European Protected Species (EPS) and Basking Shark Risk Assessment (Inshore)

Talisk Offshore Wind Farm Geophysical & Environmental Survey | Outer Hebrides

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Abbreviations

AUD INJ	Auditory Injury
CES	Crown Estate Scotland
CGNS	Celtic and Greater North Sea
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CMS	Conservation of Migratory Species
CWSH	Coastal West Scotland and Hebrides
dB	Decibel
DDV	Drop Down Video
ECRC	Export Cable Route Corridor
ECRSA	Export Cable Route Survey Area
EDR	Effective Deterrent Range
EIA	Environmental Impact Assessment
EPS	European Protected Species
FCS	Favourable Conservation Status
HF	High Frequency
HWDT	Hebridean Whale and Dolphin Trust
Hz	Hertz
IAGC	International Association of Geophysical Contractors
IAMMWG	Inter-Agency Marine Mammal Working Group
IROPI	Imperative Reasons of Overriding Public Interest
IUCN	International Union for the Conservation of Nature
JNCC	Joint Nature Conservation Committee
kHz	Kilohertz
km	Kilometre
LF	Low Frequency
m	Metres
MBES	Multibeam Echosounder
MD-LOT	Marine Directorate Licensing Operations Team
MMO	Marine Mammal Observer
MOW	Magnora Offshore Wind
MPA	Marine Protected Area
MU	Management Unit
nm	Nautical Mile
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
OSS	Offshore Substation
OWF	Offshore Wind Farm

PAM	Passive Acoustic Monitoring
PCW	Phocid Carnivores in Water
PHF	Primary High Frequency
PTS	Permanent Threshold Shift
SAC	Special Area of Conservation
SBP	Sub-Bottom Profiler
SBES	Single Beam Echosounder
SCANS	Small Cetaceans in European Atlantic Waters and the North Sea
SEL	Sound Exposure Levels
SHF	Secondary High Frequency
SLF	Secondary Low Frequency
SMWWC	Scottish Marine Wildlife Watching Code
SPA	Special Protection Area
SPL	Sound Pressure Level
SSS	Side Scan Sonar
TTS	Temporary Threshold Shift
UK	United Kingdom
USBL	Ultra Short Baseline (acoustic positioning system)
UXO	Unexploded Ordnance
VHF	Very High Frequency
WFA	Wind Farm Array
WS	West Scotland
WTG	Wind Turbine Generator

1. Introduction

1.1 Project Background

Magnora Offshore Wind N3 Limited (MOW) proposes to develop the Talisk Offshore Wind Farm (OWF). The proposed Talisk OWF comprises the following elements:

- Up to 33 Wind Turbine Generators (WTGs), associated floating foundations and substructures (such as moorings and anchoring), and associated inter-array cables;
- Export Cable(s) – a provisional preferred export cable route has been established within the Export Cable Route Corridor (ECRC);
- An Offshore Substation (OSS) and its bottom-fixed foundation; and
- A landfall location on the eastern coast of the Island of Lewis (Arnish) – the preferred landfall location is yet to be confirmed, and this will be completed through the application of a landfall site selection process as part of the Environmental Impact Assessment (EIA).

To support the planning, design and EIA of this proposed OWF development, a geophysical and benthic survey has been planned, covering the awarded option area ('Wind Farm Array' (WFA)) and the subsea cable route between the WFA and the Isle of Lewis (Figure 1.1). At its closest point, the WFA is approximately 25 km off the northern coast of the Isle of Lewis and approximately 73 km off the northwest coast of the Scottish mainland.

It should be noted that, due to the size of the survey vessel and associated survey equipment required to operate in the WFA and along the cable route, the proposed survey vessel(s) can only operate successfully in water depths >20 m. Therefore, the landfall areas down to the 20 m depth contour will be subject to separate future survey, using an appropriate vessel and equipment for operating in shallow water environments.

The proposed geophysical and benthic survey will be undertaken by Fugro GB Limited (Fugro).

1.1.1 Purpose of this EPS Risk Assessment

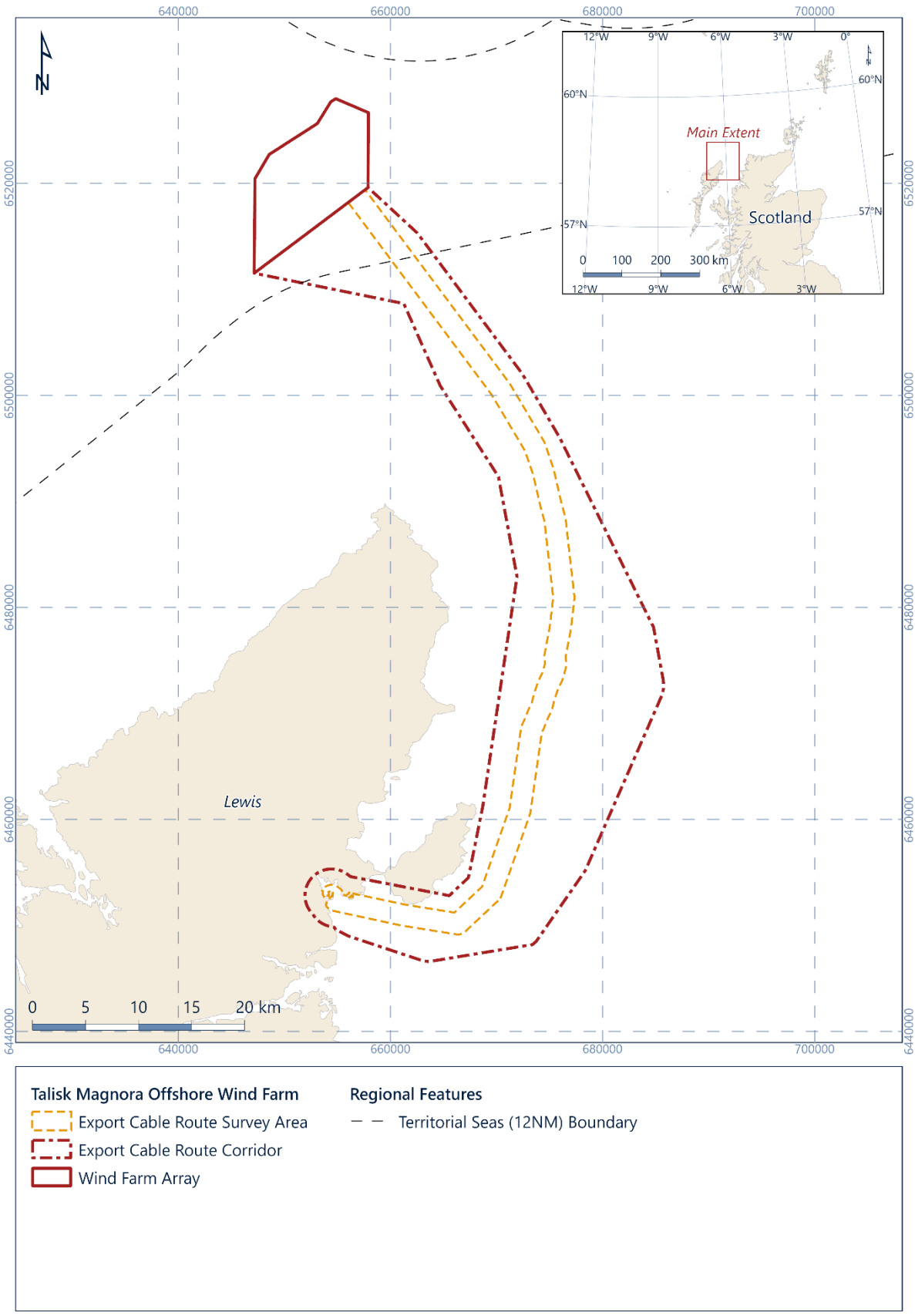
Where there is potential to harm or disturb a European Protected Species (EPS) it is necessary to assess their risk and determine whether an EPS Licence is required before such an activity takes place (see Section 1.2). The legislation governing the EPS licensing differs, depending on whether the licenced activity takes place within 12 nautical miles from shore, also referred to as 'inshore waters', or the 'territorial sea', or whether the activity takes place in United Kingdom (UK) controlled waters beyond 12 nautical miles from shore, which is referred to as the 'offshore area'.

This Risk Assessment considers the potential risk of injury and / or disturbance to marine EPS associated with the planned benthic and geophysical survey activities in the proposed survey area within 12 nautical miles offshore (i.e. within the territorial sea), for which an EPS license is

required under the Conservation (Natural Habitats, &c) Regulations 1994 (as amended). In addition, this risk assessment will also consider any potential injury/disturbance risks in relation to basking sharks, to support a basking shark licence application, as required under the Wildlife and Countryside Act 1981, as amended.

A separate EPS licence application will be submitted for the proposed 'offshore' part of the survey area (i.e. beyond the 12 nautical mile zone), which is covered under the Conservation of Offshore Marine Habitats and Species Regulations 2017.

The EPS Licence application which will be submitted to the Marine Directorate – Licensing Operations Team (MD-LOT) who will determine the applications on behalf of Scottish ministers.



Coordinate System: WGS 1984 UTM Zone 29N; **Caveats:** Esri, 2025; Flanders Marine Institute (2023). Maritime Boundaries Geodatabase: Maritime Boundaries and Exclusive Economic Zones (200NM); Contains public sector information, licensed under the Open Government Licence v3.0, from Crown Estate Scotland.

Figure 1.1: Proposed survey areas for the planned Talisk OWF and preferred offshore export cable route to shore

1.2 Protection for EPS

All species of cetacean (whale, dolphin and porpoise) occurring in UK waters are listed in Annex IV of the Habitats Directive (European Commission Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Flora and Fauna) as an EPS. Sea turtles are also listed as EPS.

Species qualifying as an EPS means that they are species of community interest in need of strict protection, as directed by Article 12 of the Directive. This protection is afforded in Scottish territorial waters (out to 12 nm) under the Conservation (Natural Habitats, &c.) Regulations 1994 (as amended) (hereafter the "Habitats Regulations"). Regulation 39(1) of the Habitats Regulations makes it an offence, with certain exceptions, to:

- Deliberately or recklessly capture, injure or kill a wild animal of an EPS; or
- Deliberately or recklessly:
    - Harass a wild animal or group of wild animals of an EPS;
    - Disturb such an animal while it is occupying a structure or place which it uses for shelter or protection;
    - Disturb such an animal while it is rearing or otherwise caring for its young;
    - Obstruct access to a breeding site or resting place of such an animal, or otherwise to deny the animal use of the breeding site or resting place;
    - Disturb such an animal in a manner that is, or in circumstances which are, likely to significantly affect the local distribution or abundance of the species to which it belongs;
    - Disturb such an animal in a manner that is, or in circumstances which are, likely to impair its ability to survive, breed, or reproduce, or rear or otherwise care for its young; or
    - Disturb such an animal while it is migrating or hibernating.

Further protection is afforded through an additional disturbance offence given under Regulation 39(2) of the Habitats Regulations which states:

"…it is an offence to deliberately or recklessly disturb any dolphin, porpoise or whale (cetacean)".

1.2.1 Requirement for an EPS Licence

The need for a licence to disturb and / or injure EPS will be determined by MD-LOT on behalf of Scottish Ministers as the licensing authority for purely marine species. MD-LOT will seek advice from NatureScot (formerly Scottish Natural Heritage) when determining whether to grant a licence. The findings from the EPS Risk Assessment presented in this document are designed to support the decision-making process.

Any application for a licence that exempts a licence holder from the requirement to adhere to the protection afforded to EPS must pass all three of the following tests (Marine Scotland, 2020):

- The licence application must relate to one of the purposes referred to in Regulation 44(2);
- There must be no satisfactory alternative(s) to the proposed activity (Regulation 44(3)(a)); and
- 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(3)(b)).

1.3 Other Protected Species

1.3.1 Basking Shark

While basking shark (*Cetorhinus maximus*) are not classified as EPS, they do receive legal protection under Scottish and UK legislation. In Scotland, basking sharks are protected under Schedule 5 of the Wildlife and Countryside Act 1981, which makes it an offence to kill, injure, or take basking sharks from the wild in territorial waters (up to 12 nm). Their protection was further strengthened by amendments under the Nature Conservation (Scotland) Act 2004, which extended offences to include intentional or reckless disturbance or harassment. Furthermore, basking sharks are listed under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and the Convention on the Conservation of Migratory Species (CMS), ensuring protection from international trade and conservation measures across their migratory range.

Additionally, the Marine (Scotland) Act 2010 provides further conservation measures through Marine Protected Areas (MPAs), where basking sharks are a protected feature in specific sites, such as the Sea of the Hebrides MPA (see Section 3.5). Activities that could pose a risk to basking sharks within these MPAs are subject to management measures to reduce disturbance and protect their critical habitats.

Basking sharks are considered a sensitive species that could be affected by certain activities, including those associated with the proposed survey activities. As a result, they have been included in this Risk Assessment to ensure that any potential impacts on basking shark populations are thoroughly assessed and mitigated as far as possible. The inclusion of basking sharks in this assessment ensures that legal compliance is met and that appropriate mitigation measures are considered to reduce the potential for disturbance, harassment, or injury.

1.3.1.1 Requirement for a Basking Shark Licence

The need for a licence to disturb and / or injure basking sharks will be determined by MD-LOT as the licensing authority with advice from NatureScot. The findings from the Risk Assessment presented in this document are designed to support the decision-making process. The granting of a Basking Shark Licence is dependent on the same three tests required for the granting of an EPS Licence (see Section 1.2.1).

2. Proposed Survey Activities

2.1 Survey Location and Schedule

The geophysical and benthic survey for the proposed Talisk OWF will cover the following areas (Figure 1.1):

- The WFA (approximate total survey area: 103 km^2, approximate survey area within inshore area: 0 km^2); and
- An Export Cable Route Survey Area (ECRSA) (approximately 1-2 km in width) located within the ECRC (approximate total area within inshore area: 756.9 km^2) – a provisional preferred route option has been identified (Figure 1.1) although this may be subject to change (approximate total survey area: 177.1 km^2, approximate survey area within inshore area: 162.4 km^2).

Survey area coordinates are provided in Appendix A.

It is anticipated that the survey operations will be undertaken between 1 July 2025 and 30 November 2025 and are estimated to take 59 days to complete.

2.2 Survey Vessels

The proposed survey operations will be undertaken by a dedicated offshore survey vessel however the exact vessel is still to be confirmed at this time. It is anticipated that the selected vessel will be from those detailed in Table 2.1.

Table 2.1: Vessels in consideration for the proposed inshore survey campaign

Vessel	Vessel Image
Fugro Galaxy	

Vessel	Vessel Image
Fugro Meridian	
Fugro Searcher	
Fugro Venturer	

2.3 Survey Equipment

The purpose of the geophysical survey is to gather detailed information to support the optimal placement of WTG foundations and the offshore export cable route, by determining seabed characteristics to inform the project design. This includes confirming water depths, identifying seabed features and obstructions such as pockmarks, anchor scars, and shallow geological conditions, and assessing potential hazards like man-made objects or unexploded ordnance (UXO) that could affect safe installation.

The geophysical survey will also provide seabed characterisation data to aid in selecting geotechnical and environmental sampling locations.

The benthic survey will comprise benthic grab sampling (using Van Veen, Day and/or Hamon equipment grabs) and drop-down video (DDV) surveying.

It is anticipated that the main potential impacts from any aspects of the proposed survey on EPS are those related to underwater noise generation. Table 2.2 lists all survey equipment that generates underwater noise. It should be noted that this information is subject to confirmation and may vary slightly between survey vessels but is deemed to be representative for the equipment that will be used during the actual survey.

Table 2.2: Survey equipment list

Equipment	Type	Underwater Noise Characteristics	
		Frequency	Source Level [dB re 1µPa]
Kongsberg HiPAP 502	Ultra-short baseline acoustic positioning system (USBL)	21 – 30.5 kHz	190 - 203
Kongsberg EA600	Single beam echosounder (SBES)	200 – 710 kHz (for water depths < 450 m)	Unknown
Kongsberg EM2040 Dual Rx	Multi-beam echosounder (MBES)	200 – 400 kHz	248
Edgetech 4205	Side scan sonar (SSS)	230 - 850 kHz	196
Innomar Medium SES 2000	Sub-bottom profiler (SBP)	Primary frequencies: 85 – 115 kHz Secondary frequency: 1, 5, 6, 8, 10, 12, 15 kHz	247 - 250

2.3.1 Single Beam Echosounder (SBES)

Precision hydrographic echosounders provide accurate measurement of water depth directly below the vessel using high frequency pulses. The exact frequency ranges are dependent on the depth range and typically range between 200 kHz and 710 kHz for water depths < 450 m, as present across the proposed survey area.

2.3.2 Multibeam Echosounder (MBES)

MBES are used to obtain detailed maps of the seafloor which show water depths. They measure water depth by recording the two-way travel time of a high frequency pulse emitted by a transducer. The beams produce a fanned arc composed of individual beams (also known as a swath). Multi-beam echosounders can, typically, carry out 200 or more simultaneous measurements.

2.3.3 Side Scan Sonar (SSS)

Side scan sonar (SSS) is used to generate an accurate image of the seabed. An acoustic beam is used to obtain the sonic image of a relatively narrow area of seabed to either side of the instrument by measuring the amplitude of back scattered return signals. The frequencies

used by side-scan sonar are generally high and outside of the main hearing range of all marine species. The higher frequency systems provide higher resolution, but shorter-range measurements.

2.3.4 Sub-Bottom Profiler (SBP)

Sub-bottom profilers (SBP), also known as shallow seismic systems, are used to identify and characterise layers of sediment or rock under the seafloor. A transducer emits a sound pulse vertically downwards towards the seafloor, and a receiver records the return of the pulse once it has been reflected off the seafloor.

2.3.5 Ultra-short Baseline Acoustic Positioning System (USBL)

USBLs are used to determine the position of subsea survey items by emitting acoustic signals between a hull-mounted transducer and a subsea transponder. The system calculates range and bearing based on the time delay between transmission and reception of acoustic pulses. USBL systems can operate continuously or intermittently, depending on survey requirements, and do not interact with the seabed.

3. Protected Species and Areas

3.1 Overview

As listed in Annex IV of the Habitats Directive, all cetacean species are of community interest in need of strict protection as EPS. These species are fully protected in Scottish territorial waters (out to 12 nm) under the Habitats Regulations. Harbour porpoise (*Phocoena phocoena*) and bottlenose dolphin (*Tursiops truncatus*) are listed individually, while the remaining cetacean species are encapsulated in the Habitats Directive as "all other cetacea". In addition, sea turtles are also listed as EPS.

A total of 19 cetacean species have been recorded in UK waters (Reid et al., 2003). Of these, there are 11 cetacean species known to be present off the northwest coast of Scotland, in the vicinity of the survey area (Gilles et al., 2023; van Geel et al., 2022; Hammond et al., 2021; Hague et al., 2020; Reid et al., 2003) comprising:

- Atlantic white-sided dolphin (*Lagenorhynchus acutus*);
- Beaked whales (Ziphiidae);
- Bottlenose dolphin;
- Common dolphin (*Delphinus delphis*);
- Harbour porpoise;
- Humpback whale (*Megaptera novaeangliae*);
- Killer whale (*Orcinus orca*);
- Long-finned pilot whale (*Globicephala melas*);
- Minke whale (*Balaenoptera acutorostrata*);
- Risso's dolphin (*Grampus griseus*); and
- White-beaked dolphin (*Lagenorhynchus albirostris*).

Five species of marine turtle have been recorded in UK waters. However, only the leatherback turtle (*Dermochelys coriacea*) is considered resident, with sightings predominantly along the western coasts of Scotland and the northern Irish Sea (Botterell et al., 2020). Therefore, only the leatherback turtle is considered hereafter.

Basking sharks, also a protected species in Scottish waters, have been recorded all around Scotland, with notable concentrations found in the Sea of the Hebrides, along the west coast of the Scottish Highlands, and further north along the Orkney and Shetland Isles (Witt et al., 2016; 2019). Therefore, basking sharks have been included in this assessment.

The available information on spatial and temporal distribution, abundance and density of the most frequently observed cetaceans and other protected species within the proposed inshore survey activities area has been reviewed and summarised in the following sections.

3.2 Cetacean Species

Regional surveys have identified the presence of EPS within the wider region, that encompasses the proposed inshore survey area. The Small Cetaceans in European Atlantic waters and the North Sea (SCANS) IV and III aerial and ship-based surveys, conducted in 2022 and 2016 respectively, were designed to estimate the large-scale abundance of cetaceans across European Atlantic waters, into smaller reference areas (Gilles et al., 2023; Hammond et al., 2021).

Table 3.1 presents the EPS identified in the wider region alongside the relevant density (individuals/km^2) and abundance estimates for the SCANS-IV Block CS-J and Block CS-H, as well as SCANS-III survey Block K and Block I, which are pertinent to these activities and cover the north coast of Scotland and northern Isle of Lewis, where the proposed inshore survey activities area is located (Figure 3.1).

Considering the SCANS data and species distribution models developed from survey data collected in the northeast Atlantic between 1980 and 2018, the key cetacean species which may be encountered within the proposed inshore survey area relevant for this risk assessment include Atlantic white-sided dolphin, beaked whale, bottlenose dolphin, common dolphin, harbour porpoise, long-finned pilot whale, minke whale, Risso's dolphin, striped dolphin and white-beaked dolphin (Gilles et al., 2023; Hammond et al., 2021; Waggitt et al., 2019).

Other cetacean species, such as humpback whales and killer whales, occur in low numbers in Scottish waters and are usually observed in deeper offshore areas (Hague et al., 2020; van Geel et al., 2022). They are infrequently sighted in coastal waters around the Hebrides, although their numbers remain very low across multiple survey efforts (Gilles et al., 2023; Hague et al., 2020; Hammond et al., 2021). Species distribution models also did not highlight the presence of these species within the proposed survey area (Waggitt et al., 2019). Given the infrequent sightings and very low recorded abundance, it is reasonable to conclude that these species are unlikely to be present within the proposed survey area. Therefore, they are not further considered in this EPS risk assessment.

Cetaceans are wide-ranging species that cover broad geographic areas, often crossing multiple national jurisdictions. This makes it challenging to accurately define and monitor populations, as they may vary across different regions. To address this, defined species Management Units (MUs) are used to structure the monitoring and protection of cetacean populations in UK waters. A MU refers to a specific geographical area in which individuals of a particular cetacean species are found, and to which management of human activities is applied. It may be smaller than what is believed to be a 'population', to reflect spatial differences in human activities and their management (Inter-Agency Marine Mammal Working Group (IAMMWG), 2023). In this context, 'population' is defined as a collection of individuals of the same species found in the same area, where genetic variation occurs within the population and between other populations. The use of MUs ensures that the species'

movement patterns, habitat preferences, and trends are considered in the assessment of cetacean species, whilst also addressing relevant jurisdictional boundaries and the management of human activities.

The IAMMWG has defined MUs for the seven most common cetacean species found in UK waters. The species-specific MUs are being used as the reference population for the purpose of this risk assessment. By using these MUs, the risk assessment ensures that the potential impacts of the proposed inshore survey activities are evaluated in relation to the larger populations that could be affected. This approach provides a more localised estimate of potential disturbance or injury to these protected species.

The relevant MUs encompassing the proposed inshore survey activities area are listed below, and their associated abundances are listed in Table 3.1:

- West Scotland (WS) MU: Harbour porpoise
- Coastal West Scotland and Hebrides (CWSH) MU: Bottlenose dolphin
- Celtic and Greater North Sea (CGNS) MU:
    - Atlantic white-sided dolphin;
    - Common dolphin;
    - Minke whale;
    - Risso's dolphin; and
    - White-beaked dolphin.

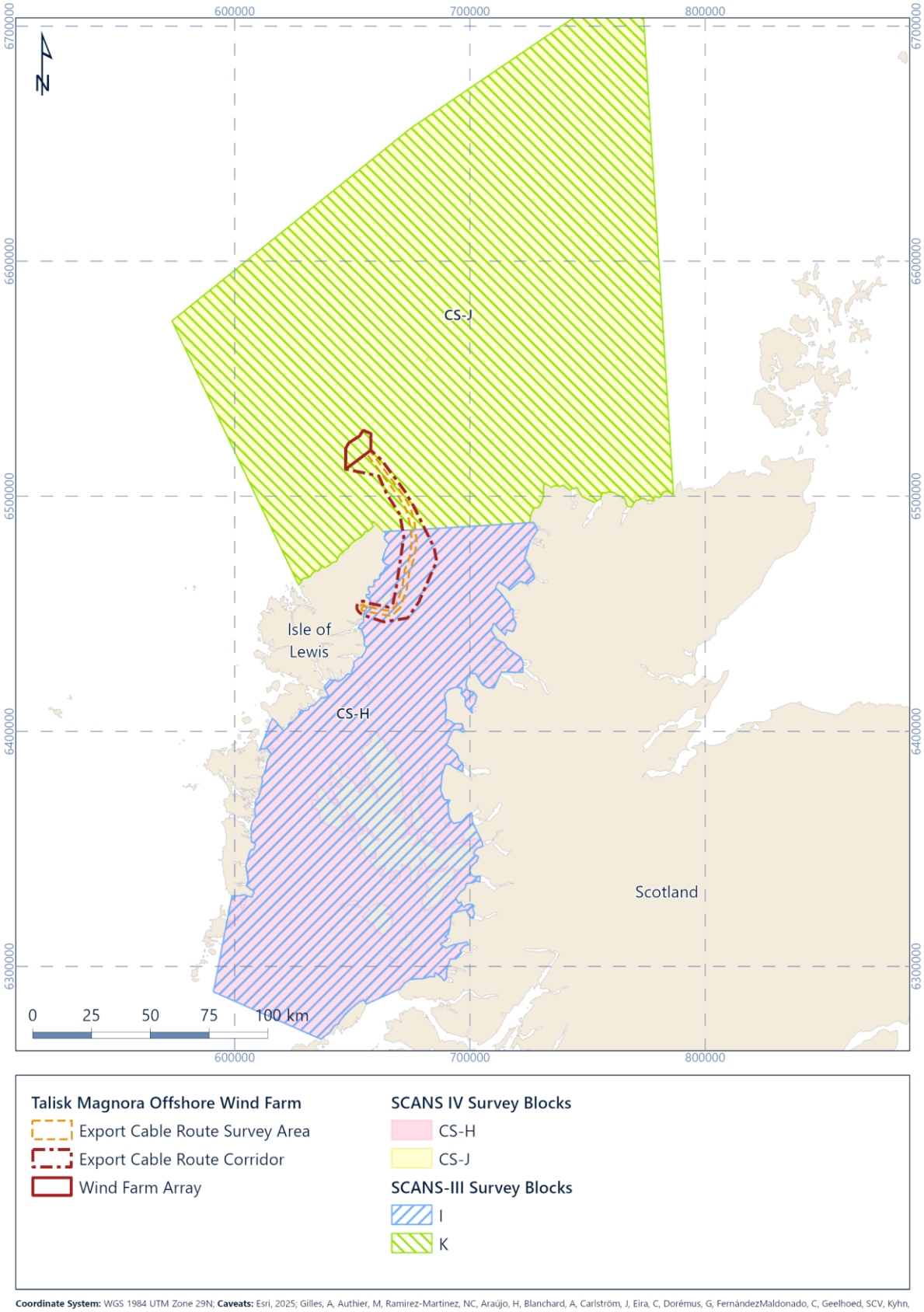
As the IAMMWG has defined MUs only for the most common cetacean species in the UK, the total estimated abundance reported in SCANS-III or SCANS-IV in European Atlantic waters has been included in Table 3.1 for beaked whales, long-finned pilot whales and striped dolphins.

Table 3.1: Density and abundance estimates for cetaceans occurring in the proposed survey area

Cetacean	Distribution	Estimated Density (individuals/km^2)				Estimated Abundance (number of individuals)				
		SCANS-IV Block CS-J	SCANS-III Block K	SCANS-IV Block CS-H	SCANS-III Block I	SCANS-IV Block CS-J	SCANS-III Block K	SCANS-IV Block CS-H	SCANS-III Block I	MU
Atlantic white-sided dolphin	Predominantly offshore species but can be occasionally found along the continental shelf.	0.0233	N/A	0.0279	N/A	756	N/A	390	N/A	18 128 (CGNS MU)
Beaked whale	Predominantly offshore species, found mostly along the Atlantic coastline.	N/A	0.0065	0.0034	N/A	N/A	211	47	N/A	1 489* (SCANS-III)
Bottlenose dolphin	Found in both coastal and offshore waters.	N/A	N/A	0.3421	N/A	N/A	N/A	4 784	N/A	45 (CWSH MU)
Common dolphin	Found in both coastal and offshore waters, commonly in the Celtic and North Sea regions.	N/A	N/A	0.926	N/A	N/A	N/A	12 958	N/A	102 656 (CGNS MU)
Harbour porpoise	Individuals can be found in nearshore and offshore waters throughout the North Sea.	0.0994	0.308	0.3911	0.397	3 231	9 999	5 470	5 556	28 936 (WS MU)
Long-finned pilot whale	Predominantly offshore species but can be occasionally encountered in coastal waters.	N/A	0.0537	N/A	N/A	N/A	1 745	N/A	N/A	5 215* (SCANS-III)
Minke whale	Individuals can be found in nearshore and offshore waters	0.0221	0.0091	0.0353	0.0204	718	295	493	285	20 118 (CGNS MU)

Cetacean	Distribution	Estimated Density (individuals/km^2)				Estimated Abundance (number of individuals)				
		SCANS-IV Block CS-J	SCANS-III Block K	SCANS-IV Block CS-H	SCANS-III Block I	SCANS-IV Block CS-J	SCANS-III Block K	SCANS-IV Block CS-H	SCANS-III Block I	MU
	throughout the North Sea									
Risso's dolphin	Predominantly continental shelf water species, particularly in deep offshore regions.	0.0288	0.0135	0.0244	N/A	936	440	341	N/A	12 262 (CGNS MU)
Striped dolphin	Predominantly offshore species but can be found over the continental shelf.	N/A	0.0044	N/A	N/A	N/A	142	N/A	N/A	19 253* (SCANS-III)
White-beaked dolphin	Predominantly offshore species, found in colder waters of the North Sea.	0.2565	0.217	0.1380	N/A	8 335	7 055	1 930	N/A	43 951 (CGNS MU)

Notes
* = Total estimated abundance for European Atlantic waters as reported in SCANS-IV or SCANS-III has been used due to the species not having a defined MU according to IAMMWG (2023).
Sources: Gilles et al., 2023; Hammond et al., 2021; IAMMWG, 2023.



Coordinate System: WGS 1984 UTM Zone 29N; **Caveats:** Esri, 2025; Gilles, A, Authier, M, Ramirez-Martinez, NC, Araújo, H, Blanchard, A, Carlström, J, Eira, C, Dorémus, G, FernándezMaldonado, C, Geelhoed, SCV, Kyhn, L, Laran, S, Nachtsheim, D, Panigada, S, Pigeault, R, Sequeira, M, Sveegaard, S, Taylor, NL, Owen, K, Saavedra, C, Vázquez-Bonales, JA, Unger, B, Hammond, PS (2023). Estimates of cetacean abundance in European Atlantic waters in summer 2022 from the SCANS-IV aerial and shipboard surveys. Final report published 29 September 2023. 64 pp. https://tinyurl.com/3ynt6swa; Hammond, PS, Lacey, A, Gilles, A, Viquerat, S, Börjesson, P, Herr, H, Macleod, K, Ridoux, V, Santos, MB, Scheidat, M, Teilmann, J, Vingada, J, Øien, N (2021). Estimates of cetacean abundance in European Atlantic waters in summer 2016 from the SCANS-III aerial and shipboard surveys. https://scans3.wp.st-andrews.ac.uk/files/2021/06/SCANS-III_design-based_estimates_final_report_revised_June_2021.pdf; Contains public sector information, licensed under the Open Government Licence v3.0, from Crown Estate Scotland.

Figure 3.1: Relevant SCANS IV and SCANS III survey blocks

3.2.1 Atlantic White-Sided Dolphin

Atlantic white-sided dolphins are present in Scottish waters during the summer months. They can be observed in offshore waters at the edge and beyond the continental shelf, predominantly around the Hebrides, Northern Isles, and the northern North Sea (Hague et al., 2020).

SCANS-III did not record Atlantic white-sided dolphins in Block K or I but were observed during SCANS-IV surveys in both Block CS-J and CS-H (Hammond et al., 2021; Table 3.1). The maximum estimated density in the region was recorded in SCANS-IV Block CS-H, with a density of 0.0279 animals/km^2 and an estimated abundance of 390 individuals (Gilles et al., 2023; Table 3.1).

A single MU for Atlantic white-sided dolphin is present, the CGNS MU, with an estimated 18 128 individuals. In the UK portion of the MU, 12 293 individuals are accounted for (IAMMWG, 2023).

Surveys conducted by the Hebridean Whale and Dolphin Trust (HWDT) between 2003 and 2017 in the west of Scotland reported that Atlantic white-sided dolphins accounted for 0.03 % of total sightings. However, these surveys only covered the southern portion of the ECRC and did not include the WFA where this species is more likely to be encountered due to its preference for deeper waters (HWDT, 2018).

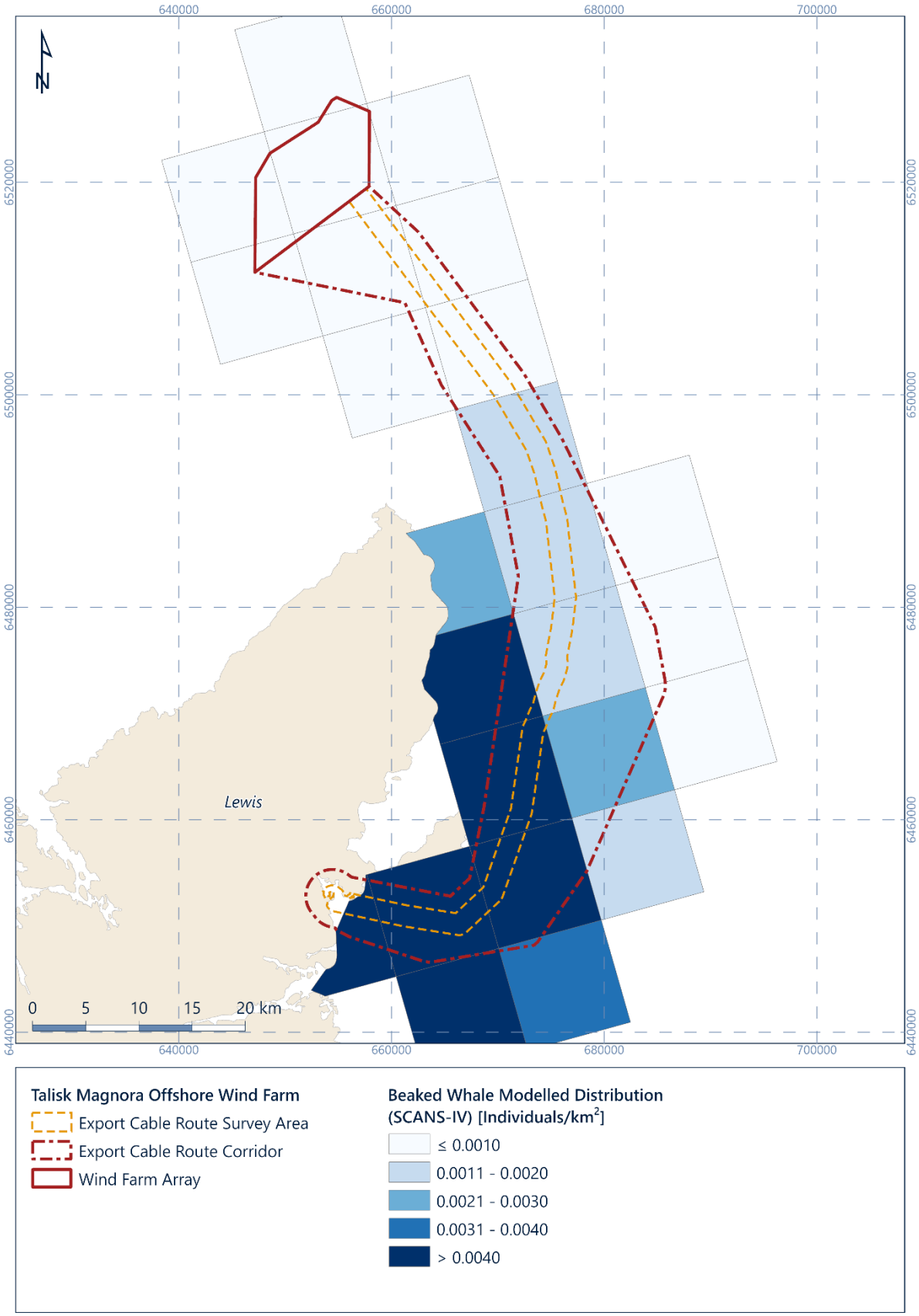
The conservation status of Atlantic white-sided dolphins in the UK is currently classed as unknown due to insufficient information (Joint Nature Conservation Committee (JNCC), 2019).

3.2.2 Beaked Whale

Beaked whales prefer deep offshore waters and are rarely encountered in Scottish waters, with most encounters recorded in offshore waters west of the Hebrides (Hague et al., 2020).

SCANS-IV and SCANS-III surveys did not observe beaked whales in Blocks CS-J and I, respectively (Gilles et al., 2023; Hammond et al., 2021; Table 3.1). The species was recorded in Block CS-H (Figure 3.2) and K, with a maximum estimated density of 0.0065 animals/km^2 and an abundance of 211 individuals reported in SCANS-III Block K (Gilles et al., 2023; Hammond et al., 2021). The difference in abundance recorded in SCANS-III compared to SCANS-IV likely reflects temporal and spatial variation in cetacean distribution within the survey region. This variation may be influenced by environmental factors, prey availability, seasonal movements, or broader population trends that impact species presence over time.

A MU for beaked whales has not been defined by IAMMWG (2023) and MU abundance estimates for beaked whales are not available. Therefore, the total estimated abundance of beaked whales in European Atlantic waters reported in SCANS-III was used, accounting for 1 489 individuals (Hammond et al., 2021; Table 3.1).



Coordinate System: WGS 1984 UTM Zone 29N; **Caveats:** Esri, 2025; Gilles, A, Authier, M, Pigeault, R, Ramirez Martinez, NC, Benoit, V, Carlström, J, Eira, C, Geelhoed, SCV, Laran, S, Sequeira, M, Sveegaard, S, Taylor, NL, Saavedra, C, Vazquez Bonales, JA, Hammond, PS (2025). Spatial models of cetacean density in European Atlantic waters based on SCANS-IV summer 2022 survey data. Final report published 14 May 2025. 31 pp plus Appendix. https://tinyurl.com/3rv246v5; Contains public sector information, licensed under the Open Government Licence v3.0, from Crown Estate Scotland.

Figure 3.2: SCANS-IV modelled distribution of beaked whale in the proposed survey areas

HWDT between 2003 and 2017 reported that beaked whales were sighted only once, reflecting the species' preference for offshore waters (HWDT, 2018).

The conservation status in the UK of the most commonly encountered species of beaked whales has not been assessed (JNCC, 2019).

3.2.3 Bottlenose Dolphin

Bottlenose dolphins are present year-round in UK waters, present in coastal areas and offshore areas as different species ecotypes (Hague et al., 2020). NatureScot (2024a) advises that there is a Scottish west coast sub-population of bottlenose dolphin, comprising approximately 55 individuals, residing south of the Sea of the Hebrides. This population ranges between Skye, Kintyre, and around the Isle of Barra and as such this west coast population is more concentrated in these areas (NatureScot, 2024a).

SCANS-IV and SCANS-III did not record bottlenose dolphin in Block CS-J or Block K (Gilles et al., 2023; Hammond et al., 2021; Table 3.1). SCANS-IV Block CS-H had an estimated abundance of 4 784 individuals, with a density of 0.3421 animals/km^2 (Gilles et al., 2023; Figure 3.3). However, the abundance estimates for coastal bottlenose dolphins according to IAMMWG in the CWSH MU are only estimated to be around 45 individuals, resulting in a local density of 0.0010 animals/km^2 which is therefore believed to be more representative than the density estimates provided in SCANS reports.

HWDT surveys from 2003-2017 reported that bottlenose dolphins accounted for 0.5 % of all sightings, mainly in coastal areas, overlapping the ECRC (HWDT, 2018).

The conservation status of bottlenose dolphins in the UK is currently classed as unknown due to insufficient information (JNCC, 2019).

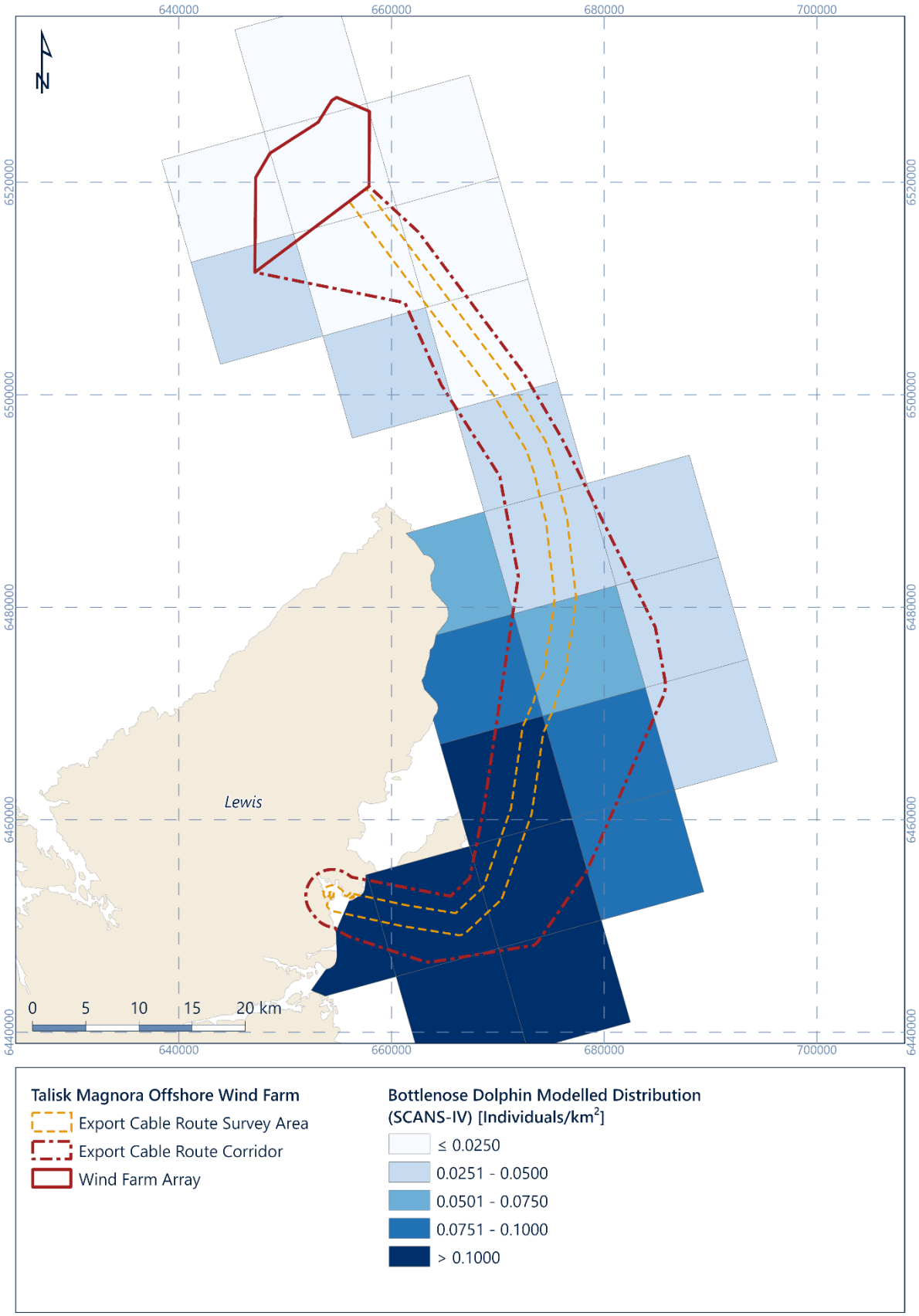
3.2.4 Common Dolphin

Common dolphins are present in UK waters, with numbers peaking in the summer season (Hague et al., 2020). They were not recorded in SCANS-IV Block CS-J, SCANS-III Block K and Block I (Gilles et al., 2023; Hammond et al., 2021; Table 3.1). Therefore, the maximum and only estimate provided was in SCANS-IV Block CS-H with an estimated abundance of 12 958 individuals and a density of 0.926 animals/km^2 (Gilles et al., 2023; Figure 3.4).

There is a single MU for common dolphin, the CGNS MU, with an estimated 102 656 individuals. The UK portion of the MU contains an estimated 57 417 individuals (IAMMWG, 2023).

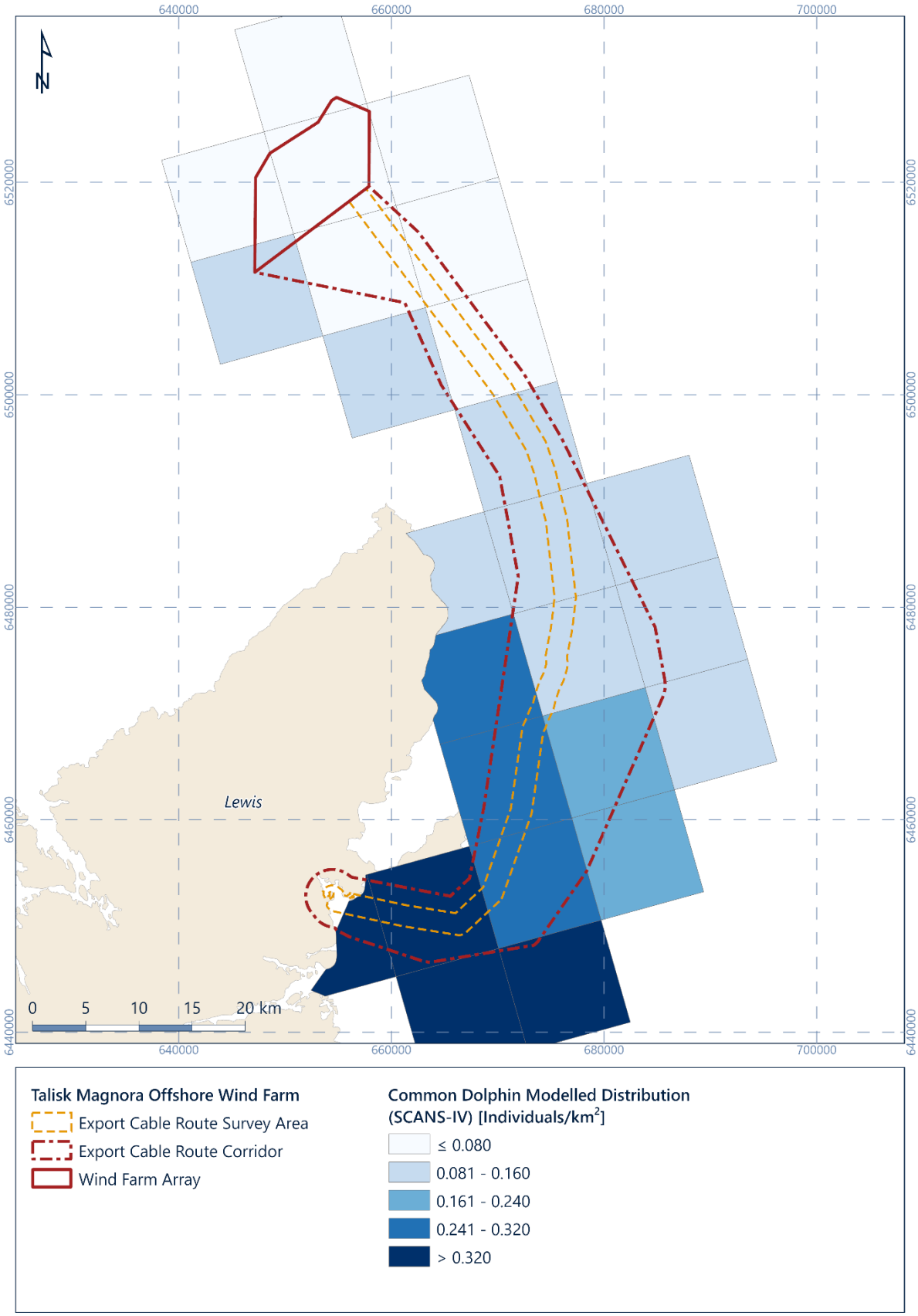
HWDT surveys from 2003-2017 reported that common dolphins made up 4 % of all cetacean sightings, although survey effort was concentrated in the Inner Hebrides (HWDT, 2018).

The conservation status of common dolphin in the UK is currently classed as unknown due to insufficient information (JNCC, 2019).



Coordinate System: WGS 1984 UTM Zone 29N; **Caveats:** Esri, 2025; Gilles, A, Authier, M, Pigeault, R, Ramirez Martinez, NC, Benoit, V, Carlström, J, Eira, C, Geelhoed, SCV, Laran, S, Sequeira, M, Sveegaard, S, Taylor, NL, Saavedra, C, Vazquez Bonales, JA, Hammond, PS (2025). Spatial models of cetacean density in European Atlantic waters based on SCANS-IV summer 2022 survey data. Final report published 14 May 2025. 31 pp plus Appendix. https://tinyurl.com/3rv246v5; Contains public sector information, licensed under the Open Government Licence v3.0, from Crown Estate Scotland.

Figure 3.3: SCANS-IV modelled distribution of bottlenose dolphin in the proposed survey areas



Coordinate System: WGS 1984 UTM Zone 29N; **Caveats:** Esri, 2025; Gilles, A, Authier, M, Pigeault, R, Ramirez Martinez, NC, Benoit, V, Carlström, J, Eira, C, Geelhoed, SCV, Laran, S, Sequeira, M, Sveegaard, S, Taylor, NL, Saavedra, C, Vazquez Bonales, JA, Hammond, PS (2025). Spatial models of cetacean density in European Atlantic waters based on SCANS-IV summer 2022 survey data. Final report published 14 May 2025. 31 pp plus Appendix. https://tinyurl.com/3rv246v5; Contains public sector information, licensed under the Open Government Licence v3.0, from Crown Estate Scotland.

Figure 3.4: SCANS-IV modelled distribution of common dolphin in the proposed survey areas

3.2.5 Harbour Porpoise

Harbour porpoise are the most abundant cetacean species in the British Isles, where they occur year-round (Hague et al., 2020). Considering the relevant SCANS-IV and SCANS-III surveys, the maximum estimated density recorded in this region was during SCANS-III Block I, with a density of 0.397 individuals/km^2 and an estimated abundance of 5 556 individuals (Hammond et al., 2021; Table 3.1; Figure 3.5).

There is an estimated harbour porpoise abundance within the WS MU of 28 936 individuals, with 24 305 individuals within the UK portion of the MU (IAMMWG, 2023).

Surveys conducted by the HWDT from 2002-2017 reported that harbour porpoises accounted for 45 % of all cetacean sightings (HWDT, 2018).

The conservation status of harbour porpoise in the UK is currently classed as unknown due to insufficient information (JNCC, 2019).

3.2.6 Long-Finned Pilot Whale

Long-finned pilot whales mainly occur in deep offshore waters in the west of Scotland (Hague et al., 2020). The species was only observed during SCANS-III surveys in Block K, where an estimated density of 0.0537 individuals/km^2 and an estimated abundance of 1 745 individuals were reported (Hammond et al., 2021; Table 3.1).

A MU for long-finned pilot whales has not been defined by IAMMWG (2023), therefore the SCANS-III total estimated species abundance in European Atlantic waters was considered, with 5 215 individuals reported in the area (Hammond et al., 2021).

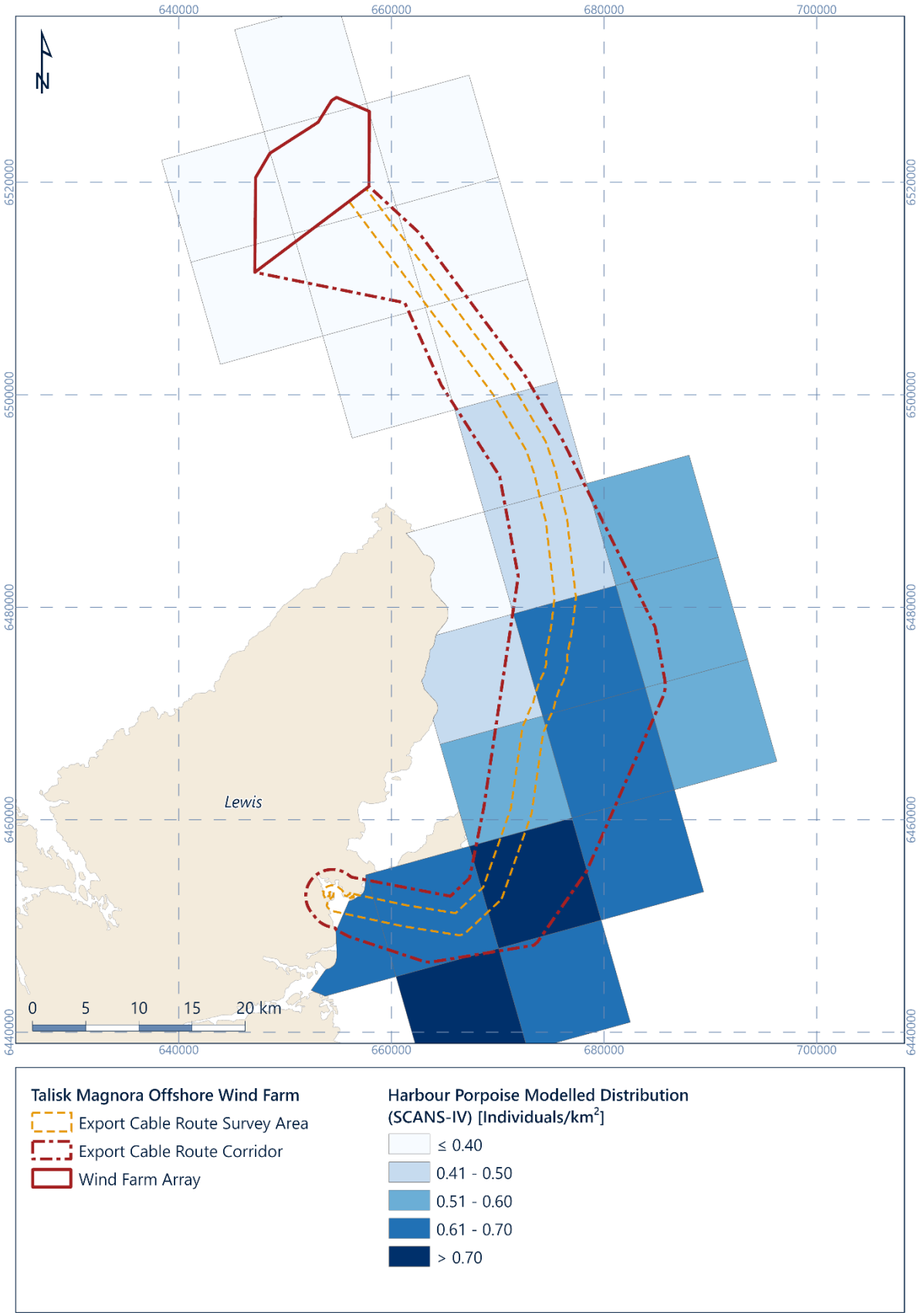
Long-finned pilot whales were not encountered during the HWDT surveys between 2003 and 2017 due to the survey effort limited to coastal areas mainly overlapping with the ECRC (HWDT, 2018).

The conservation status of long-finned pilot whale in the UK is currently classed as unknown due to insufficient information (JNCC, 2019).

3.2.7 Minke Whale

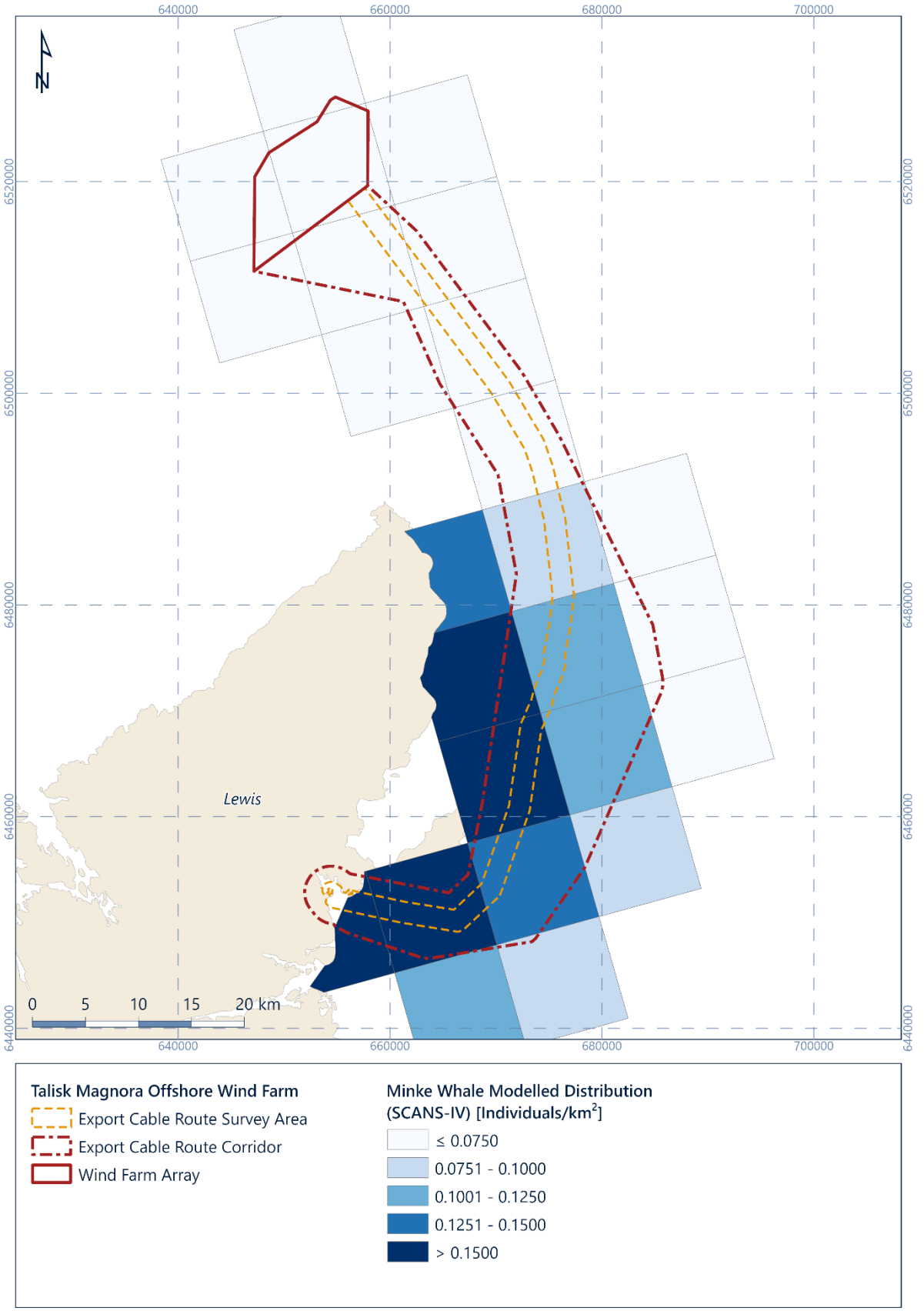
Minke whales are the most abundant baleen whale in UK waters and are regularly sighted in Scottish waters, with sightings peaking during the summer months (Hague et al., 2020). Minke whales are found in water depths up to 200 m, usually individually or as pairs but they do form larger groups (up to 15 individuals) whilst foraging (Allen et al., 2024).

The maximum density was recorded in SCANS-IV Block CS-H, 0.0353 individuals/km^2 with an abundance of 493 individuals (Gilles et al., 2023; Table 3.1; Figure 3.6). There is an estimated abundance of 20 118 minke whale within the CGNS MU, the only MU for minke whale. There are an estimated 10 288 individuals within the UK portion of the CGNS MU (IAMMWG, 2023).



Coordinate System: WGS 1984 UTM Zone 29N; **Caveats:** Esri, 2025; Gilles, A, Authier, M, Pigeault, R, Ramirez Martinez, NC, Benoit, V, Carlström, J, Eira, C, Geelhoed, SCV, Laran, S, Sequeira, M, Sveegaard, S, Taylor, NL, Saavedra, C, Vazquez Bonales, JA, Hammond, PS (2025). Spatial models of cetacean density in European Atlantic waters based on SCANS-IV summer 2022 survey data. Final report published 14 May 2025. 31 pp plus Appendix. https://tinyurl.com/3rv246v5; Contains public sector information, licensed under the Open Government Licence v3.0, from Crown Estate Scotland.

Figure 3.5: SCANS-IV modelled distribution of harbour porpoise in the proposed survey areas



Coordinate System: WGS 1984 UTM Zone 29N; **Caveats:** Esri, 2025; Gilles, A, Authier, M, Pigeault, R, Ramirez Martinez, NC, Benoit, V, Carlström, J, Eira, C, Geelhoed, SCV, Laran, S, Sequeira, M, Sveegaard, S, Taylor, NL, Saavedra, C, Vazquez Bonales, JA, Hammond, PS (2025). Spatial models of cetacean density in European Atlantic waters based on SCANS-IV summer 2022 survey data. Final report published 14 May 2025. 31 pp plus Appendix. https://tinyurl.com/3rv246v5; Contains public sector information, licensed under the Open Government Licence v3.0, from Crown Estate Scotland.

Figure 3.6: SCANS-IV modelled distribution of minke whale in the proposed survey areas

Minke whale made up 7 % of all sightings by HWDT during a 15-year period from 2003-2017 (HWDT, 2018). Survey effort during the HWDT surveys was concentrated in the Inner Hebrides near Tobermory, and as a result the survey effort in the ECRC and Landfall Area of Search was lower.

The conservation status for minke whale is currently unknown in the UK due to insufficient information (JNCC, 2019).

3.2.8 Risso's Dolphin

Risso's dolphins are resident year-round in Scottish waters, with numbers peaking seasonally in summer (Hague et al., 2020). They are most commonly sighted in northwest Scotland and the Outer Hebrides, with the highest concentrations around the Isle of Lewis, near the WFA and ECRC (Hodgins et al., 2024; Weir et al., 2019; Evans et al., 2003).

The maximum estimated density between SCANS surveys was within SCANS-IV Block CS-J, being 0.0288 individuals/km^2 and an abundance of 936 individuals (Gilles et al., 2023; Table 3.1). Risso's dolphins are part of the CGNS MU, with an estimated abundance of 12 262 individuals, including 8 687 in UK waters (IAMMWG, 2023).

High encounter rates have been recorded during the HWDT surveys near the Butt of Lewis, which overlaps with the ECRC (HWDT, 2018). The ECRC overlaps with the North-east Lewis MPA, for which Risso's dolphins are a protected feature (NatureScot, 2025a).

The conservation status of Risso's dolphin in the UK is currently unknown due to insufficient information (JNCC, 2019).

3.2.9 Striped Dolphin

Striped dolphins typically occur in offshore waters beyond the continental shelf and are infrequent visitors of Scottish waters (Reid et al., 2003). They were recorded only during the SCANS-III surveys in Block K, with the estimated density and abundance being 0.0044 individuals/km^2 and 142 individuals respectively (Hammond et al., 2021; Table 3.1).

No MU was defined for the species (IAMMWG, 2023), therefore the total estimated abundance of 19 253 individuals in European Atlantic waters reported in SCANS-III was taken into consideration (Hammond et al., 2021).

Striped dolphins were not observed during the 2003-2017 HWDT surveys in the Hebridean seas, likely attributed to the preference of this species for deeper waters (HWDT, 2018).

The conservation status of striped dolphins in the UK has not been assessed (JNCC, 2019).

3.2.10 White-Beaked Dolphin

White-beaked dolphins are present year-round throughout Scottish waters, with increased sightings in summer months (Hague et al., 2020). The maximum estimated density of

white-beaked dolphin in SCANS-IV Block CS-J was 0.2565 individuals/km^2 with an estimated abundance of 8 335 individuals (Gilles et al., 2023; Table 3.1;Figure 3.7).

There is an estimated abundance of 43 951 individuals within the CGNS MU, the only MU for white-beaked dolphin. There are an estimated 34 025 individuals within the UK portion of the CGNS MU (IAMMWG, 2023).

HWDT surveys from 2003-2017 reported sightings concentrated in the Outer Hebrides and off the Butt of Lewis (HWDT, 2018), overlapping with the ECRC.

The conservation status of white-beaked dolphins in the UK is currently classed as unknown due to insufficient information (JNCC, 2019).

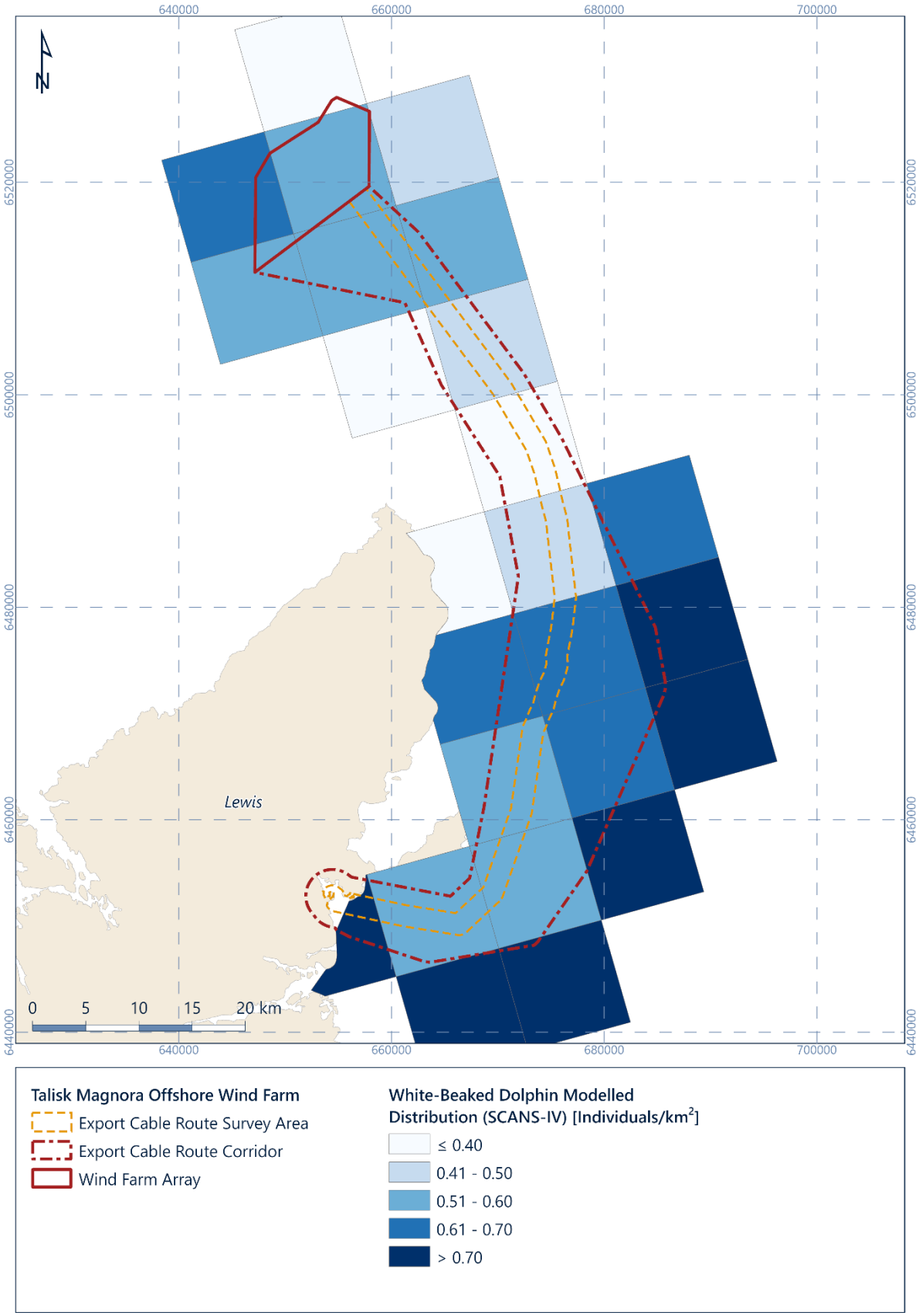


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Figure 3.7: SCANS-IV modelled distribution of white-beaked dolphin in the proposed survey areas

3.3 Other EPS

3.3.1 Leatherback Turtle

Leatherback turtles have been recorded around UK waters but become increasingly rare at higher latitudes (Weir, 2001). In Scotland, approximately 38 sightings of leatherback turtles were reported between 2010 and 2022 (Penrose & Westfield, 2023), with around 5 confirmed sightings recorded in the Outer Hebrides between 1997 and 2021 (NBN Trust, 2025). Live leatherback turtles have predominantly been sighted off the west coast of Scotland, Wales, and southwest England, particularly in 2021.

In September 2020, the HWDT recorded a leatherback turtle approximately 15 miles west of the Isle of Muck. This was a notable sighting, marking HWDT's first record of the species in over 17 years (HWDT, 2020).

As sightings in this region of Scottish waters are very infrequent, leatherback turtles are not included further in this assessment.

3.3.2 Sturgeon

The European Sturgeon (*Acipenser sturio*) was formerly abundant across much of coastal Europe however it is now critically endangered as a result of habitat alteration and bycatch in the Greater North Sea, Celtic Seas, Bay of Biscay and Iberian Coast (OSPAR, 2020).

Today, the species is largely confined to a population centred on the River Gironde in France (OSPAR, 2009). Individuals are typically thought to be restricted to French waters but may stray into the Southern North Sea however data to support this remains limited (OSPAR, 2009).

Sturgeons are not thought to be present within the planned survey area and therefore they are not considered further in this assessment.

3.4 Other Protected Species

3.4.1 Basking Shark

Basking sharks (*Cetorhinus maximus*) are a wide-ranging species ranging from the warm temperate waters of the European continental shelf as far north as the Arctic (Sims, 2008; Evans et al., 2011). Whilst the sightings of most individuals are made in shallow, coastal waters records of basking sharks from offshore cetacean surveys and pelagic driftnet records, together with more recent telemetry studies, suggest that the species also utilises deeper, offshore waters (Booth et al., 2013).

Within UK waters, the basking shark is a seasonal visitor, arriving in significant numbers in May and remaining until October with "hotspots" typically located in the southwest of England (Devon and Cornwall), the Isle of Man and the western coast of Scotland (Booth et al., 2013; Pikesley et al., 2024). Within the west coast of Scotland sightings are usually concentrated in the Clyde, north and west of Mull, Coll and Tiree and the Small Isles

of the Inner Hebrides (Booth et al., 2013; Bloomfield & Solandt, 2008; Pikesley et al., 2024). The waters around the Small Isles, specifically Hyskeir and Canna, are considered to support high numbers of basking sharks involved in courtship behaviour and frequent breaching activities have been recorded here (Hayes et al., 2018). Warming of European waters has led to an increase in the number of sightings being made further north in Scottish waters with occasional records around Orkney and Shetland (Evans et al., 2011). However, the occurrence and distribution of basking sharks in these areas are poorly understood and sightings are typically widely scattered with little to no concentration of sightings in an area (Evans et al., 2011; Hayes et al., 2018).

A record of basking shark sightings around the Inner Hebrides are summarised in Bloomfield & Solandt (2008) with the majority concentrated around Coll, Tiree, north and west of Mull and Canna. Data available from NatureScot (2023) reports on the aggregated annual effort-related basking shark sightings densities (animals/km^2) based on HWDT Effort-Related sightings data from 2003-2011 (Figure 3.8). Data shows that sightings of basking sharks are typically highest around Coll, Tiree and Rhum with the majority of sightings concentrated to the southwest of Tiree (NatureScot, 2023). Within the proposed inshore survey area, reported densities range between 0.00-0.114 animals/km^2, indicating low to very low basking shark presence in the area of the proposed survey (NatureScot, 2023). However, as basking shark distribution can be influenced by seasonal plankton availability, water temperature, and oceanographic conditions, the potential for localised, temporary aggregations cannot be ruled out.

Basking sharks are not included in JNCC Species Conservation Status Assessment (2019); however, the species is currently classified as 'Endangered' on the International Union for the Conservation of Nature (IUCN) Red List of Endangered Species at the global, European, and Mediterranean levels (Rigby et al., 2021). The population status of basking sharks in UK waters remains uncertain due to insufficient data (The Shark Trust, 2018).

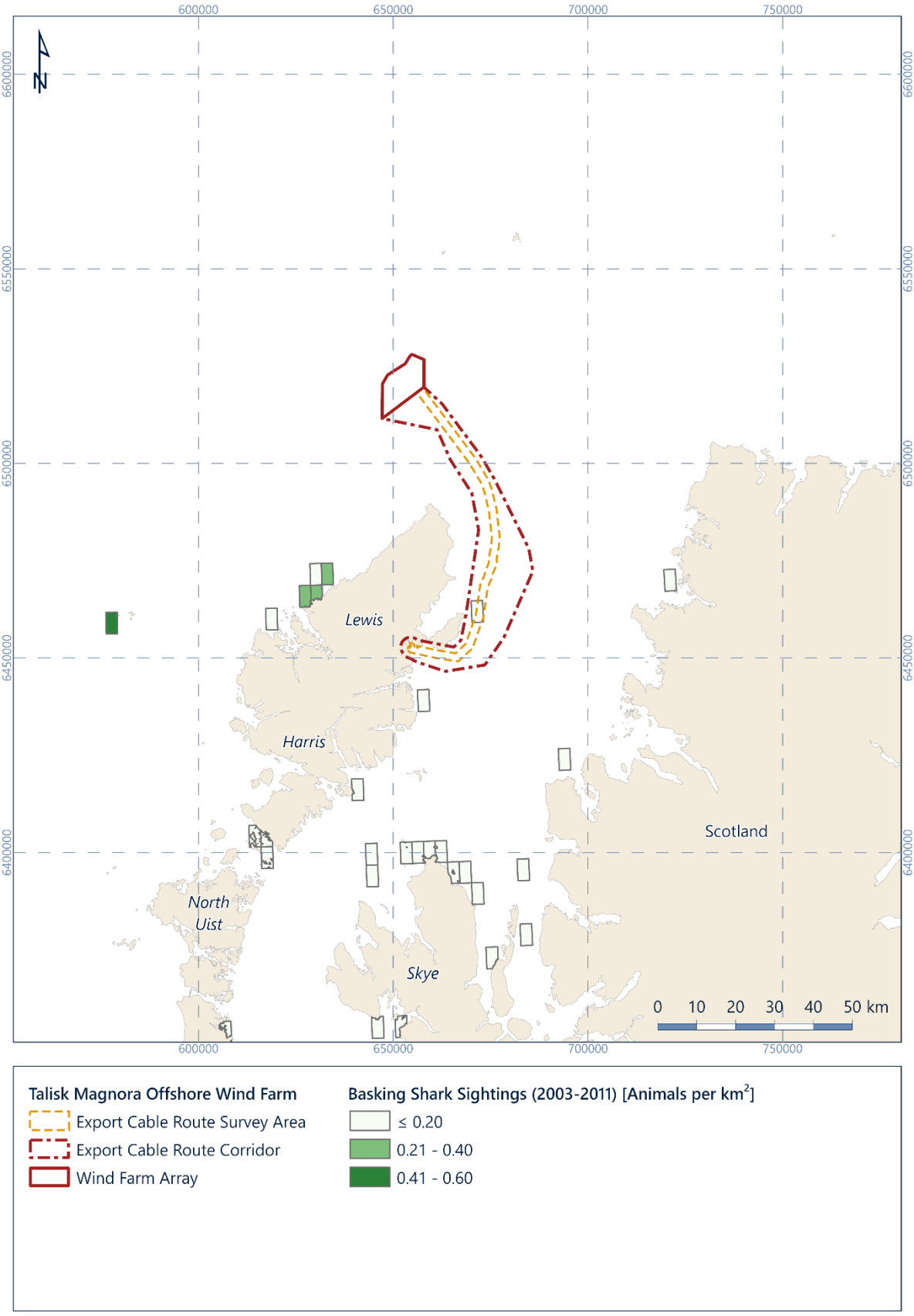

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Figure 3.8: Aggregated annual effort-related basking shark sightings density around the project area

3.5 Protected Areas

A number of protected sites have been designated around the Inner Hebrides including Special Protection Areas (SPAs), Special Areas of Conservation (SACs), Nature Conservation Marine Protected Areas (MPAs) and RAMSAR sites and the proposed survey operations pass through and close to a number of protected sites. The proposed inshore survey operations will overlap with two protected areas, the North-east Lewis MPA (57 % overlap) and the Inner Hebrides and the Minches SAC (2 % overlap). The protected areas closest to the proposed survey areas are summarised below and are shown in Figure 3.9.

The North-east Lewis MPA is designated for the presence of Risso's dolphins and two species of sandeel, the Raitt's sandeel (*Ammodytes marinus*) and the Lesser sandeel (*Ammodytes tobianus*). Geomorphological features are also protected within this conservation area specifically 'Marine Geomorphology of the Scottish Shelf Seabed' (longitudinal bedform field) and 'Quaternary of Scotland' (glaciated channels/troughs, landscape of areal glacial scour, mega-scale glacial lineations). All of these features are assessed as being in a "Favourable" condition (NatureScot, 2025a).

The single protected feature of the Inner Hebrides and the Minches SAC is the harbour porpoise which is assessed as being in a "Favourable" condition (NatureScot, 2024b).

The Shiant East Bank MPA, located 4.5 km to the south of the ECRC, is designated for the presence of 'Northern sea fan and sponge communities', 'Circalittoral sand and mixed sediment communities', 'Shelf banks and mounds', and the geomorphological feature 'Quaternary of Scotland' (drumlinoid forms, glacial lineations, iceberg ploughmark field, streamlined bedrock). All of these features are assessed as being in 'Favourable' condition (NatureScot, 2025b).

The Wester Ross MPA, located 24.5 km from the ECRC, is designated for the protection of seven biodiversity features including burrowed mud, circalittoral muddy sand communities, flame shell beds, kelp and seaweed communities on sublittoral sediment, maerl beds, maerl or coarse shell gravel with burrowing sea cucumbers, and northern feather star aggregations on mixed substrata. In addition, four geodiversity features are also designated features of this protected site. These are Marine Geomorphology of the Scottish Shelf Seabed, Seabed Fluid and Gas Seep, Submarine Mass Movement, and Quaternary of Scotland. All of these features are assessed as being in a 'Favourable' condition with the exception of Flame shell beds and Maerl beds which are assessed as being in 'Unfavourable' condition (NatureScot, 2024c).

Shiant Isles SPA, 23 km south of the ECRC, is designated for the protection of six species of breeding seabirds, a breeding seabird assemblage, non-breeding Greenland barnacle goose, and their supporting habitats. Of these protected features, Atlantic puffin (breeding) and Razorbill (breeding) are assessed as being in a 'Favourable' condition. The other protected features are assessed as being in 'Unfavourable' condition (NatureScot, 2024d).

The Sea of Hebrides MPA, located 75 km southwest of the ECRC, is designated for the protection of basking shark, minke whale, fronts and a geodiversity feature, Marine Geomorphology of the Scottish Shelf Seabed (Inner Hebrides Carbonate Production Area). All of the above protected features are assessed as being in a 'Favourable' condition (NatureScot, 2025c).

The location of these protected areas, and others outside of the survey area, are shown Figure 3.9.

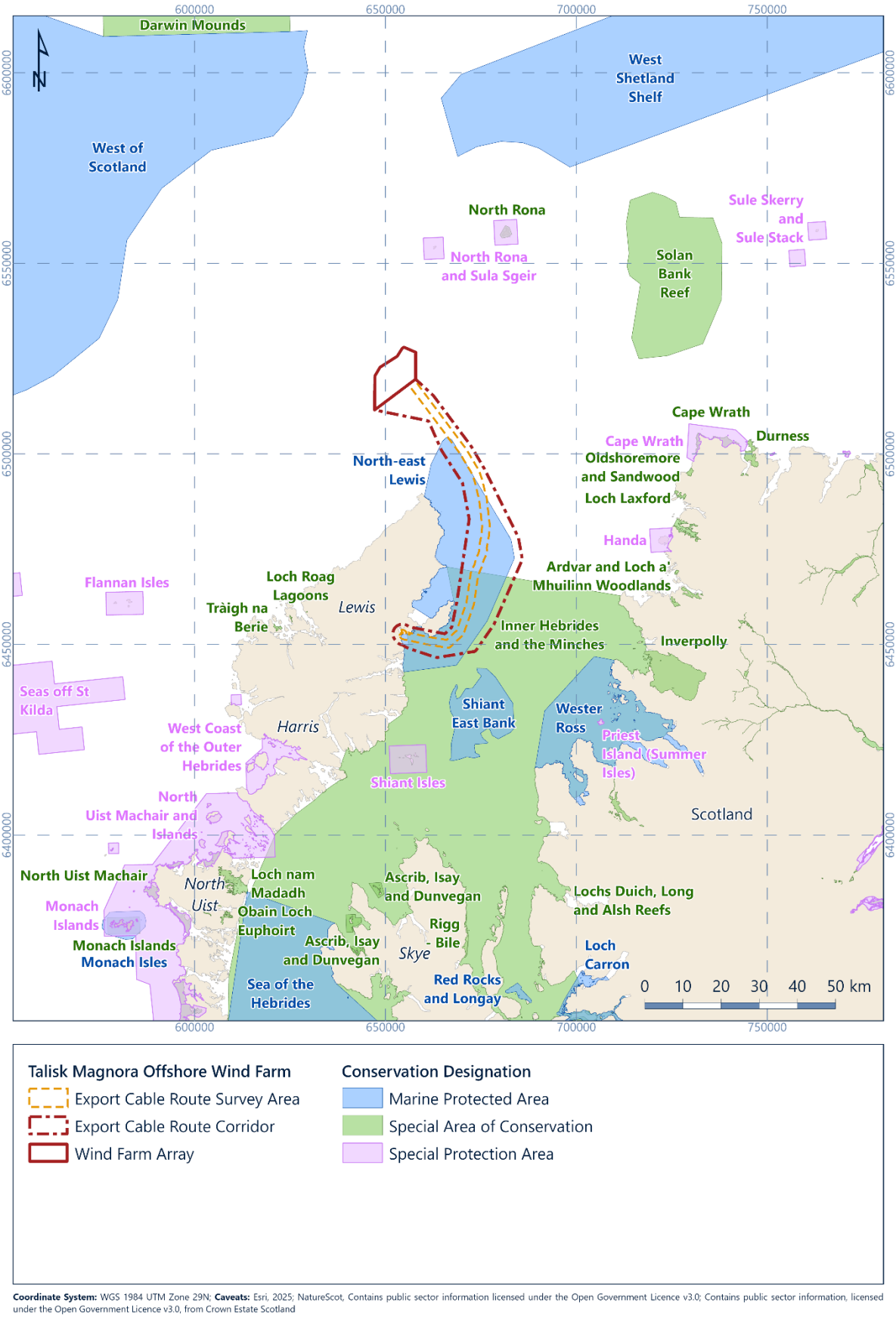

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Figure 3.9: Protected areas in the wider area of the planned survey operations

4. EPS Risk Assessment

In recent years there has been growing awareness of the potential for manmade underwater noise to impact marine animals, particularly marine mammals and fish.

The dominant source of naturally occurring noise across the frequencies from 1 Hz to 100 kHz is associated with ocean surface waves generated by the wind (NRC, 2003). Other natural sounds in the sea include currents, rain, echo-location and communication noises generated by cetaceans and other natural sources such as tectonic activity.

In addition to naturally occurring sounds, there is anthropogenic noise generated by air traffic, shipping activity and the oil and gas industry. Of these, shipping is the dominant source of sound in the world's oceans, generally within a range from five to a few hundred Hertz (NRC, 2003). However, sound generated by geophysical survey equipment such as seismic surveys are also major contributors to low-frequency sound field in certain areas, such as the North Atlantic (Nieukirk et al, 2004; Tyack, 2008). These ambient noise levels in the oceans have increased significantly over the last few decades (e.g. Hatch & Wright, 2007; Andrew et al, 2002; Jalkanen et al., 2022), giving marine animals little time to adapt to these changes in an evolutionary sense.

4.1 Sound Sources

The main sound source during this survey operation will be the intermittent sound pulses generated by the Sub-Bottom Profiler (SBP), Multibeam Echosounder (MBES), Single beam echosounder (SBES), Side Scan Sonar (SSS) and Ultra-short baseline acoustic positioning systems (USBLs). The MBES, SBES and SSS systems operate at frequencies >200 kHz which is beyond the hearing range of marine mammals, rendering them inaudible. Furthermore, any underwater sound generated at these high frequencies will attenuate very quickly over short distances, thus limiting the distance that the sound travels through the water column. Therefore, these sources are typically not considered to be of any concern in relation to their potential to cause injury or disturbance to marine wildlife. For example, the JNCC guidelines for minimising the risk of injury to marine mammals from geophysical surveys (JNCC, 2017) states that MBES undertaken in shallower waters, i.e. those less than 200 m deep, are not typically considered to be of concern to cetacean species as it is thought the higher frequencies typically used in these operations fall outside the hearing frequencies of cetaceans and the sounds produced are likely to attenuate more quickly than the lower frequencies used in deeper waters. The two main underwater sources of potential concern are therefore the SBP and the USBL systems, which are assessed below.

4.1.1 Sub-Bottom Profiler Sound Spreading and Attenuation

The Innomar SES-2000 medium-100 Parametric Sub-bottom profiler uses the principle of "parametric" or "nonlinear" acoustics to generate short narrow-beam sound pulses. The SES-2000 medium-100 Parametric has a source level of 247-250 dB re: 1µPa @ 1m (0-peak),

with an associated sound exposure level (SEL) of around 228 dB re: 1µPa^2-s (single pulse for maximum duty cycle of 1.4 %).

A parametric SBP makes use of a physical effect, which generates low-frequency sound waves by transmitting two slightly different high frequencies (around 100 kHz) at high sound pressures simultaneously. The transmitted 'primary high frequency' (PHF) sound waves interact in the water and new frequencies are generated. These new frequency components, so called 'secondary high frequencies' (SHF) and 'secondary low frequencies' (SLF).

The SHF component comprises the sum of the primary frequencies and harmonics (integer multiples of the original frequencies) and is at least 6 dB below the PHF source level. The SHF components will attenuate over very short distances however, due to the high absorption coefficient of high frequency underwater sound in seawater.

The SES-2000 medium-100 sub-bottom profiler can be adjusted to generate SLF pulses at 4, 5, 6, 8, 10, 12, or 15 kHz, which are used as the source pulse for the sub-bottom profiling. The SLF sound fields have much lower amplitudes (typically 30-40 dB lower than the primary waves).

Furthermore, it should be noted that the SES-2000 medium-100 SBP system is strongly directional, with the vast majority of the signal being emitted straight downward, as illustrated in Figure 4.1.

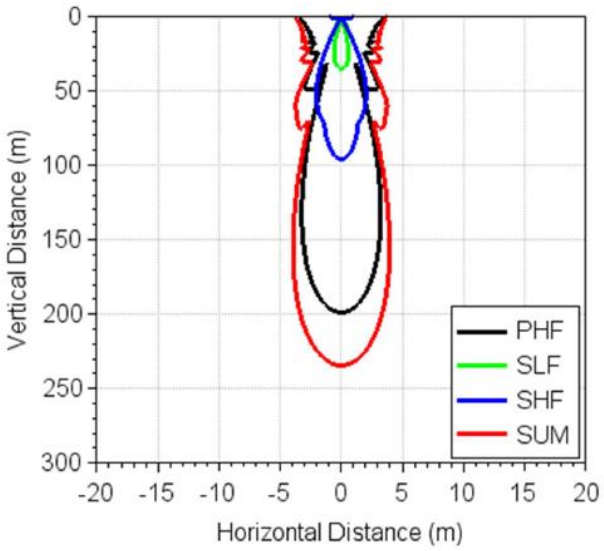

Figure 4.1: Modelling Example 196 dB Isopleth of SES-2000 medium-100 Parametric SBP (Wunderlich, 2021)

This figure shows the modelled 196 dB isopleths for the individual elements (PHF, SLF and SHF) and all three parts combined (SUM) of the sound signature of the SES-2000 medium-100 SPB system, clearly illustrating the large asymmetry between the horizontal and vertical underwater sound attenuation.

Table 4.1 shows the Vertical and Horizontal distances, for a number of set cumulative SEL values over a 24 hour period, as well as for a single pulse sound pressure level (SPL) at 196 dB

re: 1µPa @ 1m, for the SES-2000 medium-100 SBP system as modelled by Innomar (Wunderlich, 2021).

Figure 4.2 shows a graphical representation of the same SEL values at horizontal distances from the sound source.

Table 4.1: Vertical and Horizontal distance from Innomar SES-2000 medium-100 SBP transducer at certain set SPL and SEL values

	SEL <218 dB re: 1µPa²-s (24hrs)	SEL<168 dB re: 1µPa²-s (24hrs)	SEL<160 dB re: 1µPa²-s (24hrs)	SEL<140 dB re: 1µPa²-s (24hrs)	SPL <196 dB re: 1µPa @ 1m
Vertical Distance	300 m	3 350 m	6 500 m	20 000 m	240 m
Horizontal Distance	10 m	550 m	800 m	1 800 m	<5 m
Source: Wunderlich, 2021					

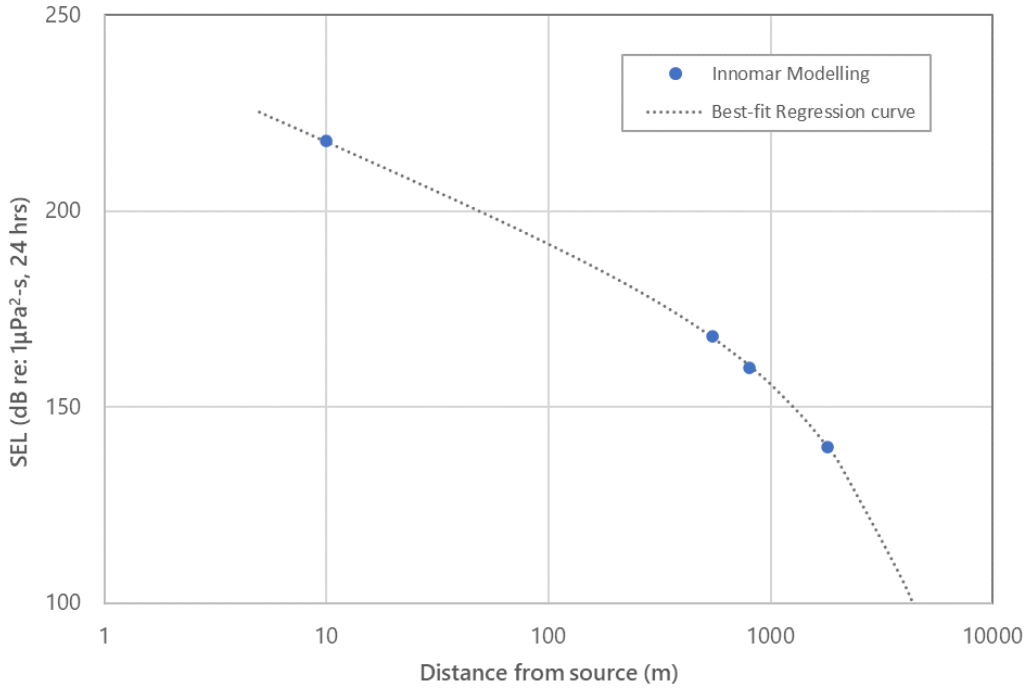

Figure 4.2: Horizontal Sound Attenuation Innomar SES-2000 medium-100 SBP

4.1.2 USBL Sound Spreading and Attenuation

It is anticipated that the USBLs used for the proposed geophysical and benthic survey will be Kongsberg HiPAP 502 USBLs, or similar. This system has an operating frequency range between 21-30.5 kHz and therefore falls within the hearing range of all EPS hearing groups (see Table 4.2 below). In addition, the source pressure levels produced by the USBL are listed to range between 190 and 203 dB re: 1µPa @ 1m (0-peak).

There is very limited information available on the behaviour of underwater noise produced by USBLs. A field study undertaken by JASCO in the Danish part of the North Sea, measured the

underwater noise generated of the Fugro Pioneer survey vessel, whilst it was deploying various types of survey equipment, including a USBL (Pace et al., 2021). This study found the source peak levels to be slightly lower than the numbers quoted above, when calculating the measured sound levels back to their original source level. Measurements were taken at various distances both along the survey direction (end-fire) and in an off-axis (broadside) direction of the survey vessel (Figure 4.3).

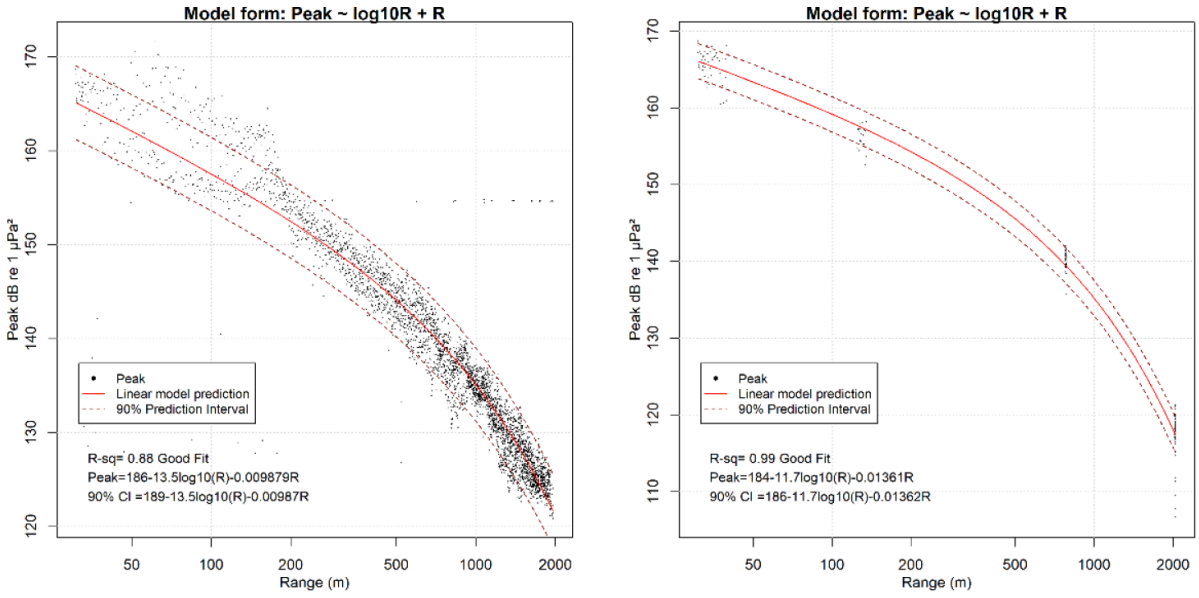

Figure 4.3: USBL Sound Pressure Levels (Lpeak)

The figure shows the SPL (0-pk) in the end-fire direction (left) and the broadside direction (right) for the pass with the USBL beacon active. The solid line is the best fit of the empirical function to the SPL. The dashed line is the best-fit line shifted up to exceed 90% of the SPL values (i.e., the 90th percentile fit). Using the 90th percentile fit, the back-calculated source level ranges between 186 and 189 re: 1µPa @ 1m for the end-fire and broadside directions, respectively.

The same study measured SEL values produced by the USBL, which can be used to calculate the potential cumulative exposure values over a 24 period (Figure 4.4).

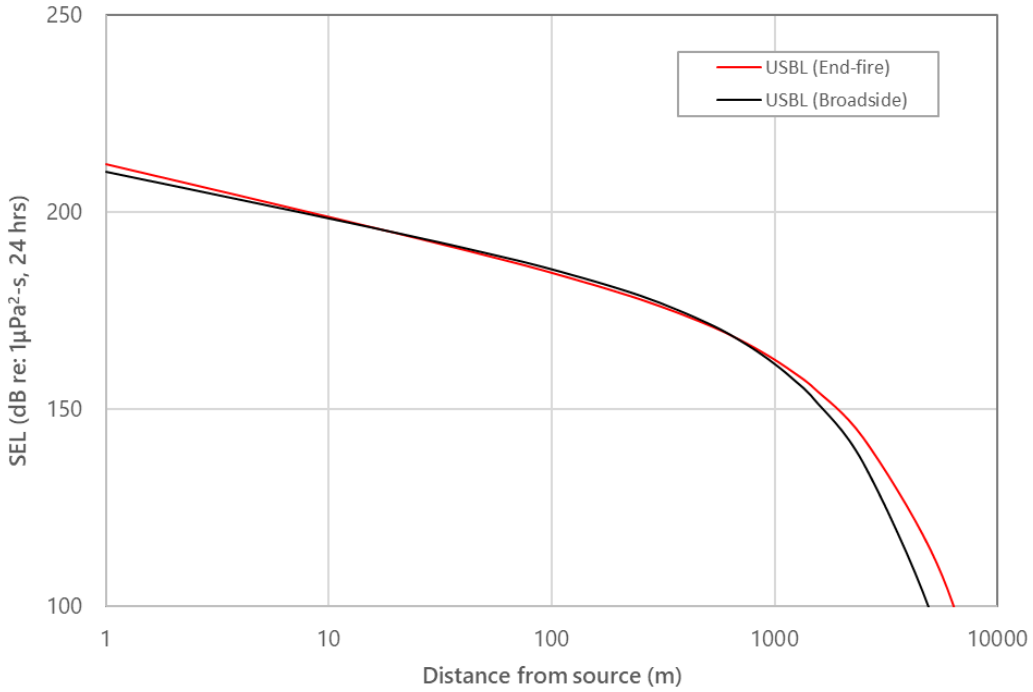

Figure 4.4: SEL_{CUM} for the USBL over a 24 Hr period

4.2 Impacts from Underwater Sound

This section assesses potential impacts from underwater sound focussing on marine mammals which are one of the groups believed to be most at risk from noise impacts. Sound is a particularly efficient way to propagate energy through the ocean, and many marine animals use hearing as their primary sense. Cetaceans are heavily dependent on sound for food-finding, communication, reproduction, detection of predators and navigation (Weilgart, 2007; Hildebrand, 2004).

The ocean is a naturally noisy environment and cetaceans have evolved ears that function well within this context. A review of anatomical and behavioural studies by Ketten (2004) indicated that whales and dolphins may be more resistant than many land mammals to temporary threshold shifts (loss of hearing sensitivity). However, these data also show that they are subject to disease and aging processes and are therefore not immune to hearing loss. Increasing ambient noise via human activities is a reasonable candidate for exacerbating or accelerating such losses (Ketten, 2004).

The introduction of additional noise into the marine environment could potentially result in an injury or cause a disturbance by interfering with the animals' ability to determine the presence of other individuals, predators, prey and underwater features and obstructions. This could therefore cause short-term behavioural changes and in more extreme cases, auditory damage. In addition to marine mammals, underwater sound may also cause behavioural changes in other animals such as fish and cephalopods.

Potential effects of anthropogenic sound sources on marine animals range from disturbance which may lead to (temporary) displacement from feeding or breeding areas to auditory damage and in extreme cases could potentially even result in tissue trauma or mortality (Carroll et al., 2017). Anthropogenic noise in the marine environment has been shown to affect foraging, vocalisation and movement of marine mammals, whilst bony fish have been shown to display changes in movement patterns and feeding and antipredator behaviour (Chapuis et al., 2019). Conversely, some marine species (or certain individuals of a species) may experience no effect from exposure to sound sources, particularly if the received frequency does not exceed their hearing thresholds, rendering them inaudible for those animals (Carroll et al., 2017).

4.2.1 Impacts on Marine Mammals

Marine mammals use sound in various important contexts, such as in social interactions, foraging, and response to predators (Southall et al., 2007). Hearing is the primary sensory system for marine mammals, which is clearly shown by their level of ear and neural auditory centre development (Ketten, 2004). As the sea has never been a silent place, the ears of marine mammals, and those of whales and dolphins in particular, have evolved to function well within this context of ambient noise. However, little information exists to describe how marine mammals respond physically and behaviourally to intense sounds and to long-term increases in ambient noise levels (NRC, 2003).

4.2.1.1 Hearing Sensitivity

Marine mammals vary regarding to their hearing sensitivities and in order to assess the impacts of sound can be classed into functional hearing groups. These hearing groups were introduced by Southall et al. (2007) and remain under continuous review and consequently have been updated several times since (i.e.: NMFS, 2016; NMFS, 2018; Southall et al., 2019; NMFS, 2024). The classification into functional hearing groups takes into account that not all marine mammal species have identical hearing or susceptibility to noise-induced hearing loss. Table 4.2 applies the most up to date classification by NMFS (2024) to the species that may be present in the wider vicinity of the area of the proposed survey operations. Outside their generalized hearing ranges, the risk of auditory impacts from sounds is considered highly unlikely or very low.

Table 4.2: Function marine hearing groups for marine mammals potentially present in the survey area

Functional hearing group	Estimated auditory band width	Species potentially present in the survey area
Low-frequency cetaceans	7 Hz to 36 kHz	Minke whale.
High frequency cetaceans *(formerly referred to as Mid-frequency cetaceans)*	150 Hz to 160 kHz	Atlantic white-sided dolphin, bottlenose dolphin, common dolphin, Risso's dolphin, long-finned pilot whale, white-beaked dolphin, striped dolphin and beaked whales.

Functional hearing group	Estimated auditory band width	Species potentially present in the survey area
Very high-frequency cetaceans *(formerly referred to High-frequency cetaceans)*	200 Hz to 165 kHz	Harbour porpoise.
Pinnipeds in water	40 Hz to 90 kHz	Grey seal; common seal.
Sources: BODC, 1998, Reid et al., 2003, NOAA, 2018 and Southall et al 2019. Functional hearing groups in NOAA (2018) have been re-classified in Southall et al (2019) as low frequency, high frequency and very high frequency.		

According to this classification, harbour porpoises are regarded as 'very high-frequency cetaceans', whereas dolphin species and beaked whales present around the Inner Hebrides are classified as 'high-frequency cetaceans'. These classifications are based on the fact that odontocetes have highly advanced echolocation systems that use intermediate to very high frequencies. They also produce social sounds in a lower-frequency band, including generally low to intermediate frequencies (1 kHz to tens of kHz). Consequently, their functional hearing is expected to cover this whole range; however, their hearing sensitivity typically peaks at or near the frequency where echolocation signals are strongest (Southall et al., 2019).

The large baleen whales (mysticetes) are all categorised as low-frequency cetaceans. The most likely mysticete species present around Inner Hebrides is the minke whale. Only very limited direct measurements of hearing exist for these animals and theories regarding their sensory capabilities are consequently mostly speculative[1]. In these species, hearing sensitivity has been estimated from behavioural responses (or lack thereof) to sounds at various frequencies, most common vocalisation frequencies, body size, ambient noise levels at the frequencies they use most, and cochlear morphology. At present, the lower and upper frequencies for functional hearing in mysticetes, collectively, are estimated to be 7 Hz and 35 kHz (NOAA, 2018).

Research indicates that marine mammals can react differently to the introduction of additional noise into the marine environment. Reactions may vary depending on sound source level, propagation conditions and ambient noise, in addition to species, age, sex, habitat, individual variation, and previous habituation to noise (Richardson et al., 1995). It should also be noted that marine mammals react differently to stationary noise, compared to sudden bursts of noise and noises that appear to be coming towards them. Studies suggest that most cetaceans will alter their course or display avoidance reactions to a noise that appears to be moving directly towards them. Stationary noises, outwith an immediate zone of discomfort to the animal, seem to have a lesser effect in disturbing migration patterns and animal feeding, although data and observations on this matter are limited (Davis et al., 1990).

[1] The National Marine Mammal Foundation successfully collected preliminary hearing data on two minke whales during their third field season (2023) in Norway. These data have implications for not only the generalized hearing range for low-frequency cetaceans but also on their weighting function. However, at this time, no official results have been published. Furthermore, a fourth field season (2024) has concluded, where more data were collected (NMFS, 2024).

4.2.1.2 Potential Injury Impacts

As indicated above, the main two underwater noise sources with the potential to injure and/or disturb EPS are the SBP and USBL. There are few direct data regarding the effects of intense sound on cetaceans, making it difficult to predict accurate safe exposure levels for these mammals (Finneran et al., 2000). Nonetheless, over the past two decades or so, various attempts have been made to create a set of injury criteria for individual marine mammals exposed to discrete noise events and several threshold criteria and methods for determining how sound levels are perceived by marine mammals are available (e.g. the dBht method and other hearing weighted and linear measures) and each has its own advantages and disadvantages.

JNCC guidance (JNCC, 2010) recommends using the injury criteria proposed by Southall et al. (2007) which are based on a combination of linear (i.e. un-weighted) peak pressure levels and mammal hearing weighted (M-weighted) sound exposure levels (SEL). As mentioned above, since the original injury criteria proposed in Southall et al. (2007) have been updated several times since and the current NMFS (2024) thresholds are therefore regarded as the most up to date thresholds and have been used in this assessment.

These injury criteria aim to set acoustic thresholds, at which individual marine mammals are predicted to experience temporary threshold shift (TTS) or auditory injury (AUD INJ), as a result of acute, incidental exposure to underwater anthropogenic sound sources. TTS is defined as a temporary, reversible increase in the threshold of audibility at a specified frequency or portion of an individual's hearing range above a previously established reference level. In contrast, AUD INJ is defined as damage to the inner ear that can result in destruction of tissue, such as the loss of cochlear neuron synapses or auditory neuropathy, which may or may not result in a permanent threshold shift (PTS). PTS is a permanent, irreversible increase in the threshold of audibility at a specified frequency or portion of an individual's hearing range above a previously established reference level (NMFS, 2024).

The acoustic thresholds for the type of underwater sound that will be generated by the proposed geophysical survey are based on dual metrics of peak sound level for a single pulse (SPL_R) and the cumulative sound exposure level (SEL_{cum}) over a 24 hr time period.

The SPL_R sound pressure level thresholds are based on the unweighted, or 'flat', threshold values for impulsive sounds, which are fixed for each hearing group. The SEL_{cum} thresholds however, are frequency dependent and therefore should be weighted accordingly. However, as explained in Section 4.1.1 the Innomar SES-2000 medium sub-bottom profiler produces a sound field covering a wide range of frequencies that overlap with the audible spectrum of all marine mammals groups (see Table 4.2). Similarly, the operating frequency range of the USBL overlaps with the peak hearing range of high frequency (HF) cetaceans and is very close to that of VHF cetaceans. Therefore, no weighting adjustments have been used in the assessment to ensure the most conservative assessment method.

Table 4.3 presents the acoustic AUD INJ thresholds for peak sound pressure level measured at distance R (SPL_R) and the cumulative sound exposure level (SEL_{cum}), for a recommended accumulation period of 24 hrs.

Table 4.3: AUD INJ onset thresholds for impulsive underwater sound

Marine Mammal Group and species potentially present in the vicinity of the survey area	AUD INJ onset, SPL_R, 0-pk, flat (dB re 1µPa)	AUD INJ onset SEL_{cum}, 24hr (weigthed) (dB re 1µPa^2-s)
Low-frequency (LF) cetaceans Minke whale	222	183
High-frequency (HF) cetaceans Atlantic white-sided dolphin, bottlenose dolphin, common dolphin, Risso's dolphin, long-finned pilot whale, white-beaked dolphin, striped dolphin and beaked whales	230	193
Very high-frequency (VHF) cetaceans Harbour Porpoise	202	159
Phocid carnivores in water (PCW) Grey and Common seals	223	183
Source: NMFS, 2024		

The modelling results in Figure 4.1 and Table 4.3 show that the SPL_R isopleth of 196 dB re 1µPa extends to 240 m straight underneath the SBP, but only extends 5 m in any direction horizontally around the SBP. With the lowest AUD INJ SPL_R onset threshold in Table 4.3 being 202 dB for harbour porpoises, it seems therefore extremely unlikely that the first assessment criterium for an injury caused by a single pulse would be breached.

The proposed USBL system has a reported sound pressure level range 190 to 203 dB re: 1µPa @ 1m (0-peak), which is close to the auditory injury (AUD INJ) of 202 dB for a single pulse sound for very high-frequency (VHF) cetaceans hearing groups (i.e. including harbour porpoises). However, as described in Section 4.1.2 above, back-calculated SPL levels from the field study showed these to be slightly lower ranging between 186 and 189 dB re: 1µPa @ 1m (0-peak). The same study also showed that even if the source level would be around the AUD INJ levels for harbour porpoises, these levels would only occur within a few metres from the sound source and will be attenuated by at least 8.2 dB at 5 m distance and 11.7 dB at 10 m from the sound source, bringing it well below the AUD INJ level. Consequently, the potential for AUD INJ onset threshold to be breached by a single pulse from the USBL is considered unlikely.

The second assessment criterium looks at the auditory thresholds for the cumulative SEL values over a 24 hour period. The modelling results for the SBP summarised in Table 4.1 and Figure 4.2 show that the horizontal distance to the AUD INJ onset threshold for cumulative sound exposure over any 24 hr period (SEL_{cum}) for the most sensitive species group, i.e. the harbour porpoises, is approximately 865 m. The VHF SEL_{cum} threshold for the USBL is 1,250 m (see Figure 4.4 above).

However, it should be noted that this method assumes that any affected animal would remain in close proximity to, even following, the survey vessel for a period of 24 hours in order to exceed these thresholds, which is highly unlikely, as animals experiencing any discomfort caused by high sound levels are expected to (temporarily) move out of the area.

4.2.1.3 Potential EPS Disturbance Impacts

As explained in Section 1.2 above, it is an offence to deliberately disturb European Protected Species (EPS; species listed in Annex IV of the Habitats Directive) under Habitat Regulations 1994 and the Conservation of Offshore Marine Habitats and Species Regulations 2017, which implement the protection requirements of the Habitats and Birds Directives in the offshore marine area.

Therefore, an assessment has been undertaken to determine if any of the proposed survey operations taking place would potentially cause a 'disturbance offence' to any EPS, and subsequently would require a disturbance licence under these regulations. The potential disturbance caused by survey operations mainly refers to (underwater) noise.

EPS include all cetaceans, turtles and sturgeon. In UK waters, the latter two are at the limits of their global distributions (which are centred elsewhere in the west Atlantic or Europe) and only occur in low numbers around the UK. It is therefore extremely unlikely that a significant group of these animals would be present, or that their local abundance or distribution would be significantly affected by marine impacts (JNCC, 2010). Therefore, only cetaceans will be considered in this assessment from hereon.

As described above, it is unlikely that the proposed survey operations would cause any injury to cetaceans, however, a certain level of behavioural responses may be expected from individual cetaceans reacting to the produced underwater sound. Therefore, this assessment will be based on whether any of these behavioural responses could potentially significantly affect the local distribution or abundance of any of the cetacean species potentially present in the survey area.

No studies could be identified on the direct impacts of (parametric) sub-bottom profiling surveys and/or USBL systems. However, several studies are available on the behaviour of (small) odontocetes to seismic survey sound, which generally show some form of avoidance during survey operations, and these have been used as a proxy to estimate behavioural effects ranges for the proposed survey. Although, it should be noted that the vast majority of underwater sound energy produced by seismic surveys is typically at much lower frequencies than that produced by the proposed SBP operations, with the potential of travelling over much greater distances. Hence, while the effects described below are used as a proxy for the anticipated responses, they are not necessarily completely analogous to the proposed SBP operations and are likely to describe the more extreme end of the response ranges anticipated from the proposed survey activities covered in this assessment.

A study by Goold (1996) reported general avoidance behaviour of common dolphins to airgun sound at up to 1 km during a 2D seismic survey off the coast of Pembrokeshire in the Irish Sea. Another study, looking at the effects of seismic surveys around the UK, showed that small cetaceans remained significantly further from the seismic vessel during periods of shooting (Stone & Tasker, 2006). Comparable behaviour was observed for Atlantic spotted dolphins by Weir (2008) during seismic exploration offshore Angola.

All three authors suggest that the avoidance behaviour appeared to be limited to within a few kilometres from the seismic airgun array. A similar effect was reported by Parente & de Araújo (2005) who reported a reduction in cetacean diversity, mainly among members of the family Delphinidae, during seismic surveying offshore Brazil.

Thompson et al. (2013) found behavioural responses to 2D seismic survey noise in the Moray Firth in harbour porpoises within 5-10 km; although animals were typically detected again at affected sites within a few hours. Contrary to this, in their review of the effects of seismic surveys on marine mammals, Gordon et al. (2003), quote a study which showed no change in the rate of detection of harbour porpoises during two seismic surveys, using an automated click detector.

Most studies on cetaceans report behavioural responses at received sound levels around 140 to 160 dB re 1 µPa, and sometimes even higher (e.g. Southall et al., 2007; Richardson et al., 1995). These responses typically consist of subtle effects on surfacing and respiration patterns. Sound levels of 150 to 180 dB will generally evoke behavioural avoidance reactions (Richardson et al., 1995). An underwater sound pressure level around 150 dB would be expected to occur around 228 m from the SBP sound source and 780 m from the USBL.

Table 4.4 shows cetacean species that may be present in the survey area, and which may therefore be affected by underwater noise generated by the proposed survey. It also presents an estimate of the number of individuals per species that may be expected to be present within the predicted zone of disturbance (i.e. up to 2 km distance from the SBP).

In addition to the above assessment, it should also be noted that the proposed inshore survey area partly overlaps with the Inner Hebrides and Minches SAC, which designated for the presence of harbour porpoises. Assessment guidance from JNCC et al. (2020) for noise disturbance against conservation objectives for harbour porpoise SACs recommends using a 5 km Effective Deterrent Range (EDR) for high-resolution geophysical surveys. The EDR represents the distance within which a proposed activity is expected to be able to result in a potential EPS disturbance and is based on observed effects, such as a reduction in porpoise vocal activity or sightings. The predicted impact ranges of the proposed survey equipment, including those for the parametric SBP and USBL, fit comfortably within this EDR range so, in this instance, the 5 km EDR can be considered a highly conservative threshold for assessing the number of animals that may be subjected to disturbance, as a result of the proposed survey operations.

SCANS-III data Blocks K and I and SCANS-IV data from Blocks CS-J and CS-H have been used to represent cetacean density in the vicinity of the survey area (Gilles et al., 2023; Hammond et al., 2021), selecting the highest density where applicable whilst data from IAMMWG (2023) was used to represent abundance in the survey area as summarised in Table 4.4.

Table 4.4: Cetaceans potentially affected by proposed survey activities and their estimated population size based on MUs and SCANS-IV or SCANS-III data

Cetacean species	Density (animals / km^2)	Disturbance Zone (5 km)		Estimated Abundance over MUs or SCANS
		No. of Animals Affected	% of Population Affected	
Atlantic white-sided dolphin	0.0279	2.19	0.01	18 128
Beaked whales	0.0065	0.51	0.03	1 489*
Bottlenose dolphin	0.0010**	0.08	0.18	45
Common dolphin	0.926	72.73	0.07	102 656
Harbour porpoise	0.397	31.18	0.11	28 936
Long-finned pilot whale	0.0537	4.22	0.08	5 215*
Minke whale	0.0353	2.77	0.01	20 118
Risso's dolphin	0.0288	2.26	0.02	12 262
Striped dolphin	0.0044	0.35	0.002	19 253*
White-beaked dolphin	0.2565	20.15	0.05	43 951

Notes
Density refers to maximum estimated density reported in SCANS-III or SCANS-IV Blocks K, I, CS-J, or CS-H.
* = Total estimated abundance for European Atlantic waters as reported in SCANS-IV or SCANS-III has been used due to the species not having a defined MU according to IAMMWG (2023).
** = The density for bottlenose dolphins has been determined using the MU for the coastal ecotype, which is believed to be more representative than the density estimate provided in SCANS for this area.
Sources: Gilles et al., 2023; Hammond et al., 2021; IAMMWG, 2023.

Table 4.4 shows that common dolphins, harbour porpoises and white-beaked dolphins are the most abundant species present in the survey area, and thus the most likely species to be affected. In addition, it is also noted that part of the inshore survey area overlaps with a small part (2%) of the Hebrides and the Minches SAC, for which harbour porpoises are a qualifying feature, and 58% of the North-east Lewis MPA, for which Risso's dolphins are a qualifying feature.

In line with Article 41(1)(b) and (2) of the Habitat Regulations, an impact should be considered as significant if it compromises the conservation status of the species within its natural range, whereby disturbance impacts affecting less than 1 % of the reference

population are generally deemed negligible and unlikely to result in long-term population decline or disruption to the species' FCS.

Table 4.4 shows that the percentage of the population affected are all well below this 1% threshold, and thus are unlikely to qualify as causing a disturbance offense.

In conclusion, no physical injuries are expected as a result of the underwater sound pulses generated by the parametric SBP, USBL or any other geophysical survey equipment during the proposed survey. However, any cetaceans in the immediate vicinity may exhibit avoidance responses and other subtler behavioural effects. It should be noted that the thresholds used to predict zones of effect around the survey equipment are precautionary, representing the lower limits of responsiveness from published studies, as reviewed by Southall et al. (2007), for example. As a consequence, not all marine mammals exposed to these levels of noise will respond as predicted, and some may show no measurable effects. In addition, the type and intensity of an animal's response is believed to vary depending on the ratio between the anthropogenic sound and ambient noise levels, the rate of change of the sound; and also the behavioural context and motivations at the time, the previous experience of exposed individuals and how the animal interprets the sound, i.e. as a predator or just an annoying stimulus (JNCC, 2010).

The Stage 1 Risk Assessment above shows that the risk of an injury or disturbance offence being committed is very low but can never be ruled out completely. Therefore, on this occasion, Fugro wishes to apply for an EPS disturbance licence for the survey operations.

4.2.2 Impact on Basking Sharks

Sharks, including basking sharks, only have an inner ear. Their ears comprise two small holes which are located on either side of their head, behind the eyes. They are made up of 3 cartilage tubes filled with fluid and lined with hair cells. Sound waves cause these tiny hairs to vibrate and the brain then interprets the sound (The Shark Trust, 2018).

The paired inner ears, as in all fishes, detect the particle motion component of a sound. Unlike most bony fishes however, cartilaginous fishes (including sharks) do not possess a swim bladder, which responds to the pressure component of a sound, and therefore are thought to only be sensitive to particle motion (Chapuis et al., 2019). Consequently, the hearing sensitivity of sharks is limited to low frequency sounds only (between 20 Hz to 1 500 Hz) peaking between 200 and 600 Hz, depending on the species (Carroll et al., 2017 and Chapuis et al., 2019).

Little information exists on sound detection in basking sharks and there is no direct evidence of sound causing this species mortality or stress (Wilson et al., 2020). The aforementioned estimated hearing bandwidth of elasmobranchs is well below that of the geophysical survey equipment proposed for use in the survey operations (see Table 2.2). Furthermore, basking sharks are not known to vocalise and do not rely on hearing to forage. Hence, increased vessel noise is not considered likely have any impact on the species (Booth et al., 2013).

Observations of basking sharks during seismic survey operations off Shetland noted that individuals and small groups continued to be observed even during firing of the air guns (Hayes et al., 2018).

Therefore, it is very unlikely that basking sharks will be (significantly) affected by the underwater sound produced by any of the survey equipment, and thus no disturbance or injury from the effects of the additional underwater sound are anticipated.

Even though, basking sharks are considered to have a low sensitivity to noise, it is advised that any pressures associated with scientific acoustic surveys should be minimised through existing best practice, such as the JNCC 2017 Guidelines, to ensure basking sharks are not disrupted, particularly between the months of April and October (NatureScot, 2019).

In contrast, basking sharks have been observed diving and moving away from areas when disturbed by boats, although other observations note that basking sharks remain relatively unaware of surface vessels (Bloomfield & Solandt, 2008 and Speedie & Johnson, 2008).

Therefore, they potentially may be susceptible to ship strikes, although there is a lack of information on the frequency of such events (Booth et al., 2013). The risk of collision increases with increased vessel speeds and also vessel size. Whilst vessels of all sizes can cause collisions, incidents involving larger vessels and higher speeds tend to result in more serious consequences (Laist et al., 2001). Collisions can cause serious injuries, including fractures, bruising, cuts, and in some cases, fatalities (Van Waerebeek et al., 2007).

Vanderlaan and Taggart (2006) found a direct correlation between vessel size, speed, and the severity of injury showing that vessels travelling at speeds below 11.8 knots reduce the likelihood of lethal injury to whales by more than 50 %.

The vessel speed during the proposed survey operations will be between 4 and 5 knots which will significantly reduce the collision risk. To further mitigate and reduce the risk of collision with survey vessels or towed equipment during the survey operations it is proposed that marine mammal observers (MMOs) undertake a pre-survey watch to detect basking sharks when at the surface in line with the JNCC guidelines for minimising the risk of injury to marine mammals from geophysical surveys (JNCC, 2017) and any line turns are conducted in accordance with the mitigation measures detailed in the same guidance, as discussed in Section 4.3. An ongoing watch for basking sharks will be maintained during the survey operations where conditions permit (i.e. during hours of daylight).

The species apparent relative lack of awareness of vessel traffic and susceptibility to ship strikes conversely means that they are not likely to be susceptible to disturbance from the presence of additional vessels in an area (Speedie et al., 2009 in Booth et al., 2013). Thus, it is considered unlikely that the physical presence of the survey vessel itself will have a significant impact on basking sharks. However, to mitigate and reduce any potential risk of collision codes of conduct for vessel operators, such as the Scottish Marine Wildlife Watching Code

(SMWWC), will be adhered to and the survey vessels have observers onboard to look out for basking sharks during transit and survey operations.

The survey operations are planned to take place between July and November which coincides with a general increase in basking shark sightings in Scotland during the summer and the annual peak which typically occurs in August (Bloomfield & Solandt, 2008). However, as seen in Figure 3.8, the proposed survey operations are generally located away from the areas of the highest numbers of sightings of basking sharks which are typically recorded most frequently to west of Lewis, and the Inner Hebrides (Bloomfield & Solandt, 2008).

The proposed survey operations are of a temporary nature, lasting approximately 59 days in total.

For the reasons expanded on above, it is therefore not considered likely that the proposed survey operations will result in a significant disturbance effect on basking sharks in the area.

Mitigation measures, as detailed in Section 4.3, will further reduce the potential for any disturbance or injury threat to basking sharks during survey operations.

The basking shark Risk Assessment above shows that the risk of an injury or disturbance offence being committed is low but cannot be completely dismissed. Therefore, on this occasion, Fugro wishes to apply for a basking shark licence for the survey operations.

4.2.3 Cumulative Impacts

Gordon et al. (1998) suggest that cumulative effects on feeding, migration and social behaviour in marine mammals may lead to wider population effects, particularly in areas of high interest where many seismic surveys occur at the same. However, to date there are no ready means of estimating the contribution of a specific activity to the cumulative effects of all human activities on a species or population (Moore et al., 2012). This knowledge gap of cumulative impacts is widely acknowledged (e.g. NRC, 2003; Gordon et al., 2003; Southall et al. 2007; Boyd et al. 2011).

As a result, at present, no causal links have been (or can be) made between cumulative impacts and geophysical survey activities. For example, various studies in northwestern Australia and along the Californian coast indicated that baleen whales continue to migrate into areas of consistently high (seismic) survey activity (McCauley & Young, 1994); Richardson et al., (1987) found no evidence that bowhead whales were avoiding areas of seismic exploration in the Beaufort Sea during a long term study, and; the bottlenose dolphin population in the Moray Firth did not seem to be affected by the repeated seismic surveying activity in the area (Thompson *et al.*, 2013; Evans & Nice 1996; Turnpenny & Nedwell, 1994). Although currently unproven, Fugro does acknowledge that the potential for cumulative effects on marine mammals is plausible and will therefore adopt the following precautionary measures in the planning and execution of this seismic survey.

Bearing in mind the distances at which behavioural effects may occur in marine mammals and fish from a single geophysical survey, it is considered good industry practise to undertake such surveys consecutively through appropriate planning and co-operation, where possible. It is also worth noting that geophysical surveys should not be undertaken in close proximity to each other for technical reasons as that would interfere with data collection. The JNCC noise registry currently lists one potential SBP operation to take place in Loch Eireasort, near Cearsiadar on the Isle of Lewis, between January and December 2025. Given the sheltered location of this survey inside Loch Eireasort and the distance of >10 km between this survey location and the proposed inshore survey area, no significant cumulative effects are expected to occur, even if these surveys would be taking place simultaneously. In the unlikely event that both surveys would occur concurrently and the acoustic footprints would overlap, Fugro will follow the International Association of Geophysical Contractors (IAGC) practice of time share between seismic marine crews, thereby minimising the potential for cumulative impacts.

Other producers of underwater sound that may interact with the seismic survey are shipping and fishing. In general, sound levels of shipping and fishing activities are typically attenuated to below levels expected to cause any effects on marine mammal or fish behaviour within a few km from the source. Fishing vessel activity in the area is not concentrated in any particular location, and commercial shipping traffic levels are typically low. Due to the transitory and temporary nature of noise inputs to the sea from other sea users (i.e. fishing and shipping), the interaction of these with underwater noise is unlikely to cause any significant cumulative impacts.

4.3 Mitigation Measures

One of the main mitigation measures in reducing environmental impacts from geophysical survey operations is to minimise the amount of anthropogenic noise entering the marine environment. Therefore, the proposed operations will use the lowest practicable power levels throughout the survey, and the SBP, USBL and other geophysical survey equipment will only be fired when necessary.

To minimise potential impacts on EPS and basking sharks in the area, the survey operations will adhere to the JNCC guidelines for 'minimising the risk of injury to marine mammals from geophysical surveys' (JNCC, 2017) including the use of MMOs and soft starts, where practical (i.e. where the equipment is capable of undertaking a soft start).

A trained, non-dedicated MMO will be present on the survey vessel. The MMOs will survey the sea surface for the presence of cetaceans and basking sharks within 500 m of the survey site ensuring no individuals are present prior to the commencement of any survey operations. The use of Passive Acoustic Monitoring (PAM) on the offshore vessel is proposed as a complimentary mitigation measure for the survey works undertaken in the hours of darkness.

Not all geophysical survey equipment proposed for use in the survey operations are capable of undertaking “soft start” procedures, however where the devices allow this it shall be used.

Personnel on the survey will ensure the operations are undertaken in compliance with the SMWWC.

By adhering to the mitigation measures detailed above, any disturbance effects on marine EPS or basking sharks in the area will be kept to a minimum and should not impact on the FCS of the species likely to be found within the survey area.

5. The Licence Application Tests

5.1 Overview

As described in Section 1.1, the proposed survey activities for Talisk OWF will take place within the 12 nm limit of Scottish territorial waters (i.e. within the inshore region). The activities include the use of geophysical survey techniques, such as SBP and USBL. These techniques generate underwater noise, which has the potential to cause auditory impacts to EPS, particularly cetaceans.

5.2 European Protected Species Licensing Tests

Based on the proposed equipment, the spatial and temporal scale of the proposed survey activities, and the mitigation measures proposed (as detailed in Section 4.3), the geophysical survey activities planned are unlikely to result in harassment, injury or mortality of an EPS as defined under Regulation 39(1) of the Habitats Regulations. Therefore, it is considered that an EPS Licence is not being sought for these offences.

The same assessment considers that disturbance of an EPS due to the proposed inshore survey activities is unlikely, but it cannot be completely dismissed. Any potential to disturb an EPS is anticipated to be highly localised and short-term. Consequently, the level of disturbance is assessed as being insufficient to lead to any effects at the population level. Nonetheless, to ensure legal compliance, an EPS Licence is being sought under Regulation 44 of the Habitats Regulations.

Under Regulation 44 of the Habitats Regulations, an EPS Licence can only be granted if all three legal tests, detailed below, are satisfied:

- Test 1: There must be a licensable purpose for which licences can be granted;
- Test 2: There must be no satisfactory alternative; and
- Test 3: The proposed action must not be detrimental to maintaining the species at 'Favourable Conservation Status'.

5.2.1 Test 1 –There must be a licensable purpose for which licences can be granted

Only activities that are carried out for certain 'purposes' may be licensed. These purposes are defined under Regulation 44(2) of the Habitats Regulations (as amended) and include:

- (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) Protecting any zoological or botanical collection;

- (e) Preserving public health or public safety or other imperative reasons of overriding public interest (IROPI) including those of a social or economic nature and beneficial consequences of primary importance for the environment;
- (f) Preventing the spread of disease; or
- (g) Preventing serious damage to livestock, foodstuffs for livestock, crops, vegetables, fruit, growing timber or any other form of property or to fisheries.

The proposed survey activities are considered to meet the requirements of Regulation 44(2)(e) by providing an environmental benefit on both a national and international scale through compliance with policy and legislative goals regarding the development of renewable energy projects and targets to mitigate the impacts of climate change.

The Climate Change (Emissions Reduction Targets) (Scotland) Act 2019 sets a binding target of net-zero emissions of all greenhouse gasses by 2045 and the development of renewable energy projects, such as the planned Talisk offshore wind farm is a key factor in reaching this target.

If the proposed survey operations did not proceed, the Project cannot progress through the consenting and development phases, thereby delaying or preventing the delivery of crucial renewable energy infrastructure.

Therefore, it is considered that the planned survey operations meet the requirements of the first test when determining whether a licence for the proposed activity should be granted.

5.2.2 Test 2 – There must be no satisfactory alternative

As set out in Regulation 44(3)(a) of the Habitat Regulations, a licence to disturb and / or injure EPS may only be granted if Marine Directorate are satisfied that there are 'no satisfactory alternative' to the proposed activity.

With respect to the planned survey operations, the following alternatives were considered:

- Alternative survey locations – an alternative survey location for the proposed offshore wind farm is not achievable as the lease area has been agreed with Crown Estate Scotland (CES) and the survey must be undertaken within the areas defined in relevant project consents and licences. The survey operations will focus on specific areas / locations, pre-identified from desktop studies, to confirm the suitability of those areas / locations for the Project. Surveying elsewhere would not provide the location specific data required to assist in de-risking the project.
- Alternative survey methods – The survey equipment is already planned to operate at the lowest sound levels possible without affecting the accuracy of the data obtained. While lower-noise alternatives exist, they would compromise the resolution and accuracy of the data required for project planning. An alternative to using geophysical survey equipment, such as the SBP, would rely on additional grab samples or to undertake geotechnical sampling of the seabed such as drilling of boreholes and or cone penetration tests CPTs). However, the former would not be suitable for gathering

complete information on seabed conditions and both would not offer continuous data of the seabed across the survey area whilst also leaving significant gaps between sampling locations. It is considered that there is no suitable alternative method of collecting 100% coverage of geodata over the proposed cable routes without using geophysical noise emitting equipment.

- No survey option – if the survey operations were not undertaken this would prevent the OWF project from progressing, leading to significant delays in Scotland's renewable energy targets.

The geophysical and benthic survey results will be used to identify any potential hazards that should be avoided by the development. Additionally, the geophysical survey results will be used within the EIA for the baseline characterisation of multiple technical topics. For example, within the modelling of coastal processes, benthic and marine archaeology. This survey is fundamental to ensure a robust EIA is carried out for the Talisk OWF. In summary, the project cannot be safely developed without the survey.

Therefore, it is considered that the planned survey operations meet the requirements of the second test when determining whether a licence for the proposed activity should be granted.

5.2.3 Test 3 –The proposed action must not be detrimental to maintaining the species at 'Favourable Conservation Status'

Licences may only be granted where the proposed activity will not be detrimental to the maintenance of the species at a FCS within their natural range (Regulation 44(3)(b)).

The assessment set out in Section 4 considers that there will be no injuries to EPS as a result of the planned activities. The percentage of the total population of the identified species which may be disturbed by the proposed survey operations is considered to be negligible (i.e., less than 1 % of the worst-case considered densities within the proposed survey area as identified in the Table 4.4 in Section 4.2.1.3). Therefore, the impact is considered to not be detrimental to the maintenance of the population of the species concerned at a FCS.

Furthermore, as described in Section 4.2.1, if any disturbance does occur it will be brief, over a small area, with recovery likely within a short timeframe. Given the extensive suitable habitat available surrounding the Project, it is not likely that a behavioural response (disturbance) would impair the ability of the species to maintain itself on a long-term basis.

Based on these factors, it is concluded that the proposed activity will not significantly impact the FCS of any EPS and, therefore, it is considered that the planned survey operations meet the requirements of the third test when determining whether a licence for the proposed activity should be granted.

5.3 Basking Shark Licensing Tests

Similar to the tests for licensing injury and / or disturbance of EPS (Section 5.2), when considering whether to grant a licence to injure and / or disturb Basking sharks, Marine

Directorate, as the appropriate authority acting on behalf of the Scottish Ministers, must ensure that there is a licensable purpose for which a licence may be granted.

Only activities defined under Regulation 16(3) of the Wildlife and Countryside Act 1981 (as amended) that are carried out for certain purposes may be licensed and include:

- (a) for scientific research or educational purposes;
- (b) for the purpose of ringing or marking, or examining any ring or mark on, wild animals;
- (c) for the purpose of conserving wild birds, wild animals or wild plants or introducing them to particular areas;
    - (ca) for the purpose of conserving any area of natural habitat;
- (d) for the purpose of protecting any zoological or botanical collection;
- (e) for the purpose of photography;
- (f) for the purpose of preserving public health or public safety;
- (g) for the purpose of preventing the spread of disease;
- (h) for the purpose of preventing serious damage to livestock, foodstuffs for livestock, crops, vegetables, fruit, growing timber or any other form of property or to fisheries; or
- (i) for any other social, economic or environmental purpose.

Furthermore, the appropriate authority may not grant a licence under 16(3)(i) unless they are satisfied:

- (a) that undertaking the conduct authorised by the licence will give rise to, or contribute towards the achievement of, a significant social, economic or environmental benefit; and
- (b) that there is no other satisfactory solution.

With respect to the proposed survey operations, it is considered that they meet the requirements of Regulation 16(3) for the same reasons set out in Section 5.2.1 above i.e. that they provide an environmental benefit by contributing to the development of a renewable energy project which will mitigate the impacts of climate change.

6. Conclusions

MOW propose to develop the Talisk OWF and have appointed Fugro to undertake a geophysical and benthic survey of the planned WFA and ECRC to shore. Fugro has prepared a risk assessment which considers the potential impacts of the survey operations on EPS and basking sharks to support potential licence applications to injure and / or disturb these species.

The conclusions of this risk assessment are as follows:

- The risk of injury to EPS or basking sharks from the proposed survey activities is assessed as being very small. Mitigation measures, as outlined in Section 4.3, will further reduce the risk of injury to EPS. Therefore, there is negligible risk of an injury offence and a licence to injure either EPS or basking sharks is not required;
- The proposed survey activities may create a temporary, localised disturbance to EPS in the area from underwater noise generated by the survey equipment. Consequently, a small percentage of the local EPS population may be temporarily disturbed by the proposed survey activities. Therefore, a licence to disturb EPS is requested for these proposed survey activities;
- Basking sharks are not thought to be affected by the underwater noise generated by the survey equipment and therefore disturbance effects are considered unlikely. However, the proposed survey activities may result in short term, localised disturbance due to the presence and movement of the survey vessels. Therefore, a licence to disturb basking sharks is requested for these proposed survey activities;
- There is considered to be no potential for any impacts to designated nature conservation sites for cetaceans or basking sharks from the proposed survey operations.

The risk assessment provides justifications for the planned survey operations satisfying all three tests for determining an EPS licence application which are that the activity has a licensable purpose, there are no satisfactory alternatives, and it will not be detrimental to the FCS of any EPS species. Similarly, a justification for a licence to disturb basking sharks is also provided which shows that the proposed activity has a licensable purpose.

It is considered that with the mitigation measures identified in place, the disturbance of EPS and basking shark will be reduced to near negligible levels.

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Appendix A

Survey Coordinates

A.1 Survey Coordinates

Survey Area Corners	Latitude (DD)	Longitude (DD)	Coordinate System
Wind Farm Array			
1	58.79883°N	6.45175°W	UTM Zone 29 WGS 1984
2	58.81884°N	6.427°W	UTM Zone 29 WGS 1984
3	58.84335°N	6.34661°W	UTM Zone 29 WGS 1984
4	58.71875°N	6.45896°W	UTM Zone 29 WGS 1984
5	58.78747°N	6.2681°W	UTM Zone 29 WGS 1984
6	58.85082°N	6.2624°W	UTM Zone 29 WGS 1984
7	58.86131°N	6.3232°W	UTM Zone 29 WGS 1984
8	58.86381°N	6.315°W	UTM Zone 29 WGS 1984
Export Cable Route Corridor			
1	58.71875°N	6.45896°W	UTM Zone 29 WGS 1984
2	58.78747°N	6.2681°W	UTM Zone 29 WGS 1984
3	58.74717°N	6.19088°W	UTM Zone 29 WGS 1984
4	58.68802°N	6.21772°W	UTM Zone 29 WGS 1984
5	58.61725°N	6.16428°W	UTM Zone 29 WGS 1984
6	58.6242°N	6.03026°W	UTM Zone 29 WGS 1984
7	58.53808°N	6.07625°W	UTM Zone 29 WGS 1984
8	58.45288°N	6.05338°W	UTM Zone 29 WGS 1984
9	58.4047°N	5.83693°W	UTM Zone 29 WGS 1984
10	58.34724°N	5.82835°W	UTM Zone 29 WGS 1984
11	58.35343°N	5.82504°W	UTM Zone 29 WGS 1984
12	58.20165°N	5.96451°W	UTM Zone 29 WGS 1984
13	58.19987°N	6.15236°W	UTM Zone 29 WGS 1984
14	58.18535°N	6.18428°W	UTM Zone 29 WGS 1984
15	58.14367°N	6.04795°W	UTM Zone 29 WGS 1984
16	58.14029°N	6.06466°W	UTM Zone 29 WGS 1984
17	58.14029°N	6.05826°W	UTM Zone 29 WGS 1984
18	58.14122°N	6.05334°W	UTM Zone 29 WGS 1984
19	58.1302784°N	6.2208781°W	UTM Zone 29 WGS 1984
20	58.1312620°N	6.2306152°W	UTM Zone 29 WGS 1984
21	58.1545920°N	6.3481601°W	UTM Zone 29 WGS 1984
22	58.1605493°N	6.3680480°W	UTM Zone 29 WGS 1984
23	58.1798822°N	6.3804339°W	UTM Zone 29 WGS 1984
24	58.1890120°N	6.3564220°W	UTM Zone 29 WGS 1984
25	58.2017736°N	6.3167225°W	UTM Zone 29 WGS 1984
Notes			

Survey Area Corners	Latitude (DD)	Longitude (DD)	Coordinate System
Wind Farm Array			
DD = Decimal Degrees			