9. NOISE & VIBRATION

9.1 Introduction

9.1.1 Overview

This section of the rEIAR assesses the potential for any likely significant effects of noise and vibration effects of arising from the Subject Development. For a detailed description of the Subject Site please refer to Chapter 3 Description.

Noise impact assessments have been prepared for the construction phase at the nearest Noise Sensitive Locations (NSLs). Baseline noise levels representative of the nearest NSLs in the vicinity of the site were measured as part of the planning application for the Permitted Development and have informed this assessment. Noise-sensitive locations in this context are any occupied dwelling house, hostel, health building or place of worship and may include areas of particular scenic quality or special recreational amenity importance. In this instance all of the NSLs are dwellings. A total of 14 houses were identified as NSL in the original EIAR for the Permitted Development, four of which are described as derelict. The closest works area to a receptor location which is identified as receptor H257 is noted as 500m. This is further described in section 9.6.1. Note, location H257 was involved in the Permitted Development.

It is important to note that in the case of construction noise in general, once the noise generating activity has ceased, any environmental noise effects also stop, and there is no effect which persists after the noise has stopped.

9.1.2 Statement of Authority

This chapter of the rEIAR has been prepared by the following staff of AWN Consulting Ltd:

Alistair Maclaurin

This chapter has been prepared by Alistair Maclaurin (Senior Acoustic Consultant) of AWN Consulting Ltd. Alistair holds a BSc in Creative Music and Sound Technology and a Diploma in Acoustics and Noise Control. He is a member of the Institute of Acoustics. Alistair has worked in the field of acoustics since 2012. He has been the lead noise consultant across various sites on major infrastructure projects such as Crossrail and Thames Tideway Tunnel, specialising in construction noise assessment and control. Additionally, he has undertaken various other environmental noise assessments for infrastructure developments and planning reports across the UK and Ireland including wind and solar farm EIARs.

Dermot Blunnie

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

9.2 Fundamentals of Acoustics

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

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

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

An indication of the level of some common sounds on the dB(A) scale is presented in **Figure 9-1**. For a glossary of terms used in this chapter please refer to Appendix 9-1.

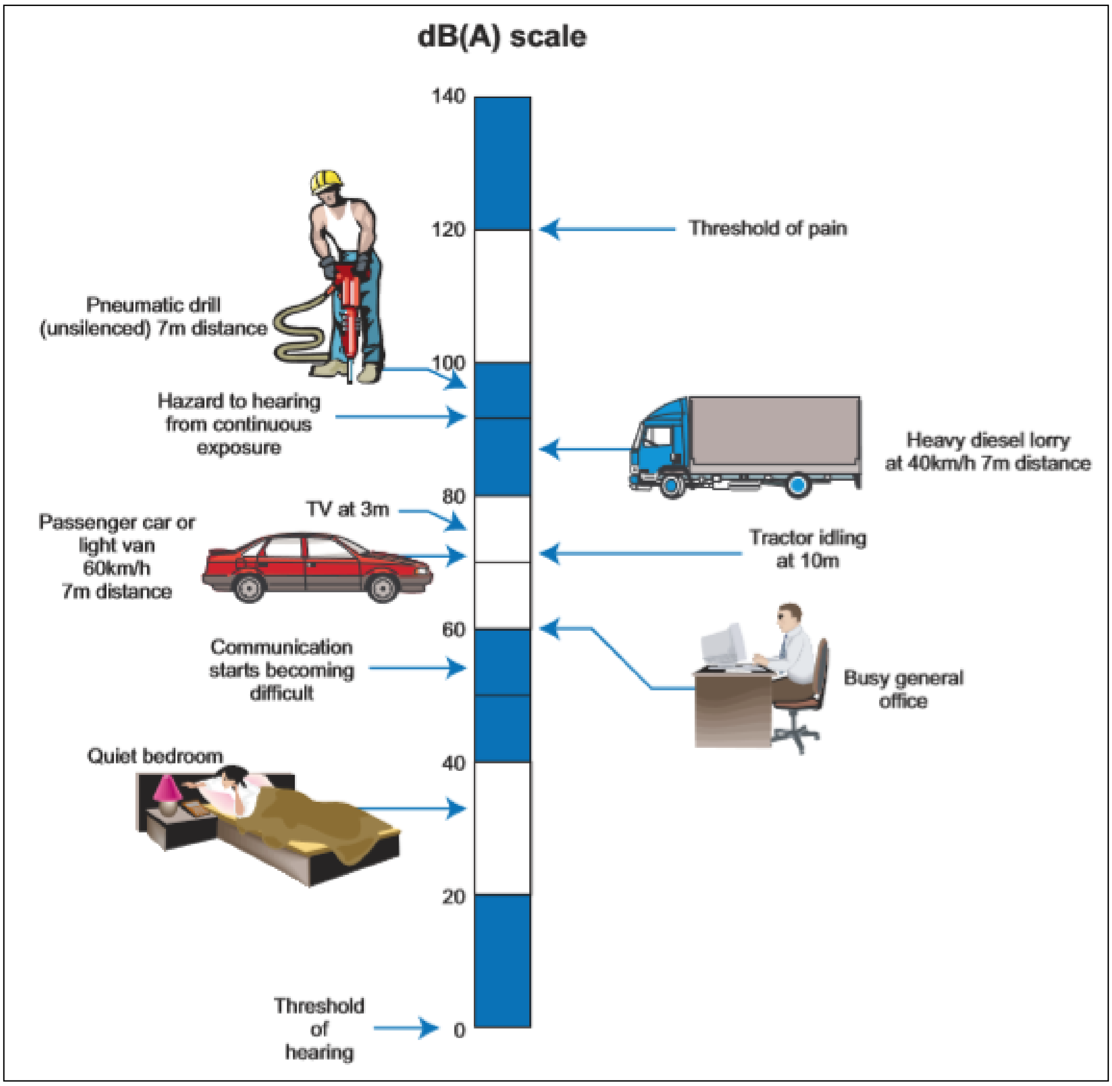

Figure 9.1 The level of typical common sounds on the dB(A) scale (NRA Guidelines for the Treatment of Noise and Vibration in National Road Schemes, 2004)

9.3 Assessment Methodology

The assessment of impacts has been undertaken with reference to the most appropriate guidance documents relating to noise and vibration for the Subject Development construction activities, which are set out within the relevant sections of this chapter.

In addition to the specific guidance documents outlined below, the Environmental Impact Assessment (EIA) guidelines listed in **Chapter 1 Introduction** were considered and consulted for the purposes of preparing this rEIAR chapter.

The methodology adopted for this noise impact assessment is summarised as follows:

- Review of appropriate guidance to identify appropriate noise and vibration criteria for the Subject Development;
- Characterise the receiving environment through baseline noise surveys at various NSLs surrounding the Site;
- Undertake predictive calculations to assess the potential impacts associated with the various phases and related activities at NSLs; evaluate the potential noise and vibration impacts and effects;
- Describe the significance of the residual noise and vibration effects associated with the Subject Development.

9.3.1 Difficulties

No difficulties were encountered in undertaking the noise and vibration impact assessment.

9.4 Guidance

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

9.4.1 Construction Phase Noise

Noise

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

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

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

Table 9-1 sets out the values which, when exceeded, potentially signify a significant effect at the facades of residential receptors as recommended by BS 5228 – 1. These levels relate to construction noise only.

Table 9-1 Recommended vibration limits

Assessment category and threshold value period ($L_{Aeq,T}$)	Threshold value, in decibels (dB)		
	Category A Note A	Category B Note B	Category C Note C
Night-time (23:00 to 07:00hrs)	45	50	55
Evenings and weekends Note D	55	60	65
Daytime (07:00 – 19:00hrs) and Saturdays (07:00 – 13:00hrs)	65	70	75

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

It should be noted that this assessment method is only valid for residential properties.

For the appropriate period (e.g. daytime) the ambient noise level is determined and rounded to the nearest 5dB. An extensive noise survey was undertaken for the EIAR of the Permitted Development, reference to this survey shows that in this instance, with the rural nature of the site, all properties in the vicinity of the Subject Development have ambient noise levels in the range of 40 to 50 dB L_{Aeq}. Therefore, all properties will be afforded a Category A designation. This results in a daytime construction noise threshold of 65dB $L_{Aeq,T}$

See Section 9.6.2 for the detailed assessment in relation to the construction of the Subject Development. If the specific construction noise level exceeds the appropriate category value (e.g. 65dB $L_{Aeq,T}$ during daytime periods) then a significant effect is deemed to have occurred.

Vibration

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

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

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

BS 7385 states that there should typically be no cosmetic damage if transient vibration does not exceed 15 mm/s at low frequencies rising to 20 mm/s at 15 Hz and 50 mm/s at 40 Hz and above. These guidelines relate to relatively modern buildings and should be reduced to 50% or less for more critical buildings.

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

The NRA document Guidelines for the Treatment of Noise and Vibration in National Road Schemes also contains information on the permissible construction vibration levels during the construction phase as shown in Table 9-2.

Table 9-2 Assessment of impact by reference to existing noise levels

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

9.4.2 Construction Phase Traffic

There are no specific guidelines or limits relating to traffic related sources along the local or surrounding roads. Given that construction traffic from the Subject Development will make use of existing roads already carrying traffic volumes, it is appropriate to assess the calculated increase in traffic noise levels that will arise because of vehicular movements associated with the Subject Development.

For the assessment of potential noise impacts from construction related traffic along public roads, it is proposed to adopt guidance from Highways England (now National Highways) Design Manual for Roads and Bridges Sustainability & Environment Appraisal LA 111 Noise and Vibration (Revision 2) (hereafter referred to as DMRB).

Table 10-3, taken from DMRB offers guidance as to the likely short-term impact associated with any change in traffic noise level.

Table 9-3 Classification of magnitude of traffic noise changes in the short-term (Source DMRB, 2020)

Change in Sound Level (dB(A))	DMRB Magnitude of Impact (Short-term)
Less than 1 dB	No Change
1.0 – 2.9	Minor
3.0 – 4.9	Moderate
≥5	Major

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

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

The DMRB guidance will be used to assess the predicted increases in traffic levels on public roads associated with the Subject Development and comment on the short-term impacts during the construction phase. Where a major or moderate impact is identified due to the change in traffic noise level, reference will be made to the overall predicted noise level from construction traffic in the context of the construction noise criteria outlined in Section 9.4.1.

9.4.3 Operational Phase Noise

It's noted that the Subject Development will become a passive element of the Meenbog Windfarm in terms of operational noise & vibration impacts. There are no alterations to turbine layouts or to plant item locations, hence there is no change to the operational impacts as described in the EIAR for the Permitted Development.

9.5 Receiving Environment

The Subject Development site is located in Co. Donegal approximately 8km southwest of the twin towns of Ballybofey and Stranorlar and approximately 12km northeast of Donegal Town.

The study area for the noise and vibration impact assessment was defined by the area where there is potential for noise and vibration impacts at NSL's associated with the Subject Development during the construction work for the deviations.

NSL's in proximity to the deviation sites and those situated along haul routes have the most potential to experience noise and vibration impacts. Taking account of the typical works associated with the deviations, the study area is based on the nearest NSL's to the working areas, these distances are confirmed in the relevant sections and are typically representative of the closest identified NSL or at defined set back distances from proposed activity.

Receptor locations in the area are residential detached houses that are sporadically spread throughout the study area Figure 9-2 provides an overview of all receptor locations identified in the original EIAR application.

Figure 9-2 Nearest identified receptors. Reference numbers are taken from the original wind farm EIAR.

9.6 Likely Significant Effects and associated Mitigation Measures

9.6.1 Do-Nothing Scenario

Under the Do-Nothing scenario, the 25 deviations that comprise the Subject Development would be removed and restored to the greatest extent practicable. The Meenbog Wind Farm would then be completed in accordance with the current planning permission (ABP Ref: PA05E.300460). This approach may lead to environmental effects due to the potentially extensive groundworks required to remove and restore the existing peat cells, portions of access roads, laybys, and hardstands, and peat containment berm. New access road sections and hardstands would then be constructed in the slightly different, and less optimal, locations shown on the permitted Meenbog Wind Farm plans. Unauthorised borrow pits would be backfilled to the greatest extent possible with spoil and peat and revegetated. Unauthorised peat cells would be dismantled, and the stored peat material would be removed from the site for disposal elsewhere.

Additional noise impacts would occur at a similar location and scale as they did for the Subject Development.

9.6.2 Subject Development Noise Impacts

A variety of items of plant were in use for the purposes of construction activities for the Subject Development. Plant items ranged from HGVs, excavators and also included impulsive noise from activities such as rock-breaking. BS-5228 provides empirical data for typical plant items found on construction sites. All works will be limited to the working hours of 7am-7pm.Plant items and their source noise levels associated with this development are provided in Table 9-5.

Table 9-4 Plant Reference Noise Levels

Plant Item	BS5228 Ref	$L_{Aeq,dB}$ at 10m
Excavator mounted rock breaker	BS 5228-1:2009 Table C.9:11	93
Excavator (Ground excavation & earthworks)	BS 5228-1:2009 Table C.2:16	75
HGV	BS 5228-1:2009 Table C.10:18	83*

**Note: HGV source data is an $L_{Amax,dB}$ passby*

Note that rock breaking activity noise levels are significantly higher than the other construction activities that took place during the construction phase of the permitted development or deviations, hence, for the purposes of this assessment it is considered prudent to demonstrate the potential impacts associated with the noisiest scenario, this is where rock-breaking occurred at the closest deviation to the receptor locations. Considering the high noise level of the rock-breaking activity it will encompass plant items for all other activities that may have occurred. Hence, if construction activities including rock-breaking as a worst-case don't cause a significant impact at the closest receptors there will be no significant impacts associated with any of the construction activities.

The components of the Subject Development are plotted in Figure 9-3 alongside the receptor locations. The figure shows that the closest works area to a receptor location which is identified as receptor H257 is noted as 500m.

Calculations have been performed to determine the noise level of potential rock breaking at this receptor location using formulae referenced in BS5228 and considering mixed ground conditions. The predicted construction noise noise level at the receptor location is 56 dB $L_{Aeq,T}$. Construction noise was likely audible during impulsive works, however, the worst case noise level is predicted as being significantly below the threshold, hence the impact can be described as Negative, Temporary and Not Significant to Slight. Overall the impact is considered Not Significant.

Note that this is a worst-case scenario as it assumes that rock breaking activities occur for 100% of the working period without any mitigation applied. It's likely that percentage on times throughout the working period would have been lower and that rock breaking activities may not have occurred at all locations within the Subject Development, hence, it's likely that lower construction noise levels would have resulted.

It is understood that there was also the potential for blasting to have been undertaken. This would be considered a momentary impact. At this stage there is no way to calculate the potential noise level that occurred due to this activity, however, the impact would be momentary and once the activity had occurred the noise environment would return to the existing state.

It's possible that simultaneous construction works at components of the Subject Development occurred during periods of the construction programme. Given that the worst case predicted noise level for construction works is nearly 10 dB below the construction noise threshold, it can be concluded that a significant impact due to cumulative construction activities on site would be unlikely. As an example, considering a worst-case scenario of breaking occurring simultaneously at both Nos. 20 and 21 deviations, the resultant noise level would be 59 dB $L_{Aeq,T}$ at the closet receptor (H257) which is still below the adopted construction noise thresholds. The resultant impact would be described as negative, not significant to slight and temporary. Overall, the cumulative impact for these construction activities is considered not significant.

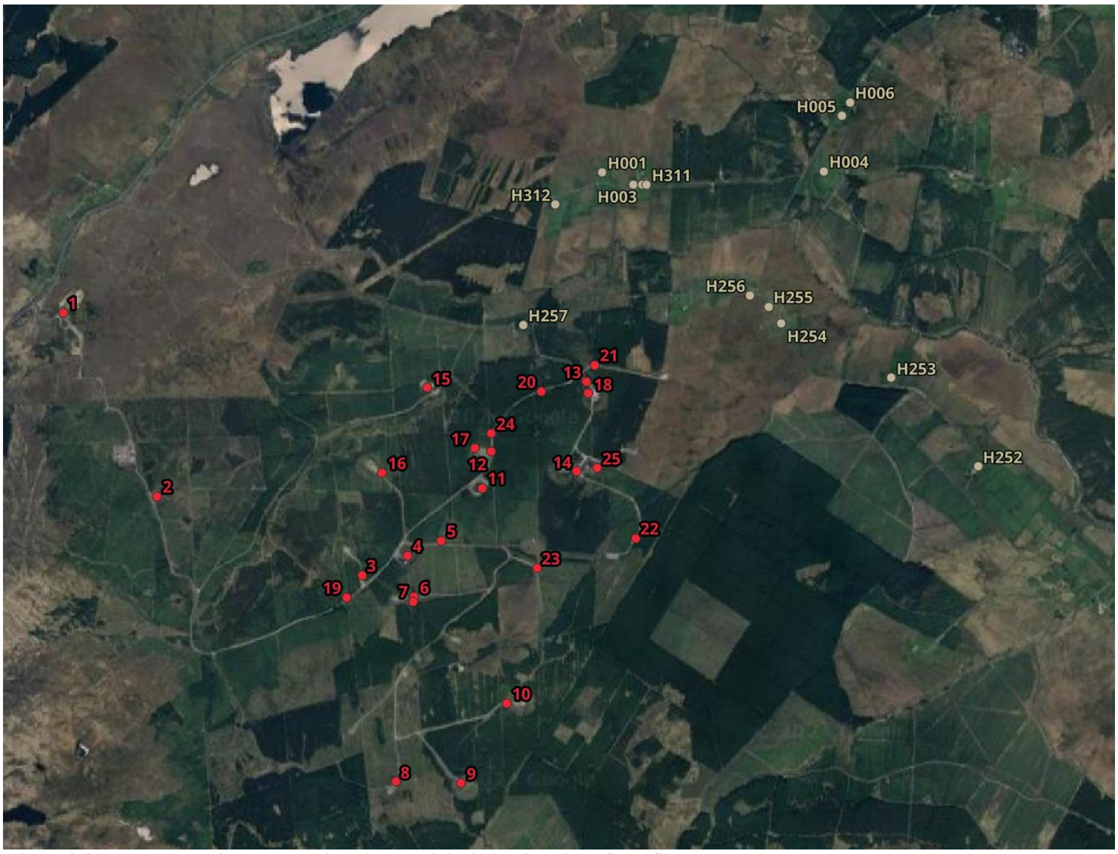

Figure 9.2 Image presenting receptor locations and deviation locations (in red)

9.6.3 Subject Development Vibration Impacts

During rock breaking, there is potential for vibration to be generated through the ground. Empirical data for this activity is not provided in the BS 5228-2:2009+A1:2014 (BSI 2014b) standard, however the likely level of vibration from this activity is expected to be significantly below the vibration criteria for building damage or perceptibility based on experience from other sites. AWN Consulting Ltd have previously conducted vibration measurements under controlled conditions, during trial construction works, where breaking was carried out. The trial construction works consisted of the use of the following plant and equipment when measured at various distances:

- 3 tonne hydraulic breaker on small CAT tracked excavator; and
- 6 tonne hydraulic breaker on large Liebherr tracked excavator.

Vibration measurements were conducted during various staged activities and at various distances. Peak vibration levels during staged activities using the 3 Tonne Breaker ranged from 0.48 PPV (mm/s) to 0.25 PPV (mm/s) at distances of 10m to 50m respectively from the breaking activities. Using a 6 Tonne Breaker, measured vibration levels ranged between 1.4 PPV (mm/s) to 0.24 PPV (mm/s) at distances of 10m to 50m respectively.

Whilst these measurements relate to a breaking of concrete, the range of values recorded provides some context in relation typical ranges of vibration generated by construction breaking activity. The vibration levels experienced at surrounding receptors will be well below the criteria of cosmetic building damage and perceptibility given the large distance (500m+) between work areas and receptors. Hence, the impact is defined as Neutral, Not Significant and Temporary.

9.6.4 Construction Traffic

It is understood that all construction traffic was routed along the originally planned routes as detailed in the EIAR of the Permitted Development, and that no additional traffic movements were made as a result of the Subject Development construction works as discussed in Chapter 13 of this rEIAR. There was therefore no construction traffic related noise effects as a result of the Subject Development.

9.6.5 Cumulative Impacts

As discussed previously, considering the worst case predicted construction noise levels are well below the adopted construction criteria, cumulative impacts of significance during the construction stage were unlikely. In terms of cumulative construction noise levels between the Permitted Development and the deviations, predictions for the Permitted Developments indicates that the highest noise levels of 48 dB would impact on the report locations. This is significantly below the construction noise threshold to the extent that it cannot cause a cumulative impact. The impacts are considered to be negative, not significant to slight and temporary. Overall the effect is not significant.

Given that the layout of operational plant has not been altered, there is no change to the operational impacts identified in the original EIAR application. Hence, the cumulative impacts remain unchanged and all noise levels are predicted to be within the adopted noise criteria.

9.6.6 Decommissioning

The Subject Development will not alter the effects associated with the decommissioning of the Meenbog Windfarm. The mitigation measures that will be considered in relation to any decommissioning of the Meenbog Windfarm are the same as those set out for the Permitted Development.

9.7 Mitigation

The construction of the Subject Development was carried out as part of the Meenbog Windfarm and mitigation within the original EIAR and associated CEMP were to be adhered to. The mitigation measures relation to Noise and Vibration are reproduced below.

- No plant used on site will be permitted to cause an on-going public nuisance due to noise.
- The best means practicable, including proper maintenance of plant, will be employed to minimise the noise produced by on site operations.
- All vehicles and mechanical plant will be fitted with effective exhaust silencers and maintained in good working order for the duration of the contract.
- Compressors will be attenuated models fitted with properly lined and sealed acoustic covers which will be kept closed whenever the machines are in use and all ancillary pneumatic tools shall be fitted with suitable silencers.
- Machinery that is used intermittently will be shut down or throttled back to a minimum during periods when not in use.
- Any plant, such as generators or pumps, which is required to operate before 07:00hrs or after 19:00hrs will be surrounded by an acoustic enclosure or portable screen.
- During the course of the construction programme, supervision of the works will include ensuring compliance with the limits detailed in Table 9-1 using methods outlined in British Standard BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise.
- The hours of construction activity will be limited to avoid unsociable hours where possible. Construction operations shall generally be restricted to between 7:00hrs and 19:00hrs weekdays and between 7:00hrs and 19:00hrs on Saturdays. However, to ensure that optimal use is made of good weather period or at critical periods within the programme (i.e. concrete pours) it could occasionally be necessary to work out of these hours. Any such out of hours working would be agreed in advance with the local planning authority.

Where rock breaking is employed, the following are examples of measures that will be considered, where necessary, to mitigate noise emissions from these activities:

- Fit suitably designed muffler or sound reduction equipment to the rock breaking tool to reduce noise without impairing machine efficiency.
- Ensure all leaks in air lines are sealed.
- Use a dampened bit to eliminate ringing.
- Erect acoustic screen between compressor or generator and noise sensitive area. When possible, line of sight between top of machine and reception point needs to be obscured.
- Enclose breaker or rock drill in portable or fixed acoustic enclosure with suitable ventilation.

Where blasting was employed, the following mitigation measures were employed to control the impact of vibration during blasting activities:

- Trial blasts were undertaken to obtain scaled distance analysis;
- Appropriate burden to avoid over or under confinement of the charge;
- Accurate setting out and drilling;
- Appropriate charging;
- Appropriate stemming with appropriate material such as sized gravel or stone
- chipping;
- Delay detonation to ensure small maximum instantaneous charges;
- Decked charges and in-hole delays;
- Blast monitoring to enable adjustment of subsequent charges;
- Good blast design to maximise efficiency and reduce vibration;
- Avoid using exposed detonating cord on the surface;

9.8 Residual Impacts

In accordance with EPA criteria for description of effects, the potential effects at the nearest NLS associated with the construction of the Subject Development are as follows:

Table 9-5 Potential effects at the nearest NSL

Quality	*Significance*	*Duration*
Negative	Not Significant to Slight	Temporary

Operational noise impacts remain unaltered from the original EIAR assessment and are not applicable here.

9.9 Significance of Effects

Overall the effects from the Subject Development were not significant.