Planning and Environmental Consultants

Environmental Impact Assessment Report

Taurbeg Wind Farm Extension of Operational Life

Chapter 12 – Noise and Vibration

DOCUMENT DETAILS

Client:	**Taurbeg Ltd**
Project Title:	**Taurbeg Wind Farm Extension of Operational Life**
Project Number:	**231030**
Document Title:	**Environmental Impact Assessment Report**
Document File Name:	**Ch. 11 Noise and Vibration – F - 2025.06.24 - 231030**
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Planning and Environmental Consultants

Rev	Status	Date	Author(s)	Approved By
01	Final	2025.06.24	MS	DB

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12.1 Introduction

12.1.1 Background & Objectives

This chapter of the EIAR describes the assessment undertaken of the potential noise and vibration impacts associated with the Proposed Project (Proposed Lifetime Extension for the existing Taurbeg Wind Farm and Proposed Offsetting Measures). The Proposed Lifetime Extension consists of the continued operation of the existing Taurbeg Wind Farm (permitted under Cork CC Pl. Ref N/2002/3608) for a further period of 10 years from the date of expiry (2026) of the current planning permission. The Proposed Offsetting lands are located in Knockatee and Coom, Co. Kerry, approximately 12 km west from the Taurbeg Wind Farm site. A full description of the Proposed Project is provided in Chapter 4: Description of Proposed Project.

There are no modifications proposed for the continued operation of the existing Taurbeg Wind Farm that will affect the existing noise and vibration emissions from the Proposed Lifetime Extension. As all elements of the Taurbeg wind farm are existing, there is no construction phase associated with Proposed Lifetime Extension. A noise assessment has been conducted for the deforestation works at the Proposed Offsetting lands required for the mitigation of potential effects of the continued operation of the existing Taurbeg Wind Farm.

Nearby existing operational wind turbines are located at Knockacummer and Glentane 1 & 2 wind farms (collective known as Glentane / Glentanemacelligot Wind Farm) and these developments have been included in the cumulative wind turbine noise assessment.

The current *Wind Energy Development Guidelines for Planning Authorities*, published by the Department of the Environment, Heritage and Local Government in 2006, defines a noise sensitive location (NSL) as any occupied dwelling house, hostel, health building or place of worship and may include areas of particular scenic quality or special recreational amenity importance. In this assessment, all of the NSLs are residential dwellings, some of which are denoted as derelict. In the EIAR, all residential dwellings are referred to as Sensitive Receptors. Therefore, any reference to NSLs or Sensitive Receptors in Chapter 12 are referring to the same receptors.

To inform this assessment, existing noise levels have been measured at a set of locations, representative of the nearest NSLs in the vicinity of the site, to assess the potential impacts associated with the Proposed Lifetime Extension. Background noise levels have been derived for these locations based on guidance in the Institute of Acoustics (IOA) document *A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise* (2013) (IOA GPG).

12.1.2 Statement of Authority

This chapter of the EIAR has been prepared by the following staff of AWN Consulting Ltd.

Dermot Blunnie (Associate (Acoustics)) holds a BEng (Hons) in Sound Engineering, MSc in Applied Acoustics and has completed the Institute of Acoustics (IOA) Diploma in Acoustics and Noise Control. He has been working in the field of acoustics since 2008 and is a member of the Institute of Engineers Ireland (MIEI) and the Institute of Acoustics (MIOA). He has extensive knowledge and experience in relation to commissioning noise monitoring and impact assessment of wind farms as well as a detailed knowledge of acoustic standards and proprietary noise modelling software packages. He has commissioned noise surveys and completed noise impact assessments for numerous wind farm projects within Ireland.

Miguel Cartuyvels (Acoustic Consultant) holds a BEng (Hons) in Industrial Engineering and is a member (TechIOA) of the Institute of Acoustics. Miguel has worked in the field of acoustics since 2021, where he has contributed to numerous projects related to environmental surveying, noise modelling, and impact assessment for various sectors, including wind energy, industrial, commercial, and residential.

This chapter of the EIAR has been reviewed by Mike Simms (Principal Acoustic Consultant) holds a BE and MEngSc in Mechanical Engineering and is a member of the Institute of Acoustics (MIOA) and of the Institution of Engineering and Technology (MIET). Mike has worked in the field of acoustics for over 20 years. He has extensive experience in all aspects of environmental surveying, noise modelling and impact assessment for various sectors including, wind energy, industrial, commercial and residential.

12.2 Fundamentals of Acoustics

A sound wave travelling through the air is a regular disturbance of the atmospheric pressure. These pressure fluctuations are detected by the human ear, producing the sensation of hearing. To take account of the vast range of pressure levels that can be detected by the ear, it is convenient to measure sound in terms of a logarithmic ratio of sound pressures. These values are expressed as Sound Pressure Levels (SPL) in decibels (dB).

The human audible range of sounds expressed in terms of Sound Pressure Levels (SPL) is 0 dB (for the threshold of hearing) to 120 dB (for the threshold of pain). In general, a subjective impression of doubling of loudness corresponds to a tenfold increase in sound energy which conveniently equates to a 10 dB increase in SPL. It should be noted that a doubling in sound energy (such as may be caused by a doubling of traffic flows) increases the SPL by 3 dB.

The frequency of sound is the rate at which a sound wave oscillates is expressed in Hertz (Hz). The sensitivity of the human ear to different frequencies in the audible range is not uniform. For example, hearing sensitivity decreases markedly as frequency falls below 250Hz. In order to rank the SPL of various noise sources, the measured level has to be adjusted to give comparatively more weight to the frequencies that are readily detected by the human ear. The 'A-weighting' system defined in the international standard, BS ISO 226:2003 Acoustics. Normal Equal-loudness Level Contours has been found to provide the best correlations with human response to perceived loudness. SPLs measured using 'A-weighting' are expressed in terms of dB(A).

An indication of the level of some common sounds on the dB(A) scale is presented in Figure 12-1.

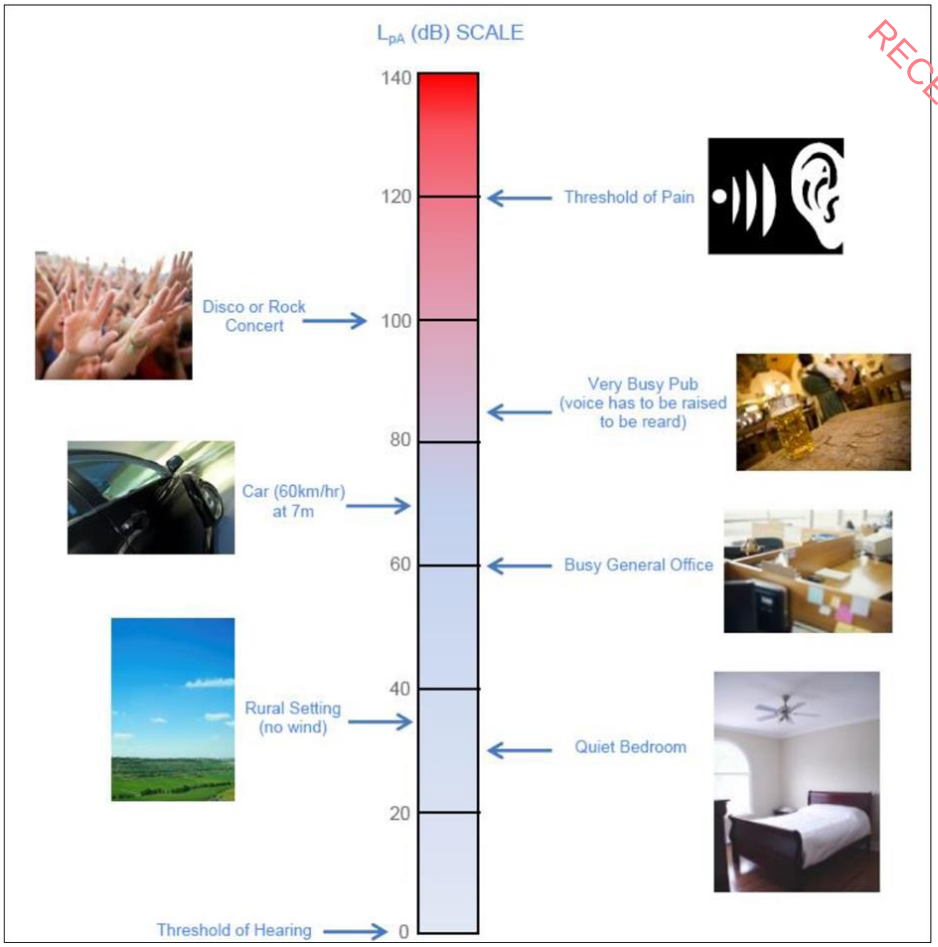

Figure 12-1 dB(A) Scale & Indicative Noise Levels – (EPA NG4 – 2016))

For a glossary of terms used in this chapter please refer to Appendix 12-1.

12.3 Assessment Methodology

The assessment of impacts has been undertaken with reference to the most appropriate guidance documents relating to noise and vibration for the extended operational and standard decommissioning phases of the Proposed Lifetime Extension, which are set out within the relevant sections of this chapter.

In addition to the specific guidance documents discussed in this section, the Environmental Impact Assessment (EIA) guidelines and legislative context presented in Chapter 1 (Introduction) have been considered and consulted for the purposes of preparing this EIAR chapter.

The methodology adopted for this noise and vibration impact assessment for the Proposed Project is summarised as follows:

- Characterise the receiving environment through noise surveys at various NSLs where required.
- Undertake predictive calculations to assess the potential impacts associated with the extended operational and decommission phases of the Proposed Lifetime Extension and the Proposed Offsetting Measures.
- Evaluate the potential noise and vibration impacts and effects.
- Specify mitigation measures and monitoring requirements, where necessary, control and reduce the identified potential outward impacts relating to noise and vibration from the Proposed Project; and

- Describe the significance of the residual noise and vibration effects associated with the Proposed Project.

12.3.1 EPA Description of Effects

The significance of effects of the Proposed Project shall be described in accordance with the EPA guidance document '*Guidelines on the information to be contained in Environmental Impact Assessment Reports (EIAR)',* (EPA,2022). Details of the methodology for describing the significance of the effects are provided in Chapter 1 – Introduction.

The effects associated with the Proposed Lifetime Extension and are described with respect to the EPA guidance in the relevant sections of this chapter.

12.3.2 Guidance Documents and Assessment Criteria

The following sections review the best practice and applicable guidance that is commonly adopted in relation to developments such as the one under consideration here.

12.3.2.1 Extended Operational Phase Noise

12.3.2.1.1 *Underground Cables*

It is not considered that any significant operational noise or vibration effects are likely in relation to the underground electrical and communications cabling within the site connecting the wind turbines and the met mast to the on-site 38kV substation. The underground cabling will not generate any noise during the operational phase. Therefore, an assessment of noise and vibration from underground cables for the continued operation has been scoped out of this assessment.

12.3.2.1.2 *Onsite Substation*

The existing onsite 38kV substation will continue operation as part of the Proposed Lifetime Extension. The nearest NSL or Sensitive Receptor to the onsite substation is located at approximately 1.2 km. At this distance there is no likelihood of any significant effects from noise or vibration. Therefore, an assessment of noise and vibration from the continued operation of the onsite substation has been scoped out of this assessment.

12.3.2.1.3 *Wind Turbine Noise*

There are no conditions of the planning permission for the Taurbeg Wind Farm (Cork Co. Co. Planning Reference No. N/2002/3608) relating to environmental noise.

It is noted that if the Proposed Project is granted permission for continued operation, the wind farm would continue as currently operating and there would be no change to the existing noise environment from the operation of the Taurbeg Wind Farm.

The approach adopted for this assessment is to assess operational noise from the wind farm, in so far is practicable, as if it were a new wind turbine development. The noise assessment methodology summarised in the following sections has been based on guidance in relation to acceptable levels of noise from wind farms as contained in the document Wind Energy Development Guidelines for Planning Authorities published by the Department of the Environment, Heritage, and Local Government (DEHLG) in 2006 (2006 WEDGs). These guidelines are in turn based on detailed recommendations set out in the Department of Trade & Industry (UK) Energy Technology Support Unit (ETSU) publication "*The Assessment and Rating of Noise from Wind Farms"* (1996). The ETSU document has been used to supplement the guidance contained within the "*Wind Energy Development*

Guidelines" publication where necessary. Reference is also made to noise limits in planning conditions for other nearby operational wind turbine developments.

The Assessment and Rating of Noise from Wind Farms – ETSU-R-97

The core of the noise guidance contained within the Wind Energy Development Guidelines guidance document is based on the 1996 ETSU publication *The Assessment and Rating of Noise from Wind Farms (ETSU-R-97).*

ETSU-R-97 calls for the control of wind turbine noise by the application of noise limits at the nearest noise sensitive properties. ETSU-R-97 considers that absolute noise limits applied at all wind speeds are not suited to wind turbine developments and recommends that noise limits should be set relative to the existing background noise levels at noise sensitive locations. A critical aspect of the noise assessment of wind energy proposals relates to the identification of baseline noise levels through on-site noise surveys.

ETSU-R-97 states on page 58, "*absolute noise limits and margins above background should relate to the cumulative effect of all wind turbines in the area which contribute to the noise received at the properties in question".* Therefore, the noise contribution from all wind turbine developments in the area shall be considered in the assessment.

The ETSU-R-97 guidance allows for a higher level of turbine noise operation at properties that have an involvement in the development, both as a higher fixed level of 45 dB L_{A90} and/or a higher level above the prevailing background noise level.

Institute of Acoustics Good Practice Guide

The guidance contained within the institute of Acoustics (IOA) document *A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise* (2013) (IOA GPG) and Supplementary Guidance Notes are considered to represent best practice and have been adopted for this assessment. The IOA GPG states, that at a minimum continuous baseline noise monitoring should be carried out at the nearest noise sensitive locations for typically a two-week period and should capture a representative sample of wind speeds in the area (i.e. cut in speeds to wind speed of rated sound power of the proposed turbine). Background noise measurements (i.e. $L_{A90,10min}$) should be related to wind speed measurements that are collated at the site of the wind turbine development. Regression analysis is then conducted on the data sets to derive background noise levels at various wind speeds to establish the appropriate day and night-time noise criterion curves.

Noise emissions associated with the wind turbine presented in this Chapter have predicted in accordance with ISO 9613: *Acoustics – Attenuation of sound outdoors, Part 2: General method of calculation* (2004). This is a noise prediction standard that considers noise attenuation offered, amongst others, by distance, ground absorption, directivity and atmospheric absorption. Noise predictions and contours are typically prepared for various wind speeds, and the predicted levels are compared against the relevant noise criterion curve to demonstrate compliance with the appropriate noise criteria.

Where noise predictions indicate that reductions in noise emissions are required in order to satisfy any adopted criteria, consideration can be given to detailed downwind analysis and operating turbines in low noise mode, which is an option on the wind turbine units.

For guidance on the methodology for the background noise survey and operation impact assessment for wind turbine noise, the IOA GPG has been adopted.

The IOA GPG states that cumulative noise exceedances should be avoided and where existing or permitted development is at the noise limit, any new turbine noise sources should be designed to be 10 dB below the limit value. Reference will be made to this guidance when considering potential cumulative impacts from any other existing permitted or proposed wind farms in the surrounding

environment. In the first instance, to determine if they need to be included in the wind turbine noise assessment or if they can be scoped out of the cumulative assessment. noise levels within 10 dB of any existing wind farms at the same receptor location, then a cumulative noise impact assessment is necessary.

Section 5.1 of the IOA GPG provide criteria to determine whether a cumulative turbine noise assessment is necessary:

> *"5.1.4 During scoping of a new wind farm development consideration should be given to cumulative noise impacts from any other wind farms in the locality. If the proposed wind farm produces*
>
> *5.1.5 Equally, in such cases where noise from the proposed wind farm is predicted to be 10 dB greater than that from the existing wind farm (but compliant with ETSU-R-97 in its own right), then a cumulative noise impact assessment would not be necessary."*

An appraisal of the study area for the cumulative turbine noise impact assessment is presented in Section 10.3.5 and 10.3.6.

Wind Energy Development Guidelines

Section 5.6 of the *Wind Energy Development Guidelines* published by the Department of the Environment, Heritage and Local Government (2006) addresses noise and outlines the appropriate noise criteria in relation to wind farm developments.

The following extracts from this document are considered:

> *"An appropriate balance must be achieved between power generation and noise impact."*

While this comment is noted it is stated that the Guidelines give no specific advice in relation to what constitutes an '*appropriate balance*'. In the absence of this, guidance will be taken from alternative and appropriate publications.

Wind Energy Development Guidelines (2006) also state that:

> *"In the case of wind energy development, a noise sensitive location includes any occupied house, hostel, health building or place of worship and may include areas of particular scenic quality or special recreational importance. Noise limits should apply only to those areas frequently used for relaxation of activities for which a quiet environment is highly desirable. Noise limits should be applied to external locations and should reflect the variation in both turbine source noise and background noise with wind speed."*

As shown the calculations presented in Section 10.4.2 of this chapter, the various requirements identified in the extract above have been incorporated in the assessment.

> *"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."*

This represents the commonly adopted daytime noise criterion curve in relation to wind farm developments. However, an important caveat should be noted as detailed in the following extract.

> *"However, in very quiet areas, the use of a margin of 5 dB(A) above background noise at nearby noise sensitive properties is not necessary to offer a reasonable degree of protection and may unduly restrict wind energy developments which should be recognised as having wider national and global benefits. Instead, in low noise environments where background*

noise is less than 30 dB(A), it is recommended that the daytime level of the $L_{A90, 10min}$ of the wind energy development be limited to an absolute level within the range of 35 – 40 dB(A).”

In relation to night-time periods the following guidance is given:

“A fixed limit of 43 dB(A) will protect sleep inside properties during the night.”

This limit is defined in terms of the $L_{A90,10min}$ parameter. This represents the commonly adopted night-time lower limit noise criterion curve in relation to wind farm developments.

In summary, the Wind Energy Development Guidelines outlines the following guidance to identify appropriate wind turbine noise criteria curves at noise sensitive locations:

- an appropriate absolute limit level for quiet daytime environments with background noise levels of less than 30 dB $L_{A90,10min}$;
- 45 dB $L_{A90,10min}$ for daytime environments with background noise levels of greater than 30 dB $L_{A90,10min}$ or a maximum increase of 5 dB above background noise (whichever is higher), and;
- 43 dB $L_{A90,10min}$ for night-time periods.

While the caveat of an increase of 5 dB(A) above background for night-time operation is not explicit within 2006 WEDGs, it is based on the methodology in ETSU and commonly applied in wind turbine noise assessments, it is utilised in numerous examples of planning conditions issued by local authorities and An Bord Pleanála (ABP). An increase of 5 dB(A) above background for night-time operation has been imposed through planning conditions at nearby wind farm developments (Knockacummer and Glentane / Glentanemacelligot Wind Farms).

This set of criteria has been chosen as it is in line with the intent of the relevant Irish guidance. The proposed operational noise criteria for wind turbine noise at noise sensitive locations are presented in Section 10.4.2.

Review of Planning Conditions for Other Operational Noise on Existing Wind Energy Developments in the Study Area

There are no planning conditions controlling noise for the existing Taurbeg Wind Farm. To determine appropriate noise limits in accordance with proposed criteria for wind turbine operations, it is important to consider any existing planning controls for turbine noise on other wind farm developments within the study area.

Best practice for setting wind turbine noise limits is that any turbine limits should relate to the cumulative turbine noise level from all turbines at Noise Sensitive Locations (NSLs). It is not uncommon for older wind farm developments in Ireland to have conditioned noise limits that conflict with, or do not align with, those of neighbouring wind farm developments.

When setting appropriate turbine noise limits in accordance with the criteria following the applicable guidance (2006 WEDGs), it is important to bear in mind that where an existing wind turbine development is the dominant source of turbine noise at a given NSL, this must be considered in the context of the planning condition for noise under which that particular development operates.

In practical terms, the proposed turbine noise limits for the Proposed Lifetime Extension should apply to the nearest NSLs where it can be reasonably determined that the noise contribution from the operation of the Proposed Lifetime Extension is the dominant wind turbine source or has a significant contribution to the cumulative turbine noise level at a given NSL.

The planning permission for the Glentane Phase 1 Wind Farm development (Planning Reference 06/4077) places a limit on noise levels at a lower threshold of 43 dB $L_{A90,10\text{-}min}$ with an allowance for +5

dB above background noise through Condition no. 17 of the grant of planning. It is understood that a similar noise condition applies to Glentane Phase 2. It is also noted that this condition relates to all periods, day and night. Condition 17 states:

> "*Noise levels emanating from the proposed development following commissioning when measured externally shall not exceed the greater of 43dB (A) L_{90} or 5dB above background levels.*
>
> *If noise contains a discrete continuous note (whine, hiss, hum etc.), or if there are distinct impulses in the noise (bangs, clicks, clatters or thumps), or if the noise is irregular enough in character to attract attention, a penalty of +5 dB shall be applied to the measured noise level and this increased level shall be used in assessing compliance with the specified levels."*

While the planning condition noise limits for Glentane Phase 1 is not strictly in line with best practice, they are not dissimilar of those applied in grants of permission issued by ABP for similar developments. A fixed lower threshold of 43 dB L_{A90} is applied to daytime. Given the precedents for this condition and the fact that the Proposed Lifetime Extension shares common NSLs, it is reasonable to apply the same 43 dB L_{A90} as a lower threshold for cumulative turbine noise during daytime periods, where background noise levels are less than 30 dB L_{A90} (refer to Section 10.3.2.2.3 for discussion of the turbine noise criteria). Having NSLs in the study area with two different cumulative turbine noise limits may lead to complications in demonstrating planning compliance and enforcement. In our professional opinion it would be appropriate to maintain the same conditions, adopting a daytime lower threshold of 43 dB L_{A90} for the Proposed Lifetime Extension as a cumulative turbine noise limit, to align to the conditioned turbine noise limits to others in the area to avoid practical difficulties in terms of demonstrating compliance. Ultimately, the turbine noise emission from the Proposed Lifetime Extension will remain unchanged.

Condition 14 of the ABP grant of planning permission for the Knockacummer Wind Farm relates to noise and states the following requirement:

> *(a) Noise levels measured externally during the operation of the development at the nearest noise sensitive location shall not exceed 5 dBA above ambient noise levels.*
>
> *(b) Prior to the commissioning of the plant, the developers shall arrange for the monitoring of noise levels within one year of the commissioning of the development. The nature and extent of the monitoring programme, and noise sensitive locations to be monitored, shall be agreed with the planning authority. Mitigation measures shall be submitted to the planning authority for written agreement in the event of noise levels exceeding the permitted levels and having an adverse impact on nearby noise sensitive properties.*

Condition 14 from Knockacummer Wind Farm is not typical of planning conditions for noise from wind turbine development and does not align with best practice guidance for wind turbine noise. The limit values are not clearly defined, and there is no lower threshold limit stipulated. However, it is understood that the intent is to apply an allowance in the turbine noise limit of 5 dB above background noise levels at all periods, day and night.

The proposed operation turbine noise limits for the Lifetime Extension are presented in Section 12.4.2.

Future Potential Guidance Change

In December 2019, the Draft Revised Wind Energy Development Guidelines (2019 Draft) were published for consultation and at the time of writing, the final guidelines have yet to be published. It is important to note that during the public consultation on the 2019 Draft, several concerns relating to the proposed approach of the 2019 Draft have been expressed by various parties. Specific concerns expressed by a group of acoustic professionals working in the field are most relevant. The group was made up of acousticians who act for wind farm developers, Councils, Government bodies and

residents' groups (all of whom are members of the Institute of Acoustics, IOA). The group contained several of the authors / contributors to ETSU-R-97, the IOA Good Practice Guide (IOA GPG) and the IOA Amplitude Modulation Working Group, which are all referenced extensively in the draft guidelines. A statement from the group can be reviewed at:

https://www.ioa.org.uk/wind-energy-development-guidelines-wedg-consultation-irish-department-housing-planning-community-and

A copy of the group's consultation response can be viewed at:

https://tneigroup-com.stackstaging.com/wp-content/uploads/2022/05/WEDG-consultation-joint-response-R0.pdf

The following statement is of note from the response:

> *"a number of acousticians working in the field have raised serious concerns over the significant amount of technical errors, ambiguities and inconsistencies in the content of the draft WEDG and these were highlighted during the consultation process by a group of acousticians"*

The following statements was submitted by the Minister for Housing, Local Government and Heritage during a Dail Eireann Debates on 13 June 2023[1]

> *"My Department is currently undertaking a focused review of the 2006 Wind Energy Development Guidelines. The review is addressing a number of key aspects including noise, setback distance, shadow flicker, community obligation, community dividend and grid connections.*
>
> *Guidance on the noise aspect, which is highly technical in nature, is currently being finalised by my Department in conjunction with the Department of the Environment, Climate and Communications (DECC), which has primary responsibility for environmental noise matters. Both Departments are engaging on proposals regarding the measurement and assessment of noise from wind turbines to ensure they are robust and fit for purpose having regard to, inter alia, the revised 2030 target to generate up to 80% of our electricity from renewable sources.*
>
> *In this connection, DECC has recently appointed an acoustic expert, who has commenced work to inform any amendments to the noise aspect of the Guidelines. My Department in conjunction with DECC will make any further changes to the draft Guidelines which are deemed necessary or appropriate in the wake of this work, with a view to bringing the review of the Guidelines to a conclusion. My Department will be in a better position to provide an update on the expected publication date of the revised Guidelines once this process has concluded.*
>
> *It should be noted that Action EL/23/4 of the Climate Action Plan 2023 Annex of Actions contains a commitment to having new draft Guidelines prepared by the end of Q4 2023, with revised Guidelines to be published in 2024.*
>
> *When finalised, the revised Guidelines will be issued under section 28 of the Planning and Development Act 2000, as amended. Planning authorities and, where applicable, An Bord Pleanála, must have regard to guidelines issued under section 28 in the performance of their functions generally under the Planning Acts. In the meantime, the current 2006 Wind Energy Development Guidelines remain in force."*

1 https://www.oireachtas.ie/en/debates/question/2023-06-13/780/

At the time of writing, no new draft Guidelines have been published and there is no confirmed timeframe for their publication. The assessment of wind turbine noise presented in this EIAR is based on the guidance outlined in the 2006 WEDGs and has been supplemented with best practice guidance from ESTU-R-97 and the IOA GPG. If updated Wind Energy Guidelines are published during the application process for the Proposed Lifetime Extension it is anticipated that any relevant changes affecting the noise will be addressed through an appropriate planning condition, or where a supplementary assessment is necessary, through provision of additional information.

World Health Organisation (WHO) Noise Guidelines for the European Region

The World Health Organisation (WHO) *Environmental Noise Guidelines for the European Region* (2018) provide guidance on protecting human health from exposure to environmental noise. They set health-based recommendations based on average environmental noise exposure of several sources of environmental noise, including wind turbine noise. Recommendations are rated as either 'strong' or 'conditional'. A strong recommendation, "*can be adopted as policy in most situations*" whereas a conditional recommendation, "*requires a policy-making process with substantial debate and involvement of various stakeholders. There is less certainty of its efficacy owing to lower quality of evidence of a net benefit, opposing values and preferences of individuals and populations affected or the high resource implications of the recommendation, meaning there may be circumstances or settings in which it will not apply*".

The objective of the WHO Environmental Noise Guidelines for the European Region that was published in October 2018 is to provide recommendations for protecting human health from exposure to environmental noise from transportation, wind farm and leisure sources of noise. The guidelines present recommendations for each noise source type in terms of L_{den} and L_{night} levels above which there is potential for adverse health risks.

In relation to wind turbine noise, the WHO Guideline Development Group (GDG) state the following:

> *"For average noise exposure, the GDG* ***conditionally*** *recommends reducing noise levels produced by wind turbines below 45 dB L_{den}, as wind turbine noise above this level is associated with adverse health effects.*
>
> *No recommendation is made for average night noise exposure L_{night} of wind turbines. The quality of evidence of night-time exposure to wind turbine noise is too low to allow a recommendation.*
>
> *To reduce health effects, the GDG* ***conditionally*** *recommends that policymakers implement suitable measures to reduce noise exposure from wind turbines in the population exposed to levels above the guideline values for average noise exposure. No evidence is available, however, to facilitate the recommendation of one particular type of intervention over another."*

The quality of evidence used for the WHO research is stated as being 'Low', the recommendations are therefore conditional.

There is potential increased uncertainty due to the parameter used by the WHO for assessment of exposure (i.e. L_{den}), which it is acknowledged may be a poor characterisation of wind turbine noise and may limit the ability to observe associations between wind turbine noise and health outcomes, as stated below.

> *"Even though correlations between noise indicators tend to be high (especially between LAeq-like indicators) and conversions between indicators do not normally influence the correlations between the noise indicator and a particular health effect, important assumptions remain when exposure to wind turbine noise in L_{den} is converted from original sound pressure level values. The conversion requires, as variable, the statistical distribution of annual wind speed at a particular height, which depends on the type of wind turbine and meteorological conditions at*

a particular geographical location. Such input variables may not be directly applicable for use in other sites. They are sometimes used without specific validation for a particular area, however, because of practical limitations or lack of data and resources. This can lead to increased uncertainty in the assessment of the relationship between wind turbine noise exposure and health outcomes. Based on all these factors, it may be concluded that the acoustical description of wind turbine noise by means of L_{den} or L_{night} may be a poor characterization of wind turbine noise and may limit the ability to observe associations between wind turbine noise and health outcomes

Further work is required to assess fully the benefits and harms of exposure to environmental noise from wind turbines and to clarify whether the potential benefits associated with reducing exposure to environmental noise for individuals living in the vicinity of wind turbines outweigh the impact on the development of renewable energy policies in the WHO European Region."

Based upon the review set out above, it is concluded that the conditional WHO recommended average noise exposure level (i.e. 45 dB L_{den}) should not currently be applied as target noise criteria for an existing or proposed wind turbine development in Ireland.

12.3.2.1.4 *Low Frequency Noise and Infrasound*

Low Frequency Noise is noise that is dominated by frequency components less than approximately 200Hz whereas Infrasound is typically described as sound at frequencies below 20Hz. In relation to Infrasound, the following extract from the EPA document *Guidance Note for Noise Assessment of Wind Turbine Operations at EPA Licensed Sites* (NG3) (EPA, 2011) is noted here:

"There is similarly no significant infrasound from wind turbines. Infrasound is high level sound at frequencies below 20 Hz. This was a prominent feature of passive yaw "downwind" turbines where the blades were positioned downwind of the tower which resulted in a characteristic "thump" as each blade passed through the wake caused by the turbine tower. With modern active yaw turbines (i.e. the blades are upwind of the tower and the turbine is turned to face into the wind by a wind direction sensor on the nacelle activating a yaw motor) this is no longer a significant feature."

The UK Institute of Acoustics Bulletin in March 2009 included a statement of agreement between acoustic consultants regularly employed on behalf of wind farm developers, and conversely acoustic consultants regularly employed on behalf of community groups campaigning against wind farm developments (IAO JS2009). The intent of the article was to promote consistent assessment practices, and to assist in restricting wind farm noise disputes to legitimate matters of concern. The article notes the following with respect to infrasound:

"Infrasound is the term generally used to describe sound at frequencies below 20 Hz. At separation distances from wind turbines which are typical of residential locations the levels of infrasound from wind turbines are well below the human perception level. Infrasound from wind turbines is often at levels below that of the noise generated by wind around buildings and other obstacles.

Sounds at frequencies from about 20 Hz to 200 Hz are conventionally referred to as low-frequency sounds. A report for the DTI in 2006 by Hayes McKenzie concluded that neither infrasound nor low frequency noise was a significant factor at the separation distances at which people lived. This was confirmed by a peer review by a number of consultants working in this field. We concur with this view."

The article concludes that:

"from examination of reports of the studies referred to above, and other reports widely available on internet sites, we conclude that there is no robust evidence that low frequency

noise (including 'infrasound') or ground-borne vibration from wind farms generally has adverse effects on wind farm neighbours".

A report released in January 2013 by the South Australian Environment Protection Authority, namely, *Infrasound levels near windfarms and in other environments* (EPA, 2013)[2] found that the level of infrasound from wind turbines is insignificant and no different to any other source of noise, and that the worst contributors to household infrasound are air-conditioners, traffic and noise generated by people.

The EPA's study concluded that the level of infrasound at houses near wind turbines was no greater than in other urban and rural environments, and stated that:

> "*The contribution of wind turbines to the measured infrasound levels is insignificant in comparison with the background level of infrasound in the environment."*

In conclusion, low frequency noise and infrasound associated with wind turbines is expected to be below perceptibility thresholds and are not likely to result in any significant effects at NSLs. The are no criteria proposed to assess low frequency noise or infrasound as part of the EIAR.

12.3.2.1.5 *Amplitude Modulation*

In the context of this assessment, amplitude modulation (AM) is defined in the IOA Noise Working Group (Wind Turbine Noise) Amplitude Modulation Working Group (AMWG) document A Method for Rating Amplitude Modulation in Wind Turbine Noise (IOA, 2016) as:

> *"Periodic fluctuations in the level of audible noise from a wind turbine (or wind turbines), the frequency of the fluctuations being related to the blade passing frequency (BPF) of the turbine rotor(s)."*

It is now generally accepted that there are two mechanisms which can cause amplitude modulation:

- 'Normal' AM, and;
- 'Other' AM (sometimes referred to 'Excessive' AM).

In both cases, the result is a regular fluctuation in amplitude at the Blade Passing Frequency (BPF) of the wind turbine blades (the rate at which the blades of the turbine pass a fixed point). For a three-bladed turbine rotating at 20 rpm, this equates to a modulation frequency of 1 Hz.

'Normal' AM	An observer at ground level close to a wind turbine will experience 'blade swish' because of the directional characteristics of the noise radiated from the trailing edge of the blades as it rotates towards and then away from the observer. This effect is reduced for an observer on or close to the turbine axis, and therefore would not generally be expected to be significant at typical separation distances, at least on relatively level sites. The RenewableUK AM project (RenewableUK, 2013) has coined the term 'normal' AM (NAM) for this inherent characteristic of wind turbine noise, which has long been recognised and was discussed in ETSU-R-97 in 1996.
'Other' AM	In some cases AM is observed at large distances from a wind turbine (or turbines). The sound is generally heard as a periodic 'thumping' or 'whoomphing' at relatively low frequencies.

[2] *EPA South Australia, 2013, Wind farms https://www.epa.sa.gov.au/files/477912_infrasound.pdf*

On sites where it has been reported, occurrences appear to be occasional, although they can persist for several hours under some conditions, dependent on atmospheric factors, including wind speed and direction.

It was proposed in the RenewableUK 2013 study that the fundamental cause of this type of AM is transient stall conditions occurring as the blades rotate, giving rise to the periodic thumping at the blade passing frequency.

Transient stall represents a fundamentally different mechanism from blade swish and can be heard at relatively large distances, primarily downwind of the rotor blade.

The RenewableUK AM project report adopted the term 'Other AM' (OAM) for this characteristic. The terms 'enhanced' or 'excess' AM (EAM) have been used by others, although such definitions do not distinguish between the source mechanisms and presuppose a 'normal' level of AM, presumably relating back to blade swish as described in ETSU-R-97.

Frequency of Occurrence of AM

Research by Salford University commissioned by the Department of Environment Food and Rural Affairs (DEFRA), the Department of Business, Enterprise and Regulatory Reform (BERR) and the Department of Communities and Local Government (CLG) investigated the issue of AM associated with wind turbine noise at existing sites. The results were reviewed and published in the report 'Research into Aerodynamic Modulation of Wind Turbine Noise' (2007). The conclusions of this report were that aerodynamic modulation was only considered to be an issue at four, and a possible issue at a further eight, of 133 sites in the UK that were operational at the time of the study and considered within the review. At the four sites where AM was confirmed as an issue, it was considered that conditions associated with AM might occur between about 7 and 15% of the time. It also emerged that for three out of the four sites the complaints have subsided, in one case due to the introduction of a turbine control system.

It is not possible to predict an occurrence of AM at the planning stage. While OAM can occur it is noted that the research has shown that it is a rare event associated with a limited number of wind farms.

RenewableUK Research Document states the following in relation to matter:

Page 68 Module F — *"even on those limited sites where it has been reported, its frequency of occurrence appears to be at best infrequent and intermittent."*

Page 6 Module F — *"It has also been the experience of the project team that, even at those wind farm sites where AM has been reported or identified to be an issue, its occurrence may be relatively infrequent. Thus, the capture of time periods when subjectively significant AM occurs may involve elapsed periods of several weeks or even months."*

Page 61 Module F — *"There is nothing at the planning stage that can presently be used to indicate a positive likelihood of OAM occurring at any given proposed wind farm site, based either on the site's general characteristics or on the known characteristics of the wind turbines to be installed."*

Concluding Comments on Amplitude Modulation

It is critical to this discussion to recognise that amplitude modulation (AM) is an inherent characteristic of wind turbine noise. A distinction must be made between 'Normal' AM, which is a regular fluctuation

in noise levels, and 'Other' or 'Excessive' AM, which can be more pronounced and potentially disruptive. Normal AM is typically expected and accounted for in noise assessments, whereas Excessive AM should it occur may require additional mitigation measures due to its potential impact on nearby residents.

Research and Guidance in the field of wind turbine noise AM is ongoing with publications being issued by the Institute of Acoustics (IOA) Noise working Group (Wind Turbine Noise) Amplitude Modulation Working Group (AMWG) namely, *A Method for Rating Amplitude Modulation in Wind Turbine Noise* (August 2016) (The Reference Method). The document proposes an objective method for measuring and rating AM. The AMWG does not propose what level of AM is likely to result in adverse community response or propose any limits for AM. The purpose of the group is simply to use existing research to develop a Reference Methodology for the measurement and rating of amplitude modulation.

A 2016 report commissioned by the UK government *Wind turbine AM review: Phase 2 report. 3514482A Issue 3. Department for Business, Energy & Industrial Strategy* completed by WSP Parsons Brinckerhoff recommended the use of a penalty scheme as a potential planning condition for AM to cover periods of complaints due to unacceptable AM. The report included the following caveat "*Any condition developed using the elements proposed in this study should be subject to a period of testing and review. The period should cover a number of sites where the condition has been implemented and would be typically in the order of 2-5 years from planning approval being granted.*"

To date there is no clear industry consensus on how AM should be regulated or managed through the planning stage. In the context of a site seeking permission to continue operation, reference is made to the mitigation measures in respect of AM described in section 12.6.1.1.1.

12.3.2.1.6 *Human Health Effects from Wind Turbine Noise*

There is currently no credible evidence to link wind turbine noise exposure in the environment to adverse health impacts. For further details of potential health impacts effects associated with the Proposed Project, refer to Chapter 5 (Population and Human Health) of this EIAR.

12.3.2.2 Operational Phase Vibration

Any vibration generated from the operation of a wind turbine unit will decrease significantly over distance. A recent report from Germany published by the State Office for the Environment, Measurement and Nature Conservation of the Federal State of Baden-Württemberg in 2016, "Low Frequency Noise Incl. Infrasound from Wind Turbines and Other Sources" conducted vibration measurements study for an operational Nordex N117 – 2.4 MW wind turbine. The report concluded that at distances of less than 300 m from the turbine vibration levels had dropped so far that they could no longer be differentiated from the background vibration levels. The shortest distance from any turbine to a wind turbine is 734 m.

There are no reported cases of perceptible vibration from the operation of the Taurbeg Wind Farm at any NSL. Therefore, vibration criteria are not specified for the operational phase of the project.

12.3.2.3 Decommissioning Phase

There is no construction associated with the Proposed Lifetime Extension, however, if permitted the Taurbeg Wind Farm would be decommissioned in 2036. The appropriate criteria for the decommissioning phases of the existing Taurbeg Wind Farm are provided here.

The above-ground turbine components will be removed; however, the turbine bases and hardstanding will be left in-situ and covering with topsoil. Electrical cabling connecting the site infrastructure to the

on-site substation will be removed, while the ducting itself will remain in-situ. The substation will remain as a permanent part of the grid network.

It is proposed that the site roadways be left in situ, as appropriate, so as to facilitate on-going access to local landowners. If it were to be confirmed that the roads were not required in the future for any other useful purpose, they could be covered over with local topsoil and left to reseed, however, that is not envisaged at this time.

Refer to Chapter 4 of this EIAR (Description of Proposed Project) for full details of proposed decommissioning.

12.3.2.3.1 Noise Criteria

There is no published statutory Irish guidance relating to the maximum permissible noise levels that may be generated during the construction or decommissioning phase of a project. Local authorities normally control construction activities by imposing limits on the hours of works and may consider noise limits at their discretion.

In the absence of specific noise limits, appropriate criteria relating to permissible construction and decommissioning noise levels for a development of this scale may be found in the *British Standard 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise*.

The approach adopted here calls for the designation of a NSL into a specific category (A, B or C) based on existing ambient noise levels in the area. This then sets a threshold noise value that, if exceeded (construction or decommissioning noise only) at the façade of residential, noise sensitive locations, indicates a potential significant noise impact is associated with the decommissioning activities.

Table 12-1 sets out the values which, when exceeded, potentially signify a significant effect at the facades of residential receptors as recommended by BS 5228 – 1.

Table 12-1 Example Threshold of Potential Significant Effect at Noise Sensitive Locations

Assessment category and threshold value period (T)	Threshold values, $L_{Aeq,T}$ dB		
	Category A [Note A]	Category B [Note B]	Category C [Note C]
Night-time (23:00 to 07:00hrs)	45	50	55
Evenings and weekends [Note D]	55	60	65
Daytime (07:00 – 19:00hrs)	65	70	75

Note A Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are less than these values.
Note B Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are the same as category A values.
Note C Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are higher than category A values.
Note D 19:00 – 23:00 weekdays, 13:00 – 23:00 Saturdays and 07:00 – 23:00 Sundays.

For the appropriate period (e.g. daytime) the ambient noise level is determined and rounded to the nearest 5 dB. In this instance, with the rural nature of the site, properties near the development have daytime ambient noise levels that typically range from 40 to 50 dB $L_{Aeq,1hr}$. Therefore, as a precautionary approach, all properties will be afforded a Category A designation.

If the specific noise level due to decommissioning exceeds the appropriate category value (e.g. 65 dB $L_{Aeq,T}$ during daytime periods) then a significant effect is deemed to have occurred.

12.3.2.3.2 Additional Vehicular Activity on Public Roads - Noise

There are no specific guidelines or limits relating to traffic related sources along the local or surrounding roads. Given that decommissioning traffic from the Taurbeg Wind Farm will make use of existing roads already carrying traffic volumes, it is appropriate to assess the calculated increase in traffic noise levels that will arise because of vehicular movements associated with the decommissioning of the Taurbeg Wind Farm. To assist with the interpretation of the noise associated with additional vehicular traffic on public roads, Table 12-2, adapted from United Kingdom Highways Agency (UKHA) Design Manual for Roads and Bridges (DMRB) Sustainability & Environment Appraisal LA 111 Noise and Vibration Revision 2 (UKHA 2020), offers guidance as to the likely impact in the short-term associated with any change in traffic noise level.

Table 12-2 Classification of magnitude of traffic noise changes in the short-term (Source DMRB, 2020)

Change in Sound Level (dB(A))	Subjective Reaction	DMRB Magnitude of Impact (Short-term)	EPA Significance of Effect
Less than 1 dB	Inaudible	No Change	Imperceptible
1.0 – 2.9	Barely Perceptible	Minor	Slight/Moderate
3.0 – 4.9	Perceptible	Moderate	Significant
≥5	Up to a doubling of loudness	Major	Very Significant

The guidance outlined in Table 12-2 will be used to assess the predicted increases in traffic levels on public roads associated with the decommissioning of the Taurbeg Wind Farm. Where an impact is identified due to the change in traffic noise level, reference will be made to the overall predicted noise level from decommissioning traffic in the context of the decommissioning noise criteria outlined in Section 12.3.2.3.1.

12.3.2.3.3 Consideration of Duration When Assessing Effect

Section 3.19 of LA 111, DMRB states that construction noise and construction traffic noise shall constitute a significant effect where it is determined that a major or moderate magnitude of impact will occur for a duration exceeding:

- 10 or more days or nights in any 15 consecutive days or nights; or,
- A total number of days exceeding 40 in any 6 consecutive months.

12.3.2.3.4 Decommissioning Phase - Vibration

Vibration standards come in two varieties: those dealing with human comfort and those dealing with cosmetic or structural damage to buildings. With respect to the decommissioning of the Taurbeg Wind Farm, the range of relevant criteria used for building protection is expressed in terms of Peak Particle Velocity (PPV) in mm/s.

Guidance relevant to acceptable vibration within buildings is contained in the following documents:

- *BS 7385 – Evaluation and measurement for vibration in buildings – Part 2: Guide to damage levels from groundborne vibration (1993); and*
- *BS 5228 – Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration (2009+A1:2014).*

BS 7385 states that there should typically be no cosmetic damage if transient vibration does not exceed 15 mm/s at low frequencies rising to 20 mm/s at 15 Hz and 50 mm/s at 40 Hz and above.

BS 5228-2 recommends that, for soundly constructed residential property and similar structures that are generally in good repair, a threshold for minor or cosmetic (i.e. non-structural) damage should be taken as a peak particle velocity of 15 mm/s for transient vibration at frequencies below 15 Hz and 20 mm/s at frequencies above than 15 Hz. Below these vibration magnitudes minor damage is unlikely, although where there is existing damage, these limits may be reduced by up to 50%. In addition, where continuous vibration is generated, the limits discussed above may need to be reduced by 50%.

The Transport Infrastructure Ireland (TII) *Good Practice Guidance for the Treatment of Noise during the Planning of National Road Schemes* (TII, 2014) also contains information on the permissible construction vibration levels during the construction phase as shown in Table 12-3.

Table 12-3 Allowable Transient Vibration at Properties

Allowable vibration (in terms of peak particle velocity) at the closest part of sensitive property to the source of vibration, at a frequency of		
Less than 10Hz	10 to 50Hz	50 to 100Hz (and above)
8 mm/s	12.5 mm/s	20 mm/s

12.3.2.4 Proposed Offsetting Measures

The Proposed Offsetting Measures will be achieved by permanent removal of approximately 105.5Ha of plantation forestry to create new viable hen harrier habitat. It is also proposed to restore approximately 17.7 ha of farmland habitat for the benefit of hen harrier. Restoration measures include planting and restoring of hedgerow, implementation of a rotational grazing scheme, planting of linear wildlife crop, predator fencing and cease on fertiliser application. Further detail regarding the Proposed Offsetting Measures can be found in Appendix 7-7. The proposed deforestation works will be of short-term duration and will involve permanent removal of trees which has potential to generate noise to the environment. Refer to Chapter 4 (Description of Proposed Project) for full details of Proposed Offsetting Measures.

There is no published statutory Irish guidance relating to the maximum permissible noise levels that may be generated by the proposed works. In the absence of specific noise limits, appropriate criteria relating to permissible construction and decommissioning noise levels outlined Section 12.3.2.3 are proposed.

12.3.3 Study Area

The study area for the noise and vibration impact assessment was defined by the area where there is potential for noise and vibration impacts and effects at NSLs associated with the Proposed Lifetime Extension during the decommissioning, and operational phases.

12.3.3.1 Operational Phase Noise

For the operational phase, the study area should cover, at a minimum, the area predicted to exceed 35 dB L_{A90} from all existing, permitted, and proposed wind turbines. Due to the potential for cumulative effects with other existing wind farm developments, the study area for the Proposed Lifetime Extension covers at a minimum the area predicted to exceed 30 dB L_{A90} at the maximum predicted noise

emission level for the Taurbeg Turbines isolation. Refer to Appendix 12-5 which displays the relevant noise contours maps which identify this area.

12.3.3.2 Short Term Activities

12.3.3.2.1 *Decommissioning Phase*

During the decommissioning phase, noise could occur at any location within the redline boundary and along public roads where there are increases in traffic associated with the Proposed Lifetime Extension.

NSLs in proximity to specific demolition activities and those situated along public road with the potential for additional traffic flows associated with the decommissioning have the most potential to experience noise and vibration from the Taurbeg Wind Farm. The study area is based on the nearest NSLs to the working areas, these distances are confirmed in the relevant sections and representative of the closest identified NSL or at defined set back distances from the proposed works.

12.3.3.2.2 *Proposed Offsetting Measures*

NSLs in proximity to deforestation activities have the most potential to experience noise impacts and effects. The study area is based on the nearest NSLs to the working areas, or at defined set back distances from the proposed works.

12.3.4 Background Noise Assessment

As the Taurbeg Wind Farm is operational, and there are other operational wind farms in the areas it was necessary to adapt the background noise survey methodology, within the framework and principles of the IOA GPG.

As mentioned in section 2.2.2 of the GPG: "*Any contribution to background noise levels of noise from an existing wind farm must be excluded when assigning background noise and setting noise limits for a new development.*" There are a number of ways of achieving this, as described in section 5.2 of GPG:

> *5.2.2 Where a new wind farm is proposed and a receptor is also within the area acoustically affected by an already operational wind farm, then noise from the existing wind farm must not be allowed to influence the background noise measurements for the proposed development.*
>
> *5.2.3 In the presence of an existing wind farm, suitable background noise levels can be derived by one of the following methods:*
>
> 1. *switching off the existing wind farm during the background noise level survey (with associated significant cost implications);*
> 2. *accounting for the contribution of the existing wind farm in the measurement data e.g. directional filtering (only including background data when it is not influenced by the existing turbines e.g. upwind of the receptor, but mindful of other extraneous noise sources e.g. motorways) or subtracting a prediction of noise from the existing wind farm from the measured noise levels;*
> 3. *utilising an agreed proxy location removed from the area acoustically affected by the existing wind farm/s; or*
> 4. *utilising background noise level data as presented within the Environmental Statement/s for the original wind farm/s (the suitability of the background noise level data should be established).*

Option 1 will have commercial implications and a negative impact on renewable energy production, on that basis it is the least preferred option. In this instance, a combination of option 2 (directional filtering

and subtracting a prediction of the noise from existing wind turbines), and option 3 (selecting locations where that will provide noise measurements at positions upwind of operational turbines, i.e. where the influence of operational turbines is least) was chosen. Further details are presented in the following sections and in Appendix 12-3.

All measurement data collected during the background noise surveys has been carried out in accordance with the IOA GPG and accompanying *Supplementary Guidance Note 1: Data Collection* (2014) discussed in the following Section.

It is important to note that background noise levels should derived such that there is no noise contribution from the existing wind turbines. In contrast, the terms 'baseline noise level' or the 'existing noise levels' environment, incorporate current noise contributions from the operation of the existing turbines.

12.3.4.1 Choice of Measurement Locations

A computer-based 3D model of the wind farm was prepared using the coordinates of the operational turbines' coordinates using the selected software DGMR iNoise (See Appendix 12-4 for more detail on wind turbine noise calculations). The model was used to prepare a set of noise contours based on the sound power levels of the operational turbines, at rated power wind speed, i.e. the wind speed at which the turbines reach their rated power and the highest sound power levels The selected noise monitoring locations are considered robust to capture the typical representative background noise levels at NSLs surrounding the proposed development. Appendix 12-3 presents full details of the background noise survey and selection of locations.

On review of the noise contour, three locations were selected for noise monitoring. The principles for the selection are that the noise environment must be typical of the noise environment at other nearby locations. Coordinates for the noise monitoring locations are detailed in Table 12-4 and Figure 12-2 .

Table 12-4 Noise Measurement Location Coordinates

Location	Coordinates – Irish Transverse Mercator (ITM)	
	Easting	Northing
NML 1	523,693	610,287
NML 2	521,032	612,392
NML 3	521,477	611,213

Project: Taurbeg Wind Farm
Extension of Operational Life

Description: Noise Monitoring Location Selection

- Taurbeg Turbines
- Internal Roads
- NML Selection

Google Satellite

Figure 12-2

N

0 300 600 m

Trinity Consultants
awnconsulting

The Tecpro Building, Clonshaugh Business and Technology Park,
Dublin 17

T: +353 1 847 4220 | F: +353 1 847 4257

Significant noise sources in this area were noted to be farming activity, intermittent local traffic movements, activity in and around the residences and wind generated noise from local foliage. Depending on wind speed and direction during visits, noise from existing wind turbines was audible to varying degrees.

There were no perceptible sources of vibration noted at any of the survey locations.

Appendix 12-3 presents full details of the background noise survey methodology instrumentation and results, including the location-specific wind direction filtering applied at each location to derive the background noise levels. Additional information is included in Appendix 12-2 (Copies of Calibration Certificates)

Section 12.4.1 of this chapter presents the results of the background noise survey and Section 12.4.2 presents the derived noise criteria for the operational wind farm.

12.3.4.1.1 *Wind Speed Measurements*

Wind speed measurements were obtained from a Zephir ZX300 Lidar unit installed and operated by MKO. A copy of the Lidar installation report is included in Appendix 12-7 (Copy of Lidar Installation Report).

12.3.4.2 Analysis of Background Noise Data

As well as the location-specific filtering, the data sets have been filtered to remove issues such as the dawn chorus and the influence of other atypical noise sources. An example of atypical sources would be short, isolated periods of raised noise levels attributable to local sources, agricultural activity, boiler flues, operation of gardening equipment etc. In addition, sample periods affected by rainfall or when rainfall resulted in prolonged periods of atypical noise levels have also been screened from the data sets. The assessment methods outlined above are in line with the guidance contained in the IOA GPG.

The results presented Appendix 12-3 and summarised in the following sections refer to the noise data collated during 'quiet periods' of the day and night as defined in the IOA GPG. These periods are defined as follows:

- Daytime Amenity hours are:
  - all evenings from 18:00 to 23:00hrs;
  - Saturday afternoons from 13:00 to 18:00hrs, and;
  - all day Sunday from 07:00 to 18:00hrs.
- Night-time hours are 23:00 to 07:00hrs.

12.3.4.2.1 *Consideration of Wind Shear*

Wind shear is defined as the change of wind speed with height above ground. Any reference to wind speed in this chapter should be understood to be at standardised 10 m height. The standardised equations used to determine the wind speed at standardised 10 m above ground are presented in Appendix 12-3. Any reference to wind speed in this chapter should be understood to be at standardised 10 m height unless otherwise stated.

12.3.5 Turbine Noise Calculations

A series of computer-based prediction models have been prepared to quantify the noise level associated with the operation of the Taurbeg Wind Farm. This section discusses the methodology for the noise modelling process.

12.3.5.1 Noise Modelling Software

Proprietary noise calculation software was used for the purposes of this impact assessment. The selected software, DGMR iNoise Enterprise, calculates noise levels in accordance with ISO 9613: *Acoustics – Attenuation of sound outdoors, Part 2: General method of calculation*, (ISO, 2024).

iNoise is a proprietary noise calculation package for computing noise levels and propagation of noise sources. iNoise calculates noise levels in different ways depending on the selected prediction standard. In general, however, the resultant noise level is calculated considering a range of factors affecting the propagation of sound, including:

- the magnitude of the noise source in terms of A weighted sound power levels (L_{WA});
- the distance between the source and receiver;
- the presence of obstacles such as screens or barriers in the propagation path;
- the presence of reflecting surfaces;
- the hardness of the ground between the source and receiver;
- Attenuation due to atmospheric absorption; and
- Meteorological effects such as wind gradient, temperature gradient and humidity (these have significant impact at distances greater than approximately 400 m).

12.3.5.2 Input Data and Assumptions

The calculation settings, input data and any assumptions made in the assessment are described in the following sections. Additional information relating to the noise model inputs and calculation settings is provided in Appendix 12-4.

12.3.5.2.1 *Turbine Details*

Table 12-5 details the co-ordinates of the 11 No. existing turbines at Taurbeg Wind Farm.

Table 12-5 Taurbeg Wind Farm Turbine Co-ordinates

Turbine	ITM X	ITM Y
T01	522,663	611,397
T02	522,412	611,957
T03	521,979	611,966
T05	522,259	612,226
T06	522,588	612,264
T07	522,868	612,172
T08	522,129	611,694
T09	522,876	611,649
T10	522,892	610,971
T11	522,972	611,296
T12	522,439	611,635

The installed turbines at the Taurbeg wind farm are Bonus (now Siemens) 2.3MW models with a hub height of 67 m and a rotor diameter of 82.4 m.

The installed turbines at the existing Taurbeg Wind Farm are no longer in production, and there is a degree of uncertainty on the sound power noise emission data of these turbines. To assess the turbine noise for the Proposed Lifetime Extension, reference has been made to published data for the Siemens SWT-2.3-82 VS turbines in the AWN database and a review of various test reports for similar turbine types to those installed at Taurbeg Wind Farm.

The published data from Siemens for the SWT-2.3-82 VS[3/4] confirms a maximum turbine sound power noise level of 104.5 dBA at ≥8 m/s. Review of other documents show similar noise emission levels for the SWT-2.3-82 VS and similar Siemens turbine models, however a test report[5] was sourced that indicated that a similar turbines had maximum turbine sound power noise level of up to 108.2 dBA at 10 m/s . This higher range is considered unlikely but the data from the various sources does indicate a range of potential noise emissions from the installed turbines. A review of the downwind measured noise data from the AWN survey with the Taurbeg Wind Farm in operation indicate that it is it most likely that the noise emissions associated with the operation of the Taurbeg turbines are at the lower end of the range identified. It is important to note that the testing methodology to determine the sound power emission from a turbines per IEC 61400-11 *Wind turbines - Part 11: Acoustic noise measurement techniques* is very different form background survey methodology employed for this assessment detailed in Section 12.3.4.

The approach adopted for this assessment is to consider two operational scenarios to consider the range of potential sound power noise emissions that have been identified for the installed turbines at the Taurbeg Wind Farm:

- The first assuming the 'Higher Range of Noise Emissions' as presented in Table 12-6 below, and
- The second assuming the 'Lower Range of Noise Emissions' as presented in Table 12-7 below.

This approach provides a robust assessment of the likely impacts and effects, with the 'Higher Noise Emissions' scenario representing a worst-case situation.

Table 12-6 Sound Power Level Spectra for Higher Range of Noise Emissions for a hub height of 67 m

Wind Speed (m/s)	Octave Band Centre Frequency (Hz)								dB L_{WA}
	63	125	250	500	1000	2000	4000	8000	
6	82.9	90.5	93.2	96.7	95.2	93.8	90.9	83.8	101.8
7	86.2	93.7	95.0	97.4	96.0	96.0	93.8	86.3	103.4
8	88.2	95.4	95.5	97.4	97.3	98.5	96.9	89.4	104.9
9	91.0	97.8	97.7	98.9	100.1	100.6	97.6	88.8	106.9
10	92.2	99.1	98.9	100.1	101.3	101.9	98.9	90.0	108.2

[3] Acoustic Emissions, SWT-2.3-82 VS Document ID: E R WP-EN431-10-0000-0160-00 PE / 2009.03.31
[4] Acoustic Emissions, SWT-2.3-82 VS Document ID: E R WP-EN431-10-0000-0162-00 PE / 2009.03.31
[5] Measurement of Noise Emission from an AN BONUS 2.3MW/82, BONUS 2.3 MW Wind Turbine situated at Blåhøj, Denmark 2002.12.10

Table 12-7 Sound Power Level Spectra for Lower Range of Noise Emissions for a hub height of 67 m

Wind Speed (m/s)	Octave Band Centre Frequency (Hz)								dB L_{WA}
	63	125	250	500	1000	2000	4000	8000	
4	62.9	74.7	83.5	84.6	84.1	82.0	79.8	73.6	90.3
5	70.0	81.8	90.6	91.7	91.2	89.1	86.9	80.7	97.4
6	75.0	86.8	95.6	96.7	96.2	94.1	91.9	85.7	102.4
7	77.5	87.5	96.2	98.3	98.6	96.0	94.1	88.3	104.2
≥8	77.8	87.8	96.5	98.6	98.9	96.3	94.4	88.6	104.5

The turbine sound power levels in Table 12-6 and Table 12-7 are presented in terms of the L_{Aeq} parameter. As explained further in Section 10.4.2, the wind turbine noise criteria are expressed in terms of an L_{A90} criterion. Best practice guidance in the IOA GPG states that "*L_{A90} levels should be determined from calculated L_{Aeq} levels by subtraction of 2 dB*". A 2 dB reduction has therefore been applied in the noise model calculation. All predicted noise levels in this chapter are presented in terms of L_{A90} parameter, i.e., this reduction of 2 dB is applied in the noise prediction calculations.

The IOA GPG states that in noise propagation calculations an allowance for uncertainty of the noise emissions must be considered. In the absence of any stated uncertainty in the manufacturers data, a +2 dB uncertainty for the Lower Noise Emissions scenario while as allowance for uncertainty of +1 dB has been added in the noise predictions calculation for the High Noise Emissions scenario as that was specifically stated in the associated documentation.

Finally, best practice specifies that should any tonal component be present, a penalty shall be added to the predicted noise levels. The level of this penalty is described in ETSU-R-97 and is related to the level by which any tonal components exceed audibility. For the purposes of this assessment a tonal penalty has not been included in the predicted turbine noise levels. In relation to tonal noise from the operation of the wind turbines, refer to mitigation measures in Section 12.6.1.1.2.

Appenidx 10-4 presents full details of the turbine specifications and the sound power emission for both the Higher and Lower Range across various wind speeds that have been used in this assessment. The following wind turbine developments have been included in the cumulative turbine noise assessment.

- Knockacummer; and
- Glentane / Glentanemacelligot Wind Farm (Glentane Phase 1 & Phase 2).

12.3.5.3 Consideration of Wind Direction and Noise Propagation

When considering noise impacts of wind turbines, the effects of propagation in different wind directions should be considered. The day-to-day operations of the optimised development will not result in a worst-case condition of all noise locations being downwind of all turbines at the same time i.e. omni-directional predictions. Therefore, to address this issue, a review of expected noise levels downwind of the turbines has been prepared for various wind directions in accordance with the IOA GPG Guidance.

For any given wind direction, a property can be assigned one of the following classifications in relation to turbine noise propagation:

- Downwind (i.e. 0° ±80°);
- Crosswind (i.e. 90° ±10° and 270° ±10°), and;
- Upwind (i.e. 180° ±80°).

Table 12-8 presents the directivity attenuation factor that has been applied to turbines when considering noise propagation in downwind conditions (full downwind is represented by 0° and full upwind is 180°).

Table 12-8 Turbine Directivity Attenuation with Consideration of Wind Direction

Wind Direction Sector	Degrees (°)	Attenuation (dB)
Downwind	280 – 360 & 0 - 80	0
Crosswind	260 – 280 & 80 - 100	2
Upwind	230 - 250	5
	220	5.5
	210	6
	200	6.5
	190	7
	180	7.5

12.3.5.4 Assessment of Turbine Noise Levels

The predicted turbine noise level from the Proposed Lifetime Extension will be compared against the derived turbine noise limits and any exceedances of the limits will be identified and assessed. Where necessary, appropriate mitigation measures will be detailed.

12.3.6 Decommissioning Noise Calculations

A variety of items of plant will be used for decommissioning. There will be vehicular movements to and from the site that will make use of existing roads. There is the potential for generation of noise from these activities.

Due to the nature of decommissioning activities, it is difficult to calculate the actual magnitude of emissions to the local environment in the absence of details on the specific plant items and methods to be employed. The standard best practice approach is to predict typical noise levels at the NSLs using guidance set out in British Standard BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise.

The methodology adopted for the assessment of decommissioning noise is to analyse the various elements of the decommissioning phase in isolation. For each element, the typical construction noise

sources are assessed along with typical sound pressure levels and spectra from BS 5228-1 at various distances from these works.

12.4 Receiving Environment

This stage of the assessment was to determine typical background noise levels at representative NSLs surrounding the development site. The background noise survey was conducted through installing unattended sound level meters at three locations in the surrounding area.

12.4.1 Background Noise Levels

Appendix 12-3 presents the results of the background noise surveys as analysed in accordance with the methodology in Section 12.3.3.

Table 12-9 presents the various derived $L_{A90,10min}$ noise levels for each of the monitoring locations for daytime quiet periods and night-time periods. These levels have been derived using analysis carried out on the data sets in line with guidance contained the IOA *GPG* and its SGN No. 2 *Data Collection.*

Values in parenthesis are used where, for higher wind speeds during day and night-time periods, the measurements obtained during the survey did not have sufficient data points at these wind speeds. In accordance with IOA GPG Supplementary Guidance Note 2: *Data Processing & Derivation of ETSU-R-97 Background Curves*, paragraph 2.9.1: "*Where background noise data has not been collected for higher wind speeds it may be appropriate to cap the background noise curve (and therefore the associated noise limit)*".

Table 12-9 Derived Background Noise Levels of $L_{A90,10min}$ for Various Wind Speeds

Location	Period	Derived $L_{A90,10\,min}$ Levels (dB) at various Standardised 10m Height Wind Speed (m/s)							
		3	4	5	6	7	8	9	10
NML 1	Day	22.6	25.3	28.0	30.8	33.6	36.4	39.1	41.7
	Night	19.9	22.7	25.9	29.4	32.8	36.0	38.7	40.7
NML 2	Day	26.5	28.3	30.2	32.1	34.0	35.9	37.8	39.6
	Night	26.0	27.2	28.6	30.4	32.8	36.0	40.1	(40.1)
NML 3	Day	31.1	33.8	34.8	35.2	37.5	40.1	42.3	44.3
	Night	30.5	33.4	34.5	34.6	36.5	38.8	(38.8)	(38.8)

12.4.2 Wind Turbine Noise Criteria

With respect to the relevant guidance documents outlined in Section 10.3.2.2 the following noise criteria curves have been identified for the Proposed Lifetime Extension. The criteria curves have been derived following a detailed review of the background noise data conducted at the nearest noise sensitive locations.

It is proposed to adopt a lower daytime threshold of 40 dB $L_{A90,10\text{-}min}$ for low noise environments where the background noise is less than 30 dB(A). This follows a review of the prevailing background noise levels and is considered appropriate in light of the following:

- The EPA document 'Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4)' proposes a daytime noise criterion of 45 dB L_{Aeq} in 'areas of low background noise'. Turbine noise limits are detailed in terms of the L_{A90} parameter while the NG4 daytime limit is detailed in terms of the L_{Aeq}. The accepted difference between the L_{Aeq} and L_{A90} for wind turbine noise assessments is 2 dB, i.e., 45 dB L_{Aeq} equates to 43 L_{A90}. This approach accounts for the 3 dB difference when comparing the NG4 limits and the 2006 WEDGs limits. The proposed lower threshold daytime criterion for wind turbine noise here is 3 dB more stringent than the equivalent daytime noise limit for areas of low background noise outlined in NG4.
- Glentane Phase 1 is conditioned with a lower threshold of 43 dB L_{A90}.
- A lower threshold of 40 or 43 dB is commonly adopted in planning conditions for similar wind energy developments that have been granted planning permission by ABP and local planning authorities in recent years for example Derrinlough Wind Farm (ABP Ref: 306706-20) Derryadd Wind Farm (ABP Ref: PL14.303592[6]), Coole Wind Farm (ABP Ref: PL25M.300686) Cloncreen Wind Farm (ABP Ref: PA0047), Meenbog Wind Farm (ABP Ref: PL05E.300460), Borrisbeg Wind Farm (ABP-318704-23) and Ballivor Wind Farm (ABP-316212-23).

As previously discussed in Section 12.3.2.4, the nearby Glentane / Glentanemacelligot Wind Farm a fixed lower threshold of 43 dB L_{A90} is applied to daytime periods through its planning condition. Given the precedence of this condition and the fact that the Proposed Lifetime Extension shares common Sensitive Receptors, it is reasonable to apply a 43 dB as a lower threshold for cumulative turbine noise during daytime periods where background noise levels are less than 30 dB L_{A90}. Having Sensitive Receptors in the study area with two different cumulative turbine noise limits may lead to complications in demonstrating planning compliance and enforcement. In our professional opinion and from a technical perspective, it would be more appropriate to adopt a daytime lower threshold of 43 dB for the Proposed Lifetime Extension. Ultimately, the turbine noise emission from the Proposed Lifetime Extension will remain unchanged.

Based on the guidance listed above, the proposed operational limits in $L_{A90,10min}$ for the Proposed Lifetime Extension are:

- 43 dB $L_{A90,10min}$ for quiet daytime environments of less than 30 dB $L_{A90,10min}$;
- 45 dB $L_{A90,10min}$ for daytime environments greater than 30 dB $L_{A90,10min}$ or a maximum increase of 5 dB above background noise (whichever is higher), and;
- 43 dB $L_{A90,10min}$ or a maximum increase of 5 dB above background noise (whichever is higher) for night-time periods.

A noise criteria envelope, based on the lowest turbine noise limits derived across NML1, NML2, and NML3 at the various wind speeds has been derived for daytime and night-time and used as assessment criteria at all other non-surveyed Sensitive Receptors as a conservative approach to the assessment.

Table 12-10 outlines the derived noise criteria curves which are based on the background noise levels derived and presented in Table 12-9. With reference to Table 12-10, the sound power level of the turbine reaches is understood to reach a maximum level at 10 m/s. It is sufficient therefore to consider wind speed up to 10 m/s for this assessment, in line with the best with practice guidance.

6 Decision subsequently quashed

Table 12-10 Noise Criteria Curves

Location	Period	Turbine Noise Limits (dB, $L_{A90,10\ min}$) at Various Standardised 10 m Height Wind Speed (m/s)							
		3	4	5	6	7	8	9	10
NML 1	Day	43.0	43.0	43.0	45.0	45.0	45.0	45.0	46.1
	Night	43.0	43.0	43.0	43.0	43.0	43.0	43.7	45.7
NML 2	Day	43.0	43.0	45.0	45.0	45.0	45.0	45.0	45.0
	Night	43.0	43.0	43.0	43.0	43.0	43.0	45.1	45.1
NML 3	Day	45.0	45.0	45.0	45.0	45.0	45.1	47.3	49.3
	Night	43.0	43.0	43.0	43.0	43.0	43.8	43.8	43.8

12.5 Likely Significant Effects and Associated Mitigation Measures

12.5.1 Do-Nothing Scenario

If the Proposed Project were not to proceed, the existing wind farm will be decommissioned when the current permission expires. As part of the decommissioning stage, the existing turbines would be dismantled, and the site reinstated to its original condition; please see Section 4.7 in Chapter 4 of this EIAR for further details regarding decommissioning. Potential noise and vibration impacts associated with the decommissioning phase are presented in Section 12.5.3 below. In the do-nothing scenario, there will be potential short-term, moderate negative noise impacts on nearby sensitive receptors during the decommissioning phase. However, once the existing turbines are decommissioned, there will be no further potential for noise effects.

12.5.2 Operational Phase Potential Impacts

12.5.2.1 Turbine Noise Assessment

The cumulative turbine noise levels have been calculated for a set of 70 no. Sensitive Receptors identified within the study area. Many of the Sensitive Receptors are situated closer to turbines from other developments than to Taurbeg Wind Farm turbines. In many instances the dominant turbine noise at the Sensitive Receptor is from other developments.

Using the assessment methodology described in Section 12.3.5 the predicted turbine noise levels have been calculated at all Sensitive Receptors within the study area of the Proposed Lifetime Extension for the two noise emission scenarios under consideration. A worst-case omni-directional turbine noise prediction assessment has been carried out using the ISO 9613-2 calculation standard and best practice guidance for turbine noise prediction contained in the IOA GPG. These calculations are based on 'worst-case' conditions favourable to noise propagation, i.e., downwind propagation from source to receiver and/or downward refraction under temperature inversions.

The results of the noise prediction models have been compared against the turbine noise limits that have been assigned to each of the Sensitive Receptors as described in Section 12.4.2 , which have been

derived in accordance with the criteria set out in Section 12.3.2.1.3. The results are presented here for the higher and lower range of potential noise emissions derived for the existing Taurbeg wind turbines. Results for the full set of receptors are presented in Appendix 12-6. A series of noise contour maps showing the predicted omni-directional turbine noise levels for both potential operating scenarios at the Proposed Lifetime Extension are presented in Appendix 12-5.

12.5.2.1.1 *Assessment with Higher Noise Emissions Assumed for Taurbeg Turbines*

Assuming the worst case higher turbine noise emissions scenario for the installed turbines at Taurbeg wind farm (see Table 12-6), potential exceedances of the assessment criteria are noted at 6 no. locations: H006, H011, H022, H023, H032 and H053. At all other Sensitive Receptors the predicted omni-directional cumulative turbine noise levels are below the turbine noise criteria proposed for the Proposed Lifetime Extension.

An investigation into these potential exceedances confirms that the predicted turbine noise is dominated by other existing wind farms and there is no significant contribution to turbine noise from the operation of the Taurbeg turbines associated with the Proposed Lifetime Extension.

The predicted turbine noise contribution from the Proposed Lifetime Extension at Sensitive Receptors H006, H022, H023, and H053 is more than 10 dB below the noise level of other existing turbines. Therefore, according to the guidance in Section 12.3.2.1.3 no cumulative assessment is necessary, as there is no significant contribution to turbine noise at these receptors from the operation of the existing Taurbeg turbines. At the remaining two Sensitive Receptors, H011 and H032 the dominant source of turbine noise at these locations is associated with other existing wind farms, each is discussed in turn below.

The nearest Taurbeg turbine to H032 is T10 at approximately 1.9 km. The cumulative turbine noise levels at H032 are dominated by turbine noise from the Glentane / Glentanemacelligot Wind Farm. The contribution to the cumulative turbine noise at H032 from the operation of the Taurbeg turbines associated with the Proposed Lifetime Extension approximately 8 dB below the noise level of other existing turbines; this is not significant, as the magnitude of the potential predicted cumulative increase due to the Taurbeg turbines is imperceptible. Moreover, the magnitude of potential exceedances predicted in the omni-directional assessment are ≤0.5 dB which is negligible in the context of this assessment.

The nearest Taurbeg turbine to H011 is T16 at approximately 1.2 km. The cumulative turbine noise levels at H011 are dominated by turbine noise from the Knockacummer Wind Farm. The contribution to the cumulative turbine noise at H011 from the operation of the Taurbeg turbines associated with the Proposed Lifetime Extension approximately 7 dB below the noise level of other existing turbines, again this is not significant, as the magnitude of the potential predicted cumulative increase due to the Taurbeg turbines is less than 1 dB and imperceptible. This assessment assumes the higher range of the potential noise emissions associated with the existing Taurbeg turbines and it is re-iterated that the predicted noise levels also include an allowance for uncertainty which is greater than the exceedances noted in the predicted turbine noise levels.

For the higher noise emission scenario, Table 12-11 presents the predicted noise levels for each of 2 no. Sensitive Receptors where potential exceedance of the criteria has been identified in the omni-directional turbine noise predictions, along with the applicable criteria and the magnitude of the potential exceedance. As noted in Section 12.4.2, a noise criteria envelope, based on the lowest turbine noise limits derived across NML1, NML2, and NML3 at the various wind speeds has been derived for daytime and night-time and used as assessment criteria at all other non-surveyed Sensitive Receptors as a conservative approach to the assessment.

It is important to note that these two Sensitive Receptors H011 and H032 are in proximity to the Knockacummer and Glentane / Glentanemacelligot turbines, and the turbine noise from these other developments is the greater contributor to the total wind turbine noise level at these Sensitive

Receptors. These other developments are subject to separate planning conditions. The turbine noise assessment criteria adopted for this assessment and the methodology are conservative and derived in accordance with best practice guidance to assess the impacts and effects of the Proposed Lifetime Extension only. Any potential exceedance identified should not be taken as evidence or indication of non-compliance of other operational sites with their planning conditions.

Table 12-11 Predicted Noise Levels with Potential Cumulative Exceedances (higher noise emission scenario)

House Ref	Parameter	Predicted Noise Level dB L_{A90} at Standardised Wind Speed at 10m				
		6	7	8	9	10
H011	Predicted	42.4	43.4	43.9	44.2	44.4
	Daytime Criterion	45	45	45	45	45
	Daytime Excess	–	–	–	–	–
	Night-time Criterion	43	43	43	43.7	43.8
	Night-time Excess	–	0.4	0.9	0.5	0.6
H032	Predicted	42.0	43.0	43.5	43.7	43.9
	Daytime Criterion	45	45	45	45	45
	Daytime Excess	–	–	–	–	–
	Night-time Criterion	43	43	43	43.7	43.8
	Night-time Excess	–	–	0.5	–	0.1

Table 12-11 confirms that there are no predicted exceedances of the assessment criteria during daytime and the potential exceeded during night time periods are between 0.1 and 0.9 dB.

The next stage in the assessment is to consider the effects of wind direction. As presented in Section 12.3.5.3 above, the effect of the directionality of noise emissions from wind turbines means that in certain wind directions, noise levels are less than the values presented in Table 12-11, as a given noise-sensitive location cannot be downwind of all turbines at the same time.

Directional noise prediction models have been developed to identify the number and magnitude of exceedances of the noise criteria at the various Sensitive Receptors. Table 12-12 and Table 12-13 reviews the predicted noise levels against the noise criteria curves for the proposed Lifetime Extension at the various wind directions.

Table 12-12 Review of Predicted Exceedances in Various Wind Direction Sectors – H011

House Ref	Parameter	Predicted exceedance in Noise Level dB L_{A90} at Standardised Wind Speed at 10m $_{A.G.L.}$				
		6	7	8	9	10
H011	Omni-directional	42.4	43.4	43.9	44.2	44.4
	North (N)	38.3	39.3	39.8	40.1	40.3
	Northeast	41.0	42.0	42.5	42.8	43.0

House Ref	Parameter	Predicted exceedance in Noise Level dB L_{A90} at Standardised Wind Speed at 10m A.G.L.				
		6	7	8	9	10
	East	42.0	43.0	43.5	43.8	44.0
	Southeast	42.4	43.4	43.9	44.2	44.4
	South	41.9	42.9	43.4	43.7	43.9
	Southwest	39.8	40.8	41.3	41.6	41.8
	West	37.6	38.6	39.1	39.4	39.6
	Northwest	36.3	37.3	37.8	38.1	38.3
	Daytime Criterion	45	45	45	45	45
	Daytime Excess Accounting for Wind Direction	-	-	-	-	-
	Night-time Criterion	43	43	43	43.7	43.8
	Night-time Excess Accounting for Wind Direction	-	0.4 (SE)	0.5 (E) 0.9 (SE) 0.4 (S)	0.1 (E) 0.6 (SE)	0.2 (E) 0.6 (SE) 0.1 (S)

The assessment of directional cumulative noise prediction for H011 in Table 12-13 confirms that the predicted turbine noise levels are below the assessment noise criteria noise which the exception of a potential exceedance of between 0.1 to 0.9 dB in a limited number of wind speed and direction sectors. It is reiterated that the contribution to the cumulative turbine noise at H011 from the operation of the Taurbeg turbines associated with the Proposed Lifetime Extension is not significant, as the magnitude of the potential predicted cumulative increase due to the Taurbeg turbines would be imperceptible. When considering changes to the predicted turbine noise levels it is important to highlight that, for sounds of the same nature, a change of 3 dB is considered the minimum difference detectable to the average human ear; changes of +/-1 dB are therefore insignificant in the context of this review.

Table 12-13 Review of Predicted Exceedances in Various Wind Direction Sectors - H032

House Ref	Parameter	Predicted exceedance in Noise Level dB L_{A90} at Standardised Wind Speed at 10m A.G.L.				
		6	7	8	9	10
H032	Omni-directional	42.0	43.0	43.5	43.7	43.9
	North (N)	40.6	41.6	42.1	42.3	42.5
	Northeast (NE)	39.3	40.3	40.8	41.0	41.2
	East	37.6	38.6	39.1	39.3	39.5
	Southeast	37.7	38.7	39.2	39.4	39.6

House Ref	Parameter	Predicted exceedance in Noise Level dB L_{A90} at Standardised Wind Speed at 10m A.G.L.				
		6	7	8	9	10
	South	39.3	40.3	40.8	41.0	41.2
	Southwest	40.5	41.5	42.0	42.2	42.4
	West	41.5	42.5	43.0	43.2	43.4
	Northwest	41.4	42.4	42.9	43.1	43.3
	Daytime Criterion	45	45	45	45	45
	Daytime Excess Accounting for Wind Direction	-	-	-	-	-
	Night-time Criterion	43	43	43	43.7	43.8
	Night-time Excess Accounting for Wind Direction	-	-	-	-	-

The assessment of directional cumulative noise prediction for H032 in Table 12-13 confirms that the predicted turbine noise levels are below the assessment noise criteria in all wind speeds and wind direction sectors.

Summary of Assessment with Higher Noise Emissions Assumed for Taurbeg Turbines

Assuming the worst case, i.e. with the Taurbeg turbines having the higher noise emissions in the potential range, the cumulative assessment has identified potential cumulative exceedances at one Sensitive Receptor H011. At this Sensitive Receptors, the predicted noise levels are dominated by turbine noise from the Knockacummer Wind Farm, and the cumulative contribution from the Taurbeg turbines is not significant. The differences in the predicted cumulative noise turbine noise levels with the Taurbeg turbines associated with the Proposed Lifetime Extension is negligible, and imperceptible to the human ear. In the context of this review, it is noted that if the Proposed Lifetime Extension is permitted, there will be no change to the existing noise environment.

The turbine noise assessment criteria adopted for this assessment and the methodology are conservative and derived in accordance with best practice guidance to assess the impacts and effects of the Proposed Lifetime Extension only. Any potential exceedance identified should not be taken as evidence or indication of non-compliance of other operational sites with their relevant planning conditions.

The noise prediction calculations have been made using the ISO 9613:2024-2 standard and relate to conditions favourable to noise propagation (typically downwind propagation from source to receiver and/or downward refraction under temperature inversions) and an uncertainty factor has been applied to turbine emissions.

The next stage in this assessment is to consider the potential impacts and effects of the Proposed Project for the assumed scenario with the sound power emissions for the existing turbines at Taurbeg Wind Farm associated with eth Proposed Lifetime Extension are at the lower range of the potential sound power emissions identified for the installed turbines. This review is presented in Section 12.5.2.1.2.

12.5.2.1.2 *Assessment with Lower Noise Emissions Assumed for the Existing Taurbeg Turbines*

Assuming the scenario for the lower turbine noise emissions for the installed turbines at Taurbeg Wind Farm (see Table 12-7), potential exceedances of the noise criteria are noted at the same 6 no. Sensitive Receptors: H006, H011, H022, H023, H032 and H053. As the noise contribution from the Taurbeg turbines is lower in the scenario a similar conclusion can be reach for this assessment.

The predicted turbine noise contribution from the Proposed Lifetime Extension at Sensitive Receptors H006, H022, H023, and H053 is more than 10 dB below the noise level of other existing turbines. Therefore, according to the guidance in Section 12.3.2.1.3 no cumulative assessment is necessary, as there is no significant contribution to turbine noise at these receptors from the operation of the existing Taurbeg turbines.

With the lower turbine noise emissions for the installed turbines at Taurbeg Wind Farm the predicted turbine noise contribution from the Proposed Lifetime Extension at H011 is more than 10 dB below the noise level of other existing turbines. No cumulative assessment is necessary, as there is no significant contribution to turbine noise at H011 from the operation of the existing Taurbeg turbines.

At Sensitive Receptor H032 the directional assessment presented in Section 12.5.2.1.1 confirmed that the predicted turbine noise levels are below the assessment noise criteria in all wind speeds and wind direction sectors. The same conclusion can be reached in this scenario where the contribution to the cumulative turbine noise levels from the is significantly lower.

Assuming the installed Taurbeg turbine operating with the lower noise emissions in the range identified, the contribution from the Taurbeg turbine is significantly lower at all locations. The cumulative turbine noise levels are dominated by noise from turbines at other developments, and any contribution from the Taurbeg turbines associated with the Proposed Lifetime Extension is not significant as any changes in the cumulative will be negligible and imperceptible to the human ear. In the context of this review, it is noted that if the Proposed Lifetime Extension were permitted, there would be no change to the existing noise environment.

12.5.2.1.3 *Description of Effects*

Taurbeg Wind Farm was commissioned in 2006 and has been in operation for 19 years, is it not considered that a significant effect on the noise environment is associated with the continuation of its operation. The assessment, presented in Section 12.5.2.1.1 and 12.5.2.1.2, has found that turbine noise from the operation of the Proposed Lifetime Extension will be within best practice turbine noise criteria at all locations with no likely significant cumulative impacts or effects predicted. With respect to the EPA criteria for description of effects, the potential worst-case cumulative effects at the nearest Sensitive Receptor associated with the Proposed Lifetime Extension are described below.

Quality	Significance	Duration
Neutral	Imperceptible	Medium-term

12.5.3 Proposed Offsetting Measures Potential Impacts

Noise prediction calculations for the Proposed Offsetting Measures have been conducted using the methodology outlined in Section 12.3.2.3.

Proposed Offsetting Measures will be conducted during standard daytime working hours (i.e., weekdays 07:00–19:00 and Saturdays 07:00–13:00). However, to optimise favourable weather conditions, address critical periods in the schedule (e.g., specific equipment usage), or accommodate the transportation, occasional work outside of these hours may be necessary. Any such out-of-hours operations will be communicated in advance to the Local Authority.

Table 12-14 outlines the likely noise levels associated with deforestation activity at the Proposed Offsetting lands at varying set back distances from the works. The calculations are based on typical sound pressure noise levels derived from BS 5228-1:2009 for the proposed activities and assume an operating time of 50% for each plant item, equivalent to 6 hours within a 12-hour assessment period.

Table 12-14 Typical Noise Levels – Deforestation

Item (BS 5228-1 Ref.)	Plant Noise Level at 10m Distance (dB $L_{Aeq,T}$) [7]	Highest Predicted Plant Noise Level (dB $L_{Aeq,T}$)				
		50m Distance	75m Distance	100m Distance	200m Distance	60m Distance
Wheeled loader (C2.8) x 2	68	49	44	41	33	29
Tracked excavator (C2.2) x 2	77	58	53	50	42	38
Petrol-driven chainsaw (D2.14)	86	64	59	56	48	44
Total Construction Noise		**65**	**60**	**57**	**49**	**45**

These predicted levels of noise associated with deforestation activities are within the construction noise criterion outlined in Table 12-1, where the works occur at distances of greater than 50 m for the nearest sensitive receptor it is concluded that there will be no significant noise impact associated with these activities and no specific mitigation measures are required.

In the unlikely event that the works occur at distance closer than 50 m from the nearest sensitive receptor, the calculations indicate that the noise threshold outlined in Table 12-1 may be exceeded. However, for a significant effect to occur, the duration of the of any such exceedance would need to be greater than the durations listed in Section 12.3.2.3.3 according to the guidance outlined in Section 12.3.2.3. Due to the nature of the Proposed Offsetting Measures as described in Chapter 4 (Description of Proposed Project), a significant effect is not expected to occur at any Sensitive Receptor as the activity is not likely to occur with 50 m from a sensitive receptor, and specific mitigation measures are therefore not required.

A chipping machine is proposed to chip the timber following a drying-out period. The chipping machine will be located at a sufficient setback distance from any Sensitive Receptor to ensure that the potential noise impacts are minimised and remain below the threshold for significant noise impacts.

12.5.4 Decommissioning Phase Potential Impacts

Decommissioning noise prediction calculations have been conducted using the assessment methodology outlined in Section 12.3.2.1. Noise levels are predicted at the nearest Sensitive Receptor to each element of the works and compared against the criteria in Section 12.3.2.3.1. Several indicative sources that would be expected on a site of this nature have been identified and noise predictions of their potential impacts prepared to the nearest Sensitive Receptor. This represents a conservative approach to the assessment; decommissioning noise levels will be lower at properties located further from the works. The source noise levels referred to in this section are indicative of the type of plant items and activities associated with the decommissioning of the Taurbeg Wind Farm.

[7] All plant noise levels are derived from BS 5228: Part 1

In general, the distances between the decommissioning activities associated with the Taurbeg Wind Farm and the nearest Sensitive Receptors (minimum of 731m) are such that there will be no significant noise and vibration impacts at Sensitive Receptors. The following sections present an assessment of the main stages of the decommissioning phase that have the potential for associated noise and vibration impacts, all other stages and elements are considered unlikely to have any significant noise and vibration impacts.

Decommissioning activities will be carried out during normal daytime working hours (i.e., weekdays 0700 – 1900 hrs and Saturdays 0700 – 1300 hrs). However, to ensure that optimal use is made of good weather period or at critical periods within the programme (e.g., crane use) or to accommodate removal of large turbine component along public routes it could be necessary on occasion to work outside of these hours. Any such out of hours working will be notified in advance to the Local Authority.

Noise from decommissioning of the turbines are calculated to the closest noise sensitive receptors, with the nearest Sensitive Receptor being H010 at approximately 731 m from T08.

Table 12-15 details the noise levels associated with decommissioning noise sources assessed in this instance along with typical sound pressure levels from BS 5228 – 1: 2009. Calculations have assumed an on-time of 66% for each item of plant i.e. 8 hours over a 12-hour assessment period.

Table 12-15 Typical decommissioning Noise Levels – Turbines

Item (BS 5228 Ref.)	Activity/Notes	Plant Noise level at 10m Distance (dB $L_{Aeq,T}$)[8]	Predicted Noise Level (dB $L_{Aeq,T}$) at distance (m) 731 m – nearest Sensitive Receptor to turbine location
HGV Movement (C.2.30)	Transporting fill and other materials	79	34
Tracked Excavator (C.4.64)	Moving soil and rubble	77	32
General Works (Various)	All general activities plus deliveries/removals of materials and plant	84	39
Dumper Truck (C.4.4)	Backfilling Turbine Foundations	76	31
Mobile Telescopic Crane (C.4.39)	Turbine dismantling	77	32
Dewatering Pumps (D.7.70)	If required	80	-
Predicted Combined Decommissioning Noise Level		-	**43**

The assessment to H010 is sufficient to assess the noise impacts and effects of all decomposition activities. Due to the additional distances from the works, the predicted noise level will be further attenuated.

8 All plant noise levels are derived from BS5228: Part 1

The predicted noise level of 43 dB $L_{Aeq,T}$ to the nearest Sensitive Receptor is well within the construction noise criterion outlined in Table 12-1, therefore it is concluded that there will be no significant noise impact associated with decommissioning activities, and no specific mitigation measures are required.

12.5.4.1 Decommissioning Traffic Noise

This section reviews the potential noise impacts associated with traffic on the local road network. The information presented in Chapter 15 (Material Assets) has been used to inform the assessment.

12.5.4.1.1 *Proposed Lifetime Extension*

It is not expected that there will be any significant increase in traffic noise along public roads directly associated with the decommissioning phase of the Proposed Lifetime Extension that would result in a significant negative effect at residential receptors. This is concluded on the basis that it is estimated that 157 truckloads will travel to and from site over a period of 3 - 6 months. Assuming all of these journeys occurred over a period of 10 consecutive days which as per the guidance in 12.3.2.3.3 must be exceeded to constitute a significant effect, the total noise level associated with decommissioning traffic on public roads during this period would be of the order of 50 dB $L_{Aeq,T}$ which is well below the is well within the construction noise criterion outlined in Table 12-1.

12.5.4.1.2 *Proposed Offsetting Lands*

It is not expected that there will be any significant increase in traffic noise along public roads directly associated with the Proposed Offsetting Lands that would result in a significant negative effect at residential receptors. This is concluded on the basis that it is estimated that there will be approximately 20 days when 5 HGV loads or 10 HGV movements will be generated to and from the Proposed Offsetting lands. This a relative small number of trips and the total noise level associated with the HGV movements on public roads during this period would be less than 40 dB $L_{Aeq,T}$ which is well below the is well within the construction noise criterion outlined in Table 12-1.

12.5.4.1 Vibration

Due to the distance of the proposed works from Sensitive Receptors, vibration effects are not likely at any Sensitive Receptor.

12.5.4.2 Description of Effects

The likely predicted noise and vibration impacts are below the limits and/or thresholds identified. With respect to the EPA's criteria for description of effects, the likely potential associated effects at the nearest Sensitive Receptors associated with the decommissioning phase of the Proposed Lifetime Extension and the Proposed Offsetting Lands are as described below:

Quality	Significance	Duration
Negative	Not Significant	Short-term

12.6 Mitigation Measures

The assessment of potential effects has demonstrated that the Proposed Project is expected to comply with the identified criteria for the operational and decommissioning phases and the Proposed Offsetting Measures, therefore no specific mitigation measures are required.

12.6.1 Extended Operational Phase

12.6.1.1 Wind Turbines

An assessment of the operational wind turbine noise levels has been undertaken in accordance with best practice guidelines and procedures as outlined in Section 10.3. The findings of the assessment, presented in Section 12.5.2.1 has confirmed that no significant cumulative impacts or effects are predicted from the operational noise turbine levels associated with the Proposed Lifetime Extension. Therefore, no specific mitigation measures are required.

If the Proposed Project is granted permission to continue operating, a commissioning noise survey can be carried out as detailed in Section 12.6.1.1.2. In the unlikely event of any exceedances of the conditioned turbine noise limits being identified as a result of the Proposed Lifetime Extension, these exceedances will be mitigated through curtailment of turbine(s) in the relevant wind speed and wind directions. The curtailment strategy will be developed for the installed turbines to achieve the relevant noise criteria at all Sensitive Receptors.

The installed turbine can be programmed to run in reduced modes of operation (or low noise modes) to achieve the attenuation required in the specific wind conditions (i.e. wind speed and direction). Operating the turbines in reduced noise modes is referred to as curtailment, which typically results in a corresponding reduction in energy generation capacity for the turbine(s). For any turbine curtailment strategy that is developed, consideration must be given to the practical benefits. This is particularly the case with cumulative turbine noise, where two or more wind farm developments contribute to the overall turbine noise level. In these instances, curtailment of the non-dominant turbines may only achieve an imperceptible and unmeasurable change in the total wind turbine noise level at a given receptor. Such curtailment may unnecessarily reduce the electrical power generating capacity of a wind farm, for an imperceptible change to the overall turbine noise levels.

12.6.1.1.1 *Amplitude Modulation*

In the event that a complaint which indicates potential excessive amplitude modulation (AM) associated with the Proposed Lifetime Extension, the operator will employ a qualified acoustic consultant to assess the level of AM in accordance with the methods outlined in the Institute of Acoustics IOA Noise Working Group (Wind Turbine Noise) *Amplitude Modulation Working Group Final Report: A Method for Rating Amplitude Modulation in Wind Turbine Noise* (9 August 2016) or subsequent revisions.

The measurement method outlined in the IOA AMWG document, known as the 'Reference Method', will provide a robust and reliable indicator of AM and yield important information on the frequency and duration of occurrence, which can be used to evaluate different operational conditions including method to mitigate any excessive AM. These mitigation measures, if required, will consist of the implementation of operational controls for the relevant turbine type, which will include turbine curtailment under specific operational conditions.

In the absence of widely accepted and robust planning conditions to control amplitude modulation (AM) from wind turbines, the commitments outlined in this EIAR are considered best practice. The proposed approach will ensure that any negative impacts arising from AM associated with the operation of the proposed development will be effectively addressed by the operator.

12.6.1.1.2 *Monitoring*

As discussed above, commissioning noise surveys will be undertaken to ensure compliance with any noise conditions applied to the development. It is common practice to commence surveys within six months of a wind farm being commissioned – in this instance, continuing its operation. If an exceedance of the noise criteria is identified as part of the commissioning assessment, the guidance outlined in the IOA GPG and Supplementary Guidance Note 5: Post Completion Measurements (July 2014) will be followed, and relevant corrective actions taken. The commissioning survey will include a review for the presence of audible tones associated with the operation of the wind turbine farm in accordance with Annex C of ISO 1996-2:2017 *Acoustics — Description, measurement and assessment of environmental noise Part 2: Determination of sound pressure levels*.

For example, implementation of noise reduced operational modes resulting in curtailment of turbine operation can be implemented for specific turbines in specific wind conditions to ensure turbine noise levels are within the relevant noise criterion curves/planning conditions limits. Such curtailment can be applied using the wind farm SCADA system without undue effect on the wind turbine performance. Following implementation of these measures, noise surveys can be repeated to confirm compliance with the noise criteria.

12.6.2 Proposed Offsetting Measures

The contract documents will specify that the Contractor undertaking the works will be obliged to adopt best practice noise abatement measures contained in British Standard BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise.

12.6.3 Decommissioning Phase

The contract documents will specify that the Contractor undertaking the decommissioning works will be obliged to adopt best practice noise abatement measures contained in British Standard BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise and BS 5228-2:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Vibration.

The following best practice mitigation measures from these documents will be implemented as required for the duration of the decommissioning phase:

- Limiting the hours during which site activities likely to create high levels of noise or vibration are permitted;
- Establishing channels of communication between the contractor/developer, Local Authority and residents;
- Monitoring typical levels of noise and vibration during critical periods and at sensitive locations;
- Selection of plant with low inherent potential for generation of noise and/ or vibration where practical;
- Placing of noise generating / vibratory plant as far away from sensitive properties as practical within the site constraints, and;
- The hours of construction activity will be limited to avoid unsociable hours where possible. Works operations shall generally be restricted to between 7:00hrs and 19:00hrs Monday to Friday and Saturday between 7:00hrs and 13:00hrs.

12.7 Description of Residual Effects

12.7.1 Extended Operational Phase

12.7.1.1 Wind Turbine Noise

With respect to the EPA criteria for description of effects, the potential worst-case effects at the nearest sensitive receptor associated with the Proposed Lifetime Extension are described below. In the context of this review, it is noted that if the Proposed Project is permitted there will be no change to the existing noise environment.

Quality	Significance	Duration
Neutral	Imperceptible	Medium-term

12.7.1.2 Vibration

There are no expected sources of vibration associated with the Proposed Lifetime Extension. In relation to of vibration the associated effect is summarised as follows:

Quality	Significance	Duration
Neutral	Imperceptible	Medium-term

12.7.2 Proposed Offsetting Measures

During the Offsetting Measures, there will be some negative effects on nearby sensitive receptors due to noise emissions from site traffic and other on-site activities associated with deforestation works. The noise and impacts associated with the proposed activities are expected to within the criteria in Section 12.3.2.4.

With respect to the EPA criteria for description of effects, the anticipated associated effects at the nearest sensitive receptors associated with the decommissioning phase are described below.

Quality	Significance	Duration
Negative	Not Significant	Short-term

12.7.3 Decommissioning Phase

During the decommissioning phase of the Taurbeg Wind Farm there will be some effect on nearby sensitive receptors due to noise emissions from site traffic and other on-site activities. The noise and vibration impacts associated with any decommissioning of the site within the criteria in Section 12.3.2.3.

With respect to the EPA criteria for description of effects, the anticipated associated effects at the nearest sensitive receptors associated with the decommissioning phase are described below.

Quality	Significance	Duration
Negative	Not Significant	Short-term

12.8 Cumulative Effects

12.8.1 Wind Turbine Noise

Existing permitted and proposed wind farm developments with the potential for cumulative impacts have been considered as part of the turbine noise impact assessment. A review of existing, proposed and permitted wind turbine developments in the wider study area has been undertaken in accordance with the guidance contained in the IOA GPG. A full cumulative turbine noise assessment has been undertaken in accordance with the IOA GPG, considering the Proposed Lifetime Extension, Knockacummer Glentane / Glentanemacelligot Wind Farms.

12.8.2 Proposed Offsetting Measures

It is not anticipated that there will be any other activities that would give rise to significant cumulative effects during the Proposed Offsetting Measures. For construction activities occurring near Sensitive Receptors, considering the distance to any other projects and the noise emissions associated with these activities, cumulative noise effects are unlikely. As stated in Section 12.6.2, the Contractor undertaking the works will adopt best practice noise abatement measures contained in British Standard BS 5228-1.

12.8.3 Decommissioning

It is not anticipated that there will be any other activities that would give rise to significant cumulative effects during the decommissioning phase. The predicted noise emissions for the proposed development are not of enough magnitude to cause an increase in cumulative decommissioning noise levels exceeding the threshold for significant impacts at any Sensitive Receptor.

The predicted noise levels from decommissioning activity would need to be in excess of 55 dB $L_{Aeq,T}$ at an NSL in order for a potential cumulative construction noise increase to exceed the noise thresholds. The assessment in Section 12.5.4 confirms that the predicted noise levels from activities at any NSL are ≤55 dB $L_{Aeq,T}$ and therefore the potential for any cumulative noise effect from all of the proposed activities occurring simultaneously or with construction/decommissioning activities from other developments is unlikely and not significant.