Chapter 12: Noise and Vibration

Contents

12 Noise and Vibration

12.1 Executive Summary

12.1.1 Bow Acoustics have been commissioned to undertake a noise assessment for the construction and operation of the Proposed Development. Noise will be emitted by equipment and vehicles used during construction and decommissioning of the Proposed Development and by the turbines and substation during operation. The level of noise emitted by the sources and the distance from those sources to the receiver locations are the main factors determining levels of noise at receptor locations.

Construction Noise

12.1.2 Construction noise has been assessed by a desk-based study of the potential construction programme and by assuming the Proposed Development is constructed using standard and common methods. Noise levels have been calculated for receiver locations closest to the areas of work and compared with guideline and baseline values. Construction noise, by its very nature, tends to be temporary and highly variable and therefore much less likely to cause adverse effects. It is concluded that noise generated through construction activities would be of **minor** significant effect (not significant in the context of the EIA Regulations).

Operational Noise

12.1.3 Operational turbines emit noise from the rotating blades as they pass through the air. This noise can sometimes be described as having a regular 'swish'. The amount of noise emitted tends to vary depending on the wind speed. When there is little wind the turbine rotors will turn slowly and produce lower noise levels than during high winds when the turbine reaches its maximum output and maximum rotational speed. Background noise levels at nearby noise sensitive receptors (NSRs) will also change with wind speed, increasing in level as wind speeds rise due to wind in trees and around buildings, etc.

12.1.4 Noise levels from the operation of the turbines have been predicted at NSRs around the area most likely to be affected by noise. Surveys have been performed to establish existing baseline noise levels at four locations. Noise limits have been derived from data about the existing noise environment following the method stipulated in national planning guidance. The assessment takes account of the potential combination of the noise from the Proposed Development along with other wind farms in line with current best practice.

12.1.5 Predicted operational noise levels have been compared to the limit values to demonstrate that turbines of the type and size which would be installed can operate within the limits so derived. It is concluded therefore that operational noise levels from the Proposed Development will be within levels recommended in national guidance for wind energy schemes.

12.1.6 Operational noise levels from the substation for the Proposed Development have been calculated and assessed in accordance with the relevant guidance and British Standard. It is concluded that it would result in a **negligible** effect (not significant in the context of the EIA Regulations).

12.2 Introduction

12.2.1 This chapter considers the likely significant effects of the Proposed Development on neighbouring NSRs in respect of noise. It details the construction, operational and decommissioning noise assessment resulting from the Proposed Development.

12.2.2 The noise assessment was undertaken by, and the chapter has been authored by Richard Carter, a director of Bow Acoustics. Richard (C.Eng, B.Eng (Hons) MIOA) is a Chartered Acoustics Engineer and a full member of the Institute of Acoustics with over 19 years' experience in the assessment of environmental noise, 14 years of which specialised in wind turbine noise.

12.2.3 The noise assessment included a baseline noise survey, which was undertaken by Simon Waddell (BSc. (Hons) MIOA). Simon is an Associate with ITPEnergised and has over 13 years' experience in environmental noise, much of which has centred on wind farms, both in the UK and abroad.

12.3 Legislation, Policy and Guidelines

12.3.1 The relevant legislation, policy and guidance documentation that have been taken into consideration during this assessment are detailed below.

Legislation

<u>Environmental Protection Act 1990</u>

12.3.2 The Environmental Protection Act 1990 (EPA) provides powers to control noise where a statutory noise nuisance exists. Section 80 of the EPA states that where a statutory nuisance exists, or is likely to occur

or reoccur, then the responsible Local Authority shall serve a notice requiring the abatement of the nuisance; or prohibiting its occurrence or reoccurrence, as well as requiring any such steps as may be necessary to abate the nuisance including a specification of the timescales in which to take such action. Section 82 of the EPA provides an individual subject to a statutory nuisance the right to make representations to the courts and for the courts to take such action, as may be appropriate, against the originator of that nuisance such that the nuisance is abated.

Planning Policy

12.3.3 Chapter 4 describes the national and local policy background relevant to the Proposed Development referring to the Development Plan consisting of the provisions of the National Planning Framework 4 (NPF4) and The Highland-wide Local Development Plan (HwLDP). Specific references to noise are discussed as follows.

National Planning Framework 4

12.3.4 Policy 11 of NPF4 states that any renewable development will require project design and mitigation to demonstrate how impacts such as residential amenity have been addressed, which includes potential amenity effects in relation to noise immissions.

Planning Advice Note PAN 1/2011

12.3.5 PAN 1/2011 provides advice on the role of the planning system in helping to prevent and limit the adverse effects of noise. PAN1/2011 provides general advice on a range of noise related planning matters, including references to noise associated with both construction activities and operational wind farms. In relation to operational noise from wind farms, paragraph 29 states that:

"There are two sources of noise from wind turbines - the mechanical noise from the turbines and the aerodynamic noise from the blades. Mechanical noise is related to engineering design. Aerodynamic noise varies with rotor design and wind speed, and is generally greatest at low speeds. Good acoustical design and siting of turbines is essential to minimise the potential to generate noise. Web based planning advice on renewable technologies for Onshore wind turbines provides advice on 'The Assessment and Rating of Noise from Wind Farms' (ETSU-R-97) published by the former Department of Trade and Industry [DTI] and the findings of the Salford University report into Aerodynamic Modulation of Wind Turbine Noise."

12.3.6 PAN 1/2011 advises the preference to control construction noise through the Control of Pollution Act 1974 and the Pollution Prevention Control Act 1999, over the use of planning conditions.

Planning Advice Note PAN50

12.3.7 PAN50 gives guidance on the environmental effects of mineral working. The main document summarises the key issues with regard to various environmental effects relating to surface mineral extraction and processing including road traffic, blasting and noise.

Onshore Wind Turbines: Planning Advice

12.3.8 The Scottish Government's Onshore Wind Turbine web-based guidance document [accessed September 2024] provides further advice on noise from wind turbines. It too confirms that ETSU-R-97 should be followed to assess and rate noise from wind turbines until such a time an update is available. Further reference is made to the Institute of Acoustics 'Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise' (IOA GPG) as current industry good practice and the appropriate document to be used by all IOA members and those undertaking assessments to ETSU-R-97.

Onshore Wind Policy Statement

12.3.9 The Scottish Government issued their Onshore Wind Policy Statement in December 2022 which sets a target of 20 GW of installed onshore wind capacity in Scotland by 2030. Section 3.7 discusses noise from wind turbines and how it should be assessed. It too confirms that ETSU-R-97 and the IOA GPG should be followed to assess and rate noise from wind turbines until such a time as new guidance is produced.

Assessment of Noise: Technical Advice Note

12.3.10 The Scottish Government's Assessment of Noise: Technical Advice Note provides guidance aimed to assist in the technical evaluation of noise assessment and the significance of impact. This document refers to the web-based planning advice and ETSU-R-97 when assessing noise from wind turbines.

The Highland-wide Local Development Plan

12.3.11 The Highland-wide Local Development Plan (HwLDP) was adopted on 5 April 2012 (The Highland Council, 2012). The HwLDP sets out the overarching spatial planning policy for the whole of the Highland Council area, except the area covered by the Cairngorms National Park Local Plan, which is subject to a separate Development Plan. A new Highland Local Development Plan (HLDP) is currently being prepared and

expected to be adopted towards the end of 2025. At the time of writing, no draft of the HLDP was available; therefore, the HwLDP has been used in this assessment.

12.3.12 Chapter 22 of HwLDP addresses sustainable development and climate change and recognises the great potential the Highlands area has for renewable energy generation. Onshore wind is recognised as one of the technologies making substantial contributions to renewable energy production in The Highlands.

12.3.13 Policy 67, Renewable Energy proposed developments, of the HwLDP states:

"… Subject to balancing with these considerations and taking into account any mitigation measures to be included, the Council will support proposals [for renewable energy generation] where it is satisfied that they are located, sited and designed such that they will not be significantly detrimental overall, either individually or cumulatively with other developments (see Glossary), having regard in particular to any significant effects on the following: … the safety and amenity of any regularly occupied buildings and the grounds that they occupy- having regard to visual intrusion or the likely effect of noise generation…"

12.3.14 Policy 72, Pollution, of the HwLDP states:

"Proposals that may result in significant pollution such as noise … will only be approved where a detailed assessment report on the levels, character and transmission and receiving environment of the potential pollution is provided by the applicant to show how the pollution can be appropriately avoided and if necessary mitigated…

… Major Developments and developments that are subject of Environmental Impact Assessment will be expected to follow a robust project environmental management process, following the approach set out in the Council's Guidance Note "Construction Environmental Management Process for Large Scale Projects" or a similar approach."

Onshore Wind Energy Supplementary Guidance

12.3.15 The Onshore Wind Energy Supplementary Guidance (OWESG) (The Highland Council, 2016) sets out how The Highland Council (THC) intend to manage onshore wind energy development proposals. Section 4 of the OWESG details key development plan considerations and has a sub-section on noise assessments which recognises ETSU-R-97 and the Institute of Acoustics Good Practice Guide as best practice when assessing noise from wind turbines. Both these documents are discussed further below.

12.3.16 In response to the generally lower levels of background noise found in the Highlands, THC seek to achieve noise limits at sensitive locations that are at the lower end of the range indicated in national guidance. Advice is given to consult with THC over the suitability of survey locations. Cumulative noise from other wind farms in the area is to be adequately assessed in accordance with best practice, which includes consideration of both predicted and consented levels.

Guidance

ETSU-R-97

12.3.17 As introduced above, the ETSU report ETSU-R-97 'The Assessment and Rating of Noise from Wind Farms' (ETSU-R-97) is endorsed by national planning policy as the appropriate guidance document for the assessment of noise from wind turbines. The basic aim of ETSU-R-97 is to provide indicative noise levels thought to offer reasonable protection to wind farm neighbours without placing unreasonable restrictions on wind farm developments, or adding unduly to the costs and administrative burdens on wind farm developers or local authorities.

12.3.18 ETSU-R-97 recommends that the acceptability of wind farm noise should be assessed relative to existing background noise levels at nearby properties. It recognises that both background noise and wind turbine noise vary with wind speed and suggests that noise from wind turbines should be limited to 5 dB above the background noise at all times. It does however also suggest absolute lower fixed limits of between 35 and 40 dB L_{A90} for day time and 43 dB L_{A90} for night-time. The limits advised in ETSU-R-97 apply to the total wind turbine noise at a receptor location and not just to one proposed wind farm.

12.3.19 An increased noise limit of 45 dB L_{A90}, or background noise plus 5 dB, whichever is greater, is suggested for both day time and night-time periods for properties where the occupier has financial involvement in the wind farm.

12.3.20 Where noise at the nearest property is limited to 35 dB L_{A90} up to wind speeds of 10 m/s, then it need not be considered in the noise assessment, as protection of the amenity of these properties can be controlled through a simplified noise limit.

12.3.21 Where the need for a background noise survey is required, ETSU-R-97 provides guidance on the appropriate positioning, equipment, and duration of survey.

Institute of Acoustics' Good Practice Guide to ETSU-R-97

12.3.22 'A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise' was published by the Institute of Acoustics in 2013. This document provides guidance on noise

assessment of wind turbines above 50 kW, reflecting the original principles within ETSU-R-97. The IOA GPG contains six Supplementary Guidance Notes that covers data collection, data processing, wind turbine sound power levels, wind shear, post completion measurements and propagation over water for onshore.

12.3.23 The IOA GPG does not replace the limits within ETSU-R-97, but it does provide good practice guidance on the use of ETSU-R-97 in relation to background noise surveys and on the prediction of wind turbine noise. This is on the proviso that the appropriate input parameters and correction factors are used for the prediction of wind turbine noise, as follows:

- downwind propagation;
- a receptor height of 4 m;
- atmospheric conditions of 10 °C and 70 % humidity;
- a ground absorption factor of G = 0.5; and
- turbine noise emission levels which include a margin for uncertainty.

12.3.24 The guidance document has been endorsed, on behalf of Scottish Government, for use on wind turbine noise assessments.

ISO 9613-2

12.3.25 ISO 9613-2: 2024 'Acoustics – Attenuation of sound during propagation outdoors Part 2: Engineering method for the prediction of sound pressure levels outdoors' provides a robust prediction method for calculating the noise levels at receiver locations, endorsed by the IOA GPG as the method to use when calculating wind turbine noise propagation.

British Standard 5228

12.3.26 For detailed guidance on construction noise and its control, the Technical Advice Note refers to British Standard BS 5228 'Noise control on construction and open sites', Parts 1 to 4 but confirms that the updated version of this standard, published in January 2009 is relevant when used within the planning process. The 2009 version consolidates all previous parts of the standard into BS 5228-1: 2009 (amended 2014) (BS 5228-1) for airborne noise and BS 5228-2: 2009 (amended 2014) (BS 5228-2) for ground borne vibration. These updated versions have therefore been adopted as the relevant versions upon which to base this assessment.

12.3.27 BS 5228-1 provides guidance on a range of considerations relating to construction noise including the legislative framework, general control measures, example methods for estimating construction noise levels and example criteria which may be considered when assessing impact magnitude. Similarly, BS 5228-2 provides general guidance on legislation, prediction, control and assessment criteria for construction vibration.

Calculation of Road Traffic Noise

12.3.28 The former Department of Transport and Welsh Office memorandum Calculation of Road Traffic Noise (CRTN) published in 1988 sets out standard methods and procedures to predict and measure road traffic noise. These procedures were primarily intended 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.

12.4 Consultation

12.4.1 The Environmental Health Officer (EHO) at THC was consulted throughout the assessment. An initial consultation letter was issued to THC on 22 September 2023 that set out an overview of the assessment method and potential noise survey locations. The response from THC, dated 15 February 2024, confirms agreement on the approach and advises of another wind farm in the area that recently submitted a Scoping Report, Tarvie Wind Farm. Following consideration of the potential cumulative impacts with Tarvie Wind Farm, a second consultation letter was issued on 16 April 2024, which set out revised survey locations and further information about the assessment. Table 12.1 summarises the points raised during the consultation.

Table 12.1 – Consultation

Consultee and Date	Points Raised by Bow Acoustics (for the Applicant)	Consultation Response	Applicant Response
THC 22 September 2023	Initial introduction of the Proposed Development, NSRs identified, overview of the assessment method,	THC email dated 15 February 2024 advises of Tarvie Wind Farm which is in Scoping at this time, and	Tarvie Wind Farm has been considered in the assessment. Section 12.12 discusses this further.

Consultee and Date	Points Raised by Bow Acoustics (for the Applicant)	Consultation Response	Applicant Response
	other wind farms identified within 10 km, and areas of assessment to be scoped out	agreed on the other points raised in the consultation letter.	The assessment summarised in this chapter of the EIA Report reflects the agreed methodology. Section 12.5 details this method.
THC 16 April 2024	Tarvie Wind Farm has the potential to cumulatively impact NSRs considered in the assessment of the Proposed Development. As a result, details of background survey locations were provided. It was confirmed that the following wind farms do not contribute to cumulative noise levels: – Abhainn Dubh; – Fairburn; – Corriemoillie; – Kirkan; and – Lochuichart and extensions.	THC email dated 1 May 2024, agreed with the proposed monitoring locations and that they would be subject to access.	Background noise survey was carried out and included measurement locations in all the agreed areas. Paragraph 12.5.5 details the background survey locations.

12.5 Assessment Methodology and Significance Criteria

Study Area

12.5.1 The study area for the assessment of operational noise is shown on Figure 12.1 and has been defined in accordance with the IOA GPG to include NSRs where noise immission levels from the Proposed Development are predicted to be within 10 dB of those from other relevant wind energy developments, and the predicted cumulative wind farm noise immission level is greater than 35 dB $L_{A90,10min}$, at up to 10 m/s wind speed. A desktop assessment was undertaken to confirm that none of the cumulative wind farms identified in Table 2.1 would meet this criterion. During consultation, THC advised of Tarvie Wind Farm that has the potential to contribute cumulatively. Tarvie Wind Farm is not as progressed in the planning process as the Proposed Development and as such limited information is available. Contact has been made with the noise assessment team of Tarvie Wind Farm and the most up to date information has been accounted for at the time of writing.

12.5.2 Note in the above, and subsequently in this assessment, the term 'noise emission' relates to the sound power level actually radiated from each turbine, whereas the term 'noise immission' relates to the sound pressure level (the perceived noise) at any NSR due to the combined operation of all wind turbines on the Proposed Development. All wind farm noise immission levels in this report are presented in terms of the L_{A90} noise indicator in accordance with the recommendations of the ETSU-R-97 report, obtained by subtracting 2 dB(A) from the calculated L_{Aeq} noise levels based on the turbine sound power levels.

12.5.3 The NSRs considered in the assessment are listed in Table 12.2 and shown on Figure 12.1. Table 12.2 also provides the coordinates of the NSRs and their distance to the nearest turbine within the Proposed Development. The assessment has included locations representative of other, more distant locations, and does not consider every dwelling within the study area. This is in line with current best practice.

Table 12.2 – NSRs within the Assessment

ID	Name	Easting	Northing	Distance to nearest turbine, m	Nearest turbine ID
NSR01	Tigh Fiodha Larder Holiday Cottage	240506	863792	1688	T6
NSR02	Bridgefield House Little Garve	239553	862762	2475	T6
NSR03	The Cottage	239902	862228	2259	T6
NSR04	7 Stirling Drive Garve	239535	861592	2775	T7
NSR05	5 Station Road Garve	239537	861147	2940	T7
NSR06	Coach House	240307	861603	2049	T7
NSR07	Strathgarve Lodge	240508	861400	1968	T7
NSR08	Lochview	239858	860171	3246	T7
NSR09	Glensgaich	245854	860898	2568	T5
NSR10	Blackwater Cottages	241907	859062	2897	T9
NSR11	Cluaran Tarvie	242549	858889	2906	T9

ID	Name	Easting	Northing	Distance to nearest turbine, m	Nearest turbine ID
NSR12	Druim-cruaidh Tarvie	241652	858477	3535	T9
NSR13	The Rowans	242203	858144	3699	T9

12.5.4 As part of the construction works for the Proposed Development an off-site turning circle for Abnormal Indivisible Load (AIL) vehicles is to be constructed off the A835, approximately 6 km north of the site access. This is more distant to other areas of the Proposed Development and as such, a separate study area will be included around these works. The AIL study area includes a number of NSRs to the east of the off-site turning circle, with Inchbae Cottage / Inchbae Farm being the closest at 25 m from track works and Rancho Del Rio being the furthest inside the study area at 500 m. The assessment considers the range in noise levels from the construction of the Off-site turning circle, likely to be experienced by these NSRs.

Site Visit

12.5.5 A background noise survey was carried out at four noise measurement locations (NML) around the site, as shown on Figure 12.1 and listed in Table 12.3. The locations were chosen in consultation with THC. The monitoring locations are in line with that discussed with THC prior to the monitoring being undertaken as being representative of the background noise environment for the nearest residences to the Proposed Development, with the addition of NML3, Station Road at the request of a nearby resident as asked during the second round of public exhibitions in May 2024. Minor alterations have been made as compared with that originally proposed, following visits to the area where the most appropriate locations could be determined and, in some cases, due to access issues. None of the survey locations were influenced by existing wind turbine noise.

Table 12.3 – Background Noise Measurement Locations

ID	Name	Easting	Northing
NML1	Tigh Fiodha	240435	863838
NML2	The Cottage	239874	862197
NML3	Station Road	239542	861143
NML4	Cluaran	242542	858903

12.5.6 Full details of the background survey and measurement locations are provided in Technical Appendix 12.1. The background noise monitoring exercise was conducted over a period of approximately three weeks. The equipment used for the survey comprised four Rion NL 52 logging sound level meters and a tipping-bucket rain gauge. All sound level meters were enclosed in environmental cases and continuous logging at the required ten-minute averaging periods. Outdoor enhanced windshield systems were used to reduce wind induced noise on the microphones and provide protection from rain. These windshield systems were supplied by the sound level meter manufacturer and maintain the required performance of the whole measurement system when fitted. The environmental enclosures provided an installed microphone height of approximately 1.2 m to 1.5 m above ground level, consistent with the requirements of ETSU-R-97 and the IOA GPG.

12.5.7 The sound level meters were located on the Proposed Development side of the dwelling where possible, never closer than 3.5 m from the façade of the property and as far away as was practical from obvious atypical, localised sources of noise such as running water, trees or boiler flues.

12.5.8 All measurement systems were calibrated on their deployment on 3 June 2024 and upon collection of the equipment on 24 July 2024. No acoustically important (>0.5 dB(A)) drifts in calibration were found to have occurred on any of the systems.

12.5.9 The sound level meters logged the $L_{A90,10min}$ and $L_{Aeq,10min}$ noise levels continuously over the survey period, using Greenwich Mean Time (GMT) time reference. Wind data was measured by the SoDAR unit installed on the site, which also logged using the same 10-minute periods and GMT reference. The rain gauge also logged using GMT reference and was installed at NML4 Cluaran.

12.5.10 In accordance with the GPG guidance, the ten metres height wind speed data required by ETSU-R-97 was derived (or ‘standardised’) from measurements made at heights representative of the hub heights of the proposed turbines. This therefore accounts for the potential effect of site-specific wind shear. Wind speeds were measured using the SoDAR at multiple heights, including 100 m and 120 m. Values of wind speed at a standardised height of ten metres were calculated from those measured by the SoDAR unit (‘standardised wind speed’).

12.5.11 The SoDAR wind monitor was installed by trained and experienced technicians from Carbon 2050 Ltd, an appropriate expert within the field, in an area with no obstructions that could affect the data (location

241586, 863364). The SoDAR remained in good working condition throughout the survey. The installation report for the SoDAR is included in Appendix 12.4 and Appendix 12.5.

Assessment of Potential Effect Significance

Construction Noise and Vibration

12.5.12 BS 5228-1 has been used as the appropriate reference for the method of calculation and assessment of construction noise effects. At this stage of a development, it is not feasible to accurately specify exact construction techniques or locations where construction activity is likely to take place. Therefore, various assumptions have been made based on best practice and typical wind farm construction projects. The calculation follows Annex F of BS 5228-1 and assumes the following:

- plant is operational for 100% of the working day;
- there would be no screening effects;
- propagation over mixed ground (50% hard 50% soft); and
- construction activity is assumed to occur at a single point from receiver (closest point to the nearest receiver to represent a worst case).

12.5.13 Table 12.4 lists the key construction activities, the associated types of plant normally involved, and the expected worst-case sound power level over a working day for each activity. Sound power data has been obtained from the database of current sound levels of equipment and site activities supplied in Annex C of BS 5228-1.

Table 12.4 – Construction Plant Sound Power Levels

Task	Total Sound Power Level dB L_{WA}	Details of Plant or Equipment
Construct temporary site compound	118	Excavator, dump truck, pumping concrete, delivery lorries
Construct site tracks	118	Excavators, dump trucks, tippers, bulldozers, vibrating roller
Construct substation	112	Excavator, concrete mixing lorry, delivery lorries
Construct crane hard standings	116	Excavator, concrete mixing lorry, dump trucks
Construct turbine foundations	121	Piling Rig, excavators, dump trucks, concrete mixing lorries, mobile cranes, diesel water pumps, pneumatic hammers, compressors, vibratory pokers
Erect turbines	121	Cranes, turbine delivery vehicles, articulated lorries for crane movement, generators, torque guns
Reinstate crane bases	116	Excavator, dump truck
Borrow pit quarrying	127	Primary and secondary stone crushers, excavators, screening systems, pneumatic breakers, conveyors
Off-site turning circle	108	Excavator, tipper truck, dumper and welfare unit

12.5.14 The calculated construction noise levels are compared with absolute noise limits for temporary construction activities which are commonly regarded as providing an acceptable level of protection from the short-term noise levels associated with construction activities, based on guidance from BS 5228-1.

12.5.15 Rock extraction from borrow pits by means of blasting operations could be required and has been included in the assessment. Blasting operations can generate airborne pressure waves or ‘air overpressure’ which contains both audible (approximately 20 Hz to 20k Hz) and infrasonic pressure waves (<20 Hz), which, although outside the range of human hearing, can sometimes be felt. The relevant guidance documents advise controlling air overpressure with good practices during the setting and detonation of charges as opposed to absolute limits on the levels produced; therefore, no absolute limits for air overpressure or noise from blasting can be presented in the assessment. Other site activity associated with quarrying, such as stone crushing and the operation of plant including excavators, breakers and conveyors have been included in the noise assessment.

12.5.16 In accordance with the guidance in BS 6472 and PAN50, ground vibration caused by blasting operations will be considered acceptable if peak particle velocity (PPV) levels, at the nearest sensitive locations, do not exceed 6 mm/s for 95% of all blasts measured over any 6-month period, and no individual blast exceeds a PPV of 12 mm/s.

12.5.17 Separate consideration is also given to the possible noise effects of construction-related traffic passing to and from the site along local surrounding roads. In considering potential noise levels associated with construction traffic movement on public roads, reference is made to the accepted UK prediction methodology provided by CRTN.

12.5.18 Road traffic data have been provided for roads used by construction vehicles which represents the Average Annual Weekday Total (AAWT) two-way flows for the worst-case period of construction. The full prediction given in CRTN results in an absolute road traffic noise level at a receiver location. For the purpose of this assessment the change in road traffic noise is of concern and not the absolute level. This has been

achieved by calculating the Basic Noise Level (BNL) with corrections for heavy vehicles and low flow as described in CRTN. This is considered acceptable to provide a reasonable estimate of the likely change in road traffic noise.

12.5.19 The peak of construction in terms of vehicular movements is reported in Chapter 13: Site Access, Traffic and Transport to occur in month two. Chapter 13 Table 13.12 provides 2028 baseline traffic flow data, without construction vehicles, and the additional construction traffic flow data during the busiest months. These show an increase in road traffic during the peak months on eight road links to be between 0% and 9%.

Operational Noise

12.5.20 ETSU-R-97 provides a robust basis for assessing impacts of operational noise from wind turbines. Noise limits for wind farm developments are derived from background measurements and fixed values, and wind turbine immission levels are calculated for the NSRs in the assessment. Consequently, the test applied to operational noise is whether or not the calculated wind farm noise immission levels at nearby NSRs lie below the noise limits derived in accordance with ETSU-R-97. The principle method for assessing operational wind turbine noise set out in ETSU-R-97 calculates immission from, and sets noise limits for, all wind turbines in a given area.

12.5.21 An important component of the calculation of noise immission level is the selection of an appropriate wind turbine. The IOA GPG notes that most sites at the planning stage will not have selected a preferred turbine, therefore a representative candidate turbine should be selected to provide appropriate noise levels. Once noise levels have been predicted at the potentially affected properties, compliance with noise limits can be assessed and design advice provided if compliance with the limits is considered unlikely.

12.5.22 The Vestas V162 7.2 MW turbine with a hub height of 119 m and 99 m and equipped with trailing edge serrations has been selected as the candidate turbine for this assessment, as discussed further in paragraph 12.5.51. The manufacturer's noise emission data[1] has been provided directly at hub height wind speeds and excludes any margin for uncertainty, and as such an additional 2 dB has been included in the sound power levels in this assessment, as detailed in Table 12.5.

Table 12.5 – Vestas V162 7.2 MW Overall Noise Emission Data

Detail	Wind Speed at Hub Height										
	≤5	6	7	8	9	10	11	12	13	14	15
Sound Power Level, dB LWA including 2 dB uncertainty	96.0	97.0	100.3	103.5	106.1	106.6	106.7	106.8	107.0	107.3	107.5

12.5.23 Vestas have also supplied the octave band frequency spectrum equivalent to the maximum sound power level[2], detailed in Table 12.6. The values specified in Table 12.6 also include 2 dB uncertainty.

Table 12.6 – Vestas V162 7.2 MW Octave Band Frequency Noise Emission Data

Detail	Octave Band Centre Frequency, Hz								
	63	125	250	500	1000	2000	4000	8000	(A)
Sound Power Level, dB LWA including 2 dB uncertainty	91.1	98.7	101.9	102.1	100.4	95.8	88.2	77.4	107.5

12.5.24 The ISO 9613-2 model has been used to calculate the noise immission levels at the NSRs as advised in the IOA GPG. The model accounts for the attenuation due to geometric spreading, atmospheric absorption, and barrier and ground effects and assumes the following parameters:

- octave band data which accounts for the sound frequency characteristics of the turbines;
- receiver height of 4 m above local ground;
- mixed ground (G=0.5);
- an air absorption based on a temperature of 10°C and 70 % relative humidity;
- attenuation due to terrain screening has been limited to a maximum of 2 dB(A); and
- in situations of propagation above concave ground, a correction of +3 dB was added.

12.5.25 The above method is consistent with the recommendations of the IOA GPG. The IOA GPG also allows for directional effects to be taken into account within the noise modelling which can reduce the noise immission

[1] Vestas Wind Systems (2022) Document 0114-3777 Performance Specification EnVentus V162-7.2 MW 50/60 Hz, V4
[2] Vestas Wind Systems (2023) Document 0116-1715_03 Third Octave Band Emission EnVentus V162-7.2 MW 50/60 Hz

level at a receptor. However, predictions have been made assuming downwind propagation from every turbine to every receptor at the same time as a worst case.

12.5.26 Separate noise limits apply for the day time and night time, chosen to protect a property's external amenity and to prevent sleep disturbance indoors, respectively. Noise limits comprise the greater of two elements:

- a lower fixed value; and
- a derived relative value equal to the prevailing background curve plus 5 dB(A).

12.5.27 As set out in paragraph 12.3.18, the lower fixed portion of the daytime noise limit should lie within the range of 35 dB L_{A90} and 40 dB L_{A90}. In the case of the Proposed Development, a conservative value for the fixed portion of the day time noise limit of 35 dB L_{A90} has been applied.

12.5.28 During the night-time period, the fixed portion of the noise limit has been set to 38 dB L_{A90}. These noise limits align with THC Scoping Opinion as shown in Technical Appendix 6.2.

12.5.29 The exception to the lower fixed portion of the noise limit discussed above, is when a property occupier has a financial involvement in the wind farm development; however, in the case of the Proposed Development none of the assessment locations meet this criterion.

12.5.30 The prevailing background curve is derived from noise data, using the $L_{A90,\ 10min}$ parameter, measured at a representative location of a receptor and wind data measured at a location that is representative of the proposed wind turbines. Data measured during the ETSU-R-97 'quiet periods of the day' inform the day time prevailing background curve. These quiet periods are: weekdays between 18:00 and 23:00, Saturdays between 13:00 and 23:00 and all day on Sundays (07:00 to 23:00). Data measured between 23:00 and 07:00 inform the night-time prevailing background curve.

12.5.31 Data displaying evidence of being influenced by extraneous sources such as boiler flues, localised plant or watercourses were excluded. Periods of rainfall, including 30 minutes after were also excluded.

Substation

12.5.32 In addition to operational noise from the turbines, noise from the operation of the substation has been assessed. The main noise sources associated with the substation are likely to be the power transformers and their cooling fans. The transformer noise is generally fairly constant, once energised, whereas the cooling fans operate as needed, depending on load and ambient temperature. The noise from the transformers is usually tonal in nature with most energy contained within discrete frequency components at 100 Hz and harmonics thereof. The cooling fans are likely to be broadband in nature but switch on and off.

12.5.33 The proposed substation is located approximately 1.5 km from the nearest residential property, Strathgarve Lodge. The specifications of the transformers likely to be used for the substation are not defined at this stage; therefore, it is assumed that there will be two transformers, each with a sound power level of 85 dB(A), based on experience of typical installations for wind farms of this scale.

12.5.34 The operational noise from the substation has been predicted at the nearest residential property following the methodology set out in ISO 9613-2. The substation operational noise level predictions have been undertaken using a receiver height of four metres above local ground level, mixed soft and hard ground (G=0.5) and an air absorption based on a temperature of 10°C and 70 % relative humidity. No allowance has been included for screening provided by terrain or intervening buildings.

12.5.35 In accordance with the method described in BS 4142 a correction, based on professional judgement, for the potential acoustic features has also been included to provide the 'rating level'. Corrections can be applied for tonal, impulsive and / or intermittent characteristics that have the potential to lead to increased awareness of a sound. As a precaution, +2 dB has been included for a tone that is just perceptible. The 'rating level' is compared against the typical background noise levels to estimate the likely impact. An essential part of the BS 4142 assessment is to consider the context of the development in the surrounding area, which has been taken into account through the consideration of several factors including the absolute level of the noise, as discussed further in paragraph 12.5.45.

Requirements for Mitigation

12.5.36 Where construction noise impacts have been identified to potentially result in a significant effect, mitigation will be required. Standard mitigation for construction noise is discussed further in paragraphs 12.7.3 and

12.7.4. Additional mitigation can be specified to control specific construction activities, if identified to be necessary.

12.5.37 Where the wind farm noise immission level exceeds the noise limit at a NSR, additional mitigation will be required.

12.5.38 As part of the ongoing Proposed Development design evolution, where exceedances of noise limits have been identified, turbines have been moved wherever practicable to a location to reduce operational wind turbine noise to a level below the limit.

Assessment of Residual Effect Significance

Sensitivity

12.5.39 All of the relevant NSRs within the assessment area are dwellings, which are of high sensitivity. This applies to both construction and operational noise.

Magnitude

12.5.40 BS 5228-1 informative Annex E provides example criteria that may be used to consider the magnitude of any construction noise impacts. The criteria do not represent mandatory limits but rather a set of example approaches intended to reflect the type of methods commonly applied to construction noise. The example methods are presented as a range of possible approaches (both facade and free field noise levels, hourly and day time averaged noise levels) according to the ambient noise characteristics of the area in question, the type of development under consideration, and the expected hours of construction activity. In broad terms, the example criteria are based on a set of fixed limit values which, if exceeded, may result in a large impact unless ambient noise levels (i.e. regularly occurring levels without construction) are sufficiently high to provide a degree of masking of construction noise.

12.5.41 Based on the range of guidance values set out in BS 5228 Annex E and PAN50, the following impact assessment scale has been derived. The values have been chosen in recognition of the relatively low ambient noise typically observed in rural environments. The presented criteria have been normalised to free-field day time noise levels occurring over a time period, T, equal to the duration of a working day on site. BS 5228 1 Annex E provides varied definitions for the range of day time working hours which can be grouped for equal consideration. The values presented in Table 12.7 have been chosen to relate to day time hours from 07:00 to 19:00 on weekdays, and 07:00 to 13:00 on Saturdays.

Table 12.7 – Magnitude Criteria for Construction Noise

Magnitude	Noise Level dB $L_{Aeq, T}$		Description
	4 weeks or more	Up to 4 weeks	
High	> 75	> 85	Trigger level for noise insulation works, or costs thereof, as set out in E.4 of BS 5228-1.
Medium	> 65 and ≤ 75	> 75 and ≤ 85	Most stringent threshold values for potential significant effects given in Annex E of BS 5228-1 for example methods relevant to Proposed Development is exceeded.
Low	> 55 and ≤ 65	> 65 and ≤ 75	Noise is likely to be audible, but unlikely to change behaviour. BS 5228-1 thresholds not exceeded.
Negligible	≤ 55	≤ 65	At least 10 dB below the most stringent criteria provided in of BS 5228-1.

12.5.42 When considering the impact of short-term changes in traffic noise associated with the construction activities on existing roads in the vicinity of the Proposed Development, reference can be made to the criteria set out in the Design Manual for Roads and Bridges (DMRB), as summarised in Table 12.8. The change in noise level is calculated using the CRTN methodology to compare HGV corrected BNL with and without construction traffic, as described in paragraph 12.5.18.

Table 12.8 – Magnitude Criteria for Construction Traffic Noise

Magnitude	Description
High	Change in HGV corrected BNL of 5 dB or greater
Medium	Change in HGV corrected BNL of at least 3 dB and less than 5 dB
Low	Change in HGV corrected BNL of at least 1 dB and less than 3 dB
Negligible	Change in HGV corrected BNL of less than 1 dB

12.5.43 Operational noise effects have been determined following ETSU-R-97 and the IOA GPG, which if they do not exceed noise limits derived following the same guidance, whilst potentially adverse, are considered to be not significant in EIA terms.

12.5.44 Noise from the operation of the substation has been assessed using the methodology in BS 4142, which compares the 'rating level' from the specific source with typical baseline background noise levels in the

context of the Proposed Development. An important factor when considering the context is the absolute level of sound, where it is stated in BS 4142 that:

"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."

12.5.45 The standard offers no guidance about what background and rating levels are considered low; however, the 1997 version of the standard stated that background sound levels below around 30 dB L_{A90}, and rating levels below around 35 dB L_{Ar}, were considered very low and therefore outside the scope of the assessment method.

12.5.46 Table 12.9 sets out the magnitude criteria for operational noise impacts from the substation, based on the above considerations.

Table 12.9 – Magnitude Criteria for Substation Operational Noise

Magnitude	Description
High	Rating level exceeds background by 10 dB or more, and is greater than 35 dB
Medium	Rating level exceeds background by 5 dB to 10 dB, and is greater than 35 dB
Low	Rating level exceeds background, by a maximum of 5 dB, or is less than 35 dB
Negligible	Rating level equal to, or less than, background and less than 35 dB

Significance

12.5.47 The predicted significance of the effect was determined through a standard method of assessment based on professional judgement, considering both sensitivity of the NSR and magnitude of change as detailed in Table 12.10 for construction noise. As discussed in paragraph 12.5.39, all residential receptors have an equal sensitivity of 'High'. Major and moderate effects are considered significant in the context of the EIA Regulations.

Table 12.10 – Significance Criteria – Construction Noise

Magnitude of impact	Significance of effect for high sensitivity receptor
High	Major
Medium	Moderate
Low	Minor
Negligible	Negligible

12.5.48 The assessment of the significance of effects from operational and cumulative wind turbine noise is made as follows, with reference to ETSU-R-97 and Scottish Planning Guidance:

- Where operational and cumulative noise levels at receptors are below the relevant ETSU-R-97 noise limits, this is determined to be adverse but 'not significant'.
- Where operational and cumulative noise levels at receptors are above the relevant ETSU-R-97 noise limits, this is determined to be adverse and 'significant'.

Cumulative Assessment

12.5.49 Operational cumulative noise effects are considered as an inherent part of the assessment methodology detailed in this Chapter. Therefore, a separate cumulative assessment is not required for operational noise, but is included for construction noise.

Limitations and Assumptions of Assessment

12.5.50 For construction noise and vibration, predicted noise levels are based on assuming standard machinery and equipment are used and that these are operated in the way intended by their manufacturers. It is also assumed, on a precautionary basis, that these items of equipment are all used at the closest point of the proposed works area to each of the receptor locations. These are considered to be a precautionary assumption, with noise/vibration levels lower than predicted for much of the construction period.

12.5.51 For operational noise, the exact model of turbine to be used at the site would be the result of a future tendering process and therefore, an indicative turbine model (Vestas V162 7.2 MW) has been assumed for the operational noise assessment. The turbine model assumed is considered representative of the upper end of the range of noise emissions for turbines which may be installed at the site. For the other

wind farms included in the assessment, robust assumptions of the potential noise emissions which may be allowed for that site under its consent were considered in line with current good practice.

12.5.52 Noise emissions for all wind turbines were considered on a robust basis by the addition of 2 dB uncertainty.

12.5.53 For the operational substation, although the final equipment selection and installation arrangements are not known, the assessment is based upon experience of similar schemes and typical associated noise emission levels.

12.6 Baseline Conditions

12.6.1 Technical Appendix 12.1 provides details of the background noise survey locations and the noise climates experienced there. The noise climate at all survey locations can be described as fairly typical for rural amenity influenced by wind disturbed vegetation, distant road traffic, natural noises such as birds and livestock, with occasional distant aircraft.

12.6.2 Technical Appendix 12.2 shows the range of wind conditions experienced during the noise survey period. During the quiet day time and night-time periods a good spread of data was obtained up to wind speeds of 9 m/s and a range of wind directions.

12.6.3 Technical Appendix 12.2 also shows the results of the background noise measurements at each of the four survey locations. The background noise data is presented in terms of $L_{A90,10min}$ background noise levels plotted as a function of standardised wind speed. Two graphs are shown for each location, one for quiet day time periods and the other for night-time periods, both derived in accordance with ETSU-R-97.

12.6.4 The background noise survey was conducted during a time of year when in the UK dawn chorus noise can be pronounced. Evidence was found that the measured night-time prevailing background noise levels were elevated during the early morning period. Therefore, data measured during the period between 03:00 hours and 07:00 hours has been excluded from all the locations as a precautionary worst case.

12.6.5 ETSU-R-97 requires that any data affected by rainfall be excluded from the analysis. The rain gauge installed during the noise survey period was used to exclude those periods where rain was indicated.

12.6.6 In addition to the impact noise on surrounding vegetation and the sound level meter itself, in some environments rainfall can result in appreciable changes in background sound levels, for example as a result of wet roads which increase tyre noise emissions or dissipating flow noise in water courses and drainage systems. The monitoring locations were also positioned as far as practically possible from any residential drainage systems, and water courses to minimise any associated noise influence. Based on the above, rainfall is considered to have a limited effect on background sound levels. In addition to noise data that was recorded during rain fall, a period of 30 minutes after rainfall was recorded to stop was also excluded to minimise any further atypical levels of elevated background due to these effects.

12.6.7 The measured background noise data may also have been increased by other extraneous sources or atypical events. Time histories of the noise levels at each survey location were therefore inspected to look for any atypical relationships when compared to the wind speeds present during that time. Any elevated levels found in this way were excluded. The trend of the data when plotted against wind speed was also inspected to look for atypical relationships or outliers within the dataset (particularly at low wind speeds) which were excluded. Any data removed from the analysis in this way is indicated on the graphs included in Technical Appendix 12.2 as red squares. The analysis and filtering of the data was therefore undertaken in accordance with current good practice as set out in the IOA GPG.

12.6.8 Following removal of extraneous data points, as described above, best fit lines were generated using a polynomial fit of a maximum of 4th order, as summarised in Table 12.11 and Table 12.12, for the quiet day time and night-time respectively. As advised above, background noise data was measured during windspeed of up to 9 m/s, so data is provided in Table 12.11 and Table 12.12 up to this value. For locations where data is limited at higher wind speeds, the background noise level for the highest included wind speed has been used to inform the noise limit at this point and all wind speeds above. The use of such data caps is in accordance with the GPG.

Table 12.11 – Quiet Day Time Measured Background Noise Levels

Survey Location	Background Noise Level, dB L_{A90}, for Standardised Wind Speed, m/s								
	1	2	3	4	5	6	7	8	9
NML1 Tigh Fiodha	39	39	40	41	42	42	43	44	46
NML2 The Cottage	30	31	32	33	34	36	38	40	42
NML3 Station Road	32	33	34	35	36	37	39	40	41
NML4 Cluaran	29	30	31	32	33	34	36	37	39

Table 12.12 – Night-time Measured Background Noise Levels

Survey Location	Background Noise Level, dB L_{A90}, for Standardised Wind Speed, m/s								
	1	2	3	4	5	6	7	8	9
NML1 Tigh Fiodha	39	39	39	40	40	40	41	41	42

Survey Location	Background Noise Level, dB L_{A90}, for Standardised Wind Speed, m/s								
	1	2	3	4	5	6	7	8	9
NML2 The Cottage	25	26	27	28	30	31	32	34	36
NML3 Station Road	22	23	24	25	26	28	29	30	31
NML4 Cluaran	22	24	25	27	28	29	30	31	32

12.6.9 The overall ETSU-R-97 noise limits used in the assessment of the Proposed Development at the NSRs are set out in the Table 12.13 for the quiet day time and Table 12.14 for the night-time periods. As discussed in paragraphs 12.5.26 to 12.5.29 the fixed portion of the limit is set to 35 dB L_{A90} during the day and 38 dB L_{A90} during the night-time at all locations. All windspeeds are standardised values. It is noted that NML1 Tigh Fiodha satisfies the criterion for financial involvement and would qualify for a slightly higher noise limit at lower wind speeds. However, survey data from this location is used as a proxy for another nearby assessment location, so noise limits given in Table 12.13 and Table 12.14 assume no financial involvement status.

Table 12.13 – Day Time Overall ETSU-R-97 Noise Limits for Survey Locations

Survey Location	Overall ETSU-R-97 Noise Limit, dB L_{A90}, for Standardised Wind Speed, m/s								
	1	2	3	4	5	6	7	8	9
NML1 Tigh Fiodha	44	44	45	46	47	47	48	49	51
NML2 The Cottage	35	36	37	38	39	41	43	45	47
NML3 Station Road	37	38	39	40	41	42	44	45	46
NML4 Cluaran	35	35	36	37	38	39	41	42	44

Table 12.14 – Night-time Overall ETSU-R-97 Noise Limits for Survey Locations

Survey Location	Overall ETSU-R-97 Noise Limit, dB L_{A90}, for Standardised Wind Speed, m/s								
	1	2	3	4	5	6	7	8	9
NML1 Tigh Fiodha	44	44	44	45	45	45	46	46	47
NML2 The Cottage	38	38	38	38	38	38	38	39	41
NML3 Station Road	38	38	38	38	38	38	38	38	38
NML4 Cluaran	38	38	38	38	38	38	38	38	38

Future Baseline in absence of Proposed Development

12.6.10 The existing baseline is not expected to change by the time the Proposed Development would be implemented, if approved.

12.7 Standard Mitigation

12.7.1 Noise levels were calculated for progressive configurations of the Proposed Development and compared against the derived noise limits. Advice was provided to the design team, including confirmation that noise levels for the final layout complied with the ETSU-R-97 criteria, mainly due to the large separation distances involved.

12.7.2 In terms of operational noise generated by the Proposed Development, the turbine considered here includes trailing edge serrations which have the effect of reducing source noise levels as compared with turbine blades which do not have such modifications. Turbines of the size and scale considered for the Proposed Development typically include this feature as a matter of course, and it is expected that the actual turbine for potential installation at the site, should consent be granted, will have similar blade modifications. Nevertheless, noise associated with the operation of the Proposed Development will be required to meet any consented (planning condition) noise limits in this respect, regardless of the specific design of turbine, and appropriate due diligence and/or further planning submissions will be required to ensure that this is the case.

12.7.3 To reduce the potential impacts of construction noise, the following good practice measures are proposed and where appropriate are to be included in the Construction Environmental Management Plan (CEMP):

- Those activities that may give rise to audible noise at the surrounding properties and heavy goods vehicle deliveries to the site will be limited to the hours 08:00 to 19:00 Monday to Friday and 08:00 to 13:00 on Saturdays. Turbine deliveries will only take place outside these times with the prior

consent of THC and the Police. Those activities that are unlikely to give rise to noise audible at the site boundary will continue outside of the stated hours.

- All construction activities shall adhere to good practice as set out in BS 5228-1.
- All equipment will be maintained in good working order and any associated noise attenuation such as engine casing and exhaust silencers shall remain fitted at all times.
- Where flexibility exists, activities will be separated from residential neighbours by the maximum practicable distances.
- A site management regime will be developed to control the movement of vehicles to and from the Proposed Development site.
- Construction plant capable of generating significant noise and vibration levels will be operated in a manner to restrict the duration of the higher magnitude levels.

12.7.4 If blasting is used at the proposed borrow pits, the following additional measures would also be implemented through the CEMP:

- Blasting should take place under controlled conditions with the agreement of THC.
- Good practices during the setting and detonation of charge should be followed, in order to control air overpressure, in line with guidance set out in PAN50 and BS 5228-2.
- Vibration levels at the nearest sensitive properties are best controlled through on-site testing processes, with progressively increased charges, carried out in consultation with THC. Ground vibration caused by blasting operations at the nearest sensitive locations, should not exceed 6 mm/s for 95 % of all blasts measured over any 6-month period, and no individual blast exceeding a PPV of 12 mm/s.

12.7.5 An Outline CEMP is provided in Technical Appendix 3.1.

12.8 Receptors Brought Forward for Assessment

12.8.1 The selection of the NSRs is discussed in paragraph 12.5.3 and those included in the assessment are set out in Table 12.2. For each of these NSRs appropriate noise limits have been applied based on Table 12.13 and Table 12.14 for the day time and night time respectively. The use of the data in this way is justified by the comparable terrain and the dominant influence of natural sources on background noise levels throughout the area, particularly at increased wind speeds. This approach is consistent with the guidance provided by ETSU-R-97 and current good practice as set out in the IOA GPG.

12.8.2 Table 12.15 and Table 12.16 present the overall ETSU-R-97 noise limits for all the assessment locations.

Table 12.15 – Day Time Overall ETSU-R-97 Noise Limits for Assessment Locations

Assessment Location	Overall ETSU-R-97 Noise Limit, dB L_{A90}, for Standardised Wind Speed, m/s								
	1	2	3	4	5	6	7	8	9+
NSR01 Tigh Fiodha Larder	44	44	45	46	47	47	48	49	51
NSR02 Bridgefield House	35	36	37	38	39	41	43	45	47
NSR03 The Cottage	35	36	37	38	39	41	43	45	47
NSR04 7 Stirling Drive	37	38	39	40	41	42	44	45	46
NSR05 5 Station Road	37	38	39	40	41	42	44	45	46
NSR06 Coach House	35	36	37	38	39	41	43	45	47
NSR07 Strathgarve Lodge	35	36	37	38	39	41	43	45	47
NSR08 Lochview	37	38	39	40	41	42	44	45	46
NSR09 Glensgaich	35	35	36	37	38	39	41	42	44
NSR10 Blackwater Cottages	35	35	36	37	38	39	41	42	44
NSR11 Cluaran	35	35	36	37	38	39	41	42	44
NSR12 Druim-cruaidh	35	35	36	37	38	39	41	42	44
NSR13 The Rowans	35	35	36	37	38	39	41	42	44

Table 12.16 – Night-time Overall ETSU-R-97 Noise Limits for Assessment Locations

Assessment Location	Overall ETSU-R-97 Noise Limit, dB L_{A90}, for Standardised Wind Speed, m/s								
	1	2	3	4	5	6	7	8	9+
NSR01 Tigh Fiodha Larder	44	44	44	45	45	45	46	46	47
NSR02 Bridgefield House	38	38	38	38	38	38	38	39	41
NSR03 The Cottage	38	38	38	38	38	38	38	39	41
NSR04 7 Stirling Drive	38	38	38	38	38	38	38	38	38
NSR05 5 Station Road	38	38	38	38	38	38	38	38	38
NSR06 Coach House	38	38	38	38	38	38	38	39	41
NSR07 Strathgarve Lodge	38	38	38	38	38	38	38	39	41
NSR08 Lochview	38	38	38	38	38	38	38	38	38

Assessment Location	Overall ETSU-R-97 Noise Limit, dB L_{A90}, for Standardised Wind Speed, m/s								
	1	2	3	4	5	6	7	8	9+
NSR09 Glensgaich	38	38	38	38	38	38	38	38	38
NSR10 Blackwater Cottages	38	38	38	38	38	38	38	38	38
NSR11 Cluaran	38	38	38	38	38	38	38	38	38
NSR12 Druim-cruaidh	38	38	38	38	38	38	38	38	38
NSR13 The Rowans	38	38	38	38	38	38	38	38	38

12.9 Potential Effects

Construction

12.9.1 Table 12.17 sets out the predicted construction noise levels at the NSR situated closest to each of the construction tasks. It must be emphasised that these predictions only relate to the noise level occurring during the time when the activity is closest to the referenced property. In many cases the separating distances will be considerably greater for the majority of the construction period and the predictions are therefore the worst-case periods of the construction phase.

Table 12.17 – Construction Noise Levels

Task	Nearest NSR	Minimum distance to nearest NSR, m	Predicted upper construction noise level, dB L_{Aeq}
Construct temporary site compound	NSR01 Tigh Fiodha Larder	350	57
Construct site tracks	NSR01 Tigh Fiodha Larder	120	67
Construct substation	NSR07 Strathgarve Lodge	1,500	37
Construct crane hard standings	NSR01 Tigh Fiodha Larder	1,540	40
Construct turbine foundations	NSR01 Tigh Fiodha Larder	1,680	44
Erect turbines	NSR01 Tigh Fiodha Larder	1,680	44
Reinstate crane bases	NSR01 Tigh Fiodha Larder	1,540	36
Borrow pit quarrying	NSR01 Tigh Fiodha Larder	1,650	51
Off-site turning circle	Inchbae Farm / Rancho Del Rio	25 / 300	72 / 48

12.9.2 The worst case construction noise level for the turbines and associated infrastructure is predicted to occur during the construction of site tracks with a level of 67 dB L_{Aeq} at NSR01 Tigh Fiodha Larder Holiday Cottage. This is based on the shortest distance between the access track and receiver location. Noise levels will quickly diminish as site track construction progresses, moving the activity further from the property. Once activity is a distance of 150 m or greater from the receiver, the construction noise level falls below 65 dB. The plant would only be operational within this distance for a period of a few days, and considerably less than four weeks. This would equate to a low magnitude of impact (Table 12.7). All other construction noise impacts would be of low or negligible magnitude.

12.9.3 During construction of the off-site turning circle noise levels are predicted to range between 72 dB L_{Aeq} and 48 dB L_{Aeq}, depending on the location of the plant and which NSR is considered. The total construction period for the off-site turning circle is estimated to be a maximum of 8 weeks. The duration that works take place at the shortest distance to the closest NSR will be brief, approximately two days. The overall impact would be of low or negligible magnitude.

12.9.4 A low magnitude of impact at a high sensitive receptor equates to an adverse effect of **minor** significance.

12.9.5 In addition to on-site activities, construction traffic passing to and from the site will also represent a potential source of noise to surrounding properties. Traffic flow data, as reported in Chapter 13, has been used to confirm the likely type and number of vehicles using the nearby roads for cases with and without construction traffic, as summarised in Table 12.18.

Table 12.18 – Changes in Road Traffic Noise Due to Construction Vehicles

Link	2028 Baseline (no construction)			2028 with construction traffic			Change in BNL, dB
	Total Traffic	% HGV	BNL, dB	Total Traffic	% HGV	BNL, dB	
A835: Inchbae Farm to A832 Junction	2,265	8.6	66.0	2,461	14.4	67.3	1.3
A835: A832 Junction to A834 Junction at Contin	3,841	17.6	70.0	4,037	20.7	70.6	0.6
A835: A834 Junction at Contin to A832 Junction at Moy Bridge	4,899	11.6	70.3	5,095	14.3	70.8	0.5
A835: A832 Junction at Moy Bridge to A862 Junction at Maryburgh Roundabout	4,967	19.6	71.3	5,163	22.0	71.8	0.4
A835: A862 Junction at Maryburgh Roundabout to B9169 Junction at Leanaig	11,087	8.8	73.4	11,283	10.0	73.7	0.3

Link	2028 Baseline (no construction)			2028 with construction traffic			Change in BNL, dB
	Total Traffic	% HGV	BNL, dB	Total Traffic	% HGV	BNL, dB	
A835: B9169 Junction at Leanaig to A9 Junction at Tore	10,060	9.6	73.1	10,256	11.0	73.4	0.3
A9 North of Tore Roundabout	11,044	38.5	74.7	11,142	38.9	74.8	0.1
A9 Artafallie (B9161) to Tore Roundabout	24,703	18.7	76.2	24,801	18.9	76.2	0.1

12.9.6 A maximum predicted increase of 1.3 dB in road traffic noise is predicted during the busiest month for the number of construction vehicles. This would equate to a low impact (Table 12.8).

12.9.7 A low magnitude of impact at a high sensitive receptor equates to an effect of minor significance.

Operation

12.9.8 Table 12.19 presents the wind turbine noise immission levels of the Proposed Development, calculated at each of the NSRs for the given standardised wind speed range 4 m/s to 12 m/s. This information is illustrated graphically in Technical Appendix 12.3.

Table 12.19 – Proposed Development Wind Turbine Noise Immission Levels

Assessment Location	Noise Immission Level, dB L_{A90}, for Standardised Wind Speed, m/s								
	4	5	6	7	8	9	10	11	12
NSR01 Tigh Fiodha Larder	22	27	31	32	32	32	33	33	33
NSR02 Bridgefield House	20	24	29	30	30	30	30	30	30
NSR03 The Cottage	20	24	28	29	29	30	30	30	30
NSR04 7 Stirling Drive	18	22	27	28	28	28	28	28	28
NSR05 5 Station Road	17	22	26	27	27	28	28	28	28
NSR06 Coach House	20	24	28	29	30	30	30	30	30
NSR07 Strathgarve Lodge	20	25	29	30	30	30	31	31	31
NSR08 Lochview	17	22	26	27	27	27	28	28	28
NSR09 Glensgaich	18	22	27	28	28	28	29	29	29
NSR10 Blackwater Cottages	19	23	27	28	29	29	29	29	29
NSR11 Cluaran	19	24	28	29	29	29	30	30	30
NSR12 Druim-cruaidh	19	23	28	29	29	29	29	29	29
NSR13 The Rowans	18	23	27	28	28	28	29	29	29

12.9.9 When comparing the wind turbine noise immission level (Table 12.19) with the ETSU-R-97 noise limits for the day time (Table 12.15) and night-time (Table 12.16) it can be seen that the immission level does not exceed the limit for any receptor or any wind speed. As the ETSU-R-97 noise limits are not exceeded, operational noise effects are considered to be not significant (as per paragraph 12.5.48).

12.9.10 At some locations, under some wind conditions and for a certain proportion of the time, the wind farm noise may be audible, which represents an adverse noise effect. However, the noise effect associated with the operation of the Proposed Development is below the ETSU-R-97 noise limits for all locations and all wind speeds. As set out in paragraph 12.5.48, this is considered to be not significant.

Substation

12.9.11 Operational noise from the substation for the Proposed Development at the nearest NSR, NSR07 Strathgarve Lodge, is calculated to be 13 dB. When including a potential +2 dB penalty for the character of the noise, the resulting 'rating level' would be of 15 dB. Background noise levels were measured near to Strathgarve Lodge, at NML2 The Cottage. The lowest typical background noise at this representative measurement location was reported to be 25 dB at low wind speeds during the night-time . When assessed against the criteria derived in Table 12.9, this would correspond to a negligible noise impact on a highly sensitive receptor, and therefore result in a **negligible** effect which is not significant.

Decommissioning

12.9.12 Upon decommissioning of the Proposed Development, the wind turbines would be disassembled and all above ground components would be separated and removed off-site for reuse or recycling. Turbine foundations would remain in place underground with the top 1m of the turbine foundation removed and disposed of appropriately. The excavated foundation would be reprofiled with soil and reseeded. See Section 3.8 of Chapter 3 for further details of the decommissioning process. These activities would be undertaken during daytime hours, and noise, which would be of a lesser impact than for construction, will be controlled through the relevant guidance and standards in place at the time of decommissioning.

12.9.13 Site access tracks could be in use for purposes other than the operation of the Proposed Development by the time the decommissioning of the Proposed Development is to be considered, and therefore it may be more appropriate to leave the site access tracks in situ for future use. If the tracks were not required in the

future for any other useful purpose, they could be removed where required. This would involve removing hard core material and placement of topsoil. The impact is expected to be less than that during the construction stage and therefore would not be any greater than a low magnitude.

12.9.14 The majority of decommissioning activities would be of negligible impact, with the noise from the removal of site access tracks having the potential to be a low magnitude impact. A low magnitude impact upon a high sensitive receptor equates to an effect of **minor** significance which is not significant.

12.10 Additional Mitigation and Enhancement

12.10.1 The construction noise impacts have been predicted accounting for standard mitigation specified in paragraph 12.7.3. As confirmed in paragraph 12.9.4, the predicted impacts correspond to a temporary minor adverse effect. Therefore, no additional mitigation will be required during this phase.

12.10.2 As set out in paragraph 12.9.9, the operational noise levels associated with the Proposed Development will meet the requirements of ETSU-R-97, which can be controlled through planning condition noise limits. Therefore, no mitigation will be required during this phase.

12.10.3 The only other noise associated with the operation of the Proposed Development is that of the substation. Paragraph 12.9.11 confirms that this would have a negligible effect, and therefore, mitigation would not be necessary.

12.10.4 The decommissioning noise impacts are confirmed in paragraph 12.9.14 to be of temporary minor adverse effect. Therefore, no mitigation will be required during this phase.

12.11 Residual Effects

Construction

12.11.1 As discussed above, noise resulting from the construction of the Proposed Development is expected to meet typical noise limits for activities of this type without any specific mitigation being required, corresponding to a temporary **minor** adverse effect. As a result, the residual effect remains as not significant.

Operation

12.11.2 The operational noise assessment indicates that predicted turbine noise levels, based on the installation of an appropriate candidate turbine, can meet the requirements of ETSU-R-97 without the requirement for mitigation/curtailment. Appropriate control measures can be put in place through the imposition of planning conditions which will enforce this in practice.

12.11.3 The operational noise assessment of the substation confirms there to be a negligible effect which is not significant.

Decommissioning

12.11.4 Noise resulting from the decommissioning of the Proposed Development is expected to meet typical noise limits for activities of this type without any specific mitigation being required, corresponding to a temporary minor adverse effect. As a result, the residual effect remains as not significant.

12.12 Cumulative Assessment

12.12.1 As discussed in paragraph 12.5.1, there is limited information available regarding Tarvie Wind Farm. At the time of writing the Tarvie Wind Farm noise consultants confirmed that background noise monitoring had not yet been undertaken and the development was still in the design stage. Therefore, it was not possible to model the turbines for this potential neighbouring development, or confirm what the likely noise limits would be for the NSRs close to it.

12.12.2 It is common practice in cases like these for the second development that passes through the planning system to undertake the cumulative impact assessment, as all the necessary information will be available to conduct a complete and comprehensive assessment.

12.12.3 During consultation THC asked that consideration is given to potential cumulative impacts with Tarvie Wind Farm. Therefore, qualitative consideration has been given in this regard, given the lack of information. Four of the NSRs within this assessment are situated roughly between Tarvie Wind Farm and the Proposed Development: NSR10 – NSR13. The greatest wind turbine noise immission level from the Proposed

Development at these receptors is 30 dB L_{A90}, as shown in Table 12.19. This assumes down-wind propagation, which results in highest noise immission levels.

12.12.4 The IOA GPG provides advice on potential directional effects of a wind farm: under upwind propagation conditions between a given NSR and the wind farm the noise immission level at that NSR can be as much as 10 dB(A) to 15 dB(A) lower than the level predicted assuming down-wind propagation.

12.12.5 When Tarvie Wind Farm will be producing their greatest noise immission level at NSR10 – NSR13 the Proposed Development will be upwind and therefore producing noise immission levels of 15 dB – 20 dB at these locations. This value is 15 dB(A) to 20 dB(A) below the most stringent noise limit set in ETSU-R-97 and the IOA GPG, of 35 dB L_{A90}. When adding two noise levels together that are 10 dB(A) or greater apart, the cumulative total will be equal to the higher individual noise level. Therefore, it would not be possible for the Proposed Development to increase the cumulative noise over a limit of at least 35 dB L_{A90} that would otherwise remain within.

12.12.6 When the Proposed Development will be producing their greatest noise immission level at NSR10 – NSR13 Tarvie Wind Farm will be upwind and therefore producing levels 10 dB(A) to 15 dB(A) lower than those predicted under down-wind conditions. Tarvie Wind Farm would have to be producing 35 dB L_{A90} (under upwind conditions) to increase the maximum down-wind immission from the Proposed Development of 30 dB L_{A90} to a cumulative total of 36 dB L_{A90}. However, Tarvie Wind Farm would have to comply under down-wind propagation which would be 45 dB to 50 dB L_{A90} and therefore, reliant on high background noise levels providing much higher noise limits. In such a case, the Proposed Development would not be contributing cumulatively.

12.13 Summary

12.13.1 This chapter has presented an assessment of the impacts of construction and operational noise from the Proposed Development on the residents of nearby dwellings.

12.13.2 Several residential properties have been selected as being representative of the closest located properties to the Proposed Development. Noise assessments have been undertaken at these properties by comparing predicted construction and operational noise levels with relevant assessment criteria. In the case of construction noise, relevant assessment criteria are in the form of absolute limit values derived from a range of environmental noise guidance. In relation to operational noise, the limits have been derived from the existing background noise levels at three surrounding properties, as derived from measurements made over approximately four weeks at each location.

12.13.3 The construction noise assessment has determined that associated levels are expected to be audible at various times throughout the construction programme, but remain within acceptable limits such that their temporary impacts are considered of **minor** significant effect (not significant in the context of the EIA Regulations).

12.13.4 Operational noise from the wind farm has been assessed in accordance with the methodology set out in ETSU-R-97, 'The Assessment and Rating of Noise from Wind Farms'. This document provides a robust basis for assessing the operational noise of a wind farm as recommended by Scottish Planning Policy. The assessment process set out in ETSU-R-97 includes cumulative operational noise from other wind energy developments in the area. There are no other wind farms, operational, proposed or otherwise, in the area that would cumulatively contribute to wind turbine noise at the assessment locations.

12.13.5 It has been demonstrated that both the daytime and night-time noise limits can be satisfied at all assessment properties across all wind speeds. This assessment has been based on the use of the manufacturer's warranted sound power data for the Vestas V162 7.2 MW wind turbine which is typical of the type and size of turbine which is being considered for this site, and assuming worst case downwind propagation.

12.13.6 In summary, the overall levels of construction noise are considered to represent a **minor** significant effect (not significant in the context of the EIA Regulations). At some locations under some wind conditions and for a certain proportion of the time, the Proposed Development noise may be audible; however, operational noise immission levels comply with the criteria of the guidance commended by planning policy for the assessment of wind farm noise (operational effects are assessed to be not significant in the context of the EIA Regulations). Operational noise from the substation is considered to represent a **negligible** effect (not significant in the context of the EIA Regulations).

Table 12.20 – Summary of residual effects

Likely Significant Effect	Mitigation	How Implemented	Residual Effect
Construction noise	n/a	n/a	Temporary minor (not significant)
Operational noise (turbines)	n/a	n/a	Not significant
Operational noise (substation)	n/a	n/a	Negligible (not significant)

12.14 References

BSI (2008). BS6472-2 Guide to Evaluation of Human Exposure to Vibration in Buildings – Part 2: Blast Induced Vibration.

BSI (2014). BS5228 Code of practice for noise and vibration control on construction and open sites – Part 1: Noise.

BSI (2019). BS4142 Methods for Rating and Assessing Industrial and Commercial Sound.

HMSO Department of Transport (1988). The Calculation of Road Traffic Noise.

HMSO (1990). Environmental Protection Act, Part III.

Institute of Acoustics (2013). Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise. https://www.ioa.org.uk/publications/wind-turbine-noise Accessed November 2024.

International Standards Organisation (2024). ISO 9613-2 Acoustics – Attenuation of Sound During Propagation Outdoors – Part 2: Engineering Method for the Prediction of Sound Pressure Level Outdoors.

Noise Working Group for the Department of Trade and Industry (1996). ETSU-R-97 The Assessment and Rating of Noise from Wind Farms. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/49869/ETSU_Full_copy__Searchable_.pdf Accessed November 2024.

Scottish Government (1996). Planning Advice Note 50: Controlling the Environmental Effects of Surface Mineral Workings. https://www.gov.scot/publications/planning-advice-note-pan-50-controlling-environmental-effects-surface-mineral/ Accessed November 2024.

Scottish Government (2011). Assessment of Noise: Technical Advice Note.

https://www.gov.scot/publications/technical-advice-note-assessment-noise/ Accessed November 2024.

Scottish Government (2011). Planning Advice Note 1/2011: Planning and Noise. https://www.gov.scot/publications/planning-advice-note-1-2011-planning-noise/ Accessed November 2024.

Scottish Government (2014). Onshore Wind Turbines: Planning Advice. https://www.gov.scot/publications/onshore-wind-turbines-planning-advice/ Accessed November 2024.

Scottish Government (2022). Onshore Wind: Policy Statement 2022. https://www.gov.scot/publications/onshore-wind-policy-statement-2022/ Accessed November 2024.

Scottish Government (2023). National Planning Framework 4. https://www.gov.scot/publications/national-planning-framework-4/ Accessed November 2024.

The Highland Council (2012). Highland-wide Local proposed development Plan. THC: available online from: https://www.highland.gov.uk/info/178/local_and_statutory_development_plans/199/highland-wide_local_development_plan Accessed November 2024.

The Highland Council (2016). Onshore wind energy: supplementary guidance. THC: available online from: https://www.highland.gov.uk/downloads/file/16949/onshore_wind_energy_supplementary_guidance-_nov_2016 Accessed November 2024.

Transport Scotland (2020). Design Manual for Roads and Bridges, LA111 Noise and Vibration.