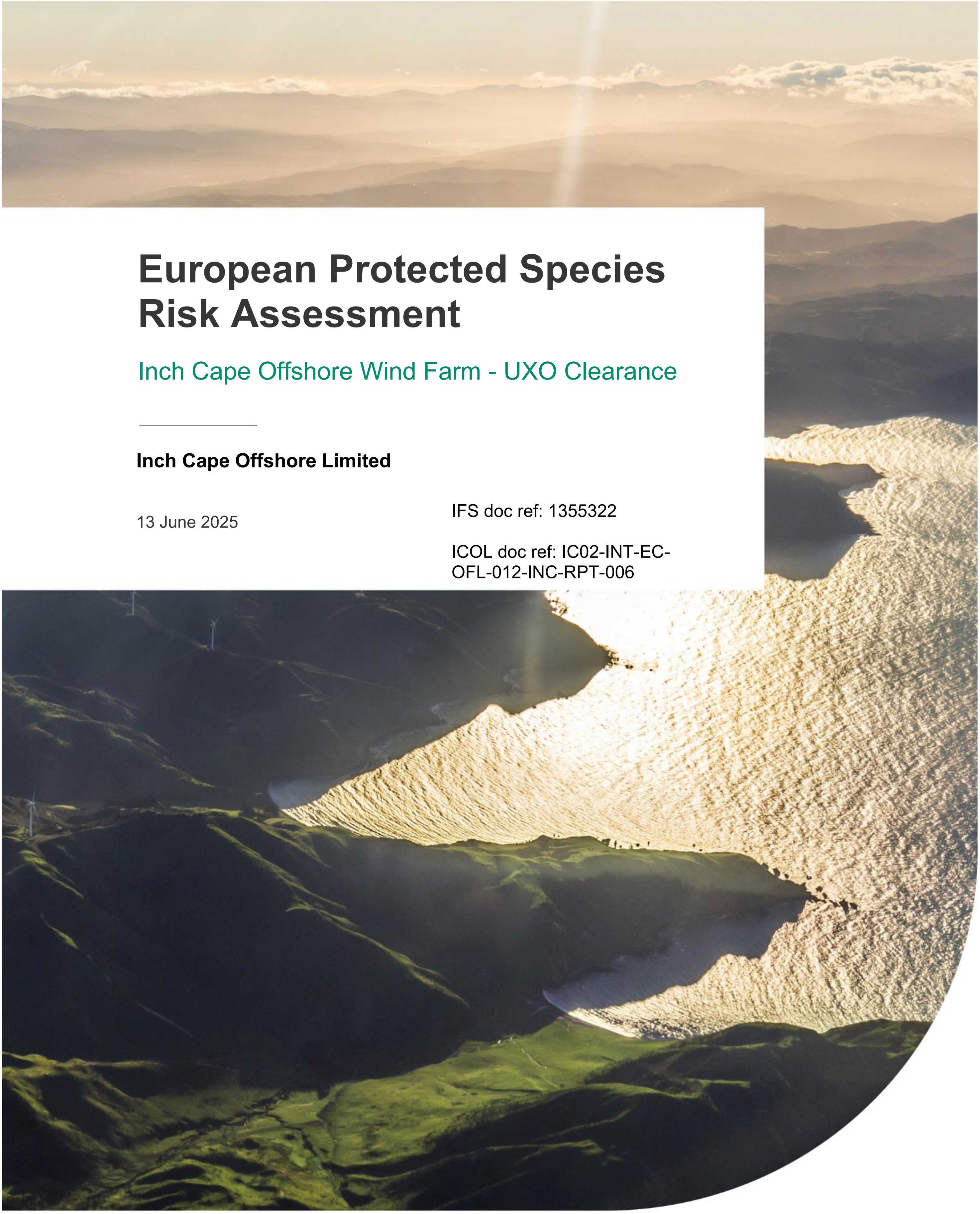

European Protected Species Risk Assessment

Inch Cape Offshore Wind Farm - UXO Clearance

Inch Cape Offshore Limited

13 June 2025

IFS doc ref: 1355322

ICOL doc ref: IC02-INT-EC-OFL-012-INC-RPT-006

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Document history

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Issue	Date	Revision Details
A	23/05/2024	First Draft
B	28/06/2024	Second Draft
C	10/07/2024	Third Draft
D	18/07/2024	Fourth Draft
E	26/07/2024	Final draft
F	03/06/2025	Update to Programme
G	13/06/2025	Update to programme (new submission)

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Contents

Acronyms and Abbreviations

Acronyms and Abbreviations	
ADD	Acoustic Deterrent Device
ALARP	As Low as Reasonably Practicable
BEIS	Department for Business, Energy & Industrial Strategy
CI	Confidence Interval
cUXO	Confirmed UXO
DA	Development Area
ECC	Export Cable Corridor
EDR	Effective Deterrence Ranges
EEC	European Economic Community
EPS	European Protected Species
EU	European Union
FCS	Favourable Conservation Status
HRA	Habitat Regulations Assessment
IAMMWG	Inter Agency Marine Mammal Working Group
ICOL	Inch Cape Offshore Limited
JNCC	Joint Nature Conservation Committee
kHz	Kilohertz
km	Kilometre
m	Metre
ML	Marine Licence
MMMP	Marine Mammal Mitigation Protocol
MMO	Marine Mammal Observer
MPA	Marine Protected Area
MTD	Marine Technology Directorate
MU	Management Unit
NAS	Noise Abatement System
NEQ	Net Explosive Quantity
OWF	Offshore Wind Farm
PAM	Passive Acoustic Monitoring
PTS	Permanent Threshold Shift
pUXO	Potential Unexploded Ordnance
RA	Risk Assessment
RIAA	Report to Inform Appropriate Assessment
ROV	Remotely Operated Vehicle
SAC	Special Area of Conservation

Acronyms and Abbreviations	
SCANS	Small Cetaceans in European Atlantic Waters and the North Sea
SCOS	Special Committee on Seals
SEI	Supporting Environmental Information
SEL	Sound Exposure Level
SNH	Scottish Natural Heritage
SPL	Sound Pressure Level
SSC	Suspended Sediment Concentration
STW	Scottish Territorial Waters
UK	United Kingdom
USBL	Ultra-short Baseline
UXO	Unexploded Ordnance
WTG	Wind Turbine Generators

1. Introduction

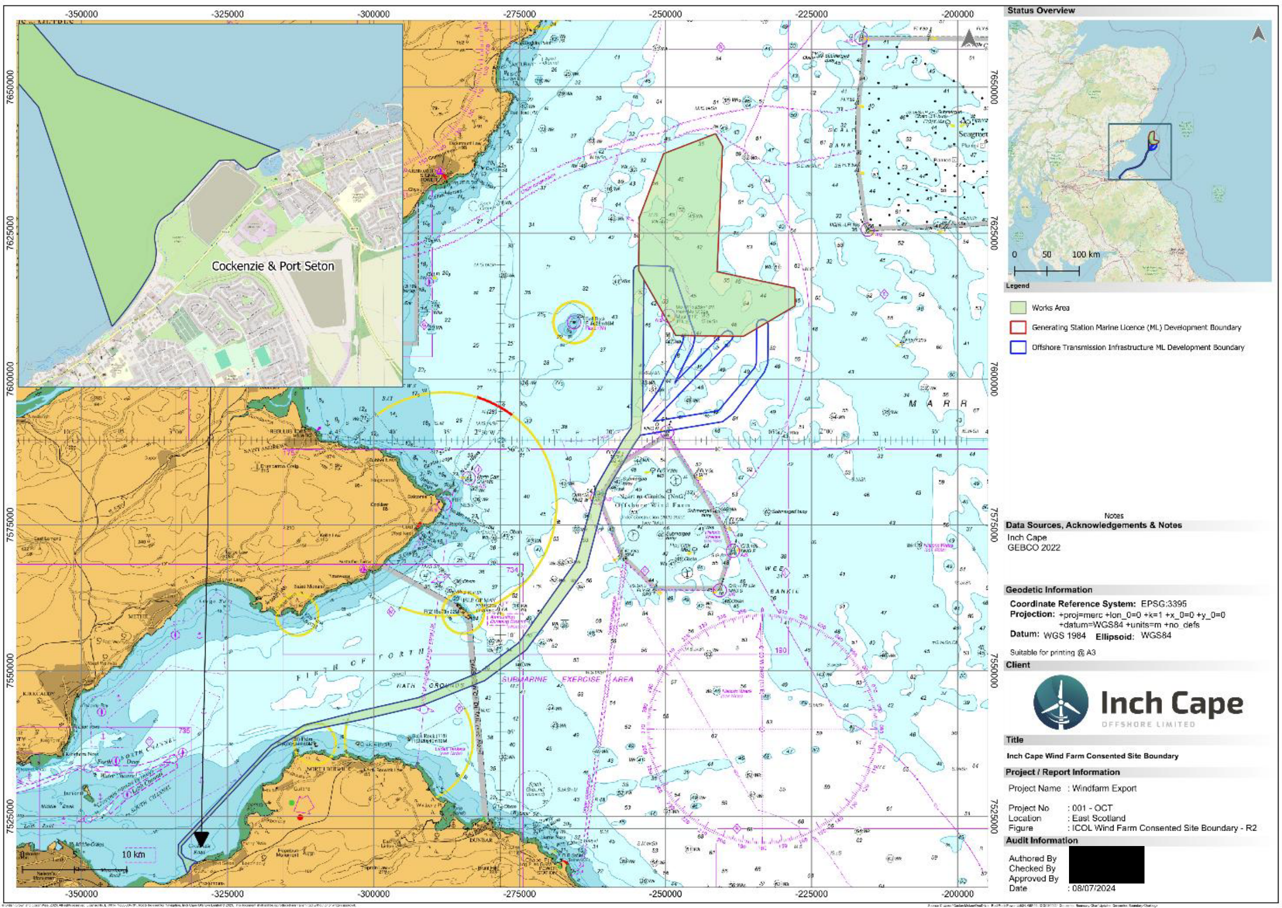
Inch Cape Offshore Limited (ICOL) has consent to develop an offshore wind farm (OWF) in the outer Firth of Tay region within Scottish Territorial Waters (STW). The consented Inch Cape OWF will comprise up to 72 wind turbine generators (WTGs) and be located approximately 15 km to the east of the Angus coastline (Figure 1.1). The Development Area (DA) is in water depths of between 40 - 59 m.

It is possible that unexploded ordnance (UXO) may be present on the site (DA and offshore export cable corridor (ECC)). Following potential unexploded ordnance (pUXO) target investigation work, and prior to installation of the Inch Cape OWF, UXO clearance work may be required. A Marine Licence (ML) is being sought for this (UXO clearance) work.

This document assesses the potential risk to marine European Protected Species (EPS), basking sharks and seals from the proposed UXO clearance work in order to ascertain whether EPS and basking shark licences are required and can be awarded.

An EPS Licence to Disturb (EPS/BS-00010894) (valid until 30 June 2025) and a Marine Licence (MS-00010883) were granted in October 2024 for the UXO clearance during early construction for the Inch Cape Offshore Wind Farm.

Figure 1.1: Inch Cape Offshore Wind Farm site location



2. Purpose of this Document

The objective of this document is to outline the UXO clearance activities associated with the Inch Cape OWF and assess potential effects of these activities on EPS in UK waters.

This EPS Risk Assessment (RA) supports the application for a Marine Licence for the clearance of UXO. In addition to this EPS RA, Supporting Environmental Information (SEI; doc ref: IC02-INT-EC-OFL-012-INC-RPT-003) and Report to Inform Appropriate Assessment (RIAA; doc ref: IC02-INT-EC-OFL-012-INC-RPT-004) documents have also been produced to support the ML application. The SEI and RIAA documents consider any potential impacts and the necessary mitigation measures required to ensure that no significant or adverse (in Habitat Regulations Assessment (HRA) terms) effects will occur (including to marine mammals). A Marine Mammal Mitigation Plan (MMMP; doc ref: IC02-INT-EC-OFL-012-INC-PLA-001) has also been prepared which complements this EPS RA.

ICOL is seeking to extend the current UXO clearance EPS Licence to Disturb (EPS/BS-00010894) and the Marine Licence (MS-00010883) to the end of the construction period (end of Q4 2027) to enable UXO clearance operations throughout the entire construction period.

3. Planned Work

The objective of the proposed UXO clearance work is to reduce the risk of UXO to as low as reasonably practicable (ALARP) status for personnel, vessels and the project infrastructure once installed.

It is anticipated that a maximum of 85 confirmed UXO (cUXO) targets may be present at the Project (DA and ECC) and require clearance. It is anticipated that 75 cUXO targets will be cleared using low order clearance methods whilst up to 10 cUXO may require high order clearance methods. These numbers are based on the findings of the UXO Threat and RA which is based on current published data on UXO presence in the project area.

It is likely that different types of cUXO may be present (Table 3.1), many of which are likely to have been subject to degradation or burying over time. It is anticipated that the largest UXO will have a net explosive quantity (NEQ) of 245 kg in the OWF DA and 1179 kg in the ECC.

A variety of options for managing UXOs on site are available and will be considered on a case-by-case basis:

- Micro-siting i.e., avoidance of UXO;
- Relocation ('lift and shift') of UXO (where deemed safe to do so); and
- Clearance of UXO using either low or high order clearance. Low order clearance will be used in the first instance. High order clearance will be used as a last resort.

It should be noted that in the case of UXO relocation, live UXO's will only be relocated when it is unsafe to clear in situ. In these cases, the UXO will be moved to an identified safe location within the development area for future disposal.

Different sized initiation explosives may be required for different sized UXOs. Here initiation explosives of low order 50g-250g, High order 5kg-10kg, have been assessed.

All relocation and clearance work will be undertaken by specialists in accordance with the appropriate regulations and guidance.

Table 3.1: Types and sizes of UXO which may be present in the Inch Cape OWF DA and ECC

NEQ (kg TNT)	Description	Location	
		DA	ECC
6	Small WWII Projectile	x	
15	Artillery Projectile		x
25	Small WWII Aerial Bomb	x	x
49	Large WWII Projectile	x	x
130	Medium WWII Aerial Bomb		x
165	WWI Mine	x	x
220	Large WWII Aerial Bomb	x	x
227	British WWII Mine	x	x
254	WWI Torpedo	x	x
354	WWII Aerial Torpedo		x
1179	German WWII Mine		x

Source: UXO Threat and RA.

3.1. Proposed Vessels

It has not yet been confirmed which vessels will be used for the UXO clearance work. It is likely that up to three vessels will be required:

- An ‘ROV support vessel’;
- Rigid Inflatable support vessel.
- A support vessel for the deployment of a noise abatement system (NAS) if required (High order only)

3.2. Timing and Duration

The UXO clearance works will be undertaken between the start of Q2 2025 and the end of Q4 2027.

4. Legal Requirements

4.1. EPS

All species of cetacean (whales, dolphins and porpoises) and marine turtles in waters around the UK are considered EPS under Annex IV of the Habitats Directive (Council Directive 92/43/EEC) which covers animal and plant species of community interest in need of strict protection.

The need to consider EPS in waters off Scotland comes from two articles of legislation, these are:

- The Conservation (Natural Habitats &c.) Regulations 1994 (as amended in Scotland) which transposes the Conservation of Natural Habitats and Wild Fauna and Flora Directive (Council Directive 92/43/EEC; referred to as the Habitats Directive) into Scottish law. This legislation covers Scottish Territorial Waters; and
- The Conservation of Offshore Marine Habitats and Species Regulations 2017 (known as the Offshore Regulations) which transpose the Habitats Directive into UK law for all offshore activities. This legislation covers UK waters beyond the 12 nm limit.

Both regulations (collectively known as the 'Habitat and Offshore Marine Regulations') provide for the designation of protected European sites (Special Areas of Conservation (SACs)) and the protection of EPS as designated under the Habitats Directive.

The Offshore Regulations state in section 45, that it is an offence to:

- Deliberately capture, kill or injure any wild animal of an EPS, as listed under Annex IV of the Habitats Directive;
- Damage or destroy, or cause deterioration of the breeding sites or resting places of a EPS; and
- Deliberately disturb EPS (in particular disturbance which is likely to impair the ability of a significant group of animals of that species to survive, breed, rear, or nurture their young, or which might affect significantly their local distribution or abundance).

The Conservation of Habitats and Species Regulations 1994 (as amended in Scotland) state, under section 39, that it is an offence to:

- Deliberately or **recklessly** capture, kill or injure a wild animal of an EPS, as listed under Annex IV of the Habitats Directive;
- Damage or **recklessly** destroy, or cause deterioration of the breeding sites or resting places of an EPS;
- Deliberately or **recklessly** disturb EPS (in particular, disturbance which is likely to impair their ability to survive, breed, reproduce, nurture their young, migrate or hibernate, or which might affect significantly their local distribution or abundance);
- Disturb **any** EPS in a matter that is, or in circumstances which are, likely to significantly affect the local distribution or abundance of the species to which it belongs; and
- **Deliberately or recklessly disturb any dolphin, porpoise or whale (cetacean) through Regulation 39 (2)**.

The additional protection afforded by the Conservation of Habitats and Species Regulations 1994 (as amended in Scotland) has been shown in **bold** in the list above. It is therefore an offence to deliberately or recklessly disturb a single cetacean in Scottish Territorial Waters.

In addition, any means of capturing or killing which is indiscriminate and capable of causing the local disappearance of - or serious disturbance to - any population of EPS is an offence.

Licences may be granted by the Marine Directorate (on behalf of the Scottish Ministers) which would allow otherwise illegal activities to go ahead.

Three tests must be passed before a licence can be granted:

1. The licence must relate to one of the purposes referred to in Regulation 44, which are:
   a. scientific research or educational purposes;
   b. ringing or marking, or examining any ring or mark on, wild animals;

   c. conserving wild animals, including wild birds, or wild plants or introducing them to particular areas;
   d. conserving natural habitats;
   e. protecting any zoological or botanical collection;
   f. preserving public health or public safety or other imperative reasons of overriding public interest including those of a social or economic nature and beneficial consequences of primary importance for the environment;
   g. preventing the spread of disease; or
   h. preventing serious damage to livestock, foodstuffs for livestock, crops, vegetables, fruit, growing timber or any other form of property or to fisheries;
2. There must be no satisfactory alternative (Regulation 44, 3a); and
3. The action authorised must not be detrimental to the maintenance of the population of the species concerned at a Favourable Conservation Status (FCS) in their natural range (Regulation 44, 3b).

FCS is defined in the Habitats Directive as the following:

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

The proposed Inch Cape OWF (DA and ECC) is within the 12 nm limit of Scotland's Territorial Waters. However, sound from the proposed work has the potential to affect animals within both Scottish Territorial and offshore waters. Both the Habitats and Offshore Regulations therefore apply.

4.2. Other non-EPS

4.2.1. Phocid Seals

Unlike cetaceans, phocid seals are not listed on Annex IV of the Habitats Directive and are therefore not EPS. Both grey and harbour seal are however listed on Annex II (animal and plant species of community interest whose conservation requires the designation of SACs) and Annex V (animal and plant species of community interest whose taking in the wild and exploitation may be the subject of management measures) of the Habitats Directive.

In addition, harbour and grey seals are UK Biodiversity Action Plan priority species.

In Scotland seals are also protected under the Marine (Scotland) Act 2010 and the Protection of Seals (Designation of Haul-Out Sites) (Scotland) Order 2014.

4.2.2. Basking Sharks

Basking sharks are protected under Schedule 5 of the Wildlife and Countryside Act 1981 (as amended) meaning that it is an offence to:

- Intentionally or recklessly kill, injure or take fish;
- Possess or sell fish; and
- Intentionally or recklessly disturb or harass fish.

4.3. Guidance

The Marine Directorate and Scottish Natural Heritage (SNH) (now Nature Scot) produced guidance for Scottish inshore waters ‘The protection of Marine European Protected Species from injury and disturbance’ in March 2014 (Marine Scotland and SNH, 2014). This guidance was updated in July 2020 (Marine Scotland and SNH, 2020). Marine Directorate recognise that the guidance ‘…reflects a precautionary approach…’ to the interpretation of the Habitats Directive with regards to EPS and requires the careful examination of the potential impact of proposed offshore activities, and the resultant noise produced, on individual animals likely to be present at the location.

The guidance states that the two main potential causes of death or injury are physical contact (with a vessel) and anthropogenic noise. Likelihood of disturbance for individuals includes factors such as:

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

Likelihood of potential impacts should include the following considerations:

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

5. EPS in the Region of the Inch Cape OWF

Four cetacean species are considered to occur on a relatively common basis in the vicinity of the Inch Cape OWF: Harbour porpoise (*Phocoena phocoena*), bottlenose dolphin (*Tursiops truncatus),* white-beaked dolphin (*Lagenorhynchus albirostris*) and minke whale (*Balaenoptera acutorostrata*) (Arso Civil *et al*., 2021; Gilles *et al.,* 2023; IAMMWG, 2023). Occasional visitors to the region include common dolphin (*Delphinus delphis*), Risso's dolphin (*Grampus griseus*), white-sided dolphin (*Lagenorhynchus acutus*), killer whale (*Orcinus orca*), long-finned pilot whale (*Globicephala melas*) and fin whale (*Balaenoptera physalus)*. Sightings of humpback whale (*Megaptera novaeangliae*) and sei whale (*Balaenoptera borealis*) have also been recorded in recent years[1].

5.1.1. Harbour Porpoise

The harbour porpoise is widespread around the UK, including the North Sea, Irish Sea, the seas west of Ireland and Scotland, and northwards to Orkney and Shetland. Since the 1990s it has become much less common around the Northern Isles, but it appears to be returning to the English Channel and southern North Sea, where it was infrequent in the late 1980s. The recent fourth Small Cetaceans in European Atlantic Waters and the North Sea (SCANS-IV) survey results, the latest in a series of large-scale surveys for cetaceans in European Atlantic waters, show that the harbour porpoise population in the North Sea is stable and there is very little difference in the estimated abundance from 2016 – 2022 (Gilles *et al.,* 2023).

Harbour porpoise density in the vicinity of the Inch Cape OWF, from SCANS-IV, is provided in Table 5.1. The relevant Inter Agency Marine Mammal Working Group (IAMMWG) Management Unit (MU) (whole and UK portion) abundance estimates are also provided and can be considered as the reference populations.

The closest designated site for harbour porpoise (Southern North Sea SAC) is greater than 200 km from the Inch Cape OWF.

Table 5.1: Harbour porpoise density and reference population abundance

Density (animals per km^2)	Management Unit	Abundance	95% Confidence Interval (CI)* for MU Abundance Estimate
0.5985	North Sea	346,601	289,498 - 419,967
	UK portion of North Sea	*159,632*	*127,442 - 199,954*

Source: Gilles et al. (2023) – SCANS-IV Block NS-D; IAMMWG (2023).

** An interval which is expected to typically contain the parameter being estimated.*

5.1.2. Bottlenose Dolphin

Both inshore and offshore bottlenose dolphin ecotypes are recognised in UK waters. The two largest inshore bottlenose dolphin populations are located in the Moray Firth, East Scotland and Cardigan Bay, Wales, which both have SACs designated for them. The east coast of Scotland bottlenose dolphin population has expanded south since the 1990s and now around 53% of the population uses the Tay Estuary and surrounding waters, which is adjacent to the Inch Cape OWF (Arso Civil *et al.* 2021).

Due to the behaviour and social structure of the inshore bottlenose dolphin population, which regularly travels along the coastline in close-knit groups, it is difficult to represent their density accurately. For example, the recent SCANS-IV survey did not detect any bottlenose dolphins in the relevant survey block for the Inch Cape OWF and therefore no density was estimated (Gilles *et al.,* 2023). As such, a density surface was created for the inshore bottlenose dolphin population using the most recent population estimate for east Scotland. The five-year weighted average for

[1] https://www.seawatchfoundation.org.uk/recentsightings/

the East Coast population (224, CIs: 214-234)[2] was assumed to be split 50:50 between the east coast (from Rattray Head south) and the Moray Firth (Cape Wrath to Rattray Head). The 20 m depth contour was used to differentiate between the 'coastal strip' (where inshore bottlenose dolphins tend to be encountered) and the 'non-coastal strip' (where inshore bottlenose dolphins tend not to be encountered). The choice of the 20 m contour was informed by data from the south side of the Moray Firth where greater than 95% of sightings made were within the 20 m depth contour (Culloch and Robinson, 2008; Robinson *et al*., 2007). The 112 individuals assumed to be present on the east coast (i.e., 50% of the population of 224 individuals) were distributed evenly across the area inside the 20 m depth contour on a 5 km x 5 km grid. Zero density was used beyond the 20 m depth contour and within the Forth and Inner Tay (where bottlenose dolphins are known not to be regularly present).

Additionally, in the absence of a density estimate for bottlenose dolphins from the SCANS-IV survey, the density of bottlenose dolphins in the vicinity of the Inch Cape OWF from SCANS-III has been used and is provided in Table 5.2 (Hammond *et al.* 2021).

The IAMMWG has accounted for the two ecotypes by defining two MUs, the Coastal East Scotland MU and the Greater North Sea MU (whole and UK portion). The abundance estimates for these are provided in Table 5.2. Considering that both inshore and offshore bottlenose dolphins may be impacted by the proposed work, the management units have been used as the reference populations.

The closest designated site for bottlenose dolphins (Moray Firth SAC) is greater than 200 km from the Inch Cape OWF, however, with the southerly expansion of the east Scotland bottlenose dolphin population there is likely high connectivity between the Proposed Development and animals from the population which uses this SAC.

Table 5.2: Bottlenose dolphin density and reference population abundance estimates

Density (animals per km^2)	Management Unit	Abundance	95% CI
0.0298	Coastal East Scotland	224	214 - 234
	Greater North Sea	2,022	548 - 7,453
	UK portion of Greater North Sea	*1,885*	*476 – 7,461*

Source: Hammond et al. (2021) – SCANS-III Block R; IAMMWG (2023).

5.1.3. White-beaked Dolphin

White-beaked dolphins are detected predominantly offshore in UK waters and their highest densities have been estimated around the Shetland Islands, northern North Sea and northwest Scotland (Gilles *et al*., 2023). The density of white-beaked dolphins in the vicinity of the Inch Cape OWF, from SCANS-IV, is provided in Table 5.3. The relevant IAMMWG MU (whole and UK portion) abundance estimates are also provided and can be considered as the reference populations. There are no designated sites (SACs) for white-beaked dolphins (not listed on Annex II of the Habitats Directive).

Table 5.3: White-beaked dolphin density and reference population abundance

Density (animals per km^2)	Management Unit	Abundance	95% CI
0.0799	Celtic and Greater North Seas	43,951	28,439 - 67,924
	UK portion of Celtic and Greater North Seas	*34,025*	*20,026 – 57,807*

Source: Gilles et al. (2023) – SCANS-IV Block NS-D; IAMMWG (2023).

2 https://www.nature.scot/doc/east-coast-scotland-bottlenose-dolphins-estimate-population-size-2015-2019

5.1.4. Minke Whale

Minke whales are the smallest of the baleen whales and are widespread around the UK. There was some evidence that minke whale distribution in the North Sea was shifting south between 1994 and 2005 (Hammond *et al.* 2013). In subsequent surveys the distribution appeared to remain consistent until the recent SCANS-IV survey which showed many sightings further south in the North Sea than previously seen. There is no evidence of a change in abundance for minke whales in the North Sea from 1989-2022 (Gilles *et al*., 2023).

Minke whale density in the vicinity of the Inch Cape OWF, from SCANS-IV, is provided in Table 5.4. Block NS-D is the highest density block for minke whales from this survey. The relevant IAMMWG MU (whole and UK portion) abundance estimates are also provided and can be considered as the reference populations.

The closest protected area for minke whale (Southern Trench Marine Protected Area (MPA)) is approximately 98 km from the Inch Cape OWF at its closest point. There are no designated sites (SACs) for minke whales (the species is not listed on Annex II of the Habitats Directive).

Table 5.4: Minke whale density and reference population abundance

Density (animals per km^2)	Management Unit	Abundance	95% CI
0.0419	Celtic and Greater North Seas	20,118	14,061 - 28,786
	UK portion of Celtic and Greater North Seas	*10,288*	*6,210 – 17,0412*

Source: Gilles et al. (2023) – SCANS-IV Block NS-D; IAMMWG (2023).

5.2. Marine Turtles

In addition to marine mammals, there are up to five species of marine turtle which have been sighted in British waters. The leatherback turtle (*Dermochelys coriacea*) is the most commonly recorded species in UK waters however, the species is thought to be at the most extreme northern limit of its natural range in UK waters with its range being limited by the 15ºC isotherm (McMahon and Hays, 2006; BEIS, 2016). Sightings in the North Sea are uncommon with most UK sightings occurring in the Irish Sea (BEIS, 2016). Due to the low likelihood of occurrence of marine turtles in the vicinity of the Inch Cape OWF, they have not been considered further. However, any mitigation proposed for cetacean EPS will also be applied to marine turtles.

5.3. Other (non-EPS) Species

5.3.1. Basking Shark

Basking sharks are protected under Schedule 5 of the Wildlife and Countryside Act 1981. There have been few sightings of this species in the North Sea (Drewery, 2012; Wilson *et al*., 2020) which indicates a low abundance in the vicinity of the Inch Cape OWF. Due to their habit of feeding at slow speed very close to the surface, basking sharks are potentially at risk from collision with boat traffic (Wilson *et al*., 2020). In contrast, although there is little information on sound detection in basking sharks, there is no direct evidence of sound causing basking shark mortality or stress (Wilson *et al*., 2020). Although the potential effects of noise on basking sharks have not therefore been assessed, any mitigation measures proposed for EPS will also be applied to basking sharks.

5.3.2. Seals

Two seal species occur on a relatively common basis in the North Sea: Grey seal (*Halichoerus grypus*) and harbour seal (*Phoca vitulina*) (Carter *et al*., 2022).

Grey seals

Grey seals are among the rarest seals in the world; the UK population represents about 40% of the world population and 95% of the EU population. Grey seals spend most of the year at sea and may range widely in search of prey. They come ashore in autumn to form breeding colonies on rocky shores, beaches, in caves, occasionally on sandbanks, and on small largely uninhabited islands.

In the east of Scotland the most recent estimate of grey seal pup production is 7,261 pups (2019) and the most recent August count of adult grey seals is 2,707 (2021) (SCOS, 2022).

The closest SAC which lists grey seal as a qualifying interest feature (Isle of May SAC) is 4 - 5 km from the Inch Cape OWF (export cable corridor) at its closest point. The Isle of May SAC has a stable or potentially declining population of grey seals with an estimated pup production of 1,885 (2019) and an August count of 97 (2021) (SCOS 2022).

Harbour seals

Harbour seals have a near-circumpolar distribution, with at least four subspecies recognised. Only the eastern Atlantic subspecies occurs in Europe. The UK population represents about 5% of the world population and approximately 50% of the EU population. Harbour seals are the characteristic seal of sandflats and estuaries but are also found on rocky shores in Scotland. As pups swim almost immediately after birth, seals can breed on sheltered tidal areas where banks allow access to deep water. Seals may range widely in search of prey, but individuals often return to favoured haul-out sites. The closest SAC which lists harbour seal as a qualifying interest feature (Firth of Tay and Eden Estuary) is approximately 25 km from the Inch Cape OWF at its closest point.

In east Scotland harbour seals are in decline. A complete survey of the East Scotland Seal Management Area was carried out by the Sea Mammal Research Unit in 2021. A total of 261 harbour seals were counted, which was 26% lower than the previous survey in 2016, of which 41 were in the Firth of Tay and Eden Estuary SAC (SCOS 2022).

Table 5.5 provides absolute density and abundance estimates for both grey and harbour seals, which were calculated using the relative density of at-sea distribution estimates from Carter et al., 2022. The methodology for making these estimates is provided in Appendix A. The density estimates were created for the Inch Cape OWF (DA and ECC) plus a 30 km buffer. The size of this buffer was based on the maximum range calculated for temporary threshold shift for phocids in water (Barham, 2024). Abundance estimates were also calculated, for both the Inch Cape OWF plus 30 km buffer and the East Scotland Seal Management Area. Minimum abundance estimates (N_{min}) are also provided for the East Scotland Seal Management Area in SCOS (2022). As these estimates are more conservative than the modelled abundance estimates both are presented and used as the reference population for grey seals and harbour seals.

Table 5.5: Seal density and reference population abundance estimates

Species	Density (animals per km^2)	Management Unit	Abundance estimates calculated using Carter *et al.* (2022)	SCOS (2022) abundance estimate
Grey seal	1.2660	East Scotland	18,259	10,106
Harbour seal	0.0474	East Scotland	377	262

Source: Appendix A, SCOS 2022.

6. Description of Potential Impacts and Risk Assessment

During the UXO clearance work, there is potential for marine EPS to be impacted. The main activities associated with the work which may impact these species are:

- Increased anthropogenic noise from UXO clearance work;
- Increased anthropogenic noise from use of Ultra-short Baseline (USBL) equipment;
- Risk of collision with vessels; and
- Changes in turbidity.

6.1. Overview of the Potential Effects of Anthropogenic Noise on Marine Mammals

It is widely documented that marine mammals are sensitive to underwater noise with the level of sensitivity depending on the hearing ability of the species (Table 6.1).

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

- Lethal effects and physical injury;
- Auditory injury; and
- Behavioural responses.

Table 6.1: Marine mammal hearing ranges

Functional hearing group	Example species	Estimated auditory bandwidth (kHz)
Low frequency cetacean	Minke whale	0.007 – 35
High frequency cetacean	Bottlenose dolphin	0.15 – 160
Very high frequency cetacean	Harbour porpoise	0.2 – 160
Phocid carnivores in water	Harbour seal Grey seal	0.05 – 86

Source: Southall et al. (2019).

6.1.1. Lethal Effects and Physical Injury

Because of the increased hazardousness of the shock wave associated with underwater detonations, potential physiological effects include mortality and direct (i.e., non-auditory) tissue damage known as primary blast injury (Finneran and Jenkins, 2012; Robinson *et al*., 2022). Primary blast injuries from explosive detonations are the result of differential compression and rapid re-expansion of adjacent tissues of different acoustic properties (e.g., between gas-filled and fluid-filled tissues or between bone and soft tissues). These injuries usually manifest themselves in the gas-containing organs (lung and gut) and auditory structures (e.g., rupture of the eardrum across the gas-filled spaces of the outer and inner ear).

6.1.2. Auditory Injury

Southall *et al.* (2019) provide thresholds for received sound levels that have the potential to induce the onset of auditory injury in marine mammals (Table 6.2). It is worth noting that the criteria refer only to the ‘onset’ of injury risk rather than a confident assessment of an occurrence of the effect.

JNCC *et al*. (2010a) proposes that a permanent shift in the hearing thresholds (PTS) of an EPS would constitute an injury offence. The Southall *et al*. criteria for injury are based on quantitative sound level and exposure thresholds over which PTS onset could occur (Table 6.2). If it is likely that an EPS could become exposed to sound at or above the levels proposed, then there is a risk that an injury offence could occur.

Table 6.2: Permanent threshold shift (PTS) thresholds

Functional hearing group	Example species	Impulsive		Non-impulsive
		SPL_{peak} (dB re 1 μPa)	SEL (dB re 1 μPa²s)	SEL (dB re 1 μPa²s)
Low frequency cetacean	Minke whale	219	183	199
High frequency cetacean	Bottlenose dolphin White-beaked dolphin	230	185	198
Very high frequency cetacean	Harbour porpoise	202	155	173
Phocid carnivores in water	Harbour seal Grey seal	218	185	201

Source: Southall et al. (2019).

6.1.3. Behavioural Responses

Behavioural responses may arise where an activity is audible (see Table 6.1) and at a level above ambient noise. Due to the very short duration and likely small number of potential acoustic events during the proposed UXO clearance work, behavioural responses are likely to only occur in the very short term (in response to the detonation sequence on a given day should high order clearance be required). Studies looking at the effects of a commercial two-dimensional seismic survey and ADD playbacks on cetaceans in the Moray Firth found that fine-scale behavioural responses by harbour porpoise occurred during the work, but that animals were typically detected again at affected sites within a few hours (Thompson *et al*., 2013; Thompson *et al*., 2020). Therefore, following cessation of each detonation event, it is considered likely that any behavioural effects will be reversible and that animals will resume normal behaviour within the short term.

The number of animals which may exhibit behavioural responses to the proposed UXO clearance (from both low order clearance and high order clearance) was estimated using the default effective deterrence ranges (EDR) for explosives (5 km and 26 km respectively) (JNCC, 2023a).

6.2. UXO Clearance Work (Pre-Mitigation)

The predicted impact ranges from the proposed UXO clearance work were modelled by Subacoustech Environmental (Subacoustech; Barham, 2024). Modelling was carried out for all four marine mammal hearing groups.

Because the pUXO investigations have yet to take place, a range of UXO types and sizes have been assessed (Table 3.1). Note, not all charge weights were modelled by Subacoustech; as a precaution, the modelled impact range for the next heaviest weight has been used in these cases.

As noted by Barham (2024), the large number of unknown variables that will affect the output of UXO located for an extended period on the seabed lead to a great degree of uncertainty which makes accuracy challenging in a desktop assessment. The assessment uses calculations based on a methodology proposed by Soloway and Dahl (2014), following Arons (1954) and MTD (1996). It is expected that the presented ranges overestimate the actual ranges of impact that would occur in practice, both from physical sound propagation and biological perspective.

The calculation parameters were all chosen to be conservative, leading to an upper estimate for source noise levels, and the risk of impact will be reduced over increasing range as the initial shock wave dissipates. This is not only due to the reduction in absolute noise level, but also the changing characteristics of the propagating sound wave.

This assessment has used the impulsive ranges. As noted in Barham (2024), these ranges are most relevant close to the blast. At greater ranges, and especially acoustically in shallow water, the sound pulse will spread out in time, becoming less 'sharp' and thus less injurious. Active research is currently underway into the identification of the distance at which the pulse can be considered effectively non-impulsive (likely to be at around 3.5 km from the source; Hastie *et al*., 2019). Because the modelled non-impulsive ranges (Barham, 2024) are smaller than this transition point the impulsive ranges have been used in this assessment. This assessment is therefore overly conservative.

6.2.1. Lethal Effects and Physical Injury

Although the potential for lethal effects and physical injury has not been modelled it is assumed that, in the absence of mitigation, they may occur as a result of the proposed UXO clearance work should individuals be present in close proximity to any high order detonations.

6.2.2. Auditory Injury

6.2.2.1. Very High Frequency Cetaceans

The modelled PTS impact ranges for very high frequency cetaceans (harbour porpoise) for the various potential charge weights are shown in Table 6.3 below. For low order clearance the greatest of the impulsive PTS impact ranges (SPL_{peak}/SEL_{ss}) is 0.99 km. For the greatest of the high order charges (i.e., the worst case), the greatest of the impulsive PTS impact ranges is 16.6 km.

Using these ranges, and assuming that spreading is approximately spherical (area = πr^2), the number of harbour porpoise which have the potential to be present within the zones of potential impact has been estimated (Table 6.4) using the SCANS-IV density estimate for Block NS-D (Table 5.1) where the Inch Cape OWF is located. The percentage of the relevant reference populations (Table 5.1) this represents has also been presented.

Table 6.3: Pre-mitigation PTS ranges (km) – very high frequency cetaceans (harbour porpoise)

Charge weight (kg TNT)		Impulsive		Non-impulsive
		SPL_{peak} (km)	SEL_{ss} (km)	SEL_{ss} (km)
Low Order	**0.05**	0.58	0.04	0.001
	0.25	0.99	0.08	0.003
High Order	**6.00**	2.80	0.32	0.016
	15.00	3.90	0.47	0.025
	25.00	4.60	0.56	0.033
	49.00	5.70	0.71	0.045
	130.00	8.60	1.00	0.081
	165.00	8.60	1.00	0.081
	220.00	9.60	1.10	0.094
	227.00	9.60	1.10	0.094

Charge weight (kg TNT)	Impulsive		Non-impulsive
	SPL_{peak} (km)	SEL_{ss} (km)	SEL_{ss} (km)
254.00	10.00	1.10	0.099
354.00	11.10	1.30	0.110
1179.00	16.60	1.70	0.190

Source: Barham (2024)

Table 6.4: Number of harbour porpoise which have the potential to be present within the pre-mitigation zones of potential impact

Charge weight (kg)		SPL_{peak} range (km)	Area (km^2)	Number of individuals	% of reference population	
					MU	UK portion of MU
Low Order	**0.05**	0.58	1.06	1	<0.001	0.001
	0.25	0.99	3.08	2	0.001	0.001
High Order	**6.00**	2.80	24.63	15	0.004	0.009
	15.00	3.90	47.78	29	0.008	0.018
	25.00	4.60	66.48	40	0.011	0.025
	49.00	5.70	102.07	61	0.018	0.038
	130.00	8.60	232.35	139	0.040	0.087
	165.00	8.60	232.35	139	0.040	0.087
	220.00	9.60	289.53	173	0.050	0.108
	227.00	9.60	289.53	173	0.050	0.108
	254.00	10.00	314.16	188	0.054	0.118
	354.00	11.10	387.08	232	0.067	0.145
	1179.00	16.60	865.70	518	0.149	0.324

6.2.2.2. High Frequency Cetaceans

The modelled PTS impact ranges for high frequency cetaceans (bottlenose dolphins and white-beaked dolphin) for the various potential charge weights are shown in Table 6.5 below. For low order clearance the greatest of the PTS ranges (SPL_{peak}/SEL_{ss}) is 0.06 km. For the greatest of the high order charges (i.e., the worst case), the greatest of the PTS ranges is 0.96 km.

Using these ranges, and assuming that spreading is approximately spherical (area = πr^2), the number of white-beaked dolphin which have the potential to be present within the zones of potential impact has been estimated (Table 6.6) using the SCANS-IV density estimate for Block NS-D (Table 5.3). The percentage of the relevant reference populations (Table 5.3) this represents has also been presented.

Using the modelled density surface for bottlenose dolphins it was calculated that the closest grid cell (5 km x 5 km) with a density estimate for bottlenose dolphins (see section 5.1.2) was 10.35 km from the Inch Cape OWF DA and 2.07 km from the offshore export cable corridor. Therefore, considering the maximum PTS range of 0.96 km, it is likely that no bottlenose dolphins will be affected by the UXO clearance work. However, as a precaution, the number of bottlenose dolphins which have the potential to be present within the zones of potential impact has been estimated (Table 6.7) using the SCANS-III density estimate for Block R (Table 5.2) where the Inch Cape OWF is located. The percentage of the relevant reference populations (Table 5.2) this represents has also been presented.

Table 6.5: Pre-mitigation PTS ranges (km) – high frequency cetaceans (bottlenose dolphin and white-beaked dolphin)

Charge weight (kg TNT)		Impulsive		Non-impulsive
		SPL_{peak} (km)	SEL_{ss} (km)	SEL_{ss} (km)
Low Order	**0.05**	0.03	<0.001	<0.001
	0.25	0.06	0.001	<0.001
High Order	**6.00**	0.16	0.005	<0.001
	15.00	0.22	0.009	<0.001
	25.00	0.26	0.011	0.001
	49.00	0.33	0.016	0.001
	130.00	0.50	0.029	0.003
	165.00	0.50	0.029	0.003
	220.00	0.55	0.034	0.003
	227.00	0.55	0.034	0.003
	254.00	0.57	0.036	0.003
	354.00	0.64	0.042	0.004
	1179.00	0.96	0.075	0.007

Source: Barham (2024)

Table 6.6: Number of white-beaked dolphin which have the potential to be present within the pre-mitigation zones of potential impact

Charge weight (kg)		SPL_{peak} range (km)	Area (km²)	Number of individuals	% of reference population	
					MU	UK portion of MU
Low Order	**0.05**	0.03	0.003	<1	<0.002	<0.003
	0.25	0.06	0.01	<1	<0.002	<0.003
High Order	**6.00**	0.16	0.08	<1	<0.002	<0.003
	15.00	0.22	0.15	<1	<0.002	<0.003
	25.00	0.26	0.21	<1	<0.002	<0.003
	49.00	0.33	0.34	<1	<0.002	<0.003
	130.00	0.50	0.79	<1	<0.002	<0.003
	165.00	0.50	0.79	<1	<0.002	<0.003
	220.00	0.55	0.95	<1	<0.002	<0.003
	227.00	0.55	0.95	<1	<0.002	<0.003
	254.00	0.57	1.02	<1	<0.002	<0.003
	354.00	0.64	1.29	<1	<0.002	<0.003
	1179.00	0.96	2.90	<1	<0.002	<0.003

Table 6.7: Number of bottlenose dolphin which have the potential to be present within the pre-mitigation zones of potential impact

Charge weight (kg)		SPL_{peak} range (km)	Area (km^2)	Number of individuals	% of Coastal East Scotland reference population	% of Greater North Sea reference population	
						MU	UK portion of MU
Low Order	0.05	0.03	0.003	<1	<0.446	<0.049	<0.053
	0.25	0.06	0.01	<1	<0.446	<0.049	<0.053
High Order	6.00	0.16	0.08	<1	<0.446	<0.049	<0.053
	15.00	0.22	0.15	<1	<0.446	<0.049	<0.053
	25.00	0.26	0.21	<1	<0.446	<0.049	<0.053
	49.00	0.33	0.34	<1	<0.446	<0.049	<0.053
	130.00	0.50	0.79	<1	<0.446	<0.049	<0.053
	165.00	0.50	0.79	<1	<0.446	<0.049	<0.053
	220.00	0.55	0.95	<1	<0.446	<0.049	<0.053
	227.00	0.55	0.95	<1	<0.446	<0.049	<0.053
	254.00	0.57	1.02	<1	<0.446	<0.049	<0.053
	354.00	0.64	1.29	<1	<0.446	<0.049	<0.053
	1179.00	0.96	2.90	<1	<0.446	<0.049	<0.053

6.2.2.3. Low Frequency Cetaceans

The modelled PTS impact ranges for low frequency cetaceans (minke whale) for the various potential charge weights are shown in Table 6.8 below. For low order clearance the greatest of the PTS ranges (SPL_{peak}/SEL_{ss}) is 0.23 km. For the greatest of the high order charges (i.e., the worst case), the greatest of the PTS ranges is 14 km.

Using these ranges, and assuming that spreading is approximately spherical (area = πr^2), the number of minke whale which have the potential to be present within the zones of potential impact has been estimated (Table 6.9) using the SCANS-IV density estimate for Block NS-D (Table 5.4) where the Inch Cape OWF is located. The percentage of the relevant reference populations (Table 5.4) this represents has also been presented.

Table 6.8: Pre-mitigation PTS ranges (km) – low frequency cetaceans (minke whale)

Charge weight (kg TNT)		Impulsive		Non-impulsive
		SPL_{peak} (km)	SEL_{ss} (km)	SEL_{ss} (km)
Low Order	0.05	0.10	0.10	0.006
	0.25	0.17	0.23	0.013
High Order	6.00	0.50	1.0	0.064
	15.00	0.69	1.70	0.100
	25.00	0.81	2.10	0.120
	49.00	1.0	3.00	0.180
	130.00	1.50	5.40	0.320
	165.00	1.50	5.40	0.320
	220.00	1.70	6.30	0.380

Charge weight (kg TNT)		Impulsive		Non-impulsive
		SPL$_{peak}$ (km)	SEL$_{ss}$ (km)	SEL$_{ss}$ (km)
	227.00	1.70	6.30	0.380
	254.00	1.70	6.70	0.400
	354.00	1.90	7.80	0.470
	1179.00	2.90	14.00	0.850

Source: Barham (2024)

Table 6.9: Number of minke whale which have the potential to be present within the pre-mitigation zones of potential impact

Charge weight (kg)		SEL$_{ss}$ range (km)	Area (km^2)	Number of individuals	% of reference population	
					MU	UK portion of MU
Low Order	**0.05**	0.10	0.03	<1	<0.005	<0.010
	0.25	0.23	0.17	<1	<0.005	<0.010
High Order	**6.00**	1.0	3.14	<1	<0.005	<0.010
	15.00	1.70	9.08	<1	<0.005	<0.010
	25.00	2.10	13.85	1	0.005	0.010
	49.00	3.00	28.27	1	0.005	0.010
	130.00	5.40	91.61	4	0.020	0.039
	165.00	5.40	91.61	4	0.020	0.039
	220.00	6.30	124.69	5	0.025	0.049
	227.00	6.30	124.69	5	0.025	0.049
	254.00	6.70	141.03	6	0.030	0.058
	354.00	7.80	191.13	8	0.040	0.078
	1179.00	14.00	615.75	26	0.129	0.253

6.2.2.4. Phocid Carnivores in Water

The modelled PTS impact ranges for phocid carnivores in water (grey seal and harbour seal) for the various potential charge weights are shown in Table 6.10 below. For low order clearance the greatest of the PTS ranges (SPL$_{peak}$/SEL$_{ss}$) is 0.19 km. For the greatest of the high order charges (i.e., the worst case), the greatest of the PTS ranges is 3.2 km.

Using these ranges, and assuming that spreading is approximately spherical (area = πr^2), the number of grey seals and harbour seals which have the potential to be present within the zones of potential impact (Table 6.11) has been estimated using the modelled density estimates for each species (Appendix A) in the vicinity of the Project. The percentage of the relevant reference populations (East Scotland; Table 5.5) this represents has also been presented.

Table 6.10: PTS ranges (km) – phocid carnivores in water (grey seal and harbour seal)

Charge weight (kg TNT)		Impulsive		Non-impulsive
		SPL$_{peak}$ (km)	SEL$_{ss}$ (km)	SEL$_{ss}$ (km)
Low Order	**0.05**	0.11	0.02	0.001
	0.25	0.19	0.04	0.002

Charge weight (kg TNT)		Impulsive		Non-impulsive
		SPL$_{peak}$ (km)	SEL$_{ss}$ (km)	SEL$_{ss}$ (km)
High Order	**6.00**	0.56	0.19	0.011
	15.00	0.76	0.30	0.017
	25.00	0.90	0.38	0.022
	49.00	1.10	0.53	0.031
	130.00	1.70	0.97	0.057
	165.00	1.70	0.97	0.057
	220.00	1.80	1.10	0.067
	227.00	1.80	1.10	0.067
	254.00	1.90	1.10	0.071
	354.00	2.10	1.40	0.084
	1179.00	3.20	2.50	0.150

Source: Barham (2024)

Table 6.11: Number of grey seal and harbour seal which have the potential to be present within the pre-mitigation zones of potential impact

Charge weight (kg)		SPL$_{peak}$ range (km)	Area (km^2)	Grey seal		Harbour seal	
				Number impacted	% of reference population*	Number impacted	% of reference population*
Low Order	**0.05**	0.11	0.04	<1	0.000 - 0.001	<1	0.000 – 0.001
	0.25	0.19	0.11	1	0.000 - 0.001	<1	0.001 – 0.002
High Order	**6.00**	0.56	0.99	1	0.009 - 0.017	<1	0.012 – 0.018
	15.00	0.76	1.81	2	0.007 – 0.012	<1	0.023 – 0.033
	25.00	0.90	2.54	3	0.013 – 0.023	<1	0.032 – 0.046
	49.00	1.10	3.80	5	0.018 – 0.032	<1	0.048 – 0.069
	130.00	1.70	9.08	11	0.026 – 0.048	<1	0.114 – 0.164
	165.00	1.70	9.08	11	0.026 – 0.048	<1	0.114 – 0.164
	220.00	1.80	10.18	13	0.071 – 0.128	<1	0.128 – 0.184
	227.00	1.80	10.18	13	0.071 – 0.128	<1	0.128 – 0.184
	254.00	1.90	11.34	14	0.079 – 0.142	1	0.143 – 0.205
	354.00	2.10	13.85	18	0.096 – 0.174	1	0.174 – 0.251
	1179.00	3.20	32.17	41	0.223 - 0.403	2	0.404 – 0.582

**First value based on abundance estimate calculated from Carter et al. (2022), second value from N_{min} abundance estimate from SCOS (2022).*

6.2.3. Behavioural Responses

To estimate the number of individuals which have the potential to be exposed to sound levels which may induce a behavioural response, the following EDRs (for harbour porpoise) were used for all species:

- Low order clearance: 5 km (JNCC, 2023a); and
- High order clearance: 26 km (JNCC, 2020).

The area of the zone of potential effect (assuming that spreading is approximately spherical) was calculated using the equation area = πr^2 where r = 5 for low, and 26 for high, order clearance and equates to:

- Low order clearance: 78.5 km^2; and
- High order clearance: 2123.7 km^2.

The number of individuals with potential to be present within these zones was then estimated (Table 6.12) using the density information presented in Section 5. The worst case has been presented for each bottlenose dolphin MU i.e., responses exhibited by only the coastal population or responses exhibited by only the offshore population (whole and UK portion).

Table 6.12: Number of individuals which may exhibit behavioural responses following low and high order clearance

Species	Number of individuals	% of reference population (*UK portion*)	
Low order clearance			
Harbour porpoise	47	0.014 *(0.029)*	
Bottlenose dolphin	2	Coastal East Scotland 0.893	Greater North Sea 0.099 *(0.106)*
White-beaked dolphin	6	0.014 *(0.018)*	
Minke whale	3	0.015 *(0.029)*	
		Modelled abundance from Carter et al. (2022)	N_{min} abundance estimate from SCOS (2022)
Grey seal	99	0.542	0.980
Harbour seal	4	1.061	1.527
High order clearance			
Harbour porpoise	1271	0.367 *(0.796)*	
Bottlenose dolphin	63	Coastal East Scotland 28.125	Greater North Sea 3.116 *(3.342)*
White-beaked dolphin	170	0.387 *(0.500)*	
Minke whale	89	0.442 *(0.865)*	
		Modelled abundance from Carter et al. (2022)	N_{min} abundance estimate from SCOS (2022)
Grey seal	2689	14.727	26.608
Harbour seal	101	26.790	38.550

6.3. Increased Anthropogenic Noise from Use of USBL Equipment

It is likely that USBL equipment will be used if ROVs are being used, for example to place donor charges. The typical frequency range of USBLs is 18-55 kHz which is within the hearing range of marine mammals (see Table 6.1). As long as the source level of the USBLs used is less than 202 dB re 1 μPa (the lowest of the SPL_{peak} thresholds for auditory injury) there is no potential for auditory injury. Potential for disturbance is short-term, sporadic and without any likely negative impact on the species – and therefore considered to be trivial.

6.4. Risk of Collision with Vessels

The presence of a small number of UXO clearance/guard vessels (maximum three for each UXO clearance event) will be very spatially and temporally limited and is not considered to notably increase vessel traffic in the area above baseline levels. The vessels will either be stationary or moving slowly during the proposed work. Where possible and appropriate, vessels will not exceed 14 knots when transiting to and between work sites.

The species present within the inshore and offshore waters of the Inch Cape OWF are considered to be habituated to the presence of vessels. They are predominately small and agile making them less susceptible to collisions than, for example, large whale species.

Although the consequences of a collision (i.e., mortality, injury) may be severe, the likelihood of occurrence is very low for these species in this area and therefore the risk is considered to be negligible. Nonetheless, during transits, when vessel speed may be greater, transit watches (section 7.2) will be conducted.

6.5. Changes in Turbidity

Unlike low order, high order detonation of UXOs (should they be required) is likely to cause a temporary local increase in suspended sediment concentrations (SSCs) and therefore turbidity. Although SSCs may have settled by the time animals return to the UXO location, marine mammals are used to navigating and foraging in highly turbid environments (e.g., areas where the tide is running) and are therefore expected to be unaffected by such perturbations. Only a small area will be affected, with suitable alternative habitat being available locally in the meantime. The risk of changes in turbidity affecting navigation and foraging success are therefore considered to be negligible.

7. Mitigation Measures

7.1. UXO Clearance

In order to ensure the absence of marine EPS, basking sharks and seals in the vicinity of the clearance work mitigation will be put in place.

This mitigation has been designed around the greatest (i.e., worst case) potential impact ranges which are those for very high frequency cetaceans (i.e., harbour porpoise). If the potential impacts on harbour porpoise are predicted to be negated through mitigation, this will also be the case for all other marine mammal species.

The mitigation follows:

- The Joint Nature Conservation Committee (JNCC) guidelines for the use of explosives (JNCC, 2010b);
- The 2022 UXO clearance Joint Position Statement (which applies to England, Northern Ireland and Scotland) (UK Government, 2025) and prioritises low noise alternatives over high order detonations;
- The 2023 JNCC guidance for the use of Passive Acoustic Monitoring (PAM) in UK waters for minimising the risk of injury to marine mammals from offshore activities (JNCC, 2023b); and
- The JNCC 'Marine mammals and noise mitigation' webpage (https://jncc.gov.uk/our-work/marine-mammals-and-noise-mitigation/#alternatives-when-clearing-unexploded-ordnance).

The mitigation has been summarised in Table 7.1.

Table 7.1: Summary of mitgation measures

Approach	Mitigation measures
Micro-siting	Locations within the DA and ECC will be 'micro-sited' to avoid the UXO and prevent the need for a detonation where deemed safe to do so
Lift and shift	The 'lift and shift' approach (to move the UXO to another location) will be considered on a case-by-case basis where deemed safe to do so
Low order clearance	Pre-work search (min. 60 mins) Low order clearance Post-detonation search (min. 15 mins)
High order clearance	Pre-work search (min. 60 mins) Use of an ADD (see Table 7.2) Use of a NAS (UXO >49 kg) High order clearance Post-detonation search (min. 15 mins)

Further details on the mitigation are:

- Methods to avoid the need for UXO clearance will be considered for every cUXO in the first instance. If deemed safe do so alternative methods include:
- Micro-siting i.e., avoidance of UXO; and

- Relocation ('lift and shift') of UXO (where deemed safe to do so)[3].
- Work will only commence during the hours of daylight and good visibility (i.e., when conditions are suitable for visual monitoring and visibility exceeds 1 km);
- Low order clearance methods will be used in the first instance. Three attempts will be made before moving to high order clearance methods. High order clearance will only be used by exception with evidence provided to demonstrate that low order clearance has not been or would not be successful;
- At least two dedicated Marine Mammal Observers[4] (MMOs) and one dedicated PAM operator[5] will conduct a minimum 60-minute visual and passive acoustic pre-work search of a 1 km radius mitigation zone to ensure the absence of marine mammals in the zone prior to the start of operations. The MMOs and PAM equipment and operator will be positioned such that they can effectively search the mitigation zone. Should a marine mammal be detected in the mitigation zone during the pre-work search by the MMOs or PAM operator, and it cannot be confirmed that the animal has moved out of the mitigation zone at the end of the search, a minimum of a 20-minute delay from the time of the last detection will be required prior to any clearance work taking place;
- For all high order UXO clearance an ADD will be used to encourage animals to flee from the zone of potential harm. Indicative periods of ADD use based on zones of potential harm for the different charge sizes and animal flee speeds are shown in Table 7.2;
- The ADD procedure will start after at least 30 minutes of the pre-work search has been conducted. The pre-work search by both the MMOs and PAM operator will continue throughout the period of ADD use and during the detonation procedure;
- For high order clearance of > 49 kg in weight a NAS (e.g., bubble curtain) will be used in order to reduce potential noise impacts. It is thought that using a NAS will result in a 6 dB reduction in peak sound pressure level and therefore reduce the radius, within which the level is above a given threshold, by around half (as a minimum), and the corresponding area by about 75% (Verfuss *et al.* 2019); and
- Following detonation of the UXO, a visual search of at least 15 minutes' duration will be conducted within the mitigation zone by the MMOs (JNCC, 2010b).

Further information on the mitigation procedures are provided in the MMMP (doc ref: IC02-INT-EC-OFL-012-INC-PLA-001).

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[3] It should be noted that if relocation ('lift and shift') of any UXO is undertaken, and it is deemed that there is a potential of detonation during this process, then the full mitigation procedure for the corresponding UXO charge weight should be undertaken. In the case of UXO relocation, live UXO's will only be relocated when it is unsafe to clear in situ. In these cases, the UXO will be moved to an identified safe location within the licensed area for future disposal.

[4] MMOs will be trained (i.e., JNCC MMO certified) and experienced (i.e., have at least three years of field experience for marine mammals (and be familiar with the identification of the marine mammal species likely to be encountered in the area) and practical experience of implementing the JNCC guidelines).

[5] PAM operators will be suitably trained and have an appropriate level of experience of conducting PAM for mitigation.

Table 7.2: Outline of the mitigation (pre-work search and period of ADD use) time by UXO weight

Mitigation phase		UXO weight (kg)												
		Low order		High Order										
								NAS used						
		0.5	0.25	6	15	25	49	130	165	220	227	254	354	1179
Visual and passive acoustic pre-work search (mins)		60	60	35	30	30	30	30	30	30	30	30	30	30
	Period of ADD use (mins)	0	0	25	35	45	60	40	40	50	50	50	55	90
Total mitigation time (mins)		60	60	60	65	75	90	70	70	80	80	80	85	120

7.2. Transit Watches

An observer on the bridge of all vessels will keep watch for EPS, basking sharks and seals during all transits to and from the work sites. Any sightings will be communicated to the Officer on watch as soon as is practicable and the following actions implemented:

- The Officer on watch will ensure that EPS, basking sharks and seals are avoided where safe to do so; and
- The Officer on watch will minimise high powered manoeuvres or rapid changes of course where this does not impair safety.

The observer may be the Master of the vessel, a member of the bridge crew, another member of the ship's crew or an MMO as appropriate. Observers will be briefed on the Scottish Marine Wildlife Watching Code[6] and Basking Shark Code of Conduct[7].

6 Scottish Marine Wildlife Watching Code | NatureScot

7 Download.ashx (sharktrust.org)

8. Assessment of Potential for Residual (Post-Mitigation) Effects as a result of UXO Clearance Work

The extension of the UXO clearance programme until the end of construction (end of Q4, 2027) will not change the outcome of the original risk assessment, and the original conclusions remain valid.

8.1. Lethal Effects and Physical Injury

It is likely that the visual and passive acoustic pre-work search of the (1 km radius) mitigation zone alone will be sufficient to negate the potential for lethal effects and physical injury. With this, in combination with the other mitigation procedures outlined in Table 7.1, individuals will not be present in close proximity to the proposed UXO clearance work and the potential for lethal effects and physical injury is nil.

8.2. Auditory Injury

It is likely that pre-work searches (1 km radius zone) alone will be sufficient to negate the potential for auditory injury as a result of low order clearance work using a 0.05 kg or 0.25 kg initiation explosive.

For all high order UXO clearance ADD use will be required to ensure no individuals will be present in the zone of potential effect for auditory injury. For each of the hearing groups, the range of the zone able to be cleared by the ADD was estimated using the length of time it will be used for (Table 7.2) and the swim (or flee) speed of species belonging to that hearing group (1.4 m/s, 1.5 m/s or 1.97 m/s (SNH 2016, Otani *et al*,, 2000 and Kastelein *et al*., 2018, respectively)). This ADD duration was adjusted to include the 1 km mitigation zone cleared during the pre-work search and the reduction in PTS impact range from the use of a NAS for high order clearance >49 kg.

The number of individuals of each marine mammal species which have the potential to be impacted post-mitigation was also estimated for comparison with the pre-mitigation numbers presented in Section 6. Using the calculated deterrence ranges after mitigation, and assuming that spreading is approximately spherical (area = πr2 (where r = the range cleared)), the number of individuals estimated to be in the clearance zone was estimated using the density estimates for each marine mammal species (Section 5) where the Inch Cape OWF is located. By subtracting these estimates from the number of individuals with potential to be impacted pre-mitigation (Section 6.2.2) after the NAS has been used, the number of individuals remaining in the impact zone after mitigation was calculated.

8.2.1. Very High Frequency Cetaceans

The clearance ranges for very high frequency cetaceans (harbour porpoises) for each of the different mitigation methods (pre-work search, use of an ADD for high order clearance, and use of a NAS for high order clearance >49 kg) for all low order initiation explosive weights and all high order UXO charge weights is presented in Table 8.1. Using these ranges, no harbour porpoise will be present within the zones of potential effect for auditory injury (PTS; see Table 8.2) for either low order or high order clearance. This is the case regardless of which of the three swim speeds is used to estimate range. With these mitigations, the potential for auditory injury is nil for harbour porpoise.

8.2.2. Other Hearing Groups

The mitigation was designed around the greatest (i.e., worst case) potential impact ranges which are those for very high frequency cetaceans (i.e., harbour porpoise). Therefore, with mitigation (pre-work search, use of an ADD for high order clearance and use of a NAS for high order clearance >49 kg), high frequency cetaceans (bottlenose dolphins and white-beaked dolphins), low frequency cetaceans (minke whales) and phocid carnivores in water (seals), will not be present within the zones of potential effect for auditory injury. Therefore, the potential for auditory injury is nil for all species.

Table 8.1: Range cleared of very high frequency cetaceans (harbour porpoise) post-mitigation

Charge weight (kg TNT)		SPL$_{peak}$ (km)		Range cleared (km)						
				Pre-work search	ADD use			Total (pre-work search and ADD use)		
		No mitigation	After use of a NAS for UXO >49 kg		1.4 m/s flee speed	1.5 m/s flee speed	1.97 m/s flee speed	1.4 m/s flee speed	1.5 m/s flee speed	1.97 m/s flee speed
Low Order	**0.05**	0.58	n/a	1	0	0	0	1	1	1
	0.25	0.99	n/a	1	0	0	0	1	1	1
High Order	**6**	2.8	n/a	1	2.1	2.25	2.96	3.1	3.25	3.96
	15	3.9	n/a	1	2.94	3.15	4.14	3.94	4.15	5.14
	25	4.6	n/a	1	3.78	4.05	5.32	4.78	5.05	6.32
	49	5.7	n/a	1	5.04	5.4	7.09	6.04	6.4	8.09
	130	8.6	4.30	1	3.36	3.6	4.73	4.36	4.6	5.73
	165	8.6	4.30	1	3.36	3.6	4.73	4.36	4.6	5.73
	220	9.6	4.80	1	4.2	4.5	5.91	5.2	5.5	6.91
	227	9.6	4.80	1	4.2	4.5	5.91	5.2	5.5	6.91
	254	10	5.00	1	4.2	4.5	5.91	5.2	5.5	6.91
	354	11.1	5.55	1	4.62	4.95	6.5	5.62	5.95	7.5
	1179	16.6	8.30	1	7.56	8.1	10.64	8.56	9.1	11.64

Table 8.2: Number of harbour porpoise which have the potential to be present within the zones of potential impact post mitgation

Charge weight (kg)		No mitigation	After use of a NAS for UXO >49 kg	Number of individuals impacted – Post pre-work search and ADD use: 1.4 m/s flee speed	1.5 m/s flee speed	1.97 m/s flee speed
Low Order	0.05	1	n/a	0	0	0
	0.25	2	n/a	0	0	0
High Order	6	15	n/a	0	0	0
	15	29	n/a	0	0	0
	25	40	n/a	0	0	0
	49	61	n/a	0	0	0
	130	139	35	0	0	0
	165	139	35	0	0	0
	220	173	43	0	0	0
	227	173	43	0	0	0
	254	188	47	0	0	0
	354	232	58	0	0	0
	1179	518	130	0	0	0

8.3. Behavioural Responses

Behavioural responses will likely be short term; Thompson *et al*. (2020) showed that the minimum time to the first porpoise detection following a 15 minute ADD playback was 133 minutes for all C-PODs within 1 km of the playbacks. Suitable local alternative habitat is likely to be available in the meantime therefore the energetic costs of fleeing should be able to be met relatively quickly. Because each piece of clearance work will only take a few hours, it is unlikely that animals will be excluded from key areas for significant periods of time.

The potential for behavioural responses will be reduced by use of a NAS for high order clearances > 49 kg. The 15 km EDR for harbour porpoises provided in the JNCC Marine Noise Registry Help and Guidance (JNCC, 2023a) for high order UXO clearance with noise abatement has been used to estimate the number of animals in the zone (the area of which is 706.9 km^2) which may exhibit behavioural responses for all species (Table 8.3). Behavioural responses will not be reduced through use of an ADD because this approach relies on inducing a behavioural response in order that animals move out of the zone of a more deleterious potential effect[8]. Again, the worst case has been presented for each bottlenose dolphin MU i.e., responses exhibited by only the coastal population or responses exhibited by only the offshore population (whole or UK portion).

Table 8.3: Number of individuals which may exhibit behavioural responses following high order clearance with noise abatement

Species	Number of individuals	% of reference population (*UK portion*)	
Harbour porpoise	423	0.122 *(0.265)*	
Bottlenose dolphin	21	Coastal East Scotland 9.375	Greater North Sea 1.039 *(1.114)*
White-beaked dolphin	56	0.127 *(0.165)*	
Minke whale	30	0.149 *(0.292)*	
		Modelled abundance from Carter et al. (2022)	N_{min} abundance estimate from SCOS (2022)
Grey seal	895	4.901	8.856
Harbour seal	34	9.019	12.977

[8] As such, the number of individuals which have the potential to be exposed to sound levels which may induce a behavioural response to low order clearance work remains the same as the pre-mitigation estimates (Table 6.12) and has not been replicated here.

9. Assessment of Potential for Offence

The extension of the UXO clearance programme until the end of construction (end of Q4, 2027) will not change the outcome of the original risk assessment, and the original conclusions regarding the issue of EPS Licences, remain valid.

9.1. UXO Clearance Work

The conclusions of the assessment of residual (post-mitigation) effects as a result of the proposed UXO clearance work are as follows:

- The potential for lethal effects and physical injury is nil for all species;
- For low order clearance, the potential for auditory injury is nil for all species;
- For high order clearance, the potential for auditory injury is nil for all species;
- Behavioural responses will likely be short term therefore the energetic costs of fleeing should be able to be met relatively quickly. In line with the definition provided by JNCC *et al*. (2010a), this level of disturbance is sporadic without any likely negative impact on the species and therefore considered to be "trivial".

This potential impact is not considered to be detrimental to the maintenance of the population of the species concerned at a Favourable Conservation Status (FCS) in their natural range. As such, an EPS licence (to disturb) can be awarded.

9.2. Increased Anthropogenic Noise from Use of USBL Equipment

The conclusions of the assessment of effects as a result of increased anthropogenic noise from use of USBL equipment are as follows:

- There is no potential for auditory injury; and
- Potential for disturbance is short-term, sporadic, and without any likely negative impact on the species – and therefore considered to be "trivial".

This potential impact is not considered to be detrimental to the maintenance of the population of the species concerned at an FCS in their natural range. As such, an EPS licence (to disturb) can be awarded.

9.3. Risk of Collision with Vessels

The risk of collision with vessels involved in the proposed UXO clearance work is negligible for the species likely to be present in this area. Nonetheless, watches will be undertaken during transits whilst vessels will be moving more quickly (see section 7.2).

This potential impact is not considered to be detrimental to the maintenance of the population of the species concerned at an FCS in their natural range and does not constitute an offence therefore an EPS licence will not be required for this aspect of the proposed work.

9.4. Changes in Turbidity

The risk of changes in turbidity affecting navigation and foraging success of species likely to be present in this area is negligible.

This potential impact is not considered to be detrimental to the maintenance of the population of the species concerned at an FCS in their natural range and does not constitute an offence therefore an EPS licence will not be required for this aspect of the proposed work.

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Appendices

A. Inch Cape Density Estimation of Seals

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