NISA Cable Assessment Area

Annex IV and Seals Species Risk Assessment

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Glossary

Term	Definition
Decibel (dB)	A customary scale commonly used (in various ways) for reporting levels of sound. A difference of 10 dB corresponds to a factor of 10 in sound power. The actual sound measurement is compared to a fixed reference level and the "decibel" value is defined to be $10\log_{10}(actual/reference)$ where $(actual/reference)$ is a power ratio. Because sound power is usually proportional to sound pressure squared, the decibel value for sound pressure is $20\log_{10}(actual\ pressure/reference\ pressure)$. The standard reference for underwater sound is 1 micropascal (µPa). The dB symbol is followed by a second symbol identifying the specific reference value (e.g., re 1 µPa).
Passive Acoustic Monitoring (PAM)	The use of hydro-acoustic receivers to detect the presence of marine mammals by monitoring their acoustic emissions.
Peak pressure	The highest pressure above or below ambient that is associated with a sound wave.
Peak-to-peak pressure	The sum of the highest positive and negative pressures that are associated with a sound wave.
Permanent Threshold Shift (PTS)	A permanent total or partial loss of hearing caused by acoustic trauma. PTS results in irreversible damage to the sensory hair cells of the ear, and thus a permanent reduction of hearing acuity
Sound Exposure Level (SEL)	The constant sound level acting for one second, which has the same amount of acoustic energy, as indicated by the square of the sound pressure, as the original sound. It is the time-integrated, sound-pressure-squared level. SEL is typically used to compare transient sound events having different time durations, pressure levels, and temporal characteristics.
Sound Pressure Level (SPL)	The sound pressure level is an expression of sound pressure using the decibel (dB) scale; the standard frequency pressures of which are 1 µPa for water and 20 µPa for air.
Temporary Threshold Shift (TTS)	Temporary reduction of hearing acuity because of exposure to sound over time. Exposure to high levels of sound over relatively short time periods could cause the same level of TTS as exposure to lower levels of sound over longer time periods. The mechanisms underlying TTS are not well understood, but there may be some temporary damage to the sensory cells. The duration of TTS varies depending on the nature of the stimulus.
Unweighted sound level	Sound levels which are "raw" or have not been adjusted in any way, for example to account for the hearing ability of a species.
Weighted sound level	A sound level which has been adjusted with respect to a "weighting envelope" in the frequency domain, typically to make an unweighted level relevant to a particular species. Examples of this are the dB(A), where the overall sound level has been adjusted to account for the hearing ability of humans in air, or the filters used by Southall *et al*. (2019) for marine mammals.

1 Introduction

North Irish Sea Array Windfarm Limited (NISA Ltd.), which is a wholly owned subsidiary of Statkraft Ireland Ltd., provides this report in support of an application for a Licence under Section 3 of the Foreshore Act, as amended, to carry out site investigation works to determine the suitability of the application area as an export cable route for the North Irish Sea Array (NISA) offshore wind farm.

NISA Ltd is currently investigating the feasibility of developing an offshore wind farm (OWF) located in the Irish Sea, 7 km to 17 km off the coast of Dublin, Meath and Louth and previously submitted a foreshore licence application (FS007031) for the site investigations on the array site (shown in red outline in Figure 3-1). Nisa Ltd intends to undertake further site investigations activities at the proposed Foreshore Licence Application Area for export cable route (shown in red outline in Figure 3-1) in order to inform the location and design of the export cable route to facilitate the export cable between the array site and the landfall. The site investigation activities will include geophysical, geotechnical, ecological and archaeological surveys.

Of these, those with potential to affect Annex IV and other protected marine mammal species are limited to geophysical and geotechnical surveys, as the equipment used in the remaining surveys will not emit sound. These surveys aim to accurately map seabed conditions and hazards within the area and gather information on ground conditions and geology, with the objective of informing the engineering and detailed design of the export cable route, as well as informing the environmental assessments.

The geophysical and geotechnical surveys will be undertaken within the Foreshore Licence Area (see Figure 3-1), which covers a total area of approximately 106.2 km^2. However, the entire site will not be subject to site investigations and information relating to refinement of the site investigation area is described in Section 3.1.

1.1 Aim of this report

This report is part of the Foreshore Licence Application to the Foreshore Unit of the Department of Housing, Planning and Local Government and includes information to inform a Risk Assessment for Annex IV species under Article 12 of the Habitats Directive (92/43/EEC).

This report is provided as a response to a Request for Further Information from the Foreshore Unit of the Department of Housing, Planning and Local Government, dated 17th December 2021, and aims to support the application process and provide the necessary information to the competent authorities to assist them in making an informed decision on the likely impact of this project on Annex IV species and other protected marine mammals species in Irish waters.

This information is provided in accordance with the following Sections of the 'Guidance to Manage the Risk to Marine Mammals from Man-made Sound Sources in Irish Waters' (DAHG, 2014)

- Section 4.3.2 Drilling (2)
- Section 4.3.4 Geophysical Acoustics Activities (iii)

1.2 Methods

The report provides an assessment of the presence/absence of populations of Annex IV species and other protected marine mammals in the vicinity of the NISA Cable Assessment Area (CAA), estimates of the frequency and density of occurrence of these species, together with estimates of the likely effects from the proposed relevant site investigations. Additionally, the report proposes a set of measures to mitigate those effects.

The present risk assessment was based on a review of the available literature, as well as an underwater noise modelling exercise which was carried out for various geophysical and geotechnical activities expected during survey work on the NISA Offshore Wind Farm (OWF) site. The modelling has been undertaken at the north-east and south-west corners of the NISA OWF area for all noise sources to give the widest spatial coverage. Although the survey vessel will be constantly moving during the survey, this selection of locations provided a precautionary assessment. The SW location is close to the NISA CAA, which also has similar shallower depths. For this reason, the SW location was used in the present report to characterise the underwater noise and perceived sound levels during the proposed geophysical and geotechnical surveys on the NISA CAA. The noise sources modelled were multi-beam echosounders (MBES), side scan sonar (SSS), various sub-bottom profilers (SBP) and drilling equipment and the modelling results were used to inform this Annex IV and other marine mammal species Risk Assessment.

2 Legislation and Regulation

2.1 European Protected Species (EPS)

All species of cetacean (whales, dolphins and porpoises) occurring in European Union (EU) waters are considered European Protected Species (EPS) under Annex IV of the Habitats Directive (Council Directive 92/43/EEC). As directed by Article 12 of the Directive, species listed in Annex IV are considered species of community interest in need of strict protection across their entire natural range within the EU, both within and outside Natura 2000 sites. In addition to cetaceans, other EPS occurring in Irish waters are the Eurasian otter (*Lutra lutra*) and the leatherback turtle (*Dermochelys coriacea*).

The Habitats Directive has been transposed into Irish law by the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. No 477 of 2011) and subsequent amendments. These consolidate the earlier European Communities (Natural Habitats) Regulations 1997 to 2005 and the European Communities (Birds and Natural Habitats) (Control of Recreational Activities) Regulations 2010.

These Regulations provide for the strict protection of Annex IV listed species, including all cetaceans, in their natural range. 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.

'Deliberate' has been interpreted in European Commission, in its 2007 'Guidance document on the strict protection of animal species of community interest under the Habitats Directive 92/43/EEC', as

> *"'Deliberate' actions are to be understood as actions by a person who knows, in light of the relevant legislation that applies to the species involved, and the general information delivered to the public, that his action will most likely lead to an offence against a species, but intends this offence or, if not, consciously accepts the foreseeable results of his action".*

Therefore, anyone carrying out an activity which they should reasonably have known could cause injury as defined in the Regulations, could be committing an offence.

Under Regulation 54 of the Birds and Habitats Regulations 2011, a specific derogation licence may be granted by the Minister (for Arts, Heritage and the Gaeltacht) which would allow activities, otherwise considered an offense, to go ahead provided that:

- There is no satisfactory alternative; and

- The action authorised will not be detrimental to the maintenance of the populations of the species concerned at a Favourable Conservation Status (FCS) in their natural range.

Such derogation licence will be subject to such conditions, restrictions, limitations or requirements as the Minister considers appropriate.

FCS is defined in the Habitats Directive as the following:

- 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.

In Ireland, further protection is afforded to all cetaceans, as well as grey (*Halichoerus grypus*) and harbour (*Phoca vitulina*) seals and the Eurasian otter under the Wildlife Act (1976) and its subsequent amendments. Under the Wildlife Act and its amendments, it is an offence to hunt, injure or wilfully interfere with, disturb or destroy the resting or breeding place of a protected species (except in some instances under licence or Ministerial permit). The Wildlife Act applies to waters within Ireland's Territorial Sea, i.e., out to the 12 NM limit from the baseline[1].

2.2 Guidance

In 2007, the National Parks and Wildlife Service (NPWS) of the Department of Arts, Heritage and the Gaeltacht (DAHG) produced a 'Code of Practice for the Protection of Marine Mammals during Acoustic Seafloor Surveys in Irish Waters' (DAHG, 2007). These were reviewed and amended in 2014 to produce 'Guidance to manage the risk to marine mammals from man-made sound sources in Irish waters' (DAHG, 2014). This guidance aims to:

1. Give an understanding of selected sound sources introduced into the environment by specific human activities, which may impact detrimentally on protected marine mammal populations or individuals of those species,
2. Describe a structured, staged process for the informed assessment of risk and decision making with regard to such sources
3. Outline practical risk avoidance and/or risk reduction measures which must be considered in order to minimise the potential effects of sound sources on the natural ecology of marine mammal species

This DAHG (2014) guidance recommends that listed coastal and marine activities, including drilling operations and geophysical acoustic surveys, undergo a risk assessment for anthropogenic sound-related impacts on relevant protected marine mammal species to address any area-specific sensitivities, both in temporal and spatial extent, and to inform the consenting process. This document also sets out a generalised framework for the consideration of risk from particular sound-producing

[1] The baseline is the low water mark from which the limit of the territorial seas is measured (i.e. 12 NM)

activities in the waters of Ireland's Exclusive Economic Zone (EEZ) and offers guidance for planning and risk management, where necessary.

Additionally, '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', published in 2010 by the JNCC, Natural England and the Countryside Council for Wales (now Natural Resources Wales) (JNCC *et al.*, 2010), and the JNCC guidelines for minimising the risk of injury to marine mammals from geophysical surveys (JNCC, 2017) have been used as a complement to the DAHG (2014) guidelines.

3 Proposed survey works

The Preliminary Campaign is intended to inform the developer of the baseline ground conditions and to facilitate early-stage concept development. It generally includes a geophysical campaign and the preliminary geotechnical campaign. The information obtained will also be used for the design of future site investigations including the selection of appropriate drilling equipment and testing techniques to match the ground conditions. The geophysical and geotechnical scope of works outlined in Table 3-1 and detailed in the sections below refer to the preliminary stage of site investigation activities.

Table 3-1: Summary of proposed survey methodologies

Survey	Purpose
Geophysical	
Multibeam echo sounder	Collect topographical data of the seabed
Side scan sonar	Develop an image of the seafloor
Magnetometer	Identify magnetic anomalies and hazard mapping for metal obstructions, shipwrecks and unexploded ordnance on the surface and in the sub-surface
Sub-bottom Profiling	Develop an image of the subsurface, identifying different strata encountered
Higher Energy Sub-surface Acoustic Sources	To identify and characterise the deeper layers of sediment/bedrock underneath the seafloor
Geotechnical	
Boreholes	Sample and test soil and rock material, typically to depth of up to 70 m below the seafloor (bsf).
CPTs	Method for testing the soils strength parameters, typically to a depth of 25 – 40 m bsf
Vibrocore	Sample seafloor sediments (shallow depths)
Grab Samples	Sample seafloor sediments (shallow depths)

3.1 Proposed survey area

The proposed area for the geophysical and geotechnical surveys is located in the north-west Irish sea off the coasts of Co. Dublin and Co. Meath.

The proposed survey area is all within 12 NM of the coast, in keeping with the current foreshore legislation which does not provide for licences beyond that distance. The site is defined as an irregular polygon which extends out from the Mean High-Water Mark (MHWM) to approximately 16 km offshore to the array site, with the depths ranging between 0 m and 41.3 m. The Foreshore Licence Site Investigation Area for the NISA CAA has a total area of 106.2 km^2 (see Figure 3-1).

NISA Ltd will investigate three landfalls and cable routes options but not all routes will be used for the wind farm cabling. The purpose of this site investigation is to investigate the feasibility of the different routes to allow NISA Ltd to determine the most preferred option. If the site investigation activities indicates that the area is suitable for the export cable from the array site to shore, the design of the cable, cable route and landing points etc. will be incorporated into the overall project design. The

overall project will then be progressed in accordance with the National Marine Planning Framework and other relevant legislation in due course including the new consenting regime for offshore renewable energy being legislated for through the Maritime Area Planning Bill (MAP).

The Foreshore Licence Application Area (red boundary), as well as the Offshore Windfarm (OWF) Area (black boundary) are shown Figure 3-1. The NISA OWF site is shown for information purposes only, and the NISA OWF site inside the 12 NM boundary is subject to a separate Foreshore Licence Application - FS007031). The coordinates of the Foreshore Licence Application Area are set out (in ITM95 and WG84/UTM29N) in Table 3-2.

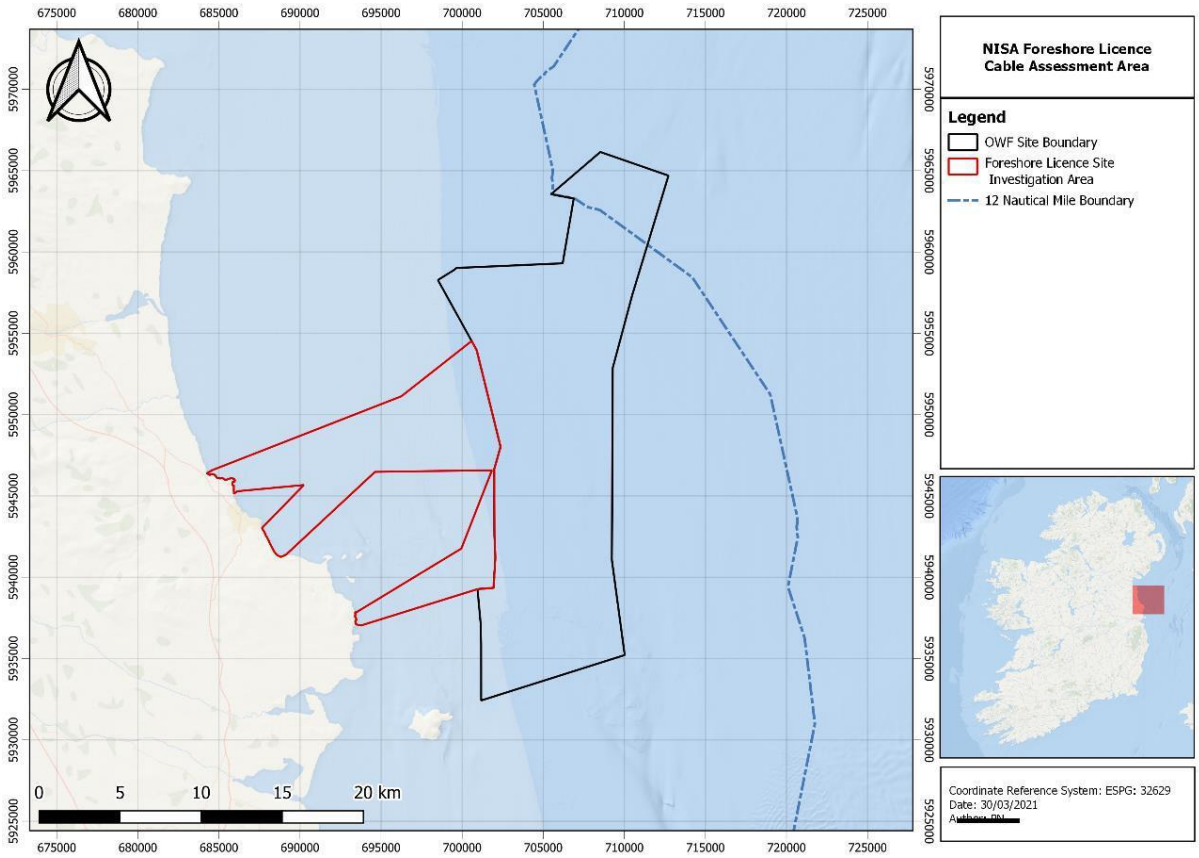

Figure 3-1: Foreshore Licence Application Area (red boundary), and NISA Offshore Wind Farm Area (black boundary; for information purposes only)

Table 3-2: Foreshore Licence Application Area Coordinates

System: IRENET95 ITM			WGS 84 / UTM zone 30N	
ID	Easting	Northing	Easting	Northing
1	734619.1	774283.2	304531.1	5954313.9
2	734914.2	773720.0	304785.9	5953731.3
3	736305.0	767750.8	305753.9	5947679.0
4	735893.8	766379.9	305247.4	5946340.4
5	735852.6	762367.7	304924.6	5942340.8

System: IRENET95 ITM			WGS 84 / UTM zone 30N	
ID	Easting	Northing	Easting	Northing
6	735884.9	760941.0	304856.7	5940915.4
7	735752.6	759088.9	304594.8	5939077.1
8	734760.4	759022.8	303600.4	5939080.8
9	727568.8	756893.2	296276.5	5937460.9
10	727332.9	756934.2	296044.2	5937518.4
11	727206.8	757704.5	295972.3	5938295.7
12	727295.8	757718.8	296062.2	5938303.7
13	733798.3	761528.6	302816.4	5941648.0
14	735754.5	766318.6	305104.1	5946289.0
15	728541.3	766318.6	297908.4	5946795.6
16	722966.4	761290.8	291993.6	5942171.1
17	721529.9	762972.0	290678.5	5943949.2
18	724142.3	765573.2	293467.4	5946360.9
19	720033.1	765246.7	289345.0	5946323.7
20	719817.1	765094.9	289118.8	5946187.5
21	718193.6	766390.2	287590.1	5947593.9
22	718494.1	766561.4	287901.9	5947743.5
23	730235.3	770944.7	299923.3	5951291.6

3.2 Geophysical survey

Statkraft intends to carry out a number of geophysical surveys throughout the proposed marine survey area. The collected data will be used to better understand the water depths, topography and relief structure of the seabed and the subsurface structure, in particular the sub-surface stratigraphy, confirming the bedrock elevation. The process uses remote sensing techniques and the equipment used will not make contact with the seafloor.

The surveys will be conducted using electromagnetic or acoustic tools, summarized in Table 3-3. While the exact equipment to be used will be confirmed following a tender process to procure the site investigation contractor, the equipment listed in this report represents typical equipment used during geophysical survey activities for offshore wind development related data collection. All equipment listed may not be required but has been included within this risk assessment to cover worst-case scenarios. The acoustic frequencies given below are indicative. These may change on site if dictated by the ground conditions however the precautionary approach has been adopted and the indicative values provided in Table 3-3 are the maximum expected for these types of surveys.

Table 3-3: Equipment proposed for the geophysical survey work

Equipment type	Purpose	Frequency Range	Maximum Source Pressure Level (dB re 1 µPa @ 1 m)
Multi-beam Echosounder (MBES)	MBES is a system for collecting detailed topographical data of the seabed. Determines depth and nature of the seabed by transmitting sound pulses (active sonar). Transmits broad acoustic pulse.	200 - 400 kHz (700kHz optional)	200-228
Side Scan Sonar (SSS)	Determines depth and nature of the seabed by transmitting sound pulses (active sonar).	300 - 900 kHz	228
Sub-bottom Profiler (SBP) - Innomar	Identifies and measures sediment layers below the seabed.	85 - 115 kHz	247 max, but typically operated at <200
Sub-bottom Profiler (SBP) - Pinger	Identifies and measures sediment layers below the seabed.	3.5 - 7.0 kHz	220
Ultra-high resolution seismic survey - Sparker	Identifies and characterises the deeper layers of sediment/bedrock underneath the seafloor.	Around 1.4 kHz	211
Magnetometer	Locates and identifies ferrous objects on the seabed.	No sound emitted	No sound emitted

The proposed geophysical survey techniques are described below.

3.2.1 Bathymetric Surveying

A multi-beam echosounder (MBES) system will be used to provide detailed bathymetric mapping throughout the survey area. They measure water depth by recording the two-way travel time of a high frequency pulse emitted by a transducer. The beams produce a fanned arc composed of individual beams (also known as a swathe). Multi-beam echo-sounders can, typically, carry out 200 or more simultaneous measurements.

A typical MBES used for site survey activities would be an R2Sonic 2024 operating at 400 kHz with a recommended repetition rate of 20 µs. Source noise levels for this equipment are expected to be up to 228 dB re 1 µPa (SPL_{peak}) @ 1 m at this frequency.

3.2.2 Side Scan Sonar (SSS)

Side scan sonar is a dual frequency hydrographic sonar used to generate an accurate image of the seabed. An acoustic beam is used to obtain an accurate image of a narrow area of seabed to either side of the instrument by measuring the amplitude of back-scattered return signals. SSS is a towed sensor which is typically towed behind the vessel at a specified depth on an armoured tow cable, although some models can be pole mounted on the side of the vessel or mounted on to an ROV.

A typical SSS system used during the site survey activities would be an Edgetech 4200 operating at frequencies between 300 and 900 kHz with an expected pulse interval of 200 ms. As with the MBES, source noise levels of up to 228 dB re 1 µPa (SPL_{peak}) @ 1 m are expected at the peak frequencies. The frequency range used will be determined by the survey objectives.

3.2.3 Sub-bottom Profiling (SBP)

Shallow sub-bottom profiling surveying aims to create a 2-D or 3-D image of the subsurface up to potential depths of approximately 50 m below seabed, depending on the geological conditions encountered and the choice of system used. Different types of SBP are available including chirp, pinger, boomer, sparker and parametric chirp systems. The most appropriate system will be decided depending on the seabed, anticipated geological environment and the objectives of the survey. Indicative examples of typical systems are:

- An Innomar SES-2000 Medium SBP, which operates between 85 and 115 kHz at a typical rate of 40 pulses per second (Wunderlich, 2016). This device carries a max output of 247 dB re 1 µPa (SPL_{peak}) @ 1 m however for these surveys that max is likely to be c.200 dB re 1 µPa (SPL_{peak}) @ 1 m
- A Neptune T335 pinger SBP, operating at frequencies between 3.5 and 7.0 kHz and a standard repetition rate of 0.7 ms (Byun *et al*., 2019)

3.2.4 Ultra-high resolution seismic survey (UHRS)

Ultra-high resolution seismic survey, or sparkers, use a high voltage impulse that generates a spark across a pair of electrodes forming a gas bubble whose oscillations generate the sound. UHRS are used to gain a 2D or 3D interpretation of the deeper strata. Depending on the water depth and the geological conditions, typical systems have the potential to penetrate down to approximately 200 m below seabed. The type of system used would ultimately depend on the objectives of the survey and the known geological conditions.

The Geo Marine Geo-source 200-400 sparker with a Geo Spark 1000 source is a typical example of the type of system that may be proposed; with a central operating frequency of 1.4 kHz and a source power in the range of 400-1000 joules; again, depending on the geology and the survey objectives. This is considered low power in comparison to the oil and gas equivalent. It was included for modelling as a worse case however this device is highly unlikely to be used at this site based on the known conditions.

3.2.5 Magnetometer

The magnetometer is a passive towed device used to detect ferrous objects on the surface or in the subsurface. Magnetometer surveys are widely used prior to intrusive works such as geotechnical surveying and construction works to highlight any obstruction or potential risk such as unexploded ordnance. The magnetometer will be a Cesium marine magnetometer such as the Geometrics G-882 and capable of recording variations in magnetic field strength during survey to an accuracy of ± 0.5nT.

Magnetometers are passive devices and do not emit any sound. As such, magnetometers will not be considered any further in this report.

3.3 Geotechnical survey

The purpose of the geotechnical surveys is to evaluate the nature and mechanical properties of the superficial seabed sediments and/or bedrock formations.

Figure 3-2 below shows the indicative geotechnical site investigation locations across the Foreshore Licence Site Investigation Area. Figure 3-3, Figure 3-4 and Figure 3-5 show the indicative geotechnical investigation locations along the northern, central and southern landfall areas respectively. The exact location, quantity, target depths and type of scheduled preliminary geotechnical sampling will be determined following the interpretation of the geophysical survey, but will comprise of a maximum of:

- 18 no. boreholes (6 at each landfall location)
- 70 no. seabed CPTs
- 70 no. core samples acquired by vibrocore or gravity corer
- 130 no. grab samples

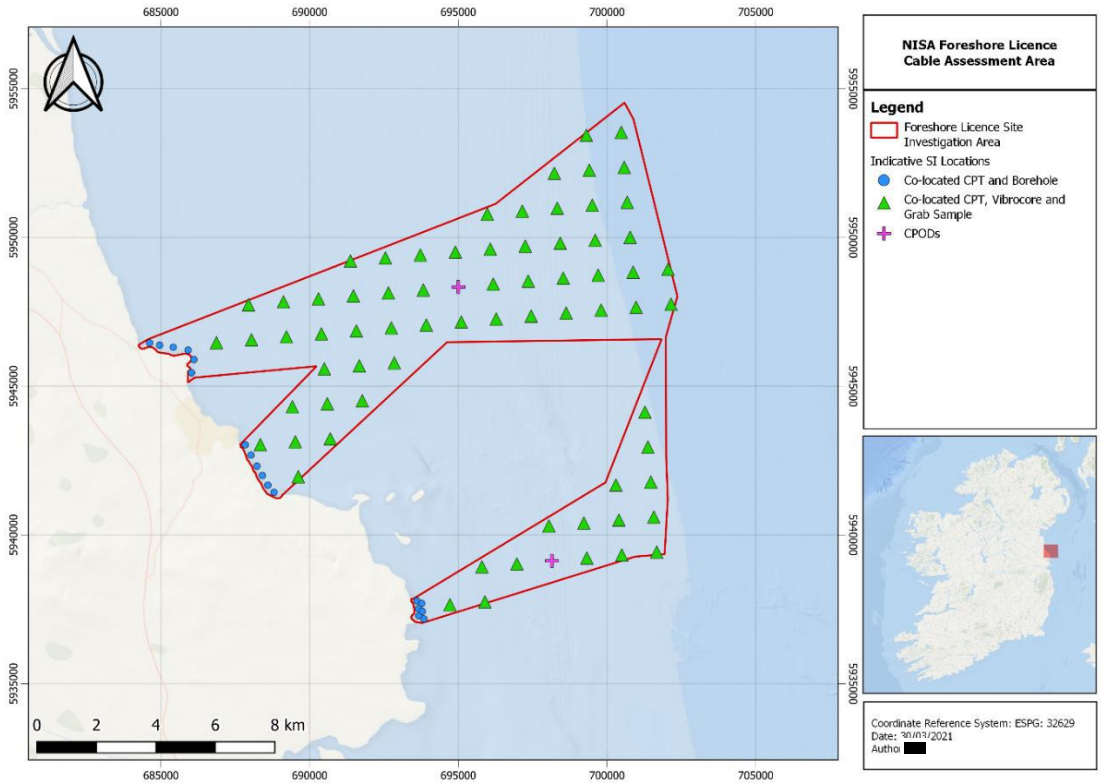

Figure 3-2: Indicative geotechnical site investigation locations presenting three landfall and cable route options which will be narrowed down following the site investigations.

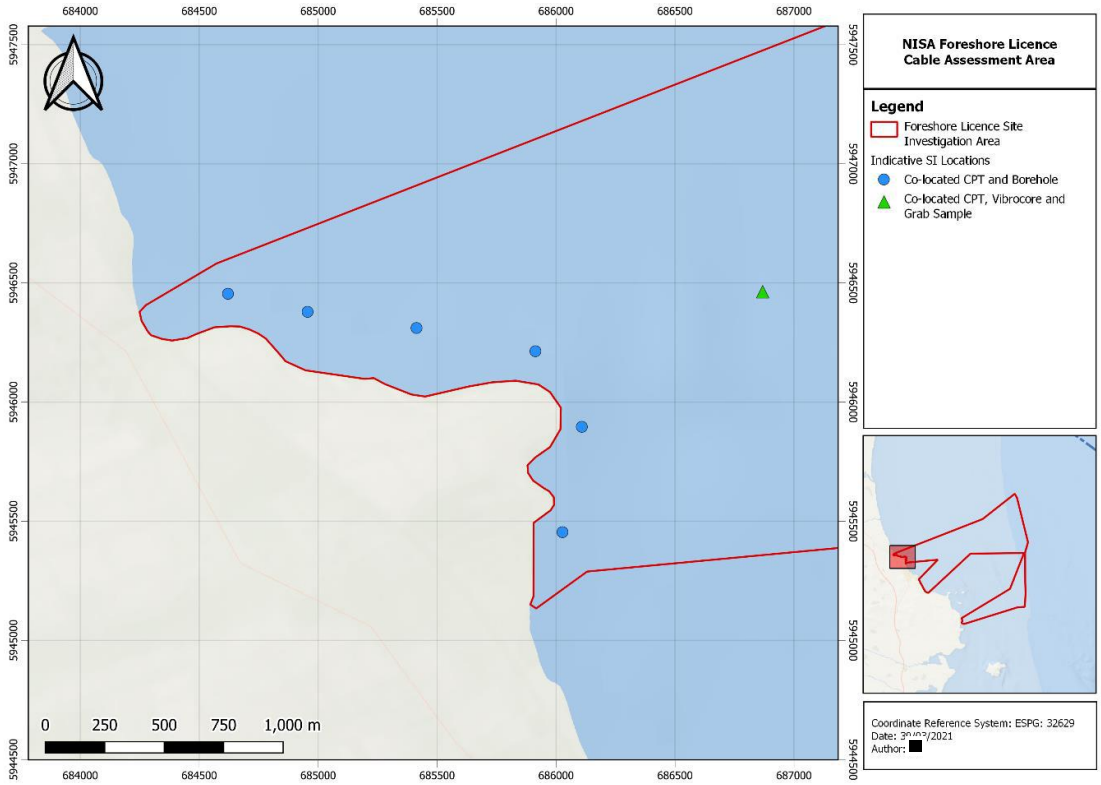

Figure 3-3: Northern Landfall Area

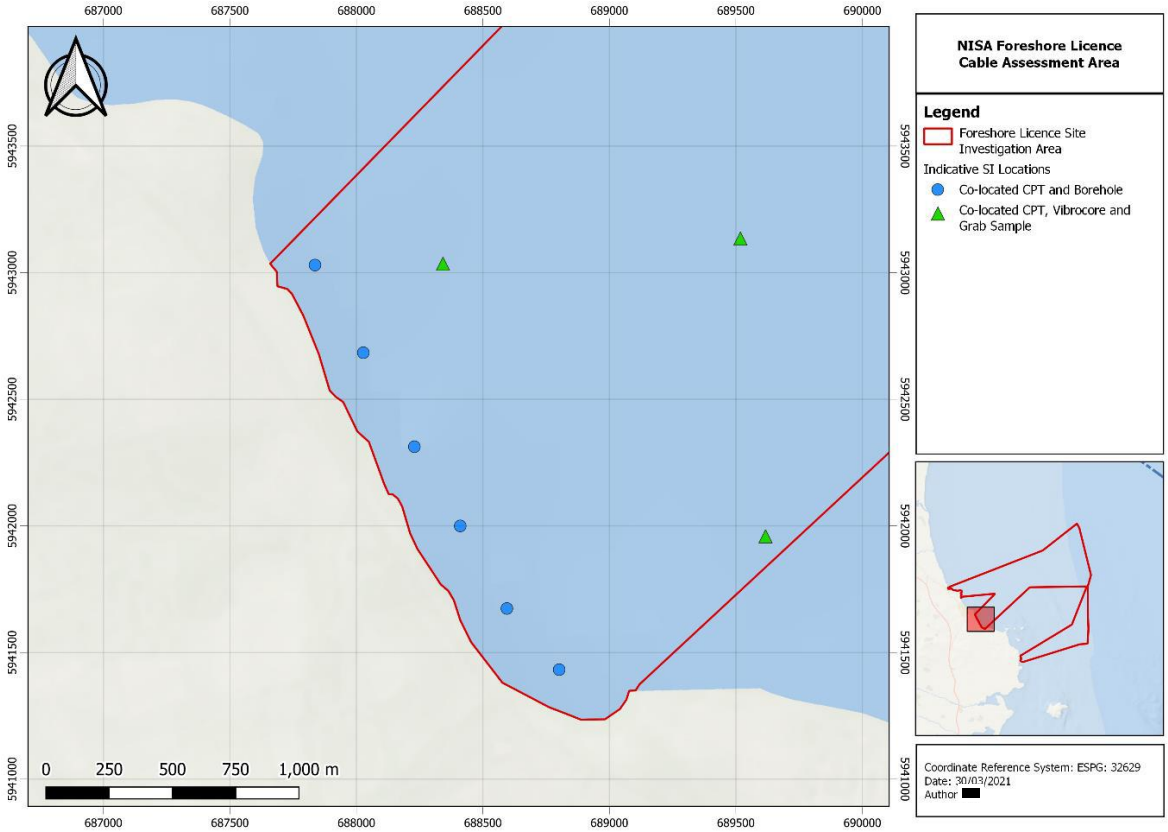

Figure 3-4: Central Landfall Area

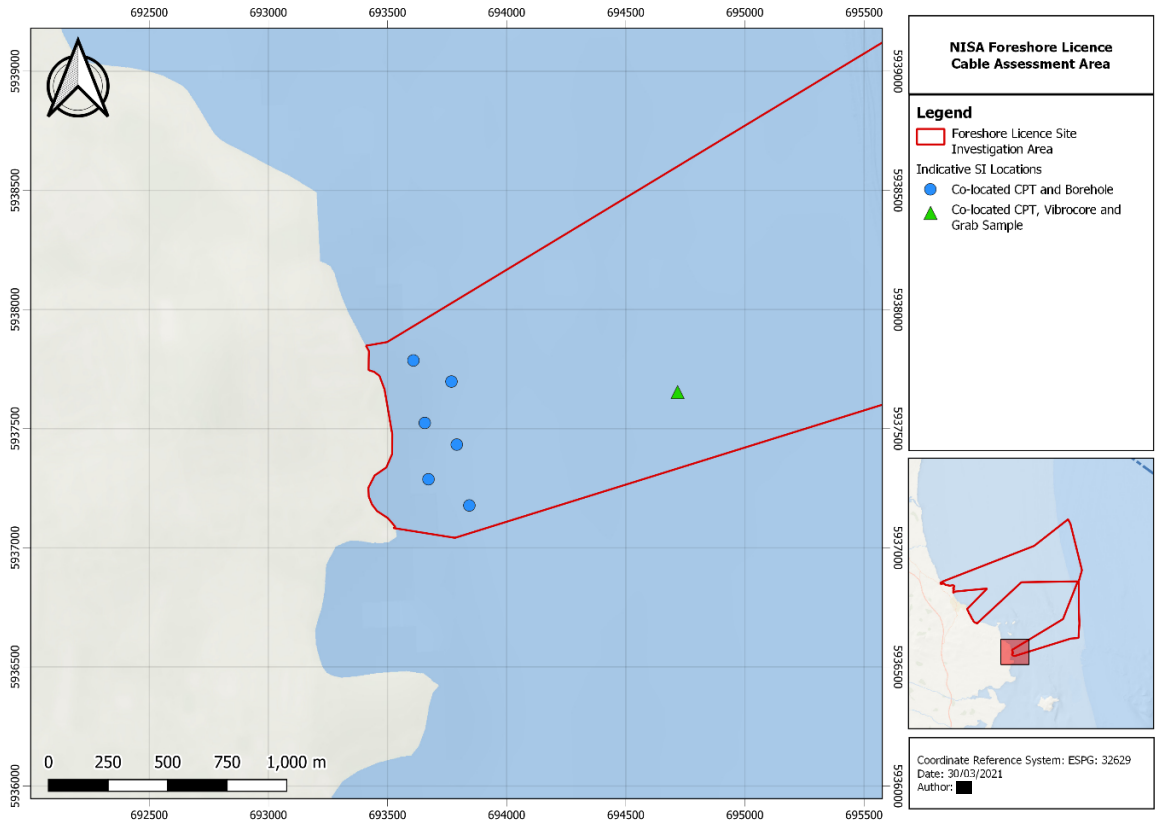

Figure 3-5: Southern Landfall Area

Generic frequency and source level data for Geotechnical drilling activity in the form of boring and coring has been based around drilling measurements undertaken by Subacoustech Environmental supplemented with source levels and frequency spectra from Erbe and McPherson (2017).

Unlike the other sources considered, boring and coring activities are continuous rather than pulsed noise sources.

Table 3-4: Geotechnical survey work proposed

Survey type	Purpose	Anticipated no. of locations	Frequency range	Maximum Source Pressure Level (dB re 1 µPa @ 1 m)
Vibrocore	Used to determine the sediment structure and composition of the seabed	40	30 Hz	187.4
Cone Penetration Testing (CPT)	Used to determine the geotechnical engineering properties of sediments	40	28 Hz	118-145
Boreholes	Determine soil composition and soil strength	12	120 Hz	145

3.4 Survey schedule

Subject to the award of a Foreshore licence, as well as favourable weather conditions, Statkraft propose a survey works schedule that will be phased over a total of 5 years. To minimise the risk associated with poor winter weather conditions, Statkraft would seek to carry out most of the proposed site investigation works between March and October within the five years following award of a Foreshore Licence.

Given the current Covid-19 global pandemic and the uncertainty still associated with its evolution, as well as the uncertainty associated with the timing for obtaining a Foreshore Licence, it is not possible at the time of writing to provide exact details on the proposed survey schedule. However, the intention is to begin survey activities as soon as feasible following award of the Foreshore Licence, preferably in spring of 2022 with a staged programme of investigations over the subsequent four years (2023, 2024, 2025, 2026), capitalising on suitable weather windows over the total period of five years.

This phased approach will progress the overall development towards detailed design stage. Procurement of survey contractors will be undertaken to ensure that suitable weather windows can be utilised as soon as possible following licence award. The exact survey mobilisation dates will be known at that point in the process.

3.5 Proposed vessels

A number of different marine vessels will be required for the deployment, execution and recovery of the various proposed survey methodologies. It is anticipated that different vessels will be required for the geotechnical and the geophysical stages of the survey, however, it is expected that a maximum of 2 vessels would be operating at any one time within the application area.

Geophysical survey vessels are typically between 15 m and 60 m in length and have an endurance of up to 14 days. These vessels are likely to use a local port for mobilisation and replenishment.

Geotechnical survey vessels are typically between 55 and 90 m in length and have an endurance of up to 28 days. Their port of mobilisation will depend on previous work but may be Irish, UK, or another European location. Should mobilisation from a local port be required, Dublin Port and Warren Point will be suitable options depending on requirement.

The exact vessels to be used will be confirmed following a tender process to procure the survey contractor.

4 Annex IV species

Ireland has recorded 25 species of cetacean, all of which are recognised as protected species under the EU Habitats Directive and the Irish Wildlife Act 1976, as amended. Of these 25 species, only eight – Harbour porpoise, Bottlenose dolphin, Common dolphin, Risso's dolphin, Killer whale, Minke whale, Fin whale and Humpback whale – have been recorded off the east coast and may be present in the proposed survey area at least on a seasonal basis, whereas others are either transitional visitors or have only been documented from stranding data (O'Brien *et al.*, 2009; Wall *et al.,* 2013, Marine Atlas, 2021). Harbour porpoise, Bottlenose dolphin, Common dolphin and Risso's dolphin are thought to be present year-round, while Minke whales are considered to be seasonal visitors in the summer (Berrow, 2001; NPWS, 2019). In addition, leatherback turtle has also been observed off the coast of Wicklow in recent years. The Otter may also interact with very small areas of the landfalls should they be present in any rivers within range of landfall areas; the Foreshore Licence Application Area is outside the range of any otter within any SAC.

Table 4-1 presents a short synopsis of the Annex IV species that may be found within or near the proposed site investigation area.

Table 4-1: Annex IV species that may be found within or near the Foreshore Licence Application Area

Species	Species Information
Harbour Porpoise (*Phocoena phocoena)*	Generally found in the northern latitudes of the Pacific and Atlantic oceans, mainly in the continental margins. They are the most widespread of any species in Ireland, observed in all inshore waters around the entire coastline and almost all records were within 10 km of the coast (Berrow *et al.*, 2010). The harbour porpoise is the smallest cetacean found in Irish waters, which can make observing it difficult in anything other than calmer waters. The NPWS Harbour Porpoise information page (2019) states that previous surveys undertaken in Ireland have established that monitoring requires a dedicated vessel during near-calm sea conditions to make a reliable count of harbour porpoises.
Bottlenose dolphin (*Tursiops truncatus*)	A large, gregarious dolphin widely distributed around Ireland and found in tropical and temperate waters worldwide (Wall *et al*., 2013). Resident or semi-resident populations are known from the Shannon Estuary, Tralee Bay, the Mayo coast and Cork Harbour. Results from a study by Mirimin *et al*. (2011) comparing bottlenose dolphin biopsies indicate that a larger pelagic population exists that is genetically distinct from the Irish coastal populations.
Short-beaked common dolphin (*Delphinus delphis*)	Deemed the second most frequently reported species of cetacean after the harbour porpoise; and are the most abundant of all cetacean species recorded in Ireland (Berrow *et al.*, 2010). There appears to be an eastward movement of this species along the south coast during autumn and winter, with sightings peaking off County Kerry towards late summer, off County Cork between September and January and off County Waterford between November and February (Berrow *et al.*, 2010).
Risso's dolphin (*Grampus griseus*)	In Ireland during the summer months Risso's Dolphin favours inshore waters and offshore islands, especially The Saltee Islands off County Wexford, the County Cork coast and the Blasket Islands off County Kerry in contrast to deep-water habitats elsewhere in the world (IWDG, 2019). According to Berrow *et al.* (2010), most sightings occur between May and July suggesting a late spring inshore movement, but the species has been recorded in all areas

Species	Species Information
	and in all months. Risso's dolphin were reported off all coasts and were the dolphin species most regularly recorded in the Irish Sea, with counties Wicklow and Wexford accounting for 41% of all inshore Risso's dolphin sightings (Berrow *et al*., 2010).
Killer whale (*Orcinus orca*)	Killer whales are the largest delphinid growing up to 9.5m. They are easily identified with striking coloration and large dorsal fins, particularly in the adult males. They are the most widely distributed cetacean in the world (Shirihai & Jarrett, 2006), and have been recorded off all Irish coasts in all seasons, with markedly fewer sightings in the Irish Sea (Wall *et al.*, 2013). Photo identification has linked killer whales sighted off Ireland with the "West Coast Community" resident off Scotland (Berrow *et al.*, 2010).
Minke whale (*Balaenoptera acutorostrata*)	The minke whale is the most common and widely distributed of the baleen whales in Ireland and the most likely to be encountered in shallow waters. The smallest of the baleen whales, their length averages 8.5 metres. Usually encountered singly or in small groups, sightings are most frequent off the Irish coast in spring and autumn (Wall *et al*., 2013).
Fin whale (*Balaenoptera physalus*)	The second-largest animal in the world after the blue whale (*Balaenoptera musculus)* and the largest baleen whale likely to be present close to shore off Ireland. Growing up to 24m in the North Atlantic their distribution is worldwide but concentrated in temperate waters (Shirihai & Jarrett, 2006). In Irish waters, nearshore sightings cluster to the South of the country but they are also well-represented off the shelf edge in deeper waters (Wall *et al.*, 2013).
Humpback whale (*Megaptera novaeangliae*)	This is the largest baleen whale that could be expected on site. Sightings of the iconic humpback have increased recently in Irish waters with concentrations around the south and southwest coasts, although all coasts are represented. The Irish photo-ID catalogue of unique humpback whale sightings currently comprises more than 100 animals (IWDG, 2020).
Eurasian otter (*Lutra lutra*)	Coastal dwelling otters require access to a freshwater source as they must regularly cleanse their fur of salt as this can affect its insulating properties and therefore their territorial range will be directed by access to freshwater. In Ireland, the territory of female otters is 6.5 ± 1.0km in coastal environments (de Jongh *et al*. 2010) and for males may be larger extend, where for both: females and males a total width of coastal water body would be 80m (NPWS, *Lutra lutra* (1355) Conservation Status Assessment Report). Under water, hearing sensitivity is significantly reduced when compared to sea lions and other pinniped species, demonstrating that otter hearing is primarily adapted to receive airborne sounds (Ghoul A. *et al.*, 2014).
Leatherback turtle (*Dermochelys coriacea*)	Leatherback turtles are the largest extant sea turtle and have many unique anatomical and physiological adaptations. These include the absence of a hard shell, possession of an extensive layer of peripheral blubber (Davenport *et al*. 1990), proportionally larger fore flippers than other species of sea turtle (Joyce & Gauthier 2004), and a rete-like arrangement of blood vessels at the proximal end of each fore flipper (counter-current heat exchangers) (Greer *et al*. 1973; Davenport *et al*. 1990). They are generally spotted off the south and south-west coasts of Ireland during the summer months however have been spotted in recent years off the coast of Wicklow.

The present assessment will only consider the species regularly found in the Irish Sea, as other species will be occasional. Although not considered specifically in this assessment due to their low likelihood of occurrence, any assessment of, or mitigation measures put in place for the species assessed here are considered to be appropriate/relevant for other less commonly occurring species.

The leatherback turtle (*Dermochelys coriacea*) is the most common turtle species found in Irish waters, but with sightings concentrated off the southwest coast of Ireland (King and Berrow, 2009; Doyle *et al*., 2007). Due to the low likelihood of occurrence in the NISA CAA, it is proposed that marine turtles are not considered further. However, any mitigation proposed for cetacean species will also be applied to turtles.

The Small Cetaceans in European Atlantic waters and the North Sea (SCANS) III surveys were undertaken in the summer of 2016 (Hammond *et al*., 2017). Densities for most common cetacean species encountered during the survey were estimated for the different survey blocks. The NISA CAA is located within SCANS III Block E. SCANS III surveys found harbour porpoise, bottlenose dolphin, Risso's dolphin and minke whale in this block. The SCANS III data suggest that harbour porpoises are the most common cetacean in the Irish Sea (see Table 4-2). This is also supported by other sightings data (Berrow *et al*., 2018; Berrow *et al.,* 2008; DAHG, 2009).

Table 4-2: Density and abundance estimates for species in the project area from SCANS III surveys (block E)

Species	SCANS III density estimate	MU	Abundance of animals in MU
Harbour porpoise	0.239	Celtic Sea	104,695
Bottlenose dolphin	0.008	Irish Sea	397
Risso's dolphin	0.031	Celtic and Greater North Sea	No current estimate available
Minke whale	0.017	Celtic and Greater North Sea	23,528
Common dolphin	No current estimate	Celtic and Greater North Sea	56,556

Source: Hammond *et al.* (2017) and IAMMWG (2015)

Aerial surveys were undertaken across Ireland's Exclusive Economic Zone (EEZ) as part of the ObSERVE Programme in both summer and winter from 2015 to 2017 (Rogan *et al*., 2018). The NISA CAA is located within ObSERVE stratum 5 (11,110 km^2). Similarly to SCANS III, the ObSERVE surveys sighted harbour porpoise, bottlenose dolphin, Risso's dolphin and minke whale in this stratum. Sightings of marine mammal species were continuously higher in summer months than in winter. Harbour porpoises were the most sighted species (see Table 4-3) and stratum 5 showed higher densities than other strata surveyed. Only one sighting of a group of five bottlenose dolphins was recorded during the whole survey, and as with SCANS III, no common dolphins were recorded within the Irish Sea with sightings predominately occurring off the south and west of Ireland. Risso's dolphins sighted during these surveys were thought to represent a community that is frequently located near the Saltee Islands off Co. Wexford. Group size in this community is estimated to range from 1 to 10 individuals (Rogan *et al.,* 2018; Wall *et al.*, 2013). For minke whales, the predictive modelling carried out from this survey suggested that the Irish Sea is more important for this species during the summer period than during winter.

Table 4-3: Density estimates for species in the project area from ObSERVE surveys (stratum 5)

Species	Season	Animals per km²
Harbour porpoise	Summer '15	0.196
	Winter '15	0.244
	Summer '16	0.295
	Winter '16	0.260
Bottlenose dolphin	Winter '16	0.036
Risso's dolphin	Summer '15	0.0032
Minke whale	Summer '15	0.014
	Summer '16	0.005
Common dolphin	No sightings	No sightings

Source: Rogan *et al.* (2018)

4.1 Other protected marine mammal species – Pinnipeds

Two species of pinnipeds, grey seal (*Halichoerus grypus*) and harbour seal (*Phoca vitulina*), are commonly found in Irish waters. Both species range widely in the Irish Sea as evidenced by tagging studies in the region (Hammond *et al*., 2005; Thompson *et al.,* 2012).

Lambay Island SAC, which partially overlaps with the NISA CAA, is designated for grey and harbour seal. It supports the principal breeding colony of grey seal on the east coast of Ireland, and it also contains regionally significant numbers of harbour seal. Grey seals and harbour seals occur year around and the island's intertidal shorelines, coves and caves are used by resting and moulting seals.

Table 4-4 presents a short synopsis of the seal species that may be found within or near the proposed site investigation area.

Table 4-4: Seal species that may be found within or near the Foreshore Licence Application Area

Species	Species Information
Grey Seal (*Halichoerus grypus*)	The grey seal is the larger and more abundant of the two seals resident in Ireland. They spend much of the year at sea and may range widely in search of prey, extending predominantly into continental shelf and slope waters (NPWS, 2011). They come ashore in autumn to form breeding colonies on rocky shores, beaches, and caves – often on small uninhabited islands. They are found all around the coast wherever habitats are suitable and are most abundant along the exposed south, southwest, and west coasts. The two major Irish breeding sites for grey seals are the Inishkea Islands (Mayo) and the Blasket Islands (Kerry). Smaller groups breed at Lambay Island (Dublin), Slyne Head (Galway) and the Saltee Islands (Wexford) (NPWS, 2019)
Harbour Seal (*Phoca vitulina*)	The harbour, or common seal, is the smaller of the two seals resident in Ireland. Despite its name, it is less common than the grey seal. In Ireland, harbour seals occur in estuarine, coastal and fully marine areas and also occupy regular haul-out sites about which animals breed, moult, rest and engage in social activity. The greatest numbers of common seals are found along the western seaboard predominantly in relatively sheltered areas

	(often estuaries and sand or mudflats) that are not subject to much human disturbance (NPWS, 2019). Harbour seals have comparatively short-range movements in relation to grey seals (NPWS, 2019), with typical foraging ranges being less than 20 km from haulout sites (Cronin *et al.,* 2010; Carter *et al*., 2020).

5 Risk Assessment for the protection of Annex IV species under Article 12 of the Habitats Directive

The purpose of this section is to examine the possible impacts of the proposed activities on those Annex IV species identified as having the potential to be present in the area, and address protective measures aimed at reducing any impact to these species. According to Wall *et al*. (2013) and Berrow *et al*. (2010), these species have been recorded in the area previously, therefore it is assumed for the purpose of this appraisal that they could be present in the area at any time of the year.

5.1 Identification of Relevant Annex IV Species

According to Wall *et al*. (2013) and Berrow *et al*. (2010), the area subject to the activities proposed under this application for a Foreshore Licence is known to be within the range of the following Annex IV Species:

- Harbour porpoise
- Bottlenose dolphin
- Common dolphin
- Risso's dolphin
- Killer whale
- Minke whale
- Fin whale
- Humpback whale

Other protected marine mammal species that may occur within the proposed survey area are

- Grey seal
- Harbour seal

5.2 Potential environmental impacts

The following are the potential environmental impacts that have been identified given the nature of the site investigation activities proposed under this application:

- Increased underwater noise;
- Increased collision risk; and
- Pollution event

5.3 Assessment of underwater noise

Over the past 20 years it has become increasingly evident that noise from human activities in and around underwater environments can have an impact on the marine species in the area. As a result, scientific interest in the hearing abilities of aquatic animal species, which may be affected by noise,

has increased. These studies are primarily based on evidence from high level sources of underwater noise such as blasting or impact piling, as these sources are likely to have the greatest environmental impact. The extent to which intense underwater sound might cause an adverse environmental impact in a species is dependent upon the incident sound level, sound frequency, duration of exposure and/or the repetition rate of the sound wave (e.g. Hastings and Popper, 2005).

Adverse impacts of underwater sound can be broadly summarised into three categories:

- Physical traumatic injury and fatality
- Auditory injury – either permanent threshold shift (PTS) where unrecoverable hearing damage may occur, or temporary threshold shift (TTS) where a temporary reduction in hearing sensitivity may occur in individual receptors
- Disturbance (temporary or continuous) – disruptions to behavioural patterns, including, but not limited to, migration, breathing, nursing, breeding, foraging, socialising and / or sheltering. This impact factor does not have the potential to cause injury.

To determine the potential for noise to impact cetaceans, perceived sound levels are compared to available estimated thresholds for injury or disturbance.

In order to characterise the underwater noise and determine the perceived sound levels during geophysical and geotechnical surveys on the NISA OWF site, which is adjacent to the NISA CAA, an underwater noise modelling exercise was carried out and the predicted maximum impact ranges for the various sound sources was calculated. The two modelling locations used for the NISA OWF study are presented in Figure 5-3. These modelling locations have been selected to give a geographical spread of the potential noise levels over the entire NISA OWF site, covering the worst-case, deep-water location at the NE location (noise will tend to spread further in deeper water) and shallower water, closer to the coast at the SW location.

The SW location is close to the NISA CAA, which also has similar shallower depths. For this reason, the SW location was used in the present report to characterise the underwater noise and perceived sound levels during the proposed geophysical and geotechnical surveys on the NISA CAA.

The expected survey equipment modelled includes a multi-beam echosounder (MBES), side scan sonar (SSS), various sub-bottom profilers (SBP), as well as seabed boring and coring. Additional modelling has been undertaken to reflect a scenario where noise from the MBES, SSS, and the Innomar SBP are all operating simultaneously.

5.3.1 Impact assessment criteria

5.3.1.1 Auditory injury

The main metrics and criteria considered in this report to assess auditory injury are those proposed by Southall *et al.* (2019), as requested by the Foreshore Unit of the Department of Housing, Planning and Local Government in a Request for Further Information dated 17th December 2017. At the time of writing these include the most up to date and authoritative criteria for assessing environmental effects for use in impact assessments. The older, superseded Southall *et al*. (2007) criteria have also been

included, in line with the current guidance from the Department of Arts, Heritage and the Gaeltacht (2014).

Southall *et al.* (2019)

The Southall *et al*. (2019) paper is effectively an update of the previous Southall *et al.* (2007) paper and provides identical thresholds to those from the National Marine Fisheries Service (NMFS) (2018) guidance for marine mammals. The concepts presented here for Southall *et al.* (2019) are also relevant for Southall *et al. (*2007), which is described separately below.

The Southall *et al*. (2019) guidance groups marine mammals into groups of similar species and applies filters to the unweighted noise to approximate the hearing sensitivities of the receptor in question. The hearing groups given in Southall *et al*. (2019) are their auditory function are summarised in Table 5-1and Figure 5-1.

Table 5-1: Marine mammal hearing groups (from Southall *et al*., 2019)

Hearing group	Generalised hearing range	Example species
Low-frequency cetaceans (LF)	7 Hz to 35 kHz	Baleen whales
High-frequency cetaceans (HF)	150 Hz to 160 kHz	Dolphins, toothed whales, beaked whales, bottlenose whales (including bottlenose dolphin)
Very high-frequency cetaceans (VHF)	275 Hz to 160 kHz	True porpoises (including harbour porpoise)
Phocid carnivores in water (PCW)	50 Hz to 86 kHz	True seals (including harbour seal)

Table 5-1 shows the wide hearing range for the different species groups, however as shown in Figure 5-1 hearing sensitivity is not linear. The audiogram for the different species is curved with each species group displaying higher sensitivity at different frequencies. For example a number of harbour porpoise have been exposed to noise at different frequencies to determine the decibel level at which they can hear certain frequency sounds. Maximum sensitivity was found to be at 125kHz (peak sensitivity of echolocation pulses produced by harbour porpoises) with slight differences in intensity level across animals ranging between 39 dB re 1 µPa to 47 dB re 1 µPa. Range of best

hearing was between 13kHz and 140kHz with sensitivity falling by 10dB per octave below 16 kHz and dropping sharply above 125kHz (Kastelein et al., 2015)(Kastelein et al., 2017).

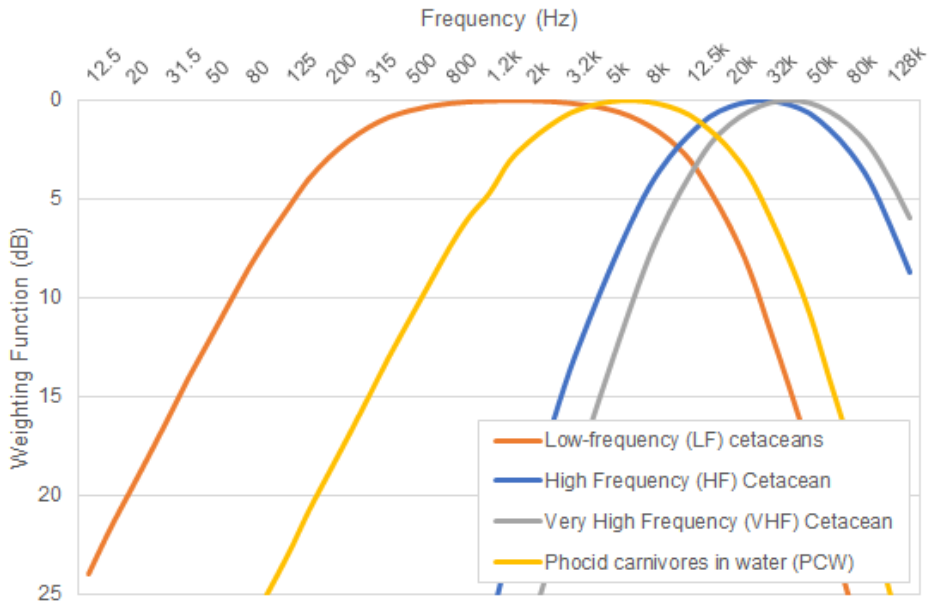

Figure 5-1: Auditory weighting functions for low-frequency cetaceans (LF), high-frequency cetaceans (HF), very high-frequency cetaceans (VHF), and phocid carnivores in water (PCW) (from Southall *et al.*, 2019)

Southall *et al*. (2019) also gives individual criteria based on whether the noise source is considered impulsive or non-impulsive. Impulsive noises are characterised as having high peak sound pressure, short duration, fast rise-time and broad frequency content at source, and non-impulsive sources as steady-state noise. Explosives, impact piling and seismic airguns are considered impulsive noise sources and sonars, vibro-piling, drilling and other low-level continuous noises are considered non-impulsive. A non-impulsive noise does not necessarily have to have a long duration.

Southall *et al*. (2019) presents single strike, unweighted peak criteria (SPL_{peak}) and cumulative weighted sound exposure criteria (SEL_{cum}, i.e., can include more than a single sound impulse) for both permanent threshold shift (PTS), where unrecoverable hearing damage may occur, and temporary threshold shift (TTS), where a temporary reduction in hearing sensitivity may occur in individual receptors. These dual criteria are only used for impulsive noise – the criteria set giving the greatest calculated range is used as the PTS impact range.

As sound pulses propagate through the environment and dissipate, they lose their most injurious characteristics (e.g., rapid pulse rise time and high peak sound pressure) and become more like a "non-pulse" at greater distances (Southall *et al.*, 2019). Therefore, results for all sound types have been included, as at greater ranges pulsed sound can be classified as nonpulses.

Table 5-2 and Table 5-3 present the Southall *et al*. (2019) criteria for the onset of PTS and TTS risk for each of the key marine mammal hearing groups considering impulsive and non-impulsive sources.

Table 5-2: Single strike SPL_{peak} criteria for PTS and TTS in marine mammals (Southall *et al.*, 2019)

Southall *et al.* (2019)	Unweighted SPL_{peak} (dB re 1 µPa) Impulsive	
	PTS	TTS
Low-frequency cetaceans (LF)	219	213
High-frequency cetaceans (HF)	230	224
Very high-frequency cetaceans (VHF)	202	196
Phocid carnivores in water (PCW)	218	212

Table 5-3: Impulsive and non-impulsive SEL_{cum} criteria for PTS and TTS in marine mammals (Southall *et al.*, 2019)

Southall *et al.* (2019)	Weighted SEL_{cum} (dB re 1 µPa2s)			
	Impulsive		Non-impulsive	
	PTS	TTS	PTS	TTS
Low-frequency cetaceans (LF)	183	168	199	179
High-frequency cetaceans (HF)	185	170	198	178
Very high-frequency cetaceans (VHF)	155	140	173	153
Phocid carnivores in water (PCW)	185	170	201	181

Where SEL_{cum} are required, a fleeing animal model has been used for marine mammals. This assumes that a receptor, when exposed to high noise levels, will swim away from the noise source. For this, a constant fleeing speed of 3.25 ms^{-1} has been assumed for the low-frequency cetaceans (LF) group (Blix and Folkow, 1995), based on data for minke whale, and for other receptors, a constant rate of 1.5 ms^{-1} has been assumed for fleeing, which is a cruising speed for a harbour porpoise (Otani *et al.*, 2000). These are considered worst case assumptions as marine mammals are expected to be able to swim much faster under stress conditions (Kastelein *et al.* 2018).

Southall *et al.* (2007)

The Southall *et al*. (2007) noise exposure criteria are a precursor to the Southall *et al*. (2019). They have been updated and superseded by the US National Marine Fisheries Service (NMFS, 2018) and Southall *et al*. (2019). Therefore, it is now considered best practice to use the Southall *et al*. (2019) criteria for guidance on underwater noise exposure. In line with the current guidance from the DAHG (2014) the criteria from the Southall *et al*. (2007) study have also been included in this assessment.

Southall *et al.* (2007) defined a set of auditory injury and behavioural response criteria based on unweighted SPL_{peak} and M-weighted SELs. The M-weightings are a series of generalised frequency response filters, that, when applied to noise data, can represent the levels of underwater noise perceived by marine mammals.

Southall *et al.* (2007) group marine mammals into five groups, four of which are relevant to underwater noise (the fifth is for pinnipeds in air). For each group an approximate frequency range of hearing is given based on known audiogram data or inferred from other information such as auditory morphology. A summary of the M-weighting functions is given in Table 5-4, and illustrated in Figure 5-2.

Table 5-4: Marine mammal hearing groups and genera represented in each M-weighting group from Southall *et al.* (2007)

Functional hearing group	Est. auditory bandwidth	Example species
Low-frequency cetaceans	7 Hz to 22 kHz	Minke whale
Mid-frequency cetaceans	150 Hz to 160 kHz	Bottlenose dolphin Common dolphin Risso's dolphin
High-frequency cetaceans	200 Hz to 180 kHz	Harbour porpoise
Pinnipeds in water	75 Hz to 75 kHz	Harbour seal Grey seal

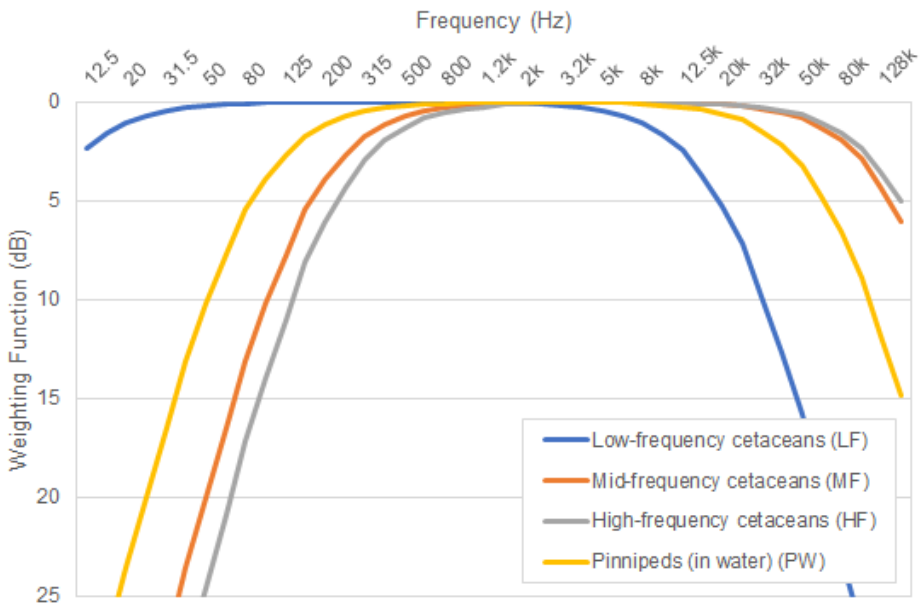

Figure 5-2: The M-weighting functions from Southall *et al.* (2007) for the marine mammal hearing groups considered

These criteria from Southall *et al.* (2007) are presented in Table 5-5 for injury response. For each hearing group, criteria for injury response are given for single pulses, multiple pulses, and non-pulses.

Table 5-5: Unweighted SPL_{peak} and M-weighted SEL injury criteria for individual marine mammals from Southall *et al.* (2007)

Marine mammal group		Sound type	
		Single or Multiple pulses	Nonpulses
Low-frequency cetaceans	SPL	230 dB re 1 µPa (peak)	230 dB re 1 µPa (peak)
	SEL	198 dB re 1 μPa^2s (M_{lf})	215 dB re 1 μPa^2s (M_{lf})
Mid-frequency cetaceans	SPL	230 dB re 1 µPa (peak)	230 dB re 1 µPa (peak)
	SEL	198 dB re 1 μPa^2s (M_{mf})	215 dB re 1 μPa^2s (M_{mf})
High-frequency cetaceans	SPL	230 dB re 1 µPa (peak)	230 dB re 1 µPa (peak)
	SEL	198 dB re 1 μPa^2s (M_{hf})	215 dB re 1 μPa^2s (M_{hf})
Pinnipeds in water	SPL	218 dB re 1 µPa (peak)	218 dB re 1 µPa (peak)
	SEL	186 dB re 1 μPa^2s (M_{pw})	203 dB re 1 μPa^2s (M_{pw})

5.3.1.2 Disturbance/behavioural response

The criteria from Southall *et al.* (2007, 2019) used in the underwater noise modelling exercise and detailed above, focus on thresholds for the onset of injury, either permanent (PTS) or temporary (TTS). Southall *et al.* (2007) only allowed for the prediction of behavioural response impact ranges for single pulse events. As all the survey equipment expected to be used is either multiple pulse (MBES, SSS and SBPs) or continuous (boring and coring), alternative criteria are needed to access disturbance/behavioural response to marine mammals.

Where possible, assessment of the potential for a behavioural response has used information from the literature where this has been explored.

In the absence of such information, the dB_{ht} approach has been used. The dB_{ht}(*Species*) metric (Nedwell *et al*., 2007) has been developed as a means for quantifying the potential for a behavioural impact on a species in the underwater environment. The dB_{ht} metric is a measure of perception, which is defined as an objective measurement of the amount a noise is above the threshold of hearing of an animal, so the level is in "dBs referenced to hearing threshold", hence the "ht" suffix. The dB_{ht}(*Species*) level therefore corresponds to the likely loudness of the sound perceived by that species. Since different species have different hearing abilities, a given sound will have a different level on this scale for each species, therefore the animal for which the level is calculated (for a given noise source) must be specified (Nedwell *et al*., 2007).

In summary, where a specific animal is under consideration, the animal must be specified, for example, 90 dB_{ht}(*Phocoena phocoena*) would be interpreted as "a sound level 90 dB above the hearing of a harbour porpoise". However, generalised comments are also possible, such as "animals will tend to react to sound at levels above 90 dB_{ht}" which means, above their own specific hearing threshold. Table 5-6 summarises the assessment criteria for the dB_{ht}.

Table 5-6: Assessment criteria to estimate the potential behavioural responses by marine mammals to underwater noise (Nedwell *et al.*, 2007, Nedwell *et al.*, 2008)

Level in dB_{ht}(*Species*)	Effect
0-50	Low likelihood of disturbance
75	Significant avoidance reaction occurs in a majority of individuals
90 and above	Strong avoidance reaction by virtually all individuals
Above 110	Tolerance limit of sound; unbearably loud
Above 130	Possibility of traumatic hearing damage from single event

5.3.2 Modelling methodology

The level of underwater noise around the operation of the equipment has been estimated using a combined parabolic equation and ray tracing modelling methodology. The modelling considers a wide array of input parameters including source noise level, sound frequency content, seabed properties and the sound speed profile of the water column. Full account is also taken of the bathymetry in the areas surrounding the survey site.

The modelling has been undertaken at the north-east and south-west corners of the NISA OWF area for all noise sources to give the widest spatial coverage. Although the survey vessel will be constantly moving during the survey, this selection of locations provided a precautionary assessment. The SW location is close to the NISA CAA, which also has similar shallower depths. For this reason, the SW location was used in the present report to characterise the underwater noise and perceived sound levels during the proposed geophysical and geotechnical surveys on the NISA CAA.

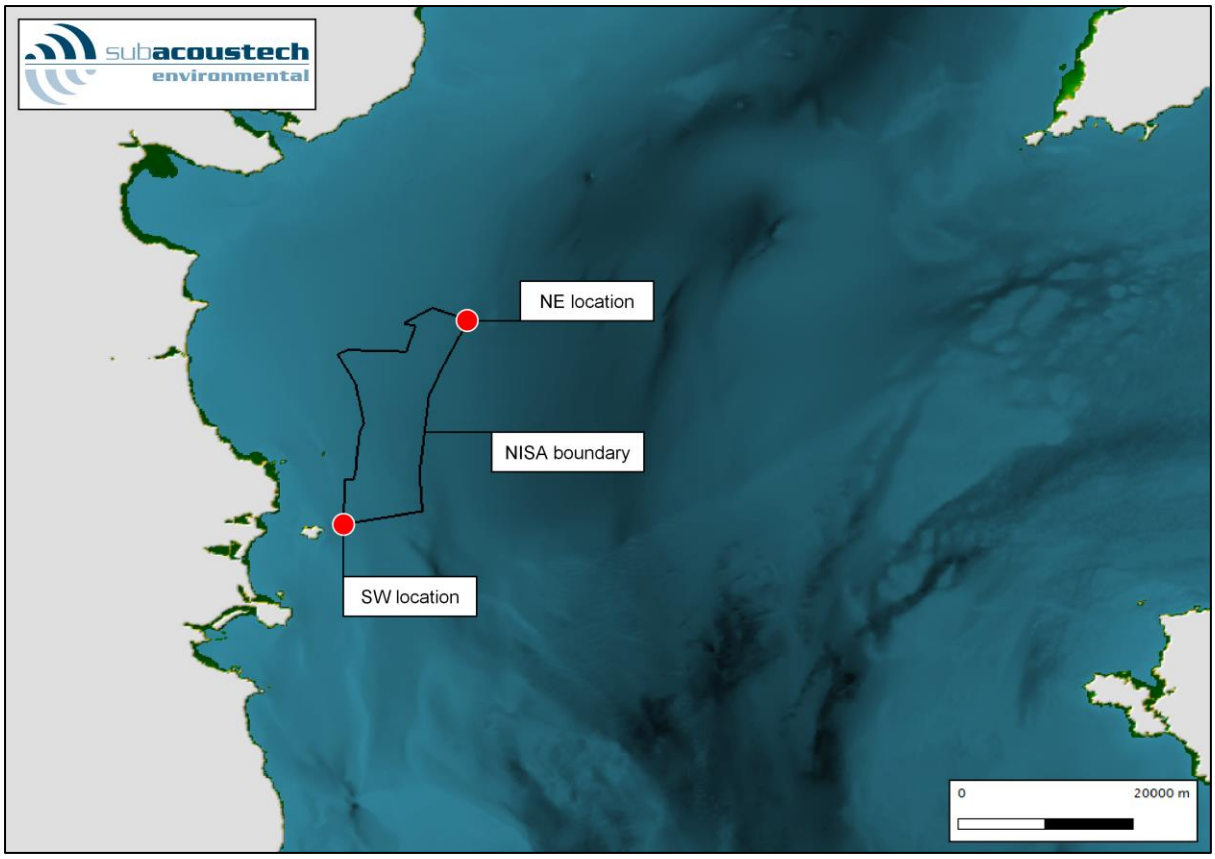

Figure 5-3: Map showing the locations used for modelling in the Northern Irish Sea along with the current boundary of the NISA OWF. The SW location was used in the present report to characterise the underwater noise and perceived sound levels during the surveys on the NISA CAA.

5.3.3 Source levels and frequency content

The equipment used for the noise sources in the modelling is typical of that used in geophysical site survey operations. Any assumptions made with regards to signal (pulse) repetition and frequency content have been presented in section 3.2. Source levels for the modelling have been derived for this equipment using data available from manufacturers and from empirical measurements of similar equipment from Subacoustech Environmental's noise measurement database.

A summary of the peak sound pressure level (SPL_{peak}) and sound exposure level (SEL) source levels are given in Table 5-7. The equipment has been given equivalent source levels appropriate to the frequency range used for modelling (12.5 Hz to 160 kHz); frequencies above this range have not been used as the receptors considered in this study cannot perceive frequencies higher than this. No SPL_{peak} source level is given for boring and coring noise as this is designated as a continuous or non-pulsed source – SPL_{peak} noise levels are most appropriate for impulsive noise. All equipment SELs have been normalised to 1 second, considering the interval and repetition rate of the multiple pulse sources. The third-octave band spectra for these sources, in terms of 1s SEL, are presented in Figure 5-4.

Table 5-7: Summary of the SPL_{peak} and 1-second SEL source levels for the noise sources considered for this study

Noise source	SPL_{peak} source level (dB re 1 µPa @ 1 m)	1s SEL source level (dB re 1 µPa²s @ 1 m)
MBES	205.0	168.7
SSS	203.2	166.2
Innomar SBP	210.7	203.7
Pinger SBP	220.0	193.8
Sparker SBP	211.0	203.0
Boring / Coring	-	159.7

All of the geophysical survey sources are directional, as the sound is designed to be discharged towards the seabed. Typically, the source levels provided by manufacturers represent the level of sound directly under the source, "on axis". Where data is available, these source levels have been adjusted to present an "off-axis" source level better for predicting noise levels as they propagate at long range, roughly horizontally. These source levels are presented in Table 5-7. For example, based on data from Wunderlich (2016), the Innomar SBP has an SPL_{peak} source level of 247 dB re 1 µPa @ 1 m, however information from NOAA (2020) shows that off-axis reduction of 36.3 dB is expected, and thus a source level of 210.7 dB is used for the modelling. Where off-axis data is not available, the noise level is overestimated and extremely conservative due to the differences in axis and off axis propagation of sound for the devices.

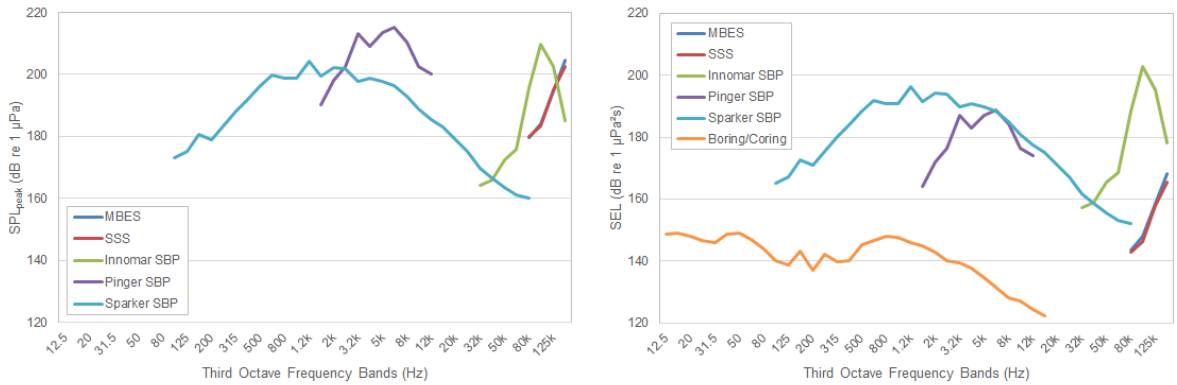

Figure 5-4: Source third octave band levels (SPL_{peak} and 1 s SEL) for all the modelled sources

It is also expected that several of the noise sources will be present and operational at the same time. Additional modelling has been undertaken to reflect a scenario where noise from the MBES, SSS, and Innomar SBP are all operating. To create a source level and frequency input for the concurrent noise scenario, the frequency spectra for the MBES, SSS, and the Innomar SBP have been combined to create a single input spectrum. This is shown in Figure 5-5 and results in overall source levels of 211.6 dB re 1 µPa @ 1 m (SPL_{peak}) and 203.7 dB re 1 µPa²s @ 1 m (SEL). As expected, this is slightly above the highest source levels for the loudest single source.

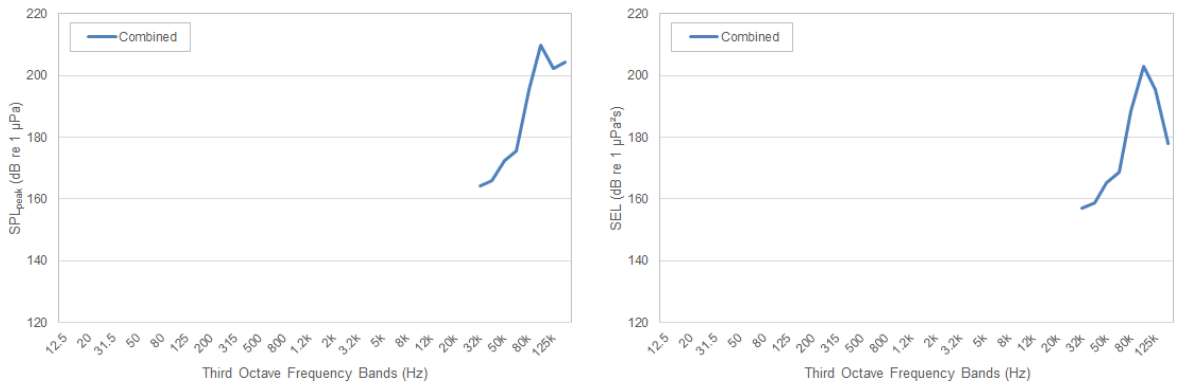

Figure 5-5: Source third octave band levels (SPL_{peak} and 1 s SEL) for the modelled combined noise sources (MBES, SSS, and Innomar SBP)

For each modelling scenario it has been assumed that the noise source is located 5 m below the water surface, except for boring and coring where the source is on the seabed.

Where cumulative exposure is being calculated, constant operation over 24-hours has been assumed.

5.3.4 Modelling results

This section presents modelling results in terms of the biologically significant noise metrics and impact criteria detailed in section 5.3.1. These results will help guide the assessment of environmental impact in marine species from the various geophysical and geotechnical survey operations proposed at the survey area. In each case the loudest predicted level modelled at any depth in the water column has been used as a worst-case assumption.

The loudest source, in terms of biological impact, is predicted to be the sparker SBP, due to the combination of the source level (Table 5-7) and that its output contains relatively lower frequencies compared to the other sources (Figure 5-4), which tend to travel further. It is also the case that high-frequency noise attenuates faster than lower frequencies, and as such, small impact ranges are predicted for sources with only high-frequency components, including MBES, SSS, the Innomar SBP, and therefore the combined source scenario.

The predicted maximum injury impact ranges for the various sound sources at the SW Location, considering the criteria used in Southall *et al*. (2019), are summarized in

Table 5-8 and described in the sections below.

Table 5-8: Summary of the modelled Southall *et al.* (2019) maximum PTS and TTS impact ranges for marine mammals from all sound sources. LF = Low-frequency cetaceans (LF), HF = High-frequency cetaceans, VHF = Very high-frequency cetaceans and PCW = Phocid carnivores in water

Sound source	Max. PTS impact ranges				Max. TTS impact ranges			
	LF	HF	VHF	PCW	LF	HF	VHF	PCW
MBES	< 100 m	< 100 m	< 100 m	< 100 m	< 100 m	< 100 m	170 m	< 100 m
SSS	< 100 m	< 100 m	< 100 m	< 100 m	< 100 m	< 100 m	130 m	< 100 m
Innomar	< 100 m	< 100 m	720 m	< 100 m	< 100 m	370 m	1.1 km	< 100 m
Concurrent	< 100 m	< 100 m	720 m	< 100 m	< 100 m	370 m	1.1 km	< 100 m
Pinger	< 100 m	< 100 m	2.5 km	160 m	2.3 km	830 m	6.2 km	2.3 km
Sparker	1.1 km	< 100 m	2.9 km	730 m	6.3 km	1.1 km	6.9 km	4.3 km
Boring and Coring	< 100 m	< 100 m	< 100 m	< 100 m	< 100 m	< 100 m	< 100 m	< 100 m

5.3.4.1 Bathymetric Surveying (MBES)

The high-frequency characteristics of the noise emitted by the MBES system results in rapid attenuation away from the source, resulting in relatively small impact ranges. The maximum injury impact ranges are predicted to be smaller than 50 m for single strike, and smaller than 100 m for impulsive and non-impulsive noises for all marine mammal groups, except for the VHF cetaceans hearing group, for which the largest impact ranges predicted are 170 m when considering cumulative weighted sound exposure criteria (weighted SEL_{cum}) for impulsive noises.

5.3.4.2 Side Scan Sonar (SSS)

The high-frequency spectrum of the SSS results in relatively small impact ranges. As with the MBES, the maximum injury impact ranges are predicted to be smaller than 100 m for all the considered noise criteria, except for TTS in VHF cetaceans, where a maximum range of 130 m is predicted.

5.3.4.3 Innomar SBP

As with the MBES and SSS, the high-frequency nature of the noise emitted by the Innomar SBP results in relatively small impact ranges. As previously, the maximum injury impact ranges are predicted to be smaller than 50 m for single strike, and smaller than 100 m for multiple and non-pulses for most marine mammal groups. The largest impact ranges predicted are for VHF cetaceans using the impulsive criteria, with maximum ranges of 770 m predicted for PTS and 1.1 km for TTS.

5.3.4.4 Concurrent noise sources – MBES, SSS and Innomar SBP

For the concurrent operation of MBES, SSS, and Innomar SBP, the largest predicted ranges are similar to the loudest of the single source impact ranges, as this source, the Innomar SBP, dominates the combined source level. As before, the maximum injury impact ranges are predicted to be smaller than 50 m for single strike, and smaller than 100 m for multiple and non-pulses for most marine mammal groups. The largest impact ranges predicted are again for VHF cetaceans using the impulsive criteria, with maximum ranges of 770 m predicted for PTS and 1.1 km for TTS.

5.3.4.5 Pinger SBP

Due to the lower frequencies present for the pinger SBP compared to the MBES, SSS and Innomar sources, the noise spreads to greater distances, with maximum impact ranges predicted for the VHF cetacean hearing groups of 2.5 km for PTS and 6.2 km for TTS when using the weighted SEL_{cum} criteira for impulsive noises.

However, a number of worst-case scenario assumptions have been applied by the model, including duration, noise level in the water column, and a source level based around a maximum from literature that is likely to be reduced when considering "off-axis" noise. Therefore, as discussed in section 5.3.3, it is likely that these predicted ranges are an overestimation by the model, and that the more injurious, impulsive nature of the sound will be significantly reduced with increasing distance from the sound source. Furthermore the outcome of the modelling exercise conflicts with the real-world observations of harbour porpoise responses to geophysical (seismic) survey activity in the Moray Firth during site investigations for oil and gas exploration (Thompson et al., 2013). It should be noted that the power of the devices used in those site investigations would be many multiples more powerful than the devices proposed under this licence application (refer Section 5.3.5.2).

5.3.4.6 Ultra-high resolution seismic – Sparker SBP

Due to the combination of a high source level and lower frequency components, the predicted noise from the sparker SBP travels further than the other geophysical survey sources considered in the modelling exercise. The largest impact ranges are predicted for VHF cetaceans using the impulsive criteria, with maximum ranges of 2.9 km for PTS and 6.9 km for TTS. The predicted impact ranges for the LF cetaceans and PCW pinnipeds hearing groups are also larger than those predicted for the other sources, due to the low frequency components of the sparker source.

Similarly to the Pinger SBP, it is likely that the more injurious, impulsive nature of the sound will be significantly reduced as the distance from the sound source increases, but the worst-case scenario assumption has been applied. As discussed in section 5.3.3, the results from this source are likely to be an overestimate of the potential impact as it is likely that a lower noise level will be present horizontally (i.e., off-axis) from the source. As above the outcome of the modelling exercise conflicts with the real-world observations of harbour porpoise responses to geophysical (seismic) survey activity in the Moray Firth during site investigations for oil and gas exploration (Thompson et al., 2013) and again the devices used in the Moray Firth were many times more powerful than the devices proposed under this application.

5.3.4.7 Post Modelling Update to Sparker Data

Since the modelling was undertaken information has been received from the manufacturer for offshore axis measurements which indicates that the PTS and TTS ranges are much lower than the modelling suggests. The work undertaken by the manufacturer shows approximate ranges for PTS and TTS for the Dura Spark 400 of:

- At distances greater than 100m SEL drops below 155 dB re 1µPa² (PTS)
- At distances greater than 300m SEL drops below 140dB re 1µPa² (TTS)

Source: AAE Technologies, 2021

NISA Ltd anticipates that the Duraspark 400 is the largest sparker system that will be used for the site investigation activities.

5.3.4.8 Boring and Coring

Unlike the sources presented in the previous section, boring and coring is categorised as a non-impulsive, non-pulsed, or continuous noise source. Due to the low level of noise predicted from boring and coring activity, all considered impact ranges are predicted to be smaller than 100 m.

5.3.5 Noise impact of survey equipment

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.

The equipment used for the noise sources in the modelling is typical of that used in geophysical and geotechnical site survey operations. Source levels for the modelling have been derived for this equipment using data available from manufacturers and from empirical measurements of similar equipment from Subacoustech Environmental's noise measurement database where available. All the equipment has been given equivalent source levels appropriate to the frequency range used for modelling (12.5 Hz to 160 kHz).

It should be stressed that, by its nature, mathematical modelling will produce results which indicate a precise range at which a criterion will be reached, but this does not reflect the inherent uncertainty in the process. The results give a specific numerical value to a process with a vast number of variables and parameters, including many that change constantly in real world conditions. Most modelling parameters, such as the source noise level, the duration of operation and the location, are selected to be precautionary to avoid the risk of underestimating an impact. While the results given present specific ranges at which each impact threshold is met based on the modelling results, the ranges should be taken as indicative, albeit worst case, in determining where environmental effects may occur in receptors during the proposed geophysical survey operations.

5.3.5.1 Auditory injury

As discussed in the previous sections, the survey equipment proposed, both geophysical and geotechnical, has been predicted to have the potential to be detected by marine mammals, with the potential for TTS onset in individuals in close proximity to the sound sources. The MBES, SSS and the Innomar could therefore cause localised short-term behavioural impacts such as avoidance. However, for the VHF hearing group in particular, which includes the harbour porpoise, the Pinger and the Sparker have been predicted by the model to have a maximum impact range of 6.2 and 6.9 km respectively for TTS, and 2.5 km and 2.9 km respectively for PTS.

As discussed in section 5.3.3, the results from these sources are likely to be an overestimate of the potential impact, as it is likely that a lower noise level will be present horizontally (off-axis) from the source. In addition, the model assumes that an animal would remain in the small zone of ensonification for a prolonged period, which is highly unlikely, as animals when exposed to high noise levels, will swim away from the noise source (JNCC *et al.*, 2010) and marine mammals are able to swim fast under stress conditions (Kastelein *et al.* 2018).

NISA Ltd will comply with the the standard mitigation measures, as detailed in the DAHG (2014) guidance, such as pre-works survey and soft start. In addition, with respect to the use of either a pinger or sparker NISA Ltd will follow international best practice as outlined in Section 2.2 – Electromagnetic Sources within the JNCC Guidelines for minimising the risk of injury to marine mammals from geophysical surveys (JNCC, 2017). Mitigation proposed in relation to these surveys is outlined in section 6.

5.3.5.2 Disturbance/Behavioural response

Geophysical survey equipment

There is potential for the proposed geophysical survey equipment to cause disturbance or a behavioural response in marine mammals. Although the frequencies proposed fall within the hearing ranges of marine mammals occurring within the vicinity of the proposed works, the most likely response will be temporary behavioural avoidance. There is evidence by Thomson *et al.* (2013) that suggests that short-term disturbance by a commercial two-dimensional seismic survey does not lead to long-term displacement of harbour porpoises.

Section 4 of this report provides information on the density and distribution of the cetacean species likely to be present within the NISA CAA site during the proposed survey works. According to the results of the SCANS III (Hammond *et al*., 2017) and the ObSERVE Programme (Rogan *et al*., 2018), harbour porpoise is expected to be the most abundant marine mammal species in the NISA CAA. Other cetaceans recorded in the area are in low numbers and the data does not suggest regular use by them.

Using information from Thompson *et al.* (2013), where harbour porpoise responses to geophysical (seismic) survey activity in the Moray Firth were observed over ranges of 5 to 10 km, the number of individuals within the NISA CAA site which have the potential to be affected by the proposed geophysical survey has been estimated (Table 5-9). The noise levels produced by the oil and gas exploration geophysical surveys described in Thompson *et al.* (2013) will be well above those produced by the sound sources described here, and so the use of 10 km is considered to result in highly conservative estimates. Therefore, for the purposes of this assessment, an impact range of 5 km is considered appropriate to represent the worst-case for the sound sources proposed.

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.* (2017) 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, 2015; see Table 4-2) 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 5-9).

Table 5-9: Number of individuals and percentage of reference population estimated to have the potential to be disturbed by geophysical survey equipment

Species	Potential impact		No. of individuals within the area of potential impact	% of reference population with potential to be affected
	Range (km)	Area (km^2)		
Harbour porpoise	5	78.5	23	0.02
Minke whale	5	78.5	1	0.01
Bottlenose dolphin	5	78.5	3	0.7
Risso's dolphin	5	78.5	0	0.01

Source: SCANS III (Hammond *et al.*, 2017) and ObSERVE (Rogan *et al.*, 2018) density estimates and reference population abundance estimates used in calculations from IAMMWG (2015)

Geotechnical survey equipment

Due to the low level of noise predicted from boring and coring activity, there is potential for the proposed geotechnical survey equipment to cause disturbance or a behavioural response on marine mammals in close proximity to the sound source. However, the impacts of the geotechnical surveys are thought to be of low concern in terms of disturbance to Annex IV species (JNCC, 2010).

Unlike the sources presented in the previous section, boring and coring is categorised as a non-impulsive, non-pulsed, or continuous noise source. Although the frequencies proposed fall within the hearing ranges of marine mammals occurring within the vicinity of the proposed works, their most likely response will be temporary behavioural avoidance.

Corroborating this is the study by Nedwell and Brooker (2008), who took a series of measurements of the underwater noise during underwater pin pile drilling operations as part of the installation of the SeaGen tidal turbine device in Strandford Lough, Northern Ireland. 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, which is comparable to the proposed geotechnical survey work (see Table 3-4). The recordings also indicated that the perceived noise levels fall below background noise levels only a few hundred metres from the drilling operation.

Nedwell and Brooker (2008) assessed the likelihood of avoidance of the drilling noise using the dB_{ht} approach (see section 5.3.1.2). The data indicated that the noise did not exceed the 90 dB_{ht} level (see Table 5-6) at any measured range and that the 75 dB_{ht} and 50 dB_{ht} (*Phoca vitulina*) avoidance ranges were 1.5 m and 85 m respectively. For harbour porpoise, the data indicated that perceived levels of background noise were generally higher than perceived levels of drilling noise, with drilling noise only occasionally increasing above minimum background noise levels. The most frequent level of perceived drilling noise was at 62 dB_{ht} (*Phocoena phocoena*), well below the threshold for significant avoidance reaction.

As such, marine mammals are considered unlikely to be disturbed by noise from drilling and therefore, comparable geotechnical survey activities such as boring and coring, unless they are in the close vicinity of the work. This is unlikely due to small-scale temporary displacement which is likely to occur as a result of the presence of the survey vessel itself.

5.4 Assessment of collision risk

5.4.1 Collision risk

Ship strikes are known to be a cause of mortality for whales and dolphins worldwide (Pace *et al.*, 2006; Laist *et al.,* 2001). Non-lethal collisions have also been documented (Laist *et al.,* 2001; Van Waerebeek *et al.*, 2007). The number of strikes is poorly understood (Laist *et al.,* 2001) since large proportions are likely to be unrecorded (David, 2006). Reported injuries can be divided into two broad categories: blunt trauma from impact and lacerations from propellers. Such injuries may not always result in immediate death, resulting 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). Vessels travelling at a speed of 14 knots or over appear to cause the most severe injuries with sick or juvenile animals being the most vulnerable (Laist *et al.,* 2001).

Slower vessels following a consistent trajectory allow cetaceans the opportunity to avoid collisions, and marine mammals occur at relatively low abundance across the NISA CAA site.

5.4.2 Prediction of impact

The vessels to be used in the proposed surveys are yet to be confirmed, but due to the nature of the surveys it is envisaged that different vessels will be required for the geotechnical and the geophysical stages of the survey. Geophysical survey vessels are typically between 15 m and 60 m in length and have an endurance of up to 14 days. Geotechnical survey vessels are typically 55-90 m in length and have an endurance of up to 28 days.

It is expected that a maximum of 2 vessels would be operating at any one time within the application area.

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 accustomed to vessel movements. The small number of vessels (1-2) 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 and seals are extremely unlikely and there is no risk of significant effects.

5.5 Assessment of pollution event

The International Convention for the Prevention of Pollution from Ships, 1973 as modified by the Protocol of 1978 (MARPOL 73/78, MARPOL is short for maritime pollution and 73/78 short for the years 1973 and 1978) is one of the most important international marine environmental conventions. It aims to prevent both operational and accidental discharge into the marine from sea going vessels. Ireland ratified the various elements of the MARPOL Convention through the Sea Pollution Act 1991, the Sea Pollution (Amendment) Act 1999 and the Sea Pollution (Miscellaneous Provisions) Act 2006. It was given further legal effect through several Statutory Instruments under these Acts. The Acts place a legal obligation upon operators of vessels to implement measures to prevent both operational and accidental discharges from ships of substances, which may damage the marine environment as well as human health.

While the site investigation activities will result in a temporary increase in vessels using the area, which would therefore theoretically increase the risk of accidents and resultant fuel spills, in light of the legal obligations outlined above an incidence of pollution, whether from operational activities or from an accidental occurrence, is considered not likely.

All vessels used during the survey campaign shall, as required by law, be MARPOL compliant and fully certified by the Maritime Safety Office. This is standard practice for all survey activities irrespective of the survey operator and as it is required by law is built into the survey design. Therefore, it is considered not likely that there would be any occurrence of a pollution event either accidental or otherwise that could directly or indirectly affect any Annex IV Species. It is not considered further as an impact to Annex IV species in this report.

6 Mitigation measures

In line with Irish best practice guidelines 'Guidance to manage the risk to marine mammals from man-made sound sources in Irish waters' from DAHG (2014) which are now being incorporated into the standard operating procedures of all geophysical and geotechnical surveys in Irish waters, the measures detailed below will be applied to, where possible, prevent and if not reduce injury and disturbance to Annex IV species during all noise emitting site investigation activities. While these are not specifically aimed at leatherback turtle, the mitigation proposed for cetacean species, in particular the soft-start procedure, will also be relevant to these species.

Disturbance to any of the species considered in this report will be of a temporary nature. As previously stated, all geophysical surveys will adhere to international best practice, including the protocol 'Guidance to Manage the Risk to Marine Mammals from Man-made Sound Sources in Irish Waters' (DAHG, 2014) which will be followed at all times. This protocol is considered sufficient by the competent authority (NPWS) to mitigate for disturbance to marine mammal species.

In addition, the proposed works will be short in duration and of a temporary nature and survey vessels will be slow moving (c. 5 knots) while engaged in the survey activities, therefore any risk due to collision is unlikely.

6.1 Marine Mammal Monitoring

A qualified and experienced Marine Mammals Observer (MMO) will be appointed to monitor for marine mammals and to log all relevant events using standardised data forms provided by the DAHG. During daylight hours the MMO(s) will carry out visual observations to monitor for the presence of cetaceans before the soft start commences and will recommend delays in the commencement of the geophysical operations should any species be detected within the 500 m monitored zone (see below).

In order to allow 24-hour operation, 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) will be employed to undertake pre-start surveys during these times.

6.2 Pre-start monitoring

Visual (MMO) and acoustic (PAM) monitoring if required will be conducted for a pre soft start search of 30 minutes i.e. prior to the commencement of marine geophysical and geotechnical operations (MBES, SSS, sub-bottom profiling, geotechnical seabed sampling). This will involve a visual (during daylight hours) and acoustic assessment (during poor visibility or at night) to determine if any cetaceans are within 1000 m of the activities for the geophysical survey activities and 500m of the activities for geotechnical surveys.

6.3 Monitored zone

Should any cetaceans be detected within a radial distance of 1000 m of the survey vessel, commencement of marine geophysical operations will be delayed until their passage, or the transit of the vessel, results in the cetaceans being more than 1000 m away from the vessel. In both cases, there will be a 30-minute delay from the time of the last sighting within 1000 m of the source to the commencement / recommencement of the operations. The Marine Mammal Observer (MMO) will use a distance measuring stick or reticule binoculars to ascertain distances to marine mammals. *Note: once started, geophysical operations will not cease should cetaceans approach the survey vessel.*

6.4 Drilling activities

Once normal drilling operations commence, there is no requirement to halt or discontinue the activity at night-time, nor if weather or visibility conditions deteriorate, nor if marine mammals occur within the Monitored Zone.

6.5 Soft start

A soft start is the gradual ramping of power over a set period of time, to give any cetaceans adequate time to leave the area.

Once the soft start 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 (1000 m radial distance of the sound source for geophysical survey activities and 500m of the geotechnical sampling activities).

In commencing a seismic survey operation, including any testing of seismic sound sources, where the output peak sound pressure level exceeds 170 dB re: 1µPa @1m, the following ramp up procedure will be undertaken in line with the DAHG (2014) guidance:

1. Where it is possible according to the operational parameters of the equipment concerned, energy output will commence from a low energy start-up 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.
3. If marine mammals enter or are detected within the monitored zone while the ramp-up procedure is under way but incomplete, the energy output will not be increased until the marine mammals are no longer within the monitored zone.

6.6 Line changes

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 preferably undergo a reduction in energy output to a lower state where the peak sound pressure level from any operating

source is 170 dB re 1 µPa @ 1 m. Prior to the start of the next line/station, if the power was shut down, all pre-survey monitoring measures and soft start procedures will be followed as for start-up. If there has been a reduction in power, a soft start will be undertaken gradually from the lower output level. The latter sound reduction measure will 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).

6.7 Breaks in survey periods

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

If there is a break in drilling sound output for a period greater than 30 minutes, then all Pre-Start Monitoring will be undertaken in accordance with the above conditions prior to the recommencement of drilling activity.

6.8 Reporting

All recordings of cetaceans will be made using standardised data forms provided by the DAHG. Full reporting on operations and mitigation will be provided to the DAHG to facilitate reporting under Article 17 of the EC Habitats Directive and future improvements to guidance (DAHG, 2014). The report will also include feedback on how successful the mitigation measures were. This requirement will be communicated to the MMOs and PAM operators at project start up meetings and at crew change.

6.9 Survey vessel speed and course

The project survey vessels will be moving at a maximum speed of approximately 4-5 knots during surveys to allow cetaceans to move away from the vessel should they be disturbed by the vessel presence or noise emissions. During transit times, the survey vessels will be travelling at speeds greater than 4 knots. However, these movements are not considered to deviate from normal vessel traffic in the project area. Should an EPS be found to be in the direct path of a survey vessel, during or outside of survey times, the survey vessel will slow down or, if possible, alter course to avoid collision.

7 Conclusion

Drawing on the information presented in the DAHG (2014) guidance document, and the information provided in this report, it is demonstrated that sounds likely to be produced during the proposed survey activities are within the auditory ranges of the species known to commonly occur in the vicinity of the NISA CAA.

The assessment of effects demonstrates that, with the implementation of the mitigation measures detailed in section 6, the planned geophysical and geotechnical surveys are unlikely to result in the injury or killing of an Annex IV species, or other protected marine mammals species, namely seals. The proposed survey activities may, nevertheless, present a short-term, temporary, and localised disturbance to some Annex IV or seals species from the vicinity of the survey works as a result of operation of the proposed equipment. However, this disturbance is not considered to have a negative effect on Annex IV or seals species due to:

- The short-term duration of the survey works
- The relatively localised and transient nature, both in duration and frequency, of the operations
- The proposed mitigation to follow best practice guidelines (detailed in Section 6).

Therefore, it can be concluded that the proposed survey operations will not result in the committing of any offence under Article 12 of the Habitats Directive towards any of the species listed in Annex IV of the Habitats Directive that are likely to occur within the NISA CAA and have been considered in this report.

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