hammer energy, in joules (J)	Between 1.5 and 85 kJ
Potential energy of a raised tamper, in joules (J)	Between 1 and 12 MJ
Distance measured along the ground surface, in m	57 m for closest NSR 113 to tower

14.6.15 Table 14.13 shows the worst-case results of the groundborne vibration due to piling. Vibratory compaction, percussive piling, and dynamic compaction have been calculated in the case these activities will take place.

Table 14.13: Groundborne Vibration Results from Foundation Works at Tower 140 on NSR 113

Vibration Operation	Resultant PPV (mms-1)	Magnitude of Impact
Vibratory Compaction (Steady State)	0.55	Low
Vibratory Compaction (Start Up and Run Down)	1.06	Medium
Percussive Piling	0.24	Negligible
Vibratory Piling	0.21	Negligible

14.6.16 All impacts for potential vibration works apart from vibratory compaction have been assessed as ***Low***. In the worst case, the vibratory compaction will be perceptible, therefore, the significance of effect for construction vibration is ***Medium***.

14.6.17 The vibratory compaction for startup and run down is determined by the number of vibrating drums, the maximum amplitude of drum vibration and the vibrating roller drum width. These are currently assessed to the absolute maximum for the distance to the nearest NSR. The Principal Contractor should update this assessment when information is made available. BS 5228-2 guidance suggests that prior warning should be given to local residents for a vibration level of 1.0 mms^{-1}. At distances greater than 57 m and given the maximum conservative assumptions, the vibration level would no longer exceed 1.0 mms^{-1}, therefore any NSRs within this range should be given prior warning.

14.6.18 Vibration due to traffic on access routes has been assessed. Vehicle movements are not known at time of writing. Therefore, it assumed one heavy goods vehicle is passing by the NSRs per hour. Groundborne vibration arises primarily from the interaction of vehicle tires with irregularities in the road surface, such as potholes, cracks, or bumps. In this case, the road defect is a 5 mm depression, which could amplify groundborne vibrations. However, it is important to consider the condition of the road surface, ground conditions, and vehicle characteristics when evaluating the magnitude of impact.

14.6.19 In this case, with a vehicle traveling at an assumed maximum 60 km/h over a 5 mm road defect, at a distance of 5 metres from any property, it is expected that the resultant maximum PPV is 0.4 $mm.s^{-1}$ would fall within the ***minor*** impact range according to Table 3.33 of LA 111. This would likely result in a ***low*** significance of effect.

14.6.20 Construction-related traffic vibrations are typically temporary and transient, depending on the frequency and volume of construction vehicle movements. LA 111 provides criteria for determining significance based on the duration of the vibration impacts, which shall constitute a likely significant effect:

- 10 or more days or nights within any 15 consecutive days, or 40 or more days within any 6 consecutive months.

14.6.21 In this scenario, if the vibration occurs frequently (e.g., if multiple vehicles drive over the defect daily), a more detailed evaluation of the long-term vibration impact may be necessary.

Mitigation During Construction

14.6.22 If works are to be conducted in the evenings, the 55 dB limit is breached at a majority of the NSRs for all construction phases except felling, as shown in Appendix 14.5 (Volume 4).

14.6.23 Due to the assessment being performed on assumed information at this stage, a more detailed construction noise assessment with a CNMP, in accordance with the guidance and procedures outlined in BS 5228-1 will need to be conducted by the Principal Contractor. The CNMP is expected to be embedded within the Construction Environmental Management Document (CEMD). Procedures will include:

- minimising the noise as much as is reasonably practicable at source;
- attenuation of noise propagation by the addition of acoustic absorptive screens or barriers within the site;
- 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 residents.

14.6.24 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. Delivery vehicles should follow routes that minimise use of residential roads;
- ensure plant and equipment are regularly and properly maintained. All plant should be situated to sufficiently minimise noise impact at nearby properties;
- 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,
- working typically not to take place outside of hours defined in the construction schedule.

14.6.25 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 noise sensitive receptors 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 and necessary to shield high-noise level activities; and
- provide lined acoustic enclosures for equipment such as portable generators.

14.6.26 It is expected that the detailed construction noise assessment and CNMP will address any remaining predicted noise excess in the relevant periods as required, and should be conducted prior to the commencement of any construction works.

Residual Construction Noise Effects

14.6.27 There is the potential for ***significant*** impact during construction due to noise. The information used in this assessment may not be accurate to the actual equipment used on site, therefore, this assessment is required to be reviewed and updated as necessary by the Principal Contractor once the specifics are known. It is expected that with the implementation of a CNMP 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***.

Operational Phase

14.6.28 The corona-induced audible noise of the OHL in rainfall has been calculated using the EPRI[6] method as recommended in TGN(E)322. Information of the Triple Oslo conductor has been supplied for this calculation. The external rain-induced noise levels will be assessed using the TGN(E)322 methodology developed by National Grid, which is recommended by the Department of Energy & Climate Change for the assessment of rain induced noise.

14.6.29 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 noise is generally inaudible. For these reasons, an alternative noise assessment method to deal with rain-induced noise is required.

14.6.30 In the TGN(E)322 method, where the tiered system screens out receptors of low wet noise in Tier 1 and if necessary, assesses the combined wet and dry noise in Tier 2. 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.

14.6.31 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 14.14.

Table 14.14: 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-leafed ground cover vegetation, such as grass lawn, meadow, hayfield shortly after mowing, field of small-leaf plants.

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

Miller Curve	Description
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-leafed 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-leafed crops or vegetation, such as corn starting 15 to 30 m distance.
R-5	Large area of fully leafed trees or large-leafed crops or vegetation surrounding the area of interest.

14.6.32 Most receptors are of ***Medium*** sensitivity. As shown in Appendix 14.6 (Volume 4), for the Tier 1 assessment, the wet noise at each location is predicted to be between 34 and 50 dB. Also detailed is the distance from the NSRs to the nearest point on the existing line.

14.6.33 Audible noise from the wet overhead line falls below 34 dB for 12 receptors. This results in ***Negligible*** magnitude of impact at these NSRs and therefore ***not significant***.

14.6.34 This analysis includes a conservative assessment of the span between towers 67 and 65 where GAP Matthew is a proposed conductor. The noise emission of this type of conductor however is unknown, therefore, Twin Totara is assumed as this is the noisiest conductor known at time of writing. Old Lodge (322942, 714334) is 152 metres from the OHL and Pitmedden Farm (322531, 714129) is 292 metres from the OHL. Both NSRs are more likely to be impacted by the GAP Matthew, therefore, the noise emission is assumed to be similar to a Twin Totara. Wet noise at Pitmedden Farm is predicted to be 33.8 dBA and therefore passes at a Tier 1 assessment. Old Lodge wet noise is predicted to be 39.3 dBA. It proceeds to a Tier 2 assessment.

14.6.35 379 NSRs are required to proceed to a Tier 2 assessment. 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 01/06/2014 to 31/05/2024. If combined noise is above 36.8 dBA, NSRs will proceed to a Tier 3 assessment. The results of this assessment are also shown in Appendix 14.6 (Volume 4). The combined wet and dry noise at the Old Lodge is predicted to be 29.5 dB(A) and therefore passes a Tier 2 assessment, assuming the Twin Totara noise emissions.

14.6.36 The Tier 2 assessment for the remaining 379 NSRs indicates excess above 36.8 dB(A) and therefore adverse impact at one receptor, NSR 109. This is the only NSR to proceed to a Tier 3 assessment, where the background noise in wet conditions is considered. A 3 dB tonal penalty is applied to dry noise and compared against measured background noise level. A 6 dB tonal penalty is applied to the wet noise, which is compared to background noise adjusted for noise due to rainfall.

14.6.37 Results of the Tier 3 assessment are shown in Appendix 14.6 (Volume 4) The excess of wet noise above background is 12 dB for NSR 109. This excess of wet noise only applies during nighttime conditions. Due to predicted excess at this receptor, additional assessment has been performed to compare the nighttime wet noise to daytime wet noise.

14.6.38 A noise study conducted by Noise Assessments Ltd in support of the planning approval of the property show the background noise during the day to be 51 to 52 dB(A). The levels measured are understandably high due to the

proximity of the A90. It is expected that there would be further increases of noise during wet conditions due to interactions with the road traffic.

14.6.39 Table 14.15 shows the results of a daytime and nighttime assessment of the wet noise levels.

Table 14.15: Daytime and Nighttime Wet Noise Assessment

Wet Noise		Day			Night		
Wet Noise (dB(A))	Wet Noise Rating (dB(A))	Background Noise Level (dB(A))	Background Noise Level Adjusted for Wet Conditions (dB(A))	Wet Noise Excess (dB(A))	Background Noise Level Adjusted for Wet Conditions (dB(A))	Background Noise Level Adjusted for Wet Conditions (dB(A))	Wet Noise Excess (dB(A))
45.5	52	51	51	1	35.5	40	11

14.6.40 The daytime noise level is very high due to pre-existing traffic noise levels and the impact from the overhead line will be barely perceptible.

14.6.41 The daytime external operational noise assessed to TGN(E)322 methodology at NSR 109 is assessed as a ***low*** magnitude of impact, therefore assessed as a ***minor*** effect which is ***not significance***.

14.6.42 The nighttime external operational noise assessed to TGN(E)322 methodology at NSR 109 is assessed as a potential high magnitude of impact. For nighttime conditions, operational noise shall constitute a significant effect only where it is determined a **High** or **Medium** magnitude while also exceeding the internal noise limits of 30 dB(A) set out in BS8233 or exceeds NR20 criteria. This is due to the context of the assessment, during nighttime conditions it is more appropriate to consider internal noise and the potential for sleep disturbance, rather than the external amenity which is likely not in use during these times.

Internal Noise Assessment

14.6.43 According to Table 4 of BS8233, the indoor ambient noise levels in the nighttime should not exceed 30 dB $L_{Aeq,8hr}$. In addition, octave band levels should meet an NR 20 rating for nighttime and NR25 rating for daytime.

14.6.44 The external noise levels and spectra have been considered at each receptor. An external to internal noise calculation has been performed on the basis of a partially open window for the nearest receptors. The small element parameter level difference (Dn,e) is given by the Titon Xtra Sound Attenuator V75+C60. This product has been recommended by Perth and Kinross Council for the planning permission of NSR 109 on the basis that traffic noise is a high noise source. NSR 109 is currently under construction, where windows will be fitted with a minimum 32 dB Rw+Ctr rated glazing and 40 dB Dne,w+Ctr acoustic trickle ventilation. The level difference values are estimated from acoustic trickle ventilation in Table 14.16.

Table 14.16: Estimated Level Difference Through Acoustic Trickle Ventilation

63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	Dn,e
-44.0	-38.0	-38.0	-40.0	-38.0	-41.0	-43.0	40

14.6.45 The internal noise levels at NSRs 109 are assessed as ***negligible*** and ***not significant***.

Mitigation During Operation

14.6.46 The results of the internal noise assessment for the existing site are presented in Table 14.17.

Table 14.17: Predicted Internal Noise Levels

NSR	External Noise Level (dB(A))	Level (dB(Z))							
		63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	Total (dB(A))
NR 25	--	55	44	35	29	25	22	20	-
NR 20	-	51	39	31	24	20	17	14	-
109	44.3	-14.3	-8.0	1.5	-13.2	-9.0	-9.6	-10.7	-2.2

14.6.47 The results above show that for the Proposed Development, the internal noise level at the closest NSR meets the 30 dB limit as well as falling below the NR 20 and NR 25 curves, therefore it is predicted that the internal noise level at NSR 109 meet the 30 dB limit and NR curves.

14.6.48 Therefore, in context, although the external noise levels do not meet the requirements of a BS4142 assessment during nighttime periods, the internal noise levels are acceptable at NSR 109.

14.6.49 The proposed conductor type, Triple Oslo, has the potential to produce high noise in wet conditions, the assessment indicates that all but one of the NSRs pass a Tier 2 assessment, this is due to the limited time in which it rains in the Study Area. However, when it does rain, the noise from the Proposed Development is predicted to be high enough at NSR 109 for a low magnitude of impact at the external amenity during daytime conditions, and high magnitude impact at the external amenity at night, however, the external amenity is considered to be irrelevant at this time. For sleep disturbance at night, the internal noise does not exceed 30 dB or an NR 20 curve and therefore the overall impact magnitude is considered ***low*** and therefore a ***minor*** effect which is ***not significant***.

Residual Operational Noise Effects

14.6.50 The assessment predicts 12 NSRs with ***negligible*** effects, 378 NSRs with ***minor*** effects and one NSR with a ***major*** effect. The outcome of the assessment predicts that residual noise would be ***minor*** and ***not significant***.

Schedule of Mitigation

14.6.51 Table 14.18 summarises the noise and vibration mitigation measures required for the Proposed Development.

Table 14.18: Summary of Noise and Vibration Mitigation Measures

Mitigation Item	Location	Timing of Measure	Description	Mitigation Purpose/ Objective	Specific Consultation or Approval Required	Potential Monitoring Requirements
NV-1	Proposed Development	By design, prior to construction	Attaching dampers to conductors at both ends near tower structure. Suppliers of dampers and insulators required to test for potential noise issues.	To minimise aeolian noise caused by incident wind.	None.	Aeolian noise can be monitored continuously in a long-term survey as this phenomenon is infrequent and difficult to predict.
NV-2	Proposed Development	During construction	Construction Noise Management Plan (CNMP).	To reduce noise impact.	Principal Contractor will update schedule.	Compliance during evening hours to ensure 55 dB limit is met.

Cumulative Effects

14.6.52 Table 14.19 presents the summary of cumulative effects from associated SSEN Transmission developments.

Table 14.19: Interactive (intra) cumulative assessment for Associated SSEN Developments

Development	Ref. on Figure 5.1	Location	Description	Status	Residual Significant Effects (if known) / information from any available sources on likely significant effects	Cumulative Assessment	Additional Mitigation
Alyth – Tealing 275 kV OHL upgrade	A	Alyth -Tealing	Upgrade of approximately 16 km of an existing 275 kV OHL between Alyth Substation and Tower 685 north-west of Tealing Substation to enable operation at 400 kV.	EIA Report in preparation (alongside the EIA Report for the Proposed Development.	No significant effects.	Cumulative noise with the proposed upgraded Alyth to Tealing 400 kV OHL has been considered. The Proposed Development and the Alyth to Tealing OHL are 1.6 km apart at the nearest point. Cumulative noise is predicted to be negligible and therefore not significant.	None
Emmock (Tealing) substation	B	Near Emmock Road, Tealing	Construction of a new 400 kV substation in Tealing.	Scoping Report submitted 2nd July 2024.	Not available.	Emmock (Tealing) substation is a source of noise in the Study Area associated with the Proposed Development. The Proposed Development is assessed for worst-case noise in wet conditions. In these conditions, the background noise is raised due to rainfall, therefore, operational noise from Emmock (Tealing) 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. Receptors that are within 500 m of the Proposed Development are at least 2 km from Emmock (Tealing) substation. These cumulative receptors are unlikely to exceed wet background noise with contributions from Emmock (Tealing) substation and the	None.

Development	Ref. on Figure 5.1	Location	Description	Status	Residual Significant Effects (if known) / information from any available sources on likely significant effects	Cumulative Assessment	Additional Mitigation
						Proposed Development. The worst-case noise effects of Emmock (Tealing) substation are assessed in dry conditions, where noise from the Proposed Development is negligible. Therefore, cumulative noise in dry and wet conditions is not significant.	
Kintore - Tealing 400 kV Connection	C	Kintore - Tealing	Construction of a new 400 kV OHL between Kintore and Tealing.	In Preparation – no screening or scoping submitted.	Not available.	Receptors were considered where noise from the Kintore to Tealing 400 kV OHL line could cause cumulative impact with the Proposed Development and the Alyth to Tealing OHL. As a Tier 1 assessment which compares noise to a 34 dBA limit, receptors were assessed where the combination of wet noise from the conductors of the three relevant OHLs would exceed 34 dBA. There are no NSRs that are within this range. Cumulative noise from the Kintore-Tealing 400 kV OHL is therefore deemed as not significant.	None.
Alyth-Tealing and Tealing-Westfield OHL Tealing (Emmock) substation tie-ins and associated tower dismantling	D	Tealing	Construction of a new OHL originating at some point on the existing OHLfrom the Alyth-Tealing OHL between Tower 680 and Tower 682, as well as the Proposed Development between Tower 180 and Tower 182 (likely Tower 181),	In Preparation – no screening or scoping submitted.	Not available.	The noise from the proposed OHLs has been estimated at each NSR, and the total cumulative noise predicted from existing OHLs. Four NSRs have shown to require further analysis. All other NSRs predict negligible impact. The four NSRs are situated in Jeanfield (Jeanfield Farm, Jeanfield Steadings, Jeanfield Farmhouse, and East Jeanfield	None.

Development	Ref. on Figure 5.1	Location	Description	Status	Residual Significant Effects (if known) / information from any available sources on likely significant effects	Cumulative Assessment	Additional Mitigation
			connecting to the new proposed Tealing (Emmock) substation. This will enable the removal of approximately 1.5 km of redundant OHL between Towers 680/682 and 180/182, and the existing Tealing Substation.			Farm). An evaluation of worst-case noise contributions has been performed for existing and proposed OHLs. All noise impacts at these locations are predicted to be dominated by the noise from the Tealing-Westfield 400 kV OHL upgrade. NSRs at Jeanfield will not be impacted by tie-ins, tiebacks, or diversions and therefore predicted impact is negligible. Operational noise has been assessed and any potential significant effects identified would result from cumulative noise from existing or proposed future OHLs. Operational noise from the tie ins, tie backs and temporary diversions is predicted to be negligible. Therefore, no significant effects are likely for operational noise.	

14.6.53 Table 14.20 presents the summary of inter cumulative effects from other SSEN Transmission and third-party developments.

Table 14.20: 21 In-combination (inter) Cumulative Assessment for Other SSEN and 3rd Party Developments

Development	Ref. on Figure 5.1	Location	Description	Status	Residual Significant Effects (if known) / information from any available sources on likely significant effects	Cumulative Assessment	Additional Mitigation
Muir of Pert Energy Storage Facility	E	Muir of Pert Farm, Tealing, Dundee DD4 0QL	Energy storage facility up to 50 MW, compound of equipment, access, fencing, security cameras, landscaping, tree planting, demolition of derelict buildings and other associated works	Proposal of Application (PAN) Approved Subject to Conditions 12th July 2023 and EIA Screening Request submitted and determined EIA Not Required 11th July 2023.	Not available.	The construction of the energy storage facility 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 construction noise management plan 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 Energy Storage Facility site 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 Alyth-Tealing OHL 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 Contractor, and a CNMP. Therefore, with the appropriate mitigation, residual effects are likely to be minor and not significant. Cumulative operational noise as above. The site is 3 km from the OHL, where NSRs relevant to the site will have negligible impacts from the OHL.	None.

Development	Ref. on Figure 5.1	Location	Description	Status	Residual Significant Effects (if known) / information from any available sources on likely significant effects	Cumulative Assessment	Additional Mitigation
						Therefore, cumulative impacts due to the Energy Storage System would be low and considered to have negligible impact.	
Moatmill Bridge Tealing Energy Storage Facility	F	Land at Moatmill Bridge, Tealing	Energy storage facility up to 50 MW, compound of equipment, meter building, fencing, security cameras, new belt of native trees and landscaping.	PAN Approved Subject to Conditions 3rd May 2023.	Not available.	Cumulative construction noise as above. Cumulative operational noise as above. The site is 3 km from the OHL, where NSRs relevant to the site will have negligible impacts from the OHL. Therefore, cumulative impacts due to the Energy Storage System would be low and considered to have negligible impact.	None.
Tealing Solar Energy Park	G	Near Duntrune, DD4 0PR	Application for Installation of a solar energy park of approximately 100 MW and all associated infrastructure.	Application submitted 17th November 2023. EIA not required.	Not available.	Cumulative construction noise as above. Cumulative operational noise as above. The site is 4 km from the OHL, where NSRs relevant to the site will have negligible impacts from the OHL. Therefore, cumulative impacts due to the Energy Park would be low and considered to have negligible impact	None.
Tealing Battery Energy Storage Farm	H	Land to the north-east of Gagie Home Farm, Duntrune, DD4 OPR	Application for Installation of an 80 MW Battery Energy Storage Facility (BESS) and associated infrastructure.	Application Consented 13th December 2023 EIA not required.	Not available.	Cumulative construction noise as above. Cumulative operational noise as above. The site is 4 km from the OHL, where NSRs relevant to the site will have negligible impacts from the OHL. Therefore, cumulative impacts due to the Energy Storage Farm would be low and considered to have negligible impact.	None.

Development	Ref. on Figure 5.1	Location	Description	Status	Residual Significant Effects (if known) / information from any available sources on likely significant effects	Cumulative Assessment	Additional Mitigation
Solar Farm at land 500 m East of Stoneygroves Liff	I	Land 500 m East of Stoneygroves Liff	Solar farm installation with an export capacity of 20 MW (AC) (with peak generation capacity of 24-28 MW) comprising ground-mounted solar photovoltaic arrays together with associated infrastructure and landscaping.	Application Approved Subject to Conditions 13th March 2024.	Not available.	Cumulative construction noise as above. Cumulative operational noise as above. The site is over 2 km from the OHL, where NSRs relevant to the site will have negligible impacts from the OHL. Therefore, cumulative impacts due to the Energy Storage System would be low and considered to have negligible impact.	None.
Battery Energy Storage at Cordon Farm, Abernethy	J	Land 600 m north-east of Cordon Farm, Abernethy	Formation of 30 MW BESS facility with associated access and infrastructure.	Proposal of Application submitted 6th December 2022.	Not available.	Cumulative construction noise as above. Cumulative operational noise as above. Therefore, cumulative impacts due to the Battery Energy Storage System would be low and considered to have negligible impact.	None.
Jamesfield Energy Storage Facility	K	Land 140 m north-east of Jamesfield Organic Centre Newburgh	Formation of a 49 MW battery energy storage facility comprising battery storage units, ancillary buildings, vehicular access, landscaping and associated works.	Application Consented 28th September 2022. EIA not required.	Not available.	Cumulative operational 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 other 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.	None.

Development	Ref. on Figure 5.1	Location	Description	Status	Residual Significant Effects (if known) / information from any available sources on likely significant effects	Cumulative Assessment	Additional Mitigation
Balnuith Farm BESS (Tealing)	L	Balnuith Farm, Tealing, DD4 0RE	The construction and operation of a battery energy storage facility for the storage of up to a 249 MW of electricity together with associated infrastructure, substation, security fencing, CCTV, security lighting and landscaping.	Screening Opinion issued 6th September 2023.	Not available.	Cumulative construction noise as above. Cumulative operational noise as above. The site is 2 km from the OHL, where NSRs relevant to the BESS site will have negligible impacts from the OHL. Therefore, cumulative impacts due to the BESS would be low and considered to have negligible impact.	None.
Fithie Energy Park BESS	M	Land to the north-west of Tealing Substation	Construction and Operation of up to 1400 MW battery energy storage system (BESS) and associated infrastructure	Screening Report submitted ECU00005034	Not available.	Cumulative construction noise as above. The battery storage containers will be fitted with air conditioning units and the operation of the facility, as a whole, may create noise. 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 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 other developments such as the BESS development less likely to have an impact on the relevant receptors.	None.

Development	Ref. on Figure 5.1	Location	Description	Status	Residual Significant Effects (if known) / information from any available sources on likely significant effects	Cumulative Assessment	Additional Mitigation
						The site is approximately 2 km from the OHL, where NSRs relevant to the BESS site will have negligible impacts from the OHL. Therefore, cumulative impacts due to the BESS would be low and considered to have negligible impact.	
Myreton BESS	N	Land to the south of Tealing Substation	A proposed BESS system with an installed capacity of around 750 MW.	Screening Report submitted 22nd February 2024.	Not available.	Cumulative construction noise as above. Cumulative operational noise as above. The site is 2 km from the OHL, where NSRs relevant to the BESS site will have negligible impacts from the OHL. Therefore, cumulative impacts due to the BESS would be low and considered to have negligible impact.	None
SPEN TKUP Lines (Uprate to 400 kV operation)	O	Tower YS065 (SHET/SPT Border) near Pitmedden Forest to YS001 (Westfield) and YJ084 (Westfield) to YJ001 (Longannet)7	Increase voltage of approximately 30 km of OHL from 275 kV to 400 kV	No EIA screening or scoping available. Only high-level plan of route available.	Not available.	Cumulative construction noise as above. The nature and occurrence of the operational noise of the SPEN TKUP lines will be the similar to the Proposed Development. The uprating of the SPEN TKUP lines is likely to increase operational noise at nearby NSRs. Noise at NSRs is assessed by calculating noise from the nearest line and associated conductor type. The SPEN TKUP OHL has been assessed for the span between towers 65 and 67, assuming a similar conductor type (400 kV Twin Totara). The noise is assessed to be	None.

7 https://www.spenergynetworks.co.uk/pages/tkup_project.aspx#tablist1-tab2

Development	Ref. on Figure 5.1	Location	Description	Status	Residual Significant Effects (if known) / information from any available sources on likely significant effects	Cumulative Assessment	Additional Mitigation
						low impact at the nearby NSRs. At these NSRs the SPEN TKUP line will be dominant and the Proposed Development is not predicted to increase noise by a significant amount to which the cumulative assessment predicts significant impacts. Any significant impacts are likely to be assessed in the SPEN TKUP Lines noise assessment. Therefore, cumulative impacts due to the SPEN TKUP lines would be low and considered to have negligible impact.	

14.7 Summary

14.7.1 This chapter has considered the potential noise effects that could arise due to the Proposed Development during the construction and operational phases at the closest NSRs. The assessment has taken account of applicable planning policy and current guidance.

14.7.2 A desk-based construction noise assessment, in line with BS 5228, has been prepared for the purpose of assessing the effects of the works on any nearby residents. NSRs in the vicinity fall under Category A, and if construction takes place in the evenings and weekends working hours, noise is predicted to be above the 55 dB limit at the noise sensitive receptors during the foundations, dismantling and stringing works and is therefore predicted to result in ***Major (significant)*** impact without mitigation.

14.7.3 The construction noise assessment is based on assumed information at this stage and should be updated with information from the Principal Contractor. Mitigation in the form of the implementation of a robust construction noise management plan to detail the duration dismantling and stringing activities and location of foundations will ensure the residual construction noise of the Proposed Development will have ***minor*** (***not significant***) impact on nearby NSRs.

14.7.4 Operational noise has been assessed to TGN(E)322, BS4142, and BS8233 standards. The results of the tiered TGN(E)322 assessment predict at NSR 109 ***minor*** impacts which is ***not significant***.

14.7.5 An internal noise assessment was conducted for the operational noise from the Proposed Development, according to BS 8233. This concluded that noise is below 30 dB inside the properties and is below NR 20 and NR 25 curves. This is an indication of ***negligible*** impact which is ***not significant***.

14.7.6 Cumulative noise has been considered from existing operational noise from nearby developments. Receptors potentially impacted by nearby OHLs pass a Tier 1 TGN(E)322 assessment thus deeming cumulative noise ***not significant***. This is also the case for cumulative noise from nearby substations, BESS sites and Energy Storage sites.

14.7.7 Upon completion of the Proposed Development, compliance measurements are recommended to ensure operational noise emissions meet noise limits and that the emissions are in agreement with the levels predicted in this chapter.