CONTENTS

TABLES

FIGURES

APPENDICES

Introduction

Background

9.1 This chapter assesses the potential noise and vibration effects of all elements of the Proposed Development, as described in **Chapter 2** of this EIAR. The assessment considers the Proposed Development's construction, operation and decommissioning phases. Whilst reasonable effort has been made to ensure that this chapter is easy to understand, it is technical in nature; to assist the reader, a glossary of terminology is included in **Appendix 9-1** found in Volume III of this EIAR.

9.2 Potential construction noise and vibration impacts have been determined with reference to British Standard 5228:2009+A1:2014 *Code of Practice for Noise and Vibration Control on Construction and Open Sites Part 1 Noise* (BS 5228-1), as is current best practice in the absence of any Ireland specific guidance.

9.3 The operational noise assessment documented in this chapter is 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 then Department of the Environment, Heritage and Local Government (now the Department of Housing, Local Government and Heritage) in 2006 (the '2006 Guidelines'). Potential operational noise impacts associated with the Proposed Development have been determined in accordance with the UK Institute of Acoustics' (IOA), A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise, 2013 (IOA GPG), which is considered in Ireland to be current best practice. Operational noise associated with the Proposed Development includes noise from the proposed wind turbines and substation.

9.4 Although in December 2019, the Draft Revised Wind Energy Development Guidelines were published for consultation, these guidelines have yet to be finalised, have not been adopted and are not considered best practice. The 2006 Guidelines, as supplemented by the ESTU-R-97 and IOA methodologies described below, are considered best practice and have been applied in this assessment. The methodology is described in further detail starting at paragraph 9.33.

9.5 Consideration has been given to the cumulative developments listed in **Table 2-1** of **Chapter 2** of this EIAR and none of the proposed or existing cumulative wind farms could satisfy the criteria described in paragraph 9.56 for cumulative contribution to overall noise impacts. Operational vibration impacts are discussed in more detail in paragraph 9.29 to paragraph 9.31, where is it concluded in accordance with best practice that a vibration assessment is not required. Therefore, no cumulative noise and vibration impacts are likely.

9.6 Decommissioning noise and vibration impacts have been assessed in accordance with the same British Standards as the construction noise assessment.

Statement of Authority

9.7 This assessment was prepared by Richard Carter CEng, BEng (Hons), MIOA, a Director at Bow Acoustics Ltd., on behalf of SLR. Richard has worked in the field of acoustics for over 18 years, with over 13 years' experience specialising in the assessment of wind farm noise. Richard has a Bachelor of Engineering (BEng (Hons)), a post graduate diploma in acoustics and noise control, is a member of the Institute of Acoustics (MIOA) and a Chartered Engineer (CEng). 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.

9.8 The background noise measurements were undertaken by Aldona Binchy MSc. Eng PIEMA, MIAH, AAG Environmental Engineering, a Principal of SLR, with 19 years of experience conducting environmental noise surveys. Aldona completed the Environmental Noise Competency Course with Industrial Noise and Vibration Centre. Aldona has extensive experience of undertaking noise monitoring programmes in accordance with relevant standards and best practice methods.

Description of Noise and Vibration Impacts

Construction Noise & Vibration

9.9 Noise is generated from the construction of the turbine foundations, the erection of the turbines, the excavation of trenches for cables, and the construction of associated hard standings and access tracks, and construction of the substation.

9.10 Noise from vehicles on local roads and access tracks is also generated from the delivery of the turbine components and construction materials, notably aggregates, concrete and steel reinforcement.

9.11 Vibration is generated by construction activities such as rock breaking and passing heavy goods vehicles. The threshold of human perception of vibration is stated in British Standard 5228-2:2009+A1:2014 (see paragraph 9.51) to be in the range of 0.14mm/s to 0.3mm/s, described as “might just be perceptible”. The standard also provides guideline values for damage to buildings from vibration of 15mm/s at 4Hz increasing to 20mm/s at 15Hz and 50mm/s at 40Hz and above.

9.12 Vibration levels of onsite construction activities such as rock breaking at borrow pits and turbine foundation excavations would be less than 15mm/s 10m from the construction activity. The nearest vibration sensitive locations are sufficiently distant, over 500m, that vibration will not be perceivable by residents at their dwellings and building damage will not occur from construction incurred vibration.

9.13 Some construction activities taking place outside the main wind farm site and associated with cable trenching have the potential to generate vibration and will take place closer to vibration sensitive receptors than activities within the main wind farm site. It is expected that vibration levels from trenching activities, such as tracked excavators, disc cutters and pneumatic breakers will be 0.7mm/s at 10m distance, depending on ground conditions with very stiff cohesive soils containing large obstacles resulting in higher vibration levels than loose granular soils. Whilst this may be perceptible for some residents of dwellings situated within this distance, it will be for a brief period of less than a day while the construction work is at this minimum distance, before construction activity progresses along the cable route, increasing the distance between it and the dwelling, thus reducing the vibration impact. The vibration impact, both in magnitude and duration of exposure, will be comparable to that experienced during other highway road works and substantially below the threshold of structural damage. As such, construction vibration will not be considered further in this chapter.

Operational Noise & Vibration

9.14 Once constructed and operating, wind turbines may emit two types of noise: aerodynamic noise from the blades, and mechanical noise from other components, both of which contribute to the overall noise level from the turbine which has been assessed in this chapter. Extraneous noise tends to be perceived when the wind speeds are low as natural noise sources are supressed, although at very low wind speeds wind turbine blades do not rotate or rotate very slowly and so, at these wind speeds, negligible wind turbine noise is generated. In higher winds, wind turbine noise is generally masked by the normal sound of wind blowing through trees and around buildings. The level of this natural 'masking' noise relative to the level of wind turbine noise determines the subjective audibility of the Proposed Development. The relationship between wind turbine noise and the naturally occurring masking noise at nearby noise sensitive receptors (NSRs) will therefore form the basis of the assessment of the levels of noise against accepted standards that form current best practice, discussed in paragraph 9.34 to paragraph 9.54.

9.15 Ancillary equipment such as transformers at the proposed substation can also generate noise; however, this is at a much lower level than the noise generated by wind turbines. Operational noise impacts from the Proposed Substation have been considered in this chapter.

Blade Swish (Amplitude Modulation of Aerodynamic Noise)

9.16 Amplitude modulation (AM) is the periodic variation in the amplitude of aerodynamic noise generated during the operation of a wind turbine. The noise assessment methodology presented in ETSU-R-97, sets out noise limits which already account for likely encountered levels of amplitude modulation from wind turbines.

9.17 A study was carried out on behalf of the UK's Government Department for Business, Enterprise and Regulatory Reform (BERR) by the University of Salford, which investigated the incidence of noise complaints associated with wind farms and whether these were associated with AM (University of Salford, 2007). This report defined AM as aerodynamic noise fluctuations from wind turbines at blade passing frequency. Its aims were to ascertain the prevalence of AM on UK wind farm sites, to try to gain a better understanding of the likely causes, and to establish whether further research into AM is required.

9.18 The study concluded that AM with a greater degree of fluctuation than normal had occurred at only a small number of wind farms in the UK (4 of 133), and only for between 7% and 15% of the time. It also states that, at the time of writing, the causes of this were not well understood and that prediction of the effect was not currently possible.

9.19 This research was updated in 2013 by an in-depth study undertaken by Renewable UK, which considered 'other AM' (OAM). OAM is defined as AM with atypical characteristics which could not be explained by standard causal factors. The study identified that many of the previously suggested causes of AM have little or no association to the occurrence of OAM in practice. The generation of OAM was likely based upon the interaction of several factors, the combination and contributions of which are unique to each site. Based on current best engineering knowledge, it is not possible to predict whether any particular site is more or less likely to give rise to OAM.

9.20 In 2016, the IOA proposed a measurement technique to quantify the level of AM present in any particular sample of wind farm noise (Institute of Acoustics, 2016). This technique is supported by the UK's Government Department of Business, Energy & Industrial Strategy (BEIS, formerly the Department of Energy & Climate Change) who have published guidance which follows on from the conclusions of the IOA study in order to define an appropriate

assessment method for AM, including a penalty scheme and an outline planning condition (BEIS, 2016).

9.21 The Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise was published by the Institute of Acoustics in May 2013 (IOA GPG) discusses AM. Section 7.2.1 of the IOA GPG remains current best practice and states: "*The evidence in relation to 'Excess' or 'Other' Amplitude Modulation (AM) is still developing. At the time of writing, current practice is not to assign a planning condition to deal with AM*".

9.22 Presently there is no method for predicting AM or OAM and as such it is best practice to not carry out an AM assessment. Therefore, AM will not be considered further in this chapter.

Infrasound & Low Frequency Noise

9.23 Low frequency noise is noise that occurs within the frequency range of 20 Hz to 160 Hz. Infrasound is noise occurring at frequencies below that at which sound is normally audible, that is, less than about 20 Hz, due to the significantly reduced sensitivity of the ear at such frequencies. For low frequency sound to be perceptible, it must be at very high amplitude, and it is considered that when such sounds are perceptible then they can cause considerable annoyance.

9.24 A study, published in 2006 by acoustic consultants Hayes McKenzie on behalf of the then UK's Government Department of Trade and Industry (DTI) (now the Department for Innovation, Universities and Skills and the Department for Business, Enterprise and Regulatory Reform), investigated low frequency noise from wind farms (Hayes McKenzie, 2006). This study concluded that there is no evidence of health effects arising from infrasound or low frequency noise generated by wind turbines.

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

9.26 In an article for the IOA, Bowdler et al. (2009) discusses the relevant factors for noise assessments from wind farms, including a section on vibration and low frequency noise. It concludes that: "*...there is no robust evidence that low frequency noise (including 'infrasound') or ground-borne vibration from wind farms generally has adverse effects on wind farm neighbours.*"

9.27 The studies discussed above are current and represent best knowledge. It is best practice to not carry out a specific assessment of infrasound and low-frequency noise and therefore, it will not be considered further in this chapter.

Tonal Noise

9.28 Tonal noise is the concentrations of acoustic energy over relatively small bands of frequency. Tonality found in wind turbine sound is most often of mechanical origin, which over the years has been engineered out of modern wind turbines and is generally caused by structural resonances in the mechanical parts of the turbine. Modern day wind turbines are highly unlikely to generate tonal noise unless there is a fault with a mechanical component such as the gearbox as a result of poor maintenance. Therefore, a correctly

operating wind turbine will not produce noise of a tonal nature and will not be considered further in this chapter.

Vibration

9.29 Research undertaken by D J Snow (1997) found that levels of ground-borne vibration 100 m from the nearest wind turbine were significantly below criteria for 'critical working areas' given by British Standard BS 6472:1992 Evaluation of human exposure to vibration in buildings (1 Hz to 80 Hz) and were lower than limits specified for residential premises by an even greater margin (Snow, 1997). Subsequently, BS 6472-1:2008 has superseded BS 6472:1992 and no longer applies to critical working areas, where vibration criteria are more stringent than those for human perception. Therefore, the ground-borne vibration measured by Snow 100m from a wind turbine were also significantly below human perception and the thresholds set out in BS 6472-1:2008 for probability of adverse comment.

9.30 More recently, the Low Frequency Noise Report published in 2016 by the Federal State of Baden-Württemberg simultaneously measured vibration at several locations at increasing distance from an operational Nordex N117 – 2.4 MW wind turbine with a hub height of 140.6m, which is representative from an operational vibration point of view to the candidate turbines. The report concluded that at less than 300m from the turbine, the vibration levels had reduced such that they could no longer be differentiated from the background vibration levels.

9.31 The separation distances between the wind turbines and the closest sensitive receptors are at least 700m. Therefore, it is current best practice to not carry out a specific assessment of vibration arising from the operation of wind turbines, and it is not considered further in this chapter. It should be noted that the receptor locations used for the noise and vibration assessment correspond to the amenity space and not necessarily the dwelling; therefore, the quoted minimum distance may differ from other assessments.

Decommissioning noise and vibration

9.32 The noise and vibration levels generated during the decommissioning of a wind farm are lower than those generated during its construction due to the reduced number of operations required, as discussed in paragraphs 9.129 to 9.131. Therefore, as a worst case it is assumed that the noise and vibration impacts calculated for the construction phase will equally apply to the decommissioning phase.

Assessment Methodology

9.33 An overview of the methodology for the assessment of construction, operational and decommissioning noise and vibration impacts for the Proposed Development is as follows:

- review of relevant guidance.
- identification of Noise Sensitive Receptors (NSRs) and the extent of the study area.
- if required, measurement of prevailing wind speed dependant background noise levels at NSRs to establish appropriate noise limits.
- prediction of the noise and vibration impact associated with the Proposed Development; and
- assessment of the significant effect of any impacts.
- assessment of the significant effects of any cumulative impacts.

- specification of mitigation measures, where necessary.
- assessment of the significant effects of any residual impacts.

Relevant Guidance

9.34 A summary overview of the guidance documentation adhered to in this assessment is provided below. The following sections provide further details of how they have been applied.

Guidelines on the Information to be Contained in Environmental Impact Assessment Reports, 2022

9.35 Published in May 2022 by the Environmental Protection Agency (EPA), these guidelines supersede draft 2017 guidelines and provide consistency on the information to be contained in Environmental Impact Assessment Reports (EIAR) with the objective of improving their quality.

Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4), 2016

9.36 Published in 2016 by the EPA, these guidelines assist licensed sites with the assessment of their potential and actual noise impact on the local environment.

Westmeath County Development Plan 2021 – 2027

9.37 Chapter 10 of Westmeath County Development Plan 2021 – 2027 (WCDP), adopted in May 2021, provides details of the Council's Transport, Infrastructure and Energy strategy. Section 10.19 addresses noise pollution in general from all types of transport, infrastructure and energy developments. This section sets out a general requirement for all developments to be "… *designed and operated in a manner that will minimise and contain noise levels, having regard to national guidelines*…". Further reference is made to the Westmeath Noise Action Plan 2013 – 2018.

9.38 Section 10.23 of the WCDP addresses wind energy developments, where such proposals are encouraged provided that they would not have an adverse effect. Furthermore, proposals for wind energy developments need to demonstrate that human health has been considered, which includes a specific reference to noise. The Development Plan specifies that noise impacts give regard to the World Health Organisation's 2018 Environmental Noise Guidelines for the European Region.

Westmeath Noise Action Plan 2013 – 2018

9.39 Westmeath County Noise Action Plan 2021 – 2027 was prepared as a requirement of the Environmental Noise Regulations and provides details of the Council's strategy for long-term management of environmental noise from transportation sources. As such no specific advice is provided in regard to the assessment of noise from wind farms.

Meath County Development Plan 2021 – 2027

9.40 In the context of Wind Energy, the Meath County Development Plan (MCDP) states that

'*The Council will continue to support and encourage the principle of development of wind energy, in accordance with Government policy and having regard to the provisions of the*

Landscape Characterisation Assessment of the County and the Wind Energy Development Guidelines (2006) or any revisions thereof'.

9.41 Relevant policies within the MCDP are set out within Section 6.15 Energy. It is the Policy of the Council

- To support Ireland's renewable energy commitments outlined in national policy by facilitating the development and exploitation of renewable energy sources such as solar, wind, geothermal, hydro and bio-energy at suitable locations within the County where such development does not have a negative impact on the surrounding environment (including water quality), landscape, biodiversity or local amenities so as to provide for further residential and enterprise development within the county. INF OBJ 39

9.42 Within the Development Management Section of the MCDP, Policy DM POL 28 requires compliance with the Wind Energy Development Guidelines, (2006) and Circular PL20-13, and any updates thereof. Any proposal shall be supported by both a technical and an environmental statement prepared to an acceptable standard which sets out how the proposal complies with the Guidelines.

Meath County Noise Action Plan, 2019

9.43 The Meath County Noise Action Plan 2019 was prepared as a requirement of the Environmental Noise Regulations and provides details of the Council's strategy for long-term management of environmental noise from transportation sources. As such no specific advice is provided in regard to the assessment of noise from wind farms, it is noted that wind energy developments are subject to a number of planning and operational criteria.

Wind Energy Development Planning Guidelines, 2006

9.44 Published by the then Department of Environment, Heritage and Local Government (now the Department of Housing, Local Government and Heritage), these Guidelines offer advice for many aspects of wind energy development, including noise, which is covered in Section 5.6. At the time of writing, the 2006 Guidelines remain in force. Best practice for operational noise assessment is to apply the 2006 Guidelines as supplemented by ETSU-R-97 and IOA GPG (see below).

Draft Revised Wind Energy Development Guidelines, 2019

9.45 Published by the Department of Housing, Planning and Local Government (DoHPLG). These guidelines are currently under review and are yet to be adopted, with further revisions to the text, including noise guidance, anticipated. Until such a time as these guidelines are re-published for public consultation, the 2006 Guidelines remain in place. The noise assessment section of the draft guidelines are not considered best practice, and have not been applied in this assessment.

ETSU-R-97 The Assessment & Rating of Noise from Wind Farms, 1996

9.46 The Assessment and Rating of Noise from Wind Farms - ETSU-R-97, 1996, provides a framework for the assessment and rating of noise from wind farms. In Ireland, under the 2006 Guidelines, the determination of background noise levels and limits is carried out using the ETSU-R-97 methodology.

Institute of Acoustics Good Practice Guide, 2013

9.47 The IOA GPG is supported by a suite of six Supplementary Guidance Notes, published in 2014. The guide presents current good practice in the application of ETSU-R-97 assessment methodology for wind turbine developments at the various stages of the assessment process.

Best Practice Guidelines for the Irish Wind Energy Industry, 2012

9.48 The Best Practice Guidelines for the Irish Wind Energy Industry, published by the Irish Wind Energy Association, sets various guidelines for the industry to encourage responsible and sensitive wind farm development, which takes into consideration the concerns of local communities, planners, and other interested groups. Section 6.3.3. addresses the assessment of noise and confirms that the 2006 Guidelines should be followed, and reference is made to ETSU-R-97 as the appropriate method for the determination of existing background noise levels. Construction noise impacts should be assessed in accordance with British Standard BS 5228-1.

British Standard BS 5228, 2014

9.49 British Standard BS 5228 refers to the need for the protection against noise (in Part 1) and vibration (in Part 2) for people living in the vicinity of construction or open sites.

9.50 Part 1, or BS 5228-1:2009+A1:2014, sets out a methodology for predicting noise levels arising from a wide variety of construction activities and it contains tables of sound power levels generated by mobile and fixed plant. Annex E of BS 5228-1 gives example criteria that may be used to consider the significant effect of any construction noise impact. The criteria are not mandatory and are presented as a set of example approaches that reflect the type of methods commonly applied to construction noise.

9.51 Part 2, or BS 5228-2:2009+A1:2014 (BS 5228-2), gives recommendations for basic methods of vibration control relating to construction and open sites. Annexes E and F of BS 5228-2 includes guidance on the subject of vibration from blasting sites, whereas Annex G discusses air overpressure resulting from blasting.

International Standard ISO 9613-2, 1996

9.52 International Standard ISO 9613-2, Acoustics – Attenuation of Sound During Propagation outdoors – Part 2: General Method of Calculation, specifies an engineering method for accurately predicting levels of environmental noise at a distance from a variety of sources. It is recognised in current best practice, including the IOA GPG, as the appropriate method when calculating noise immission levels from wind turbines.

9.53 Note that in the above, and subsequently in this assessment, the term ‘noise emission’ relates to the sound power level of a wind turbine, whereas the term ‘noise immission’ relates to the sound pressure level experienced at a receptor location.

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

9.54 The WHO Environmental Noise Guidelines for the European Region 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.

Study Area

9.55 The study area for the construction and decommissioning noise is limited to the nearest Noise-Sensitive Receptor (NSR) in each general direction during the construction or decommissioning phase under assessment. The calculation for construction and decommissioning noise assumes no reduction for screening and assumes downwind propagation; therefore, other, more distant NSRs would be exposed to lower levels of noise and do not need to be considered also.

9.56 The study area for the operational noise assessment, as defined in the IOA GPG, comprises the area where noise levels from the Proposed Development are predicted to be within 10 dB of those from other relevant wind energy developments, and the predicted cumulative wind farm noise level is greater than 35 dB, $L_{A90,10min}$. The $L_{A90,\ 10min}$ parameter is used to describe wind turbine noise and it represents the level of noise exceeded for 90% of the measurement period, 10 minutes. No other wind energy developments have been identified that would contribute to the cumulative noise levels, so the study area for operational noise has been defined as the area where wind turbine noise from the Proposed Development is greater than 35 dB $_{LA90}$.

9.57 NSRs are properties within the study area which are potentially sensitive to noise and, as such, may require protection from nearby noise sources. The 2006 Guidelines list NSRs as dwellings, hostels, health buildings, places of worship and may also include areas of particular scenic quality or specially recreational amenity importance.

9.58 The NSRs identified within this assessment are all residential dwellings and during the operational phase wind turbine noise immission levels are predicted to a location representative of each outdoor amenity area rather the façade of the property. This is in line with the IOA GPG which states (at paragraph 4.3.8) that "*calculations should be made at points representative of the relevant outdoor amenity area (as defined in ETSU-R-97) at locations nearest to the proposed wind farm development*".

9.59 It is not always appropriate to assess operational wind turbine noise impacts at all nearby NSRs, as a worst-case can be presented with a selection of NSRs. Where multiple NSRs are in the same general direction from the Proposed Development, it may be appropriate to present results for just one of these which represents the highest noise levels that could be experienced at any of them.

9.60 **Table 9-1** details the identified NSRs for the assessment of operational and construction noise and **Figure 9.1** shows the location of each NSR in relation to the Proposed Development. It should be noted that NSR19 is included to assess the construction noise impacts only and falls outside the study area parameters described above for operational noise from the wind turbines. Receptors marked with an * denote that they have financial involvement with the Proposed Development.

9.61 NSRs were identified via a desktop review in July 2023 of the Eircode database and satellite imagery.

Table 9-1: Noise Sensitive Receptors

NSR ID	Eircode	Easting (ITM)	Northing (ITM)
NSR01	C15 D2W0	662194	768485
NSR02	C15 VN81	662414	768512
NSR03	C15 EW89	664354	767856
NSR04	C15 VX09	664116	767113
NSR05*	C15 WF29	663614	766584
NSR06	C15 AE28	663528	766496
NSR07	C15 V188	663196	766691
NSR08*	C15 PX93	662929	766801
NSR09	N91 HW88	662886	767051
NSR10	N91 E4X8	662656	766987
NSR11	N91 FP89	662714	767026
NSR12	Unknown	662633	766895
NSR13	N91 WD32	661775	766236
NSR14	N91 CK46	661216	765240
NSR15	N91 W3P1	662449	764704
NSR16	N91 K763	661289	764365
NSR17	N91 KA40	663385	765083
NSR18	N91 HX40	663530	765742
NSR19 (Construction only)	C15 K096	664269	768851

Evaluation Criteria

Construction Noise Criteria

9.62 There is no statutory Irish guidance relating to the maximum permissible noise level that may be generated during the construction phase of a project. In the absence of specific noise limits, appropriate emission criteria relating to permissible construction noise levels for a development of this scale may be found in the BS 5228-1 Annex E.

9.63 The criteria do not represent mandatory limits but rather a set of example approaches intended to reflect the type of methods commonly applied to construction noise. In broad terms, the example criteria are based on a set of fixed limit values which, if exceeded, may result in a significant effect unless ambient noise levels are sufficiently high to provide a degree of masking of construction noise.

9.64 The range of guidance values detailed in BS 5228-1 Annex E have been used to numerically define the magnitude of impact. As construction noise will always be an introduction of a noise source which would otherwise not be there, where impacts are identified to occur, they will always be adverse:

- where construction noise levels at receptors are below the adopted daytime noise limit of 65 dB L_{Aeq} for a sustained period of time, this is determined to be ‘not significant’; and
- where construction noise levels at receptors are above the adopted daytime noise limit of 65 dB L_{Aeq} for a period of one month or more, this is determined to be ‘significant’.

9.65 It should be noted that the parameter used to describe noise from construction activities is the L_{Aeq}, which is the equivalent continuous sound pressure level of a fluctuating noise over a given period.

Operational Noise Criteria

9.66 The operational noise assessment applies the current 2006 Guidelines and is supplemented by ETSU-R-97 and the IOA GPG as set out below.

9.67 The 2006 Guidelines contain recommended noise limits to control operational noise from wind farms and state:

'In general, a lower fixed limit of 45 dB(A) or a maximum increase of 5dB(A) above background noise at nearby noise sensitive locations is considered appropriate to provide protection to wind energy development neighbours. However, in very quiet areas, the use of a margin of 5dB(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 LA90,10min of the wind energy development noise be limited to an absolute level within the range of 35-40 dB(A).

Separate noise limits should apply for day-time and for night-time. During the night, the protection of external amenity becomes less important and the emphasis should be on preventing sleep disturbance. A fixed limit of 43dB(A) will protect sleep inside properties during the night'.

9.68 Operational noise limits comprise two elements: a lower fixed limit, and a maximum increase above background noise levels, whichever is greater. Separate noise limits apply for the daytime and night-time.

9.69 The day-time background noise level is derived from data measured during the 'quiet periods of the day' defined in ETSU-R-97: these comprise weekday evenings (18:00 to 23:00), Saturday afternoons and evenings (13:00 to 23:00) and all day and evening on Sundays (07:00 to 23:00). The night-time background noise level is derived from data measured during the night-time periods (23:00 to 07:00) with no differentiation being made between weekdays and weekends.

9.70 ETSU-R-97 provides further guidance where a property occupier has a financial involvement in the wind farm development. Where this is the case then the lower fixed portion of the noise limit at that property is set to 45 dB(A) during both the daytime and the night-time periods, even in low noise environments.

9.71 The assessment of significance of effects from operational wind turbine noise immission at a NSR is:

- not significant if the noise limits derived according to the 2006 Guidelines is not exceeded; or
- significant if the noise limit derived according to the 2006 Guidelines is exceeded.

9.72 Furthermore, Westmeath County Development Plan specifies that noise assessments for wind energy developments should have regard to the World Health Organisation's 2018 Environmental Noise Guidelines for the European Region. This document provides guidance on protecting human health from exposure to environmental 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.

9.73 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 Lden, as wind turbine noise above this level is associated with adverse health effects.

No recommendation is made for average night noise exposure Lnight 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 policy-makers 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'.

9.74 The quality of evidence that the chosen noise level is effective is stated as being 'low'; therefore, the recommendations are conditional. A conditional recommendation would require agreement and further debate of stakeholders (such as, but not limited to the public, government bodies, wind farm developers and operators as well as turbine manufacturers) before it becomes adopted into any legislative context.

9.75 Furthermore, the parameters used by the WHO for assessment of exposure (i.e. L_{den} and L_{night}) is acknowledged to provide 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 Lden 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 Lden or Lnight may be a poor characterization of wind turbine noise and may limit the ability to observe associations between wind turbine noise and health outcomes'.

9.76 The WHO document goes on to state that:

'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'.

9.77 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. However, the WHO Environmental Noise Guidelines aim to support the legislation and

policy-making process on local, national and international levels, thus may be considered by Irish policy makers for any future revisions of Irish National Guidelines.

Significance of impact

9.78 The EIAR guidelines (EPA, 2022) provide criteria for determining the significance of environmental impacts and the effects in broad terms for all assessment topics. The EIAR guidelines (EPA, 2022) recognise that professional judgment, relevant guidance and standards play an important role in the determination of significance, and as such do not quantify the impacts in decibel terms.

9.79 By definition, a NSRs will be sensitive to noise. Set out above are the thresholds of significance for the construction and operational phases, if the predicted impacts are below these thresholds at a NSR, it is considered that no significant effect occurs.

Consultation requirements

9.80 **Chapter 1** of the EIAR refers to scoping consultation. Noise was raised ten times during doorstep consultation which accounted for 2% of concerns raised. In addition, statutory consultees raised the comments with regard to noise as summarised in **Table 9-2**. Submissions and feedback have informed the project design and this EIAR chapter.

Table 9-2: Consultee Comments

Consultee	Summary of comment	Where the comment is addressed
Health Services Executive Environmental Health Department Westmeath	A noise and vibration assessment is to be included in the EIAR	Chapter 9
Planning Department of Meath County Council	Consideration should be given to noise (max) limits in draft Wind Energy Guidelines 2019	Paragraph 9.45 and paragraph 9.66
Transport Infrastructure Ireland	The EIAR/EIS should consider the Environmental Noise Regulations 2006 (SI 140 of 2006) and, in particular, how the development will affect future action plans by the relevant competent authority. The developer may need to consider the incorporation of noise barriers to reduce noise impacts (see Guidelines for the Treatment of Noise and Vibration in National Road Schemes (1st Rev., National Roads Authority, 2004)).	See Chapter 14 for the Traffic and Transport Assessment and how the development will affect future action plans, if relevant. Paragraph 9.107 and paragraph 9.108.

Assumptions & limitations

9.81 No significant information gaps were identified, and the assessment was undertaken in line with relevant standards and policy documents, as set out in paragraph 9.34 to paragraph 9.54.

Existing Environment

9.82 A baseline noise survey was carried out by SLR (see paragraph 9.8) between Friday 16th September 2022 and Friday 28th October 2022 at a total of six noise measurement locations (NML) that represent the NSRs in the study area. Monitoring was carried out for a minimum

of 28 days and a maximum of 42 days at each of the NMLs. This total exceeds the two-weeks recommended in the IWEI Best Practice Guidelines and the IOA GPG. **Table 9-3** details the background noise survey locations and **Figure 9.1** shows their location relative to the Proposed Development.

Table 9-3: Noise Measurement Locations

NML ID	Eircode	Easting (ITM)	Northing (ITM)
NML1	C15 D2W0	662209	768518
NML2	C15 WF29	663612	766574
NML3	C15 PX93	662926	766799
NML4	N91 CK46	661217	765238
NML5	N91 K763	661275	764360
NML6	N91 F721	663691	765366

9.83 In line with the IOA GPG, the background survey data have been used as a proxy for some NSRs where monitoring was not carried out. This is considered appropriate due to the comparable distances from local roads or streams. Furthermore, as set out above, it is not necessary to assess every NSR in the area. Details of which survey location has been used as a proxy for the corresponding assessment location are included in **Table 9-4**. It should be noted that NSR19 is included to assess the construction noise impacts of the substation only and falls outside the study area parameters described in paragraph 9.56 for operational noise from the wind turbines. Therefore, a proxy location has not been assigned to NSR19.

Table 9-4: Proxy Locations for Noise Sensitive Receptors

NSR ID	Eircode	NML ID	Eircode
NSR01	C15 D2W0	NML1	C15 D2W0
NSR02	C15 VN81	NML1	C15 D2W0
NSR03	C15 EW89	NML2	C15 WF29
NSR04	C15 VX09	NML2	C15 WF29
NSR05	C15 WF29	NML2	C15 WF29
NSR06	C15 AE28	NML2	C15 WF29
NSR07	C15 V188	NML3	C15 PX93
NSR08	C15 PX93	NML3	C15 PX93
NSR09	N91 HW88	NML3	C15 PX93
NSR10	N91 E4X8	NML3	C15 PX93
NSR11	N91 FP89	NML3	C15 PX93
NSR12	unknown	NML3	C15 PX93
NSR13	N91 WD32	NML3	C15 PX93
NSR14	N91 CK46	NML4	N91 CK46
NSR15	N91 W3P1	NML5	N91 K763
NSR16	N91 K763	NML5	N91 K763
NSR17	N91 KA40	NML6	N91 F721
NSR18	N91 HX40	NML6	N91 F721

9.84 The equipment used for the background noise survey comprised Class 1 logging sound level meters, each enclosed in environmental cases to protect from the weather. Outdoor enhanced windshields were used to reduce wind induced noise on the microphones and provide protection from rain. These windshields were supplied by the sound level meter manufacturer and maintain the required performance of the whole measurement system when fitted. The installed microphone height was approximately 1.5m.

9.85 The sound level meters were located between 3.5m and 20m from the façade of the property and as far away as was practical from obvious atypical localised sources of noise such as running water, tall trees or boiler flues.

9.86 Details and photographs of the measurement locations can be found in **Appendix 9-2** found in Volume III of this EIAR.

9.87 Sound level meters were all field calibrated during their installation and collection, with no acoustically significant (>0.5 dB(A)) drifts in calibration observed. The equipment used and locations chosen followed the IOA GPG guidelines in all cases.

9.88 The sound level meters logged the $L_{A90,10min}$ and $L_{Aeq,10min}$ noise levels continuously over the survey period, using Coordinated Universal Time (UTC) time reference. Wind data were measured using a Light Detection and Ranging (LiDAR) remote sensing measurement system that also logged data using the same 10-minute periods and UTC time reference.

9.89 The use of a LiDAR to monitor the wind data is endorsed by the IOA GPG as one of three preferred methods of capturing such data. The LiDAR was installed on site (co-ordinates 662942, 766764) by ZX Measurement Services, experts in wind measurements for such applications. Further details regarding the LiDAR and the calculation of the corresponding wind speed referenced to a standardised height of 10 m in accordance with the IOA GPG are set out in **Appendix 9-5** found in Volume III of this EIAR.

9.90 NML4 and NML5 had a rain logger installed to monitor periods of rainfall during the background noise survey. The rain logger comprised a Davis tipping bucket detector, set to record if any rain was detected during the same 10-minute measurement period used by the sound level meters and wind data. The data from the rain logger was also synchronised to the UTC time reference.

Analysis of the Baseline Data

9.91 The measured background noise data, standardised wind speed data and rain data for identical periods have been collated and reviewed for atypical relationships between noise level and wind speed, periods of rain fall and any extraneous data. Where these traits have been identified this data has been excluded from the analysis. In the case of rainfall, its effects on noise can be detected both during (as it hits vegetation), and immediately after it stops, and in some cases for a short while after it has stopped (as streams and burns swell to carry run-off rainwater). Periods of rain plus the following 30-minute periods have been excluded. A regular spike in noise was noted at NML4 between 19:10 and 19:50 (IST) every day, so this period was excluded for that location. Full details of excluded periods can be found in **Appendix 9-2** found in Volume III of this EIAR.

9.92 Best fit lines were generated through the remaining data using a polynomial fit of a maximum of 4th order, so as to best represent the typical values. These lines form the prevailing background noise level curve for each measurement location, as set out in **Table 9-5** and **Appendix 9-3** found in Volume III of this EIAR provides this information graphically.

9.93 If the prevailing background noise is shown to be higher at lower wind speeds, the lowest derived background noise level has been applied for all wind speeds below the minimum value, in accordance with the IOA GPG. Furthermore, the derived prevailing background noise polynomial curve was not extended beyond the range covered by adequate data points. Where a noise limit is required at higher wind speeds; it was restricted to the highest derived point, as indicated by an * in **Table 9-5**.

Table 9-5: Prevailing Background Noise Levels

NML ID	Period	Prevailing background noise level, dB $L_{A90, 10min}$ at standardised wind speed, m/s								
		4	5	6	7	8	9	10	11	12
NML1	Quiet daytime	23.4	25.7	29.2	33.8	39.3	45.5	52.3	52.3*	52.3*
	Night-time	17.1	20.6	26.0	32.2	38.4	43.9	48.3	51.0	51.0*

NML ID	Period	Prevailing background noise level, dB $L_{A90, 10min}$ at standardised wind speed, m/s								
		4	5	6	7	8	9	10	11	12
NML2	Quiet daytime	31.5	32.6	34.3	36.6	39.4	42.8	42.8*	42.8*	42.8*
	Night-time	20.1	22.7	26.4	30.8	35.6	40.3	44.6	44.6*	44.6*
NML3	Quiet daytime	25.8	27.9	30.9	34.7	39.1	44.2	44.2*	44.2*	44.2*
	Night-time	18.4	21.3	25.4	30.5	36.2	42.2	48.0	48.0*	48.0*
NML4	Quiet daytime	29.1	30.4	32.3	35.0	38.4	42.5	42.5*	42.5*	42.5*
	Night-time	20.4	22.5	25.6	29.6	34.3	39.5	44.9	44.9*	44.9*
NML5	Quiet daytime	36.1	36.8	38.1	39.8	42.1	44.9	48.1	48.1*	48.1*
	Night-time	21.7	24.3	28.0	32.2	36.7	41.1	44.9	47.8	47.8*
NML6	Quiet daytime	33.3	34.2	35.4	37.0	38.9	41.1	41.1*	41.1*	41.1*
	Night-time	20.5	23.2	26.9	31.2	35.8	40.3	40.3*	40.3*	40.3*

Wind Farm Noise Limits

9.94 The Proposed Development has been assessed against the 2006 Guidelines. The 2006 Guidelines provide guidance on the setting of appropriate noise limits, relative to wind speed. These limits comprise two elements: a lower fixed value; and a derived relative value equal to the prevailing background curve plus 5 dB(A), with the greater of these two elements at each integer wind speed forming the limit value. During the night-time a fixed limit of 43 dB L_{A90} is designed to prevent sleep disturbance indoors. During the daytime and in low noise environments, where the background noise levels are less than 30 dB L_{A90}, the 2006 Guidelines recommend a value of between 35 dB L_{A90} and 40 dB L_{A90} for the lower fixed element of the daytime noise limit. Where the prevailing background noise levels exceed 30 dB L_{A90} during the daytime, the 2006 Guidelines set the fixed portion of the limit to 45 dB L_{A90}.

9.95 It is proposed that a value of 40 dB L_{A90} is set for the fixed element of the daytime noise limit for wind speeds where the background noise is less than 30 dB L_{A90}. This follows a review of the prevailing baseline noise survey data contained in this assessment and on-going developments in terms of Irish guidance on the issue of wind turbine noise 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(A) in 'areas of low background noise'. The proposed lower threshold here is 5 dB more stringent than this level; and
- it should be reiterated that the 2006 Wind Energy Development Guidelines for Planning Authorities states that "An appropriate balance must be achieved between power generation and noise impact." Based on a review of the aforementioned EPA NG4 national guidance in relation to acceptable noise levels in areas of low background noise it is considered that the criteria adopted as part of this assessment are robust.

9.96 In line with ETSU-R-97, financially involved properties are subject to a limit based on the maximum of 45 dB L_{A90} or 5 dB above background during the daytime and night-time.

9.97 In summary, the operational noise limits for the Proposed Development at non-financially involved properties are:

- 40 dB L_{A90} for daytime windspeeds where the typical background noise is less than 30 dB L_{A90};

- 45 dB L_{A90} for daytime windspeeds where the typical background noise is greater than 30 dB L_{A90} or a maximum increase of 5 dB(A) above background noise (whichever is the higher); and
- 43 dB L_{A90} for night-time periods or a maximum increase of 5 dB(A) above background noise (whichever is the higher).

9.98 And at financially involved properties:

- 45 dB L_{A90} for daytime and night-time or a maximum increase of 5 dB(A) above background noise (whichever is higher)

9.99 This set of criteria has been chosen as it is in line with the 2006 Guidelines and ETSU-R-97 and is comparable to noise planning conditions applied to similar developments previously granted planning permission by An Bord Pleanála. The noise limits are detailed in **Table 9-6** and graphically in **Appendix 9-4** found in Volume III of this EIAR.

Table 9-6: Derived Noise Limits

NSR ID	Period	Derived noise limit, dB $L_{A90, 10min}$ at standardised wind speed, m/s								
		4	5	6	7	8	9	10	11	12
NSR01	Daytime	40	40	40	45	45	51	57	57	57
	Night-time	43	43	43	43	43	49	53	56	56
NSR02	Daytime	40	40	40	45	45	51	57	57	57
	Night-time	43	43	43	43	43	49	53	56	56
NSR03	Daytime	45	45	45	45	45	48	48	48	48
	Night-time	43	43	43	43	43	45	48	48	48
NSR04	Daytime	45	45	45	45	45	48	48	48	48
	Night-time	43	43	43	43	43	45	48	48	48
NSR05	Daytime	45	45	45	45	45	48	48	48	48
	Night-time	45	45	45	45	45	45	48	48	48
NSR06	Daytime	45	45	45	45	45	48	48	48	48
	Night-time	43	43	43	43	43	45	48	48	48
NSR07	Daytime	40	40	45	45	45	49	49	49	49
	Night-time	43	43	43	43	43	47	50	50	50
NSR08	Daytime	45	45	45	45	45	49	49	49	49
	Night-time	45	45	45	45	45	47	50	50	50
NSR09	Daytime	40	40	45	45	45	49	49	49	49
	Night-time	43	43	43	43	43	47	50	50	50
NSR10	Daytime	40	40	45	45	45	49	49	49	49
	Night-time	43	43	43	43	43	47	50	50	50
NSR11	Daytime	40	40	45	45	45	49	49	49	49
	Night-time	43	43	43	43	43	47	50	50	50
NSR12	Daytime	40	40	45	45	45	49	49	49	49
	Night-time	43	43	43	43	43	47	50	50	50
NSR13	Daytime	40	40	45	45	45	49	49	49	49
	Night-time	43	43	43	43	43	47	50	50	50
NSR14	Daytime	40	45	45	45	45	47	47	47	47
	Night-time	43	43	43	43	43	44	47	47	47
NSR15	Daytime	45	45	45	45	47	50	53	53	53
	Night-time	43	43	43	43	43	46	50	53	53
NSR16	Daytime	45	45	45	45	47	50	53	53	53
	Night-time	43	43	43	43	43	46	50	53	53
NSR17	Daytime	45	45	45	45	45	46	46	46	46
	Night-time	43	43	43	43	43	45	45	45	45
NSR18	Daytime	45	45	45	45	45	46	46	46	46

NSR ID	Period	Derived noise limit, dB $L_{A90, 10min}$ at standardised wind speed, m/s								
		4	5	6	7	8	9	10	11	12
	Night-time	43	43	43	43	43	45	45	45	45

Potential Impacts

Do Nothing Scenario

9.100 Currently the Proposed Development is not constructed or operational, which if this remained to be the case, the existing noise environment would remain largely unchanged. No other developments have been identified that would alter the existing environment.

Potential Impacts – Construction

Proposed Development

9.101 The level of construction noise that occurs at the NSRs will be highly dependent on a number of factors such as the final site programme, equipment types used for each process, and the operating conditions that prevail during construction. It is not practically feasible to specify each and every element of the factors that may affect noise levels, therefore it is necessary to make reasonable allowance for the level of noise emissions that may be associated with key phases of the construction. Whilst the proposed turbine model installed on site will be subject to a future procurement process, the level of construction noise will not differ with alternative machines as the same construction techniques and plant will be used in the same locations. This assessment has considered the variations within the dimensional permutations set out in **Table 2-1** of **Chapter 2** of this EIAR. Therefore, the construction noise assessment remains valid for all turbine types considered in Chapter 2 of the EIAR.

9.102 To determine representative noise emission levels for this study, reference has been made to the scheduled sound power data provided by BS 5228-1. Based on experience of the types and quantity of equipment proposed to be used for constructing this wind farm, the scheduled sound power data has been used to deduce the upper sound emission level over the course of a working day. In determining the rating applicable to the working day, it is proposed that the plant will operate for between 75% and 100% of the working day. This represents a hypothetical worst case scenario, as in many instances, the plant would actually be expected to operate for a reduced percentage, thus resulting in noise levels lower than predicted in this assessment. This does not contradict any mitigation measures proposed in the EIAR.

9.103 To relate the sound power emissions to predicted noise levels at surrounding properties, the prediction methodology outlined in BS 5228-1 has been adopted. The prediction method accounts for factors including screening and soft ground attenuation. The size of the site and resulting separation distances to surrounding properties allows the calculations to be reliably based on positioning all the equipment at a single point within a particular working area, for example: in the case of turbine erection, it is reasonable to assume all associated construction plant is positioned at the base of the turbine under consideration. In applying the BS 5228-1 methodology, it has been conservatively assumed that there are no screening effects, and that the ground cover is characterised as 50% hard / 50% soft.

9.104 **Table 9-7** lists the key construction activities, the associated types of plant involved, the expected total sound power level over a working day for each activity, the NSR which would be closest to the activity for a portion of construction, and the predicted noise level. It must

be emphasised that these predictions only relate the noise level occurring during the time when the activity is closest to the referenced NSR. In many cases such as access track construction and turbine erection, the separating distances will be considerably greater for the majority of the construction period and the predictions are therefore the worst-case periods of the construction phase.

Table 9-7: Predicted Construction Noise Levels

Task name	Plant	Total sound power level, dB L_{WA}	Nearest receiver	Minimum distance to receiver, m	Predicted noise level, dB L_{Aeq}
Construct temporary site compounds	excavators / dump trucks / tippers / rollers/ delivery trucks	116	NSR11	500	51
Construct site tracks	excavators / dump trucks / tippers / dozers / vibrating rollers	114	NSR07	40	74
Construct Sub-Station	excavators / concrete trucks / delivery trucks	111	NSR19	150	58
Construct crane hard standings	excavators / dump trucks	112	NSR08	700	44
Construct turbine foundations	piling rigs / excavators / tippers / concrete trucks / mobile cranes / water pumps / pneumatic hammers / compressors / vibratory pokers	120	NSR08	700	52
Excavate and lay site cables	excavators / dump trucks / tractors & cable drum trailers / wacker plates	112	NSR08	700	44
Erect turbines	cranes / turbine delivery vehicles / artics for crane movement / generators / torque guns	118	NSR08	700	50
Reinstate crane bases	excavator / dump truck	113	NSR08	700	42
Borrow pit quarrying	Primary and secondary stone crushers / excavators / screening systems / pneumatic breakers / conveyors	126	NSR09	430	63

9.105 Comparing the above predicted construction noise levels to the range of background noise levels measured around the site suggests that the noisier construction activities will be audible at various times throughout the construction phase. However, comparing the levels to the significance criteria presented previously indicates that for the majority of construction activities the noise generated will be not significant. In terms of significant levels, when access track construction activity is closest to NSR07, predicted noise levels are likely to represent those which will be significant for a very short term period when activity is closest to the receptors. This period of time will depend on the progression rate of construction works, but is unlikely to be more than two days and could be as little as a few hours. Noise levels will quickly diminish as construction progresses, moving the activity further from the NSRs. Once access track construction work is 100m away or further the predicted construction noise levels will fall below the significance criteria. The short term nature of this activity consequently categorises the effects to be not significant.

9.106 It is proposed that the excavation of borrow pits will require a large crusher, two large excavators, screening plant all operating at 80% of the time, and a field conveyor system operating continuously. Confirmatory investigations may reveal that the ground conditions

do not require all of this equipment, in which case the noise levels will be lower than that set out in **Table 9-7**.

Site Traffic

9.107 In addition to on-site activities, construction traffic passing to and from the site will also represent a potential source of noise to surrounding NSRs. The transport and traffic assessment presented in **Chapter 14** of the EIAR has identified that there will be additional light goods vehicles travelling to and from the Proposed Development Site during the construction phase. These are expected to peak during the morning and evening as contractors from the site arrive and depart for the day and are envisaged not to be a continuous source of noise emissions. The noise impact from construction personnel movements to and from the site is expected to be low. The construction traffic data remains the same for all potential turbine types considered in **Chapter 2** of this EIAR. Therefore, the assessment of noise from construction vehicles is appropriate for all turbines.

9.108 All deliveries of turbine components to the site will only be by way of the proposed transport route outlined in **Chapter 14**. The most intensive period of the works programme will be during month five. During this time several construction activities are programmed in parallel. **Table 14-10** of **Chapter 14** reports a maximum number of construction HGVs of 140 per day which includes the accumulation of the substation and wind farm construction vehicles.

9.109 The likely noise effects of HGV movements are assessed through consideration of the cumulative noise level associated with a series of individual events. The noise level associated with an event of short duration, such as a vehicle drive-by, may be expressed in terms of its Sound Exposure Level (SEL). The SEL can be used to calculate the contribution of an event or series of events to the overall noise level in a given period. The appropriate formula is as follows.

$$L_{Aeq,T} = SEL + 10\log n - 10\log t - 20\log\left(\frac{r_2}{r_1}\right)$$

9.110 Where:

$L_{Aeq,T}$ is the equivalent continuous sound level over the time period T (s);
N is the number of events over the course of time period T.
r_2 is the distance to the calculation point
r_1 is the distance from vehicle to the point of original measurement

9.111 BS 5228-1 Table C.11 provides general sound level data for various construction plant. A Sound Exposure Level for a HGV movement of 83 dB at a distance of 10m can be assumed from this table. Based on a minimal distance of 8m from the passing HGVs and assuming that all HGVs travel on the same road and that there is no screening present as a worst case, the noise from these vehicles will be 60 dB L_{Aeq}. With reference to paragraph 9.64, this level will be below the threshold of significance and will therefore not give rise to significant effects from noise.

Cable Routes

9.112 The Proposed Development will include an electricity substation, to which each wind turbine will be connected via underground cables that follow the public road. This substation will be connected to the grid via further cables connecting to the existing overhead line in Clonmellon. The proposed plant to be in operation during the laying of underground cables for the connection to the substation and thereafter to the grid are provided in **Table 9-8** together with the corresponding noise levels calculated at set distances back.

Table 9-8: Predicted Cable Route Construction Noise Levels

Task name	Plant	Sound power level, dB L_{WA}	On time %	Predicted noise level, dB L_{Aeq}			
				10 m	25 m	50 m	100 m
Dust suppression	Road Sweeper	104	10	66	58	51	45
Breaking road surface	Mini excavator with hydraulic breaker	111	25	77	69	62	56
Rolling and compacting	Vibratory roller	105	50	74	66	59	53
Trenching	Wheeled excavator	98	50	67	59	52	46
Cutting concrete	Hand held circular saw	114	10	76	68	61	55
Tipping fill	Dump truck tipping fill	107	10	69	61	54	48
Compaction	Petrol vibratory plate	108	10	70	62	55	49

9.113 The noise levels presented in **Table 9-8** may only occur for only short periods of time at a very limited number of dwellings. The nature of the construction work associated with the burying of cables under the existing roads will be comparable to other roadwork activity and will quickly diminish as work progresses along the road. There are eight dwellings located within 10 m of the cable route construction works and 48 that are within 25 m. For these dwellings, in some instances, the worst case predicted grid connection construction noise level exceeds the noise limit of 65 dB $L_{Aeq,1hr}$. However, these elevated noise levels will only occur for short durations of one or two days when construction activity is at its closest at a limited number of dwellings. Given the nature of the cable route works, construction activities will not occur over an extended period at any one location and therefore, the effects will be not significant. Notwithstanding this, mitigation measures will be implemented in full as set out in paragraph 9.132.

Potential Impacts – Operational

Wind Farm – Input Parameters

9.114 The ISO 9613-2 model has been used to calculate the noise immission levels at the NSRs as advised in the IOA GPG. The model accounts for the attenuation due to geometric spreading, atmospheric absorption, and barrier and ground effects. All attenuation calculations have been made on an octave band basis and therefore account for the sound frequency characteristics of the turbines.

9.115 All noise level predictions have been undertaken using a receiver height of four metres above local ground level, mixed ground (G=0.5) and an air absorption based on a temperature of 10°C and 70% relative humidity. A receiver height of four metres will be typical of first floor windows and result in slightly higher predicted noise levels than if a 1.2 to 1.5 metre receiver height were chosen in the ISO 9613 algorithm. The attenuation due to terrain screening accounted for in the calculations has been limited to a maximum of 2 dB(A). In situations of propagation above concave ground, a correction of +3dB was added.

9.116 This method is consistent with the recommendations of the above-referenced IOA GPG which provides recommendations on the appropriate approach when predicting wind turbine noise levels. The IOA GPG also allows for directional effects to be taken into account within the noise modelling: under upwind propagation conditions between a given receiver and the wind farm the noise immission level at that receiver can be as much as 10 dB(A) to 15 dB(A) lower than the level predicted using the ISO 9613-2 model. However, predictions have been made assuming downwind propagation from every turbine to every receptor at the same time as a worst case.

9.117 The exact model of turbine that will be installed at the Proposed Development Site will be the subject of a competitive procurement process prior to the construction of the wind farm, which will be several years post-consent if the project is successful at the planning stage. The Siemens Gamesa SG155 6.6MW and the Vestas V162 7.2MW wind turbines are two such candidate turbines within the range proposed for this development which may be selected by the developer subject to availability and the above-mentioned procurement process at that time. These candidate machines have representative noise emission levels to other turbines that are currently available of the permutations within the range that is being applied for and assessed within this EIAR. Both machines have been modelled separately and are fully assessed in this chapter.

9.118 Both of the turbine types assessed have been modelled using the same layout as indicated on **Figure 9.1**. The candidate turbines are variable speed, pitch regulated machines, the SG155 has a rotor diameter of 155 metres and a hub height of 97.5 metres, the V162 has a rotor diameter of 162m and a hub height of 99 metres. Due to their variable speed operation the sound power output of the turbines varies considerably with wind speed, being quieter at the lower wind speeds when the blades are rotating more slowly.

9.119 Siemens Gamesa and Vestas have supplied noise emission data for the SG155 6.6 MW and the V162 7.2 MW turbines respectively, which represent the values that the manufacturers specify will not be exceeded in practice. In the absence of specific information about the uncertainty allowances in the SG155 data, a further correction factor of +2 dB was added to the Siemens Gamesa specification data in line with guidance in the IOA GPG. As outlined in manufacturer warranty documents provided by Vestas for Ireland, an uncertainty of +1 dB(A) has been applied; therefore, a further correction factor of +1 dB was added to the specification data for the V162 machine in line with these documents and in accordance with the IOA GPG. The Vestas V162 is fitted with serrated trailing edges as standard. The sound power data for both machines have been made available for hub height wind speeds of 3 m/s to 15 m/s inclusive. In addition to the overall sound power data, sound power frequency distribution for the turbines has been specified, based on an energetic average of the available information at each octave band. The overall sound power and spectral data are presented in **Table 9-9** and **Table 9-10** for the SG155 machine and in **Table 9-11** and **Table 9-12** for the V162 machine.

9.120 The assessment presented in this EIA Report assumes that all wind turbines are operating in their standard unconstrained mode. Noise reduced modes are available for the candidate turbines and are provided for reference only in **Table 9-9** (operational modes N1 to N6) and **Table 9-11** (operational modes SO2 to SO6). Noise reduced modes can be applied to one or more turbines to reduce noise immission levels at a NSR. These data have been included for information only as noise reduced modes are not relied upon in this assessment.

Table 9-9: Siemens Gamesa SG155-6.6MW Sound Power Levels, dB L_{WA}

Operational mode	Hub height wind speed, m/s. Sound power level dB L_{WA}. Source: D2359800/04, 29/07/21							
	3	4	5	6	7	8	9	≥10
Unconstrained	94.0	94.0	96.8	100.8	104.1	107.0	107.0	107.0
N1	94.0	94.0	96.8	100.8	104.1	106.0	106.0	106.0
N2	94.0	94.0	96.8	100.8	104.1	105.5	105.5	105.5
N3	94.0	94.0	96.8	100.8	104.0	104.0	104.0	104.0
N4	94.0	94.0	96.8	100.8	103.0	103.0	103.0	103.0
N5	94.0	94.0	96.8	100.8	102.0	102.0	102.0	102.0
N6	94.0	94.0	96.8	100.8	101.0	101.0	101.0	101.0

Table 9-10: Siemens Gamesa SG155-6.6MW Sound Power Frequency Distribution, dB L_{WA}

Operational mode	Octave band centre frequency, Hz. Sound power level dB L_{WA}. Source: D2359800/04, 29/07/21							
	63	125	250	500	1000	2000	4000	8000
All	80.4	87.8	92.4	94.7	94.5	94.8	88.6	73.2

Table 9-11: Vestas V162-7.2MW Sound Power Levels, dB L_{WA}

Operational mode	Hub height wind speed, m/s. Sound power level dB L_{WA}. Source: 0114-3777 V03, 01/07/22										
	≤5	6	7	8	9	10	11	12	13	14	15
Unconstrained	95.0	96.0	99.3	102.5	105.1	105.6	105.7	105.8	106.0	106.3	106.5
SO2	95.0	96.0	99.3	102.3	103.0	103.0	103.0	103.0	103.0	103.0	103.0
SO3	95.0	96.0	99.2	101.8	101.9	102.0	102.0	102.0	102.0	102.0	102.0
SO4	95.0	96.0	99.2	101.0	101.0	101.0	101.0	101.0	101.0	101.0	101.0
SO5	95.0	96.0	99.2	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
SO6	95.0	96.0	98.8	99.0	99.0	99.0	99.0	99.0	99.0	99.0	99.0

Table 9-12: Vestas V162-7.2MW Sound Power Frequency Distribution, dB L_{WA}

Operational mode	Octave band centre frequency, Hz. Sound power level dB L_{WA}. Source: 0114-3777 V03, 01/07/22							
	63	125	250	500	1000	2000	4000	8000
All	89.2	96.8	100.0	100.2	98.5	93.9	86.3	75.5

Wind Farm – Operational Noise Immission Levels

9.121 The assessment of operational wind turbine noise for each of the survey locations (NMLs) is shown in **Table 9-13** and **Table 9-14** for the SG155 and V162 machines respectively. A negative exceedance indicates that the turbine immission level is below the appropriate limit. Predicted noise immission levels for standardised wind speed from 4 m/s to 10 m/s are presented for the NSRs with the highest predicted wind turbine immission level where that survey data are used as a proxy (see **Table 9-4** to see which NSRs share the same NML), rather than all locations for brevity. The reason being that if compliance can be demonstrated at the NSR with the highest immission level of a group of receptors that share the same limit, then wind turbine noise at all the remaining NSRs within that group will also comply with the limit. The predictions assume unconstrained operation and downwind propagation. All these factors represent a worst-case as noise immission levels will be the highest in this scenario. In practice, NSRs will not be downwind of all turbines at any one time and the actual noise levels will be lower than those presented in **Table 9-13** and **Table 9-14**. Calculations have been carried out to one decimal place and presented as whole numbers in **Table 9-13** and **Table 9-14**; therefore, in some cases the exceedance may not exactly equal the difference between the presented values for the limit and immission.

9.122 All wind farm noise immission levels in this report are presented in terms of the $L_{A90,T}$ noise indicator in accordance with the recommendations of the IOA GPG, obtained by subtracting 2 dB(A) from the calculated $L_{Aeq,T}$ noise levels based on the turbine sound power levels presented in **Table 9-9** to **Table 9-12**.

Table 9-13: Assessment of Predicted Wind Farm Noise Immission Levels – SG155-6.6MW

NSR ID (NML ID)	Description	Standardised wind speed, m/s. Noise level dB L_{A90}						
		4	5	6	7	8	9	≥10
NSR02 (NML1)	Wind turbine immission	31	36	38	38	38	38	38
	Daytime limit	40	40	40	45	45	51	57

NSR ID (NML ID)	Description	Standardised wind speed, m/s. Noise level dB L_{A90}						
		4	5	6	7	8	9	≥10
	Daytime exceedance	**-9**	**-4**	**-2**	**-7**	**-7**	**-12**	**-19**
	Night-time limit	43	43	43	43	43	49	53
	Night-time exceedance	**-12**	**-7**	**-5**	**-5**	**-5**	**-11**	**-15**
NSR06 (NML2)	Wind turbine immission	31	36	38	38	38	38	38
	Daytime limit	45	45	45	45	45	48	48
	Daytime exceedance	**-14**	**-9**	**-7**	**-7**	**-7**	**-10**	**-10**
	Night-time limit	43	43	43	43	43	45	48
	Night-time exceedance	**-12**	**-7**	**-5**	**-5**	**-5**	**-7**	**-10**
NSR09 (NML3)	Wind turbine immission	33	38	41	41	41	41	41
	Daytime limit	40	40	45	45	45	49	49
	Daytime exceedance	**-7**	**-2**	**-4**	**-4**	**-4**	**-9**	**-9**
	Night-time limit	43	43	43	43	43	47	50
	Night-time exceedance	**-10**	**-5**	**-2**	**-2**	**-2**	**-7**	**-10**
NSR14 (NML4)	Wind turbine immission	30	35	37	37	37	37	37
	Daytime limit	40	45	45	45	45	47	47
	Daytime exceedance	**-10**	**-10**	**-8**	**-8**	**-8**	**-10**	**-10**
	Night-time limit	43	43	43	43	43	44	47
	Night-time exceedance	**-13**	**-8**	**-6**	**-6**	**-6**	**-7**	**-10**
NSR15 (NML5)	Wind turbine immission	33	38	40	40	40	40	40
	Daytime limit	45	45	45	45	47	50	53
	Daytime exceedance	**-12**	**-7**	**-5**	**-5**	**-7**	**-10**	**-13**
	Night-time limit	43	43	43	43	43	46	50
	Night-time exceedance	**-10**	**-5**	**-3**	**-3**	**-3**	**-6**	**-10**
NSR18 (NML6)	Wind turbine immission	32	37	39	39	39	39	39
	Daytime limit	45	45	45	45	45	46	46
	Daytime exceedance	**-12**	**-7**	**-5**	**-5**	**-5**	**-6**	**-6**
	Night-time limit	43	43	43	43	43	45	45
	Night-time exceedance	**-10**	**-5**	**-3**	**-3**	**-3**	**-5**	**-5**

Table 9-14: Assessment of Predicted Wind Farm Noise Immission Levels – V162-7.2MW

NSR ID (NML ID)	Description	Standardised wind speed, m/s. Noise level dB L_{A90}						
		4	5	6	7	8	9	≥10
NSR02 (NML1)	Wind turbine immission	28	32	36	38	38	38	39
	Daytime limit	40	40	40	45	45	51	57
	Daytime exceedance	**-12**	**-8**	**-4**	**-7**	**-7**	**-12**	**-18**
	Night-time limit	43	43	43	43	43	49	53
	Night-time exceedance	**-15**	**-11**	**-7**	**-5**	**-5**	**-11**	**-14**
NSR06 (NML2)	Wind turbine immission	28	32	37	38	38	39	39
	Daytime limit	45	45	45	45	45	48	48
	Daytime exceedance	**-17**	**-13**	**-8**	**-7**	**-7**	**-9**	**-9**
	Night-time limit	43	43	43	43	43	45	48
	Night-time exceedance	**-15**	**-11**	**-6**	**-5**	**-5**	**-7**	**-9**
NSR09 (NML3)	Wind turbine immission	31	35	39	41	41	41	41
	Daytime limit	40	40	45	45	45	49	49
	Daytime exceedance	**-9**	**-5**	**-6**	**-4**	**-4**	**-8**	**-8**
	Night-time limit	43	43	43	43	43	47	50
	Night-time exceedance	**-12**	**-8**	**-4**	**-2**	**-2**	**-6**	**-9**
NSR14 (NML4)	Wind turbine immission	27	31	36	37	37	38	38
	Daytime limit	40	45	45	45	45	47	47
	Daytime exceedance	**-13**	**-14**	**-9**	**-8**	**-8**	**-10**	**-9**
	Night-time limit	43	43	43	43	43	44	47

NSR ID (NML ID)	Description	Standardised wind speed, m/s. Noise level dB L_{A90}						
		4	5	6	7	8	9	≥10
	Night-time exceedance	**-16**	**-12**	**-7**	**-6**	**-6**	**-7**	**-9**
NSR15 (NML5)	Wind turbine immission	30	34	38	40	40	40	41
	Daytime limit	45	45	45	45	47	50	53
	Daytime exceedance	**-15**	**-11**	**-7**	**-5**	**-7**	**-10**	**-12**
	Night-time limit	43	43	43	43	43	46	50
	Night-time exceedance	**-13**	**-9**	**-5**	**-3**	**-3**	**-6**	**-9**
NSR18 (NML6)	Wind turbine immission	29	33	38	39	39	40	40
	Daytime limit	45	45	45	45	45	46	46
	Daytime exceedance	**-16**	**-12**	**-7**	**-6**	**-6**	**-7**	**-6**
	Night-time limit	43	43	43	43	43	45	45
	Night-time exceedance	**-14**	**-10**	**-5**	**-4**	**-4**	**-6**	**-5**

9.123 The results of the assessment shown in **Table 9-13** and **Table 9-14** confirm that the predicted wind farm noise immission levels for both candidate machines assessed do not exceed the daytime or night-time noise limits derived in accordance with the Wind Energy Guidelines (2006) under all wind speeds and at all locations. Accordingly, no significant effects are predicted during the operational phase.

9.124 Within the turbine range parameters proposed in **Chapter 2**, only the hub height affects the operational noise impacts. The overall tip height and rotor diameter of the turbine do not influence the noise emissions of any turbine selected within the range. The noise assessment has considered predicted noise levels for the Siemens Gamesa SG155-6.6MW machine with the lowest hub height within the range of 97.5m, and the Vestas V162-7.2MW machine which has the highest hub height within the range of 99m. As such, any difference associated with a change in hub height within the turbine range has also been assessed as it will be within the minimum and maximum hub height scenarios that have been set out in this chapter.

9.125 Aside from the hub height, sound power level and sound power frequency distribution may affect the operational noise effects. Whichever wind turbine is selected within the range will take into account these factors, to ensure that operational noise levels do not exceed the operational noise limits as set out in Table 9-6 and do not give rise to any significant operational noise effects.

Substation

9.126 Details of the proposed substation options are described in **Chapter 2** of the EIAR. The substation is proposed to be operational 24/7.

9.127 The following extract from the EirGrid Evidence Based Environmental Studies Study 8: Noise – Literature review and evidence-based field study on the noise effects of high voltage transmission development (May 2016) states the following in relation to noise effects associated with 110 kV substation installations: -

'The survey on the 110kV substation at Dunfirth indicated that measured noise levels (LAeq) were less than 40 dB(A) at 5m from each of the boundaries of the substation. This is below the WHO night-time free-field threshold limit of 42 dB for preventing effects on sleep and well below the WHO daytime threshold limits for serious and moderate annoyance in outdoor living areas (i.e. 55 dB and 50 dB respectively). Spectral analysis of the data recorded at this site demonstrated that there were no distinct tonal elements to the recorded noise level. To avoid any noise impacts from 110 kV substations at sensitive receptors, it is recommended that a minimum distance of 5m is maintained between 110kV substations and the land boundary of any noise sensitive property'.

9.128 The Proposed Substation has comparable noise emissions to the 110kV unit discussed above and considering the distance between the Proposed Development and the nearest NSR (i.e. approximately 150m from NSR19), noise from the proposed substation is assessed to be not likely to result in significant adverse noise effects. It is predicted, therefore, that the expected noise levels experienced at the nearest dwelling will be less than 20 dB(A). It is concluded, therefore, that there will be no significant noise emissions from the operation of the Proposed Substation.

Potential Impacts – Decommissioning

9.129 Upon decommissioning of the Proposed Development, the wind turbines will be disassembled and all above ground components will be separated and removed off-site. It is proposed that turbine foundations will remain in place underground and will be covered with earth and reseeded as appropriate. These activities will be undertaken during daytime hours, and noise, which will be of a lesser impact than for construction. As construction noise impacts will be not significant, decommissioning noise will also be not significant.

9.130 Site access tracks could be in use for purposes other than the operation of the Proposed Development by the time the decommissioning of the Proposed Development is underway, and therefore it may be more appropriate to leave the site access tracks in situ for future use. If the roads were not required in the future for any other useful purpose, they will be removed where required. This would involve removing hard core material and placement of topsoil. If the access tracks are removed, the noise impact is expected to be less than that during the construction stage and therefore not significant.

9.131 It is proposed that underground cables will not be dug up and removed, instead they will be cut back and remain in-situ. If required, cables can be removed by disconnecting at jointing bays and termination points and pulled out through the ducting. There will not be a need to retrench to achieve this. The works associated with the cutting back of the underground cable will have a negligible impact and no trenching will be required.

Mitigation Measures

Construction Mitigation

9.132 The predicted noise levels from onsite construction activity from the Proposed Development are predominantly below the noise limit for the threshold of significance. Some tasks, whilst at shortest distance to the nearest NSR, have the potential to temporarily exceed the limit. To reduce the potential effects of construction noise, the following mitigation measures will be implemented in full and are included in the CEMP found in Volume III of this EIAR:

- Those activities that may give rise to audible noise at the surrounding properties and heavy goods vehicle deliveries to the site will be limited to the hours 07:00 to 19:00 Monday to Friday and 07:00 to 13:00 on Saturdays. Those activities that are unlikely to give rise to noise audible at the site boundary may continue outside of the stated hours. If abnormal load deliveries, such as the turbines, are required outside of the stated hours, it will be subject to agreement with the relevant planning authority and it will be ensured that vehicles on local roads do not wait outside residential properties with their engines idling, and that the local residents will be informed sufficiently far in advance of any activities likely to occur outside of normal working hours.
- Construction works traffic will be restricted to the approved access routes
- All construction activities will adhere to good practice as set out in BS 5228-1.

- All equipment will be maintained in good working order and any associated noise attenuation such as engine casing and exhaust silencers shall remain fitted at all times.
- Where flexibility exists, activities will be separated from residential neighbours by the maximum possible distances.
- A site management regime will be developed to control the movement of vehicles to and from the site.

Operational Mitigation

9.133 An assessment of the operational noise levels has been undertaken in accordance with current best practice guidelines and procedures as outlined in this Chapter. This assessment has assumed SG155-6.6 MW and the V162-7.2MW turbine technology operating in standard unconstrained mode, which will give rise to the highest noise immission levels. The findings of the assessment confirm that the predicted operational noise levels are within the noise criteria and not significant. As such, mitigation measures are not required. The final choice of wind turbine will comply with the noise limits specified in this chapter. It is not currently envisaged that noise reduced modes will be required, however they will be applied if necessary to comply with the noise requirements set out in this chapter.

9.134 As noted in paragraph 9.124, a change in hub height within the proposed range will not change the significance of the effects and so no mitigation is required, regardless of which turbine parameters are installed within the range of the set out in **Chapter 2**.

Residual Impacts

Construction Noise

9.135 With mitigation measures, the construction and decommissioning noise levels will be below the relevant noise limit of 65 dB $L_{Aeq,1hr}$ for operations exceeding one month, and therefore construction noise impacts are not considered to be significant.

9.136 The residual construction noise impacts will therefore be not significant.

Operational Noise

9.137 The assessment has assessed all permutations within the range and confirmed no mitigation is necessary for the control of operation noise to comply with current best practice guidance as set out in this assessment; therefore, the residual impacts will also be not significant. The selected installed turbine within the range will have emission levels such that the noise immission levels at NSRs will be within the noise criteria assessed within this chapter to ensure there are no significant effects.

Cumulative Effects

9.138 When assessing noise impacts, different standards, criteria, noise parameters and calculation methods apply for different sources of noise. Each source of noise will have the potential to impact NSRs differently due to the nature and character of the noise produced, which is accounted for in the relevant standard or guidance document. It is not appropriate to assess noise from one source type using the method or criteria of another source type,

even when occurring cumulatively. Therefore, the cumulative assessment applies only to wind turbine noise.

9.139 As set out in paragraph 9.56, cumulative noise effects occur when two or more wind farms produce noise levels at the same receptor location that are within 10 dB of each other and the total cumulative noise level is 35 dB L_{A90} or greater. The reason being that if two noise levels that are 10 dB or greater in difference are added together, the cumulative total noise would still equal the highest original value. E.g. 25 dB + 35 dB = 35 dB.

9.140 The nearest wind farm to the Proposed Development is Bracklyn Wind Farm (planning reference PA25M.311565) which has been consented and will comprise nine turbines approximately 5 km to the south of the Proposed Development.

9.141 A second development, Ballivor Wind Farm (planning reference PA25M.316212) is under planning consideration at the time of writing and is also proposed adjacent to Bracklyn Wind Farm. The proposal is for 26 wind turbines, which will range from 5 km to approximately 15 km from the Proposed Development.

9.142 Given their distance from the Proposed Development, the two other wind farms are calculated to produce a combined level of noise with each other of less than 25 dB L_{A90} at any of the NSRs within this assessment. Therefore, it would not be possible for these other wind farms to have any cumulative effect at an NSR exposed to 35 dB L_{A90} or greater.

Conclusion

9.143 When considering a development of this nature, the potential noise and vibration effects on the environment must be considered for the construction, operation and decommissioning phases.

9.144 This chapter comprehensively assesses all scenarios within the turbine range which is described in **Chapter 2**. The potential impacts that could arise from the Proposed Development during the construction, and decommissioning phases relate to increases in noise due to construction and decommissioning activities. There will be no change to the potential impacts or predicted effects irrespective of which turbine is selected within the turbine range.

9.145 The construction noise assessment has determined that mitigation will not be required to reduce a significant effect but will be implemented as part of best practice for the control of noise. The associated residual levels are expected to be audible at various times throughout the construction programme but remain with acceptable limits such that their temporary effects are not significant.

9.146 Operational noise from the Proposed Development has been assessed in accordance with current best practice. It has been demonstrated that both the daytime and night time noise limits will not be exceeded at any of the NSRs across all wind speeds without any constraint. These operation effects are not significant. As described in this Chapter, this assessment applies to all parameters within the range of permutations set out in **Chapter 2** of the EIAR. The candidate machines have representative noise emission levels to other turbines that are currently available within the range being applied for and any installed turbine will operate within the noise limits set out in this Chapter.

9.147 In summary, the noise and vibration impact of the Proposed Development is not significant in the context of best practice.

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Figures

Figure 9-1: Noise Monitoring Locations and Noise Sensitive Receptor Locations

660000 662000 664000 666000

770000

768000

N

T1 T2 T3 T4 T5 T6 T7 T8

NML1 NML2 NML3 NML4 NML5 NML6

NSR01 NSR02 NSR03 NSR04 NSR05 NSR06 NSR07 NSR08 NSR09 NSR10 NSR11 NSR12 NSR13 NSR14 NSR15 NSR16 NSR17 NSR18 NSR19

Darcy's Cross Roads
Milestone Cross Roads
Lough Sheck Cross Roads
Glenmellon
Killua Castle Deer Park
N52
L1546

0 1 2
Kilometres

LEGEND

- Proposed Development Site Boundary
- Proposed Turbine Location
- Proposed Internal Cable Route
- Proposed Cable Route
- Proposed Substation Location
- Existing High Voltage Transmission Line
- Noise Sensitive Receptor
- Noise Monitoring Location

Kells
N52
Delvin
N51
Athboy

KNOCKANARRAGH WIND FARM LIMITED

SLR
7 DUNDRUM BUSINESS PARK
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NOISE

NOISE MONITORING LOCATIONS AND NOISE SENSITIVE RECEPTOR LOCATIONS

FIGURE 9-1

Scale 1:25,000 @ A3

Date OCTOBER 2023

02036.00812.0079.0 Noise Monitoring Locations and Noise Sensitive Receptor Locations

Appendices

Appendix 9-1: Glossary of Terminology

Appendix 9-2: Baseline Noise Survey Details

Appendix 9-3: Background Noise Levels

Appendix 9-4: Noise Limits

Appendix 9-5: IoA Good Practice Guidance

(Refer to EIAR Volume III for Appendices)