ANNEX IV SPECIES RISK ASSESSMENT OF DOGNOSE BANK, WHITEGATE, CO CORK

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1 | INTRODUCTION

The Irish Whale and Dolphin Group (IWDG) was contracted by Malachy Walsh and Partners (MWP) to carry out an Annex IV Species Risk Assessment of proposed marine site investigations at Dognose, Corkbeg, Whitegate, Cork. Annex IV species include cetaceans, marine turtle, otter and bats. Although not listed on Annex IV, we have included pinnipeds (seals) and basking sharks in this assessment as they frequently occur, in and adjacent to, Cork Harbour.

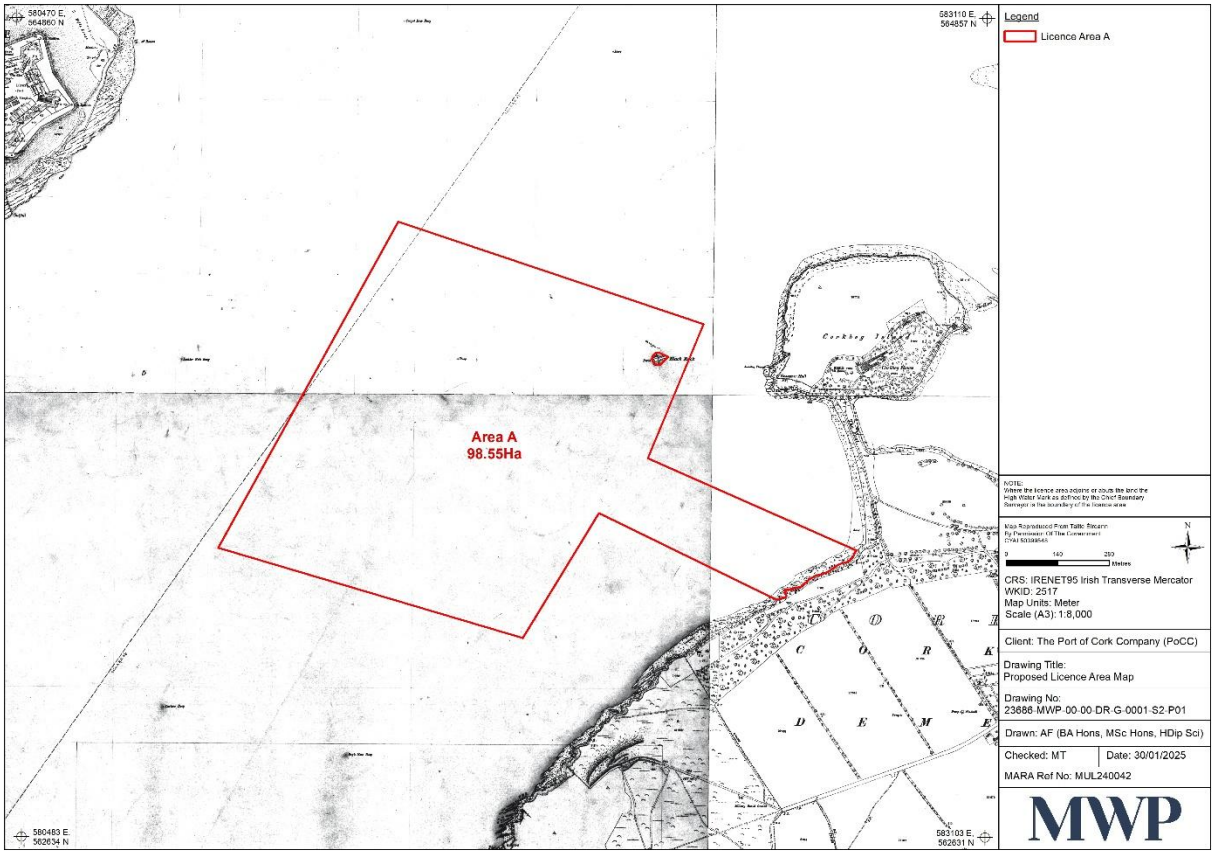

Figure 1: Location of proposed geophysical survey

Proposed works

Geophysical and geotechnical surveys are proposed for an area west of Whitegate Oil Refinery (Figure 1). The geophysical survey will consist of sub bottom profiler single channel seismic reflection, underwater multichannel analysis of surface waves (UMASW) and seismic refraction surveys. For the geotechnical survey, approximately 20 boreholes and 20 Cone Penetration Tests will be required in total. Boreholes will be drilled using cable percussion rig and a rotary coring rig. The number of legs used for the operations is dependent on seabed conditions, current strength and wave action. For the application area, four legs are the most likely scenario; however, this may be variable with weather conditions.

Receiving Environment

The receiving environment includes the area being investigated by geophysical and geotechnical surveys and adjacent waters which may be affected in Cork Harbour and its approaches. The receiving environment includes the benthos, the benthic, demersal and pelagic fish in the area, and the species listed on Annex IV including marine mammals, marine turtles, otter and bats.

2 | METHODS

This risk assessment was based on original data collected by the IWDG and a review of the available literature. The IWDG Sightings dataset, which is validated and updated daily was accessed and data from the 10 year period 2012 to 2021 was exported and mapped. Marine mammals and turtles are highly mobile and there are no SACs for Annex IV species in the vicinity of Cork Harbour.

3 | LEGAL STATUS

Irish cetaceans (whales, dolphins and porpoises), pinnipeds, otter and Leatherback Turtle are all protected under national legislation and under a number of international directives and agreements which Ireland is signatory to. All cetaceans, as well as grey and harbour seals, are protected under the Wildlife Act (1976) and amendments (2000, 2005, 2010 and 2012). Under the 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 under license or permit). The act applies out to the 12 nml limit of Irish territorial waters.

All cetaceans, otter and Leatherback Turtle are protected under Annex IV of the EC Habitats Directive (92/43/EEC). The Directive lists Annex IV species of community interest 'in need of strict protection'. Pinnipeds are not listed on Annex IV but are listed on Annex II, which also includes the harbour porpoise (*Phocoena phocoena*), bottlenose dolphin (*Tursiops truncatus*), leatherback turtle (*Dermochelys coriacea*) and otter (*Lutra lutra*) which are of community interest and whose conservation requires the designation of special areas of conservation.

Ireland is also signatory to conservation agreements such as the Bonn Convention on Migratory Species (1983), the OSPAR Convention for the Protection of the Marine Environment of the northeast Atlantic (1992) and the Berne Convention on Conservation of European Wildlife and Natural Habitats (1979).

Under the EU Marine Strategy Framework Directive with respect to maintaining good environmental status (GES), "*human activities should occur at levels that do not adversely affect the harbour porpoise community at the site*" and "*proposed activities or operations should not introduce man-made energy at levels that could result in a significant negative impact on individuals and/or the community of harbour porpoise within the site*". This refers

to the "*aquatic habitats used by the species in addition to important natural behaviours during the species annual cycle*".

In 2007, the National Parks and Wildlife Service (NPWS) of the Department of Arts, Heritage and the Gaeltacht produced a '*Code of Practice for the Protection of Marine Mammals during Acoustic Seafloor Surveys in Irish Waters* (NPWS, 2007). These were subsequently reviewed and amended to produce '*Guidance to manage the risk to marine mammals from man-made sound sources in Irish waters*' (NPWS, 2014). The guidelines recommend that listed coastal and marine activities be subject to a risk assessment for anthropogenic sound-related impacts on relevant protected marine mammal species to address any area-specific sensitivities, both in timing and spatial extent, and to inform the consenting process.

Once the listed activity has been subject to a risk assessment, the regulator may decide to refuse consent, to grant consent with no requirement for mitigation, or to grant consent subject to specified mitigation measures.

4 | BASELINE ENVIRONMENT

4.1 | Ambient Noise Levels

Ambient, or background noise, is defined as any sound other than the sound being monitored (primary sound) and, in the marine environment, is a combination of naturally occurring biological and physical sound sources including sediment transfer, waves and rain and that of a biological origin including fish, crustaceans and from marine mammals. The impact of noise created by human activity is strongly influenced by background or ambient noise, the impact is less in a noisy environment compared to a quiet environment and it's the intensity and frequency of this increased noise compared to the ambient levels at a site, which defines its impact. As ambient noise levels increase, the ability to detect a biologically important sound decreases. The point at which a sound is no longer detectable over ambient noise is known as acoustic masking. The range at which an animal is able to detect these signals reduces with increasing levels of ambient noise (Richardson *et al.* 1995). This is important when considering the impact of sound sources on marine mammals by the proposed works.

Ambient noise levels worldwide have been on the rise in recent decades with developments in industry and, in particular, in commercial shipping. In the North Pacific, low frequency background noise has approximately doubled in each of the past four decades (Andrew *et al.* 2002), resulting in at least a 15- to 20-dB increase in ambient noise. In recent years, interest has grown in the effects of anthropogenic noise on marine life.

A high-resolution autonomous underwater sound recording device was deployed outside Cork Harbour in 2012 as part of a pilot scheme to explore monitoring obligations under the Marine Strategy Framework Directive (Sutton *et al.* 2014). The RTSYS system was deployed for 16 days (April to August) with a sampling rate of 156.25 kHz. This deployment recorded background noise at a maximum of around 80 dB re 1 µPa, which fluctuated mainly in response to environmental variables, the major peaks (at around 120 – 130 dB re 1 µPa) coincided with windy events. Anthropogenic sound was dominated by shipping activity, whose sound emissions dominated the ambient noise for a short period of time, with levels returning to background between ship passing events.

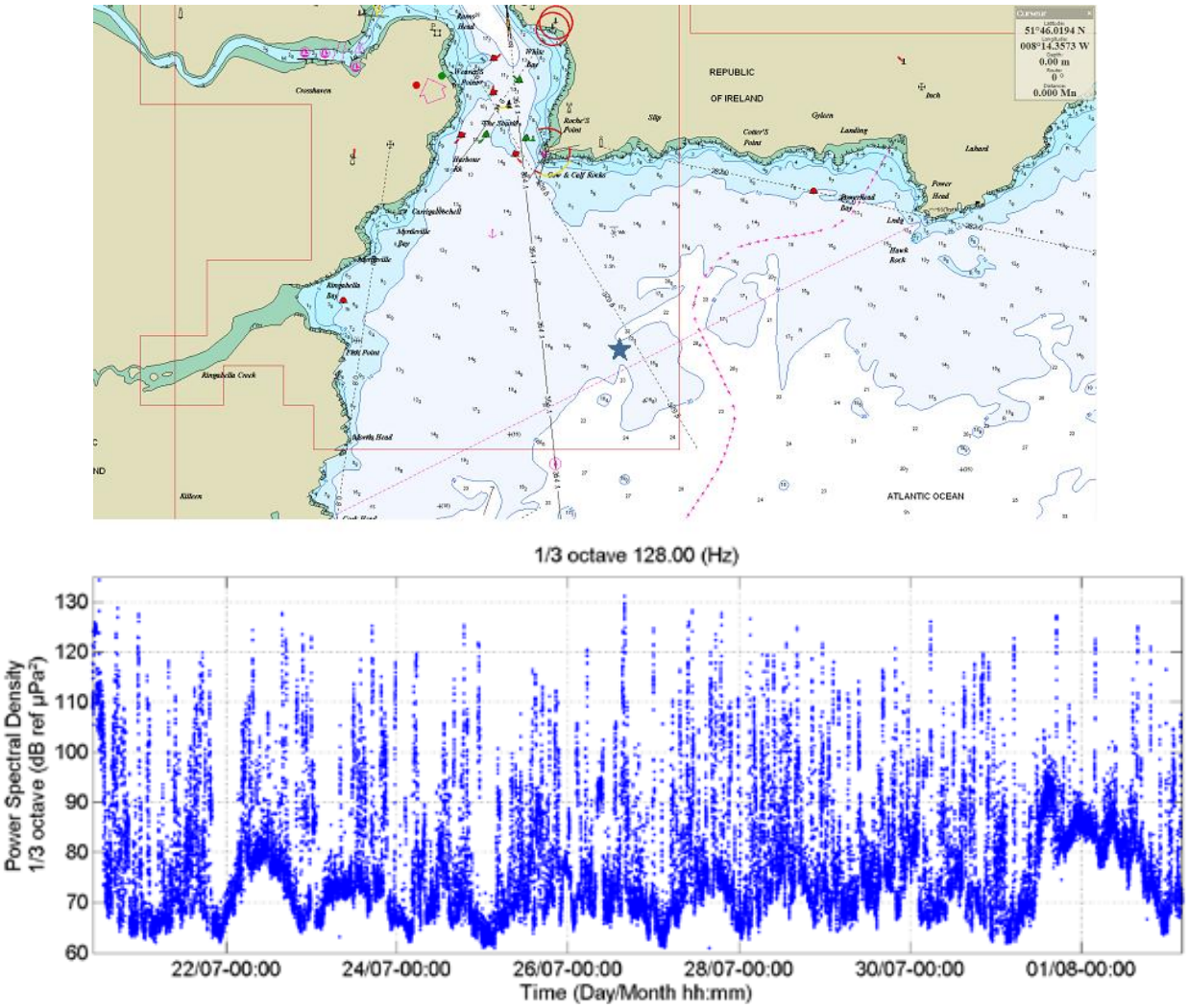

Figure 2. Location and results of RTSYS system deployed at the dump site in 2012 (from Sutton *et al.* 2014)

4.2 | Marine Mammals

This risk assessment was based on original data collected by the IWDG and a review of the available literature. The IWDG Sightings dataset, which is validated and updated daily, was accessed (on 24 August 2022) and data over a 10 year period (2012 to 2021) was exported and mapped.

A review of validated cetacean (whale, dolphin and porpoise records) submitted to the IWDG accessed 122 records of cetaceans and (Table 1). Seven cetacean species were recorded with 83 (68%) recorded to species level (Table 2). Bottlenose dolphin was the most frequently recorded species with 26.2% of all records, followed by common dolphin (18.9%).

Minke whale (7.4%) and Harbour porpoise (9.8%) were also frequently recorded with humpback whale and Risso's dolphin also occasionally recorded (Table 2).

Table 1. Cetacean sightings (including IWDG downgrades) recorded in Cork Harbour and adjacent waters from 2012-2021.

Species	No. sightings	No. individuals	% of records
Bottlenose dolphin	32	224	26.2
Common dolphin	23	1743	18.9
Harbour porpoise	12	22	9.8
Minke whale	9	31	7.4
Fin whale	4	14	3.3
Humpback whale	2	2	1.6
Risso's dolphin	1	8	0.8
Dolphin species possibly harbour porpoise	11	74	
Dolphin species	15	234	
Large whale species	5	10	
Whale sp.	6	8	
Cetacean species	2	2	
Total	**122**	**2372**	

4.2.1 Cetaceans

Bottlenose dolphin (Tursiops truncatus)

Bottlenose dolphins occur off the Cork coast (Fig.3) but at relatively lower frequency than along the west coast (Berrow *et al.* 2010). Animals encountered inshore are likely to derive from a coastal population which range around the entire Irish coastline and to adjacent UK and mainland Europe coasts (O'Brien *et al.* 2009; Robinson *et al.* 2012).

Many historic bottlenose dolphin sightings in the vicinity of Cork Harbour relate to a small pod of 6-7 bottlenose dolphins which were resident at the mouth of Harbour (Ryan *et al.* 2010). Although bottlenose dolphins are frequently recorded, no sightings of this "resident" group have been reported since May 2013. Sightings of small groups of non-resident dolphins throughout the year but data from land-based effort watches indicate a peak in late autumn / early winter which may coincide with the presence of pelagic schooling fish in the area. Bottlenose dolphins are typically encountered in group sizes of 5 but up to 30 animals. Larger group sizes have been recorded but predominantly in offshore areas. Inshore animals will readily approach vessels but are less likely to engage in extended periods of bow riding than common dolphins.

Common dolphin (Dephinus delphis)

Common dolphins occur frequently and at high densities off the Cork coast (Wall *et al.* 2013). They are frequently encountered in the area for most of the year (Fig. 3) including in the inner harbor near the city, though these individuals frequently live strand and die. Abundance typically falls to a minimum during April and May but peaks in the vicinity of Cork Harbour during autumn and winter, coinciding with the presence of pelagic schooling fish in the area (Wall *et al.* 2013). Common dolphins are regularly recorded at the spoil grounds (Fig. 3). They are

gregarious and commonly occur in group sizes of tens of animals. During the autumn and winter, group sizes numbering many tens or even hundreds of animals are not uncommon off the Cork coast. They readily approach vessels and may bow ride for extended periods.

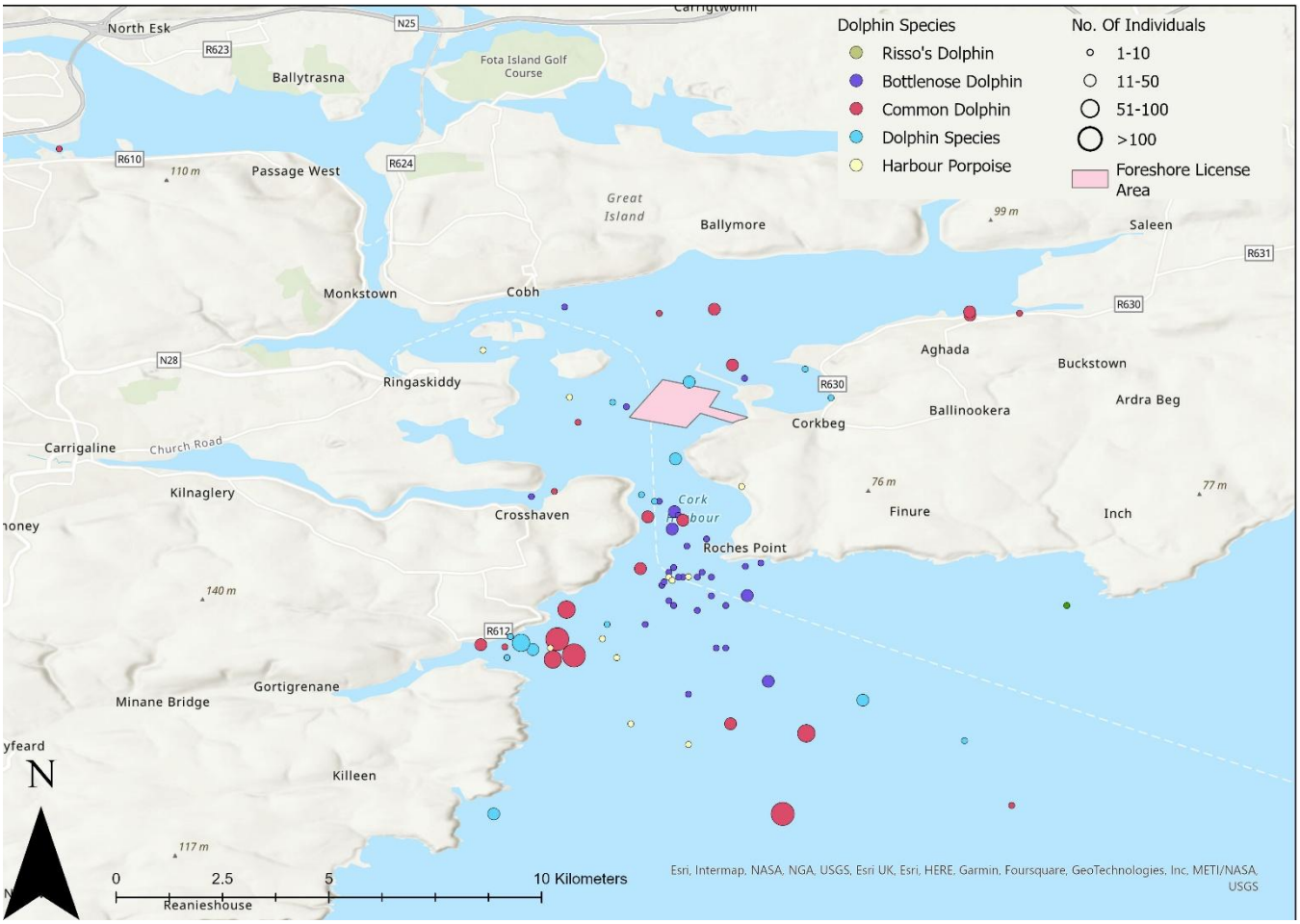

Figure 3: Sightings of Dolphins in Cork Harbour and adjacent waters.

Harbour porpoise (Phocoena phocoena)

Harbour porpoise are the most widespread and abundant cetacean in inshore Irish waters, with highest abundances in the Irish Sea (Berrow *et al.* 2010). Harbour porpoise were one the most frequently recorded cetacean species during maintenance dredging operations for the Port of Cork over the September-October period (Russell and Levesque, 2014; O'Dwyer, 2017. Sightings were outside of Cork Harbour, during transit to and at the disposal site. Harbour porpoise are widespread and have been sighted within Cork Harbour and on the spoil ground (Fig. 4). Harbour porpoise are typically encountered as individuals or in small groups of 2-3 animals throughout the year, but with a peak in group size during the autumn off the Cork coast. They normally will avoid medium and large vessels.

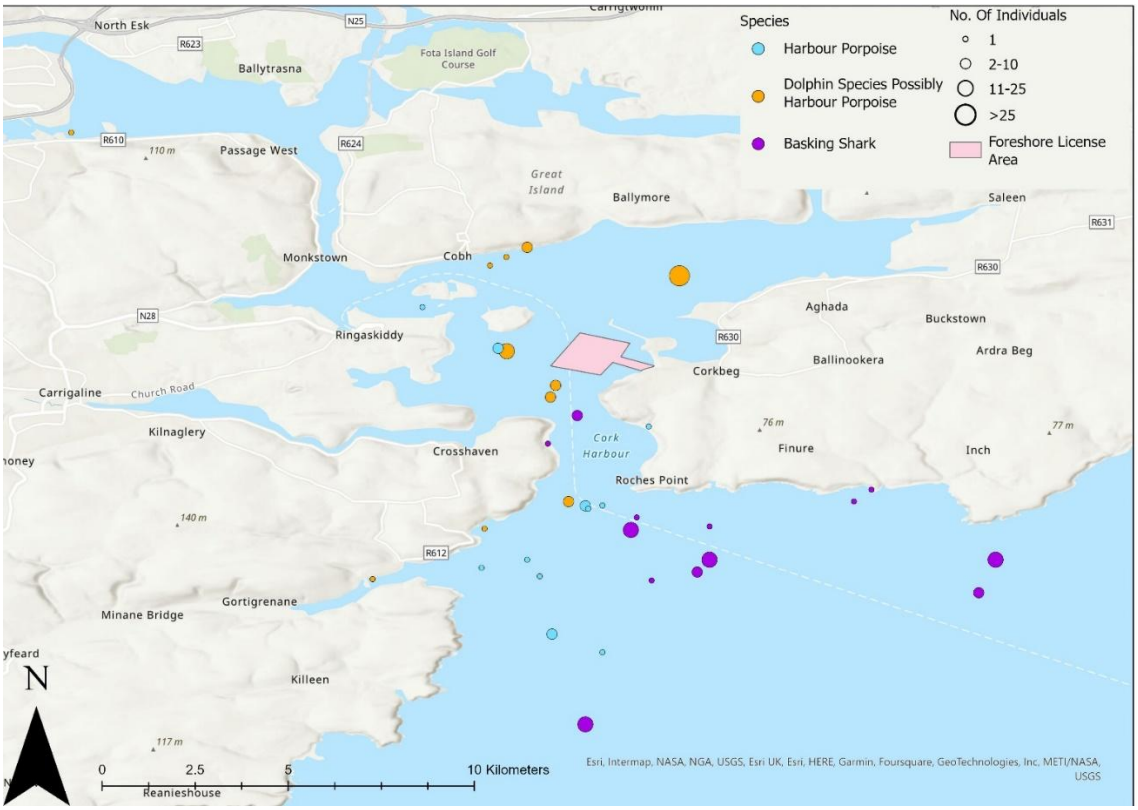

Figure 4: Sightings of Harbour Porpoise and basking shark in Cork Harbour and adjacent waters.

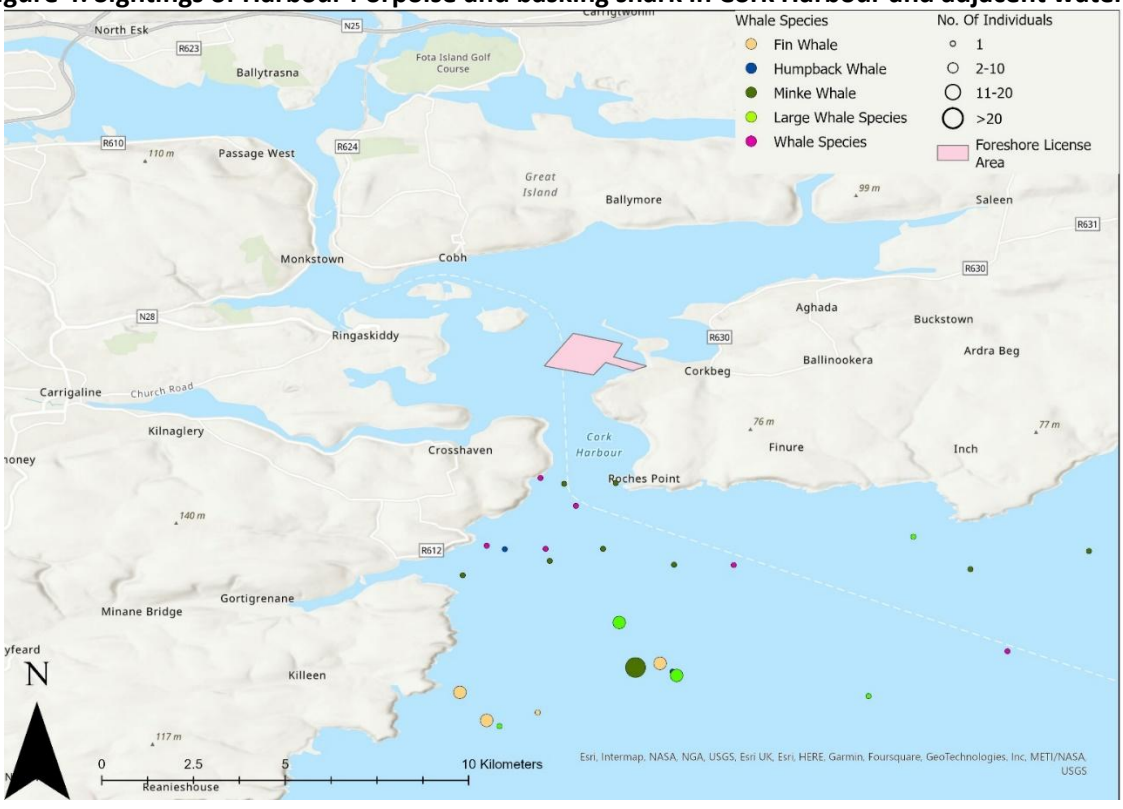

Figure 5: Sightings of baleen whales in Cork Harbour and adjacent waters.

Minke whale (Balaenoptera acutorostrata)

Minke whales occur frequently off the Cork coast and at the entrance to Cork Harbour, including on the spoil ground (Fig. 5). They occur from late spring to early winter but are largely absent during winter and early spring (Berrow *et al. 2010*). Minke whale abundance in the vicinity of Cork Harbour peak in late summer and autumn, and coincide with the presence of pelagic schooling fish in the area (Wall *et al.* 2013). Minke whales were recorded off Roches Point during dredging operations for the Port of Cork in 2014 and 2017 (Russell and Levesque, 2014; O'Dwyer 2017). Minke whales are typically encountered as individuals. In the late summer and autumn loose feeding aggregations of two to five animals may be encountered. They do not typically approach large vessels but can be quite inquisitive and may approach slow moving or static vessels.

Fin whale (Balaenoptera physalus)

Fin whales regularly occur off the Cork coast (Whooley *et al.* 2011) and have been recorded at the entrance to Cork Harbour (Fig. 5). They occur from June to January but are largely absent from February to May (Berrow *et al.* 2010). Fin whale abundance in the vicinity of Cork Harbour coincides with the presence of pelagic schooling fish (Wall *et al.* 2013). Fin whales were observed during dredging operations in 2014 (Russell and Levesque, 2014). Photo-identification studies indicate a significant degree of site fidelity by fin whales using these foraging grounds (Whooley *et al.* 2011). Fin whales are typically encountered as individuals or in small groups of 2-3 animals but during autumn and early winter loose feeding aggregations of up to 10 - 12 animals may be encountered. They do not typically approach large vessels.

Humpback whale (Megaptera novaengliae)

Humpback whales occur regularly but in smaller numbers than fin whales off the Cork coast. They are recorded from June to January but are largely absent from February to May. Humpback whales occur in the vicinity of Cork Harbour peak in autumn and early winter (Fig 5), which coincides with the presence of pelagic schooling fish in the area (Wall *et al.*, 2013). Photo-identification studies indicate a significant degree of site fidelity by humpback whales using these foraging grounds (Ryan *et al.* 2015). Humpback whales are typically encountered as individuals or in pairs off the Cork coast. They do not readily approach large vessels but can be quite inquisitive and may approach slow moving or static vessels.

Risso's dolphin (Grampus griseus)

Risso's dolphins are sighted occasionally at the entrance to Cork Harbour and adjacent waters (Fig. 3). Risso's dolphins are not abundant in Irish waters but tend to be patchily distributed (Wall *et al.* 2013).

4.3 Other Annex IV species

Other Annex IV species of interest include marine turtles, otter and rare seal species (Table 3). Data from the National Biodiversity Data Centre was also accessed to help inform this Annex IV assessment.

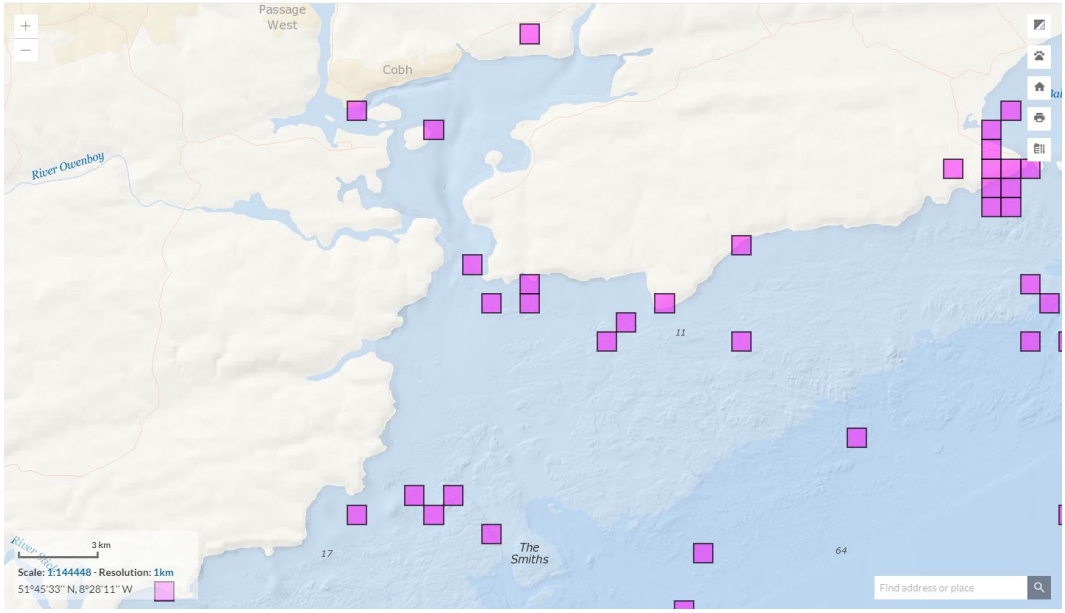

Figure 6. Map of leatherback turtle sighting records around Cork Harbour (map courtesy of the National Biodiversity Data Centre).

4.3.1 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 (Doyle 2007) and a rete-like arrangement of blood vessels at the proximal end of each fore flipper (counter-current heat exchangers) (Doyle 2007). Leatherback turtles have been frequently recorded off Cork Harbour, with records throughout the year but most between July and September (Fig. 6; King and Berrow 2009). Loggerhead turtle (*Caretta caretta*) has also been recorded off Cork Harbour but only very rarely (King and Berrow 2009).

4.3.2 Otter (Lutra lutra)

Otters are widespread around Cork Harbour. Smiddy (1993) surveyed the east side of Cork Harbour and suggested it provided good habitat for otters. Reid *et al.* (2013) categorised Co Cork as having intermediate densities (0.10/0.15 females per km^2) compared to other parts of Ireland. Otters were present in all 10km^2 blocks around Cork Harbour between 2007-2011 (Reid *et al.* 2013). Surveys for otters were carried out and evidence (spraints) of otter activity adjacent to the beach were noted in the EIAR.

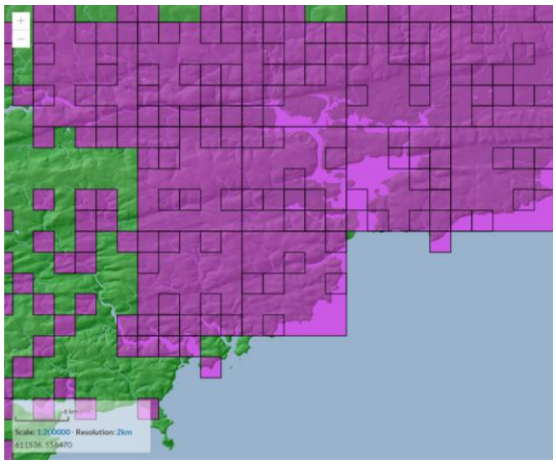

Figure 7a. Map of otter distribution around Cork Harbour (map courtesy of the National Biodiversity Data Centre).

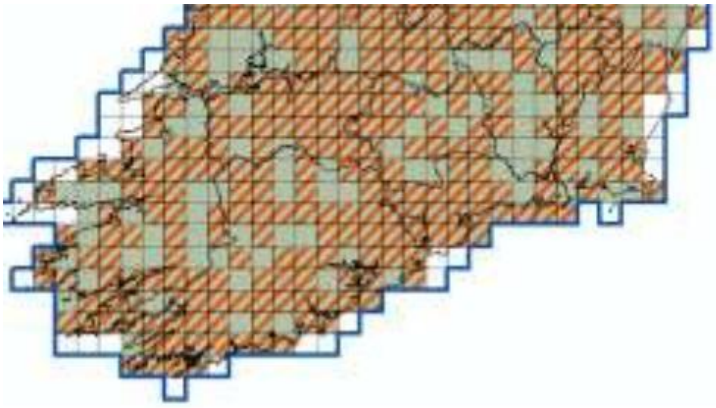

Figure 7b. Map of otter distribution around Cork (from Reid et al. 2013).

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 it may be a larger extent, where for both females and males a total width of coastal water body would be 80m (NPWS, *Lutra lutra* (1355) Conservation Status Assessment Report). Underwater, hearing sensitivity is significantly reduced compared to pinniped species, demonstrating that otter hearing is primarily adapted to receive airborne sounds (Ghoul *et a*l. 2014).

4.3.3 Bats

Bats are also protected under the EU Habitats Directive (92/43/EEC). The lesser horseshoe bat which is found in the Republic of Ireland only is listed in Annex II of the EU Habitats Directive, while all bat species are listed in Annex IV of the Directive. This Annex IV Species Risk Assessment has also considered the potential for any impacts from the proposed activities at the site on any of the ten species of bat that are confirmed as resident in Ireland (Kelleher and Marnell, 2006).

In the EAIR a review of existing bat records within a 10km radius of the study site (sourced from BCIreland's National Bat Records Database) showed that six Irish bat species have been recorded locally. The most frequently recorded was the common pipistrelle bat (*Pipistrellus pipistrellus sensu lato*) according to data supplied by the National Biodiversity Data Centre.

Figure 8. Map of bat distribution around Cork Harbour (map courtesy of the National Biodiversity Data Centre).

4.4| Non-Annex IV species of conservation interest (ETP)

4.4.1 Basking shark (*Cetorhinus maximus*)

Basking sharks were observed along the coast and off the Old Head of Kinsale, including at the mouth of the harbour (Fig. 4). Basking sharks are seasonally abundant on the surface during early spring and summer but may occur in continental shelf Irish waters throughout the year.

4.3.2 Pinnipeds

Grey and harbour seals are distributed around the entire Irish coast with grey seals being more abundant along the western seaboard (Cronin *et al.* 2004; O'Cadhla *et al.* 2007; O'Cadhla and Strong 2007).

Grey Seal (Halichoerus grypus)

There are no recorded grey seal breeding sites in Cork Harbour (O'Cadhla *et al.* 2007; Morris and Duck 2019), however grey seals have been noted hauled out in Cork Harbour. Grey seals range long distances while foraging (Cronin *et al.* 2016) and may be expected to be encountered regularly within the harbour and at the disposal site. They were the most frequently recorded marine mammal during dredging operations in 2014 and 2017 with between 57 and 70% of all sightings being of grey seals, usually single individuals (Russell and Levesque 2014; O'Dwyer 2017).

Harbour or Common Seal (Phoca vitulina)

There were no harbour seal haul-out sites or breeding sites recorded within Cork Harbour during National Parks and Wildlife Service (NPWS) surveys (Cronin *et al.* 2004; Morris and Duck 2019). A small number of harbour seals (six) were recorded hauled out at Kinsale Harbour, to the west (Cronin *et al.* 2004). Harbour seals are much less frequently recorded within Cork Harbour but have been recorded along the shipping channel. Harbour seals pup in June-July and the moulting period occurs after breeding, starting in June and ending in November, with a peak in mid-September (Cronin *et al.* 2014).

5| IMPACT ASSESSMENT

The potential effects of geophysical and geotechnical on Annex IV species was addressed by assessing the likelihood that these species would be exposed, or interact, with marine activities. Impacts assessed include likelihood of occurrence, and disturbance especially from noise emitted during surveys and drilling and dredging and from additional marine vessels. Acoustic disturbance includes the ability of the individual to detect increased noise levels over ambient levels, masking, Temporary Threshold Shift (TTS) and Permanente Threshold Shift (PTS) and behavioural impacts, i.e. resulting in a behavioural change by individuals. The potential effects on turbidity and indirect impacts on preferred prey are also considered.

5.1 | Description of Activities

5.1.1 Geophysical Survey

The proposed geophysical investigation will consist of sub bottom profiler single channel seismic reflection, underwater multichannel analysis of surface waves (UMASW) and seismic refraction surveys. The interpretation of the geophysical survey forms the basis of the scope of work for geotechnical surveys. The surveys are likely to take three weeks to complete.

5.1.1 Geotechnical Survey

The exact location and spacing of the geotechnical sampling, within the survey corridor will be determined following interpretation of the geophysical data. Depending upon the requirement identified from interpretation of the geophysical data, approximately 20 boreholes (cable percussive with rotary follow-on) and 20 Cone Penetration Tests (CPT's) will be required in total, along with associated sampling and laboratory testing. Boreholes will be drilled using cable percussion rig and a **rotary coring rig**.

Each borehole will have a seabed footprint of approximately 0.5m^2 and risings of approximately 11m^3 (assuming a borehole depth of up to 25m) will be dispersed around the drill site as a cuttings pile. The borehole will be left to collapse naturally following completion of drilling where the cuttings are likely to fall back down the hole. Boreholes will likely be drilled from a **jack-up platform**. The number of legs used for the operations is dependent on seabed conditions, current strength and wave action. For the application area, four legs are the most likely scenario; however, this may be variable with weather conditions.

The Piezocone penetrometer for CPT shall have a minimum 10 tonne capability and a maximum depth penetration of 6m below seabed. The CPT is undertaken by pushing an instrumented cone into the ground at a constant speed, with continuous measurement of the cone end resistance, the friction along the sleeve of the cone, and the pore water pressure. The geotechnical investigation works are likely to take 12 weeks to complete.

5.1.3. Turbidity

Seabed disturbance drilling could result in a local increase in turbidity. Marine mammals often inhabit turbid environments and many utilize acoustic techniques to communicate and navigate.

5.1.4 Indirect impacts on prey

Indirect impacts may occur on Annex IV species if the distribution or abundance of their preferred prey is impacted by dredging and disposal activities.

5.2 | Literature Review of Impacts and Mitigation

The NPWS '*Guidance to manage the risk to marine mammals from man-made sound sources in Irish waters – January 2014*' recommends that listed coastal and marine activities, undergo a risk assessment for anthropogenic sound-related impacts on relevant protected marine mammal species to address any area-specific sensitivities, both in timing and spatial extent, and to inform the consenting process. It is required that such an assessment must competently identify the risks according to the available evidence and consider (i) direct, (ii) indirect and (iii) cumulative effects of anthropogenic sound (NPWS 2014).

5.2.1 Geophysical Survey Impacts

Geophysical and geotechnical equipment produce a wide range of frequencies and source levels. MacGillivray *et al.* (2014) used modelling explore the acoustic effects of marine survey sound sources on marine mammals. They reviewed the acoustic signatures of widely used equipment (see Table 2).

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.

Sub-bottom profilers produced frequencies of 1-6 kHz at a source level of 200 dB re 1µPa @1m, while multibeam and side-scan sonar much higher frequencies of 200-230kHz at 218-229 dB re 1µPa @1m. The model indicated that odontocetes were most likely to hear sounds from mid-frequency sources (fishery, communication, and hydrographic systems), mysticetes from low-frequency sources (sub-bottom profiler and airguns), and pinnipeds from both mid and low-frequency sources. High-frequency sources (side-scan and multibeam) generated the lowest estimated sensation levels for all marine mammal species groups.

5.2.1 Side scan sonar, sub-bottom profiling

Sub-bottom profilers are typically low to mid-frequency with high source levels and could impact of marine mammals (Table 3). Typical level magnitudes of *Sub-Bottom Profilers* used by IFREMER (2016) showed transmitted signals were quite homogeneous between constructors (Ixblue, Kongsberg, Knudsen). The peak levels of acoustic pressure were in the range 213 to 228 dB re 1µPa @1m. The FM signal features a long modulation typically of few tens of ms with a relatively constant level in the frequency band. The typical pulse length was 80 ms, and the usable frequency band was between 1.8 and 5.3 kHz. The SPL (Sound Pressure Level) received is equal to 213 dB re 1µPa@1m with a pulse length of 80 ms, is 202 dB re 1 µPa².s @ 1m (IFREMER 2016).

Table 3. typical sound characteristics of a range of sub-bottom profilers (from https://www.federalregister.gov/documents/2015/06/30/2015-16012)

Model	High Frequency	Parametric or low Frequency	Source level primary	Source level parametric	
Atlas Parasound	18-33 kHz	0.5 to 6kHz	242/245dB	206/200 dB	Whale warning mode
Kongsberg SBP 120		2.5 to 7 kHz	220 dB		
Innomar SES-2000 Deep Parametric sub-bottom profilers	35 kHz	2, 3, 4, 5, 6, 7 kHz	244 dB		
Huntec boomer		0.5 to 8 kHz	205 dB		
Edgetech 512i		1 to 12 kHz	198 dB		
SIG '2 mille' mini-sparker		1 to 6 kHz	204 dB		
Arena Sub K-Chirp 3310		2 to 8 KHz	204 dB		
Applied Acoustics AA201 and AA301 boomer		1 to 6 kHz	212/215 dB		
Applied Acoustics Squid 500/2000 sparker		1 to 3.5 kHz	216/222 dB		
Applied Acoustics S-Boom		1 to 5 kHz	222dB approx.		

Acoustic sources are prone to impact marine mammals when the values of SPL and SEL received by the marine mammals are above specific tolerance thresholds (depending on the signal type and frequency, and on marine mammal species). Southall et al. (2007) recommend a threshold of 215-230 dB re. 1µPa²×s. The results suggest that auditory damage is only likely if animals pass the transducer at close range and that the impact on marine mammals can be mitigated by implementing prior detection and shut down procedures.

5.2.2 Cone Penetration Tests (CPTs)

Site investigations will be a combination of cable percussion and rotary drilled boreholes, carried out using a drilling rig set-up on a jack up barge. Cone Penetrometer Test (CPT) is used to determine the geotechnical engineering properties of sediments. Boreholes will be drilled using cable percussion rig and a rotary coring rig.

5.2.3 Increased turbidity

Any increases in turbidity are unlikely to affect Annex IV species. Marine mammals often inhabit turbid environments, and many utilise sophisticated sonar systems to sense the environment around them (Au *et al.* 2000). Pinnipeds do not produce sonar for prey detection purposes, however Newby *et al.* (1970) reported apparent blindness in three harbour seals on Gertrude Island, Puget Sound, Washington and found them to appear healthy suggesting their ability to forage was unaffected by blindness. McConnell *et al.* (1999) tracked grey seals in the North Sea and included one blind seal in their study. No significant difference in foraging behaviour was found indicating vision is not essential to pinnipeds' survival or ability to forage.

5.2.4 Indirect impacts on prey

Prey such as fish and crustaceans could be affected by low to mid-frequency sound sources if close on start-up.

5.3 Risk Assessment

The potential for disturbance to marine mammals is greatest when elevated levels of underwater noise are considered. Marine mammals, especially cetaceans, have well developed acoustic capabilities and are sensitive to sound at much higher frequencies than humans (Richardson *et al.* 1995). They are less sensitive to the lower frequencies but there is still great uncertainty over the effects of sound pressure levels on marine mammals and thus the assessment of its impact. Sources of noise include that generated during geophysical surveys and caused by drilling, and CPT and associated vessels during marine operations.

5.3.1 Acoustic disturbance

Effects on marine mammals

Erbe and McPherson (2017) measured the acoustic output during geotechnical site investigations prior to marine construction. Drilling (120 kW, 83 mm diameter drill bit, 1500 rpm, 16–17 m drill depth in sand and mudstone) and SPT (50 mm diameter test tube, 15 mm wall thickness, 100 kg hammer, 1 m drop height) by a jack-up rig in 7–13 m of water were recorded with a drifting hydrophone at 10–50 m range. Source levels ranged at around 142–145 dB re 1 lPa rms @ 1 m (30–2000 Hz) for drilling and 151–160 dB re 1 lPa2 s @ 1 m (20–24 000 Hz) for standard penetration testing.

Sound produced by drilling at 145 dB re: 1 mPa@1m will not elicit a behavioural response, temporary threshold shift (TTS) or permanent threshold shift (PTS) in marine mammals within the survey area according to the behavioural response criteria proposed by Southall et al. (2007). Sound from penetration testing although higher did not exceed thresholds likely to cause a significant effect even at close range not lead to TTS. In addition, the sound produced is intermittent and generated for short durations, resulting in minimal exposure periods.

Although there are few empirical studies on the effects of geophysical and geotechnical techniques on pinnipeds or odontocetes (Richardson *et al.* 1995). Elevated noise from sub-bottom profilers could affect seals which are sensitive to a lower frequency ranges than odontocetes (Todd *et al.* 2015).

Anderwald *et al.* (2013) found that grey seals showed some level of avoidance to high construction vessel traffic in Ireland, but this study was in a relatively pristine environment compared to the already heavily impact Dublin Harbour. Pinnipeds may exhibit much tolerance and often haul out on man-made structures where there is considerable human activity. This exposure may lead to some chronic exposure to man-made noise, with which

they tolerate. Ecological or physiological requirements may leave some marine mammals with no choice but to remain in these areas and continue to become chronically exposed to the effects of noise. In areas with repeated exposure, mammals may become habituated with a decline in avoidance responses and thus become less sensitive to noise and disturbance (Richardson *et al.* 1995). Reactions, when measured, have only occurred when received sound levels are well above ambient levels.

Increased vessel activity including a jack-up barge will occur. Marine mammals are sensitive to geophysical surveys but tolerant of shipping noise, being repeatedly exposed to many vessels, small and large. Pinnipeds also exhibit much tolerance and often haul out on man-made structures where there is considerable human activity. Marine turtles, bats and otter are unlikely to occur at the site. Based on these findings it is concluded that the proposed works could have an impact on the Annex IV cetacean species without mitigation.

Otter and Marine Turtles

Otters are also quite sensitive to the low frequency range but less sensitive than marine mammals. They can therefore hear and are susceptible to the noise of shipping, geotechnical drilling, SBP and HESS. However only those individuals within the water will be exposed and then only when very close to the activities. The area has low suitability for otter as it occurs offshore. Otters could potentially forage offshore but the site is considered to be of negligible value for otter. Based on these findings in relation to otter it is concluded that the proposed works will have no impact on the Annex IV species otter.

The likelihood of otters or marine turtles being in the area geophysical or geotechnical surveys is extremely low. If they did occur, they could be impacted by the geophysical survey if they were very close to the sound source. The presence of small vessels and a jack-up barge and the associated noise produced, could lead to a very localised increase in vessel traffic and associated noise, but is very unlikely to have a significant impact on any Annex IV species.

Bats

The area has low suitability for bats as it occurs offshore. Bats could forage at or transit the site however no linear features which could function as significant commuting routes and/or feeding areas will be affected. Considering its offshore nature, the site is considered to be of negligible value for bats. Based on these findings in relation to bats as it is concluded that the proposed works will have no impact on the terrestrial Annex IV bat species.

5.3.2 Physical Disturbance

The risk of injury or mortality is considered extremely low as marine mammals are exposed to considerable vessel traffic on a daily basis and would be aware of their presence. The geophysical vessel is small and slow thus any animals in the area would have sufficient time to avoid any collisions and thus injury or mortality.

5.3.3 Collision Risk

Collisions are extremely unlikely due to the small size and slow speed of the survey vessel.

5.3.4 Indirect impacts on preferred prey

No adverse effects on fish species is expected from marine operations.

5.3.5 Potential disturbance to life-cycle

The proposed marine operations will not cause any adverse effects on Annex IV species in the area as the affected area affected is small and disturbance local.

5.3.5 Cumulative Effects

Cumulative effects will be very limited as duration is short (15 weeks in total) and no other marine activities are planned in the immediate area to the best of our knowledge, leading to no cumulative effects.

6 | MITIGATION MEASURES

Marine mammal Mitigation

Potential mitigation measures during marine site investigations are limited. The most effective mitigation is through the use of a Marine Mammal Observer (MMO) who ensures that there are no marine mammals within a pre-agreed distance prior to the onset of marine site investigations. The MMO can also record any reaction to the geophysical and geotechnical investigations. However, this mitigation measure will only be effective during daylight hours and in favourable weather conditions.

The National Parks and Wildlife Service recommend a distance of 1000m for geophysical survey and 500m radial distance of the drilling sound sources in water depths of <200m (NPWS 2014) on commencement.

Guidance to Manage the Risk to Marine Mammals from Man-made Sound Sources in Irish Waters

The mitigation measures recommended by the NPWS are for the presence of a trained and experienced Marine Observer (MMO) to ensure a “buffer zone” is clear of marine mammals prior to the start of noise inducing activities. The proposed mitigation measures (Guidance to Manage the Risk to Marine Mammals from Man-made Sound Sources in Irish Waters) recommended by the Department of Arts, Heritage and the Gaeltacht in 2014 are designed to mitigate any possible effects.

The following mitigation measures are proposed to minimise the potential impacts on marine mammals and to allow animals move away from the area of dredging and HDD operations:

1. A dedicated, qualified and experienced Marine Mammal Observer will conduct a 30-minute watch for marine mammals within 1000m (geophysical) and 500m (geotechnical) prior to start up. If an Annex IV species (cetacean, marine turtle or otter) or seal is sighted within the Mitigation Zone (MZ), start-up must be delayed until the animal(s) is observed to move outside the MZ or the 30 minutes has passed without the animal being sighted within the mitigation zone.
2. Geophysical and geotechnical activities shall only commence in daylight hours where effective visual monitoring, as performed and determined by the MMO, has been achieved. Where effective visual monitoring, as determined by the MMO, is not possible the sound-producing activities shall be postponed until effective visual monitoring is possible.
3. Once normal 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 MZ.

6.1 Disturbance

The most effective way of mitigating the potential effects of acoustic disturbance is through the provision of an MMO ensuring no marine mammals are present within an agreed mitigation zone.

6.2 Collision, injury and mortality

There is no risk of injury, mortality or collision.

6.3 Disruption of normal behaviour

Geophysical and geotechnical investigations activity is very local and of relatively short duration and any disturbance will be short term. Sound exposure levels from geophysical and geotechnical investigations maybe above levels that are able to cause disturbance to a marine mammal, including, masking or behavioural impacts. The presence of an additional vessel and the associated noise produced, is very unlikely to have a significant impact on marine mammals.

7 | NPWS ASSESSMENT

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

Bottlenose dolphins are the most frequently recorded marine mammal species adjacent to the site. Grey seals are frequently observed in, and at the mouth, of Cork Harbour. Common dolphin, minke and fin whales occur in the wider area. No moulting sites for grey or harbour seals occur in Cork Harbour. All marine mammals are part of a larger population and are very mobile. Otters do not occur at the site while marine turtles are extremely rare. Bats may occur very occasionally in the area of the proposed works, but no specific foraging area exist at or adjacent to the marine area of interest.

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

The project will not cause injury or death nor disturbance with proposed mitigation, as any impacts including noise associated with the project is local and of short duration.

The activities proposed during this project consist of geophysical and geotechnical (drilling and CPT) operations. It is unlikely any noise generated will be capable of causing excessive disturbance or permanent or temporary hearing injury to a marine mammal. Localised disturbance to marine mammals in the works area may occur during operations without mitigation.

The risk of injury or mortality is considered extremely low as Annex IV species, if they occurred in the immediate vicinity of the site are exposed to human activity on a daily basis and would be accommodated.

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

No abundance estimates for marine mammals exposed to the proposed activity are available but the numbers in the harbour are generally low. Seals occur in low numbers within the harbour and counts at breeding and moulting sites are available at sites >50km from Cork Harbour. Cetaceans occur in small numbers in the harbour but in greater numbers at the disposal site but no robust density estimates for the site are available. The numbers of all marine mammals present at the disposal site and exposed to elevated noise levels are likely to be in the low 10s. Otter do not occur at the site and bats if at all would be passing through. Only a

few individual marine turtles have been recorded in Cork Harbour over the past few decades and are extremely unlikely to occur during the proposed surveys.

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

Cetaceans occurring within Cork Harbour can be sporadic but some species such as bottlenose dolphins may occur more during summer months. Other species such as harbour porpoise occur throughout the year at the site while common dolphin abundance peaks during autumn. Harbour porpoise and common dolphin adults with calves have been recorded at the disposal site during summer and autumn months. As there are no known pupping or moulting sites for seal within or adjacent to Cork Harbour it will have no effect.

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

There are no data to suggest that any particular gender or age group Annex IV species predominates in the area suggesting marine operations site are likely to expose all age groups and both gender.

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

Marine mammals occur at the site but there is no evidence the site is close to important foraging, nursery, resting or migration routes. No long-term displacement will occur. While a range of Annex IV species occur throughout the year and during for some species at important feeding times (e.g. autumn for fin whales), the marine activities will not lead to any significant disturbance. Small numbers of grey seals may occur in the vicinity of the site but they are accommodated to human activities and are unlikely to be affected. No otters occur and bats, if they occur, are likely to be just transitting the site.

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

No long-term disturbance of Annex IV species in the area will occur, short term affects can be mitigated. All Annex IV species (with the exception of marine turtles) are accommodated to human activities and are likely to recover from any temporary disturbance within hours or days.

8 | RESIDUAL IMPACTS

With implementation of the above mitigation measures, it is very unlikely that there will be any negative residual impacts from the proposed marine operations on Annex IV species in the area.

9 | SUMMARY

Cork Harbour and its approaches are important for some Annex IV species in the area including the occurrence of bottlenose dolphins and grey seals adjacent to the proposed site. Mitigation to reduce impacts on Annex IV cetacean species is recommended and if implemented will result in no significant impacts. Mitigation is recommended through provision of an MMO during geophysical and geotechnical activities to comply with NPWS (2014) guidelines.

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