12 NOISE

12.1 Introduction

This Chapter of the Environmental Impact Assessment Report (EIA Report) evaluates the effects of the Ladyfield Renewable Energy Park (the Development) on the acoustic environment. This assessment was undertaken by Arcus Consultancy Services Limited (Arcus).

This Chapter of the EIA Report is structured as follows:

- Legislation, Policy and Guidance;
- Assessment Methodology and Significance Criteria;
- Baseline Conditions;
- Assessment of Potential Effects;
- Mitigation and Residual Effects;
- Cumulative Effect Assessment;
- Summary of Effects;
- Statement of Significance; and
- Glossary.

This Chapter of the EIA Report is supported by the following figures provided in Volume 2a: Figures excluding LVIA:

- Figure 12.1: Cumulative Noise Contour Plot; and
- Figure 12.2: BESS and Substation Noise Map.

This Chapter is supported by the following Technical Appendix document provided in Volume 3: EIA Report Technical Appendices:

- A12.1: Baseline Noise Survey Records; and
- A12.2: Details of Construction Plant.

The following terms are used within this Chapter to describe the Development and various associated study areas:

- The Development: the whole physical process involved in the development of Ladyfield Renewable Energy Park, including wind farm construction, operation and decommissioning (i.e., not a piece of land or an area);
- The Site boundary: the red line or application boundary as shown in Figure 1.2;
- The Site: the land within the Site Boundary available for turbine development, substation and Battery Electrical Storage Site (BESS) compound, and associated wind farm infrastructure; and
- Cumulative Assessment Study Area: the area defined by the orange shading within the purple 35 decibels (dB(A)) contour line shown in Figure 12.1 (See Section 12.3.3.1 for further details).

12.2 Legislation, Policy and Guidance

12.2.1 Legislation

The following legislation is of relevance to the noise assessment:

- The Control of Pollution Act 1974 (CoPA 1974)[342];
- The Environmental Protection Act 1990[343] (EPA 1990); and

[342] UK Government (1974) The control of Pollution Act 1974, available at: http://www.legislation.gov.uk/ukpga/1974/40 (Accessed 02.10.23)
[343] UK Government (1990) The Environmental Protection Act 1990. Available at: http://www.legislation.gov.uk/ukpga/1990/43/contents (Accessed 02.10.23)

- The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017[344].

12.2.1.1 The Control of Pollution Act 1974

CoPA 1974 provides Local Authorities with powers to control noise and vibration from construction sites.

Section 60 of the CoPA 1974 enables a Local Authority to serve a notice, on persons carrying out construction work, of its requirements for the control of site noise. This may specify plant or machinery that is or is not to be used; the hours during which construction work may be carried out; the level of noise or vibration that may be emitted; and provide for changes in circumstances. Appeal procedures are available.

Section 61 of the CoPA 1974 allows for those carrying out construction work to apply to the Local Authority in advance for consent to carry out the works. This is not mandatory, but is often advantageous for the developer, as once consent is issued, the Local Authority is no longer able to take action under Section 60 of CoPA 1974 or Section 80 of the EPA 1990, provided the works are carried out in accordance with the Section 61 consent. It does not, however, prevent nuisance action under Section 82 of the EPA 1990.

12.2.1.2 The Environmental Protection Act 1990

The EPA 1990 specifies mandatory powers available to Local Authorities in respect of any noise that either constitutes or is likely to cause a statutory nuisance, which is also defined in the CoPA 1974. A duty is imposed on Local Authorities to carry out inspections to identify statutory nuisances, and to serve abatement notices against these. Procedures are also specified with regard to complaints from persons affected by a statutory nuisance.

12.2.1.3 The Electricity Works 2017

In Scotland, onshore renewable energy developments that have capacity to generate over 50 MW require consent from the Scottish Ministers under the Electricity Act 1989 (the Electricity Act)[345]. In such cases the relevant Local Planning Authority (LPA) is a statutory consultee in the development management process and procedures.

Schedule 4 of The Electricity Works outlined information to be included in the Environmental Impact Assessment Reports which included the assessment of noise and vibration, the document states:

'*The description of the likely significant effects on the factors specified in regulation 4(3) should cover the direct effects and any indirect, secondary, cumulative, transboundary, short-term, medium- term and long-term, permanent and temporary, positive and negative effects of the development.*'

And:

'*A description of the measures envisaged to avoid, prevent, reduce or, if possible, offset any identified significant adverse effects on the environment and, where appropriate, of any proposed monitoring arrangements (for example the preparation of a post-project analysis). That description should explain the extent, to which significant adverse effects on the environment are avoided, prevented, reduced or offset, and should cover both the construction and operational phases.*'

The requirements stated in this schedule have been covered in this assessment, including; direct, indirect, cumulative, short/mid/long-term effects as well as any mitigation measures to prevent significant adverse effects where possible.

[344] The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017 [Online] http://www.legislation.gov.uk/ssi/2017/101/contents/made (Accessed 02.10.23)
[345] Electricity Act 1989 [Online] Available at: https://www.legislation.gov.uk/ukpga/1989/29/contents Accessed 02.10.23)

12.2.2 Policy and Guidance

The following is a summary of the key policy and guidance of relevance to this Chapter.

12.2.2.1 The National Planning Policy Framework (NPF4)

Scotland 2045 – Our Fourth National Planning Framework[346] was formally adopted on the 13th of February 2023. The policy aims to manage land-use and development in the long-term public interest. With regards to noise, the document states in Policy 11-e '*In addition, project design and mitigation will demonstrate how the following impacts are addressed: i). impacts on communities and individual dwellings, including, residential amenity, visual impact, noise and shadow flicker*'; and further emphasises the need for a noise impact assessment for development likely to result in significant effects, in Policy 23-e '*Development proposals that are likely to raise unacceptable noise issues will not be supported. The agent of change principle applies to noise sensitive development. A Noise Impact Assessment may be required where the nature of the proposal or its location suggests that significant effects are likely*'.

12.2.2.2 Construction Noise & Vibration

Guidance relevant to the effects of noise and vibration during construction and decommissioning is provided by BS 5228:2009+A1:2014 (BS 5228)[347]. This standard:

- Is published in two parts: Part 1 – Noise; and Part 2 - Vibration;
- Refers to the need for the protection against noise and vibration of persons living and working in the vicinity of, and those working on construction and open sites;
- Recommends procedures for noise and vibration control in respect of construction operations;
- Stresses the importance of community relations, and states that early establishment and maintenance of these relations throughout site operations will go some way towards allaying people's concerns;
- Provides recommendations regarding the supervision, planning, preparation and execution of works, emphasising the need to consider noise at every stage of the operation;
- Describes methods of controlling noise at source and its spread; and
- Includes a discussion of noise control targets and example criteria for the assessment of the significance of noise effects.
- Describes method and criteria for assessing construction noise against either the ABC method, or 5dB above background methods. The ABC method described in Table E.1 of the standard outlines the lowest threshold value for daytime as 65 dB(A), presented in Figure 12.1 below.

[346] Scottish Government (2023) *National Planning Framework 4* [Online] Available at: https://www.gov.scot/publications/national-planning-framework-4/pages/1/ (Accessed 02.10.23)
[347] BS 5228:2009+A1:2014 Code of Practice for noise and vibration control on construction and open sites – Part 1: Noise and Part 2: Vibration.

Figure 12.1: ABC Method for Construction Noise in BS 5228-1

Table E.1 **Example threshold of A1 potential significant A1 effect at dwellings**

Assessment category and threshold value period	Threshold value, in decibels (dB) A1 ($L_{Aeq,T}$) A1		
	Category A [A)]	Category B [B)]	Category C [C)]
Night-time (23.00–07.00)	45	50	55
Evenings and weekends [D)]	55	60	65
Daytime (07.00–19.00) and Saturdays (07.00–13.00)	65	70	75

A1 *NOTE 1 A potential significant effect is indicated if the $L_{Aeq,T}$ noise level arising from the site exceeds the threshold level for the category appropriate to the ambient noise level.*

NOTE 2 If the ambient noise level exceeds the Category C threshold values given in the table (i.e. the ambient noise level is higher than the above values), then a potential significant effect is indicated if the total $L_{Aeq,T}$ noise level for the period increases by more than 3 dB due to site noise. A1

NOTE 3 Applied to residential receptors only.

A) Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are less than these values.

B) Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are the same as category A values.

C) Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are higher than category A values.

D) 19.00–23.00 weekdays, 13.00–23.00 Saturdays and 07.00–23.00 Sundays.

- Describes in Part 2 the vibration threshold values to human tolerance at 10 mm/s (Table B.1) and guide values for cosmetic damage to buildings in Table B.2 of the standard, presented in Figure 12.2 below.

Figure 12.2: BS 5228-2 Guide Vibration Values for Cosmetic Damage

Table B.2 **Transient vibration guide values for cosmetic damage**

Line (see Figure B.1)	Type of building	Peak component particle velocity in frequency range of predominant pulse	
		4 Hz to 15 Hz	15 Hz and above
1	Reinforced or framed structures Industrial and heavy commercial buildings	50 mm/s at 4 Hz and above	50 mm/s at 4 Hz and above
2	Unreinforced or light framed structures Residential or light commercial buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

NOTE 1 Values referred to are at the base of the building.

NOTE 2 For line 2, at frequencies below 4 Hz, a maximum displacement of 0.6 mm (zero to peak) is not to be exceeded.

12.2.2.3 Wind Turbine Operational Noise

The following guidance and information sources have been considered in the assessment of operational noise from the wind turbines:

- The Scottish Government's web-based planning information on onshore wind turbines (last updated May 2014)[348];
- Planning Advice Note 1/2011 (PAN 1/2011): Planning and Noise[349];

[348] Scottish Government (2014) Onshore Wind Turbines Planning Advice [Online] Available at: https://www.gov.scot/publications/onshore-wind-turbines-planning-advice/ (Accessed 02.10.23)
[349] The Scottish Government 2011 Planning Advice Note Pan 1/2011 Planning and Noise and accompanying Technical Advice Note, 2011. [Online] Available at: https://www.gov.scot/publications/planning-advice-note-1-2011-planning-noise/ (Accessed 02.10.23)

- ETSU-R-97: The Assessment and Rating of Noise from Wind Farms[350]; and
- A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise[351].

The Scottish Government's web-based planning information on onshore wind turbines

The Scottish Government's web-based information provides advice to Local Authorities on the planning issues associated with wind farm development. With respect to noise from wind farms, it refers to ETSU-R-97: The Assessment and Rating of Noise from Wind Farms and the Institute of Acoustics' Good Practice Guide (the GPG).

It goes on to refer to PAN 1/2011 as providing advice on the role of the planning system in helping to prevent and limit the adverse effects of noise, and states that the associated Technical Advice Note (TAN) provides guidance which may assist in the technical evaluation of a noise assessment.

PAN 1/2011 promotes the principles of good acoustic design and the appropriate location of new potentially noisy development. The TAN offers advice on the assessment of noise impact and includes details of the legislation, technical standards and codes of practice appropriate to specific noise issues. Appendix 1 of the TAN: Assessment of Noise describes the use of ETSU-R-97 in the assessment of wind turbine noise.

ETSU-R-97

ETSU-R-97 provides a framework for the assessment and rating of noise from wind turbine installations. It is the standard for wind farm developments in the UK, and the methodology has therefore been adopted for the present assessment.

Both background noise and noise from wind turbines typically vary with wind speed. According to ETSU-R-97, wind farm noise assessments should therefore consider the site-specific relationship between wind speed and background noise, along with the particular noise emission characteristics of the proposed wind turbines.

ETSU-R-97 specifies the use of the $L_{A90,10min}$ descriptor for both background and wind turbine noise. Therefore, unless otherwise specified, all references to noise levels within this Chapter relate to this descriptor. Similarly, all wind speeds referred to relate to a height of 10 metres (m) Above Ground Level (AGL) at the location of the Development, standardised in accordance with current good practice guidance.

The document recommends the application of external noise limits at the nearest noise sensitive properties, to protect outside amenity and prevent sleep disturbance inside dwellings. These limits take the form of a 5 dB margin above the prevailing background noise level, except where background noise levels are lower than certain thresholds, where fixed lower limits apply. Separate limits apply for daytime and night-time periods, as outlined below. The limits apply to the cumulative effects of all wind turbines that affect a particular location.

A 'simplified criterion' is also described which may be applicable where there are large separation distances between the proposed turbines and nearest noise-sensitive receptors. In such cases, a fixed limit of 35 dB, $L_{A90,10min}$ applies, without reference to background noise levels.

During daytime, the guidance specifies limits designed to protect the amenity of residents whilst within the external amenity areas of their properties. The limits are based on the prevailing background noise level for 'lower daytime' periods, defined in ESTU-R-97 as:

- 18:00 – 23:00 every day; plus
- 13:00 – 18:00 on Saturday; and
- 07:00 – 18:00 on Sundays.

[350] ETSU 1996, ETSU-R-97 The Assessment and Rating of Noise from Wind Turbines, ETSU for the DTI, 1996.
[351] A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind turbine Noise, IOA, 2013.

ETSU-R-97 recommends that the fixed lower noise limit for daytime should be set within the range 35 to 40 dB, $L_{A90,10min}$, with choice of value dependent on the following factors:

- The number of dwellings in the neighbourhood of the Development;
- The effect of the noise limits on the number of kilo Watt hours (kWh) generated; and
- The duration and level of exposure.

Different standards apply at night, where potential sleep disturbance is the primary concern rather than the requirement to protect outdoor amenity. Night-time is considered to be all periods between 23:00 and 07:00. A limit of 43 dB(A) is recommended at night at wind speeds or locations where the prevailing wind speed related night-time background noise level is lower than 38 dB(A). At other times, the limit of 5 dB above the prevailing wind speed-related background noise level applies. The value of night-time fixed lower limit was selected in order to ensure that internal noise levels remained below those considered to have the potential to cause sleep disturbance, taking account of the attenuation of noise when passing from outdoors to indoors, and making allowance for the presence of open windows.

Where the occupier of the property has a financial interest in the Development (otherwise known as being a Financially Involved property), ETSU-R-97 states that the fixed lower noise limit for both daytime and night-time can be increased to 45 dB(A) and that *"…consideration should be given to increasing the permissible margin above background"*.

The IOA Good Practice Guide

The GPG was published by the Institute of Acoustics (IOA) in May 2013 and has been endorsed by the Scottish Government as current industry good practice. The GPG is supported by a suite of six Supplementary Guidance Notes (SGNs), published in 2014. The guide presents good practice in the application of the ETSU-R-97 assessment methodology at various stages of the assessment process. The recommendations provided in the GPG been followed throughout this assessment.

The GPG provides advice on the assessment of cumulative noise impact, detailing a number of possible cumulative scenarios and recommended approaches. Advice is also provided with regard to the geographical scope of a cumulative noise assessment, to determine the area within which a cumulative noise assessment is necessary.

Where a new noise source is introduced to a given scenario with a noise level which is predicted to be 10 dB or more below the existing level, the increase in the total noise level is considered to be negligible. On this basis, the necessary extents of a cumulative noise assessment can be determined. Paragraph 5.1.4 of the GPG states:

"If the proposed wind farm produces noise levels within 10 dB of any existing wind farm(s) at the same receptor location, then a cumulative noise impact assessment is necessary".

As noted in ETSU-R-97, noise from existing wind turbines should not form part of the background noise level from which noise limits for new wind energy developments are derived.

12.2.2.4 Substation and Battery Energy Storage System (BESS) Operational Noise

Operational noise resulting from the substation and BESS has been considered against Noise Rating (NR) criteria levels, sometimes referred to as NR curves[352].

NR levels were developed by the International Organisation for Standardisation (ISO) to determine acceptable indoor sound environment for hearing preservation, speech intelligibility, and annoyance. They serve as a standardised way to measure and specify noise within buildings / occupied spaces, taking into account the frequency content of the noise.

To obtain an NR level, the predicted unweighted decibel (dB) noise spectrum within a receptor building is compared to a series of octave-band values.

[352] ISO 1996-1:2016(en) *Acoustics – Description, measurement, and assessment of environmental noise – Part 1: Basic quantities and assessment procedures*.

NR levels are regularly used by Local Authorities to assess noise levels due to electrical plant and air handling/cooling units and are considered a suitable methodology for the purposes of this assessment. Some examples of NR level values[353] typically specified for a range of applications are shown in Table 12.1.

Table 12.1: NR Level Criteria

NR Level Value	Application
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, hospital operating theatres and wards, flats, hotels, executive offices
NR 40	Halls, corridors, cloakrooms, restaurants, night clubs, offices, shops
NR 45	Department stores, supermarkets, canteen, general offices
NR 50	Typing pools, offices with business machines
NR 60	Light engineering works
NR 70	Foundries, heavy engineering works

As can be seen from Table 12.1, a criterion of NR 30 is typically applied for private dwellings and NR 25 can be adopted for quieter night-time periods within dwellings. Noise levels from the proposed BESS and substation is assessed against both criteria for the respective day and night periods.

12.2.2.5 Low-Frequency Noise, Infrasound, Amplitude Modulation and Vibration

Low Frequency Noise and Infrasound

A study[354], published in 2006 by acoustic consultants Hayes McKenzie on the behalf of the Department of Trade and Industry (DTI), investigated low frequency noise from wind farms. This study concluded that there is no evidence of health effects arising from either infrasound or low frequency noise generated by wind turbines, but that complaints attributed to low frequency noise were in fact, possibly due to a phenomenon known as Amplitude Modulation (AM).

In February 2013, the Environmental Protection Authority of South Australia published the results of a study into infrasound levels near wind farms[355]. This study measured infrasound levels at urban locations, rural locations with wind turbines close by, and rural locations with no wind turbines in the vicinity. It found that infrasound levels near wind farms are comparable to levels away from wind farms in both urban and rural locations. Infrasound levels were also measured during organised shut downs of the wind farms; the results showed that there was no noticeable difference in infrasound levels whether the turbines were active or inactive.

Bowdler et al. (2009)[356] concludes that:

"...there is no robust evidence that low-frequency noise (including 'infrasound') or ground-borne vibration from wind farms generally has adverse effects on wind farm neighbours".

In 2018 the World Health Organization (WHO) Regional Office for Europe published "*Environmental Noise Guidelines for European Region*", which found that the current evidence available in relation

[353] ISO Recommendation ISO/R 1996-1971
[354] The measurement of low frequency noise at three UK wind farms, Hayes Mckenzie, The Department for Trade and Industry, URN 06/1412, 2006.
[355] Environment Protection authority (2013) Infrasound levels near wind farms and in other environments [online] Available at: http://www.epa.sa.gov.au/xstd_files/Noise/Report/infrasound.pdf (Accessed 02.10.23).
[356] Bowdler et al. (2009). Prediction and Assessment of Wind Turbine Noise: Agreement about relevant factors for noise assessment from wind energy projects. Acoustic Bulletin, Vol 34 No2 March/April 2009, Institute of Acoustics.

to the health effects of noise from wind turbines, other than annoyance, is either absent or of poor quality. In regards to infrasound, it states:

"…Wind turbines can generate infrasound or lower frequencies of sound than traffic sources. However, few studies relating exposure to such noise from wind turbines to health effects are available. It is also unknown whether lower frequencies of sound generated outdoors are audible indoors, particularly when windows are closed".

There is currently no scientific consensus that infrasound from wind turbines cause adverse health effects, and any current research in this field is still disputed or under review. As guidelines or policy is currently unavailable, and in accordance with the current industry practice, an assessment of infrasound is not undertaken in this application.

Amplitude Modulation

A study[357] was carried out on behalf of the Department for Business, Enterprise and Regulatory Reform (BERR) by the University of Salford, which investigated the incidence of noise complaints associated with wind farms and whether these were associated with AM. This report defined AM as aerodynamic noise from wind turbines with a greater degree of fluctuation than normal at blade passing frequency. Its aims were to ascertain the prevalence of AM on UK wind farm sites, to try to gain a better understanding of the likely causes and to establish whether further research into AM is required.

The study concluded that AM has occurred at only a small number of wind farms in the UK (4 of 133), and only between 7% and 15% of the time. It also stated that the causes of AM are not well understood and that prediction of the effect is not currently possible.

This research was updated in 2013 by an in-depth study undertaken by Renewable UK[358], which identified that many of the previously suggested causes of AM have little or no association to the occurrence of AM in practice. The generation of AM is based upon the interaction of a number of factors, the combination and contributions of which are unique to each site. With the current knowledge, it is not possible to predict whether any particular site is more or less likely to give rise to AM, and the incidence of AM occurring at any particular site remains low, as identified in the University of Salford study.

In 2016, the IOA proposed a measurement technique[359] to quantify the level of AM present in any particular sample of wind farm noise. This technique is supported by a review commissioned by the Department of Business, Energy & Industrial Strategy (BEIS, now known as the Department for Energy Security and Net Zero)[360], which follows on from the conclusions of the IOA study in order to define an appropriate assessment method for AM, including a penalty scheme and an outline planning condition. Notwithstanding this, the suggested outline planning condition is not as yet validated or endorsed by the UK government, the study remains in a draft form and would require site-specific legal advice on its appropriateness to a specific development. Section 7.2.1 of the GPG, therefore, remains current, stating:

"The evidence in relation to 'Excess' or 'Other' Amplitude Modulation (AM) is still developing. At the time of writing, current practice is not to assign a planning condition to deal with AM".

Vibration

Research undertaken by Snow[361] found that levels of ground-borne vibration 100 m from the operation of the nearest wind turbine were significantly below criteria for 'critical working areas'

[357] Research into aerodynamic modulation of wind turbine noise'. Report by University of Salford, The Department for Business, Enterprise and Regulatory Reform, URN 07/1235, July 2007.
[358] Renewable UK, 2013: Wind Turbine Amplitude Modulation: Research to Improve Understanding as to its Cause and Effects.
[359] Institute of Acoustics, (2016) A Method for Rating Amplitude Modulation in Wind Turbine Noise.
[360] BEIS, (2016), Review of the evidence on the response to amplitude modulation from wind turbines.
[361] ETSU (1997), Low Frequency Noise and Vibrations Measurement at a Modern Wind Farm, prepared by D J Snow.

given by British Standard BS 6472:1992 Evaluation of human exposure to vibration in buildings (1 Hz to 80 Hz), and were lower than limits specified for residential premises by an even greater margin.

Ground-borne vibration from wind turbines can be detected using sophisticated instruments several kilometres from the wind farm site as reported by Keele University[362]. This report clearly shows that, although detectable using highly sensitive instruments, the magnitude of the vibration is orders of magnitude below the human level of perception and does not pose any risk to human health.

Conclusion

No specific assessments of low-frequency noise, infrasound, AM or vibration from the operation of the turbines are considered necessary, and therefore not considered further.

12.3 Assessment Methodology and Significance Criteria

12.3.1 Scoping Responses and Consultations

A summary of consultation is provided in Table 12.2.

Table 12.2: Consultation

Consultee	Type and Date	Summary of Consultation Response	Response to Consultee
Argyll and Bute Council ('the Council')	Consultation Response 27th October 2021	No objections to the noise assessment methodology outlined in the scoping report and council consultation. Agreed Cumulative to be included: (EC00005267) Blarghour Wind Farm (in Planning); and (02/00953/DET) Clachan Flats Wind Farm (Operational). Agreed monitoring locations and receptors: • Ladyfield Farm • Drimfern; • Linnieghluttain; and • Maam House	The assessment has been carried out in accordance with the methodology outlined in the Scoping Report and consultation. See Section 12.3.2.5 for cumulative developments. See Section 12.4.1 for receptors and monitoring locations: monitoring location Linnieghluttain replaced with Three Bridges due to lack of response when contacted regarding access.
	Further consultation response 2nd March 2022	It is expected that a noise impact assessment (NIA) containing sufficient detail and calculations would be provided with the application. This should consider the potential impact at any dwelling which is lawfully existing or a site which has planning permission for use as a dwelling.	A NIA has been undertaken in line with all relevant legislation and guidance, including ETSU-R-97 and the IoA GPG. See Section 12.2.2.3
		Details of any mitigation measures should be included in the NIA.	Details of mitigation measures, if required, are included in the relevant Section.
		It is acceptable for turbine noise predictions to be undertaken using the characteristics of an appropriate candidate turbine. It should be expected that any planning approval will include a condition which requires the	See Section 12.3.4

[362] Microseismic and infrasound monitoring of low frequency noise and vibrations from wind farms: recommendations on the siting of wind farms in the vicinity of Eskdalemuir, Scotland". Keele University, 2005.

Consultee	Type and Date	Summary of Consultation Response	Response to Consultee
		demonstration of compliance of the turbines to be installed with any noise limits.	
		Where calculations have been undertaken and corrections have been made in accordance with IoA Good Practice Guide recommendations (e.g., across a valley or topographical screening) the NIA should include a table providing full details.	No receptors required corrections for valley or topographical screening in this assessment.
		It is unclear at this stage if there will be any access tracks which may be in close proximity to residential properties. It would be expected that the application would present finalised details of access arrangements and propose mitigation measures.	Details of assessment methodology, and track locations, are detailed in Section 12.3.2.1

12.3.2 Scope of Assessment

12.3.2.1 Construction and Decommissioning Noise Assessment Methodology

The assessment of noise from the construction and decommissioning phases has been limited to noise-sensitive receptors within 500 m of the construction and decommissioning works, as beyond this distance there is no reasonable prospect of a significant effect. All infrastructure elements (BESS, substation, wind turbines) of the Development are located at a distance greater than 500 m from the surrounding Noise-Sensitive Receptors (NSRs) and significant effects are unlikely from these construction works, as such, control through best practice as in Section 12.6.1 will be adopted, as advocated in BS 5228. Figure 2.1 presents the infrastructure locations, new road layout, and road access point to the Development

The Site will be accessed via two access points off the A819. A new access junction and crossing is proposed at NGR 209101, 716517, to be constructed in the north of the Site; the crossing located 450 m from the nearest NSR. Secondly, an existing access junction at NGR 208923, 713010 and existing crossing over the River Aray would be upgraded, located 55 m from the nearest NSR.

On this basis, an assessment of site clearance and construction noise for the proposed bridge at the south entrance has been undertaken. The proposed crossing to the north is 450 m from the NSR, and road construction works are temporary in duration, therefore, noise levels from typical road works machinery at this access road is unlikely to exceed the lowest daytime noise threshold[363].

As part of the construction process, water extraction may be required from the nearby River Aray, which runs past a number of residential properties. The specific location for the water extraction is yet to be finalised, however, following good practice, it will be located as far as reasonably practicable from the nearest property, furthermore, the extraction process will only be undertaken during construction times on site and will not run continuously. Given the upper emission levels of 79 dB(A) at 10m[364] for a water pump or water extracting tanker; noise from water extraction process will not exceed the lowest daytime threshold criteria in BS 5228-1 (65 dB(A)) at distances further than 50 m, as such, provided that the water extraction point is further than 100 m distance from the nearest NSR as a conservative approach, this process will not have significant effects and assessment of noise from this process is scoped out.

Construction noise will be limited in duration to working hours between 07:00 and 19:00 Monday to Saturday, and no construction work will be expected on Sundays or Bank Holidays. Any works outside of these hours will need to be approved in writing by the Council. Construction noise will

[363] Lowest daytime threshold of 65 dB(A) in 'ABC method' outlined in BS5228-1: Noise
[364] Table c.4: Ref no: 88 / 89 from BS5228:2009+A1:2104-1: Noise

be managed via a site-specific Noise Management Plan (NMP) provided to the Council. The embedded mitigation contained in the NMP will include the commitment to liaise directly with local residents, and the wider community via a Community Liaison Group. Construction activities will follow good practice measures outlined in Section 12.6.1.

Vibration effects from construction activities are anticipated to be negligible due to large distances to NSR with the exception of south access bridge replacement works, where construction vibration will be managed through continuous construction vibration monitoring, measures outlined in Section 12.6.1.

12.3.2.2 Construction Traffic Noise on Public Roads

Noise from construction traffic on public roads has been assessed on the basis of the change in traffic noise levels due to the addition of traffic associated with construction of the Development. Projected baseline traffic flows for each location at the predicted time of construction have been sourced from Table 13.10 in Chapter 13: Traffic and Transport. The percentage increases in traffic have then been used together with the number of vehicles, proportion of HGVs and likely speed (based on the type of road) to calculate the likely change in traffic noise level due to construction traffic for peak month of the construction programme, using the method described in Calculation of Road Traffic Noise (CRTN)[365].

Throughout the construction phase of the Development, deliveries of concrete will occur periodically, increasing vehicle flows above that during the peak month when no deliveries take place. As such, assessment of the peak month daily construction traffic including concrete delivery has also been included. As outlined in Section 13.7.1 of Chapter 13, deliveries of concrete are anticipated to occur on a maximum of 13 non-consecutive days. In accordance with CRTN, magnitude of impact is categorised as follows:

- Negligible: <1 dB change in noise levels;
- Minor: 1–3 dB change in noise levels;
- Moderate: 3-5 dB change in noise levels; and
- Major: >5 dB change in noise levels.

An impact of negligible and minor is considered not significant and impact of moderate and major are considered significant in terms of EIA regulations.

In the event that on-site concrete batching is employed, the increases in traffic assessed for concrete delivery days would not occur.

12.3.2.3 Blasting and Borrow Pit Excavation

Rock extraction from borrow pits by means of blasting operations could be required. Blasting operations can generate airborne pressure waves or "air overpressure" which contains both audible (approximately 20Hz to 20kHz) and infrasonic pressure waves (<20Hz), 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 excavation activities such as stone crushing and the operation of plant such as, excavators, breakers, and conveyors, will be undertaken at the existing quarry located south of the Development (NGR 209387, 714173). The quarry is located 1,070 m from the nearest receptor (NGR 208281, 714112). Based on the collective upper noise emission levels for typical crushers and excavation plant, as provided in BS5228-1, noise from excavation activities (including stone crushing) is unlikely to exceed the relative daytime criteria at 1 km distance, and therefore, an assessment of excavation activities is scoped out.

[365] Calculation of Road Traffic Noise, Department of the Environment, 1988

12.3.2.4 Operational Noise Assessment Methodology

Typically, the operational noise assessment process comprises the following steps:

i) Identification of potential receptors (typically residential dwellings);

ii) Determining the prevailing, wind speed-dependent background noise levels at nearby receptors;

iii) Establishment of limits for acceptable levels of wind turbine noise, based on the background noise levels and appropriate fixed lower limits;

iv) Prediction of the likely levels of wind turbine noise received at each receptor; and

v) Comparison of the predicted levels with the noise limits.

The method of measuring background noise is described in ETSU-R-97, and supported by the GPG. In brief, it involves continuous measurement of both background noise levels at a representative number of receptors and wind speeds on the development site for a period of at least one week. The resulting data is then sorted into quiet daytime and night-time periods and the relationship between wind speed and background noise established for each location. For the purpose of this assessment, background noise levels have been derived from the survey data, as described in Section 12.3.5.

Selection of Wind Turbine Fixed Lower Noise Limits

As discussed at Section 12.2.2.3, the noise limits described in ETSU-R-97 are a combination of a 5 dB margin above the prevailing wind speed-dependent background noise level and fixed lower limits, applicable where background noise levels are low. These limits apply to cumulative effects. The daytime fixed lower noise limit is defined as a value within the range 35 to 40 dB.

The daytime cumulative and the subsequent apportioned noise limits (for the Development in isolation) are based on a fixed lower limit of 40 dB $L_{A90,10min}$, or 5 dB above background (the most stringent under ETSU-R-97 methodology). The night-time cumulative and apportioned noise limits are based on a fixed lower limit of 43 dB $L_{A90,10min}$, or 5 dB above background, as per ETSU-R-97 requirements. Further detail is provided in Section 12.4.3

A provision is included within ETSU-R-97 for higher fixed lower limit of 45 dB for daytime and night-time periods where a receptor has Financial Involvement with a development. A number of receptors along the A819, including Ladyfield Farm, have indirect financial involvement in the Development. However, as a conservative approach the higher fixed limit for Financially involved receptors has not been applied and lower limits have been used in the assessment at all properties.

Noise Predictions

Noise predictions have been made using industry standard 3D noise modelling software SoundPLAN (v8.2), which implements the ISO 9613-2[366] methodology and takes account of the specific data and parameters recommended in the GPG, as summarised below:

- The turbine sound power levels should be stated and these should include an appropriate allowance for measurement uncertainty. If the provided data contains no allowance for measurement uncertainty, or uncertainties are not stated, an additional 2 dB should be included.
- Atmospheric absorption should be calculated based on conditions of 10°C and 70% relative humidity.
- The ground factor assumed should be G=0.5 (mixed ground) except in urban areas or where noise propagates across large bodies of water, where G=0 (hard ground) should be assumed.
- A receiver height of 4.0 m should be assumed.

[366] ISO 9613-2:1996 Acoustics — Attenuation of sound during propagation outdoors — Part 2: General method of calculation.

- Barrier attenuation should be limited to 2 dB, when there is no line of sight from the receptor to the turbine.
- An additional 3 dB should be added to noise immission levels at properties located across a valley or with heavily concave ground between the receptor location and the wind turbine(s)[367].
- The predicted noise levels ($L_{Aeq,t}$) should be converted to the required $L_{A90,10min}$ by subtracting 2 dB.

ISO 9613-2 provides a prediction of noise levels likely to occur under worst case conditions; those favourable to the propagation of sound, i.e., down-wind or under a moderate, ground-based temperature inversion as often occurs at night (often referred to as stable atmospheric conditions). The specific measures recommended in the GPG have been shown to provide good correlation with levels of wind turbine noise measured at operational wind farms[368,369].

12.3.2.5 Cumulative Noise Assessment

ETSU-R-97 states that the assessment should take account of the effect of noise from all wind turbines that may affect a particular receptor. A screening exercise was conducted to identify any wind turbines either operational, consented, or proposed (i.e., the subject of a current planning application), considered to have the potential to result in cumulative noise impacts when assessed in conjunction with the Development. For the purposes of the noise assessment, a search area of 5 km from the Development has been used to identify cumulative wind farm developments, and a search area of 2.5 km from the Development has been used to identify single wind turbine cumulative developments. At greater distances, these respective cumulative development types are not considered to have the potential to result in cumulative noise impacts.

Three cumulative developments have been identified, as detailed in Table 12.3. It should be noted that An Carr Dubh (formally Car Duibh) wind farm was identified during scoping as a cumulative development by Nature Scot. The application for An Carr Dubh wind farm was recently submitted in May 2023, as such, it has now been included in this assessment.

Table 12.3 Cumulative Developments

Development	Planning Reference	Status	No. of Turbines
Blarghour Variation	ECU00004754	Planning	14
Clachan Flats	07/00362/NMA	Operational	9
An Carr Dubh	23/00795/S36	Planning	13

The relevant data applied in this assessment for the cumulative wind farms is detailed in Section 12.5.3

Cumulative noise effects have been addressed through the derivation of apportioned noise limits (see Section 12.5.3.2), which define the noise 'budget' available to the Development. Cumulative noise is therefore an inherent part of the operational noise assessment, and a separate cumulative assessment is not required.

The method of predicting windfarm noise levels is described in the GPG as discussed in Section 12.2.2.3. This method has been applied to all operational noise predictions within this Chapter of the EIA Report.

12.3.2.6 Wind Turbine Noise Significance Criteria

The acceptable limits for wind turbine operational noise are clearly defined in ETSU-R-97. Therefore, this assessment determines whether the calculated immission levels at nearby noise

[367] Equation to determine concave ground as presented in Section 4.3.9 of the GPG.
[368] Bullmore et al. (2009). Wind Farm Noise Predictions and Comparison with Measurements, Third International Meeting on Wind Turbine Noise, Aalborg, Denmark 17 – 19 June 2009.
[369] Cooper & Evans (2013). Effects of different meteorological conditions on wind turbine noise.

sensitive properties lie below the noise limits derived in accordance with ETSU-R-97. Where the noise immission levels at noise-sensitive receptors are shown to be below derived noise limits, the effect is considered to be not significant in terms of The Electrical Works 2017 Act (UK)[370]

As such, the approach to assessment followed in other technical chapters within this EIA Report is not applicable to the effects of wind turbine noise, and effects are not considered in terms of their magnitude and the sensitivity of receptors as these factors are implicit in the limits defined by ETSU-R-97. Compliance or exceedance to applicable ETSU-R-97 limits is therefore taken respectively as 'significant' or 'not significant' effects in terms of EIA regulations.

12.3.2.7 Final Decommissioning Noise

Noise produced during final decommissioning of the Development is likely to be of a similar nature to that during construction, although the duration of decommissioning will be shorter than that of construction. The parameters of construction noise would also be applicable to decommissioning noise (i.e., similar activity, distance to receptors), and therefore, decommissioning noise is also scoped out of this assessment. Any legislation, guidance or good practice relevant at the time of decommissioning would be complied with.

12.3.2.8 BESS and Substation Noise

Potential noise effects arising from the operation of the proposed BESS and substation, has also been assessed.

Operational substation noise is produced primarily by electrical equipment such as transformers, inverters, and heating, ventilation, and air conditioning (HVAC) units, located on site. Noise levels from these sources are generally low. For BESS developments, the key noise source is from operation of cooling fans which are generally located on, or near, the containerised battery units.

In order to determine the potential for a significant effect, modelling has been undertaken in line with ISO 9613 (see Section 12.3.2.4: Noise Predictions). The exact layout of the BESS and substation is not finalised at this stage, as such, an indicative layout with expected number of battery units, inverters, and transformers, have been used to determine overall noise levels from the BESS and substation compound, which was used to determine noise levels at the nearest receptor.

12.3.2.9 Elements Scoped Out of Assessment

The following elements have been scoped out of the assessment for reasons described in previous sections of this Chapter:

- Decommissioning noise;
- Blasting and borrow pit excavation noise;
- Low frequency noise;
- Infrasound;
- Amplitude Modulation; and
- Vibration.

12.3.3 Study Area

12.3.3.1 Operational Noise and Cumulative Operational Noise

The GPG states that a cumulative assessment is required in areas where the difference in predicted noise levels between the Development and other wind energy developments is less than 10 dB (i.e., the Study Area). The Study Area for the operational noise assessment, defined in accordance with the GPG, is shown in Figure 12.1: Cumulative Noise Plot. It comprises the area where cumulative wind turbine noise levels are greater than 35 dB, $L_{A90,10min}$, and where noise levels from the Development are 10 dB greater than, or within 10 dB of, noise levels from cumulative

[370] The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017 [Online] http://www.legislation.gov.uk/ssi/2017/101/contents/made (Accessed 02.10.23)

developments. This is shown in Figure 12.1 as the grey shaded and orange shaded areas respectively within the 35 dB, $L_{A90,10min}$ contour.

A number of assessment locations have been identified within the Study Area; these are detailed in Table 12.6.

12.3.4 Design Parameters

The GPG notes that most sites at planning stage will not have selected a preferred turbine, therefore a candidate turbine representative of a range of turbines should be selected to provide appropriate source 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.

The candidate turbine being considered for the Development is the Vestas V136 4.5 MW with a maximum tip height of 180 m and hub height of 112 m, with Serrated Trailing Edges (STE). Table 12.4 details the sound power level data at the standardised 10 m height for windspeeds between 4 ms^{-1} and 12 ms^{-1}. The sound power level data includes a margin for uncertainty; in line with the GPG a +2 dB correction for uncertainty has been included in the sound power levels detailed in Table 12.4.

Table 12.4 Noise Emission Data – Sound Power Level, dB, L_{WA}

Candidate Turbine	**Standardised 10 m Wind Speed, ms^{-1}**								
	4	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
	Sound Power Level, dB(A)								
Vestas V136 4.5 MW, 112 m hub height, STE	97.5	102.5	105.6	105.9	105.9	105.9	105.9	105.9	105.9

The octave-band frequency spectrum at the wind speed for which the maximum sound power level is achieved (7 ms^{-1}) is detailed in Table 12.5.

Table 12.5 Octave-band Spectra – Vestas V136 4.5MW (STE)

	Standardised 10 m Wind Speed, (7 ms^{-1})							
	63 Hz	**125 Hz**	**250 Hz**	**500 Hz**	**1000 Hz**	**2000 Hz**	**4000 Hz**	**8000 Hz**
	Sound Power Level, dB(A)							
Sound Power Level, dB, LWA, Scaled to 105.9 dB(A)[371]	83.9	92.5	98.1	100.9	100.6	97.3	91.1	81.9

12.3.5 Methodology for the Assessment of Effects

12.3.5.1 Assessment Limitations

Baseline noise monitoring locations were selected to provide a conservative representation of the background noise levels in the local area following advice contained within the GPG.

Background noise measurements were obtained during the baseline noise survey for the full range of wind speeds required by the GPG for both daytime and night-time periods.

It is therefore concluded that no significant assessment limitations exist.

[371] Performance Specification V136-4.0/4.2 MW 50/60 Hz (Low HH) Document no.: 0067-7066 V02 2017-11-18

12.3.5.2 Embedded Mitigation

Operational noise was considered in the design of the turbine layout. Each layout iteration was modelled to determine its noise impact, and the effects on the energy output of the Development on any noise mitigation measured that may be required. Through this iterative process, the layout design was optimised to ensure that the Development could operate efficiently within appropriate noise limits.

12.3.5.3 Implications of Climate Change

The consequences of the projected climate change scenario, as outlined in Chapter 16 of this ES, are unlikely to substantially affect baseline noise conditions of this assessment as periods of rainfall are excluded and the variation with wind speed was taken into account, in line with requirements of ETSU-R-97 and current good practice.

12.3.5.4 Future Baseline in Absence of the Development

Provided no other significant development would be in operation, the environmental noise levels in the absence of the Development are likely to remain largely similar to those currently experienced.

12.3.5.5 Micro-siting

The locations of the turbines and other infrastructure would be subject to 'micro-siting'. This process allows for minor changes in turbine or infrastructure locations to respond to possible variations in ground conditions across the Site, which would only be confirmed following detailed Site investigation work carried out immediately prior to construction. This process also provides scope for further mitigation of localised potential environmental effects through avoidance of sensitive features. It is anticipated that the agreed 'tolerance' micro-siting distance of 50 m would form a condition accompanying any consent. A change of 50 m in position will have negligible effects (<0.5 dB) on the turbine noise levels and as such the results of this assessment remain valid and accounts for the micro-siting tolerance of 50 m.

12.4 Baseline Conditions

12.4.1 Receptor Identification

Potential noise-sensitive receptors have been identified using Ordnance Survey (OS) MasterMap AddressBase, a database which combines the locations of buildings and other features from large-scale digital mapping with the Royal Mail's address database, along with aerial photography and site visits. Of the identified receptors located within the Study Area, a representative selection has been assessed. Providing the assessed receptors are shown to be compliant with the requirements of ETSU-R-97, receptors located further from the Development would also comply.

12.4.2 Assessed Receptors

The assessed receptors are a representative selection of those located within the Study Area identified in Figure 12.2. For each of these receptors, Table 12.6 details the source of the respective background noise levels, from which the cumulative noise limits are derived. These receptors are the closest to the Development, within the 10 dB Development level difference area (green shaded area in Figure 12.1) and representative of the other receptors surrounding the Development at similar distances.

Table 12.6 Operational Noise Receptors

Receptor ID	X Coordinate (ING)	Y Coordinate (ING)	Source of Background Noise Data
Ladyfield Farm	209035	715596	Ladyfield Farm
Drimfern	208319	714588	Drimfern

Receptor ID	X Coordinate (ING)	Y Coordinate (ING)	Source of Background Noise Data
Three Bridges	208802	712402	Three Bridges
Maam House	212188	712860	Maam House
North Tullich	208909	716076	Ladyfield Farm
South Tullich	208505	715431	Ladyfield Farm
Linnieghluttain	208935	712956	Three Bridges

12.4.3 Operational Noise

12.4.3.1 Baseline Noise Survey

Four properties were identified for the purposes of baseline noise monitoring as presented in Table 12.7 and agreed in scoping consultation with the Council's Environmental Health Officer (EHO). Due to access limitations at Linnieghluttain, a substitute location (Three Bridges) was used for the baseline noise monitoring, this location was considered representative of Linnieghluttain and surrounding NSR in the proximity. Background noise monitoring was carried out at these locations, in accordance with ETSU-R-97 and the GPG. The following specific measures ensured this compliance:

- Type 1[372] measuring equipment (Rion NL-31) was used, which was calibrated at the start of the survey and at each site visit. No significant calibration drift occurred (i.e., no more than 0.5 dB) with exception of the first survey period at Three Bridges where a calibration drift of 0.8 dB occurred. As a result, a second survey period was undertaken where no significant calibration drift was found. The measurements from the initial survey period have been excluded from the analysis undertaken for Three Bridges (see "additional exclusions" in Chart 12-5 – Quiet Daytime – Three Bridges Chart 12-5 and Chart 12-6).
- Noise monitoring equipment was equipped with specially-designed, dual-layer windshields manufactured by Rion, which have been confirmed by the supplier as being suitable for use in elevated wind speeds and meeting the requirements of the GPG.
- Measurements were performed at a height of 1.4 m above ground level, in free-field conditions, i.e., a minimum of 3.5 m from any reflective surface other than the ground;
- Background noise levels were recorded at continuous 10-minute intervals, as $L_{A90,10min}$.
- During the survey, wind speeds were measured using on-site met mast equipment (anemometer), measuring wind speeds at various heights. Measurements at heights of 91 m and 70 m were taken and then interpolated to the standardised 10 m wind speeds, following the procedure described in the GPG;
- A logging rain gauge was deployed at each location.
- Any periods of elevated background noise levels which were not considered representative of the location were identified and excluded from analysis.
- The GPG recommends at least 200 valid data points in each quiet daytime and night-time period for each monitoring location, after exclusions are taken into account. This was exceeded at all monitoring locations.

Survey record sheets and calibration certificates for noise and wind monitoring equipment used during the survey are included in Technical Appendix A12.1.

Noise monitoring commenced at all locations on the 28th January 2022, however upon servicing the equipment on the 21st February 2022 the sound level meter at Three Bridges recorded a calibration drift of 0.8 dB, above the criteria for significant drift (0.5 dB). As such, the survey period was extended at all locations until the 16th March 2022 to capture sufficient data in accordance with the GPG. There have been no major changes or development in the area since the baseline

[372] As defined in BS EN 06651:1994 Specification for Sound Level Meters

survey, as such, the baseline acoustic environment is not expected to have changed from January 2022 and the measured dataset remains valid for the assessment.

Table 12.7 details the baseline noise monitoring locations.

Table 12.7 Baseline Noise Monitoring Locations

Measurement Location Name	X Coordinate	Y Coordinate	Description of Location
Ladyfield Farm	209035	715596	West of Development (closest NSR) Rear of wooden cabin associated with residence. Location chosen to shield noise monitor from influence of nearby river and road.
Drimfern	208319	714588	Southwest of Development Drive area to side of residence. Location chosen to shield noise monitor from influence of nearby river.
Three Bridges	208802	712402	South of Development Garden area behind house. Location chosen to shield noise monitor from influence of nearby river.
Maam House	212188	712860	Southeast of Development Garden area to the side of residence.

The background noise data were analysed according to the following process:

- Synchronisation of measured noise level ($L_{A90,10min}$), 10 m standardised wind speed, wind direction and rainfall data, correcting for differences in the timestamp averaging period (i.e., start or end of the 10-minute period) and daylight saving time (GMT/BST) for each.
- Exclusion of any 10-minute periods where rainfall was recorded, (including the preceding 10-minute period), and any other atypical periods judged to have been affected by rainfall (referred to in Charts 12.1 to 12.8 'additional exclusions').
- Dawn chorus occurred between 0800-0900 during the survey period, as expected during January time, this was out of the night-time periods (2300-0700), as such, dawn chorus was automatically excluded along with daytime dataset and did not require explicit exclusions.
- Elimination of any periods where the sound level meters recorded 'over-range' measurements as these are likely to be associated with short-duration, high intensity noise events or sources, such as machinery which may not be typical of the background noise environment.
- Exclusion of any data points which were considered 'outliers' relative to the overall dataset, located above the resulting trendline.
- Sorting of data into 'quiet daytime' and night-time periods, as defined in ETSU-R-97.
- Preparation of an X-Y scatter plot of measured noise levels against standardised 10 m wind speed for quiet daytime and night-time periods.
- Application of a polynomial trendline to the plot, using Microsoft Excel's 'Trendline' function. In all cases, the use of third order polynomial trendlines was considered most appropriate.
- Determination of the prevailing background noise levels from the trendline curves.

12.4.3.2 Background Noise Levels

Chart 12-1 to Chart 12-8 detail the results of the background noise data analysis for each location, for quiet daytime and night periods, as defined in ETSU-R-97.

Chart 12-1 – Quiet Daytime – Ladyfield Farm

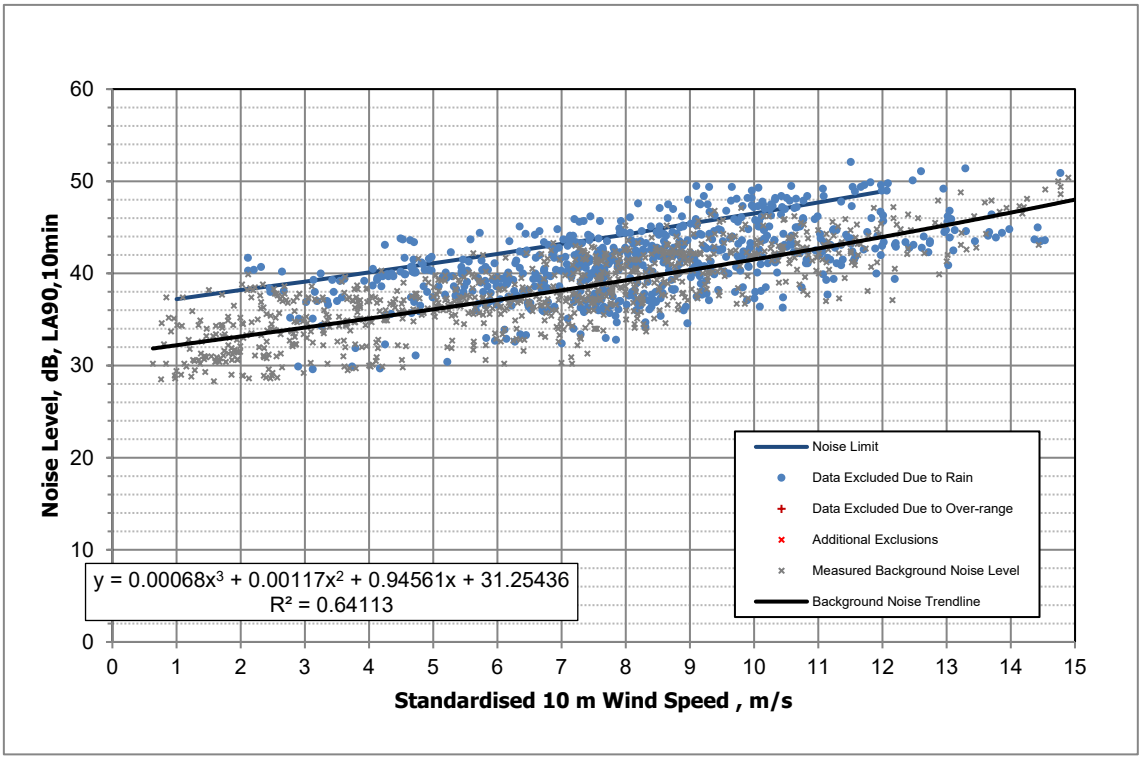

Chart 12-2 – Night-time – Ladyfield Farm

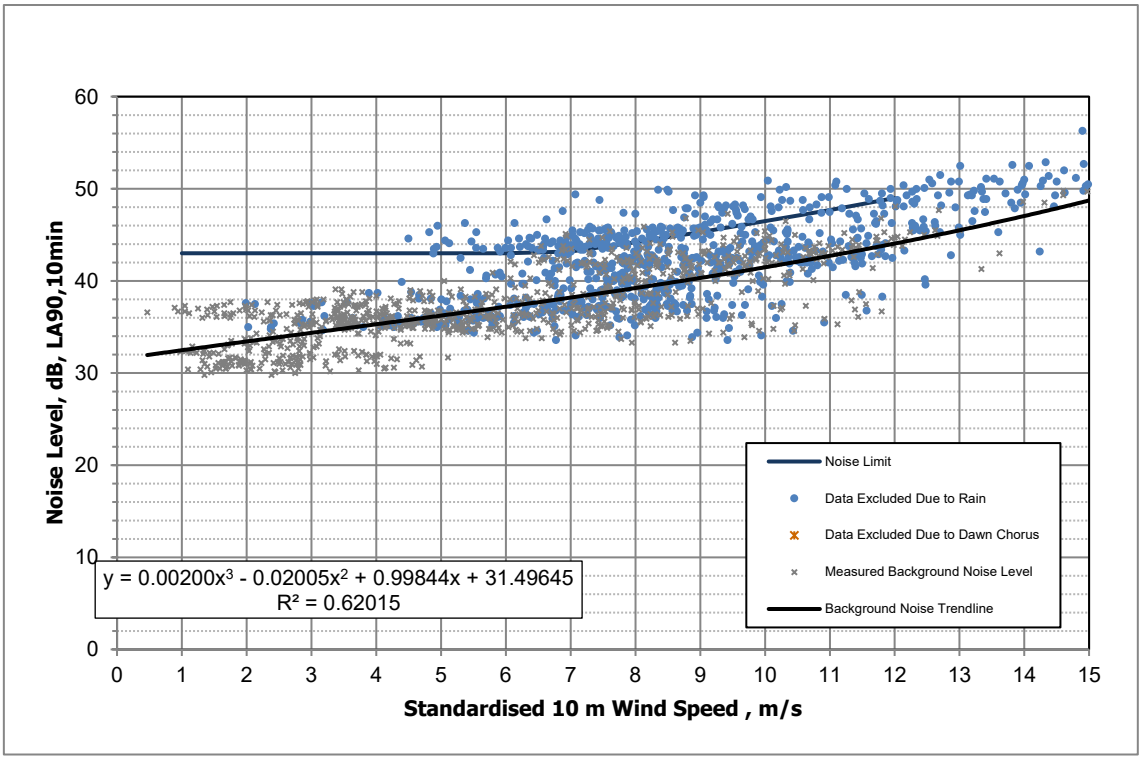

Chart 12-3 – Quiet Daytime - Drimfern

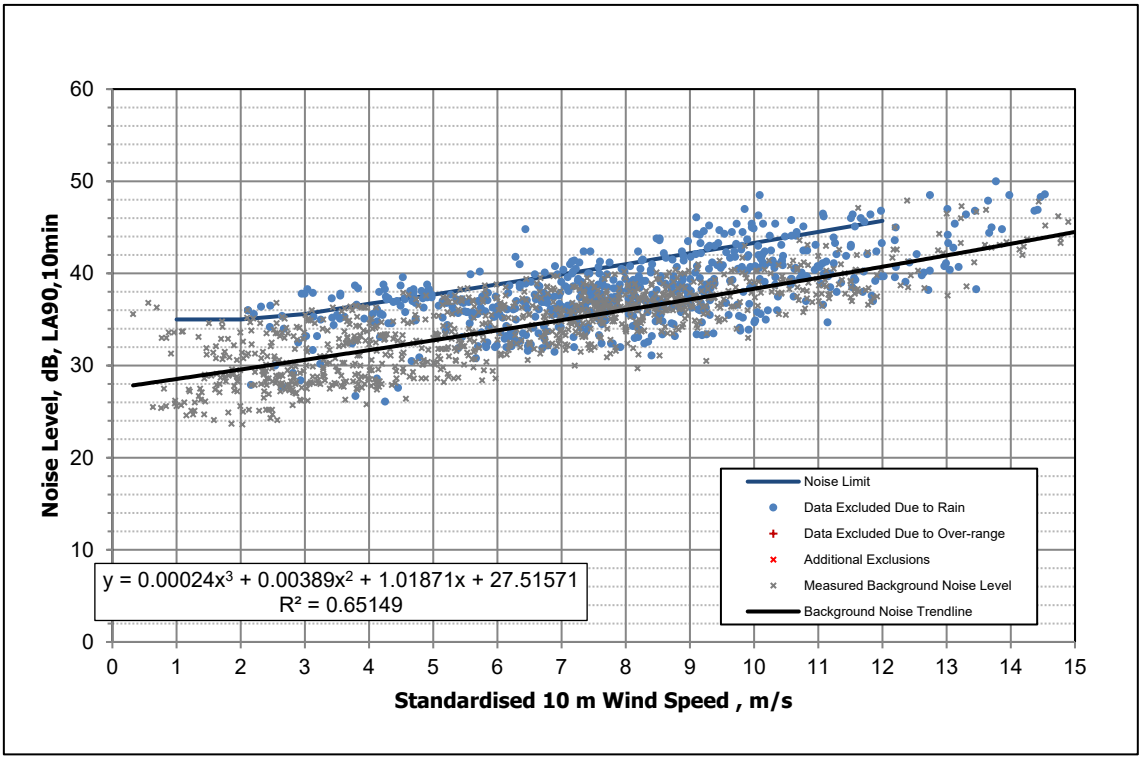

Chart 12-4 – Night-time - Drimfern

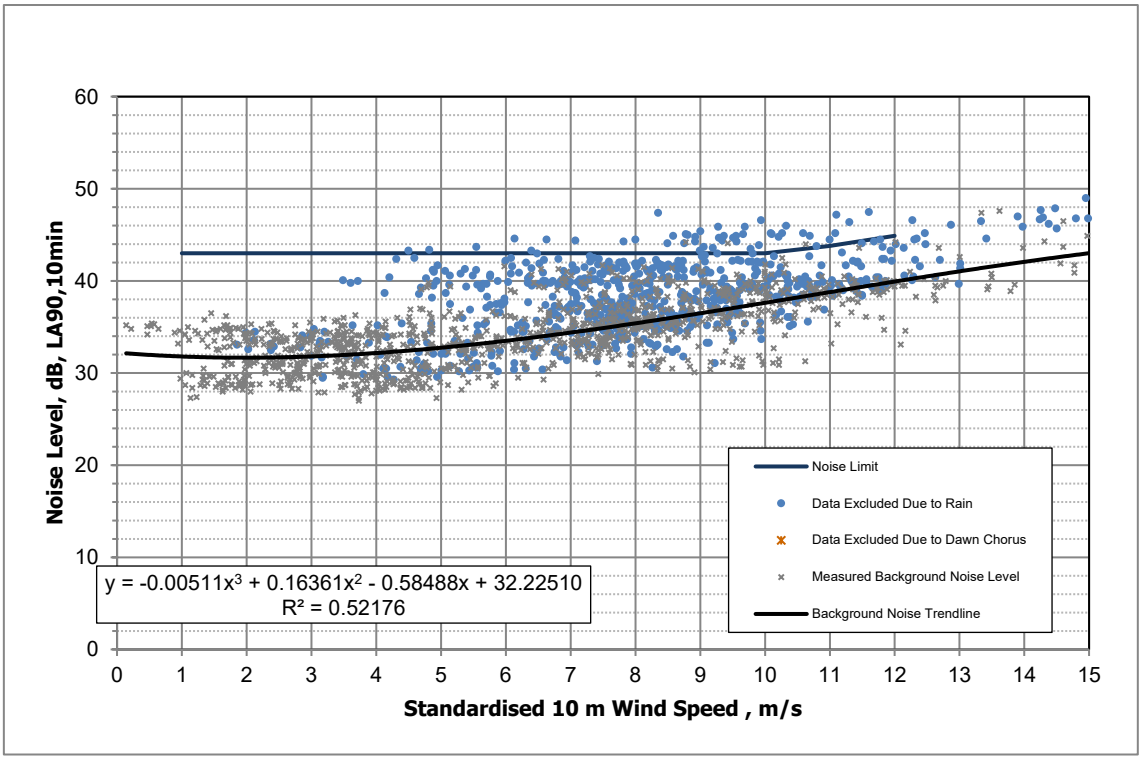

Chart 12-5 – Quiet Daytime – Three Bridges

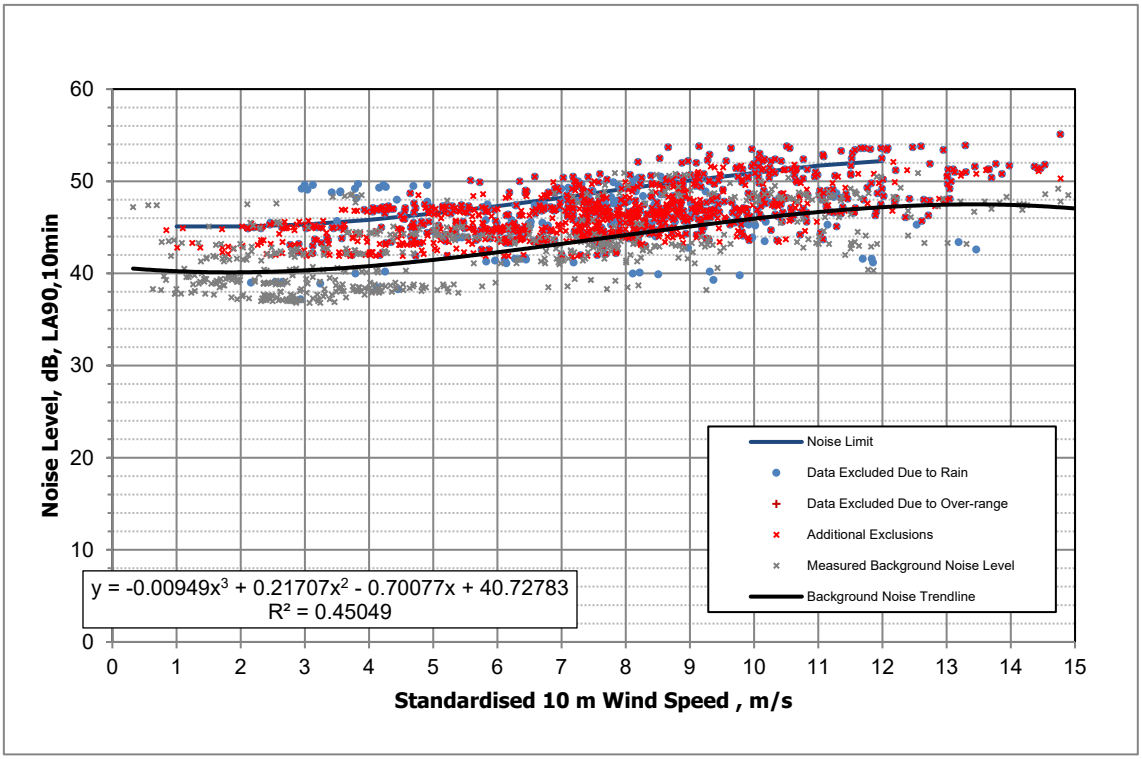

Chart 12-6 – Night-time – Three Bridges

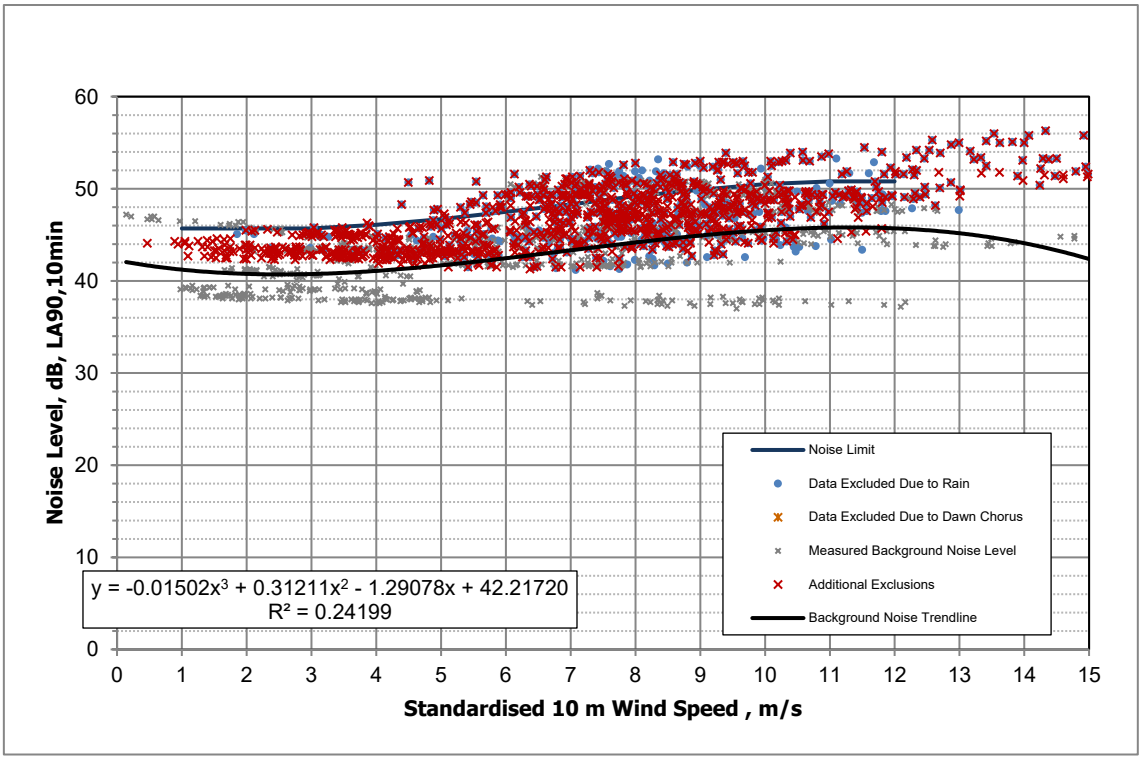

Chart 12-7– Quiet Daytime – Maam House

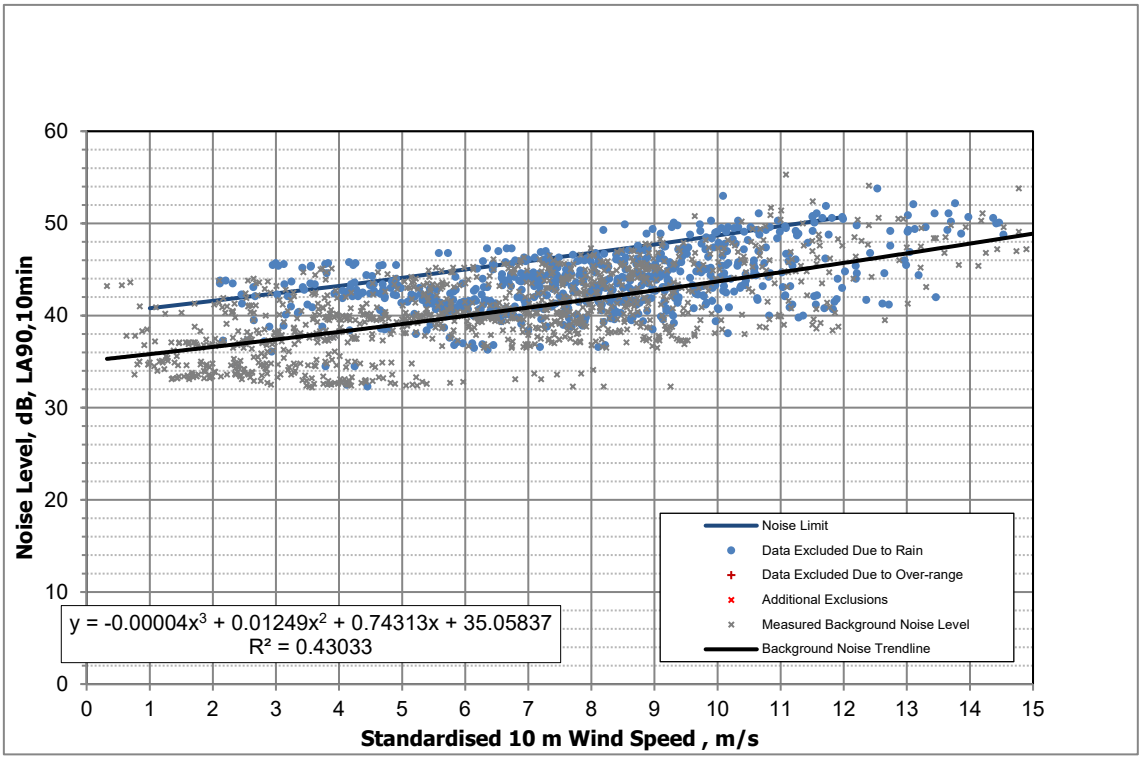

Chart 12-8– Night-time – Maam House

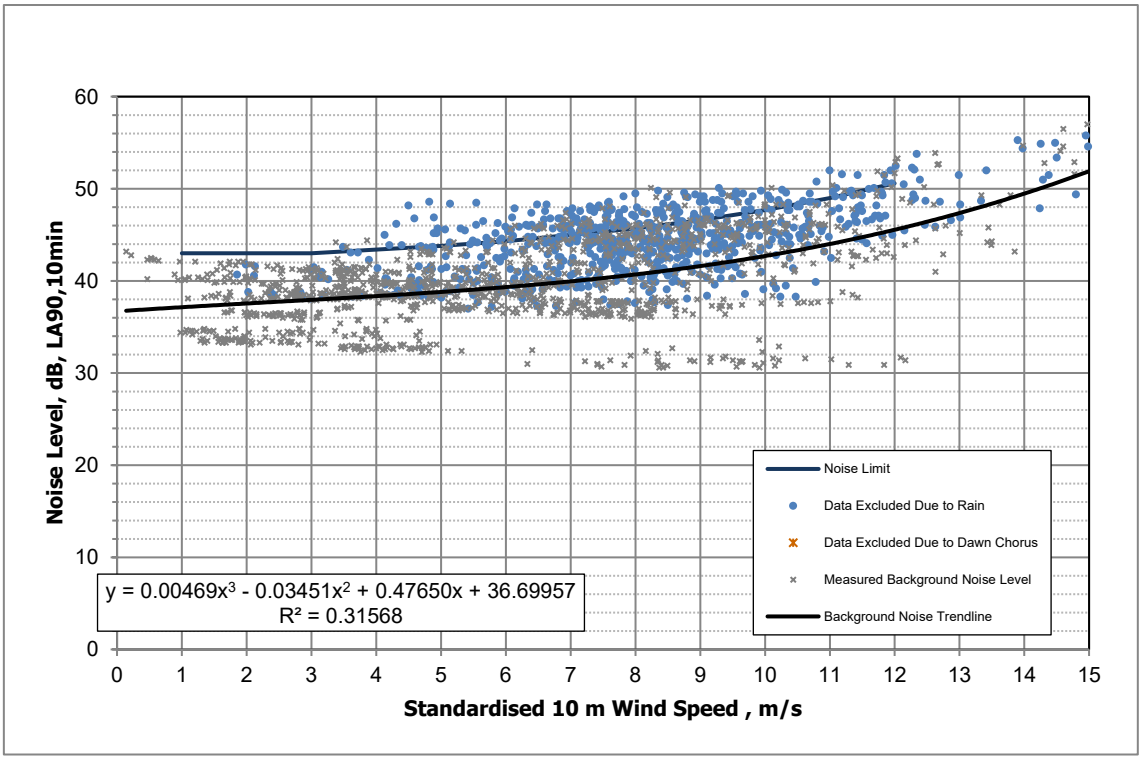

Table 12.8 and Table 12.9 present the derived background noise levels for daytime and night-time periods.

Table 12.8 Derived Background Noise Levels - Daytime

Monitoring Location	Wind Speed Standardised to a height of 10 m / Background Noise Level dB(A)											
	1	2	3	4	5	6	7	8	9	10	11	12
Ladyfield Farm	32.2	33.2	34.1	35.1	36.1	37.1	38.2	39.2	40.4	41.5	42.7	43.9
Drimfern	28.5	29.6	30.6	31.7	32.7	33.8	34.9	36.0	37.2	38.3	39.5	40.7
Three Bridges	40.1	40.1	40.3	40.8	41.5	42.3	43.2	44.2	45.1	45.9	46.7	47.2
Maam House	35.8	36.6	37.4	38.2	39.1	40.0	40.9	41.8	42.7	43.7	44.7	45.7

Table 12.9 Derived Background Noise Levels – Night-time

Monitoring Location	Wind Speed Standardised to a height of 10 m / Background Noise Level dB(A)											
	1	2	3	4	5	6	7	8	9	10	11	12
Ladyfield Farm	32.5	33.4	34.4	35.3	36.2	37.2	38.2	39.2	40.3	41.5	42.7	44.0
Drimfern	31.7	31.7	31.8	32.2	32.8	33.5	34.4	35.4	36.5	37.6	38.8	39.9
Three Bridges	40.7	40.7	40.7	41.1	41.7	42.5	43.3	44.2	44.9	45.5	45.8	45.8
Maam House	37.1	37.6	37.9	38.4	38.8	39.3	40.0	40.7	41.6	42.7	44.0	45.6

12.5 Assessment of Potential Effects

12.5.1 Construction Traffic Noise

Details of the calculation of the change in road traffic noise levels are contained in Technical Appendix A12.2.

Table 12.10 and Table 12.11 provide a summary of the results for the estimated worst-case increase in traffic flows for each location for both days where there are no concrete deliveries, and where concrete deliveries will take place. The resulting magnitude of effect as described in Section 12.3.2.2 is also included. The results are based on the peak month's day average traffic as a worst-case impact.

Table 12.10 Predicted Construction Traffic Noise Effects – Non-concrete Day

Location	Change in Traffic Noise Level, dB	Magnitude of Effect
A85 near Taynuilt	0.2	Negligible
A85 near Clifton	0.7	Negligible
A85 near Arrivain	0.6	Negligible
A83 near Auchnabreac	0.3	Negligible
A819 North	0.8	Negligible
A819 South	0.8	Negligible

Table 12.11 Predicted Construction Traffic Noise Effects – Concrete Day

Location	Change in Traffic Noise Level, dB	Magnitude of Effect
A85 near Taynuilt	1.2	Minor
A85 near Clifton	3.4	Moderate
A85 near Arrivain	2.8	Minor
A83 near Auchnabreac	1.9	Minor

Location	Change in Traffic Noise Level, dB	Magnitude of Effect
A819 North	3.6	Moderate
A819 South	3.5	Moderate

It can be seen from the Table 12.10 and Table 12.11 above that on non-concrete days:

- The predicted change in noise levels at all relevant roads is negligible.

On Days where there would be deliveries of concrete:

- The predicted change in noise levels along A85 near Taynuilt, Arrivain, and Auchnabreac is minor, and moderate at A85 near Clifton and A819 (North and South).

Effects on days without concrete deliveries, and days with concrete deliveries would therefore be **not significant** in terms of the EIA Regulations with the exception of A85 near Clifton and the A819 North and South which are predicted to be **significant** on concrete days only**.** Mitigation to manage and reduce this effect to not significant is discussed in Section 12.6.1

12.5.2 Construction Noise

Construction from south access bridge replacement is expected to be undertaken in proximity to an NSR and as such a detailed construction assessment has been undertaken.

The proposed access junction to the south of the Development is located 55 m from the nearest NSR: Linnieghluttain (NGR 208935 712956). Table 12.12 below presents the construction programme for the proposed road and bridge works.

Table 12.12: Construction Noise Assessment (Linnieghluttain– Junction and Bridge Replacement Works

BS5228 Ref	Plant	Sound Power Level, dB L_{WA}	Sound Pressure Level at NSR, dB $L_{Aeq,T}$
Access Junction Works			
Site clearance & excavation (6 days)			
C2.17	Tracked Excavator	104	66
C2.28	Wheeled Loader	107	69
D2.14	Petrol Driven Chain Saw	114	76
C10.22	Feed Hopper	97	59
C4.56	Wheeled Excavator	111	73
C5.24	Vibratory Roller	112	74
	Total	**118**	**80**
Fill and compacting (3 days)			
C2.17	Tracked Excavator	104	66
C2.28	Wheeled Loader	114	76
C4.56	Wheeled Excavator	111	73
C5.24	Vibratory Roller	112	74
	Total	**117**	**79**
Kerbing (2 days)			

BS5228 Ref	Plant	Sound Power Level, dB L_{WA}	Sound Pressure Level at NSR, dB $L_{Aeq,T}$
C4.56	Wheeled Excavator	111	73
C2.33	Articulated Dump Truck (tipping fill)	108	70
C2.30	Dump Truck	107	69
	Total	**114**	**76**
Subbase and tarmac to entrance (3 days)			
C2.17	Tracked Excavator	104	66
C2.28	Wheeled Loader	114	76
C4.56	Wheeled Excavator	111	73
C5.24	Vibratory Roller	112	74
C5.31	Asphalt Paver	105	67
C2.28	Wheeled Loader	110	72
	Total	**118**	**80**
Reinstatement and signage (1 day)			
C5.12	Dozer (Spreading fill/soil)	105	67
C4.90	Road Sweeper (lining_	104	66
C5.24	Vibratory Roller	112	74
	Total	**113**	**75**
Bridge Replacement Works			
Construction of access for both sides of bridge (4 days)			
C2.17	Tracked Excavator	104	62
C2.28	Wheeled Loader	112	70
D2.14	Petrol Driven Chain Saw	114	72
C10.22	Feed Hopper	97	55
C4.56	Wheeled Excavator	111	69
C5.24	Vibratory Roller	112	70
	Total	**119**	**77**
Abutment foundation works (4 days)			
C2.23	Wheeled Excavator	98	56
C2.17	Tracked Excavator	104	62
C2.28	Wheeled Loader	104	62
	Total	**108**	**66**
Casting abutment works (3 weeks)			
C4.23	Wheel Mobile crane	98	56
C2.33	Articulated Dump Truck (tipping fill)	111	70

BS5228 Ref	Plant	Sound Power Level, dB L_{WA}	Sound Pressure Level at NSR, dB $L_{Aeq,T}$
C2.34	Lorry	108	66
C4.56	Wheeled Excavator	111	69
	Total	**115**	**74**
Assembly of bridge (1 week)			
C3.28	Tracked Mobile Crane	95	53
C5.5	Compressor	93	51
C2.23	Wheeled Excavator	98	56
Total		**101**	**59**
Complete new access of bridge (2 days)			
C2.17	Tracked Excavator	104	62
C5.24	Vibratory Roller	112	70
C4.56	Wheeled Excavator	111	69
	Total	**115**	**73**
Removal of existing bridge structure (2 days)			
C3.28	Tracked Mobile Crane	95	53
C5.5	Compressor	93	51
C4.56	Wheeled Excavator	111	69
D2.14	Petrol Driven Chain Saw	114	72
	Total	**116**	**74**

As seen in Table 12.12 above, the highest sound pressure level at the curtilage of the nearest NSR is 80 dB(A) for 3 days during the junction works and 77 dB(A) for 4 days during construction of access for the bridge activity. Most of the activities also exceed the lower threshold of construction noise in BS 5228-1 (see Section 12.2.2.2) and is considered **significant** in terms of EIA regulations. Mitigation for this effect is discussed in Section 12.6.1, and will be incorporated in the Construction Environmental Management Plan (CEMP).

Similar activities will be undertaken for the proposed new bridge at the north access, however, the nearest NSR to the proposed bridge is at 450 m distance, therefore, the expected sound levels at the NSR are lower (range from 33 – 51 dB(A)) which are below the BS 5228-1 lower threshold.

Construction noise from all activities including: road upgrade works, new bridge construction, borrow pit works, BESS compound construction, turbine hardstanding foundation works, are **not significant** in terms of EIA regulations, with the exception of junction and bridge replacement works to the south access, which requires monitoring and mitigation measures outlined in Section 12.6.1 to reduce the effect to **not significant**.

12.5.3 Operational Wind Turbine Noise

12.5.3.1 Cumulative Noise Limits

Table 12.13 details the ETSU-R-97 cumulative noise limits for each assessed receptor. It is from these limits that apportioned noise limits applicable to the Development are derived.

Table 12.13 Cumulative Noise Limits

Receptor Name	Standardised 10 m Wind Speed, ms-1								
	4	5	6	7	8	9	10	11	12
	Cumulative Noise Limit, dB, $L_{A90,10min}$								
Daytime									
Ladyfield Farm	40.1	41.1	42.1	43.2	44.2	45.4	46.5	47.7	48.9
Drimfern	40.0	40.0	40.0	40.0	41.0	42.2	43.3	44.5	45.7
Three Bridges	45.8	46.5	47.3	48.2	49.2	50.1	50.9	51.7	52.2
Maam House	43.2	44.1	45.0	45.9	46.8	47.7	48.7	49.7	50.7
North Tullich	40.1	41.1	42.1	43.2	44.2	45.4	46.5	47.7	48.9
South Tullich	40.1	41.1	42.1	43.2	44.2	45.4	46.5	47.7	48.9
Night-time									
Ladyfield Farm	43.0	43.0	43.0	43.2	44.2	45.3	46.5	47.7	49.0
Drimfern	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.8	44.9
Three Bridges	46.1	46.7	47.5	48.3	49.2	49.9	50.5	50.8	50.8
Maam House	43.4	43.8	44.3	45.0	45.7	46.6	47.7	49.0	50.6
North Tullich	43.0	43.0	43.0	43.2	44.2	45.3	46.5	47.7	49.0
South Tullich	43.0	43.0	43.0	43.2	44.2	45.3	46.5	47.7	49.0

12.5.3.2 Calculation of Apportioned Noise Limits

The cumulative development included in this assessment is detailed in Table 12.3. When assessing cumulative noise levels, consideration should be given to any noise limits or other noise-related planning conditions applicable to each development. Where there is no reasonable prospect of a cumulative development producing noise levels up to its consented (or proposed) limits, the GPG recommends that predicted noise levels should be used along with an additional safety margin. This approach prevents the sterilisation of an area in which existing wind turbine noise levels are substantially lower than the ETSU-R-97 limits, enabling further appropriate development to be considered.

Details of the noise emission data for the cumulative development are presented in Table 12.14 and Table 12.15[373].

Table 12.14: Noise Emission Data – Blarghour, Clachan Flats, An Carr Dubh wind farms

Sound Power Level, dB, LWA, inc. 2 dB allowance for uncertainty	Standardised 10 m Wind Speed, ms-1								
	4	5	6	7	8	9	10	11	12
	Sound Power Level, dB(A)								
Siemens Gamesa S155 6MW Mode 0 STE, Hub height 102.5m (Blarghour)	99.8	104.7	107.0	107.0	107.0	107.0	107.0	107.0	107.0

[373] Data source Craignagapple Wind Farm Further Environmental Information Report (2016). Sound power level data provided inclusive of uncertainty (amount not specified).

Sound Power Level, dB, LWA, inc. 2 dB allowance for uncertainty	Standardised 10 m Wind Speed, ms-1								
	4	5	6	7	8	9	10	11	12
	Sound Power Level, dB(A)								
Vestas V66 1.75MW[374], Hub Height 60m[375] (Clachan)	108.8	108.8	108.8	108.8	108.8	108.8	108.8	108.8	108.8
Vestas V150 6MW Hub Height 105m (An Carr Dubh)	98.2	102.5	106.0	106.8	106.9	106.9	106.9	106.9	106.9

The octave-band frequency spectrum at the wind speed 8 ms^{-1} is detailed in Table 12.15.

Table 12.15: Octave-band Spectra – Blarghour, Clachan Flats, and An Carr Dubh

	Standardised 10 m Wind Speed, ms^{-1}							
	63	125	250	500	1000	2000	4000	8000
	Sound Power Level, dB(A)							
Siemens Gamesa S155 6MW								
Vestas V66 1.75MW,	88.8	95.5	99.9	103.2	103.2	101.1	98.0	-
Vestas V150 6MW	88.1	95.7	100.4	102.1	101.0	96.9	89.9	79.9

Table 12.16 details the predicted 'adjusted' noise levels for Blarghour and Clachan wind farms (i.e., cumulative excluding noise due to the Development) for each of the assessed receptors identified in Table 12.6. It should be borne in mind that as the noise assessment follows GPG advice with regard to cumulative noise effects, the noise levels presented in Table 12.16 are a theoretical worst case (including a 2 dB headroom adjustment); a number of other conservative assumptions have also been made as detailed in the previous sections of this Chapter, such as the assumption that each receptor is directly downwind of all turbines simultaneously, which cannot occur in practice.

Table 12.16: Predicted Noise Levels – Cumulative (excluding Development)

Receptor	Standardised Wind Speed at 10 m AGL, ms^{-1}								
	4	5	6	7	8	9	10	11	12[376]
	Predicted Noise Level, dB, $L_{A90,10min}$								
Ladyfield Farm	16.2	18.4	21.2	22.5	22.6	22.6	22.6	22.6	22.6
Drimfern	16.9	19.9	23.0	24.4	24.6	24.6	24.6	24.6	24.6
Three Bridges	18.8	21.1	23.5	24.5	24.7	24.7	24.7	24.7	24.7
Maam House	20.7	21.0	21.6	22.0	22.1	22.1	22.1	22.1	22.1
North Tullich	15.9	18.2	21.0	22.3	22.5	22.5	22.5	22.5	22.5
South Tullich	16.7	19.3	22.2	23.6	23.8	23.8	23.8	23.8	23.8
Linnieghluttain	18.6	20.5	22.8	23.9	24.1	24.1	24.1	24.1	24.1

[374] The EIA for Clachan Flats assessed noise based on Vestas V66 1.75MW wind turbines; turbine in operation may differ but will be of the same or lower sound power levels, as such, the V66 is used in this assessment.
[375] Due to the old turbine model; data on Sound Power levels across wind speeds was not available, therefore, the maximum Sound Power Levels have been adopted for all wind speeds as a worst-case assumption.
[376] Levels at 10, 11, and 12m/s wind speed were set the same as 9m/s predicted levels.

12.5.3.3 Apportioned Noise Limits

Cumulative noise effects have been addressed through the derivation of apportioned noise limits. Apportioned noise limits are created by logarithmically subtracting the other development noise (i.e., Blarghour, Clachan, and An Carr Dubh) from the cumulative noise limits. The result is the remaining noise budget available to the Development.

The resulting apportioned limits applicable to the Development in isolation are presented in Table 12.17. These limits may be presented in the planning conditions of any consent for the Development and will ensure the Development's compliance with ETSU-R-97 when considered both individually and cumulatively.

Table 12.17: Noise Limits Apportioned to the Development in Isolation

Receptor	**Standardised Wind Speed at 10 m AGL, ms^{-1}**								
	4	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
	Noise Limit, dB, $L_{A90,10min}$								
Daytime									
Ladyfield Farm	40.1	41.1	42.1	43.1	44.2	45.3	46.5	47.7	48.9
Drimfern	36.7	37.7	38.8	39.9	40.9	42.1	43.3	44.5	45.7
Three Bridges	45.8	46.5	47.3	48.2	49.1	50.1	50.9	51.6	52.2
Maam House	43.2	44.1	44.9	45.8	46.8	47.7	48.7	49.7	50.7
North Tullich	40.1	41.1	42.1	43.1	44.2	45.3	46.5	47.7	48.9
South Tullich	40.1	41.1	42.1	43.1	44.2	45.3	46.5	47.7	48.9
Linnieghluttain	45.8	46.5	47.3	48.2	49.1	50.1	50.9	51.6	52.2
Night-time									
Ladyfield Farm	43.0	43.0	43.0	43.2	44.2	45.3	46.5	47.7	49.0
Drimfern	43.0	43.0	43.0	42.9	42.9	42.9	42.9	43.7	44.9
Three Bridges	46.1	46.7	47.4	48.3	49.2	49.9	50.5	50.8	50.8
Maam House	43.3	43.8	44.3	44.9	45.7	46.6	47.7	49.0	50.5
North Tullich	43.0	43.0	43.0	43.2	44.2	45.3	46.5	47.7	49.0
South Tullich	43.0	43.0	43.0	43.1	44.2	45.3	46.5	47.7	49.0
Linnieghluttain	46.1	46.7	47.4	48.3	49.2	49.9	50.5	50.8	50.8

12.5.3.4 Predicted Noise Levels due to the Development

Table 12.18 details the predicted noise immission levels due to the operation of the Development, following the methodology described in Section 12.3.2.4, and using the noise emission data presented in Table 12.4 and Table 12.5. As previously noted, predicted noise levels are worst-case, based upon the assumption that each receptor is directly downwind of all Development turbines simultaneously, which cannot occur in practice.

Table 12.18: Predicted Operational Noise Levels due to the Development

Receptor	Standardised Wind Speed at 10 m AGL, ms^{-1}								
	4	5	6	7	8	9	10	11	12
	Predicted Noise Level, dB, $L_{A90,10min}$								
Ladyfield Farm	27.9	32.9	36.0	36.3	36.3	36.3	36.3	36.3	36.3
Drimfern	25.4	30.4	33.5	33.8	33.8	33.8	33.8	33.8	33.8
Three Bridges	17.0	22.0	25.1	25.4	25.4	25.4	25.4	25.4	25.4
Maam House	16.9	21.9	25.0	25.3	25.3	25.3	25.3	25.3	25.3
North Tullich	29.0	34.0	37.1	37.4	37.4	37.4	37.4	37.4	37.4
South Tullich	27.6	32.6	35.7	36.0	36.0	36.0	36.0	36.0	36.0
Linnieghluttain	18.9	23.9	27	27.3	27.3	27.3	27.3	27.3	27.3

Table 12.19 details the difference (margin) between predicted noise immission levels (Table 12.18) and the apportioned noise limits (Table 12.17) for the assessed receptors. A negative margin indicates that the predicted noise level is below the derived noise limit.

Table 12.19: Margin between Predicted Development Turbine Noise and Apportioned Noise Limits

Receptor	Standardised 10 m Wind Speed, ms^{-1}								
	4	5	6	7	8	9	10	11	12
	Margin, dB								
Daytime									
Ladyfield Farm	-12.2	-8.2	-6.1	-6.8	-7.9	-9.0	-10.2	-11.4	-12.6
Drimfern	-11.3	-7.3	-5.3	-6.1	-7.1	-8.3	-9.5	-10.7	-11.9
Three Bridges	-28.8	-24.5	-22.2	-22.8	-23.7	-24.7	-25.5	-26.2	-26.8
Maam House	-26.3	-22.2	-19.9	-20.5	-21.5	-22.4	-23.4	-24.4	-25.4
North Tullich	-11.1	-7.1	-5.0	-5.7	-6.8	-7.9	-9.1	-10.3	-11.5
South Tullich	-12.5	-8.5	-6.4	-7.1	-8.2	-9.3	-10.5	-11.7	-12.9
Linnieghluttain	-26.9	-22.6	-20.3	-20.9	-21.8	-22.8	-23.6	-24.3	-24.9
Night-time									
Ladyfield Farm	-15.1	-10.1	-7.0	-6.9	-7.9	-9.0	-10.2	-11.4	-12.7
Drimfern	-17.6	-12.6	-9.5	-9.1	-9.1	-9.1	-9.1	-9.9	-11.1
Three Bridges	-29.1	-24.7	-22.3	-22.9	-23.8	-24.5	-25.1	-25.4	-25.4
Maam House	-26.4	-21.9	-19.3	-19.6	-20.4	-21.3	-22.4	-23.7	-25.2
North Tullich	-14.0	-9.0	-5.9	-5.8	-6.8	-7.9	-9.1	-10.3	-11.6
South Tullich	-15.4	-10.4	-7.3	-7.1	-8.2	-9.3	-10.5	-11.7	-13.0
Linnieghluttain	-27.2	-22.8	-20.4	-21.0	-21.9	-22.6	-23.2	-23.5	-23.5

As Table 12.19 shows, worst-case noise levels due to the Development meet the apportioned noise limits at all assessed receptors, and as such are **not significant** in terms of the EIA Regulations.

12.5.4 BESS and Substation Noise

In addition to the above, consideration has been given to potential noise effects arising from the proposed BESS and substation, as noted in Section 12.3.2.8

The nearest noise-sensitive receptor (North Tullich) is located approximately 600 m southwest of the proposed BESS and substation compound. In order to determine the potential for a significant effect, modelling has been undertaken with the sources presented in Table 12.20 below.

Table 12.20: Substation/BESS Noise Emitting Plant

Noise Emitting Plant	No. of plant in Development	Sound Power Level (per unit), dB L_{WA}
Battery HVAC Units	80 (2 per battery unit)	78
Inverters	40 (1 per battery unit)	87
Transformers	2	67

An assessment against the NR criteria at the nearest receptor (North Tullich at 600 m) has been made. Unweighted octave band levels at a height of 4 m have been predicted at the nearest noise-sensitive receptors.

The assessment accounts for an open window attenuation of 15 dB D_n, this value and the associated attenuation spectrum are taken from research results undertaken by Napier University[377] and supporting research findings in the Environmental Research and Public Health journal[378]. The research shows that typical attenuation of slightly open or tilted windows ranges from 14 to 19 dB on average across frequencies, and as such a 15 dB attenuation has been taken as representative.

Table 12.21: NR Curve Assessment – North Tullich

North Tullich	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1000	2000	4000	8000
Un-weighted Sound Pressure Level at Façade, dB(Z)	59	41	34	28	26	22	0	0
Open window attenuation, dB(Z)	20	14	14	16	14	17	19	19
Resulting Internal Sound Pressure Level, dB(Z)	39	27	20	12	12	5	-19	-19
Difference to NR30, dB(Z)	-21	-21	-20	-22	-18	-22	-44	-42
Difference to NR25, dB(Z)	-17	-17	-15	-18	-13	-17	-39	-37

As seen in table above, the resulting noise levels from BESS and substation operation is significantly below the NR30 and NR25 criteria, and meet the NR12 curve.

Development noise levels from the BESS and Substation are more than 10 dB below the noise levels from the turbines (Table 12.18) therefore, BESS and substation noise will have negligible combination effect on the operational wind farm noise levels presented in the report. North Tullich is the nearest receptor, therefore, it is understood that noise levels at further away receptors will be lower than those presented above.

[377] NANR116: Open/Closed Window Research – Sound Insulation Through Ventilated Domestic Windows: Napier University 2007
[378] Barbara et al. Difference between Outdoor and Indoor Sound Levels for Open, Tilted, and Closed windows: International Journal of Environmental Research and Public Health.

12.6 Mitigation and Residual Effects

12.6.1 Construction and Decommissioning Noise

The good practice measures detailed below will be implemented to manage the effects of noise and vibration during construction activities, and will be required of all contractors:

- Construction noise will be managed via a site-specific Noise Management Plan (NMP) provided to the Council. The embedded mitigation contained in the NMP will include the commitment to liaise directly with local residents, and the wider community via a Community Liaison Group.
- It is proposed that construction activities be limited to between 07:00 and 19:00 Monday to Saturday, with no construction work expected on Sundays or Bank Holidays. Any works out-with these hours will need to be approved in writing by the Council.
- Where practicable, night-time working will not be carried out. Local residents shall be notified in advance of any night-time construction activities likely to generate significant noise levels, e.g., abnormal load movement;
- The site contractors shall be required to employ the best practicable means of reducing noise emissions from plant, machinery, and construction activities, as advocated in BS 5228-1:2009;
- Where practicable, the work programme will be phased, which would help to reduce the combined effects arising from several noisy operations;
- Where necessary and practicable, noise from fixed plant and equipment will be contained within suitable acoustic enclosures or behind acoustic screens;
- All sub-contractors appointed by the main contractor will be formally and legally obliged, and required through contract, to comply with all environmental noise conditions;
- Any plant and equipment normally required for operation at night (23:00 - 07:00), e.g. generators or dewatering pumps, shall be silenced or suitably shielded to ensure that the night-time lower threshold of 45 dB, $L_{Aeq,night}$ shall not be exceeded at the nearest noise-sensitive receptors; and
- Rock extraction from borrow pits by means of blasting operations is anticipated, and a Blast Management Plan will be prepared by the Contractor in advance of any blasting operations.

With Specific regards to the south access bridge replacement works; the following measures should be implemented to reduce the effects of construction noise:

- Heavy machinery and loud plant would be fitted with silencers/attenuators where possible to reduce noise as far as reasonably practicable;
- Nearest resident will be notified in advance of expected loud construction activity and duration;
- Where possible, operation of noisy machinery / loud activity should be planned in phases and limited to notified hours of the day;
- The site contractors shall be required to employ the best practicable means of reducing vibration from plant, machinery, and construction activities, as advocated in BS 5228-2:2009; and
- Construction noise & vibration monitoring will be undertaken at the façade of the nearest NSR (Linnieghluttain) during the southern junction and bridge replacement works, the monitoring equipment should measure $L_{Aeq,1hour}$ and Peak Particle Velocity (PPV) in accordance with BS 5228-1&2. Where measured noise levels exceed the threshold value of 65 dB(A) or vibration levels exceed 10 mm/s PPV, respective construction activity should be reviewed and mitigation measures implemented in the construction activity should be improved where necessary as part of the CEMP. This will ensure that construction noise is managed to the appropriate limits and effects are mitigated to '**not significant'**.

As stated in Section 12.3.2.3, stone is required to be extracted from borrow pits potentially by means of blasting, although the borrow bit is located more than 1 km from any sensitive property the following process would be employed to ensure that the effects of blasting noise and vibration on nearby properties are adequately controlled:

- Compliance with planning conditions specifying limits to vibration resulting from blasting, restrictions on times of blasting, and a requirement for vibration monitoring;
- Preparation of a Scheme of Blasting, which will be submitted to the Council for approval prior to the commencement of any blasting;
- Any blasting on-site would only take place between the hours of 10:00 to 16:00 on Monday to Friday inclusive and 10:00 to 12:00 on Saturdays, with no blasting taking place on a Sunday unless otherwise approved in advance in writing by the Council; and
- Provision of information on blasting to neighbouring residents.

Application of the above measures to manage construction noise will ensure that effects are minimised as far as is reasonably practicable and that the construction process is operated in compliance with the relevant legislation.

12.6.2 Operational Noise

As demonstrated in Table 12.19, operational wind turbine noise due to the Development is compliant with the noise limits derived in line with the requirements of ETSU-R-97 and the GPG, therefore no mitigation is required for operational noise.

It is expected that a condition relating to a demonstration of compliance will be included as part of planning consent. Example conditions and assessment methodology relating to this is provided in Section 7 of the GPG.

12.6.3 Residual Effects

Application of the above measures to manage construction noise will ensure that effects are minimised as far as is reasonably practicable and that the construction process is operated in compliance with the relevant legislation. Construction noise and traffic effect are temporary and will only be in effect over the period of the construction programme, therefore, no residual effects are anticipated after completion.

The residual operational effects are the same as the operational effects identified in this assessment.

12.7 Summary of Effects

Table 12.22 provides a summary of the effects detailed within this chapter.

Table 12.22: Summary of Effects

Receptor	Potential Effect	Significance of Effect	Mitigation Proposed	Residual Effect
Construction Phase				
All Receptors	N/A (see Section 12.3.2.1)	Significant (see Section 12.5 and 12.5.2)	Mitigation measures specified in Section 12.6.1.	**Not Significant**
Operational Phase				
All Receptors	N/A (see Section 12.3.2.6)	Not Significant	None	**Not Significant**
Final Decommissioning Phase				
All Receptors	N/A (see Section 12.3.2.1)	Not Significant	Good practice measures specified in Section 12.6.1.	**Not Significant**

12.8 Statement of Significance

An assessment of potential noise effects associated with the Development has been carried out.

Predicted noise levels due to increased traffic movements on public roads as a result of the Development have been assessed. The increase in road traffic noise due to the construction of the Development has been found to be **not significant** in terms of the EIA Regulations for non-concrete delivery days and **significant** at A85 Clifton and A819 (North & South) only during concrete delivery days. Construction activities are found to be **not significant** except for bridge replacement works at the south access which has been found to be **significant** without any mitigation measures in place. Mitigation measures to reduce and manage these effects to **not significant** in accordance with the relevant standards have been outlined in Section 12.6.1.

The effect of operational noise has been assessed in accordance with ETSU-R-97 and in line with current best practice (i.e., the GPG). It has been shown that the Development would comply with the requirements of ETSU-R-97 at all receptor locations. The effect of operational noise is therefore **not significant** in terms of the EIA Regulations.

The cumulative effects of the Development in conjunction with nearby wind energy developments either operational, consented or the subject of a current planning application were taken into consideration in the above assessment, in accordance with ETSU-R-97 and the GPG. The effect of cumulative operational noise is therefore **not significant** in terms of the EIA Regulations.

Noise during decommissioning will be of a similar nature to that of construction and will be managed to ensure compliance with best practice, legislation, and guidelines current at the time in order to ensure that effects are **not significant** in terms of the EIA Regulations.