Appendix E Addendum

Fish and Shellfish Ecology - Supporting Information

ORIEL WINDFARM
OFFSHORE RENEWABLE ENERGY

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A TETRA TECH COMPANY

JERA NEX BP

ESB Energy for generations

ORIEL WIND FARM PROJECT

Natura Impact Statement Addendum

Appendix E Addendum: Fish and Shellfish Ecology – Supporting Information

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1 FISH AND SHELLFISH ECOLOGY SUPPORTING INFORMATION - ADDENDUM

1.1 Introduction

This Addendum provides supplementary information to the description of potential impacts of the Oriel Wind Farm Project (hereafter referred to as "the Project") on fish and shellfish ecology as presented in Appendix E: Fish and Shellfish Ecology – Supporting Information of the Natura Impact Statement (NIS). The supplementary information is provided in response to a request for further information (RFI) from An Coimisiún Pleanála (ACP) (formerly An Bord Pleanála) on the planning application (case reference ABP-319799-24) for the Oriel Wind Farm Project (hereafter referred to as "the Project").

Table 1A-4 in the NIS Addendum lists the schedule of information requested for Fish and Shellfish (RFI 10) and outlines which information requests resulted in further information requirements for the NIS and this Addendum to appendix E. Table 1A-4 also describes if the supplementary information amends the NIS conclusions.

The headings and subheadings in this Addendum correspond to those used in appendix E of the NIS. The reader is directed to review the information presented in this Addendum alongside the information presented in Appendix E.

1.2 Purpose

No changes to NIS Appendix E: Fish and Shellfish Ecology – Supporting Information.

1.3 Zone of Influence

No changes to NIS Appendix E: Fish and Shellfish Ecology – Supporting Information.

1.4 Consultation

No changes to NIS Appendix E: Fish and Shellfish Ecology – Supporting Information.

2 METHODOLOGY TO INFORM THE BASELINE

2.1 Desktop study

No changes to NIS Appendix E: Fish and Shellfish Ecology – Supporting Information.

2.2 Identification of relevant European sites and features (species and habitats)

No changes to NIS Appendix E: Fish and Shellfish Ecology – Supporting Information.

3 BASELINE ENVIRONMENT

3.1 Relevant European site

No changes to NIS Appendix E: Fish and Shellfish Ecology – Supporting Information.

3.2 Relevant qualifying features

3.2.1 Atlantic salmon

No changes to NIS Appendix E: Fish and Shellfish Ecology – Supporting Information.

3.2.2 Sea lamprey

No changes to NIS Appendix E: Fish and Shellfish Ecology – Supporting Information.

3.2.3 River lamprey

No changes to NIS Appendix E: Fish and Shellfish Ecology – Supporting Information.

3.2.4 Twaite shad

No changes to NIS Appendix E: Fish and Shellfish Ecology – Supporting Information.

3.2.5 Freshwater pearl mussel

No changes to NIS Appendix E: Fish and Shellfish Ecology – Supporting Information.

4 KEY PARAMETERS FOR ASSESSMENT

4.1 Project design parameters

No changes to NIS Appendix E: Fish and Shellfish Ecology – Supporting Information.

4.2 Measures included in the Project

No changes to NIS Appendix E: Fish and Shellfish Ecology – Supporting Information.

4.3 Impacts scoped out of the assessment

In response to RFI 10.E.i-iii, additional information has been provided for screening out likely significant effects on Annex II diadromous fish species due to seabed disturbance leading to the release of sediment contaminants, the clearance of UXO, and the colonisation of hard structures respectively (see Table 4A-1).

In response to RFI 10.F.v, additional detail has been provided using the results of the updated noise modelling to justify screening out Likely Significant Effects (LSEs) on Annex II diadromous fish species from operational noise from wind turbines (see Table 4A-1).

Table 4A-1: Impacts scoped out of the assessment for fish and shellfish ecology.

Potential impact	Justification
Seabed disturbance leading to the release of sediment contaminants and resulting potential effects on fish and shellfish ecology	Site specific sediment sampling for contaminants was undertaken within the Project boundaries in September 2024. The site-specific survey recorded that organochlorines, PCBs, total extractable hydrocarbons, tributyltin and dibutyltin, polycyclic aromatic hydrocarbons and most metals at all stations were below all relevant impact thresholds. Only arsenic slightly exceeded the lower limit of the Cronin *et al.* (2006) guidelines at one station (27.2 mg/kg, compared to the lower level threshold of 20 mg/kg). Table 4.3 of NIS Appendix E: Fish and Shellfish Ecology – Supporting Information set out that there is limited potential of contamination to sediments from anthropogenic activities given the sediment types and lack of anthropogenic activities which might lead to sediment contamination and site specific surveys have demonstrated this to be the case. As such, there is no potential for significant effects on diadromous fish receptors from this impact and this impact has therefore been screened out with no potential for likely significant effects.
Clearance of Unexploded Ordnance (UXO) leading to effects on fish and shellfish ecology	As outlined in section 2 of the NIS, there is low risk of encountering UXO during the development of the Project and as such, UXO clearance is not anticipated to be required. In the unlikely event UXOs are found, the location of infrastructure will be adjusted to avoid the obstacle. As there will be no requirement for the clearance of UXOs there will be no impact on diadromous fish species.
Colonisation of hard structures	There is the potential for subsurface structures to provide suitable substrate for colonisation of some benthic species, including crustacea, molluscs etc. which may have consequent effects on fish and shellfish populations. For diadromous fish species, the increase in surface area suitable for colonisation would be extremely small in the context of hard and soft sediment habitats in the Fish and Shellfish Ecology Study Area through which they will migrate. This would not have a likely significant effect on the diversity or population levels of the species which could occasionally utilise these environments for feeding during migrations through the Fish and Shellfish Ecology Study Area to and from SACs in the region. Due to the highly limited scale of any potential effect (i.e. around the turbines only), the large area covered by migration routes for these species and the large distance between the offshore wind farm area and SACs, this impact has therefore been screened out, with no potential for likely significant effects.
Disturbance to fish from underwater noise generated by wind turbines during operation	Noise generated by operational wind turbines is of a very low frequency and low sound pressure level (Andersson *et al.,* 2011). Studies have found that sound levels are only high enough to possibly cause a behavioural reaction within metres from a wind turbine (Sigray and Andersson, 2011; Andersson *et al.,* 2011) and therefore such levels are not considered to have potentially significant effects

Potential impact	Justification
	on diadromous fish receptors. This was supported by section 3.2 of appendix C-1 Addendum: Updated Subsea Noise Modelling Report, which concluded that *effects (e.g. injury or behavioural effects) would be limited to the immediate vicinity of turbine foundations; e.g. temporary threshold shift (*TTS) would only occur within a range of 4 m if the receptors were exposed to 12 hours of continuous operation sound which is unlikely to occur due to the highly mobile nature of diadromous fish. This impact has therefore been screened out, with no potential for likely significant effects.

5 IMPACT METHODOLOGY

5.1.1 Overview

No changes to NIS Appendix E: Fish and Shellfish Ecology – Supporting Information.

5.1.2 Impact assessment criteria

No changes to NIS Appendix E: Fish and Shellfish Ecology – Supporting Information.

5.1.3 European sites

No changes to NIS Appendix E: Fish and Shellfish Ecology – Supporting Information.

6 POTENTIAL IMPACTS

6.1 Temporary subtidal habitat loss/disturbance

6.1.1 Construction phase

No changes to NIS Appendix E: Fish and Shellfish Ecology – Supporting Information.

6.1.2 Operational and maintenance phase

No changes to NIS Appendix E: Fish and Shellfish Ecology – Supporting Information.

6.1.3 Decommissioning phase

No changes to NIS Appendix E: Fish and Shellfish Ecology – Supporting Information.

6.2 Injury and/or disturbance to fish from underwater noise during pile-driving

In response to RFI 10.F.i, Table 6A-2 has been provided to show updated modelling results for diadromous fish receptors.

In response to RFI 10.F.ii, the corrected outputs from the revised modelling have been inserted into Table 6A-1 and Table 6A-2.

In response to RFI 10.F.i, the updated modelling outputs have been presented in appendix C-1 Addendum: Updated Subsea Noise Modelling Report and these have been used to update impact ranges for diadromous fish. There was no overall change to the assessment conclusion.

In response to RFI 10.F.ii, information on behavioural responses has been adapted to focus on highly sensitive Group 4 fish, including twaite shad.

In response to RFI 10.F.iii, the total affected areas for the SEL_{cum} metric have been presented in Table 6A-2.

In response to RFI 10.L, additional data and research was referenced to provide a more site-specific characterisation of underwater sound impacts.

6.2.1 Construction phase

Magnitude of effect

No changes to NIS Appendix E: Fish and Shellfish Ecology Supporting Information.

Sensitivity of the receptor

The information on sensitivities of diadromous fish receptors to underwater noise remains unchanged with the following sections providing updates or further details on species sensitivities.

Injury

Injury ranges for fish have been updated to account for revised site specific underwater noise modelling for the Project (see appendix C-1 Addendum: Updated Subsea Noise Modelling Report) and to account for both static and moving receptors. The impact ranges presented in Table 6A-1 and Table 6A-2 therefore supersede the equivalent ranges presented in Tables 6-2 and 6-3 respectively in appendix E: Fish and Shellfish Ecology - Supporting Information.

Table 6A-1: Summary of peak pressure injury ranges for fish due to installation of one monopile at the west of the offshore wind farm area (assuming hammer energy of 3,500 kJ) (Table replaces Table 6-2 in appendix E).

Fish Type	Injury Type	Threshold (SPL_{pk}, dB re 1 μPa)	Range (m)	
			First Strike	Max
No swim bladder (particle motion detection)	Mortality	213	273	684
	Recoverable injury	213	273	684
Swim bladder not involved in hearing (particle motion detection)	Mortality	207	439	1,101
	Recoverable injury	207	439	1,101
Swim bladder involved in hearing (primarily pressure detection)	Mortality	207	439	1,101
	Recoverable injury	207	439	1,101
Fish eggs and larvae	Mortality	207	439	1,101

Table 6A-2: Summary of SEL_{cum} injury ranges for fleeing and static fish group receptors due to the installation of one monopile at the west of the offshore wind farm area (N/E = threshold not exceeded) (Table replaces Table 6-3 in appendix E).

Fish Type	Injury Type	Threshold (SEL_{cum}, dB re 1 μPa²s)	Range (m) Moving	Range (m) Static	Area of effect (km²) Moving	Area of effect (km²) Static
No swim bladder (particle motion detection)	Mortality	219	N/E	385	N/E	0.47
	Recoverable injury	216	N/E	516	N/E	0.84
Swim bladder not involved in hearing (particle motion detection)	Mortality	210	21	935	0.001	2.75
	Recoverable injury	203	147	1,860	0.068	10.87
Swim bladder involved in hearing (primarily pressure detection)	Mortality	207	51	1,250	0.008	4.91
	Recoverable injury	203	147	1,860	0.068	10.87
Fish eggs and larvae	Mortality	210	935	935	2.75	2.75
All fish types	Temporary threshold shift (TTS)	186	5,520	9,620	96	291

Behaviour

The following section has been amended to account for the updated underwater modelling outputs (see appendix C-1 Addendum: Updated Subsea Noise Modelling Report).

The modelled outputs indicated that noise attenuation is rapid with distance from foundation location. They also indicate that, based on a behavioural response occurring at levels in excess of 160 dB re 1 μPa SPL_{peak}, the more sensitive diadromous fish species, such as twaite shad, may exhibit behavioural responses within approximately 13 km to 22 km from the source in the west (for other diadromous fish species, these ranges are expected to be considerably smaller due to lower sensitivity). It should be noted, however, that this noise level is lower than the levels reported by the existing studies on the effect of noise on fish behaviour, and as such should be considered to be conservative. These results broadly align with qualitative thresholds for behavioural effects on fish as set out in Table 6-4 of appendix E: Fish and Shellfish Ecology Supporting

Information, with moderate risk of behavioural effects in the range of hundreds to thousands of metres from the piling activity, depending on the species.

The overall number of twaite shad and other diadromous fish receptors affected by piling operations at any one time will be small due to the highly mobile nature of these species. Further, the duration of piling (i.e. piling being intermittent events occurring on up to 26 days during the construction phase) is also a relatively short term and temporary disturbance in the context of spawning seasons for these species.

As set out in appendix E: Fish and Shellfish Ecology Supporting Information, increased tolerance (and decreased sensitivity) to underwater sound may occur for some diadromous fish during key life history stages, such as spawning or migration. This was demonstrated in an investigation into the impact of impulsive seismic air gun surveys on feeding herring schools, which found a slight but not significant reduction in swimming speed when exposed to the sound impact (Peña *et al.*, 2013). The findings of this survey indicated that feeding herring did not display avoidance responses to seismic sound sources, even when the vessel came into close proximity to herring, which indicated an awareness of and response to impulsive anthropogenic sound, which would be expected in response to piling, but not a significant response when fish were highly motivated to remain within an area – in this case during feeding, but potentially also in spawning. Twaite shad is also a clupeid species and likely to have similar sensitivities to underwater noise as herring. It is possible that this species could respond similarly if in the vicinity of the piling operations during migration periods when the drive to reach key spawning grounds potentially reduces the risk of disruption to migration.

The behavioural effects from the underwater noise, at the levels expected as a result of the pile driving for the Project, are likely to be limited for diadromous fish receptors, which could have the potential to experience barrier effects to their migration if impacted by underwater noise from piling. As noted in the paragraphs above, the noise contours associated with piling operations at the maximum hammer energy, with noise levels in excess of 160 dB re 1 µPa SPL_{peak}, are expected to lead to behavioural effects on diadromous fish receptors (noting that species such as Atlantic salmon are expected to have relatively low sensitivity to noise). Broadly, the maximum range at which these behavioural responses are likely to occur is approximately 13 km to 22 km from the noise source, with this only extending to small sections of the coast at the greatest hammer energies (i.e. lower hammer energies would result in smaller ranges). Therefore, there is a large area still available for diadromous fish to navigate along the coast, whilst mostly avoiding the noise source, when migrating to and from rivers in which these species may spawn (e.g. River Boyne and River Blackwater SAC and other non-SAC rivers on the east coast of Ireland). This, combined with the intermittent and short term nature of piling noise, indicates there is a very low potential for diadromous species to experience barrier effects to migration when moving from freshwater systems into and within the marine environment.

Summary

Therefore, given the varying levels of sensitivity associated with diadromous fish receptors, fish groups 2, 3 and 4, which include salmonids, lamprey and shad, are deemed to be of low to high vulnerability, medium recoverability and of local to international importance within the Fish and Shellfish Ecology Study Area. The sensitivity of these fish receptors is therefore considered to be medium.

6.3 Increased suspended sediment concentrations and associated sediment deposition

In response to RFI 10.G, specific consideration of updated marine processes modelling (see appendix B Addendum: Marine Processes Technical Report (see section 3.3.1)) has been added to the magnitude of effect section of the impact assessment below.

6.3.1 Construction phase

Magnitude of effect

Updated marine processes modelling was carried out and is presented in appendix B Addendum: Marine Processes Technical Report. The updated modelling indicated that much of the drilled material associated with the installation of the monopiles would settle in the immediate vicinity of the installation at maximum levels of 100 mm, and a depth of 0.3 mm of deposition at a range of several hundred metres. This is due to the slow drilling rate of 0.25 m/hour allowing fines to be widely dispersed while larger material settles at the release point.

The installation of offshore cables would lead to distribution of the sediment with an expected deposition depth of less than 20 mm, with the majority of sediment settling close to cable trenches, and final settled depths expected to be less than 5 mm beyond the offshore cable corridor route. All other model outputs remained the same and with respect to impacts on diadromous fish receptors, the magnitude is unchanged from appendix E: Fish and Shellfish Ecology Supporting Information.

The increased SSC and associated sediment deposition is predicted to be of localised spatial extent, short term duration, intermittent and high reversibility due to site hydrodynamics. It is predicted that the impact will affect diadromous fish receptors directly. The magnitude is therefore, considered to be low.

Sensitivity of the receptor

No changes to NIS Appendix E: Fish and Shellfish Ecology – Supporting Information.

6.3.2 Operational and maintenance phase

No changes to NIS Appendix E: Fish and Shellfish Ecology – Supporting Information.

6.3.3 Decommissioning phase

No changes to NIS Appendix E: Fish and Shellfish Ecology – Supporting Information.

6.4 Long-term subtidal habitat loss

6.4.1 Operational and maintenance phase

No changes to NIS Appendix E: Fish and Shellfish Ecology – Supporting Information.

6.5 Electromagnetic Fields (EMF) from subsea electrical cabling

In response to RFI 10.H, a summary of more recent research on the effects of EMFs on fish ecology, including diadromous fish species, has been provided.

In response to RFI 10.I, all uses of μT have been converted to mG. Also, additional clarification on the CSA (2019) reference has been added to the magnitude section, and a description of the project-specific magnitude has been added. The rest of the assessment remains the same.

6.5.1 Operational and maintenance phase

Magnitude of effect

The presence and operation of inter-array cables and offshore cable within the offshore wind farm area and offshore cable corridor may lead to a localised EMF affecting fish and shellfish receptors. EMF comprise both the electrical (E) fields, measured in volts per metre (V/m), and the magnetic (B) fields, measured in microtesla (μT) or milligauss (mG). Background measurements of the magnetic field are approximately 50 μT (or 500 mG) in the North Sea, and the naturally occurring electric field in the North Sea is approximately 25 μV/m (Tasker *et al.,* 2010). It is common practice to block the direct electrical field (E) using conductive sheathing, meaning that the EMFs that are emitted into the marine environment are the magnetic field (B) and the resultant induced electrical field (iE). It is generally considered impractical to assume that cables can be buried at depths that will reduce the magnitude of the B field, and hence the sediment-sea water interface iE field, to below that at which these fields could be detected by certain marine organisms on or close to the seabed (Gill et al., 2005, Gill et al., 2009). By burying a cable, the magnetic field at the seabed is reduced due to the distance between the cable and the seabed surface as a result of field decay with distance from the cable (CSA, 2019).

CSA (2019) found EMF levels directly over live AC undersea power cables associated with offshore wind energy projects range between 65 mG and 5 mG for inter-array cables (34.5 kV or 66 kV, and 155-165 mm in diameter) respectively and 165 mG and 10 mG for export cables (138 kV to 230 kV, and 20 cm to 30 cm in diameter), at heights of 1 m above the seabed and at the seabed surface, respectively. At lateral distances of between 3 m and 7.5 m from the cable, magnetic fields greatly reduced to between 10 mG and <0.1 mG for inter-array cables, and 15 mG and <0.1 mG for export cables, at heights of 1 m above the seabed and at the seabed surface, respectively.

The induced electric fields directly over live AC undersea power cables ranged between 1.7 mV/m and 0.1 mV/m for inter-array cables and 3.7 mV/m and 0.2 mV/m for export cables, at heights of 1 m above the seabed and at the seabed surface, respectively. At lateral distances of between 3 m and 7.5 m electric fields reduced to between 0.01 mV/m and 1.1 mV/m for inter-array cables and 0.02 mV/m and 1.3 mV/m for export cables at heights of 1 m above the seabed and at the seabed surface respectively.

The Project will operate up to 41 km of 66 kV inter-array cables and up to 16 km of 220 kV offshore export cables, buried up a depth of between 0.5 m and 3 m where practical. Cable protection may be required along 50% of the length of both cable types. As such, the reported EMF levels from CSA (2019) are broadly comparable to those anticipated from the Project.

The impact therefore is predicted to be of local spatial extent (i.e. restricted to within Fish and Shellfish Ecology Study Area), long term duration (i.e. the lifetime of the Project), continuous and irreversible during the operational and maintenance phase (recoverability is possible following completion of decommissioning). It is predicted that the impact has the potential to affect diadromous fish receptors directly. The magnitude is therefore, considered to be low.

Sensitivity of the receptor

As set out above, this section provides an overview of the latest research on the effects of EMF on fish and shellfish which were not available at the time of writing of the EIAR. More recent research has shown both large yellow croaker *Larimichthys crocea* and the black sea bream *Acanthopagrus schlegelii* showing reduced swimming velocity and increased antioxidant enzyme production when exposed to EMF levels of a minimum of 15,000 mG, but this did not impact nutrient absorption capacity and was reversible to baseline conditions within several days (Xu *et al.*, 2025). Also, zebrafish *Danio rerio* showed increased response times and reduced learning performance when exposed to EMF fields of 600 mG (Ziegenbalg *et al.*, 2025). It should be noted that these EMF levels are considerably higher than those predicted to be associated with buried cables for the Project.

In regard to egg and larvae EMF exposure risks, a recent study found pike and sea trout eggs exhibited increased mortality, but vimba bream *Vimba vimba* and common chub *Leuciscus cephalus* eggs showed no significant change in mortality (Jan and Tański, 2025). This indicates that egg mortality is species-dependent, with this supported by eggs of the Atlantic haddock *Melanogrammus aeglefinus* showing no mortality, malformations, or changes in egg hatching when exposed to a range of EMFs from 1.26 mG, to 503 mG (Guillebon *et al.*, 2025). Similarly, pike *Esox Lucius* embryos were statistically unaffected in terms of spatial distribution and survival by exposure to 0.15 to 1.34 mG EMFs around 110 kV high voltage transmission cables, or EMFs of 5.23 to 9.56 mG around 220 kV cables (Krzystolik *et al.*, 2024). However, significant numbers of hatched larvae exhibited heart rates of over 100 beats per minute, and significant reductions in yolk sac reserves even at the lowest EMF intensity (Guillebon *et al.*, 2025). Similar physical responses were also noted in zebrafish larvae in their first four days of growth, with exposure to EMFs increasing heart rates and reducing sleep periods (Lavinya, 2025).

In terms of elasmobranch research, fourteen small-spotted catshark *Scyliorhinus canicula* were exposed to 150 mG AC, 196 mG DC, and control treatments. No startle responses were noted at EMF onset, no altered movement toward or away from the cable was recorded, and crossings only reduced by 25% over the DC EMFs compared to the AC and control trials (Hermans *et al.*, 2025).

Also, the potential of electromagnetic fields to hinder movement of diadromous species into and out of the marine environment is recognised (Lennox *et al.*, 2025), but further research is required to determine the magnitude of this impact (Verhelst *et al.*, 2025). All of the more up-to-date additional information is in line with previous findings, and has therefore not changed the overall sensitivity from Appendix E: Fish and Shellfish Ecology - Supporting Information.

7 IN-COMBINATION EFFECTS

7.1 Methodology

The in-combination assessment (ICA) takes into account the impact associated with the Project together with other projects. The projects selected as relevant to the in-combination assessment have based upon the results of an updated project screening exercise (see appendix J Addendum: Screening – In-Combination Effects). Each project has been considered on a case-by-case basis for screening in or out of this assessment based upon data confidence, effect-receptor pathways and the spatial/temporal scales involved.

The approach to in-combination assessment is identical to that set out in appendix E: Fish and Shellfish Ecology – Supporting Information of the NIS with specific projects screened into the in-combination assessment outlined in Table 7A-1 and Figure 7A-1.

Collaboration with the other Phase 1 projects has informed the in-combination assessment. This included discussions amongst the project teams on the approach and methodologies regarding alignment of sensitivities and magnitudes and key receptor species.

Table 7A-1: Updated list of other projects considered within the in-combination assessment for Fish and Shellfish Ecology*.

Project/Plan	Status	Distance from offshore wind farm area (km)	Distance from offshore cable corridor (km)	Description of Project	Dates of construction (if applicable)	Dates of operation (if applicable)	Overlap with Project
Renewables							
North Irish Sea Array (NISA)	Maritime Area Consent; Planning	16.2	18.1	~~EIA Scoping Report (2021) refers to the construction of an offshore wind farm of up to 500 MW, consisting of 36 turbines with a maximum height of 320 m and rotor diameter of up to 290 m. Offshore substation platforms may be required.~~ EIAR (2024) details two Project options consisting of a wind farm with a maximum of 49 turbines and a maximum rotor diameter of 276m. One offshore substation is required. The proposed export capacity is 700 MW.[1]	~~Unknown~~ Estimated 2027-2030	~~Unknown~~ (Design life minimum 35 years) Estimated commencement in 2030	Potential for construction and operation phases to overlap with the Project. Spatial overlap unlikely for impacts such as SSC, habitat loss and EMF. Potential for spatial overlap associated with underwater noise emissions.
Dublin Array	Maritime Area Consent; Planning	61.2	57	~~Scoping report (2020) refers to the construction of Bray and Kish offshore wind farm of up to 900 MW, consisting of up to 61 turbines with a maximum height of 308 m and rotor diameter of up to 285 m and up to three offshore substation platforms.~~[2] EIAR (2025) refers to the construction of an offshore wind farm with an export capacity of 824 MW. The EIAR considers three design options with a maximum	~~Unknown~~ Estimated 2027-2030 Construction is anticipated to range from 18 to 30 months.	~~Unknown~~ (Design life minimum 35 years) Estimated commencement in 2030	Potential for construction and operation phases to overlap with the Project. Spatial overlap unlikely for impacts such as SSC, habitat loss and EMF. Potential for spatial overlap associated with underwater noise emissions.

* Note: Changes to project list presented in EIAR (2024) are shown in blue and strikethrough.

[1] https://northirishseaarraysid.ie/

[2] Project website: https://dublinarray.com/project-information/key-facts/: states between 39 and 50 turbines (total project capacity 824 MW) individual tip heights between approx. 270 m and 310 m.

Project/Plan	Status	Distance from offshore wind farm area (km)	Distance from offshore cable corridor (km)	Description of Project	Dates of construction (if applicable)	Dates of operation (if applicable)	Overlap with Project
				number of turbines of 50 and a maximum rotor diameter of 278 m.[3]			
Codling Wind Park	Maritime Area Consent; Planning	61.4	57.2	~~EIA Scoping report (2020) refers to the construction of an offshore wind farm of up to 1500 MW, consisting of up to 140 turbines with a maximum height of 320 m and rotor diameter of up to 288 m. The project will also contain up to five offshore substation platforms.~~[4] EIAR (2024) refers to the construction of an offshore wind farm with the export capacity of 1300 MW. Two WTG Layout Options are proposed, with a maximum number of turbines of 75 and a maximum rotor diameter of 276. Three offshore substations are required.[5]	~~Unknown~~ Estimated 2027-2030. Construction anticipated to range from three to four years.	~~Unknown~~ Estimated commencement in 2030 (Design life minimum 35 years) 25-year operational lifetime	Potential for construction and operation phases to overlap with the Project. Spatial overlap unlikely for impacts such as SSC, habitat loss and EMF. Potential for spatial overlap associated with underwater noise emissions.
Arklow Bank Wind Park Phase 2	Maritime Area Consent; Planning	107.1	104.7	~~EIA Scoping Report: The project will include between 37 and 56 turbines ad up to two Offshore Substation Platforms (OSP) and foundation substructures. The area in which the proposed wind turbines, inter-array cables and OSP(s) will be located on Arklow Bank covers an area of seabed approximately 64km2.~~[6]	~~Unknown~~ Estimated 2027-2030	~~Unknown~~ (Design life minimum 35 years) Estimated commencement in 2030	Potential for construction and operation phases to overlap with the Project. Spatial overlap unlikely for impacts such as SSC, habitat loss and EMF. Potential for spatial overlap associated with underwater noise emissions.

[3] https://dublinarray-marineplanning.ie/eiar/

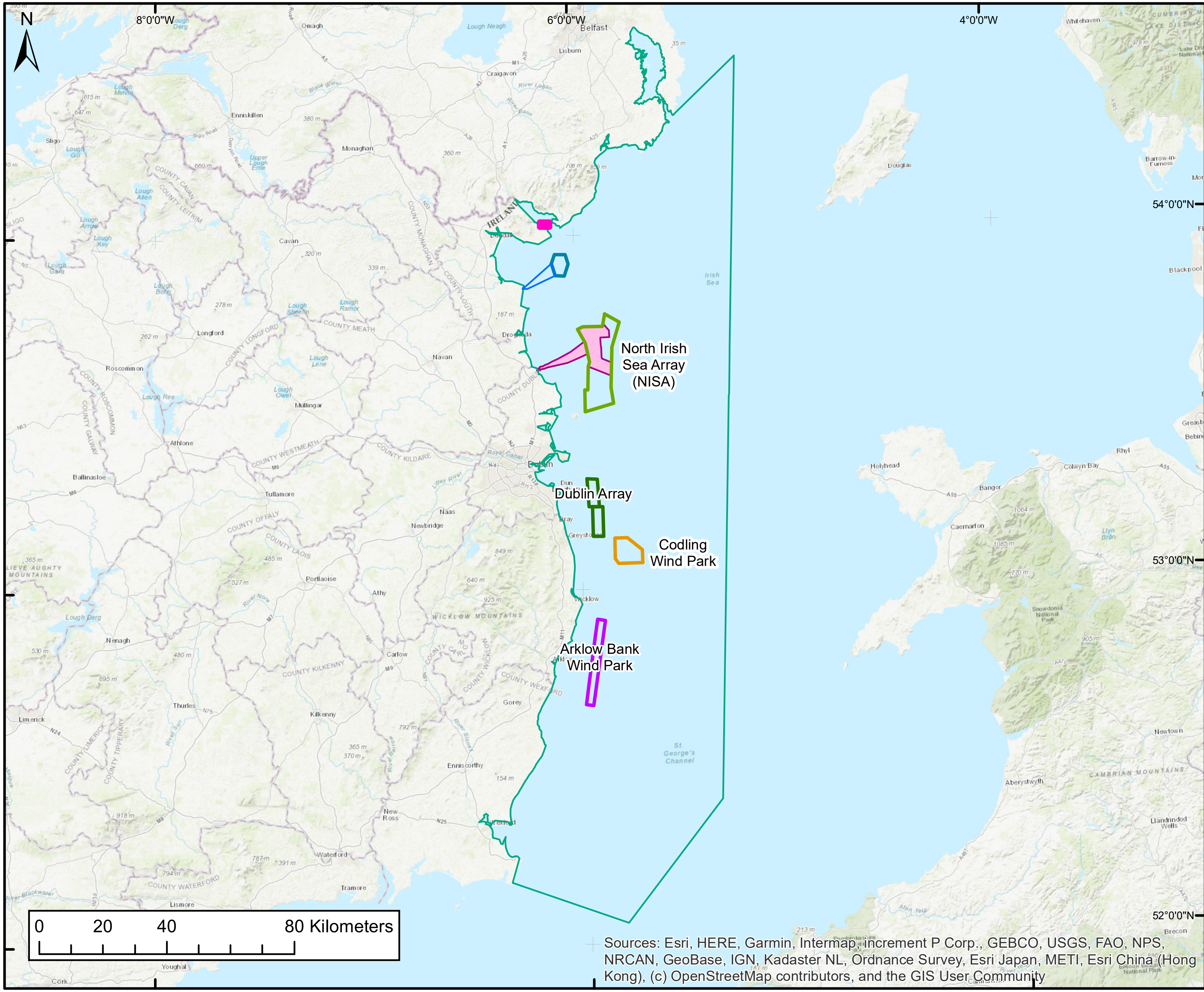
[4] Project website: https://codlingwindpark.ie/the-project/: states max energy output 1300 MW, 100 turbines, turbine tip height max 320 m.

[5] https://codlingwindparkplanningapplication.ie/environmental-impact-assessment-report-eiar/

[6] Project website https://www.sserenewables.com/: states between 36 and 60 turbines (up to 800MW) along with one to two OSS and foundation substructures, a network of inter-array cabling and two offshore export cables.

Project/Plan	Status	Distance from offshore wind farm area (km)	Distance from offshore cable corridor (km)	Description of Project	Dates of construction (if applicable)	Dates of operation (if applicable)	Overlap with Project
				EIAR (2024) refers to an offshore wind farm with an export capacity of 800 MW. Two Project Design Options are proposed with a maximum number of turbines of 56 and maximum rotor diameter of 250 m. Two offshore substations are required.[7]			
Greenore Port Project	MAC Received and Planning Consented	9.9	12.4	ORE O&M Facility at Greenore Port as a support base for three offshore windfarms on the East Coast of Ireland. It will require a pontoon to accommodate Crew Transfer Vessels. Dredging within the nearshore and the construction of a new quay wall is also required.	3 years estimated 2025 to 2028	60 years	Potential for construction and operation phases to overlap with the Project. Spatial overlap unlikely for impacts such as SSC, habitat loss and EMF. Potential for spatial overlap associated with underwater noise emissions.
NISA Site Investigations	MAC received	16.9	18.1	Site investigation activities to inform the development of the North Irish Sea Array (NISA) offshore windfarm (OWF) and export cable, off the coasts of counties Dublin, Meath and Louth. These site investigations include hydrological and geophysical, geotechnical, metocean, ecological, archaeological and water quality surveys.	-	Licence term for site investigations is seven years from 2024 to 2031	Potential for construction and operation phases to overlap with the Project. Spatial overlap unlikely for impacts such as SSC, habitat loss and EMF. Potential for spatial overlap associated with underwater noise emissions.

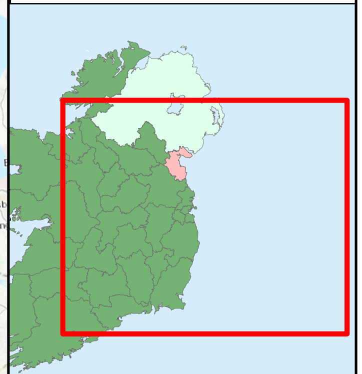
[7] https://www.arklowbank2offshoreplanning.ie/eiar/



Legend

- Project Offshore Wind Farm Area
- Project Offshore Cable Corridor
- Dublin Array
- Arklow Bank Wind Park
- Codling Offshore Wind Farm
- North Irish Sea Array (NISA)
- Western Irish Sea Fish and Shellfish Ecology Study Area
- NISA Site investigations (LIC230001)
- Greenore Port ORE O&M Facility (MAC20230003)

Data Sources: Client



Client

ORIEL WINDFARM
OFFSHORE RENEWABLE ENERGY

Project

Oriel Wind Farm Project

Title **Figure 7A-1**

Other projects screened in for in-combination assessment for Fish and Shellfish Ecology

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Issue Details

Drawn By: MJ	**Project No.** MDR1520C
Checked By: MJ	**File Ref:**
Approved By: CC	MDR1520C_FAS_E_1203_FINAL
Scale: 1:1,592,230@ A4	**Projection:** ITM (IRENET95)
Date: 04/12/2025	Geographic Co-ordinates: ETRS89

Table 7A-2 presents the relevant project design parameters from Table 7A-2 4-1 in appendix E: Fish and Shellfish Ecology - Supporting Information of the NIS (2024), which are used to assess the potential in-combination effects of the Project with the other projects identified in Table 7A-1 (where information is available).

In line with the NIS, for the purposes of this report, cumulative underwater noise emissions have been assessed within the Western Irish Sea Fish and Shellfish Ecology Study Area. In-combination effects associated with temporary and permanent habitat loss, suspended sediments and generation of electrical magnetic fields have not been assessed, given the small areas of seabed substrates that will be disturbed/removed as a consequence of the construction, operational and maintenance and/or decommissioning phases of the identified projects screened into the in-combination assessment, and the localised impacts associated with the electrical magnetic fields generated by operational subsea cables respectively (particularly given the large distances between the Project and other projects).

Table 7A-2: Project design parameters considered for the in-combination assessment of potential cumulative impacts on Fish and Shellfish Ecology.

Potential impact	Phase			Project design parameters	Justification
	C	O	D		
Injury and/or disturbance to fish from underwater noise during pile-driving	✓	×	×	Project design parameter as described for the Project (Table 4-1 in Appendix E: Fish and Shellfish Ecology – Supporting Information) assessed in-combination with the following other projects: • NISA; • Codling Wind Park; • Dublin Array; • Arklow Bank Wind Park Phase 2; and • Greenore Port Project.	Maximum potential for in-combination effects from underwater noise from construction operations within the Western Irish Sea Fish and Shellfish Ecology Study Area.

7.1.1 In-combination assessment

A description of the in-combination effects upon Fish and Shellfish Ecology receptors arising from the identified impact is given below.

Injury and/or disturbance to fish from underwater noise during pile-driving

Construction phase

Magnitude of impact

The installation of foundations within the offshore wind farm area, together with the projects identified in Table 7A-2, may lead to injury and/or disturbance to fish from underwater noise during pile driving. Other projects screened into the assessment within the Western Irish Sea Fish and Shellfish Ecology Study Area include the NISA, Codling Wind Park, Dublin Array and Arklow Bank Wind Park Phase 2 offshore wind farms and Greenore Port Project.

Injury or mortality of fish from piling noise would not be expected to occur cumulatively, due to the small range within which potential injury effects would be expected (i.e. predicted to occur within the range of hundreds to low thousands of metres of piling activity within each of the identified projects) and the large distances between identified projects (i.e. tens of km). In-combination effects of underwater noise are therefore discussed in the context of behavioural effects, particularly on migratory route for diadromous species and spawning or nursery habitats for marine species.

The Greenore Port Project will include the installation of a quay wall and the insertion of two piles associated with the new pontoon as well as dredging and vessel noise (Greenore Port Unlimited Company, 2024). This may create underwater noise however effects will only occur in very close proximity to the quay and pontoon during start-up as well as intermittently throughout the operational phase (Greenore Port Unlimited Company, 2024).

The Arklow Bank Wind Park Phase 2 EIAR has provided a more detailed design scenario for this project. The design scenario considers the installation of 56 wind turbines (with pile diameters between 7 to 11 m) and two offshore substation platforms (OSPs) (with pile diameters between 7 and 14 m), both using a maximum hammer energy of 6,600 kJ (SSE Renewables, 2024). A soft start will be performed and the total number of days pilling will occur will be four days for OSPs and 75 days for wind turbines (SSE Renewables, 2024). Modelling undertaken for the project indicates the largest recoverable injury range are predicted to be up to 7.9 km (>203 dB SEL_{cum} threshold, assuming stationary receptors), when the animal is assumed to be fleeing these ranges reduce to less than 100 m (SSE Renewables, 2024). Maximum temporary threshold shift (TTS) (>186 dB SEL_{cum} threshold) are predicted up to 50 km for stationary animals, reducing to 36 km for fleeing animals (SSE Renewables, 2024).

The Codling Wind Park EIAR has confirmed the installation of 75 wind turbines using a hammer energy between 400 and 4400 kJ across 75 piling days in total (Codling Wind Park, 2024). Alternatively wind turbine foundations may be installed by vibro-piling or drilling. Additionally three OSPs will be installed requiring up to three piles using a hammer energy between 400 and 4400 kJ, requiring up to three days of piling overall (Codling Wind Park, 2024). Up to ten UXO may also require clearing as a result of construction for the Codling Wind Park. Mortal injury may occur over an approximate area of 0.25 km^2 in a stationary model or less than 100 m in a fleeing model, and an area of 15 km^2 or a maximum distance of 2,300 m from the source for cumulative level exposure (Codling Wind Park, 2024). TTS may occur out to a maximum distance of 34 km from the source for cumulative exposure in a stationary model or 24 km in a fleeing model (Codling Wind Park, 2024).

The NISA EIAR described how the project will result in increased underwater noise as a result of the installation of 51 wind turbine and OSP monopiles with a diameter of 12.5 m using a 5,500 kJ hammer or 144 pin-piles with a 6 m diameter with a hammer energy of 3,000 kJ. Additionally, UXO clearance, vessel noise and geophysical survey will contribute additional noise (Statkraft, 2024). Modelling undertaken for the project found mortality ranges could extent to 4.2 km (SEL_{cum} static), recoverable injury ranges could extent to 9.5 km (SEL_{cum} static) and TTS could occur out to 59 km from the source (SEL_{cum} static) (Statkraft, 2024). Associated site investigations may give rise to disturbance from vibration and underwater noise associated with the survey however, investigations will be short in duration, of a temporary nature and highly limited impact ranges.

The Dublin Array Offshore Wind Farm EIAR assessed the installation of up to 50 wind turbines using either 13 m diameter monopiles with a maximum hammer energy of 6,372 kJ or 5.75 m pin-piles with a maximum hammer energy of 4,695 kJ requiring a maximum piling duration of 125 days over 19 months (associated with the installation of pin-piles) (Kish Offshore Wind Ltd., 2024). Modelling undertaken for the project has identified mortality and potential mortality injury out to 2.1 km (SEL_{cum} static), recoverable injury out to 3.8 km (SEL_{cum} static) and TTS out to 29 km (SEL_{cum} static).

The quantification of the above projects in relation to the injury and/or disturbance to fish from underwater noise during pile-driving impact does not change the conclusion as provided in the Appendix E: Fish and Shellfish Ecology – Supporting Information of the NIS. As anticipated in the NIS, the impact of the other offshore wind projects is of a similar scale to the Oriel Wind Farm Project. The nearest offshore wind farm is 16 km from the Project therefore the potential for cumulative injury impacts would only apply to TTS using a SEL_{cum} static model (if each piling event occurs simultaneously across both projects which is unlikely), the inclusion of a fleeing response reduces the range of TTS for all projects. Therefore it is not expected that there will be a spatial overlap of TTS effects associated with each project in the event that construction timeframes coincide.

While there are likely to be cumulative behavioural effects on fish and shellfish receptors from the projects discussed above, these effects will be short term, temporary and reversible, with evidence from other offshore wind farms (as presented in the Project EIAR and NIS) demonstrating recovery of fish populations following piling operations.

The impact is predicted to be of local/regional spatial extent, short to medium term duration, intermittent during the construction phases and high reversibility. It is predicted that the impact will affect the receptor directly.

Sensitivity of receptor

Sensitivities of fish and shellfish receptors to underwater noise are fully detailed in section 6.2.1 and in appendix E: Fish and Shellfish Ecology – Supporting Information of the NIS. Fish injury as a result of piling noise would only be expected in the close proximity to piling operations, and the area within which effects on fish larvae would be expected is similarly small, though it is unclear whether effects on fish larvae would include injury or mortality.

Behavioural effects on fish species as a result of piling noise are predicted to be dependent on the nature of the fish and shellfish receptors, with larger impact ranges predicted for pelagic fish than for demersal fish species. A detailed description of sensitivity of diadromous fish to underwater noise emissions is described in section 6.2.1 in appendix E: Fish and Shellfish Ecology – Supporting Information of the NIS.

The spread of behavioural impact ranges predicted for the identified projects reflects some of the uncertainty associated with behavioural effects criteria, with any behavioural effects also dependent on factors such as type of fish, its sex, age and condition, stressors to which the fish is or has been exposed or the reasons and drivers for the fish being in the area.

Effects on migratory species are likely to be limited to behavioural effects within the ranges discussed for the projects listed above. Shad, being more sensitive to the acoustic pressure component of piling noise, would be expected to be affected according to the ranges presented for herring, while European eel, lamprey species, sea trout and Atlantic salmon are likely to be affected to relatively smaller ranges. Due to the distance between the offshore wind projects (i.e. between 16 km and 107 km) and the distance of these projects from the coast (approximately 5 km), there is minimal potential for in-combination effects from piling noise to represent a barrier to migratory species moving to and from SACs identified in the NIS for the projects identified, particularly taking into account the intermittency of piling activities.

Therefore, given the varying levels of sensitivity associated with identified fish qualifying features, salmonids and shad (Group 2 and 4 fish) are deemed to be of medium to high vulnerability, medium recoverability and of international importance within the Western Irish Sea Fish and Shellfish Ecology Study Area. The sensitivity of these fish receptors is therefore considered to be medium.

Lamprey (Group 1 fish) are deemed to be of low vulnerability, medium recoverability and of local to regional importance within the Western Irish Sea Fish and Shellfish Ecology Study Area. The sensitivity of these fish receptors is therefore considered to be low.

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