Illaunbaun Wind Farm - Environmental Impact Assessment Report

Chapter 13: Noise and Vibration

ACRONYMS

AA	Appropriate Assessment
ABP	An Bord Pleanála
AM	Amplitude Modulation
BS	British Standard
BSI	British Standards Institution
DHPLG	Department of Housing, Planning and Local Government
DoEHLG	Department of Environment, Heritage and Local Government
EIA	Environmental Impact Assessment
EPA	Environmental Protection Authority
ETSU	Energy Technology Support Unit
IOA	Institute of Acoustics
ISO	International Standards Organisation
ITM	Irish Transverse Mercator
LiDAR	Light Detection and Ranging
LWA	Sound Power Level
MIT	Massachusetts Institute of Technology
MW	Megawatt
NAM	Normal Amplitude Modulation
NML	Noise Monitoring Location
NRA	National Roads Authority
NRA	National Roads Authority
OAM	Other Amplitude Modulation
STE	Serrated Trailing Edge
UK	United Kingdom
VTT	Technical Research Centre of Finland
WHO	World Health Organisation

GLOSSARY OF TERMS

Ambient	The ambient noise level is the noise level measured in the absence of the intrusive noise or the noise requiring control. Ambient noise levels are frequently measured to determine the situation prior to the addition of a new noise source.
dB	Decibel. The unit of sound level.
dBA	A-weighted decibel. The A-weighting approximates the response of the human ear.
Frequency	Sound can occur over a range of frequencies extending from the very low, such as the rumble of thunder, up to the very high such as the crash of cymbals. Sound is generally described over the frequency range from 63Hz to 4000Hz (4kHz). This is roughly equal to the range of frequencies on a piano.
Octave Band	Sound, which can occur over a range of frequencies, may be divided into octave bands for analysis. The audible frequency range is generally divided into 7 octave bands. The octave band frequencies are 63Hz, 125Hz, 250Hz, 1kHz, 2kHz and 4kHz.
$L_{Aeq(t)}$	The equivalent continuous (time-averaged) A-weighted sound level. This is commonly referred to as the average noise level. The suffix "t" represents the time period to which the noise level relates, e.g. (8 h) would represent a period of 8 hours, (15 min) would represent a period of 15 minutes and (2200-0700) would represent a measurement time between 10 pm and 7 am.
L_{A90}	The noise level exceeded for 90% of the measurement period. This is commonly referred to as the background noise level.

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13.1 INTRODUCTION

This chapter of the Environmental Impact Assessment (EIA) Report presents the assessment of the likely significant effects (as per the "EIA Regulations") of the Proposed Development on Noise and Vibration arising from the construction and operation of the Proposed Development, both alone and cumulatively with other plans and projects, and was determined following the issue of the *Illaunbaun Wind Farm - Environmental Impact Assessment Scoping Report* to stakeholders described in Chapter 6: Project Scoping and Consultation.

The assessment presented is informed by the following technical chapters/appendices:

- Chapter 5: Project Description

The primary purpose of this report is to describe the noise impact on the receiving environment and analyse any potential development related effects on it.

This chapter comprises of the following elements:

- Summary of relevant policy and guidance;
- Data sources used to characterise the Study Area;
- Summary of consultations with stakeholders;
- Methodology followed in assessing the impacts of the Proposed Development (such as information of the Study Area and the approach taken in assessing the potential impacts);
- Review of baseline conditions;
- Assessment of likely effects arising from the construction and operation of the Proposed Development;
- Identification of further mitigation measures and/or monitoring requirements (if any) in respect of any significant effects (following the 'mitigation hierarchy' of avoidance, minimisation, restoration and offsets in consecutive order); and
- Summary of residual impact assessment determinations in the case of any additional mitigation measures identified during this process.

13.2 GUIDANCE

13.2.1 CONSTRUCTION AND DECOMMISSIONING PHASE GUIDANCE

There is no published national guidance relating to the maximum permissible noise level that may be generated during the construction or decommissioning phase of a project. In the absence of national guidance, the noise assessment is carried out in accordance with the guidance contained in the following documents:

- Guidelines for the Treatment of Noise and Vibration in National Road Schemes (NRA, 2014)

- BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites (BSI, 2014)

13.2.1.1 GUIDELINES FOR THE TREATMENT OF NOISE AND VIBRATION IN NATIONAL ROAD SCHEMES (NRA, 2014)

The NRA (2014) Guidelines provide noise limits (Table 13-1) which are acceptable and states, where it is deemed necessary to predict noise levels associated with construction noise, that this should be done in accordance with BS 5228-1:2009+A1:2014.

13.2.1.2 BS 5228-1:2009+A1:2014 CODE OF PRACTICE FOR NOISE AND VIBRATION CONTROL ON CONSTRUCTION AND OPEN SITES (BSI, 2014)

Part 1 of BS 5228-1:2009+A1:2014 deals with noise prediction and control. It recommends procedures for noise control in respect of construction and demolition operations. The standard stresses the importance of community relations, and states that early establishment and maintenance of the relations throughout the carrying out of site operations will go some way towards allaying people's concerns. Some of the more relevant factors that are likely to affect the acceptability of construction noise are:

- The attitude of local residents to the development
- Site location relevant to noise sensitive receptors
- Duration of site operations
- Hours of work
- The characteristics of the noise produced

Recommendations are made regarding the supervision, planning, preparation and execution of works, emphasising the need to consider noise at every stage of the activity. Measures to control noise are described, including control of noise at source by, e.g.:

- Substitution of plant or activities for less noisy ones
- Modification of plant or equipment by less noisy ones
- Using noise control enclosures
- Siting of equipment and its method of use
- Maintenance of equipment
- And controlling the spread of noise by increasing distance between plant and receptors, or by the provision of acoustic screening

Example criteria for the assessment of the significance of noise effects are also given, although these are not mandatory.

Methods of calculating the levels of noise resulting from construction and demolition activities are provided, as are updated source levels for various plant, equipment and construction activities.

13.2.2 OPERATIONAL PHASE GUIDANCE

The noise assessment is carried out in accordance with the guidance contained in the following documents:

- Wind Energy Development Guidelines, Guidelines for Planning Authorities (DoEHLG, 2006) (the 2006 Guidelines);
- Draft Revised Wind Energy Development Guidelines (DHPLG, 2019);
- Recent An Bord Pleanála Decisions on Noise Limits;
- World Health Organisation (WHO) Environmental Noise Guidelines for European Region (WHO, 2018);
- The Assessment and Rating of Noise from Wind Farms (ETSU-R-97) (ETSU, 1996);
- A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise, including Supplementary Guidance Note 4: Wind Shear' (Institute of Acoustics, 2013);
- ISO 1996-1:2016 Acoustics – Description and Measurement of Environmental Noise - Part 1: Basic Quantities and Procedures (ISO, 2016); and
- Guidelines for the Treatment of Noise and Vibration in National Road Schemes (NRA, 2014)

13.2.2.1 WIND ENERGY DEVELOPMENT GUIDELINES (DOEHLG, 2006)

The following are a number of key extracts from the 2006 Guidelines in relation to noise impact:

<u>General Noise Impact</u>

> "Noise impact should be assessed by reference to the nature and character of noise sensitive locations."
>
> "Separate noise limits should apply for day-time and for night-time"
>
> "Noise limits should be applied to external locations and should reflect the variation in both turbine source noise and background noise with wind speed."

<u>Measurement Units</u>

> "The descriptor [$L_{A90\ 10min}$] which allows reliable measurements to be made without corruption from relatively loud transitory noise events from other sources, should be used for assessing both wind energy development noise and background noise."

<u>Specific Noise Limits</u>

> "Noise limits should be applied to external locations and should reflect the variation in both turbine source noise and background noise with wind speed."

> "In general, a lower fixed limit of 45 dB(A) or a maximum increase of 5 dB(A) above background noise at nearby noise sensitive locations is considered appropriate to provide protection to wind energy development neighbours.
>
> However, in very quiet areas, the use of the margin of 5 dB(A) above the background noise at nearby noise sensitive properties is not necessary to offer a reasonable degree of protection and may unduly restrict wind energy developments. Instead in low noise environments where background noise is less than 30 dB(A), it is recommended that the daytime level of $L_{A90\ 10min}$ of the wind energy development noise should be limited to an absolute level within the range 35-40 dB(A)".
>
> "During the night the protection of external amenity becomes less important and the emphasis should be on preventing sleep disturbance. A fixed limit of 43 dB(A) will protect sleep inside properties during the night"

The 2006 Guidelines do not specify daytime or night-time hours. However, it is considered good practice to follow the framework given in ETSU-R-97 and the Institute of Acoustics (IOA) Good Practice Guide where daytime and night-time hours are specified. The limits are based on the prevailing background noise level for 'quiet daytime' periods, defined in ETSU-R-97 as:

- Quiet waking hours or quiet day-time periods are defined as:
  - All evenings from 18:00 to 23:00 hrs
  - Saturday afternoon from 13:00 to 18.00 hrs and all-day Sunday 07:00 to 18:00 hrs
- Night-time is defined as 23:00 to 07:00 hrs

13.2.2.2 AN BORD PLEANÁLA (ABP, 2022)

A recent decision by An Bord Pleanála (ABP-309306-21, dated 26th September 2022 (ABP, 2022)) gave limits in accordance with the 2006 Guidelines and were as follows:

"(a) between 7am and 11pm:

(i) the greater of 5 dB(A) $L_{90,10min}$ above background noise levels, or 45 dB(A) $L_{90,10min}$, at wind speeds of 5m/s (metres per second) or greater,

(ii) 40 dB(A) $L_{90,10min}$, at all other wind speeds.

(b) 43 dB(A) $L_{90,10min}$ at all other times "

where wind speeds are standardised at 10m (metres) above ground level."

13.2.2.3 WORLD HEALTH ORGANISATION GUIDELINES (WHO, 2018)

The most recent WHO 2018 Guidelines *Environmental Noise Guidelines for the European Region* gives a recommendation limit of 45 dB L_{den} (day, evening, night) which is based on low quality evidence. This is an annual average noise level, based on wind speed and direction in the vicinity of the site with no specific limits for night.

13.2.2.4 DRAFT REVISED WIND ENERGY DEVELOPMENT GUIDELINES 2019 (DHPLG, 2019)

There have been a number of draft guidelines published by the Department of Housing, Local Government and Heritage over the years with the latest one being in December 2019. The Draft Revised Wind Energy Development Guidelines, currently in draft format, are subject to significant public and stakeholder consultation and liable to change, in line with best practice.

A tender has been issued by the Department of Environment, Climate and Communications to review and re-draft the Wind Energy Development Guidelines. This process has yet to be completed.

This assessment is based on the current guidance outlined in Section 13.2.2.1 (the 2006 Guidelines).

13.3 ASSESSMENT METHODOLOGY

13.3.1 STATEMENT OF COMPETENCE

Irwin Carr Consulting is based in County Down. The company has a proven track record in noise and vibration impact assessments throughout the UK and Ireland, with extensive knowledge of the issues in relation to noise from wind energy developments.

Dr Chris Jordan and Mark Burke undertook the noise monitoring and modelling in this assessment, and both contributed to the report.

Mark is a Consultant in Irwin Carr Consulting, primarily responsible for environmental noise and noise monitoring. He has experience working in both the public and private sectors having previously obtained a BSc (Hons) Degree in Environmental Health.

Chris is a Technical Director in Irwin Carr Consulting, primarily responsible for environmental noise and noise modelling. He has over 20 years' experience working in both the public and private sectors, having previously obtained a BSc (Hons) Degree in Environmental Health, a Post-Graduate Diploma in Acoustics and a PhD in the field of acoustics. Chris has been responsible for undertaking and reviewing noise impact assessments on numerous large scale wind farms throughout the UK and Ireland.

13.3.2 CONSTRUCTION AND DECOMMISSIONING PHASE ASSESSMENT METHODOLOGY

The NRA (2014) Guidelines for construction and decommissioning noise which are considered acceptable are presented in Table 13-1.

Table 13-1: NRA Guidelines – Acceptable noise level limits

Day/Times	Guideline Limits
Monday to Friday 07:00 – 19:00 hrs 19:00 – 22:00 hrs	70 dB $L_{Aeq(1hr)}$ and L_{Amax} 80 dB *60 dB $L_{Aeq(1hr)}$ and L_{Amax} 65 dB
Saturday 08:00 – 16:30 hrs	65 dB $L_{Aeq(1hr)}$ and L_{Amax} 75 dB

Day/Times	Guideline Limits
Sunday and Bank Holidays 08:00 – 16:00 hrs	*60 dB $L_{Aeq(1hr)}$ and L_{Amax} 65 dB

* Construction at these times, other than required by an emergency works, will normally require explicit permission from the relevant local authority.

<u>Construction Times for The Proposed Development</u>

The construction times for this Proposed Development are:

Monday to Friday: 07.00 to 19.00 hrs, Saturday 08.00 to 13.00 hrs with no work on Sunday, or Bank Holidays.

Part 1 of BS 5228-1:2009+A1:2014 provides several example criteria for the assessment of the significance of noise effects from construction activities. Noise levels generated by construction activities are considered significant if:

- The L_{eq}, period level of construction noise exceeds lower threshold values of 65 dB(A) during daytime, 55 dB(A) during evenings and weekends or 45 dB(A) at night.
- The total noise level (pre-construction ambient noise plus construction noise) exceeds the pre-construction noise level by 5 dB(A) or more for a period of one month or more.

Construction noise from wind farm development or decommissioning is not considered an intensive activity. The main noise sources will be associated with the construction of the Turbine Foundations and Turbine Hardstands. Lesser noise source activity will be construction of Site Access Tracks, temporary construction compound, turbine erection and the construction of a 38 kV (kilovolts) electrical substation.

Decommissioning will likely involve the remediation of Turbine Hardstand Areas and Turbine Foundations, where they will be covered in topsoil and allowed to revegetate. Site Access Tracks will likely be left *in-situ* for use by the landowners. Underground Internal Wind Farm Cables will be removed, and the ducting left *in-situ*. Therefore, the decommissioning phase is likely to be shorter and less intrusive than the construction phase with the resultant effects being less.

All workers associated with the Proposed Development will be subject to the Health and Safety Authority Guidance which states that for noise exposure levels likely to exceed 80 dB(A) (expressed as $L_{ep,d}$ 8 hour dB(A)) there is the potential of risk of damage to hearing. All workers on site will be given guidance on how to comply with the 'First Action Level'.

13.3.2.1 EVALUATION OF POTENTIAL CONSTRUCTION AND DECOMMISSIONING PHASE EFFECTS

The potential impacts of construction are evaluated by comparing the predicted noise levels against the guideline limits given in Table 13-1 based on the NRA guidelines (NRA, 2014), and sample criteria in Part 1 of BS 5228-1:2009+A1:2014 (BSI, 2014) in Section 11.3.1.

13.3.3 OPERATIONAL PHASE ASSESSMENT METHODOLOGY

13.3.3.1 ACOUSTIC TERMINOLOGY

Sound is simply the pressure oscillations that reach our ears. These are characterised by their amplitude, measured in decibels (dB), and their frequency, measured in Hertz (Hz). Noise is unwanted or undesirable sound, it does not accumulate in the environment, is transitory, fluctuates, and is normally localised. Environmental noise is normally assessed in terms of A-weighted decibels, either depicted as dBA or dB(A), when the 'A weighted' filter in the measuring device elicits a response which provides a good correlation with the human ear. The criteria for environmental noise control are of annoyance or nuisance rather than damage. In general, a noise level is liable to provoke a complaint whenever its level exceeds the ambient noise by a certain margin, or when it attains an absolute level. A change in noise level of 3 dB(A) is 'barely perceptible', while an increase in noise level of 10 dB(A) is perceived as a twofold increase in loudness. A noise level exceeding 85 dB(A) gives a significant risk of hearing damage. Construction and industrial noise sources are normally assessed and expressed using equivalent continuous levels, L_{Aeq}. Wind turbine source noise is generally expressed in L_{eq} dB(A) and in sound power levels (L_{WA} dB). Sound power level is a measure of the noise source while sound pressure level is a measurement taken at a distance from the noise source carried out with a noise meter.

Operational wind turbine noise is assessed using the L_{A90} descriptor, which allows reliable measurements to be made without corruption from relatively loud transitory noise events from other sources. The L_{A90} should be used for assessing both the wind energy development noise and background noise as stated in the 2006 and 2019 (draft) Irish wind energy development guidelines. As discussed in ETSU-R-97, the L_{A90} is 1.5-2.5 dB(A) less than the L_{Aeq} measured over the same period. In this assessment, the difference between L_{Aeq} and L_{A90} is given as 2 dB(A) which is best practice, and the value most commonly applied in wind farm assessments in Ireland. Wind turbine noise levels are given as sound power levels (L_{WA}) dB at integer wind speeds up to maximum L_{WA} levels. Table 13-2 presents a comparison of noise levels in our everyday environment.

Table 13-2: Comparison of sound pressure level in our environment

Source/Activity	Indicative noise level dB(A)
Threshold of hearing	0
Rural night-time background	20-50
Quiet bedroom	35
Wind farm at 350 m	35-45
Busy road at 5 km	35-45
Car at 65 km/hr at 100 m	55
Busy general office	60
Conversation	60
Truck at 50 km/hr at 100 m	65

Source/Activity	Indicative noise level dB(A)
Inside a typical shopping centre	70-75
Inside a modern car at around 90 km/hr	75-80
Passenger cabin of jet aircraft	85
City Traffic	90
Pneumatic drill at 7 m	95
Jet aircraft at 250 m	105
Threshold of pain	140

13.3.3.2 DESK STUDY

The locations for noise monitoring were selected by inspection of site layout maps and by identifying the nearest receptors surrounding the proposed wind farm. The Noise Study Area has been defined such that the predicted results have been included for all residential receptors within 2 km (kilometres) of the wind farm.

The four noise monitoring locations are considered representative of the local noise environment.

13.3.3.3 ACQUISITION AND ANALYSIS OF BACKGROUND DATA

The 2006 Guidelines (DoEHLG, 2006), ETSU-R-97 (ETSU, 1996) and the IOA Good Practice Guide (IOA, 2013) recommend the measurement and use of wind speed data, against which background noise measurements are correlated. The IOA Good Practice Guide Supplementary Guidance Note 4 (exert presented in Technical Appendix A13-02, (IOA, 2013)) gives the methodology to account for wind shear, calculation to hub height and to standardise 10 m height wind speed.

A LiDAR (light detection and ranging) positioned within the site during the noise survey was used for wind data measurements over 10-minute intervals.

The 91.5 m hub height wind speed was then standardised to 10 m height wind speed with the wind speed plotted against the 10-minute background noise data to derive a best fit polynomial curve.

13.3.3.4 PREDICTION OF WIND TURBINE NOISE LEVELS

The predicted noise levels are based on the methodology given in the IOA Good Practice Guide (IOA, 2013). Noise level calculations are based on ISO 9613-2:2014 (IOS, 2024) which provides a prediction of noise levels likely to occur under worst-case down-wind conditions.

There are numerous models for predicting noise from a point source and some of these models are specifically used for the prediction of noise from wind farms. SoundPLAN software package was used to calculate the noise level at the receptors. The propagation model calculates the predicted sound pressure levels by taking the source sound power level for each turbine in their respective octave bands and subtracting a number of attenuation factors according to the following formula:

$$\text{Predicted Octave Band Noise level} = LW + D - (Ageo + Aatm + Agr + Abar + Amis)$$

A_{geo} -Geometric Spreading

Geometric (spherical) spreading from a simple free-field point source results in attenuation over distance according to:

$$Lp = Lw - (20 \log R + 11)$$

Where:

L_p = sound pressure level

L_w = sound power level

R = distance from the turbine to receiver

D – Directivity Factor

The directivity factor allows for adjustment where the sound radiated in the direction of the receptor is higher than that for which the sound power level is specified. In this case, the sound power levels are predicted as worst-case propagation conditions, i.e. all receptors are assumed to be in downwind conditions.

A_{gr} - Ground Effects

Ground effect is the result of sound reflected by the ground interfering with the sound propagating directly from the turbine to receiver. The prediction of ground effects is complex and depends on the source height, receiver height, propagation height between the source and receiver and the intervening ground conditions.

Ground conditions are described according to a variable defined as G, which varies between 0 for hard ground and 1 for soft ground. Although in reality the ground is predominately porous, it has been modelled as mixed 50% hard and 50% porous corresponding to a ground absorption coefficient of 0.5. Predictions have been carried out using a source height corresponding to the proposed height of the turbine nacelle, a receiver height of 4 m and an assumed ground factor of G=0.5 as recommended in the IOA Good Practice Guide (IOA, 2013).

A_{bar} - Barrier Attenuation

The effect of a barrier (including a natural barrier) between a noise source and receptor is that noise will be reduced according to the path difference (difference between the direct distance between source to receptor and distance between source and receptor over the barrier). The reduction is relative to the frequency spectrum of the sound and may be predicted according to the method given in ISO 9613-2:2024. In practice, barriers can become less effective in downwind conditions. A barrier can be very effective when it lies within a few metres of the receptor. In the prediction model, zero attenuation is given for barrier effects, which is a worst-case scenario setting.

A_{atm} - Atmospheric Absorption

Sound emergence through the atmosphere is attenuated by conversion of sound energy to heat. This energy is dependent on the temperature and relative humidity of the air, but only weakly on ambient pressure through which the sound is travelling and is frequency dependent, with increasing attenuation towards higher frequencies. The attenuation by atmospheric absorption A_{atm} in decibels during propagation through distance in metres is given by:

$$A_{atm} = d \times \alpha,$$

α = atmospheric absorption coefficient in dB/m

d = distance from turbine

Values of α from ISO 9613 Part 1, corresponding to a temperature of 100°C and a relative humidity of 70% has been used for these predictions and are presented in Table 13-3 below. These values are recommended in the IOA Good Practice Guide (IOA, 2013).

Table 13-3: Atmospheric Absorption Coefficient

Octave Band Centre Frequency (Hz)	Atmospheric Absorption Coefficient (dB/m)
63	0.0001
125	0.0004
250	0.001
500	0.0019
1000	0.0037
2000	0.0097
4000	0.0328
8000	0.117

A_{misc} – Miscellaneous Other Effects

ISO 9613-2:2024 includes effects of propagation through foliage, industrial plants and housing as additional attenuation effects. These have not been included here and any such effects are unlikely to significantly reduce noise levels below those predicted.

The 9613-2:2024 standard calculates under downwind propagation conditions and therefore predicts the average downwind sound pressure level at each dwelling. The model assumes that the wind is directly downwind from each turbine to each dwelling. The prediction model is calculated as a worst-case scenario.

The predicted octaves from each of the turbines are summed to give the predicted noise level expressed as L_{Aeq} dB.

No allowance has been made for the character of noise emitted by the turbines, however in general the emissions from wind turbines are broadband in nature. In the unlikely event of a turbine exhibiting clearly tonal components at any receptor, the turbine would be turned down or stopped until such tonality is ameliorated. A guarantee will be required in the procurement of the turbines to be used onsite, stating that there should be no clearly tonal or impulsive components audible at any noise sensitive receptor location.

The predicted noise levels $L_{Aeq,10min}$ are converted to the required $L_{A90,10min}$ by subtracting 2 dB(A).

13.3.3.5 EVALUATION OF POTENTIAL OPERATIONAL PHASE EFFECTS

The potential operational phase impacts are evaluated by comparing the predicted noise levels against the day and night-time noise limits given in Section 13.4.4. The predicted noise levels are calculated according to the IOA Good Practice Guide as detailed in Section 13.3.3 and potential impacts are assessed against the noise limits at the nearest receptors.

13.3.4 CONSULTATION

Consultation was carried out with landowners who were familiar with the site. Access to the nearest dwellings to undertake noise level monitoring was carried out with permission from the householders / landowners.

13.3.5 DATA SOURCES

For EIA purposes one candidate turbine, the Vestas V117-4.2 megawatts (MW) operating in unrestricted mode 0, with serrated trailing edge (STE), has been selected with a hub height of 91.5 m (tip height 150 m) for the EIA technical assessment. The tip of the blades with STE (serrated trailing edge) lowers noise emissions without reducing energy output, and the selected turbine will have STE as standard. The worst-case sound power level at each wind speed from 4 m/s to 12 m/s was input into the noise model.

A copy of the manufacturers performance specification for the turbines used in the assessment when operating in unrestricted mode 0 with STE is presented in the Technical Appendix A13-07.

The prediction modelling is based on the turbines operating at full power and all turbines fitted with STE which reduces noise emissions of each turbine. The IOA Good Practice Guide (IOA, 2013) recommends that an uncertainty value is required to be added to the turbine emission data prior to modelling. Depending on the type of manufacturer's data, the uncertainty value will range from 0 to 2 dBA. However, as no uncertainty is stated in the manufacturer's data sheet, a maximum uncertainty value of 2 dBA has been applied in line with the IOA Good Practice Guide (IOA, 2013). Table 13-4 presents the noise emission data for the turbine up to maximum sound power output at varying hub height wind speed at 91.5 m hub height. Table 13-5 presents the maximum sound power output at varying wind speed (presented at standardised 10 m height) for the turbine with a hub height of 91.5 m. A value of 2 dBA is subtracted from the present sound power levels to account for conversion from L_{Aeq} to L_{A90}, in line with best practice.

Table 13-4: Hub Height Noise Emission Data, Vestas V117 – 4.2MW, STE, 91.5 m hub height

Hub Height Wind Speed ms^{-1}	Sound Power Level dBA (without uncertainty)
4	92.8
5	94.0
6	97.0
7	100.0
8	102.8
9	105.1
10	106.0
11	106.0
12	106.0

Table 13-5: Standardised 10 m Height Noise Emission Data, Vestas V117 – 4.2 MW, STE, 91.5 m hub height

Standardised 10 m Height Wind Speed ms^{-1}	Sound Power Level dBA (without uncertainty)
4	96.2
5	100.5
6	103.8
7	105.7
8	106.0
9	106.0
10	106.0
11	106.0
12	106.0

The octave band values are given in Table 13-6 for the V117 – 4.2 MW as input into the prediction model.

Table 13-6: Octave Band Spectrum of Vestas V117 – 4.2 MW, STE, 91.5 m – Rated power

Octave Band (Hz)	Sound Power Level dBA (without uncertainty)
31.5	76.5
63	86.3
125	93.5
250	98.3
500	100.5

Octave Band (Hz)	Sound Power Level dBA (without uncertainty)
1000	100.4
2000	97.7
4000	92.6
8000	84.9
L_{WA}	106.0

13.3.6 LIMITATIONS OF ASSESSMENT

The Institute of Acoustics released a *Statement in Respect of Wind Farm Noise Assessment* dated December 2024 (IOA, 2024). The relevant sections relating to Amplitude Modulation, Infrasound, Low Frequency Noise and Vibration are replicated below:

> "Amplitude Modulation
>
> 'Amplitude Modulation' (AM) is a feature of the character of wind farm noise caused by the cyclical nature of the blades. An understanding of the causal mechanisms has been gained in recent years, along with control methods to help assist with sites where AM can lead to complaints. An IOA endorsed metric was published in 2016 and can be found at: [http://ioa.org.uk/publications/wind-turbine-noise]. A sample planning condition was proposed by IOA members which was published in the IOA bulletin (November-December 2017 issue).
>
> Infrasound
>
> The IOA is aware that there is some information presented at planning inquiries suggesting the potential for physiological health effects from infrasound from wind turbines. It is current advice to members that there is no need to assess infrasound as part of the noise impact assessment process, as the absolute levels are well below those reported to trigger physiological health effects based on peer reviewed research to date.
>
> Low Frequency Noise
>
> The IOA is aware that there is some information presented at planning inquiries suggesting the potential for physiological health effects from low frequency noise from wind turbines. It is current advice to members that there is no need to assess low frequency noise as part of the noise impact assessment process, as the absolute levels, whilst potentially audible at typical receptor distances, are well below those reported to trigger physiological health effects based on peer reviewed research to date.
>
> Vibration
>
> Vibration from operational wind turbines has been measured by extremely sensitive measurement equipment such as seismic arrays. but in terms of human

perception, measured vibration levels are well below perception thresholds even on the actual wind turbine sites. There is, therefore, no need to assess vibration affecting people for operational wind turbine developments."

Given the above, Amplitude Modulation, Infrasound, Low Frequency Noise and Vibration have been screened out of the operational phase assessment.

13.4 BASELINE: NOISE IN RECEIVING ENVIRONMENT

Potential receptors in the area around the Proposed Development were initially identified from Ordnance Survey maps, Google maps, EPA maps and site visits. A number of predictions were prepared for the layout of the Proposed Development to determine the sphere of influence and potential noise-sensitive receptors, including occupied and un-occupied dwellings. Receptor locations were verified through visits to the area surrounding the Proposed Development.

Baseline noise monitoring was undertaken between 7th November and 1st December 2023 at the locations presented in Figure 13-1 and described in Table 13-7. Noise data was recorded for a representative range of wind speeds during the monitoring period, correlating with the onsite LiDAR.

Figure 13-1 Baseline Noise Survey Locations

Table 13-7: Baseline Noise Survey Locations

Location	Eircodes/ITM Reference	Description of Location
NML1	V95 P2N5 510953.680993	Monitor located approximately 20 m from the front of the house with the main noise sources being low levels off traffic flow and wind effects on vegetation.
NML2	V95 RX8D 509037,680395	Monitor located approximately 15 m from the front of the house with the main noise sources being local domestic and farming activity and wind effects on vegetation.
NML3	V95 TF83 508117,681762	Monitor located approximately 20 m from the front of the house and approximately 5 m from the end of a building on the site. The main noise sources being low levels of traffic flow, wind effects on vegetation and the operation of a childcare facility on the site.
NML4	V95 PA44 510329,682567	Monitor located approximately 15 m from the rear of the house, with the main noise sources being wind effects on vegetation.

Measuring background noise requires the carrying out of continuous noise level monitoring at receptors for a period that includes a range of wind speeds which correspond to the maximum sound power of the candidate turbines being proposed which is usually 3 to 4 weeks duration. The candidate turbine assessed reaches maximum sound power level at a mean wind speed of 8 m/s at 10 m standardised height and generates the highest noise level for that turbine specification.

The survey was carried out in accordance with ETSU-R-97 (ETSU, 1996) and the IOA Good Practice Guide (IOA, 2013) with the following implemented:

- Measurement of background noise levels at 10-minute intervals was undertaken using Type 1 instruments.
- Concurrent measurements of noise and mean wind were made at 10-minute intervals with the mean wind speed recorded from a LiDAR on the Proposed Development Site. The methodology is given in Section 11.3.3.
- The background noise measurement recorded continuously included 10-minute intervals, as $L_{A90,10min}$ along with a series of other parameters including $L_{Aeq,10min}$.

- Noise measurements were recorded at a height of 1.2 - 1.5 m above ground level and more than 5 m from any reflective surface, other than the porous ground.
- Electronic rain gauges were installed onsite at NML 1 and NML3 to monitor rainfall at 10-minute intervals over the duration of the noise survey. Rain data which impacted on noise levels were removed from the noise data set prior to analysis.
- The standardised 10 m wind speed was plotted against the time synchronised background noise levels using a best-fit polynomial line.

13.4.1 INSTRUMENTATION USED

The following instrumentation was used in the baseline survey measurements:

- Larson Davis Precision Integrating Sound Level Analyser/Data logger with 1/2" Condenser Microphones. Microphone was fitted with double skin windscreens based on that specified in W/31/00386/REP *Noise Measurements in Windy Conditions*.
- Calibration Type: Larson Davis Precision Acoustic Calibrator.
- Rain Gauge Type: TR-525M tipping bucket rain gauge, 0.2 mm pulse with LOGBOX datalogger

All acoustic instrumentation was calibrated before and after the survey and the drift of calibration was less than 0.3 dB(A), which is within accepted guidelines. Calibration certificates of the acoustic instruments are included in Technical Appendix A13-06.

13.4.2 PREVAILING BACKGROUND NOISE LEVELS

Table 13-8 presents the background noise levels obtained from quiet daytime and night-time measurement periods at the baseline measurement locations. The main noise sources are low road traffic noise from the surrounding road network, some low intensity agriculture activity in the surrounding farms and vegetation wind induced noise.

Further to collecting and downloading the noise level meter at NML1 it was noted that it had developed a fault and thus the data could not be relied upon.

Table 13-8: Prevailing Background Noise Levels

Monitoring Location	Prevailing Background noise levels $L_{90,10min}$ dB(A)									
	Standardised Mean 10 m height wind speed (m/s)									
		4	5	6	7	8	9	10	11	12
NML2	Day	20.0	20.7	21.7	23.0	24.6	26.3	28.1	30.1	32.1
	Background +5	25.0	25.7	26.7	28.0	29.6	31.3	33.1	35.1	37.1
	Night	20.3	21.3	22.5	23.9	25.4	26.9	28.6	30.3	32.1
	Background +5	25.3	26.3	27.5	28.9	30.4	31.9	33.6	35.5	37.1
NML3	Day	24.0	24.5	25.4	26.6	28.2	30.0	32.0	34.1	36.4
	Background +5	29.0	29.5	30.4	31.6	33.2	35.0	37.0	39.0	41.4
	Night	24.3	24.8	25.6	26.6	27.8	29.2	30.8	32.5	34.3
	Background +5	29.3	29.8	30.6	31.6	32.8	34.2	35.8	37.5	39.3
NML4	Day	27.3	27.2	27.6	28.3	29.3	30.5	31.9	33.5	35.2
	Background +5	32.3	32.2	32.6	33.3	34.3	35.5	36.9	38.2	40.2
	Night	25.7	26.2	26.9	27.8	28.8	30.0	31.3	32.7	34.3
	Background +5	30.7	31.2	31.9	32.8	33.8	35.0	36.3	37.7	39.3

Technical Appendix A13-03 of this chapter plots the derived background noise levels for each noise monitoring location.

13.4.3 NOISE ASSESSMENT LOCATIONS

The monitoring locations were chosen so that the distance was sufficient to ensure no noise contribution from any other operating wind turbines in the wider locality.

Should the predicted operational noise levels from the Proposed Development comply with the requirements of the 2006 Guidelines (DoEHLG, 2006) at the closest receptors, it may be assumed that the predicted noise levels at receptors further away from the Proposed Development will also comply, due to the attenuation of turbine noise levels with distance. The receptor locations are presented in Table 11-12.

13.4.4 NOISE LIMITS

The noise limits for the Proposed Development are based on the limits contained within the Wind Energy Development Guidelines 2006 (DoEHLG, 2006) and on the background levels obtained in Table 13-8. A lower fixed limit of 45 dB(A) for daytime could be applied, however a more stringent limit is applied with the lowest background noise levels and a limit of 43 dB(A) being applied for day and night for all receptors.

Given the low background noise levels measured at all noise monitoring locations, the lower fixed limit of 40/43 dB(A) has been applied to all locations – this is the most stringent limit available under the Wind Energy Development Guidelines 2006 (DoEHLG, 2006).

Table 13-9: Derived Noise Limits

Monitoring Location	Prevailing Background noise levels $L_{90,10min}$ dB(A)									
	Standardised Mean 10 m height wind speed (m/s)									
		4	5	6	7	8	9	10	11	12
NML1	Day	40.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
	Night	40.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
NML2	Day	40.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
	Night	40.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
NML3	Day	40.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
	Night	40.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
NML4	Day	40.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
	Night	40.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0

13.5 ASSESSMENT OF EFFECTS

13.5.1 DO NOTHING SCENARIO

The noise environment around the Proposed Development site will remain as measured within the baseline noise level survey and will be dictated by low road traffic noise from the surrounding road network, some low intensity agriculture activity in the surrounding farms and vegetation wind induced noise.

13.5.2 CONSTRUCTION AND DECOMMISSIONING PHASE IMPACTS

As has been previously stated, the construction and decommissioning process associated with wind farms are not considered intensive and are temporary works, most of which are carried out at a considerable distance from receptors. The main noise sources will be associated with the construction of the Turbine Foundations, Turbine Hardstands, Grid Connection and compound, with lesser sources being the construction of the on Site 38 kV Electrical Substation. The main construction traffic to the Site will be during a very short period where ready-mix trucks deliver concrete for the turbine bases. While delivery of material from local quarries for upgrade of Site Access Tracks, Turbine Hardstands, Temporary Storage Compound and 38 kV Electrical Substation will be for longer periods but will be of less intensity, generating lower levels of noise along the routes. During delivery of materials, trucks will access the site from a different route than leaving the Site, thereby reducing traffic noise at receptors along the local road network. The delivery of turbines by large trucks travelling at very low speed will generate very low levels of noise at receptors along the Turbine Delivery Route.

It is not possible to specify the precise noise levels of emissions from the construction equipment until such time as a contractor is chosen and construction plant has been selected. However, Table 13-10 indicates typical construction range of noise levels for this type of activity (levels from author’s database and BS 5228-1:2009+A1:2014 (BSI, 2014)). Predictions are made for receptors nearest to the turbine bases / hardstands activity, compound development and for receptors at varying distance from the Grid Connection route.

Table 13-10: Typical noise levels from Construction Works

Activity	L_{eq} dB(A) at 10 m
General Construction (pile driving, ready-mix trucks pouring concrete)	70-84 dB(A)
Tracked excavator removing topsoil, subsoil for foundation	80- 87 dB(A)
Rock breaker and excavator loading	82-89 dB(A)
Vibrating rollers including tipping material	76-86 dB(A)
Grid Connection: Trenching Tracked excavator 14 t (tonne), pneumatic breaker, vibratory roller 71 t, tractor	71 – 71 dB(A)
Excavator loading / tipping, excavator and Vibratory roller	80- 87 dB(A)

The difference in noise levels between two locations can be calculated as:

$$L_{p2} - L_{p1} = 10 \log (R_2 / R_1)^2 - (A_{atm} + A_{gr} + A_{br} + A_{mis})$$

$$= 20 \log (R_2 / R_1) - (A_{atm} + A_{gr} + A_{br} + A_{mis})$$

where:

L_{p1} = sound pressure level at location 1

L_{p2} = sound pressure level at location 2

R_1 = distance from source to location 1

R_2 = distance from source to location 2

and where:

A_{atm} = Attenuation due to air absorption

A_{gr} = Attenuation due to ground absorption

A_{br} = Attenuation provided by a barrier

A_{mis} = Attenuation provided by miscellaneous other effects

In the calculations, attenuation by A_{atm}, A_{gr} and A_{mis} is taken as 3 dB(A) where distances are more than 200 m from a source and as zero within 200 m - amelioration by barriers is not accounted for.

Table 13-11 presents the noise levels predicted from construction activity at varying distances. The main noise sources are assumed to be the construction of the Turbine Foundations, Turbine Hardstands and Grid connection. The development of the Site Access Tracks, construction of the new on Site 38 kV Electrical Substation, works on the Substation and Site Control Building will also take place, however the noise levels associated with this activity will be lower and of shorter duration than other works. The main road traffic noise will be associated with the delivery of ready-mix concrete for Turbine Foundations.

The maximum construction noise levels associated with the Proposed Development and Grid Connection are listed in Table 13-11. At receptor locations further away, noise levels will be less than that predicted. Works associated with Decommissioning will be no more than the levels predicted in Table 13-11.

Table 13-11: Predicted Construction Noise Levels

Activity taken as 100% per hour	Distance of Activity (m)	L_{eq} dB(A) 1_{hr} range
General Construction (pile driving, ready-mix trucks pouring concrete)	540 m to R1	32-46 dB(A)
Tracked excavator removing topsoil, subsoil for foundation	540 m to R1	42-49 dB(A)
Rock breaker and excavator loading at nearest turbine T2	540 m to R1	44-51 dB(A)
Vibrating rollers including tipping material set down area close to T2	540 m to R1	38-48 dB(A)
Grid Connection: Trenching Tracked excavator 14 t, pneumatic breaker, vibratory roller 71 t, tractor	At varying distances along route: 15 m 20 m 40 m 80 m	64.5-67.5 dB(A) 62-65 dB(A) 56-59 dB(A) 49.9-52.9 dB(A)
Construction of compound (loading / tipping, excavator and Vibratory roller)	540 m to R1	42-49 dB(A)

Construction Traffic

The delivery of turbines to the Site will generate low level traffic noise as the vehicles carrying the turbines will move slowly along the local roads where impact is expected to be greatest. The main construction noise generated by traffic to and from the Site will be due to ready-mix trucks delivering concrete with trucking of spoil being carried out at the same time. The concrete pour for each individual turbine will be required to be completed in a short a period as possible (usually within 10 hours).

Each turbine will require approximately 650 m^3 of concrete while each ready-mix truck has a capacity of 8 m^3. This results in 81 loads of concrete and 162 truck movements for each turbine. For delivery of concrete the timeframe envisaged for each turbine concrete pour is taken as 10 hrs. This equates to an average of 16.2 movements per hour.

The general expression for predicting the $L_{Aeq,1hr}$ alongside a haul road used by single engine items of mobile plant is:

$$L_{Aeq,1hr} = L_{WA} - 33 + 10\log_{10}Q - 10\log_{10}V - 10\log_{10}d$$

where:

L_{WA} = the sound power level of the truck, in decibels (dB);

Q = 16.2, the number of vehicles per hour;

V = 60, the average vehicle speed, in kilometres per hour (km/h);

d = the distance of receiving position from the centre of haul road, in metres (m).

Typically haul roads are placed 20m from neighbouring dwellings, which results in the following prediction:

$$L_{Aeq,1hr} = 105 - 33 + 10\log16.2 - 10\log60 - 10\log20 = 53.3\ L_{Aeq,1hr}.$$

In those occasions when haul roads are closer, at 10 m from the roadside the noise levels equate to 56.3 $L_{Aeq,1hr}$. The trucking for the concrete pour will extend for a total of 6 days (1 day for each turbine). In practice the levels generated by truck movement should be lower than predicted due to the smooth surface on the local roads.

Grid Connection-Cable laying along road by trenching

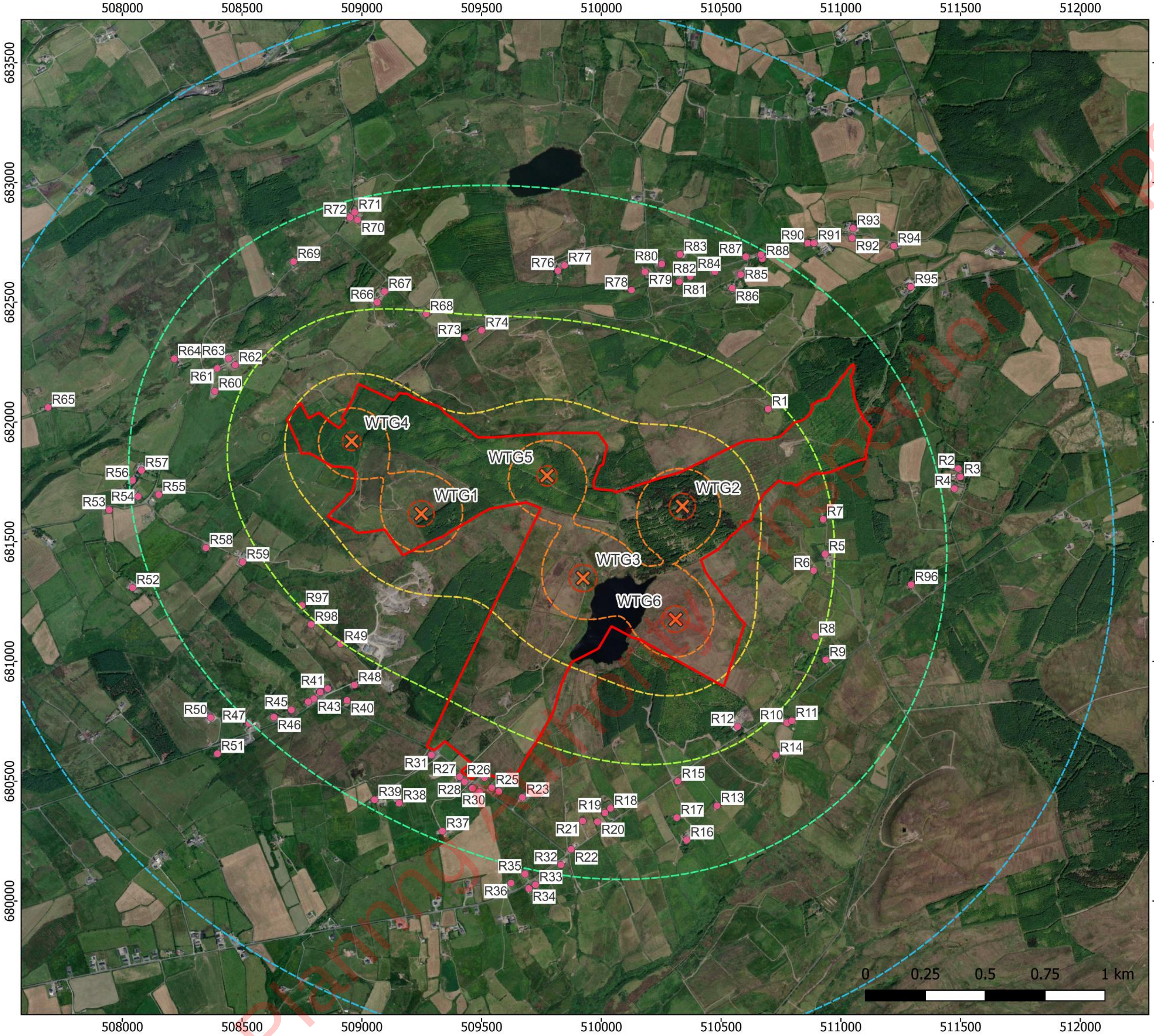
Cable laying and trenching will occur along the Grid Connection route from the On-site 38 kV Substation to the nearest 110/38 kV Substation, which means maximum levels will pertain no more than 0.5 days equivalent (4 hours) at any single receptor.

Construction noise levels are based on continuous operation. In practice, most plant will operate at a maximum level for short intervals.

13.5.3 OPERATIONAL PHASE IMPACTS

The preferred turbine model, the V117-4.2MW will be fitted with STE as standard which is best practice. A serrated extension of the trailing edge to the rotor blades mitigates noise emissions by effectively breaking up the turbulence on the tooth flanks into smaller eddies. The intensity of the pressure fluctuations is reduced which mitigates the noise emissions. Since the intensity of the noise emissions is largely dependent on the flow speed, STE are only installed on the outer rotor blade area where the rotary speed is the highest. Typically, STE reduces the noise levels by 2 to 3 dB(A) depending on specific turbine used.

Table 13-12 presents the predicted noise levels for the operational phase at the nearest receptors to the Proposed Development at varying wind speeds for each receptor location. A noise contour map of the 6no. turbine of the Proposed Development, at maximum sound power output at a wind speed of 12 m/s at 10 m height, is presented in Figure 13-2. The presented noise predictions and contour map in Figure 13-2 assumes that all turbines are simultaneously upwind to each receptor location all of the time (continuously) which results in an overprediction of the noise levels.



Illaunbaun Wind Farm
Noise: Isolation

Legend

- Development Area
- Wind Turbine Generators
- Noise Receptor Locations

Levels LrD
In dB(A)

- 30
- 35
- 40
- 45
- 50
- 55

CRS: IRENET95
Scale: 1:15000
Plot size: A3
Author: HB
Revision: 00

N

Figure 13-2: Predicted noise levels (isolation)

Table 13-12: Predicted Noise Levels as L_{A90} at Varying Wind Speeds from the Proposed Development

Receptor ID	Predicted noise levels $L_{90,10min}$ dB(A)										
	Standardised Mean 10 m height wind speed (m/s)										
	Easting	Northing	4	5	6	7	8	9	10	11	12
R1	510696	682054	32.3	36.6	39.9	41.8	42.1	42.1	42.1	42.1	42.1
R2	511490	681806	26.0	30.3	33.6	35.5	35.8	35.8	35.8	35.8	35.8
R3	511499	681771	26.0	30.3	33.6	35.5	35.8	35.8	35.8	35.8	35.8
R4	511474	681722	26.3	30.6	33.9	35.8	36.1	36.1	36.1	36.1	36.1
R5	510934	681449	32.1	36.4	39.7	41.6	41.9	41.9	41.9	41.9	41.9
R6	510886	681380	32.8	37.1	40.4	42.3	42.6	42.6	42.6	42.6	42.6
R7	510926	681594	32.2	36.5	39.8	41.7	42.0	42.0	42.0	42.0	42.0
R8	510893	681105	32.0	36.3	39.6	41.5	41.8	41.8	41.8	41.8	41.8
R9	510937	681007	31.0	35.3	38.6	40.5	40.8	40.8	40.8	40.8	40.8
R10	510775	680744	30.8	35.1	38.4	40.3	40.6	40.6	40.6	40.6	40.6
R11	510795	680753	30.7	35.0	38.3	40.2	40.5	40.5	40.5	40.5	40.5
R12	510569	680728	32.5	36.8	40.1	42.0	42.3	42.3	42.3	42.3	42.3
R13	510483	680398	29.1	33.4	36.7	38.6	38.9	38.9	38.9	38.9	38.9
R14	510729	680609	30.0	34.3	37.6	39.5	39.8	39.8	39.8	39.8	39.8
R15	510319	680500	30.6	34.9	38.2	40.1	40.4	40.4	40.4	40.4	40.4
R16	510356	680255	28.0	32.3	35.6	37.5	37.8	37.8	37.8	37.8	37.8
R17	510315	680348	29.0	33.3	36.6	38.5	38.8	38.8	38.8	38.8	38.8
R18	510038	680387	29.5	33.8	37.1	39.0	39.3	39.3	39.3	39.3	39.3
R19	510015	680368	29.3	33.6	36.9	38.8	39.1	39.1	39.1	39.1	39.1
R20	509984	680331	28.9	33.2	36.5	38.4	38.7	38.7	38.7	38.7	38.7
R21	509922	680334	28.8	33.1	36.4	38.3	38.6	38.6	38.6	38.6	38.6
R22	509874	680216	27.7	32.0	35.3	37.2	37.5	37.5	37.5	37.5	37.5
R23	509670	680433	29.2	33.5	36.8	38.7	39.0	39.0	39.0	39.0	39.0
R24	509572	680458	29.1	33.4	36.7	38.6	38.9	38.9	38.9	38.9	38.9
R25	509542	680473	29.2	33.5	36.8	38.7	39.0	39.0	39.0	39.0	39.0
R26	509512	680515	29.4	33.7	37.0	38.9	39.2	39.2	39.2	39.2	39.2
R27	509408	680519	29.1	33.4	36.7	38.6	38.9	38.9	38.9	38.9	38.9
R28	509429	680498	29.0	33.3	36.6	38.5	38.8	38.8	38.8	38.8	38.8
R29	509461	680471	28.9	33.2	36.5	38.4	38.7	38.7	38.7	38.7	38.7

Receptor ID	Predicted noise levels $L_{90,10min}$ dB(A)										
	Standardised Mean 10 m height wind speed (m/s)										
	Easting	Northing	4	5	6	7	8	9	10	11	12
R30	509491	680455	28.8	33.1	36.4	38.3	38.6	38.6	38.6	38.6	38.6
R31	509290	680610	29.4	33.7	37.0	38.9	39.2	39.2	39.2	39.2	39.2
R32	509831	680151	27.1	31.4	34.7	36.6	36.9	36.9	36.9	36.9	36.9
R33	509725	680068	26.3	30.6	33.9	35.8	36.1	36.1	36.1	36.1	36.1
R34	509697	680052	26.2	30.5	33.8	35.7	36.0	36.0	36.0	36.0	36.0
R35	509681	680113	26.6	30.9	34.2	36.1	36.4	36.4	36.4	36.4	36.4
R36	509623	680075	26.2	30.5	33.8	35.7	36.0	36.0	36.0	36.0	36.0
R37	509336	680292	27.1	31.4	34.7	36.6	36.9	36.9	36.9	36.9	36.9
R38	509156	680409	27.4	31.7	35.0	36.9	37.2	37.2	37.2	37.2	37.2
R39	509053	680423	27.1	31.4	34.7	36.6	36.9	36.9	36.9	36.9	36.9
R40	508938	680838	29.6	33.9	37.2	39.1	39.4	39.4	39.4	39.4	39.4
R41	508857	680887	29.6	33.9	37.2	39.1	39.4	39.4	39.4	39.4	39.4
R42	508826	680872	29.3	33.6	36.9	38.8	39.1	39.1	39.1	39.1	39.1
R43	508800	680845	28.9	33.2	36.5	38.4	38.7	38.7	38.7	38.7	38.7
R44	508776	680832	28.7	33.0	36.3	38.2	38.5	38.5	38.5	38.5	38.5
R45	508706	680798	28.0	32.3	35.6	37.5	37.8	37.8	37.8	37.8	37.8
R46	508633	680768	27.4	31.7	35.0	36.9	37.2	37.2	37.2	37.2	37.2
R47	508529	680742	26.7	31.0	34.3	36.2	36.5	36.5	36.5	36.5	36.5
R48	508969	680902	30.3	34.6	37.9	39.8	40.1	40.1	40.1	40.1	40.1
R49	508911	681074	31.5	35.8	39.1	41.0	41.3	41.3	41.3	41.3	41.3
R50	508369	680766	25.9	30.2	33.5	35.4	35.7	35.7	35.7	35.7	35.7
R51	508397	680615	25.3	29.6	32.9	34.8	35.1	35.1	35.1	35.1	35.1
R52	508043	681308	26.0	30.3	33.6	35.5	35.8	35.8	35.8	35.8	35.8
R53	507945	681633	25.9	30.2	33.5	35.4	35.7	35.7	35.7	35.7	35.7
R54	508066	681689	27.0	31.3	34.6	36.5	36.8	36.8	36.8	36.8	36.8
R55	508152	681697	27.9	32.2	35.5	37.4	37.7	37.7	37.7	37.7	37.7
R56	508042	681756	26.8	31.1	34.4	36.3	36.6	36.6	36.6	36.6	36.6
R57	508080	681798	27.2	31.5	34.8	36.7	37.0	37.0	37.0	37.0	37.0
R58	508349	681475	29.3	33.6	36.9	38.8	39.1	39.1	39.1	39.1	39.1
R59	508502	681415	30.6	34.9	38.2	40.1	40.4	40.4	40.4	40.4	40.4
R60	508386	682129	30.1	34.4	37.7	39.6	39.9	39.9	39.9	39.9	39.9

Receptor ID	Predicted noise levels $L_{90,10min}$ dB(A)										
	Standardised Mean 10 m height wind speed (m/s)										
	Easting	Northing	4	5	6	7	8	9	10	11	12
R61	508396	682224	29.7	34.0	37.3	39.2	39.5	39.5	39.5	39.5	39.5
R62	508471	682238	30.4	34.7	38.0	39.9	40.2	40.2	40.2	40.2	40.2
R63	508444	682265	29.9	34.2	37.5	39.4	39.7	39.7	39.7	39.7	39.7
R64	508217	682264	27.6	31.9	35.2	37.1	37.4	37.4	37.4	37.4	37.4
R65	507690	682061	23.8	28.1	31.4	33.3	33.6	33.6	33.6	33.6	33.6
R66	509064	682500	31.2	35.5	38.8	40.7	41.0	41.0	41.0	41.0	41.0
R67	509095	682545	30.7	35.0	38.3	40.2	40.5	40.5	40.5	40.5	40.5
R68	509269	682452	31.7	36.0	39.3	41.2	41.5	41.5	41.5	41.5	41.5
R69	508715	682670	28.3	32.6	35.9	37.8	38.1	38.1	38.1	38.1	38.1
R70	508982	682844	27.5	31.8	35.1	37.0	37.3	37.3	37.3	37.3	37.3
R71	508970	682876	27.2	31.5	34.8	36.7	37.0	37.0	37.0	37.0	37.0
R72	508951	682854	27.3	31.6	34.9	36.8	37.1	37.1	37.1	37.1	37.1
R73	509429	682352	32.7	37.0	40.3	42.2	42.5	42.5	42.5	42.5	42.5
R74	509500	682383	32.3	36.6	39.9	41.8	42.1	42.1	42.1	42.1	42.1
R76	509819	682632	32.1	36.4	39.7	41.6	41.9	41.9	41.9	41.9	41.9
R77	509846	682654	29.6	33.9	37.2	39.1	39.4	39.4	39.4	39.4	39.4
R78	510126	682551	29.4	33.7	37.0	38.9	39.2	39.2	39.2	39.2	39.2
R79	510182	682627	29.9	34.2	37.5	39.4	39.7	39.7	39.7	39.7	39.7
R80	510252	682660	29.0	33.3	36.6	38.5	38.8	38.8	38.8	38.8	38.8
R81	510325	682586	28.6	32.9	36.2	38.1	38.4	38.4	38.4	38.4	38.4
R82	510371	682608	29.0	33.3	36.6	38.5	38.8	38.8	38.8	38.8	38.8
R83	510328	682700	28.7	33.0	36.3	38.2	38.5	38.5	38.5	38.5	38.5
R84	510474	682628	28.1	32.4	35.7	37.6	37.9	37.9	37.9	37.9	37.9
R85	510582	682616	28.2	32.5	35.8	37.7	38.0	38.0	38.0	38.0	38.0
R86	510546	682559	27.9	32.2	35.5	37.4	37.7	37.7	37.7	37.7	37.7
R87	510603	682690	28.5	32.8	36.1	38.0	38.3	38.3	38.3	38.3	38.3
R88	510672	682682	27.2	31.5	34.8	36.7	37.0	37.0	37.0	37.0	37.0
R89	510666	682699	27.0	31.3	34.6	36.5	36.8	36.8	36.8	36.8	36.8
R90	510862	682747	26.9	31.2	34.5	36.4	36.7	36.7	36.7	36.7	36.7
R91	510888	682747	25.8	30.1	33.4	35.3	35.6	35.6	35.6	35.6	35.6
R92	511047	682768	25.7	30.0	33.3	35.2	35.5	35.5	35.5	35.5	35.5

Receptor ID	Predicted noise levels $L_{90,10min}$ dB(A)										
	Standardised Mean 10 m height wind speed (m/s)										
	Easting	Northing	4	5	6	7	8	9	10	11	12
R93	511051	682809	24.9	29.2	32.5	34.4	34.7	34.7	34.7	34.7	34.7
R94	511221	682735	24.6	28.9	32.2	34.1	34.4	34.4	34.4	34.4	34.4
R95	511292	682564	24.2	28.5	31.8	33.7	34.0	34.0	34.0	34.0	34.0
R96	511293	681321	24.7	29.0	32.3	34.2	34.5	34.5	34.5	34.5	34.5
R97	508750	681234	28.0	32.3	35.6	37.5	37.8	37.8	37.8	37.8	37.8
R98	508788	681155	31.7	36.0	39.3	41.2	41.5	41.5	41.5	41.5	41.5

Technical Appendix A13-04 presents a graphical representation of the above predictions for the loudest 5 receptors for each of the noise monitoring locations.

13.5.4 CONSTRUCTION AND DECOMMISSIONING PHASE NOISE ASSESSMENT

The higher levels predicted are from the Grid Connection and delivery of concrete for Turbine Foundations. These maximum noise levels will persist for no more than 10 hours at any receptor. All predicted noise levels are well within NRA guidelines (NRA, 2004) given as acceptable and are considered slight. Construction noise is a temporary activity.

All activity is predicted without additional mufflers, or without topographic screening. The maximum road traffic noise, which is generated by ready-mix trucks delivering concrete for Turbine Foundations, will be short term and of 6 days duration. The predicted noise levels are well within the NRA guidelines (NRA, 2004) given as acceptable and are therefore considered as not significant.

Ground vibration from any rock breaking will be below the threshold of sensitivity to humans of 0.2 mm/s peak particle velocity (Wiss & Parmlee, 1974) at all receptors. The effects of noise and vibration from onsite construction activities are therefore considered not significant.

13.5.5 OPERATIONAL PHASE NOISE ASSESSMENT

Comparison has been made of the predicted operational noise levels from the Proposed Development based on the limits described in Section 13.2.2.1 in the 2006 Guidelines (DoEHLG, 2006) and taking into consideration the recent An Bord Pleanála decision (ABP, 2022) described in Section 13.2.2.2.

As can be seen from Table 13-12 and Table 13-13, the predicted noise levels are lower than the noise limits at all receptors, at all wind speeds, and are therefore compliant with the noise limits and are not significant in terms of EIA.

The predicted noise levels assume that all receptors are directly downwind of all turbines at all times, which is a physical impossibility but served to provide a worst-case assessment.

Table 13-13: Margin between Predicted Noise Levels and 40/43 dB(A) Noise Limit

Receptor ID	Margin between predicted noise levels and 40/43 dB(A) noise limit dB(A)										
	Standardised Mean 10 m height wind speed (m/s)										
	Easting	Northing	4	5	6	7	8	9	10	11	12
R1	510696	682054	-7.7	-6.4	-3.1	-1.2	-0.9	-0.9	-0.9	-0.9	-0.9
R2	511490	681806	-14.0	-12.7	-9.4	-7.5	-7.2	-7.2	-7.2	-7.2	-7.2
R3	511499	681771	-14.0	-12.7	-9.4	-7.5	-7.2	-7.2	-7.2	-7.2	-7.2
R4	511474	681722	-13.7	-12.4	-9.1	-7.2	-6.9	-6.9	-6.9	-6.9	-6.9
R5	510934	681449	-7.9	-6.6	-3.3	-1.4	-1.1	-1.1	-1.1	-1.1	-1.1
R6	510886	681380	-7.2	-5.9	-2.6	-0.7	-0.4	-0.4	-0.4	-0.4	-0.4
R7	510926	681594	-7.8	-6.5	-3.2	-1.3	-1.0	-1.0	-1.0	-1.0	-1.0
R8	510893	681105	-8.0	-6.7	-3.4	-1.5	-1.2	-1.2	-1.2	-1.2	-1.2
R9	510937	681007	-9.0	-7.7	-4.4	-2.5	-2.2	-2.2	-2.2	-2.2	-2.2
R10	510775	680744	-9.2	-7.9	-4.6	-2.7	-2.4	-2.4	-2.4	-2.4	-2.4
R11	510795	680753	-9.3	-8.0	-4.7	-2.8	-2.5	-2.5	-2.5	-2.5	-2.5
R12	510569	680728	-7.5	-6.2	-2.9	-1.0	-0.7	-0.7	-0.7	-0.7	-0.7
R13	510483	680398	-10.9	-9.6	-6.3	-4.4	-4.1	-4.1	-4.1	-4.1	-4.1
R14	510729	680609	-10.0	-8.7	-5.4	-3.5	-3.2	-3.2	-3.2	-3.2	-3.2
R15	510319	680500	-9.4	-8.1	-4.8	-2.9	-2.6	-2.6	-2.6	-2.6	-2.6
R16	510356	680255	-12.0	-10.7	-7.4	-5.5	-5.2	-5.2	-5.2	-5.2	-5.2
R17	510315	680348	-11.0	-9.7	-6.4	-4.5	-4.2	-4.2	-4.2	-4.2	-4.2
R18	510038	680387	-10.5	-9.2	-5.9	-4.0	-3.7	-3.7	-3.7	-3.7	-3.7
R19	510015	680368	-10.7	-9.4	-6.1	-4.2	-3.9	-3.9	-3.9	-3.9	-3.9
R20	509984	680331	-11.1	-9.8	-6.5	-4.6	-4.3	-4.3	-4.3	-4.3	-4.3
R21	509922	680334	-11.2	-9.9	-6.6	-4.7	-4.4	-4.4	-4.4	-4.4	-4.4
R22	509874	680216	-12.3	-11.0	-7.7	-5.8	-5.5	-5.5	-5.5	-5.5	-5.5
R23	509670	680433	-10.8	-9.5	-6.2	-4.3	-4.0	-4.0	-4.0	-4.0	-4.0
R24	509572	680458	-10.9	-9.6	-6.3	-4.4	-4.1	-4.1	-4.1	-4.1	-4.1
R25	509542	680473	-10.8	-9.5	-6.2	-4.3	-4.0	-4.0	-4.0	-4.0	-4.0
R26	509512	680515	-10.6	-9.3	-6.0	-4.1	-3.8	-3.8	-3.8	-3.8	-3.8
R27	509408	680519	-10.9	-9.6	-6.3	-4.4	-4.1	-4.1	-4.1	-4.1	-4.1
R28	509429	680498	-11.0	-9.7	-6.4	-4.5	-4.2	-4.2	-4.2	-4.2	-4.2
R29	509461	680471	-11.1	-9.8	-6.5	-4.6	-4.3	-4.3	-4.3	-4.3	-4.3
R30	509491	680455	-11.2	-9.9	-6.6	-4.7	-4.4	-4.4	-4.4	-4.4	-4.4

Receptor ID	Margin between predicted noise levels and 40/43 dB(A) noise limit dB(A)									
	Standardised Mean 10 m height wind speed (m/s)									
	Easting	Northing	4	5	6	7	8	9	10	11	12
R31	509290	680610	-10.6	-9.3	-6.0	-4.1	-3.8	-3.8	-3.8	-3.8	-3.8
R32	509831	680151	-12.9	-11.6	-8.3	-6.4	-6.1	-6.1	-6.1	-6.1	-6.1
R33	509725	680068	-13.7	-12.4	-9.1	-7.2	-6.9	-6.9	-6.9	-6.9	-6.9
R34	509697	680052	-13.8	-12.5	-9.2	-7.3	-7.0	-7.0	-7.0	-7.0	-7.0
R35	509681	680113	-13.4	-12.1	-8.8	-6.9	-6.6	-6.6	-6.6	-6.6	-6.6
R36	509623	680075	-13.8	-12.5	-9.2	-7.3	-7.0	-7.0	-7.0	-7.0	-7.0
R37	509336	680292	-12.9	-11.6	-8.3	-6.4	-6.1	-6.1	-6.1	-6.1	-6.1
R38	509156	680409	-12.6	-11.3	-8.0	-6.1	-5.8	-5.8	-5.8	-5.8	-5.8
R39	509053	680423	-12.9	-11.6	-8.3	-6.4	-6.1	-6.1	-6.1	-6.1	-6.1
R40	508938	680838	-10.4	-9.1	-5.8	-3.9	-3.6	-3.6	-3.6	-3.6	-3.6
R41	508857	680887	-10.4	-9.1	-5.8	-3.9	-3.6	-3.6	-3.6	-3.6	-3.6
R42	508826	680872	-10.7	-9.4	-6.1	-4.2	-3.9	-3.9	-3.9	-3.9	-3.9
R43	508800	680845	-11.1	-9.8	-6.5	-4.6	-4.3	-4.3	-4.3	-4.3	-4.3
R44	508776	680832	-11.3	-10.0	-6.7	-4.8	-4.5	-4.5	-4.5	-4.5	-4.5
R45	508706	680798	-12.0	-10.7	-7.4	-5.5	-5.2	-5.2	-5.2	-5.2	-5.2
R46	508633	680768	-12.6	-11.3	-8.0	-6.1	-5.8	-5.8	-5.8	-5.8	-5.8
R47	508529	680742	-13.3	-12.0	-8.7	-6.8	-6.5	-6.5	-6.5	-6.5	-6.5
R48	508969	680902	-9.7	-8.4	-5.1	-3.2	-2.9	-2.9	-2.9	-2.9	-2.9
R49	508911	681074	-8.5	-7.2	-3.9	-2.0	-1.7	-1.7	-1.7	-1.7	-1.7
R50	508369	680766	-14.1	-12.8	-9.5	-7.6	-7.3	-7.3	-7.3	-7.3	-7.3
R51	508397	680615	-14.7	-13.4	-10.1	-8.2	-7.9	-7.9	-7.9	-7.9	-7.9
R52	508043	681308	-14.0	-12.7	-9.4	-7.5	-7.2	-7.2	-7.2	-7.2	-7.2
R53	507945	681633	-14.1	-12.8	-9.5	-7.6	-7.3	-7.3	-7.3	-7.3	-7.3
R54	508066	681689	-13.0	-11.7	-8.4	-6.5	-6.2	-6.2	-6.2	-6.2	-6.2
R55	508152	681697	-12.1	-10.8	-7.5	-5.6	-5.3	-5.3	-5.3	-5.3	-5.3
R56	508042	681756	-13.2	-11.9	-8.6	-6.7	-6.4	-6.4	-6.4	-6.4	-6.4
R57	508080	681798	-12.8	-11.5	-8.2	-6.3	-6.0	-6.0	-6.0	-6.0	-6.0
R58	508349	681475	-10.7	-9.4	-6.1	-4.2	-3.9	-3.9	-3.9	-3.9	-3.9
R59	508502	681415	-9.4	-8.1	-4.8	-2.9	-2.6	-2.6	-2.6	-2.6	-2.6
R60	508386	682129	-9.9	-8.6	-5.3	-3.4	-3.1	-3.1	-3.1	-3.1	-3.1
R61	508396	682224	-10.3	-9.0	-5.7	-3.8	-3.5	-3.5	-3.5	-3.5	-3.5

Receptor ID	Margin between predicted noise levels and 40/43 dB(A) noise limit dB(A)										
	Standardised Mean 10 m height wind speed (m/s)										
	Easting	Northing	4	5	6	7	8	9	10	11	12
R62	508471	682238	-9.6	-8.3	-5.0	-3.1	-2.8	-2.8	-2.8	-2.8	-2.8
R63	508444	682265	-10.1	-8.8	-5.5	-3.6	-3.3	-3.3	-3.3	-3.3	-3.3
R64	508217	682264	-12.4	-11.1	-7.8	-5.9	-5.6	-5.6	-5.6	-5.6	-5.6
R65	507690	682061	-16.2	-14.9	-11.6	-9.7	-9.4	-9.4	-9.4	-9.4	-9.4
R66	509064	682500	-8.8	-7.5	-4.2	-2.3	-2.0	-2.0	-2.0	-2.0	-2.0
R67	509095	682545	-9.3	-8.0	-4.7	-2.8	-2.5	-2.5	-2.5	-2.5	-2.5
R68	509269	682452	-8.3	-7.0	-3.7	-1.8	-1.5	-1.5	-1.5	-1.5	-1.5
R69	508715	682670	-11.7	-10.4	-7.1	-5.2	-4.9	-4.9	-4.9	-4.9	-4.9
R70	508982	682844	-12.5	-11.2	-7.9	-6.0	-5.7	-5.7	-5.7	-5.7	-5.7
R71	508970	682876	-12.8	-11.5	-8.2	-6.3	-6.0	-6.0	-6.0	-6.0	-6.0
R72	508951	682854	-12.7	-11.4	-8.1	-6.2	-5.9	-5.9	-5.9	-5.9	-5.9
R73	509429	682352	-7.3	-6.0	-2.7	-0.8	-0.5	-0.5	-0.5	-0.5	-0.5
R74	509500	682383	-7.7	-6.4	-3.1	-1.2	-0.9	-0.9	-0.9	-0.9	-0.9
R76	509819	682632	-7.9	-6.6	-3.3	-1.4	-1.1	-1.1	-1.1	-1.1	-1.1
R77	509846	682654	-10.4	-9.1	-5.8	-3.9	-3.6	-3.6	-3.6	-3.6	-3.6
R78	510126	682551	-10.6	-9.3	-6.0	-4.1	-3.8	-3.8	-3.8	-3.8	-3.8
R79	510182	682627	-10.1	-8.8	-5.5	-3.6	-3.3	-3.3	-3.3	-3.3	-3.3
R80	510252	682660	-11.0	-9.7	-6.4	-4.5	-4.2	-4.2	-4.2	-4.2	-4.2
R81	510325	682586	-11.4	-10.1	-6.8	-4.9	-4.6	-4.6	-4.6	-4.6	-4.6
R82	510371	682608	-11.0	-9.7	-6.4	-4.5	-4.2	-4.2	-4.2	-4.2	-4.2
R83	510328	682700	-11.3	-10.0	-6.7	-4.8	-4.5	-4.5	-4.5	-4.5	-4.5
R84	510474	682628	-11.9	-10.6	-7.3	-5.4	-5.1	-5.1	-5.1	-5.1	-5.1
R85	510582	682616	-11.8	-10.5	-7.2	-5.3	-5.0	-5.0	-5.0	-5.0	-5.0
R86	510546	682559	-12.1	-10.8	-7.5	-5.6	-5.3	-5.3	-5.3	-5.3	-5.3
R87	510603	682690	-11.5	-10.2	-6.9	-5.0	-4.7	-4.7	-4.7	-4.7	-4.7
R88	510672	682682	-12.8	-11.5	-8.2	-6.3	-6.0	-6.0	-6.0	-6.0	-6.0
R89	510666	682699	-13.0	-11.7	-8.4	-6.5	-6.2	-6.2	-6.2	-6.2	-6.2
R90	510862	682747	-13.1	-11.8	-8.5	-6.6	-6.3	-6.3	-6.3	-6.3	-6.3
R91	510888	682747	-14.2	-12.9	-9.6	-7.7	-7.4	-7.4	-7.4	-7.4	-7.4
R92	511047	682768	-14.3	-13.0	-9.7	-7.8	-7.5	-7.5	-7.5	-7.5	-7.5
R93	511051	682809	-15.1	-13.8	-10.5	-8.6	-8.3	-8.3	-8.3	-8.3	-8.3

Receptor ID	Margin between predicted noise levels and 40/43 dB(A) noise limit dB(A)										
	Standardised Mean 10 m height wind speed (m/s)										
	Easting	Northing	4	5	6	7	8	9	10	11	12
R94	511221	682735	-15.4	-14.1	-10.8	-8.9	-8.6	-8.6	-8.6	-8.6	-8.6
R95	511292	682564	-15.8	-14.5	-11.2	-9.3	-9.0	-9.0	-9.0	-9.0	-9.0
R96	511293	681321	-15.3	-14.0	-10.7	-8.8	-8.5	-8.5	-8.5	-8.5	-8.5
R97	508750	681234	-12.0	-10.7	-7.4	-5.5	-5.2	-5.2	-5.2	-5.2	-5.2
R98	508788	681155	-8.3	-7.0	-3.7	-1.8	-1.5	-1.5	-1.5	-1.5	-1.5

A noise contour map of the combined effects of all 6no. turbines is presented with a maximum sound power output at a wind speed of 12 ms^{-1} at 10 m height in Figure 13-2. The contour map in Figure 13-2 assumes that all turbines are simultaneously upwind at the same time to each receptor location which results in an overprediction of the noise levels.

13.5.6 CUMULATIVE EFFECTS AND OTHER INTERACTIONS

13.5.6.1 CONSTRUCTION AND DECOMMISSIONING PHASE

It is not expected that cumulative effects will be present during the construction and decommissioning phase of the Proposed Development.

13.5.6.2 OPERATIONAL PHASE

The only other wind farm either constructed, permitted or proposed, located within 2 km of the Proposed Development (and hence be of potential material influence) is Slieveacurry Wind Farm – 9no. turbines - Vestas V150 4.2 MW, 100 m hub height. The sound power level data as relied upon for this assessment is presented in Table 13-14 and Table 13-15 as derived from manufacturer's data.

Table 13-14: Noise Emission Data, Vestas V150 – 4.2 MW, STE, 100 m hub height

Standardised 10 m Height Wind Speed m/s	Sound Power Level dB(A) (without uncertainty)
4	96.4
5	100.6
6	103.4
7	104.7
8	104.9
9	104.9
10	104.9
11	104.9
12	104.9

The octave band values are given in Table 13-15 for the V150 – 4.2 MW as input to the prediction model.

Table 13-15: Octave Band Spectrum of Vestas V150 – 4.2 MW, STE, 100 m – Rated power

Standardised 10 m Height Wind Speed m/s	Sound Power Level dB(A) (without uncertainty)
63	84.9
125	92.1
250	96.9
500	99.2
1000	99.0
2000	96.3
4000	95.3
8000	83.4
L_{WA}	104.9

Table 13-16 presents the cumulative predicted noise levels at the nearest receptors to the Proposed Development at varying wind speeds for each receptor location. A noise contour map of the cumulative noise impact at maximum sound power output at a wind speed of 12 m/s at 10 m height is presented in Figure 13-3. The contour map in Figure 13-3 assumes that all turbines are simultaneously upwind to each receptor location all of the time (continuously) which results in an overprediction of the noise levels.

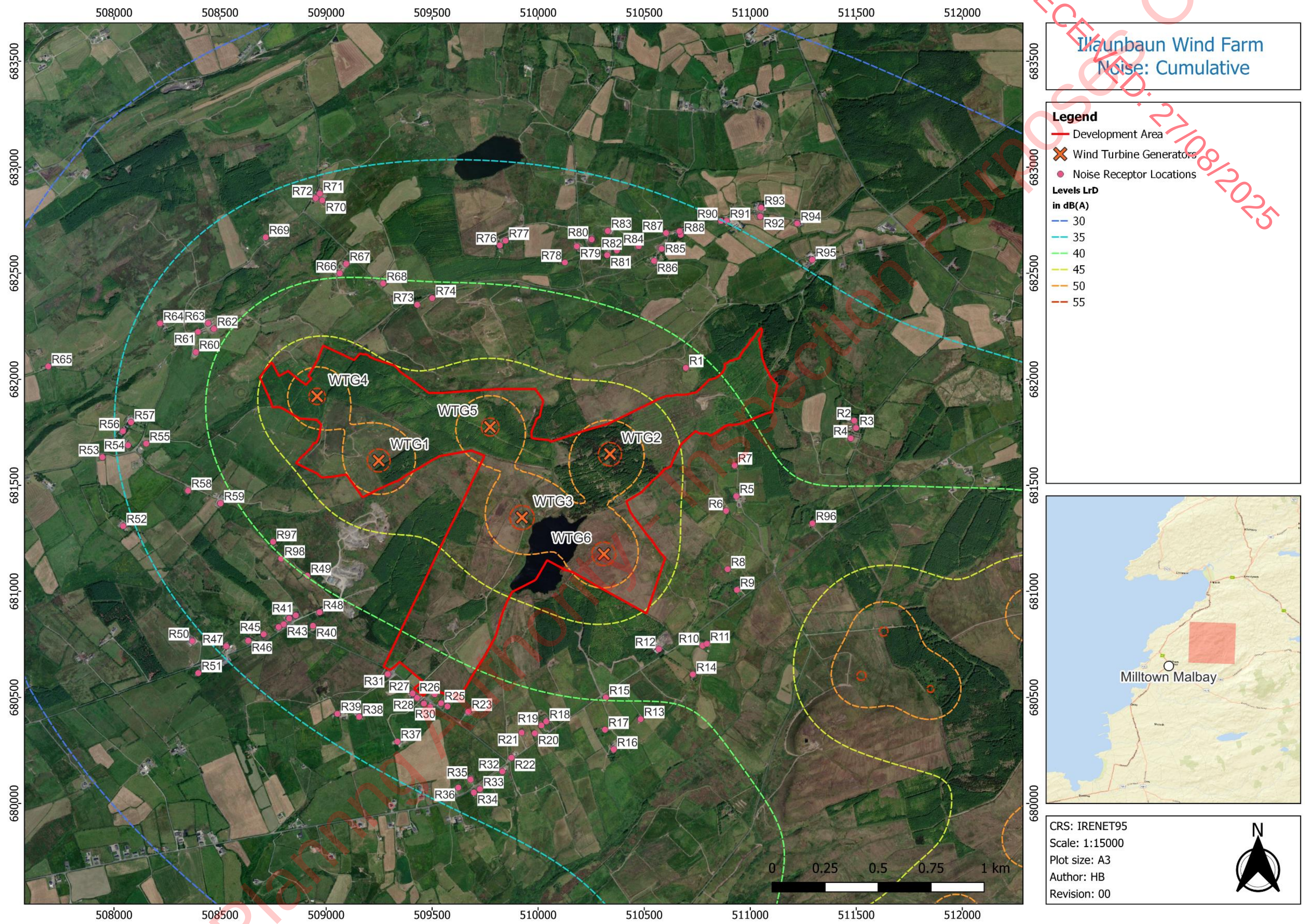


Figure 13-3: Predicted noise levels (cumulative)

Table 13-16: Predicted cumulative noise levels as L_{A90} at Varying Wind Speeds

Receptor ID	Predicted noise levels $L_{90,10min}$ dB(A)										
	Standardised Mean 10 m height wind speed (m/s)										
	Easting	Northing	4	5	6	7	8	9	10	11	12
R1	510696	682054	33.0	37.2	40.5	42.3	42.6	42.6	42.6	42.6	42.6
R2	511490	681806	30.5	34.7	37.7	39.3	39.5	39.5	39.5	39.5	39.5
R3	511499	681771	30.7	34.9	37.9	39.4	39.7	39.7	39.7	39.7	39.7
R4	511474	681722	31.1	35.3	38.3	39.8	40.0	40.0	40.0	40.0	40.0
R5	510934	681449	33.8	38.1	41.2	43.0	43.3	43.3	43.3	43.3	43.3
R6	510886	681380	34.3	38.6	41.7	43.5	43.7	43.7	43.7	43.7	43.7
R7	510926	681594	33.5	37.8	41.0	42.7	43.0	43.0	43.0	43.0	43.0
R8	510893	681105	34.4	38.7	41.8	43.4	43.7	43.7	43.7	43.7	43.7
R9	510937	681007	34.4	38.6	41.7	43.3	43.5	43.5	43.5	43.5	43.5
R10	510775	680744	33.8	38.1	41.1	42.8	43.0	43.0	43.0	43.0	43.0
R11	510795	680753	33.9	38.1	41.2	42.8	43.1	43.1	43.1	43.1	43.1
R12	510569	680728	34.0	38.3	41.5	43.2	43.5	43.5	43.5	43.5	43.5
R13	510483	680398	31.7	35.9	39.0	40.7	40.9	40.9	40.9	40.9	40.9
R14	510729	680609	33.2	37.4	40.5	42.1	42.4	42.4	42.4	42.4	42.4
R15	510319	680500	32.2	36.4	39.6	41.3	41.6	41.6	41.6	41.6	41.6
R16	510356	680255	30.6	34.8	37.9	39.6	39.8	39.8	39.8	39.8	39.8
R17	510315	680348	31.1	35.3	38.4	40.1	40.4	40.4	40.4	40.4	40.4
R18	510038	680387	30.8	35.1	38.2	40.0	40.3	40.3	40.3	40.3	40.3
R19	510015	680368	30.6	34.9	38.1	39.8	40.1	40.1	40.1	40.1	40.1
R20	509984	680331	30.3	34.5	37.7	39.5	39.8	39.8	39.8	39.8	39.8
R21	509922	680334	30.1	34.4	37.6	39.4	39.6	39.6	39.6	39.6	39.6
R22	509874	680216	29.2	33.5	36.7	38.4	38.7	38.7	38.7	38.7	38.7
R23	509670	680433	30.1	34.4	37.6	39.4	39.7	39.7	39.7	39.7	39.7
R24	509572	680458	30.0	34.2	37.5	39.3	39.6	39.6	39.6	39.6	39.6
R25	509542	680473	30.0	34.2	37.5	39.3	39.6	39.6	39.6	39.6	39.6
R26	509512	680515	30.1	34.4	37.7	39.5	39.8	39.8	39.8	39.8	39.8
R27	509408	680519	29.8	34.1	37.3	39.1	39.4	39.4	39.4	39.4	39.4
R28	509429	680498	29.7	34.0	37.2	39.0	39.3	39.3	39.3	39.3	39.3
R29	509461	680471	29.7	33.9	37.2	39.0	39.3	39.3	39.3	39.3	39.3
R30	509491	680455	29.7	33.9	37.2	39.0	39.3	39.3	39.3	39.3	39.3

Receptor ID	Predicted noise levels $L_{90,10min}$ dB(A)										
	Standardised Mean 10 m height wind speed (m/s)										
	Easting	Northing	4	5	6	7	8	9	10	11	12
R31	509290	680610	29.9	34.2	37.5	39.3	39.6	39.6	39.6	39.6	39.6
R32	509831	680151	28.8	33.0	36.2	37.9	38.2	38.2	38.2	38.2	38.2
R33	509725	680068	28.0	32.3	35.5	37.2	37.5	37.5	37.5	37.5	37.5
R34	509697	680052	27.9	32.1	35.3	37.0	37.3	37.3	37.3	37.3	37.3
R35	509681	680113	28.1	32.4	35.6	37.3	37.6	37.6	37.6	37.6	37.6
R36	509623	680075	27.8	32.0	35.2	36.9	37.2	37.2	37.2	37.2	37.2
R37	509336	680292	28.1	32.4	35.6	37.4	37.7	37.7	37.7	37.7	37.7
R38	509156	680409	28.2	32.4	35.7	37.5	37.8	37.8	37.8	37.8	37.8
R39	509053	680423	27.8	32.1	35.3	37.2	37.5	37.5	37.5	37.5	37.5
R40	508938	680838	30.0	34.3	37.5	39.4	39.7	39.7	39.7	39.7	39.7
R41	508857	680887	29.9	34.2	37.5	39.3	39.6	39.6	39.6	39.6	39.6
R42	508826	680872	29.6	33.9	37.2	39.0	39.3	39.3	39.3	39.3	39.3
R43	508800	680845	29.3	33.6	36.9	38.7	39.0	39.0	39.0	39.0	39.0
R44	508776	680832	29.1	33.4	36.6	38.5	38.8	38.8	38.8	38.8	38.8
R45	508706	680798	28.5	32.8	36.0	37.9	38.2	38.2	38.2	38.2	38.2
R46	508633	680768	27.9	32.2	35.5	37.3	37.6	37.6	37.6	37.6	37.6
R47	508529	680742	27.2	31.5	34.8	36.6	36.9	36.9	36.9	36.9	36.9
R48	508969	680902	30.6	34.9	38.2	40.1	40.4	40.4	40.4	40.4	40.4
R49	508911	681074	31.8	36.1	39.4	41.2	41.5	41.5	41.5	41.5	41.5
R50	508369	680766	26.5	30.8	34.0	35.9	36.2	36.2	36.2	36.2	36.2
R51	508397	680615	26.0	30.2	33.5	35.3	35.6	35.6	35.6	35.6	35.6
R52	508043	681308	26.4	30.7	34.0	35.8	36.1	36.1	36.1	36.1	36.1
R53	507945	681633	26.3	30.5	33.8	35.7	36.0	36.0	36.0	36.0	36.0
R54	508066	681689	27.3	31.6	34.9	36.7	37.0	37.0	37.0	37.0	37.0
R55	508152	681697	28.1	32.4	35.7	37.6	37.9	37.9	37.9	37.9	37.9
R56	508042	681756	27.1	31.4	34.7	36.6	36.9	36.9	36.9	36.9	36.9
R57	508080	681798	27.5	31.8	35.1	36.9	37.2	37.2	37.2	37.2	37.2
R58	508349	681475	29.5	33.8	37.1	39.0	39.3	39.3	39.3	39.3	39.3
R59	508502	681415	30.8	35.1	38.4	40.2	40.5	40.5	40.5	40.5	40.5
R60	508386	682129	30.2	34.5	37.8	39.7	40.0	40.0	40.0	40.0	40.0
R61	508396	682224	29.8	34.1	37.4	39.3	39.6	39.6	39.6	39.6	39.6

Receptor ID	Predicted noise levels $L_{90,10min}$ dB(A)										
	Standardised Mean 10 m height wind speed (m/s)										
	Easting	Northing	4	5	6	7	8	9	10	11	12
R62	508471	682238	30.6	34.9	38.2	40.0	40.3	40.3	40.3	40.3	40.3
R63	508444	682265	30.1	34.4	37.7	39.5	39.8	39.8	39.8	39.8	39.8
R64	508217	682264	27.8	32.1	35.4	37.3	37.6	37.6	37.6	37.6	37.6
R65	507690	682061	24.1	28.4	31.6	33.5	33.8	33.8	33.8	33.8	33.8
R66	509064	682500	31.4	35.7	39.0	40.8	41.1	41.1	41.1	41.1	41.1
R67	509095	682545	30.9	35.2	38.4	40.3	40.6	40.6	40.6	40.6	40.6
R68	509269	682452	31.9	36.2	39.5	41.4	41.7	41.7	41.7	41.7	41.7
R69	508715	682670	28.5	32.8	36.1	37.9	38.2	38.2	38.2	38.2	38.2
R70	508982	682844	27.8	32.1	35.4	37.2	37.5	37.5	37.5	37.5	37.5
R71	508970	682876	27.5	31.8	35.1	36.9	37.2	37.2	37.2	37.2	37.2
R72	508951	682854	27.7	32.0	35.2	37.1	37.4	37.4	37.4	37.4	37.4
R73	509429	682352	32.9	37.2	40.4	42.3	42.6	42.6	42.6	42.6	42.6
R74	509500	682383	32.5	36.8	40.1	41.9	42.2	42.2	42.2	42.2	42.2
R76	509819	682632	32.4	36.7	40.0	41.8	42.1	42.1	42.1	42.1	42.1
R77	509846	682654	30.0	34.3	37.5	39.4	39.7	39.7	39.7	39.7	39.7
R78	510126	682551	29.8	34.0	37.3	39.2	39.5	39.5	39.5	39.5	39.5
R79	510182	682627	30.3	34.6	37.9	39.7	40.0	40.0	40.0	40.0	40.0
R80	510252	682660	29.6	33.9	37.1	39.0	39.2	39.2	39.2	39.2	39.2
R81	510325	682586	29.2	33.5	36.7	38.5	38.8	38.8	38.8	38.8	38.8
R82	510371	682608	29.6	33.9	37.1	39.0	39.3	39.3	39.3	39.3	39.3
R83	510328	682700	29.3	33.6	36.9	38.7	39.0	39.0	39.0	39.0	39.0
R84	510474	682628	28.7	33.0	36.2	38.1	38.4	38.4	38.4	38.4	38.4
R85	510582	682616	28.9	33.2	36.5	38.3	38.6	38.6	38.6	38.6	38.6
R86	510546	682559	28.7	33.0	36.2	38.0	38.3	38.3	38.3	38.3	38.3
R87	510603	682690	29.3	33.6	36.8	38.6	38.9	38.9	38.9	38.9	38.9
R88	510672	682682	28.2	32.5	35.7	37.5	37.8	37.8	37.8	37.8	37.8
R89	510666	682699	28.1	32.3	35.5	37.3	37.6	37.6	37.6	37.6	37.6
R90	510862	682747	28.0	32.2	35.4	37.2	37.5	37.5	37.5	37.5	37.5
R91	510888	682747	27.1	31.4	34.6	36.4	36.6	36.6	36.6	36.6	36.6
R92	511047	682768	27.1	31.4	34.5	36.3	36.6	36.6	36.6	36.6	36.6
R93	511051	682809	26.6	30.8	34.0	35.7	36.0	36.0	36.0	36.0	36.0

Receptor ID	Predicted noise levels $L_{90,10min}$ dB(A)										
	Standardised Mean 10 m height wind speed (m/s)										
	Easting	Northing	4	5	6	7	8	9	10	11	12
R94	511221	682735	26.3	30.6	33.8	35.5	35.8	35.8	35.8	35.8	35.8
R95	511292	682564	26.3	30.6	33.7	35.4	35.7	35.7	35.7	35.7	35.7
R96	511293	681321	27.0	31.3	34.4	36.1	36.3	36.3	36.3	36.3	36.3
R97	508750	681234	33.8	38.1	41.0	42.5	42.7	42.7	42.7	42.7	42.7
R98	508788	681155	31.9	36.2	39.5	41.4	41.7	41.7	41.7	41.7	41.7

Technical Appendix A13-04 presents a graphical representation of the above predictions for the loudest 5 receptors for each of the noise monitoring locations.

Table 13-17: Margin between Cumulative Predicted Noise Levels and 40/43 dB(A) Noise Limit

Receptor ID	Margin between cumulative predicted noise levels and 40/43 dB(A) noise limit dB(A)										
	Standardised Mean 10 m height wind speed (m/s)										
	Easting	Northing	4	5	6	7	8	9	10	11	12
R1	510696	682054	-7.0	-5.8	-2.5	-0.7	-0.4	-0.4	-0.4	-0.4	-0.4
R2	511490	681806	-9.5	-8.3	-5.3	-3.7	-3.5	-3.5	-3.5	-3.5	-3.5
R3	511499	681771	-9.3	-8.1	-5.1	-3.6	-3.3	-3.3	-3.3	-3.3	-3.3
R4	511474	681722	-8.9	-7.7	-4.7	-3.2	-3.0	-3.0	-3.0	-3.0	-3.0
R5	510934	681449	-6.2	-4.9	-1.8	0.0	0.3	0.3	0.3	0.3	0.3
R6	510886	681380	-5.7	-4.4	-1.3	0.5	0.7	0.7	0.7	0.7	0.7
R7	510926	681594	-6.5	-5.2	-2.0	-0.3	0.0	0.0	0.0	0.0	0.0
R8	510893	681105	-5.6	-4.3	-1.2	0.4	0.7	0.7	0.7	0.7	0.7
R9	510937	681007	-5.6	-4.4	-1.3	0.3	0.5	0.5	0.5	0.5	0.5
R10	510775	680744	-6.2	-4.9	-1.9	-0.2	0.0	0.0	0.0	0.0	0.0
R11	510795	680753	-6.1	-4.9	-1.8	-0.2	0.1	0.1	0.1	0.1	0.1
R12	510569	680728	-6.0	-4.7	-1.5	0.2	0.5	0.5	0.5	0.5	0.5
R13	510483	680398	-8.3	-7.1	-4.0	-2.3	-2.1	-2.1	-2.1	-2.1	-2.1
R14	510729	680609	-6.8	-5.6	-2.5	-0.9	-0.6	-0.6	-0.6	-0.6	-0.6
R15	510319	680500	-7.8	-6.6	-3.4	-1.7	-1.4	-1.4	-1.4	-1.4	-1.4
R16	510356	680255	-9.4	-8.2	-5.1	-3.4	-3.2	-3.2	-3.2	-3.2	-3.2
R17	510315	680348	-8.9	-7.7	-4.6	-2.9	-2.6	-2.6	-2.6	-2.6	-2.6
R18	510038	680387	-9.2	-7.9	-4.8	-3.0	-2.7	-2.7	-2.7	-2.7	-2.7
R19	510015	680368	-9.4	-8.1	-4.9	-3.2	-2.9	-2.9	-2.9	-2.9	-2.9
R20	509984	680331	-9.7	-8.5	-5.3	-3.5	-3.2	-3.2	-3.2	-3.2	-3.2

Receptor ID	Margin between cumulative predicted noise levels and 40/43 dB(A) noise limit dB(A)										
	Standardised Mean 10 m height wind speed (m/s)										
	Easting	Northing	4	5	6	7	8	9	10	11	12
R21	509922	680334	-9.9	-8.6	-5.4	-3.6	-3.4	-3.4	-3.4	-3.4	-3.4
R22	509874	680216	-10.8	-9.5	-6.3	-4.6	-4.3	-4.3	-4.3	-4.3	-4.3
R23	509670	680433	-9.9	-8.6	-5.4	-3.6	-3.3	-3.3	-3.3	-3.3	-3.3
R24	509572	680458	-10.0	-8.8	-5.5	-3.7	-3.4	-3.4	-3.4	-3.4	-3.4
R25	509542	680473	-10.0	-8.8	-5.5	-3.7	-3.4	-3.4	-3.4	-3.4	-3.4
R26	509512	680515	-9.9	-8.6	-5.3	-3.5	-3.2	-3.2	-3.2	-3.2	-3.2
R27	509408	680519	-10.2	-8.9	-5.7	-3.9	-3.6	-3.6	-3.6	-3.6	-3.6
R28	509429	680498	-10.3	-9.0	-5.8	-4.0	-3.7	-3.7	-3.7	-3.7	-3.7
R29	509461	680471	-10.3	-9.1	-5.8	-4.0	-3.7	-3.7	-3.7	-3.7	-3.7
R30	509491	680455	-10.3	-9.1	-5.8	-4.0	-3.7	-3.7	-3.7	-3.7	-3.7
R31	509290	680610	-10.1	-8.8	-5.5	-3.7	-3.4	-3.4	-3.4	-3.4	-3.4
R32	509831	680151	-11.2	-10.0	-6.8	-5.1	-4.8	-4.8	-4.8	-4.8	-4.8
R33	509725	680068	-12.0	-10.7	-7.5	-5.8	-5.5	-5.5	-5.5	-5.5	-5.5
R34	509697	680052	-12.1	-10.9	-7.7	-6.0	-5.7	-5.7	-5.7	-5.7	-5.7
R35	509681	680113	-11.9	-10.6	-7.4	-5.7	-5.4	-5.4	-5.4	-5.4	-5.4
R36	509623	680075	-12.2	-11.0	-7.8	-6.1	-5.8	-5.8	-5.8	-5.8	-5.8
R37	509336	680292	-11.9	-10.6	-7.4	-5.6	-5.3	-5.3	-5.3	-5.3	-5.3
R38	509156	680409	-11.8	-10.6	-7.3	-5.5	-5.2	-5.2	-5.2	-5.2	-5.2
R39	509053	680423	-12.2	-10.9	-7.7	-5.8	-5.5	-5.5	-5.5	-5.5	-5.5
R40	508938	680838	-10.0	-8.7	-5.5	-3.6	-3.3	-3.3	-3.3	-3.3	-3.3
R41	508857	680887	-10.1	-8.8	-5.5	-3.7	-3.4	-3.4	-3.4	-3.4	-3.4
R42	508826	680872	-10.4	-9.1	-5.8	-4.0	-3.7	-3.7	-3.7	-3.7	-3.7
R43	508800	680845	-10.7	-9.4	-6.1	-4.3	-4.0	-4.0	-4.0	-4.0	-4.0
R44	508776	680832	-10.9	-9.6	-6.4	-4.5	-4.2	-4.2	-4.2	-4.2	-4.2
R45	508706	680798	-11.5	-10.2	-7.0	-5.1	-4.8	-4.8	-4.8	-4.8	-4.8
R46	508633	680768	-12.1	-10.8	-7.5	-5.7	-5.4	-5.4	-5.4	-5.4	-5.4
R47	508529	680742	-12.8	-11.5	-8.2	-6.4	-6.1	-6.1	-6.1	-6.1	-6.1
R48	508969	680902	-9.4	-8.1	-4.8	-2.9	-2.6	-2.6	-2.6	-2.6	-2.6
R49	508911	681074	-8.2	-6.9	-3.6	-1.8	-1.5	-1.5	-1.5	-1.5	-1.5
R50	508369	680766	-13.5	-12.2	-9.0	-7.1	-6.8	-6.8	-6.8	-6.8	-6.8
R51	508397	680615	-14.0	-12.8	-9.5	-7.7	-7.4	-7.4	-7.4	-7.4	-7.4

Receptor ID	Margin between cumulative predicted noise levels and 40/43 dB(A) noise limit dB(A)										
	Standardised Mean 10 m height wind speed (m/s)										
	Easting	Northing	4	5	6	7	8	9	10	11	12
R52	508043	681308	-13.6	-12.3	-9.0	-7.2	-6.9	-6.9	-6.9	-6.9	-6.9
R53	507945	681633	-13.7	-12.5	-9.2	-7.3	-7.0	-7.0	-7.0	-7.0	-7.0
R54	508066	681689	-12.7	-11.4	-8.1	-6.3	-6.0	-6.0	-6.0	-6.0	-6.0
R55	508152	681697	-11.9	-10.6	-7.3	-5.4	-5.1	-5.1	-5.1	-5.1	-5.1
R56	508042	681756	-12.9	-11.6	-8.3	-6.4	-6.1	-6.1	-6.1	-6.1	-6.1
R57	508080	681798	-12.5	-11.2	-7.9	-6.1	-5.8	-5.8	-5.8	-5.8	-5.8
R58	508349	681475	-10.5	-9.2	-5.9	-4.0	-3.7	-3.7	-3.7	-3.7	-3.7
R59	508502	681415	-9.2	-7.9	-4.6	-2.8	-2.5	-2.5	-2.5	-2.5	-2.5
R60	508386	682129	-9.8	-8.5	-5.2	-3.3	-3.0	-3.0	-3.0	-3.0	-3.0
R61	508396	682224	-10.2	-8.9	-5.6	-3.7	-3.4	-3.4	-3.4	-3.4	-3.4
R62	508471	682238	-9.4	-8.1	-4.8	-3.0	-2.7	-2.7	-2.7	-2.7	-2.7
R63	508444	682265	-9.9	-8.6	-5.3	-3.5	-3.2	-3.2	-3.2	-3.2	-3.2
R64	508217	682264	-12.2	-10.9	-7.6	-5.7	-5.4	-5.4	-5.4	-5.4	-5.4
R65	507690	682061	-15.9	-14.6	-11.4	-9.5	-9.2	-9.2	-9.2	-9.2	-9.2
R66	509064	682500	-8.6	-7.3	-4.0	-2.2	-1.9	-1.9	-1.9	-1.9	-1.9
R67	509095	682545	-9.1	-7.8	-4.6	-2.7	-2.4	-2.4	-2.4	-2.4	-2.4
R68	509269	682452	-8.1	-6.8	-3.5	-1.6	-1.3	-1.3	-1.3	-1.3	-1.3
R69	508715	682670	-11.5	-10.2	-6.9	-5.1	-4.8	-4.8	-4.8	-4.8	-4.8
R70	508982	682844	-12.2	-10.9	-7.6	-5.8	-5.5	-5.5	-5.5	-5.5	-5.5
R71	508970	682876	-12.5	-11.2	-7.9	-6.1	-5.8	-5.8	-5.8	-5.8	-5.8
R72	508951	682854	-12.3	-11.0	-7.8	-5.9	-5.6	-5.6	-5.6	-5.6	-5.6
R73	509429	682352	-7.1	-5.8	-2.6	-0.7	-0.4	-0.4	-0.4	-0.4	-0.4
R74	509500	682383	-7.5	-6.2	-2.9	-1.1	-0.8	-0.8	-0.8	-0.8	-0.8
R76	509819	682632	-7.6	-6.3	-3.0	-1.2	-0.9	-0.9	-0.9	-0.9	-0.9
R77	509846	682654	-10.0	-8.7	-5.5	-3.6	-3.3	-3.3	-3.3	-3.3	-3.3
R78	510126	682551	-10.2	-9.0	-5.7	-3.8	-3.5	-3.5	-3.5	-3.5	-3.5
R79	510182	682627	-9.7	-8.4	-5.1	-3.3	-3.0	-3.0	-3.0	-3.0	-3.0
R80	510252	682660	-10.4	-9.1	-5.9	-4.0	-3.8	-3.8	-3.8	-3.8	-3.8
R81	510325	682586	-10.8	-9.5	-6.3	-4.5	-4.2	-4.2	-4.2	-4.2	-4.2
R82	510371	682608	-10.4	-9.1	-5.9	-4.0	-3.7	-3.7	-3.7	-3.7	-3.7
R83	510328	682700	-10.7	-9.4	-6.1	-4.3	-4.0	-4.0	-4.0	-4.0	-4.0

Receptor ID	Margin between cumulative predicted noise levels and 40/43 dB(A) noise limit dB(A)										
	Standardised Mean 10 m height wind speed (m/s)										
	Easting	Northing	4	5	6	7	8	9	10	11	12
R84	510474	682628	-11.3	-10.0	-6.8	-4.9	-4.6	-4.6	-4.6	-4.6	-4.6
R85	510582	682616	-11.1	-9.8	-6.5	-4.7	-4.4	-4.4	-4.4	-4.4	-4.4
R86	510546	682559	-11.3	-10.0	-6.8	-5.0	-4.7	-4.7	-4.7	-4.7	-4.7
R87	510603	682690	-10.7	-9.4	-6.2	-4.4	-4.1	-4.1	-4.1	-4.1	-4.1
R88	510672	682682	-11.8	-10.5	-7.3	-5.5	-5.2	-5.2	-5.2	-5.2	-5.2
R89	510666	682699	-11.9	-10.7	-7.5	-5.7	-5.4	-5.4	-5.4	-5.4	-5.4
R90	510862	682747	-12.0	-10.8	-7.6	-5.8	-5.5	-5.5	-5.5	-5.5	-5.5
R91	510888	682747	-12.9	-11.6	-8.4	-6.6	-6.4	-6.4	-6.4	-6.4	-6.4
R92	511047	682768	-12.9	-11.6	-8.5	-6.7	-6.4	-6.4	-6.4	-6.4	-6.4
R93	511051	682809	-13.4	-12.2	-9.0	-7.3	-7.0	-7.0	-7.0	-7.0	-7.0
R94	511221	682735	-13.7	-12.4	-9.2	-7.5	-7.2	-7.2	-7.2	-7.2	-7.2
R95	511292	682564	-13.7	-12.4	-9.3	-7.6	-7.3	-7.3	-7.3	-7.3	-7.3
R96	511293	681321	-13.0	-11.7	-8.6	-6.9	-6.7	-6.7	-6.7	-6.7	-6.7
R97	508750	681234	-6.2	-4.9	-2.0	-0.5	-0.3	-0.3	-0.3	-0.3	-0.3
R98	508788	681155	-8.1	-6.8	-3.5	-1.6	-1.3	-1.3	-1.3	-1.3	-1.3

As can be seen from Table 13-17, the cumulative predicted noise levels are marginally higher than the noise limit of 43 dB(A) at six receptors (R5, R6, R8, R9, R11 and R12) at wind speeds from 7 to 12 m/s. The predicted noise levels assume that all receptors are directly downwind of all turbines from both wind farms at all times (omin-directional), which is a physical impossibility, but serves to provide a worst-case assessment.

The cumulative predicted noise levels are lower than the noise limits at the remaining receptors, at all wind speeds, and are therefore compliant with the noise limits, thus not significant in terms of EIA. All non-assessed properties further from the proposed wind farm will experience worst-case noise levels lower than the residential properties assessed in this chapter and therefore will also comply with the 2006 Guidelines (DoEHLG, 2006).

13.6 MITIGATION MEASURES FOR NOISE AND VIBRATION

13.6.1 CONSTRUCTION AND DECOMMISSIONING PHASE MITIGATION MEASURES

No significant construction noise effects have been identified. Therefore, no specific mitigation measures are required. However, general guidance for controlling construction noise through the use of good practice given in BS 5228-1:2009+A1:2014 (BSI, 2014), will be followed. Construction and Decommissioning of the Proposed Development shall be limited to working times given and any controls incorporated in any planning permission.

During the Decommissioning phase of the Proposed Development, noise levels are likely be no more than predicted in Table 13-11. However, it is envisaged that decommissioning will be of shorter duration. Any legislation, guidance or best practice relevant at the time of decommissioning will be complied with. Construction and decommissioning are temporary day time activities.

13.6.2 OPERATIONAL PHASE MITIGATION MEASURES

The Proposed Development has been designed to comply with the 2006 Noise Guidelines (DoEHLG, 2006) and noise limits attached as conditions to recent An Bord Pleanála decisions (ABP, 2022). The operational noise emissions from the Proposed Development in isolation comply with the noise limits at all wind speeds and receptors.

The operational noise emissions from the Proposed Development cumulatively with Slieveacurry Wind Farm minorly exceed the limit of 43 dB(A) at six receptors at wind speeds from 7 to 12 m/s based on an omni-directional assessment. Therefore, further assessment/mitigation measures are required, which are detailed in Section 13.6.2 below. It should be noted that all turbines will have STE fitted as standard to reduce noise emission levels at source.

13.6.2.1 DIRECTIVITY

The predictions made using ISO 9613-2:2014 (IOS, 2024) are “worst-case” conditions, which reflect the impossible scenario where the source to receiver propagation is always in a downwind direction (i.e. for certain receptors it is impossible to be downwind of both wind farms as the same time). When considering cumulative impacts from wind turbines using the IOA Good Practice Guidelines (IOA, 2013), the predicted noise levels were reduced by 2 dB(A) when the wind was in the region 80 - 90° from downwind, with a 10 dB(A) reduction to the predicted noise levels when in an upwind direction. A typical directivity plot is presented in Figure 13-4 below.

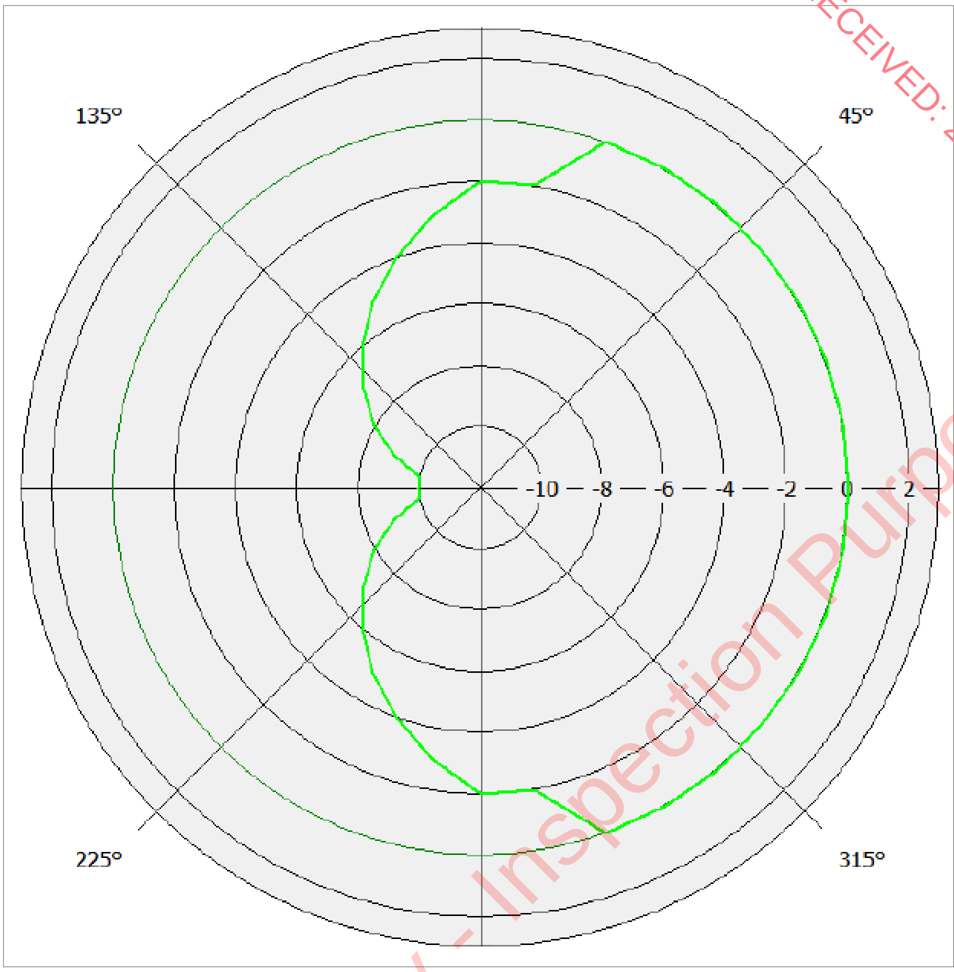


Figure 13-4: Example Directivity Plot for Westerly Wind Direction

The predicted noise levels from the proposed and cumulative wind turbines were previously assessed with a slight downward breeze in all directions. However, it would be rational to predict the impact of the wind turbines when the wind is blowing from the range of wind directions as it is possible that the predicted levels may not exceed the noise limits at receptor properties, particularly when the turbines are downwind from the properties i.e. for those receptors between the two wind farms it is not possible to be downwind of both wind farms at the same time.

Table 13-18: Impact of Directivity Assessment at relevant receptors (7 m/s wind speed)

Wind Direction (^{0}) Blowing From	Predicted noise levels $L_{90,10min}$ dB(A) Receptor					
	H5	H6	H8	H9	H11	H12
0	39.4	40.2	40.8	40.5	41.1	42.4
45	36.4	37.1	39.2	40.2	40.2	41.5
90	38.2	38.4	39.6	40.4	39.7	38.2
135	38.2	38.4	39.6	40.4	39.7	38.2
180	40.8	41.4	39.8	40.0	37.8	36.6
225	42.6	42.5	41.3	40.3	37.8	35.4
270	41.9	42.5	41.8	40.9	40.6	42.0
315	41.9	42.5	41.8	40.9	40.6	42.2
Limit	43.0	43.0	43.0	43.0	43.0	43.0

Table 13-19: Impact of Directivity Assessment at relevant receptors (8 m/s+ wind speed)

Wind Direction (^{0}) Blowing From	Predicted noise levels $L_{90,10min}$ dB(A) Receptor					
	H5	H6	H8	H9	H11	H12
0	39.7	40.5	41.1	40.8	41.4	42.7
45	36.7	37.4	39.5	40.5	40.5	41.8
90	38.5	38.7	39.9	40.7	40	38.5
135	38.5	38.7	39.9	40.7	40	38.5
180	41.1	41.7	40.1	40.3	38.1	36.9
225	42.9	42.8	41.6	40.6	38.1	35.7
270	42.2	42.8	42.1	41.2	40.9	42.3
315	42.2	42.8	42.1	41.2	40.9	42.5
Limit	43.0	43.0	43.0	43.0	43.0	43.0

It can be seen from Table 13-18 and Table 13-19 that further to consideration of directivity effects, there are no exceedances of the 2006 Noise Guidelines (DoEHLG, 2006) and noise limits attached as conditions to recent An Bord Pleanála decisions.

Given that there are no exceedances of the 2006 Noise Guidelines (DoEHLG, 2006) and noise limits attached as conditions to recent An Bord Pleanála decisions (ABP, 2022), mitigation of the operational noise from the Proposed Development would not be deemed necessary.

13.7 ASSESSMENT OF RESIDUAL EFFECTS

13.7.1 CONSTRUCTION AND DECOMMISSIONING PHASE

Construction and decommissioning noise are temporary in nature with no lasting residual effects.

13.7.2 OPERATIONAL PHASE

Operational noise will not exceed the 2006 Noise Guidelines (DoEHLG, 2006) and noise limits attached as conditions to recent An Bord Pleanála decisions (ABP, 2022). Though there is potential for noise from the Proposed Development to be audible at certain receptor locations depending on wind speed and direction, hence a minor residual effect.

13.8 MONITORING

In line with the Institute of Acoustics Good Practice Guice - Supplementary Guidance Note 5: Post Completion Measurements (IOA, 2013c), noise level monitoring will be undertaken within 6 months of the Proposed Development becoming operational to determine noise levels at receptor locations and compliance with the 2006 Noise Guidelines (DoEHLG, 2006) and noise limits attached as conditions to recent An Bord Pleanála decisions (ABP, 2022).

A measurement protocol will be shared with the local planning authority for agreement prior to undertaking any noise monitoring.

13.9 SUMMARY

Table 13-20: Summary Table

Potential Effect	Construction/ Operation	Beneficial /Adverse/ Neutral	Extent (Site/Local/ National/ Transboundary)	Short term /Long term	Direct/ Indirect	Permanent /Temporary	Reversible/ Irreversible	Significance of Effect (according to defined criteria)	Proposed mitigation	Residual Effects (according to defined criteria)
Noise	Construction	Adverse	Local	Short term	Direct	Temporary	Reversible	Not Significant	Best Practice	None
Vibration	Construction	Adverse	Local	Short term	Direct	Temporary	Reversible	Not Significant	Best Practice	None
Noise	Operation	Adverse	Local	Long term	Direct	Permanent	Reversible	Not Significant	None	Minor
Vibration	Operation	Adverse	Site	Long term	Direct	Permanent	Reversible	Not Significant	None	None
Noise	Decommissioning	Adverse	Local	Short term	Direct	Temporary	Reversible	Not Significant	Best Practice	None
Vibration	Decommissioning	Adverse	Local	Short term	Direct	Temporary	Reversible	Not Significant	Best Practice	None

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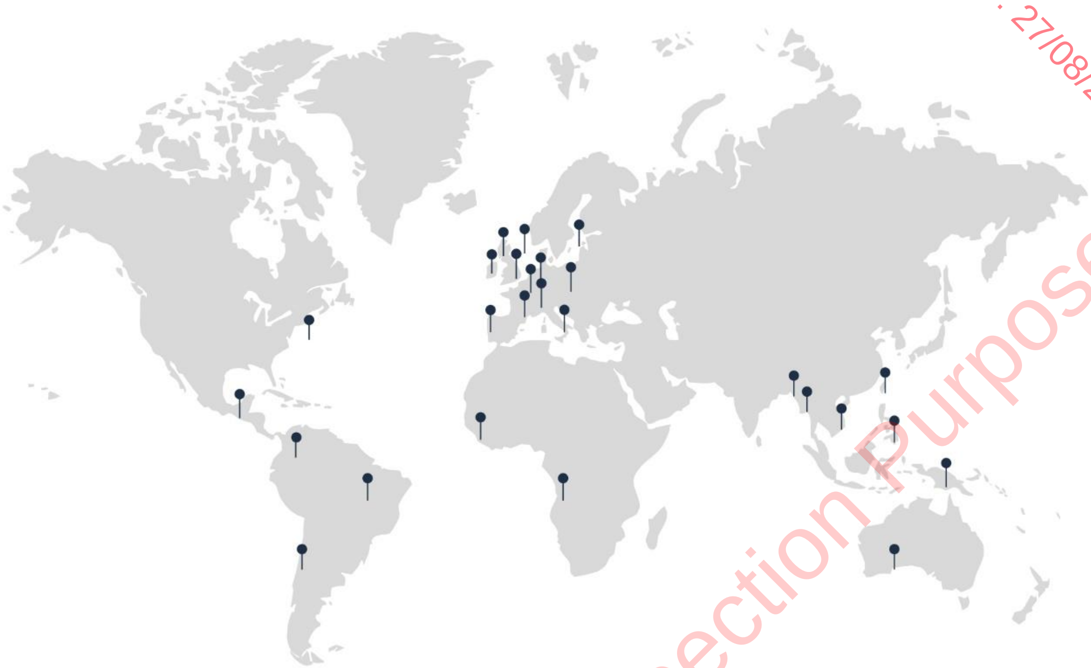

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