Risk Assessment for Annex IV Species

Foreshore Licence Application - Sea Stacks Offshore Wind

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ESB

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1. Introduction

Sea Stacks Offshore Wind which includes the export cable corridor(s) and wind turbine generator (WTG) array area (hereafter referred to as the Project), off the Republic of Ireland (ROI)'s Dublin/Wicklow coast (Figure 1.1), has been identified as potentially suitable for offshore wind development.

This report has been prepared on behalf of ESB in support of an application for a Foreshore Licence under Section 3 of the Foreshore Act 1933, as amended, to carry out site investigation works within the Foreshore Licence Application Area as part of the preliminary assessment of the suitability of Sea Stacks Offshore Wind for a fixed foundation offshore wind development. The overall area the subject of this Foreshore Licence application is 305 km^2.

The objective of this documents is to outline the activities proposed for the site investigation (SI) works (described in Section 2; Appendix A) and to assess the impact of these works on relevant Annex IV species identified as having the potential to be present in the project area, under Article 12 of the Habitats Directive (92/42/EEC)[1].

[1] All cetaceans (whales and dolphins) and marine turtles.

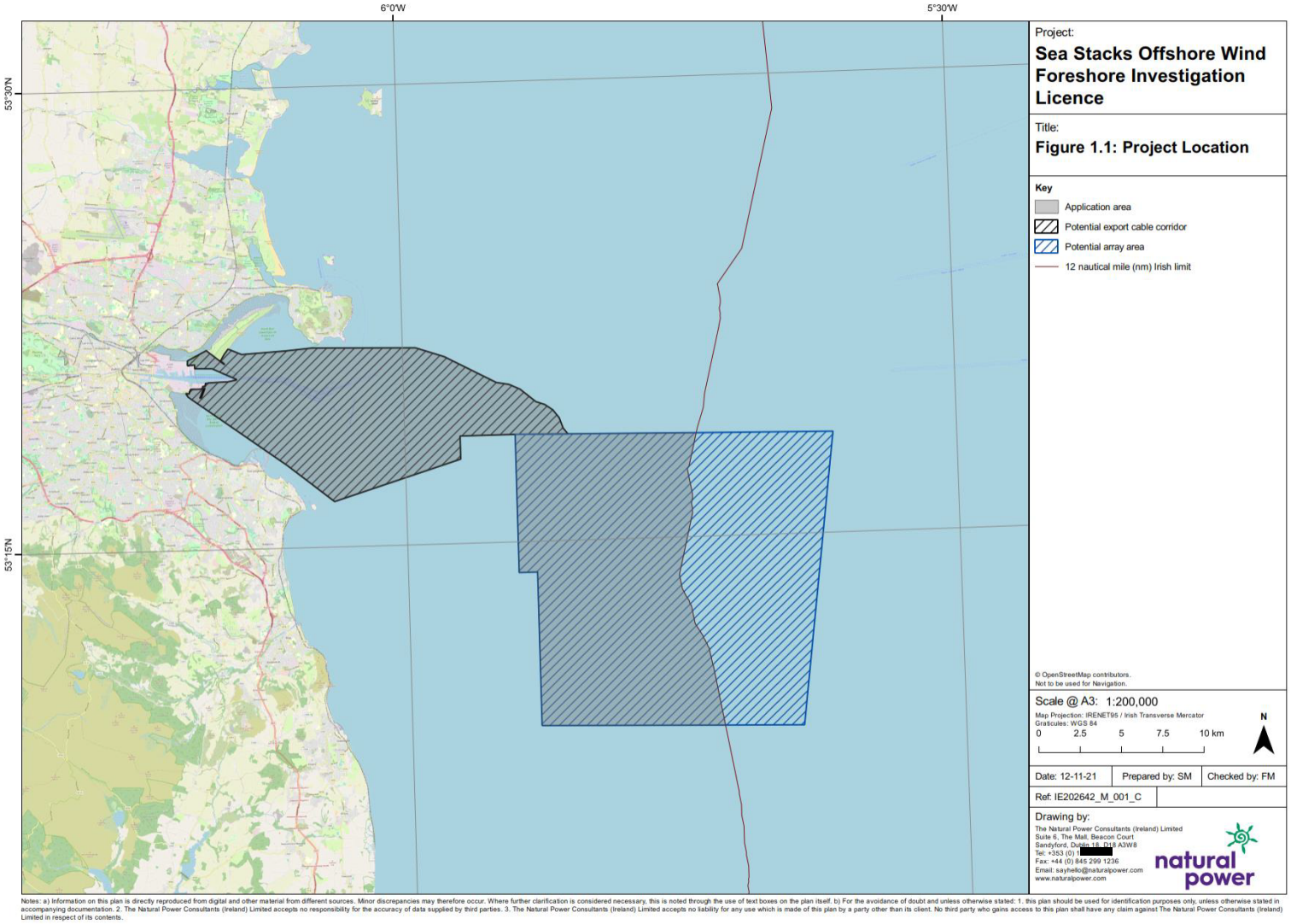

Figure 1.1: The Project (export cable corridor(s) and WTG array area) and Application area (export cable corridor(s) and the portion of the WTG array area which lies within 12 nm)

2. Planned Work

Pending receipt of the Foreshore Licence, ESB proposes to commence site investigation and baseline survey work on a phased approach in Q2/Q3 2022 with surveys proceeding over the course of the 5-year licence period. The exact dates are to be determined (pending enactment of the Maritime Area Planning (MAP) Bill and the appointment of survey contractors) but, based on the estimated scope of works to be conducted, the duration of each project scope has been estimated. ESB undertook pre-application consultation with the Foreshore Unit within the Department of Housing, Local Government and Heritage (DHLGH) in 2020 and 2021 and will consult with the Foreshore Unit and other relevant stakeholders where appropriate prior to the commencement of the site investigation and survey work described below.

A summary of the proposed site investigation and baseline survey work is presented in Table 2.1 below. Full details of the proposed site investigation work can be found in the 'Site Investigation – Schedule of Works' document (Document No. QS-000307-01-R460-002) which has been prepared to accompany ESB's application for a Foreshore Licence. Proposed (indicative) sampling locations are provided in Appendix A.

Table 2.1: Summary of the proposed site investigation and baseline survey work at Sea Stacks Offshore Wind

Scope of work (estimated duration[2])	Purpose	Details
Geophysical surveys (3 – 4 months)	Provide significant seabed and sub-seabed information to assist in the consenting, design and installation phases of the OWF project	The foreseen scope of works will primarily consist of the following surveys but may also incorporate visual surveys (e.g. drop-down video, ROV etc.) pending the development of the project's ground model: Multi beam echosounder (MBES) Sub-bottom profiler (SBP) Ultra-high resolution seismic (UHRS) Side scan sonar (SSS) Magnetometer
Geotechnical surveys (2 – 3 months)	Provide sufficient geotechnical data to allow the characterisation of the sub-seabed strata in order to refine a 3D soil model of the offshore windfarm site. These details will be used to initiate the design of the WTG and substation foundations and to carry out a comprehensive analysis of the installation methodology	The works will include the following: Seabed Piezocone Penetration Test (PCPT) testing at a pre-defined number of locations within seabed sediments, to refusal Sampling/coring boreholes at a pre-defined number of locations to a nominal depth Vibro-coring at a pre-defined number of locations to a nominal depth

[2] Subject to change based on variables such as weather conditions onsite, unforeseen seabed conditions, unforeseen obstructions etc.

Scope of work (estimated duration[2])	Purpose	Details
		Down-the -hole (or similar) Cone Penetration Testing (CPT) inside the boreholes at different depths as dictated by geotechnical conditions. Additional testing options include high pressure dilatometer testing and/or seismic wave velocity measurements Grab sampling at a pre-defined number of locations Trial pits at specified locations within cable pull-in zone Offshore and onshore laboratory testing of recovered samples
Metocean surveys (fixed 12- to 36-month period including the need for site access for data collection and maintenance as needed)	Collect accurate wind, wave, temperature, current and water level information from the project site that will be used to conduct energy yield assessments, feed into offshore sub-structure design and estimate workability range at offshore sites for defining the construction and O&M strategies	The works will include the following: Acoustic Doppler Current Profiler (ADCP) Wave buoys Floating Lidar buoy
Environmental/Ecological surveys (periodically across a 12- to 24-month period)	Collect baseline data which will be used to inform the Environmental Impact Assessment Report (EIAR)	The works may include the following: Benthic sampling Static acoustic monitoring Walkover surveys Ornithology surveys* Marine mammal surveys* Fisheries, fish and shellfish surveys* Shipping and navigation surveys* Archaeological survey

**Outwith scope of Foreshore Investigation Licence Application but included for completeness*

2.1. Timing and Duration of Activity

The exact timings and durations of surveys are yet to be confirmed but this assessment takes into account seasonal variation and therefore following the precautionary principle covers all seasons. Estimated duration is approximately 3 – 4 months for the geophysical campaign and 2 – 3 months for the preliminary geotechnical campaign. A second geotechnical survey will be determined following interpretation of the preliminary survey data and considering environmental constraints. Durations may change depending on weather conditions onsite, unforeseen seabed conditions, or unforeseen obstructions etc. Campaigns may be repeated in baseline and pre-construction years.

Once the metocean equipment is deployed (ADCP, wave buoys and floating Lidar buoy) they will remain in place for a fixed period (between 12 to 36 months). The Environmental/ecological surveys will occur periodically over a 12 to 24 month period.

2.2. Proposed Vessels

The geophysical survey will be undertaken from a vessel between 15 – 80 m in length with potential for smaller vessels to be used in nearshore / shallow water areas. An unmanned surface vehicle (USV) and/or autonomous surface vehicle (ASV) may be used for the geophysical survey (yet to be confirmed).

The geotechnical survey will be undertaken from either a dedicated geotechnical vessel (50 – 90 m in length) or alternatively a jack-up barge in more sheltered/shallow waters along the export cable corridor.

The metocean equipment will be deployed and recovered from a shallow draft anchor handling tug or a utility type vessel or similar. The seabed sampling for the environmental/ecological studies will likely be undertaken as part of either the geophysical or geotechnical surveys or may be a standalone survey.

Marine mammal and ornithology surveys will be aerial based with potential for some boat-based surveys.

3. Legal Requirements

All species of cetacean and marine turtle fauna in waters around the British Isles are listed under Annex IV of the Habitats Directive (Council Directive 92/43/EEC) which covers animal and plant species of community interest in need of strict protection.

The Habitats Directive has been transposed into Irish law by the European Communities (Birds and Natural Habitats) Regulations 2011 - 2021

These Regulations provide for the protection of cetacean and marine turtle fauna and as such it is an offence to:

- Deliberately capture or kill any specimen of these species in the wild;
- Deliberately disturb these species particularly during the period of breeding, rearing, hibernation and migration;
- Deliberately take or destroys eggs of those species from the wild;
- Damage or destroy a breeding site or resting place of such an animal; or
- Keep, transport, sell, exchange, offer for sale or offer for exchange any specimen of these species taken in the wild, other than those taken legally as referred to in Article 12(2) of the Habitats Directive.

Derogation licences may be granted by the Minister (DHLGH) which would allow otherwise illegal activities to go ahead provided that:

- There is no satisfactory alternative; and
- The action authorised will not be detrimental to the maintenance of the population of the species concerned at a Favourable Conservation Status (FCS) in their natural range.

FCS is defined in the Habitats Directive as when:

- Population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable element of its natural habitats;
- The natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future; and
- There is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.

3.1. Guidance

Guidance entitled 'The protection of marine European Protected Species from injury and disturbance: Guidance for the marine area in England and Wales and the UK offshore marine area' was published in 2010 by the JNCC, Natural England and the Countryside Council for Wales (now Natural Resources Wales) (JNCC *et al.,* 2010). In the apparent absence of equivalent guidance for Irish waters[3], this document has been used as a resource when a view is needed as to whether there is potential for an offence of deliberately disturbing or injuring/killing a marine Annex IV species (European Protected Species (EPS)) to occur within Irish territorial and offshore waters, as a result of any activity associated with the proposed works.

The guidance considers certain activities that produce loud noises in areas where an Annex IV species could be present to have the potential to result in an injury or disturbance offence, unless appropriate mitigation measures are implemented. The risk of an offence being committed is dependent on a number of factors, including the following:

[3] A request for assistance locating guidance on how the Regulations have been interpreted in Irish waters was made to the National Parks and Wildlife Service on 17/02/2020. A response was received on 03/03/2020 which suggested using the UK guidance (JNCC *et al.,* 2010) to supplement the DAHG (2014) guidelines where required.

- Presence/absence of Annex IV species;
- Noise associated with the activity and resulting impacts on Annex IV species;
- Frequency of occurrence of Annex IV species;
- Density of Annex IV species; and
- Length of exposure of Annex IV species to noise associated with proposed activities.

The JNCC *et al.* (2010) guidance also considers that the potential for disturbance from some activities can be considered "trivial". Activities which might be considered trivial include those that lead to "sporadic disturbances without any likely negative impact on the species".

For an activity to be considered "non-trivial", the JNCC guidance (JNCC *et al.,* 2010) states that "the disturbance to marine EPS would need to be likely to at least increase the risk of a certain negative impact on the species' FCS".

The guidance states that the two main potential causes of death or injury are physical contact (with a vessel) and anthropogenic noise.

Likelihood of disturbance for individuals includes factors such as:

- Spatial and temporal distribution of the animal in relation to the activity;
- Any behaviour learned from prior experience with the activity;
- Similarity of the activity to biologically important signals (particularly important in relation to activities creating sound); and
- The motivation of the animal to remain within the areas (e.g. food availability).

Assessment of likelihood of potential impacts should include the following considerations:

- Type of activity;
- Duration and frequency of the activity;
- Extent of the activity;
- Timing and location of the activity; and
- Other known activities in the area at the same time.

4. Annex IV Species in the Region of the Project in Irish Waters

During the last 10 years several different initiatives to quantify the distribution and abundance of marine mammals have been carried out in the waters of the Irish Exclusive Economic Zone (EEZ) (e.g. Berrow *et al.,* 2013; Wall *et al.,* 2013; Hammond *et al.,* 2013; Hammond *et al.,* 2021; Rogan *et al.,* 2018). Commonly found species in the Irish Sea such as harbour porpoise (*Phocoena phocoena)*, bottlenose dolphin (*Tursiops truncatus*) and minke whale (*Balaenoptera acutorostrata*) are typical of species present around the British Isles. Rare, deep diving species are unlikely to be found within the vicinity of the proposed site due to the shallow waters (12 – 67 m) and proximity to shore (11 – 32 km).

4.1. Cetaceans

More than 24 cetacean species are known to use the waters around Ireland (Wall *et al*., 2013, O'Brien *et al*., 2009) with some species only been identified from stranding data. Although many of these species are found primarily off the west coast and towards the edge of the continental shelf, five species (harbour porpoise, minke whale, Risso's dolphin (*Grampus griseus)*, bottlenose dolphin and common dolphin (*Delphinus delphis*)) are considered to occur regularly within the Irish Sea. Minke whales are considered to be seasonal visitors with all other species thought to be present year-round (Berrow, 2001; Berrow *et al,* 2010). Whilst not all less commonly occurring species of cetacean are specifically assessed, it is considered to that any assessment or mitigation measures put into place, are appropriate/relevant for all cetaceans.

Both the Small Cetaceans in European Atlantic waters and the North Sea (SCANS) III surveys and ObSERVE surveys took place in the Irish Sea. Densities for The Project is located within SCANS III Block E and ObSERVE stratum 5. The ObSERVE and SCANS III data suggest that harbour porpoises are the most common species in the Irish Sea. This is also evidenced by other sightings data (Berrow *et al*., 2018; Berrow *et al.,* 2008; O'Brien *et al.,* 2009; IWDG sightings data[4]). Abundance and density information for the five most common species is presented in Table 4.2. Killer whale (*Orcinus orca*), fin whale (*Balaenoptera physalus*) and humpback whale (*Megaptera novaeangliae*) also occur in the Irish Sea as occasional visitors (Wall *et al*., 2013; Ryan *et al.,* 2015).

Table 4.1: Main cetacean species recorded in and around the Project. Proposed reference population information taken from IAMMWG (2021) and information on density taken from Hammond *et al*. (2021) and Rogan *et al*. (2018).

	Proposed reference population			Information on density (animals per km^2)	
Common name	Management Unit	Abundance	95% CI	SCANS III (Block E)	ObSERVE (Stratum 5)[5]
Minke whale	Celtic and Irish Seas	20,118	14,061 – 28,786	0.0173	0.045
Bottlenose dolphin	Irish Sea	293	108 - 793	0.0082	0.036
Common dolphin	Celtic and Greater North Seas	102,656	58,932 – 178,822	No current estimate available	

4 https://iwdg.ie/browsers/sightings.php

[5] Corrected design-based density estimates from the ObSERVE surveys were used if available, otherwise preference was given to design-based estimates or corrected model-based estimates (depending on what was available for each species).

Common name	Proposed reference population			Information on density (animals per km²)	
	Management Unit	Abundance	95% CI	SCANS III (Block E)	ObSERVE (Stratum 5)[5]
Risso's dolphin	Celtic and Greater North Seas	12,262	5,227 – 28,764	0.0313	0.0032
Harbour porpoise	Celtic and Irish Seas	62,517	48,324 – 80,877	0.239	1.046

Source: Hammond et al. (2021), Rogan et al. (2018) and IAMMWG. (2021).

4.2. Marine Turtles

Although leatherback turtles (*Dermochelys coriacea*) are occasional visitors to the Irish Sea, they are more likely to occur off the south and west coasts of Ireland (Doyle, 2007; King and Berrow, 2009).

No marine turtles were sighted off the east coast of Ireland during the ObSERVE surveys and in the last twelve months (since October 2020) only one leatherback turtle was recorded on the Irish Whale and Dolphin Group (IWDG) sightings app (southwest Ireland).

4.3. Other (Non-Annex IV) Species

Although basking sharks and pinnipeds are not Annex IV species information has been provided below as any proposed mitigation measures will also be appropriate/relevant to these species.

4.3.1. Basking Sharks

"Hotspots" of basking sharks have been established off the coast of the Isle of Man, Southwest England and Northwest Scotland between April and November (Witt *et al*., 2012; Austin *et al.,* 2019). Although not a "hotspot", the Irish Sea regularly shows up as an area used by basking sharks (e.g. Berrow and Heardman, 1994; Southall *et al*., 2005; Witt *et al*., 2012; Doherty *et al*., 2017) with inter-annual site fidelity shown by basking sharks to the waters around the Isle of Man (Dolton *et al.,* 2019). Recent genetic studies suggest that the Irish Sea has been identified as an important migratory corridor for basking sharks travelling between aggregation sites (Lieber *et al.,* 2020). Whilst individual sharks may remain in one place for many days, telemetry data have shown that sharks are also capable of long-range movements, moving rapidly between regions over periods of a few weeks (Sims *et al*., 2003), movements which were shown to be driven principally by foraging to locate areas with the most abundant zooplankton (Sims *et al*., 2006). Peaks in plankton density are associated with peaks in basking shark abundance (Sims and Quayle, 1998) and therefore this species appears to be seasonally abundant (i.e. during summer months).

Whilst their distribution patterns are relatively well studied around Ireland and the UK, it should be noted that there are no density or abundance estimates for populations of basking sharks anywhere in the world (Sims, 2008).

During the ObSERVE surveys only one basking shark sighting occurred off the east coast of Ireland (during a summer survey; Rogan *et al.,* 2018).

4.3.2. Pinnipeds

Two pinniped species are found within Irish waters, grey seals (*Halichoerus grypus*) and harbour seals (*Phoca vitulina*).

The predicted mean number of harbour seals in the vicinity of the Lambay Island SAC, which is the closest aggregation of harbour seals to the Project, is generally one individual per 5 x 5 km grid cell (Russell *et al.,* 2017).

Recent studies confirm the low harbour seal density along the east coast of Ireland with 95% of the population recorded around the rest of the country (Morris and Duck, 2019).

Grey seals have a more varied predicted number of individuals from Greystones to Dalkey, with predicted mean numbers of between 5 and 50 individuals per grid cell (Russell *et al.,* 2017).

5. Risk Assessment

Based on the planned SI works described in Section 2, the following have been identified as activities having the potential to impact Annex IV species in the study area:

- Increased anthropogenic noise from geophysical surveys;
- Increased anthropogenic noise from geotechnical works; and
- Increased collision risk with vessels used for surveys.

5.1. Anthropogenic Noise Related Risk Assessment

5.1.1. Overview of Potential Impacts on Marine Mammals

5.1.1.1. Marine Mammal Hearing Sensitivities

Marine mammal species have different hearing sensitivity thresholds resulting in different species detecting underwater noise at varying frequency bands (Table 5.1).

Potential effects of underwater noise on marine mammals can be summarised as:

- Lethal effects and physical injury,
- Auditory injury; and
- Behavioural response.

Table 5.1: Auditory range for the three different cetacean and phocid hearing groups

Functional hearing group (Southall et al., 2019)	Example species	Estimated auditory bandwidth (kHz)
Low frequency cetacean	Minke whale	0.007-35*
High frequency cetacean	Bottlenose dolphin Common dolphin Risso's dolphin	0.15-160
Very high frequency cetacean	Harbour porpoise	0.2-180

**Includes higher cut-off frequency range from NOAA (2018) to cover worst-case scenario for low frequency cetacean auditory bandwidth*

5.1.1.2. Lethal Effect and Physical Injury

Lethal effects may occur where peak to peak levels exceed 240 dB re 1 µPa, and physical injury may occur where peak to peak levels exceed 220 dB re 1 µPa (Parvin *et al*., 2007).

5.1.1.3. Auditory Injury

Underwater sound can cause injury to the auditory system of marine mammals either following a brief exposure to extremely high sound levels or following more prolonged exposure to lower levels of continuous sound (Richardson *et al.,* 1995).

Southall *et al* (2007) provided thresholds for received sound levels that have the potential to cause auditory injury (Permanent Threshold Shift – PTS and Temporary Threshold Shift – TTS) in marine mammals which have been reflected within the DAHG (2014) document "Guidance to Manage the Risk to Marine Mammals from Man-made

Sound Sources in Irish Waters'. However, since publication threshold levels have been updated by Southall *et al*. (2019) (Tables 5.2 and 5.3) and there use for marine mammal noise assessments are considered best practice. These thresholds are based on unweighted, instantaneous peak sound pressure levels (SPLs), and weighted Sound Exposure Levels (SELs), where:

- SEL: expression of total energy of a sound wave which incorporates both the sound pressure level and duration. This measure can be considered a cumulative noise exposure, e.g. to pulsed sound such as that produced by operation of geophysical survey equipment, during a 24-hour period; and
- M-Weighted function: frequency weighting applied to the SEL accounting for the functional hearing bandwidths of the different marine mammal groups (e.g. low frequency cetacean vs. high frequency cetacean) by taking a relevant or derived species audiogram into account.

Table 5.2: Comparison of PTS thresholds – SPLs (dB re 1 µPa @ 1 m) for assessing the potential for injury to occur instantaneously.

Functional hearing group (Southall *et al.*, 2019)	Example species	Pulsed sound
Low frequency cetacean	Minke whale	219
High frequency cetacean	Bottlenose dolphin Common dolphin Risso's dolphin	230
Very high frequency cetacean	Harbour porpoise	202

Table 5.3: Comparison of PTS thresholds – SELs (dB re 1 µPa^{2}s) for assessing whether the total energy an animal receives as it flees the area will cumulatively lead to an effect over the period of time assessed (24h).

Functional hearing group (Southall *et al.*, 2019)	Example species	Non-pulsed sound	Pulsed sound
Low frequency cetacean	Minke whale	199	183
High frequency cetacean	Bottlenose dolphin Common dolphin Risso's dolphin	198	185
Very high frequency cetacean	Harbour porpoise	173	155

5.1.1.4. **Behavioural Response**

Where possible, assessment of the potential for a behavioural response has used information from studies where this has been explored e.g. Thompson *et al.* (2013) and JNCC (2020). In the absence of such information, Nedwell *et al*., 2007 method of quantifying the potential for a behavioural effect on a species in the underwater environment has been used.

5.2. Increased Noise from Geophysical Survey Equipment

The purpose of the geophysical surveys is to provide significant seabed and sub-seabed information to assist in the consenting, design and installation phases of the Project. The geophysical survey will be undertaken throughout the Project area (Appendix A).

Geophysical surveys work by directing sound at the seabed and analysing the resulting reflections, increasing anthropogenic noise in the environment. Underwater noise travels substantially further than airborne noise, therefore potential impacts can occur at distance from the sound source.

As the equipment for the geophysical surveys has yet to be determined, frequency ranges and power outputs have been collated from a variety of different sources and are considered to be the worst-case (Table 5.4). This allows for a precautionary approach when dealing with uncertainty.

The magnetometer does not emit sound therefore is not assessed here.

Table 5.4: Proposed geophysical equipment for the Project

Equipment Type	Frequency Range	Maximum Source Pressure Level (dB re 1 µPa @ 1 m)
Multibeam Echo Sounder (MBES)	200 – 700 kHz	191 – 228
Sub-bottom Profiler (SBP) – Pinger/Chirp	500 Hz – 16 kHz	149 – 225
Ultra-high Resolution Seismic (UHRS)[6] – Boomer/Sparker	300 Hz – 5 kHz	200 – 226
Side Scan Sonar (SSS)	High frequency min. 300 kHz High frequency max. 900 kHz	210 – 228
Magnetometer	No sound emitted	No sound emitted

5.2.1. Prediction of Impacts from Geophysical Survey Equipment

5.2.1.1. Lethal Effects and Physical Injury

The threshold for lethal effects resulting in the death of an individual is 240 dB re 1 µPa (Parvin *et al*., 2007). The SPLs identified for the proposed equipment for the geophysical surveys (Table 5.4) are all lower than this lethal threshold. As the proposed geophysical surveys do not reach high enough SPLs, no lethal effects are anticipated.

The threshold for physical injury is 220 dB re 1 µPa (Parvin *et al*., 2007) therefore there is potential for injury at close range if the upper source levels of equipment are reached (Table 5.4). However, high frequency sounds of equipment such as MBES/SSS are likely to attenuate quickly in shallower waters (<200 m; JNCC, 2017) therefore the risk from MBES and SSS is considered to be negligible as the maximum water depths along the development area and cable routes are less than 100 metres. In addition, the presence of the survey vessels in the area are likely to lead to small-scale temporary displacement of cetaceans, resulting in them being a sufficient distance from the survey equipment so as not to be susceptible to physical injury. Therefore, the potential for physical injury as a result of the MBES and SSS equipment is considered to be negligible.

Sound from lower frequency equipment such as the SBPs and UHRS is less likely to attenuate quickly in shallower waters, and so has the potential to induce injury at very close range. Although small-scale temporary displacement as a result of the presence of the survey vessels may be sufficient to deter animals from the zone of potential effect. Should USV/ASV be used to conduct nearshore geophysical survey work then this small-scale temporary displacement may not be sufficient to deter animals from the area and standard mitigation measures, as detailed by "Guidance to Manage the Risk to Marine Mammals from Man-made Sound Sources in Irish Waters" (DAHG, 2014) and in Section 7 below (e.g. pre-work marine mammal surveys and ramp-up procedures where possible) will be implemented either from shore if shore launched, or from the deploying vessel.

Therefore, the potential for physical injury as a result of the SBP and UHRS equipment is considered to be negligible.

[6] The risk assessment carried out on UHRS equipment covers other seismic sources of equivalent frequency and SPL including those utilised during the geotechnical surveys (e.g. borehole seismic surveys; Section 5.3).

5.2.1.2. **Auditory Injury**

The maximum source levels of all equipment have the potential to induce the onset of PTS at very close range for both low and very high (Southall *et al.,* 2019) frequency cetaceans. As mentioned above MBES and SSS has negligible potential for auditory injury (PTS) as high frequency equipment are likely to attenuate quickly in shallow (<200 m) water (JNCC, 2017).

Other equipment such as SBP and UHRS produces noise of sufficiently high power and low frequency to potentially induce PTS onset in individuals in close proximity to the noise source. This proximity to the survey vessel will likely cause temporary displacement of marine mammals in the zone of potential effect reducing the potential to induce injury with the exception of the USV/ASV. Standard mitigation measures shall (Section 7) be implemented for these pieces of noise emitting equipment.

Therefore, the potential for auditory injury as a result of the SBP and UHRS equipment is considered to be negligible.

5.2.1.3. **Behavioural Responses**

With the exception of the SBPs and UHRS, the sound emitted by the geophysical equipment will not be audible to marine mammals because the frequencies over which the equipment operates (Table 5.4) are higher than the higher frequency hearing cut-offs for each of the functional hearing groups (Table 5.1).

It is possible that the SBPs and UHRS may be detected by cetaceans and therefore their use may have the potential to cause disturbance. The most likely response will be temporary behavioural avoidance (there is evidence that short-term disturbance caused by a commercial two-dimensional seismic survey does not lead to long-term displacement of harbour porpoises (Thompson *et al*., 2013).

Using information from the Thompson *et al*. (2013) study where harbour porpoise responses to geophysical (seismic) survey vessels in the Moray Firth were observed over ranges of 5 to 10 km, the number of individuals which have the potential to be affected has been estimated (Table 5.5). The use of 10 km is considered to result in highly conservative estimates because the noise levels produced by the oil and gas exploration geophysical surveys described in Thompson *et al*. (2013) will be well in excess of those produced during the use of the equipment described here. Therefore, for the purposes of this assessment, an impact range of 5 km is considered appropriate to represent the worst-case for UHRS and SBP systems.

The 5 km radius impact range was used to calculate the area (πr^2) of potential impact (78.5 km^2). Using the calculated area and the greatest animal density estimates found in Hammond *et al*. (2021) and Rogan *et al*. (2018), the number of animals within this area of potential impact was calculated. The percentage of the appropriate reference population (IAMMWG, 2021; see Table 4.1) that could potentially be affected was calculated for each species using the number of animals in the area divided by the abundance of the reference population multiplied by 100.

The percentage of the reference population estimated to have the potential to be affected was less than 1% for the four main cetacean species occurring within the study area (Table 5.5).

Table 5.5: The number of individuals estimated to have the potential to be disturbed by geophysical survey equipment

Species	Range of potential impact (km)	Area of potential impact (km2)	Number of individuals within the area of potential impact	Percentage of reference population which has the potential to be affected
Harbour porpoise	5	78.5	82	0.13

Species	Range of potential impact (km)	Area of potential impact (km2)	Number of individuals within the area of potential impact	Percentage of reference population which has the potential to be affected
Minke whale	5	78.5	4	0.02
Bottlenose dolphin	5	78.5	3	0.96
Risso's dolphin	5	78.5	2	0.02

Source: SCANS III density estimates/ObSERVE density estimates used in calculations from Hammond et al. (2021)/Rogan et al. (2018) and reference population abundance estimates used in calculations from IAMMWG (2021).

5.3. Increased Noise from Geotechnical Surveys

The purpose of the geotechnical surveys is to provide sufficient geotechnical data to allow the characterisation of the sub-seabed strata in order to refine a 3D soil model of the offshore windfarm site. These details will be used to initiate the design of the WTG and substation foundations and to carry out a comprehensive analysis of the installation methodology.

Geotechnical surveys and the associated works may increase anthropogenic noise in the marine environment, which in turn has the potential to affect marine mammals. The impacts of the geotechnical surveys are thought to be of low concern in terms of disturbance to Annex IV species (JNCC, 2010).

The indicative quantities (Table 5.6) relate to the requirements for the preliminary geotechnical campaign, the final quantity, location and specification of equipment will be determined following interpretation of the geophysical survey data and considering environmental constraints (i.e. proximity to sensitive receptors). The works will be carried out within both the proposed WTG array area and the offshore cable corridor area. A combination of cone penetration tests (CPT)/Piezocone penetration tests (PCPT), vibrocore, borehole, borehole logging sampling may be required at a number of locations, all within the limits of the Project (Table 5.6 / Appendix A).

The drilling carried out as part of the borehole campaign will be short in temporal and spatial scale (< 20 borehole locations during preliminary surveys and up to 100 boreholes pre-construction). It is generally expected that the activity of setting up the drilling equipment will deter marine mammals from entering the immediate work area (BOEM, 2012). Borehole work may include seismic sources (see Table 5.6) however, unlike other seismic sources, borehole logging is aimed specifically down the length of the drilled borehole therefore effects are highly localised (the seismic borehole work has similar frequency range and SPL to UHRS equipment, as such this is considered to be assessed in Section 5.2).

Vibrocoring, and PCPT/CPT may be within audible range for cetacean species in the area (Table 5.1) however, both are short in temporal and spatial scales (Table 5.6), with SPL levels unlikely to exceed 187.4 dB re 1 µPa @ 1 m (BOEM, 2012; Chorney *et al*, 2011).

Table 5.6: Geotechnical survey work proposed at the Project

Survey Type	Number of Locations	Frequency Range	Maximum Source Pressure Level (dB (rms) re 1 µPa @ 1 m)
Piezocone Penetration Test (PCPT)/Cone Penetration Test (CPT)	10 – 40	28 Hz	166

Survey Type	Number of Locations	Frequency Range	Maximum Source Pressure Level (dB (rms) re 1 µPa @ 1 m)
Boreholes (Sampling/coring)[7]	5 – 15 primarily in the WTG array area with 1 – 2 export cable landfall locations	600 Hz	145 - 190
Vibrocoring	30 – 60	50 Hz	188

Source: PCPT SPL from Subacoustech 2011, Vibrocore from Chorney et al. (2011); Boreholes SPL and frequency values from BOEM (2012)/Erbe and McPherson (2017) and project specific 'Site Investigation - Schedule of Works' document.

5.2.2. Prediction of Impacts from Geotechnical Surveys

5.2.2.4. Lethal Effects and Physical Injury

There is no potential for lethal effects or physical injury (for which the thresholds are 240 dB re 1 µPa and 220 dB re 1 µPa respectively; see section 5.1) from any of the equipment used for geotechnical surveys (see Table 5.6).

5.2.2.5. Auditory Injury

The maximum source pressure levels of all equipment (Table 5.6) do not have the potential to induce the onset of PTS even at very close range. Southall *et al.,* 2019 does not provide SPLs for non-pulsed sounds (Table 5.2) therefore 230 dB re 1 µPa for cetaceans from Southall *et al*., 2007 has been used in its absence. The non-pulsed SPLs are unlikely to exceed 190 dB re 1 µPa (see Table 5.6) and therefore fall below the threshold for PTS onset. Instantaneous, rather than cumulative, PTS was considered because information on SPLs, rather than SELs, was available from equipment manufacturers.

There is no potential for auditory injury from any of the equipment used for the geotechnical surveys.

5.2.2.6. Behavioural Responses for Geotechnical Non-Pulsed Sound Sources

The information used in this assessment is based on high quality recordings of a similar operation (pin pile drilling) at another location (Strangford Lough; Nedwell and Brooker, 2008). These recordings were made at ranges of 28 m to 2.13 km from the drilling operation and indicated a source SPL of 162 dB re 1 µPa @ 1 m, i.e. comparable to the geotechnical survey work (see Table 5.6). Nedwell and Brooker (2008) assessed the likelihood of avoidance of the drilling noise by marine mammals.

The conclusions of the study were that the avoidance ranges for 'significant avoidance in the majority of individuals' and 'low likelihood of disturbance' were 1.5 m and 85 m respectively. Therefore, marine mammals are considered to be unlikely to be disturbed by noise from drilling or, as in this case, geotechnical survey work unless they are in the close vicinity of the work. This is unlikely due to small-scale temporary displacement which may occur as a result of the presence of the survey vessel itself and the setting up of the drilling equipment.

5.3. Increased Collision Risk

Vessel strikes are a known cause of mortality in marine mammals and basking sharks (Laist *et al*., 2001). Non-lethal collisions have also been documented (Laist *et al*., 2001; Van Waerebeek *et al*., 2007). Injuries from such collisions

[7] Borehole work may include potential down-the-hole high pressure dilatometer measurements and/or seismic wave velocity measurements (referred to hereafter as 'seismic boreholes')). Sound produced during seismic borehole surveys is considered to have an Source Pressure Level (SPL) of between 166 – 225 dB re 1 µPa @ 1 m and similar frequency range to that of the UHRS (see Table 2.1).

can be divided into two broad categories: blunt trauma from impact and lacerations from propellers. Injuries may result in individuals becoming vulnerable to secondary infections or predation.

Avoidance behaviour by cetaceans is often associated with fast, unpredictable boats such as speedboats and jet-skis (Bristow and Reeves, 2001; Gregory and Rowden, 2001; Leung and Leung, 2003; Buckstaff, 2004), while neutral or positive reactions have been observed with larger, slower moving vessels such as cargo ships (Leung and Leung, 2003; Sini *et al.,* 2005).

USV/ASV are increasingly used to conduct marine mammal surveys and due to the small size, slow speeds (average of 3 – 9 knots) and predictable trajectory has an additional benefit of further reducing risk of collision with marine mammal species.

Slower vessels following a consistent trajectory allow cetaceans the opportunity to avoid collisions. Marine mammals occur at relatively low abundance in the area of the Project and basking sharks are very infrequent visitors.

5.3.1. Prediction of Impact

The vessels to be used for these surveys are yet to be confirmed but due to the nature of the surveys at least two different vessels will be required. These vessels will be travelling at slow speeds, in a predefined trajectory, allowing for animals to predict movement of the vessels and avoid collisions. Cetaceans in the area are exposed to marine traffic on a regular basis and should therefore be habituated to vessel movements. The small number of vessels that will be required for these surveys will not significantly increase vessel traffic in the area. Accordingly, it is predicted that collisions between survey vessels and marine Annex IV species are extremely unlikely and there is no risk of significant effects presenting.

6. Assessment of Potential Offence

Cetaceans have been recorded within the Irish Sea all year round with harbour porpoise, common dolphin, bottlenose dolphin, minke whale and Risso's dolphin most common. Any of these species may therefore be present within the area during at least some part of the proposed survey work. Other marine Annex IV species may also be present.

Assessment of the potential for impact from geophysical survey and positioning equipment concluded that there is the potential for the sounds emitted to induce the onset of PTS (auditory injury) or cause potential for physical injury in cetacean Annex IV at close range. However, with mitigation (see Section 7) the potential for the onset of auditory/physical injury to occur is negligible. Any disturbance from geophysical survey and positioning equipment is likely to be localised, short term and reversible and, where it could be estimated, the percentage of the reference population which has the potential to be disturbed is considered to be negligible (less than 1%). Therefore, following the JNCC *et al*. (2010) guidance it can be concluded that with mitigation, the impact of sound produced by operation of equipment used during the proposed geophysical survey work is unlikely to be detrimental to the maintenance of the populations of the species concerned at a FCS in their natural range. Therefore, there is no potential for offence from this aspect of the proposed work or any other environmental investigations in which similar equipment is used.

Increased anthropogenic noise from the geotechnical surveys does not have the potential to induce lethal effects or physical or auditory injury. The displacement of Annex IV as a result of noise from geotechnical surveys can be considered 'trivial' and is very unlikely to be detrimental to the maintenance of the populations of the species concerned at a FCS level in their natural range.

The potential for collision with vessels was considered to be extremely unlikely. Therefore, following the JNCC *et al*. (2010) guidance it can be concluded that collision risk is unlikely to constitute an offence.

Therefore, there is no potential for offence from any aspect of the proposed surveys and no derogation licence is required.

7. Mitigation Measures

Operation of some of the geophysical survey systems and positioning equipment (SBP and UHRS) and seismic borehole equipment has the potential to cause physical and/or auditory injury to Annex IV species at very close range.

It is considered that standard mitigation measures, as detailed in the 2014 Department of Arts, Heritage and Gaeltacht (DAHG) Guidance and outlined below such as pre-start monitoring and ramp-up ("soft-start"), will prevent individual animals from having the potential to be exposed to the risks outlined in Section 5[8].

7.1. Mitigation Measures for Geophysical Equipment

7.1.1. Pre-Start Monitoring

A qualified and experienced[9] marine mammal observer (MMO) will be appointed to monitor for marine mammals and to log all relevant events using standardised data forms provided by the DAHG. In order to allow 24 hour working, or for work to commence when visual observation is not possible due to weather conditions or sea state, a proven Passive Acoustic Monitoring (PAM) system and experienced operator(s)[10] will be employed to undertake the pre-start monitoring during these times.

Operation of the SBP, UHRS or seismic borehole equipment shall not commence until a pre-start monitoring procedure has been completed.

As the surveys are to be conducted in waters of less than 200 m deep, the pre-start monitoring will commence a minimum of 30 minutes prior to the scheduled start time. For all surveys, a monitored zone of 500 m will be employed, i.e. if a marine mammal is observed within 500 m of the sound source in the 30 minutes prior to the scheduled start, works will be delayed until no marine mammals have been observed for 30 minutes. If the marine mammals do not leave the area, the survey vessel may alter its course to ensure that the animals are outside the monitored zone when the soft start commences. The MMO will use a distance measuring stick or reticule binoculars to ascertain distances to marine mammals.

7.1.2. Ramp-Up Procedure

A soft start is the gradual ramping up of power over a set period of time. Not all equipment has this capability inbuilt therefore the ramp-up procedure will be followed if the equipment has the capacity to do so.

In all cases, once the ramp-up commences, there is no requirement to halt or discontinue the procedure at night-time, if weather or visibility conditions deteriorate, or if marine mammals enter the Monitored Zone (500 m radial distance of the sound source). Delays between the ramp-up procedure and the start of the survey line or station will be minimised as far as possible to reduce unnecessary noise.

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[8] Any other audible sound emitting equipment used in the survey which has the potential to cause physical or auditory injury will also be included in the mitigation measures.

[9] A suitably qualified and experienced MMO is defined as someone who has undergone suitable training (JNCC MMO training course or equivalent) and in accordance with DAHG guidelines has a "*minimum of 6 weeks full-time marine mammal survey experience at sea over a 3-year period in European waters*".

[10] A suitably experienced PAM operator will as a minimum "…*be able to assemble and deploy equipment, configure the software, identify acoustic signals and interpret bearing and range information*" (JNCC, 2017).

7.1.2.1. **SBP Surveys**

During the ramp-up (where the equipment has the capacity), the sound level or power output will be allowed to gradually build over a period of 20 minutes. The soft start procedure will be implemented at all times including when testing equipment.

7.1.2.2. **UHRS and Seismic Borehole Surveys**

For the UHRS and seismic borehole surveys, the following ramp up procedure will be undertaken in line with DAHG guidance (2014):

1) Energy output will commence from a low energy start-up (e.g., starting with the smallest device in the array and gradually adding others) and be allowed to gradually build up to the necessary maximum output over a period of up to 40 minutes.

2) This controlled build-up of energy output will occur in consistent stages to provide a steady and gradual increase over the ramp-up period.

7.1.3. **Line Changes and Breaks in Survey Periods**

7.1.3.3. **SBP Surveys**

If there is a break in sound output from the SPB (or other audible source with source level above the threshold for auditory injury) for a period greater than 30 minutes (e.g. due to equipment failure, shut-down, survey line/station change) then all pre-survey monitoring measures and ramp-up (where this is possible) will recommence prior to re-starting.

7.1.3.4. **UHRS and Seismic Borehole Surveys**

Where the duration of a survey line or station change is greater than 40 minutes, the activity will, on completion of the line/station being surveyed, either cease (i.e., shut down) or undergo a reduction in energy output to a lower state where the peak sound pressure level from any operating source is 165 - 170 dB re 1 µPa @ 1 m or lower.

Prior to the start of the next line/station, if the power was shut down all pre-survey monitoring measure and ramp-up procedures will be followed as for start-up. If there has been a reduction in power, a ramp-up will be undertaken gradually from the lower output level. The latter sound reduction measure may be applied to line changes at night-time or in daytime conditions of poor visibility. Where the duration of a survey line/station change is less than 40 minutes the activity will continue as normal (i.e. under full output).

If there is a break in sound output for a period greater than 10 minutes (e.g., due to equipment failure, shut-down, survey line/station change) then all pre-survey monitoring measures and ramp-up will recommence prior to re-starting.

7.2. **Drilling**

Prior to drilling activity commencing a full pre-start monitoring (see section 7.1.1) will be undertaken. As with the ramp-up procedure for geophysical survey there is no requirement to halt or discontinue the procedure at night-time, if weather or visibility conditions deteriorate, or if marine mammals enter the Monitored Zone (500 m radial distance of the sound source) once drilling operations have commenced.

Should a break in drilling operations occur for a period greater than 30 minutes then the full pre-start monitoring procedure will occur prior to drilling activity.

7.3. Reporting

Full reporting on operations and mitigation will be provided to the DHLGH to facilitate reporting under Article 17 of the EC Habitats Directive and future improvements to guidance (DAHG, 2014).

8. Conclusion

This assessment of the activities associated with the SI work (outlined in Section 2) which have the potential to impact Annex IV species in the Project area (increased anthropogenic noise from use of the geophysical survey and positioning equipment, increased anthropogenic noise from the use of geotechnical equipment and collision with vessels) is based on a worst-case scenario and concluded that:

- There is no potential for lethal effects on marine Annex IV species;
- The potential for physical or auditory injury is considered to be negligible after mitigation measures are put into place;
- The potential for disturbance is considered to be ‘trivial’; and
- The potential for collision risk with Annex IV species is considered to be unlikely and therefore non-significant.

Therefore, the surveys will not significantly affect the FCS of any marine Annex IV species as defined in the Habitats Directive and corresponding European Communities (Birds and Natural Habitats) Regulations 2011 - 2021, and it is considered that a derogation licence is not required for the surveys described.

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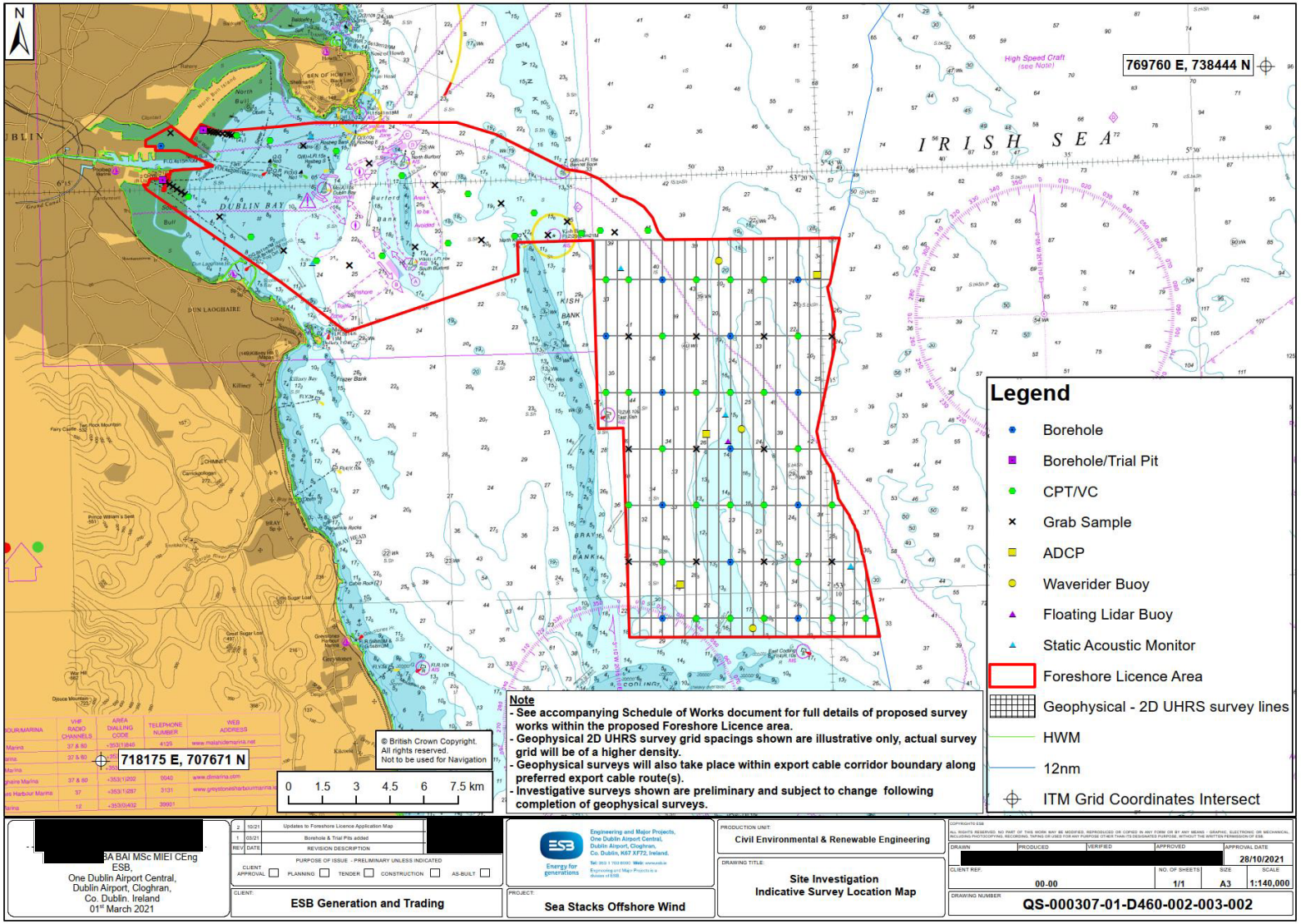
Appendices

Appendix A - Proposed (indicative) sampling locations



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