# Environmental Impact Assessment Report (EIAR)

## Seskin Wind Farm, Co. Carlow

Chapter 12 - Noise and Vibration

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# 12. NOISE & VIBRATION

## 12.1 Introduction

The Proposed Project has the potential to create noise and vibration during the construction, operational and decommissioning phases.

As detailed in Section 1.1.1 in Chapter 1, for the purposes of this EIAR, the various project components are described and assessed using the following references: 'Proposed Project', 'Proposed Wind Farm', 'Proposed Grid Connection Route' and the 'site'.

This chapter assesses the potential noise and vibration impacts at the nearest Noise Sensitive Receptors (NSRs), which are residential properties located within c. 2km of the Proposed Wind Farm. The full description of the Proposed Project is detailed in Chapter 4.

This chapter considers the likely significant noise and vibration effects associated with the construction, operation and decommissioning of the Proposed Project. 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 effects;
- Describe the mitigation measures proposed to address any likely significant effects; and assess the residual noise effects remaining, following the implementation of mitigation.

This EIAR Report is supported by the following figures and appendices:

- Figures
  - Figure 12-1: Construction Noise Assessment Locations;
  - Figure 12-2: Wind Turbines Operational Noise Assessment Locations; and,
  - Figure 12-3: Cumulative Wind Farm Locations; and
  - Figure 12-4: BESS Operational Noise Assessment Locations.
- Technical Appendices
  - Appendix 12-1: Construction Noise Report;
  - Appendix 12-2: Wind Turbine Operational Noise Report; and,
  - Appendix 12-3: BESS Operational Noise Report.

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

### 12.1.1.1 Statement of Authority

The noise and vibration assessments were carried out by TNEI Ireland Ltd. TNEI is a specialist energy consultancy with an Acoustics team that has undertaken noise assessments for over 5 GW of onshore wind farm developments. The noise work has been led by Moise Coulon, Principal Consultant at TNEI. Moise is an experienced Project Manager and Acoustician, who provides technical support and assessment of proposed and operational developments. Moise specialises in undertaking noise assessments and has worked on projects associated with a variety of sectors including renewable energy, property development and industry. Moise has extensive experience, over sixteen years, on undertaking wind farm noise assessments as well as other noise assessments (construction, industrial, residential) to support planning applications. Moise is a full member of the Institute of Acoustics.

## 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: 2009+A1:2014 'Code of practice for noise and vibration control on construction and open developments'[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];
- ISO 9613-2: 1996 'Acoustics - Attenuation of sound during propagation outdoors Part 2: General method of calculation'[5].
- British Standard BS 4142: 2014+A1:2019 'Methods for rating and assessing industrial and commercial sound' (2019) (BS 4142)[6];
- British Standard BS 8233: 2014 'Guidance on sound insulation and noise reduction for buildings' (2014)(BS 8233)[7]; and,
- Association of Acoustic Consultants of Ireland' Environmental Noise Guidance for Local Authority Planning & Enforcement Departments'(2021) (AACI Guidelines) [8].

The above documents are discussed in detail within Section 2 of Appendix 12-1, 12-2 and 12-3, where relevant.

With regards to national planning policy and guidance, it is noted that the Irish Government Wind Energy Development Guidelines for Planning Authorities (2006) (DoEHLG 2006 Guidelines) are currently under review. A set of draft updated guidelines were issued for consultation in December 2019 ('DoEHLG Draft 2019 Guidelines) but these guidelines have not, at the time of writing, been adopted. In keeping with best international practice the Draft DoEHLG 2019 Guidelines relied upon, some elements of the *'Assessment and Rating of Noise from Wind Farms'* (ETSU-R-97) and the Institute of Acoustics *'Good Practice Guidelines to the Application of ETSU-R-97 For the Assessment and Rating of Wind Turbine Noise'* (IOA GPG).

Significant concerns were raised during the public consultation process on the Draft DoEHLG 2019 Guidelines, including by a group of wind farm acousticians[9], regarding the noise section of the draft guidelines and how the authors had misinterpreted existing guidance and incorporated a number of errors within the technical approaches proposed. In light of these concerns, and the fact that significant changes would need to be made before they could be adopted, an assessment using the Draft DoEHLG 2019 Guidelines is not, in our opinion, technically feasible or appropriate and has not therefore been undertaken.

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[1] *British Standards Institute, 2014. Code of practice for noise and vibration control on construction and open sites. Noise. UK : BSI, 2014. BS 5228:2009+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] *British Standards Institute, 2019. Methods for rating and assessing industrial and commercial sound UK : BSI, 2019. BS 4142:2014+A1:2019*
[7] *British Standards Institute, 2014. Guidance on sound insulation and noise reduction for buildings UK : BSI, 2014. BS 8233:2014*
[8] *Association of Acoustic Consultants of Ireland, 2021. 'Environmental Noise Guidance for Local Authority Planning & Enforcement Departments.*
[9] *Mackay, J, Singleton, J, Reid, M, Cand, M, Mahon, J, McKenzie, A, Keaney, D, Hayes, M, Bowdler, D, Kelly, D, Jiggins, M, Irvine, G & Lester, M, 2020. Public consultation on the revised wind energy development guidelines: Joint consultation response. Available at: https://www.tneigroup.com/news_event/tnei-submit-joint-consultation-response-and-meet-with-government-regarding-proposed-updates-to-the-irish-wind-farm-noise-guidelines-wedg/*

At the time of writing this report, no further updates on the review process have been issued, however, on the 22 February 2023, a request for tender (RFT) was published for the review and redraft of the DoEHLG 2006 Guidelines by the Department of Environment. Timelines for the review are still unclear however, the Government of Irelands' Climate Action Plan 2024 includes a 2024 Action (EL/24/5) to 'Publish the Revised Wind Energy Development Guidelines for onshore wind.'

The DoEHLG 2006 Guidelines, therefore, remain the relevant statutory guidelines and, as a result, they have been used for this assessment, appropriately supplemented by the guidance in ETSU-R-97 and the IOA GPG, which are considered by TNEI to represent current best practice.

In 2018 the World Health Organisation (WHO) issued noise guidelines *'Environmental Noise Guidelines for the European Region'*[10] (the WHO Guidelines) that provide recommendations for protecting human health from exposure to environmental noise. The WHO Guidelines consider noise originating from various sources including wind turbine noise. The WHO 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 WHO Guidelines 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 WHO Guidelines make 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 WHO Guidelines state:

*'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.

The Association of Acoustic Consultants of Ireland (AACI) published the AACI Guidelines in May 2021. The guidance document provides advice to local authority officers involved in the assessment of noise reports, the drafting of noise conditions for planning purposes and permitting and also enforcement activities. Section 17 of the AACI Guidelines covers operational wind farm noise and construction noise guidance is included within Section 27. These are considered further in Section 12.4 below.

[10] *World Health Organisation, 2018. Environmental Noise Guidelines for the European Region'*

## 12.3 Scoping and Consultation



Scoping responses were sent to MKO from various parties and noise and vibration was a consideration in some of the responses. Noise and vibration was mentioned in responses from Transport Infrastructure Ireland, Carlow County Council, Kilkenny County Council and HSE Environmental Health between December 2022 and March 2023.

The considerations raised by Transport Infrastructure Ireland are all covered in this EIAR, the response stated:

> *'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)).'*

The considerations raised by Carlow County Council are all covered in this EIAR, the response stated:

> *'Noise, Vibration and Dust: Suitably scaled mapping should be provided which accurately identifies existing and proposed noise and dust monitoring stations relative to sensitive receptors. The assessment of noise impacts needs to consider noise generated from construction activities and operational noise e.g. rotating turbine noise and blade swish noise. Noise associated with the construction of access roads and cable routes should be assessed, and should include restrictions on the hours of operation to prevent noise nuisance at dwellings and other adjoining land uses/sensitive locations.'*

The considerations raised by Kilkenny County Council included a request to confirm the exact model of wind turbine. As detailed in Section 1.7.3 in Chapter 1 of this EIAR, various types and sizes of wind turbine (within a proposed range) have been selected and considered in the relevant sections of the EIAR, including this noise and vibration chapter. It is also noted within its scoping response that a specific noise limit should be adopted (45 dB(A) L90 day and 43 dB(A) L90 night) and this has been considered in this EIAR by using the fixed minimum limits in the DoEHLG 2006, however, other criteria such as background +5 dB have also used in this EIAR in line with current best practice.

All other relevant points detailed in the Scoping Response are covered in this EIAR, the Kilkenny County Council full response on noise and vibration stated:

> *'With respect to EIAR scoping issues, the recommendations indicated below provide only general guidance for the preparation of an EIAR, which may affect the national road network. The developer/scheme promoter should have regard, inter alia, to the following:*
>
> *...*
>
> *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)).*
>
> *...'*
>
> *'During the construction, operation & decommissioning stages, the applicant should ensure that all operations on site are carried out in a manner such that noise, dust, reflectance, shadow flicker, air emissions and/or odours do not result in significant impairment of, or*

*significant interference with, amenities or the environment beyond the site. The following are recommendations for consideration by the planning authority:*
*a. The hours of work for the site should be:*
*i. 07:00 to 19:00 Monday to Friday.*
*ii. 07:00 to 13:00 Saturdays.*

*b. The applicant shall confirm the exact model of Wind Turbine being proposed for this site. The proposed model of Wind Turbine shall be considered in the Seskin Wind Farm Environmental Impact Assessment Report (EIAR).*

*c. The applicant should submit an Operations Manual for the written agreement of the Planning Authority:*

*...*

*iii. The applicant should insure that all activities at the site shall not give rise to noise levels off site at the nearest occupied dwellings, which exceed the following sound pressure limits;*
*• DAY: 45dB(A) LA90 (10 minutes).*
*• NIGHT: 43dB(A) LA90 (10 minutes).*

*d. Within six months of commissioning the Wind Turbines referred to in this application, the applicant should undertake noise monitoring in order to determine the extent and characteristics of noise levels arising from the Wind Farm in the vicinity of the nearest occupied dwellings. The results should be forwarded to the Planning Authority.'*

The considerations raised by HSE Environmental Health are covered in this EIAR except the request to consider the draft WEDG 2019 guidance. Given the limitations of the Draft WEDG 2019 Guidelines explained in this EIAR (section 12.2), the Draft WEDG 2019 Guidelines have not been used and instead the WEDG 2006 supplemented by best practice guidance from ETSU-R-97 and the IOA GPG has been used for the assessment. The full response from HSE Environmental Health stated:

*'The potential impacts for noise and vibration from the proposed development on all noise sensitive locations must be clearly identified in the EIAR. The EIAR must also consider the appropriateness and effectiveness of all proposed mitigation measures to minimise noise and vibration. A baseline noise monitoring survey should be undertaken to establish the existing background noise levels. Noise from any existing turbines in the area should not be included as part of the background levels. In addition, an assessment of the predicted noise impacts during the construction phase and the operational phase of the proposed renewable energy development must be undertaken which details the change in the noise environment resulting from the proposed development. The Draft Revised Wind Energy Development Guidelines were published in December 2019. Whilst these have yet to be adopted, any proposed wind farm development should have consideration of the draft Guideline.'*

## 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 AACI Guidelines 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, using noise source data for appropriate construction plant from Annex C of the current version of BS 5228.

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

- Identify NSRs 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,
- Assess any residual adverse effects taking into account any identified mitigation measures.

Of the NSRs identified in the surroundings, a total of 18 have been chosen as CNALs. All 18 are residential properties. The CNALs represent the closest NSRs or clusters of NSRs to the Proposed Project construction activities. The 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 |
|---|---|---|
| CNAL01 | 662730 | 670033 |
| CNAL02 | 662614 | 670155 |
| CNAL03 | 663257 | 670292 |
| CNAL04 | 663822 | 670342 |
| CNAL05 | 664332 | 670302 |
| CNAL06 | 664468 | 670252 |
| CNAL07 | 664688 | 669900 |
| CNAL08 | 664705 | 669725 |
| CNAL09 | 664757 | 669384 |
| CNAL10 | 664824 | 668894 |
| CNAL11 | 664698 | 668149 |
| CNAL12 | 664248 | 667759 |
| CNAL13 | 663159 | 667611 |

| Receptor | ITM Easting | ITM Northing |
|---|---|---|
| CNAL14 | 662682 | 668093 |
| CNAL15 | 662840 | 669042 |
| CNAL16 | 662557 | 669150 |
| CNAL17 | 661841 | 668376 |
| CNAL18 | 662627 | 667433 |



The construction phase of the Proposed Project will include civil engineering works, electrical works, and turbine/met mast erection (please refer to Section 4.7.9 of Chapter 4 of this EIAR for details). 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 project of this size and the indicative construction schedule (included in Chapter 4 of this EIAR). In view of this, the plant has been modelled operating at the closest points to each NSR for a given activity in each construction phase, under a precautionary scenario as it would generate the highest noise levels, whereas in reality only certain plant and equipment will be working at the closest point for short periods of time.

The core hours for the proposed works will be normal construction hours 07:00 to 19:00 Monday to Friday and 07:00 to 13:00 Saturday. 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 of the Proposed Project outlines the tasks that will be undertaken during the construction period, which is estimated to be 18-24 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 tasks that could occur throughout the construction period (which is assumed as a maximum of 24 months). The scenarios modelled include the following construction activities:

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 CNALs and compared to the appropriate BS 5228 thresholds (detailed in Table E.1, Annex E of BS 5228). 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.

- Scenario 01: The tracks are built from the site entrance towards the construction compound and extending to turbines 5, 6 & 7. Tree felling around the location of the construction compound and turbines 5, 6 & 7 is taking place;
- Scenario 02: The remaining tracks are built from turbine 5 towards turbines 1,2,3 & 4. Tree felling around turbines 1, 2, 3 & 4 and around the BESS compound is taking place. The foundations and hardstanding for turbines 5, 6 & 7 are prepared, including excavation. Foundations are anchored and poured at Turbines 5, 6 & 7;
- Scenario 03: The foundations and hardstanding for turbines 1, 2, 3 & 4 are prepared, including excavation. Foundations are anchored and poured for turbines 1,2, 3 & 4. Backfilling and landscaping along tracks from site entrance to Turbines 5, 6 & 7. Erection of Turbines 5, 6 & 7; and

- Scenario 04: Backfilling and landscaping along tracks from turbine 5 to turbines 1,2,3 & 4. Erection of Turbines 1, 2, 3 & 4.
- Night Scenario: Night-time diesel generators for the cabin and lighting at both construction compounds are operational, just in case this is required on rare occasions.



Construction activities outside the wind turbines area, along the Proposed Grid Connection Route or the turbine delivery route distant road junctions that may need reinforcement have been assessed qualitatively. These activities will be of short duration and best practice during constructions would minimise any potential impact.

The assessment has assumed that gravity based foundations will be used onsite as is typical for most wind farm developments. Should piling be required then best practice mitigation measures will be used to limit noise output. The exact nature of the mitigation measures will vary depending on the pile type, strata to be penetrated and duration of the works required.

### 12.4.1.2 Construction Vibration

In relation to potential vibration during the construction phase of the Proposed Project, 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 Wind Turbines Noise Methodology

The assessment has been undertaken in accordance with the DoEHLG 2006 Guidelines. The AACI Guidance states the following in relation to the DoEHLG 2006 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 IOA GPG. Given the lack of detail in parts of the DoEHLG 2006 Guidelines, information contained in ETSU-R-97 and the IOA GPG has been used to supplement the DoEHLG 2006 Guidelines.

The DoEHLG 2006 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 NSRs will be below the noise limits derived in accordance with DoEHLG 2006 Guidelines and also considering nearby consented noise criteria for the permitted Bilboa and White Hill wind farms.

Of the NSRs identified, 18 Noise Assessment Locations (NALs) were selected for a detailed assessment. All are residential properties. 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 and Figure 12-3. This approach ensures that the assessment considers the worst case (loudest) noise immission level expected at the NAL. All other NSRs have also been assessed separately in Appendix 12-2.

*Table 12-4: Summary of Operational Noise Assessment Locations*

| Receptor | Easting | Northing | Elevation (m AOD) | Approximate Distance to Nearest Seskin Turbine (m) | Background Noise Data Used |
|---|---|---|---|---|---|
| NAL1 | 662730 | 670033 | 242 | 844 (T1) | NML7 |
| NAL2 | 662610 | 670156 | 240 | 1,008 (T1) | NML7 |
| NAL3 | 663257 | 670292 | 257 | 695 (T1) | NML7 |
| NAL4 | 663822 | 670342 | 271 | 718 (T2) | NML1 |

| Receptor | Easting | Northing | Elevation (m AOD) | Approximate Distance to Nearest Seskin Turbine (m) | Background Noise Data Used |
|---|---|---|---|---|---|
| NAL5 | 664335 | 670312 | 289 | 746 (T2) | NML1 |
| NAL6 | 664468 | 670252 | 290 | 768 (T2) | NML1 |
| NAL7 | 664688 | 669900 | 290 | 739 (T2) | NML2 |
| NAL8 | 664705 | 669725 | 284 | 709 (T3) | NML2 |
| NAL9 | 664928 | 669208 | 266 | 730 (T3) | NML2 |
| NAL10 | 664824 | 668894 | 270 | 710 (T3) | NML3 |
| NAL11 | 664698 | 668149 | 271 | 767 (T5) | NML3 |
| NAL12 | 664248 | 667759 | 266 | 737 (T7) | NML3 |
| NAL13 | 663144 | 667630 | 263 | 710 (T7) | NML4 |
| NAL14 | 662682 | 668090 | 251 | 933 (T6) | NML5 |
| NAL15 | 662840 | 669042 | 228 | 742 (T4) | NML6 |
| NAL16 | 662555 | 669161 | 217 | 1028 (T4) | NML6 |
| NAL17 | 661841 | 668376 | 210 | 1632 (T6) | NML5 |
| NAL18 | 662611 | 667437 | 260 | 1240 (T7) | NML5 |



The daytime and night-time periods are not defined within the DoEHLG 2006 Guidelines, therefore the assessment has considered these periods as detailed within ETSU-R-97. 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.

The DoEHLG 2006 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 criteria, and interpretation of the criteria used for the nearby permitted Bilboa Wind Farm and White Hill Wind Farm, is that turbine noise should not exceed for daytime periods:

- 40 dB(A) where background noise levels are below 30 dB; and,

- 45 dB(A) or background noise plus 5 dB, whichever is the greater, where background noise levels are greater than 30 dB (or where wind speed greater than 4 ms-1 or 5 ms-1 near the permitted Bilboa Wind Farm and the permitted White Hill Wind Farm).



The fixed minimum limit has been chosen for the daytime period with due consideration given to the limits already adopted for consented wind farm developments in the area.

The DoEHLG 2006 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 DoEHLG 2006 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. 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.

Two sets of noise limits have been derived; the Total DoEHLG 2006 Guidelines Noise limits which apply to the cumulative noise level of all relevant wind turbine developments operating in the area including the Proposed Wind Farm, and the 'Site-Specific Noise Limits' which apply to operational noise from the Proposed Wind Farm only. The 'Site-Specific Noise Limits' are 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. The only exception being the three NSRs located in between the Proposed Wind Farm and the permitted Bilboa Wind Farm where noise limits have already been set as part of the planning consent for Bilboa Wind Farm and these NSRs are in close proximity between both the Proposed Wind Farm and the permitted Bilboa Wind Farm. At these receptors a Cumulative Noise Limit (equal to the Total DoEHLG 2006 Guidelines Noise Limit) has been derived.

The aim of the operational noise assessment is to establish the Total DoEHLG 2006 Guidelines Noise Limits, determine whether a cumulative assessment is required at the nearest NSRs, derive Site-Specific Noise Limits (where applicable) and to establish whether the Proposed Wind Farm can operate within those limits. When considering the Cumulative Noise Limit, the aim of the assessment was to determine whether the cumulative noise predictions can operate within the Cumulative Noise Limit.

The exact model of turbine to be installed as part of the Proposed Wind Farm will be the result of a future tendering process and within the dimensions prescribed in this planning application should planning permission be granted. Achievement of the noise limits determined by this assessment will be a key determining requirement in the final choice of turbine for the Proposed Wind Farm. 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.

The noise assessment models the Vestas V150 6.0 MW, Nordex N149 5.7 MW and Siemens Gamesa SG 6.0-155 6.6 MW which are candidate turbines that fall within the range of turbine dimensions proposed as part of the application (ie. tip height 179.5 m – 180 m, rotor diameter 149 m – 155 m and hub height 102.5 m – 105 m). The V150 and N149 have been assumed with a proposed hub height of 105m and the SG 6.0-155 with a proposed hub height of 102.5m. These candidate turbine models are considered representative of the type of turbine that could be installed. The modelling results presented within this Chapter are based on the Vestas V150 6.0 MW turbine as that is one of the loudest turbines at the key wind speed range. Prediction modelling results for the other two candidate turbines are included within Appendix 12-2.

Calculations of operational 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, where properties are located in between groups of turbines they cannot be downwind of all turbines simultaneously, so it is appropriate to consider the effect of wind direction on predicted noise levels and the impact of directivity has been considered in the assessment (see Section 6.3 of Appendix 12-2).

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 NSRs. 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 Appendix 12-2.

Other topics relating to operational wind farm noise characteristics, such as tonality, Low Frequency Noise (LFN) and amplitude modulation were considered as part of this assessment. There is no evidence that LFN has adverse impacts on the health of wind farm neighbours and has therefore been scoped out - more information on LFN and is provided in Technical Appendix 12-2. Tonality associated with wind turbines is well understood and has been considered in accordance with the guidance in ETSU-R-97 and the IOA GPG. The topic of amplitude modulation is considered in more detail below.

#### 12.4.1.4 Amplitude Modulation

In the context of wind turbine noise, Amplitude Modulation (AM) describes a variation in noise level over time; for example, observers may describe a 'whoosh whoosh' sound, which can be heard close to a wind turbine as the blades sweep past. The AM of aerodynamic noise is an inherent characteristic of wind turbine noise and was noted in ETSU-R-97, on page 68, which states:

*'The modulation or rhythmic swish emitted by wind turbines has been considered by some to have a characteristic that is irregular enough to attract attention. The level and depth of modulation of the blade noise is, to a degree, turbine-dependent and is dependent upon the position of the observer. Some wind turbines emit a greater level of modulation of the blade noise than others. Therefore, although some wind turbines might be considered to have a character that may attract one's attention, others have noise characteristics which are considerably less intrusive and unlikely to attract one's attention and be subject to any penalty.*

*This modulation of blade noise may result in a variation of the overall A-weighted noise level by as much as 3dBA (peak to trough) when measured close to a wind turbine. As distance from the wind turbine [or] wind farm increases, this depth of modulation would be expected to decrease as atmospheric absorption attenuates the high frequency energy radiated by the blade.'*

The Acoustics community has sought to make a distinction between the AM discussed within ETSU-R-97, which is expected at most wind farms and as such may be considered as 'Normal Amplitude Modulation' (NAM), compared to the unusual AM that has sometimes been heard at some wind farms, hereinafter referred to as 'Other Amplitude Modulation' (OAM). The term OAM is used to describe an unusual feature of aerodynamic noise from wind turbines, where a greater than normal degree of regular fluctuation in sound level occurs at the blade passing frequency, typically once per second. In some literature it may also be referred to as 'Excess Amplitude Modulation' (EAM). It should be noted that the noise assessment and rating procedure detailed in ETSU-R-97 fully takes into account the presence of the intrinsic level of NAM when setting acceptable noise limits for wind farms.

Persistent OAM can be a source of nuisance to wind farm neighbours. Indeed, in a recent decision of the Irish High Court on the 8th of March 2024, the court found that frequent and sustained periods of OAM arising from the operational Ballyduff Wind Farm was an unreasonable interference with a neighbour's use and enjoyment of their property which was located approximately 359 m from the

nearest turbine. The issue of damages and/or an injunction were held over for later determination by the court but in the meantime, the court directed all parties to engage in mediation with a view to devising ***'appropriate mitigation measures and if possible, to resolve all outstanding issues between them'***. In summary, therefore, where persistent and sustained OAM arises, mitigation is possible and is the appropriate response.

A significant amount of research has been undertaken in relation to OAM and a summary of the most relevant research is included in Section 3.3 of Technical Appendix 12-2. Key outcomes of the research are that:

- It is clear that OAM, if it occurs frequently and for sustained periods, it has the potential to result in adverse impacts for wind farm neighbours.
- It is not currently possible to predict if and when OAM will occur at a proposed wind farm site. On sites where OAM has been identified it occurs intermittently and varies in terms of severity.
- There are methodologies available that can be used to measure and quantify OAM, in particular the method produced by the Amplitude Modulation Working Group (AMWG), which was formed by the Institute of Acoustics. The methodology was presented in a report '*Methods for Rating Amplitude Modulation in Wind Turbine Noise'* which was published in April 2015.
- Whilst it is possible to measure and quantify OAM using the AMWG methodology (which provides an AM rating for each 10 minute period), further study is still required to help quantify what level of OAM, if any, is acceptable. This is complicated by the fact that it is unclear whether a small amount of OAM that occurs regularly is likely to be more (or less) annoying than a large amount of OAM that occurs very infrequently.
- Notwithstanding a lack of a defined threshold detailing what level of OAM is acceptable, there are measures available which have been shown to mitigate OAM should it occur. Measures can include:
    - Changes to the operation of the relevant wind turbine(s) by changing parameters such as blade pitch;
    - Addition of blade furniture (such has vortex generators) to alter the flow of air over the wind turbine blades; and, in extreme cases,
    - Targeted wind turbine shutdowns in specific conditions where OAM is found to occur.

  Where mitigation is required, it needs to be designed on a site-specific basis.

To ensure that any future complaints relating to noise and OAM can be responded to appropriately, the Applicant proposes to appoint a community liaison officer who would be the first point of contact in the event that noise complaints were to occur and the mitigation strategy set out in Section 12.7.2 below will be employed.

#### 12.4.1.5 Cumulative Wind Turbine Operational Noise Methodology

The noise assessment considers nearby wind turbine schemes that are operational, permitted and proposed (planning application submitted). The nearby schemes found to be relevant and therefore considered in the assessment are the operational Gortahile Wind Farm (8x Nordex N90 2500 HS), the permitted Bilboa Wind Farm (5 x Vestas V117 4.2 MW SO2) and the permitted White Hill Wind Farm (7 x Vestas V162 6.2 MW).

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 DoEHLG 2006 Guidelines Noise Limits' which are applicable for all wind farm schemes in the area;

- Stage 2 – undertake a cumulative assessment, comparing Total DoEHLG 2006 Guidelines 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; and
- Stage 3 – establish the Proposed Wind Farms Site-Specific Noise Limits (at levels below the Total DoEHLG 2006 Guidelines Noise Limits, where limit apportionment is required) and compare the noise predictions from the Proposed Wind Farm on its own against the proposed Site-Specific Noise Limits. In order to the derive the Site-Specific Noise Limit an additional buffer of +2 dB 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 12-2.

#### 12.4.1.6 BESS Operational Noise Methodology

The BESS noise assessment considered two different assessment methods; namely a qualitative assessment, as detailed in BS 4142, and a quantitative assessment using guideline noise levels from BS 8233. The qualitative assessment method compares predicted noise levels to existing background sound levels, however, with due regard to guidance presented within the Association of Noise Consultants (ANC) BS 4142 Technical Note 2020[11], it was deemed that this assessment methodology was not appropriate, due to the background noise levels being low (<30 dB $L_{A90}$) and the predicted BESS noise also being low (<35 dB $L_{Aeq}$). Accordingly, the assessment was made against fixed guideline levels detailed in BS 8233.

BS 8233 presents guideline noise levels for daytime and night-time periods for a number of different building types; for residential developments these are based on guidelines issued by the WHO. The daytime internal noise criteria of 35 dB $L_{Aeq}$ for bedrooms and living room areas was used to set an external noise level criteria of 48 dB $L_{Aeq}$ (i.e. assuming 13 dB attenuation offered by partially opened window). Similarly, the night internal noise criteria of 30 dB for bedroom areas was used to set a fixed external noise level criteria of 43 dB $L_{Aeq}$.

To predict the noise immission levels attributable to the BESS, a noise propagation model was created using the propriety noise modelling software CadnaA[12]. Within the software, complex models can be produced to simulate the propagation of noise according to a wide range of international calculation standards. For this assessment noise propagation was calculated in accordance with ISO 9613-2. In order to assess the theoretical precautionary scenario , the model did not include the use of specific mitigation measures such as the use of barriers, attenuated louvres, low noise plant or enclosures. The model also assumed that all plant was operating concurrently, continuously and at maximum noise output.

The assessed receptors are the same as in Table 12-4 above (for the Proposed Wind Farm) and have been labelled as BESS Noise Assessment Locations (BNALs) and shown in context of the BESS location on Figure 12-4.

[11] *Association of Noise Consultants. ANC Good Practice Working Group, BS 4142:2014+A1:2019 Technical Note. s.1. 2020*
[12] *CadnaA (Computer Aided Noise Abatement) software by Datakustik.*

N

Moated Site

Acharue

Gallows Hill

Tullouoreen Cross Rds

Seskinrea

Ridge

Knockagarry

Seskin Upper

The Butts

hilips

NML07 NML01 NML02 NML06 NML05 NML04 NML03

CNAL 1 CNAL 2 CNAL 3 CNAL 4 CNAL 5 CNAL 6 CNAL 7 CNAL 8 CNAL 9 CNAL 10 CNAL 11 CNAL 12 CNAL 13 CNAL 14 CNAL 15 CNAL 16 CNAL 17 CNAL 18

62 63 64 65 66 67 68 69 70

Kilometre
0 0.5 1



## LEGEND

- Proposed EIAR Site Boundary
- Construction Noise Assessment Locations (CNALs)
- Noise Monitoring Locations (NMLs)
- Proposed Turbine Delivery Route
- Proposed Grid Connection Route
- Proposed Turbine Foundation
- Proposed Turbine Hardstanding area
- Proposed New Roads
- Proposed Upgrades to Existing Roads
- Proposed Temporary Construction Compounds
- Proposed Met Mast
- Proposed Battery Energy Compound
- Proposed Onsite 38 kV Substation



| Rev. | Date | Amendment Details | Drawn | Approved |
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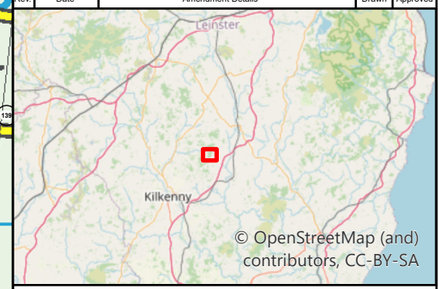
| 0 | 11/03/2024 | FIRST ISSUE | ST | MC |



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Client: EDF renewables

Drawing Status: FOR PLANNING

Project Title: SESKIN WIND FARM, CO. CARLOW

Drawing Title: FIGURE 12-1: CONSTRUCTION NOISE ASSESSMENT LOCATIONS

| Scale: | Original Size: | Spatial Reference: |
|---|---|---|
| 1:12,500 | A3 | IRENET95 Irish Transverse Mercator |

Drawing Number: IE00102-013

N

Moated Site

Black Br

Philips Br

Agharue

Tullougreen Cross Rds

The Butts

Seskinrea

Bridge

Knockagarry

Seski

Gallows Hill

River

NML01 NML02 NML03 NML04 NML05 NML06 NML07

NAL1 NAL2 NAL3 NAL4 NAL5 NAL6 NAL7 NAL8 NAL9 NAL10 NAL11 NAL12 NAL13 NAL14 NAL15 NAL16 NAL17 NAL18

1 2 3 4 5 6 7

62 63 64 65 66 67 68 69 70

RECEIVED: 23/05/2024

0 0.5 1 Kilometre



## LEGEND

- Proposed EIAR Site Boundary
- Noise Monitoring Locations (NMLs)
- Noise Assessment Locations (NALs)

**Wind Farms**

- Seskin (Proposed Project)
- White Hills (Permitted)
- Bilboa (Permitted)
- Gortahile (Existing)

**Noise Sensitive Receptors (NSRs)**

- NSRs Represented By Noise Monitoring Location (NML) 1
- NSRs Represented By Noise Monitoring Location (NML) 2
- NSRs Represented By Noise Monitoring Location (NML) 3
- NSRs Represented By Noise Monitoring Location (NML) 4
- NSRs Represented By Noise Monitoring Location (NML) 5
- NSRs Represented By Noise Monitoring Location (NML) 6
- NSRs Represented By Noise Monitoring Location (NML) 7

| Rev. | Date | Amendment Details | Drawn | Approved |
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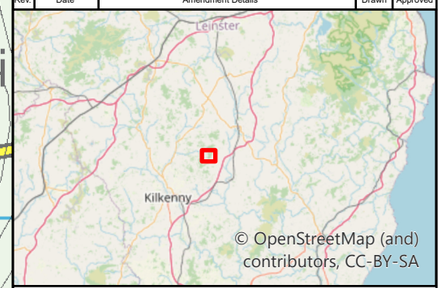
| 0 | 11/03/2024 | FIRST ISSUE | ST | MC |



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Client: EDF renewables

Drawing Status: FOR PLANNING

Project Title: SESKIN WIND FARM, CO. CARLOW

Drawing Title: FIGURE 12-2: WIND FARM NOISE MONITORING AND ASSESSMENT LOCATIONS

| Scale: | Original Size: | Spatial Reference: |
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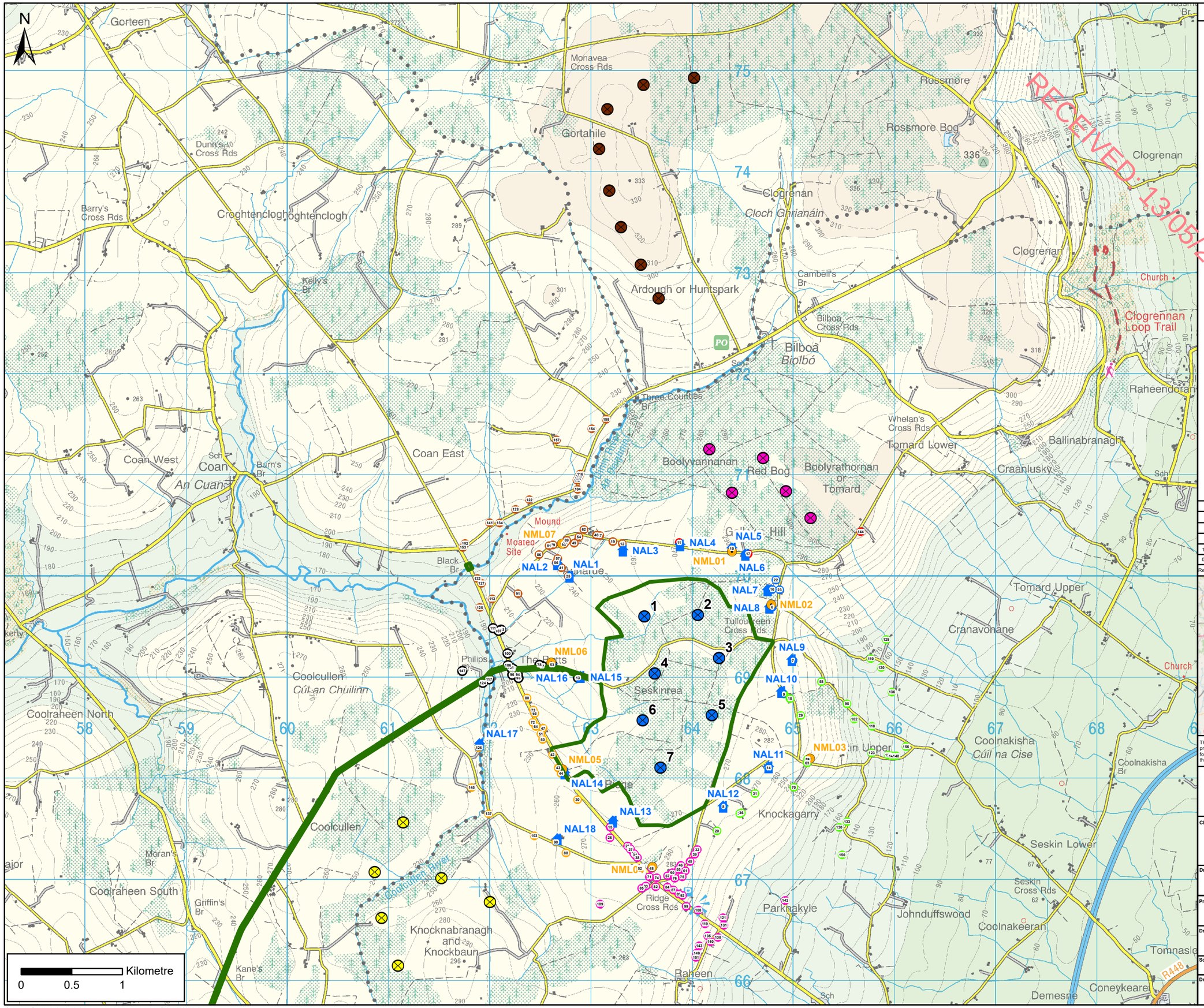
Drawing Number: IE00102-011




## LEGEND

- Proposed EIAR Site Boundary
- Noise Monitoring Locations (NMLs)
- Noise Assessment Locations (NALs)

**Wind Farms**

- Seskin (Proposed Project)
- White Hills (Permitted)
- Bilboa (Permitted)
- Gortahile (Existing)

**Noise Sensitive Receptors (NSRs)**

- NSRs Represented By Noise Monitoring Location (NML) 1
- NSRs Represented By Noise Monitoring Location (NML) 2
- NSRs Represented By Noise Monitoring Location (NML) 3
- NSRs Represented By Noise Monitoring Location (NML) 4
- NSRs Represented By Noise Monitoring Location (NML) 5
- NSRs Represented By Noise Monitoring Location (NML) 6
- NSRs Represented By Noise Monitoring Location (NML) 7

| Rev. | Date | Amendment Details | Drawn | Approved |
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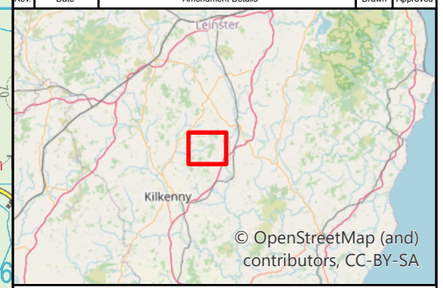
| 0 | 11/03/2024 | FIRST ISSUE | ST | MC |






Client: EDF renewables

Drawing Status: FOR PLANNING

Project Title: SESKIN WIND FARM, CO. CARLOW

Drawing Title: FIGURE 12-3: CUMULATIVE WIND FARM LOCATIONS

| Scale: | Original Size: | Spatial Reference: |
|---|---|---|
| 1:35,000 | A3 | IRENET95 Irish Transverse Mercator |

Drawing Number: IE00102-011


Moated Site

NML07
BNAL02
BNAL01
BNAL03
BNAL04
NML01
BNAL05
BNAL06
BNAL07
NML02
BNAL08
BNAL09
BNAL10
BNAL11
BNAL12
BNAL13
NML04
BNAL14
NML05
BNAL15
NML06
BNAL16
BNAL17
BNAL18

RECEIVED 13/05/2024

N

0 0.5 1 Kilometre



## LEGEND

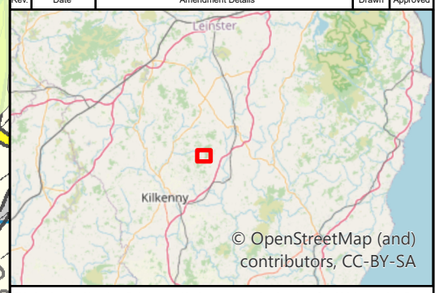
- Proposed EIAR Site Boundary
- Battery Noise Assessments (BNALs)
- Noise Monitoring Locations (NMLs)
- BESS Modelled Noise Sources
- Noise Sensitive Receptors (NSRs)

### Predicted Noise Levels (dBA)

| | |
|---|---|
| 20 - 25 | 55 - 60 |
| 25 - 30 | 60 - 65 |
| 30 - 35 | 65 - 70 |
| 35 - 40 | 70 - 75 |
| 40 - 45 | 75 - 80 |
| 45 - 50 | 80 - 85 |
| 50 - 55 | |

Noise contours modelled in accordance with ISO 9613 Part 2:1996 at a height of 4 m and displayed on a 10 m by 10 m grid. All noise sources assumed to be operating concurrently.
All levels shown as dB LAeq(t)

| Rev. | Date | Amendment Details | Drawn | Approved |
|---|---|---|---|---|
| 0 | 01/05/2024 | CLIENT COMMENTS | JCM | MC |
| 0 | 11/03/2024 | FIRST ISSUE | MR | MC |






Client: EDF renewables

Drawing Status: FOR INFORMATION

Project Title: SESKIN WIND FARM, CO. CARLOW

Drawing Title: FIGURE 12-4: BESS NOISE CONTOUR PLOT

| Scale: | Original Size: | Spatial Reference: |
|---|---|---|
| 1:12,500 | A3 | IRENET95 Irish Transverse Mercator |

Drawing Number: IE00102-012

## 12.4.4 Potential Effects Scoped Out

### 12.4.4.1 Decommissioning

Activities that occur during the decommissioning of the Proposed Project 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. Decommissioning of the Proposed Project is detailed in Section 4.10 of Chapter 4 of this EIAR and in the Decommissioning Plan (Appendix 4-8).

### 12.4.4.2 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 BS 5228-2:2009+A1:2014 *'Code of practice for noise and vibration control on construction and open sites' – Part 2: Vibration* [13]. Following on from these tests, blasts will 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'* [14] and BS6472: 2008 *'Guide to evaluation of human exposure to vibration in buildings. Blast-induced vibration'* [15]. A condition could be attached to the consent to require compliance with these limits.

Given the relative distances between the potential locations of blasting and the closest sensitive receptors, a blast engineer will be able to calculate appropriate MIC values that will ensure that vibration levels will be within the guideline limits detailed within BS 7385-2: 1993 and BS 6472-2: 2008. Therefore, this has been scoped out of further detailed consideration.

## 12.4.5 Method of Baseline Characterisation

### 12.4.5.1 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). A total of 158 NSRs were identified within a 2 km search area, these are nearly all residential properties surrounding the Proposed Wind Farm, only a few were derelict and one is a church. Seven NMLs were selected to represent background noise levels at all NSRs, and they are located to the north, east, south and west of the Proposed Wind Farm. 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 Appendix 12-2.

Construction works related to Proposed Grid Connection Route and road and junction improvements may occur outwith the Proposed Wind Farm site so this has been assessed qualitatively.

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

### 12.4.5.2 Field Survey

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

Background noise monitoring was undertaken over the period 26th January 2023 to 5th April 2023 at seven NMLs (shown on Figure 12-2). The NMLs were installed, where possible within or in proximity to the amenity area at the residential dwellings. The noise monitoring equipment was sited with due consideration of local noise sources such as boiler flues, watercourses, and vegetation. Further details on the NMLs can be found within Appendix 12-2.

*Table 12-5: Summary of Noise Monitoring Locations*

| Receptor | ITM Easting | ITM Northing |
|---|---|---|
| NML1 | 664333 | 670281 |
| NML2 | 664721 | 669755 |
| NML3 | 665105 | 668234 |
| NML4 | 663548 | 667162 |
| NML5 | 662658 | 668128 |
| NML6 | 662547 | 669183 |
| NML7 | 662653 | 670357 |

Simultaneous wind speed/direction data were recorded within the Proposed Wind Farm at various heights using a LiDAR Unit located at Irish Transverse Mercator reference 663858, 669397. The wind speed data collected at 100m and 110m was used to calculate wind speed at 105 m (proposed maximum hub height) which was then standardised to 10m 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. There were no data limitations.

## 12.4.6 Criteria for the Assessment of Effects

The Environmental Protection Agency document *'Guidelines on the information to be contained in Environmental Impact Assessment Reports'* [16] has been adhered to for the assessment of potential effects as summarised below, and detailed in Section 1.7.2 in Chapter 1 of the EIAR.

### 12.4.6.1 Criteria for Assessing Significance – Construction Noise

The significance criteria adopted for this assessment are based on Appendix E part E.3.2 of BS 5228-1:2009+A1:2014 and detailed in

Table 12-6 below.

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

*Table 12-6: Construction Noise Significance Criteria*

| Significance of Effect | Significance Level | |
|---|---|---|
| | Not Significant | Potentially Significant |
| Category A<br>Daytime (07:00 – 19:00) and Saturdays (07:00 to 13:00) | ≤65dB $L_{Aeq, T}$ | >65dB $L_{Aeq, T}$ |
| Category A<br>Evenings and Weekends (19:00 – 23:00) | <55dB $L_{Aeq, T}$ | >55dB $L_{Aeq, T}$ |
| Category A<br>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).* | | |

It should be noted that exceedance of the limit does not in itself indicate a significant effect, rather, the standard states '*If the site noise level exceeds the appropriate category value, then a potential significant effect is indicated. The assessor then needs to consider other project-specific factors, such as the number of receptors affected and the duration and character of the impact, to determine if there is a significant effect.*'

### 12.4.6.2 Criteria for Assessing Significance – Wind Turbine Operational Noise

The DoEHLG 2006 Guidelines 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 DoEHLG 2006 Guidelines derived noise limits ensures that noise from the Proposed Wind Farm will comply with current Government guidance.

In terms of the EIA Regulations, in this noise and vibration assessment the use of the term "significance" refers to compliance or non-compliance with the DoEHLG 2006 Guidelines derived noise limits. For situations where predicted wind turbine noise meets or is less than the noise limits defined in DoEHLG 2006 Guidelines, then the noise effects are deemed not significant. Any breach of the derived Total DoEHLG 2006 Guidelines or Site-Specific Noise Limits due to the Proposed Wind Farm has the potential to result in a significant effect.

It is not possible to predict if OAM will occur at any given site and if it does, how frequent and sustained it might be. In the event that OAM occurs frequently and for sustained periods, it has the potential to result in adverse impacts.

### 12.4.6.3 Criteria for Assessing Significance – BESS Operational Noise

The use of the term 'significance' for the assessment of operational noise from the BESS refers to compliance / non-compliance with the noise BS 8233 fixed noise criteria. Any breach is deemed to result in a significant effect.

#### 12.4.6.4 Limitations and Assumptions

The noise data collected during the background noise survey are representative of the typical background noise levels at the nearest NSRs. The guidance in the DoEHLG 2006 Guidelines 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.

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.

For construction noise, predictions have been undertaken based on an indicative construction programme and typical activities expected.

As detailed in Section 1.7.3 in Chapter 1 of this EIAR, various types and sizes of wind turbines, within the proposed ranges, have been selected and considered in the relevant sections of the EIAR. For the noise and vibration assessment, three candidate wind turbine models have been used for predictions of operational noise from the Proposed Wind Farm, 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 the Local Authority, derived in this noise assessment.

Representative candidate plant were modelled for the BESS noise predictions.

No other assumptions or data gaps have been identified.

## 12.5 Baseline Conditions

### 12.5.1 Current Baseline

The Proposed Wind Farm 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 DoEHLG 2006 Guidelines[17]). The predominant sound sources in the area are wind induced noise (wind passing through vegetation and around buildings) and birdsong, with cars on local roads also audible on occasions.

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 in accordance with best practice. 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 | 18.6 | 21.1 | 22.9 | 24.7 | 26.7 | 29.4 | 32.7 | 36.6 | 40.7 | 44.6 | 47.6 | 48.8 |
| NML2 | 20.9 | 23.3 | 24.9 | 26.2 | 27.8 | 30.0 | 32.9 | 36.4 | 40.4 | 44.4 | 48.0 | 50.4 |

[17] *Section 5.4 of the DoEHLG 2006 Guidelines 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 | 26.8 | 27.5 | 28.5 | 29.7 | 31.2 | 32.9 | 34.9 | 37.2 | 39.7 | 42.5 | 45.6 | 48.9 |
| NML4 | 22.9 | 24.2 | 26.0 | 28.3 | 30.9 | 33.8 | 36.9 | 40.0 | 43.0 | 46.0 | 48.6 | 50.9 |
| NML5 | 30.5 | 30.5 | 30.6 | 31.2 | 32.1 | 33.5 | 35.2 | 37.4 | 39.9 | 42.8 | 46.1 | 49.8 |
| NML6 | 25.3 | 25.7 | 26.3 | 27.0 | 27.9 | 29.2 | 30.8 | 33.0 | 35.8 | 39.3 | 43.7 | 43.7 |
| NML7 | 27.5 | 27.7 | 28.1 | 28.8 | 29.6 | 30.9 | 32.6 | 34.8 | 37.5 | 41.0 | 45.1 | 50.1 |

*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 | 18.6 | 18.6 | 18.8 | 20.6 | 23.6 | 27.4 | 31.7 | 36.0 | 40.1 | 43.4 | 45.8 | 46.6 |
| NML2 | 21.1 | 21.1 | 21.1 | 22.4 | 24.9 | 28.2 | 32.0 | 36.0 | 39.8 | 43.1 | 45.6 | 46.9 |
| NML3 | 23.2 | 23.2 | 23.6 | 24.8 | 26.9 | 29.5 | 32.6 | 36.0 | 39.4 | 42.9 | 46.1 | 48.9 |
| NML4 | 20.1 | 20.1 | 20.1 | 22.2 | 25.6 | 29.9 | 34.4 | 38.7 | 42.4 | 45.3 | 47.2 | 47.9 |
| NML5 | 22.2 | 22.2 | 22.2 | 23.1 | 25.2 | 28.2 | 31.7 | 35.4 | 39.2 | 42.7 | 45.5 | 47.5 |
| NML6 | 20.3 | 20.3 | 20.7 | 21.8 | 23.5 | 25.7 | 28.3 | 31.3 | 34.6 | 38.0 | 41.6 | 45.2 |
| NML7 | 22.6 | 22.6 | 22.6 | 23.3 | 25.0 | 27.5 | 30.4 | 33.7 | 37.1 | 40.4 | 43.3 | 45.7 |

## 12.5.2 Future Baseline

It is possible that noise propagation and resulting noise immission levels could change over the life of the project due to climate change (as noise attenuation is influenced by air temperature, relative humidity, and ground conditions). However, noise limits are set based on current background noise levels in the absence of wind turbine noise and would be set for the lifetime of the Proposed Project. The operator would be required to meet them for the duration of the consent.

## 12.5.3 Summary of Sensitive Receptors

### 12.5.3.1 Scoped Out Receptors

All the buildings within a c. 2 km of the Proposed Wind Farm turbines have been identified. Of the 158 buildings identified, a number have subsequently identified as derelict. These locations are not considered to be NSRs for the purposes of this assessment and have not been considered further. The locations of the NSRs are presented in Figure 12-2.

### 12.5.3.2 Scoped In Receptors

Of all NSRs in the 2km search area (see Figure 12-2) around the Proposed Wind Farm, a sample of the nearest and likely to be most sensitive to noise was labelled as Construction Noise Assessment Locations (CNALs), Noise Assessment Locations (NALs) or Battery Noise Assessment Locations (BNALs), all of which are nearly identical and labelled differently for three specific noise assessments. These were chosen to represent the noise sensitive receptors located closest to the Proposed Project during either the construction or operational phase. Some of the assessment locations were included to consider locations which may be close to both the Proposed Wind Farm and nearby operational/ permitted wind farms.

The assessment results for the CNALs, NALs and BNALs have been presented within the main body of this report, whilst results for all other NSRs have been included for completeness within Annex 3 of Appendices 12-1, Annex 5 of Appendices 12-2 and Annex 6 of Appendix 12-3.

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 thresholds from BS5228 Category A (lowest thresholds in the ABC method) and the 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.

*Table 12-9: Predicted Precautionary Scenario Construction Noise Immission Levels*

| Construction 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 | Night |
| CNAL01 | 65 | 55 | 45 | 39 | 44 | 43 | 42 | 16 |
| CNAL02 | 65 | 55 | 45 | 37 | 42 | 40 | 40 | 17 |
| CNAL03 | 65 | 55 | 45 | 36 | 46 | 44 | 44 | 16 |
| CNAL04 | 65 | 55 | 45 | 35 | 47 | 44 | 45 | 16 |
| CNAL05 | 65 | 55 | 45 | 35 | 44 | 45 | 44 | 15 |
| CNAL06 | 65 | 55 | 45 | 33 | 40 | 40 | 39 | 15 |
| CNAL07 | 65 | 55 | 45 | 34 | 43 | 42 | 42 | 16 |
| CNAL08 | 65 | 55 | 45 | 35 | 43 | 43 | 42 | 16 |
| CNAL09 | 65 | 55 | 45 | 36 | 43 | 43 | 41 | 16 |
| CNAL10 | 65 | 55 | 45 | 38 | 46 | 44 | 42 | 16 |
| CNAL11 | 65 | 55 | 45 | 39 | 43 | 42 | 37 | 15 |
| CNAL12 | 65 | 55 | 45 | 41 | 42 | 42 | 36 | 16 |

| Construction 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 | Night |
| CNAL13 | 65 | 55 | 45 | 48 | 44 | 45 | 40 | 20 |
| CNAL14 | 65 | 55 | 45 | 63 | 46 | 54 | 40 | 24 |
| CNAL15 | 65 | 55 | 45 | 49 | 46 | 47 | 44 | 25 |
| CNAL16 | 65 | 55 | 45 | 44 | 41 | 43 | 40 | 18 |
| CNAL17 | 65 | 55 | 45 | 35 | 35 | 35 | 32 | 12 |
| CNAL18 | 65 | 55 | 45 | 39 | 38 | 38 | 35 | 16 |



The wind turbines construction noise assessment results show that the theoretical precautionary scenario predicted construction noise levels in core hours for Scenarios 1-4 are below the 65 dB(A) threshold Levels at all CNALs. The night-time scenario included in the assessment to appraise an unlikely occurrence of work occurring outside of core hours also shows that predictions are below the night-time 45 dB(A) criteria at all CNALs. If considering potential evening and week-end work (outside of core hours), the predictions shows that the Evenings and Weekends 55 dB(A) criteria could be exceeded at CNAL14 located immediately adjacent to the site entrance tracks, however this would be assuming construction of tracks right next to the property in an evening which is outside the proposed core hours and is therefore not anticipated to occur. Therefore, there would be **no significant construction noise effects**.

For the Proposed Grid Connection Route, the amount of required plant is relatively small, typically being based around an excavator for trenching and backfill activities. As such, construction activities in any one location will be limited in duration and adverse noise effects are anticipated to be negligible. Where construction activities occur directly beside a dwelling, the noise levels at that location are likely to be in the region of 75 – 80 dB(A) for a short period of time. It should be noted, however, that this would only occur where construction activities are directly outside the curtilage of a dwelling within approximately 20m and would result in an instant noise level increase (i.e. not considering a full construction day). To put this into context, trenching and backfill activities are anticipated to move along the Proposed Grid Connection Route at approximately 150m to 300m a day, therefore, the length of time when construction activities will be occurring adjacent to any given receptor is only likely to be for a few hours. For the majority of the time, plant and equipment will be located at greater distances from dwellings and therefore, noise levels will be lower. It is possible that noise levels from trenching and backfill operations may occasionally exceed the BS 5228 threshold if within 20m to a dwelling, however this would only occur for a short period of time at any one location.

At some watercourse, culvert and drain crossings there may be a requirement for Horizontal Directional Drilling (HDD). Specifically, this could be required for some small bridge or water crossings. HDD for large crossings would require the use of multiple items of plant including pumps, mud recyclers, drilling rigs and generators, however, the proposed plant for these small crossings is a small Vermeer D36 x 50 Directional Drill. Calculations of the Vermeer DD rig, assuming a source noise level of 94 dB(A) at 1m, indicates that noise levels would be below the 65dB(A) threshold from a distance of approximately 30m. For small crossings, the work would likely be completed within 1 and 2 weeks so it will be short term only. Where activities involving the small HDD drilling rig are within 30m of a dwelling then noise mitigation measures will be implemented. This includes the erection of temporary boarding alongside the drilling rig or use of 'acoustic blanket panels' to hang from heras fencing or similar. This should be installed 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. Examples of appropriate products include Echo Noise Defender and Soundex DeciBloc.

Construction works related to distant road junction improvements may also occur outwith the CNALs considered above, in close proximity to some residential receptors. It is possible that noise from these activities may at times exceed the guideline levels, however it should be noted that this will be a short-term, temporary impact. Good practice during construction is recommended and will reduce noise levels from these short-term works to minimum levels.

Accordingly, the impact is deemed **not significant for construction activities associated with cable trenching, bridge crossings and distant road junction upgrades**.

## 12.6.2 Potential Construction Vibration Effects

Due to the large separation distances between the construction activity areas on the Proposed Wind Farm site and the nearest receptors, no significant effects are anticipated. Where construction activities on the Proposed Grid Connection Route are close to residential receptors, some local vibration effects may be present, however, levels are expected to be low and of limited duration. Also, similarly to construction noise, good practice during construction is recommended and will reduce vibration levels from these short-term works to minimum levels. Accordingly, the impact is deemed **not significant for construction vibration.**

## 12.6.3 Potential Operational Noise Effects

### 12.6.3.1 Setting the Total DoEHLG 2006 Guidelines Noise Limits (Stage 1)

Based on the prevailing background noise levels, the Total DoEHLG 2006 Guidelines 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 DoEHLG 2006 Guidelines 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 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 45.0 | 45.0 | 45.0 | 45.0 | 46.0 | 50.1 | 55.1 |
| NAL2 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 45.0 | 45.0 | 45.0 | 45.0 | 46.0 | 50.1 | 55.1 |
| NAL3 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 45.0 | 45.0 | 45.0 | 45.0 | 46.0 | 50.1 | 55.1 |
| NAL4* | 40.0 | 40.0 | 40.0 | 45.0 | 45.0 | 45.0 | 45.0 | 45.0 | 45.7 | 49.6 | 52.6 | 53.8 |
| NAL5* | 40.0 | 40.0 | 40.0 | 45.0 | 45.0 | 45.0 | 45.0 | 45.0 | 45.7 | 49.6 | 52.6 | 53.8 |
| NAL6* | 40.0 | 40.0 | 40.0 | 45.0 | 45.0 | 45.0 | 45.0 | 45.0 | 45.7 | 49.6 | 52.6 | 53.8 |
| NAL7 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 45.0 | 45.0 | 45.0 | 45.4 | 49.4 | 53.0 | 55.4 |
| NAL8 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 45.0 | 45.0 | 45.0 | 45.4 | 49.4 | 53.0 | 55.4 |
| NAL9 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 45.0 | 45.0 | 45.0 | 45.4 | 49.4 | 53.0 | 55.4 |
| NAL10 | 40.0 | 40.0 | 40.0 | 40.0 | 45.0 | 45.0 | 45.0 | 45.0 | 45.0 | 47.5 | 50.6 | 53.9 |
| NAL11 | 40.0 | 40.0 | 40.0 | 40.0 | 45.0 | 45.0 | 45.0 | 45.0 | 45.0 | 47.5 | 50.6 | 53.9 |
| NAL12 | 40.0 | 40.0 | 40.0 | 40.0 | 45.0 | 45.0 | 45.0 | 45.0 | 45.0 | 47.5 | 50.6 | 53.9 |
| NAL13 | 40.0 | 40.0 | 40.0 | 40.0 | 45.0 | 45.0 | 45.0 | 45.0 | 48.0 | 51.0 | 53.6 | 55.9 |

| Noise Assessment Location | Wind Speed ($ms^{-1}$) as standardised to 10m height | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| NAL14 | 45.0 | 45.0 | 45.0 | 45.0 | 45.0 | 45.0 | 45.0 | 45.0 | 45.0 | 47.8 | 51.1 | 54.8 |
| NAL15 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 45.0 | 45.0 | 45.0 | 45.0 | 48.7 | 48.7 |
| NAL16 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 45.0 | 45.0 | 45.0 | 45.0 | 48.7 | 48.7 |
| NAL17** | 45.0 | 45.0 | 45.0 | 45.0 | 45.0 | 45.0 | 45.0 | 45.0 | 45.0 | 47.8 | 51.1 | 54.8 |
| NAL18** | 45.0 | 45.0 | 45.0 | 45.0 | 45.0 | 45.0 | 45.0 | 45.0 | 45.0 | 47.8 | 51.1 | 54.8 |

** for NAL 4, 5, 6 daytime, fixed at 45dB from 4m/s as per Bilboa Wind Farm noise condition.*
*** for NAL 17 and 18, fixed at 45dB from 5m/s as per White Hill Wind Farm noise condition.*

*Table 12-11: Total DoEHLG 2006 Guidelines 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 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 45.4 | 48.3 | 50.7 |
| NAL2 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 45.4 | 48.3 | 50.7 |
| NAL3 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 45.4 | 48.3 | 50.7 |
| NAL4 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 45.1 | 48.4 | 50.8 | 51.6 |
| NAL5 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 45.1 | 48.4 | 50.8 | 51.6 |
| NAL6 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 45.1 | 48.4 | 50.8 | 51.6 |
| NAL7 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 44.8 | 48.1 | 50.6 | 51.9 |
| NAL8 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 44.8 | 48.1 | 50.6 | 51.9 |
| NAL9 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 44.8 | 48.1 | 50.6 | 51.9 |
| NAL10 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 44.4 | 47.9 | 51.1 | 53.9 |
| NAL11 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 44.4 | 47.9 | 51.1 | 53.9 |
| NAL12 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 44.4 | 47.9 | 51.1 | 53.9 |
| NAL13 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.7 | 47.4 | 50.3 | 52.2 | 52.9 |
| NAL14 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 44.2 | 47.7 | 50.5 | 52.5 |
| NAL15 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 46.6 | 50.2 |
| NAL16 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 46.6 | 50.2 |
| NAL17 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 44.2 | 47.7 | 50.5 | 52.5 |
| NAL18 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 44.2 | 47.7 | 50.5 | 52.5 |

### 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 DoEHLG 2006 Guidelines Noise Limits and predicted likely cumulative Proposed Wind Farm noise levels for daytime hours and night-time hours, when using the Vestas V150 6.0 MW on a 105m hub, as the precautionary scenario candidate wind turbine for the Proposed Wind Farm.

The result of the likely cumulative noise assessment show that the Proposed Wind Farm can operate concurrently with the other operational and permitted wind farms in the area, whilst still meeting the Total DoEHLG 2006 Guidelines Noise limits at all NALs expect NAL15 and as such there would be **no significant effects** at those receptors. At NAL15 a marginal exceedance of 0.7 dB is observed during the daytime period at 6 $ms^{-1}$. There would therefore be a potential **significant effect** at NAL15. Mitigation in the form of low noise mode operation is proposed for specific wind speed and direction, for the Proposed Wind Farm. To put the exceedance 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 DoEHLG 2006 Guidelines 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.'*

It is not possible to predict if OAM will occur at the NALs surrounding this Proposed Project and if it does, how frequent and sustained it might be. In the event that frequent and sustained OAM occurs there is the potential for this to result in an adverse impact in the absence of mitigation.

*Table 12-12: Compliance Table – Comparison of predicted likely cumulative noise levels (all schemes) against the Total DoEHLG 2006 Guidelines 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 | Total DoEHLG 2006 Guidelines Noise Limit | 40 | 40 | 40 | 40 | 40 | 45 | 45 | 45 | 45 | 46 | 50.1 | 55.1 |
| | Predicted Cumulative Wind Turbine Noise $L_{A90}$ | - | - | 27.3 | 30.6 | 34.8 | 38.1 | 38.9 | 39.0 | 39.0 | 39.1 | 39.1 | 39.1 |
| | Exceedance Level | - | - | -12.7 | -9.4 | -5.2 | -6.9 | -6.1 | -6 | -6 | -6.9 | -11 | -16 |
| NAL2 | Total DoEHLG 2006 Guidelines Noise Limit | 40 | 40 | 40 | 40 | 40 | 45 | 45 | 45 | 45 | 46 | 50.1 | 55.1 |
| | Predicted Cumulative Wind Turbine Noise $L_{A90}$ | - | - | 26.3 | 29.6 | 33.8 | 37 | 37.8 | 37.9 | 38 | 38 | 38 | 38 |
| | Exceedance Level | - | - | -13.7 | -10.4 | -6.2 | -8.0 | -7.2 | -7.1 | -7.0 | -8.0 | -12.1 | -17.1 |
| NAL3 | Total DoEHLG 2006 Guidelines Noise Limit | 40 | 40 | 40 | 40 | 40 | 45 | 45 | 45 | 45 | 46 | 50.1 | 55.1 |
| | Predicted Cumulative Wind Turbine Noise $L_{A90}$ | - | - | 29.1 | 32.4 | 36.6 | 39.8 | 40.5 | 40.7 | 40.7 | 40.7 | 40.7 | 40.7 |
| | Exceedance Level | - | - | -10.9 | -7.6 | -3.4 | -5.2 | -4.5 | -4.3 | -4.3 | -5.3 | -9.4 | -14.4 |
| NAL4 | Total DoEHLG 2006 Guidelines Noise Limit | 40.0 | 40.0 | 40.0 | 45.0 | 45.0 | 45.0 | 45.0 | 45.0 | 45.7 | 49.6 | 52.6 | 53.8 |
| | Predicted Cumulative Wind Turbine Noise $L_{A90}$ | - | - | 30.3 | 33.4 | 37.6 | 40.6 | 41.3 | 41.4 | 41.6 | 41.6 | 41.6 | 41.6 |
| | Exceedance Level | - | - | -9.7 | -11.6 | -7.4 | -4.4 | -3.7 | -3.6 | -4.1 | -8 | -11 | -12.2 |
| NAL5 | Total DoEHLG 2006 Guidelines Noise Limit | 40 | 40 | 40 | 45 | 45 | 45 | 45 | 45 | 45.7 | 49.6 | 52.6 | 53.8 |
| | Predicted Cumulative Wind Turbine Noise $L_{A90}$ | - | - | 30.3 | 33.5 | 37.6 | 40.5 | 41.2 | 41.3 | 41.5 | 41.5 | 41.5 | 41.5 |
| | Exceedance Level | - | - | -9.7 | -11.5 | -7.4 | -4.5 | -3.8 | -3.7 | -4.2 | -8.1 | -11.1 | -12.3 |
| NAL6 | Total DoEHLG 2006 Guidelines Noise Limit | 40 | 40 | 40 | 45 | 45 | 45 | 45 | 45 | 45.7 | 49.6 | 52.6 | 53.8 |
| | Predicted Cumulative Wind Turbine Noise $L_{A90}$ | - | - | 30.4 | 33.5 | 37.6 | 40.5 | 41.2 | 41.4 | 41.5 | 41.6 | 41.6 | 41.6 |

| NAL | | Wind Speed ($ms^{-1}$) as standardised to 10m height | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| | Exceedance Level | - | - | -9.6 | -11.5 | -7.4 | -4.5 | -3.8 | -3.6 | -4.2 | -8.0 | -11.0 | -12.2 |
| NAL7 | Total DoEHLG 2006 Guidelines Noise Limit | 40 | 40 | 40 | 40 | 40 | 45 | 45 | 45 | 45.4 | 49.4 | 53 | 55.4 |
| | Predicted Cumulative Wind Turbine Noise $L_{A90}$ | - | - | 29.6 | 32.8 | 37 | 40.2 | 40.9 | 41 | 41.1 | 41.2 | 41.2 | 41.2 |
| | Exceedance Level | - | - | -10.4 | -7.2 | -3 | -4.8 | -4.1 | -4 | -4.3 | -8.2 | -11.8 | -14.2 |
| NAL8 | Total DoEHLG 2006 Guidelines Noise Limit | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 45.0 | 45.0 | 45.0 | 45.4 | 49.4 | 53.0 | 55.4 |
| | Predicted Cumulative Wind Turbine Noise $L_{A90}$ | - | - | 30.2 | 33.4 | 37.6 | 40.8 | 41.6 | 41.7 | 41.7 | 41.8 | 41.8 | 41.8 |
| | Exceedance Level | - | - | -9.8 | -6.6 | -2.4 | -4.2 | -3.4 | -3.3 | -3.7 | -7.6 | -11.2 | -13.6 |
| NAL9 | Total DoEHLG 2006 Guidelines Noise Limit | 40 | 40 | 40 | 40 | 40 | 45 | 45 | 45 | 45.4 | 49.4 | 53 | 55.4 |
| | Predicted Cumulative Wind Turbine Noise $L_{A90}$ | - | - | 28.9 | 32.2 | 36.4 | 39.7 | 40.5 | 40.6 | 40.6 | 40.7 | 40.7 | 40.7 |
| | Exceedance Level | - | - | -11.1 | -7.8 | -3.6 | -5.3 | -4.5 | -4.4 | -4.8 | -8.7 | -12.3 | -14.7 |
| NAL10 | Total DoEHLG 2006 Guidelines Noise Limit | 40 | 40 | 40 | 40 | 45 | 45 | 45 | 45 | 45 | 47.5 | 50.6 | 53.9 |
| | Predicted Cumulative Wind Turbine Noise $L_{A90}$ | - | - | 29.5 | 32.8 | 37.1 | 40.5 | 41.3 | 41.4 | 41.4 | 41.4 | 41.4 | 41.4 |
| | Exceedance Level | - | - | -10.5 | -7.2 | -7.9 | -4.5 | -3.7 | -3.6 | -3.6 | -6.1 | -9.2 | -12.5 |
| NAL11 | Total DoEHLG 2006 Guidelines Noise Limit | 40 | 40 | 40 | 40 | 45 | 45 | 45 | 45 | 45 | 47.5 | 50.6 | 53.9 |
| | Predicted Cumulative Wind Turbine Noise $L_{A90}$ | - | - | 27.9 | 31.2 | 35.4 | 38.8 | 39.6 | 39.7 | 39.8 | 39.8 | 39.8 | 39.8 |
| | Exceedance Level | - | - | -12.1 | -8.8 | -9.6 | -6.2 | -5.4 | -5.3 | -5.2 | -7.7 | -10.8 | -14.1 |
| NAL12 | Total DoEHLG 2006 Guidelines Noise Limit | 40.0 | 40.0 | 40.0 | 40.0 | 45.0 | 45.0 | 45.0 | 45.0 | 45.0 | 47.5 | 50.6 | 53.9 |
| | Predicted Cumulative Wind Turbine Noise $L_{A90}$ | - | - | 28.2 | 31.5 | 35.8 | 39.2 | 40 | 40.1 | 40.1 | 40.1 | 40.1 | 40.1 |

| NAL | | Wind Speed ($ms^{-1}$) as standardised to 10m height | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| | Exceedance Level | - | - | -11.8 | -8.5 | -9.2 | -5.8 | -5 | -4.9 | -4.9 | -7.4 | -10.5 | -13.8 |
| NAL13 | Total DoEHLG 2006 Guidelines Noise Limit | 40 | 40 | 40 | 40 | 45 | 45 | 45 | 45 | 48 | 51 | 53.6 | 55.9 |
| | Predicted Cumulative Wind Turbine Noise $L_{A90}$ | - | - | 28.2 | 31.3 | 35.5 | 39.0 | 39.8 | 39.9 | 39.9 | 39.9 | 39.9 | 39.9 |
| | Exceedance Level | - | - | -11.8 | -8.7 | -9.5 | -6 | -5.2 | -5.1 | -8.1 | -11.1 | -13.7 | -16 |
| NAL14 | Total DoEHLG 2006 Guidelines Noise Limit | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 47.8 | 51.1 | 54.8 |
| | Predicted Cumulative Wind Turbine Noise $L_{A90}$ | - | - | 26.8 | 30.2 | 34.4 | 37.8 | 38.6 | 38.8 | 38.8 | 38.8 | 38.8 | 38.8 |
| | Exceedance Level | - | - | -18.2 | -14.8 | -10.6 | -7.2 | -6.4 | -6.2 | -6.2 | -9.0 | -12.3 | -16.0 |
| NAL15 | Total DoEHLG 2006 Guidelines Noise Limit | 40 | 40 | 40 | 40 | 40 | 40 | 45 | 45 | 45 | 45 | 48.7 | 48.7 |
| | Predicted Cumulative Wind Turbine Noise $L_{A90}$ | - | - | 29.6 | 33 | 37.2 | **40*** | 41.5 | 41.6 | 41.6 | 41.6 | 41.6 | 41.6 |
| | Exceedance Level | - | - | -10.4 | -7 | -2.8 | **0*** | -3.5 | -3.4 | -3.4 | -3.4 | -7.1 | -7.1 |
| NAL16 | Total DoEHLG 2006 Guidelines Noise Limit | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 45.0 | 45.0 | 45.0 | 45.0 | 48.7 | 48.7 |
| | Predicted Cumulative Wind Turbine Noise $L_{A90}$ | - | - | 27.2 | 30.5 | 34.8 | 38.2 | 39 | 39.1 | 39.1 | 39.1 | 39.1 | 39.1 |
| | Exceedance Level | - | - | -12.8 | -9.5 | -5.2 | -1.8 | -6 | -5.9 | -5.9 | -5.9 | -9.6 | -9.6 |
| NAL17 | Total DoEHLG 2006 Guidelines Noise Limit | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 47.8 | 51.1 | 54.8 |
| | Predicted Cumulative Wind Turbine Noise $L_{A90}$ | - | - | 26.5 | 28.7 | 32.7 | 36.2 | 37.2 | 37.2 | 37.2 | 37.2 | 37.2 | 37.2 |
| | Exceedance Level | - | - | -18.5 | -16.3 | -12.3 | -8.8 | -7.8 | -7.8 | -7.8 | -10.6 | -13.9 | -17.6 |
| NAL18 | Total DoEHLG 2006 Guidelines Noise Limit | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 47.8 | 51.1 | 54.8 |
| | Predicted Cumulative Wind Turbine Noise $L_{A90}$ | - | - | 27.3 | 29.3 | 33.4 | 36.8 | 37.8 | 37.8 | 37.8 | 37.8 | 37.8 | 37.8 |

| NAL | | Wind Speed ($ms^{-1}$) as standardised to 10m height | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| | Exceedance Level | - | - | -17.7 | -15.7 | -11.6 | -8.2 | -7.2 | -7.2 | -7.2 | -10.0 | -13.3 | -17.0 |

**a 0.7 dB exceedance was predicted in full mode for the V150. The values shown in the table include the application of reduced noise mode for a limited range of wind speeds and wind directions.*

*Table 12-13: Compliance Table – Comparison of predicted likely cumulative noise levels (all schemes) against the Total DoEHLG 2006 Guidelines 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 | Total DoEHLG 2006 Guidelines Noise Limit | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 45.4 | 48.3 | 50.7 |
| | Predicted Cumulative Wind Turbine Noise $L_{A90}$ | - | - | 27.3 | 30.6 | 34.8 | 38.1 | 38.9 | 39.0 | 39.0 | 39.1 | 39.1 | 39.1 |
| | Exceedance Level | - | - | -15.7 | -12.4 | -8.2 | -4.9 | -4.1 | -4 | -4 | -6.3 | -9.2 | -11.6 |
| NAL2 | Total DoEHLG 2006 Guidelines Noise Limit | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 45.4 | 48.3 | 50.7 |
| | Predicted Cumulative Wind Turbine Noise $L_{A90}$ | - | - | 26.3 | 29.6 | 33.8 | 37 | 37.8 | 37.9 | 38 | 38 | 38 | 38 |
| | Exceedance Level | - | - | -16.7 | -13.4 | -9.2 | -6.0 | -5.2 | -5.1 | -5.0 | -7.4 | -10.3 | -12.7 |
| NAL3 | Total DoEHLG 2006 Guidelines Noise Limit | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 45.4 | 48.3 | 50.7 |
| | Predicted Cumulative Wind Turbine Noise $L_{A90}$ | - | - | 29.1 | 32.4 | 36.6 | 39.8 | 40.5 | 40.7 | 40.7 | 40.7 | 40.7 | 40.7 |
| | Exceedance Level | - | - | -13.9 | -10.6 | -6.4 | -3.2 | -2.5 | -2.3 | -2.3 | -4.7 | -7.6 | -10 |
| NAL4 | Total DoEHLG 2006 Guidelines Noise Limit | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 45.1 | 48.4 | 50.8 | 51.6 |
| | Predicted Cumulative Wind Turbine Noise $L_{A90}$ | - | - | 30.3 | 33.4 | 37.6 | 40.6 | 41.3 | 41.4 | 41.6 | 41.6 | 41.6 | 41.6 |
| | Exceedance Level | - | - | -12.7 | -9.6 | -5.4 | -2.4 | -1.7 | -1.6 | -3.5 | -6.8 | -9.2 | -10 |
| NAL5 | Total DoEHLG 2006 Guidelines Noise Limit | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 45.1 | 48.4 | 50.8 | 51.6 |
| | Predicted Cumulative Wind Turbine Noise $L_{A90}$ | - | - | 30.3 | 33.5 | 37.6 | 40.5 | 41.2 | 41.3 | 41.5 | 41.5 | 41.5 | 41.5 |
| | Exceedance Level | - | - | -12.7 | -9.5 | -5.4 | -2.5 | -1.8 | -1.7 | -3.6 | -6.9 | -9.3 | -10.1 |
| NAL6 | Total DoEHLG 2006 Guidelines Noise Limit | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 45.1 | 48.4 | 50.8 | 51.6 |
| | Predicted Cumulative Wind Turbine Noise $L_{A90}$ | - | - | 30.4 | 33.5 | 37.6 | 40.5 | 41.2 | 41.4 | 41.5 | 41.6 | 41.6 | 41.6 |

| NAL | | Wind Speed ($ms^{-1}$) as standardised to 10m height | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| | Exceedance Level | - | - | -12.6 | -9.5 | -5.4 | -2.5 | -1.8 | -1.6 | -3.6 | -6.8 | -9.2 | -10.0 |
| NAL7 | Total DoEHLG 2006 Guidelines Noise Limit | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 44.8 | 48.1 | 50.6 | 51.9 |
| | Predicted Cumulative Wind Turbine Noise $L_{A90}$ | - | - | 29.6 | 32.8 | 37 | 40.2 | 40.9 | 41 | 41.1 | 41.2 | 41.2 | 41.2 |
| | Exceedance Level | - | - | -13.4 | -10.2 | -6 | -2.8 | -2.1 | -2 | -3.7 | -6.9 | -9.4 | -10.7 |
| NAL8 | Total DoEHLG 2006 Guidelines Noise Limit | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 44.8 | 48.1 | 50.6 | 51.9 |
| | Predicted Cumulative Wind Turbine Noise $L_{A90}$ | - | - | 30.2 | 33.4 | 37.6 | 40.8 | 41.6 | 41.7 | 41.7 | 41.8 | 41.8 | 41.8 |
| | Exceedance Level | - | - | -12.8 | -9.6 | -5.4 | -2.2 | -1.4 | -1.3 | -3.1 | -6.3 | -8.8 | -10.1 |
| NAL9 | Total DoEHLG 2006 Guidelines Noise Limit | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 44.8 | 48.1 | 50.6 | 51.9 |
| | Predicted Cumulative Wind Turbine Noise $L_{A90}$ | - | - | 28.9 | 32.2 | 36.4 | 39.7 | 40.5 | 40.6 | 40.6 | 40.7 | 40.7 | 40.7 |
| | Exceedance Level | - | - | -14.1 | -10.8 | -6.6 | -3.3 | -2.5 | -2.4 | -4.2 | -7.4 | -9.9 | -11.2 |
| NAL10 | Total DoEHLG 2006 Guidelines Noise Limit | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 44.4 | 47.9 | 51.1 | 53.9 |
| | Predicted Cumulative Wind Turbine Noise $L_{A90}$ | - | - | 29.5 | 32.8 | 37.1 | 40.5 | 41.3 | 41.4 | 41.4 | 41.4 | 41.4 | 41.4 |
| | Exceedance Level | - | - | -13.5 | -10.2 | -5.9 | -2.5 | -1.7 | -1.6 | -3.0 | -6.5 | -9.7 | -12.5 |
| NAL11 | Total DoEHLG 2006 Guidelines Noise Limit | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 44.4 | 47.9 | 51.1 | 53.9 |
| | Predicted Cumulative Wind Turbine Noise $L_{A90}$ | - | - | 27.9 | 31.2 | 35.4 | 38.8 | 39.6 | 39.7 | 39.8 | 39.8 | 39.8 | 39.8 |
| | Exceedance Level | - | - | -15.1 | -11.8 | -7.6 | -4.2 | -3.4 | -3.3 | -4.6 | -8.1 | -11.3 | -14.1 |
| NAL12 | Total DoEHLG 2006 Guidelines Noise Limit | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 44.4 | 47.9 | 51.1 | 53.9 |
| | Predicted Cumulative Wind Turbine Noise $L_{A90}$ | - | - | 28.2 | 31.5 | 35.8 | 39.2 | 40 | 40.1 | 40.1 | 40.1 | 40.1 | 40.1 |

| NAL | | Wind Speed ($ms^{-1}$) as standardised to 10m height | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| | Exceedance Level | - | - | -14.8 | -11.5 | -7.2 | -3.8 | -3 | -2.9 | -4.3 | -7.8 | -11 | -13.8 |
| NAL13 | Total DoEHLG 2006 Guidelines Noise Limit | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43.7 | 47.4 | 50.3 | 52.2 | 52.9 |
| | Predicted Cumulative Wind Turbine Noise $L_{A90}$ | - | - | 28.2 | 31.3 | 35.5 | 39.0 | 39.8 | 39.9 | 39.9 | 39.9 | 39.9 | 39.9 |
| | Exceedance Level | - | - | -14.8 | -11.7 | -7.5 | -4 | -3.2 | -3.8 | -7.5 | -10.4 | -12.3 | -13 |
| NAL14 | Total DoEHLG 2006 Guidelines Noise Limit | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 44.2 | 47.7 | 50.5 | 52.5 |
| | Predicted Cumulative Wind Turbine Noise $L_{A90}$ | - | - | 26.8 | 30.2 | 34.4 | 37.8 | 38.6 | 38.8 | 38.8 | 38.8 | 38.8 | 38.8 |
| | Exceedance Level | - | - | -16.2 | -12.8 | -8.6 | -5.2 | -4.4 | -4.2 | -5.4 | -8.9 | -11.7 | -13.7 |
| NAL15 | Total DoEHLG 2006 Guidelines Noise Limit | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 46.6 | 50.2 |
| | Predicted Cumulative Wind Turbine Noise $L_{A90}$ | - | - | 29.6 | 33 | 37.2 | 40.7 | 41.5 | 41.6 | 41.6 | 41.6 | 41.6 | 41.6 |
| | Exceedance Level | - | - | -13.4 | -10 | -5.8 | -2.3 | -1.5 | -1.4 | -1.4 | -1.4 | -5 | -8.6 |
| NAL16 | Total DoEHLG 2006 Guidelines Noise Limit | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 43.0 | 46.6 | 50.2 |
| | Predicted Cumulative Wind Turbine Noise $L_{A90}$ | - | - | 27.2 | 30.5 | 34.8 | 38.2 | 39 | 39.1 | 39.1 | 39.1 | 39.1 | 39.1 |
| | Exceedance Level | - | - | -15.8 | -12.5 | -8.2 | -4.8 | -4 | -3.9 | -3.9 | -3.9 | -7.5 | -11.1 |
| NAL17 | Total DoEHLG 2006 Guidelines Noise Limit | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 44.2 | 47.7 | 50.5 | 52.5 |
| | Predicted Cumulative Wind Turbine Noise $L_{A90}$ | - | - | 26.5 | 28.7 | 32.7 | 36.2 | 37.2 | 37.2 | 37.2 | 37.2 | 37.2 | 37.2 |
| | Exceedance Level | - | - | -16.5 | -14.3 | -10.3 | -6.8 | -5.8 | -5.8 | -7 | -10.5 | -13.3 | -15.3 |
| NAL18 | Total DoEHLG 2006 Guidelines Noise Limit | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 44.2 | 47.7 | 50.5 | 52.5 |
| | Predicted Cumulative Wind Turbine Noise $L_{A90}$ | - | - | 27.3 | 29.3 | 33.4 | 36.8 | 37.8 | 37.8 | 37.8 | 37.8 | 37.8 | 37.8 |

| NAL | | Wind Speed ($ms^{-1}$) as standardised to 10m height | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| | Exceedance Level | - | - | -15.7 | -13.7 | -9.6 | -6.2 | -5.2 | -5.2 | -6.4 | -9.9 | -12.7 | -14.7 |

### 12.6.3.3 Operational Phase - Derivation of Site-Specific Noise Limits for the Proposed Wind Farm (Stage 3)

In order to protect residential amenity, the initial recommendations are that cumulatively, all wind farms (including the Proposed Wind Farm) operate within the Total DoEHLG 2006 Guidelines Noise Limits, as demonstrated in the Stage 2 above.

Another 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 Wind Farm are required; these have been derived for each NAL except NAL4-6 (near the permitted Bilboa Wind Farm) where a cumulative noise condition is proposed instead due to existing noise limits at those NALs and close proximity between the Proposed Wind Farm and the permitted Bilboa Wind Farm.

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 Wind Farm.

The Site-Specific Noise Limits were compared to the predictions of the Proposed Wind Farm operating on its own, and the results, based on the precautionary scenario candidate turbine for the Proposed Wind Farm (Vestas V150), are summarised below in Table 12-14 for the daytime and Table 12-15 for the night-time. More details on the calculation of the Site-Specific Noise Limits and predictions for the other two candidate wind turbines is provided in Appendix 12-2 and show very similar predictions and outcomes when compared to the V150.

The Stage 3 assessment shows that the predicted wind turbine noise levels from the Proposed Wind Farm on its own meet the Site-Specific Noise Limits at NALs 1-3, 7-14, 16-18 for both daytime and night time periods and as such there would be **no significant effects** at those receptors. At NAL15 a small exceedance of the Site-Specific Noise Limit was predicted during the daytime at 6 $ms^{-1}$ (0.8 dB). There would therefore be a potential **significant effect** at NAL15. Mitigation in the form of low noise mode operation is proposed for specific wind speed and direction, for the candidate turbine.

As detailed Site-Specific Noise Limits have not been derived for NALs 4-6 and these receptors are assessed below based on a Cumulative Noise Conditioning.

*Table 12-14: Compliance Table – Comparison of predicted noise levels from the Proposed Wind Farm 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 | Site-Specific Noise Limit, $L_{A90}$ | - | - | 39.9 | 39.9 | 39.6 | 44.8 | 44.8 | 44.7 | 44.7 | 45.8 | 50.0 | 55.1 |
| | Proposed Wind Farm Turbine Noise $L_{A90}$ | - | - | 25.9 | 29.3 | 33.6 | 37.1 | 37.9 | 38.0 | 38.0 | 38.0 | 38.0 | 38.0 |
| | Exceedance Level | - | - | -14.0 | -10.6 | -6.0 | -7.7 | -6.9 | -6.7 | -6.7 | -7.8 | -12.0 | -17.1 |
| NAL2 | Site-Specific Noise Limit, $L_{A90}$ | - | - | 39.9 | 39.9 | 39.6 | 44.8 | 44.8 | 44.8 | 44.7 | 45.8 | 50.0 | 55.1 |
| | Proposed Wind Farm Turbine Noise $L_{A90}$ | - | - | 24.4 | 27.8 | 32.1 | 35.6 | 36.4 | 36.5 | 36.5 | 36.5 | 36.5 | 36.5 |
| | Exceedance Level | - | - | -15.5 | -12.1 | -7.5 | -9.2 | -8.4 | -8.3 | -8.2 | -9.3 | -13.5 | -18.6 |
| NAL3 | Site-Specific Noise Limit, $L_{A90}$ | - | - | 39.9 | 39.7 | 39.3 | 44.6 | 44.6 | 44.6 | 44.5 | 45.6 | 50.0 | 55.1 |
| | Proposed Wind Farm Turbine Noise $L_{A90}$ | - | - | 27.5 | 30.9 | 35.2 | 38.7 | 39.5 | 39.6 | 39.6 | 39.6 | 39.6 | 39.6 |
| | Exceedance Level | - | - | -12.4 | -8.8 | -4.1 | -5.9 | -5.1 | -5.0 | -4.9 | -6.0 | -10.4 | -15.5 |
| NAL7 | Site-Specific Noise Limit, $L_{A90}$ | - | - | 39.8 | 39.6 | 38.8 | 44.4 | 44.4 | 44.3 | 44.7 | 49.1 | 52.9 | 55.3 |
| | Proposed Wind Farm Turbine Noise $L_{A90}$ | - | - | 27.9 | 31.3 | 35.6 | 39.1 | 39.9 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 |
| | Exceedance Level | - | - | -11.9 | -8.3 | -3.2 | -5.3 | -4.5 | -4.3 | -4.7 | -9.1 | -12.9 | -15.3 |
| NAL8 | Site-Specific Noise Limit, $L_{A90}$ | - | - | 39.8 | 39.7 | 39.2 | 44.6 | 44.6 | 44.5 | 44.9 | 49.2 | 52.9 | 55.4 |
| | Proposed Wind Farm Turbine Noise $L_{A90}$ | - | - | 28.8 | 32.2 | 36.5 | 40.0 | 40.8 | 40.9 | 40.9 | 40.9 | 40.9 | 40.9 |
| | Exceedance Level | - | - | -11.0 | -7.5 | -2.7 | -4.6 | -3.8 | -3.6 | -4.0 | -8.3 | -12.0 | -14.5 |
| NAL9 | Site-Specific Noise Limit, $L_{A90}$ | - | - | 39.9 | 39.9 | 39.7 | 44.8 | 44.8 | 44.8 | 45.2 | 49.3 | 53.0 | 55.4 |
| | Proposed Wind Farm Turbine Noise $L_{A90}$ | - | - | 27.9 | 31.3 | 35.6 | 39.1 | 39.9 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 |
| | Exceedance Level | - | - | -12.0 | -8.6 | -4.1 | -5.7 | -4.9 | -4.8 | -5.2 | -9.3 | -13.0 | -15.4 |
| NAL10 | Site-Specific Noise Limit, $L_{A90}$ | - | - | 39.9 | 39.9 | 44.9 | 44.9 | 44.8 | 44.8 | 44.8 | 47.4 | 50.5 | 53.9 |
| | Proposed Wind Farm Turbine Noise $L_{A90}$ | - | - | 28.9 | 32.3 | 36.6 | 40.1 | 40.9 | 41.0 | 41.0 | 41.0 | 41.0 | 41.0 |
| | Exceedance Level | - | - | -11.0 | -7.6 | -8.3 | -4.8 | -3.9 | -3.8 | -3.8 | -6.4 | -9.5 | -12.9 |
| NAL11 | Site-Specific Noise Limit, $L_{A90}$ | - | - | 40.0 | 39.9 | 44.9 | 44.9 | 44.9 | 44.9 | 44.9 | 47.4 | 50.6 | 53.9 |
| | Proposed Wind Farm Turbine Noise $L_{A90}$ | - | - | 27.2 | 30.6 | 34.9 | 38.4 | 39.2 | 39.3 | 39.3 | 39.3 | 39.3 | 39.3 |
| | Exceedance Level | - | - | -12.8 | -9.3 | -10.0 | -6.5 | -5.7 | -5.6 | -5.6 | -8.1 | -11.3 | -14.6 |
| NAL12 | Site-Specific Noise Limit, $L_{A90}$ | - | - | 40.0 | 39.9 | 44.9 | 44.9 | 44.9 | 44.9 | 44.9 | 47.4 | 50.6 | 53.9 |
| | Proposed Wind Farm Turbine Noise $L_{A90}$ | - | - | 27.6 | 31.0 | 35.3 | 38.8 | 39.6 | 39.7 | 39.7 | 39.7 | 39.7 | 39.7 |

| NAL | | Wind Speed (ms$^{-1}$) as standardised to 10m height | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| | Exceedance Level | - | - | -12.4 | -8.9 | -9.6 | -6.1 | -5.3 | -5.2 | -5.2 | -7.7 | -10.9 | -14.2 |
| NAL13 | Site-Specific Noise Limit, $L_{A90}$ | - | - | 39.9 | 39.9 | 44.9 | 44.8 | 44.7 | 44.7 | 47.9 | 50.9 | 53.6 | 55.9 |
| | Proposed Wind Farm Turbine Noise $L_{A90}$ | - | - | 27.0 | 30.4 | 34.7 | 38.2 | 39.0 | 39.1 | 39.1 | 39.1 | 39.1 | 39.1 |
| | Exceedance Level | - | - | -12.9 | -9.5 | -10.2 | -6.6 | -5.7 | -5.6 | -8.8 | -11.8 | -14.5 | -16.8 |
| NAL14 | Site-Specific Noise Limit, $L_{A90}$ | - | - | 45.0 | 45.0 | 44.9 | 44.7 | 44.7 | 44.7 | 44.7 | 47.6 | 51.0 | 54.8 |
| | Proposed Wind Farm Turbine Noise $L_{A90}$ | - | - | 26.2 | 29.6 | 33.9 | 37.4 | 38.2 | 38.3 | 38.3 | 38.3 | 38.3 | 38.3 |
| | Exceedance Level | - | - | -18.8 | -15.4 | -11.0 | -7.3 | -6.5 | -6.4 | -6.4 | -9.3 | -12.7 | -16.5 |
| NAL15 | Site-Specific Noise Limit, $L_{A90}$ | - | - | 40.0 | 39.9 | 39.8 | 39.6 | 44.8 | 44.8 | 44.8 | 44.8 | 48.6 | 48.6 |
| | Proposed Wind Farm Turbine Noise $L_{A90}$ | - | - | 29.2 | 32.6 | 36.9 | 39.6* | 41.2 | 41.3 | 41.3 | 41.3 | 41.3 | 41.3 |
| | Exceedance Level | - | - | -10.8 | -7.3 | -2.9 | 0.0* | -3.6 | -3.5 | -3.5 | -3.5 | -7.3 | -7.3 |
| NAL16 | Site-Specific Noise Limit, $L_{A90}$ | - | - | 40.0 | 39.9 | 39.8 | 39.6 | 44.9 | 44.8 | 44.8 | 44.8 | 48.6 | 48.6 |
| | Proposed Wind Farm Turbine Noise $L_{A90}$ | - | - | 26.5 | 29.9 | 34.2 | 37.7 | 38.5 | 38.6 | 38.6 | 38.6 | 38.6 | 38.6 |
| | Exceedance Level | - | - | -13.5 | -10.0 | -5.6 | -1.9 | -6.4 | -6.2 | -6.2 | -6.2 | -10.0 | -10.0 |
| NAL17 | Site-Specific Noise Limit, $L_{A90}$ | - | - | 45.0 | 44.9 | 44.8 | 44.6 | 44.5 | 44.5 | 44.5 | 47.5 | 51.0 | 54.7 |
| | Proposed Wind Farm Turbine Noise $L_{A90}$ | - | - | 20.9 | 24.3 | 28.6 | 32.1 | 32.9 | 33.0 | 33.0 | 33.0 | 33.0 | 33.0 |
| | Exceedance Level | - | - | -24.1 | -20.6 | -16.2 | -12.5 | -11.6 | -11.5 | -11.5 | -14.5 | -18.0 | -21.7 |
| NAL18 | Site-Specific Noise Limit, $L_{A90}$ | - | - | 44.9 | 44.9 | 44.8 | 44.4 | 44.3 | 44.3 | 44.3 | 47.4 | 50.9 | 54.7 |
| | Proposed Wind Farm Turbine Noise $L_{A90}$ | - | - | 22.6 | 26.0 | 30.3 | 33.8 | 34.6 | 34.7 | 34.7 | 34.7 | 34.7 | 34.7 |
| | Exceedance Level | - | - | -22.3 | -18.9 | -14.5 | -10.6 | -9.7 | -9.6 | -9.6 | -12.7 | -16.2 | -20.0 |

**a 0.8 dB exceedance was predicted in full mode for the V150. The values shown in the table include the application of a reduced noise mode for a limited range of wind speeds and wind directions.*

*Table 12-15: Compliance Table – Comparison of predicted noise levels from the Proposed Wind Farm 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 | Site-Specific Noise Limit, $L_{A90}$ | - | - | 43.0 | 42.9 | 42.8 | 42.7 | 42.6 | 42.6 | 42.6 | 45.2 | 48.2 | 50.6 |
| | Proposed Wind Farm Turbine Noise $L_{A90}$ | - | - | 25.9 | 29.3 | 33.6 | 37.1 | 37.9 | 38.0 | 38.0 | 38.0 | 38.0 | 38.0 |
| | Exceedance Level | - | - | -17.1 | -13.6 | -9.2 | -5.6 | -4.7 | -4.6 | -4.6 | -7.2 | -10.2 | -12.6 |
| NAL2 | Site-Specific Noise Limit, $L_{A90}$ | - | - | 43.0 | 42.9 | 42.8 | 42.7 | 42.6 | 42.6 | 42.6 | 45.2 | 48.2 | 50.6 |
| | Proposed Wind Farm Turbine Noise $L_{A90}$ | - | - | 24.4 | 27.8 | 32.1 | 35.6 | 36.4 | 36.5 | 36.5 | 36.5 | 36.5 | 36.5 |
| | Exceedance Level | - | - | -18.6 | -15.1 | -10.7 | -7.1 | -6.2 | -6.1 | -6.1 | -8.7 | -11.7 | -14.1 |
| NAL3 | Site-Specific Noise Limit, $L_{A90}$ | - | - | 42.9 | 42.9 | 42.7 | 42.4 | 42.3 | 42.3 | 42.3 | 45.0 | 48.1 | 50.6 |
| | Proposed Wind Farm Turbine Noise $L_{A90}$ | - | - | 27.5 | 30.9 | 35.2 | 38.7 | 39.5 | 39.6 | 39.6 | 39.6 | 39.6 | 39.6 |
| | Exceedance Level | - | - | -15.4 | -12.0 | -7.5 | -3.7 | -2.8 | -2.7 | -2.7 | -5.4 | -8.5 | -11.0 |
| NAL7 | Site-Specific Noise Limit, $L_{A90}$ | - | - | 42.9 | 42.8 | 42.5 | 42.1 | 41.9 | 41.9 | 44.0 | 47.7 | 50.4 | 51.8 |
| | Proposed Wind Farm Turbine Noise $L_{A90}$ | - | - | 27.9 | 31.3 | 35.6 | 39.1 | 39.9 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 |
| | Exceedance Level | - | - | -15.0 | -11.5 | -6.9 | -3.0 | -2.0 | -1.9 | -4.0 | -7.7 | -10.4 | -11.8 |
| NAL8 | Site-Specific Noise Limit, $L_{A90}$ | - | - | 42.9 | 42.9 | 42.6 | 42.4 | 42.3 | 42.3 | 44.3 | 47.8 | 50.5 | 51.8 |
| | Proposed Wind Farm Turbine Noise $L_{A90}$ | - | - | 28.8 | 32.2 | 36.5 | 40.0 | 40.8 | 40.9 | 40.9 | 40.9 | 40.9 | 40.9 |
| | Exceedance Level | - | - | -14.1 | -10.7 | -6.1 | -2.4 | -1.5 | -1.4 | -3.4 | -6.9 | -9.6 | -10.9 |
| NAL9 | Site-Specific Noise Limit, $L_{A90}$ | - | - | 43.0 | 42.9 | 42.8 | 42.7 | 42.7 | 42.7 | 44.6 | 48.0 | 50.5 | 51.9 |
| | Proposed Wind Farm Turbine Noise $L_{A90}$ | - | - | 27.9 | 31.3 | 35.6 | 39.1 | 39.9 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 |
| | Exceedance Level | - | - | -15.1 | -11.6 | -7.2 | -3.6 | -2.8 | -2.7 | -4.6 | -8.0 | -10.5 | -11.9 |
| NAL10 | Site-Specific Noise Limit, $L_{A90}$ | - | - | 43.0 | 42.9 | 42.9 | 42.8 | 42.7 | 42.7 | 44.2 | 47.8 | 51.1 | 53.9 |
| | Proposed Wind Farm Turbine Noise $L_{A90}$ | - | - | 28.9 | 32.3 | 36.6 | 40.1 | 40.9 | 41.0 | 41.0 | 41.0 | 41.0 | 41.0 |
| | Exceedance Level | - | - | -14.1 | -10.6 | -6.3 | -2.7 | -1.8 | -1.7 | -3.2 | -6.8 | -10.1 | -12.9 |
| NAL11 | Site-Specific Noise Limit, $L_{A90}$ | - | - | 43.0 | 43.0 | 42.9 | 42.8 | 42.8 | 42.8 | 44.3 | 47.8 | 51.1 | 53.9 |
| | Proposed Wind Farm Turbine Noise $L_{A90}$ | - | - | 27.2 | 30.6 | 34.9 | 38.4 | 39.2 | 39.3 | 39.3 | 39.3 | 39.3 | 39.3 |
| | Exceedance Level | - | - | -15.8 | -12.4 | -8.0 | -4.4 | -3.6 | -3.5 | -5.0 | -8.5 | -11.8 | -14.6 |
| NAL12 | Site-Specific Noise Limit, $L_{A90}$ | - | - | 43.0 | 43.0 | 42.9 | 42.8 | 42.8 | 42.8 | 44.2 | 47.8 | 51.1 | 53.9 |
| | Proposed Wind Farm Turbine Noise $L_{A90}$ | - | - | 27.6 | 31.0 | 35.3 | 38.8 | 39.6 | 39.7 | 39.7 | 39.7 | 39.7 | 39.7 |
| | Exceedance Level | - | - | -15.4 | -12.0 | -7.6 | -4.0 | -3.2 | -3.1 | -4.5 | -8.1 | -11.4 | -14.2 |

| NAL | | Wind Speed ($ms^{-1}$) as standardised to 10m height | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| NAL13 | Site-Specific Noise Limit, $L_{A90}$ | - | - | 43.0 | 42.9 | 42.8 | 42.6 | 42.5 | 43.3 | 47.2 | 50.2 | 52.1 | 52.9 |
| | Proposed Wind Farm Turbine Noise $L_{A90}$ | - | - | 27.0 | 30.4 | 34.7 | 38.2 | 39.0 | 39.1 | 39.1 | 39.1 | 39.1 | 39.1 |
| | Exceedance Level | - | - | -16.0 | -12.5 | -8.1 | -4.4 | -3.5 | -4.2 | -8.1 | -11.1 | -13.0 | -13.8 |
| NAL14 | Site-Specific Noise Limit, $L_{A90}$ | - | - | 43.0 | 42.9 | 42.8 | 42.6 | 42.5 | 42.5 | 43.8 | 47.5 | 50.4 | 52.4 |
| | Proposed Wind Farm Turbine Noise $L_{A90}$ | - | - | 26.2 | 29.6 | 33.9 | 37.4 | 38.2 | 38.3 | 38.3 | 38.3 | 38.3 | 38.3 |
| | Exceedance Level | - | - | -16.8 | -13.3 | -8.9 | -5.2 | -4.3 | -4.2 | -5.5 | -9.2 | -12.1 | -14.1 |
| NAL15 | Site-Specific Noise Limit, $L_{A90}$ | - | - | 43.0 | 43.0 | 42.9 | 42.8 | 42.7 | 42.7 | 42.7 | 42.7 | 46.5 | 50.1 |
| | Proposed Wind Farm Turbine Noise $L_{A90}$ | - | - | 29.2 | 32.6 | 36.9 | 40.4 | 41.2 | 41.3 | 41.3 | 41.3 | 41.3 | 41.3 |
| | Exceedance Level | - | - | -13.8 | -10.4 | -6.0 | -2.4 | -1.5 | -1.4 | -1.4 | -1.4 | -5.2 | -8.8 |
| NAL16 | Site-Specific Noise Limit, $L_{A90}$ | - | - | 43.0 | 43.0 | 42.9 | 42.8 | 42.8 | 42.7 | 42.7 | 42.7 | 46.5 | 50.2 |
| | Proposed Wind Farm Turbine Noise $L_{A90}$ | - | - | 26.5 | 29.9 | 34.2 | 37.7 | 38.5 | 38.6 | 38.6 | 38.6 | 38.6 | 38.6 |
| | Exceedance Level | - | - | -16.5 | -13.1 | -8.7 | -5.1 | -4.3 | -4.1 | -4.1 | -4.1 | -7.9 | -11.6 |
| NAL17 | Site-Specific Noise Limit, $L_{A90}$ | - | - | 42.9 | 42.9 | 42.7 | 42.3 | 42.1 | 42.1 | 43.6 | 47.4 | 50.4 | 52.4 |
| | Proposed Wind Farm Turbine Noise $L_{A90}$ | - | - | 20.9 | 24.3 | 28.6 | 32.1 | 32.9 | 33.0 | 33.0 | 33.0 | 33.0 | 33.0 |
| | Exceedance Level | - | - | -22.0 | -18.6 | -14.1 | -10.2 | -9.2 | -9.1 | -10.6 | -14.4 | -17.4 | -19.4 |
| NAL18 | Site-Specific Noise Limit, $L_{A90}$ | - | - | 42.9 | 42.8 | 42.6 | 42.1 | 41.8 | 41.8 | 43.3 | 47.3 | 50.3 | 52.4 |
| | Proposed Wind Farm Turbine Noise $L_{A90}$ | - | - | 22.6 | 26.0 | 30.3 | 33.8 | 34.6 | 34.7 | 34.7 | 34.7 | 34.7 | 34.7 |
| | Exceedance Level | - | - | -20.3 | -16.8 | -12.3 | -8.3 | -7.2 | -7.1 | -8.6 | -12.6 | -15.6 | -17.7 |

### Cumulative Noise Conditioning

At NALs 4-6, noise limits for the permitted Bilboa Wind Farm have already been established and these receptors are in close proximity between the Proposed Wind Farm and the permitted Bilboa Wind Farm. On that basis a Cumulative Noise Condition (which in this case is the same as the Total DoEHLG 2006 Guidelines Noise Limit) has been proposed whereby the Proposed Wind Farm would be conditioned to ensure that the cumulative wind turbine noise (from the combined operation of the permitted Bilboa Wind Farm and the Proposed Wind Farm) would be below the Cumulative Noise Limit. At NALs 4-6, as demonstrated in Table 12-12 and Table 12-13 above, the combined cumulative noise immission remains below, or equal to, the Total DoEHLG 2006 Guidelines Noise Limit, thus indicating that both schemes can operate concurrently at these receptors. As such there would be no significant effects at NALs 4-6.

If the situation arose whereby noise levels from the permitted Bilboa Wind Farm increased to use a greater amount of the noise limits than predicted, then the Proposed Wind Farm may then need to implement mitigation to reduce noise levels to ensure that the Cumulative Noise Limit is met. In the event that noise from the permitted Bilboa Wind Farm used all of the Cumulative Noise Limit, noise from the Proposed Wind Farm would need to be reduced such that it has a negligible additional contribution. For the Proposed Wind Farm to have a negligible additional contribution it would need to comply with a Backstop Noise Limits which have been derived to be 10 dB below the Cumulative Noise Limits. Further information on the Backstop Noise Limits are included within Appendix 12-2. In the event that the Proposed Wind Farm needed to operate to the Backstop Noise Limits, noise mitigation would likely be required, for certain wind speeds and wind directions. A set of suggested Noise Conditions are presented within Annex 9 of Appendix 12-2 which present Site-Specific Noise Limits for NALs 1-3 and 7-18 and Cumulative Noise Limits and Backstop Noise Limits for NALs 4-6.

#### 12.6.3.1 Operational Noise from BESS

The BESS predictions show that the operational noise levels are significantly below the BS 8233 guideline noise levels. Accordingly, there would be **no significant effects**. Full details of the modelling and assessment can be found in Appendix 12-3.

### 12.6.4 Potential Cumulative Effects

Potential cumulative effects on noise and vibration between the Proposed Project and other permitted or proposed projects and plans in the area, (wind energy or otherwise), as set out in Section 2.9 in Chapter 2 of this EIAR, were also considered as part of this assessment. The developments considered as part of the cumulative effect assessment are described in Section 2.9 of this EIAR.

#### 12.6.4.1 Construction Phase

The construction noise assessment has shown that predictions for the Proposed Project on its own are well below the BS5228 threshold during proposed core hours of work therefore there are sufficient margin at nearby receptors for other construction work to occur simultaneously in the area. The only exception would be CNAL14 during early work on site entrance tracks where only 2dB margin in core hours is predicted. However, work for the Proposed Project will be in temporary phases and very unlikely to occur at the same time and same location as any other nearby projects near the same receptors. As such, no cumulative noise effects are anticipated in relation to the construction of the Proposed Project, and other permitted or proposed projects and plans in the area, as set out in Section 2.9 in Chapter 2 of this EIAR.

No cumulative noise effects are anticipated in relation to construction of the Proposed Grid Connection Route and other permitted or proposed projects and plans in the area, as set out in Section 2.9 in

Chapter 2 of this EIAR, as construction activities will be transient in nature along the route and will not be in any one location long enough for a significant impact to occur.

Therefore, **no significant cumulative construction noise and vibration effects** are anticipated.

#### 12.6.4.2 Operational Phase

The Proposed Wind Farm turbine 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 Wind Farm can operate concurrently with the operational and permitted wind farms and there would therefore be **no significant cumulative wind turbines operational noise effects** at all NALs except at NAL15. At NAL15 a minor exceedance of the Total DoEHLG 2006 Guidelines Noise Limits was predicted therefore there would be a potential **significant effect** at NAL15 in the absence of mitigation.

The proposed BESS is located centrally within the Proposed Wind Farm and receptors are relatively distant with low predicted BESS noise levels. As such **no significant cumulative BESS operational noise is anticipated**.

## 12.7 Mitigation

### 12.7.1 Mitigation during Construction

No significant effects resulting from construction noise and vibration are predicted. Nevertheless, good practice during construction is recommended and will be presented in a Construction Environmental Management Plan (CEMP) (Appendix 4-4) to minimise any potential impacts.

The core hours for the proposed works will be normal construction hours 07:00 to 19:00 Monday to Friday and 07:00 to 13:00 Saturday. 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. If occasional work is undertaken outside of core hours, especially during construction of access tracks at the site entrance, this should be agreed in advance.

Good onsite practices, both for construction of the Proposed Wind Farm and the Proposed Grid Connection Route will be implemented to minimise the likely effects. Particular care will be taken at watercourse, culvert and drain crossings along the Proposed Grid Connection Route. Section 8 of BS 5228-1:2009+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 onsite, 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.
- At any location within 30m of a residential receptor, where directional drilling activities are required for the Proposed Grid Connection Route, the installation of temporary boarding alongside the drilling rig or 'acoustic blanket panels' hanging from heras fencing (or similar) may be used to mitigate noise emissions.

## 12.7.2 Mitigation during Operation

The exact make and model of wind turbine to be used at the Proposed Wind Farm would 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 the Proposed Wind Farm turbines. The noise modelling results presented within this EIAR Chapter are based on the Vestas V150 6.0 MW turbine, which results in the highest predicted noise levels at the key wind speed range and is the precautionary scenario Proposed Wind Farm turbine. Predicted operational noise levels for two other candidate turbines are also included within Technical Appendix 12-2.

The assessment for the Vestas V150 6.0 MW turbine shows an exceedance of the derived noise limits for a limited range of wind speeds and wind directions at NAL 15 during the daytime period (6 ms-1 and broadly north-easterlies) and as a result, the assessment presented here assumes the targeted use of mode management[18] for a limited range of wind speeds and directions for the daytime period to demonstrate that the noise limits can be met.

The assessment presented for the other two candidate turbines also demonstrate that the noise limits can be adhered to by implementing low noise mode, however, depending on the final turbine selected, it's blade type and the confirmation of final warranted levels from the manufacturer, mode management may or may not be required.

Whilst it is not possible to predict if OAM will occur, in the event that complaints are received regarding OAM, mitigation measures are available. The design of such mitigation measures can only be determined once the wind farm is operational if OAM is found to occur frequently and at sustained levels. For this Proposed Project, the developer is committed to investigating noise complaints, inclusive of any complaint which may relate to OAM (i.e. beyond overall noise levels found in planning conditions). To deal with the eventuality of a complaint, the developer proposes the following:

- A community liaison officer will be appointed prior to first generation of electricity and contact details made publicly available;
- Any complaint relating to noise can be reported to the community liaison officer, who will undertake an initial screening of the complaint (review of logs submitted, review of wind conditions and turbine data etc.) and speak to the complainant in person, with an eventual visit to the complainant location if possible;
- Following initial screening, the community liaison officer will be responsible for commissioning a detailed noise complaint investigation. This will include appointing a qualified acoustic consultant to undertake noise measurements at the complaint location and quantify the occurrence and depth (in dB) of OAM for every 10 minute of the measurement campaign. The measured 10 minute noise levels and OAM

[18] *This involves operating turbines in low noise mode. This usually involves restricting the rotor speed with a corresponding reduction in noise emissions and electrical power generation.*

depth would also be correlated with 10 minute wind conditions and operational data to find patterns; and,

- If frequent and sustained OAM is found, then appropriate mitigation would be designed and implemented and the complainant informed by the community liaison officer. Mitigation measures considered would include: changes to the operation of the relevant wind turbine(s) by changing software parameters such as blade pitch for specific wind conditions and time periods, addition of blade furniture (such as vortex generators) to alter the flow of air over the wind turbine blades; and, in extreme cases, targeted wind turbine shutdowns in specific conditions.



No specific mitigation measures are proposed for the BESS.

# 12.8 Assessment of Residual Effects

## 12.8.1 Residual Construction Effects

Predicted construction noise and vibration 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

Following the implementation of mode management for NAL15, predicted Proposed Wind Farm operational noise levels at all the NALs lie below the daytime and night time Site-Specific Noise Limits. In addition, the cumulative noise predictions from the Proposed Wind Farm and other operational and consented wind farms lie below the Total DoEHLG 2006 Guidelines Noise Limits. Whilst it is not possible to predict if OAM will occur, potential mitigation measures to reduce OAM have been identified in Section 12.7.2 above. The detail of the appropriate mitigation to be adopted will be determined once the wind farm is operational if and when OAM were to occur, following on-site noise measurements and assessments triggered by a complaint investigation. Having applied appropriate mitigation measures there would be **no significant residual effects.**

At some locations, under some wind conditions, and for a certain proportion of the time, operational noise from the Proposed Wind Farm would be audible; however, it would be at an acceptable level in relation to the DoEHLG 2006 Guidelines and as such, regardless of which turbine dimensions are selected within the proposed range, there would be **no significant residual effects from operational wind turbine noise**.

No mitigation was identified to be required for operational noise regarding the proposed BESS, so there would be **no significant residual effects from operational BESS noise.**

## 12.8.3 Residual Cumulative Effects

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

Following the implementation of mode management for NAL15, predicted Proposed Wind Farm operational noise levels at all the NALs lie below the Total DoEHLG 2006 Guidelines Noise Limits during the daytime and night-time periods. 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 BS 5228: Part 1 2009+A1:2014 indicate that construction noise levels are below the guidelines considered acceptable at all receptors and that predicted levels would be short term. Construction vibration would also likely be at low levels and would be short term. 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. Therefore, **no significant noise and vibration effects are anticipated for the construction and decommissioning phases.** Good practice during construction and decommissioning is recommended to minimise any potential noise impacts.

The guidance contained within the DoEHLG 2006 Guidelines was used to assess the likely operational noise impact of the Proposed Wind Farm. Predicted levels and measured background noise levels indicate that for dwellings neighbouring the Proposed Wind Farm, wind turbine noise would meet the noise criteria established in accordance with the DoEHLG 2006 Guidelines, therefore **no significant effects are anticipated for the wind turbine operational noise.** In order to meet the Total DoEHLG 2006 Guidelines and Site-Specific Noise Limits at NAL15, mode management would be required in daytime for certain wind speeds and wind directions (6 $ms^{-1}$ and broadly north easterlies) based on the three candidate turbines considered in this assessment.

There are a range of wind turbine models that would be appropriate for the Proposed Wind Farm. The candidate wind turbines used for this assessment were chosen in order to allow a representative assessment of the noise impacts. Should the Proposed Wind Farm 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 noise limits determined and contained within any condition imposed.

Whilst it is not possible to predict if OAM will occur, potential mitigation measures to reduce OAM have been identified and the developer is proposing to appoint a community liaison officer with a commitment to investigate complaints which may relate to OAM. However, the detail of appropriate mitigation to be adopted can only be determined once the wind farm is operational, following on-site noise measurements and assessments triggered by a complaint investigation. In the event that frequent and sustained OAM is identified, suitable mitigation will be implemented and therefore no significant effects are likely as a result of OAM.

Predicted BESS noise levels will be below the BS 8233 guideline levels; therefore **the BESS operational noise impact is not significant,** and no mitigation is suggested.

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# Non-Technical Summary

A noise and vibration assessment was undertaken to determine the likely significant effects from the construction, operational and decommissioning phases of the Proposed Wind Farm, at nearby noise sensitive receptors (residential properties).

A comprehensive background noise survey was undertaken at seven noise monitoring locations. The data was analysed in conjunction with onsite measured wind speed data.

Predicted construction noise levels at the nearest noise sensitive receptors during all phases of construction are below the threshold values within BS 5228 and that predicted levels would be short term. Construction vibration would also likely be at low levels and would be short term. Therefore the effect from construction noise and vibration is 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.

The operational noise assessment was undertaken in three stages, which involved setting the Total DoEHLG 2006 Guidelines Noise Limits (which are limits for noise from all wind farms in the area) at the nearest noise sensitive receptors (NSRs), predicting the likely effects (undertaking cumulative noise predictions) and finally setting Site-Specific Noise Limits for the operation of the Proposed Wind Farm on its own. The Total DoEHLG 2006 Guidelines Noise Limits have been derived in relation to background noise levels and other applicable criteria in accordance with the DoEHLG 2006 Guidelines.

Predicted cumulative operational noise levels indicate that for noise sensitive receptors neighbouring the Proposed Wind Farm, cumulative wind turbine noise (which considers noise predictions from all nearby operational and permitted wind farms and the Proposed Wind Farm) would meet the Total DoEHLG 2006 Guidelines Noise Limits at all Noise Assessment Locations. In order to meet the noise limits at one receptor, mode management would be required in daytime for a limited range of wind speeds and wind directions (6 $ms^{-1}$ and broadly north easterlies) based on the candidate turbines considered in this assessment.

The Total DoEHLG 2006 Guidelines Noise Limit is applicable to all operational and permitted wind farms in the area so Site-Specific Noise Limits have also been derived to control the specific noise from the Proposed Wind Farm. In accordance with the guidance in IOA GPG, the Site-Specific Noise Limits have been derived with due regard to cumulative noise by accounting for the proportion of the Total DoEHLG 2006 Guidelines Noise Limit which is potentially being used by other nearby developments. The Site-Specific Noise Limits have been derived in accordance with the IOA GPG.

Predictions of Proposed Wind Farm turbine noise have been made in accordance with good practice using three candidate wind turbines with serrated trailing edge blades, a 149-155m rotor diameter range and a hub height of 102.5-105 m. Predicted operational noise levels from the Proposed Wind Farm indicate that for noise sensitive receptors neighbouring the Proposed Wind Farm, wind turbine noise from the Proposed Wind Farm would meet the Site-Specific Noise Limits at all Noise Assessment Locations (NAL) and are therefore deemed to be not significant. In order to meet the noise limits at one receptor, mode management would be required for a limited range of wind speeds and wind directions based on the three candidate turbines considered in this assessment.

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

Noise limits have already been established for a number of NSRs located in close proximity between the Proposed Wind Farm and the permitted Bilboa Wind Farm. On that basis a Cumulative Noise Condition has been proposed whereby the Proposed Wind Farm, at the NSRs locations, would be conditioned to ensure that the cumulative wind turbine noise (from the combined operation of the permitted Bilboa Wind Farm and the Proposed Wind Farm) would meet the Cumulative Noise Limits. If the event that noise immission from the permitted Bilboa Wind Farm increased to use a greater amount of the Cumulative Noise Limit than predicted, then the Proposed Wind Farm may then need to operate to a more restrictive Backstop Noise Limits which would be set 10 dB below the Cumulative Noise Limits.



The three candidate wind turbine models were chosen in order to allow a representative assessment of the noise impacts. Should the Proposed Wind Farm receive planning permission, 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 noise limits determined and contained within any condition imposed.

Predicted operational noise levels from the BESS are below the BS 8233 guideline levels at all noise sensitive receptors. Therefore, the BESS operational noise impact is not significant, and no mitigation is suggested.