10 NOISE

10.1 INTRODUCTION

This Chapter of the EIAR assesses the like significant effects of the Development from noise impacts. This assessment was undertaken by Brendan O'Reilly of Noise & Vibration Consultants Limited and Shane Carr of Irwin Carr Ltd.

The assessment considers the potential effects during the following phases of the Development:

- Construction of the Development
- Operation of the Development
- Decommissioning of the Development

The Development refers to all elements of the application for the construction and operation of the wind farm including the grid connection, road traffic to site, peat disposal and upgrade to the 110kV Substation (**Chapter 2: Project Description**).

This chapter of the EIAR is supported by the Figures in **Volume III** and following Technical Appendices documents provided in **Volume IV** of this EIAR:

- **Technical Appendix 10.1**: Photos of noise monitors in-situ
- **Technical Appendix 10.2**: Wind speed calculations for Hub Height
- **Technical Appendix 10.3**: Sound Plan noise outputs
- **Technical Appendix 10.4**: Calibration certificates of noise instruments
- **Technical Appendix 10.5**: Candidate turbine manufacturer's noise emission data

10.1.1 Statement of Authority

Brendan O'Reilly has a Master's degree in noise and vibration from Liverpool University and has over 40 years' experience in noise and vibration control (and many years' experience in preparation of noise impact statements) and has been a member of a number of professional organisations. Brendan was a co-author and project partner (as a senior noise consultant) in 'Environmental Quality Objectives Noise in Quiet Areas' administered by the Environmental Protection Agency. Brendan has considerable experience in the assessment of noise impact and have compiled studies for in excess of 100 wind farm developments throughout Ireland, north and south.

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

noise modelling in this assessment and contributed to the report. Shane is a Director in Irwin Carr Consulting, primarily responsible for environmental noise and noise modelling. He has over 22 years' experience working in both the public and private sectors having previously obtained a BSc (Hons) Degree in Environmental Health and a Post-Graduate Diploma in Acoustics. Shane has been responsible for undertaking and reviewing noise impact assessments on numerous large scale wind farms throughout the UK and Ireland.

10.1.2 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, 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 by a certain margin, the pre-existing noise level 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 in excess of 85 dB (A) gives a significant risk of hearing damage. Construction and industrial noise sources are normally assessed and expressed using equivalent continuous levels, LAeq[1]. Wind turbine source noise is generally expressed in Leq dBA and in sound power levels (LWA 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 LA90[2] descriptor, which allows reliable measurements to be made without corruption from relatively loud transitory noise events from other sources. The LA90 should be used for assessing both the wind energy development noise and background noise as stated in the 2006 Guidelines. As discussed in ETSU-R-97[3] the LA90 is 1.5-2.5dBA less than the LAeq measured over the same period. In this assessment, the difference between LAeq and LA90 is given as 2dBA which is best practice and the value most commonly applied in windfarm assessments in Ireland. Wind turbine noise levels are given as

[1] L_{Aeq} is defined as being the A-weighted equivalent continuous steady sound level that has the same sound energy as the real fluctuating sound during the sample period and effectively represents a type of average value.

[2] LA90, or L90dBA is defined as the noise level equaled or exceeded for 90% of the measurement interval and with windfarm noise the interval used is 10 minutes.

[3] ETSU-R-97, The Assessment & Rating of Noise from Wind Farms, June 1996

sound power levels (LWA) dB at integer wind speeds up to maximum LWA levels. Table 10.1 gives a comparison of noise levels in our everyday environment.

Table 10:1 Comparison of sound pressure level in our Environment[4]

Source/Activity	Indicative noise level dBA
Threshold of hearing	0
Rural night-time background	20-50
Quiet bedroom	35
Windfarm at 350m	35-45
Busy road at 5 km	35-45
Car at 65km/hr at 100m	55
Busy general office	60
Conversation	60
Truck at 50km/hr at 100m	65
Inside a typical shopping centre	70-75
Inside a modern car at around 90km/hr	75-80
Passenger cabin of jet aircraft	85
City Traffic	90
Pneumatic drill at 7m	95
Jet aircraft at 250m	105
Threshold of pain	140

10.1.3 Assessment Structure

This assessment contains the following sections:

- Assessment Methodology and Significance Criteria – a description of the methods used in baseline surveys and in the assessment of the significance of effects
- Baseline Description - a description of the baseline noise of the area surrounding the Development based on the results of surveys, desk information and consultations, and a summary of any information required for the assessment that could not be obtained
- Assessment of Likely Significant Effects - identifying the ways in which noise receptors could be affected by the Development, including a summary of the measures taken during design of the Development to minimise noise effects
- Mitigation Measures and Residual Effects - a description of measures recommended to off-set likely significant effects and a summary of the significance of the effects of the EIA Development after mitigation measures have been implemented

[4] Fact sheet published by the Australian Government (Greenhouse Office) and the Australian Wind Energy Association

- Cumulative Effects – identifying the potential for effects of the Development to combine with those from other windfarm developments
- Summary of Effects
- Statement of Significance

10.2 ASSESSMENT METHODOLOGY AND SIGNIFICANCE CRITERIA FOR THE OPERATIONAL PHASE

10.2.1 Assessment Methodology

This assessment has involved the following elements, further details of which are provided in the following sections:

- Legislation and guidance review
- Desk study, including review of available maps and published information
- Site walkover
- Evaluation of likely effects
- Evaluation of the significance of these effects
- Identification of measures to avoid and mitigate likely significant effects

10.2.2 Description of Effects

The significance of effects of the proposed development is described in accordance with the EPA guidance document '*Guidelines on the information to be contained in the Environmental Impact Assessment Reports (EIAR), EPA May 2022'*. The details of the methodology for describing the significance of effects are provided in Table 3.4: Section 3.7.3 of the aforementioned EPA 2022 document.

10.2.3 Relevant Legislation and Guidance

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

- Wind Energy Development Guidelines (WEDG)[5] (the 2006 Guidelines)
- WHO 2018 Environmental Noise Guidelines for European Region (WHO 2018)
- Draft Revised Wind Energy Development Guidelines December 2019 (DRWEDG 2019).

[5] Department of Environment, Heritage and Local Government: Wind Energy Development Guidelines, Guidelines for Planning Authorities 2006 Energy

- 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'[6] (the IOA Good Practice Guide)
- ISO 19967 Acoustics-Description and Measurement of Environmental Noise - Part 1: Basic Quantities and Procedures (ISO 1996)
- ETSU-R-978: The Assessment & Rating of Noise from Wind Farms (ETSU-R-97)
- Institute of Acoustics Amplitude Modulation Working Group9, WSP Turbine AM Review10 and IEC 6140011
- National Roads Authority (NRA) Guidelines for the Treatment of Noise and Vibration in National Road Schemes, 2004

10.2.3.1 Wind Energy Development Guidelines 2006

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

General Noise Impact

"*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."

Measurement Units

"The descriptor [LA90 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."

Specific Noise Limits

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

[6] Institute of Acoustics (2013) A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise
[7] ISO 1996/1- Acoustics-Description and Measurement of Environmental Noise - Part 1: Basic Quantities and Procedures
[8] ETSU-R-97: Acoustics-The Assessment & Rating of Noise from Wind Farms: ETSU for the DTI, UK, 1996
[9] IOA Noise Working Group (Wind Turbine Noise) Amplitude Modulation Working Group, Final Report, A Method for Rating Amplitude Modulation in Wind Turbine Noise, August 2016
[10] Wind Turbine AM Review, Phase 2 Report, Department of Energy & Climate Change, WSP/Parsons Brinckerhoff, August 2016
[11] IEC Technical Specification 61400-11-2 Wind energy generation systems – Part 11-2: Acoustic noise measurement techniques – Measurement of wind turbine sound characteristics in receptor position, 2024

"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 LA90,10min 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) L90,10min which 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 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

10.2.3.2 An Bord Pleanála

2021 An Bord Pleanála Decisions

Recent decision by ABP gave limits (ABP-309306-21, dated 26 September 2022 and ABP-314602-22 dated 27 February 2025) in accordance with the 2006 Guidelines and were as follows:

(a) between 7am and 11pm:

(i) the greater of 5 dB(A) L90,10min above background noise levels, or 45 dB(A) L90, 10min, at wind speeds of 5m/s or greater,

(ii) 40 dB(A) L90, 10min, at all other wind speeds.

(b) 43 dB(A) L90,10min at all other times

where wind speeds are measured at 10 metres above ground level.

This shows recent ABP decisions to be consistent with the limit levels in the WEDG06.

10.2.3.3 World Health Guidelines (WHO) 2018

The most recent WHO 2018 Guidelines: 'Environmental Noise Guidelines for the European Region' gives a recommendation limit of 45dB Lden 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.

10.2.3.4 Draft Revised Wind Energy Development Guidelines 2019 (DRWEDG 2019)

There have been a number of draft guidelines over the years with the latest one being in December 2019. The DRWEDG 2019 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.

10.2.4 Desk Study

The locations for noise monitoring were selected by inspection of site maps and by identifying the nearest receptors surrounding the wind turbines. The Noise Study Area has been defined such that the predicted results have been included for all residential receptors within 2.7km of the wind farm.

The general principles of siting of background noise monitoring locations are presented in SB8 on P9 of the Institute of Acoustics Good Practice Guide. Further information is included within the Supplementary Guidance Note 1 in Section 2.5.

There is an element of judgement in the siting of noise monitoring equipment with particular attention paid to potential local sources which could affect the measured noise levels.

The noise monitoring location is considered representative of the local noise environment, but in order to ensure conservatism the lowest measured background levels are relied up in this assessment.

10.2.5 Acquisition and Analysis of Background Noise Data

The 2006 Guidelines, ETSU-R-97 and the IOA Good Practice Guide 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[12].(**Appendix 10.2**) gives the methodology to account for wind shear, calculation to hub height and to standardise 10m height wind speed.

LiDAR was located within the Site during the noise survey was used for wind data measurements at heights of 80m and 60m with wind shear derived and used to calculate to the proposed turbine hub height wind speed of 82m.

The 82m hub height wind speed was then standardised to 10m height wind speed with the wind speed plotted against the 10 minute background noise data to derive a best fit polynomial curve.

10.2.6 Prediction of Wind Turbine Noise Levels

The predicted noise levels are based on the methodology given in the IOA Good Practice Guide. Noise level calculations are based on ISO 9613-2[13] 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 windfarms. 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:

Predicted Octave Band Noise level = LW +D – (A_{geo} +A_{atm} +A_{gr} + A_{br} +A_{mis})j

The predicted octaves from each of the turbines are summed to give the predicted noise level expressed as dBA.

No allowance has been made for the character of noise emitted by the turbines in the modelling process, 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 procurements of the turbine to be used onsite, stating that there should be no clearly tonal or impulsive components audible at any noise sensitive receptor location.

[12] IOA, A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise-Supplementary Guidance Note 4: Wind Shear

[13] ISO 9613-2 Acoustics -Attenuation of sound during propagation outdoors, Part 2: General Method of Calculation

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:

Lp = sound pressure level

Lw = 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. Our predictions have been carried out using a source height corresponding to the proposed height of the turbine nacelle, a receiver height of 4m and an assumed ground factor of G=0.5 as recommended in the IOA Good Practice Guide.

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. 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 emergency 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 x α,

α = atmospheric absorption coefficient in dBm^{-1}

d = distance from turbine

Values of α from ISO 9613 Part 1, corresponding to a temperature of 10^0C and a relative humidity of 70% has been used for these predictions and are given in **Table 10.2** below. These values are recommended in the IOA Good Practice Guide.

Table 10:2: Frequency dependent atmospheric attenuation coefficients (dB/m)

Octave Band Centre Frequency (Hz)	63	125	250	500	1k	2k	4k	8k
Atmospheric Absorption Coefficient (dB/m)	0.0001	0.0004	0.001	0.0019	0.0037	0.0097	0.0328	0.117

A_{misc} – Miscellaneous Other Effects

ISO 9613 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 ISO 9613-2 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 noise levels $L_{Aeq\ 10min}$ are converted to the required $L_{A90,10min}$ by subtracting 2 dBA.

10.2.7 Aerodynamic Modulation or Aerodynamic Noise

Aerodynamic noise originates from the flow of air over, under and around the blades and is generally broadband in character. It is directly linked to the movement of the rotors through the air and will occur to varying degrees whenever the turbine blades move. Aerodynamic noise is generally both broadband i.e. it does not contain a distinguishable note or tone, and of random character, although the level is not constant and fluctuates in time with the movement of the blades. The dominant character of such aerodynamic noise is therefore normally a 'swish' type of sound, which is familiar to most people who have stood near to a large wind turbine.

The sound level of aerodynamic noise from wind turbine blades is not completely steady but is modulated (fluctuates) in a cycle of increased and then reduced level, sometimes called "*blade swish*", typically occurring in step with the angle of rotation of the blades and so being periodic at the rotor's rotational speed – for typical commercial turbines, this is at a rate of around once or twice per second. This phenomenon is known as Amplitude Modulation of Aerodynamic Noise or more succinctly by the acronym AM. In some situations, however, the modulation characteristics can change in character to the point where it can potentially give rise to increased disturbance.

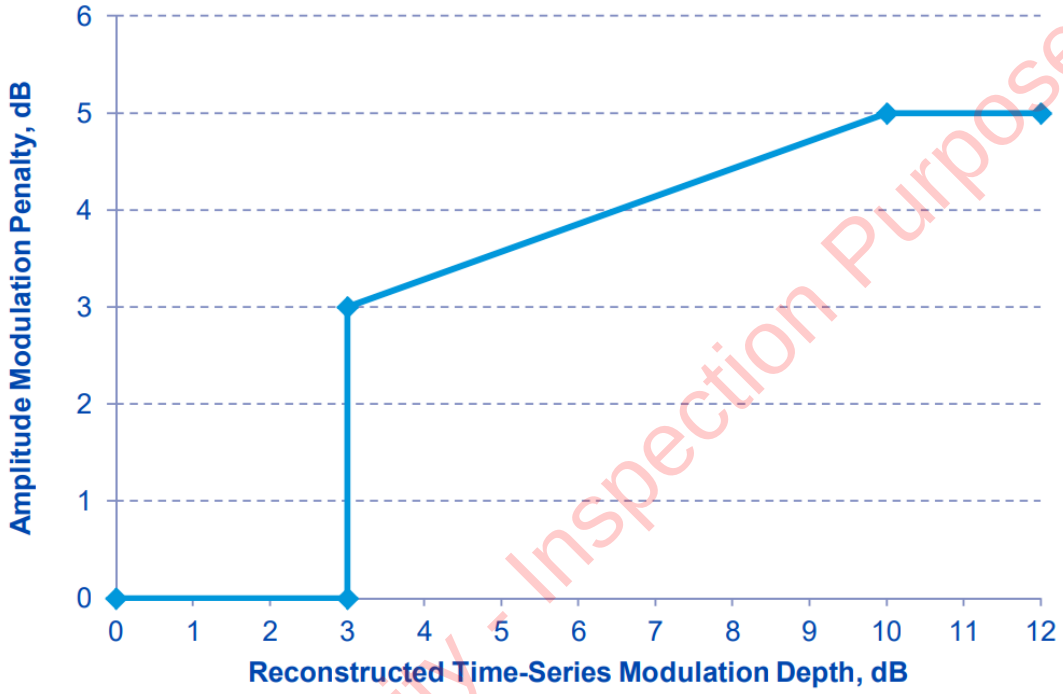
In early wind turbine designs, where the rotor was positioned downwind of the tower, a pronounced 'beat' was audible as each blade passed through the turbulent wake shed from the tower. However, this effect does not exist for the upwind rotor designs found on the majority of modern wind farms where the air flow to the blades is not interrupted by the tower structure. Instead, it seems that aerodynamic modulation is due to fluctuation of the primary mechanisms of aerodynamic noise generation.

The assessment methodology for AM had been evolving in recent times for both the measurement metric and the applicable penalty**.** The Renewable UK[14] research initially identified Normal Amplitude Modulation (NAM) and Other Amplitude Modulation (OAM). This 2013 work identifies a threshold where the AM comes to a level which should be penalised. This principle was followed on in the IoAAMWG[15] consultation documents which after a detailed consultation[16] period presented a metric for quantifying AM.

[14] Wind Turbine Amplitude Modulation: Research to Improve Understanding as to its cause and effect, 13 December 2013
[15] INSTITUTE OF ACOUSTICS IOA Noise Working Group (Wind Turbine Noise) Amplitude Modulation Working Group Discussion Document Methods for Rating Amplitude Modulation in Wind Turbine Noise, April 2015
[16] IOA CONSULTATION QUESTIONNAIRE FOR "METHODS FOR RATING AMPLITUDE MODULATION IN WIND TURBINE NOISE" APRIL 2015

The most recent information in relation assessing AM comes in the IEC TS 61400-11. The scope of this document includes an assessment of the sound characteristics of the noise and relies on the Institute of Acoustics Reference Method (IoA RM) to quantify the AM level along with the WSP Phase 2 Report which identified a penalty scheme as shown **Figure 1** below.

Figure 1: Proposed Penalty Scheme



Current scientific knowledge is such that AM cannot be predicted at the planning stage but can only be measured once the wind farm becomes operational, although the maximum level of penalty can be seen to be 5dB.

The methodology contained within the IoA RM and IEC 61400 allows quantification of all aspects of AM and the penalty scheme identified above allows quantification of any mitigation in the event that any is required. An appropriate penalty can be added onto the measured LA90 noise level, to ensure overall noise levels comply with the applicable noise limit.

It is my professional opinion that AM should be assessed in line with the IEC 61400-11-2 from 2024.

10.2.8 Infrasound and Low Frequency Noise and Vibration

There is always low frequency (or infrasound) noise present in the ambient quiet background. It is generated by natural sources such as road traffic, wind effects through air and vegetation,

wave motion, water flow in streams and rivers. There are also low frequency emissions from many sources found in modern life, such as household appliances (e.g., washing machines, air conditioners, fridges, heating systems, boilers, burners, heat pumps, extraction systems, electric or battery clocks, sky box, etc.), Other sources include water flowing through pipes within your home and in water flow from municipal water supply. Vibration of elements of structures (low frequency, less than 20Hz)) can be generated by local activity in one's home by way of normal routine activity, like climbing stairs, walking on the floor, closing doors etc. When sitting in a moving vehicle very high levels of low frequency vibration/sound is experienced.

The frequency range of audible noise is in the range of 20 to 20,000Hz and low frequency noise is generally from about 2 to 200Hz with infrasound typically of frequencies below 20Hz. There appears to be little or no agreement about the biological effects of low frequency noise on human health and there is evidence to suggest that there are no serious consequences to people's health from infrasound exposure.

A study of low frequency noise (infrasound) and vibration around a modern windfarm was carried out for ETSU and reported in ETSU W/13/00392/REP – '*Low Frequency Noise and Vibration Measurements at a Modern Wind Farm*'[17]. The results showed levels of infrasound to be below accepted thresholds of perception even on the Site. Furthermore, a document prepared for the World Health Organisation, states that *"there is no reliable evidence that infrasound below the hearing threshold produce physiological or psychological effects".*

Significant research carried out on low frequency noise has been in the area of blasting (air overpressure) which falls into a very low frequency range (2-20Hz), although with a considerably higher magnitude. Interestingly most microphones recording air-overpressure (low frequency sound) is linear down to 2 Hz with a range that does not go below a level of 88dB, as below that value trigger can occur from relatively low wind speeds (a gust of wind at 9m/s equates to an air overpressure of 133dB).

The level of ground vibration from the operation of the windfarms is below human threshold of perception, 0.2mm/s[18] at the base of a turbine.

[17] ETSU W/13/00392/REP – '*Low Frequency Noise and Vibration Measurements at a Modern Wind Farm'.*
[18] Wiss, J. F., and Parmelee, R. A.. (1974) Human Perception of Transient Vibrations, "*Journal of Structural Division"*, ASCE, Vol 100, No. S74, PP. 773-787

South Australian Environment Protection Authority (EPA) Infrasound Study

A report released in January 2013 by the South Australian EPA[19] found that the level of infrasound from wind turbines is insignificant and no different to any other sources of noise, and that the worst contributors to household infrasound are air-conditioners, traffic and noise generated by people. The study included several houses in rural and urban areas, houses both adjacent to a wind farm and away from turbines and measured the levels of infrasound with the wind farms operating and also switched off. There were no noticeable differences in the level of infrasound under all these different conditions. In fact, the lowest levels of infrasound were recorded at one of the houses closest to a wind farm, whereas the highest levels were found in an urban office building. The South Australian study found: '*the contribution of wind turbines to the measured infrasound levels is insignificant in comparison with the background level of infrasound in the environment*'.

Massachusetts Institute of Technology (MIT)

A report by an Independent Expert Panel prepared for Massachusetts Department of Health (2012)[20] which consisted of a panel that included seven individuals with backgrounds in public health, epidemiology, toxicology, neurology and sleep medicine, neuroscience, and mechanical engineering, all considered independent experts from academic institutions. The report found that *"there is insufficient evidence that the noise from wind turbines is directly (i.e., independent from an effect on annoyance or sleep) causing health problems or disease'* and '*available evidence shows that infrasound levels near wind turbines cannot impact the vestibular system"*.

Technical Research Centre of Finland

A long-term study into so-called "wind turbine syndrome"[21] health problems supposedly caused by low-frequency sound from spinning blades has concluded that this "infrasound" has absolutely no physical impact on the human body.

The study conducted by the Technical Research Centre of Finland (VTT) and others, commissioned by the Finnish government, found that infrasound sound waves with frequencies below the range of human hearing cause no measurable changes in the human body, and cannot in any way be detected by the human ear.

[19] http://www.epa.sa.gov.au/environmental_info/noise/wind_farms
[20] Infrasound Does Not Explain Symptoms Related to Wind Turbines, Finnish Government, June 2020, https://www.vttresearch.com/en/news-and-ideas/vtt-studied-health-effects-infrasound-wind-turbine-noise-multidisciplinary

[21] Report by Leigh Collins, 21st April 2020 on a study commissioned by the Finnish Government into infrasound and wind turbine syndrome

Infrasound measurements were taken inside and outside local dwellings near two Finnish wind farms, as well as inside the facilities and beyond them, for 308 days.

Measurements showed that the infrasound levels in rural areas with wind farms were about the same as levels in a regular urban environment.
"Infrasound samples representing the worst-case scenarios were picked out from the measurement data and used in the listening tests," said VTT.

"The participants in the listening tests were divided into two groups based on how they reported wind turbine infrasound related symptoms: people who suffered from those and people who never had symptoms."

"The participants were unable to make out infrasonic frequencies in wind turbine noise, and the presence of infrasound made no difference to how annoying the participants perceived the noise, and their autonomous nervous system did not respond to it. There were no differences between the results of the two groups."

10.2.9 Field Work

Baseline noise monitoring was undertaken between 28 June and 28 July 2022 (see **Appendix 10.1**). The continuous monitoring period coincided with the wind speed monitoring over the same period and at the same 10-minute intervals. Noise data was recorded for a representative range of wind speeds during the monitoring period as required by the IoA Good Practice Guide

The monitoring locations were chosen so that the distance from existing wind farms was sufficient to ensure no noise contribution from any of the other three operating wind farms. The locations away from busy roads also contributes to a low background noise, thereby allowing them to be used as a reference for the nearest locations surrounding the proposal.

10.2.10 Consultation

Consultation was carried out with landowners who were familiar with the site. Access to the nearest dwellings was carried out with permission from the householders / landowners. Consultation was also carried out with the Health and Safety Executive (HSE) whose Environmental Health Service (EHS) identified the Moyasta National School as a potential receptor. This site has been included in the assessment.

10.2.11 Noise Assessment Methodology

In summary, the assessment process comprised:

- Identification of potential receptors, i.e. houses and other potentially noise-sensitive locations;
- Measurement of existing background noise levels at representative locations close to the Site;
- Prediction of the likely noise levels of wind turbines received at each receptor;
- Comparison of the predicted levels with noise limits; and
- Cumulative noise assessment (**Section 10.3**)

Potential receptors in the area around the Development were initially identified from Ordnance Survey maps, google maps, EPA maps and Site visits. Background measurements were carried out at the locations shown in **Appendix 10.1**.

The method of measuring background noise is described in ISO 1996 and ETSU-R-97. In practice, it means carrying out continuous monitoring of background noise levels 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 7m/s at 10m height and generates the highest noise level for that turbine specification.

The method of predicting noise levels of wind turbines at receptors is discussed in **Section 10.2.3.2.** This method was applied to the calculations for both contour plots and individual receptor predictions.

It is standard practice to predict noise levels for a reference wind speed and to adjust these for other wind speeds, according to the variation in sound power level with wind speed.

For EIA purposes a candidate turbine, the Vestas V136-4.5 megawatts (MW) operating in unrestricted Mode P04 with serrated trailing edge (STE) as standard has been selected with a hub height of 82m for the EIA technical assessment. The tip of the blades with STE lowers noise emissions without reducing energy output. The selected turbine will have STE as standard.

A copy of the manufacturers noise specification for the turbine used in the assessment are given in the **Appendix 10.5**.

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 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 2dBA. However, as no uncertainty is given then an uncertainty value of 2dBA is given in both tables. **Table 10.3** gives the noise emission data of the V136 turbine up to maximum sound power output at varying wind speed at hub height. **Table 10.4** gives the maximum sound power output at varying wind speed (presented at standardised 10m height) for the V136-4.5MW with a hub height of 82m. An uncertainty value of 2dBA is subtracted to account for conversion from LAeq to LA90 which is best practise.

Table 10:3: Noise Emission Data, Vestas V136-4.5MW, STE at Maximum Sound Power (LWA dB) at Hub Height at varying wind speed

Hub Height Wind Speed, ms^{-1}	4	5	6	7	8	9	10	11	12
Sound Power Level, dB LWA at Varying Wind Speeds	91.1	92.8	95.9	99.5	102.8	103.9	103.9	103.9	103.9
Uncertainty added and conversion of LAeq to LA90	0	0	0	0	0	0	0	0	0

Table 10:4: Noise Emission Data, Vestas V136-4.5MW, STE at Maximum Sound Power (LWA dB) at Standardised 10m Height wind Speed

Standardised 10m Height Wind Speed ms^{-1}	4	5	6	7	8	9	10	11	12
Sound Power Level dB LWA derived from 104m hub height	95.2	100.2	103.5	103.9	103.9	103.9	103.9	103.9	103.9
Uncertainty added and Conversion of LAeq to LAeq	0	0	0	0	0	0	0	0	0

The octave band values are given in **Table 10.5** with uncertainty values and conversion for LAeq to LA90 added as input to the prediction model. It is important to note that the maximum sound power level of a specific turbine does not change with variation in hub height, however minor variation occurs at the lower wind speeds with change in hub height. The proposed turbine for this development has no variation in hub height.

Table 10:5: Octave Band Spectrum of Vestas V136-4.5MW, STE at Maximum Sound Power (LWA dB) at 7m/s wind speed

Octave Band Frequency (Hz)	63	125	250	500	1000	2000	4000	8000
Sound Power Level, dB LWA at 11 ms^{-1}	85.2	92.6	97.6	99.4	98.3	94.2	87.3	77.3
Uncertainty added to octaves and conversion of LAeq to LA90	0	0	0	0	0	0	0	0

10.3 CUMULATIVE ASSESSMENT

Cumulative effects from any existing, consented or application-stage wind farms within 3km of the wind farm have been taken into consideration as the potential for cumulative effects beyond this distance is considered negligible. This is due to the attenuation due to distance outside this range being more than 10dB.

On this basis, the cumulative effect of the operational Tullabrack Wind Farm located 2,000m northwest, the existing Moanmore Wind Farm located 1,800m west-northwest, and Ballykett Wind Farm located 2,700m east of the Development were assessed. The operational Tullabrack Wind Farm comprises six no. Enercon E82 turbines each rated at 2.3MW, the operational Moanmore Wind Farm comprises seven no. Enercon E70 turbines each rated at 2.3MW, and the recently submitted Ballykett Wind Farm comprises 4no. Vestas V136 turbines each rated at 4.5MW. The maximum noise emission data at varying wind speeds (at standardised 10m height) is presented for both the Enercon E82, 2.3MW wind turbines of 78m hub height, and Enercon E70, 2.3MW wind turbines of 85m hub height is given in **Table 10.6** and **Table 10.7**. The noise emission data for Ballykett Wind Farm can be seen in **Table 10.3** and **Table 10.4** above.

Table 10:6: Noise Emission Levels of Enercon E82, 2.3MW w/1dB uncertainty

Standardised 10m Height Wind Speed ms^{-1}	4	5	6	7	8	9	10	11	12
Sound Power Level dB LWA derived from 104m hub height	96.1	96.1	99.5	101.3	102	102	102	102	102
Uncertainty added and Conversion of LAeq to LAeq	-1	-1	-1	-1	-1	-1	-1	-1	-1

Table 10:7: Noise Emission Levels of Enercon E70, 2.3MW w/1dB uncertainty

Standardised 10m Height Wind Speed ms^{-1}	4	5	6	7	8	9	10	11	12
Sound Power Level dB LWA derived from 104m hub height	94.1	94.1	99.7	101.1	102.5	103	103	103	103
Uncertainty added and Conversion of LAeq to LAeq	-1	-1	-1	-1	-1	-1	-1	-1	-1

The octave band values at maximum sound power output for Tullabrack and the existing Moanmore Wind Farm are given in **Table 10.8** and **Table 10.9** with uncertainty values and conversion for LAeq to LA90 added as input to the prediction model. Octave band values for Ballykett Wind Farm can be seen in **Table 10.5** above.

Table 10:8: Octave Band Spectrum of Enercon E82, 2.3MW

Octave Band Frequency (Hz)	63	125	250	500	1000	2000	4000	8000
Sound Power Level, dB LWA at 11 ms^{-1}	84.4	93	93.4	97	97.3	91	78.2	72.2
Uncertainty added to octaves and conversion of LAeq to LA90	-1	-1	-1	-1	-1	-1	-1	-1

Table 10: 9: Octave Band Spectrum of Enercon E70, 2.3MW

Octave Band Frequency (Hz)	63	125	250	500	1000	2000	4000	8000
Sound Power Level, dB LWA at 11 ms^{-1}	86.1	94.6	98.3	97.1	92.2	87.7	82.8	76.8
Uncertainty added to octaves and conversion of LAeq to LA90	-1	-1	-1	-1	-1	-1	-1	-1

10.4 NOISE LIMITS

The method of deriving operational noise limits, described in **Section 10.2.3.2,** is based on the Wind Energy Development Guidelines 2006.

The noise limits for the Moanmore Lower Wind Farm are designed to meet:

'Wind turbine noise arising from the proposed development, by itself or in combination with other existing or permitted wind energy development in the vicinity, shall not exceed:

- *the greater of 5 dB(A) L90,10min above background noise levels, or 45 dB(A) L90, 10min, at wind speeds of 5m/s or greater, between 07:00 and 23:00hrs:*
- *40 dB(A) L90, 10min, at all other wind speeds.*
- *43 dB(A) L90,10min at all other times*

where wind speeds are measured at 10m above ground level. Where properties are financially involved, a 45dB(A) L90,10min limit can be applied.'

10.5 CONSTRUCTION ASSESSMENT METHODOLOGY

10.5.1 Relevant Guidance

There is no published national guidance relating to the maximum permissible noise level that may be generated during the construction phase of a project. However National Roads Authority (NRA) give limit values which are acceptable (the NRA Guidelines)[22]. Guidance to predict and control noise is also given in BS 5228:2009-1+A12014, *Code of Practice for Noise and Vibration Control on Construction and Open Sites* (two parts) where Part 1 deal with Noise[23].

10.5.2 NRA Guidelines for the Treatment of Noise and Vibration in National Road Schemes

The NRA Guidelines provide noise limits which are acceptable and states that where it is deemed necessary to predict noise levels associated with construction noise that this should be done in accordance with BS 5228.

10.5.3 BS 5228: 2009-1A; 2014 Code of Practice for Noise and Vibration Control on Construction and Open Sites

Part 1 of BS5228 deals with noise prediction and control. It recommends procedures for noise control in respect of construction 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 receptors 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.

[22] National Roads Authority, *Guidelines for Noise and Vibration in National Road Schemes, 2014.*
[23] BS 5228-1: 2009 Code of Practice for Noise and Vibration Control on Construction and Open Sites: *Code of Practice for Basic Information and Procedures for Noise Control*.

- Substitution of plant or activities by 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
- 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 activities are provided, as are updated source levels for various plant, equipment and construction activities.

10.5.4 Construction and Decommissioning Noise Assessment Methodology

The NRA guidelines for construction noise which are considered acceptable are given in **Table 10.10**.

Table 10:10: Noise levels that are considered acceptable based on the NRA guidelines

Day / Times	Guideline Limits
Monday to Friday 07:00 – 19:00hrs 19:00 – 22:00hrs	 70dB LAeq, (1h) and LAmax 80dB *60dB LAeq, (1h) and LAmax 65dB*
Saturday 08:00 – 16:30hrs	 65dB LAeq,1h and LAmax75dB
Sunday and Bank Holidays 08:00 – 16:00hrs	 *60dB LAeq,1h and LAmax 65dB*

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

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

The proposed normal construction times for this Development are:

- Monday to Friday: 07.00 to 19.00hrs, Saturday 08.00 to 16.30hrs with no work on Sunday, or Bank Holidays.

Part 1 of BS 5228 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 LAeq, period level of construction noise exceeds lower threshold values of 65dB during daytime, 55dB during evenings and weekends or 45dB at night.
- The total noise level (pre-construction ambient noise plus construction noise) exceeds the pre-construction noise level by 5dB or more for a period of one month or more.

Construction noise from windfarm development, or decommissioning is not considered an intensive activity. The main noise sources will be associated with the HGV movements and construction of the Turbine Foundations and Turbine Hardstands. Lesser noise source activity will be construction of Site Access Tracks, temporary construction compound and turbine erection. It is proposed to construct an Electricity Substation on the Site, as shown on **Figure 1.2**. This will provide a connection point between the proposed wind farm and the existing grid connection at Tullabrack 110kV substation.

The Grid Connection can be summarised as follows:

- Underground Cable (UGC) single 38kV circuit from Moanmore wind farm utilising sections of UGC primarily public roads, regional roads, and private lands to Tullabrack substation. [approx. 1.69km]

Decommissioning will likely involve the remediation of Turbine Hardstand Areas and Turbine Foundations, where they will be covered in topsoil/peat 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 Development will be subject to the Health and Safety Authority Guidance[24] which states that for noise exposure noise levels likely to exceed 80 dBA (expressed as Lep,d 8 hour dBA) that 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'.

[24] Noise - Frequently Asked Questions - Health and Safety Authority (hsa.ie)

10.6 EVALUATION OF LIKELY SIGNIFICANT EFFECTS

The potential impacts of construction are evaluated by comparing the predicted noise levels against the guideline limits given in **Table 10.10.** Noise levels that are acceptable based on the NRA guidelines**,** and sample criteria in Part 1 of BS 5228 in **Section 10.5.4**.

The potential operational impacts are evaluated by comparing the predicted noise levels against the day and night-time noise limits given in **Section 10.7.5**. The predicted noise levels are carried out according to the IOA Good Practice Guide and potential impacts are assessed against the noise limits at the nearest receptors.

10.6.1 Sensitivity

The sensitivity of the Development during construction is based on the guideline values in **Table 10.10:** Noise levels that are acceptable based on the NRA guidelines**,** and sample criteria in Part 1 of BS 5228. The sensitivity of the Development during operation is based on the values in **Section 10.4.2** and **Section 10.4.4.3**.

10.6.2 Magnitude

The magnitude of potential impacts of construction is based on the values in **Table 10.14.** The magnitude of the Development during operation is based on the values in **Table 10.10**.

10.6.3 Significance Criteria

The significance of construction is based on the likely significant impacts based on the predicted values and compliance with the guideline limits in **Table 10.10** and sample criteria of in Part 1 of BS 5228.

The significance of the likely effects of the Development have been assessed by taking into account the noise limits at receptors and the degree to which compliance has been met.

10.7 BASELINE DESCRIPTION

10.7.1 Identification of Potential Receptors

A number of predictions were prepared for the layout of the windfarm. Based on the initial layout, potential noise-sensitive receptors including occupied and un-occupied dwellings were identified from maps. Receptor locations were verified through visits to the area surrounding the Development.

10.7.2 Selection of Baseline Noise Survey Locations

Three baseline noise survey locations were selected on the basis of their locations relative to the turbine layout.

10.7.3 Baseline Noise Survey

Baseline noise measurements were carried out continuously between 28th June and 28th July 2022 at the receptor locations given in **Table 10.11** (Photos of monitor in-situ in Technical **Appendix 10.1**).

Table 10: 11: Baseline Noise Survey

Location	ING Reference	Description of Location
H3	498244, 658551	Monitor located is in a field away from the house with main noise sources being road traffic and local farming activity.
H4	498376, 658551	Monitor located in the garden away from the house with main noise sources being distant road traffic and local farming activity.
H26	496650, 657481	Monitor located in the garden of the house with main noise sources being local farming and distant road traffic.

The survey was carried out in accordance with ISO 1996, ETSU-R-97 and the IOA Good Practice Guide 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 Development Site. The methodology is given in **Section 10.2.4.**
- The background noise measurement recorded continuously included 10-minute intervals, as LA90, 10min along with a series of other parameters including LAeq,10min.
- Noise measurements were recorded at a height of 1.2-1.5m above ground level and more than 5m from any reflective surface other than the porous ground.

- An electronic rain gauge was installed onsite at H3 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 10m wind speed was plotted against the time synchronised background noise levels using a best-fit polynomial line.

10.7.4 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 Conditions25'.
- Calibration Type: Larson Davis Precision Acoustic Calibrator.
- Rain Gauge Type: TR-525met tipping bucket rain gauge, 0.2mm pulse with LOGBOX datalogger

All acoustic instrumentation was calibrated before and after the survey and the drift of calibration was less than 0.3dB within accepted guidelines. Survey measurement data and calibration certificates of the acoustic instruments are included in Technical **Appendix 10.4.**

10.7.5 Prevailing Background Noise Levels

Table 10.12 gives the background noise levels obtained from quiet daytime and night-time measurement periods at the baseline measurement location. The main noise sources are dominant low road traffic on the N67. The area is not defined as a low noise environment in the WEDG06 as the daytime background is above 30dB LA90 for all location except one and it is below 30dB only at 4m/s wind speed.

Table 10:12: Prevailing Background Noise Levels

Monitoring Location		Prevailing Background (B/G) noise levels LA90dB, 10min Standardised Mean 10 m Height Wind Speed, (m/s)					
		4	5	6	7	8	9
H3	Day	29.0	31.4	33.8	36.0	37.5	38.0
	B/G+5	34.0	36.4	38.8	41	42.5	43
H3	Night	21.7	23.1	24.9	27.3	30.3	34.1
	B/G+5	26.7	28.1	29.9	32.3	35.3	39.1
H4	Day	38.4	38.6	39.0	40.0	41.9	45.1
	B/G+5	43.4	43.6	44.0	45.0	46.9	50.1

[25] W/31/00386/REP 'Noise Measurements in Windy Conditions'.

H4	Night	26.4	27.4	29.1	31.8	35.6	40.7
	B/G+5	31.4	32.4	34.1	26.8	40.6	45.7
H26	Day	31.0	33.7	36.5	38.9	40.5	41.0
	B/G+5	36.0	38.7	41.5	43.9	45.5	46.0
H26	Night	24.8	26.2	28.2	31.2	25.4	40.7
	B/G+5	29.8	32.2	33.5	36.2	40.4	45.7

10.7.6 Noise Assessment Locations

The monitoring locations were chosen so that the distance was sufficient to ensure no noise contribution from any of the other two operating wind farms. These locations away from busy roads also contributes to a low background noise, thereby allowing it to be used as a reference for all of the nearest receptor locations surrounding the proposal.

Should the predicted operational noise levels from the Development comply with the requirements of the 2006 Guidelines at the closest receptors, it may be assumed that the predicted noise levels at receptors further away from the Development will also comply, due to the attenuation of turbine noise levels with distance. The location is given in **Table 10.11.**

10.8 NOISE LIMITS

The noise limits for the Development are based on the limits contained within the Wind Energy Development Guidelines 2006 and on the background levels obtained in **Table 10.12**. A lower fixed limit of 45dBA for daytime could be applied, however a more stringent limit is applied with regard to the night-time. The lowest background noise levels obtained at location H3 used as the basis for the assessment at all receptors with a limit of 43dBA being applied for day and night, rather than the 45dB daytime level.

Table 10:13: Derived Background Day and Night Noise Levels used in Assessment

Monitoring Location	Prevailing Background (B/G) noise levels LA90dB, 10min Standardised Mean 10 m Height Wind Speed, (m/s)						
		4	5	6	7	8	9
H3	Day	29.0	31.4	33.8	36.0	37.5	38.0
	B/G+5	34.0	36.4	38.8	41	42.5	43
Noise Limit		43	43	43	43	43	43
H3	Night	21.7	23.1	24.9	27.3	30.3	34.1
	B/G+5	26.7	28.1	29.9	32.3	35.3	39.1
Noise Limit		43	43	43	43	43	43

10.9 DEVELOPMENT DESIGN MITIGATION

The preferred turbine model, the V136 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 2-3dBA depending on specific turbine used.

10.10 ASSESSMENT OF POTENTIAL EFFECTS

10.10.1 Construction Noise

10.10.1.1 Typical Construction and Decommissioning Noise Levels

As has been previously stated, the construction process associated with windfarms is not considered intensive and is temporary works, most of which is carried out at considerable distances from receptors as the turbines bases are at least 600m from any receptor location. The main noise sources will be associated with the construction of the Turbine Foundations, Turbine Hardstands, grid connection, processing in the borrow pit locations, with lesser sources being site access roads and construction of a 38kV substation. Decommissioning noise levels will be in the same order as construction levels but of shorter duration.

The material for the Development will be imported from local quarries via the local road network with the main road traffic noise being generated for a short period with delivery of concrete for the Turbine Foundations to take 6 days. Delivery of the turbines to the Development will generate very low noise levels as the vehicles transporting will travel at low speed.

It is not possible to specify the precise noise levels of emissions from the construction plant and equipment until such time as a contractor is chosen and construction plant has been selected. However, **Table 10.14** indicates typical construction related noise levels for this type of Development activity. Predictions are made for the nearest receptor to the Development and receptors at varying distances from the grid connection.

Table 10:14: Typical Noise Levels from Construction Works

Activity	L_{Aeq} at 10m
General Construction (pile driving, HGV's ready-mix trucks pouring concrete)	70-84dBA
Tracked excavator removing topsoil, subsoil for foundation	80- 87dBA

Activity	L_{Aeq} at 10m
Rock breaker, mobile crusher, vibratory rollers, trucks loading and tipping material	82-89dBA
Grid Connection: Trenching Tracked excavator 14t, pneumatic breaker, vibratory roller 71t, tractor	70-74dBA
Horizontal directional drilling: Drill Rig (diesel), mud pump, diesel generator /tractor	69-71dBA*
Spreading spoil, Tracked excavator and tractors	69-74
Road widening, Excavator and tractor trailer	70-74

*Recent measurements (2022) taken by author of HDD

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 3dBA where distances are more than 200m from a source and as zero within 200m -amelioration by barriers is not accounted for.

Table 10.15 gives 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, Grid connection. The development of the Site Access Tracks, construction of the new Onsite 38kV 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.

Road traffic is dealt with under a sub-heading within this section.

The maximum construction noise levels associated with the Development and Grid connection are listed in **Table 10.15.** 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 10.15**.

Table 10:15: Predicted Construction Noise Levels

Receptor	Activity taken as 100% per hour	LAeq dB 1hr range
H2-nearest house to a turbine	Foundation works: trucks pouring concrete, large tracked excavator moving topsoil/subsoil	30-47
H2-nearest house to a turbine	Rock breaking, vibratory roller, trucks loading/tipping	42-49
Grid connection: Trenching Receptors at varying distances	Tracked excavator 14t, pneumatic breaker, vibratory roller 71t, tractor	64-68 58-62 52-56
Grid Connection: Trenching Tracked excavator 14t, pneumatic breaker, vibratory roller 71t, tractor	At varying distances along route: 15m 20m 40m 80m	 67.5-70.5dBA 65-68dBA 59-62dBA 53-56dBA
Construction of compound (loading / tipping, excavator and Vibratory roller)	720m to nearest receptor	39.9-46.9dBA

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 650m^3 of concrete while each ready-mix truck has a capacity of 8m^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 1 hr LAeq alongside a haul road used by single engine items of mobile plant is:

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

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).

LAeq = 105-33 +10log16.2 – 10log60 – 10log20 = 53.3 LAeq 1hr.

At 10m from the roadside the noise levels equate to 56.3 LAeq 1hr. The trucking for the concrete pour will extend for a total of 3 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 110kV Substation to the Tullybrack 110kV 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.

10.10.2 Assessment of Construction Noise

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 4 hours at any receptor. All predicted noise levels are well within NRA guidelines 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 3 days' duration. The predicted noise levels are well within the NRA guidelines given as acceptable and are therefore considered as not significant.

The effects of noise and vibration from onsite construction activities are therefore considered not significant.

10.10.3 Description of Effects - Construction

The criteria for description of effects for all construction noise activity and the potential worst-case effects, at the nearest receptors is given below.

Table 10:16: Description of Effects – Construction

Quality	Significance	Duration
Negative	Not Significant	Temporary

10.10.4 Decommissioning

Noise effects during the Decommissioning phase of the Development are likely to be of a similar nature to that during construction but of shorter duration. Site Access Tracks and Turbine Foundations will be left in place and covered over with topsoil/peat. It is likely that the duration of the Decommissioning phase will be of shorter duration than that during construction. There will be no delivery of concrete to site during decommissioning which removes a major noise contributor during construction.

Any legislation, guidance, or best practice relevant at the time of decommissioning will be complied with.

10.10.5 Description of Effects – Decommissioning

The criteria for description of effects for all decommissioning noise activity and the potential worst-case effects, at the nearest receptors is given below.

Table 10:17: Description of Effects – Decommissioning

Quality	Significance	Duration
Negative	Not Significant	Temporary

10.11 PREDICTED OPERATIONAL NOISE LEVELS

Table 10.18 gives the predicted noise levels at the nearest receptors to the Development at varying wind speeds for each receptor location. A noise contour map of the 3 no. turbine Development at maximum sound power output at a wind speed of 7ms^{-1} at 10m height is presented in **Appendix 10.3**. The contour map in **Appendix 10.3** assumes that all turbines are simultaneously downwind to each location all of the time (continuously) which results in an overprediction of the noise levels.

Table 10:18: Predicted Noise Levels as LA90 at Varying Wind Speeds from the Development

House ID	ING Easting	ING Northing	4m/s dBA	5m/s dBA	6m/s dBA	7m/s dBA	8m/s dBA	9m/s dBA	10m/s dBA	11m/s dBA	12m/s dBA
H1*	498280	657469	35.7	39	39.4	39.4	39.4	39.4	39.4	39.4	39.4
H2	498287	658418	35.5	38.8	39.2	39.2	39.2	39.2	39.2	39.2	39.2
H3	497569	657205	35.8	39.1	39.5	39.5	39.5	39.5	39.5	39.5	39.5
H4	498382	657964	36.1	39.4	39.8	39.8	39.8	39.8	39.8	39.8	39.8
H5	498410	657916	35.8	39.1	39.5	39.5	39.5	39.5	39.5	39.5	39.5
H6	497486	658726	35.4	38.7	39.1	39.1	39.1	39.1	39.1	39.1	39.1
H7	498420	657877	35.6	38.9	39.3	39.3	39.3	39.3	39.3	39.3	39.3
H8	498432	657801	35.3	38.6	39	39	39	39	39	39	39
H9	498431	657843	35.4	38.7	39.1	39.1	39.1	39.1	39.1	39.1	39.1
H10	498261	658557	34.6	37.9	38.3	38.3	38.3	38.3	38.3	38.3	38.3
H11	498184	658653	34.4	37.7	38.1	38.1	38.1	38.1	38.1	38.1	38.1
H12	498456	657905	35.1	38.4	38.8	38.8	38.8	38.8	38.8	38.8	38.8
H13	498486	657830	34.7	38	38.4	38.4	38.4	38.4	38.4	38.4	38.4
H14	497318	658698	35.1	38.4	38.8	38.8	38.8	38.8	38.8	38.8	38.8
H15	498510	657780	34.3	37.6	38	38	38	38	38	38	38
H16	498533	657671	33.7	37	37.4	37.4	37.4	37.4	37.4	37.4	37.4
H17	498482	658243	34.1	37.4	37.8	37.8	37.8	37.8	37.8	37.8	37.8
H18	498172	658805	33	36.3	36.7	36.7	36.7	36.7	36.7	36.7	36.7
H19	498566	657577	33	36.3	36.7	36.7	36.7	36.7	36.7	36.7	36.7
H20	497071	658703	33.6	36.9	37.3	37.3	37.3	37.3	37.3	37.3	37.3
H21	498151	658844	32.7	36	36.4	36.4	36.4	36.4	36.4	36.4	36.4
H22	498150	658878	32.4	35.7	36.1	36.1	36.1	36.1	36.1	36.1	36.1
H23	498454	658590	32.6	35.9	36.3	36.3	36.3	36.3	36.3	36.3	36.3
H24	496946	658692	32.9	36.2	36.6	36.6	36.6	36.6	36.6	36.6	36.6
H25	496668	657439	32.1	35.4	35.8	35.8	35.8	35.8	35.8	35.8	35.8
H26	496635	657469	32	35.3	35.7	35.7	35.7	35.7	35.7	35.7	35.7
H27	498140	658917	32.1	35.4	35.8	35.8	35.8	35.8	35.8	35.8	35.8
H28	498492	658591	32.2	35.5	35.9	35.9	35.9	35.9	35.9	35.9	35.9
H29	496881	658695	32.4	35.7	36.1	36.1	36.1	36.1	36.1	36.1	36.1
H30	496848	658686	32.2	35.5	35.9	35.9	35.9	35.9	35.9	35.9	35.9
H31	496798	658676	31.9	35.2	35.6	35.6	35.6	35.6	35.6	35.6	35.6
H32	497329	656988	32.6	35.9	36.3	36.3	36.3	36.3	36.3	36.3	36.3
H33	497332	656948	32.2	35.5	35.9	35.9	35.9	35.9	35.9	35.9	35.9

House ID	ING Easting	ING Northing	4m/s dBA	5m/s dBA	6m/s dBA	7m/s dBA	8m/s dBA	9m/s dBA	10m/s dBA	11m/s dBA	12m/s dBA
H34	498181	656888	31	34.3	34.7	34.7	34.7	34.7	34.7	34.7	34.7
H35	496711	658683	31.2	34.5	34.9	34.9	34.9	34.9	34.9	34.9	34.9
H36	497339	656906	31.8	35.1	35.5	35.5	35.5	35.5	35.5	35.5	35.5
H37	498240	656887	30.7	34	34.4	34.4	34.4	34.4	34.4	34.4	34.4
H38	497332	656873	31.5	34.8	35.2	35.2	35.2	35.2	35.2	35.2	35.2
H39	498731	657336	30.4	33.7	34.1	34.1	34.1	34.1	34.1	34.1	34.1
H40	497362	656826	31.1	34.4	34.8	34.8	34.8	34.8	34.8	34.8	34.8
H41	497317	656843	31.1	34.4	34.8	34.8	34.8	34.8	34.8	34.8	34.8
H42	496704	658783	30.5	33.8	34.2	34.2	34.2	34.2	34.2	34.2	34.2
H43	498359	656875	30.1	33.4	33.8	33.8	33.8	33.8	33.8	33.8	33.8
H44	498334	656854	30	33.3	33.7	33.7	33.7	33.7	33.7	33.7	33.7
H45	496286	658061	29.8	33.1	33.5	33.5	33.5	33.5	33.5	33.5	33.5
H46	498311	656836	30	33.3	33.7	33.7	33.7	33.7	33.7	33.7	33.7
H47	498544	657009	30	33.3	33.7	33.7	33.7	33.7	33.7	33.7	33.7
H48	496739	658836	30.4	33.7	34.1	34.1	34.1	34.1	34.1	34.1	34.1
H49	498713	657205	30	33.3	33.7	33.7	33.7	33.7	33.7	33.7	33.7
H50	498884	657642	30.1	33.4	33.8	33.8	33.8	33.8	33.8	33.8	33.8
H51	498629	658803	29.9	33.2	33.6	33.6	33.6	33.6	33.6	33.6	33.6
H52	497087	656875	30.6	33.9	34.3	34.3	34.3	34.3	34.3	34.3	34.3
H53	497262	656801	30.6	33.9	34.3	34.3	34.3	34.3	34.3	34.3	34.3
H54	497290	656784	30.5	33.8	34.2	34.2	34.2	34.2	34.2	34.2	34.2
H55	498124	656683	29.4	32.7	33.1	33.1	33.1	33.1	33.1	33.1	33.1
H56	497114	656834	30.4	33.7	34.1	34.1	34.1	34.1	34.1	34.1	34.1
H57	497914	656633	29.5	32.8	33.2	33.2	33.2	33.2	33.2	33.2	33.2
H58	496940	659020	30.2	33.5	33.9	33.9	33.9	33.9	33.9	33.9	33.9
H59	498027	656637	29.3	32.6	33	33	33	33	33	33	33
H60	497885	656613	29.4	32.7	33.1	33.1	33.1	33.1	33.1	33.1	33.1
H61	498728	657071	29.2	32.5	32.9	32.9	32.9	32.9	32.9	32.9	32.9
H62	497376	656675	29.8	33.1	33.5	33.5	33.5	33.5	33.5	33.5	33.5
H63	497443	656650	29.7	33	33.4	33.4	33.4	33.4	33.4	33.4	33.4
H64	496886	656865	29.7	33	33.4	33.4	33.4	33.4	33.4	33.4	33.4
H65	497473	656635	29.6	32.9	33.3	33.3	33.3	33.3	33.3	33.3	33.3
H66	497857	656591	29.2	32.5	32.9	32.9	32.9	32.9	32.9	32.9	32.9
H67	497502	656615	29.5	32.8	33.2	33.2	33.2	33.2	33.2	33.2	33.2
H68	497832	656572	29.1	32.4	32.8	32.8	32.8	32.8	32.8	32.8	32.8

House ID	ING Easting	ING Northing	4m/s dBA	5m/s dBA	6m/s dBA	7m/s dBA	8m/s dBA	9m/s dBA	10m/s dBA	11m/s dBA	12m/s dBA
H69	497803	656555	29	32.3	32.7	32.7	32.7	32.7	32.7	32.7	32.7
H70	496312	658591	28.7	32	32.4	32.4	32.4	32.4	32.4	32.4	32.4
H71	498744	656992	28.6	31.9	32.3	32.3	32.3	32.3	32.3	32.3	32.3
H72	496277	658568	28.6	31.9	32.3	32.3	32.3	32.3	32.3	32.3	32.3
H73	498795	657042	28.6	31.9	32.3	32.3	32.3	32.3	32.3	32.3	32.3
H74	496707	656890	29	32.3	32.7	32.7	32.7	32.7	32.7	32.7	32.7
H75	496452	657094	28.7	32	32.4	32.4	32.4	32.4	32.4	32.4	32.4
H76	498847	658716	28.9	32.2	32.6	32.6	32.6	32.6	32.6	32.6	32.6
H77	496559	656976	28.7	32	32.4	32.4	32.4	32.4	32.4	32.4	32.4
H78	496506	657019	28.6	31.9	32.3	32.3	32.3	32.3	32.3	32.3	32.3
H79	499048	657629	28.7	32	32.4	32.4	32.4	32.4	32.4	32.4	32.4
H80	496597	656921	28.6	31.9	32.3	32.3	32.3	32.3	32.3	32.3	32.3
H81	497232	656617	29	32.3	32.7	32.7	32.7	32.7	32.7	32.7	32.7
H82	498850	657037	28.2	31.5	31.9	31.9	31.9	31.9	31.9	31.9	31.9
H83	497728	656482	28.4	31.7	32.1	32.1	32.1	32.1	32.1	32.1	32.1
H84	498763	656912	28.1	31.4	31.8	31.8	31.8	31.8	31.8	31.8	31.8
H85	496181	658531	28	31.3	31.7	31.7	31.7	31.7	31.7	31.7	31.7
H86	497786	656464	28.3	31.6	32	32	32	32	32	32	32
H87	498116	656502	28.1	31.4	31.8	31.8	31.8	31.8	31.8	31.8	31.8
H88	498155	656508	28	31.3	31.7	31.7	31.7	31.7	31.7	31.7	31.7
H89	498889	657037	28	31.3	31.7	31.7	31.7	31.7	31.7	31.7	31.7
H90	497247	656569	28.7	32	32.4	32.4	32.4	32.4	32.4	32.4	32.4
H91	498149	656490	27.9	31.2	31.6	31.6	31.6	31.6	31.6	31.6	31.6
H92	498785	656875	27.8	31.1	31.5	31.5	31.5	31.5	31.5	31.5	31.5
H93	496134	658563	27.6	30.9	31.3	31.3	31.3	31.3	31.3	31.3	31.3
H94	498752	656793	27.5	30.8	31.2	31.2	31.2	31.2	31.2	31.2	31.2
H95	496075	658482	27.4	30.7	31.1	31.1	31.1	31.1	31.1	31.1	31.1
H96	497374	659476	27.9	31.2	31.6	31.6	31.6	31.6	31.6	31.6	31.6
H97	497456	659513	27.8	31.1	31.5	31.5	31.5	31.5	31.5	31.5	31.5
H98	499204	657725	27.7	31	31.4	31.4	31.4	31.4	31.4	31.4	31.4
H99	496018	658458	27.1	30.4	30.8	30.8	30.8	30.8	30.8	30.8	30.8
H100	498989	656992	27.2	30.5	30.9	30.9	30.9	30.9	30.9	30.9	30.9
H101	498817	656759	27	30.3	30.7	30.7	30.7	30.7	30.7	30.7	30.7
H102	499243	657751	27.4	30.7	31.1	31.1	31.1	31.1	31.1	31.1	31.1
H103	496529	659156	27.4	30.7	31.1	31.1	31.1	31.1	31.1	31.1	31.1

House ID	ING Easting	ING Northing	4m/s dBA	5m/s dBA	6m/s dBA	7m/s dBA	8m/s dBA	9m/s dBA	10m/s dBA	11m/s dBA	12m/s dBA
H104	499263	657825	27.3	30.6	31	31	31	31	31	31	31
H105	495970	658467	26.7	30	30.4	30.4	30.4	30.4	30.4	30.4	30.4
H106	498105	656327	26.9	30.2	30.6	30.6	30.6	30.6	30.6	30.6	30.6
H107	498835	656719	26.7	30	30.4	30.4	30.4	30.4	30.4	30.4	30.4
H108	496187	657029	26.8	30.1	30.5	30.5	30.5	30.5	30.5	30.5	30.5
H109	499096	657055	26.8	30.1	30.5	30.5	30.5	30.5	30.5	30.5	30.5
H110	497702	659639	26.9	30.2	30.6	30.6	30.6	30.6	30.6	30.6	30.6
H111	496528	659201	27.1	30.4	30.8	30.8	30.8	30.8	30.8	30.8	30.8
H112	495919	658416	26.5	29.8	30.2	30.2	30.2	30.2	30.2	30.2	30.2
H113	498838	656683	26.5	29.8	30.2	30.2	30.2	30.2	30.2	30.2	30.2
H114	498848	656658	26.4	29.7	30.1	30.1	30.1	30.1	30.1	30.1	30.1
H115	495911	658504	26.3	29.6	30	30	30	30	30	30	30
H116	497726	659690	26.6	29.9	30.3	30.3	30.3	30.3	30.3	30.3	30.3
H117	497720	659702	26.5	29.8	30.2	30.2	30.2	30.2	30.2	30.2	30.2
H118	496527	659272	26.7	30	30.4	30.4	30.4	30.4	30.4	30.4	30.4
H119	498858	656627	26.2	29.5	29.9	29.9	29.9	29.9	29.9	29.9	29.9
H120	498877	656638	26.1	29.4	29.8	29.8	29.8	29.8	29.8	29.8	29.8
H121	497712	659720	26.4	29.7	30.1	30.1	30.1	30.1	30.1	30.1	30.1
H122	497666	659725	26.3	29.6	30	30	30	30	30	30	30
H123	498239	656248	26.1	29.4	29.8	29.8	29.8	29.8	29.8	29.8	29.8
H124	498867	656595	26	29.3	29.7	29.7	29.7	29.7	29.7	29.7	29.7
H125	496593	659367	26.5	29.8	30.2	30.2	30.2	30.2	30.2	30.2	30.2
H126	498275	656236	25.9	29.2	29.6	29.6	29.6	29.6	29.6	29.6	29.6
H127	498357	656259	25.9	29.2	29.6	29.6	29.6	29.6	29.6	29.6	29.6
H128	498877	656564	25.8	29.1	29.5	29.5	29.5	29.5	29.5	29.5	29.5
H129	495877	658649	25.7	29	29.4	29.4	29.4	29.4	29.4	29.4	29.4
H130	495792	657434	25.5	28.8	29.2	29.2	29.2	29.2	29.2	29.2	29.2
H131	498385	656239	25.7	29	29.4	29.4	29.4	29.4	29.4	29.4	29.4
H132	495879	658693	25.6	28.9	29.3	29.3	29.3	29.3	29.3	29.3	29.3
H133	495966	657036	25.6	28.9	29.3	29.3	29.3	29.3	29.3	29.3	29.3
H134	498323	656200	25.6	28.9	29.3	29.3	29.3	29.3	29.3	29.3	29.3
H135	499447	657920	26.1	29.4	29.8	29.8	29.8	29.8	29.8	29.8	29.8
H136	495869	658730	25.4	28.7	29.1	29.1	29.1	29.1	29.1	29.1	29.1
H137	498349	656194	25.5	28.8	29.2	29.2	29.2	29.2	29.2	29.2	29.2
H138	497726	659826	25.7	29	29.4	29.4	29.4	29.4	29.4	29.4	29.4

House ID	ING Easting	ING Northing	4m/s dBA	5m/s dBA	6m/s dBA	7m/s dBA	8m/s dBA	9m/s dBA	10m/s dBA	11m/s dBA	12m/s dBA
H139	498367	656184	25.4	28.7	29.1	29.1	29.1	29.1	29.1	29.1	29.1
H140	498380	656179	25.3	28.6	29	29	29	29	29	29	29
H141	499483	657944	25.8	29.1	29.5	29.5	29.5	29.5	29.5	29.5	29.5
H142**	495884	658812	25.3	28.6	29	29	29	29	29	29	29
H143	498443	656200	25.3	28.6	29	29	29	29	29	29	29
H144	498475	656182	25.1	28.4	28.8	28.8	28.8	28.8	28.8	28.8	28.8
H145	498414	656153	25.1	28.4	28.8	28.8	28.8	28.8	28.8	28.8	28.8
H146	495834	658794	25.1	28.4	28.8	28.8	28.8	28.8	28.8	28.8	28.8
H147	499465	657289	25.2	28.5	28.9	28.9	28.9	28.9	28.9	28.9	28.9
H148	495845	657055	25	28.3	28.7	28.7	28.7	28.7	28.7	28.7	28.7
H149	499543	657842	25.4	28.7	29.1	29.1	29.1	29.1	29.1	29.1	29.1
H150	498135	659862	25	28.3	28.7	28.7	28.7	28.7	28.7	28.7	28.7
H151	497459	656039	25.3	28.6	29	29	29	29	29	29	29
H152	495891	658951	24.9	28.2	28.6	28.6	28.6	28.6	28.6	28.6	28.6
H153	498477	656117	24.8	28.1	28.5	28.5	28.5	28.5	28.5	28.5	28.5
H154	495809	658871	24.7	28	28.4	28.4	28.4	28.4	28.4	28.4	28.4
H155	499595	658009	25.1	28.4	28.8	28.8	28.8	28.8	28.8	28.8	28.8
H156	498888	656317	24.5	27.8	28.2	28.2	28.2	28.2	28.2	28.2	28.2
H157	495831	658975	24.6	27.9	28.3	28.3	28.3	28.3	28.3	28.3	28.3
H158	498896	656287	24.4	27.7	28.1	28.1	28.1	28.1	28.1	28.1	28.1
H159	495816	659005	24.4	27.7	28.1	28.1	28.1	28.1	28.1	28.1	28.1
H160	498569	656079	24.3	27.6	28	28	28	28	28	28	28
H161	495676	657117	24.2	27.5	27.9	27.9	27.9	27.9	27.9	27.9	27.9
H162	498907	656261	24.2	27.5	27.9	27.9	27.9	27.9	27.9	27.9	27.9
H163	497537	660013	24.5	27.8	28.2	28.2	28.2	28.2	28.2	28.2	28.2
H164	498615	656073	24.2	27.5	27.9	27.9	27.9	27.9	27.9	27.9	27.9
H165	497275	655954	24.6	27.9	28.3	28.3	28.3	28.3	28.3	28.3	28.3
H166	499674	658050	24.7	28	28.4	28.4	28.4	28.4	28.4	28.4	28.4
H167	496916	659866	24.6	27.9	28.3	28.3	28.3	28.3	28.3	28.3	28.3
H168	498918	656226	24	27.3	27.7	27.7	27.7	27.7	27.7	27.7	27.7
H169	498745	656110	24	27.3	27.7	27.7	27.7	27.7	27.7	27.7	27.7
H170	495782	659054	24.1	27.4	27.8	27.8	27.8	27.8	27.8	27.8	27.8
H171	497902	655849	24.1	27.4	27.8	27.8	27.8	27.8	27.8	27.8	27.8
H172	497535	660067	24.2	27.5	27.9	27.9	27.9	27.9	27.9	27.9	27.9
H173	495793	659099	24	27.3	27.7	27.7	27.7	27.7	27.7	27.7	27.7

House ID	ING Easting	ING Northing	4m/s dBA	5m/s dBA	6m/s dBA	7m/s dBA	8m/s dBA	9m/s dBA	10m/s dBA	11m/s dBA	12m/s dBA
H174	498919	656196	23.9	27.2	27.6	27.6	27.6	27.6	27.6	27.6	27.6
H175	499694	657354	24.1	27.4	27.8	27.8	27.8	27.8	27.8	27.8	27.8
H176	498673	656022	23.8	27.1	27.5	27.5	27.5	27.5	27.5	27.5	27.5
H177	497990	660091	23.9	27.2	27.6	27.6	27.6	27.6	27.6	27.6	27.6
H178	497452	660089	24	27.3	27.7	27.7	27.7	27.7	27.7	27.7	27.7
H179	496934	659938	24.3	27.6	28	28	28	28	28	28	28
H180	498934	656167	23.7	27	27.4	27.4	27.4	27.4	27.4	27.4	27.4
H181	499156	656325	23.6	26.9	27.3	27.3	27.3	27.3	27.3	27.3	27.3
H182	498707	656005	23.6	26.9	27.3	27.3	27.3	27.3	27.3	27.3	27.3
H183	499750	657404	23.8	27.1	27.5	27.5	27.5	27.5	27.5	27.5	27.5

*H1 is an old house being used as a tack room and is not considered a sensitive receptor

**H142 Moyasta National School.

There is an inherent conservatism in the prediction noise modelling when it is carried out in line with ETSU-R-97 and the IOA GPG. Scientific papers referenced within the IOAGPG note that predicted noise levels are in the region of 2dB more conservative than the measured levels taken during post compliance monitoring. The maximum penalty applicable for AM is 5dB. There are fourteen properties within 5dB of the 43dB lower fixed limit, when all of the turbines are operating at their maximum noise levels.

The turbines to be installed on this site are able to operate in various modes. If specific conditions arise that AM is generated, the operator can amend the operating mode to sufficiently mitigate the generation of AM or reduce the overall noise level to achieved set noise limits.

10.11.1 Operational Noise Assessment

The assessment was made of the predicted operational noise levels from the Development based on the limits described in **Section 10.2.3.1** in the 2006 Guidelines .

As can be seen from **Table 10.19** the predicted noise levels at all receptors are lower than the noise limits in all cases, 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 worst case that all turbines are directly down-wind to nearest receptors (as per **Section 10.2.6**).

Table 10:19: Margin between Predicted Noise Levels and Noise Limit of 43dBA

	ITM	ITM	4m/s	5m/s	6m/s	7m/s	8m/s	9m/s	10m/s	11m/s	12m/s
House ID	Easting	Northing	dBA	dBA	dBA	dBA	dBA	dBA	dBA	dBA	dBA
H1	498280	657469	-7.3	-4	-3.6	-3.6	-3.6	-3.6	-3.6	-3.6	-3.6
H2	498287	658418	-7.5	-4.2	-3.8	-3.8	-3.8	-3.8	-3.8	-3.8	-3.8
H3	497569	657205	-7.2	-3.9	-3.5	-3.5	-3.5	-3.5	-3.5	-3.5	-3.5
H4	498382	657964	-6.9	-3.6	-3.2	-3.2	-3.2	-3.2	-3.2	-3.2	-3.2
H5	498410	657916	-7.2	-3.9	-3.5	-3.5	-3.5	-3.5	-3.5	-3.5	-3.5
H6	497486	658726	-7.6	-4.3	-3.9	-3.9	-3.9	-3.9	-3.9	-3.9	-3.9
H7	498420	657877	-7.4	-4.1	-3.7	-3.7	-3.7	-3.7	-3.7	-3.7	-3.7
H8	498432	657801	-7.7	-4.4	-4	-4	-4	-4	-4	-4	-4
H9	498431	657843	-7.6	-4.3	-3.9	-3.9	-3.9	-3.9	-3.9	-3.9	-3.9
H10	498261	658557	-8.4	-5.1	-4.7	-4.7	-4.7	-4.7	-4.7	-4.7	-4.7
H11	498184	658653	-8.6	-5.3	-4.9	-4.9	-4.9	-4.9	-4.9	-4.9	-4.9
H12	498456	657905	-7.9	-4.6	-4.2	-4.2	-4.2	-4.2	-4.2	-4.2	-4.2
H13	498486	657830	-8.3	-5	-4.6	-4.6	-4.6	-4.6	-4.6	-4.6	-4.6
H14	497318	658698	-7.9	-4.6	-4.2	-4.2	-4.2	-4.2	-4.2	-4.2	-4.2
H15	498510	657780	-8.7	-5.4	-5	-5	-5	-5	-5	-5	-5
H16	498533	657671	-9.3	-6	-5.6	-5.6	-5.6	-5.6	-5.6	-5.6	-5.6
H17	498482	658243	-8.9	-5.6	-5.2	-5.2	-5.2	-5.2	-5.2	-5.2	-5.2
H18	498172	658805	-10	-6.7	-6.3	-6.3	-6.3	-6.3	-6.3	-6.3	-6.3
H19	498566	657577	-10	-6.7	-6.3	-6.3	-6.3	-6.3	-6.3	-6.3	-6.3
H20	497071	658703	-9.4	-6.1	-5.7	-5.7	-5.7	-5.7	-5.7	-5.7	-5.7
H21	498151	658844	-10.3	-7	-6.6	-6.6	-6.6	-6.6	-6.6	-6.6	-6.6
H22	498150	658878	-10.6	-7.3	-6.9	-6.9	-6.9	-6.9	-6.9	-6.9	-6.9
H23	498454	658590	-10.4	-7.1	-6.7	-6.7	-6.7	-6.7	-6.7	-6.7	-6.7
H24	496946	658692	-10.1	-6.8	-6.4	-6.4	-6.4	-6.4	-6.4	-6.4	-6.4
H25	496668	657439	-10.9	-7.6	-7.2	-7.2	-7.2	-7.2	-7.2	-7.2	-7.2
H26	496635	657469	-11	-7.7	-7.3	-7.3	-7.3	-7.3	-7.3	-7.3	-7.3
H27	498140	658917	-10.9	-7.6	-7.2	-7.2	-7.2	-7.2	-7.2	-7.2	-7.2
H28	498492	658591	-10.8	-7.5	-7.1	-7.1	-7.1	-7.1	-7.1	-7.1	-7.1
H29	496881	658695	-10.6	-7.3	-6.9	-6.9	-6.9	-6.9	-6.9	-6.9	-6.9
H30	496848	658686	-10.8	-7.5	-7.1	-7.1	-7.1	-7.1	-7.1	-7.1	-7.1
H31	496798	658676	-11.1	-7.8	-7.4	-7.4	-7.4	-7.4	-7.4	-7.4	-7.4

House ID	ITM Easting	ITM Northing	4m/s dBA	5m/s dBA	6m/s dBA	7m/s dBA	8m/s dBA	9m/s dBA	10m/s dBA	11m/s dBA	12m/s dBA
H32	497329	656988	-10.4	-7.1	-6.7	-6.7	-6.7	-6.7	-6.7	-6.7	-6.7
H33	497332	656948	-10.8	-7.5	-7.1	-7.1	-7.1	-7.1	-7.1	-7.1	-7.1
H34	498181	656888	-12	-8.7	-8.3	-8.3	-8.3	-8.3	-8.3	-8.3	-8.3
H35	496711	658683	-11.8	-8.5	-8.1	-8.1	-8.1	-8.1	-8.1	-8.1	-8.1
H36	497339	656906	-11.2	-7.9	-7.5	-7.5	-7.5	-7.5	-7.5	-7.5	-7.5
H37	498240	656887	-12.3	-9	-8.6	-8.6	-8.6	-8.6	-8.6	-8.6	-8.6
H38	497332	656873	-11.5	-8.2	-7.8	-7.8	-7.8	-7.8	-7.8	-7.8	-7.8
H39	498731	657336	-12.6	-9.3	-8.9	-8.9	-8.9	-8.9	-8.9	-8.9	-8.9
H40	497362	656826	-11.9	-8.6	-8.2	-8.2	-8.2	-8.2	-8.2	-8.2	-8.2
H41	497317	656843	-11.9	-8.6	-8.2	-8.2	-8.2	-8.2	-8.2	-8.2	-8.2
H42	496704	658783	-12.5	-9.2	-8.8	-8.8	-8.8	-8.8	-8.8	-8.8	-8.8
H43	498359	656875	-12.9	-9.6	-9.2	-9.2	-9.2	-9.2	-9.2	-9.2	-9.2
H44	498334	656854	-13	-9.7	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3
H45	496286	658061	-13.2	-9.9	-9.5	-9.5	-9.5	-9.5	-9.5	-9.5	-9.5
H46	498311	656836	-13	-9.7	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3
H47	498544	657009	-13	-9.7	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3
H48	496739	658836	-12.6	-9.3	-8.9	-8.9	-8.9	-8.9	-8.9	-8.9	-8.9
H49	498713	657205	-13	-9.7	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3	-9.3
H50	498884	657642	-12.9	-9.6	-9.2	-9.2	-9.2	-9.2	-9.2	-9.2	-9.2
H51	498629	658803	-13.1	-9.8	-9.4	-9.4	-9.4	-9.4	-9.4	-9.4	-9.4
H52	497087	656875	-12.4	-9.1	-8.7	-8.7	-8.7	-8.7	-8.7	-8.7	-8.7
H53	497262	656801	-12.4	-9.1	-8.7	-8.7	-8.7	-8.7	-8.7	-8.7	-8.7
H54	497290	656784	-12.5	-9.2	-8.8	-8.8	-8.8	-8.8	-8.8	-8.8	-8.8
H55	498124	656683	-13.6	-10.3	-9.9	-9.9	-9.9	-9.9	-9.9	-9.9	-9.9
H56	497114	656834	-12.6	-9.3	-8.9	-8.9	-8.9	-8.9	-8.9	-8.9	-8.9
H57	497914	656633	-13.5	-10.2	-9.8	-9.8	-9.8	-9.8	-9.8	-9.8	-9.8
H58	496940	659020	-12.8	-9.5	-9.1	-9.1	-9.1	-9.1	-9.1	-9.1	-9.1
H59	498027	656637	-13.7	-10.4	-10	-10	-10	-10	-10	-10	-10
H60	497885	656613	-13.6	-10.3	-9.9	-9.9	-9.9	-9.9	-9.9	-9.9	-9.9
H61	498728	657071	-13.8	-10.5	-10.1	-10.1	-10.1	-10.1	-10.1	-10.1	-10.1
H62	497376	656675	-13.2	-9.9	-9.5	-9.5	-9.5	-9.5	-9.5	-9.5	-9.5
H63	497443	656650	-13.3	-10	-9.6	-9.6	-9.6	-9.6	-9.6	-9.6	-9.6
H64	496886	656865	-13.3	-10	-9.6	-9.6	-9.6	-9.6	-9.6	-9.6	-9.6
H65	497473	656635	-13.4	-10.1	-9.7	-9.7	-9.7	-9.7	-9.7	-9.7	-9.7
H66	497857	656591	-13.8	-10.5	-10.1	-10.1	-10.1	-10.1	-10.1	-10.1	-10.1

House ID	ITM Easting	ITM Northing	4m/s dBA	5m/s dBA	6m/s dBA	7m/s dBA	8m/s dBA	9m/s dBA	10m/s dBA	11m/s dBA	12m/s dBA
H67	497502	656615	-13.5	-10.2	-9.8	-9.8	-9.8	-9.8	-9.8	-9.8	-9.8
H68	497832	656572	-13.9	-10.6	-10.2	-10.2	-10.2	-10.2	-10.2	-10.2	-10.2
H69	497803	656555	-14	-10.7	-10.3	-10.3	-10.3	-10.3	-10.3	-10.3	-10.3
H70	496312	658591	-14.3	-11	-10.6	-10.6	-10.6	-10.6	-10.6	-10.6	-10.6
H71	498744	656992	-14.4	-11.1	-10.7	-10.7	-10.7	-10.7	-10.7	-10.7	-10.7
H72	496277	658568	-14.4	-11.1	-10.7	-10.7	-10.7	-10.7	-10.7	-10.7	-10.7
H73	498795	657042	-14.4	-11.1	-10.7	-10.7	-10.7	-10.7	-10.7	-10.7	-10.7
H74	496707	656890	-14	-10.7	-10.3	-10.3	-10.3	-10.3	-10.3	-10.3	-10.3
H75	496452	657094	-14.3	-11	-10.6	-10.6	-10.6	-10.6	-10.6	-10.6	-10.6
H76	498847	658716	-14.1	-10.8	-10.4	-10.4	-10.4	-10.4	-10.4	-10.4	-10.4
H77	496559	656976	-14.3	-11	-10.6	-10.6	-10.6	-10.6	-10.6	-10.6	-10.6
H78	496506	657019	-14.4	-11.1	-10.7	-10.7	-10.7	-10.7	-10.7	-10.7	-10.7
H79	499048	657629	-14.3	-11	-10.6	-10.6	-10.6	-10.6	-10.6	-10.6	-10.6
H80	496597	656921	-14.4	-11.1	-10.7	-10.7	-10.7	-10.7	-10.7	-10.7	-10.7
H81	497232	656617	-14	-10.7	-10.3	-10.3	-10.3	-10.3	-10.3	-10.3	-10.3
H82	498850	657037	-14.8	-11.5	-11.1	-11.1	-11.1	-11.1	-11.1	-11.1	-11.1
H83	497728	656482	-14.6	-11.3	-10.9	-10.9	-10.9	-10.9	-10.9	-10.9	-10.9
H84	498763	656912	-14.9	-11.6	-11.2	-11.2	-11.2	-11.2	-11.2	-11.2	-11.2
H85	496181	658531	-15	-11.7	-11.3	-11.3	-11.3	-11.3	-11.3	-11.3	-11.3
H86	497786	656464	-14.7	-11.4	-11	-11	-11	-11	-11	-11	-11
H87	498116	656502	-14.9	-11.6	-11.2	-11.2	-11.2	-11.2	-11.2	-11.2	-11.2
H88	498155	656508	-15	-11.7	-11.3	-11.3	-11.3	-11.3	-11.3	-11.3	-11.3
H89	498889	657037	-15	-11.7	-11.3	-11.3	-11.3	-11.3	-11.3	-11.3	-11.3
H90	497247	656569	-14.3	-11	-10.6	-10.6	-10.6	-10.6	-10.6	-10.6	-10.6
H91	498149	656490	-15.1	-11.8	-11.4	-11.4	-11.4	-11.4	-11.4	-11.4	-11.4
H92	498785	656875	-15.2	-11.9	-11.5	-11.5	-11.5	-11.5	-11.5	-11.5	-11.5
H93	496134	658563	-15.4	-12.1	-11.7	-11.7	-11.7	-11.7	-11.7	-11.7	-11.7
H94	498752	656793	-15.5	-12.2	-11.8	-11.8	-11.8	-11.8	-11.8	-11.8	-11.8
H95	496075	658482	-15.6	-12.3	-11.9	-11.9	-11.9	-11.9	-11.9	-11.9	-11.9
H96	497374	659476	-15.1	-11.8	-11.4	-11.4	-11.4	-11.4	-11.4	-11.4	-11.4
H97	497456	659513	-15.2	-11.9	-11.5	-11.5	-11.5	-11.5	-11.5	-11.5	-11.5
H98	499204	657725	-15.3	-12	-11.6	-11.6	-11.6	-11.6	-11.6	-11.6	-11.6
H99	496018	658458	-15.9	-12.6	-12.2	-12.2	-12.2	-12.2	-12.2	-12.2	-12.2
H100	498989	656992	-15.8	-12.5	-12.1	-12.1	-12.1	-12.1	-12.1	-12.1	-12.1
H101	498817	656759	-16	-12.7	-12.3	-12.3	-12.3	-12.3	-12.3	-12.3	-12.3

House ID	ITM Easting	ITM Northing	4m/s dBA	5m/s dBA	6m/s dBA	7m/s dBA	8m/s dBA	9m/s dBA	10m/s dBA	11m/s dBA	12m/s dBA
H102	499243	657751	-15.6	-12.3	-11.9	-11.9	-11.9	-11.9	-11.9	-11.9	-11.9
H103	496529	659156	-15.6	-12.3	-11.9	-11.9	-11.9	-11.9	-11.9	-11.9	-11.9
H104	499263	657825	-15.7	-12.4	-12	-12	-12	-12	-12	-12	-12
H105	495970	658467	-16.3	-13	-12.6	-12.6	-12.6	-12.6	-12.6	-12.6	-12.6
H106	498105	656327	-16.1	-12.8	-12.4	-12.4	-12.4	-12.4	-12.4	-12.4	-12.4
H107	498835	656719	-16.3	-13	-12.6	-12.6	-12.6	-12.6	-12.6	-12.6	-12.6
H108	496187	657029	-16.2	-12.9	-12.5	-12.5	-12.5	-12.5	-12.5	-12.5	-12.5
H109	499096	657055	-16.2	-12.9	-12.5	-12.5	-12.5	-12.5	-12.5	-12.5	-12.5
H110	497702	659639	-16.1	-12.8	-12.4	-12.4	-12.4	-12.4	-12.4	-12.4	-12.4
H111	496528	659201	-15.9	-12.6	-12.2	-12.2	-12.2	-12.2	-12.2	-12.2	-12.2
H112	495919	658416	-16.5	-13.2	-12.8	-12.8	-12.8	-12.8	-12.8	-12.8	-12.8
H113	498838	656683	-16.5	-13.2	-12.8	-12.8	-12.8	-12.8	-12.8	-12.8	-12.8
H114	498848	656658	-16.6	-13.3	-12.9	-12.9	-12.9	-12.9	-12.9	-12.9	-12.9
H115	495911	658504	-16.7	-13.4	-13	-13	-13	-13	-13	-13	-13
H116	497726	659690	-16.4	-13.1	-12.7	-12.7	-12.7	-12.7	-12.7	-12.7	-12.7
H117	497720	659702	-16.5	-13.2	-12.8	-12.8	-12.8	-12.8	-12.8	-12.8	-12.8
H118	496527	659272	-16.3	-13	-12.6	-12.6	-12.6	-12.6	-12.6	-12.6	-12.6
H119	498858	656627	-16.8	-13.5	-13.1	-13.1	-13.1	-13.1	-13.1	-13.1	-13.1
H120	498877	656638	-16.9	-13.6	-13.2	-13.2	-13.2	-13.2	-13.2	-13.2	-13.2
H121	497712	659720	-16.6	-13.3	-12.9	-12.9	-12.9	-12.9	-12.9	-12.9	-12.9
H122	497666	659725	-16.7	-13.4	-13	-13	-13	-13	-13	-13	-13
H123	498239	656248	-16.9	-13.6	-13.2	-13.2	-13.2	-13.2	-13.2	-13.2	-13.2
H124	498867	656595	-17	-13.7	-13.3	-13.3	-13.3	-13.3	-13.3	-13.3	-13.3
H125	496593	659367	-16.5	-13.2	-12.8	-12.8	-12.8	-12.8	-12.8	-12.8	-12.8
H126	498275	656236	-17.1	-13.8	-13.4	-13.4	-13.4	-13.4	-13.4	-13.4	-13.4
H127	498357	656259	-17.1	-13.8	-13.4	-13.4	-13.4	-13.4	-13.4	-13.4	-13.4
H128	498877	656564	-17.2	-13.9	-13.5	-13.5	-13.5	-13.5	-13.5	-13.5	-13.5
H129	495877	658649	-17.3	-14	-13.6	-13.6	-13.6	-13.6	-13.6	-13.6	-13.6
H130	495792	657434	-17.5	-14.2	-13.8	-13.8	-13.8	-13.8	-13.8	-13.8	-13.8
H131	498385	656239	-17.3	-14	-13.6	-13.6	-13.6	-13.6	-13.6	-13.6	-13.6
H132	495879	658693	-17.4	-14.1	-13.7	-13.7	-13.7	-13.7	-13.7	-13.7	-13.7
H133	495966	657036	-17.4	-14.1	-13.7	-13.7	-13.7	-13.7	-13.7	-13.7	-13.7
H134	498323	656200	-17.4	-14.1	-13.7	-13.7	-13.7	-13.7	-13.7	-13.7	-13.7
H135	499447	657920	-16.9	-13.6	-13.2	-13.2	-13.2	-13.2	-13.2	-13.2	-13.2
H136	495869	658730	-17.6	-14.3	-13.9	-13.9	-13.9	-13.9	-13.9	-13.9	-13.9

House ID	ITM Easting	ITM Northing	4m/s dBA	5m/s dBA	6m/s dBA	7m/s dBA	8m/s dBA	9m/s dBA	10m/s dBA	11m/s dBA	12m/s dBA
H137	498349	656194	-17.5	-14.2	-13.8	-13.8	-13.8	-13.8	-13.8	-13.8	-13.8
H138	497726	659826	-17.3	-14	-13.6	-13.6	-13.6	-13.6	-13.6	-13.6	-13.6
H139	498367	656184	-17.6	-14.3	-13.9	-13.9	-13.9	-13.9	-13.9	-13.9	-13.9
H140	498380	656179	-17.7	-14.4	-14	-14	-14	-14	-14	-14	-14
H141	499483	657944	-17.2	-13.9	-13.5	-13.5	-13.5	-13.5	-13.5	-13.5	-13.5
H142	495884	658812	-17.7	-14.4	-14	-14	-14	-14	-14	-14	-14
H143	498443	656200	-17.7	-14.4	-14	-14	-14	-14	-14	-14	-14
H144	498475	656182	-17.9	-14.6	-14.2	-14.2	-14.2	-14.2	-14.2	-14.2	-14.2
H145	498414	656153	-17.9	-14.6	-14.2	-14.2	-14.2	-14.2	-14.2	-14.2	-14.2
H146	495834	658794	-17.9	-14.6	-14.2	-14.2	-14.2	-14.2	-14.2	-14.2	-14.2
H147	499465	657289	-17.8	-14.5	-14.1	-14.1	-14.1	-14.1	-14.1	-14.1	-14.1
H148	495845	657055	-18	-14.7	-14.3	-14.3	-14.3	-14.3	-14.3	-14.3	-14.3
H149	499543	657842	-17.6	-14.3	-13.9	-13.9	-13.9	-13.9	-13.9	-13.9	-13.9
H150	498135	659862	-18	-14.7	-14.3	-14.3	-14.3	-14.3	-14.3	-14.3	-14.3
H151	497459	656039	-17.7	-14.4	-14	-14	-14	-14	-14	-14	-14
H152	495891	658951	-18.1	-14.8	-14.4	-14.4	-14.4	-14.4	-14.4	-14.4	-14.4
H153	498477	656117	-18.2	-14.9	-14.5	-14.5	-14.5	-14.5	-14.5	-14.5	-14.5
H154	495809	658871	-18.3	-15	-14.6	-14.6	-14.6	-14.6	-14.6	-14.6	-14.6
H155	499595	658009	-17.9	-14.6	-14.2	-14.2	-14.2	-14.2	-14.2	-14.2	-14.2
H156	498888	656317	-18.5	-15.2	-14.8	-14.8	-14.8	-14.8	-14.8	-14.8	-14.8
H157	495831	658975	-18.4	-15.1	-14.7	-14.7	-14.7	-14.7	-14.7	-14.7	-14.7
H158	498896	656287	-18.6	-15.3	-14.9	-14.9	-14.9	-14.9	-14.9	-14.9	-14.9
H159	495816	659005	-18.6	-15.3	-14.9	-14.9	-14.9	-14.9	-14.9	-14.9	-14.9
H160	498569	656079	-18.7	-15.4	-15	-15	-15	-15	-15	-15	-15
H161	495676	657117	-18.8	-15.5	-15.1	-15.1	-15.1	-15.1	-15.1	-15.1	-15.1
H162	498907	656261	-18.8	-15.5	-15.1	-15.1	-15.1	-15.1	-15.1	-15.1	-15.1
H163	497537	660013	-18.5	-15.2	-14.8	-14.8	-14.8	-14.8	-14.8	-14.8	-14.8
H164	498615	656073	-18.8	-15.5	-15.1	-15.1	-15.1	-15.1	-15.1	-15.1	-15.1
H165	497275	655954	-18.4	-15.1	-14.7	-14.7	-14.7	-14.7	-14.7	-14.7	-14.7
H166	499674	658050	-18.3	-15	-14.6	-14.6	-14.6	-14.6	-14.6	-14.6	-14.6
H167	496916	659866	-18.4	-15.1	-14.7	-14.7	-14.7	-14.7	-14.7	-14.7	-14.7
H168	498918	656226	-19	-15.7	-15.3	-15.3	-15.3	-15.3	-15.3	-15.3	-15.3
H169	498745	656110	-19	-15.7	-15.3	-15.3	-15.3	-15.3	-15.3	-15.3	-15.3
H170	495782	659054	-18.9	-15.6	-15.2	-15.2	-15.2	-15.2	-15.2	-15.2	-15.2
H171	497902	655849	-18.9	-15.6	-15.2	-15.2	-15.2	-15.2	-15.2	-15.2	-15.2

House ID	ITM Easting	ITM Northing	4m/s dBA	5m/s dBA	6m/s dBA	7m/s dBA	8m/s dBA	9m/s dBA	10m/s dBA	11m/s dBA	12m/s dBA
H172	497535	660067	-18.8	-15.5	-15.1	-15.1	-15.1	-15.1	-15.1	-15.1	-15.1
H173	495793	659099	-19	-15.7	-15.3	-15.3	-15.3	-15.3	-15.3	-15.3	-15.3
H174	498919	656196	-19.1	-15.8	-15.4	-15.4	-15.4	-15.4	-15.4	-15.4	-15.4
H175	499694	657354	-18.9	-15.6	-15.2	-15.2	-15.2	-15.2	-15.2	-15.2	-15.2
H176	498673	656022	-19.2	-15.9	-15.5	-15.5	-15.5	-15.5	-15.5	-15.5	-15.5
H177	497990	660091	-19.1	-15.8	-15.4	-15.4	-15.4	-15.4	-15.4	-15.4	-15.4
H178	497452	660089	-19	-15.7	-15.3	-15.3	-15.3	-15.3	-15.3	-15.3	-15.3
H179	496934	659938	-18.7	-15.4	-15	-15	-15	-15	-15	-15	-15
H180	498934	656167	-19.3	-16	-15.6	-15.6	-15.6	-15.6	-15.6	-15.6	-15.6
H181	499156	656325	-19.4	-16.1	-15.7	-15.7	-15.7	-15.7	-15.7	-15.7	-15.7
H182	498707	656005	-19.4	-16.1	-15.7	-15.7	-15.7	-15.7	-15.7	-15.7	-15.7
H183	499750	657404	-19.2	-15.9	-15.5	-15.5	-15.5	-15.5	-15.5	-15.5	-15.5

A noise contour map of the cumulative effects of all three turbines is presented with a maximum sound power output at a wind speed of 7ms^{-1} at 10m height in **Appendix 10.3**. The contour map in **Appendix 10.3** assumes that all turbines are propagating noise simultaneously in a downwind direction to each location which results in an overprediction of the noise levels, representing the worst case scenario.

Charts 10.1 to **10.6** of this section plots the derived background noise levels, background plus 5 trendline with the predicted noise levels against a noise limit of 43dB(A).

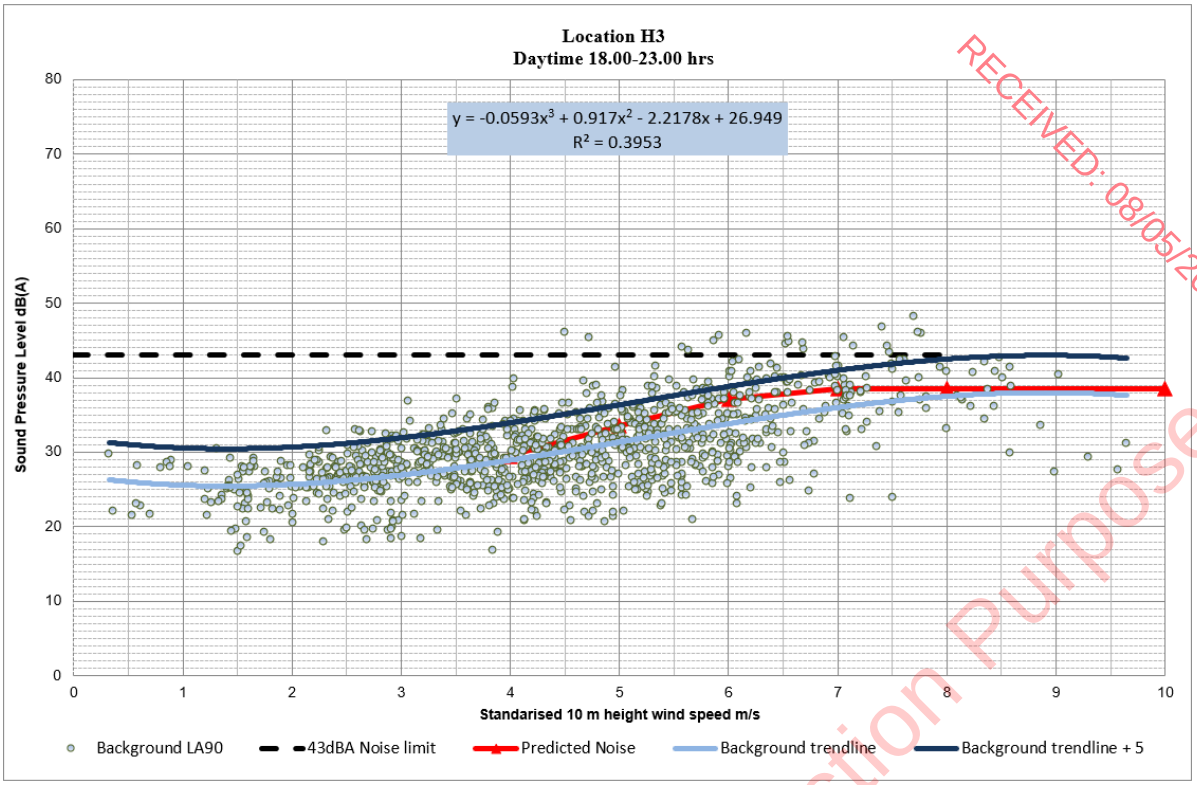


Chart 10.1: H3 for daytime, background noise level, predicted level and assessment limit

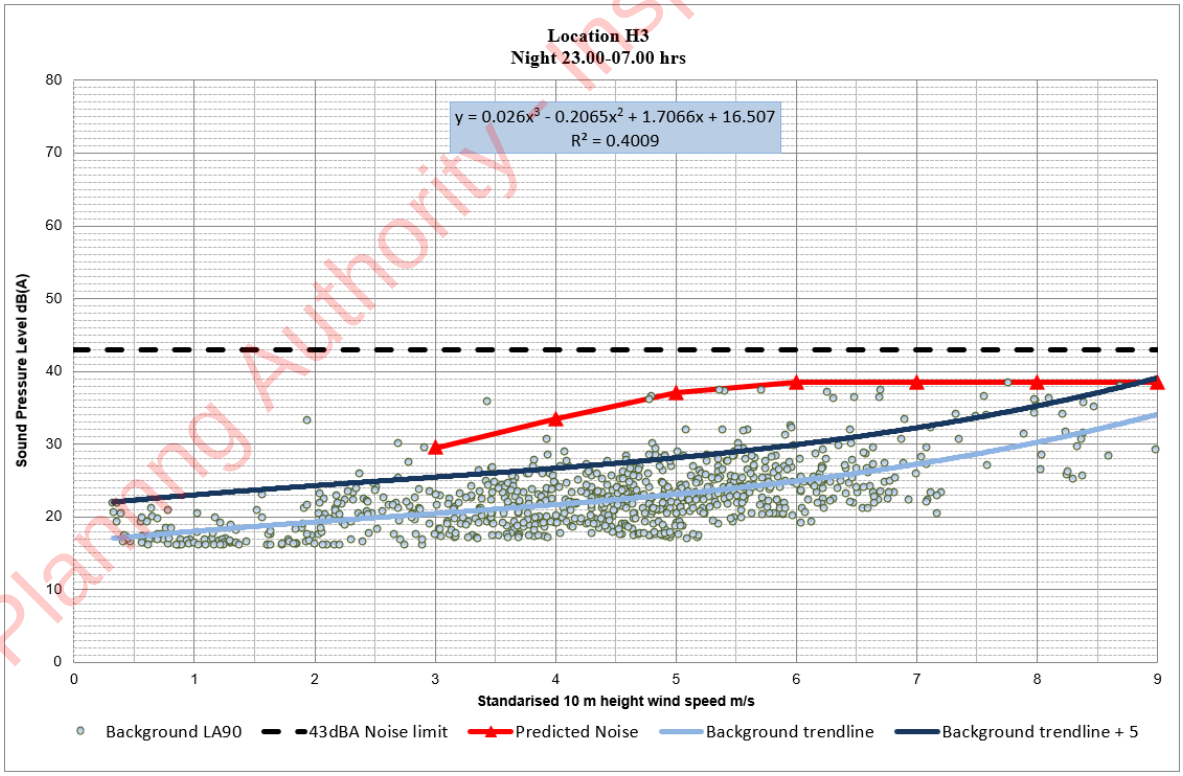


Chart 10.2: H3 for night-time, background noise level, predicted level and assessment limit

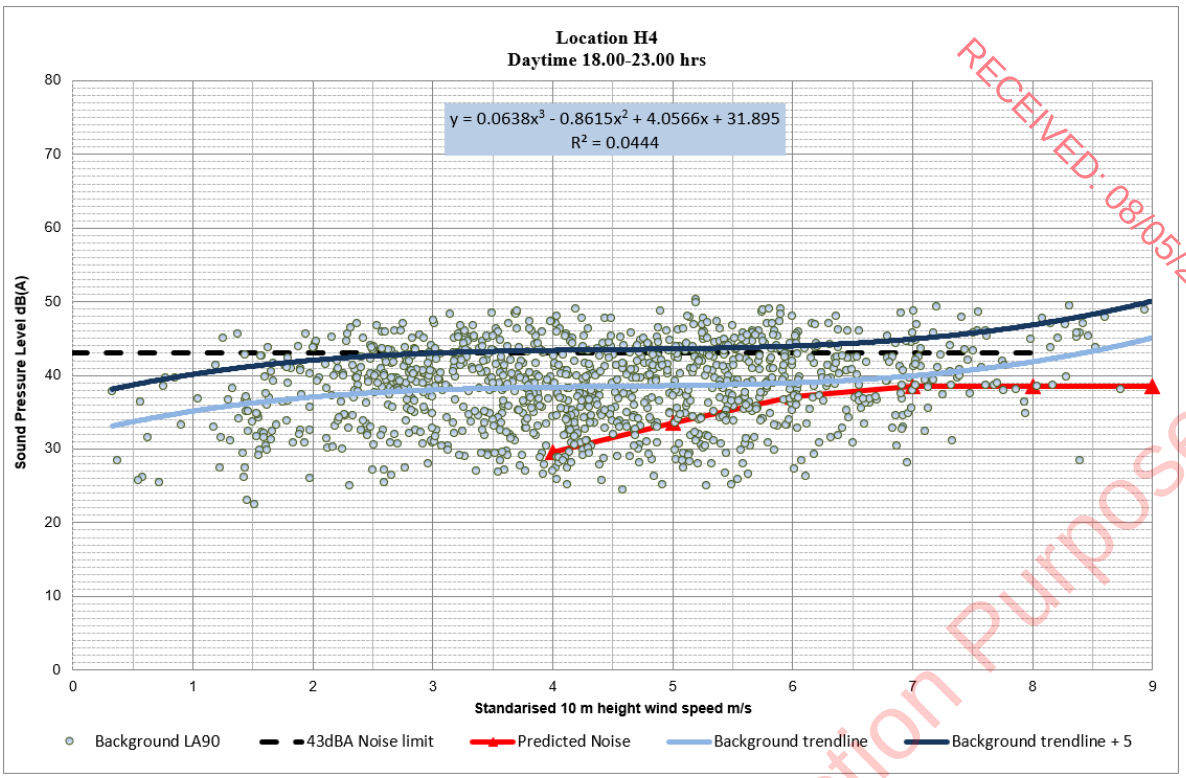


Chart 10.3: H4 for daytime, background noise level, predicted level and assessment limit

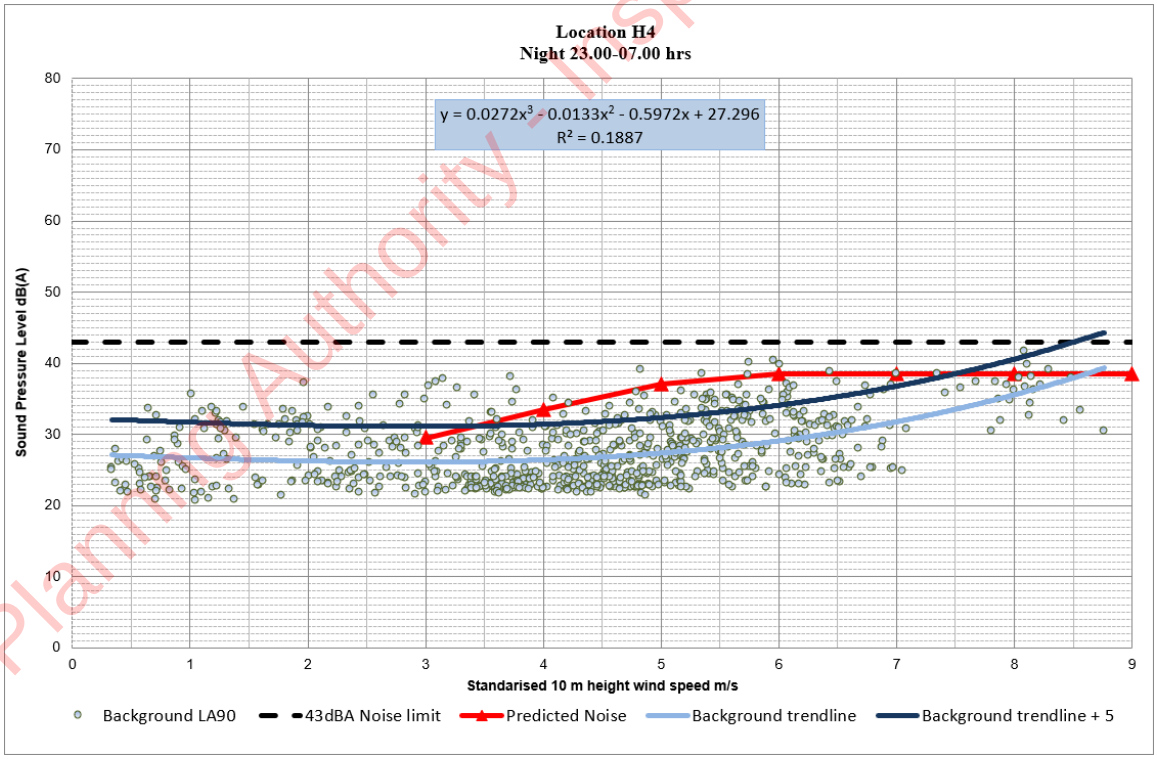


Chart 10.4: H4 for night-time, background noise level, predicted level and assessment limit

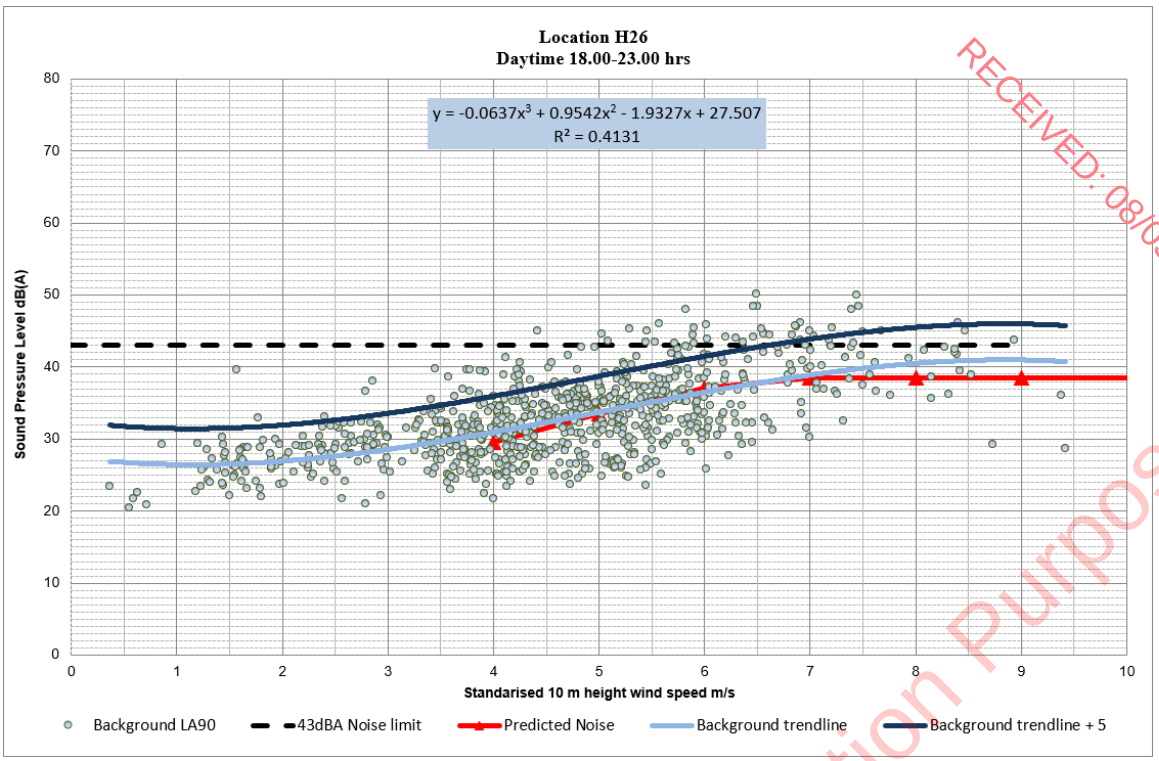


Chart 10.5: H26 for daytime, background noise level, predicted level and assessment limit

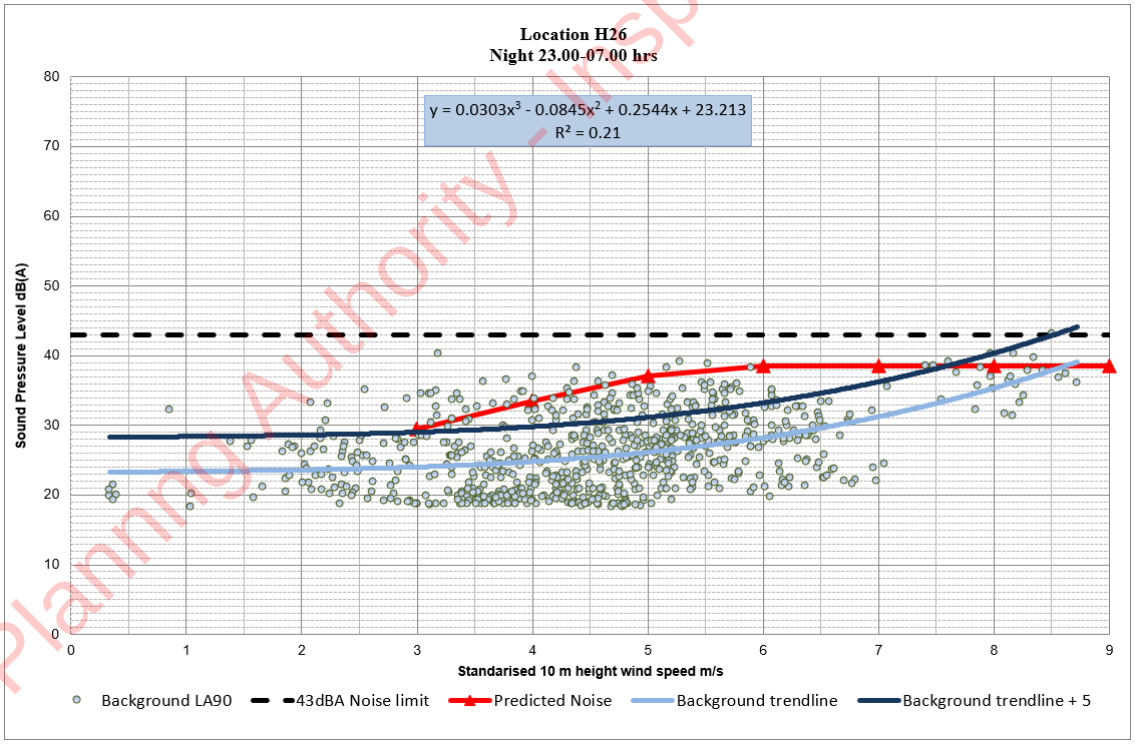


Chart 10.6: H26 for night-time, background noise level, predicted level and assessment limit

10.12 CUMULATIVE EFFECTS ASSESSMENT

An assessment of the cumulative effects of noise from the Development together with both the nearby six turbine operational Tullabrack Wind Farm, seven turbine operational Moanmore

Wind Farm, and recently submitted four turbine Ballykett Wind Farm located west-northwest and east of the Development has been undertaken.

10.12.1 Cumulative assessment locations

The same receptor locations used for the Development are also used in the cumulative assessment. The assessment is a worst-case scenario with the assumption made that the predicted noise levels to receptors are downwind from both wind farms and individual turbines are at the same time, a scenario that cannot occur in practise.

10.12.2 Noise Limits

The noise limits are the same as that used in **Table 10.13**, a limit of LA90 43dB for day and night.

10.12.3 Cumulative Noise Levels

Table 10.20 gives details of the predicted cumulative noise levels for the nearest receptors to the Development.

Table 10:20: Predicted Cumulative Noise Levels for each Receptor

	ITM	ITM	4m/s	5m/s	6m/s	7m/s	8m/s	9m/s	10m/s	11m/s	12m/s
House ID	Easting	Northing	dBA	dBA	dBA	dBA	dBA	dBA	dBA	dBA	dBA
H1	498280	657469	36.4	39.4	40.4	40.7	41.1	41.2	41.2	41.2	41.2
H2	498287	658418	35.6	38.9	39.4	39.5	39.6	39.6	39.6	39.6	39.6
H3	497569	657205	36.6	39.5	40.6	40.9	41.3	41.5	41.5	41.5	41.5
H4	498382	657964	36.5	39.6	40.4	40.7	40.9	41.0	41.0	41.0	41.0
H5	498410	657916	36.2	39.3	40.1	40.4	40.6	40.7	40.7	40.7	40.7
H6	497486	658726	35.9	38.9	39.8	40.0	40.3	40.4	40.4	40.4	40.4
H7	498420	657877	36.0	39.1	39.9	40.1	40.3	40.4	40.4	40.4	40.4
H8	498432	657801	35.8	38.8	39.7	39.9	40.2	40.3	40.3	40.3	40.3
H9	498431	657843	36.2	39.1	40.3	40.6	41.1	41.2	41.2	41.2	41.2
H10	498261	658557	35.1	38.1	39.0	39.2	39.5	39.6	39.6	39.6	39.6
H11	498184	658653	35.0	38.0	39.0	39.3	39.6	39.7	39.7	39.7	39.7
H12	498456	657905	35.6	38.7	39.5	39.8	40.1	40.2	40.2	40.2	40.2
H13	498486	657830	35.5	38.4	39.5	39.8	40.2	40.4	40.3	40.4	40.4
H14	497318	658698	35.6	38.7	39.5	39.7	40.0	40.1	40.1	40.1	40.1
H15	498510	657780	34.8	37.9	38.7	39.0	39.3	39.4	39.4	39.4	39.4
H16	498533	657671	34.2	37.3	38.1	38.4	38.7	38.8	38.8	38.8	38.8

House ID	ITM Easting	ITM Northing	4m/s dBA	5m/s dBA	6m/s dBA	7m/s dBA	8m/s dBA	9m/s dBA	10m/s dBA	11m/s dBA	12m/s dBA
H17	498482	658243	35.4	38.0	39.5	40.0	40.6	40.8	40.8	40.8	40.8
H18	498172	658805	34.6	37.1	38.8	39.5	40.1	40.4	40.3	40.4	40.4
H19	498566	657577	33.6	36.6	37.6	37.9	38.3	38.4	38.4	38.4	38.4
H20	497071	658703	35.1	37.7	39.3	39.9	40.6	40.8	40.8	40.8	40.8
H21	498151	658844	34.4	36.9	38.7	39.4	40.0	40.3	40.3	40.3	40.3
H22	498150	658878	34.3	36.7	38.7	39.4	40.2	40.4	40.4	40.4	40.4
H23	498454	658590	34.4	36.8	38.6	39.3	40.0	40.2	40.2	40.2	40.2
H24	496946	658692	33.4	36.4	37.2	37.5	37.7	37.8	37.8	37.8	37.8
H25	496668	657439	32.3	35.5	36.1	36.2	36.4	36.4	36.4	36.4	36.4
H26	496635	657469	32.2	35.4	36.0	36.1	36.3	36.3	36.3	36.3	36.3
H27	498140	658917	32.6	35.6	36.5	36.7	36.9	37.0	37.0	37.0	37.0
H28	498492	658591	32.5	35.6	36.3	36.4	36.5	36.6	36.6	36.6	36.6
H29	496881	658695	32.8	35.9	36.7	36.9	37.1	37.2	37.2	37.2	37.2
H30	496848	658686	32.6	35.7	36.5	36.7	36.9	37.0	37.0	37.0	37.0
H31	496798	658676	32.3	35.4	36.1	36.3	36.5	36.6	36.6	36.6	36.6
H32	497329	656988	32.8	36.0	36.6	36.7	36.9	36.9	36.9	36.9	36.9
H33	497332	656948	32.6	35.7	36.4	36.7	36.9	37.0	36.9	37.0	37.0
H34	498181	656888	31.5	34.6	35.4	35.6	35.8	35.9	35.9	35.9	35.9
H35	496711	658683	31.5	34.7	35.3	35.5	35.7	35.7	35.7	35.7	35.7
H36	497339	656906	32.1	35.2	35.9	36.0	36.1	36.2	36.2	36.2	36.2
H37	498240	656887	31.2	34.3	35.1	35.4	35.6	35.7	35.7	35.7	35.7
H38	497332	656873	32.2	35.2	36.2	36.6	36.9	37.0	37.0	37.0	37.0
H39	498731	657336	30.8	33.9	34.6	34.8	35.0	35.0	35.0	35.0	35.0
H40	497362	656826	31.6	34.7	35.5	35.7	35.9	36.0	36.0	36.0	36.0
H41	497317	656843	31.6	34.7	35.5	35.7	35.9	36.0	36.0	36.0	36.0
H42	496704	658783	30.8	34.0	34.7	34.9	35.0	35.1	35.1	35.1	35.1
H43	498359	656875	30.8	33.8	34.8	35.2	35.5	35.6	35.6	35.6	35.6
H44	498334	656854	30.6	33.6	34.5	34.8	35.1	35.2	35.2	35.2	35.2
H45	496286	658061	33.7	35.4	38.4	39.5	40.5	40.8	40.8	40.8	40.8
H46	498311	656836	30.9	33.8	34.9	35.3	35.7	35.9	35.9	35.9	35.9
H47	498544	657009	31.5	34.1	35.8	36.4	37.0	37.2	37.2	37.2	37.2
H48	496739	658836	31.0	34.0	34.9	35.1	35.4	35.5	35.5	35.5	35.5
H49	498713	657205	30.3	33.5	34.2	34.4	34.6	34.6	34.6	34.6	34.6
H50	498884	657642	30.5	33.6	34.3	34.5	34.7	34.7	34.7	34.7	34.7
H51	498629	658803	30.3	33.4	34.1	34.3	34.5	34.6	34.6	34.6	34.6

House ID	ITM Easting	ITM Northing	4m/s dBA	5m/s dBA	6m/s dBA	7m/s dBA	8m/s dBA	9m/s dBA	10m/s dBA	11m/s dBA	12m/s dBA
H52	497087	656875	30.9	34.1	34.8	34.9	35.1	35.2	35.2	35.2	35.2
H53	497262	656801	31.2	34.2	35.1	35.3	35.6	35.7	35.7	35.7	35.7
H54	497290	656784	30.9	34.0	34.8	35.1	35.3	35.4	35.4	35.4	35.4
H55	498124	656683	29.9	33.0	33.8	34.0	34.3	34.4	34.4	34.4	34.4
H56	497114	656834	30.7	33.9	34.5	34.7	34.9	34.9	34.9	34.9	34.9
H57	497914	656633	29.9	33.0	33.7	33.9	34.1	34.2	34.2	34.2	34.2
H58	496940	659020	30.6	33.7	34.5	34.7	35.0	35.0	35.0	35.0	35.0
H59	498027	656637	29.8	32.9	33.7	33.9	34.2	34.3	34.3	34.3	34.3
H60	497885	656613	30.3	33.2	34.4	34.8	35.2	35.3	35.3	35.3	35.3
H61	498728	657071	29.7	32.8	33.6	33.8	34.1	34.2	34.2	34.2	34.2
H62	497376	656675	30.2	33.3	34.0	34.2	34.4	34.5	34.5	34.5	34.5
H63	497443	656650	30.1	33.2	33.9	34.1	34.3	34.4	34.4	34.4	34.4
H64	496886	656865	30.1	33.2	33.9	34.1	34.3	34.4	34.4	34.4	34.4
H65	497473	656635	29.9	33.1	33.8	34.0	34.1	34.2	34.2	34.2	34.2
H66	497857	656591	30.2	33.0	34.2	34.6	35.1	35.2	35.2	35.2	35.2
H67	497502	656615	29.9	33.0	33.8	34.0	34.2	34.3	34.3	34.3	34.3
H68	497832	656572	29.6	32.7	33.5	33.7	34.0	34.1	34.1	34.1	34.1
H69	497803	656555	34.6	35.8	39.6	40.8	41.9	42.3	42.3	42.3	42.3
H70	496312	658591	29.2	32.3	33.1	33.4	33.7	33.7	33.7	33.8	33.8
H71	498744	656992	29.6	32.5	33.7	34.2	34.6	34.8	34.8	34.8	34.8
H72	496277	658568	29.7	32.5	33.8	34.3	34.7	34.9	34.9	34.9	34.9
H73	498795	657042	29.0	32.1	32.8	33.0	33.2	33.3	33.3	33.3	33.3
H74	496707	656890	30.9	33.4	35.3	36.0	36.6	36.9	36.9	36.9	36.9
H75	496452	657094	29.1	32.2	32.9	33.1	33.3	33.4	33.4	33.4	33.4
H76	498847	658716	29.5	32.5	33.3	33.6	33.9	34.0	34.0	34.0	34.0
H77	496559	656976	29.8	32.6	33.9	34.4	34.8	35.0	35.0	35.0	35.0
H78	496506	657019	29.0	32.1	32.8	33.0	33.2	33.3	33.3	33.3	33.3
H79	499048	657629	29.1	32.2	32.9	33.1	33.3	33.3	33.3	33.3	33.3
H80	496597	656921	29.5	32.4	33.6	34.1	34.5	34.6	34.6	34.6	34.6
H81	497232	656617	29.5	32.6	33.4	33.7	33.9	34.0	34.0	34.0	34.0
H82	498850	657037	28.7	31.8	32.7	33.0	33.2	33.3	33.3	33.3	33.3
H83	497728	656482	28.8	31.9	32.6	32.8	33.0	33.1	33.1	33.1	33.1
H84	498763	656912	28.6	31.7	32.5	32.8	33.0	33.1	33.1	33.1	33.1
H85	496181	658531	28.7	31.7	32.6	32.9	33.3	33.4	33.3	33.4	33.4
H86	497786	656464	28.9	31.9	32.9	33.2	33.4	33.5	33.5	33.5	33.5

House ID	ITM Easting	ITM Northing	4m/s dBA	5m/s dBA	6m/s dBA	7m/s dBA	8m/s dBA	9m/s dBA	10m/s dBA	11m/s dBA	12m/s dBA
H87	498116	656502	28.7	31.7	32.6	32.9	33.1	33.2	33.2	33.2	33.2
H88	498155	656508	29.3	32.0	33.5	34.0	34.5	34.7	34.7	34.7	34.7
H89	498889	657037	29.0	31.9	33.2	33.6	34.1	34.2	34.2	34.2	34.2
H90	497247	656569	29.2	32.3	33.2	33.5	33.7	33.8	33.8	33.8	33.8
H91	498149	656490	28.4	31.5	32.3	32.6	32.8	32.9	32.9	32.9	32.9
H92	498785	656875	28.4	31.4	32.3	32.6	32.9	33.0	33.0	33.0	33.0
H93	496134	658563	28.6	31.5	32.8	33.3	33.7	33.8	33.8	33.8	33.8
H94	498752	656793	29.8	32.1	34.2	35.0	35.7	35.9	35.9	35.9	35.9
H95	496075	658482	30.3	32.5	35.0	35.9	36.7	37.0	37.0	37.0	37.0
H96	497374	659476	28.5	31.5	32.4	32.7	33.0	33.1	33.1	33.1	33.1
H97	497456	659513	29.0	31.8	33.3	33.8	34.3	34.5	34.4	34.5	34.5
H98	499204	657725	30.2	32.4	34.6	35.4	36.2	36.4	36.4	36.4	36.4
H99	496018	658458	28.2	31.1	32.4	32.9	33.4	33.5	33.5	33.5	33.5
H100	498989	656992	27.8	30.8	31.7	32.0	32.4	32.5	32.5	32.5	32.5
H101	498817	656759	30.3	32.3	35.0	36.0	36.8	37.1	37.1	37.1	37.1
H102	499243	657751	30.7	32.7	35.5	36.4	37.3	37.7	37.6	37.7	37.7
H103	496529	659156	28.4	31.3	32.6	33.1	33.5	33.6	33.6	33.6	33.6
H104	499263	657825	28.0	31.0	32.0	32.3	32.6	32.7	32.7	32.7	32.7
H105	495970	658467	28.4	31.0	32.8	33.5	34.1	34.3	34.3	34.3	34.3
H106	498105	656327	27.6	30.5	31.5	31.8	32.1	32.2	32.2	32.2	32.2
H107	498835	656719	27.9	30.7	32.1	32.6	33.0	33.2	33.2	33.2	33.2
H108	496187	657029	30.6	32.4	35.2	36.2	37.2	37.5	37.5	37.5	37.5
H109	499096	657055	27.3	30.3	31.1	31.4	31.6	31.7	31.7	31.7	31.7
H110	497702	659639	28.1	30.8	32.1	32.6	33.0	33.2	33.2	33.2	33.2
H111	496528	659201	27.8	30.8	31.8	32.1	32.4	32.5	32.5	32.5	32.5
H112	495919	658416	27.7	30.5	31.9	32.4	32.9	33.0	33.0	33.0	33.0
H113	498838	656683	27.2	30.1	31.1	31.5	31.8	31.9	31.9	31.9	31.9
H114	498848	656658	27.7	30.4	31.7	32.3	32.8	32.9	32.9	32.9	32.9
H115	495911	658504	27.5	30.3	31.7	32.3	32.7	32.9	32.9	32.9	32.9
H116	497726	659690	27.3	30.2	31.2	31.5	31.8	31.9	31.9	31.9	31.9
H117	497720	659702	30.7	32.3	35.3	36.4	37.3	37.7	37.7	37.7	37.7
H118	496527	659272	30.7	32.4	35.3	36.3	37.3	37.6	37.6	37.6	37.6
H119	498858	656627	27.0	30.0	31.1	31.5	31.8	32.0	32.0	32.0	32.0
H120	498877	656638	27.3	30.1	31.6	32.1	32.6	32.7	32.7	32.7	32.7
H121	497712	659720	27.1	30.0	31.0	31.3	31.7	31.8	31.8	31.8	31.8

House ID	ITM Easting	ITM Northing	4m/s dBA	5m/s dBA	6m/s dBA	7m/s dBA	8m/s dBA	9m/s dBA	10m/s dBA	11m/s dBA	12m/s dBA
H122	497666	659725	30.5	32.1	35.1	36.2	37.1	37.4	37.4	37.4	37.4
H123	498239	656248	30.4	32.0	35.0	36.0	37.0	37.3	37.3	37.3	37.3
H124	498867	656595	26.9	29.8	30.9	31.3	31.7	31.8	31.8	31.8	31.8
H125	496593	659367	27.3	30.3	31.4	31.8	32.1	32.2	32.2	32.2	32.2
H126	498275	656236	27.2	30.0	31.4	31.9	32.4	32.5	32.5	32.6	32.6
H127	498357	656259	27.3	29.9	31.4	32.0	32.5	32.7	32.7	32.7	32.7
H128	498877	656564	26.7	29.7	30.8	31.3	31.7	31.8	31.8	31.8	31.8
H129	495877	658649	26.6	29.5	30.7	31.1	31.5	31.7	31.6	31.7	31.7
H130	495792	657434	30.8	32.3	35.9	37.0	38.1	38.4	38.4	38.5	38.5
H131	498385	656239	27.3	29.8	31.3	31.9	32.5	32.7	32.7	32.7	32.7
H132	495879	658693	26.5	29.4	30.6	31.1	31.5	31.6	31.6	31.6	31.6
H133	495966	657036	26.5	29.4	30.6	31.1	31.5	31.6	31.6	31.6	31.6
H134	498323	656200	26.5	29.3	30.4	30.8	31.2	31.3	31.3	31.3	31.3
H135	499447	657920	26.6	29.7	30.5	30.7	31.0	31.1	31.1	31.1	31.1
H136	495869	658730	26.4	29.3	30.5	30.9	31.3	31.5	31.4	31.5	31.5
H137	498349	656194	26.0	29.0	29.9	30.1	30.4	30.5	30.5	30.5	30.5
H138	497726	659826	26.6	29.6	30.8	31.2	31.6	31.7	31.7	31.7	31.7
H139	498367	656184	30.3	31.7	34.9	36.1	37.1	37.4	37.4	37.4	37.4
H140	498380	656179	30.8	32.3	35.9	37.1	38.2	38.5	38.5	38.5	38.5
H141	499483	657944	26.6	29.5	30.6	30.9	31.3	31.5	31.5	31.5	31.5
H142	495884	658812	26.3	29.2	30.4	30.9	31.3	31.4	31.4	31.5	31.5
H143	498443	656200	26.3	29.2	30.4	30.9	31.3	31.4	31.4	31.4	31.4
H144	498475	656182	26.1	28.9	30.0	30.4	30.8	31.0	31.0	31.0	31.0
H145	498414	656153	27.9	30.3	32.7	33.6	34.3	34.6	34.5	34.6	34.6
H146	495834	658794	30.1	31.7	35.2	36.3	37.3	37.6	37.6	37.7	37.7
H147	499465	657289	26.2	29.0	30.1	30.6	31.0	31.1	31.1	31.1	31.1
H148	495845	657055	33.1	33.9	38.0	39.4	40.5	40.9	40.9	40.9	40.9
H149	499543	657842	26.1	29.1	30.0	30.4	30.7	30.8	30.8	30.8	30.8
H150	498135	659862	26.1	28.9	30.2	30.7	31.1	31.2	31.2	31.2	31.2
H151	497459	656039	25.8	28.8	29.7	29.9	30.2	30.3	30.3	30.3	30.3
H152	495891	658951	30.9	32.2	36.0	37.2	38.3	38.7	38.7	38.7	38.7
H153	498477	656117	25.8	28.6	29.8	30.2	30.7	30.8	30.8	30.8	30.8
H154	495809	658871	26.0	28.8	30.3	30.9	31.3	31.5	31.5	31.5	31.5
H155	499595	658009	26.1	28.9	30.1	30.5	31.0	31.1	31.1	31.1	31.1
H156	498888	656317	25.9	28.6	30.1	30.7	31.2	31.4	31.3	31.4	31.4

House ID	ITM Easting	ITM Northing	4m/s dBA	5m/s dBA	6m/s dBA	7m/s dBA	8m/s dBA	9m/s dBA	10m/s dBA	11m/s dBA	12m/s dBA
H157	495831	658975	25.6	28.4	29.6	30.1	30.5	30.7	30.7	30.7	30.7
H158	498896	656287	25.6	28.4	29.8	30.3	30.7	30.9	30.9	30.9	30.9
H159	495816	659005	25.8	28.5	30.0	30.6	31.1	31.3	31.2	31.3	31.3
H160	498569	656079	25.5	28.3	29.7	30.2	30.7	30.8	30.8	30.8	30.8
H161	495676	657117	25.4	28.1	29.4	29.9	30.4	30.5	30.5	30.5	30.5
H162	498907	656261	24.9	27.9	28.9	29.2	29.6	29.7	29.7	29.7	29.7
H163	497537	660013	29.2	30.6	33.7	34.8	35.8	36.1	36.1	36.1	36.1
H164	498615	656073	25.6	28.4	29.9	30.5	31.0	31.1	31.1	31.1	31.1
H165	497275	655954	25.8	28.6	30.0	30.5	31.0	31.1	31.1	31.1	31.1
H166	499674	658050	25.2	28.3	29.1	29.4	29.7	29.8	29.8	29.8	29.8
H167	496916	659866	31.2	32.2	35.9	37.1	38.2	38.5	38.5	38.5	38.5
H168	498918	656226	28.9	30.3	33.4	34.6	35.5	35.8	35.8	35.8	35.8
H169	498745	656110	25.2	27.9	29.3	29.8	30.3	30.4	30.4	30.4	30.4
H170	495782	659054	25.0	27.9	29.1	29.5	29.9	30.0	30.0	30.0	30.0
H171	497902	655849	31.6	32.4	36.3	37.6	38.7	39.0	39.0	39.0	39.0
H172	497535	660067	25.6	28.4	29.9	30.4	30.9	31.1	31.0	31.1	31.1
H173	495793	659099	26.9	28.9	31.2	32.1	32.9	33.1	33.1	33.1	33.1
H174	498919	656196	27.9	29.9	32.8	33.9	34.7	35.0	34.9	35.0	35.0
H175	499694	657354	28.6	30.1	33.0	34.2	35.1	35.4	35.4	35.4	35.4
H176	498673	656022	25.1	27.9	29.4	29.9	30.4	30.5	30.5	30.6	30.6
H177	497990	660091	25.4	28.1	29.7	30.3	30.8	30.9	30.9	30.9	30.9
H178	497452	660089	25.2	27.9	29.2	29.7	30.2	30.4	30.4	30.4	30.4
H179	496934	659938	25.5	28.4	29.8	30.3	30.8	30.9	30.9	30.9	30.9
H180	498934	656167	25.5	28.1	29.9	30.6	31.2	31.3	31.3	31.3	31.3
H181	499156	656325	24.9	27.7	29.2	29.8	30.3	30.4	30.4	30.4	30.4
H182	498707	656005	24.9	27.6	28.9	29.5	30.0	30.1	30.1	30.1	30.1
H183	499750	657404	26.8	28.8	31.1	32.1	32.9	33.1	33.1	33.1	33.1

A noise contour map of the cumulative effects of all turbines is presented with a maximum sound power output at a wind speed of 8m/s at 10m height in **Appendix 10.3**. The contour map assumes that all turbines are simultaneously propagating noise in a downwind direction at the same time to each location which results in an overprediction of the noise levels reflective of the worst case scenario.

10.12.4 Cumulative Noise assessment

The assessment was made with predicted operational noise levels from the Development against noise limits in the Wind Energy Development Guidelines 2006. All predicted noise levels are within the noise limits. **Table 10.19** gives the difference between the predicted cumulative noise levels in Table **10.18** and noise limits for each receptor. A negative margin indicates that the predicted noise levels are within the lower fixed 43dBA limit, which means the levels are within the day and night limits.

Table 10:21: Margin between Predicted Cumulative Noise Levels and Lower Fixed Limit of 43dBA

	ING	ING	4m/s	5m/s	6m/s	7m/s	8m/s	9m/s	10m/s	11m/s	12m/s
House ID	Easting	Northing	dBA	dBA	dBA	dBA	dBA	dBA	dBA	dBA	dBA
H1	498280	657469	-6.6	-3.6	-2.6	-2.3	-1.9	-1.8	-1.8	-1.8	-1.8
H2	498287	658418	-7.4	-4.1	-3.6	-3.5	-3.4	-3.4	-3.4	-3.4	-3.4
H3	497569	657205	-6.4	-3.5	-2.4	-2.1	-1.7	-1.5	-1.5	-1.5	-1.5
H4	498382	657964	-6.5	-3.4	-2.6	-2.3	-2.1	-2.0	-2.0	-2.0	-2.0
H5	498410	657916	-6.8	-3.7	-2.9	-2.6	-2.4	-2.3	-2.3	-2.3	-2.3
H6	497486	658726	-7.1	-4.1	-3.2	-3.0	-2.7	-2.6	-2.6	-2.6	-2.6
H7	498420	657877	-7.0	-3.9	-3.1	-2.9	-2.7	-2.6	-2.6	-2.6	-2.6
H8	498432	657801	-7.2	-4.2	-3.3	-3.1	-2.8	-2.7	-2.7	-2.7	-2.7
H9	498431	657843	-6.8	-3.9	-2.7	-2.4	-1.9	-1.8	-1.8	-1.8	-1.8
H10	498261	658557	-7.9	-4.9	-4.0	-3.8	-3.5	-3.4	-3.4	-3.4	-3.4
H11	498184	658653	-8.0	-5.0	-4.0	-3.7	-3.4	-3.3	-3.3	-3.3	-3.3
H12	498456	657905	-7.4	-4.3	-3.5	-3.2	-2.9	-2.8	-2.8	-2.8	-2.8
H13	498486	657830	-7.5	-4.6	-3.5	-3.2	-2.8	-2.6	-2.7	-2.6	-2.6
H14	497318	658698	-7.4	-4.3	-3.5	-3.3	-3.0	-2.9	-2.9	-2.9	-2.9
H15	498510	657780	-8.2	-5.1	-4.3	-4.0	-3.7	-3.6	-3.6	-3.6	-3.6
H16	498533	657671	-8.8	-5.7	-4.9	-4.6	-4.3	-4.2	-4.2	-4.2	-4.2
H17	498482	658243	-7.6	-5.0	-3.5	-3.0	-2.4	-2.2	-2.2	-2.2	-2.2
H18	498172	658805	-8.4	-5.9	-4.2	-3.5	-2.9	-2.6	-2.7	-2.6	-2.6
H19	498566	657577	-9.4	-6.4	-5.4	-5.1	-4.7	-4.6	-4.6	-4.6	-4.6
H20	497071	658703	-7.9	-5.3	-3.7	-3.1	-2.4	-2.2	-2.2	-2.2	-2.2
H21	498151	658844	-8.6	-6.1	-4.3	-3.6	-3.0	-2.7	-2.7	-2.7	-2.7
H22	498150	658878	-8.7	-6.3	-4.3	-3.6	-2.8	-2.6	-2.6	-2.6	-2.6
H23	498454	658590	-8.6	-6.2	-4.4	-3.7	-3.0	-2.8	-2.8	-2.8	-2.8
H24	496946	658692	-9.6	-6.6	-5.8	-5.5	-5.3	-5.2	-5.2	-5.2	-5.2
H25	496668	657439	-10.7	-7.5	-6.9	-6.8	-6.6	-6.6	-6.6	-6.6	-6.6

House ID	ING Easting	ING Northing	4m/s dBA	5m/s dBA	6m/s dBA	7m/s dBA	8m/s dBA	9m/s dBA	10m/s dBA	11m/s dBA	12m/s dBA
H26	496635	657469	-10.8	-7.6	-7.0	-6.9	-6.7	-6.7	-6.7	-6.7	-6.7
H27	498140	658917	-10.4	-7.4	-6.5	-6.3	-6.1	-6.0	-6.0	-6.0	-6.0
H28	498492	658591	-10.5	-7.4	-6.7	-6.6	-6.5	-6.4	-6.4	-6.4	-6.4
H29	496881	658695	-10.2	-7.1	-6.3	-6.1	-5.9	-5.8	-5.8	-5.8	-5.8
H30	496848	658686	-10.4	-7.3	-6.5	-6.3	-6.1	-6.0	-6.0	-6.0	-6.0
H31	496798	658676	-10.7	-7.6	-6.9	-6.7	-6.5	-6.4	-6.4	-6.4	-6.4
H32	497329	656988	-10.2	-7.0	-6.4	-6.3	-6.1	-6.1	-6.1	-6.1	-6.1
H33	497332	656948	-10.4	-7.3	-6.6	-6.3	-6.1	-6.0	-6.1	-6.0	-6.0
H34	498181	656888	-11.5	-8.4	-7.6	-7.4	-7.2	-7.1	-7.1	-7.1	-7.1
H35	496711	658683	-11.5	-8.3	-7.7	-7.5	-7.3	-7.3	-7.3	-7.3	-7.3
H36	497339	656906	-10.9	-7.8	-7.1	-7.0	-6.9	-6.8	-6.8	-6.8	-6.8
H37	498240	656887	-11.8	-8.7	-7.9	-7.6	-7.4	-7.3	-7.3	-7.3	-7.3
H38	497332	656873	-10.8	-7.8	-6.8	-6.4	-6.1	-6.0	-6.0	-6.0	-6.0
H39	498731	657336	-12.2	-9.1	-8.4	-8.2	-8.0	-8.0	-8.0	-8.0	-8.0
H40	497362	656826	-11.4	-8.3	-7.5	-7.3	-7.1	-7.0	-7.0	-7.0	-7.0
H41	497317	656843	-11.4	-8.3	-7.5	-7.3	-7.1	-7.0	-7.0	-7.0	-7.0
H42	496704	658783	-12.2	-9.0	-8.3	-8.1	-8.0	-7.9	-7.9	-7.9	-7.9
H43	498359	656875	-12.2	-9.2	-8.2	-7.8	-7.5	-7.4	-7.4	-7.4	-7.4
H44	498334	656854	-12.4	-9.4	-8.5	-8.2	-7.9	-7.8	-7.8	-7.8	-7.8
H45	496286	658061	-9.3	-7.6	-4.6	-3.5	-2.5	-2.2	-2.2	-2.2	-2.2
H46	498311	656836	-12.1	-9.2	-8.1	-7.7	-7.3	-7.1	-7.1	-7.1	-7.1
H47	498544	657009	-11.5	-8.9	-7.2	-6.6	-6.0	-5.8	-5.8	-5.8	-5.8
H48	496739	658836	-12.0	-9.0	-8.1	-7.9	-7.6	-7.5	-7.5	-7.5	-7.5
H49	498713	657205	-12.7	-9.5	-8.8	-8.6	-8.4	-8.4	-8.4	-8.4	-8.4
H50	498884	657642	-12.5	-9.4	-8.7	-8.5	-8.3	-8.3	-8.3	-8.3	-8.3
H51	498629	658803	-12.7	-9.6	-8.9	-8.7	-8.5	-8.4	-8.4	-8.4	-8.4
H52	497087	656875	-12.1	-8.9	-8.2	-8.1	-7.9	-7.8	-7.8	-7.8	-7.8
H53	497262	656801	-11.8	-8.8	-7.9	-7.7	-7.4	-7.3	-7.3	-7.3	-7.3
H54	497290	656784	-12.1	-9.0	-8.2	-7.9	-7.7	-7.6	-7.6	-7.6	-7.6
H55	498124	656683	-13.1	-10.0	-9.2	-9.0	-8.7	-8.6	-8.6	-8.6	-8.6
H56	497114	656834	-12.3	-9.1	-8.5	-8.3	-8.1	-8.1	-8.1	-8.1	-8.1
H57	497914	656633	-13.1	-10.0	-9.3	-9.1	-8.9	-8.8	-8.8	-8.8	-8.8
H58	496940	659020	-12.4	-9.3	-8.5	-8.3	-8.0	-8.0	-8.0	-8.0	-8.0
H59	498027	656637	-13.2	-10.1	-9.3	-9.1	-8.8	-8.7	-8.7	-8.7	-8.7
H60	497885	656613	-12.7	-9.8	-8.6	-8.2	-7.8	-7.7	-7.7	-7.7	-7.7

House ID	ING Easting	ING Northing	4m/s dBA	5m/s dBA	6m/s dBA	7m/s dBA	8m/s dBA	9m/s dBA	10m/s dBA	11m/s dBA	12m/s dBA
H61	498728	657071	-13.3	-10.2	-9.4	-9.2	-8.9	-8.8	-8.8	-8.8	-8.8
H62	497376	656675	-12.8	-9.7	-9.0	-8.8	-8.6	-8.5	-8.5	-8.5	-8.5
H63	497443	656650	-12.9	-9.8	-9.1	-8.9	-8.7	-8.6	-8.6	-8.6	-8.6
H64	496886	656865	-12.9	-9.8	-9.1	-8.9	-8.7	-8.6	-8.6	-8.6	-8.6
H65	497473	656635	-13.1	-9.9	-9.2	-9.0	-8.9	-8.8	-8.8	-8.8	-8.8
H66	497857	656591	-12.8	-10.0	-8.8	-8.4	-7.9	-7.8	-7.8	-7.8	-7.8
H67	497502	656615	-13.1	-10.0	-9.2	-9.0	-8.8	-8.7	-8.7	-8.7	-8.7
H68	497832	656572	-13.4	-10.3	-9.5	-9.3	-9.0	-8.9	-8.9	-8.9	-8.9
H69	497803	656555	-8.4	-7.2	-3.4	-2.2	-1.1	-0.7	-0.7	-0.7	-0.7
H70	496312	658591	-13.8	-10.7	-9.9	-9.6	-9.3	-9.3	-9.3	-9.2	-9.2
H71	498744	656992	-13.4	-10.5	-9.3	-8.8	-8.4	-8.2	-8.2	-8.2	-8.2
H72	496277	658568	-13.3	-10.5	-9.2	-8.7	-8.3	-8.1	-8.1	-8.1	-8.1
H73	498795	657042	-14.0	-10.9	-10.2	-10.0	-9.8	-9.7	-9.7	-9.7	-9.7
H74	496707	656890	-12.1	-9.6	-7.7	-7.0	-6.4	-6.1	-6.1	-6.1	-6.1
H75	496452	657094	-13.9	-10.8	-10.1	-9.9	-9.7	-9.6	-9.6	-9.6	-9.6
H76	498847	658716	-13.5	-10.5	-9.7	-9.4	-9.1	-9.0	-9.0	-9.0	-9.0
H77	496559	656976	-13.2	-10.4	-9.1	-8.6	-8.2	-8.0	-8.0	-8.0	-8.0
H78	496506	657019	-14.0	-10.9	-10.2	-10.0	-9.8	-9.7	-9.7	-9.7	-9.7
H79	499048	657629	-13.9	-10.8	-10.1	-9.9	-9.7	-9.7	-9.7	-9.7	-9.7
H80	496597	656921	-13.5	-10.6	-9.4	-8.9	-8.5	-8.4	-8.4	-8.4	-8.4
H81	497232	656617	-13.5	-10.4	-9.6	-9.3	-9.1	-9.0	-9.0	-9.0	-9.0
H82	498850	657037	-14.3	-11.2	-10.3	-10.0	-9.8	-9.7	-9.7	-9.7	-9.7
H83	497728	656482	-14.2	-11.1	-10.4	-10.2	-10.0	-9.9	-9.9	-9.9	-9.9
H84	498763	656912	-14.4	-11.3	-10.5	-10.2	-10.0	-9.9	-9.9	-9.9	-9.9
H85	496181	658531	-14.3	-11.3	-10.4	-10.1	-9.7	-9.6	-9.7	-9.6	-9.6
H86	497786	656464	-14.1	-11.1	-10.1	-9.8	-9.6	-9.5	-9.5	-9.5	-9.5
H87	498116	656502	-14.3	-11.3	-10.4	-10.1	-9.9	-9.8	-9.8	-9.8	-9.8
H88	498155	656508	-13.7	-11.0	-9.5	-9.0	-8.5	-8.3	-8.3	-8.3	-8.3
H89	498889	657037	-14.0	-11.1	-9.8	-9.4	-8.9	-8.8	-8.8	-8.8	-8.8
H90	497247	656569	-13.8	-10.7	-9.8	-9.5	-9.3	-9.2	-9.2	-9.2	-9.2
H91	498149	656490	-14.6	-11.5	-10.7	-10.4	-10.2	-10.1	-10.1	-10.1	-10.1
H92	498785	656875	-14.6	-11.6	-10.7	-10.4	-10.1	-10.0	-10.0	-10.0	-10.0
H93	496134	658563	-14.4	-11.5	-10.2	-9.7	-9.3	-9.2	-9.2	-9.2	-9.2
H94	498752	656793	-13.2	-10.9	-8.8	-8.0	-7.3	-7.1	-7.1	-7.1	-7.1
H95	496075	658482	-12.7	-10.5	-8.0	-7.1	-6.3	-6.0	-6.0	-6.0	-6.0

House ID	ING Easting	ING Northing	4m/s dBA	5m/s dBA	6m/s dBA	7m/s dBA	8m/s dBA	9m/s dBA	10m/s dBA	11m/s dBA	12m/s dBA
H96	497374	659476	-14.5	-11.5	-10.6	-10.3	-10.0	-9.9	-9.9	-9.9	-9.9
H97	497456	659513	-14.0	-11.2	-9.7	-9.2	-8.7	-8.5	-8.6	-8.5	-8.5
H98	499204	657725	-12.8	-10.6	-8.4	-7.6	-6.8	-6.6	-6.6	-6.6	-6.6
H99	496018	658458	-14.8	-11.9	-10.6	-10.1	-9.6	-9.5	-9.5	-9.5	-9.5
H100	498989	656992	-15.2	-12.2	-11.3	-11.0	-10.6	-10.5	-10.5	-10.5	-10.5
H101	498817	656759	-12.7	-10.7	-8.0	-7.0	-6.2	-5.9	-5.9	-5.9	-5.9
H102	499243	657751	-12.3	-10.3	-7.5	-6.6	-5.7	-5.3	-5.4	-5.3	-5.3
H103	496529	659156	-14.6	-11.7	-10.4	-9.9	-9.5	-9.4	-9.4	-9.4	-9.4
H104	499263	657825	-15.0	-12.0	-11.0	-10.7	-10.4	-10.3	-10.3	-10.3	-10.3
H105	495970	658467	-14.6	-12.0	-10.2	-9.5	-8.9	-8.7	-8.7	-8.7	-8.7
H106	498105	656327	-15.4	-12.5	-11.5	-11.2	-10.9	-10.8	-10.8	-10.8	-10.8
H107	498835	656719	-15.1	-12.3	-10.9	-10.4	-10.0	-9.8	-9.8	-9.8	-9.8
H108	496187	657029	-12.4	-10.6	-7.8	-6.8	-5.8	-5.5	-5.5	-5.5	-5.5
H109	499096	657055	-15.7	-12.7	-11.9	-11.6	-11.4	-11.3	-11.3	-11.3	-11.3
H110	497702	659639	-14.9	-12.2	-10.9	-10.4	-10.0	-9.8	-9.8	-9.8	-9.8
H111	496528	659201	-15.2	-12.2	-11.2	-10.9	-10.6	-10.5	-10.5	-10.5	-10.5
H112	495919	658416	-15.3	-12.5	-11.1	-10.6	-10.1	-10.0	-10.0	-10.0	-10.0
H113	498838	656683	-15.8	-12.9	-11.9	-11.5	-11.2	-11.1	-11.1	-11.1	-11.1
H114	498848	656658	-15.3	-12.6	-11.3	-10.7	-10.2	-10.1	-10.1	-10.1	-10.1
H115	495911	658504	-15.5	-12.7	-11.3	-10.7	-10.3	-10.1	-10.1	-10.1	-10.1
H116	497726	659690	-15.7	-12.8	-11.8	-11.5	-11.2	-11.1	-11.1	-11.1	-11.1
H117	497720	659702	-12.3	-10.7	-7.7	-6.6	-5.7	-5.3	-5.3	-5.3	-5.3
H118	496527	659272	-12.3	-10.6	-7.7	-6.7	-5.7	-5.4	-5.4	-5.4	-5.4
H119	498858	656627	-16.0	-13.0	-11.9	-11.5	-11.2	-11.0	-11.0	-11.0	-11.0
H120	498877	656638	-15.7	-12.9	-11.4	-10.9	-10.4	-10.3	-10.3	-10.3	-10.3
H121	497712	659720	-15.9	-13.0	-12.0	-11.7	-11.3	-11.2	-11.2	-11.2	-11.2
H122	497666	659725	-12.5	-10.9	-7.9	-6.8	-5.9	-5.6	-5.6	-5.6	-5.6
H123	498239	656248	-12.6	-11.0	-8.0	-7.0	-6.0	-5.7	-5.7	-5.7	-5.7
H124	498867	656595	-16.1	-13.2	-12.1	-11.7	-11.3	-11.2	-11.2	-11.2	-11.2
H125	496593	659367	-15.7	-12.7	-11.6	-11.2	-10.9	-10.8	-10.8	-10.8	-10.8
H126	498275	656236	-15.8	-13.0	-11.6	-11.1	-10.6	-10.5	-10.5	-10.4	-10.4
H127	498357	656259	-15.7	-13.1	-11.6	-11.0	-10.5	-10.3	-10.3	-10.3	-10.3
H128	498877	656564	-16.3	-13.3	-12.2	-11.7	-11.3	-11.2	-11.2	-11.2	-11.2
H129	495877	658649	-16.4	-13.5	-12.3	-11.9	-11.5	-11.3	-11.4	-11.3	-11.3
H130	495792	657434	-12.2	-10.7	-7.1	-6.0	-4.9	-4.6	-4.6	-4.5	-4.5

House ID	ING Easting	ING Northing	4m/s dBA	5m/s dBA	6m/s dBA	7m/s dBA	8m/s dBA	9m/s dBA	10m/s dBA	11m/s dBA	12m/s dBA
H131	498385	656239	-15.7	-13.2	-11.7	-11.1	-10.5	-10.3	-10.3	-10.3	-10.3
H132	495879	658693	-16.5	-13.6	-12.4	-11.9	-11.5	-11.4	-11.4	-11.4	-11.4
H133	495966	657036	-16.5	-13.6	-12.4	-11.9	-11.5	-11.4	-11.4	-11.4	-11.4
H134	498323	656200	-16.5	-13.7	-12.6	-12.2	-11.8	-11.7	-11.7	-11.7	-11.7
H135	499447	657920	-16.4	-13.3	-12.5	-12.3	-12.0	-11.9	-11.9	-11.9	-11.9
H136	495869	658730	-16.6	-13.7	-12.5	-12.1	-11.7	-11.5	-11.6	-11.5	-11.5
H137	498349	656194	-17.0	-14.0	-13.1	-12.9	-12.6	-12.5	-12.5	-12.5	-12.5
H138	497726	659826	-16.4	-13.4	-12.2	-11.8	-11.4	-11.3	-11.3	-11.3	-11.3
H139	498367	656184	-12.7	-11.3	-8.1	-6.9	-5.9	-5.6	-5.6	-5.6	-5.6
H140	498380	656179	-12.2	-10.7	-7.1	-5.9	-4.8	-4.5	-4.5	-4.5	-4.5
H141	499483	657944	-16.4	-13.5	-12.4	-12.1	-11.7	-11.5	-11.5	-11.5	-11.5
H142	495884	658812	-16.7	-13.8	-12.6	-12.1	-11.7	-11.6	-11.6	-11.5	-11.5
H143	498443	656200	-16.7	-13.8	-12.6	-12.1	-11.7	-11.6	-11.6	-11.6	-11.6
H144	498475	656182	-16.9	-14.1	-13.0	-12.6	-12.2	-12.0	-12.0	-12.0	-12.0
H145	498414	656153	-15.1	-12.7	-10.3	-9.4	-8.7	-8.4	-8.5	-8.4	-8.4
H146	495834	658794	-12.9	-11.3	-7.8	-6.7	-5.7	-5.4	-5.4	-5.3	-5.3
H147	499465	657289	-16.8	-14.0	-12.9	-12.4	-12.0	-11.9	-11.9	-11.9	-11.9
H148	495845	657055	-9.9	-9.1	-5.0	-3.6	-2.5	-2.1	-2.1	-2.1	-2.1
H149	499543	657842	-16.9	-13.9	-13.0	-12.6	-12.3	-12.2	-12.2	-12.2	-12.2
H150	498135	659862	-16.9	-14.1	-12.8	-12.3	-11.9	-11.8	-11.8	-11.8	-11.8
H151	497459	656039	-17.2	-14.2	-13.3	-13.1	-12.8	-12.7	-12.7	-12.7	-12.7
H152	495891	658951	-12.1	-10.8	-7.0	-5.8	-4.7	-4.3	-4.3	-4.3	-4.3
H153	498477	656117	-17.2	-14.4	-13.2	-12.8	-12.3	-12.2	-12.2	-12.2	-12.2
H154	495809	658871	-17.0	-14.2	-12.7	-12.1	-11.7	-11.5	-11.5	-11.5	-11.5
H155	499595	658009	-16.9	-14.1	-12.9	-12.5	-12.0	-11.9	-11.9	-11.9	-11.9
H156	498888	656317	-17.1	-14.4	-12.9	-12.3	-11.8	-11.6	-11.7	-11.6	-11.6
H157	495831	658975	-17.4	-14.6	-13.4	-12.9	-12.5	-12.3	-12.3	-12.3	-12.3
H158	498896	656287	-17.4	-14.6	-13.2	-12.7	-12.3	-12.1	-12.1	-12.1	-12.1
H159	495816	659005	-17.2	-14.5	-13.0	-12.4	-11.9	-11.7	-11.8	-11.7	-11.7
H160	498569	656079	-17.5	-14.7	-13.3	-12.8	-12.3	-12.2	-12.2	-12.2	-12.2
H161	495676	657117	-17.6	-14.9	-13.6	-13.1	-12.6	-12.5	-12.5	-12.5	-12.5
H162	498907	656261	-18.1	-15.1	-14.1	-13.8	-13.4	-13.3	-13.3	-13.3	-13.3
H163	497537	660013	-13.8	-12.4	-9.3	-8.2	-7.2	-6.9	-6.9	-6.9	-6.9
H164	498615	656073	-17.4	-14.6	-13.1	-12.5	-12.0	-11.9	-11.9	-11.9	-11.9
H165	497275	655954	-17.2	-14.4	-13.0	-12.5	-12.0	-11.9	-11.9	-11.9	-11.9

House ID	ING Easting	ING Northing	4m/s dBA	5m/s dBA	6m/s dBA	7m/s dBA	8m/s dBA	9m/s dBA	10m/s dBA	11m/s dBA	12m/s dBA
H166	499674	658050	-17.8	-14.7	-13.9	-13.6	-13.3	-13.2	-13.2	-13.2	-13.2
H167	496916	659866	-11.8	-10.8	-7.1	-5.9	-4.8	-4.5	-4.5	-4.5	-4.5
H168	498918	656226	-14.1	-12.7	-9.6	-8.4	-7.5	-7.2	-7.2	-7.2	-7.2
H169	498745	656110	-17.8	-15.1	-13.7	-13.2	-12.7	-12.6	-12.6	-12.6	-12.6
H170	495782	659054	-18.0	-15.1	-13.9	-13.5	-13.1	-13.0	-13.0	-13.0	-13.0
H171	497902	655849	-11.4	-10.6	-6.7	-5.4	-4.3	-4.0	-4.0	-4.0	-4.0
H172	497535	660067	-17.4	-14.6	-13.1	-12.6	-12.1	-11.9	-12.0	-11.9	-11.9
H173	495793	659099	-16.1	-14.1	-11.8	-10.9	-10.1	-9.9	-9.9	-9.9	-9.9
H174	498919	656196	-15.1	-13.1	-10.2	-9.1	-8.3	-8.0	-8.1	-8.0	-8.0
H175	499694	657354	-14.4	-12.9	-10.0	-8.8	-7.9	-7.6	-7.6	-7.6	-7.6
H176	498673	656022	-17.9	-15.1	-13.6	-13.1	-12.6	-12.5	-12.5	-12.4	-12.4
H177	497990	660091	-17.6	-14.9	-13.3	-12.7	-12.2	-12.1	-12.1	-12.1	-12.1
H178	497452	660089	-17.8	-15.1	-13.8	-13.3	-12.8	-12.6	-12.6	-12.6	-12.6
H179	496934	659938	-17.5	-14.6	-13.2	-12.7	-12.2	-12.1	-12.1	-12.1	-12.1
H180	498934	656167	-17.5	-14.9	-13.1	-12.4	-11.8	-11.7	-11.7	-11.7	-11.7
H181	499156	656325	-18.1	-15.3	-13.8	-13.2	-12.7	-12.6	-12.6	-12.6	-12.6
H182	498707	656005	-18.1	-15.4	-14.1	-13.5	-13.0	-12.9	-12.9	-12.9	-12.9
H183	499750	657404	-16.2	-14.2	-11.9	-10.9	-10.1	-9.9	-9.9	-9.9	-9.9

It can be seen that the predicted noise level at each of the receptors are within the 43dB limit applicable within the WEDG. This considers the predicted noise levels from all of the cumulative turbines to be equivalent of the noise propagation in a downwind direction from the turbine to the receptor simultaneously. In practise this is not possible due to the location of the turbines.

10.12.5 Cumulative Noise assessment

The criteria for description of effects for all operational noise activity and the potential worst-case effects, at the nearest receptors is given below.

Table 10:22: Description of Effects – Operational Noise

Quality	Significance	Duration
Negative	Not Significant	Long Term

10.13 MITIGATION MEASURES AND RESIDUAL EFFECTS

10.13.1 Construction Noise Mitigation

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 will be followed. Construction and Decommissioning of the Development shall be limited to working times given and any controls incorporated in any planning permission.

During the Decommissioning phase of the Development, noise levels are likely be no more than predicted in **Table 10.15,** 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 is a temporary day time activity.

10.13.2 Residual Construction and Decommissioning Effects

The residual effects are the same as the construction and Decommissioning effects identified in this assessment and the effects are not significant.

10.13.3 Operational Noise Mitigation

The Development has been designed to comply with the 2006 noise Guidelines. The operational noise emissions are predicted to be compliant and well within these guidelines with no special mitigation required apart from fitting rotors with STE which is now considered best practice.

All turbines will have STE fitted as standard to reduce noise emission levels. Mitigation is not considered necessary as the effects are not considered significant.

10.13.4 Residual Operational Effects

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

10.13.5 Cumulative Effects

The cumulative effects of the permitted Tullabrack, existing Moanmore, and recently submitted Ballykett Wind Farms, located within 3.5km have been assessed and found to be in compliance with the noise limits set in the Wind Energy Development Guidelines 2006.

10.14 SUMMARY OF EFFECTS

Table 10.23 below summarises the Effects.

Table 10:23: Summary of Effects

Noise	Quality	Significance	Duration
Construction Noise	Negative	Not Significant	Temporary
Operational Noise	Negative	Not Significant	Long Term
Decommissioning Noise	Negative	Not Significant	Temporary

10.15 STATEMENT OF SIGNIFICANCE

This Section has assessed the significance of the potential effects of the Development during operation, construction and decommissioning.

The effects of noise from the operation of the Development has been assessed using 2006 Guidelines with the methodology described in ETSU-R-97 and the IOA Good Practice Guide. Noise levels during operation of the Development have been predicted using the best practice of calculation technique, compared with the noise limits in the 2006 Guidelines and found to be compliant.

There has been a consultation process in relation to the revision of the 2019 Wind Energy Development Guidelines. This document provided the basis for a discussion on amendments of the noise limits applicable to wind turbine developments. It is understood that there will be revisions to the draft consultation documents, however a mitigation strategy to incorporate a reduction in sound power level outputs with respect to directionality can be put in place to comply with any specific variation in noise limit levels if new more restrictive guidelines are adopted. All turbines have software incorporated so that the sound power levels can be reduced by direction and energy output.

The noise levels predicted at the nearest receptors are orders of magnitude below the level at which risk of hearing damage, or indeed negative health effects are possible.

Noise during construction of the Development and decommissioning will be managed to comply with best practice, legislation and guidelines current at that time so that effects are not significant.

TECHNICAL APPENDIX 10.1

Noise Monitors In-Situ

Location of noise monitor in-situ at H3

Location of noise monitor in-situ at H26

Location of noise monitor in-situ at H4

TECHNICAL APPENDIX 10.2

Wind Speed Calculations for Hub Height

A GOOD PRACTICE GUIDE TO THE APPLICATION OF ETSU-R-97 FOR THE ASSESSMENT AND RATING OF WIND TURBINE NOISE

Institute of Acoustics

4.5 Wind Shear Corrections

4.5.1 Basing the predictions on sound power data tested in accordance with the IEC 61400-11 standard (or equivalent) should mean that the wind reference used corresponds to hub height wind speeds, standardised to 10 m height using a fixed correction (see **Annex A**). These predictions can then be compared to background levels and/or associated noise limits derived using an equivalent wind speed reference, which will have wind shear taken into account directly.

4.5.2 When this is not the case, for example when considering background data measured against direct wind speed measurements at 10 m height, it is necessary to apply corrections to account for this. Any such corrections should be clearly outlined and detailed in any noise assessment so that they can be reviewed by any assessor. The assessment should be made using the most detailed information available.

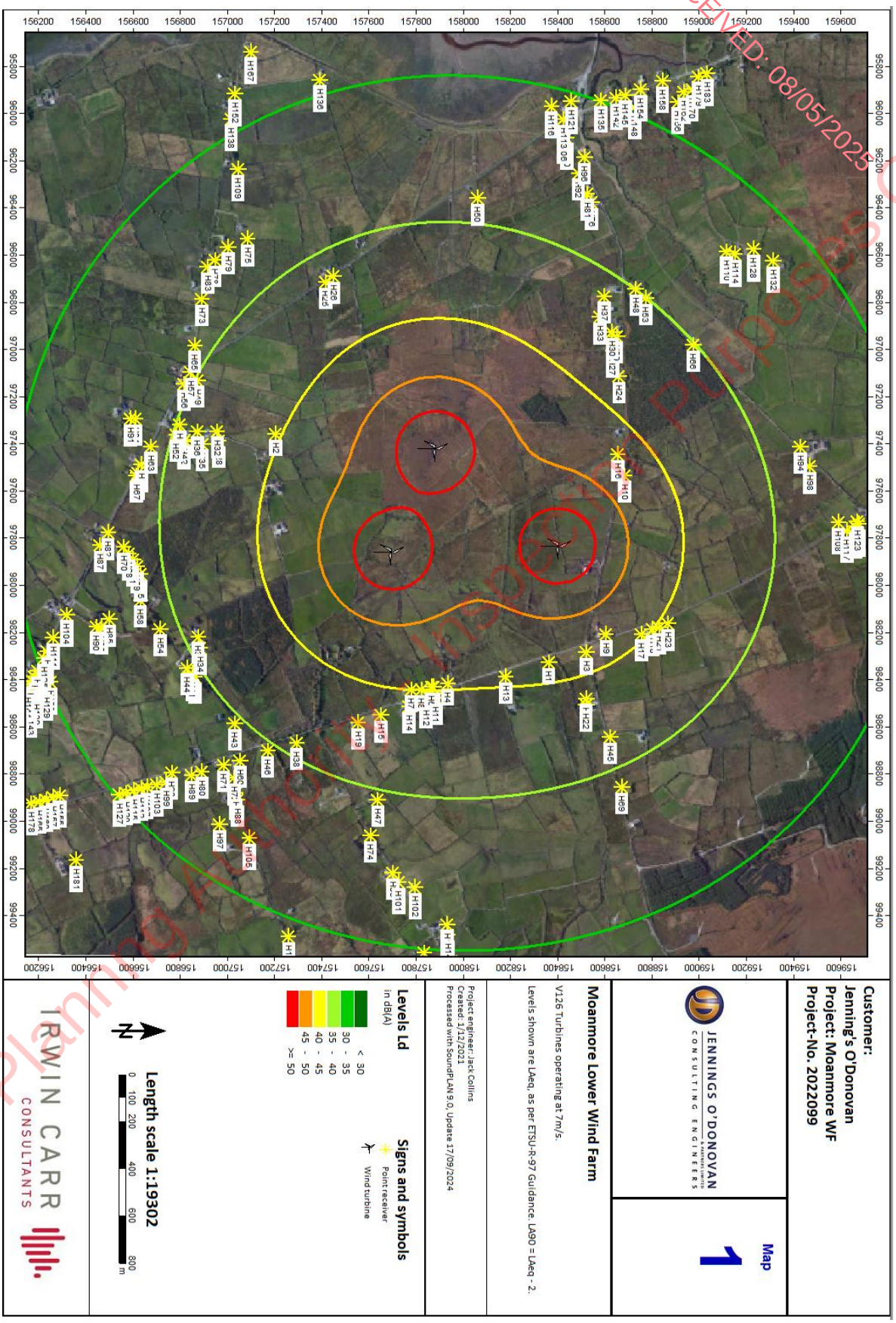
4.5.3 Examples of methods which can be used to correct predictions to account for wind shear effects, when only using a 10 m mast, are included in **Supplementary Guidance Note 4** (wind shear). This note presents methods to calculate corrections on the basis of long-term data measured at different heights, but as such data may not be available for a specific site, typical shear values are also presented. Alternatively, similarly derived corrections representing typical (average) shear values can be applied to the wind speed reference used for the derived typical background noise levels.

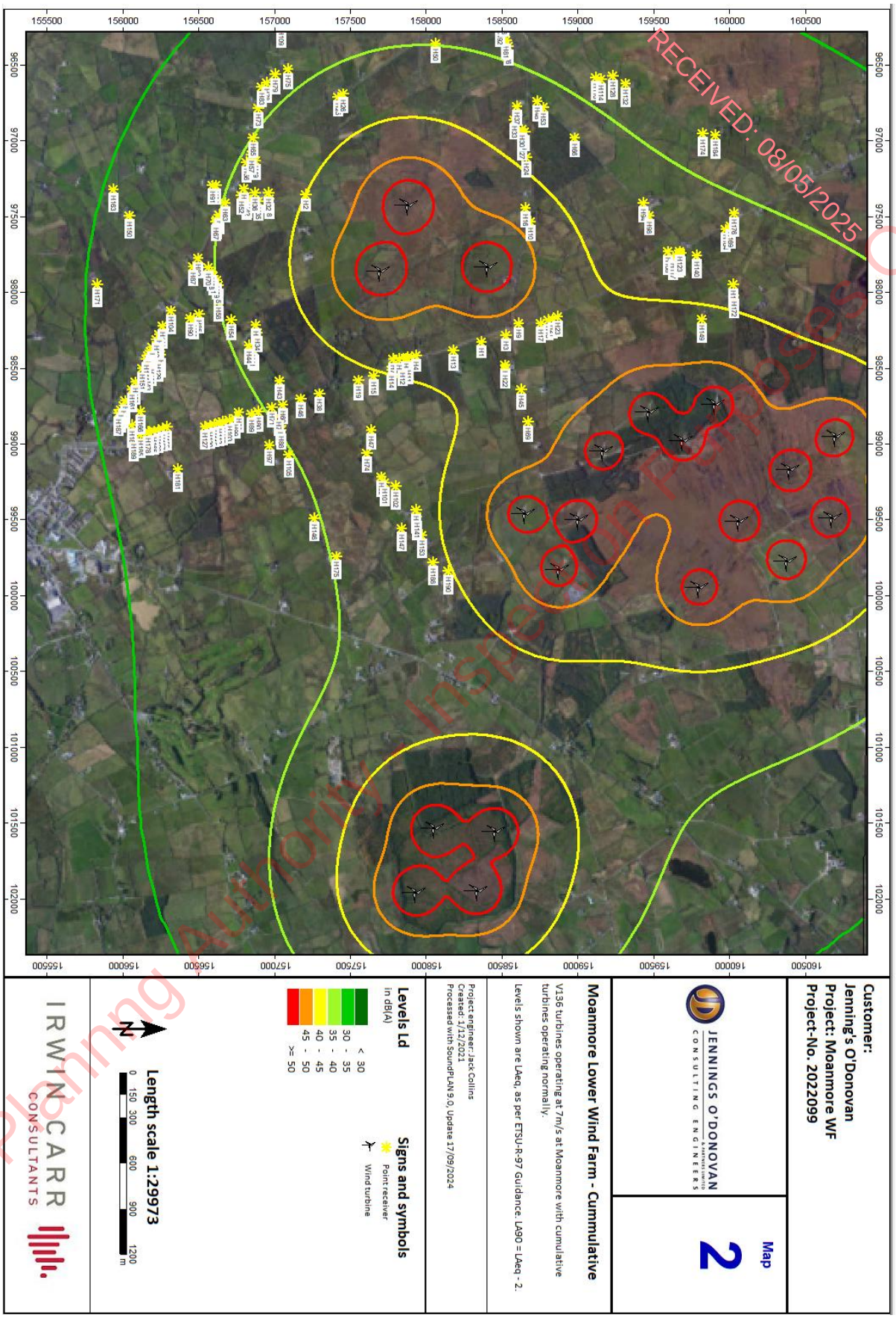
4.5.4 The following simplified method is proposed for ease of use: applying a fixed correction by subtracting the following factors from the wind speed reference used in the turbine predictions: 1 m/s for turbine hub heights of up to 30 m, 2 m/s for hub heights of up to 60 m and 3 m/s for hub heights of more than 60 m. Such a generic approach would be suitable in the context of a study made using a 10 m mast to limit costs, in the absence of site-specific data.

4.5.5 If it can be demonstrated that the predicted levels are below the applicable lower fixed limits regardless of wind speed, it can be seen that wind shear would not have an effect on the assessment and this may form the basis of a suitable planning condition.

TECHNICAL APPENDIX 10.3

SoundPlan Noise Outputs




Customer:
Jenning's O'Donovan
Project: Moanmore WF
Project-No. 2022099
JENNINGS O'DONOVAN
CONSULTING ENGINEERS
Map
2
Moanmore Lower Wind Farm - Cummulative
V136 turbines operating at 7m/s at Moanmore with cumulative turbines operating normally.
Levels shown are LAeq, as per ETSU-R-97 Guidance. LA90 = LAeq - 2.
Project engineer: Jack Collins
Created: 1/12/2021
Processed with SoundPLAN 9.0, Update 17/09/2024
Levels Ld
in dB(A)
< 30
30 - 35
35 - 40
40 - 45
45 - 50
>= 50
Signs and symbols
Point receiver
Wind turbine
N
Length scale 1:29973
0 150 300 600 900 1200
m
IRWIN CARR
CONSULTANTS
RECEIVED: 08/05/2025
Clare Planning Authority - Inspection Purposes Only!

TECHNICAL APPENDIX 10.4

Calibration Certificates of Noise Instruments

Calibration Certificate

Certificate Number 2022001449
Customer:
Noise & Vibration Consulants Ltd
Navan, County Meath Ireland
,

Model Number	LxT SE	***Procedure Number***	D0001.8378
Serial Number	0007005	***Technician***	Jacob Cannon
Test Results	**Pass**	***Calibration Date***	3 Feb 2022
Initial Condition	As Manufactured	***Calibration Due***	
		Temperature	23.61 °C ± 0.25 °C
Description	Sound Expert LxT Class 1 Sound Level Meter Firmware Revision: 2.404	***Humidity***	51.2 %RH ± 2.0 %RH
		Static Pressure	86.96 kPa ± 0.13 kPa

Evaluation Method Tested electrically using Larson Davis PRMLxT1L S/N 077589 and a 12.0 pF capacitor to simulate microphone capacitance. Data reported in dB re 20 µPa assuming a microphone sensitivity of 23.6 mV/Pa.

Compliance Standards Compliant to Manufacturer Specifications and the following standards when combined with Calibration Certificate from procedure D0001.8384:

IEC 60651:2001 Type 1	ANSI S1.4-2014 Class 1
IEC 60804:2000 Type 1	ANSI S1.4 (R2006) Type 1
IEC 61252:2002	ANSI S1.25 (R2007)
IEC 61672:2013 Class 1	ANSI S1.43 (R2007) Type 1
IEC 61260:2001 Class 1	ANSI S1.11 (R2009) Class 1

Issuing lab certifies that the instrument described above meets or exceeds all specifications as stated in the referenced procedure (unless otherwise noted). It has been calibrated using measurement standards traceable to the International System of Units (SI) through the National Institute of Standards and Technology (NIST), or other national measurement institutes, and meets the requirements of ISO/IEC 17025:2017. **Test points marked with a ‡ in the uncertainties column do not fall within this laboratory's scope of accreditation.**

The quality system is registered to ISO 9001:2015.

This calibration is a direct comparison of the unit under test to the listed reference standards and did not involve any sampling plans to complete. No allowance has been made for the instability of the test device due to use, time, etc. Such allowances would be made by the customer as needed.

The uncertainties were computed in accordance with the ISO Guide to the Expression of Uncertainty in Measurement (GUM). A coverage factor of approximately 2 sigma (k=2) has been applied to the standard uncertainty to express the expanded uncertainty at approximately 95% confidence level.

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Correction data from Larson Davis LxT Manual for SoundTrack LxT & SoundExpert Lxt, I770.01 Rev O Supporting Firmware Version 4.0.5, 2019-09-10

Calibration Check Frequency: 1000 Hz; Reference Sound Pressure Level: 114 dB re 20 µPa

LARSON DAVIS - A PCB PIEZOTRONICS DIV.
1681 West 820 North
Provo, UT 84601, United States
716-684-0001

ilac-MRA ACCREDITED Cert. #3622.01

LARSON DAVIS A PCB DIVISION

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D0001.8407 Rev F

Calibration Certificate

Certificate Number 2022001448
Customer:
Noise & Vibration Consulants Ltd
Navan, County Meath Ireland

Model Number	LxT SE	***Procedure Number***	D0001.8378
Serial Number	0006991	***Technician***	Jacob Cannon
Test Results	**Pass**	***Calibration Date***	3 Feb 2022
Initial Condition	As Manufactured	***Calibration Due***	
Description	Sound Expert LxT Class 1 Sound Level Meter Firmware Revision: 2.404	***Temperature***	23.63 °C ± 0.25 °C
		Humidity	52.5 %RH ± 2.0 %RH
		Static Pressure	86.96 kPa ± 0.13 kPa

Evaluation Method Tested electrically using Larson Davis PRMLxT1L S/N 077588 and a 12.0 pF capacitor to simulate microphone capacitance. Data reported in dB re 20 µPa assuming a microphone sensitivity of 23.6 mV/Pa.

Compliance Standards Compliant to Manufacturer Specifications and the following standards when combined with Calibration Certificate from procedure D0001.8384:

IEC 60651:2001 Type 1	ANSI S1.4-2014 Class 1
IEC 60804:2000 Type 1	ANSI S1.4 (R2006) Type 1
IEC 61252:2002	ANSI S1.25 (R2007)
IEC 61672:2013 Class 1	ANSI S1.43 (R2007) Type 1
IEC 61260:2001 Class 1	ANSI S1.11 (R2009) Class 1

Issuing lab certifies that the instrument described above meets or exceeds all specifications as stated in the referenced procedure (unless otherwise noted). It has been calibrated using measurement standards traceable to the International System of Units (SI) through the National Institute of Standards and Technology (NIST), or other national measurement institutes, and meets the requirements of ISO/IEC 17025:2017. **Test points marked with a ‡ in the uncertainties column do not fall within this laboratory's scope of accreditation.**

The quality system is registered to ISO 9001:2015.

This calibration is a direct comparison of the unit under test to the listed reference standards and did not involve any sampling plans to complete. No allowance has been made for the instability of the test device due to use, time, etc. Such allowances would be made by the customer as needed.

The uncertainties were computed in accordance with the ISO Guide to the Expression of Uncertainty in Measurement (GUM). A coverage factor of approximately 2 sigma (k=2) has been applied to the standard uncertainty to express the expanded uncertainty at approximately 95% confidence level.

This report may not be reproduced, except in full, unless permission for the publication of an approved abstract is obtained in writing from the organization issuing this report.

Correction data from Larson Davis LxT Manual for SoundTrack LxT & SoundExpert Lxt, I770.01 Rev O Supporting Firmware Version 4.0.5, 2019-09-10

Calibration Check Frequency: 1000 Hz; Reference Sound Pressure Level: 114 dB re 20 µPa

LARSON DAVIS - A PCB PIEZOTRONICS DIV.
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Provo, UT 84601, United States
716-684-0001

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2022-2-3T18:01:19

D0001.8407 Rev F

Calibration Certificate

Certificate Number 2022001439
Customer:
Noise & Vibration Consulants Ltd
Navan, County Meath Ireland

Model Number	LxT SE	***Procedure Number***	D0001.8378
Serial Number	0006990	***Technician***	Jacob Cannon
Test Results	**Pass**	***Calibration Date***	3 Feb 2022
Initial Condition	As Manufactured	***Calibration Due***	
Description	Sound Expert LxT Class 1 Sound Level Meter Firmware Revision: 2.404	***Temperature***	23.59 °C ± 0.25 °C
		Humidity	51.3 %RH ± 2.0 %RH
		Static Pressure	86.94 kPa ± 0.13 kPa

Evaluation Method Tested electrically using Larson Davis PRMLxT1L S/N 077587 and a 12.0 pF capacitor to simulate microphone capacitance. Data reported in dB re 20 µPa assuming a microphone sensitivity of 23.6 mV/Pa.

Compliance Standards Compliant to Manufacturer Specifications and the following standards when combined with Calibration Certificate from procedure D0001.8384:

IEC 60651:2001 Type 1	ANSI S1.4-2014 Class 1
IEC 60804:2000 Type 1	ANSI S1.4 (R2006) Type 1
IEC 61252:2002	ANSI S1.25 (R2007)
IEC 61672:2013 Class 1	ANSI S1.43 (R2007) Type 1
IEC 61260:2001 Class 1	ANSI S1.11 (R2009) Class 1

Issuing lab certifies that the instrument described above meets or exceeds all specifications as stated in the referenced procedure (unless otherwise noted). It has been calibrated using measurement standards traceable to the International System of Units (SI) through the National Institute of Standards and Technology (NIST), or other national measurement institutes, and meets the requirements of ISO/IEC 17025:2017. **Test points marked with a ‡ in the uncertainties column do not fall within this laboratory's scope of accreditation.**

The quality system is registered to ISO 9001:2015.

This calibration is a direct comparison of the unit under test to the listed reference standards and did not involve any sampling plans to complete. No allowance has been made for the instability of the test device due to use, time, etc. Such allowances would be made by the customer as needed.

The uncertainties were computed in accordance with the ISO Guide to the Expression of Uncertainty in Measurement (GUM). A coverage factor of approximately 2 sigma (k=2) has been applied to the standard uncertainty to express the expanded uncertainty at approximately 95% confidence level.

Correction data from Larson Davis LxT Manual for SoundTrack LxT & SoundExpert Lxt, I770.01 Rev O Supporting Firmware Version 4.0.5, 2019-09-10

Calibration Check Frequency: 1000 Hz; Reference Sound Pressure Level: 114 dB re 20 µPa

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716-684-0001

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A PCB DIVISION

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D0001.8407 Rev F

TECHNICAL APPENDIX 10.5

Candidate Turbine Manufacturer's Noise Emission Data

Frequency	Hub height wind speeds [m/s]																	
	3 m/s	4 m/s	5 m/s	6 m/s	7 m/s	8 m/s	9 m/s	10 m/s	11 m/s	12 m/s	13 m/s	14 m/s	15 m/s	16 m/s	17 m/s	18 m/s	19 m/s	20 m/s
6.3 Hz	17.2	16.1	14.6	17.7	21.3	24.7	25.4	25.8	26.3	27.2	28.2	28.7	29.0	29.0	28.9	28.7	28.4	28.1
8 Hz	23.3	22.6	21.6	24.7	28.4	31.7	32.4	32.8	33.2	33.9	34.6	34.9	35.0	34.9	34.7	34.5	34.1	33.8
10 Hz	28.7	28.4	27.9	31.0	34.6	37.9	38.7	39.0	39.3	39.8	40.3	40.5	40.4	40.2	39.9	39.6	39.1	38.8
12.5 Hz	33.8	33.9	33.8	36.9	40.5	43.8	44.7	44.9	45.1	45.5	45.7	45.7	45.5	45.2	44.8	44.5	44.0	43.6
16 Hz	39.2	39.7	40.0	43.0	46.6	49.9	50.9	51.0	51.1	51.3	51.4	51.2	50.8	50.5	50.0	49.6	49.1	48.6
20 Hz	43.8	44.5	45.2	48.2	51.8	55.1	56.1	56.2	56.2	56.3	56.2	55.9	55.4	55.0	54.5	54.0	53.4	53.0
25 Hz	48.1	49.1	50.1	53.1	56.7	59.9	61.0	61.0	61.0	61.0	60.7	60.3	59.7	59.3	58.7	58.2	57.6	57.1
31.5 Hz	52.4	53.5	54.8	57.8	61.4	64.6	65.7	65.7	65.7	65.5	65.0	64.6	63.9	63.4	62.8	62.3	61.6	61.1
40 Hz	56.4	57.8	59.3	62.3	65.8	69.1	70.2	70.2	70.1	69.8	69.2	68.7	68.0	67.4	66.8	66.2	65.5	65.0
50 Hz	59.9	61.5	63.1	66.1	69.7	72.9	74.1	74.0	73.9	73.5	72.9	72.2	71.5	70.9	70.2	69.7	69.0	68.4
63 Hz	63.3	64.9	66.7	69.8	73.3	76.5	77.8	77.6	77.5	77.1	76.3	75.7	74.9	74.3	73.6	73.0	72.3	71.8
80 Hz	66.5	68.2	70.1	73.1	76.7	79.9	81.1	81.0	80.8	80.4	79.6	78.9	78.1	77.4	76.8	76.2	75.5	75.0
100 Hz	69.2	70.9	72.9	76.0	79.5	82.7	84.0	83.8	83.6	83.1	82.3	81.6	80.8	80.2	79.5	78.9	78.2	77.7
125 Hz	71.6	73.4	75.4	78.4	82.0	85.2	86.5	86.3	86.1	85.6	84.8	84.1	83.3	82.6	82.0	81.4	80.8	80.2
160 Hz	74.0	75.7	77.7	80.8	84.3	87.5	88.8	88.7	88.4	88.0	87.1	86.5	85.7	85.1	84.4	83.9	83.3	82.8
200 Hz	75.9	77.5	79.5	82.6	86.1	89.3	90.6	90.4	90.2	89.8	89.0	88.3	87.6	87.1	86.4	85.9	85.3	84.9
250 Hz	77.5	79.1	81.0	84.0	87.6	90.8	92.0	91.9	91.7	91.3	90.6	90.0	89.3	88.8	88.2	87.7	87.1	86.7
315 Hz	78.9	80.3	82.1	85.2	88.7	92.0	93.2	93.1	92.9	92.5	91.9	91.4	90.8	90.3	89.7	89.3	88.8	88.4
400 Hz	80.1	81.3	82.9	86.0	89.5	92.8	94.0	93.9	93.8	93.5	92.9	92.5	92.0	91.5	91.1	90.7	90.2	89.9
500 Hz	80.9	81.9	83.3	86.4	90.0	93.2	94.4	94.3	94.2	94.0	93.6	93.3	92.8	92.5	92.1	91.8	91.4	91.1
630 Hz	81.4	82.2	83.4	86.5	90.0	93.3	94.5	94.4	94.4	94.3	94.0	93.8	93.5	93.2	92.9	92.6	92.3	92.0
800 Hz	81.7	82.2	83.0	86.2	89.8	93.1	94.2	94.2	94.2	94.2	94.1	94.0	93.8	93.7	93.4	93.3	93.0	92.8
1 kHz	81.7	81.8	82.4	85.5	89.2	92.5	93.5	93.6	93.7	93.8	93.9	93.9	93.9	93.8	93.7	93.6	93.4	93.3
1.25 kHz	81.4	81.2	81.4	84.6	88.2	91.6	92.5	92.7	92.8	93.1	93.4	93.6	93.7	93.8	93.7	93.7	93.6	93.6
1.6 kHz	80.8	80.2	80.0	83.1	86.8	90.2	91.1	91.3	91.5	92.0	92.6	92.9	93.2	93.4	93.5	93.6	93.6	93.6
2 kHz	80.0	78.9	78.3	81.5	85.2	88.6	89.4	89.7	90.0	90.6	91.5	92.0	92.5	92.8	93.0	93.2	93.3	93.4
2.5 kHz	78.9	77.4	76.3	79.5	83.2	86.7	87.4	87.7	88.2	89.0	90.1	90.9	91.5	91.9	92.3	92.6	92.8	93.0
3.15 kHz	77.5	75.5	73.9	77.1	80.8	84.3	85.0	85.4	85.9	87.0	88.4	89.3	90.2	90.8	91.3	91.7	92.1	92.3
4 kHz	75.8	73.2	71.0	74.2	78.0	81.5	82.1	82.6	83.2	84.5	86.3	87.5	88.6	89.4	90.0	90.5	91.1	91.4
5 kHz	73.9	70.7	67.9	71.2	75.0	78.6	79.0	79.6	80.4	81.9	84.0	85.5	86.8	87.7	88.6	89.2	89.9	90.3
6.3 kHz	71.6	67.9	64.4	67.7	71.6	75.2	75.5	76.2	77.1	78.9	81.4	83.1	84.7	85.8	86.8	87.6	88.4	88.9
8 kHz	69.0	64.6	60.4	63.8	67.7	71.3	71.5	72.3	73.4	75.4	78.3	80.4	82.2	83.5	84.8	85.6	86.6	87.3
10 kHz	66.3	61.2	56.4	59.7	63.6	67.3	67.4	68.4	69.6	71.9	75.2	77.5	79.7	81.2	82.6	83.6	84.7	85.5
A-wgt	91.7	91.9	92.8	95.9	99.5	102.8	103.9	103.9	103.9	103.9	103.9	103.9	103.9	103.9	103.9	103.9	103.9	103.9