VOLUME 2: CHAPTER 14 – NOISE AND VIBRATION

Figures and Visualisations (Volume 3a and 3b of this EIA Report)

There are no figures or visualisations associated with this chapter.

Appendices (Volume 4 of this EIA Report)

14. NOISE AND VIBRATION

14.1 Introduction

This chapter considers the potential effects of noise and vibration from the Proposed Development. The assessment includes the potential effects upon on noise sensitive receptors (NSRs) during both the construction and operation of the Proposed Development. The evaluation of the baseline has been made through a combination of desk-based study, field survey and consultation. 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 (**Volume 2, Chapter 1** to **7**).

This chapter identifies the likely impacts on noise sensitive receptors associated with the construction and operation of the Proposed Development. The objectives of the chapter are to:

- identify the NSRs in the vicinity of the Proposed Development and the baseline noise environment;
- 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.

Transformers and other electrical equipment associated with substation developments emit noise at frequencies of twice the normal operating current frequency due to magnetostriction of the transformer core. In the UK the supply current frequency is 50 Hz, which results in 100 Hz and harmonics thereof being produced by the transformer. The nature of the noise generation mechanism results in tonal noise being emitted. The noise is steady state under normal operating conditions, however, with changes in electrical load, noise levels may fluctuate. The equipment is not expected to have any impulsive characteristics. Other sources of noise include cooling and Heating, Ventilation, and Air Conditioning (HVAC) systems, with a broadband spectrum.

There is the potential for construction activities to generate significant levels of noise and vibration that can impact surrounding communities. During key phases of construction—such as site clearance, excavation, and equipment operation—elevated noise and vibration levels may temporarily affect local residents. There is the potential for construction noise and vibration impacts from static, quasi static, and mobile plant items including crushing or blasting of rock, rotary piling during the construction of foundations, excavators, delivery of materials with lorries/dumper trucks, delivery and pumping of concrete; and installation of electrical infrastructure equipment.

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.

This chapter is necessarily technical in nature so, to assist the reader, a glossary of acoustic terminology is included in **Volume 4 Appendix 14.1** Acoustic Glossary.

Additional information which supports this chapter is presented in the following appendices:

- Volume 4 Appendix 14.1: Acoustic Glossary
- Volume 4 Appendix 14.2: Calibration Certificates
- Volume 4 Appendix 14.3: Source Noise Levels
- Volume 4 Appendix 14.4: Meteorological Data
- Volume 4 Appendix 14.5: Histograms of Sound Level Meter Data LAEQ

- Volume 4 Appendix 14.6: LZEQ Spectra
- Volume 4 Appendix 14.7: Construction Activities
- Volume 4 Appendix 14.8: Construction Noise Assessment
- Volume 4 Appendix 14.9: Noise Contour Map

Refer to **Volume 4 Appendix 4.1** EIA Team for details on the competent experts who undertook the assessment.

14.2 Assessment Methodology and Significance Criteria

Scope of the Assessment

The scope of this assessment is to quantify the impact that may result from the construction and operational phases (including cumulative impacts) of the Proposed Development. 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 and vibration;
- cumulative effects during construction from noise and vibration; and
- cumulative effects during operation from noise and vibration.

Legislation, Policy and Guidance

Legislation

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

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

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 2017

The current requirement for EIA in Scotland comes from the Environmental Impact Assessment (EIA) Directive (2014/52/EU) which is implemented through The Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017, which came into force on 16 May 2017.

Policy

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

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

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 2011): 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.

[1] Planning Advice Note: Planning and noise, PAN 1/2011, The Scottish Government, 2011

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: Methods for rating and assessing industrial and commercial sound.

Standards and Guidance

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

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

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.

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.

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 Highland Council and is expected to be secured by an appropriately worded planning condition.

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.

Calculation of road Traffic Noise (CRTN) 1988

The CRTN memorandum describes the standard UK procedure for the measurement and calculation of road traffic noise. According to the memorandum, the procedures are necessary to enable entitlement under the Noise Insulation Regulations to be determined but they also provide guidance appropriate to the calculation of traffic noise for more general applications e.g. environmental appraisal of road schemes, highway design and land use planning.

Design Manual for Roads and Bridges LA 111 Noise and Vibration[3]

The Design Manual for Roads and Bridges (DMRB) LA 111 Noise and Vibration document provides guidelines for the assessment and management of noise and vibration impacts associated with road projects. The guidance sets out the requirements for assessing noise and vibration impacts from road schemes, ensuring that these impacts are identified, quantified, and managed appropriately.

During any time period, the significance of the effect is defined by the lowest observable adverse effect level (LOAEL) and significant observable adverse effect level (SOAEL).

British Standard 4142:2014+A1:2019: Methods for rating and assessing industrial and commercial sound (BS 4142)[4]

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.

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

3 Design Manual for Roads and Bridges (DMRB), LA 111 Noise and Vibration, Transport Scotland, 2019

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

- Sound from the loading and unloading of goods and materials at industrial and/or commercial premises.
- 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.

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.

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.

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.

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.
- 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."

BS 4142 states for low noise conditions (which this proposed development applies):

- “For a given difference between the rating level and the background sound level, the magnitude of the overall impact might be greater for an acoustic environment where the residual sound level is high than for an acoustic environment where the residual sound level is low.
- Where background sound levels and rating levels are low, absolute levels might be as, or more relevant than the margin by which the rating level exceeds the background. This is especially true at night.”

The second statement will be relevant when background noise levels are very low, which is likely to be appropriate for the assessment of this site. Absolute levels, which is the sum of the background sound level and the specific sound source of the Proposed Development, will be assessed as the more relevant metric if background levels are deemed very low.

ISO 9613-2:2024, Acoustics — Attenuation of sound during propagation outdoors, Part 2: Engineering method for the prediction of sound pressure levels outdoors

This document specifies an engineering method for calculating the attenuation of sound during propagation outdoors in order to predict the levels of environmental noise at a distance from a variety of sources. The method predicts the equivalent continuous A-weighted sound pressure level (as described in ISO 1996-series) under meteorological conditions favourable to propagation from sources of known sound emission.

The operational noise impact assessment will be based on a 3D digital model of the Proposed Development and Study Area to industry standard in in accordance with ISO 9613-2.

BS 8233:2014[5] and Noise Rating Curves

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 BS 8233:2014 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.

British Standard 8233:2014 includes appropriate internal and external noise level criteria which are applicable to dwellings exposed to steady-state external noise sources. It is stated in BS 8233:2014 that it is desirable for internal ambient noise level not to exceed the criteria set out in **Table 14.1**: Summary of Internal Ambient Noise Level Criteria for Dwellings from BS 8233:2014.

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

Activity	Location	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

Noise Rating (NR) curves was developed by the International Organization for Standardization (ISO) 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.

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 as set out in **Table 14.2**: Noise Rating Descriptions.

Table 14.2 Noise Rating Descriptions

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

5 British Standard 8233: Guidance on sound insulation and noise reduction for buildings (BS 8233), BSI, 2014

The NR curve NR 20 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 BS 8233:2014.

NANR116 – Open/closed window research: sound Insulation Through ventilated Domestic Windows

The insulation of an open window has been generally accepted as being 10-15 dBA although its precision and affect on opening style, open area and window size, are not readily available. A programme of laboratory measurements have been undertaken by the Building Performance Centre at Napier University on behalf of the Department for Environment, Food and Rural Affairs, in order to quantify the sound insulation provided by a variety of window types, opening styles, areas of opening and ventilator devices.

Extent of the Study Area

The Study Area is located approximately 6.5 km north of Bonar Bridge, near the settlements of Clashban. The Study Area encompasses the area over which all desk-based and field data were gathered to inform the assessment presented in this chapter, in an area approximately 1,500 m immediately surrounding the Proposed Development. Within the Study Area, a total of two nearby noise sensitive receptors (NSRs) have been identified in proximity to the Proposed Development. These NSRs are approximately 650 and 800 metres from the red line boundary of the Proposed Development respectively. These NSRs are deemed to be representative of nearby residences in the surrounding areaThere are properties located to the south east of NSR 1 and 2, but these are deemed not relevant for this noise and vibration study . as if the noise criteria can be met at the closest NSRs, then any property at a greater distance will also meet the criteria. A map of the Study Area is shown in **Plate 14.1**.

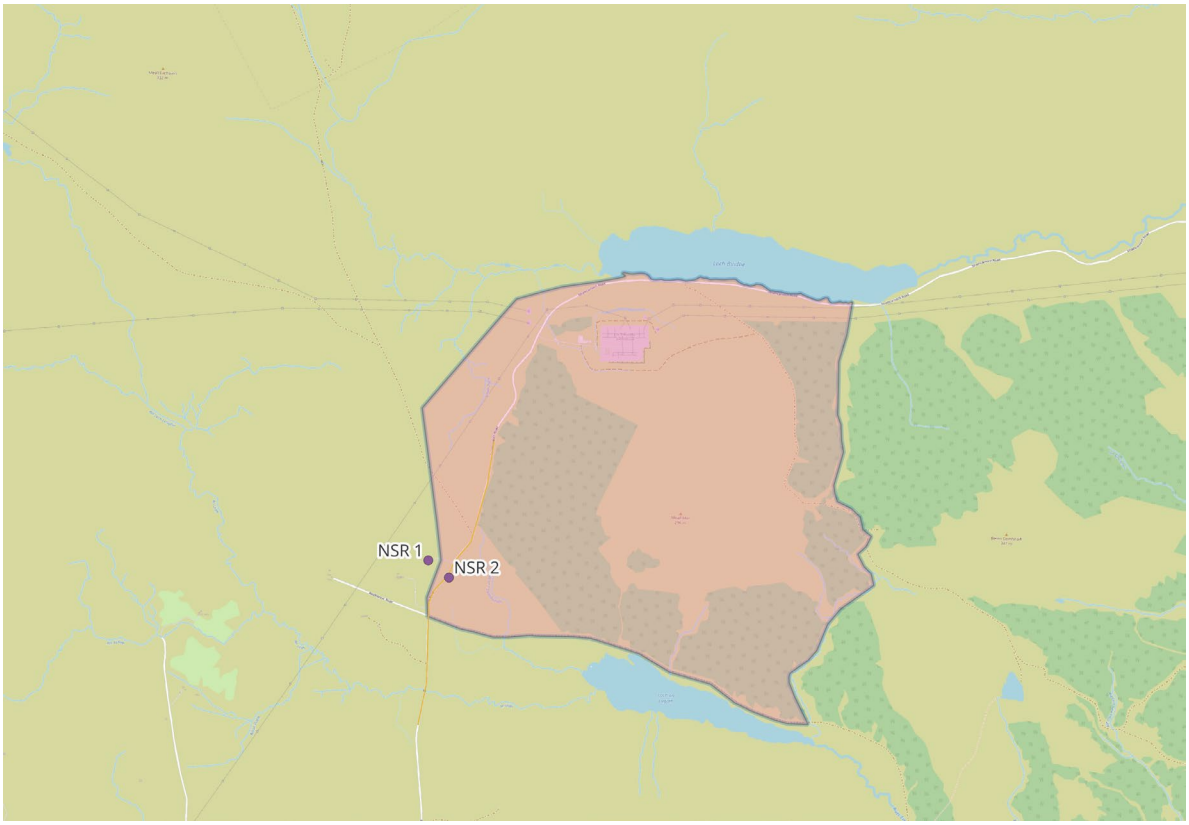

Plate 14.1 Study Area with Red Line Boundary

Consultation Undertaken To Date

Table 14.3 Consultation to Date

Body/ organisation	Type of consultation/ date	Response	How response has been considered
Highland Council – Environmental Health	Environmental Health EIA Scoping Response (24/00833/SCOP) May 2024	The EHO has advised a construction noise assessment will be required: where it is proposed to undertake work which is audible at the curtilage of any noise sensitive receptor out with the hours Mondays to Fridays 8 am to 7 pm and Saturdays 8 am to 1 pm OR where noise level during the above period are likely to exceed 75 dB(A) for short term works or 55 dB(A) for long term works. Both measurements to be taken as a $L_{Aeq,1hr}$ at the curtilage of any noise sensitive receptor. The EHO advises that noise-producing construction activities should not normally take place out with the hours of 8 am and 7 pm Monday to Friday and 8 am to 1 pm Saturdays	Construction compliance measurements are recommended during the long-term works (longer than 6 months) Construction noise will be assessed to a 55 dB limit as work is expected to be long term and take place 7 days per week, from 7 am to 7 pm.

Method of Baseline Data Collation

Noise monitoring has been conducted in the vicinity of the Proposed Development to determine the existing prevailing noise environment. Long term monitoring equipment was installed on 6 August 2024 and decommissioned on 23 August 2024. The measurements were in free-field conditions, at least 3 m from any facades which assumes there are no acoustic reflections near the equipment.

Measurements were conducted using two Rion NL-52 sound level meters which were spot calibrated with a Rion NC-74 calibrator, before, during and after the measurement campaign. These meters were housed in environmental weatherproof enclosures and used to conduct measurements over a long-term period of two weeks. Calibration certificates can be found in **Volume 4 Appendix 14.2** Calibration Certificates.

The parameters measured during the background noise (BGN) monitoring campaign, as specified in BS 4142, include the following:

- LAeq (15 minutes)
- LAeq (15 minutes) one-third octave band spectrum
- LA90 (15 minutes)
- LA90 (15 minutes) one-third octave band spectrum

As the survey is based on long-term unattended measurements, a meteorological station (Vantage Vue) was also set up in the area to monitor weather conditions. Meteorological conditions such as wind and rain will affect background noise conditions and have possible effects on noise propagation. Measurements were conducted every 15 minutes to coincide with the measured noise data as per the requirements of BS4142.

14.2.1 AddressBase data, detailed maps, and aerial photographs of the area surrounding the Proposed Development were examined and nearby noise sensitive receptors (NSRs) were identified. Representative measurement positions were found and are detailed in **Table 14.4** and **Plate 14.2**.

Table 14.4 Measurement Location Coordinates

Location	Easting	Northing	Measurement Period
BGN 1 – Clashban Croft	264345	896381	06/08/2024 to 23/08/2024
BGN 2 – Farmhouse	264221	896493	

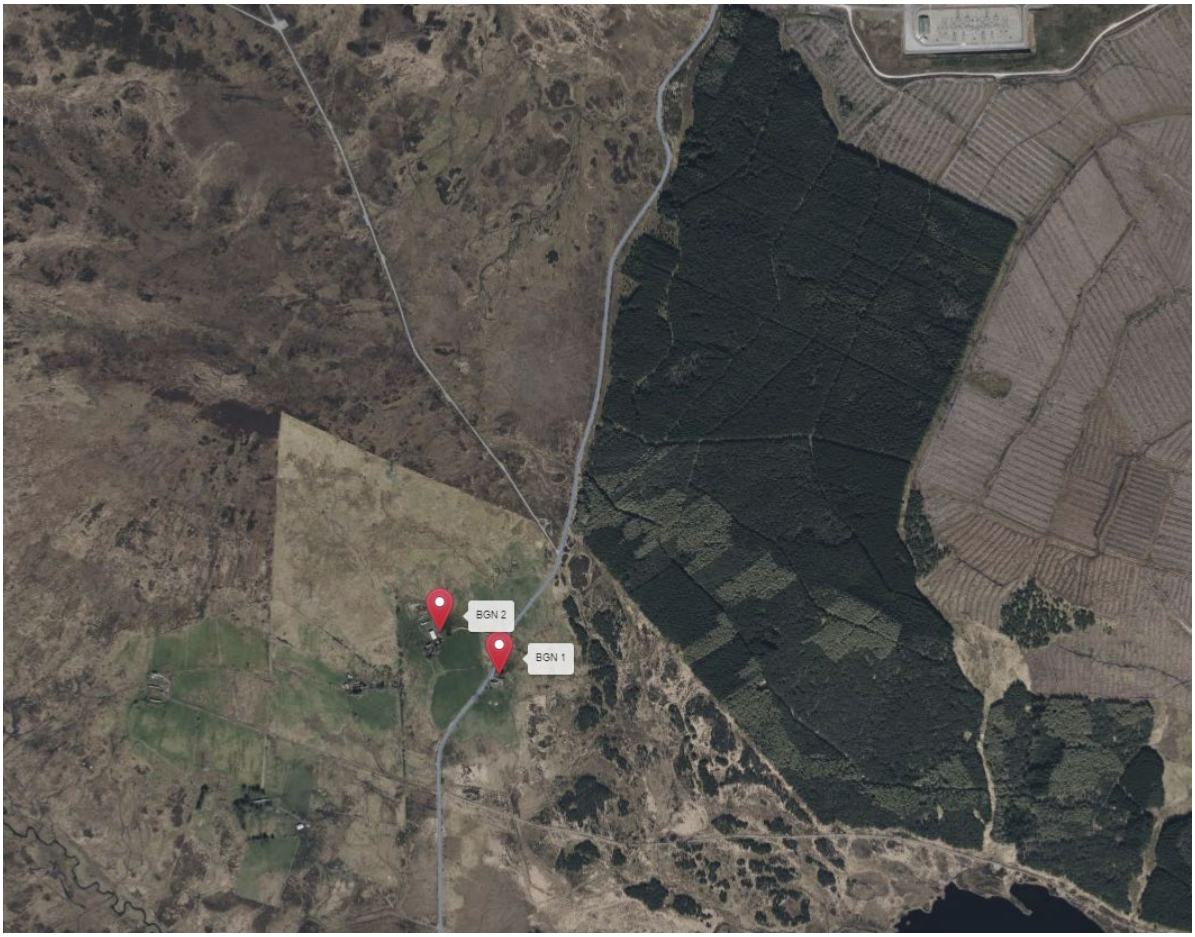

Plate 14.2 Map of Measurement Locations

Assessment Modelling

Construction Noise

A desk-based construction noise appraisal has been prepared for the purpose of assessing the effects of the construction 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.

The construction schedule has been supplied by the Applicant, which is outlined in **Table 14.5**, with likely construction equipment identified in Annex C of BS 5228-1. 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 14.5 Assumed Construction Schedule

Contract Works	Proposed Working Hours
Tree felling, Access, Enabling Works and Platform Creation	(September 2025 to August 2030 September) Every day 07:00 to 19:00
Building Civils / Structures	
Transformer Installation	
Balance of Plant	

Construction Vibration

A desk-based construction vibration appraisal has been prepared for the purpose of assessing the effects of the construction 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.

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.

Construction activities that induce vibration are likely to be limited to potential piling activities for a limited number of structures. The formulae for the prediction of groundborne vibration due to piling is taken from Table E.1 in BS5228-2.

The potential for 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

A detailed model of the Site and surrounding area has been constructed in SoundPLAN 9, considering geometric spreading, topography, screening, meteorological conditions and detailed information regarding the sources of noise, allowing for analysis of the predicted impact of the site for NSRs. All modelling assumptions are conservative and expected to result in slightly higher levels than those that would be measured.

Elevation data to a resolution of 50 m has been used to create a digital ground model, this is appropriate due to the distances from source to receiver and there being no major topography features in the surrounding area. Detailed plans for the Proposed Development layout have been provided by SSEN Transmission and used to model the site. Satellite imagery and Ordnance Survey maps have been used to aid the modelling of the surrounding area.

All modelling events are for worst-case scenarios and, therefore, modelling results are considered conservative worst-case results. These conservative estimates come inherently with the model parameters and environmental conditions assumed, the use of non-acoustically optimised input data where specifics are not available at this stage of the Proposed Development, and the use of maximum utilisation load levels for specific items such as cooling system (where in-situ these items would operate at lower loading levels).

Propagation was modelled using ISO 9613-2[6], with the following parameters:

- Ground absorption: 0.0 on paved surfaces, 0.6 elsewhere.
- Receiver height: 1.5 m above ground / floor

6 ISO 9613-2:1996 Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation, ISO, 15 December 1996.

- Temperature: 10°C
- Relative humidity: 70 %

Noise data for the proposed equipment have been based on design information from the manufacturer. Transformers and reactors (and associated cooling equipment) are based on the manufacturer internal maximum procurement specifications. Synchronous compensator and associated equipment are based on an initial, non-acoustically optimised specification, and is expected to be worst-case for assessment purposes. These levels are presented in **Volume 4 Appendix 13.3** Source Noise Levels and summarised in **Table 14.6**.

Table 14.6 Input Noise Levels for the Operational Noise Assessment

Equipment	Quantity	Housing Arrangements	Sound Power Level (SWL) (dB(A))
Transformers	3	External	86
Transformer Cooling	3	External	85
Synchronous Compensator	4 (x2 operational at any one time)	Internal	92
Synchronous Compensators (Step up Transformer)	4 (x2 operational at any one time)	External	97
Synchronous Compensators (Start up Transformer)	4 (x2 operational at any one time)	External	83
Synchronous Compensators (Auxiliary Transformer)	4 (x2 operational at any one time)	External	84
Synchronous Compensator Coolers	4 (x2 operational at any one time)	External	95
Reactor	3	External	85
Reactor Cooling	3	External	84

Determining Magnitude of Change and Sensitivity of Receptors

The sensitivity of the NSR is estimated in its current state prior to any assessment of impact 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, as recommended by TAN 2011. **Table 14.7** presents the definitions of receptor sensitivity.

Table 14.7 Evaluation of Receptor Sensitivity

Level of Sensitivity	Definition
Low	Receptors where distraction or disturbance from noise is minimal.
	Buildings not occupied during working hours. Factories and working environments with existing high noise levels. Sports grounds when spectator noise is a normal part of the event. Night Clubs.

Medium	Receptors moderately sensitive to noise, where it may cause some distraction or disturbance.
	Offices. Bars / Cafes / Restaurants where external noise may be intrusive. Sports grounds when spectator noise is not a normal part of the event and where quiet conditions are necessary (e.g. tennis, golf, bowls).
High	Receptors where people or operations are particularly susceptible to noise.
	Residential, including private gardens where appropriate. Quiet outdoor areas used for recreation. Conference facilities. Theatres / Auditoria / Studios. Schools during the daytime. Hospitals / residential care homes. Places of worship.

All NSRs considered in this assessment are residential in nature, with a semi-rural baseline noise environment. Therefore, the sensitivity of all NSRs is High.

Magnitude of Impact

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 specified standards. As reported in **Table 14.8** , the impact magnitude is worked out on a case-by-case basis for each NSR and classified as Negligible, Low, Medium, or High.

Construction Noise and Vibration

The noise criteria provided for the ABC method are detailed in BS 5228-1 are shown in **Table 14.8**.

Table 14.8 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

Night-time is defined as between 23:00 and 07:00. 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.

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.

From the outlined construction schedule, work is expected seven days a week. It is likely that the 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.

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 14.9**.

Table 14.9 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

Construction traffic for local haul roads and Site access are incorporated within the BS5228-1:2009, however additional criteria extend to construction traffic on highways. **Table 14.10** shows noise impact criteria for the assessment of changes to road traffic noise due to the addition of Proposed Development related construction traffic, with reference from Table 3.17 of DMRB, LA 111 Noise and Vibration.

Table 14.10 Construction Traffic - Magnitude of Impact at Receptors

Magnitude of Change	Traffic Noise Level Change
No Change	x < 0
Negligible	0.1= x < 0.9
Low	1.0 = x < 2.9
Medium	3 = x < 4.9
High	x > 5

In accordance with the EIA Regulations construction noise and construction traffic noise shall be defined as a significant effect where it is determined that a **High** or **Medium** magnitude of impact will occur for a duration exceeding:

- 10 or more days or nights in any 15 consecutive days or nights; and / or
- a total number of days exceeding 40 in any 6 consecutive months.

Criteria for construction vibration due to access tracks and foundation works are taken from Table B.1 in BS5228-2 and shown in **Table 14.11**. Vibration is measured as peak particle velocity (PPV) measured in millimetres per second ($mm \cdot s^{-1}$).

Table 14.11 Construction Vibration Impact Assessment Criteria

Impact Magnitude	Vibration Level, Peak Particle Velocity (PPV) ($mm.s^{-1}$)	Effect
Negligible	0.14 $mm \cdot s^{-1}$	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 $mm \cdot s^{-1}$	Vibration might be just perceptible in residential environments.
Medium	1.0 $mm \cdot s^{-1}$	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 $mm \cdot s^{-1}$	Vibration is likely to be intolerable for any more than a very brief exposure

		to this level in most building environments.

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 Noise

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 14.12**.

Table 14.12 BS4142 Impact Assessment Criteria

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.

The assessment within BS4142 is context-based (i.e. informed by the baseline level of background noise during the relevant part of the day, as well as considering what equipment is less likely to be operational at various parts of the day), as is stated in the definitions of determining impact. There is no theoretical limit to how the context can or should influence the impact assessment, but any alteration of the conclusions of an assessment due to the context should be sufficiently explained and justified for the specific circumstances in question. Section 11 of BS4142: *"Where background sound levels and rating levels are low, absolute levels might be as, or more, relevant than the margin by which the rating level exceeds the background. This is especially true at night."* The assessor will include additional consideration for internal noise levels during nighttime periods, where it is less likely that the external amenity is in use, and the preservation of internal conditions and the reduction of potential sleep disturbance is of more concern. For nighttime conditions, operational noise shall constitute a significant effect where:

- a High or Medium magnitude of impact is determined at the external amenity
- the internal noise limits of 30 dB(A) are exceeded as set out in BS8233, or the noise 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.

Significance of Effect

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 significance of effect can be derived by applying a calculation matrix (**Table 14.13**).

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.

The predicted significance of the effect was determined through the recommendations in TAN 2011 and based on professional judgement, considering both sensitivity and magnitude of change as detailed in **Table 14.13**.

Table 14.13 Matrix for Determination of Significance of Effects

Significance		Level of Significance Relative to Sensitivity of Receptor		
		Low	**Medium**	**High**
Impact Magnitude	High	Minor / Moderate	Moderate / Major	Major
	Medium	Minor	Moderate	Moderate / Major
	Low	Negligible / Minor	Minor	Minor / Moderate
	Negligible	Neutral / Slight	Neutral / Minor	Minor
	No change	Neutral	Neutral	Neutral

The level of significance and its relevance to the decision-making process is explained as follows:

- Major: These effects are likely to be important considerations but where mitigation may be effectively employed such that resultant adverse effects are likely to have a Moderate or Slight significance.
- Moderate: These effects, if adverse, while important, are not likely to be key decision-making issues.
- Minor: These effects may be raised but are unlikely to be of importance in the decision-making process.
- Neutral: No effect, not significant, noise need not be considered as a determining factor in the decision-making process.

The evaluation of effect significance shall be performed by following professional judgment, considering the context where necessary. A conservative approach to methodology has been applied, where worst-case results are reported. This is a robust approach and used to account for potential uncertainties that could affect the baseline data. Resulting effects of **Moderate** and **Major** impacts are considered significant.

Assessment Assumptions and Limitations

Estimated noise emissions from the construction of the Proposed Development have been based on the assessor's experience of previous projects of a similar nature. There is always a degree of uncertainty when conducting assessments on developments prior to completion of detailed design. This assessment considers conservative assumptions to produce a worst-case assessment to account for those uncertainties and ensure that the assessment is robust.

Modelled sound sources represent candidate plant only. The noise output of individual items of plant may vary from what is presented in this chapter after final plant specification. By way of illustration of this conservative approach to assessment, the assessment assumes all sound sources are operating continuously, simultaneously and at maximum noise output. In reality, not all sources will be operating at maximum noise level all of the time and operational noise levels may be lower than are presented in this chapter.

The sound level output of any auxiliary infrastructure is considered insignificant in comparison to the primary sound sources detailed in this chapter. Accordingly, no other items of plant have been considered within the assessment.

Unless otherwise stated, all sound levels refer to free field levels i.e. sound levels without influence from any nearby reflective surfaces.

In accordance with ISO 9613, all assessment locations are modelled as downwind of all sound sources. Propagation calculations are based on a moderate ground-based temperature inversion, such as commonly occurs at night.

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

The considered NSRs are detailed in **Table 14.14**.

Table 14.14 Receptor Locations

Receptor	Address	Easting	Northing	Distance from the Nearest Site Boundary (m)
NSR 1 – Sleasdaraidh	Strathcarnoch Road, Highland, Scotland, IV24 3AT, United Kingdom	264345	896381	650
NSR 2 - Clasbhan	Strathcarnoch Road, Highland, Scotland, IV24 3AT, United Kingdom	264221	896493	800

14.4 Baseline Conditions

The measurements were made within free-field conditions, i.e. at least 3.5 m from any acoustically reflective surfaces other than the ground. These measurement positions were deemed to represent the background noise conditions for external amenity for the surrounding NSRs.

Noise measurements were filtered for daytime and night-time conditions (night-time defined as between 23:00 and 07:00) where noise is shown to be at its lowest.

Periods of rain or windspeeds of 5 m/s or above are removed from the analysis as per BS 4142:2014. Meteorological data is shown in **Volume 4 Appendix 13.4** Meteorological Data**.**

Statistical analysis of noise levels was conducted of the histogram distribution of L_{A90} (15 minute) levels. The histograms of noise levels for both measurement locations are presented in **Volume 4 Appendix 14.5** Histograms of Sound Level Meter Data L_{A90}.

This statistical analysis was conducted for both long term measured BGN locations to define a representative BGN level at each BGN location.

In practice, there is no “single” background sound level as this is a fluctuating parameter. However, the background sound level used for the assessment is a representative average and therefore should be representative of the period being assessed.

Both the modal and mean value has been considered alongside the skew of the data set to select the appropriate representative level. **Table 14.15** provides the night-time and daytime representative L_{A90} results of the baseline noise survey.

Table 14.15 Representative Background L_{A90} Noise Levels

Location	Easting	Northing	Representative L_{A90} (dB(A)) (Nighttime)	Representative L_{A90} (dB(A)) (Daytime)
NSR 1 – Sleasdaraidh	264345	896381	21	23
NSR 2 – Clasbhan	264221	896493	21	24

The representative L_{Z90} spectra for both daytime and night for each location are presented in **Volume 4 Appendix 14.6** L_{Z90} Spectra**.**

The BGN data is mostly composed of broadband noise as there are no notable peaks in any third-octave bands. This results in a generally very low background noise at the measurement locations.

Daytime levels range from 19 dB – 33 dB L_{A90}. There is a slight elevation in broadband noise centred around the 1000 Hz one-third octave band during daytime. This is likely to be due to increased traffic noise during daytime hours. However, the majority of the levels remain very low during the day. The representative daytime value is determined as 23 and 24 dB L_{A90} respectively.

In general, the BGN data is relatively very low at night. The results of baseline noise survey show that NSRs in vicinity of the Proposed Development have a noise environment quantified between 18 – 24 dB L_{A90} during night periods. The nighttime noise environment is not dominated by any notable sources. Given the rural area, the acoustic environment is generally very quiet. The representative nighttime value is determined as 21 dB L_{A90}.

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

14.5 Issues Scoped Out

Noise from Operational Maintenance

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.

- noise from operational maintenance;
- operational vibration.

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 NSRs and has not been assessed further.

There are no anticipated vibrational issues associated with the operation of the Proposed Development at nearby NSRs. Therefore, vibration due to operation is not expected to adversely impact NSRs and has not been assessed further.

14.6 Assessment of Effects, Mitigation and Residual Effects

Potential significant effects that may result from the construction and operational phases (including cumulative) 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
- operational effects of noise from the Proposed Development on NSRs, including noise from cooling equipment and ventilation and transformer noise on NSRs.
- effects of construction vibration on the surrounding area and on NSRs, including traffic of heavy goods vehicles passing by NSRs and vibration due to piling for the foundations works.

Mitigation by Design

The design has made use of natural screening of the woods to reduce the direct propagation and natural absorption of sound between source and receiver. This provides both visual and acoustic attenuation and are most effective when either close to the source or receiver.

Construction Phase

It is not currently known what period in the day construction works are likely to occur, it is therefore assumed to take place during evening and weekends periods as shown in **Table 14.5**. Therefore, the 55 dB limit has been adopted in this case to ensure a conservative assessment takes place. Noise levels over the 55 dB limit criteria will result in **medium** impact magnitude. Excess of over 5 dB above the 55 dB limit will result in **high** impact magnitude.

At the time of writing, a list of the construction equipment expected to be used has not been supplied.

To calculate the potential construction noise levels from 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, **Volume 4 Appendix 14.7** Construction Activities shows plant activities, plant items, their quantities, their utilisation, and associated noise levels at a distance of 10 m, based on worst-case construction activities at a similar construction site. Noise due to vehicle movements is also considered in this calculation. The access route will be the Lochbuie Road / Strathcarnoch Road which runs alongside some of the NSRs. By combining the items' noise levels ($L_{A,eq}$ at 10 m from the plant (dB)) with the amount of time each will be running (utilisation) and their quantity, the total equivalent noise can be calculated for each activity. These are then logarithmically summed to give a total value for the construction noise at 10 m from the noise source, which can then be used to find the noise at any distance. To ensure a worst-case assessment, it has been assumed that all works within the phases will take place simultaneously.

The total equivalent noise level at 10 m from the plant source for each activity can be used in a propagation calculation to find the specific noise at each receptor.

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.

The proposed construction route reported in **Chapter 12** Traffic and Transport has been used as the basis for the assessment of haul routes. It is stated that a movement of 62 HGV over 10-hour delivery window, the traffic data is described as 'peak' traffic and therefore is conservative. construction traffic noise calculations have followed guidance from BS 5228-1 Annex F.2.5 'Method for mobile plant using a regular well-defined route (e.g. haul roads) and noise levels incorporated into overall construction noise assessment.

The Construction Noise Assessment **(Volume 4 Appendix 14.8** Construction Noise Assessment) predicts that construction noise has the potential to exceed the 55 dB noise limit during the earthworks and civils work stages. A maximum of 60 dB(A) is predicted at NSR 1 – Sleasdaraidh, and therefore the impact is assessed as **Medium**. A maximum of 58 dB(A) is predicted at NSR 2 – Clasbhan.

With **High** sensitivity and **Medium** impact, the worst-case construction noise during earthworks and civils work stages is assessed as **Moderate / Major** and is therefore **significant**. All other work stages are below the 55

dB limit and therefore result in **Low** impact which is **Minor / Moderate**. However, given that the assessment uses peak (and simultaneous) activity levels, it is more likely in practice to be **Minor** and **not significant**. A detailed construction schedule must be developed by the Principal Contractor when further specific information is made known and the assessment must be revisited.

Construction related traffic and transport impacts for main access routes have been assessed by calculating the relative increase in road traffic noise level adjacent to public roads used by construction traffic. The standard UK calculation method CRTN was used to calculate the noise level, at a nominal distance of 10 m from each road, using baseline traffic flows and also accounting for the addition of construction traffic as reported in **Chapter 12** Traffic and Transport.

The 24 hour average daily traffic flows reported in **Table 12.11** of **Chapter 12** Traffic and Transport have been converted to 18 hour traffic flows for the purposes of the noise calculation as is required by CRTN. Noise levels for the baseline 2026 traffic scenario are presented in **Table 14.16** for both cars and Heavy Goods Vehicles (HGVs).

Table 14.16 Predicted Peak Average 18-hr Daily Traffic

Traffic Count Location/Link ID	Total Vehicle Movements			HGV Movements Only		
	2026 Baseline	Baseline + Development	Increase (%)	2026 Baseline	Baseline + Development	Increase (%)
1 - A9, at Evelix, DfT Point ID: 8003	6361.92	6608.2	4%	329	387.28	18%
2 - A949, Near Whiteface, DfT Point ID: 80006	924.96	1171.24	27%	47.94	106.22	122%
3 - A9, Near Cuthill, DfT Point ID: 80002	6511.38	6757.66	4%	312.08	370.36	19%
4 - A9, North of Tain, DfT Point ID: 80001	7777.56	8023.84	3%	503.84	562.12	12%
6 - A9, Near Newfield, DfT Point ID: 40721	8907.44	9153.72	3%	447.44	505.72	13%

Assuming the values above, and an average speed of 40 mph, the following L10 18-hour noise levels are obtained and presented in **Table 14.17.**

Table 14.17 Predicted Peak L10 18-hour noise level dB(A)

Traffic Count Location/Link ID	L10 18-hour noise level dB(A)			Magnitude of Impact
	Noise Level 2026 Baseline	Baseline + Development	Increase	
1 - A9, at Evelix, DfT Point ID: 8003	67.5	67.9	0.4	Negligible
2 - A949, Near Whiteface, DfT Point ID: 80006	59.1	61	1.9	Low
3 - A9, Near Cuthill, DfT Point ID: 80002	67.6	67.7	0.1	Negligible
4 - A9, North of Tain, DfT Point ID: 80001	68.6	68.9	0.3	Negligible

6 - A9, Near Newfield, DfT Point ID: 40721	68.9	69.3	0.4	Negligible

Impacts on the majority of routes are predicted as **Negligible** and therefore **not significant**. The A949 has the highest change of noise levels of 1.9 dB(A), this equates to **Low** impact with reference from Table 3.17 of DMRB, LA 111 Noise and Vibration. With **High** sensitivity and **Low** impact, the worst-case construction traffic noise is assessed as **Minor / Moderate**. As the data suggests peak traffic levels which is a conservative assumption and results in a Moderate impact, it is more likely in practice to result in **Minor** impacts and is therefore **not significant**.

Construction activities resulting in vibration are largely unknown at time of writing, therefore, the worst-case parameters will be assumed for vibration. The vibration due to piling taking place at the site has been assessed for impact on the closest receptor (NSR 1 at 650 m from the nearest point on the RLB). 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 14.18**. Airborne vibration is predicted to be negligible compared to groundborne vibration.

Table 14.18 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 (J)	Between 1 and 12 MJ
Distance measured along the ground surface, in metres (m)	650 m for closest NSR

Table 14.19 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 14.19 Groundborne Vibration Results from Foundation Works at NSR 1

Vibration Operation	Resultant PPV (mms^{-1})	Magnitude of Impact
Vibratory Compaction (Steady State)	0.01	Negligible
Vibratory Compaction (Start Up and Run Down)	0.05	Negligible
Percussive Piling	0.01	Negligible

Vibratory Piling	0.01	Negligible

All impacts for potential vibration works have been assessed as **Negligible**. In the worst case, all operations are imperceptible, therefore, the effect for construction vibration is **Not Significant**.

Vibration due to traffic on access routes has been assessed. 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.

In this case, with a HGV traveling at an assumed maximum 64 km/h over a 5 mm road defect, at a distance of 10 metres from NSR 1, it is expected that the resultant PPV at NSR 1 is 0.4 $mm.s^{-1}$ would fall within the **Low** impact range. This would likely result in a **Minor / Moderate** effect**.** Vibration might be just perceptible in residential environments, however would not form any structural damage to the property. The assessment has assumed worst-case information, requiring a road defect to be directly outside of the property, therefore this effect is determined as **Minor** and therefore **Not Significant**.

Mitigation during Construction

Potential **significant** impact due to noise has been predicted during the earthworks and civils work stages. Accordingly, consistent with the requirement under the EIA Regulations (Schedule 4, para. 7), it is necessary to set out proposed mitigation of those effects at NSRs.

In accordance with best practice, construction noise will be controlled by a Construction Noise Management Plan (CNMP), in accordance with the guidance and procedures outlined in BS 5228-1. The CNMP (**Volume 2 Chapter 16** N1) will be embedded within the Construction Environmental Management Plan (CEMP) (**Volume 4 Appendix 2.2,** at para. 5.9). At the time of writing, the CEMP is in draft and therefore not finalised. Procedures will include:

- minimising the noise as much as is reasonably practicable at source;
- attenuation of noise propagation;
- 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

In order to maintain low impact on the noise environment, consideration will be given to the 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
- work typically not to take place outside of hours defined in the construction schedule.

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 static generators and when applicable portable generators, compressors and pumps.

To minimise the potential vibration impact on the nearby property due to traffic, the following measures could be implemented:

- Repair or smooth out road defects near sensitive receptors to reduce groundborne vibration.
- Limit the speed of construction vehicles passing over road defects, as lower speeds typically result in lower vibration levels.
- Monitor vibration levels at the receptor to ensure they remain below the significant thresholds defined by BS 5228-2.

Residual Construction Noise Effects

It is essential that the construction schedule is defined in detail by the Principal Contractor and a robust CNMP and best practice mitigation is implemented. Where necessary, work will be limited to daytime hours. Subject to these mitigations, the residual construction effects will fall below the construction noise limits of 65 dB during daytime conditions. No night-time working is scheduled, and any requirements for night-time working would be discussed with the Local Planning Authority (LPA) and local community before commencing.

With a CNMP in place, meeting these limits would be achievable and result in **Low** impact magnitude, with a receptor sensitivity of **High** which would have **Minor** effect and therefore **not significant**.

Operational Phase

Noise level predictions have been carried out to establish the specific noise levels at the nearest NSR to the Proposed Development. The levels predicted by the model relate to the outdoor ground floor façade of the NSR considered. A contour map of the Proposed Development is presented in **Volume 4 Appendix 14.9** Noise Contour Map.

The model considers only 50% of the synchronous condenser units active during normal operation due to only two being operational at any one time. In addition, the model considers two scenarios, including cooling and excluding cooling.

The predicted noise levels of the Proposed Development received at the NSRs are detailed in **Table 14.20** and **Table 14.21**.

Table 14.20 Proposed Development Modelled Noise Levels at NSRs – Including Cooling

Receptors	Total Specific Noise (dB(A))
NSR 1 – Sleasdaraidh	25.5
NSR 2 – Clasbhan	24.2

Table 14.21 Proposed Development Modelled Noise Levels at NSRs – Excluding Cooling

Receptors	Total Specific Noise (dB(A))
NSR 1 – Sleasdaraidh	23.2
NSR 2 – Clasbhan	22.2

The highest contributing source equipment from the Proposed Development at nearby receptors are the Step-up transformer and cooling equipment associated with the synchronous compensator units. When cooling is active, the cooling associated with the synchronous compensator units. When cooling is excluded, the dominant source is step-up transformer associated with the synchronous compensator units.

The assessments conducted are based on modelled results of the Proposed Development operating under standard yet conservative conditions. The conservative assumptions are that equipment for each scenario is operating at maximum load, and that all cooling systems are active and at 100% load, whereas this would be dependent on environmental conditions and the requirement for cooling.

The predicted operational levels at NSRs due to the Proposed Development can be compared with background noise levels in a BS 4142:2014 assessment.

BS4142 requires that, when assessing the impact of noise with a tonal component, the noise emitted from the specific sound source is subject to a rating level penalty.

The received 1/3 octave spectra at NSRs indicate that there are tonal components due to the dominant noise sources being the step-up transformers. Based on this analysis, a tonal penalty of 4 dB has been applied, representing a 'perceptible tone' as a conservative assessment approach. This potential tonal penalty is based on the subjective method described in Section 9.2 of BS4142.

The excess noise above background at the NSRs will determine the significance of impact of the Proposed Development.

A BS 4142 assessment has been performed for the Proposed Development, and the results are detailed in **Table 14.22**.

Table 14.22 BS4142 Assessment – Proposed Development – Including Cooling

Receptors	Specific Noise from Proposed Equipment	Rating Level (including +4 dB tonal penalty)	Nighttime Background Noise Level, La90(dB)	Night-time Excess above Background Noise	Daytime Background Noise Level, La90(dB)	Daytime Excess above Background Noise
NSR 1 – Sleasdaraidh	25.5	30	21	9	23	7
NSR 2 – Clasbhan	24.2	28	21	7	24	4

Table 14.23 BS4142 Assessment – Proposed Development – Excluding Cooling

Receptors	Specific Noise from Proposed Equipment	Rating Level (including +4 dB tonal penalty)	Nighttime Background Noise Level, La90(dB)	Night-time Excess above Background Noise	Daytime Background Noise Level, La90(dB)	Daytime Excess above Background Noise
NSR 1 – Sleasdaraidh	23.2	27	21	6	23	4
NSR 2 – Clasbhan	22.2	26	21	5	24	2

The results during daytime conditions predict excess above background at both receptors from both the specific noise and rating level (including a 4 dB tonal penalty).

During daytime conditions, the scenario with cooling active is the most appropriate and results in an excess of 7 dB at NSR 1 – Sleasdaraidh. The assessment shows **Medium** impact magnitude, and with **High** sensitivity receptors indicates **Moderate / Major** effect which is **significant** for operational noise during daytime conditions.

During nighttime conditions, the scenario excluding cooling is the most appropriate and results in an excess of 6 dB at NSR 1 – Sleasdaraidh. The assessment shows **Medium** impact magnitude, and with **High** sensitivity receptors indicates **Moderate / Major** effect.

Context is an important factor of a BS4142 assessment. Measured background noise levels in the area at night-time are low, and the specific noise level from the Proposed Development is predicted to be also relatively low, therefore it is necessary to consider the context of the noise, and how the impact affects the internal levels of the NSRs.

During night-time periods, it is less likely that impacts on external levels are important, and that the preservation of internal noise levels that would not impact sleep disturbance should be contextualised.

Internal Noise Assessment

According to Table 4 of BS8233, the indoor ambient noise levels in the night-time should not exceed 30 dB $L_{Aeq,8hr}$. In addition, octave band levels should meet an NR20 rating for night-time and NR25 rating for daytime.

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. The small element parameter level difference (Dn,e) has been assumed from NANR116: Sound Insulation through Ventilated Domestic Windows. The level difference values are taken from a window opening of **Table 14.24.**

Table 14.24 Level Difference Through a Partially Open Window NANR116

Opening Size	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	Dn,e
200k (mm^2)	20	14	14	16	14	17	19	16

The results of the internal noise assessment for the existing site are presented in **Table 14.25** and **Plate 14.3**.

Table 14.25 Predicted Internal Noise Levels

NSR	Level (dB(Z))							
	63 Hz	**125 Hz**	**250 Hz**	**500 Hz**	**1 kHz**	**2 kHz**	**4 kHz**	**Total (dB(A))**
NR 20	51	39	31	24	20	17	14	-
NR 25	55.2	43.7	35.2	29.2	25	21.9	19.5	-
NSR 1 - inc. cooling	21	19.3	9.9	8.6	6.2	-12.3	-45.7	10.5
NSR 2 - inc. cooling	18.4	17.5	7.9	8.3	4.3	-14.6	-47.3	9.2
NSR 1 - exc. cooling	17.6	18.1	7.7	6.5	4.2	-16.6	-19	8.6
NSR 2 - exc. Cooling	15.1	16.5	6.1	6.4	2.5	-18.3	-19	7.5

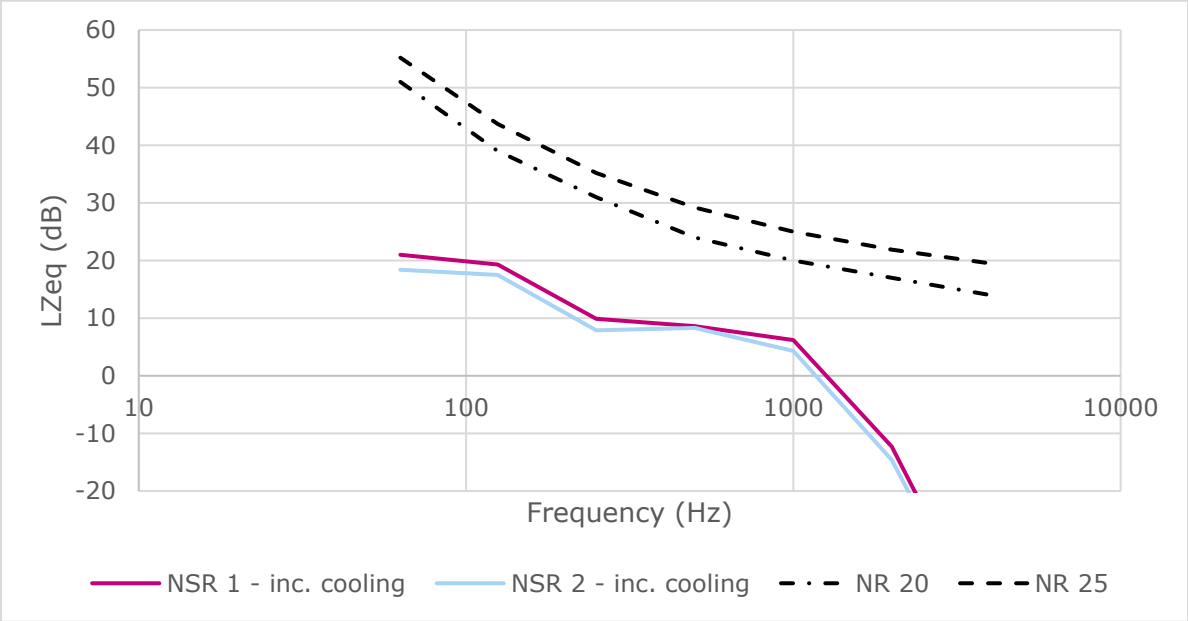

Plate 14.3 Indoor Noise Assessment

The results show that for the Proposed Development, the internal noise level at all NSRs meet the 30 dB, the NR20 limit and the NR25 limit with a significant margin. The maximum internal noise level is predicted to be 10.5 dB(A) at NSR 1 – Clasbhan, an extremely low level that would not be perceptible.

Therefore, in context, although the external noise rating levels exceed 5 dB above background noise and therefore do not meet the requirements of a BS4142 assessment during night-time periods, the internal noise levels are acceptable and a likely indicator of **Low** impact and therefore **Minor** effect, that is **not significant**.

Mitigation During Operation

It is predicted that during night time conditions there will be a **Low** impact and therefore **Minor** effect, that is **not significant** due to overall noise levels and an internal assessment. However, the worst-case results during day-time conditions predict a **Moderate** and therefore potential **significant** impact due to excess above background noise in a BS4142 assessment.

The dominant sources of noise from the site are the synchronous compensator units and its associated equipment, including external cooling and step-up transformer. The data used for these equipment items is indicative and non-acoustically optimised.

An acoustically optimised design will be progressed during the detailed design phase of the project. There are various engineering solutions and potential mitigation strategies that could be implemented to reduce noise levels from these units (**Volume 2 Chapter 16** N2).

In addition, it should be noted that the extent of the issue is determined by the load equipment and requirement for cooling. The Proposed Development is unlikely to operate at its maximum load for a significant amount of time, and therefore it is unlikely that the cooling system will be required to run at its maximum capacity. While operating at lower loadings, it is less likely that the cooling systems are required to operate at maximum levels. Therefore, the extent of noise excess is likely to be limited to out with normal operation. It is recommended that the operational modes of cooling are quantified to evaluate the frequency of the high noise occurrences. Mitigation will be sought to negate impacts while running at 100% load.

With the options of mitigation available, and the project being early in its design phase, it is expected that levels from the synchronous compensator, step-up transformer and cooling systems can be reduced to levels that would not be significantly adverse.

Residual Noise – Operational

Maintaining the design to house noise producing equipment where possible in suitably designed buildings or total acoustic enclosures will ensure noise impacts remain low.

Where it has been identified that there are potential issues with the cooling, the issue will be limited to where the Proposed Development is operating at higher loadings and requirements for the cooling system are close to its maximum level. With appropriate engineering design or mitigation, it is expected that the noise impacts would be reduced to an extent where low impact is predicted.

An updated noise impact assessment should be conducted during detailed design, following further refinement of the assessment data and the implementation of mitigation, it is expected that noise levels at NSRs would be in line with the limits proposed by the LPA.

Therefore, with the Applicant committed to meeting the proposed noise limits, **no significant** residual effects are predicted

The assessment considers the likely noise level output of the Proposed Development based on candidate plant. Source noise levels of individual items of plant, however, will vary as the final plant specifications and required control measures are determined during a commercial tendering process. Accordingly, the predicted noise levels presented in this report, or the noise levels at source, should not be used to specify particular noise level limits. Rather, it is more appropriate to consider the noise levels received at the nearest NSRs with regards to the existing sound levels in the area (as assessed by BS 4142). This allows appropriate levels of protection to be allocated to the nearest receptors, giving comfort to residents and the Local Planning Authority (LPA), whilst providing the developer with sufficient flexibility in the design and specification of plant during the tendering process.

Accordingly, the following planning conditions to control operational noise effects are proposed:

1. "The noise Rating Level (as defined in BS 4142:2014+A1:2019) from the operation of the Development shall not exceed 5 dB above the background sound levels, as measured or calculated at the nearest occupied residential Noise Sensitive Receptors (as existing or consented at the time of this consent).
2. Prior to first operation, a revised Noise Impact Assessment (NIA) shall be submitted to the LPA for approval. The NIA report shall include details of the specified plant to be installed and any required noise control measures to ensure that operational noise levels from the Development will be below the noise level limits detailed in Planning Condition 1."

Cumulative Effects

Table 14.26 shows the cumulative assessment of nearby SSEN Transmission developments.

Table 14.26 Cumulative assessment

Cumulative Development Type	Assessment
SSEN Transmission Cumulative Developments	**Existing substation:** The existing Loch Buidhe 275 / 132 kV Substation is predicted to produce **negligible** operational noise impacts. The substation is inaudible at the NSRs and the Proposed Development is closer, so will be the only cumulative development that would dominate the acoustic environment if at all. The cumulative impact of the Proposed Development and the existing (operational) substation is **negligible** and therefore ***no significant*** cumulative effects are predicted. **400 kV Line**: If the construction of the Spittal-Carnaig-Beauly 400 kV Overhead Line (OHL) is to coincide with the construction of the Proposed Development, the Principal

	Contractor must update the construction noise management plan to address the working times, activities and schedule. The OHL works are likely to be short term in comparison, however, the construction noise limit (65 dB or 55 dB) may be breached while the OHL works are ongoing, resulting in significant effects. If construction phases coincide, it is possible for cumulative construction noise to result in major effect which is significant. However, with the appropriate CNMP and coordinated approach that would be required pursuant to that CNMP, the residual effects impact is likely to be **Minor** and **not significant**. The operational noise of the Spittal-Carnaig-Beauly 400kV OHL is yet to be assessed. The worst-case operational noise impact of the Spittal-Carnaig-Beauly 400 kV OHL is assessed in wet conditions, where background noise is increased due to the rainfall, which would make the effects of the Proposed Development less likely to have an impact on the relevant receptors. For OHL noise to be at a maximum in rain, the background noise can be as high as 38 dB where the noise impact predicted from the Proposed Development is low, even including a tonal penalty. The total predicted worst-case noise from the Proposed Development is assessed in dry conditions, where the noise from the OHL is **negligible** and therefore ***no significant*** cumulative operational effects are predicted. **Carnaig 400 kV – Loch Buidhe 275 kV Underground Grid Connection**: The construction of the undergrounding of the cable for the underground cable project 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 undergrounding of a cable 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 Carnaig 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. In addition, as these developments are SSEN Transmission projects, there is greater potential for a coordinated noise management approach. Therefore, with the appropriate mitigation, residual effects are likely to be **minor** and **not significant**. Operational noise impacts of the underground cable projects would be **negligible,** and therefore result ***negligible*** cumulative operational effects which is ***not significant***.
	Balblair Wind Farm: Cumulative Construction noise as above. The operational noise impact of windfarms are assessed in different conditions to substation noise. Wind farm noise is increased in high winds, where the background noise also increases. This reduces the impact of the operational noise of the Carnaig 400 kV Substation to a negligible level, due to the increase in background noise when windfarm noise may be significant. Therefore, **no significant** cumulative effects are predicted from the Balblair Wind Farm. **Acheilidh Wind Farm**: Cumulative Construction noise as above. The EIAR of the Acheilidh Wind Farm predicted negligible noise impacts. Therefore cumulative operational noise is assessed as negligible and not significant. **Communication Mast (22/05825)**: If the construction of the Communications Mast near is to coincide with the construction of the Proposed Development, the Principal Contractor must update the construction noise management plan to address the working times, activities and schedule. The OHL works are likely to be short term in comparison, however, the construction noise limit (65 dB or 55 dB) may be breached while the OHL works are ongoing, resulting in significant effects. If construction phases coincide, it is possible for cumulative construction noise to result in major effect which is significant. However, with the appropriate CNMP and coordinated

	approach that would be required pursuant to that CNMP, the residual effects impact is likely to be **Minor** and **not significant**. Operational noise is not predicted to cause cumulative impacts and is therefore **negligible** and **not significant**.

14.7 Summary

This Chapter has considered the potential noise and vibration 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.

Construction

Noise

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 construction noise is predicted to exceed the 55 dB limit only during the during earthworks and civils work, resulting in **Moderate / Major** impacts which are potentially **significant**. However, the implementation of mitigation through a robust construction noise management plan, prioritising particularly noisy work during daytime defined hours, and careful consideration of the location of noisy work, and applying mitigation in line with BS5228 recommendations will ensure the construction noise of the Proposed Development will have **Minor** (**not significant**) impact on nearby NSRs.

Information on the construction schedule is assumed from similar projects, and therefore is subject to change depending on the Principal Contractor. An updated construction noise assessment and detailed CNMP should be issued to the LPA prior to commencement of construction that show the most up to date schedule and equipment that is expected to be used.

Vibration

The closest NSR to the site has been assessed for vibration due to piling and vehicle activity on road defects. The vibration due to piling at NSR 1 has been assessed as **negligible** and **not significant**. Vibration caused by vehicles driving on access tracks has also been assessed. Worst-case assumptions have been made for the road defects. The conservative assessment is predicted to be just perceptible, therefore, the vibration effects have been assessed as **minor** and **not significant**.

Operation

Noise

Operational noise has been assessed to BS4142 and BS8233 standards. The results of the external BS4142 assessment predict **Moderate / Major** effects with excess above background noise during daytime conditions that is potentially **Significant**. During night-time conditions, the assessment predicts **Low** impact which is **not significant** due to internal noise levels. This assessment is relatively conservative, while using inputs available for a non-acoustically optimised site and is assuming the cooling is fully active under maximum load conditions.

Noise excess is limited to the operation of the synchronous compensator units and auxiliaries including external cooling equipment. It has been identified that this issue will be limited to where the Proposed Development is operating at higher loadings and requirements for the cooling system are close to its maximum level. Mitigation is required during the detailed design and procurement phase of the project. There are many engineering solutions that can be applied to mitigate noise, including specification of low noise equipment, barriers and enclosures.

An updated noise impact assessment should be conducted during detailed design, following further refinement of the assessment data and the implementation of mitigation, it is expected that noise levels at NSR would be in line with the limits proposed by the LPA. Therefore, with the Applicant committed to meeting the noise limits, **no significant** residual effects are predicted.

Cumulative Assessment

Cumulative noise has been considered. There is the potential for **Low** impact and therefore **not significant** effect from: (i) the existing Loch Buidhe Substation; and (ii) the proposed Spittal to Loch Buidhe 400kv OHL that would connect into the Proposed Development. In relation to the Spittal to Loch Buidhe to Beauly 400 kV OHL, OHL cumulative projects are required to be controlled through an updated assessment by the Principal Contractor and a CNMP. In addition, as these developments are SSEN Transmission projects, there is greater potential for a coordinated noise management approach. Therefore, with the required mitigation, residual effects are likely to be **Minor** and **not significant**. OHL projects assessed for operational noise are predicted to have **negligible** effect.

Other cumulative developments include the 275 / 132 kV Loch Buidhe Substation. Operational noise is deemed **negligible** and **not significant** due to the distance of the projects and NSRs.

Conclusion

The assessment concludes that nearby NSRs have the potential for Moderate effects from construction and operational noise, which is potentially significant. The construction noise impact assessment must be revisited by the Principal Contractor when a full construction schedule is known, and a detailed CNMP is to be developed. Operational noise effects are expected to be reduced with appropriate engineering design or mitigation during detailed design. It is expected that engineering noise control applied to the critical noise sources associated with the synchronous compensator units can meet BS4142 criteria. An updated operational noise impact assessment demonstrating compliance is to be submitted to the LPA during detailed design. With these appropriate measures, potential residual noise from construction and operation effects are deemed not significant.