Environmental Impact Assessment Report

Carrig Renewables Wind Farm

Chapter 12 – Noise and Vibration

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00	FINAL	2023.08.25	EW/WC	MC/JS

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12. NOISE AND VIBRATION

12.1 Introduction

Wind farms have the potential to create noise and vibration during their construction, operational and decommissioning phases. This chapter assesses the potential noise and vibration impacts at the nearest Noise Sensitive Receptors (NSRs), within c. 2 km of the Proposed Development, during each of the project phases. The full description of the Proposed Development is detailed in Chapter 4.

This chapter considers the likely significant noise & vibration effects associated with the construction, operation and decommissioning of the Proposed Development. The specific objectives of the chapter are to:

- describe the existing noise baseline;
- describe the assessment methodology and significance criteria used in completing the impact assessment;
- describe the potential noise and vibration effects;
- describe the mitigation measures proposed to address any likely significant effects; and
- assess the residual effects remaining, following the implementation of mitigation.

12.1.1.1 Statement of Authority

The noise assessments were carried out by TNEI Services Ltd. TNEI is a specialist energy consultancy with an Acoustics team that has undertaken noise assessments for over 4.5 GW of onshore wind farm developments. The construction noise assessment was undertaken by Will Conway (BSc), who is an Affiliate Member of the Institute of Acoustics. The operational noise assessment was undertaken by Ewan Watson (BEng, Dip) who is an Associate Member of the Institute of Acoustics. The construction and operational noise assessments were reviewed and approved by Jim Singleton (BSc, Dip) and Moise Coulon (Dip) respectively. Jim and Moise are both full members of the Institute of Acoustics and both hold the Diploma in Acoustics and Noise Control.

This chapter is supported by the following figures and technical appendices:

- Figures
  - Figure 12-1: Construction Noise Assessment Locations;
  - Figure 12-2: Operational Noise Monitoring and Assessment Locations; and,
  - Figure 12-3: Cumulative Wind Turbines Locations.
- Technical Appendices
  - Appendix 12-1: Construction Noise Report; and
  - Appendix 12-2: Operational Noise Report.

Figures and technical appendices are referenced in the text where relevant.

12.2 Legislation, Policy and Guidelines

As well as the guidance listed in Section 1.6 of Chapter 1 of this EIAR, this assessment adhered to the following combination of guidance and assessment methodologies:

- British Standard BS 5228-1: 2009+A1:2014 'Code of practice for noise and vibration control on construction and open developments - Noise'[1];
- Department of Environment Heritage and Local Government (DoEHLG) 'Wind Energy Development Guidelines,' 2006[2];
- The Working Group on Noise from Wind Turbines (NWG) (1996). ETSU-R-97 'The Assessment and Rating of Noise from Wind Farms'[3];
- Institute of Acoustics 'A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise' (2013) (IOA GPG)[4]; and
- ISO 9613-2: 1996 'Acoustics - Attenuation of sound during propagation outdoors Part 2: General method of calculation'[5].

The above documents are discussed in detail within Appendix 12-1 and Appendix 12-2.

It is noted that the WEDG 2006 are currently under review and a set of 'draft WEDG 2019'[6] updated guidelines were issued for consultation in December 2019. The draft WEDG 2019 included reference to, and reliance upon, some elements of ETSU-R-97 and the IOA GPG, however, significant concerns were raised during the consultation process regarding the noise section of the draft WEDG 2019 and at the time of writing this report, no further updates have been issued. Given the limitations of the draft and the likelihood that significant changes would need to be made to them before they could be adopted, an assessment using those WEDG 2019 draft guidelines has not been undertaken.

The guidance in the WEDG 2006 has been used to assess operational noise from the Proposed Development and this has been supplemented by the guidance in ETSU-R-97 and the IOA GPG where appropriate. The use of these documents is considered to represent best available evidence and expertise.

In 2018 the World Health Organisation issued noise guidelines *'Environmental Noise Guidelines for the European Region'*[7] that provide recommendations for protecting human health from exposure to environmental noise. The guidelines consider noise originating from various sources including wind turbine noise. The guidelines make a series of 'strong' and 'conditional' recommendations. Two conditional recommendations were made in relation to wind turbine noise. In relation to conditional recommendations the guidance notes that:

'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 guidance makes recommendations based on noise exposure levels characterised using the L_{den} parameter. L_{den} is a weighted annual average sound pressure level over all days, evenings and nights in a year which is commonly used for transportation noise but rarely used for wind turbine noise.

In relation to wind turbine noise the guidelines state:

[1] *British Standards Institute, 2014. Code of practice for noise and vibration control on construction and open sites. Noise. UK : BSI, 2014. BS 5228-1:2009+A1:2014*
[2] *Department of Environment Heritage and Local Government (DoEHLG) 'Wind Energy Development Guidelines,' 2006.*
[3] *ETSU for the DTI (Department of Trade and Industry), 1996 . The Working Group on Noise from Wind Turbines ETSU-R-97 The Assessment and Rating of Noise from Wind Farms'.*
[4] *Institute of Acoustics, 2013. Good Practice Guidance on the application of ETSU-R-97 for wind turbine noise assessment.*
[5] *(ISO), International Organisation for Standardisation. 1996. Acoustics – Attenuation of Sound During Propagation Outdoors: Part 2 – General Method of Calculation. Geneva: ISO, 1996. ISO 9613-2:1996*
[6] *Draft Revised Wind Energy Development Guidelines, December 2019, Rialtas na héireann (Government of Ireland)*
[7] *World Health organisation, 2018. Environmental Noise Guidelines for the European Region'*

'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.'

Notwithstanding the limitations associated with the derivation of the L_{den} threshold levels, serious concerns have been raised about the practicality of using a threshold which is based on a weighed annual average which cannot actually be measured. Given the strength of recommendation and limitations associated with the use of L_{den} it is not considered appropriate to undertake an assessment against L_{den} levels.

12.3 Consultation

An EIA Scoping Report was issued to consultees and the Environmental Health Service on 14th September 2022. No scoping response has been provided. The scoping report outlined the methodology now also described in more detail in this Chapter and accompanying Technical Appendices.

12.4 Assessment Methodology and Significance Criteria

12.4.1.1 Construction Noise Methodology

There is no published statutory Irish guidance that contains suggested noise limits for construction activities, other than for road construction works, however, the Association of Acoustic Consultants of Ireland (AACI) have published 'Environmental Noise Guidance for Local Authority Planning & Enforcement Departments'[8], which states;

> *"The chief guidance document applied in the assessment of construction phase noise impacts is British Standard BS 5228:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites Part 1: Noise (2014)".*

The construction noise assessment has therefore been undertaken using the BS 5228 guidance. The prediction of construction noise levels was undertaken using the calculation methodology presented in ISO 9613:1996, together with published noise data for appropriate construction plant.

To undertake an assessment of the construction noise impact in accordance with the BS 5228 criteria, the following steps have been undertaken:

- identify noise sensitive receptors and select representative Construction Noise Assessment Locations (CNALs);
- identify applicable threshold of significant effects;
- predict noise levels for various construction noise activities;
- compare predicted noise levels against the applicable thresholds;
- where necessary, develop suitable mitigation measures to minimise any significant adverse effects during the construction phase; and, if required

[8] *Association of Acoustic Consultants of Ireland, 2021. Environmental Noise Guidance for Local Authority Planning & Enforcement Departments*

- assess any residual adverse effects taking into account any identified mitigation measures.

The Construction Noise Assessment Locations (CNAL) are summarised in Table 12-1 below and are shown on Figure 12-1.

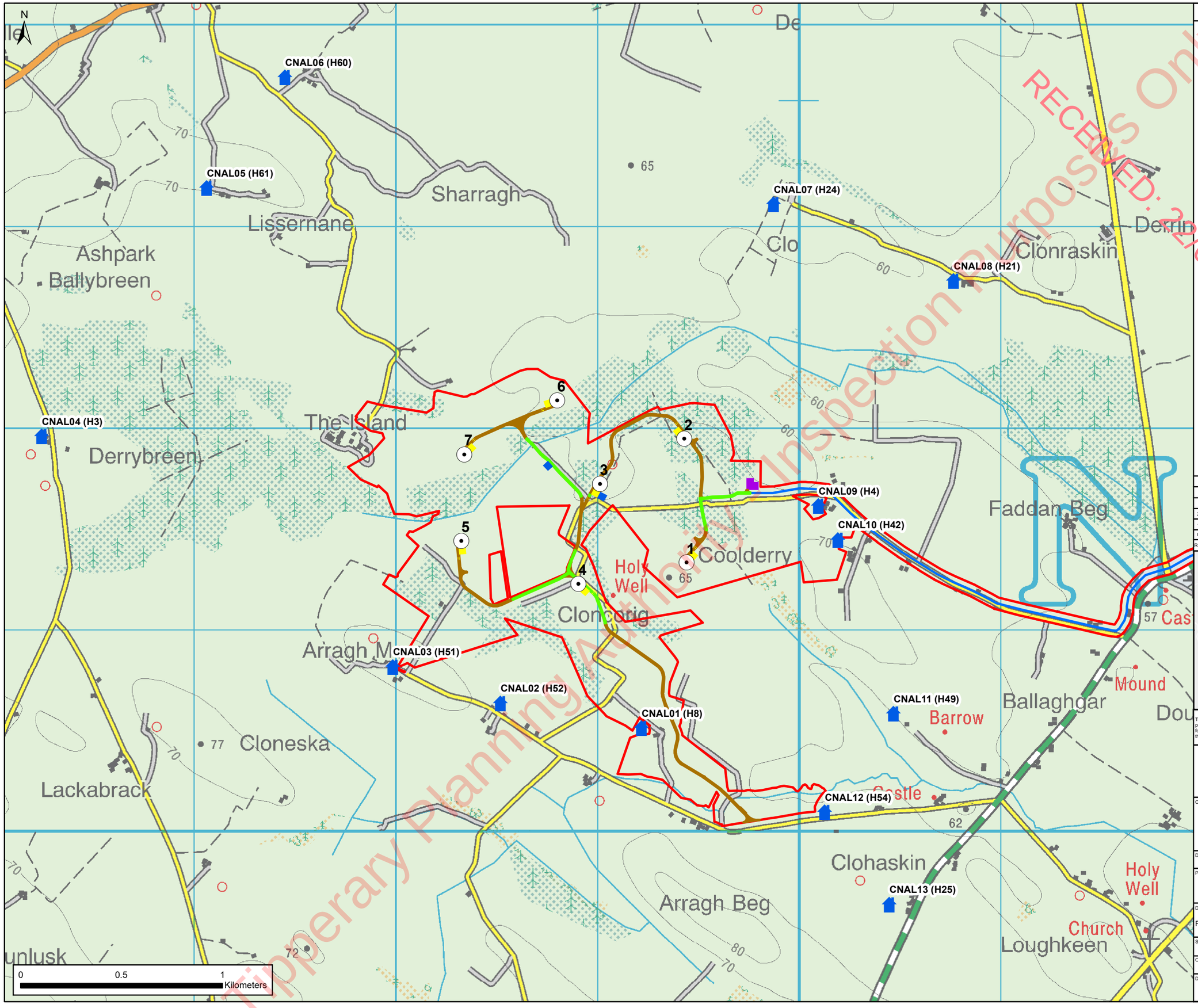
Table 12-1: Summary of Construction Noise Assessment Locations

Receptor	ITM Easting	ITM Northing
CNAL1 (H8)	599220	700514
CNAL2 (H52)	598521	700638
CNAL3 (H51)	597987	700819
CNAL4 (H3)	596246	701962
CNAL5 (H61)	597063	703194
CNAL6 (H60)	597452	703742
CNAL7 (H24)	599875	703112
CNAL8 (H21)	600767	702732
CCNAL9 (H4)	600097	701616
CNAL10 (H42)	600193	701449
CNAL11 (H49)	600469	700586
CNAL12 (H54)	600129	700098
CNAL13 (H25)	600449	699641

Construction of the Proposed Development will be undertaken in several successive phases. During each phase the plant and equipment, and the associated traffic, would influence the noise generated. The selection of plant and equipment to be used will be determined by the main contractor when they are commissioned, therefore the assessment has been based upon a typical selection of plant for a wind farm development of this size and an indicative construction timetable which is provided in Chapter 4 of this EIAR. In view of this, the plant has been modelled operating at the closest points to each receptor for a given activity in each construction phase, whereas in reality only certain plant will be working at the closest point for short periods of time.

The core hours for construction activity will be 07:00 to 19:00 Monday to Friday and 07:00 to 13:00 Saturday. Typically, there will be no working on Sundays and Public Holidays, however, it should be noted that out of necessity some activity outside of the core hours could arise, from delivery and unloading of abnormal loads or health and safety requirements, or to ensure optimal use is made of fair weather windows for concrete deliveries, the erection of turbine blades and the erection and dismantling of cranes.

Chapter 4: Description outlines the tasks that will be undertaken during the construction period, which is estimated to last between 12 and 18 months. For the purposes of this assessment, noise modelling has been undertaken for a number of construction scenarios, which simulate the likely overlap of several



NOTES

- EIAR Site Boundary
- Turbines
- Construction Noise Assessment Locations
- Proposed Upgrades to Existing Roads
- Proposed New Roads
- Construction Compounds
- Crane Pad
- Onsite Substation
- Grid Connection Route

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0	31/05/23	FIRST ISSUE	JCM	EW	EW

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Client: CARRIG RENEWABLES WIND FARM LTD

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Drawing Title: FIGURE 12.1 - CONSTRUCTION NOISE ASSESSMENT: SITE LAYOUT

Scale	Designed	Drawn	Checked	Approved
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tasks that could occur throughout the construction period. The scenarios modelled include the following construction activities:

- Scenario 01 (Q1): Construction and upgrading of tracks from the site entrance to construction compound, preparation of the construction compound and felling activities occurring around T2, T3, T6, T7, the construction compound and substation areas, as well as along the main access track.
- Scenario 02 (Q2): Construction compound completion, construction/upgrading of tracks from the compound to the base of the turbines, delivery lorry movements along site access tracks to operational construction compounds, construction of the turbine hardstanding at T3 and T6 and construction of the substation and cabling works.
- Scenario 03 (Q3): As for Scenario 02, however, construction of turbine hardstanding and has progressed to T2 and T4.
- Scenario 04 (Q4): As for Scenario 02 however, construction of turbine hardstanding at T5 and T7 and foundation works at T2, T3, T4 and T6.
- Scenario 05 (Q5): Completion of access tracks, turbine deliveries, turbine hardstanding construction at T1, turbine foundation construction at T1, T5 and T7, backfill and landscaping works and turbine erection.
- Scenario 06 (Q6): Backfill and landscaping operations around T1, T5 and T7 and on the main track by the site entrance.
- Scenario 07 (Night-time): Diesel generators are operating at the construction compounds to provide power to the site cabins and for lighting rigs.

More detailed information on each of the construction scenarios and modelling assumptions can be found within Appendix 12-1 of this EIAR. The noise levels for all Scenarios have been calculated at the Construction Noise Assessment Locations (CNALs) and compared to the appropriate BS5228 threshold. It is worth noting that for much of the working day, the noise associated with construction activities will be less than predicted as the assessment has assumed all equipment is constantly operating at full power and is located at the closest point to each receptor, whereas in practice equipment load and precise location will vary.

12.4.1.2 Construction Vibration

In relation to potential vibration during the construction phase of the Proposed Development, two sets of vibration limits should be considered; one in regard to potential for damage to buildings and one in regard to the vibration effects on people within buildings.

Threshold values to determine the potential for damage to buildings are detailed in BS 7385-2:1993 (which is also referred to in BS 5228). The unit of measurement used for this assessment method is the Peak Particle Velocity (PPV), which is measured in mm/s or $mm.s^{-1}$. For dwellings, the standard provides the guideline threshold levels, as set out in Table 12-2 below.

Table 12-2: Transient vibration guide values for building damage

Peak Component Particle Velocity (mm/s)	Damage Levels for residential buildings
15 mm/s PPV for a frequency of 4 Hz, rising to 50 mm/s PPV for a frequency of 40Hz and above.	Cosmetic
30 mm/s PPV for a frequency of 4 Hz, rising to 100 mm/s PPV for a frequency of 40Hz and above.	Minor Damage
60 mm/s PPV for a frequency of 4 Hz, rising to 200 mm/s PPV for a frequency of 40Hz and above.	Major Damage

Table B.1 of BS 5228-2, reproduced here as Table 12-3 provides guideline PPV levels that can be used in a construction setting. It is important to note that the levels refer to internal vibration within a building, and not external levels.

Table 12-3: BS5228-2 Guidance on Effects of Vibration Levels

Vibration Level (A) (B) (C)	Effect
0.14 mm.s^{-1}	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.
0.3 mm.s^{-1}	Vibration might be just perceptible in residential environments.
1.0 mm.s^{-1}	It is likely that vibration of this level in residential environments will cause complaint but can be tolerated if prior warning and explanation has been given to residents.
10 mm.s^{-1}	Vibration is likely to be intolerable for any more than a very brief exposure to this level in most building environments.
(A) The magnitudes of the values presented apply to a measurement position that is representative of the point of entry into the recipient. (B) A transfer function (which relates an external level to an internal level) needs to be applied if only external measurements are available. (C) Single or infrequent occurrences of these levels do not necessarily correspond to the stated effect in every case. The values are provided to give an initial indication of potential effects, and where these values are routinely measured or expected then an assessment in accordance with BS 6472-1 or -2, and/or other available guidance, might be appropriate to determine whether the time varying exposure is likely to give rise to any degree of adverse comment.	

With due regard to the above, external vibration level limits can be set at 15 mm/s PPV for frequencies between 4 Hz and 40 Hz and 50mm/s for frequencies above 40Hz.

Internal PPV limits can be set at somewhere between 1 mm/s^{-1} and 10.0 mm/s^{-1}, however, it should be noted that the measurement of vibration levels indoors is invasive and can be problematic. It should also be noted that the limits in Table 12-3 are generally considered guideline levels that should not be exceeded regularly or for long periods of time (see note (C) of Table 12-3).

12.4.1.3 Operational Noise Methodology

The assessment has been undertaken in accordance with the Wind Energy Development Guidelines (the Guidelines) 2006 (WEDG 2006) and this has been supplemented by the guidance in ETSU-R-97 and the IOA GPG where appropriate The Association of Acoustic Consultants of Ireland (AACI) Environmental Noise Guidance states the following in relation to the Guidelines:

'The document includes daytime and night-time noise criteria. As criteria included in the document are evidently derived from ETSU-R-97, it is considered more robust to base noise assessments on the ETSU and IOA documents, particularly as the DOEHLG document is somewhat vague. The document has been undergoing a protracted review process for several years.'

In 2013 the ETSU-R-97 guidance was supplemented by a document produced by the Institute of Acoustics titled 'A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise' (IOA GPG). Given the lack of detail in parts of the Guidelines, information contained in ETSU-R-97 and the IOA GPG has been used to supplement the Guidelines.

The Guidelines include limits for daytime and night-time periods. Consequently, the test applied to operational noise is whether or not the calculated wind farm noise levels at nearby noise sensitive properties will be below the noise limits derived in accordance with the Guidelines.

The receptors are assessed as Noise Assessment Locations (NALs). Predictions of wind turbine noise have been made at each of the NALs as detailed in Table 12-4 and shown on Figure 12-2. This approach ensures that the assessment considers the worst case (loudest) noise immission level expected at the noise sensitive receptor.

Table 12-4: Summary of Operational Noise Assessment Locations

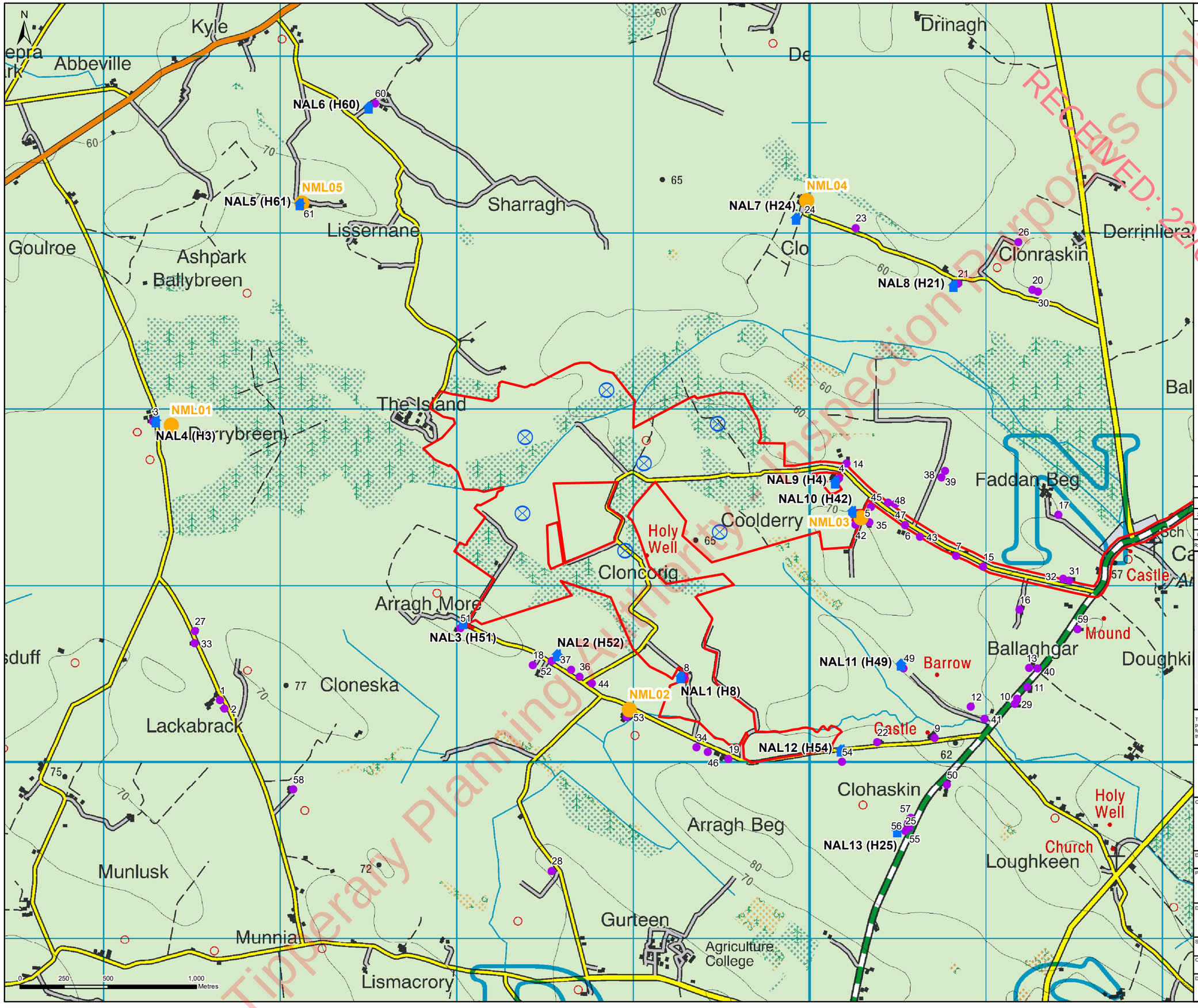
Receptor	Easting	Northing	Elevation (m AOD)	Approximate Distance to Nearest Carrig Turbine (m)	Background Noise Data Used
NAL1 (H8)	599220	700514	61.62	791 (T4)	NML2
NAL2 (H52)	598521	700638	64.53	749 (T4)	NML2
NAL3 (H51)	597987	700819	73.12	741 (T5)	NML2
NAL4 (H3)	596246	701962	65.93	2,111 (T7)	NML1
NAL5 (H61)	597063	703194	66.83	1,837 (T7)	NML5
NAL6 (H60)	597452	703742	62.33	2,088 (T6)	NML5
NAL7 (H24)	599875	703112	58.78	1,3,68 (T2)	NML4
NAL8 (H21)	600767	702732	55.6	1,576 (T2)	NML4
NAL9 (H4)	600097	701616	63.59	742 (T1)	NML3
NAL10 (H42)	600193	701449	68.1	770 (T1)	NML3
NAL11 (H49)	600469	700586	62.37	1,296 (T1)	NML3
NAL12 (H54)	600129	700098	61.86	1,474 (T1)	NML2
NAL13 (H25)	600449	699641	65.54	1,993 (T7)	NML2

The daytime and night-time periods are not defined within the Guidelines, therefore the assessment has considered these periods as detailed within IOA GPG. The quiet daytime criteria are based upon background noise levels measured during 'quiet periods of the day' comprising:

- All weekday evenings from 18:00 to 23:00;
- Saturday afternoons and evenings from 13:00 to 23:00; and
- All day Sunday 07:00 to 23:00.

For the avoidance of doubt, it should be noted that although the daytime limits are set based upon background data collected only during the quiet daytime period, they apply to the entire daytime period (07:00 – 23:00).

Night-time periods are defined as 23:00 to 07:00, with no differentiation made between weekdays and weekends.



NOTES

- EIAR Site Boundary
- Proposed Turbine Location
- Noise Monitoring Location (NML)
- Noise Assessment Location (NAL)
- Noise Sensitive Receptor (NSR)

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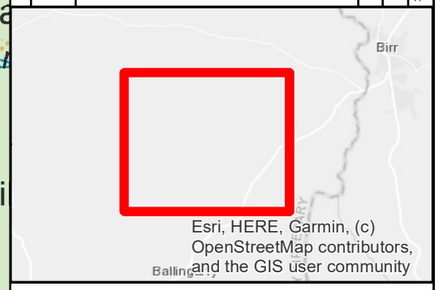
2	01/08/23	THIRD ISSUE	EW	EW	MC
1	31/05/23	SECOND ISSUE	CB	EW	MC
0	22/05/23	FIRST ISSUE	EW	MC	MC



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Project Title: CARRIG RENEWABLE ENERGY DEVELOPMENT

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The Guidelines include guidance on how to derive limits for daytime and night-time periods.

The daytime limits take account of existing background noise levels and include a fixed limit of 45 dB or background + 5 dB, whichever is the greater, except in low background noise environments where a fixed minimum limit in the range 35-40 dB should be considered. TNEIs interpretation of these limits is that turbine noise should not exceed:

- 45 dB $L_{A90,\ 10\ min}$ or background noise + 5 dB, whichever is the greater, for daytime hours (applicable where background noise levels are greater than 30 dB L_{A90}); or
- 35 - 40 dB $L_{A90,\ 10\ min}$ where background noise is less than 30 dB L_{A90}.

The 40 dB $L_{A90,\ 10\ min}$ fixed minimum limit has been chosen for the daytime period based on the noise limits imposed by conditions within recent planning decisions issued by An Bord Pleanála.

The Guidelines states that a *"fixed limit of 43 dB(A) will protect sleep inside properties during the night"*, however, whilst it is not explicit within the Guidelines, the addition of a night-time 'background noise +5 dB' parameter is commonly applied in wind turbine noise assessments. This is detailed in numerous examples of planning conditions issued by local authorities and An Bord Pleanála. On that basis, the night-time noise limits used in this assessment have been based on 43 dB or background noise + 5 dB, whichever is the greater.

The aim of the operational noise assessment is to establish the Guidelines Noise Limits and determine whether the Proposed Development can meet those limits.

The exact model of turbine to be installed as part of the Proposed Development will be the result of a future tendering process should planning permission be granted. Achievement of the Guideline Noise Limits determined by this assessment will be a key determining factor in the final choice of turbine for the Proposed Development. Whichever turbine model is ultimately selected will need to adhere to the limits set within this assessment. This can be achieved through implementation of mitigation measures, such as low-noise modes, where required. Predictions of wind turbine noise for the Proposed Development were made, based upon the sound power level data for a candidate wind turbine with an output capacity of 6.2 MW with serrated trailing edge blades and a hub height of 105 m to 110.5 m. The candidate turbine modelled is considered to be representative of the type of turbine that will be installed at the Proposed Development site based on the proposed turbine dimensions.

Calculations of operational wind turbine noise have been undertaken in accordance with International Standard ISO 9613-2, 'Acoustics – Attenuation of sound during propagation outdoors' (ISO 1996). The model calculates, on an octave band basis, attenuation due to geometric spreading, atmospheric absorption and ground effects. The noise model was set up to provide realistic noise predictions, including mixed ground attenuation (G=0.5) and atmospheric attenuation relating to 70 % relative humidity and 10°C (Section 4.3 of the IOA GPG). The receiver height modelled was 4 m.

Typically wind farm noise assessments assume all properties are downwind of all turbines at all times (as this would result in the highest wind turbine noise levels). However, in reality turbine noise will vary with wind direction.

In line with the IOA GPG, an assessment has been undertaken to determine whether a concave ground profile correction (+3 dB) or barrier correction (-2 dB), is required due to the topography between the turbines and the noise sensitive receptors. Propagation across a valley (concave ground) increases the number of reflection paths, and in turn, has the potential to increase sound levels at a given receptor. Terrain screening effects (barrier corrections) act as blocking points, subsequently reductions in sound levels at a given receptor can potentially be observed. Some concave ground and barrier corrections were required for some turbines at several receptors as detailed in the Technical Appendix 12-2.

Other topics relating to operational wind farm noise such as Amplitude Modulation (AM), a potential characteristic of wind turbine noise, and Low Frequency Noise (LFN), are also discussed in Appendix

12-2. There is no evidence that LFN has adverse impacts on the health of wind farm neighbours and currently there is no agreed methodology which can be used to predict the occurrence of AM or an agreed methodology that can be used to determine whether the effects of AM, should it occur, are likely to be significant and as such they have not been considered further in the assessment.

12.4.1.4 Cumulative Operational Noise Methodology

Due to the presence of two operational wind farm schemes, within 10 km, at Skehanagh (5 x Vestas V52) and Carrig (3 x Vestas V52), a cumulative noise assessment was undertaken in accordance with the guidance contained within the IOA GPG. The noise assessment has been undertaken in three separate stages:

- Stage 1 - Establish the 'Total WEDG Noise Limits' which are applicable for all wind farm schemes in the area;
- Stage 2 – undertake a cumulative assessment, comparing Total WEDG Noise Limits with cumulative noise predictions. At this stage, the predicted 'likely' cumulative wind turbine noise levels are the actual levels expected at a noise assessment location.
- Stage 3 – establish the 'Site Specific Noise Limits' for the Proposed Development (through apportioning the 'Total WEDG Noise Limits', where required) and compare the noise predictions from the Proposed Development on its own against the 'Site Specific Noise Limits'. In order to the derive the Site Specific Noise Limit an additional buffer of +2dB has been added to the 'likely' predicted levels summarised in Stage 2 which results in 'cautious' Site Specific Noise Limits.

The locations of all of the turbines modelled, inclusive of those considered in the cumulative noise assessment (Stage 2), are shown in Figure 12-3.

12.4.2 Potential Effects Scoped Out

12.4.2.1 Decommissioning

Activities that occur during the decommissioning of the Proposed Development are unlikely to produce higher noise levels than those produced during construction and many of the activities will be similar in nature. As such it is considered that if construction noise levels are predicted to be below the threshold levels, then decommissioning noise will also be within the threshold levels.

12.4.2.2 Blasting

The extent of any blasting requirement cannot be determined until intrusive site investigation tests are completed. Nevertheless, should blasting be required, a series of tests would be undertaken by the appointed contractor in accordance with guidance outlined in BS5228-2:2009+A1:2014[9]. Following on from these tests, blasts would be designed through appropriate specification of Maximum Instantaneous Charge (MIC) to ensure that vibration levels at the nearest NSR's would not exceed the guideline limits presented in BS 5228 and related standards such as BS 7385-2: 1993 'The Evaluation and measurement for vibration in buildings. Guide to damage levels from groundborne vibration'[10] and BS6472: 2008 'Guide to evaluation of human exposure to vibration in buildings. Blast-induced vibration'[11]. A condition could be attached to the consent to require compliance with these limits.

[9] *British Standard BS5228-2: 2009+A1:2014 'Code of practice for noise and vibration control on construction and open sites' – Part 2: Vibration*
[10] *British Standard BS7385-2: 1993 'The Evaluation and measurement for vibration in buildings. Guide to damage levels from groundborne vibration'*
[11] *British Standard BS6472: 2008 'Guide to evaluation of human exposure to vibration in buildings. Blast-induced vibration'*

NOTES

- EIAR Site Boundary
- Proposed Turbine Location
- Noise Monitoring Location (NML)
- Noise Assessment Location (NAL)
- Noise Sensitive Receptor (NSR)
- Skehanagh Wind Farm
- Carrig Wind Farm

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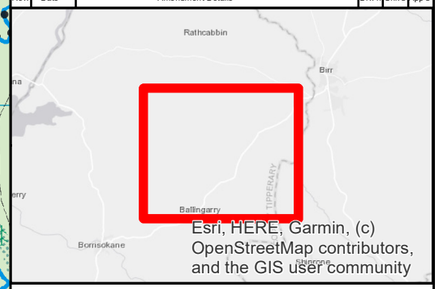
3	11/09/23	FINAL ISSUE	EW	EW	MC
2	01/08/23	THIRD ISSUE	EW	EW	MC
1	31/05/23	SECOND ISSUE	CB	EW	MC
0	22/05/23	FIRST ISSUE	EW	MC	MC



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Client: CARRIG RENEWABLES WIND FARM LTD

Drawing Status: FOR PLANNING

Project Title: CARRIG RENEWABLE ENERGY DEVELOPMENT

Drawing Title: FIGURE 12.3 - CUMULATIVE WIND TURBINE LOCATIONS

Scale	Designed	Drawn	Checked	Approved
1:30,000	EW	EW	MC	MC
Original Size	**Date**	**Date**	**Date**	**Date**
A3	11/09/2023	11/09/2023	11/09/2023	11/09/2023

Drawing Number: IE62-018

Revision: 3

Given the relative distances between the potential locations of blasting and the closest sensitive receptors will be known, the blast engineer should be able to calculate appropriate Maximum Instantaneous Charge (MIC) values that will ensure that the guideline limits within BS7385-2: 1993 and BS 6472-2: 2008 would be met, and therefore this issue can be scoped out of further detailed consideration.

12.4.3 Method of Baseline Characterisation

12.4.3.1 Extent of the Study Area

Prior to the commencement of the operational noise assessment, initial desktop noise modelling was undertaken in order to identify all NSRs and to select potential Noise Monitoring Locations (NMLs). Sixty one NSRs were identified, these are all residential properties surrounding the Proposed Development and also near to the nearby two wind farms. Five NMLs were selected by TNEI to represent all other NSRs, which are located to the north west, north east, south east, south and south west of the Proposed Development. The NSRs and NMLs are all shown on Figure 12-2 and coordinates of the NMLs are also included below in Table 12-5. More information can be found in the Technical Appendix 12-2.

12.4.3.2 Field Survey

The noise survey to determine the existing background noise environment at noise sensitive receptors neighbouring the Proposed Development was undertaken in accordance with the guidance contained within ETSU-R-97 and current good practice (IOA GPG).

Background noise monitoring was successfully undertaken over the period of November 2022 to January 2023 at all five selected NMLs (shown on Figure 12-2). The NMLs were installed adjacent to residential dwellings and were sited with consideration for local noise sources such as boiler flues, watercourses and vegetation.

Table 12-5: Summary of Noise Monitoring Locations

Receptor	ITM Easting	ITM Northing
NML1	596335	701941
NML2	598929	700328
NML3	600241	701417
NML4	599935	703213
NML5	597075	703201

Simultaneous wind speed/direction data were recorded within the site at various heights using a LIDAR Unit (located at Irish Transverse Mercator reference 597819, 701924). The wind speed data collected at 110m where standardised to 10 m height in accordance with good practice.

Wind speed/direction and rainfall data were collected over the same time scale and averaged over the same ten-minute periods as the noise data to allow analysis of the measured background noise as a function of wind speed and wind direction. All data analysis was undertaken in accordance with ETSU-R-97 and the IOA GPG.

12.4.4 Criteria for the Assessment of Effects

The Environmental Protection Agency document 'Guidelines on the information to be contained in Environmental Impact Assessment Reports' [12] has informed the criteria for the assessment of potential effects as summarised below.

12.4.4.1 Criteria for Assessing Significance – Construction Noise

The significance criteria adopted for this assessment are based on Appendix E part E.3.2 of BS5228-1:2009+A1:2014 and detailed in

Table 12-6 below.

Table 12-6: Construction Noise Significance Criteria

Significance of Effect	Significance Level	
	Not Significant	Significant
Category A Daytime (07:00 – 19:00) and Saturdays (07:00 to 13:00)	≤65dB $L_{Aeq, T}$	>65dB $L_{Aeq, T}$
Category A Evenings and Weekends (19:00 – 23:00)	<55dB $L_{Aeq, T}$	>55dB $L_{Aeq, T}$
Category A Night-time (23:00 – 07:00)	<45dB $L_{Aeq, T}$	>45dB $L_{Aeq, T}$
Note: The L_{Aeq} is the A-weighted, equivalent continuous sound level in decibels measured over a stated period of time, ($L_{Aeq,T}$) where T is the length of the assessment period (Time).		

12.4.4.2 Criteria for Assessing Significance – Operational Noise

The WEDG and ETSU-R-97 do not define significance criteria but describe a framework for the measurement of wind farm noise and give indicative noise levels considered to offer a reasonable degree of protection to wind farm neighbours, without placing unreasonable restrictions on wind farm development. Achievement of the WEDG derived noise limits ensures that wind turbine noise will comply with current Government guidance.

In terms of the EIA Regulations, in this Chapter of the EIAR the use of the term "significance" refers to compliance or non-compliance with the WEDG derived noise limits. For situations where predicted wind turbine noise meets or is less than the noise limits defined in WEDG, then the noise effects are deemed not significant. Any breach of the WEDG derived noise limits due to the Proposed Development has the potential to result in a significant effect.

12.4.4.3 Limitations and Assumptions

It has been assumed that the noise data collected during the background noise survey are representative of the typical baseline noise levels at the nearest noise sensitive receptors; the guidance in

[12] *The Environmental Protection Agency, 2022. Guidelines on the information to be contained in Environmental Impact Assessment Reports*

the WEDG supplemented by ETSU-R-97 and the IOA GPG has been followed by suitably experienced Acoustic Consultants to ensure that the data collected is as representative as possible.

A candidate wind turbine model has been used for predictions of operational noise from the Proposed Development, whilst the final model of wind turbine to be used may differ from that presented in this assessment, operational noise levels would have to comply with the noise limits imposed by An Bord Pleanála, informed by this noise assessment.

No other assumptions or data gaps have been identified.

12.5 Baseline Conditions

12.5.1 Current Baseline

The Proposed Development is located within a rural location where existing background noise levels at the NSRs are generally considered to be low (<30 dB at low wind speeds as defined in the WEDG 2006[13]). The predominant noise sources in the area are wind induced noise (wind passing through vegetation and around buildings), farm activity and birdsong. At some receptors the soundscape is affected by some distant road traffic noise, inclusive of the N52 National Secondary road.

Table 12-7 and Table 12-8 provide a summary of the background noise levels measured during the monitoring period during the quiet daytime and night-time periods. Background noise data recorded during periods of rainfall (including the preceding 10 minute period in line with IOA GPG) have been excluded from the dataset, as well as data following periods of heavy rainfall. Further information of the data recorded during the noise survey can be found in Appendix 12-2.

Table 12-7: Summary of Prevailing Background Noise Levels during Quiet Daytime Periods (dB(A))

Noise Monitoring Location	Wind Speed (ms^{-1}) as standardised to 10m height											
	1	2	3	4	5	6	7	8	9	10	11	12
NML1	20.8	20.8	21.0	22.0	23.8	26.2	29.1	32.6	36.4	40.6	45.1	49.7
NML2	23.3	23.3	23.3	24.0	25.4	27.4	30.1	33.4	37.0	41.1	45.5	50.2
NML3	25.3	25.3	25.3	25.3	25.7	26.7	28.5	31.3	35.2	40.5	47.3	47.3
NML4	25.4	25.4	25.4	25.4	25.8	26.7	28.2	30.4	33.2	36.6	40.7	40.7
NML5	20.7	20.7	21.5	22.7	24.3	26.4	29.0	32.0	35.5	39.4	43.8	48.6

Table 12-8: Summary of Prevailing Background Noise Levels during Night-time Periods (dB(A))

Noise Monitoring Location	Wind Speed (ms^{-1}) as standardised to 10m height											
	1	2	3	4	5	6	7	8	9	10	11	12
NML1	17.3	17.3	17.3	17.8	19.6	22.6	26.4	30.7	35.2	39.6	43.5	46.8
NML2	19.0	19.0	19.0	19.7	21.5	24.3	27.8	31.9	36.4	41.2	45.9	50.4

[13] *Section 5.4 of WEDG 2006 refers to ' low noise environments where background noise is less than 30 dB(A)'*

Noise Monitoring Location	Wind Speed (ms^{-1}) as standardised to 10m height											
	1	2	3	4	5	6	7	8	9	10	11	12
NML3	20.0	20.0	20.0	20.3	21.5	23.5	26.3	30.1	34.6	40.1	46.5	46.5
NML4	21.5	21.5	21.5	21.5	22.2	23.7	26.0	29.1	33.2	38.3	44.4	44.4
NML5	19.2	19.2	19.2	19.2	20.4	22.7	25.9	29.8	34.2	38.9	43.7	48.5

12.5.2 Summary of Sensitive Receptors

12.5.2.1 Scoped Out Receptors

None of the identified receptors within the c. 2 km search area of the Proposed Development have been scoped out of the assessment.

12.5.2.2 Scoped In Receptors

There are 61 no. NSRs in proximity (c.2 km search area) to the Proposed Development. These are also labelled with the letter 'H', within the rest of the EIAR. Of the 61 no. identified NSRs a much smaller sample was chosen as Construction Noise Assessment Locations (CNALs) or Noise Assessment Locations (NALs) for a detailed assessment. These were chosen to represent the noise sensitive receptors located closest to the Proposed Development during either the construction or operational phase. Also some were included to consider location which may be close to both the proposed development and nearby operational wind turbines.

The assessment results for the CNALs and NALs has been presented within the main body of this report, whilst results for all NSRs have been included for completeness within Technical Appendix 12-1 and Technical Appendix 12-2.

For the assessment locations where no background noise measurements were undertaken, noise data collected at proxy locations deemed representative of the background noise environment was used to assess the noise impacts at those receptors.

12.6 Assessment of Likely Effects

12.6.1 Potential Construction Noise Effects

Table 12-9 presents the Threshold Levels assumed and calculated noise immission levels at each CNAL for all modelled scenarios. Full details of the modelling and assessment can be found in Appendix 12-1 along with the results for all other NSRs.

The construction noise assessment results show that the worst-case predicted construction noise levels are below the Category A Threshold Levels (lowest threshold in BS8223) for all of the CNALs and for all scenarios, therefore, there would be **no significant construction noise effects**.

Although noise levels from the laying of the underground electrical cabling route have the potential to exceed the BS 5228 threshold levels during the daytime, due to the transient nature of the underground electrical cabling works, this will only occur for a short period of time at any one location. Accordingly, the impact is not deemed significant.

Table 12-9: Predicted Worst-Case Construction Noise Immission Levels

Noise Assessment Location	Category A Threshold dB $L_{Aeq, t}$				Immission Level, dB $L_{Aeq, t}$ for each Scenario					
	Daytime (07:00 – 19:00) and Saturdays (07:00 - 13:00)	Evenings (19:00-23:00 weekdays.) Weekends (13:00-23:00 Saturdays and 07:00-23:00 Sundays)	Night-Time (23:00 – 07:00)	1	2	3	4	5	6	Night
CNAL01 (H8)	65	55	45	50	43	43	47	50	43	17
CNAL02 (H52)	65	55	45	42	42	42	48	51	39	22
CNAL03 (H51)	65	55	45	40	39	39	45	49	37	21
CNAL04 (H3)	65	55	45	30	27	26	33	37	24	9
CNAL05 (H61)	65	55	45	32	29	28	36	39	25	11
CNAL06 (H60)	65	55	45	31	28	28	35	38	24	10
CNAL07 (H24)	65	55	45	36	34	34	41	43	28	14
CNAL08 (H21)	65	55	45	34	31	32	38	40	25	11
CNAL09 (H4)	65	55	45	45	48	48	51	52	37	20
CNAL10 (H42)	65	55	45	42	44	44	48	50	36	19
CNAL11 (H49)	65	55	45	41	33	34	39	43	36	12
CNAL12 (H54)	65	55	45	51	35	35	40	43	45	11
CNAL13 (H25)	65	55	45	41	30	30	36	39	36	8

12.6.2 Potential Construction Vibration Effects

Due to the large separation distances between the construction activity areas on the Wind Farm Site and the nearest receptors, no significant effects are anticipated. Where construction activities on the underground electrical cabling route are close to residential receptors, some local vibration effects may be present, however, levels are expected to be low and of limited duration.

12.6.3 Potential Operational Noise Effects

12.6.3.1 Setting the Total WEDG Noise Limits (Stage 1)

Based on the prevailing background noise levels, the Total WEDG Noise Limits have been established for each of the NALs as detailed in Table 12-10 and Table 12-11 below.

Table 12-10: Total WEDG Noise Limit - Daytime

Noise Assessment Location	Wind Speed (ms^{-1}) as standardised to 10m height											
	1	2	3	4	5	6	7	8	9	10	11	12
NAL1 (H8)	40.0	40.0	40.0	40.0	40.0	40.0	45.0	45.0	45.0	46.1	50.5	55.2
NAL2 (H52)	40.0	40.0	40.0	40.0	40.0	40.0	45.0	45.0	45.0	46.1	50.5	55.2
NAL3 (H51)	40.0	40.0	40.0	40.0	40.0	40.0	45.0	45.0	45.0	46.1	50.5	55.2
NAL4 (H3)	40.0	40.0	40.0	40.0	40.0	40.0	40.0	45.0	45.0	45.6	50.1	54.7
NAL5 (H61)	40.0	40.0	40.0	40.0	40.0	40.0	40.0	45.0	45.0	45.0	48.8	53.6
NAL6 (H60)	40.0	40.0	40.0	40.0	40.0	40.0	40.0	45.0	45.0	45.0	48.8	53.6
NAL7 (H24)	40.0	40.0	40.0	40.0	40.0	40.0	40.0	45.0	45.0	45.0	45.7	45.7
NAL8 (H21)	40.0	40.0	40.0	40.0	40.0	40.0	40.0	45.0	45.0	45.0	45.7	45.7
NAL9 (H4)	40.0	40.0	40.0	40.0	40.0	40.0	40.0	45.0	45.0	45.5	52.3	52.3
NAL10 (H42)	40.0	40.0	40.0	40.0	40.0	40.0	40.0	45.0	45.0	45.5	52.3	52.3
NAL11 (H49)	40.0	40.0	40.0	40.0	40.0	40.0	40.0	45.0	45.0	45.5	52.3	52.3
NAL12 (H54)	40.0	40.0	40.0	40.0	40.0	40.0	45.0	45.0	45.0	46.1	50.5	55.2
NAL13 (H25)	40.0	40.0	40.0	40.0	40.0	40.0	45.0	45.0	45.0	46.1	50.5	55.2

Table 12-11: Total WEDG Noise Limit – Night-time

Noise Assessment Location	Wind Speed (ms^{-1}) as standardised to 10m height											
	1	2	3	4	5	6	7	8	9	10	11	12
NAL1 (H8)	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	46.2	50.9	55.4
NAL2 (H52)	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	46.2	50.9	55.4
NAL3 (H51)	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	46.2	50.9	55.4
NAL4 (H3)	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.6	48.5	51.8
NAL5 (H61)	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.9	48.7	53.5
NAL6 (H60)	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.9	48.7	53.5
NAL7 (H24)	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.3	49.4	49.4
NAL8 (H21)	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.3	49.4	49.4
NAL9 (H4)	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	45.1	51.5	51.5
NAL10 (H42)	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	45.1	51.5	51.5

Noise Assessment Location	Wind Speed (ms^{-1}) as standardised to 10m height											
	1	2	3	4	5	6	7	8	9	10	11	12
NAL11 (H49)	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	45.1	51.5	51.5
NAL12 (H54)	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	46.2	50.9	55.4
NAL13 (H25)	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	46.2	50.9	55.4

12.6.3.2 Predicting the Likely Effects and the Requirement for a Cumulative Noise Assessment (Stage 2)

A likely cumulative noise assessment was undertaken at the NALs and the results of the cumulative assessment are shown in Table 12-12 and Table 12-13 below. The Tables detail the Total WEDG Noise Limits and predicted likely cumulative wind turbine noise levels for daytime hours and night-time hours, using the worst-case 110.5 m hub height predictions for the Proposed Development.

The result of the likely cumulative noise assessment show that the Proposed Development can operate concurrently with the operational wind farms near to the NALs, whilst still meeting the Total WEDG Noise limits established in accordance with WEDG at all NALs. The only exception is at NAL 9 where a marginal exceedance of 0.8 dB is observed only in daytime at 7m/s. Such minor exceedance would be removed by using low noise mode for the candidate turbine in that specific wind speed and in specific directions only. Therefore, there are **no significant effects** anticipated.

Table 12-12: Compliance Table – Comparison of predicted likely cumulative noise levels (all schemes) against the Total WEDG Noise Limit at each receptor - Daytime

NAL		Wind Speed (ms^{-1}) as standardised to 10m height											
		1	2	3	4	5	6	7	8	9	10	11	12
NAL1 (H8)	Total WEDG Noise Limit	40.0	40.0	40.0	40.0	40.0	40.0	45.0	45.0	45.0	46.1	50.5	55.2
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	30.9	35.0	38.6	39.8	39.8	39.8	39.8	39.8	39.8
	Exceedance Level	-	-	-	-9.1	-5.0	-1.4	-5.2	-5.2	-5.2	-6.3	-10.7	-15.4
NAL2 (H52)	Total WEDG Noise Limit	40.0	40.0	40.0	40.0	40.0	40.0	45.0	45.0	45.0	46.1	50.5	55.2
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	31.9	35.9	39.5	40.7	40.7	40.7	40.7	40.7	40.7
	Exceedance Level	-	-	-	-8.1	-4.1	-0.5	-4.3	-4.3	-4.3	-5.4	-9.8	-14.5
NAL3 (H51)	Total WEDG Noise Limit	40.0	40.0	40.0	40.0	40.0	40.0	45.0	45.0	45.0	46.1	50.5	55.2
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	31.1	35.1	38.7	39.9	39.9	39.9	39.9	39.9	39.9
	Exceedance Level	-	-	-	-8.9	-4.9	-1.3	-5.1	-5.1	-5.1	-6.2	-10.6	-15.3
NAL4 (H3)	Total WEDG Noise Limit	40.0	40.0	40.0	40.0	40.0	40.0	40.0	45.0	45.0	45.6	50.1	54.7
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	21.9	26.0	29.5	30.6	30.6	30.6	30.6	30.6	30.6
	Exceedance Level	-	-	-	-18.1	-14.0	-10.5	-9.4	-14.4	-14.4	-15.0	-19.5	-24.1
NAL5 (H61)	Total WEDG Noise Limit	40.0	40.0	40.0	40.0	40.0	40.0	40.0	45.0	45.0	45.0	48.8	53.6
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	23.0	27.1	30.6	31.8	31.8	31.8	31.8	31.8	31.8
	Exceedance Level	-	-	-	-17.0	-12.9	-9.4	-8.2	-13.2	-13.2	-13.2	-17.0	-21.8
NAL6 (H60)	Total WEDG Noise Limit	40.0	40.0	40.0	40.0	40.0	40.0	40.0	45.0	45.0	45.0	48.8	53.6
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	22.2	26.3	29.8	31.0	31.0	31.0	31.0	31.0	31.0
	Exceedance Level	-	-	-	-17.8	-13.7	-10.2	-9.0	-14.0	-14.0	-14.0	-17.8	-22.6
NAL7 (H24)	Total WEDG Noise Limit	40.0	40.0	40.0	40.0	40.0	40.0	40.0	45.0	45.0	45.0	45.7	45.7
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	26.7	30.8	34.3	35.5	35.5	35.5	35.5	35.5	35.5
	Exceedance Level	-	-	-	-13.3	-9.2	-5.7	-4.5	-9.5	-9.5	-9.5	-10.2	-10.2

NAL		Wind Speed (ms^{-1}) as standardised to 10m height											
		1	2	3	4	5	6	7	8	9	10	11	12
NAL8 (H21)	Total WEDG Noise Limit	40.0	40.0	40.0	40.0	40.0	40.0	40.0	45.0	45.0	45.0	45.7	45.7
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	24.6	28.8	32.2	33.3	33.3	33.3	33.3	33.3	33.3
	Exceedance Level	-	-	-	-15.4	-11.2	-7.8	-6.7	-11.7	-11.7	-11.7	-12.4	-12.4
NAL9 (H4)	Total WEDG Noise Limit	40.0	40.0	40.0	40.0	40.0	40.0	40.0	45.0	45.0	45.5	52.3	52.3
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	31.9	36.0	39.6	40.8	40.8	40.8	40.8	40.8	40.8
	Exceedance Level	-	-	-	-8.1	-4.0	-0.4	0.8	-4.2	-4.2	-4.7	-11.5	-11.5
NAL10 (H42)	Total WEDG Noise Limit	40.0	40.0	40.0	40.0	40.0	40.0	40.0	45.0	45.0	45.5	52.3	52.3
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	30.9	35.0	38.5	39.7	39.7	39.7	39.7	39.7	39.7
	Exceedance Level	-	-	-	-9.1	-5.0	-1.5	-0.3	-5.3	-5.3	-5.8	-12.6	-12.6
NAL11 (H49)	Total WEDG Noise Limit	40.0	40.0	40.0	40.0	40.0	40.0	40.0	45.0	45.0	45.5	52.3	52.3
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	27.1	31.4	34.6	35.6	35.6	35.6	35.6	35.6	35.6
	Exceedance Level	-	-	-	-12.9	-8.6	-5.4	-4.4	-9.4	-9.4	-9.9	-16.7	-16.7
NAL12 (H54)	Total WEDG Noise Limit	40.0	40.0	40.0	40.0	40.0	40.0	45.0	45.0	45.0	46.1	50.5	55.2
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	26.1	30.5	33.5	34.4	34.4	34.4	34.4	34.4	34.4
	Exceedance Level	-	-	-	-13.9	-9.5	-6.5	-10.6	-10.6	-10.6	-11.7	-16.1	-20.8
NAL13 (H25)	Total WEDG Noise Limit	40.0	40.0	40.0	40.0	40.0	40.0	45.0	45.0	45.0	46.1	50.5	55.2
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	26.8	31.5	33.7	34.2	34.2	34.2	34.2	34.2	34.2
	Exceedance Level	-	-	-	-13.2	-8.5	-6.3	-10.8	-10.8	-10.8	-11.9	-16.3	-21.0

Note: For the cumulative noise predictions the noise model considers the range of noise data available for each turbine type modelled. For some turbines noise data was not available for wind speeds less than 4 ms^{-1} therefore no cumulative predictions are included for wind speeds less than 4 ms^{-1}.

Table 12-13: Compliance Table – Comparison of predicted likely cumulative noise levels (all schemes) against the Total WEDG Noise Limit at each receptor – Night-time

NAL		Wind Speed (ms^{-1}) as standardised to 10m height											
		1	2	3	4	5	6	7	8	9	10	11	12
NAL1 (H8)	Total WEDG Noise Limit	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	46.2	50.9	55.4
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	30.9	35.0	38.6	39.8	39.8	39.8	39.8	39.8	39.8
	Exceedance Level	-	-	-	-12.1	-8.0	-4.4	-3.2	-3.2	-3.2	-6.4	-11.1	-15.6
NAL2 (H52)	Total WEDG Noise Limit	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	46.2	50.9	55.4
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	31.9	35.9	39.5	40.7	40.7	40.7	40.7	40.7	40.7
	Exceedance Level	-	-	-	-11.1	-7.1	-3.5	-2.3	-2.3	-2.3	-5.5	-10.2	-14.7
NAL3 (H51)	Total WEDG Noise Limit	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	46.2	50.9	55.4
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	31.1	35.1	38.7	39.9	39.9	39.9	39.9	39.9	39.9
	Exceedance Level	-	-	-	-11.9	-7.9	-4.3	-3.1	-3.1	-3.1	-6.3	-11.0	-15.5
NAL4 (H3)	Total WEDG Noise Limit	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.6	48.5	51.8
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	21.9	26.0	29.5	30.6	30.6	30.6	30.6	30.6	30.6
	Exceedance Level	-	-	-	-21.1	-17.0	-13.5	-12.4	-12.4	-12.4	-14.0	-17.9	-21.2
NAL5 (H61)	Total WEDG Noise Limit	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.9	48.7	53.5
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	23.0	27.1	30.6	31.8	31.8	31.8	31.8	31.8	31.8
	Exceedance Level	-	-	-	-20.0	-15.9	-12.4	-11.2	-11.2	-11.2	-12.1	-16.9	-21.7
NAL6 (H60)	Total WEDG Noise Limit	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.9	48.7	53.5
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	22.2	26.3	29.8	31.0	31.0	31.0	31.0	31.0	31.0
	Exceedance Level	-	-	-	-20.8	-16.7	-13.2	-12.0	-12.0	-12.0	-12.9	-17.7	-22.5
NAL7 (H24)	Total WEDG Noise Limit	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.3	49.4	49.4
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	26.7	30.8	34.3	35.5	35.5	35.5	35.5	35.5	35.5
	Exceedance Level	-	-	-	-16.3	-12.2	-8.7	-7.5	-7.5	-7.5	-7.8	-13.9	-13.9
	Total WEDG Noise Limit	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.3	49.4	49.4

NAL		Wind Speed (ms^{-1}) as standardised to 10m height											
		1	2	3	4	5	6	7	8	9	10	11	12
NAL8 (H21)	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	24.6	28.8	32.2	33.3	33.3	33.3	33.3	33.3	33.3
	Exceedance Level	-	-	-	-18.4	-14.2	-10.8	-9.7	-9.7	-9.7	-10.0	-16.1	-16.1
NAL9 (H4)	Total WEDG Noise Limit	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	45.1	51.5	51.5
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	31.9	36.0	39.6	40.8	40.8	40.8	40.8	40.8	40.8
	Exceedance Level	-	-	-	-11.1	-7.0	-3.4	-2.2	-2.2	-2.2	-4.3	-10.7	-10.7
NAL10 (H42)	Total WEDG Noise Limit	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	45.1	51.5	51.5
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	30.9	35.0	38.5	39.7	39.7	39.7	39.7	39.7	39.7
	Exceedance Level	-	-	-	-12.1	-8.0	-4.5	-3.3	-3.3	-3.3	-5.4	-11.8	-11.8
NAL11 (H49)	Total WEDG Noise Limit	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	45.1	51.5	51.5
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	27.1	31.4	34.6	35.6	35.6	35.6	35.6	35.6	35.6
	Exceedance Level	-	-	-	-15.9	-11.6	-8.4	-7.4	-7.4	-7.4	-9.5	-15.9	-15.9
NAL12 (H54)	Total WEDG Noise Limit	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	46.2	50.9	55.4
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	26.1	30.5	33.5	34.4	34.4	34.4	34.4	34.4	34.4
	Exceedance Level	-	-	-	-16.9	-12.5	-9.5	-8.6	-8.6	-8.6	-11.8	-16.5	-21.0
NAL13 (H25)	Total WEDG Noise Limit	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	46.2	50.9	55.4
	Predicted Cumulative Wind Turbine Noise L_{A90}	-	-	-	26.8	31.5	33.7	34.2	34.2	34.2	34.2	34.2	34.2
	Exceedance Level	-	-	-	-16.2	-11.5	-9.3	-8.8	-8.8	-8.8	-12.0	-16.7	-21.2

Note: For the cumulative noise predictions the noise model considers the range of noise data available for each turbine type modelled. For some turbines noise data was not available for wind speeds less than 4 ms^{-1} therefore no cumulative predictions are included for wind speeds less than 4 ms^{-1}.

12.6.3.3 Operational Phase - Derivation of Site Specific Noise Limits for the Development (Stage 3)

In order to protect residential amenity, the initial recommendations are that cumulatively, all wind farms (including the Proposed Development) operate within the Total WEDG Noise Limits, as demonstrated in the Stage 2 above.

An other recommendation is that each wind farm should operate within their own limit, whilst the cumulative situation of Stage 2 is still met. To allow this to occur, a set of Site Specific Noise limits for the Proposed Development are required and these have been derived for each NAL.

The Site Specific Noise Limits have been derived to take account of the proportion of the noise limit that has been allocated to, or could theoretically be used by, other wind farm developments in proximity to the Proposed Development. The Site Specific Noise Limits were compared to the predictions of the Proposed Development operating on its own with both a 105 m and 110.5 m hub, and the results based on the 110.5 m hub (which is marginally worst case, within 0.1 dB) are summarised below in Table 12-14 for the daytime and Table 12-15 for the night-time. More details on the calculation of site specific limits if provided in Technical Appendix 12-2.

The Stage 3 assessment shows that the predicted wind turbine noise levels from the Proposed Development on its own meet the Site Specific Noise Limits, with one small exception at NAL 9 where a marginal exceedance of 0.6 dB is observed only in daytime at 7 m/s. To put the exceedances above into context it is worth noting that decibels are logarithmic units meaning that a 3 dB change represents a doubling (or halving) of the sound energy. In terms of human perception, the WEDG state that *'A 10 dB(A) increase in sound level represents a doubling of loudness. A change of 3 dB(A) is the minimum perceptible under normal circumstances.' Also, the* minor exceedance identified would be removed by using low noise mode for the candidate turbine in that specific wind speed and in specific directions only, or alternatively by using an alternative candidate wind turbine. As such there would be **no significant effects**.

Table 12-14: Compliance Table –Comparison of predicted noise levels from the Proposed Development against the SSNL at each receptor – Daytime

NAL		Wind Speed (ms^{-1}) as standardised to 10m height											
		1	2	3	4	5	6	7	8	9	10	11	12
NAL1 (H8)	Site Specific Noise Limit, LA90	40.0	40.0	40.0	40.0	40.0	40.0	45.0	45.0	45.0	46.1	50.5	55.2
	Proposed Development Wind Turbine Noise LA90	-	-	29.2	30.8	34.9	38.5	39.8	39.8	39.8	39.8	39.8	39.8
	Exceedance Level	-	-	-10.8	-9.2	-5.1	-1.5	-5.2	-5.2	-5.2	-6.3	-10.7	-15.4
NAL2 (H52)	Site Specific Noise Limit, LA90	40.0	40.0	40.0	40.0	40.0	40.0	45.0	45.0	45.0	46.1	50.5	55.2
	Proposed Development Wind Turbine Noise LA90	-	-	30.0	31.6	35.7	39.3	40.6	40.6	40.6	40.6	40.6	40.6
	Exceedance Level	-	-	-10.0	-8.4	-4.3	-0.7	-4.4	-4.4	-4.4	-5.5	-9.9	-14.6
NAL3 (H51)	Site Specific Noise Limit, LA90	40.0	40.0	40.0	40.0	40.0	40.0	45.0	45.0	45.0	46.1	50.5	55.2
	Proposed Development Wind Turbine Noise LA90	-	-	29.2	30.9	34.9	38.5	39.8	39.8	39.8	39.8	39.8	39.8
	Exceedance Level	-	-	-10.8	-9.1	-5.1	-1.5	-5.2	-5.2	-5.2	-6.3	-10.7	-15.4
NAL4 (H3)	Site Specific Noise Limit, LA90	40.0	40.0	40.0	40.0	40.0	40.0	40.0	45.0	45.0	45.6	50.1	54.7
	Proposed Development Wind Turbine Noise LA90	-	-	19.6	21.2	25.3	28.9	30.2	30.2	30.2	30.2	30.2	30.2
	Exceedance Level	-	-	-20.4	-18.8	-14.7	-11.1	-9.8	-14.8	-14.8	-15.4	-19.9	-24.5
NAL5 (H61)	Site Specific Noise Limit, LA90	40.0	40.0	40.0	40.0	40.0	40.0	40.0	45.0	45.0	45.0	48.8	53.6
	Proposed Development Wind Turbine Noise LA90	-	-	20.9	22.6	26.6	30.3	31.5	31.5	31.5	31.5	31.5	31.5
	Exceedance Level	-	-	-19.1	-17.4	-13.4	-9.7	-8.5	-13.5	-13.5	-13.5	-17.3	-22.1
NAL6 (H60)	Site Specific Noise Limit, LA90	40.0	40.0	40.0	40.0	40.0	40.0	40.0	45.0	45.0	45.0	48.8	53.6
	Proposed Development Wind Turbine Noise LA90	-	-	20.0	21.7	25.8	29.4	30.6	30.6	30.6	30.6	30.6	30.6
	Exceedance Level	-	-	-20.0	-18.3	-14.2	-10.6	-9.4	-14.4	-14.4	-14.4	-18.2	-23.0
NAL7 (H24)	Site Specific Noise Limit, LA90	40.0	40.0	40.0	40.0	40.0	40.0	40.0	45.0	45.0	45.0	45.7	45.7
	Proposed Development Wind Turbine Noise LA90	-	-	24.7	26.4	30.4	34.0	35.3	35.3	35.3	35.3	35.3	35.3
	Exceedance Level	-	-	-15.3	-13.6	-9.6	-6.0	-4.7	-9.7	-9.7	-9.7	-10.4	-10.4
NAL8 (H21)	Site Specific Noise Limit, LA90	40.0	40.0	40.0	40.0	40.0	40.0	40.0	45.0	45.0	45.0	45.7	45.7
	Proposed Development Wind Turbine Noise LA90	-	-	22.2	23.9	28.0	31.6	32.8	32.8	32.8	32.8	32.8	32.8
	Exceedance Level	-	-	-17.8	-16.1	-12.0	-8.4	-7.2	-12.2	-12.2	-12.2	-12.9	-12.9

NAL		Wind Speed (ms^{-1}) as standardised to 10m height											
		1	2	3	4	5	6	7	8	9	10	11	12
NAL9 (H4)	Site Specific Noise Limit, LA90	40.0	40.0	40.0	40.0	40.0	40.0	40.0	45.0	45.0	45.5	52.3	52.3
	Proposed Development Wind Turbine Noise LA90	-	-	30.0	31.7	35.8	39.4	40.6	40.6	40.6	40.6	40.6	40.6
	Exceedance Level	-	-	-10.0	-8.3	-4.2	-0.6	0.6	-4.4	-4.4	-4.9	-11.7	-11.7
NAL10 (H42)	Site Specific Noise Limit, LA90	40.0	40.0	40.0	40.0	40.0	40.0	40.0	45.0	45.0	45.5	52.3	52.3
	Proposed Development Wind Turbine Noise LA90	-	-	28.9	30.6	34.6	38.3	39.5	39.5	39.5	39.5	39.5	39.5
	Exceedance Level	-	-	-11.1	-9.4	-5.4	-1.7	-0.5	-5.5	-5.5	-6.0	-12.8	-12.8
NAL11 (H49)	Site Specific Noise Limit, LA90	40.0	40.0	40.0	40.0	40.0	40.0	40.0	45.0	45.0	45.5	52.3	52.3
	Proposed Development Wind Turbine Noise LA90	-	-	23.9	25.6	29.6	33.3	34.5	34.5	34.5	34.5	34.5	34.5
	Exceedance Level	-	-	-16.1	-14.4	-10.4	-6.7	-5.5	-10.5	-10.5	-11.0	-17.8	-17.8
NAL12 (H54)	Site Specific Noise Limit, LA90	40.0	40.0	40.0	40.0	40.0	39.1	45.0	45.0	45.0	46.1	50.5	55.2
	Proposed Development Wind Turbine Noise LA90	-	-	23.1	24.8	28.9	32.5	33.7	33.7	33.7	33.7	33.7	33.7
	Exceedance Level	-	-	-16.9	-15.2	-11.1	-6.6	-11.3	-11.3	-11.3	-12.4	-16.8	-21.5
NAL13 (H25)	Site Specific Noise Limit, LA90	40.0	40.0	40.0	40.0	39.0	38.2	45.0	45.0	45.0	46.1	50.5	55.2
	Proposed Development Wind Turbine Noise LA90	-	-	19.9	21.6	25.7	29.3	30.5	30.5	30.5	30.5	30.5	30.5
	Exceedance Level	-	-	-20.1	-18.4	-13.3	-8.9	-14.5	-14.5	-14.5	-15.6	-20.0	-24.7

Note: For the noise predictions the noise model considers the range of noise data available for each turbine type modelled. For some turbines noise data was not available for wind speeds less than 3 ms^{-1} therefore no cumulative predictions are included for wind speeds less than 4 ms^{-1}.

Table 12-15: Compliance Table – Comparison of predicted noise levels from the Proposed Development against the SSNL at each receptor - Night-time

NAL		Wind Speed (ms^{-1}) as standardised to 10m height											
		1	2	3	4	5	6	7	8	9	10	11	12
NAL1 (H8)	Site Specific Noise Limit, LA90	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	46.5	51.1	55.5
	Proposed Development Wind Turbine Noise LA90	-	-	-	30.7	34.8	38.5	39.8	39.8	39.8	39.8	39.8	39.8
	Exceedance Level	-	-	-	-12.3	-8.2	-4.5	-3.2	-3.2	-3.2	-6.7	-11.3	-15.7
NAL2 (H52)	Site Specific Noise Limit, LA90	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	46.5	51.1	55.5
	Proposed Development Wind Turbine Noise LA90	-	-	-	31.5	35.6	39.3	40.6	40.6	40.6	40.6	40.6	40.6
	Exceedance Level	-	-	-	-11.5	-7.4	-3.7	-2.4	-2.4	-2.4	-5.9	-10.5	-14.9
NAL3 (H51)	Site Specific Noise Limit, LA90	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	46.5	51.1	55.5
	Proposed Development Wind Turbine Noise LA90	-	-	29.2	30.8	34.9	38.5	39.8	39.8	39.8	39.8	39.8	39.8
	Exceedance Level	-	-	-13.8	-12.2	-8.1	-4.5	-3.2	-3.2	-3.2	-6.4	-11.1	-15.6
NAL4 (H3)	Site Specific Noise Limit, LA90	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	46.2	50.9	55.4
	Proposed Development Wind Turbine Noise LA90	-	-	30.0	31.6	35.7	39.3	40.6	40.6	40.6	40.6	40.6	40.6
	Exceedance Level	-	-	-13.0	-11.4	-7.3	-3.7	-2.4	-2.4	-2.4	-5.6	-10.3	-14.8
NAL5 (H61)	Site Specific Noise Limit, LA90	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	46.2	50.9	55.4
	Proposed Development Wind Turbine Noise LA90	-	-	29.2	30.9	34.9	38.5	39.8	39.8	39.8	39.8	39.8	39.8
	Exceedance Level	-	-	-13.8	-12.1	-8.1	-4.5	-3.2	-3.2	-3.2	-6.4	-11.1	-15.6
NAL6 (H60)	Site Specific Noise Limit, LA90	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.6	48.5	51.8
	Proposed Development Wind Turbine Noise LA90	-	-	19.6	21.2	25.3	28.9	30.2	30.2	30.2	30.2	30.2	30.2
	Exceedance Level	-	-	-23.4	-21.8	-17.7	-14.1	-12.8	-12.8	-12.8	-14.4	-18.3	-21.6
NAL7 (H24)	Site Specific Noise Limit, LA90	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.9	48.7	53.5
	Proposed Development Wind Turbine Noise LA90	-	-	20.9	22.6	26.6	30.3	31.5	31.5	31.5	31.5	31.5	31.5
	Exceedance Level	-	-	-22.1	-20.4	-16.4	-12.7	-11.5	-11.5	-11.5	-12.4	-17.2	-22.0
NAL8 (H21)	Site Specific Noise Limit, LA90	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.9	48.7	53.5
	Proposed Development Wind Turbine Noise LA90	-	-	20.0	21.7	25.8	29.4	30.6	30.6	30.6	30.6	30.6	30.6
	Exceedance Level	-	-	-23.0	-21.3	-17.2	-13.6	-12.4	-12.4	-12.4	-13.3	-18.1	-22.9
	Site Specific Noise Limit, LA90	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.3	49.4	49.4

NAL		Wind Speed (ms^{-1}) as standardised to 10m height											
		1	2	3	4	5	6	7	8	9	10	11	12
NAL9 (H4)	Proposed Development Wind Turbine Noise LA90	-	-	24.7	26.4	30.4	34.0	35.3	35.3	35.3	35.3	35.3	35.3
	Exceedance Level	-	-	-18.3	-16.6	-12.6	-9.0	-7.7	-7.7	-7.7	-8.0	-14.1	-14.1
NAL10 (H42)	Site Specific Noise Limit, LA90	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.3	49.4	49.4
	Proposed Development Wind Turbine Noise LA90	-	-	22.2	23.9	28.0	31.6	32.8	32.8	32.8	32.8	32.8	32.8
	Exceedance Level	-	-	-20.8	-19.1	-15.0	-11.4	-10.2	-10.2	-10.2	-10.5	-16.6	-16.6
NAL11 (H49)	Site Specific Noise Limit, LA90	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	45.1	51.5	51.5
	Proposed Development Wind Turbine Noise LA90	-	-	30.0	31.7	35.8	39.4	40.6	40.6	40.6	40.6	40.6	40.6
	Exceedance Level	-	-	-13.0	-11.3	-7.2	-3.6	-2.4	-2.4	-2.4	-4.5	-10.9	-10.9
NAL12 (H54)	Site Specific Noise Limit, LA90	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	45.1	51.5	51.5
	Proposed Development Wind Turbine Noise LA90	-	-	28.9	30.6	34.6	38.3	39.5	39.5	39.5	39.5	39.5	39.5
	Exceedance Level	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	46.5	51.1	55.5
NAL13 (H25)	Site Specific Noise Limit, LA90	-	-	-	30.7	34.8	38.5	39.8	39.8	39.8	39.8	39.8	39.8
	Proposed Development Wind Turbine Noise LA90	-	-	-	-12.3	-8.2	-4.5	-3.2	-3.2	-3.2	-6.7	-11.3	-15.7
	Exceedance Level	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	46.5	51.1	55.5
Note: For the noise predictions the noise model considers the range of noise data available for each turbine type modelled. For some turbines noise data was not available for wind speeds less than 3 ms^{-1} therefore no cumulative predictions are included for wind speeds less than 4 ms^{-1}.													

12.6.3.1 Operational Noise from Onsite Substation

The 38 kV substation will be installed in the eastern half of the Wind Farm Site. The closest receptor to the substation is H4, which is at a distance of approximately 325 m to the east.

'EirGrid Evidence Based Environmental Studies Study 8: Noise' presents measured noise levels for a number of substations, the most similar of which being a 110 kV substation (Dunfirth Substation), albeit this is higher rated than that of the Proposed Development. Sound pressure level measurements are provided at four different locations around the substation at distances of 5 m and 10 m, which vary between 37 dB $L_{Aeq(t)}$ and 39 dB $L_{Aeq(t)}$. The document provides commentary on the measurements, stating, *"The measured noise levels at the boundary of this substation are below the daytime WHO threshold limits for serious annoyance (55 dB LAeq) and moderate annoyance (50 dB L_{Aeq}) for outdoor living areas. They are also below the night-time free-field threshold limit of 42 dB (L_{Aeq}) for preventing negative effects on sleep."*

With a separation distance of 325 m to the closest receptor, the level the predicted noise level from the substation at the receptor is less than 9dB using a simplistic calculation that does not take into account the attenuation that would be provided by atmospheric effects, topography, barriers etc. A level of 9dB is unlikely to be audible and there is **no potential for significant effects**.

There will be no operational noise from the underground electrical grid connection cabling route.

12.6.4 Potential Cumulative Effects

There are no other anticipated nearby large scale construction projects that would occur at the same time as the construction of the Proposed Development, therefore there would be **no significant cumulative construction noise effects.**

The operational noise assessment has taken cumulative impacts with other existing nearby wind farms into consideration, as described in the above assessment. The likely cumulative operational noise assessment show that the Proposed Development can operate concurrently with the operational and consented wind farms near to the NALs and there would therefore be **no significant cumulative operational noise effects**.

12.7 Mitigation

12.7.1 Mitigation during Construction

No significant effects resulting from construction noise are predicted. Nevertheless, a range of good practice measures will be presented in a Construction Environmental Management Plan (CEMP) and these will be employed to minimise noise impacts. At this stage of the development process, the assessment is based on a precautionary approach, as a detailed construction programme is not available.

Good site practices, both on the Wind Farm Site and along the Grid Connection underground electrical cabling route will be implemented to minimise the likely effects. Particular care will be taken at watercourse, culvert and drain crossings along the underground electrical cabling route, as detailed in Section 4.7.7.4 in Chapter 4 of this EIAR, where directional drilling activities are required to be undertaken. Section 8 of BS5228-1:2009+A1:2014 recommends a number of simple control measures as summarised below that will be employed onsite:

- Keep local residents informed of the proposed working schedule, where appropriate, including the times and duration of any abnormally noisy activity that may cause concern;
- All vehicles and mechanical plant will be fitted with effective exhaust silencers and be subject to programmed maintenance;
- Select inherently quiet plant where appropriate - all major compressors will be 'sound reduced' models fitted with properly lined and sealed acoustic covers, which will be kept closed whenever the machines are in use;
- All ancillary pneumatic percussive tools will be fitted with mufflers or silencers of the type recommended by the manufacturers;
- Machines will be shut down between work periods (or when not in use) or throttled down to a minimum;
- Regularly maintain all equipment used on site, including maintenance related to noise emissions;
- Vehicles will be loaded carefully to ensure minimal drop heights so as to minimise noise during this operation; and
- All ancillary plant such as generators and pumps will be positioned so as to cause minimum noise disturbance and if necessary, temporary acoustic screens or enclosures will be provided.

Within the village of Carrig, and at any location within 30 m of a residential receptor, where directional drilling activities are required for the underground grid connection cabling route, the installation of temporary boarding alongside the drilling rig or 'acoustic blanket panels' hanging from heras fencing (or similar) will be used to mitigate noise emissions. Installation will be as close to the drilling rig as is practicable and fitted so as to interrupt any direct line of site between the drilling rig and the closest residential receptors.

While it was concluded in above that there will be no significant vibration impacts associated with the construction of the Proposed Development and that no specific mitigation measures were required, it is recommended that vibration from construction activities will be limited to the values set out in Section 12.4.1.2. Given that construction activities are only likely to occur for a short duration, the use of internal vibration limits is likely to be unnecessary. Therefore, no mitigation measures are proposed.

12.7.2 Mitigation during Operation

The exact model of wind turbine, with dimensions within the range proposed, to be used for the proposed development will be the result of a future tendering process. Achievement of the noise limits determined by this assessment would be a key determining factor in the final choice of wind turbines for the site. In order to meet the Site Specific Noise limits at NAL9 the two nearest candidate turbine may need to be operated in a lower noise mode for a limited range of wind speeds and wind directions (7 ms^{-1} westerlies) in daytime period only. Other wind turbine models would be available which may not require the use of low noise modes.

12.8 Assessment of Residual Effects

12.8.1 Residual Construction Effects

Predicted wind farm construction noise levels are below the assessment criteria at all receptors, for all phases of construction. Due to the low background noise levels at some locations, elements of construction noise could be audible at the closest residential receptor for certain periods during the construction phases. However, with or without the good practice construction mitigation measures outlined above there would be **no significant residual effects**.

12.8.2 Residual Operational Effects

The cumulative noise predictions (Proposed Development and other nearby wind farms) lie below the Total WEDG Noise Limits and it has also been demonstrated that Site Specific Limits can be met following minor mitigation such as implementation of low noise modes for specific turbines. At some locations, under some wind conditions and for a certain proportion of the time operational wind farm noise would be audible; however, it would be at an acceptable level in relation to the WEDG guidelines and as such, regardless of which turbine dimensions are selected within the proposed range, there would be **no significant residual effects**.

12.8.3 Residual Cumulative Effects

It was found that without mitigation there would be no significant cumulative construction noise effects. As such there would be **no residual cumulative effects during the construction phase**.

It was found that without mitigation there would be no significant cumulative operational noise effects As such there would be **no residual cumulative effects during the operational phase**.

12.9 Summary

Predicted construction noise levels compared with the Category A criteria outlined in Section E.3 of BS5228: Part 1 2009+A1:2014 indicate that construction noise levels are below the guidelines considered acceptable at all receptors for all construction phases and therefore **no significant effects** are anticipated.

The guidance contained within the WEDG 2006 was used to assess the likely operational noise impact of the Proposed Development. Predicted cumulative levels and measured background noise levels indicate that for neighbouring dwellings, wind turbine noise from a candidate turbine would meet the Total WEDG Noise Limit, therefore the operational noise impact is **not significant.** A Site Specific Noise Limit was also calculated using worst-case assumptions and the assessment has shown that the Proposed Development operating on its own with the candidate turbine assessed in this report would meet that limit, albeit with minor requirements for mode management for the two nearest turbines to NAL9, for certain wind speeds and wind directions (7m/s and westerlies) in daytime only.

The use of Site Specific Noise Limits for the operational phase would ensure that the Proposed Development could operate concurrently with other operational wind farm developments in the area and would also ensure that the Proposed Development's individual contribution could be measured and enforced if required. The wind turbine model in this assessment was chosen in order to allow a representative assessment of the noise impacts. Should the Proposed Development receive consent, the final choice of wind turbine would be subject to a competitive tendering process and the final choice of wind turbine would, however, have to meet the Site Specific Noise Limits presented in the noise assessment.

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British Standard BS7385-2: 1993 'The Evaluation and measurement for vibration in buildings. Guide to damage levels from groundborne vibration'

British Standard BS6472: 2008 'Guide to evaluation of human exposure to vibration in buildings. Blast-induced vibration'

Non Technical Summary

A noise assessment was undertaken to determine the likely significant noise and vibration effects from the construction and operational phases of the Proposed Development.

Predicted construction noise levels at the nearest noise sensitive receptors during all phases of construction are below the threshold values within BS 5228 and are therefore deemed to be not significant. Activities related to decommissioning would use similar plant to that used for construction activities and would occur at the same locations, as such noise level output during the decommissioning phase is expected to be no higher than the construction phase.

For the operational noise assessment, a background noise survey was undertaken at five noise monitoring locations. The data was analysed in conjunction with on-site measured wind speed data and operational noise limits have been derived in accordance with the WEDG 2006.

The operational noise assessment was undertaken in three stages, which involved setting the Total WEDG Noise Limits (which are limits for noise from all wind farms in the area) at the nearest noise sensitive receptors, predicting the likely effects (undertaking cumulative noise predictions) and finally setting Site Specific Noise Limits for the operation of the Proposed Development on its own.

Predicted cumulative operational noise levels from the Proposed Development (assuming a Vestas 162 as a candidate turbine) and two nearby operational wind farms indicate that for noise sensitive neighbouring receptors, the Total WEDG Noise Limits would be met at all receptors. Two hub heights at 105 m and 110.5 m have been predicted to illustrate the noise level differences for the proposed turbine dimension range, and the assessment shows that the differences are marginal, within 0.1 dB. In accordance with the guidance in IOA GPG and worst-case assumptions, Site Specific Noise Limits have been derived with due regard to cumulative noise by accounting for the proportion of the Total WEDG Noise Limit which is potentially being used by other nearby developments. Predicted operational noise levels from the Proposed Development on its own with the candidate turbine indicate that Site Specific Noise Limits would be met, albeit with minor requirements for mode management for the two nearest turbines to NAL9, for certain wind speeds and wind directions (7m/s and westerlies) in daytime only. The effects are therefore deemed to be not significant.

A Site Specific Noise Limit was also calculated using worst-case assumptions and the assessment has shown that the Proposed Development operating on its own with the candidate turbine assessed in this report would meet that limit,

The use of Site Specific Noise Limits would ensure that the Proposed Development could operate concurrently with other operational wind farm developments in the area and would also ensure that the Proposed Development's individual contribution could be measured and enforced if required.

The wind turbine model was chosen in order to allow a representative assessment of the noise impacts. Should the Proposed Development receive consent, the final choice of wind turbine would be subject to a competitive tendering process. The final choice of wind turbine would, however, have to meet the Site Specific Noise Limits presented in the noise assessment.