RWE

Clachaig Glen Wind Farm

Environmental Impact Assessment Report

Volume 2a

Main Report

# Chapter 8: Noise

# 8. Noise

## 8.1 Introduction

8.1.1 This chapter of the Environmental Impact Assessment Report (EIAR) identifies and assesses the potential noise effects that the Proposed Development, as described in Chapter 3 of this EIAR: Project Description, may have on nearby Noise Sensitive Receptors (NSRs). It also identifies any noise mitigation that will be implemented to prevent, reduce or offset potential adverse noise effects.

8.1.2 The chapter is supported by the following Technical Appendices (EIAR Volume 3):

- Appendix 8.1: Policy and Guidance,
- Appendix 8.2: Baseline and Predicted Noise Data, and
- Appendix 8.3: Turbine Prediction Details.

### *Scope*

8.1.3 The Proposed Development has the potential to emit noise during construction, operation and decommissioning; hence, the temporal scope of this assessment includes all these phases. The proposed turbines, substation and battery storage will emit noise during the operational phase. The substation and battery storage are over 2 km from the nearest NSR. At this distance, the noise emissions from these facilities are highly unlikely to be audible and will not result in significant effects. Hence, noise from the substation and battery storage is excluded from the assessment scope.

8.1.4 The construction and operation of the Proposed Development is not anticipated to give rise to perceptible levels of vibration or ground borne noise at surrounding sensitive receptors and therefore an assessment of vibration has been scoped out.

## 8.2 Legislation, Policy and Guidance

### *Planning Policy*

8.2.1 Relevant overarching planning policies for the Proposed Development are detailed in Chapter 6 of this EIAR: Planning Policy Context. The following national and local planning policies are relevant when assessing noise:

- Scottish Planning Policy (Scottish Government, 2014), Paragraph 169,
- Argyll and Bute Local Development Plan (2015),
  - Policy LDP 6 – Supporting the Sustainable Growth of Renewables,
- Argyll and Bute Proposed Local Development Plan 2 (intended adoption 2023),

- Policy 30 – The Sustainable Growth of Renewables.

### *Guidance*

8.2.2 General planning advice relating to noise associated with new developments in Scotland is presented in Planning Advice Note (PAN) 1/2011: Planning and Noise (Scottish Government, 2011a). The purpose of PAN 1/2011 is to provide advice on the role of the planning system in helping to prevent and limit the adverse effects of noise. Information and advice on noise impact assessment (NIA) methods is provided in the associated Technical Advice Note.

8.2.3 The construction and decommissioning noise assessment has been based on British Standard BS 5228 2009+A1 2014 'Code of practice for noise and vibration control from construction and open sites' (BS 5228).

8.2.4 The operational wind turbine noise assessment has been based upon 'The Assessment and Rating of Noise from Wind Farms' (ETSU-R-97) published by the former Department of Trade and Industry (DTI, 1996), in conjunction with the Institute of Acoustics (IOA) 'A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise' (GPG) (2013). Further discussion of applicable guidance and standards is contained within Appendix 8.1: Policy and Guidance (EIAR Volume 3).

## 8.3 Methodology

### *Construction and Decommissioning Noise*

8.3.1 BS 5228 provides practical information on construction noise and vibration reduction measures and promotes a 'Best Practicable Means' approach to control noise and vibration. The calculation method provided in BS 5228 is based on the number and types of equipment operating, their associated sound power level ($L_w$), and the distance to receptors, together with the effects of any screening.

8.3.2 BS 5228 contains a methodology for the assessment of the significance of effect of construction noise in relation to the ambient noise levels, known as the "ABC method". The criteria for significance provided in BS 5228 are reproduced in Table 8-1.

**Table 8-1: Construction Noise Threshold of Potentially Significant Effect at Dwellings**

| Assessment Category | Threshold Value (decibel) dB) $L_{Aeq,T}$ | | |
|---|---|---|---|
| | 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 |

NOTE 1: A potentially significant effect is indicated if the LAeq,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 potentially significant effect is indicated if the total LAeq,T noise level for the period increases by more than 3 dB due to site noise.
NOTE 3: Applies 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, 07:00 – 23:00 Sundays.

8.3.3 For the appropriate period (night, evening/weekend, day), the ambient noise level is determined and rounded to the nearest 5 dB. The appropriate Threshold Value is then determined. The construction noise level is then compared with this Threshold Value. If the noise level from the works exceeds the Threshold Value, then there is the potential for a significant effect to occur. However, in line with best practice, this indicator of a potential significant effect is then further considered using professional judgement and taking into account a range of other factors to ensure a reasonable worst-case scenario has been applied, including:

- The duration of the impact. Based on the guidance in BS 5228, construction noise levels above the Threshold Value for less than 10-days (or 10-evenings/weekends or nights) in any 15 consecutive days, or 40-days or less (or 40 evenings / weekends or nights) in any 6-month consecutive period would not normally be considered significant,
- The timing of the impact. Night time impacts being more likely to be considered significant than daytime impacts,
- The location of the impact at the receptor. For example, a receptor may contain areas which are more or less sensitive than others, such as in a school, its office spaces or kitchens would be considered less sensitive than the classrooms, and
- The nature, times of use and design of the receptor. For example, a receptor which is not used at night would not be considered sensitive to night time construction works.

8.3.4 As details of the proposed construction schedule and plant to be used are not available at this stage, a quantitative construction noise assessment has not been carried out. Instead, a qualitative assessment focussing on best practicable means has been completed.

## *Operational Noise*

8.3.5 As per Paragraph 8.2.4, the adopted operational noise assessment method accords with the advice contained in PAN1/2011 by using the principles and guidance in ETSU-R-97 to assess noise associated with the Proposed Development. In addition, where appropriate, the guidance in the GPG (IOA, 2013) and supplementary guidance notes have been used.

8.3.6 ETSU-R-97 provides guidance on the determination of noise limits for wind farms and is the accepted guidance for such developments within the UK. This methodology has therefore been adopted for this assessment.

8.3.7 The ETSU-R-97 detailed assessment procedure specifies that noise limits should be set relative to existing background noise levels at the nearest dwellings, and that these limits should reflect the variation with wind speed of both turbine source noise and background noise. In addition, minimum fixed limit values are applied where low levels of background noise are measured. These are different for the daytime and night-time periods. The wind speed range that should be considered ranges between the cut-in speed for the turbines, usually about 4 metres per second ($ms^{-1}$) (approximately 9 miles per hour (mph)) and 12 $ms^{-1}$ (approximately 27 mph), where all wind speeds are referenced to a standardised height of 10 m. Further details are provided in Appendix 8.1: Policy and Guidance (EIAR Volume 3).

8.3.8 ETSU-R-97 states that "*if the [wind turbine] noise is limited to an $L_{A90,10min}$ of 35 dB(A) up to wind speeds of 10 $ms^{-1}$ at 10 m height, then this condition alone would offer sufficient protection of amenity, and background noise survey would be unnecessary*". Consequently, an initial screening exercise has been undertaken to identify whether the cumulative wind turbine noise levels at NSRs are likely to exceed 35 dB $L_{A90,10min}$ and where this is not the case, these NSRs have been excluded from further assessment.

8.3.9 The daytime noise minimum fixed value can be chosen from the range $L_{A90,10min}$ 35-40 dB. The precise choice of value depends on a number of factors as described on page viii of ETSU-R-97, including:

- *the number of dwellings in the neighbourhood of the wind farm*
- *the effect of noise limits on the number of kilowatt hours (kWh) generated*
- *the duration and level of exposure.*

8.3.10 The current IOA guidance regarding these three criteria (Page 17 of the IOA GPG) is as follows:

1. *"The number of neighbouring properties will depend on the nature of the area, (rural, semi-rural, urban) and is sometimes considered in relation to the size of the scheme and study area. The predicted 35 dB $L_{A90,T}$ contour (at maximum noise output up to 12 $ms^{-1}$) can provide a guide to the dwellings to be considered in this respect.*
2. *This is in practice mainly based on the relative generating capacity of the development, as larger schemes have relatively more planning merit (for noise) according to the description in ETSU-R-97. In cases when the amenity fixed limit has little or no impact on the generating capacity (i.e., noise is not a significant design constraint) then a reduced limit may be applied.*
3. *This last test is more difficult to formulate. But ETSU-R-97 notes that the likely excess of turbine noise relative to background noise levels should be a relevant consideration. In rural areas, this will often be determined by the sheltering of the property relative to the wind farm site. Account can also be taken of the effects of wind directions (including prevailing ones at the site) and likely directional effects. For cumulative developments, in some cases the effective duration of exposure may increase because of cumulative effects."*

8.3.11 If the Proposed Development's turbine noise levels result in an increase of the existing / proposed turbine noise levels of less than 0.5 dB at any given property, this demonstrates that the Proposed Development has a negligible impact at that NSR. In practice this requires that Proposed Development noise levels are 10 dB below the existing / proposed turbine noise levels for such locations.

8.3.12 The detailed assessment methodology incorporates the following steps:

- Determine the background noise level,
- Identify the cumulative noise limits for day (40 dB(A) or background +5 dB, whichever is greater) and night (43 dB(A) or background +5 dB, whichever is greater),
- Compare the predicted noise immission level from all wind turbines (Proposed Development and existing / proposed wind farms) with the cumulative noise limit,
- Logarithmically subtract the immission level from existing / proposed wind farms from the cumulative noise limit to give the apportioned limit. If existing / proposed wind farms immission levels are within 0.5 dB of the cumulative limit, then the apportioned limit is 10 dB below the cumulative limit, and
- Identify the Proposed Development noise limits, which are the apportioned limit or the limit according to ETSU-R-97, applying a daytime noise minimum fixed value of 35 dB(A), whichever is lower.

8.3.13 The Proposed Development noise limits are recommended for inclusion in the planning consent for the Proposed Development.

### *Low Frequency Sound, Infrasound and Ground-Borne Vibration*

8.3.14 The IOA Acoustics Bulletin article of March/April 2009 states that there is no robust evidence that low frequency sound, infrasound and ground-borne vibration from wind farms, generally has adverse effects on neighbours. As a result, these effects have been scoped out and have not been assessed further within this EIAR.

### *Amplitude Modulation (AM) of Aerodynamic Noise*

8.3.15 The IOA GPG (section 7.2.1) states: "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". Therefore, AM ("Other" or "Excess)" has not been considered within the assessment for the Proposed Development. Further information on OAM is provided in Appendix 8.1: Policy and Guidance (EIAR Volume 3).

### *Directivity*

8.3.16 Owing to meteorological effects, the radiated sound energy from a wind turbine does not necessarily propagate equally in all directions. This can be modelled by applying a directivity factor to the sound power levels of the turbine, which varies depending on the wind direction being assessed.

8.3.17 The predictions of cumulative turbine noise levels have applied directivity factors as required by the IOA (2013) GPG, which states that: "based on evidence from the Joule project[8.1] in conjunction with advice in BS 8233 and ISO 9613-2, current practice suggests that for a range of headings from directly downwind (0°) up to 10 degrees from crosswind (80°), there may be little to no reduction in noise levels; once in crosswind directions (90°) then the reduction may be around 2 dB(A); and when at sufficient distance upwind the reduction would be at least 10 dB(A). For intermediate directions between crosswind to upwind, a simple linear or polynomial interpolation can be used. Such reductions (due to "shadow zone" refraction effects) will in practice only progressively come into play at distances of between 5 and 10 turbine tip heights."

## *Noise Model Assumptions*

8.3.18 All noise level predictions have been undertaken using the following assumptions:

- 2 dB has been subtracted from the predicted turbine sound levels at NSRs to convert from $L_{Aeq}$ to $L_{A90}$,
- Ground Factor (ground effect) (G) of 0.5 (i.e., mixed hard and soft ground) is used for all surface areas except large bodies of water where G = 0 (hard ground), in conjunction with a margin of uncertainty in the candidate turbine sound power level data,
- Each NSR has a height above ground of 4.0 m,
- There are no screening effects from vegetation (including trees), or intervening buildings and structures,
- An air absorption factor based on a temperature of 10°C and 70% relative humidity,
- Topographic screening effects of the terrain are limited to a reduction of 2 dB if there is no direct line of sight between the highest point on the turbine rotor and the receiver location,
- A correction of +3 dB is added for propagation across a concave ground profile (valley correction),
- Free-field conditions (i.e. no acoustic reflections from adjacent façades, etc.), and
- When predicting noise levels at NSRs due to the operation of the Proposed Development, it has been assumed that the hub height wind speed is the same at all of the installed turbines and, as such, each turbine emits the same level of sound power.

8.3.19 Appendix 8.3: Turbine Predictions Details (EIAR Volume 3) provides a table of the NSRs and identifies, for each Proposed Development turbine, the screening corrections which have been applied in the predictions. No NSR / Proposed Development turbine pairs were identified at which the concave ground correction should be applied.

## *Significance Criteria*

8.3.20 Regarding the construction noise assessment, a negligible or minor magnitude of impact is not normally considered a significant effect, and a moderate or major magnitude of impact is normally considered a

[8.1] Bass J H, Bullimore A J. Development of a Wind farm Noise Propagation Prediction Model. JOR3-CT95-0091

significant effect. See Chapter 2 of this EIAR: Approach to Environmental Impact Assessment (EIA), for further information.

8.3.21 Regarding the operational noise assessment, ETSU-R-97 and the IOA (2013) GPG do not provide significance of effect criteria for assessing noise impacts from wind turbine developments in the context of EIA (predicted turbine emission levels either meet or exceed the derived noise limits). The resulting noise levels are therefore compared to the noise level limits derived from the ETSU-R-97 guidance. The significance of effect applied is based upon the predicted noise levels relative to the ETSU-R-97 noise limits. Where the ETSU-R-97 noise level limits are not exceeded this has been classified as being Not Significant. Where they are exceeded, they are considered Significant. This is the general approach used in wind farm EIAs in the UK and is considered best practice within the acoustics industry.

### *Consultation*

8.3.22 An EIA scoping report was submitted to the Scottish Government's Energy Consents Unit (ECU) in September 2020 for comment on the outlined methodology of the EIA. The Scoping Opinion issued by the ECU in October 2020 contained responses from a variety of consultees, the most relevant of which are summarised in Chapter 5 of this EIAR: Summary of Consultation. Appendices 5.1 and 5.2 (EIAR Volume 3) contain the EIA Scoping Report and EIA Scoping Opinion from the ECU respectively.

8.3.23 Included among the consultees in the Scoping Opinion was Argyll and Bute Council (ABC). The ABC Environmental Health Officer's (EHO) response included tables of the (occupied and unoccupied) closest residential properties to the Proposed Development and one plot which holds planning consent. These have been used as the NSRs in this assessment. The response indicated full agreement with the proposed methodology and therefore no further consultation was deemed necessary. The assessment methodology is consistent with the 2016 EIA (planning application reference 16/01313/PP) and relies on the baseline data collected to support the 2016 EIA, the only difference is that there are some additional NSRs included.

## 8.4 Baseline Environment

### *Overview*

8.4.1 The nearest settlement to the Proposed Development is Muasdale, which lies approximately 1.8km south west of the Development Site boundary. There are a number of scattered properties around the margins of the Development Site, including those selected for the monitoring locations.

### *Sensitive Receptors*

8.4.2 The existing NSRs likely to be most exposed to the noise emissions from the Proposed Development have been identified in Table 8-2 and illustrated in Figure 8.1 (EIAR Volume 2b). These NSRs represent the properties, and one plot with planning consent for a residential property, which are closest to the Development Site and which will therefore be exposed to the highest noise levels from the Proposed

Development. Hence worst-case impacts are considered; impacts at other NSRs in the vicinity will be of lower magnitude than those identified at these locations.

**Table 8-2: Identified NSRs and Coordinates (on the British National Grid)**

| NSR | Easting | Northing |
|---|---|---|
| High Crubasdale | 169058 | 640638 |
| North Crubasdale | 168734 | 641141 |
| South Beachmore | 168585 | 641432 |
| North Beachmore | 168900 | 641964 |
| Beachmanach | 168842 | 642703 |
| Beacharr | 169345 | 643214 |
| Various properties, Arnicle | 170982 | 638139 |
| High Clachaig | 169985 | 640844 |
| Low Clachaig | 169494 | 640379 |
| Garvalt Building Plot | 172004 | 638949 |
| The Braids | 171851 | 644762 |

8.4.3 Garvalt Building Plot is a location which was granted planning consent in January 2021 for demolition and replacement of a residential dwelling (reference: 20/01859/PP).

8.4.4 The Braids is a derelict building which was granted planning consent to become a residential property in December 2016 (reference: 16/02779/PP). No building works have yet begun on this (as of August 2021) and no building warrant has been granted, it is therefore assumed that this permission has lapsed. However, in order to undertake a precautionary assessment, it has been retained for the purposes of this noise assessment as a sensitive receptor.

## *Existing / Proposed Wind Farm Noise Levels*

8.4.5 Within 10 km of the Development Site there are several operational wind farms which affect noise levels at the identified NSRs. There are also potential wind farms not yet built but that could affect noise levels at NSRs once operational. These are identified in Table 8-3.

**Table 8-3: Existing or Proposed Wind Farms in the Vicinity**

| Site | No of Turbines | Hub Height (m) | Status | Turbine Type | Assumed Turbine Type |
|---|---|---|---|---|---|
| Auchadaduie | 3 | 60 | Operational | Vestas V80 | Yes |
| Blary Hill | 14 | 70 | Under construction; approved | Nordex N90 | No |
| Beinn an Tuirc | 46 | 40 | Operational | Vestas V47 | No |

| | | | | | |
|---|---|---|---|---|---|
| Beinn an Tuirc Extension | 19 | 58.5 | Operational | Siemens SWT82 2.3 | No |
| Beinn an Tuirc Phase III | 18 | 81 | Under construction; approved | Siemens SWT-2.3-93 | No |
| Deucheran Hill | 9 | 46/60 | Operational | Vestas V66 | No |
| Cour | 10 | 65 | Operational | Senvion MM92 | No |
| Isle of Gigha | 3 | 30 | Operational | Vestas V27 | No |
| Leim Farm, Gigha | 1 | 30 | Operational | Enercon E33 | No |
| High Constellation | 10 | 82 | Application | Nordex N133 4.8 MW | No |
| Narachan | 17 | 112 | Application | Vestas V150 5.6 MW | No |

8.4.6 Scoping requests have been submitted to ABC for other wind farms within 10 km of the Proposed Development. The final turbine numbers, dimensions, layout, types and noise emission levels are not available for these developments until a planning application is submitted. It is not therefore possible to assess the cumulative noise impact of these developments and they will not be included in the assessment.

8.4.7 An application was approved by ABC (planning application reference 18/02775/PP) to amend the Beinn an Tuirc Phase III wind farm design. This reduced the number of turbines to 16, lowered the hub height to between 69 and 70 m, and increased the rotor diameter to between 112 and 114 m. The documents available to download on the online ABC planning portal for this application do not include a noise assessment or identify a candidate turbine. Hence, there is not sufficient information available to allow the turbine noise emissions from the amended design to be predicted. The reduction in hub height and number of turbines would decrease the turbine noise levels from this wind farm compared to the original design; however, the amended design has changed the turbine type and its noise emissions are not known. It is reasonable to assume that the potential wind farm noise immission at NSRs have been reviewed by the developer and no overall increase is anticipated, as no new noise assessment was submitted as part of the revised application.. For the purposes of the Proposed Development noise assessment, the higher the cumulative noise levels are, the lower the allowable noise from the Proposed Development. Therefore, to consider a worst-case, the noise from the Beinn an Tuirc Phase III wind farm has been assumed to be as per the original design as shown in Table 8-3.

## *Noise Monitoring*

8.4.8 Background noise levels were measured to inform the 2016 EIA for the Consented Development. The monitoring took place between Wednesday 9 December 2015 and 7 January 2016 at four locations agreed with the ABC EHO as being representative of the dwellings in the vicinity of the Development Site.

8.4.9 The operational noise screening exercise (described in Paragraph 8.3.8) has been used to identify the NSRs at which a detailed assessment is needed and therefore background noise data are required. For the monitoring locations used to identify baseline levels at these NSRs, the results of the noise monitoring are shown in Table 8-10. Graphs of the analysed noise and wind data at these monitoring locations, along with a description of the monitoring procedures, are reproduced in Technical Appendix 8.2: Baseline and Predicted Noise Data (EIAR Volume 3).

8.4.10 Planning permission for the Garvalt Building Plot was granted after the 2016 EIA. Hence, baseline noise monitoring was not conducted at this location. Instead, alternative potential sources of baseline data have been reviewed. The closest existing / proposed wind farm to this NSR is the Blary Hill Wind Farm. The EIA which accompanied the planning application included background noise measurements at three locations: The Bungalow Arnicle, Kilmaluag Cottage and Upper Barr Farm. The Bungalow Arnicle was the closest measurement location to Garvalt Building Plot; however, it is not immediately apparent which of these three measurement locations is most representative of the NSR. The lowest measured background noise levels were measured at Upper Barr Farm; therefore, to ensure a worst-case scenario is assessed, these have been used to represent the background noise levels at Garvalt Building Plot. The location of Upper Barr Farm is shown on Figure 8.1 (EIAR Volume 2b). The monitoring equipment and procedures are described in the noise chapter of the Blary Hill Wind Farm EIA. This indicates that the background noise levels were collected and processed in accordance with ETSU-R-97 and the IOA GPG.

## *Future Baseline*

8.4.11 The future baseline scenario of the Development Site refers to the likely future background noise levels at nearby NSRs, without the implementation of the Proposed Development. To establish what this is likely to be, the current state of the environment (i.e. the baseline scenario) is considered and natural changes from this can be derived using available environmental information.

8.4.12 Before considering the potential future baseline scenario it is important to bear in mind the limitations of this type of appraisal. First, the natural environment is a dynamic and complex system that is constantly undergoing change. Second, such forward-looking statements by their nature involve uncertainties (for example, climate change, macroeconomic performance, and the incremental effect of decision making by the Council and / or third parties over time). It is, therefore, not reasonable to expect that all permutations of a future baseline could be interpreted and reported upon; the following predictions represent the potential outcomes of a reasonable potential future baseline scenario, based on the following assumptions and informed by professional judgement.

8.4.13 The future background noise levels at the NSRs will depend on the contributing noise sources. It is not possible to know whether the contributing noise sources will change over time. The future baseline scenario is therefore limited by the assumption that the noise sources observed to be contributing during the measurements (as described in para 8.4.11 to 8.4.16) will continue to be dominant in the future.

8.4.14 Wind induced noise in vegetation was observed to contribute at North Beachmore and North Crubasdale. Future background noise levels from this source would depend on the approach taken to

vegetation management and the wind strength. There are no reasons to believe that this would change from the current situation. Most of the land between the NSRs and the Proposed Development is used for commercial forestry, which, whilst it may occasionally be felled, is presently planned to be restocked. This is a strong indication that, for the NSRs near to these areas, future background noise levels resulting from wind in vegetation are likely to remain similar to present. This would also be the case for noise from birdcall, livestock and farm machinery.

8.4.15 Changes in road traffic flows are considered to have the greatest potential to affect the future baseline noise levels at the Development Site. Changes in road traffic occur due to natural population change and / or new developments and infrastructure within the local and wider area. This is particularly the case where noise from the A83 was audible. In general, given the assumption of continuing economic growth, road traffic noise levels would be assumed to increase accordingly. Increased future baseline noise levels would reduce the impact of the Proposed Development noise. The impact of the Proposed Development noise is therefore assessed against the current baseline, determined using the measured noise levels, which is in accordance with the guidance in ETSU-R-97.

8.4.16 Consented noise limits, from both the Consented Development and other relevant existing / proposed wind farms, are also taken into account in this assessment (see Section 8.6; Operation – Detailed Assessment).

# 8.5 Embedded Mitigation

## *Construction and Decommissioning*

8.5.1 As part of industry good practice, ‘Best Practicable Means’ will be adopted in order to mitigate against the construction and decommissioning noise impacts at NSRs. British Standard BS 5228:2009+A1:2014 provides detailed advice on methods for minimising impacts from construction noise. Measures will include the following:

- Adherence to the codes of practice for construction working and piling in BS 5228:2009+A1:2014 for minimising noise emissions from the Development Site,
- Proper use of plant and regular maintenance. All vehicles and mechanical plant used for the construction works will be maintained in good efficient working order,
- Selection of inherently quiet plant, where appropriate and possible. All major compressors should be ‘sound-reduced’ models fitted with properly lined and sealed acoustic covers which would be kept closed whenever the machines are in use and all ancillary pneumatic percussive tools would be fitted with mufflers or silencers of the type recommended by the manufacturers,
- Machines in intermittent use will be shut down during periods of inactivity or throttled down to a minimum,
- All ancillary plant such as generators, compressors and pumps to be positioned so as to cause minimum noise disturbance. If necessary, acoustic barriers or enclosures will be provided,

- Whenever possible, piling should not take place before 08.00 or after 18.00 Monday to Friday and on Saturdays should not take place before 09.00 and after 13.00. Piling should not take place on Sundays or Bank Holidays or during the night-time period,
- Use of modern plant, complying with the latest European Commission (EC) noise emission requirements (Directive 2000/14/EC),
- Arrange the Development Site operations and vehicle routes to minimise the need for reversing movements (and the associated reversing alarms), including signage reminding staff on site at intermittent locations. The Development Site layout incorporates a loop to minimise the need for reversing,
- No employees, subcontractors and persons employed on the Development Site to cause unnecessary noise from their activities (such as, excessive 'revving' of vehicle engines, music from radios and shouting, etc.),
- The proposed core hours of construction activities are 07:00 to 19:00 hours Monday to Friday, 09:00 to 17:00 Saturday, with no working on Sunday or Bank Holidays. In the event that construction activities cannot be avoided outside of these hours, such as during concrete pours or delivery, erection, commissioning and maintenance of the major components of the turbines (e.g., blade lifts), ABC would be notified in advance of such occurrences,
- Good public relations and consultation with ABC will be essential to help minimise the impacts of construction work. A Community Liaison Group (CLG) will be established to ensure that local residents are kept informed of construction activities and progress. The CLG will be informed of any periods of more intense construction activity or night-time working which may result in increased noise levels, and,
- A dedicated contact number for local residents to phone should they have any queries or complaints will be maintained during the construction works. A log will be kept of all complaints, along with the actions taken to resolve them, for the duration of the works.

## *Operation*

8.5.2 As described in the Design Statement which accompanies this Section 36 Application, the design of the Proposed Development has evolved through eleven design stages and two EIA processes. The potential for operational noise effects to occur has influenced this process, reducing the number of proposed turbines from an initial potential maximum of 58 to the consented 14 turbine layout. This design has further been amended to the currently proposed 12 turbine layout shown on Figure 1.3: Site Location Plan (EIAR Volume 2b).

8.5.3 The closest NSRs to the Proposed Development, are High Clachaig to the west-south-west, and The Braids to the north-north-west. As discussed in Paragraph 8.4.4, it appears that the planning consent for The Braids has lapsed. Nevertheless, as shown through the Design Statement (and in particular Figures DS-3 to DS-5), the proposed turbine locations in the west have been removed as the design has evolved, which has reduced noise impacts on these NSRs.

# 8.6 Assessment of Effects

## *Construction and Decommissioning*

8.6.1 With regard to construction noise, although it is acknowledged that the construction phase of the development will generate noise and vibration, the resulting effects will be temporary and the nearest property is 1.2 km from the closest area of works. Such a distance will result in considerable attenuation of construction noise levels due to the physical distance, air absorption and ground absorption, and the resulting construction noise levels will be relatively low. Noticeable construction vibration at this distance is unlikely.

8.6.2 Road traffic noise would also be considered negligible in light of the relatively infrequent number of abnormal load deliveries and the relatively small increase in light and heavy vehicles on the local road network. Some night-time transportation of turbine blades will likely be required to minimise the impact of slow-moving vehicles on road traffic flows. Such intermittent activities are not anticipated to result in significant noise effects at NSRs. Hence, no significant noise effects are expected during construction.

8.6.3 With regard to decommissioning noise, although it is acknowledged that the decommissioning phase of the development will also generate noise and vibration, again resulting effects will be temporary. The decommissioning should be completed over a shorter period than construction and involve fewer road vehicles, especially as the roads and turbine foundations are expected to remain in situ. The works are also likely to be 1.2 km from the nearest property, unless new receptors are constructed prior to decommissioning. No significant noise effects are expected during the decommissioning phase.

8.6.4 As part of industry good practice, it is proposed to adhere to the guidance contained in BS 5228:2009+A1:2014 when assessing and mitigating construction noise and vibration impacts. In particular, “Best Practicable Means” of noise mitigation will be adopted, as described in BS 5228:2009+A1:2014, which is discussed in further detail in Section 8.5.

## *Operation - Screening*

8.6.5 To identify whether the cumulative wind farm noise levels are likely to exceed 35 dB $L_{A90}$, the Proposed Development and existing / proposed wind turbine noise levels have been predicted at each NSR.

8.6.6 The selection of a turbine make and model for installation has not yet been made. A range of current turbines have been identified that fall within the development envelope described in Chapter 3 of this EIAR: Project Description, based upon their hub height and blade tip height constraints. From this range, the identified candidate turbine, upon which this assessment is based, is the Siemens Gamesa 5.0–145, as this was identified to result in the highest noise immission levels at NSRs.

8.6.7 The Proposed Development comprises twelve wind turbines, of which seven have a hub height of up to 112 m, ‘Turbine Type 1’, and the remaining have a hub height of up to 132 m, ‘Turbine Type 2’. Table 8-4 presents the sound power levels of the turbine for either hub heights, taken from the manufacturer’s specification datasheet, converted from hub height wind speed to a standardised 10 m height as

described in ETSU-R-97 at page 120 using a reference roughness length of 0.05 metres. The datasheet states that "*The noise levels shown in this document are average expected values, called $L_w$ in IEC-61400-14. To obtain the $L_{wd}$ value, as defined in IEC-61400-14, an increase of 2 dB(A) shall be considered over said $L_w$ values*". On this basis, 2 dB is added to the calculated sound power levels to account for uncertainty.

**Table 8-4 Siemens Gamesa 5.0-145 Sound Power Levels as a Function of Standardised 10 m height Wind Speed**

| Hub Height (m) | Description | Standardised Wind Speed ($ms^{-1}$) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 3 | 4 | 5 | 6 | 7 | 8 | ≥9 |
| 112 | Specification data | 95.2 | 99.0 | 104.0 | 108.3 | 109.3 | 109.3 | 109.3 |
| | Uncertainty considered | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| | Modelled data | 97.2 | 101.0 | 106.0 | 110.3 | 111.3 | 111.3 | 111.3 |
| 132 | Specification data | 95.3 | 99.5 | 104.5 | 108.8 | 109.3 | 109.3 | 109.3 |
| | Uncertainty considered | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| | Modelled data | 97.3 | 101.5 | 106.5 | 110.8 | 111.3 | 111.3 | 111.3 |

8.6.8 The turbine locations and types are presented in Table 8-5.

**Table 8-5 Proposed Development Turbine Locations (Coordinates on the British National Grid) and Types**

| Turbine Ref No. | Co-ordinates | | Turbine Type | Turbine Hub Height (m) |
|---|---|---|---|---|
| | X | Y | | |
| T1 | 172042 | 643025 | 1 | 112 |
| T2 | 173055 | 642867 | 1 | 112 |
| T3 | 171741 | 642693 | 1 | 112 |
| T4 | 171316 | 642438 | 1 | 112 |
| T5 | 172701 | 642602 | 1 | 112 |
| T6 | 171789 | 642110 | 1 | 112 |
| T7 | 172417 | 642250 | 2 | 132 |
| T8 | 171178 | 642039 | 1 | 112 |
| T10 | 170883 | 641708 | 2 | 132 |
| T11 | 171426 | 641475 | 2 | 132 |
| T13 | 172149 | 641498 | 2 | 132 |
| T14 | 171113 | 641187 | 2 | 132 |

8.6.9 The candidate turbine octave band sound power levels (including the +2 dB uncertainty) are provided in Table 8-6. For the purposes of the noise impact assessment the manufacturer's specified octave band sound levels[2] have been normalised to each of the wind speed sound power levels so that predicted noise levels at each of the NSRs can be compared against the derived quiet daytime and night-time noise criteria. The data presented are for turbine operations in a full unconstrained noise mode.

**Table 8-6 Proposed Development Turbine Octave Band Sound Power Levels ($L_{WA}$ dB)**

| Wind Speed ($ms^{-1}$) | Hub Height (m) | Octave Band Centre Frequency (Hz) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 63 | 125 | 250 | 500 | 1k | 2k | 4k | 8k |
| 3 | 112 | 79.7 | 85.3 | 88.8 | 89.8 | 91.6 | 91.2 | 85.0 | 71.5 |
| | 132 | 79.8 | 85.4 | 88.9 | 89.9 | 91.7 | 91.3 | 85.1 | 71.6 |
| 4 | 112 | 83.5 | 89.1 | 92.6 | 93.6 | 95.4 | 95.0 | 88.8 | 75.3 |
| | 132 | 84.0 | 89.6 | 93.1 | 94.1 | 95.9 | 95.5 | 89.3 | 75.8 |
| 5 | 112 | 88.5 | 94.1 | 97.6 | 98.6 | 100.4 | 100.0 | 93.8 | 80.3 |
| | 132 | 89.0 | 94.6 | 98.1 | 99.1 | 100.9 | 100.5 | 94.3 | 80.8 |
| 6 | 112 | 92.8 | 98.4 | 101.9 | 102.9 | 104.7 | 104.3 | 98.1 | 84.6 |
| | 132 | 93.3 | 98.9 | 102.4 | 103.4 | 105.2 | 104.8 | 98.6 | 85.1 |
| ≥ 7 | 112 | 93.8 | 99.4 | 102.9 | 103.9 | 105.7 | 105.3 | 99.1 | 85.6 |
| | 132 | 93.8 | 99.4 | 102.9 | 103.9 | 105.7 | 105.3 | 99.1 | 85.6 |

8.6.10 Sound power levels for the turbines detailed in Table 8-3 (Existing or Proposed Wind Farms in the Vicinity) are listed in

8.6.11 Table 8-7 (Existing / Proposed Wind Farms Cumulative Turbine Sound Power Levels ($L_{WA}$ dB) as a Function of Standardised Wind Speed (at 10 m height) including uncertainty). These values include a correction for uncertainty between 0 and 2 dB depending on the uncertainty of the source data, following the guidance in the IOA (2013) GPG Supplementary Guidance Note 3: Sound Power Level Data. Further information is provided in Appendix 8.3: Turbine Prediction Details (EIAR Volume 3).

**Table 8-7: Existing / Proposed Wind Farms Cumulative Turbine Sound Power Levels ($L_{WA}$ dB) as a Function of Standardised Wind Speed (at 10 m height) including uncertainty**

| Turbine Type | Standardised Wind Speed ($ms^{-1}$) | | | | | | |
|---|---|---|---|---|---|---|---|
| | 4 | 5 | 6 | 7 | 8 | 9 | ≥10 |
| Vestas V80 | 103.4 | 104.2 | 104.8 | 105.7 | 106.4 | 106.4 | 106.4 |
| Vestas V66 | 94.1 | 99.8 | 103.8 | 106.0 | 107.2 | 108.0 | 108.3 |
| Nordex N90 | 99.0 | 102.5 | 105.5 | 106.5 | 107.0 | 107.0 | 107.0 |
| Vestas V47 | 101.1 | 101.6 | 102.0 | 102.5 | 102.9 | 103.4 | 103.8 |
| Siemens SWT82 2.3 | 91.0 | 97.0 | 102.0 | 105.0 | 106.0 | 106.0 | 106.0 |

[2] Siemens Gamesa Renewable Energy, SG 5.0-145 Noise Emission Analysis (GD411363-en) Rev 2, 28/06/2019.

| Turbine Type | Standardised Wind Speed ($ms^{-1}$) | | | | | | |
|---|---|---|---|---|---|---|---|
| | 4 | 5 | 6 | 7 | 8 | 9 | ≥10 |
| Siemens SWT-2.3-93 | 101.0 | 103.0 | 105.0 | 107.0 | 107.0 | 107.0 | 107.0 |
| Senvion MM92 | 96.7 | 102.2 | 104.1 | 105.2 | 105.2 | 105.2 | 105.2 |
| Vestas V27 | | 98.6 | 99.1 | 99.5 | 99.9 | 100.3 | 100.7 |
| Enercon E33 | | 91.9 | 96.1 | 99.6 | 100.7 | 101.0 | 101.0 |
| Nordex N133 4.8 MW | 95.0 | 100.5 | 104.8 | 106.0 | 106.0 | 106.0 | 106.0 |
| Vestas V150 5.6 MW | 92.7 | 96.4 | 100.7 | 103.7 | 104.3 | 105.0 | 105.0 |

8.6.12 The octave band sound power levels that have been used are as shown in Table 8-8. Octave band noise levels have been normalised to each of the wind speed sound power levels given.

**Table 8-8: Existing / Proposed Wind Farms Cumulative Turbine Octave Band Sound Power Levels ($L_{WA}$ dB)**

| Turbine Specification | Octave Band Centre Frequency (Hz) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 63 | 125 | 250 | 500 | 1k | 2k | 4k | 8k |
| Vestas V80 | 84.3 | 91.6 | 96.8 | 98.2 | 96.5 | 95.5 | 88.7 | 71.6 |
| Vestas V66 | 75.0 | 82.3 | 87.5 | 88.9 | 87.2 | 86.2 | 79.4 | 62.3 |
| Nordex N90 | 84.2 | 88.3 | 92.7 | 93.1 | 91.6 | 90.5 | 86.5 | 78.9 |
| Vestas V47 | 78.4 | 86.3 | 90.0 | 95.4 | 97.2 | 93.1 | 88.1 | 69.4 |
| Siemens SWT82 2.3 | 64.4 | 74.4 | 83.1 | 85.2 | 85.5 | 82.9 | 81.0 | 75.2 |
| Siemens SWT-2.3-93 | 86.3 | 95.3 | 102.0 | 102.6 | 99.0 | 95.0 | 90.0 | 85.4 |
| Senvion MM92 | 75.6 | 82.0 | 87.5 | 91.6 | 92.6 | 87.8 | 78.5 | 63.8 |
| Vestas V27 | 70.1 | 79.2 | 85 | 90.3 | 91.8 | 87.7 | 75 | 63.8 |
| Enercon E33 | 65.4 | 74.5 | 80.3 | 85.6 | 87.1 | 83 | 70.3 | 59.1 |
| Nordex N133 4.8 MW | 77.9 | 83.6 | 85.9 | 86.7 | 88.5 | 89 | 86.7 | 76.1 |
| Vestas V150 5.6 MW | 76.4 | 84.6 | 89.7 | 91.7 | 90.5 | 86.3 | 79.1 | 68.6 |

8.6.13 Table 8-9 provides a summary of the predicted $L_{A90,10min}$ noise levels at each of the NSRs for the: Proposed Development; existing / proposed wind farms (excluding the Proposed Development); and the cumulative level (both Proposed Development and existing / proposed wind farms).

8.6.14 The predictions of the Proposed Development and the existing / proposed turbine noise levels assume that each NSR is downwind of all the modelled turbines. For some NSRs, particularly those which sit between the Proposed Development and the closest existing / proposed wind farm, they can never be downwind of both the Proposed Development and the existing / proposed turbines. Hence, there is no wind direction under which the predicted turbine noise levels from both contributors could occur

simultaneously. Therefore, to give a more realistic representation of the likely cumulative turbine noise levels, cumulative predictions have also been undertaken, which account for wind direction. The reported cumulative noise levels are for the wind direction at which the maximum level is predicted to occur, which is either equal to or below the sum of the stated levels for each contributor.

**Table 8-9: Predicted Proposed Development, Existing / Proposed Wind Farms and Overall Cumulative Turbine Noise Levels at NSRs ($L_{A90,10min}$)**

| NSR | Contributor | Standardised Wind Speed ($ms^{-1}$) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 4 | 5 | 6 | 7 | 8 | 9 | ≥10 |
| High Crubasdale | Proposed Development | 24.2 | 29.2 | 33.6 | 34.3 | 34.3 | 34.3 | 34.3 |
| | Existing / Proposed | 22.6 | 24.4 | 26.3 | 27.3 | 27.7 | 27.9 | 28.0 |
| | Cumulative | 26.5 | 30.5 | 34.3 | 35.0 | 35.1 | 35.2 | 35.2 |
| North Crubasdale | Proposed Development | 23.4 | 28.4 | 32.7 | 33.4 | 33.4 | 33.4 | 33.4 |
| | Existing / Proposed | 21.5 | 23.2 | 25.0 | 26.0 | 26.5 | 26.7 | 26.8 |
| | Cumulative | 25.6 | 29.5 | 33.3 | 34.1 | 34.2 | 34.2 | 34.2 |
| South Beachmore | Proposed Development | 22.9 | 27.9 | 32.2 | 33.0 | 33.0 | 33.0 | 33.0 |
| | Existing / Proposed | 20.4 | 22.1 | 24.1 | 25.0 | 25.5 | 25.7 | 25.8 |
| | Cumulative | 24.9 | 28.9 | 32.8 | 33.6 | 33.7 | 33.7 | 33.7 |
| North Beachmore | Proposed Development | 24.5 | 29.5 | 33.8 | 34.5 | 34.5 | 34.5 | 34.5 |
| | Existing / Proposed | 20.5 | 22.1 | 24.0 | 25.0 | 25.5 | 25.7 | 25.8 |
| | Cumulative | 25.9 | 30.2 | 34.2 | 35.0 | 35.0 | 35.0 | 35.0 |
| Beachmanach | Proposed Development | 21.9 | 26.9 | 31.2 | 32.0 | 32.0 | 32.0 | 32.0 |
| | Existing / Proposed | 18.8 | 20.6 | 22.6 | 23.5 | 24.2 | 24.3 | 24.4 |
| | Cumulative | 23.6 | 27.8 | 31.8 | 32.6 | 32.7 | 32.7 | 32.7 |
| Beacharr | Proposed Development | 23.2 | 28.2 | 32.5 | 33.3 | 33.3 | 33.3 | 33.3 |
| | Existing / Proposed | 19.0 | 20.8 | 22.7 | 23.7 | 24.3 | 24.5 | 24.6 |
| | Cumulative | 24.6 | 28.9 | 32.9 | 33.8 | 33.8 | 33.8 | 33.9 |
| Various properties, Arnicle | Proposed Development | 18.2 | 23.2 | 27.5 | 28.2 | 28.2 | 28.2 | 28.2 |
| | Existing / Proposed | 33.2 | 35.9 | 38.5 | 39.5 | 40.0 | 40.0 | 40.0 |
| | Cumulative | 33.3 | 36.0 | 38.5 | 39.5 | 40.0 | 40.0 | 40.1 |

| NSR | Contributor | Standardised Wind Speed ($ms^{-1}$) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 4 | 5 | 6 | 7 | 8 | 9 | ≥10 |
| High Clachaig | Proposed Development | 29.7 | 34.7 | 39.0 | 39.7 | 39.7 | 39.7 | 39.7 |
| | Existing / Proposed | 23.6 | 25.4 | 27.3 | 28.4 | 28.9 | 29.0 | 29.1 |
| | Cumulative | 30.7 | 35.2 | 39.3 | 40.0 | 40.0 | 40.0 | 40.0 |
| Low Clachaig | Proposed Development | 25.5 | 30.5 | 34.8 | 35.5 | 35.5 | 35.5 | 35.5 |
| | Existing / Proposed | 23.4 | 25.2 | 27.2 | 28.2 | 28.7 | 28.8 | 28.9 |
| | Cumulative | 27.6 | 31.6 | 35.5 | 36.2 | 36.3 | 36.3 | 36.3 |
| Garvalt Building Plot | Proposed Development | 22.7 | 27.7 | 32.0 | 32.7 | 32.7 | 32.7 | 32.7 |
| | Existing / Proposed | 33.1 | 35.3 | 37.6 | 38.6 | 39.0 | 39.1 | 39.2 |
| | Cumulative | 33.2 | 35.4 | 37.7 | 38.7 | 39.1 | 39.2 | 39.3 |
| The Braids | Proposed Development | 25.8 | 30.8 | 35.1 | 36.0 | 36.0 | 36.0 | 36.0 |
| | Existing / Proposed | 20.1 | 23.0 | 25.6 | 26.8 | 27.6 | 27.9 | 28.1 |
| | Cumulative | 26.9 | 31.5 | 35.6 | 36.5 | 36.6 | 36.7 | 36.7 |

8.6.15 The predicted cumulative turbine noise levels do not exceed 35 dB $L_{A90,10min}$ (when rounded to the nearest decibel) for all wind speeds at High Crubasdale, North Crubasdale, South Beachmore, North Beachmore, Beachmenach and Beacharr.

8.6.16 At the collection of properties named 'Various properties, Arnicle' in this assessment, the predicted Proposed Development turbine noise levels are at least 10 dB below the existing / proposed levels. Therefore, effects on these NSRs are Not Significant and no further assessment is required.

8.6.17 Table 8-9 shows that the change in the worst-case cumulative turbine noise level at Garvalt Building Plot, owing to the Proposed Development noise, is 0.1 dB. This shows that, whilst the worst-case Proposed Development turbine noise levels are within 10 dB of the existing / proposed turbine noise levels, there is no wind direction under which this situation could actually occur. This NSR is due south of the Proposed Development turbines; but it is north of the closest existing wind farm (Blary Hill) and to the north-west of the next closest (Beinn an Tuirc). Therefore, the worst-case wind conditions are when the wind is from the south. Under these wind conditions, the Proposed Development noise levels at this NSR will be around 10 dB lower than shown in Table 8-9, and therefore will be at least 10 dB below the existing / proposed turbine noise levels. The Proposed Development noise level is predicted to be within 10 dB of the cumulative level under wind directions of between 245 degrees and 100 degrees from north. For this range of wind directions, the maximum predicted cumulative turbine noise level is 39.0 dB(A) (wind speed of 9 to 10 $ms^{-1}$), i.e. 0.3 dB lower than the predicted maximum shown in

Table 8-9. As the predicted cumulative level under this wind condition exceeds 35 dB(A), a detailed assessment is required at this NSR.

## *Operation – Detailed Assessment*

8.6.18 The results of the screening exercise indicate that at High Clachaig, Low Clachaig, Garvalt Building Plot and The Braids, a detailed assessment is required.

8.6.19 To perform a detailed assessment, it is necessary to define a limit from the baseline according to the procedure in ETSU-R-97. The procedures used to determine the baseline conditions at each NSR are discussed below.

8.6.20 The measured background noise levels at High Crubasdale were reprocessed to determine limits in reference to the Proposed Development hub height (HH – 132 m used as it constitutes a worst-case assessment) wind speed standardised to 10 m. These reprocessed background noise levels have been used to determine the cumulative noise level limits at High Clachaig and Low Clachaig.

8.6.21 As discussed in Paragraph 8.4.10, background noise levels at Garvalt Building Plot have been assumed to be the same as those measured at Upper Barr Farm as presented in the EIA for the proposed Blary Hill Wind Farm. Upper Barr Farm is further from Garvalt Building Plot than the High Crubasdale measurement location; however, the measured background noise levels at Upper Barr Farm were lower than those at High Crubasdale. Garvalt Building Plot is also surrounded by forestry on three sides; hence, it is likely that the levels of wind-induced noise in vegetation will be higher at this location than at Upper Barr Farm, which is much further from forested areas. These points, along with the discussion in Paragraph 8.4.10, demonstrate that the assessment considers the lowest possible background noise levels at this NSR, thereby ensuring that the worst-case possible impacts at Garvalt Building Plot have been assessed. The background noise levels in the Blary Hill wind farm EIA are referenced to a hub height (67 m) wind speed standardised to 10 m. These have been corrected to refer to the wind speed at a standardised 10 m from the Proposed Development hub height, based on the wind shear exponent identified from long-term wind speed measurements at multiple heights on the Proposed Development site.

8.6.22 The conditions of the 2019 planning consent for Clachaig Glen also includes noise level limits at The Braids, which were based on background noise levels measured at Culfuar as presented in the Environmental Statement for the proposed Killean Wind Farm. These background noise levels have been corrected to refer to the wind speed at a standardised 10 m from the Proposed Development hub height.

8.6.23 These background noise levels and noise level limits at each NSR taken forward for detailed assessment are summarised in Table 8-10.

**Table 8-10: Background Noise Levels and Cumulative Noise Limits at NSRs ($L_{A90,10min}$)**

| NSR | Time Period | Description | Standardised Wind Speed ($ms^{-1}$) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| High Clachaig and Low Clachaig | Day | Background – 2016 EIA | 34.5 | 36.9 | 38.0 | 38.4 | 38.5 | 39.1 | 40.6 | 43.7 | 49.0 |
| | | Background – derived from 132 m HH | 34.2 | 36.6 | 37.7 | 37.9 | 37.9 | 38.2 | 39.2 | 41.7 | 46.0 |
| | | Derived cumulative limit from 132 m HH | 40.0 | 41.6 | 42.7 | 42.9 | 42.9 | 43.2 | 44.2 | 46.7 | 51.0 |
| | Night | Background – 2016 EIA | 35.0 | 37.4 | 38.5 | 38.7 | 38.7 | 39 | 40.1 | 42.7 | 47.3 |
| | | Background – derived from 132 m HH | 34.9 | 37.2 | 38.0 | 38.1 | 37.9 | 38.0 | 39.1 | 41.7 | 46.4 |
| | | Derived cumulative limit from 132 m HH | 43.0 | 43.0 | 43.0 | 43.1 | 43.0 | 43.0 | 44.1 | 46.7 | 51.4 |
| Garvalt Building Plot | Day | Background – Blary Hill Wind Farm ES | 29.7 | 31.1 | 32.5 | 34.0 | 35.4 | 36.8 | 38.0 | 39.0 | 39.7 |
| | | Background – adjusted to refer to 132 m HH | 29.2 | 30.5 | 31.8 | 33.1 | 34.5 | 35.7 | 37.0 | 38.1 | 39.0 |
| | | Cumulative Limit | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.7 | 42.0 | 43.1 | 44.0 |
| | Night | Background – Blary Hill Wind Farm ES | 31.1 | 32.2 | 33.3 | 34.5 | 35.7 | 36.8 | 38.0 | 39.0 | 39.9 |
| | | Background – adjusted to refer to 132 m HH | 30.7 | 31.7 | 32.7 | 33.8 | 34.9 | 36.0 | 37.0 | 38.1 | 39.0 |
| | | Cumulative Limit | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.1 | 44.0 |
| The Braids | Day | Background – Killean ES | 28.8 | 30.3 | 32.0 | 33.7 | 35.8 | 38.1 | 40.8 | 44.0 | 47.7 |
| | | Background – adjusted to refer to 132 m HH | 28.4 | 29.8 | 31.3 | 32.9 | 34.6 | 36.7 | 38.9 | 41.6 | 44.6 |
| | | Cumulative Limit | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 41.7 | 43.9 | 46.6 | 49.6 |
| | Night | Background – Killean ES | 29.9 | 31.1 | 32.6 | 34.4 | 36.5 | 39.1 | 42.1 | 45.7 | 45.7 |
| | | Background – adjusted to refer to 132 m HH | 29.5 | 30.7 | 32.0 | 33.5 | 35.3 | 37.5 | 40.0 | 42.9 | 45.7 |
| | | Cumulative Limit | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 45.0 | 47.9 | 50.7 |

8.6.24 Table 8-11 provides a summary of the ETSU-R-97 derived cumulative noise limit criterion from the baseline measurements, and the predicted cumulative wind turbine $L_{A90,10min}$ noise levels at each of the NSRs. A positive value in the “Noise Limit met by” rows indicates compliance with the relevant criterion by the number of decibels indicated. The noise levels shown relate to the wind direction under which the maximum predicted cumulative level occurs.

**Table 8-11: Comparison of Predicted Cumulative Turbine Noise Levels and Noise Limits at NSRs ($L_{A90,10min}$)**

| NSR | Description | Wind Speed ($ms^{-1}$) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| High Clachaig | Predicted Cumulative Noise Level | 30.7 | 35.2 | 39.3 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 |
| | Daytime Cumulative Noise Limit | 40.0 | 41.6 | 42.7 | 42.9 | 42.9 | 43.2 | 44.2 | 46.7 | 51.0 |
| | **Daytime Cumulative Noise Limit met by*** | 9.3 | 6.4 | 3.4 | 2.9 | 2.9 | 3.2 | 4.2 | 6.7 | 11.0 |
| | Night Time Cumulative Noise Limit | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 44.1 | 46.7 | 51.4 |
| | **Night time Cumulative Noise Limit met by*** | 12.3 | 7.8 | 3.7 | 3.0 | 3.0 | 3.0 | 4.1 | 6.7 | 11.4 |
| Low Clachaig | Predicted Cumulative Noise Level | 27.6 | 31.6 | 35.5 | 36.2 | 36.3 | 36.3 | 36.3 | 36.3 | 36.3 |
| | Daytime Cumulative Noise Limit | 40.0 | 41.6 | 42.7 | 42.9 | 42.9 | 43.2 | 44.2 | 46.7 | 51.0 |
| | **Daytime Cumulative Noise Limit met by*** | 12.4 | 10.0 | 7.2 | 6.7 | 6.6 | 6.9 | 7.9 | 10.4 | 14.7 |
| | Night Time Cumulative Noise Limit | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 44.1 | 46.7 | 51.4 |
| | **Night time Cumulative Noise Limit met by*** | 15.4 | 11.4 | 7.5 | 6.8 | 6.7 | 6.7 | 7.8 | 10.4 | 15.1 |
| Garvalt Building Plot | Predicted Cumulative Noise Level | 33.2 | 35.4 | 37.7 | 38.7 | 39.1 | 39.2 | 39.3 | 39.3 | 39.3 |
| | Daytime Cumulative Noise Limit | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.7 | 42.0 | 43.1 | 44.0 |
| | **Daytime Noise Cumulative Limit met by*** | 6.8 | 4.6 | 2.3 | 1.3 | 0.9 | 1.5 | 2.7 | 3.8 | 4.7 |
| | Night Time Cumulative Noise Limit | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.1 | 44.0 |
| | **Night time Cumulative Noise Limit met by*** | 9.8 | 7.6 | 5.3 | 4.3 | 3.9 | 3.8 | 3.7 | 3.8 | 4.7 |
| The Braids | Predicted Cumulative Noise Level | 26.9 | 31.5 | 35.6 | 36.5 | 36.6 | 36.7 | 36.7 | 36.7 | 36.7 |
| | Daytime Cumulative Noise Limit | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 41.7 | 43.9 | 46.6 | 49.6 |
| | **Daytime Cumulative Noise Limit met by*** | 13.1 | 8.5 | 4.4 | 3.5 | 3.4 | 5.0 | 7.2 | 9.9 | 12.9 |
| | Night Time Cumulative Noise Limit | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 45.0 | 47.9 | 50.7 |
| | **Night time Cumulative Noise Limit met by*** | 16.1 | 11.5 | 7.4 | 6.5 | 6.4 | 6.3 | 8.3 | 11.3 | 14.0 |

** In these rows, a negative value indicates an exceedance of the limit, a positive value indicates compliance with the limit.*

8.6.25 At all NSRs, predicted cumulative turbine noise levels are below the applicable limits at all wind speeds, by at least 0.9 dB(A). Hence, cumulative impacts are anticipated to be Not Significant.

8.6.26 To determine the apportioned noise level limit, the predicted existing / proposed turbine noise levels have been subtracted from the identified cumulative limits presented in Table 8-10. The Proposed Development noise level limits have then been identified, which are either the apportioned limit or the ETSU-R-97 limit derived from the baseline measurements, with the daytime noise minimum fixed value set to 35 dB(A), whichever is the lower. For the night-time, the Proposed Development noise limit is equal to the apportioned limit. These Proposed Development noise limits are identified and compared with the predicted Proposed Development noise levels in Table 8-12.

**Table 8-12: Comparison of Predicted Proposed Development Turbine Noise Levels and Apportioned Noise Limits at NSRs ($L_{A90,10min}$)**

| NSR | Description | Wind Speed ($ms^{-1}$) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| High Clachaig | Predicted Proposed Development Turbine Noise Level | 29.7 | 34.7 | 39.0 | 39.7 | 39.7 | 39.7 | 39.7 | 39.7 | 39.7 |
| | Apportioned Daytime Noise Limit | 39.9 | 41.5 | 42.6 | 42.7 | 42.7 | 43.0 | 44.1 | 46.6 | 51.0 |
| | Proposed Development Daytime Noise Limit | 39.2 | 41.5 | 42.6 | 42.7 | 42.7 | 43.0 | 44.1 | 46.6 | 51.0 |
| | **Proposed Development Daytime Noise Limit met by*** | 9.5 | 6.8 | 3.5 | 3.1 | 3.1 | 3.4 | 4.4 | 7.0 | 11.3 |
| | Proposed Development Night-Time Noise Limit | 42.9 | 42.9 | 42.9 | 42.8 | 42.8 | 42.8 | 44.0 | 46.6 | 51.4 |
| | **Proposed Development Night time Noise Limit met by*** | 13.2 | 8.2 | 3.9 | 3.2 | 3.2 | 3.2 | 4.3 | 7.0 | 11.7 |
| Low Clachaig | Predicted Proposed Development Turbine Noise Level | 25.5 | 30.5 | 34.8 | 35.5 | 35.5 | 35.5 | 35.5 | 35.5 | 35.5 |
| | Apportioned Daytime Noise Limit | 39.9 | 41.5 | 42.6 | 42.8 | 42.7 | 43.0 | 44.1 | 46.6 | 51.0 |
| | Proposed Development Daytime Noise Limit | 39.2 | 41.5 | 42.6 | 42.8 | 42.7 | 43.0 | 44.1 | 46.6 | 51.0 |
| | **Proposed Development Daytime Noise Limit met by*** | 13.7 | 11.0 | 7.8 | 7.3 | 7.3 | 7.6 | 8.6 | 11.2 | 15.5 |
| | Proposed Development Night-Time Noise Limit | 43.0 | 42.9 | 42.9 | 42.9 | 42.8 | 42.8 | 44.0 | 46.6 | 51.4 |
| | **Proposed Development Night time Noise Limit met by*** | 17.5 | 12.4 | 8.1 | 7.4 | 7.4 | 7.4 | 8.5 | 11.2 | 15.9 |

| NSR | Description | Wind Speed ($ms^{-1}$) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| Garvalt Building Plot | Predicted Proposed Development Turbine Noise Level | 22.7 | 27.7 | 32.0 | 32.7 | 32.7 | 32.7 | 32.7 | 32.7 | 32.7 |
| | Apportioned Daytime Noise Limit | 39.0 | 38.2 | 36.3 | 34.5 | 33.1 | 35.7 | 38.8 | 40.8 | 42.2 |
| | Proposed Development Daytime Noise Limit | 35.0 | 35.5 | 36.3 | 34.5 | 33.1 | 35.7 | 38.8 | 40.8 | 42.2 |
| | **Proposed Development Daytime Noise Limit met by*** | 12.3 | 7.8 | 4.3 | 1.8 | 0.4 | 3.0 | 6.1 | 8.1 | 9.6 |
| | Proposed Development Night-Time Noise Limit | 42.5 | 42.2 | 41.5 | 41.1 | 40.8 | 40.7 | 40.7 | 40.8 | 42.2 |
| | **Proposed Development Night time Noise Limit met by*** | 19.8 | 14.5 | 9.5 | 8.4 | 8.1 | 8.0 | 8.0 | 8.1 | 9.6 |
| The Braids | Predicted Proposed Development Turbine Noise Level | 25.8 | 30.8 | 35.1 | 36.0 | 36.0 | 36.0 | 36.0 | 36.0 | 36.0 |
| | Apportioned Daytime Noise Limit | 40.0 | 39.9 | 39.8 | 39.8 | 39.7 | 41.5 | 43.8 | 46.5 | 49.6 |
| | Proposed Development Daytime Noise Limit | 35.0 | 35.0 | 36.3 | 37.9 | 39.6 | 41.5 | 43.8 | 46.5 | 49.6 |
| | **Proposed Development Daytime Noise Limit met by*** | 9.2 | 4.2 | 1.2 | 1.8 | 3.6 | 5.5 | 7.8 | 10.5 | 13.6 |
| | Proposed Development Night-Time Noise Limit | 43.0 | 43.0 | 42.9 | 42.9 | 42.9 | 42.9 | 44.9 | 47.9 | 50.7 |
| | **Proposed Development Night time Noise Limit met by*** | 17.1 | 12.2 | 7.8 | 6.9 | 6.9 | 6.9 | 8.9 | 11.9 | 14.7 |

** In these rows, a negative value indicates an exceedance of the limit, a positive value indicates compliance with the limit*

8.6.27 At all NSRs, predicted cumulative turbine noise levels are below the applicable limits at all wind speeds, by at least 0.4 dB(A). This demonstrates that the Proposed Development operational noise effects at these NSRs are predicted to be Not Significant.

## *Micro-siting*

8.6.28 Each turbine has a 50 m micro-siting tolerance. Turbine locations have been modelled as per the co-ordinates in Table 8-5 which are the same as those in Chapter 3 of this EIAR: Project Description. It is therefore possible that some turbines may move closer to some NSRs during the micro-siting process. The effect of moving all turbines is predicted to result in a +0.3 dB(A) change in the Proposed Development noise level at the closest NSR. With this increase, the predicted Proposed Development turbine noise levels would be below the applicable apportioned noise limits at all wind speeds, by at least 0.1 dB(A).

8.6.29 It is also anticipated that there will be a condition of planning consent imposed which prevents the siting of Proposed Development turbines less than 50 m from a watercourse. Hence, the buffer around Allt Achach Na Choirce (as shown in Figure 11.6; EIAR Volume 2b) will limit the Proposed Development's siting to move closer to these NSR, other than perhaps turbines T14 and T11.

8.6.30 The sensitivity test of a worst-case assessment of micro-siting of the turbines indicates that the operational noise effects would remain Not Significant at all NSRs.

## 8.7 Cumulative Effects

8.7.1 The developments which may result in cumulative effects are identified in Chapter 2 of this EIAR: Approach to EIA. Cumulative operational noise effects have been assessed according to the requirements of ETSU-R-97 as described in paragraphs 8.6.5 to 8.6.30 and have been found to be Not Significant.

8.7.2 The construction phase of the Proposed Development also has the potential to result in cumulative noise effects on NSRs. This may result if construction works take place simultaneously at both the Proposed Development and one or more of the developments listed in Chapter 2 of this EIAR which are not yet operational, although this is highly unlikely due to grid limitations. No other known developments have been identified as having the potential for cumulative construction noise effects on NSRs.

8.7.3 The precise scale of additional noise effects will be dependent on the exact works taking place at each development at any one time in relation to nearby NSRs. The use of Best Practicable Means (BPM) as detailed within any Construction Environment Management Plan (CEMP) prepared for the scheme, will reduce the Proposed Development noise effects as far as possible. Potential effects could be reduced through mitigation, such as appropriate timing of such works through consultation with ABC who would have oversight of the other developments. Based on the currently available information, the minimum distance between the Proposed Development and the identified cumulative developments which are not yet operational is 3.8 km (Narachan Wind Farm). At this distance, no NSRs are anticipated to experience inter-project cumulative construction noise effects.

## 8.8 Inter-relationship Effects

8.8.1 Noise and other impacts, such as air quality and landscape and visual, can also affect residential amenity. As the Proposed Development will inevitably result in impacts in a variety of areas which can influence residential amenity, inter-relationship effects may occur. Air quality issues were scoped out of this EIA as per the EIA Scoping Report and responding EIA Scoping Opinion (Appendices 5.1 and 5.2 (EIAR Volume 3) respectively), whilst landscape and visual effects are considered in Chapter 7 of this EIAR. The effect of construction noise on ornithological receptors is also referenced in Chapter 10 of this EIAR: Ornithology.

# 8.9 Mitigation and Monitoring

## *Construction*

8.9.1 The best available construction methods shall be employed at all times, having regards to the principles of BPM to minimise noise and vibration impacts during the construction of the Proposed Development. Specific mitigation measures which are considered BPM are provided in Section 8.5.

8.9.2 With regard to construction activities, agreement on operational hours and working methods will be sought from ABC to minimise noise effects at NSRs. Working hours will be subject to agreement between the Contractor and ABC and regulated via the CEMP and by planning conditions. In addition, adherence to working hours will be contractually implemented between the Applicant and the Contractor. This assessment identifies that, with implementation of BPM, no significant construction noise or vibration effects are anticipated; hence, no further mitigation or monitoring measures are required.

## *Operation*

8.9.3 Noise effects as a result of the operational Proposed Development have been identified as Not Significant. Hence, no noise mitigation measures are required.

8.9.4 Requirements for noise monitoring in the event of a complaint arising will be included as a condition of planning consent. It is assumed that this will be worded similarly to the equivalent condition for the Consented Development, which is based on the example condition included in Annex B of the IOA GPG. The example condition includes a requirement that, in the event a complaint arises, the compliance monitoring methodology is agreed with the Local Authority prior to performing the measurements. The monitoring method would depend on the nature and location of the complaint. Compliance monitoring, if required, would be performed in accordance with the recommendations of the IOA GPG 'Supplementary Guidance Note 5: Post Completion Measurements' (IOA 2014).

# 8.10 Summary of Effects

8.10.1 The assessment undertaken identified that no significant effects are anticipated; hence, no specific mitigation measures are proposed. As a result, residual noise and vibration effects are Not Significant.

8.10.2 A summary of the significance of effects from the various noise and vibration effects contained within this chapter is provided in Table 8-13.

**Table 8-13 Summary of Effects**

| Receptor | Description of Potential Effect | Effect | Additional Mitigation | Residual Effects | Significance |
|---|---|---|---|---|---|
| Occupants of Residential Dwellings | Disturbance / annoyance due to temporary elevated noise or vibration | With implementation of BPM, effects, whilst adverse, are localised, | Not required | Not applicable | Localised, temporary, Not Significant |

| Receptor | Description of Potential Effect | Effect | Additional Mitigation | Residual Effects | Significance |
|---|---|---|---|---|---|
| | levels from proposed construction works | temporary and Not Significant | | | |
| | Disturbance / annoyance due to operational turbine noise levels | Identified effects are localised, permanent (during the operational life of the Proposed Development) and Not Significant | Not required | Not applicable | Localised, permanent (during the operational life of the Proposed Development), Not Significant |

# 8.11 References


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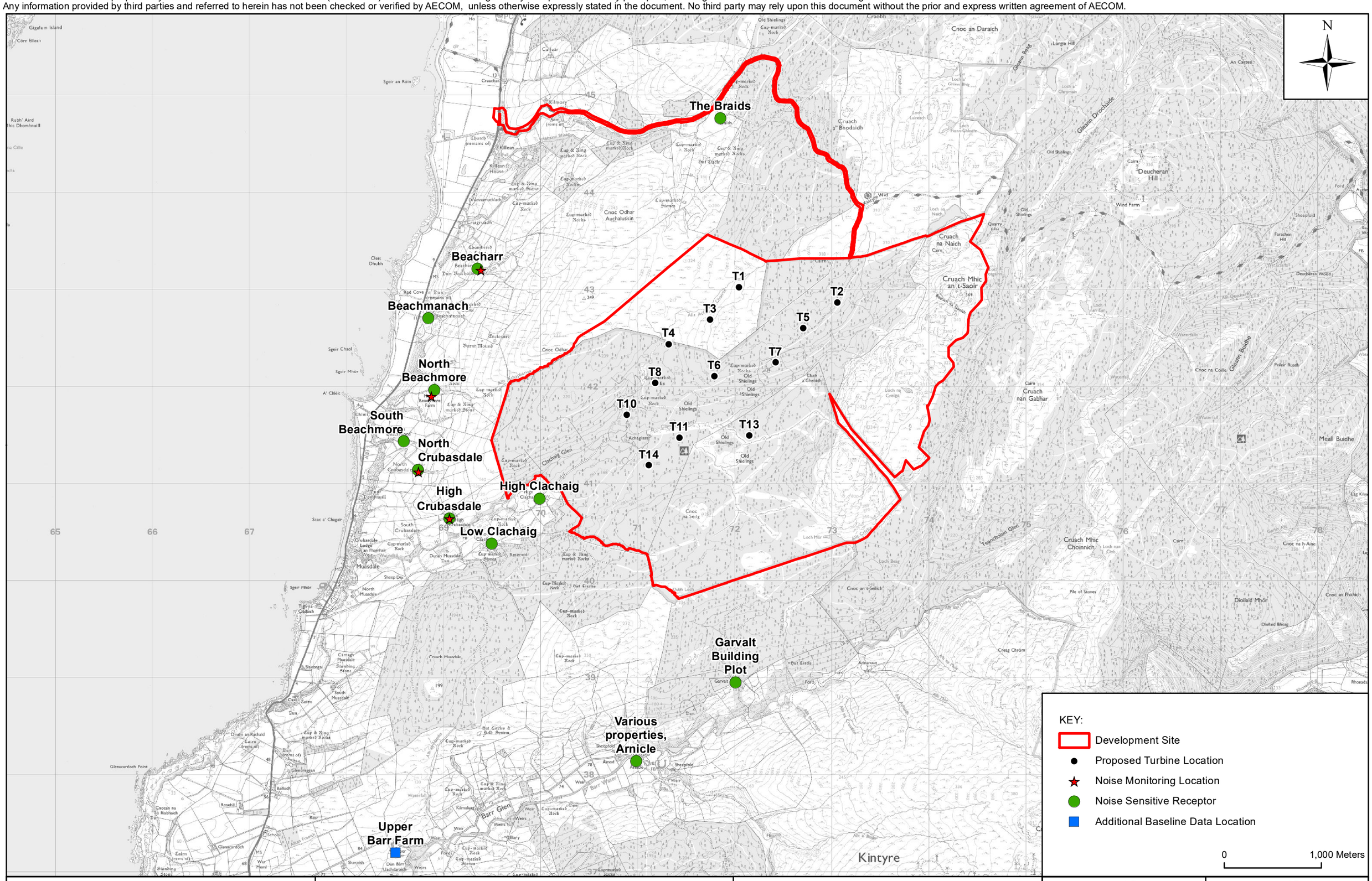
RWE

# Clachaig Glen Wind Farm

## Environmental Impact Assessment Report
## Volume 2b
## EIAR Figures

# Figure: 8.1




| | | | |
|---|---|---|---|
| Client: RWE | Title: FIGURE 8.1 NOISE MONITORING LOCATIONS AND SENSITIVE RECEPTORS | AECOM One Trinity Gardens Quayside Newcastle, NE1 2HF | Tel +44 (0) 191 224 6500 Fax +44 (0) 191 224 6599 www.aecom.com |
| Project: CLACHAIG GLEN WIND FARM ENVIRONMENTAL IMPACT ASSESSMENT | | | |

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|---|---|---|---|
| Drawn: | LC | Checked: | AR |
| Verified: | TB | Approved: | SW |
| Date: | JANUARY 2022 | Scale at A3: | 1:35,000 |
| Drawing Number: | CG_220106_EIA_8.1_v3 | | A3 |

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