Dublin Array
Generation for generations

EIAR Volume 3: Offshore Infrastructure Assessment Chapters
Chapter 16: Noise and Vibration (Terrestrial Receptors)

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Dublin Array Offshore Wind Farm

Environmental Impact Assessment Report

Volume 3, Chapter 16: Noise and Vibration (Terrestrial Receptors)

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Acronyms

Term	Definition
AM	Amplitude Modulation
BEIS	UK's Government Department of Business, Energy & Industrial Strategy
BERR	UK's Government Department for Business, Enterprise and Regulatory Reform
DLRCDP	Dún Laoghaire-Rathdown County Development Plan
DoHPLG	Department of Housing, Planning and Local Government
DTI	UK's Government Department of Trade and Industry
Dublin Array	Dublin Array Offshore Wind Farm
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EIS	Environmental Impact Statements
EPA	The Environmental Protection Act 1990
ES	Environmental Statement
IOA	Institute of Acoustics
IOA GPG	Institute of Acoustics Good Practice Guide
MDO	Maximum Design Option
ADO	Alternative Design Option
MHWS	Mean High Water Springs
NIS	Natura Impact Statements
NPO	National Policy Objective
NSR	Noise Sensitive Receptor
O&M	Operational and Maintenance
OAM	Other AM
OSP	Offshore Substation Platform
OWF	Offshore Wind Farm
SWL	Sound Power Level
WTG	Wind Turbine Generator

Glossary

Term	Definition
An Bord Pleanála (ABP)	Competent authority as defined by the Planning Acts to determine the application for development consent for Dublin Array and carry out the EIA and AA of the proposed development.
Amplitude Modulation (AM)	A variation in the loudness (amplitude) of wind turbine noise caused by changes in how the blades interact with the wind. This can create a rhythmic 'swishing' or 'thumping' sound as the blades rotate.
Construction Environmental Management Plan (CEMP)	A plan outlining measures to manage and mitigate environmental impacts during the construction phase of a project.
Decommissioning	The process of safely closing and dismantling a facility or infrastructure after its operational life has ended.
Design Flexibility Opinion	An opinion issued by An Bord Pleanála under section 287A of the Planning Acts, setting out the details which may be unconfirmed in the application for development consent.
Environmental Impact Assessment (EIA)	Assessment of the likely significant effects of a proposed project on the environment. The EIA will be carried out by An Bord Pleanála in this instance.
Environmental Impact Assessment Report (EIAR)	As defined in the Planning and Development Act 2000, as amended: 'environmental impact assessment report' means a report of the effects, if any, which proposed development, if carried out, would have on the environment and shall include the information specified in Annex IV of the Environmental Impact Assessment Directive.
Environmental Statement (ES)	A report that provides information on the environmental effects of a proposed development.
Impact piling	A method of driving piles into the ground using a hammering action.
Maritime Area Consent (MAC)	State consent which grants the holder a right to occupy a specific part of the maritime area for the purposes of proposed maritime usage as set out in the MAC and subject to such conditions (if any) as may be attached.
Maximum Design Option	The design scenario that is assessed for each impact and which would result in the greatest impact (e.g., largest footprint, longest exposure, or largest dimensions). Unless otherwise identified in the assessment it can be assumed that any other (lesser) scenario for that impact would result in no greater significance than that assessed and presented in the EIAR. The design information is based on the best available information and the parameters outlined in the project description chapters are realistic and considered estimations of future design parameters.
Noise sensitive receptor (NSR)	A location where noise can impact people's comfort, health, or well-being. This includes places such as homes, schools, hospitals, care homes, and recreational areas.
Offshore Infrastructure	Wind turbine generators, offshore substation platform, inter array cables, and offshore export cables.
Offshore substation platform (OSP)	Offshore substation which is necessary to connect the WTGs with the offshore export cable.

Term	Definition
Operational noise	Noise generated during the normal operation of a facility or infrastructure.
Piling	The process of driving piles into the ground to provide foundation support for structures.
Receiving environment	The baseline environment.
Scour protection	Measures taken to prevent erosion around the base of offshore structures.
Sound power level (SWL)	A measure of the total amount of sound energy produced by a source, such as a wind turbine, in all directions. It is expressed in decibels (dB) and is independent of distance or environment. Sound power level is used to calculate how much noise a turbine generates, helping to predict how loud it will be at different locations.
Wind Turbine Generator (WTG)	All the components of a wind turbine, including the tower, nacelle and rotor.

16 Noise and Vibration (Terrestrial Receptors)

16.1 Introduction

16.1.1 This chapter of the Environmental Impact Assessment Report (EIAR) presents the results of the Environmental Impact Assessment (EIA) for the potential impacts of the construction, Operation and Maintenance (O&M), and decommissioning phases associated with the offshore infrastructure of the proposed Dublin Array Offshore Wind Farm (Dublin Array) upon the airborne noise and vibration environment at the nearby onshore noise sensitive receptors (NSRs). Separate chapters assess other aspects of potential noise and vibration impacts. Volume 5, Chapter 5: Noise and Vibration addresses noise and vibration impacts from onshore secondary works upon onshore receptors. All references to noise and vibration throughout this chapter refer to airborne noise and vibration upon onshore NSRs.

16.1.2 This chapter describes the scope, relevant legislation, and assessment methodology. It considers any potential significant effects of the construction, operation, and decommissioning of the wind turbine generators (WTGs) by determination of the sensitivity of the receiving environment and the magnitude of any effects. Cumulative construction and operational noise effects with other proposed developments that may also have an impact on the NSRs are also considered.

16.1.3 This EIAR chapter should be read in conjunction with the following documents included within the EIAR, due to interactions between the technical aspects:

- Volume 2, Chapter 6: Project Description (hereafter referred to as the Project Description); and
- Volume 4, Appendix 4.3.16-1: Construction and Operational Noise Predictions: To be referred to for a detailed description of the construction and operational noise predictions.

16.2 Regulatory background

16.2.1 In addition to legislation, policy and guidance relevant to offshore renewables captured within Volume 2, Chapter 2: Consents, Legislation, Policy and Guidance (hereafter referred to as the Consents, Legislation, Policy, and Guidance Chapter), this section outlines legislation, guidance and policy specific to noise and vibration, including best practice guidelines.

16.2.2 Where specific Irish guidance is not available given the infancy of offshore wind in Ireland, a number of other guidance documents specific to the consideration of noise and vibration are available from jurisdictions/countries with established offshore renewable energy sectors where comprehensive guidance has been developed. The assessment of potential impacts from noise and vibration has been made with specific reference to the relevant regulations, guidelines and guidance within the Consents, Legislation, Policy and Guidance Chapter.

16.2.3 It has also been made with reference to relevant legislation, guidance and best practice including as listed below:

- European Communities (Environmental Noise) Regulations, 2018;
  - European Communities (Environmental Noise) (Amendment) Regulations, 2021
- Dublin Agglomeration Noise Action Plan 2024-2028;
- Wind Energy Development Planning Guidelines, 2006;
  - Draft Revised Wind Energy Development Guidelines, 2019
- ETSU-R-97 The Assessment and Rating of Noise from Wind Farms, 1996;
- A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise, 2013;
- Best Practice Guidelines for the Irish Wind Energy Industry, 2012;
- British Standard BS 5228, 2014; and
- BEK No. 135, 2019.

16.2.4 The relevance of specific policies or guidance and their key provisions with regards to noise and vibration and how these have been addressed within this assessment are presented in Annex A.

16.3 Consultation

16.3.1 As part of the EIA for Dublin Array, consultation has been undertaken with various statutory and non-statutory authorities and stakeholders. The Dublin Array EIAR Scoping Report (RWE, 2020) was made publicly available and issued to statutory consultees on 9th October 2020.

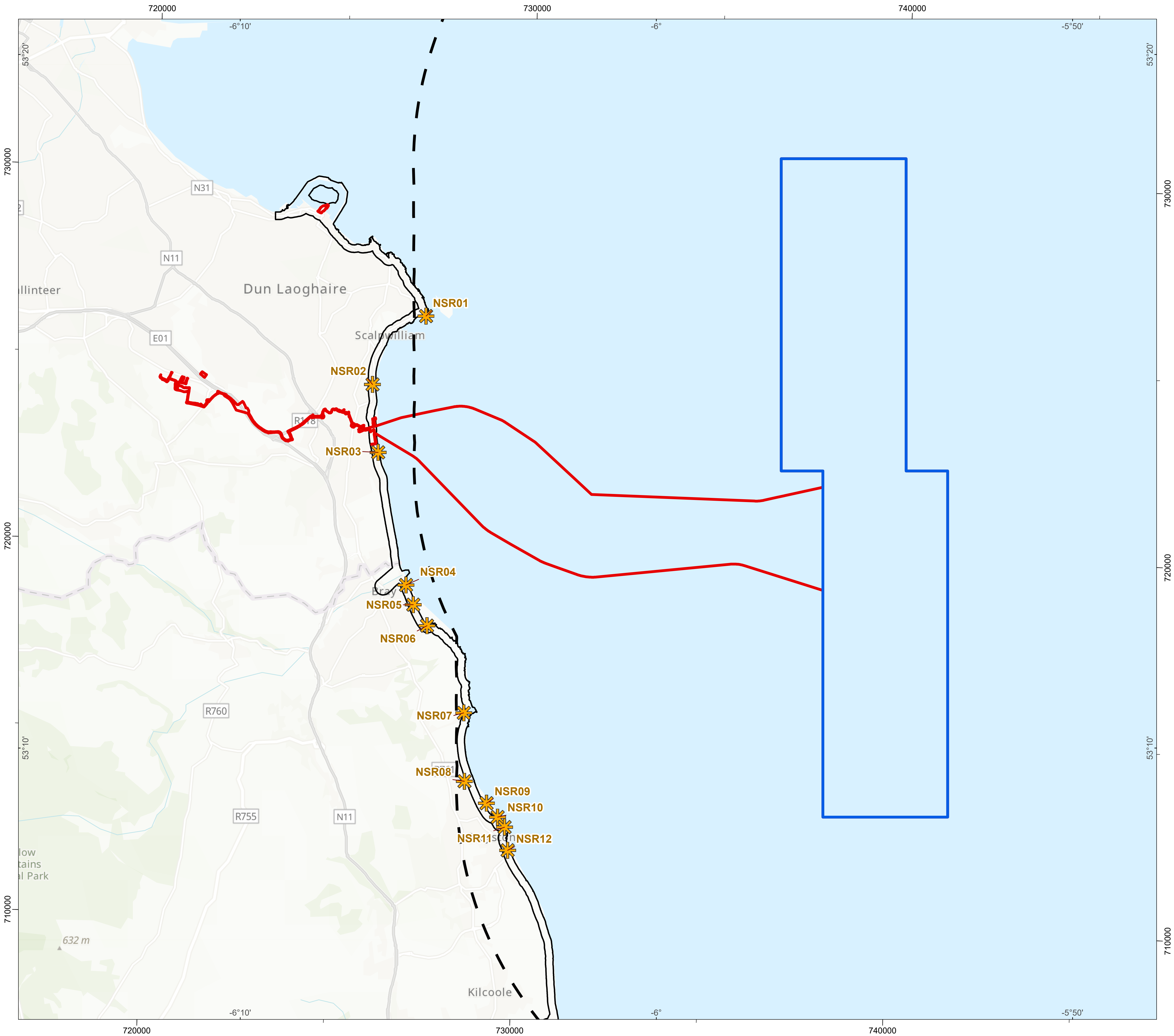
16.3.2 No comments regarding noise and vibration on onshore NSRs were received in scoping responses from statutory consultees. There was concern raised by a member of the public during public consultation that noise from the WTGs would be heard onshore. The Health and Safety Authority (HSA) responded to the Scoping Report in a letter dated 17th November 2020, however no comments relating to noise and vibration were provided.

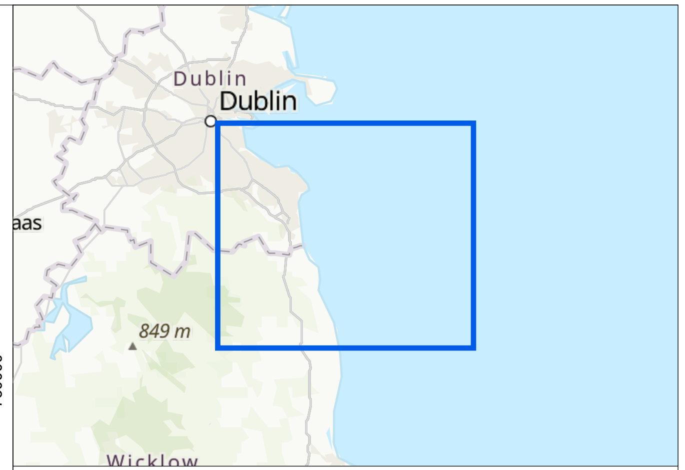
16.4 Methodology

Study area

16.4.1 The array area is located approximately 10 km east of Ireland's coastline between Dalkey, County Dublin, and Greystones, County Wicklow. For the purposes of this assessment, the noise and vibration study area for terrestrial receptors encompasses the 18 km coastline between these two areas, 200 m inland from the Mean High Water Springs (MHWS) to the MHWS line as shown in Figure 1.

16.4.2 This distance is determined using the calculation method outlined in BEK No. 135, which refers to the Danish Executive Order on Noise from Wind Turbines (Danish Ministry of the Environment and Food, 2019). This order provides a framework for assessing and controlling noise emissions from wind turbines. The method accounts for sound propagation over different terrains, with sound traveling most efficiently over water. However, it still diminishes with distance, and this attenuation becomes more pronounced as the sound wave moves from water to land, where it encounters more resistance and disperses more rapidly. Therefore, the highest noise levels on land will be present at the shoreline. Ground attenuation follows a sliding scale, increasing with distance from the coast and reaching its maximum rate of attenuation at approximately 200 m inland. Therefore, less noise attenuation will occur at distances between the coast and 200 m inland than at distances greater than 200 m. This is evidenced in the calculation method described in paragraph 16.4.4 to paragraph 16.4.7.





- Array Area
- Array Area 10 km Buffer
- Consent Application Red Line Boundary
- Noise Study Area - 200 m Mean High Water Springs Buffer
- Noise Sensitive Receptor

DRAWING STATUS

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PROJECT TITLE

Dublin Array

DRAWING TITLE

Study Area and Noise Sensitive Receptors

DRAWING NUMBER: Figure 1

PAGE NUMBER: 1 of 1

VER	DATE	REMARKS	DRAW	CHEK	APRD
01	2024-08-09	DRAFT	JK	AB	AE

0 1 2 Kilometres
0 1 2 Miles

N
GRID NORTH

SCALE	1:175,000	PLOT SIZE	A3
DATUM	WGS 1984	VERTICAL REF	ODN/LAT/MLLW
PRJ	WGS 1984 World Mercator		

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Baseline data

16.4.3 Baseline noise surveys were not conducted for the Dublin Array project due to the large separation distances between the Wind Turbine Generators (WTGs) and the nearest NSRs, which are at least 8.5 km. According to ETSU-R-97, for wind farms with very large separation distances, a simplified noise condition can be applied. If the noise is limited to an $LA_{90,10min}$ of 35 dB(A) up to wind speeds of 10 m/s at 10 m height, background noise surveys are unnecessary as this condition alone offers sufficient protection of amenity. Given that the Dublin Array meets this criterion, the most stringent daytime limit available within the Wind Energy Development Guidelines (2006) is used to control noise from the project during operation, ensuring minimal impact on nearby NSRs. Further detail is provided in section 16.5, Operational noise impact magnitude.

Assessment methodology

16.4.4 The exact model of turbine that will be installed at the array will be the subject of a competitive procurement process prior to the construction of the wind farm, which will be post-consent as described in Volume 2, Chapter 6: Project Description (hereafter referred to as the Project Description Chapter) subject to a successful planning application. It is feasible that the WTGs that are commercially available at the time of writing will no longer be available at the time of procurement. Therefore, the following three options have been assessed, accounting for the maximum number of WTGs, the largest rotor diameter turbine currently in development, and a middle option comprising a mid-sized rotor diameter and a median number of WTGs:

- Option A, 50 WTGs each with 236 m rotor diameter;
- Option B, 45 WTGs each with 250 m rotor diameter; and
- Option C, 39 WTGs each with 278 m rotor diameter.

16.4.5 The construction and operational noise impacts from the above three options have each been calculated separately and the option that resulted in the greatest noise impact represents the Maximum Design Option (MDO), as discussed further in section 16.10.

16.4.6 The calculation of noise propagation associated with both the construction and operational phases of the offshore infrastructure is in accordance with BEK No. 135. This method provides the current best practice for the calculation of wind turbine noise over a large body of water. It is recognised in the Institute of Acoustics Good Practice Guide (IOA GPG) that conventional prediction methods that are suitable for onshore wind turbine noise, such as ISO 9613-2 are not appropriate for offshore wind turbine noise as they would result in an underprediction. The method employed by BEK accounts for cylindrical spreading of sound and multiple reflections that occur over large distances and over reflective surfaces such as water.

16.4.7 The calculation was performed in octave bands from 63 Hz to 8 kHz following Equation 1.

Equation 1 calculation of sound pressure level

$$L_{pA} = L_{WA,ref} - 10 \times \log(l^2 + h^2) - 11 + \Delta L_g - \Delta L_a + \Delta L_m$$

Where:

L_{pA}	is the sound pressure level, in dB L_{Aeq}, at the calculation point
$L_{WA,ref}$	is the sound power level (SWL) of the WTG at the reference wind speed
l	is the distance from the base of the wind turbine to the calculation point
h	is the hub height of turbine above MHWS
11	is a correction of distance equal to 10 x log(4π)
ΔL_g	is a correction for terrain
ΔL_a	is the attenuation in sound due to air absorption
ΔL_m	is a correction for multiple reflections

16.4.8 For the terrain correction term, ΔL_g, 3 dB has been used when calculating the sound pressure level from offshore WTGs at an NSR close to the coast, as per BEK No. 135. For an NSR that, when viewed in the direction of the WTGs, is more than 200 m from the coast, 1.5 dB has been used. For NSRs between 0 and 200 m from the coast, a linear interpolation has been applied.

16.4.9 In simple terms, this equation calculates the level of wind turbine noise at a receptor location, factoring in how noise reduces as it spreads, accounting for how the air and ground absorb it, and how surfaces like water provide reflections.

Construction noise

16.4.10 Details of the construction works, and construction programme are described in the Project Description Chapter. Foundation structures are required to securely support the WTGs and the offshore substation platform (OSP) in a vertical position while withstanding physical loads (forces) from the wind and the marine environment. The foundation structures also provide means of safe access to and from the infrastructure.

16.4.11 A wide range of foundation options are available for the offshore infrastructure. The final foundation options will be chosen based on the selected WTGs and OSP taking account of key factors such as seabed conditions, water depth, wind, wave and current regime and economic factors. The foundation structure of the WTGs will be either a steel monopile or multileg (driven or drill-piles multileg or suction bucket multileg). The techniques used for piling will vary depending on the foundation structure, size of the turbine, and the condition of the seabed where the pile is being driven (see the Project Description Chapter).

16.4.12 Impact-driven piling is expected to produce the highest noise levels, which is therefore the assumed piling method considered in the MDO assessment for this chapter in relation to noise.

16.4.13 Typically, impact piling will have a soft start for approximately 35 minutes when the hammer energy will be 10% followed by a maximum of 200 minutes of piling of between 20% and 95% of the maximum hammer energy. There may be brief periods during the piling when a greater hammer energy is required, up to 100% of the maximum.

16.4.14 Calculations for piling noise have been based on the source noise level (hammer strike) for 6,400 kJ for a monopile foundation, as given in Table 1. The overall A-weighted sound power level (SWL) equate to the values used for Awel Y Môr Offshore Wind Farm[1] as the same piling technique and hammer energies would be used. The spectral data has been derived from BS 5228-1, Table C3 item 2 for hydraulic hammering a tubular steel pile, which has been scaled up to match the overall sound power level.

Table 1 Piling sound power levels for a monopile foundation

Hammer energy	Sound power level, dB L_{WA} in octave band centre frequency								
	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	L_{WA}
6,400 kJ	106.6	123.7	132.2	133.6	135.8	132.0	127.8	116.7	140.1

16.4.15 The calculation of construction noise uses the BEK No. 135 methodology, as given in Equation 1, and assumes the following:

- 10° C and 80% relative humidity (in accordance with BEK No. 135);
- Piling taking place at a height of 22 m above MHWS;
- Wind speed reference of V_{10} 8 m/s;
- Downwind propagation between source and receiver; and
- No correction for exposure time – assumes constant piling noise through assessment period.

Operational noise

16.4.16 Equation 1 was used to calculate the operational sound pressure level at the receiver location from each WTG within the array. The calculation of ΔL_m is carried out by determining the threshold distance for each individual WTG based on its downwind component for a wind vector from the nearest turbine to the calculation point blowing directly at the calculation point. Therefore, the calculation assumes downwind propagation for the closest WTG and corrects for the downwind component for all other WTGs. The correction for downwind component is given by Equation 2.

1 Awel Y Môr Offshore Wind Farm (Ref: EN010112-000211-6.3.10_AyM_ES_Volume3_Chapter10_Noise_and_ Vibration).

Equation 2 – calculation of downwind component

$$V_{ref,k,i} = V_{ref} \times \cos\theta_{in}$$

Where:

$V_{ref,k,i}$ is the downwind component of the wind speed at a reference height of 10 m

V_{ref} is the wind speed at a reference height of 10 m

ϑ_{in} is the angle between the direction of the calculation point to the nearest WTG and the direction form the calculation point to the i^{th} wind turbine

16.4.17 Calculations of operational noise have been performed following Equation 1 and Equation 2 for all three WTG options discussed in paragraph 16.4.4.

16.4.18 The options that resulted in the highest and lowest levels of noise at the NSRs have been included in Table 8 to represent the maximum and alternative design scenarios respectively.

16.4.19 Modern offshore WTGs, typical of those that will be installed within the array, are all variable speed, pitch regulated machines. Due to their variable speed operation the sound power output will vary considerably with wind speed, being quieter at lower wind speeds when the blades are rotating more slowly. The calculation for operational noise has used sound power data for the WTGs operating at a wind speed V_{10} of 8 m/s in accordance with BEK No. 135. Where the standardised 10 m wind speed is calculated from hub height using a logarithmic profile with a reference surface roughness of 0.05 m in accordance with IEC 61400-11 and summarised in Equation 3.

Equation 3 – wind shear to standardised 10 m

$$v_{10} = v_{hh}\frac{\ln\left(\frac{10m}{Z_{0,ref}}\right)}{\ln\left(\frac{H_{hh}}{Z_{0,ref}}\right)}$$

Where:

V_{10} is the standardised 10 m wind speed

V_{hh} is the wind speed at hub height

$Z_{0,ref}$ is the reference surface roughness of 0.05 m

H_{hh} is the height of the hub in m

16.4.20 Octave band sound power data for each of the wind turbine options set out in paragraph 16.4.4 has been supplied by turbine manufacturers under non-disclosure agreements and therefore cannot be reproduced in this chapter. A conservative approach has been adopted by adding a margin of +2 dB to the specification data supplied, in line with the IOA GPG. The assessment has therefore been carried out on the basis of manufacturer's specified data with an additional 2 dB added in accordance with the IOA GPG.

16.4.22 The following assumptions have been made for the calculation of operational wind turbine noise:

- 10° C and 80% relative humidity (in accordance with BEK No. 135);
- Source height as per the hub height given in paragraph 17.4.3 in metres above MHWS;
- Wind speed reference of V_{10} 8 m/s;
- Downwind propagation for the closest WTG, as described in paragraph 16.4.16; and
- No correction for exposure time – assumes constant noise through assessment period.

16.4.23 All predicted wind turbine noise levels at NSRs presented in this chapter use the L_{A90} noise indicator in accordance with the recommendations of the ETSU-R-97 report, which have been obtained by subtracting 2 dB(A) from the calculated L_{Aeq} noise levels as a result of the above calculation method and sound power data. This is in accordance with SB20 of the IOA GPG.

Decommissioning noise

16.4.24 A Decommissioning and Restoration Plan has been included in Volume 7, Appendix 2 of the Environmental Impact Assessment Report. The Decommissioning and Restoration Plan includes three rehabilitation schedules, one for each MAC. The decommissioning plans for the offshore infrastructure at Dublin Array will be regularly reviewed and updated to reflect advancements in scientific and technological knowledge, as well as changes in best practices and regulatory requirements. This ensures that the decommissioning process remains effective and environmentally responsible.

16.4.25 Upon decommissioning of the offshore infrastructure of the Dublin Array, the WTGs and OSP will be disassembled, and all above ground components will be separated and removed. It is proposed that piled foundations will be cut below seabed level, and the protruding section removed. This will not produce airborne sound levels with sufficient energy to propagate to shore.

16.4.26 It is envisaged that, where appropriate, buried assets such as offshore cables will be left in situ when the Dublin Array is decommissioned. Discussions with stakeholders and regulators may identify the need for cables to be wholly or partially removed. Potential recovery of these cables may then be possible using techniques including mass flow excavation, grapnels or other available future techniques, but this will require environmental assessment at the time to investigate the potential effects of the retrieval operations.

16.4.27 Therefore, the decommissioning phase would not lead to any likely significant effects.

16.5 Assessment criteria

16.5.1 The criteria for the construction and operational noise and vibration assessments and resulting effect significance is dependent on two main factors: The sensitivity of the receptor location and the impact magnitude.

Sensitivity of receptor criteria

16.5.2 The sensitivity of the environment is defined in Table 2. These apply equally to the assessment of construction and operational noise and vibration impacts and have been based on professional judgement. It should be noted that in Table 2 reference is made to the use of a particular space, such as a dwelling, sport facility or operating theatre; however, it is the persons present in these spaces that is the NSR not the building itself.

Table 2 Sensitivity/importance of the environment

Receptor sensitivity	Definition
High	Noise may be detrimental to vulnerable receptors, such as rooms within hospitals that require high level of focus (e.g. operating theatre) or care of vulnerable groups of people (e.g. high dependency unit).
Medium	Noise may cause disturbance, and a level of protection is required, but a level of tolerance is expected. Such receptors include at all times of the day; dwellings, hospital wards and care homes and daytime only receptors such as education facilities.
Low	Leisure and sports facilities including public parks and non-noise-producing employment such as offices. Noise and vibration may be heard or felt but are unlikely to result in any change in behaviour.
Negligible	All other areas including industrial and agricultural areas. Noise and vibration are unlikely to have any effect.

Magnitude of impact criteria

16.5.3 The magnitude of impact will vary depending on the nature of the source of noise experienced. Each of the relevant different sources of noise, that would arise from the offshore infrastructure, are discussed below and the magnitude of impact quantified. The values specified for the various magnitudes of impact have been derived from guidance documentation or standards relevant to nature of the source.

Construction noise impact magnitude

16.5.4 The impact of construction noise upon NSRs has been determined with reference to the BS 5228-1. Annex E of BS 5228-1 outlines criteria for evaluating the significance of construction noise effects and presents two example methods. The first method categorises the existing noise environment into three bands—Category A, B, and C—based on measured background noise levels. Category A represents areas with the lowest existing noise levels, where even a small increase in noise from construction could be more noticeable and potentially disruptive. In contrast, Category C applies to areas with the highest existing background noise levels, where additional construction noise may be less perceptible due to the already elevated ambient noise. The second method in Annex E assesses significance based on the increase in noise caused by construction activities, with different lower cut-off values depending on the time of day.

16.5.5 The most stringent threshold values for both of these two methods are the same and have been adopted to represent the threshold at which an observed effect would occur. The threshold values differ for the time of day to reflect the impacts upon typical activities at an NSR during these times.

Table 3 Construction noise threshold values

Period	Definition	Threshold, dB L_{Aeq}
Night-time	23:00 – 07:00 hours all days of the week.	45
Evenings and weekends	19:00 – 23:00 hours weekdays, 13:00 – 23:00 hours Saturdays, and 07:00 – 23:00 hours Sundays.	55
Daytime	07:00 – 19:00 hours Monday to Friday, and 07:00 – 13:00 hours Saturdays.	65

16.5.6 BS5228-1 also provides advice on the likely impacts of construction noise with regard to the duration of exposure. For areas with a prevailing quiet environment, where the construction noise level outside a residential dwelling exceeds the trigger levels reproduced in Table 4 for a period of 10 or more days in any 15 consecutive days, or for a total number of days exceeding 40 in any 6 consecutive months, it is deemed to be significant and additional measures such as noise insulation or temporary rehousing may be appropriate.

Table 4 Construction noise insultation trigger levels

Period	Relevant time period	Averaging time, T	Noise insulation trigger level, dB $L_{Aeq,\,T}$
Monday to Friday	07:00 – 08:00	1 hour	70
	08:00 – 18:00	10 hours	75
	18:00 – 19:00	1 hour	70
	19:00 – 22:00	3 hours	65
	22:00 – 07:00	1 hour	55
Saturday	07:00 – 08:00	1 hour	70
	08:00 – 13:00	5 hours	75
	13:00 – 14:00	1 hour	70
	14:00 – 22:00	3 hours	65
	22:00 – 07:00	1 hour	55
Sundays and public holidays	07:00 – 21:00	1 hour	65
	21:00 – 07:00	1 hour	55

16.5.7 The impact magnitude for construction noise has been developed for this assessment based on the above guidance and is set out in Table 5, the threshold value is as per Table 5.

Table 5 Construction noise magnitude of impact

Magnitude	Definition
High	Threshold value exceeded by more than 5 dB for a period of 10 or more days in any 15 consecutive days, or for a total number of days exceeding 40 in any 6 consecutive months.
Medium	Threshold value exceeded by more than 3 dB and up to 5 dB for a period of 10 or more days in any 15 consecutive days, or for a total number of days exceeding 40 in any 6 consecutive months.
Low	Threshold value exceeded by up to 3 dB, OR threshold value exceeded by more than 3 dB for a period of less than 10 days in any 15 consecutive days, or for a total number of days not exceeding 40 in any 6 consecutive months.
Negligible	Threshold value not exceeded.

Operational noise impact magnitude

16.5.8 The impact of operational noise from the WTGs upon existing NSRs has been determined with reference to the Wind Energy Development Planning Guidelines 2006 and supplemented by ETSU-R-97 and the IOA GPG as set out below.

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

'In general, a lower fixed limit of 45 dB(A) or a maximum increase of 5 dB(A) above background noise at nearby noise sensitive locations is considered appropriate to provide protection to wind energy development neighbours. However, in very quiet areas, the use of a margin of 5 dB(A) above background noise at nearby noise sensitive properties is not necessary to offer a reasonable degree of protection and may unduly restrict wind energy developments which should be recognised as having wider national and global benefits. Instead, in low noise environments where background noise is less than 30 dB(A), it is recommended that the daytime level of the $L_{A90,10min}$ *of the wind energy development noise be limited to an absolute level within the range of 35-40 dB(A).*

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

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

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

16.5.12 ETSU-R-97 offers an alternative simplified assessment methodology:

'For single turbines or wind farms with very large separation distances between the WTGs and the nearest properties a simplified noise condition may be suitable. We are of the opinion that, if the noise is limited to an $L_{A90,10min}$ of 35 dB(A) up to wind speeds of 10 m/s at 10 m height, then this condition alone would offer sufficient protection of amenity, and background noise surveys would be unnecessary. We feel that, even in sheltered areas when the wind speed exceeds 10 m/s on the wind farm site, some additional background noise will be generated which will increase background levels at the property.'

16.5.13 In the case of Dublin Array, separation distances between the WTGs and nearest NSRs are large, at least 8.5 km, such that at all locations noise levels will fulfil this simplified criterion, therefore background noise surveys are not required. Additionally, the 35 dB L_{A90} criterion represents the most stringent daytime limit available within the Wind Energy Development Guidelines (2006) and would form the basis for noise limits which would be used to control noise from Dublin Array during operation.

16.5.14 For the cumulative assessment of noise on terrestrial receptors from the Dublin Array WTGs together with noise from other proposed wind farms acting at the same NSR (see section 16.15 and Table 13), it is proposed that a value of 40 dB L_{A90} is set as a fixed noise limit. This accords with the Wind Energy Development Guidelines (2006) and is considered appropriate in light of the following:

- The Environmental Protection Act 1990 (EPA) document Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4) proposes a daytime noise criterion of 45 dB(A) in areas of low background noise. The proposed lower threshold here is more stringent than this level; and
- It should be reiterated that the 2006 Wind Energy Development Guidelines for Planning Authorities states that *'an appropriate balance must be achieved between power generation and noise impact.'* Based on a review of the aforementioned EPA NG4 national guidance in relation to acceptable noise levels in areas of low background noise it is considered that the criteria adopted as part of this assessment are robust.

16.5.15 A value of 40 dB L_{A90} sits within the appropriate range of lower fixed limit for the daytime in a low noise environment, and below the night-time lower fixed limit recommended in the 2006 Guidelines.

16.5.16 There is no best practice guidance that defines the magnitude of impact of wind turbine noise; therefore, the assessment of significance of effects from operational wind turbine noise at a NSR is:

- Not significant if, an NSR is exposed to WTG noise from Dublin Array that does not exceed 35 dB L_{A90} when considered in isolation of all other wind farms, and 40 dB L_{A90} when considered cumulatively with other relevant wind farms; or

- Significant if, an NSR is exposed to WTG noise from Dublin Array that does exceed 35 dB L_{A90} when considered in isolation of all other wind farms, or 40 dB L_{A90} when considered cumulatively with other relevant wind farms.

16.5.17 The above criterion applies equally 24 hours a day, 7 days a week.

16.5.18 Draft revised wind energy development guidelines were issued in 2019 which are currently under review and yet to be adopted. Until such a time as these guidelines are re-published for public consultation, the 2006 Guidelines remain in place. The noise assessment section of the draft guidelines is not considered best practice and has not been applied in this assessment.

Defining the significance of effect

16.5.19 Assessment of the significance of potential effects is described in detail in the EPA 2022 guidelines, as summarised in Table 6, which has been applied to the assessment of significance of potential construction noise effects. The assessment of significance of potential operational noise effects have been determined in accordance with the criterion set out in paragraph 16.5.16, which aligns with current best practice, the 2006 Guidelines, ETSU-R-97, and the IOA GPG, and therefore Table 6 would not apply.

16.5.20 It is noted that impact magnitudes can be adverse, neutral and positive. For this assessment, the offshore infrastructure has only the potential to introduce noise and/or vibration to the existing environment rather than offer a reduction on the levels current experienced. Therefore, Table 6 does not include the significance of effect for positive impacts.

Table 6 Significance of potential effects

Description of Impact - Magnitude		Existing Environment - Sensitivity			
		High	**Medium**	**Low**	**Negligible**
Adverse impact	**High**	Very Significant (significant)	Significant	Moderate*	Imperceptible
Adverse impact	**Medium**	Significant	Moderate*	Slight	Imperceptible
Adverse impact	**Low**	Moderate*	Slight	Slight	Imperceptible
Neutral impact	**Negligible**	Not significant	Not significant	Not significant	Imperceptible

*Moderate levels of effect have the potential, subject to the assessor's professional judgement, to be significant. Moderate will be considered as significant or not significant in EIA terms, depending on the sensitivity and magnitude of change factors evaluated. These evaluations are explained as part of the assessment, where they occur.

16.6 Receiving environment

16.6.1 The existing noise environment within the study area along the county Dublin and Wicklow coast will be made up of noise from several sources including those from natural sources such as wind, waves, rain, birds and those from anthropogenic sources such as industry, road, rail and sea transportation, shipping, fishing and aircraft. The existing ambient noise levels due to these sources will vary considerably depending on exact location within the study area, wind speed and weather conditions. Noise levels from intermittent sources such as transportation and shipping will vary depending on the level of activity within the area at any one time.

16.6.2 The existing environment is not expected to alter in the case of a do-nothing scenario, whereby the Dublin Array would not proceed.

16.7 Defining the sensitivity of the baseline

16.7.1 The sensitivity for the receptors for each potential effect, using the criteria outlined in section 16.5, are presented in section 16.9, under the subheading Sensitive receptors.

16.8 Uncertainties and technical difficulties encountered

16.8.1 No significant information gaps were identified, and the assessment has been undertaken in line with relevant standards and policy documents discussed in section 16.2.

16.8.2 The calculation of noise levels during both the construction and operational phases of the development assumes downwind propagation and the highest wind speed permitted within the calculation procedure described in BEK No. 135 as a worst-case scenario.

16.8.3 The assessment of operational WTG noise includes a correction of +2 dB to account for uncertainty allowances within the sound power data of the WTGs, as discussed in paragraph 16.4.20.

16.9 Scope of the assessment

Scoped in

16.9.1 The following impacts will be assessed:

- Construction:
  - Impact 1: Construction noise impacts upon shoreline NSRs from piling foundations for WTGs and the OSP within the array area.
- Operation and maintenance:
  - Impact 2: Operational noise impacts upon shoreline NSRs from the WTGs.

- Decommissioning:
  - Impact 3: Noise impacts upon shoreline NSRs from decommissioning the offshore infrastructure.
- Cumulative:
  - Impact 4: Construction noise impacts upon shoreline NSRs from simultaneous piling of WTG foundations within the array area with piling noise impacts of other relevant WTGs during construction of other proposed Offshore Wind Farm (OWF) developments.
  - Impact 5: Operational noise impacts upon shoreline NSRs from the WTGs with operational noise from relevant WTGs associated with other proposed OWF developments.

Scoped out from further evaluation in this EIAR

16.9.2 The following impacts are assessed in other chapters within the EIAR and as such fall outside the scope of this assessment:

- Operational or construction noise and vibration of the onshore infrastructure upon onshore receptors. This is assessed in Volume 5, Chapter 5: Noise and Vibration.

16.9.3 In addition, the following have been considered and scoped out of this assessment as discussed in more detail below:

- Amplitude modulation (AM) of operational noise;
- Infrasound and low frequency noise;
- Tonal noise; and
- Construction and operational vibration.

Amplitude modulation

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

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

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

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

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

16.9.9 The IOA GPG discusses AM. Section 7.2.1 of the IOA GPG remains current best practice and states: *'The evidence in relation to 'Excess' or 'Other' Amplitude Modulation (AM) is still developing. At the time of writing, current practice is not to assign a planning condition to deal with AM'*.

16.9.10 Subsequently, a report commissioned by the UK Department for Business, Energy & Industrial Strategy was published in February 2023 (BEIS, 2023) and concludes that the noise limits in ETSU-R-97 should be reviewed and that updated guidance on AM should be included but makes no firm recommendations with regards to any update. Therefore, until the UK or Irish governments conclude such a review, the ETSU-R-97 methodology continues to be applicable. The UK Government has also confirmed that ETSU-R-97 should continue to apply until the review recommendations are considered in further detail.

16.9.11 The above evidence shows that OAM has the potential to occur in any wind farm, however the likelihood is low. There is no available method for predicting the probability of AM or OAM occurring, or whether or not it would amount to a likely significant effect on the environment before the wind farm is constructed and operational. This is because OAM depends on a number of factors that can only be ascertained through operation of the wind farm. Therefore, give the absence of available data and the speculative nature of such an assessment, AM will not be considered further in this chapter.

Infrasound and low frequency noise

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

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

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

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

16.9.16 The studies discussed above are current, represent best knowledge and conclude that there is no evidence of impact from infrasound or low frequency noise generated by WTGs. It is therefore not necessary to carry out a specific assessment of infrasound and low-frequency noise.

Tonal Noise

16.9.17 Tonal noise refers to concentrations of acoustic energy within relatively narrow frequency bands. In WTGs, tonality is typically of mechanical origin, which has largely been engineered out of modern designs, as it is often caused by structural resonances in mechanical components. Modern WTGs are unlikely to generate tonal noise unless there is a mechanical fault, such as an issue with the gearbox due to poor maintenance. A properly functioning turbine will not produce tonal noise. If a tone does occur, ETSU-R-97 provides a rating and correction for tonal characteristics. For the purposes of this chapter, it is understood that these WTGs do not exhibit tonal noise.

Vibration

16.9.18 Research undertaken by D J Snow (1997) found that levels of ground-borne vibration 100 m from the nearest wind turbine were significantly below the criteria for 'critical working areas'[2] given by British Standard BS 6472:1992 Evaluation of Human Exposure to Vibration in Buildings (1 Hz to 80 Hz) and were lower than limits specified for human perception within residential premises by an even greater margin (Snow, 1997). Subsequently, BS 6472-1:2008 has superseded BS 6472:1992 and does no longer apply to critical working areas, where vibration criteria are more stringent than those for human perception. Therefore, the ground-borne vibration measured by Snow 100 m from a wind turbine were also significantly below human perception and the thresholds set out in BS 6472-1:2008 for probability of adverse comment.

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

16.9.20 Similarly, perceptible vibration levels experienced during construction piling will be limited to 100 m to 300 m depending on the ground conditions and energy of the pile driver. Vibration propagation from impact piling reduces exponentially with distance; therefore, small changes in distance will result in larger changes in resultant vibration. The separation distances between the WTGs and the closest NSRs are at least 8.5 km. Vibration would not be perceptible at this distance. Therefore, it is current best practice to not carry out a specific assessment of vibration arising from the construction and operation of WTGs, and it is not considered further in this chapter.

Sensitive receptors

16.9.21 NSRs have been identified within the study area as habited dwellings along the coastline. It should be noted that the list of NSRs is not intended to be exhaustive but sufficient to be representative of noise levels typical of those closest to the WTGs. Table 7 lists the NSRs included in the assessment, illustrated in Figure 1.

2 'Critical working areas' refer to environments where vibration levels must be controlled to avoid interference with sensitive equipment or precision activities, such as laboratories, manufacturing facilities, or locations housing medical or technical instruments. These areas require stricter vibration criteria than those focused on human comfort or perception.

Table 7 Assessment NSRs in the study area

ID	Description	Eircode	Easting (ITM)	Northing (ITM)
NSR01	Sorrento Hse 1 Sorrento Terrace	A96 CX47	727249	726165
NSR02	Killeen Marino Avenue East	A96 WK29	725868	724299
NSR03	Maravista 2 Seafield	D18 AE79	726066	722486
NSR04	Rear of 2 Royal Marine Terrace	A98 T0X9	726905	718957
NSR05	Montebello, Strand Row	A98 CA32	727113	718436
NSR06	6 Fontenoy Terrace	A98 K3T6	727496	717883
NSR07	Gorse Hill Centre	A98 R3H2	728543	715575
NSR08	67 The Grove Redford	A63 D400	728610	713743
NSR09	The Campion, Marina Village	A63 HY97	729217	713172
NSR10	Carraig House	A63 NN93	729523	712808
NSR11	White Lodge	A63 DX73	729717	712544
NSR12	Park Lodge, Mill Road	A63 WV70	729816	711925

16.10 Key parameters for assessment

16.10.1 As set out in the Application for Opinion under Section 287B of the Planning and Development Act 2000, flexibility is being sought where details or groups of details may not be confirmed at the time of the Planning Application. In summary, and as subsequently set out in the ABP Opinion on Flexibility (detailed within Volume 2, Chapter 3: EIA Methodology) the flexibility being sought relates to those details or groups of details associated with the following components (in summary – see further detail in see Volume 2, Chapter 6: Project Description):

- WTG (model – dimensions and number);
- OSP (dimensions);
- Array layout;
- Foundation type (WTG and OSP; types and dimensions and scour protection techniques); and
- Offshore cables (IAC and ECC; length and layout).

16.10.2 To ensure a robust and transparent assessment, and one that is compliant with the ABP Opinion on Flexibility under Section 287B, the details or groups of details associated with those components where flexibility is being sought are defined in the form of a MDO and Alternative Design Option(s) (ADO). The MDO and ADO(s) are then assessed in terms of the magnitude of the effect, to provide certainty that any option within the range of parameters will not give rise to an effect which is of greater significance than the MDO.

16.10.3 In addition to the details or groups of details associated with the components listed above (where flexibility is being sought), the confirmed design details and the range of normal construction practises are also assessed within the EIAR (see Volume 2, Chapter 6: Project Description). Whilst flexibility is not being sought for these elements (for which plans and particulars are not required under the Planning Regulations), the relevant parameters are also incorporated into the MDO and alternative option(s) table (Table 8) to ensure that all elements of the project details are fully considered and assessed. The MDO presented informs the assessment of magnitude through consideration of the extent, duration and frequency of the activity that determines the significance of the effect. ADOs are considered as part of the assessment and results presented in Appendix 4.3.16-1: Construction and Operational Noise Predictions.

16.10.4 With respect to the range of normal construction practises that are intrinsic to installation of the development, such as the nature and extent of protection for offshore cables and the design of cable crossings, but which cannot be finally determined until after consent has been secured and detailed design is completed, the parameters relevant to the receptor being assessed are quantified, assigned and assessed as a maximum and alternative, as informed by the potential for impact upon that receptor. In the event of a favourable decision on the application they will be agreed prior to the commencement of the relevant part of the development by way of compliance with a standard 'matters of detail' planning condition (see the Consents, Legislation, Policy and Guidance Chapter). Throughout, an explanation and justification is provided for the MDO and alternative(s) within the relevant tables, as it relates the details or groups of details where statutory design flexibility is being sought, and wider construction practises where flexibility is provided by way of planning compliance condition.

Table 8 Design scenarios assessed – offshore infrastructure noise and vibration impacts upon onshore receptors

Maximum design option	Alternative design options	Justification
Construction		
Impact 1: Offshore piling noise		
Option C: 39 WTGs Monopile foundation of maximum diameter (13 m) located closest to an onshore receptor installed using impact piling with maximum hammer energy of 6,400 kJ	Option A: 50 WTGs or Option B: 45 WTGs The monopile foundations for WTG options A and B are of smaller diameter than the maximum design option. However, the maximum hammer energy of 6,400 kJ may apply for all design options. The maximum hammer energy for impact driven piles for multileg WTG foundations is 4,700 kJ and will generate less noise than the maximum design scenario. In the case of both monopile and multileg structures the maximum hammer energy will not be used continuously, and noise levels will therefore be lower than predicted for the maximum design option. Foundation locations may require lower maximum hammer energies to achieve installation, resulting in lower noise levels. Alternative pile installation methods such as vibration drive, blue piling, HiLo impact driven, or pulse driven will generate less noise than impact piling. Foundations that incorporate suction buckets as an alternative to piles will not generate piling noise.	Shortest distance to shore will result in the highest noise level being received for all options. Higher levels of noise are generated for monopile foundation than multileg foundation. Impact piling (a conventional piling technique whereby the pile is repeatedly struck with a hammer to drive it into the ground) will generate the highest levels of noise for all available piling methods. Further details of all foundation installation and piling techniques can be found in the Project Description Chapter (section 6.5) See Appendix 4.3.16-1 for comparative modelled outputs of predicted construction noise levels from the three potential layouts and different foundation types.

Maximum design option	Alternative design options	Justification
Operation and maintenance		
Impact 2: Operational noise of the array		
Option A: 50 WTGs Blade tip height of 267.6 mLAT, 236 m rotor diameter, mounted on 146 m (MHWS) hub height	Option B: 45 WTGs Blade tip height of 267.6 mLAT, 250 m rotor diameter, mounted on 153 m (MHWS) minimum hub height Or Option C – 39 WTGs Blade tip height of 281.6 mLAT, 278 m rotor diameter, mounted on 167 m (MHWS) minimum hub height	Appendix 4.3.16-1 details predicted operational noise levels for Option A, B and C. Option A layout was found to produce the highest levels of noise at onshore receptors.
Decommissioning		
Impact 3: Noise from decommissioning the array		
Option A – 50 WTGs	Option B: 45 WTGs Or Option C: 39 WTGs	During the decommissioning phase, only low levels of sound are expected to be generated at distances beyond 9 km from onshore receptors. As a result, no significant effects are anticipated.
Cumulative effects		
Impact 4: Offshore cumulative piling noise with Codling Offshore Wind Farm (OWF) Dublin Array and Codling OWF simultaneously piling impact driven monopile structures at the same time.	The anticipated piling period for Codling OWF is 2027 which is outside the piling period for Dublin Array (2029 for monopile foundation option and 2029-2031 for multileg foundations). In these scenarios no simultaneous piling will occur. In the event that piling programs do coincide Dublin Array piling impact driven multileg structure and Codling OWF monopile	Shortest distance will result in the highest noise level. Simultaneous piling will result in higher noise levels than a single pile. Impact piling a monopile will generate the highest levels of noise for all available piling methods.

Maximum design option		Alternative design options	Justification
		foundations at the location closest to the same onshore receptor at the same time would result in lower noise levels than the maximum cumulative design option.	
Impact 5: Cumulative operational noise of the array with Codling OWF array	Codling OWF operating at the same time as Dublin Array Option A - 50 turbine layout with 236 m rotor diameter WTGs. Wind vector is from the nearest turbine to the NSR situated closest to both OWF.	Option B – 45 turbine array with 250 m rotor diameter WTGs, mounted on 153 m (MHWS) hub height or Option C – 39 turbine array with 278 m rotor diameter WTGs, mounted on 167m (MHWS) hub height.	Option A for Dublin Array produces the highest levels of noise at onshore receptors. Offshore wind vectors (in a direction from land to sea) will result in lower levels of wind turbine noise at the nearest NSRs.

16.11 Project Design Features and Avoidance and Preventative Measures

16.11.1 As outlined within the EIA Methodology Chapter (Volume 2, Chapter 3) and in accordance with the EPA Guidelines (2022), this EIAR describes the following:

- Project Design Features: These are features of the Dublin Array project that were selected as part of the iterative design process, which are demonstrated to avoid and prevent potential adverse effects on the environment in relation to physical processes. These are presented within Table 9.
- Other Avoidance and Preventative Measures: These are measures that were identified throughout the early development phase of the Dublin Array project, also to avoid and prevent likely significant effects, which go beyond design features. These measures were incorporated in as constituent elements of the project, they are referenced in the project description chapter of this EIAR, and they form part of the project for which development consent is being sought. These measures are distinct from design features and are found within our suite of management plans. These are also presented within Table 9.
- Additional Mitigation: These are measures that were introduced to the Dublin Array project after a likely significant effect was identified during the EIA assessment process. These measures either mitigate against the identified significant adverse effect or reduce the significance of the residual effect on the environment.

16.11.2 All measures are secured within Volume 8: Schedule of Commitments.

Table 9 Project design features and avoidance and preventative measures relating to noise and vibration

Project design feature/avoidance and preventative measure	Where secured
Construction noise will be managed in line with the guidelines set out in British Standard BS 5228-1:2009, which provides a code of practice for controlling noise and vibration on construction and open sites. The appointed contractor will implement the most suitable noise control measures to ensure compliance with the noise limits specified in this chapter. These measures will also aim to minimise noise impacts using the best practicable methods available.	PEMP will set out environmental management measures to be adopted during construction phase.
No foundations to be installed simultaneously on the Dublin Array project (concurrently).	Project Description Chapter.

16.12 Environmental assessment: Construction phase

16.12.1 The construction of the offshore infrastructure associated with a development of this nature has the potential to generate noise at shoreline NSRs. The large separation distances between the construction works and NSRs will provide sufficient attenuation of noise from the majority of construction activities. Impact piling of the foundations for the WTGs and OSPs can generate high levels of noise at source, which may still be experienced, albeit at a much lower level, at shoreline NSRs. Any disruption due to construction-related noise is a localised phenomenon and is both temporary and intermittent in nature.

16.12.2 During piling, noise from construction activities will inevitably be generated and will, during certain circumstances, be audible at some shoreline NSRs. The purpose of the assessment is to:

- Quantify the likely levels of construction noise that can be expected at NSRs;
- Quantify the magnitude of the potential construction noise impacts, the resulting level of effect and whether this is significant in EIA terms; and
- Where relevant, identify those impacts that would require specific mitigation measures for the potential noise effects to be reduced to a level considered acceptable.

Impact 1: Construction piling noise impacts on shoreline NSRs

16.12.3 Calculations assume the design scenarios set out in Table 8 and include project design measures detailed in Table 9. The predicted noise levels from piling the closest turbine foundation to each of the NSRs are shown in Table 10 for the MDO. Table 11 details the difference between the predicted piling noise levels and the threshold values set out in Table 3. Appendix 4.3.16-1 provide calculated piling noise levels for each NSR for all design options.

Table 10 Predicted noise levels from piling

NSR	Description	Maximum piling noise level, dB L_{Aeq}
NSR01	Sorrento Hse 1 Sorrento Terrace	48
NSR02	Killeen Marino Avenue East	46
NSR03	Maravista 2 Seafield	47
NSR04	Rear of 2 Royal Marine Terrace	46
NSR05	Montebello, Strand Row	46
NSR06	6 Fontenoy Terrace	46
NSR07	Gorse Hill Centre	47
NSR08	67 The Grove Redford	47
NSR09	The Campion, Marina Village	49
NSR10	Carraig House	49
NSR11	White Lodge	50
NSR12	Park Lodge, Mill Road	49

Table 11 Difference between piling construction noise levels and threshold values

NSR	Description	Difference (maximum piling noise – threshold), dB		
		Daytime (threshold 45 dB L_{Aeq})	Evenings and weekends (threshold 55 dB L_{Aeq})	Night-time (threshold 45 dB L_{Aeq})
NSR01	Sorrento Hse 1 Sorrento Terrace	-17	-7	+3
NSR02	Killeen Marino Avenue East	-19	-9	+1
NSR03	Maravista 2 Seafield	-18	-8	+2
NSR04	Rear of 2 Royal Marine Terrace	-19	-9	+1
NSR05	Montebello, Strand Row	-19	-9	+1
NSR06	6 Fontenoy Terrace	-19	-9	+1
NSR07	Gorse Hill Centre	-18	-8	+2
NSR08	67 The Grove Redford	-18	-8	+2
NSR09	The Campion, Marina Village	-16	-6	+4
NSR10	Carraig House	-16	-6	+4
NSR11	White Lodge	-15	-5	+5
NSR12	Park Lodge, Mill Road	-16	-6	+4

16.12.4 It can be seen from Table 11 that the maximum piling noise is below the daytime and the evenings and weekends thresholds at all NSRs, which is a negligible magnitude of impact. The maximum piling noise exceeds the night-time threshold by more than 3 dB (48 dB) and up to 5 dB (50 dB) at a total of five NSRs. Appendix 4.3.16-1 provides further information where it can be seen that piling the closest three WTGs to NSR01 would exceed a value of 48 dB by a fraction of a decibel. Piling noise is between 48 dB and 50 dB at NSRs 9, 10, 11 and 12 for the closest WTGs to these receptors, which range in number between two and four.

16.12.5 As illustrated in Appendix 4.3.16-1, piling noise would not exceed the night-time threshold by more than 3 dB for a period of more than four nights at any NSR even if piling were to only take place during the night-time and the closest piles were driven on consecutive nights. As set out in Table 5, such an impact would be of low magnitude.

16.12.6 The NSRs are all residential dwellings and as per Table 2 are of **Medium** sensitivity. The maximum magnitude of the impact has been assessed as **Low**, with the sensitivity of the receptors being **Medium**. Therefore, the significance of effect from construction noise as a result of impact piling wind turbine foundations is **Slight adverse**, which is not significant in EIA terms. The duration of effect would be temporary and short-term.

16.12.7 The above assessment is based on the MDO of Option C (39 WTGs) installed using impact piling with a maximum hammer energy of 6,400 kJ as set out in Table 8. The results for the ADOs are tabled in Appendix 4.3.16-1 which include impact piling of Option A and Option B with hammer energies of 6,400 kJ and 4,700 kJ. The results show up to a 2 dB reduction in the highest construction noise at any NSR.

Proposed mitigation

16.12.8 The significance of effect from construction noise is not significant in EIA terms. Therefore, no additional mitigation to that already identified in Table 9 is considered necessary.

Residual effect assessment

16.12.9 No significant adverse residual effects have been predicted in respect of construction noise.

16.13 Environmental assessment: Operational phase

16.13.1 The operation of the WTGs has the potential to generate noise at shoreline NSRs. The large separation distances between the offshore array and NSRs will attenuate operational noise; however, noise may still be experienced at some shoreline NSRs under certain conditions. As set out in paragraph 16.4.19, operational noise from WTGs is quieter at lower wind speeds and the results presented in this section correspond to reference wind speed of V_{10} 8 m/s, when most WTGs would be operating at, or very close to, their maximum sound power level. Any disruption due to operational-related noise is a localised phenomenon and will be permanent in nature for the duration of the wind farm's operation.

16.13.2 The purpose of this section of the chapter is to:

- Quantify the likely levels of operational noise that can be expected at NSRs;
- Provide comment as to the magnitude of the potential operational noise impacts, the resulting level of effect and whether this is significant in EIA terms; and
- Where relevant, identify those impacts that would require specific mitigation measures for the potential noise effects to be reduced to a level considered acceptable.

Impact 2: Operational noise impacts on shoreline NSRs

16.13.3 Calculations assume the design scenarios set out in Table 8 and include project design measures detailed in Table 9. The predicted operational noise levels from Dublin Array for the MDO at each of the NSRs are shown in Table 12.

Table 12 Dublin Array operational noise levels at V_{10} 8 m/s

NSR	Description	Maximum Operational Noise Level, dB L_{A90}	Margin to Noise Limit, dB (35 dB L_{A90})
NSR01	Sorrento Hse 1 Sorrento Terrace	33.2	-1.8
NSR02	Killeen Marino Avenue East	32.3	-2.7
NSR03	Maravista 2 Seafield	32.8	-2.2
NSR04	Rear of 2 Royal Marine Terrace	32.9	-2.1
NSR05	Montebello, Strand Row	33.0	-2.0
NSR06	6 Fontenoy Terrace	33.0	-2.0
NSR07	Gorse Hill Centre	33.1	-1.9
NSR08	67 The Grove Redford	32.6	-2.4
NSR09	The Campion, Marina Village	33.2	-1.8
NSR10	Carraig House	33.4	-1.6
NSR11	White Lodge	33.5	-1.5
NSR12	Park Lodge, Mill Road	33.3	-1.7

16.13.4 The above assessment is based on the MDO of Option A 50 WTGs as set out in Table 8. The full results for the ADOs are tabled in Appendix 4.3.16-1. The results show up to a 3.6 dB reduction in the operational noise at any NSR.

16.13.5 Also included in Table 12 is the margin between the maximum operational noise level and the noise limit of 35 dB L_{A90} discussed in paragraph 16.5.16. The maximum operational noise at any of the NSRs is 33.5 dB L_{A90}, which is below the threshold of significance. Therefore, the operational noise impacts associated with the Dublin Array WTGs will be not significant in EIA terms. The duration of effect would be for the lifetime of the Dublin Array operation.

Proposed mitigation

16.13.6 The significance of effect from operational noise is not significant in EIA terms. Therefore, no additional mitigation to that already identified in Table 9 is considered necessary.

Residual effect assessment

16.13.7 No significant adverse residual effects have been predicted in respect of operational noise.

16.14 Environmental assessment: Decommissioning phase

16.14.1 As referenced in the Project Description, the Decommissioning and Restoration Plan (Volume 7, Chapter 2), including the three rehabilitation schedules attached thereto, describes how the Applicant proposes to rehabilitate that part of the maritime area, and any other part of the maritime area, adversely affected by the permitted maritime usages that are the subject of the MACs.

16.14.2 It is based on the best scientific and technical knowledge available at the time of submission of this planning application. However, the lengthy passage of time between submission of the application and the carrying out of decommissioning works (expected to be approximately 35 years as defined in the MDO) gives rise to knowledge limitations and technical difficulties. Accordingly, the Decommissioning and Restoration Plan will be kept under review by the Applicant as the project progresses, and an alteration application will be submitted if necessary. In particular, it will be reviewed having regard to the following:

- The baseline environment at the time rehabilitation works are proposed to be carried out;
- What, if any, adverse effects have occurred that require rehabilitation;
- Technological developments relating to the rehabilitation of marine environments;
- Changes in what is accepted as best practice relating to the rehabilitation of marine environments;

- Submissions or recommendations made to the Applicant by interested parties, organisations and other bodies concerned with the rehabilitation of marine environments; and/or
- Any new relevant regulatory requirements.

16.14.3 The Decommissioning and Restoration Plan outlines the process for decommissioning of the WTG, foundations, scour protection, OSP, inter array cables and offshore ECC. The plan outlines the assumption that the most practicable environmental option is to leave certain structures in situ (e.g. inter array cables, scour protection); however, the general principle for decommissioning is for all structures to be removed and it is assumed that the WTGs will be dismantled and completely removed to shore.

16.14.4 For the purposes of the assessment of decommissioning, all activities outlined within the Decommissioning and Restoration Plan relevant to physical processes have been considered. As set out in paragraph 16.4.27, noise generated during the decommissioning of the offshore infrastructure would not lead to any likely significant effects regardless of the turbine layout within the array.

Proposed mitigation

16.14.5 The significance of effect from decommissioning noise is not significant in EIA terms. Therefore, no additional mitigation to that already identified in Table 9 is considered necessary.

Residual effect assessment

16.14.6 No significant adverse residual effects have been predicted in respect of decommissioning noise.

16.15 Environmental assessment: Cumulative effects

Methodology

16.15.1 This section outlines the cumulative impact assessment for noise and takes into account the impacts of Dublin Array alongside other plans and projects.

16.15.2 The cumulative impacts assessment for noise has been undertaken in accordance with the methodology provided in Volume 2, Chapter 4: Cumulative Impact Assessment Methodology, based on the driver, pressure, states, impacts and responses (DPSIR) model. Appendix 4.3.16-1 provides further information about the data used in determining cumulative effects.

16.15.3 The projects and plans selected as relevant to the assessment of noise impacts are based upon an initial screening exercise undertaken on a long list. Each project, plan or activity has been considered and scoped in or out on the basis of effect–receptor pathway, data confidence and the temporal and spatial scales involved.

Projects scoped out

16.15.4 Projects have been scoped out on the basis of the distance of the source-receiver-pathway, as discussed below in paragraph 16.15.5 to 16.15.5, and on the nature of the noise produced, discussed further in paragraph 16.15.6.

16.15.5 Noise, whether it is generated during construction or operation of a development, will diminish with distance. In the case of such noise propagating over large bodies of water, this is expressed by Equation 1 (paragraph 16.4.7).

16.15.6 The assessment of operational noise impacts described in paragraphs 16.4.14 to 16.4.23 and paragraphs 16.5.8 to 16.5.17 is specific to wind turbine noise and should not be applied to other sources of noise. Therefore, the cumulative operational noise can only consider other wind farms, either onshore or offshore.

Projects for cumulative assessment

16.15.7 The specific projects scoped into this cumulative impact assessment, and the tiers into which they have been allocated are presented in Table 13. The operational projects included within the table are included due to their completion/commission subsequent to the data collection process for Dublin Array and as such not included within the baseline characterisation.

Table 13 Projects for cumulative assessment construction and operational noise

Development type	Project name	Current status of development	Data confidence assessment/ phase	Planned programme
Tier 1				
-	None	n/a	n/a	n/a
Tier 2				
-	None	n/a	n/a	n/a
Tier 3				
Offshore Wind Farm	Codling Wind Park I and II	Planning Application Submitted	Medium – data directly exchanged with project noise team.	Construction may occur before, during or after Dublin Array.

Impact 4: Cumulative construction piling noise impacts on shoreline NSRs.

16.15.8 At the time of writing this report, the Codling Wind Park noise team provided predicted noise levels from impact piling of the WTGs within their development to be 31 dB L_{Aeq}. Noise levels have been calculated using this data at NSR11 and NSR12, which are the closest receptors to both Dublin Array and Codling Wind Park. Table 14 summarises the relevant steps discussed above.

16.15.9 As the predicted construction noise level from Codling Wind Park is more than 10 dB lower than the predicted construction noise level from Dublin Array (given in Table 10), concurrent piling of these projects would not increase the overall noise level. This is because on the decibel scale, a difference of 10 dB or more between two sound sources means that the quieter source contributes insignificantly to the total noise level. Therefore, cumulative construction piling noise impacts would also be of low magnitude.

16.15.10 The NSRs are all dwellings and as per Table 2 are of **Medium** sensitivity. The maximum magnitude of the impact has been assessed as **Low**, with the sensitivity of the receptors being **Medium**. Therefore, the significance of effect from cumulative construction noise as a result of impact piling wind turbine foundations simultaneously at Dublin Array and Codling Wind Park is **Slight adverse**, which is not significant in EIA terms. The duration of effect would be temporary and short-term.

Proposed mitigation

16.15.11 The significance of effect from cumulative construction noise is not significant in EIA terms. Therefore, no additional mitigation to that already identified in Table 9 is considered necessary.

Residual effect assessment

16.15.12 No significant adverse residual effects have been predicted in respect of cumulative construction noise.

Table 14 Determination of magnitude for cumulative construction piling noise

	Justification
Step 1: Drivers	Concurrent piling of the nearest WTGs within Dublin Array and Codling Wind Park to a single NSR. Piling of both projects assumed to be impact hammer driven.
Step 2: Pressures	The potential effect would be a temporary elevation in the construction noise impact magnitude, leading to a possible increase in effect level.

	Justification
Step 3: States	NSR11 and NSR12 are the closest receptors to both Dublin Array and Codling Wind Park.
Step 4: Impacts	No increase to the predicted construction noise impacts of Dublin Array.
Step 5: Responses	No additional mitigation necessary.
Conclusion	No significant adverse residual effects have been predicted in respect of cumulative construction noise.

Impact 5: Cumulative operational wind turbine noise impacts on shoreline NSRs

16.15.13 For the assessment of cumulative operational WTG noise, a noise model was produced with Dublin Array MDO and Codling OWF WTGs, as set out in Table 8. Data has been provided for Codling OWF that comprises 60 WTGs with a rotor diameter of 276 m, hub height of 176 m (MHWS) each rated at 15 MW. The predicted cumulative operational noise levels from Dublin Array and Codling OWF for the MDO at each of the NSRs are shown in Table 15.

Table 15 Cumulative operational noise levels at V_{10} 8 m/s

NSR	Description	Cumulative operational noise level, dB L_{A90}	Margin with noise limit, dB (40 dB L_{A90})
NSR01	Sorrento Hse 1 Sorrento Terrace	33.5	-6.5
NSR02	Killeen Marino Avenue East	32.8	-7.2
NSR03	Maravista 2 Seafield	33.3	-6.7
NSR04	Rear of 2 Royal Marine Terrace	33.4	-6.6
NSR05	Montebello, Strand Row	33.5	-6.5
NSR06	6 Fontenoy Terrace	33.6	-6.4
NSR07	Gorse Hill Centre	33.9	-6.1
NSR08	67 The Grove Redford	33.5	-6.5
NSR09	The Campion, Marina Village	34.2	-5.8
NSR10	Carraig House	34.4	-5.6
NSR11	White Lodge	34.5	-5.5
NSR12	Park Lodge, Mill Road	34.3	-5.7

16.15.14 Also included in Table 15 is the margin between the cumulative operational noise level and the cumulative noise limit of 40 dB L_{A90} discussed in paragraph 16.5.16. The maximum cumulative operational noise at any of the NSRs is 34.5 dB L_{A90}, which is below the threshold of significance. Therefore, the cumulative operational noise impacts will be not significant in EIA terms. The duration of effect would be permanent for the lifetime of the Dublin Array operation.

16.16 Interactions of the environmental factors

16.16.1 As a requirement of the Planning and Development Regulations 2001, as amended, and the EPA guidelines (2022), not only are the individual significant effects required to be considered when assessing the effect of a development on the environment, but so must the interrelationships between these factors be identified and assessed.

16.16.2 A matrix illustrating the likely interactions of the foregoing arising from Dublin Array on physical processes is provided in Volume 8, Chapter 1: Interactions of the Environmental Factors.

16.16.3 Interactions of the foregoing environmental factors are considered to be the effects and associated effects of different aspects of the proposal on the same receptor and include:

- Project lifetime effects: i.e. those arising throughout more than one phase of the project (construction, operation, and decommissioning) to interact to potentially create a more significant effect on a receptor than if just one phase were assessed in isolation; and
- Receptor led effects: Assessment of the scope for all effects to interact, spatially and temporally, to create inter-related effects on a receptor (or group). Receptor-led effects might be short term, temporary or transient effects, or incorporate longer term effects.

16.16.4 No lifetime effects would occur at a receptor, as noise would dissipate once a phase of the project, e.g. construction, passes.

16.16.5 Receptor led effects concern the accumulation of impacts on a single receptor between noise and vibration generated during the construction and operation of the offshore infrastructure and other environmental disciplines. It is considered likely that during the construction and operational phases, human receptors impacted by offshore noise and vibration are also likely to be affected by onshore noise and vibration impacts, which is considered in Volume 5, Chapter 5: Noise and Vibration; and visual impacts, which is considered in Volume 3, Chapter 15: Seascape, Landscape and Visual Impact Assessment. It is not anticipated that these inter-relationships will lead to any significant effects greater than the assessments presented for each discipline.

16.17 Transboundary statement

16.17.1 A screening of transboundary impacts has been carried out. It identified that there was no potential for significant transboundary effects with regard to NSRs from the Dublin Array upon the interests of other states due to the distance of Dublin Array offshore infrastructure to neighbouring states.

16.18 Summary of effects

16.18.1 This assessment has considered the potential noise and vibration effects arising from activities associated with the construction, operation and decommissioning of the offshore infrastructure of Dublin Array. MDO, and ADO parameters have been assessed.

Table 16 Summary of noise and vibration effects

Description of effect	Effect	Possible mitigation measures	Residual effect
Construction			
Impact 1	Offshore piling noise upon human receptors	Not Applicable – no additional mitigation identified	No noise and vibration significant adverse residual effects
Operation and maintenance			
Impact 2	Operational noise of the array upon human receptors	Not Applicable – no additional mitigation identified	No noise and vibration significant adverse residual effects
Decommissioning			
Impact 3	Decommissioning noise of offshore infrastructure upon human receptors	Not Applicable – no additional mitigation identified	No noise and vibration significant adverse residual effects
Cumulative effects			
Impact 4	Cumulative offshore piling noise upon human receptors	Not Applicable – no additional mitigation identified	No noise and vibration significant adverse residual effects
Impact 5	Cumulative operational noise of the array with other offshore wind farms upon human receptors	Not Applicable – no additional mitigation identified	No noise and vibration significant adverse residual effects

16.20 References

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Statutory Instruments (December 2018), 'European Communities (Environmental Noise) Regulations' https://www.irishstatutebook.ie/eli/2018/si/549/made/en/print [Accessed: December 2023]

Statutory Instruments (December 2021), 'European Communities (Environmental Noise) (Amendment) Regulations' https://www.irishstatutebook.ie/eli/2021/si/663/made/en/print [Accessed: December 2023]

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Department of Housing, Local Government and Heritage (December 2019), 'Draft Revised Wind Energy Development Guidelines' https://www.gov.ie/pdf/?file=https://assets.gov.ie/46097/6e68ea81b8084ac5b7f9343d04f0b0ef.pdf#page=null [Accessed: December 2023]

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UK Institute of Acoustics (May 2013), 'A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise' https://www.ioa.org.uk/sites/default/files/IOA%20Good%20Practice%20Guide%20on%20Wind%20Turbine%20Noise%20-%20May%202013.pdf [Accessed: December 2023]

British Standards Institution (February 2014), 'Code of practice for noise and vibration control on construction and open sites – Noise' https://knowledge.bsigroup.com/products/code-of-practice-for-noise-and-vibration-control-on-construction-and-open-sites-noise?version=standard&tab=overview [Accessed: December 2023]

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Annex A Legislation and policy

Policy/ legislation/ publisher	Name/reference/key provisions	What is covered/section where provision is addressed
Legislation		
DHPLG, 2018	European Communities (Marine Strategy Framework) Amendment Regulations, 2018 (S.I. No. 648 of 2018) https://www.irishstatutebook.ie/eli/2018/si/648/made/en/print	Transposes EU Directive 2008/56/EC (Marine Strategy Framework Directive) as amended by Commission Directive (EU) 2017/845 into Irish law.
DCCAE, 2018	European Communities (Environmental Noise) Regulations, 2018 (S.I. No. 549 of 2018) https://www.irishstatutebook.ie/eli/2018/si/549/made/en/print	Transposes the EU Environmental Noise Directive 2002/49/EC into Irish law.
DECC, 2021	European Communities (Environmental Noise) (Amendment) Regulations, 2021 (S.I. No. 663 of 2021) https://www.irishstatutebook.ie/eli/2021/si/663/made/en/print	Transposes the amendments to EU Environmental Noise Directive 2002/49/EC into Irish law.
Planning Policy and Development Control		
DoHLGH, 2023	Project Ireland 2040 National Planning Framework https://www.gov.ie/en/publication/774346-project-ireland-2040-national-planning-framework/	Sets national objectives and key principles, including NPO65 which promotes the proactive management of noise where it is likely to have significant adverse impacts on health and quality of life and recognises the importance of quiet areas, such as sea frontages, and seeks to protect them.
DLRCC, 2022	Dún Laoghaire-Rathdown County Development Plan 2022-2028 https://www.dlrcoco.ie/CDP2022-2028	Sets out the policies and objectives for the development of the County for 2022-2028. Policy EI14 addresses noise and air pollution in relation to new development which makes reference to the Dublin Agglomeration Environmental Noise Action Plan.
DA, 2018	Dublin Agglomeration Noise Action Plan 2024 – 2028 https://www.dublincity.ie/sites/default/files/2024-08/13354a-20-r014-04-f08-dublin-agglomeration-noise-action-plan_compressed.pdf	The Noise Action Plan aims to avoid, prevent and reduce, where necessary the harmful effects, including annoyance, due to long term exposure to environmental noise from transportation sources. No specific advice is provided in regard to the assessment of noise from wind farms.
WCC, 2022	Wicklow County Development Plan 2022 – 2028	Sets out a strategic spatial framework for the proper planning and sustainable

Policy/ legislation/ publisher	Name/reference/key provisions	What is covered/section where provision is addressed
	https://www.wicklow.ie/living/cdp2021	development of County Wicklow for the period between 2022 and 2028. Wind energy objective CPO16.05 promotes the development of wind energy subject to regard being taken of the noise impacts.
DoEHLG, 2006	Wind Energy Development Guidelines https://www.gov.ie/en/publication/f449e-wind-energy-development-guidelines-2006/	These Guidelines offer advice for many aspects of wind energy development, including noise. Appropriate noise limits have been set using these Guidelines for onshore NSRs for the operational noise of the offshore wind turbine array.
DoHPLG, 2019	Draft Revised Wind Energy Development Guidelines https://www.gov.ie/en/publication/9d0f66-draft-revised-wind-energy-development-guidelines-december-2019/	These draft guidelines are currently under review and are yet to be adopted. Until such a time as these guidelines are re-published for public consultation, the 2006 Guidelines remain in place. The noise assessment section of the draft guidelines is not considered best practice and has not been applied in this assessment.
Guidelines and technical standards		
ETSU, 1996	ETSU-R-97 The Assessment and Rating of Noise from Wind Farms https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/49869/ETSU_Full_copy__Searchable_.pdf	In Ireland, under the 2006 Guidelines, the determination of background noise levels and limits is typically carried out using the ETSU-R-97 methodology. The Best Practice Guidance for the Irish Wind Energy Industry refer to ETSU-R-97 when assessing noise impacts from WTGs.
IOA, 2013	A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise https://www.ioa.org.uk/publications/wind-turbine-noise	The guide, and six supporting supplementary guidance notes, present current good practice in the application of ETSU-R-97 assessment methodology for wind turbine developments at the various stages of the assessment process.
IWEA, 2012	Best Practice Guidance for the Irish Wind Energy Industry https://windenergyireland.com/images/files/9660bdfb5a4f1d276f41ae9ab54e991bb600b7.pdf	Sets various guidelines for the industry to encourage responsible and sensitive wind farm development, including the subject of noise.
BS, 2014	BS 5228:2009+A1:2014 Code of Practice for Noise and Vibration Control on Construction and Open Sites. https://knowledge.bsigroup.com/products/code-of-practice-for-noise-and-	BS 5228 is referenced in the Best Practice Guidelines for the Irish Wind Energy Industry for the assessment of construction noise impacts. Construction noise threshold criteria and noise source sound power level

Policy/ legislation/ publisher	Name/reference/key provisions	What is covered/section where provision is addressed
	vibration-control-on-construction-and-open-sites-noise?version=standard	information has been extracted from this document.
BEK, 2019	BEK No. 135 Executive Order on Noise from WTGs https://www.retsinformation.dk/eli/lta/2019/135	Danish executive order BEK No. 135 describes the appropriate method for the calculation of noise from offshore WTGs propagating over a large body of water.
EPA, 2022	Guidelines on the Information to be Contained in Environmental Impact Assessment Reports https://www.epa.ie/publications/monitoring--assessment/assessment/EIAR_Guidelines_2022_Web.pdf	These Guidelines apply to the preparation of all Environmental Impact Assessment Reports undertaken in the State (Ireland).
DCCAE, 2017	Guidance on EIS and NIS Preparation for Offshore Renewable Energy Projects https://www.gov.ie/pdf/?file=https://assets.gov.ie/76533/6a82b451-e09f-483b-849e-07d4c7baa728.pdf#page=null	The purpose of this non-statutory guidance is twofold: ▪ to assist developers in preparing Environmental Impact Statements (EIS) and Natura Impact Statements (NIS) that may be required for development projects; and ▪ to provide competent authorities, consultation bodies and the public with a basis for determining the adequacy of these statements.

Dublin Array
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