MUL Application Supporting Attachment 4.4 Risk Assessment for Annex IV Species Report

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1 RISK ASSESSMENT FOR ANNEX IV SPECIES

This RAAIVS Report has been prepared to evaluate the potential effects of proposed projects or activities on species listed under Annex IV of the European Union (EU) Habitats Directive (Directive 92/43/EEC). This report supports the MUL application process and provides information to inform the assessment of potential effects on Annex IV species, which are subject to a system of strict protection throughout their natural range, both within and outside designated Natura 2000 sites.

Where relevant, Annex IV species that are also Qualifying Interests (QIs) of SACs are considered within this assessment; however, the primary focus of this report is compliance with the strict protection provisions of Article 12 of the Habitats Directive.

The report aims to provide the necessary information to assist the competent authorities in determining whether the proposed activities have the potential to undermine the system of strict protection established for Annex IV species, whether a derogation licence under Article 16 of the Habitats Directive may be required, and, if so, whether the relevant derogation tests can be met.

The primary purpose of this RAAIVS Report is to ensure that any planned development or activity complies with the stringent protection measures mandated by the Habitats Directive, which prohibit actions that could cause those species to decline in the wild or which would impair their chances of successful breeding. Disturbance during breeding, rearing, migration or hibernation, or damage or destruction of breeding or resting places, can have a detrimental effect on species survival. The assessment of potential effects is therefore species-specific and considers the threats relevant to each species within its natural range.

1.1 LEGISLATIVE AND REGULATORY CONTEXT (INTERNATIONAL DIRECTIVES)

As directed by Article 12 of the Habitats Directive (Directive 92/43/EEC), 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 European Protected Species (EPS) occurring in Irish waters are the Eurasian otter (*Lutra lutra*), leatherback turtle and loggerhead turtle.

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). 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 destroy 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 by the 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 follows:

"'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 Article 16 of the Habitats Directive, a derogation licence may be granted by the Minister, which would allow otherwise illegal activities to go ahead provided that:

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

In addition, Ireland is also signatory to conservation agreements for the protection such as the Bonn Convention on Migratory Species (1983), the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), the Berne Convention on Conservation of European Wildlife and Natural Habitats (1979), the OSPAR Convention for the Protection of the Marine Environment of the North-East Atlantic (1992) and the International Convention for the Regulation of Whaling (ICRW). Cetaceans are also provided protection under the Whale Fisheries Act 1937.

1.2 STATEMENT OF COMPETENCY

This report has been prepared by Maggie Starr (BSc. (Hons) Marine Sciences). Maggie is a Marine Ecologist and Ornithologist with experience in terrestrial, aquatic and marine/coastal ecology and is a trained Marine Mammal Observer (MMO). Her expertise includes specialised mammal, bird (land based and aerial) and habitat surveys, as well as freshwater surveys such as assessments for white-clawed crayfish, pearl mussels, and Biotic Indices (Q-values) Surveys. Her current work includes ecological and environmental desktop studies for terrestrial, aquatic and marine environments, specialised mammal surveys, ornithological surveys, map preparation and reporting (AA/NIS, EcIA, EIAR).

This report has been checked by Charlotte Manwaring (BSc. Hons Geological Science, MSc. Geochemistry). Charlotte is a Senior Environmental Scientist at GDG with 25 years' experience and an IEMA Practitioner. She has worked across the environmental, compliance, planning and monitoring industries for both the public and private sector. She has experience in environmental impact assessment of port expansion, onshore windfarm and energy from waste projects and of marine licencing.

This report has been reviewed by Joey O'Connor (BSc. (Hons) Marine Science, MSc. Engineering in the Coastal Environment). Joey is an Environmental Impact Assessment practitioner and Marine Scientist with coastal engineering expertise and extensive experience of offshore survey and Marine Protected Area monitoring, who has undertaken multiple environmental assessments for GDG and as a statutory adviser to the UK government and its devolved administrations with the Joint Nature Conservation Committee (JNCC).

1.3 BASELINE INFORMATION

Irish waters support a range of species listed under Annex IV of the EU Habitats Directive (Directive 92/43/EEC), including cetaceans, marine turtles, bats, and the Eurasian otter (*Lutra lutra*). This section describes the baseline conditions for Annex IV species relevant to the proposed SI activities within inner Cork Harbour, with particular reference to the inner harbour environment adjacent to Spike Island and the proposed export cable options between Spike Island, Haulbowline and Rocky Island or south or Spike Island.

Baseline conditions within the MUL area therefore differ substantially from offshore or open coastal environments along the south coast of Ireland.

Baseline information has been informed by published literature, national and National Biodiversity Data Centre (NBDC)[1]), and recent RAAIVS prepared for adjacent sited within Cork Harbour. These sources provide a robust and site-relevant understanding of species occurrence and habitat use within the inner harbour.

1.3.1 AMBIENT NOISE LEVELS

Cork Harbour is a large, operational harbour with a well-established anthropogenic underwater soundscape. Ambient noise levels within the inner harbour are influenced primarily by regular commercial shipping, naval and State vessel activity, port operations, recreational boating, and associated marine infrastructure. These sources contribute to a variable but consistently elevated background noise environment compared to offshore or less developed coastal areas.

Existing assessments and monitoring undertaken within Cork Harbour indicate that underwater ambient noise is dominated by vessel-related sources, with noise levels varying spatially and temporally in response to shipping movements, tidal state, and weather conditions. Periods of elevated noise are common during routine port operations and vessel transits, while quieter periods may occur intermittently between activities.

As a result, marine receptors within Cork Harbour are regularly exposed to anthropogenic underwater noise as part of baseline conditions. This context is relevant when considering the potential effects of additional, temporary noise associated with site investigation activities, which will occur within an environment already characterised by frequent and ongoing human maritime activity.

1.3.2 RELEVANT ANNEX IV SPECIES

Annex IV species are those of European Community interest that require strict protection due to their vulnerability, rarity, or declining populations. All Annex IV species with the potential to occur within, or interact with, the proposed SI activities have been considered in this assessment.

In addition to the cetacean species listed above, other Annex IV cetacean species recorded in the wider Cork Harbour region and adjacent offshore waters include large baleen whales (such as minke, fin and humpback whale) and deep-diving odontocetes. However, desk-based assessments undertaken by the Irish Whale and Dolphin Group (IWDG) indicate that these species are primarily associated with the harbour mouth, outer harbour, and offshore waters, and their occurrence within the inner Cork Harbour environment is rare. Where recorded in the wider region, these species typically occur seasonally, with most sightings concentrated during late summer and autumn, reflecting broader migratory and foraging patterns along the south coast of Ireland. The shallow, sheltered, and highly modified nature of inner Cork Harbour is not considered suitable habitat for

[1] https://maps.biodiversityireland.ie/Map

these species, and their presence within the proposed site investigation area is considered highly unlikely. As such, these cetacean species are not considered further within this assessment.

Marine turtles recorded in Irish waters are also listed under Annex IV of the EU Habitats Directive; however, desk-based review of available records indicates that marine turtles are not a relevant receptor for the proposed SI activities within inner Cork Harbour. A review of National Biodiversity Data Centre (NBDC) records confirms that there are no records of Loggerhead Turtle within Cork Harbour. Records of Leatherback Turtle in the Cork Harbour area are limited and entirely historic, with sightings dating primarily from the 1980s and 1990s. The most recent confirmed record occurred at the harbour mouth in 2006, with no subsequent records within the inner harbour environment. Marine turtle records in the region are largely associated with offshore and open coastal waters rather than sheltered, shallow, and heavily modified harbour environments. No important foraging, breeding, or migratory habitat for marine turtles is known to occur within inner Cork Harbour. Given the absence of recent records, the offshore and pelagic habitat preferences of marine turtles, and the highly unlikely occurrence of these species within the proposed SI area, marine turtles are scoped out from further assessment.

Bat species, including Leisler's Bat (*Nyctalus leisleri*) and Common Pipistrelle (*Pipistrellus pipistrellus*), are known to occur within the wider Cork Harbour area and may forage opportunistically along shoreline features, piers, and areas of artificial lighting. The proposed SI activities will be vessel-based and confined to the marine environment within an already busy and well-lit harbour setting subject to regular commercial, recreational, and State vessel traffic. The temporary presence of survey vessels is not expected to result in a material change to existing lighting conditions, insect availability, or baseline disturbance levels. No bat roosts, maternity sites, or hibernation sites will be affected by the proposed works, and there is no requirement for modification or disturbance of built structures that could function as roosting habitat. The risk of collision between bats and low-speed vessels is considered negligible. On this basis, no pathway exists by which the proposed SI activities could result in killing or injury of bats, deliberate disturbance at a level relevant to Article 12, or damage to breeding or resting places. Bat species are therefore scoped out from further assessment.

Based on the location and nature if the proposed SI activities, the following Annex IV species are considered relevant:

Cetaceans:

- Bottlenose Dolphin (*Tursiops truncatus*)
- Harbour Porpoise (*Phocoena phocoena*)
- Common dolphins (*Delphinus delphis*)

Semi-aquatic mammal:

- Otter

1.3.2.1 CETACEANS

Overall cetacean occurrence within Cork Harbour is characterised by relatively low densities, with sightings predominantly recorded toward the harbour mouth and adjacent open waters. Inner harbour areas, including waters north of Spike Island, support lower levels of use.

Where cetaceans do occur within the inner harbour, their presence is typically transient, with individuals moving through the area rather than remaining to forage or occupy the area for extended

periods. Sightings data (IWDG) indicate some seasonal variation in cetacean occurrence within the wider Cork Harbour region, with higher levels of occurrence generally recorded during autumn and winter, while occasional records also occur during the other seasons. The shallow, sheltered and highly modified nature of the inner harbour is not considered to represent regular foraging or residency habitat for most cetacean species.

Harbour Porpoise

Where harbour porpoise enter inner harbour waters, their presence is typically brief and transient. The shallow water depths, elevated levels of vessel activity, and highly modified nature of the inner harbour environment are considered to limit its suitability as regular habitat for this species. As such, inner Cork Harbour is not considered to represent important habitat for harbour porpoise, although occasional passage through the area cannot be discounted.

Bottlenose Dolphin

Bottlenose dolphin is the most frequently recorded cetacean species within the Cork Harbour region; IWDG suggest that the species occurs throughout the wider harbour system, with sightings more commonly concentrated toward the harbour mouth and outer harbour waters (IWDG, 2025).

Occurrence within the inner harbour, including waters north of Spike Island, is less frequent and is typically associated with transient movements rather than prolonged residency. While bottlenose dolphins are known to utilise a range of coastal environments and may enter sheltered waters opportunistically, the shallow depths, high levels of vessel traffic, and heavily modified nature of the inner Cork Harbour environment limit its suitability as regular foraging or breeding habitat. As such, inner harbour areas are not considered to represent core habitat for bottlenose dolphin, although occasional use of the area cannot be excluded.

Common Dolphin

Common dolphin is a frequent and abundant cetacean species off the Cork coast and occurs regularly within the wider Cork Harbour region. IWDG suggest that the species is present for much of the year (IWDG, 2025).

Seasonal variation in occurrence is evident, with abundance typically lowest during spring (April–May) and highest during autumn and winter, coinciding with the presence of pelagic schooling fish in the vicinity of Cork Harbour (Wall *et al*., 2013). During these periods, common dolphins may occur in large, gregarious groups numbering tens to hundreds of individuals.

Common dolphins are highly mobile and behaviourally adaptable and are known to readily approach vessels, frequently engaging in bow-riding behaviour for extended periods. While the species is strongly associated with pelagic prey and more open waters, common dolphins do utilise inner Cork Harbour at times, including areas close to the city. As such, common dolphin is considered a relevant Annex IV species for the proposed SI activities.

1.3.2.2 OTTER

Otter is listed under Annex IV of the EU Habitats Directive and is known to occur widely along the Irish coastline, including estuaries and sheltered coastal environments. Within the wider Cork Harbour

area, otter occurrence has been informed by desk-based review of available records, including the National Biodiversity Data Centre (NBDC) datasets.

A review of NBDC records indicates that there are no otter records at 1 km spatial resolution within or immediately adjacent to the MUL area. The majority of available records within the wider Cork Harbour region are recorded at 10 km spatial resolution and are associated with locations including Roches Point, Saleen, Rostellan, Cobh, and Inch Beach. The most recent records, derived from the *Mammals of Ireland 2016–2025* dataset, are associated with the Saleen area.

Otter use of the inner harbour is considered variable, particularly within heavily modified and industrialised sections characterised by extensive marine infrastructure and high levels of vessel activity. The shoreline environment within the MUL area provides limited opportunities for resting or breeding, and no otter holts, couches, or regular resting places have been identified in proximity to the proposed site investigation activities.

However, Cork Harbour represents a large estuarine system where otters are known to occur, and the presence of otters within the wider harbour environment cannot be excluded. Otters may use estuarine and coastal areas flexibly in response to prey availability and disturbance levels, and may pass through or forage opportunistically within different parts of the harbour. As such, considered in this risk assessment.

1.3.3 RISK ASSESSMENT

1.3.3.1 IDENTIFICATION OF POTENTIAL IMPACTS

The assessment of potential impacts on Annex IV species has been undertaken with regard to the nature, scale, duration, and location of the proposed site investigation (SI) activities, and the characteristics of the receiving environment within Cork Harbour.

Potential impact pathways have been identified through consideration of the proposed survey methods, associated vessel activity, and temporary seabed interactions, together with the known ecological requirements and behaviour of Annex IV species occurring in the wider Cork Harbour area. The identification of impacts has also taken account of the highly modified and operational nature of the harbour environment, which is characterised by regular commercial, recreational, and State vessel activity.

On this basis, the following potential impact pathway has been identified as relevant to Annex IV species and are considered further within this assessment:

- Underwater noise associated with geophysical, geotechnical, metocean and vessel-based activities, with the potential to cause temporary behavioural disturbance or, at very close range, auditory effects.

The following impact pathways have been considered but are not expected to result in effects on Annex IV species and are therefore scoped out of further assessment:

- Loss of, or damage to, breeding or resting places, as no such features will be modified or disturbed by the proposed SI activities.
- Disturbance to foraging habitat or prey availability, given the small-scale, localised and temporary nature of seabed interactions within an already modified harbour environment.
- Increased suspended sediment or turbidity, which will be highly localised and short-lived.

- Pollution or accidental release of contaminants, due to the short duration of activities and compliance with standard maritime pollution prevention measures.
- Vessel collision risk, given the use of a single low-speed survey vessel, short transit distances within the harbour, and adherence to standard navigation and harbour speed restrictions.
- Entanglement risk, due to the temporary nature of moorings and survey equipment, the absence of slack or drifting lines, and the low likelihood of sustained interaction with Annex IV species in the inner harbour environment.
- Lighting-related effects on bat species, which have been assessed at baseline and scoped out due to the absence of a plausible pathway for impact.

1.3.4 UNDERWATER NOISE RISK ASSESSMENT

Underwater noise associated with the proposed SI activities may arise from survey vessel movements and from the operation of acoustic and seabed-interacting survey equipment. Marine mammals rely on sound for key life functions including communication, navigation and foraging, and exposure to anthropogenic underwater noise has the potential to result in acoustic masking, behavioural disturbance or displacement, and, at sufficiently high exposure levels, auditory effects such as temporary or permanent threshold shifts.

Consistent with current best practice, the assessment applies the functional hearing group framework set out by Southall *et al*. (2019), with reference also to NMFS guidance (2018; 2024). This framework categorises marine mammal receptors according to similarities in hearing sensitivity and provides thresholds for the onset of temporary threshold shift (TTS) and permanent threshold shift (PTS) resulting from exposure to both impulsive and non-impulsive underwater noise.

The functional hearing groups estimated auditory bandwidths, and corresponding PTS and TTS thresholds relevant to Annex IV species considered in this RAAIVS are presented in Table 4-1. As all noise sources associated with the proposed SI activities are non-impulsive, the non-impulsive thresholds presented in Table 4-2 are applied as conservative screening benchmarks when assessing the potential for auditory effects. Low-frequency cetaceans are included for completeness, although their occurrence within the inner Cork Harbour environment is considered highly unlikely based on the shallow depths present.

Otter is not explicitly covered within the Southall *et al*. (2019) marine mammal hearing group framework. For this assessment otter is considered within the “other carnivores” hearing group, which is considered acoustically comparable to the phocid carnivores in water group. As noted by Southall *et al*. (2019) and NMFS (2018; 2024), thresholds for auditory injury in other carnivores are likely to be higher than those for phocid carnivores. Accordingly, application of the phocid carnivore thresholds to otter represents a precautionary proxy, and any potential impacts on otter are expected to be lower than those predicted for phocid pinnipeds.

The proposed SI activities will take place within Cork Harbour, where baseline underwater noise levels are already influenced by regular commercial, recreational and State vessel activity.

The assessment that follows focuses on the potential impact pathways associated with underwater noise, informed by receptor sensitivity (Table 4-1) and the acoustic characteristics of the proposed SI activities (**Error! Reference source not found.**).

Table 4-1 Generalised marine mammal hearing groups and the zero-to-peak SPL and weighted SEL thresholds (Southall *et al*. 2019; 2007)

Hearing group & estimated auditory bandwidth (kHz)	Impulsive noise				Non-impulsive noise			
	Zero-to-peak SPL threshold (dB re 1 µPa^2)		Weighted cSEL threshold (dB re 1 µPa^{2}s)		Zero-to-peak SPL threshold (dB re 1 µPa^2)		Weighted cSEL threshold (dB re 1 µPa^{2}s)	
	PTS	TTS	PTS	TTS	PTS	TTS	PTS	TTS
LF cetaceans **0.007-35 kHz** (Minke whale)	219	213	183	168	219	213	199	179
HF cetaceans **0.15-160 kHz** (Bottlenose dolphin, Common dolphin & Risso's dolphin)	230	224	185	170	230	224	198	178
VHF cetaceans **0.275-180 kHz** (Harbour porpoise)	202	196	155	140	202	196	173	153
Phocid carnivores in water (PCW)* **0.05-86 kHz** (Grey seal & Harbour seal *Otter)	218	212	185	170	218	212	201	181
*The other carnivores hearing group includes otter species. The generalised hearing range of the other carnivores hearing group is similar to that of the phocid carnivores hearing group, but the thresholds for potential PTS and TTS impacts are higher (Southall *et al.,* 2019; NMFS, 2018, 2024). Therefore, potential impacts to other carnivores such as otters will be lower than those predicted for phocid carnivores.								

1.3.4.1 GEOPHYSICAL AND GEOTECHNICAL SURVEY SOURCES – ACOUSTIC CHARACTERISTICS

Geophysical and geotechnical survey equipment associated with the proposed SI activities produces a range of acoustic signals that differ in frequency, signal type, source level, pulse duration and repetition rate (duty cycle). In order to inform a proportionate risk assessment for Annex IV species, a **qualitative screening** of the acoustic characteristics of the proposed sound-emitting activities has been undertake, with reference to published literature on the audibility of common survey sources to marine mammals (MacGillivray *et al*., 2014). , which examined the relative audibility of commonly used shallow-water survey sound sources to marine mammals across different functional hearing groups.

Table 4-2 summarises the indicative operating frequency bands and signal characteristics of the proposed SI sound sources and identifies, on a screening basis, the Annex IV receptor groups most likely to detect each source based on frequency overlap with known auditory bandwidths (as defined in Table 4-2). This table provides a transparent link between source characteristics and receptor sensitivity and is used to support the subsequent assessment of behavioural disturbance and auditory effects, rather than to predict specific impact ranges.

The indicative frequency ranges and signal characteristics presented in Table 4-2 are informed by published characterisations of commonly used geophysical survey systems. Typical acoustic characteristics of representative survey equipment, including operating frequency ranges, pulse durations and source levels, as reported by MacGillivray *et al.* (2014) and associated references, are summarised in Figure 1-1 below.

All acoustic sources associated with the proposed SI activities are non-impulsive and are consistent with the types of survey systems assessed by MacGillivray *et al*. (2014). SBPs operate at low to mid frequencies with relatively long pulse durations but are highly directional and used intermittently. MBESs and SSSs operate at very high frequencies, which are subject to rapid attenuation and limited audibility to marine mammals beyond close range. None of the proposed survey systems are comparable to high-energy impulsive sources such as seismic airguns.

The findings of MacGillivray *et al*. (2014) indicate that the primary effect mechanism associated with the proposed geophysical and geotechnical survey activities is behavioural disturbance, rather than auditory injury.

MacGillivray *et al*. (2014) demonstrate that detectability varies according to both operating frequency and marine mammal hearing sensitivity;

- **Low-frequency sources**, such as SBP, are most audible to low-frequency cetaceans (baleen whales);
- **Mid-frequency sources** are more readily detected by odontocetes at close range;
- **High-frequency sources**, including MBES and SSS, generated the lowest estimated sensation levels across all marine mammal hearing groups, reflecting rapid attenuation in shallow water and operation at the upper limits of marine mammal hearing sensitivity.

Table 4-2 Proposed SI sound sources – indicative frequency bands and overlap with Annex IV receptor hearing groups

SI activity / source	Indicative operating frequency band (kHz)	Signal type	Annex IV receptors most likely to detect (screening)	Notes for risk screening
Sub-bottom profiler (SBP)	1–115 (device dependent)	Pulsed, non-impulsive	HF cetaceans; VHF cetaceans (depending on settings)	Lower-frequency components may be more detectable; directional; intermittent.
Multibeam echosounder (MBES)	~200–700 (water depth of <200m)	Pulsed, non-impulsive	HF cetaceans; VHF cetaceans (upper hearing range)	Shallow-water, high-frequency configuration; rapid attenuation; lower relative sensation levels.
	~12-200 (water depth of >200m)		LF cetaceans; HF cetaceans	Lower-frequency configuration used in deeper water; **not applicable to Cork Harbour conditions.**
Side-scan sonar (SSS)	600–1600	Pulsed, non-impulsive	Typically limited; may be detectable at close range	Very high frequency; rapid attenuation.
ADCP (metocean)	~500	Pulsed, non-impulsive	Limited (likely only very close range)	High frequency, generally above strongest sensitivity for most groups; low output relative to survey sonars.
CPT	0.05–16 (as specified)	Vibratory / intermittent	Otter proxy; potentially LF/HF cetaceans depending on energy distribution	Treated as low-frequency seabed-interaction noise; localised.
Vibrocore	~0.05 (50 Hz)	Vibratory / intermittent	Otter proxy; potentially LF cetaceans	Localised seabed interaction; short duration per station.
Borehole drilling (rotary)	~0.001–0.12	Continuous / intermittent	Otter proxy; potentially LF cetaceans	Low frequency; duration longer than point sampling but confined to jack-up location.
Vessel operations (survey vessel / jack-up support)	Broadband (dominant at low frequencies)	Continuous / variable	Otter proxy; LF cetaceans; HF cetaceans at close range	Contextual contributor in a busy harbour; assessed qualitatively for behavioural disturbance.

Table 1. Selected geophysical survey sources and their modeled specifications.

Type	Model	Frequency (kHz)	Beam width (−3 dB)	Beam orientation	Source level (rms dB re 1 μPa @ 1 m)	Rep. rate (/sec)	Pulse length (ms)
			Low-frequency (<10 kHz)				
Airgun array	Bolt 4×40 in^3	0.005-2 (pulse)	n/a	n/a	229[b]	0.1	100
Sub-bottom profiler	EdgeTech DW-106	1–6 (chirp)	28°–36° circular	vertical	200	15	33
			Mid-frequency (10 to 100 kHz)				
Communications transceiver	Simrad HiPAP 500 USBL	23	10° circular	2° from horizontal[a]	206	1	1000
Fish finding sonar	Simrad SX90	26	7° circular	2° from horizontal[a]	215	1	72
Hydrographic echosounder	Simrad EA500	38	7° circular	vertical	232	0.5	0.1
			High-frequency (>100 kHz)				
Multibeam echosounder	Simrad EM2000	200	150° × 1.5° rectangular	vertical	218	10	0.2
Side-scan sonar	EdgeTech 4500DF	230	50° × 0.15° rectangular	30° from horizontal	229	10	20

[a]Sonars with steerable beams were oriented toward the horizontal.
[b]Maximum source level in horizontal plane.

Figure 1-1 Typical acoustic characteristics of geophysical survey systems (from MacGillivray et al., 2014).

Sub-bottom Profilers and Other Geophysical Survey Sources

The following subsection provides a focused assessment of sub-bottom profilers as the geophysical survey source with the greatest potential for acoustic interaction, informed by Table 4-2 and Figure 1-1.

SBPs are widely used geophysical survey tools that operate at low to mid frequencies and typically emit relatively high source levels compared to other hydrographic systems. As such, SBPs represent the geophysical survey source with the greatest potential to interact acoustically with marine mammals.

Published measurements indicate that SBPs used in shallow-water site investigations produce transmitted peak sound pressure levels typically in the range of approximately 213–228 dB re 1 µPa @1 m, with relatively consistent characteristics across commonly used manufacturers and system types (IFREMER, 2016). SBP signals generally consist of frequency-modulated (FM) pulses with durations of several tens of milliseconds; typical pulse lengths of approximately 80 ms have been reported, with usable frequency bands commonly between approximately 1.8 and 5.3 kHz. For an example SBP pulse with a peak SPL of 213 dB re 1 µPa @1 m and an 80 ms duration, the corresponding single-pulse sound exposure level has been estimated at approximately 202 dB re 1 µPa²·s (IFREMER, 2016).

MacGillivray *et al*. (2014) modelled the audibility of such survey sources to marine mammals and demonstrated that low-frequency components of SBP signals are most readily detected by low-

frequency cetaceans, with odontocetes also capable of detecting these signals at close range depending on system settings and propagation conditions. However, the study also showed that high-frequency survey systems, such as MBES and SSS, generate substantially lower estimated sensation levels across all marine mammal hearing groups due to rapid attenuation in shallow water and operation near the upper limits of mammalian hearing sensitivity.

Auditory injury to marine mammals may occur only where received sound pressure levels or cumulative sound exposure levels exceed established tolerance thresholds for the relevant functional hearing group. Southall *et al*. (2007, updated in Southall *et al*., 2019) indicate that the onset of auditory injury from non-impulsive sources would require exposure at close proximity to the sound source and, for cumulative metrics, sufficient exposure duration to allow sound energy to accumulate. Consequently, potential auditory injury associated with SBP operation would be limited to scenarios in which animals pass very close to the transducer and remain within the sound field for sufficient time.

On this basis, and consistent with the findings of MacGillivray *et al*. (2014), the principal potential effect mechanism associated with SBP use during site investigation activities is considered to be **behavioural disturbance**, such as short-term avoidance or displacement, rather than auditory injury. Any such effects would be spatially localised and confined to the duration of SBP operation.

1.3.4.2 GEOTECHNICAL SURVEYS – UNDERWATER NOISE

The proposed geotechnical site investigation activities include borehole drilling, cone penetration testing (CPT), vibrocore sampling and, where required, shallow rock coring. The exact number, spacing and duration of these activities will be confirmed following interpretation of geophysical survey data; however, all geotechnical works will be undertaken within a small spatial footprint and over a short duration relative to the overall licence period.

Geotechnical surveys generate underwater noise primarily through direct seabed interaction rather than the emission of high-energy acoustic signals. Noise associated with these activities is generally low frequency in nature and intermittent or continuous over short periods at each sampling location. The principal sources of underwater noise from geotechnical surveys are summarised below.

Geotechnical seabed-interaction noise is dominated by very low frequencies and is therefore most relevant to otter (using the phocid/other carnivore proxy), with odontocete detectability limited to incidental broadband components at close range.

Borehole Drilling

Boreholes will be drilled from a jack-up platform using cable percussion and/or rotary drilling techniques. Rotary drilling produces low-frequency underwater noise, typically in the range of approximately 0.001–0.12 kHz, with reported source levels substantially lower than those associated with high-energy geophysical sources. Noise is generated through mechanical interaction between the drill bit and the seabed and is transmitted primarily through the sediment rather than the water column.

Each borehole will have a very small seabed footprint and drilling will be confined to discrete locations. While drilling duration at individual boreholes may be longer than other point sampling activities, operations will remain localised, and any underwater noise generated will be spatially restricted to the immediate vicinity of the drilling platform.

Given the low-frequency, non-impulsive nature of drilling noise, overlap with the auditory bandwidths of low-frequency cetaceans and otter is possible at close range. However, source levels associated with rotary drilling are well below established injury thresholds for non-impulsive noise, and auditory injury is not likely.

Cone Penetration Testing (CPT)

Cone penetration testing involves pushing an instrumented cone into the seabed at a constant rate to measure sediment resistance and pore pressure. CPT generates low-frequency vibratory noise associated with mechanical penetration of sediments. The activity is intermittent, short in duration at each location, and highly localised.

Noise from CPT is expected to be detectable only at close range and primarily by receptors sensitive to low-frequency sound. As with borehole drilling, source levels are substantially below thresholds associated with auditory injury, and CPT does not involve impulsive sound. Any potential effects on Annex IV species would therefore be limited to short-term behavioural responses in the immediate vicinity of active testing locations.

Vibrocore Sampling

Vibrocore sampling uses a vibrating mechanism to assist penetration of a core barrel into unconsolidated sediments. Vibrocorers typically operate at low frequencies (approximately 50 Hz) and produce intermittent vibratory noise during deployment. Each vibrocore operation is short in duration, generally lasting between 30 minutes and two hours per location, with a seabed footprint of approximately 1 m².

The low-frequency nature of vibrocore noise may overlap with the hearing sensitivity of low-frequency cetaceans and otter; however, noise emissions are localised, of short duration, and well below levels associated with auditory injury.

Rock Coring

Where shallow bedrock is encountered, limited rock coring may be undertaken to characterise near-surface geology. Rock coring produces low-frequency mechanical noise associated with drilling into hard substrate. Activities will be confined to discrete locations along the export cable corridor and will be short in duration.

Noise generated by rock coring is comparable in character to rotary drilling and is non-impulsive. Given the limited spatial extent and short duration of these activities, any underwater noise effects would be highly localised.

Summary of Geotechnical Noise Effects

All geotechnical survey activities proposed for the SI phase generate non-impulsive, low-frequency underwater noise associated with direct seabed interaction. These activities are spatially restricted, intermittent or short-term at individual locations, and do not involve high-energy acoustic sources.

Based on the characteristics of the proposed geotechnical activities, relevant hearing thresholds for Annex IV species, and the operational context of Cork Harbour, auditory injury (PTS or TTS) is not considered a plausible effect mechanism. The only potential effect pathway is limited behavioural disturbance at close range, which, if it occurs, would be spatially localised and confined to the period of active geotechnical works.

1.3.4.3 METOCEAN SURVEYS – ACOUSTIC DOPPLER CURRENT PROFILER (ADCP)

An Acoustic Doppler Current Profiler (ADCP) is a hydroacoustic instrument used to measure water current velocities by transmitting short acoustic pulses and analysing the Doppler shift of sound scattered back from suspended particles within the water column. The proposed metocean surveys may include deployment of a vessel-mounted or seabed-mounted ADCP within the survey area.

The ADCP systems proposed for use operate at high ultrasonic frequencies (≥600 kHz) and emit non-impulsive, short-duration acoustic pulses with a low duty cycle. Source sound pressure levels are low relative to other acoustic survey equipment, with maximum reported levels of approximately 120 dB re 1 µPa @ 1 m (Table 4-3).

Table 4-3 Indicative Acoustic Characteristics of Proposed ADCP Equipment

ADCP type	Example system	Deployment	Operating frequency	Maximum source level (dB re 1 µPa @ 1 m)	Signal type
Fixed ADCP	Nortek AWAC 600 kHz or 1 MHz	Bed-mounted	≥600 kHz	≤120	Short-duration, non-impulsive pulses
Vessel-mounted ADCP	Teledyne RDI WH Monitor	Hull-mounted	600 kHz	≤120	Short-duration, non-impulsive pulses

Receptor audibility and screening

The operating frequencies of the proposed ADCP systems are well above the functional hearing ranges of Annex IV marine mammals, including cetaceans and pinnipeds, as defined by Southall et al. (2007; 2019). On this basis, ADCP signals are not expected to be detectable to marine mammals in water, and auditory injury (TTS or PTS) is not likely.

Otter

Otter (*Lutra lutra*) auditory sensitivity is concentrated at much lower frequencies than those produced by ADCP systems. Given the very high operating frequencies and low source levels of the proposed ADCP equipment, no underwater noise effects on otter are predicted.

Any potential interaction between otter and the proposed metocean surveys would be limited to temporary vessel presence, rather than acoustic emissions, and would not give rise to significant disturbance given the short duration of survey activity and the availability of alternative coastal foraging habitat.

Conclusion (ADCP)

ADCP operation is assessed as posing no risk of disturbance, harm or injury to Annex IV species. The combination of very high operating frequencies, low sound pressure levels, and short-term, localised activity means that ADCP use will not result in significant effects on cetaceans, or otter.

1.3.5 CUMULATIVE EFFECTS

Cumulative effects have been considered in relation to underwater noise arising from the full suite of proposed site investigation activities, including geophysical surveys (SBP, MBES, SSS), geotechnical surveys (borehole drilling, CPT, vibrocore and rock coring), metocean surveys (ADCP), and associated survey vessel activity.

All underwater noise sources associated with the proposed site investigation are non-impulsive, spatially localised and of limited duration, with individual activities typically occurring over hours to

days at discrete locations. The surveys will be undertaken within Cork Harbour, a highly modified and operational environment where baseline underwater noise levels are already influenced by routine commercial, recreational and naval vessel traffic. This existing noise context reduces the likelihood that the temporary introduction of additional, low-intensity sound sources would give rise to meaningful cumulative effects.

While some survey activities may occur sequentially over the overall licence period, they will not be continuous, and simultaneous overlap of multiple sound-producing activities is unlikely. Even where different survey components occur in proximity or succession, the short-term and intermittent nature of the sound sources, combined with their limited spatial footprint, means that any exposure experienced by Annex IV species would be temporary and reversible.

Taking account of the characteristics of the proposed geophysical, geotechnical and metocean survey activities, the receiving environment within Cork Harbour, and the findings of the underwater noise assessment, **no significant cumulative effects on Annex IV species are predicted**, either alone or in combination with other plans or projects.

1.3.6 PROTECTION/MANAGEMENT MEASURES

Potential protection and management measures for the proposed site investigation activities have been considered with reference to the characteristics of the sound sources identified in this assessment, the receiving environment, and the NPWS (2014) Guidance to Manage the Risk to Marine Mammals from Man-made Sound Sources in Irish Waters.

The mitigation measures described below are intended to address potential effects on Annex IV marine mammals and semi-aquatic mammals, specifically cetaceans and otter, and also grey seal and harbour seal (which, while not Annex IV species, are afforded protection under Irish legislation), where relevant pathways for interaction have been identified.

The proposed SI survey area is located within an inlet/estuarine environment and within 1,500 m of the entrance to an enclosed bay/estuary. Water depths within the survey area are ≤200 m. Accordingly, the mitigation measures set out under Section 4.3.4 (Geophysical Acoustic Surveys) and Section 4.3.2 (Drilling) of NPWS (2014) are applicable where relevant.

Mitigation is only required for activities that involve active acoustic sources or drilling operations for which NPWS (2014) prescribes specific measures. Mitigation is not required for metocean surveys (ADCP) or non-drilling geotechnical seabed-interaction activities (e.g. CPTs), which have been assessed as presenting no plausible risk of injury and, at most, highly localised and temporary disturbance.

1.3.6.1 MARINE MAMMAL OBSERVER

A qualified and experienced Marine Mammal Observer (MMO) shall be appointed to monitor for marine mammals and to record all relevant observations using standardised data forms. MMO effectiveness is limited to daylight hours and suitable weather and visibility conditions.

Geophysical Acoustic Surveys (MBES, SSS and SBP)

The following mitigation measures shall be implemented for MBES, SSS and SBP surveys undertaken within the inlet/estuarine environment and within 1,500 m of the entrance to the bay/estuary:

1. Monitored Zone (MZ)
   Unless otherwise agreed with the Regulatory Authority, geophysical acoustic survey activities

shall not commence if marine mammals are detected within a 500 m radial distance of the sound source (the Monitored Zone).

2. Pre-start monitoring
   In waters up to 200 m deep, the MMO shall conduct constant-effort pre-start monitoring for a minimum of 30 minutes prior to commencement of sound-producing activities. Sound-producing activity shall not commence until at least 30 minutes have elapsed with no marine mammals detected within the MZ.
3. Daylight commencement
   Geophysical acoustic survey activities shall only commence during daylight hours where effective visual monitoring can be achieved, as determined by the MMO. Where effective visual monitoring is not possible, commencement shall be postponed until suitable conditions are restored.
4. Communication protocol
   A clear on-site communication protocol shall be agreed between the MMO and the Person in Charge to confirm whether activities may commence or resume following any break. Activities shall only proceed following positive confirmation from the MMO.
5. Ramp-up procedure
   Where the peak sound pressure level of the acoustic source exceeds 170 dB re 1 µPa @ 1 m, a ramp-up (soft-start) procedure shall be implemented prior to full output. Ramp-up shall include continued MMO monitoring and shall be undertaken over a period of 20 minutes, in accordance with NPWS (2014).
6. Once normal operations commence
   Once normal survey operations have commenced following successful pre-start monitoring and, where applicable, ramp-up, there is no requirement to halt or discontinue activities during periods of darkness, reduced visibility, or if marine mammals subsequently enter the MZ.
7. Breaks in sound output
   If there is a break in sound output greater than 30 minutes, all pre-start monitoring (and ramp-up, where applicable) shall be repeated prior to recommencement.

1.3.6.2 DRILLING ACTIVITIES

Where conventional coastal or marine drilling forms part of the proposed geotechnical SI works, the mitigation measures set out in NPWS (2014) Section 4.3.2 will be implemented:

1. A qualified and experienced MMO shall be appointed to monitor for marine mammals and to log all relevant events.
2. Unless otherwise agreed with the Regulatory Authority, drilling activity shall not commence if marine mammals are detected within a 500 m radial distance of the drilling sound source (the Monitored Zone).
3. Drilling shall only commence during daylight hours where effective visual monitoring can be achieved, as determined by the MMO.
4. In waters up to 200 m deep, 30 minutes of constant-effort pre-start monitoring shall be undertaken prior to commencement. Drilling shall not commence until at least 30 minutes have elapsed with no marine mammals detected within the MZ.

5. Once normal drilling operations have commenced, there is no requirement to halt or discontinue activities at night-time, during periods of reduced visibility, or if marine mammals subsequently occur within the MZ.
6. If there is a break in drilling sound output greater than 30 minutes, pre-start monitoring shall be repeated prior to recommencement.
7. MMO reporting shall be provided to the Regulatory Authority in accordance with NPWS (2014).

1.3.6.3 DISTURBANCE AND DISRUPTION OF NORMAL BEHAVIOUR

The implementation of the measures outlined above provides an effective mechanism for reducing the likelihood of short-term acoustic disturbance to Annex IV species associated with commencement of geophysical acoustic surveys and drilling activities. Given the localised and temporary nature of the proposed site investigation works, any behavioural responses that may occur are expected to be short-term and reversible, with no long-term consequences for individuals or populations.

1.3.7 NPWS ASSESSMENT CRITERIA

In addition to the above risk assessment, the following assessment criteria, as set out in the *Guidance to Manage the Risk to Marine Mammals from Man-made Sound Sources in Irish Waters* (NPWS, 2014), have been considered.

Do individuals or populations of Annex IV species occur within the proposed area?

Annex IV species with the potential to occur within the proposed site investigation area in inner Cork Harbour include cetaceans (bottlenose dolphin, harbour porpoise and common dolphin) and otter.

Cetacean occurrence within inner Cork Harbour is generally characterised by low densities and transient use, with sightings more frequently recorded toward the harbour mouth and outer harbour waters. Where cetaceans occur within the inner harbour, their presence is typically brief, associated with passage through the area rather than prolonged residency or foraging.

Otter is known to occur within the wider Cork Harbour system; however, use of the inner harbour is considered variable, particularly within heavily modified and industrialised sections. No otter holts, couches or regular resting places have been identified within or adjacent to the SI area.

Is the plan or project likely to result in death, injury or disturbance of individuals?

The proposed site investigation activities are not likely to result in death or injury of Annex IV species. All sound-producing activities are non-impulsive, localised and short-term. Auditory injury (PTS or TTS) has been assessed as not plausible.

Temporary disturbance of individuals may occur at close range during certain geophysical survey activities; however, any such disturbance would be short-term, localised and reversible, and further reduced through implementation of NPWS (2014) mitigation measures where applicable.

Is it possible to estimate the number of individuals of each species that are likely to be affected?

It is not possible to reliably estimate the number of individuals that may be exposed to the proposed activities. Cetaceans and otters using Cork Harbour form part of wider regional populations and are highly mobile, with variable and intermittent use of the inner harbour. Numbers of individuals present within the site investigation area at any given time are expected to be low.

Will individuals be disturbed at a sensitive location or sensitive time during their life cycle?

There are no known breeding, calving, pupping or resting sites for Annex IV species within the site investigation area. Inner Cork Harbour is not considered to represent a sensitive life-cycle location for cetaceans or otter.

The proposed activities are short-term and localised and are not expected to coincide with, or affect, sensitive periods of the species' life cycles.

Are the impacts likely to focus on a particular section of the species' population (e.g. adults vs. juveniles, males vs. females)?

There is no evidence to suggest that any particular age class or sex of cetaceans or otters is more likely to occur within the site investigation area than another. Any potential disturbance would therefore not be focused on a specific demographic group.

Will the plan or project cause displacement from key functional areas (e.g. breeding, foraging, resting or migration)?

The area does not comprise a key functional area for Annex IV species. Any temporary avoidance or displacement that may occur during geophysical survey activities would be localised and short-term, with extensive alternative habitat available within the wider harbour and adjacent coastal waters. No long-term displacement is predicted.

How quickly is the affected population likely to recover once the plan or project has ceased?

Any disturbance to Annex IV species would be confined to the period of active survey operations and would cease immediately on completion of activities. Given the short duration, limited spatial extent, and high mobility of the species concerned, individuals are expected to return to baseline behaviour immediately or within a short period following cessation of activities. No population-level effects are predicted.

1.3.8 CONCLUSION

The relevant Annex IV species which could be present in the area and potentially affected by the proposed survey activities are cetaceans and otters and bat species.

As described in Section 4.4.7 of this risk assessment, the proposed SI activities are unlikely to have significant effects on cetaceans, otters and bat species within the MUL Area. Given the scale and nature of the proposed activities it can be concluded that the proposed SI activities 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 have been considered in this report.

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