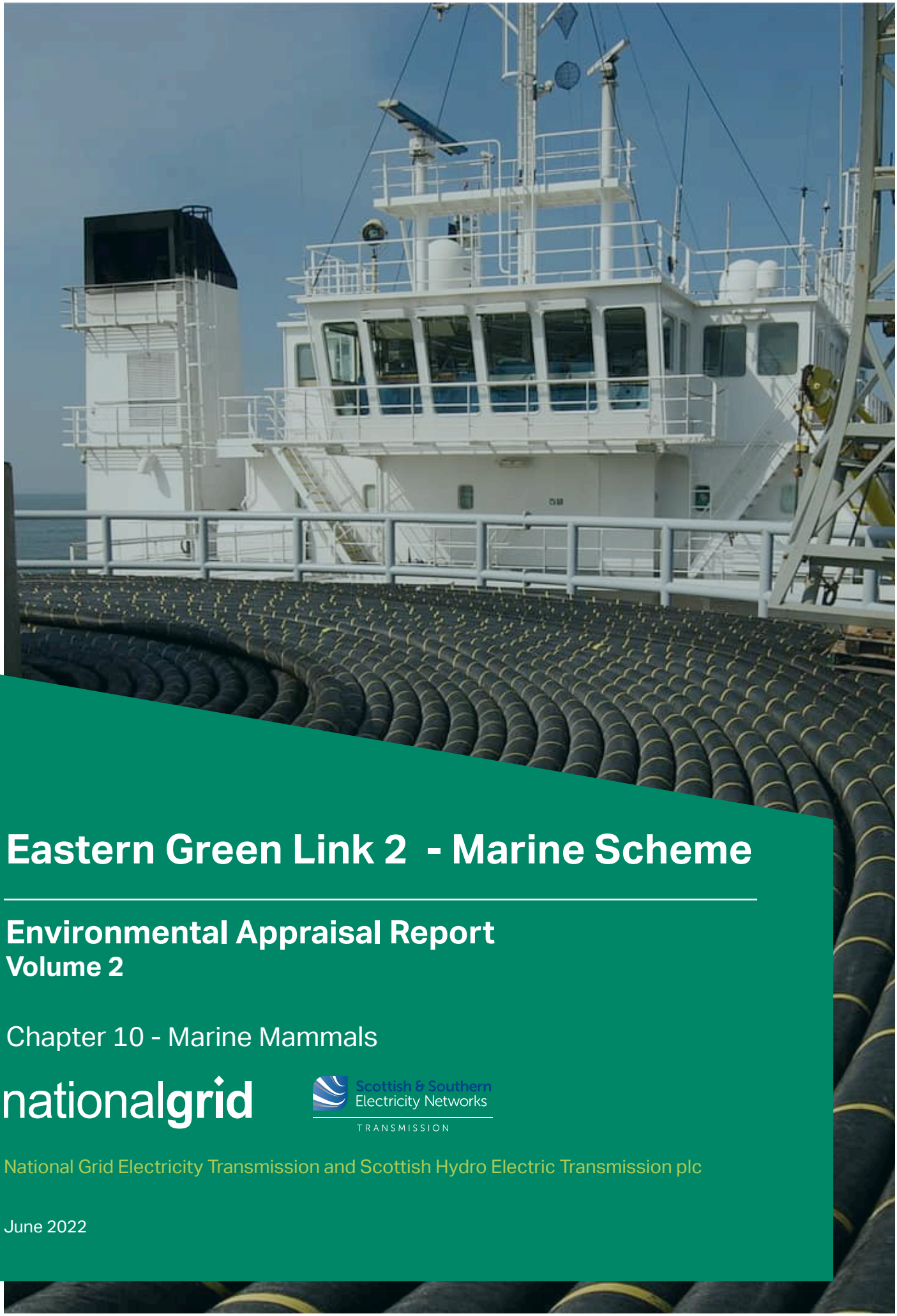


Eastern Green Link 2 - Marine Scheme

Environmental Appraisal Report
Volume 2

Chapter 10 - Marine Mammals

nationalgrid

Scottish & Southern Electricity Networks
TRANSMISSION

National Grid Electricity Transmission and Scottish Hydro Electric Transmission plc

June 2022

Table of Contents

Figures

Tables

10. Marine Mammals

10.1 Introduction

This chapter appraises the potential interactions of the Marine Scheme with marine mammals.

The marine mammal baseline, as determined through desk-based research, is presented in Section 10.5. All cetaceans are European Protected Species (EPS), and it is an offence to capture, harass or disturb them. Further detail on EPS is presented in Section 10.2.

A description of the works anticipated to be undertaken during Installation, Operation and Maintenance and Decommissioning Phases is provided in Chapter 2: Project Description. This chapter provides an overview of the marine mammal baseline (Section 10.5) and considers the potential impacts of the Marine Scheme on these receptors (Section 10.6). Where appropriate, the chapter goes on to identify proportionate measures to avoid or mitigate for any identified adverse effects that would result (Section 10.7).

The potential for interaction between the Marine Scheme and other plans and / or projects, which may result in significant cumulative effects on marine mammals, is considered in detail within Chapter 16: Cumulative and In-Combination Effects.

This chapter is supported by the following documents:

- Appendix 8.2: Eastern Green Link 2 Habitat Regulations Assessment (HRA); and
- Appendix 8.3: Eastern Green Link 2 Marine Protected Area (MPA) and Marine Conservation Zone (MCZ) Assessment.

10.2 Legislative Context

This section outlines legislation, policy, and guidance relevant to the appraisal of the potential effects on marine mammals associated with installation, operation and maintenance, and decommissioning of the Marine Scheme. For further information regarding the legislative context, refer to Chapter 3: Legislative and Policy Framework and Appendix 3.2: Topic Specific Legislation.

10.2.1 International Legislation

The following international legislation and agreements in which the UK is a signatory concerning the preservation of marine mammal populations during the planning and execution of projects such as offshore cable development in UK waters:

- The Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas 1992 (ASCOBANS) (UNEP, 1992); and
- European Union Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora adopted in 1992.

10.2.2 National Legislation

The following national and devolved legislation concerning the preservation of marine mammal populations during the planning and execution of projects such as offshore cable development in UK waters:

10.2.2.1 UK (England and Scotland)

- Wildlife and Countryside Act 1981 (HM Government, 1981);
- Marine and Coastal Access Act (MCAA) 2009 (HM Government, 2009);

- The Marine Strategy Regulations 2010 (HM Government, 2010);
- The Conservation of Habitats and Species Regulations 2017 (HM Government, 2017) (as amended); and
- The Offshore Marine Conservation (Natural Habitats &c.) Regulations 2017 (HM Government, 2017).

10.2.2.2 Scotland

- Marine (Scotland) Act 2010 (Scottish Government, 2010);
- The Protection of Seals (Designation of Haul-Out Sites) (Scotland) Amendment Order 2014 (as amended);
- The Water Environment (Controlled Activities) (Scotland) Regulations 2011. Scottish Statutory Instrument 2011 No. 209 (HMSO, 2009), as amended.
- The Conservation (Natural Habitats, &c.) (EU Exit) (Scotland) (Amendment) Regulations 2019;
- The Conservation (Natural Habitats, &c.) Regulations 1994 (Scottish Government, 1994) (as amended); and
- Nature Conservation (Scotland) Act 2004 (Scottish Government, 2004).

10.2.2.3 England

- The Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019;
- Conservation of Seals (England) Order 1999;
- The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017 (as amended);
- The Conservation of Seals Acts 1970 (UK Government, 1970); and
- Natural Environment and Rural Communities Act (HM Government, 2006).

10.2.3 International Policy

The following international policies concerning the conservation and protection of benthic ecology receptors during the planning and execution of projects such as offshore cable development:

- Convention for the Protection of the Marine Environment of the North-East Atlantic (the 'OSPAR Convention') adopted in 1998 and amended in 2007.

10.2.4 National Policy

The following national and devolved policies concerning the preservation of marine mammal populations during the planning and execution of projects such as offshore cable development in UK waters:

10.2.4.1 UK (Scotland and England)

- UK Marine Policy Statement (MPS) (HM Government, 2011); and
- UK Post 2010 Biodiversity Framework (HM Government, 2010).

10.2.4.2 Scotland

- Scottish National Marine Plan (2015) (Scottish Government, 2015).

10.2.4.3 England

- Biodiversity 2020 (HM Government, 2011);

- National Policy Statements (NPS) (HM Government, 2014);
- North East Inshore and North East Offshore Marine Plan (HM Government, 2021); and
- East Inshore and East Offshore Marine Plan (HM Government, 2021).

10.2.5 Guidance

The key guidance documents used to inform the assessment of the Marine Scheme impacts on marine mammals include:

- Chartered Institute for Ecology and Environmental Management (CIEEM) Guidelines for Ecological Impact Assessment in Britain and Ireland – Terrestrial, Freshwater, Coastal and Marine (CIEEM, Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine. Version 1.1, 2018, and updated September 2019);
- Priority Marine Features (PMF) 2014 (Scottish waters only)[1].
- Joint Nature Conservation Committee (JNCC) guidelines for minimising the risk of injury to marine mammals from geophysical surveys (JNCC, 2017);
- The Protection of Marine EPS From Injury and Disturbance: Draft Guidance for the Marine Area in England and Wales and the UK Offshore Marine Area (JNCC, Natural England, & Countryside Council for Wales, 2010);
- The Protection of Marine EPS from Injury and Disturbance for the Marine Area in Scottish Inshore Waters (Scottish Government (SG) and Scottish Natural Heritage (NatureScot, 2020);
- The Scottish Marine Wildlife Watching Code for advice, information and recommendations for watching marine wildlife (NatureScot, The Scottish Marine Wildlife Watching Code - Part 1, 2017a); and
- The Guide to Best Practice for Watching Marine Wildlife to reduce the disturbance of important marine species (NatureScot, 2017b).

10.3 The Study Area

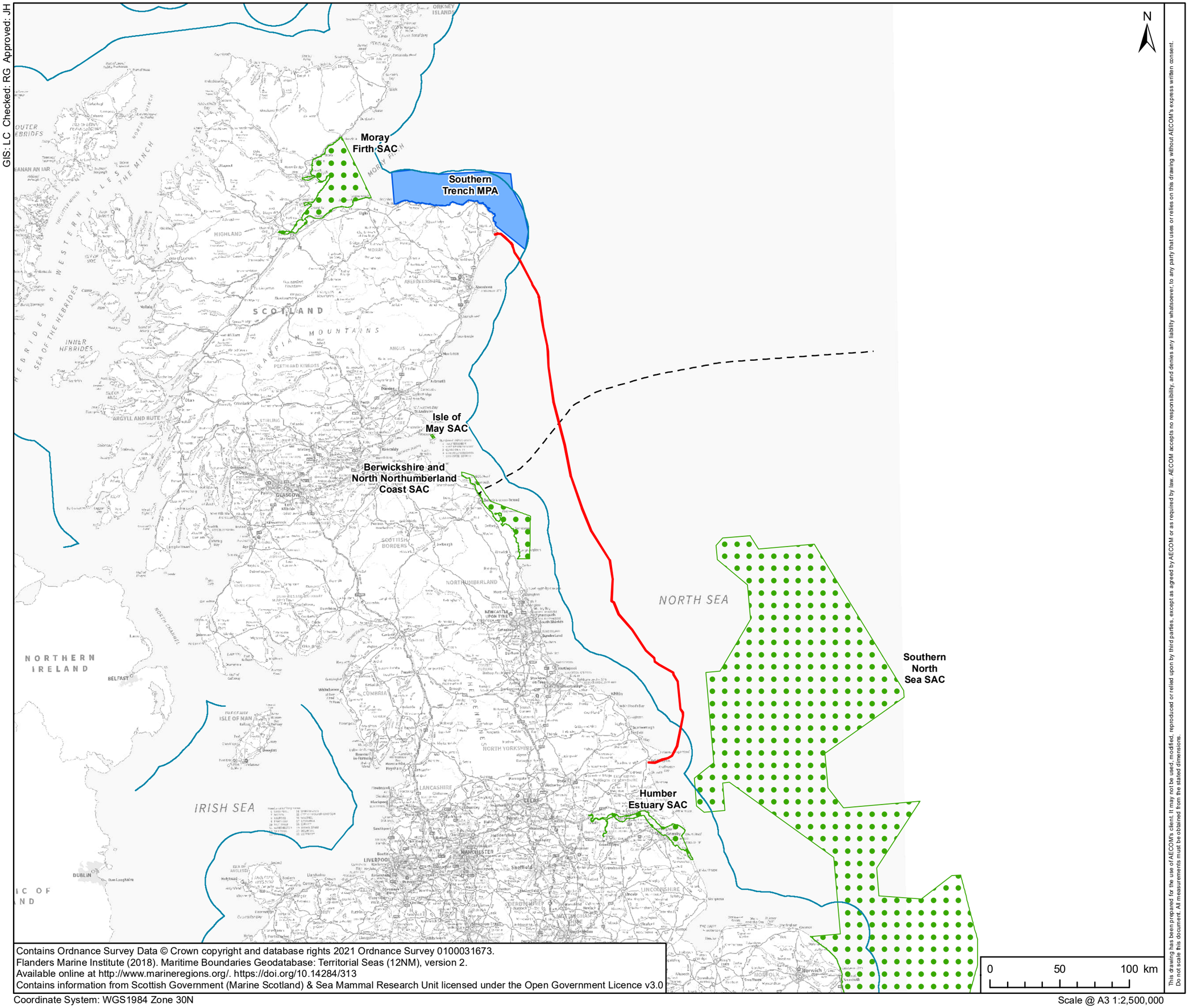
The study area for marine mammals has been determined at a scale that recognises the highly mobile and transient nature of many marine mammal species and the potential implications of local impacts on wider populations. For example, there are known to be wide ranging coastal movements of bottlenose dolphin and long-distance foraging trips of up to 135 km by grey seals.

Data to support the baseline characterisation is available at a range of different spatial scales, depending on the data source and the species of interest. For example, species specific data, based on Management Units (MUs) published by the Inter Agency Marine Mammal Working Group (IAMMWG), is available for seven of the most common cetacean species[2] included in UK waters (IAMMWG, 2015). The MUs allow abundance estimates to be calculated for each species (IAMMWG, 2021). The size of the MUs varies between species. The International Council for Exploration of the Seas has defined Assessment Units (AU) for marine mammals, such as a North Sea AU for harbour porpoise. For less common species the AU areas are much larger.

Therefore, the broad study area for the marine mammal baseline is the North Sea AU (ICES, 2018), with a focus on the region that encompasses the Marine Installation Corridor and the most extensive marine mammal movements, as illustrated in Figure 10-1.

[1] https://www.nature.scot/professional-advice/protected-areas-and-species/priority-marine-features-scotlands-seas
[2] These species are: harbour porpoise, common dolphin, bottlenose dolphin, white-beaked dolphin, white-sided dolphin, Risso's dolphin and minke whale.

GIS: LC Checked: RG Approved: JH



Coordinate System: WGS1984 Zone 30N

Scale @ A3 1:2,500,000

nationalgrid
Scottish & Southern Electricity Networks

PROJECT

Scotland England Green Link 2 / Eastern Link 2

KEY

- Marine Installation Corridor
- UK Territorial Sea Limit
- Scottish/English Water Border
- Special Area of Conservation (SAC)
- Nature Conservation Marine Protected Area (MPA)

TITLE

Figure 10-1
Study Area

REFERENCE

SEGL2_M_EAR_10-1_v4_20220614

SHEET NUMBER: 1 of 1

DATE: 14/06/2022

10.4 Approach to Appraisal and Data Sources

10.4.1 Appraisal Methodology

This appraisal applies the methodology as detailed in Chapter 4: Approach to Environmental Appraisal. The identification and appraisal of effects and mitigation are based on a combination of professional judgment and the application of the guidelines listed in Section 10.2.5.

Advice received from Marine Scotland Licensing Operations Team (MS-LOT) on 03 September 2021 and the Marine Management Organisation (MMO) on 02 November 2021 identified aspects of the Marine Scheme that have the potential to impact marine mammal receptors during Installation, Operation (including maintenance and repair), and Decommissioning Phases[3]. Details of the advice received and how it is addressed in the appraisal are provided in Chapter 6: Consultation and Stakeholder Engagement.

The design for the Marine Scheme comprises two high-voltage direct current (HVDC) cables laid either in two separate parallel trenches (unbundled) or else in a single trench with the cables bundled together. If the two-trench approach is used the cables will be spaced up to a maximum of 30 m apart (referred to as a '30 m separated bi-pole'). For both approaches, the target depth of lowering is approximately 1.5 m and the minimum depth of lowering without cable protection will be approximately 0.6 m. Therefore, the appraisal considers the two-trench scenario only, as the worst case situation that will also encompass any potential effect should the cables be bundled.

10.4.2 Data Sources and Consultations

10.4.2.1 Data Sources

Baseline conditions have been established by undertaking a desktop review of published information and through consultation with relevant organisations. The data sources used to inform the baseline description and appraisal include:

- Atlas of Cetacean Distribution in north-west European Waters (Reid & Northridge, 2003);
- UK Biodiversity Action Plan (UK BAP) (JNCC, 1994);
- Habitat-based predictions of at-sea distribution for grey and harbour seals in the British Isles (Carter, et al., 2020);
- Distribution models for harbour porpoise within the UK Exclusive Economic Zone based on 18 years of survey data collected as part of the Joint Cetacean Protocol (Heinänen & Skov, 2015);
- Inter-Agency Marine Mammal Working Group (IAMMWG) (2021);
- Marine Scotland (2017) – National Marine Plan interactive map of designated seal haul-out sites in Scotland;
- Sea Watch Foundation (2021);
- Small Cetaceans in European Atlantic waters and the North Sea (SCANS) Project. Further details in Small Cetaceans in European Atlantic waters and the North Sea (SCANS) Data (I, II and III) below (Hammond, et al., 2021);
- Special Committee on Seals (SCOS) (2020) – SCOS provides scientific advice to the government annually on matters related the management of seal populations. This includes information related to the abundance and distribution of seals;
- UK Cetacean Status Review (Evans, Anderwald, & Baines, 2003);
- UK Cetacean Strandings Investigation Programme (CSIP) (2015);
- Updated information on the distribution of Grey seal *Halichoerus grypus* and Harbour seal *Phoca vitulina* around the UK (Russell, Jones & Morris, 2017);

[3] The non-statutory scoping report is publicly available on https://marine.gov.scot/sites/default/files/segl_el1_marine_scoping_report_-_base_report_rev_2.0.pdf

- Updated distribution models for 12 species of cetacean covering the northeast Atlantic based on survey data collected between 1980 and 2018 (Waggitt et al., 2019);
- WWT Data (2001 – 2008) - WWT Consulting carried out aerial surveys for water birds. Opportunistic sightings of cetaceans, seals, turtles, sharks and ocean sunfish were also recorded and reported in WWT Consulting (2009). This data provides information about the distribution and abundance of these taxa around the British Isles; and
- Regional baselines for marine mammal knowledge across the North Sea and Atlantic areas of Scottish waters (Hague, Sinclair, & Sparling, 2020).

SCANS Data (I, II, and III)

As part of the SCANS Project, surveys have been undertaken within the study area (defined in Section 10.3) to estimate the abundance of small cetaceans across the North Sea. The first survey was undertaken in 1994 and involved standard boat-based line transect surveys and aerial transect surveys based on the specific methods of Hiby and Lovell (1998) to estimate, for the first time, the abundance of various cetacean species in the North Sea and Celtic Sea. This programme has evolved and was repeated in 2005 (Hammond, et al., 2013) (i.e., SCANS-II) and again in 2016 (Hammond et al., 2017), updated in 2021 (Hammond, et al., 2021) (i.e., SCANS-III).

It should be noted that SCANS surveys were conducted in the summer (predominantly July) and therefore data is representative of summer distributions only (Hammond, et al., 2021). However, it is understood that the densities of cetaceans around the British Isles are likely to be highest during this season (Waggitt et al., 2019). Therefore, the abundances presented in Section 10.4 are considered to represent the worst-case scenario and show the highest likely abundances to be encountered within the study area (Section □). The Marine Installation Corridor will pass directly through survey Blocks R and O. Block R includes Scottish and English waters; Block O is entirely within English waters. Estimates of abundance for each marine mammal species have been derived for each survey block and for the total survey area.

Although the Marine Installation Corridor does not directly pass-through Blocks S and T in Scottish waters, the presence of marine mammals in these blocks has also been considered due to the close proximity to the study area. Block S and Block T are located approximately 25 km and 24 km north of the Scottish landfall respectively and include the Southern Trench Marine Protected Area (MPA) and Moray Firth Special Area of Conservation (SAC). SCANS-III data shows that harbour porpoise have been sighted in Block S and Block T (Hammond, et al., 2021) which is supported by Reid et al. (2003).

Although the same area was not always sampled in each of the three SCANS monitoring years, some inference of temporal trends can be made from the data. This information can also be used to predict the potential evolution of baseline conditions for marine mammals within the study area. As such, the SCANS data represents a key data source for cetaceans.

10.4.2.1 Summary of Consultations

Advice from the MMO and MS-LOT and their respective consultees and advisers provided feedback on the Marine Scheme and EAR scope. Those consultees and advisors include NatureScot, Scottish Environment Protection Agency (SEPA), Cefas, Joint Nature Conservation Committee (JNCC), Natural England, Environment Agency and Inshore Fisheries and Conservation Authorities (IFCAs). Full details on the consultation and how comments were addressed in relation to marine mammals is provided in Chapter 6: Consultation and Stakeholder Engagement and its associated appendices.

10.4.3 Data Gaps and Limitations

The availability of data for marine mammals within the North Sea region is considered sufficient to characterise the baseline and as such provide a good understanding of the existing environment. There are, however, some limitations to marine mammal surveys, which form the basis of the baseline. This is primarily due to the highly mobile nature of marine mammal species and the potential variability in usage of the area. As a result, each survey contributing to the available library of research, realistically, only provides a snapshot.

10.5 Baseline Conditions

This Section presents the marine mammal baseline for the Marine Scheme, which covers the two groups of marine mammals which can be found in UK waters, namely cetaceans (whales, dolphins, and porpoises) and pinnipeds (seals).

A total of 28 cetacean species have been observed, and two species of seal are present, in UK waters. However, most are occasional visitors and within the Greater North Sea Ecoregion, the International Council for the Exploration of the Sea (ICES) lists four cetacean species as commonly occurring or resident and a further five as regular but less common (ICES, 2019). MUs have been defined for these species, with the exception of the killer whale and the long-finned pilot whale, by the IAMMWG to determine animal abundance estimates at appropriate spatial scales (IAMMWG, 2021). This baseline will also consider the two seal species present in the UK, the harbour seal and grey seal.

Most marine mammals are wide ranging and those recorded within the study area are likely to be individuals from larger biological populations originating at points along the English and Scottish coast. This baseline characterises marine mammal species known or likely to be present within the study area including the territorial and offshore waters of the Marine Installation Corridor.

10.5.1 Cetaceans

Within the Greater North Sea Ecoregion, the four most commonly occurring or resident cetacean species (ICES, 2019) are:

- Harbour porpoise *Phocoena phocoena*;
- Bottlenose dolphin *Tursiops truncatus*;
- White-beaked dolphin *Lagenorhynchus albirostris*; and
- Minke whale *Balaenoptera acutorostrata*.

A further five species, the short-beaked common dolphin *Delphinus delphis*, Atlantic white-sided dolphin *Lagenorhynchus acutus*, long-finned pilot whale *Globicephala melas*, killer whale *Orcinus orca*, and Risso's dolphin *Grampus griseus* occur regularly but are less common. Other species may also be occasional visitors, these include humpback whale *Megaptera novaeangliae*, sperm whale *Physeter catodon*, and beaked whales *Mesoplodon bidens*. While not specifically assessed, these species are covered by the other species detailed in this chapter. A summary of the conservation protection afforded to the four most common cetacean species is presented in Table 10-1.

Table 10-1: Summary of protection status for the four most common cetaceans known to be present in the study area

Common Name	Latin Name	Wildlife and Countryside Act, 1981	EC Habitats Directive (Annex)	Bonn Convention (Appendix)	Bern Convention (Appendix)	ASCOBANS	Priority Marine Features (Scotland)
Harbour porpoise	*Phocoena phocoena*	✓	II, IV	II[1]	II	✓	✓
Bottlenose dolphin	*Tursiops truncatus*	✓	II, IV	II[2]	II	✓	✓
White-beaked dolphin	*Lagenorhynchus albirostris*	✓	IV	II[3]	II	✓	✓
Minke whale	*Balaenoptera acutorostrata*	✓	IV	-	II	-	✓

Bonn Convention:
[1] North and Baltic Sea, western North Atlantic, Black Sea and North West African populations
[2] North and Baltic Sea populations
[3] Only North and Baltic Sea populations
Priority Marine Features: Both Offshore waters and Territorial waters

10.5.1.1 Harbour Porpoise

The harbour porpoise has a widespread distribution across the North Sea and Scottish waters, (Sea Watch Foundation, 2012a; Hague, Sinclair, & Sparling, 2020). Harbour porpoises are most common in waters less than 100 m deep, and rarely exceed 200 m depth. They are present throughout the year, with numbers peaking from July to September (Hague, Sinclair, & Sparling, 2020). Numbers during the winter months tend to be lower, though it is suggested this may be due to decreased detectability during the winter. They forage mainly for sandeel *Ammodytes* sp. (Maeda, et al., 2021) and grow up to 1.5 m in length (MacLoed, Begona Santos, Reid, Scott, & Pierce, 2007). For the east coast waters of the UK, the highest density of animals occurs in the southern region of the North Sea (Hague, Sinclair, & Sparling, 2020), reflected in the designation of the Southern North Sea SAC specifically for harbour porpoise.

Harbour porpoise have been sighted in all SCANS-III blocks in Scottish waters (Hague, Sinclair, & Sparling, 2020) (Hammond, et al., 2021). In Block S an estimated abundance of 6,147 individuals (95% CL = 3,401- 10.065) was recorded with a density of 0.152 individuals per km^2 (Hammond, et al., 2021) (Figure 10-2). Block T had an estimated abundance of 26,309 individuals (95% CL= 14,219 – 45,280), with a density of 0.402 individuals per km^2 (Hammond, et al., 2021). There have been numerous reports of harbour porpoise sightings in the Moray Firth, which sits within Block S, including by Williamson et al. (2017), although SCANS-III density modelling gives a low density for this block, indicating some local variation is missing from the broadscale density estimates.

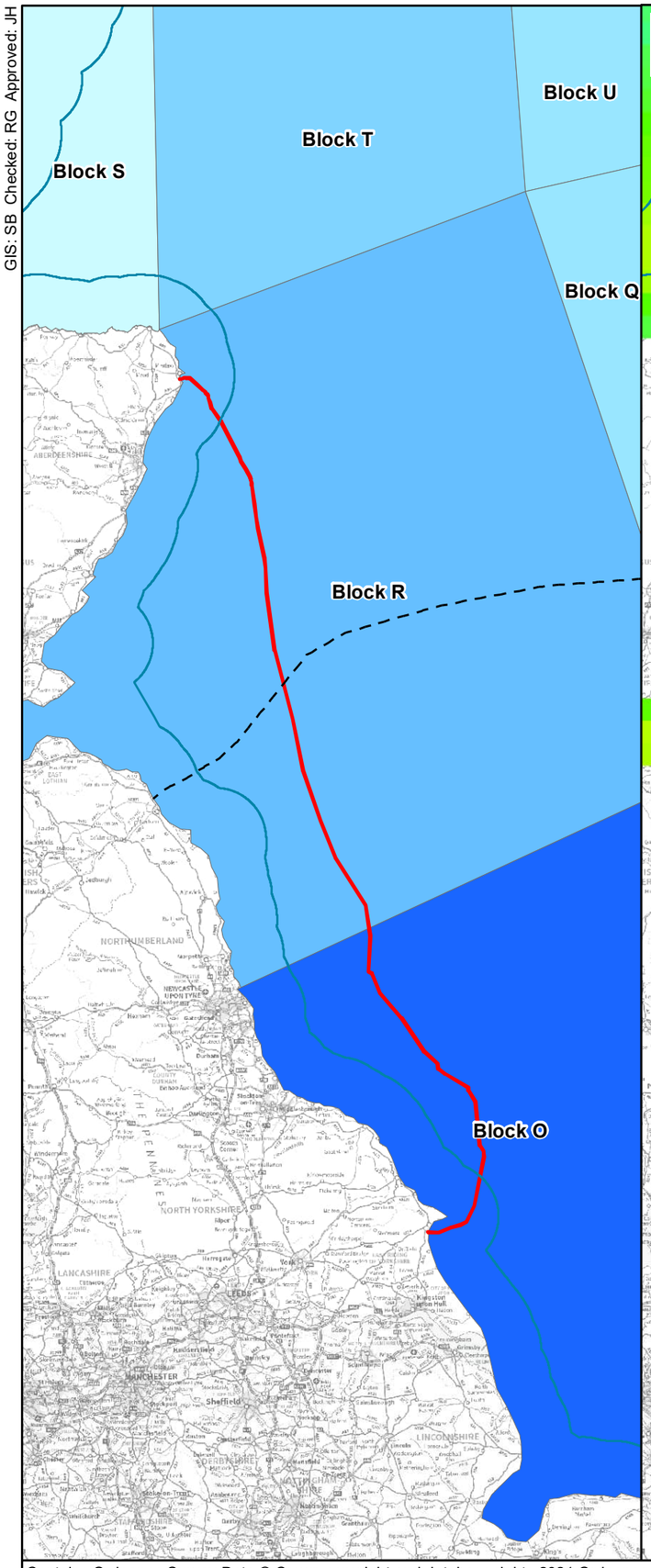
Block R, located in both Scottish and English waters, covers the largest proportion of the Marine Installation Corridor. The mean group size observed from the SCANS-III data was 1.38 individuals for Block R. In Block R an estimated abundance of 38,646 individuals (95% CL = 20,584 – 66,524) was recorded with a density of 0.599 animals per km^2 (Hammond, et al., 2021). Within the Marine Installation Corridor, the lowest SCANS-III density is recorded around the Scottish landfall from KP0 to approximately KP20 (Hague, Sinclair, & Sparling, 2020) in Block R. The highest densities are shown to be in offshore waters of Block R, with densities starting to increase around KP20 and extending south into Block O.

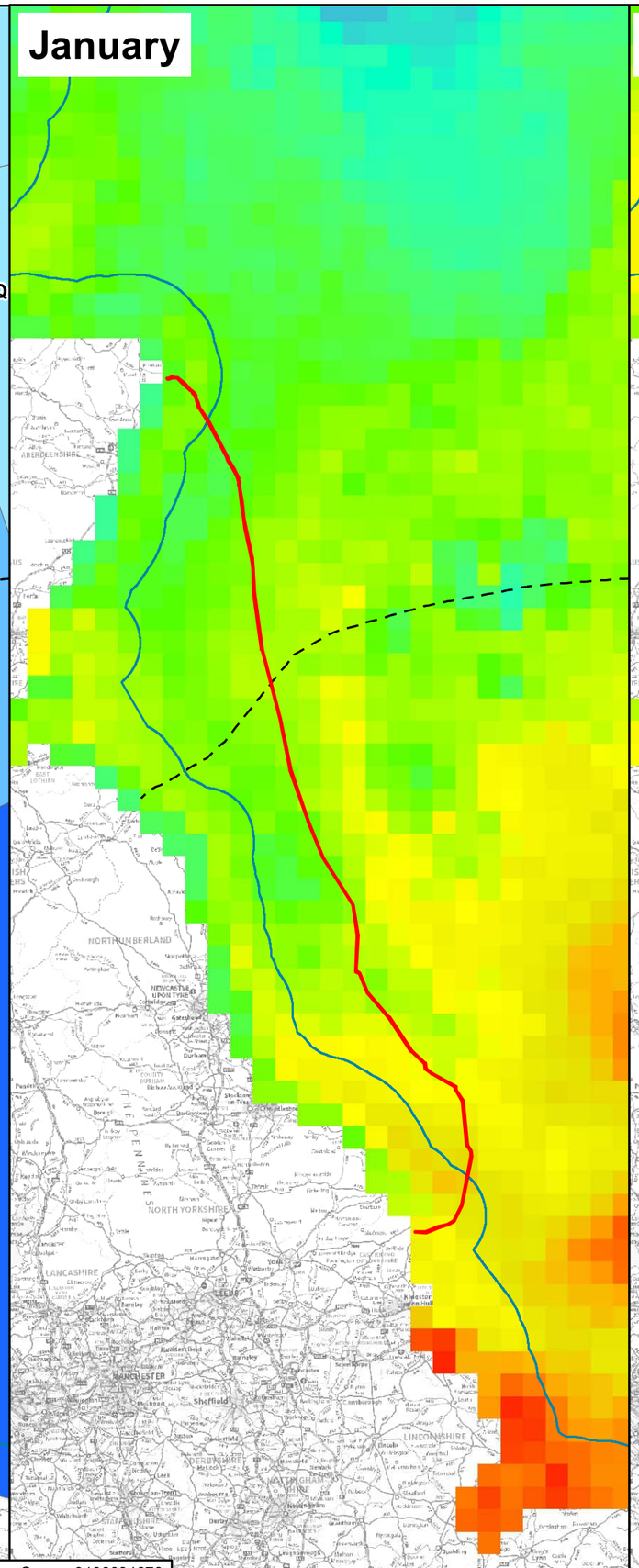
In offshore English waters, beyond the 12 NM limit, Block O covers the southern extent of the Marine Installation Corridor and was identified as having the highest abundance of harbour porpoise within the corridor. SCANS-III data give an estimated abundance of 53,485 individuals (95% Confidence Limits (CL) = 37,413 – 81,695), with a density of 0.888 individuals per $km^{2,}$ for Block O. The mean group size observed from SCANS-III data was 1.31 individuals, compared to an average of 1.35 individuals across all blocks (Hammond, et al., 2021). Figure 10-2 presents the density distribution of harbour porpoise throughout the study area as determined during the SCANS-III survey undertaken in 2016. These densities suggest that harbour porpoises are highly likely to be present in the Marine Installation Corridor, particularly in the section passing through Block O.

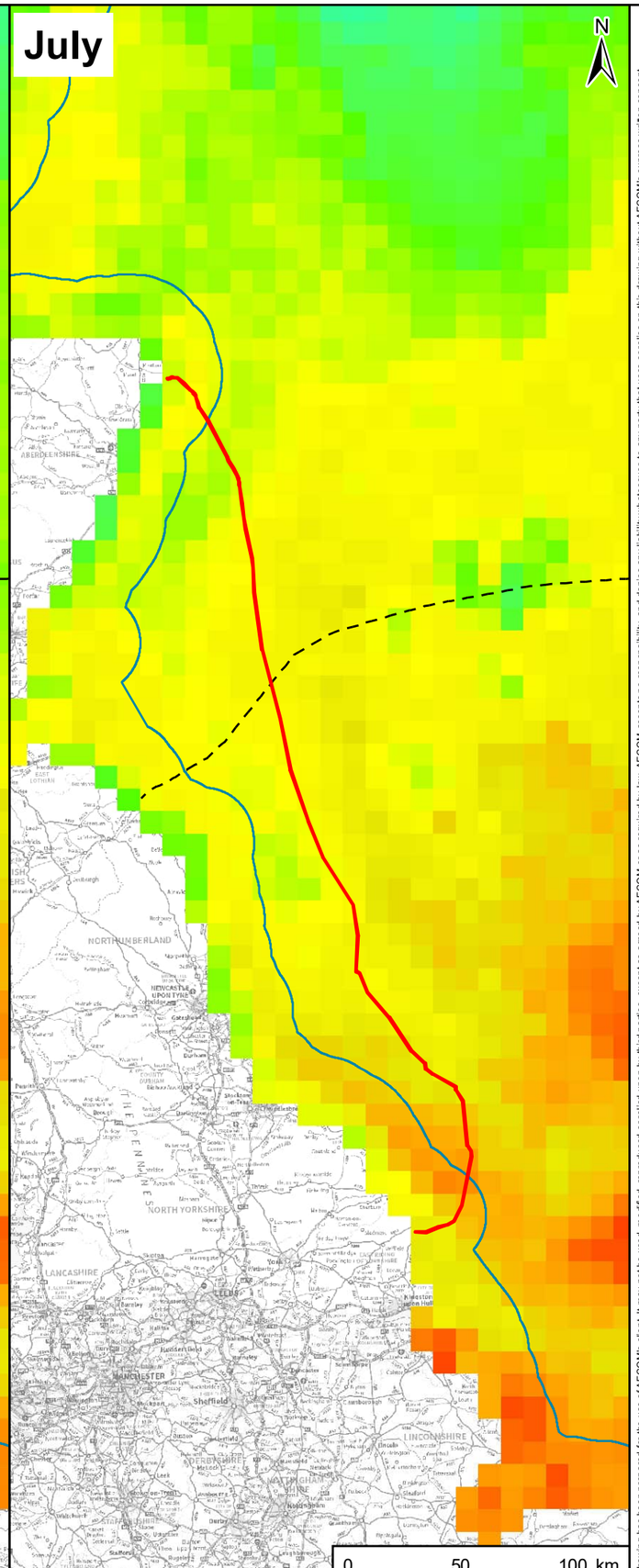
Recent model predictions by Waggitt et al. (2019) for both summer and winter densities of harbour porpoise show summer densities increasing towards the Scottish landfall and encompassing the Marine Installation Corridor in offshore waters of the northern North Sea (Figure 10-2). Seasonal variation models produced by Waggitt et al. (2019) show a northward shift in harbour porpoise density between April-September to north eastern Scotland including Peterhead and the northern North Sea, with densities showing a southward shift during October to March, bringing higher densities of harbour porpoise to the English landfall and the central North Sea.

The most recent abundance estimate reported for the North Sea MU, was derived from updated data by IAMMWG (2021) of the SCANS-III survey (Hammond, et al., 2021) where 346,601 individuals (95% Confidence Interval (CI) = 289,498 – 419,967) were reported. Of these, 159,632 individuals (95% CI = 127,442 – 199,954) were thought to be present in the UK portion of the MU (i.e., abundance within the UK Exclusive Economic Zone (EEZ)) (IAMMWG, 2021).

GIS: SB Checked: RG Approved: JH







Coordinate System: WGS1984 Zone 30N

0 50 100 km

Scale @ A3 1:2,500,000

nationalgrid
Scottish & Southern Electricity Networks

PROJECT
Eastern Green Link 2

KEY

- Marine Installation Corridor
- UK Territorial Sea Limit
- Scottish/English Water Border

Harbour Porpoise Density

(animals per sq km)

- 0.1- 0.2
- 0.3 - 0.4
- 0.4 - 0.5
- 0.5 - 0.6
- 0.8 - 0.9

Distribution of Harbour Porpoise (Waggit 2019)

Value

High : 1.1

Low : 0

TITLE

Figure 10-2
Harbour porpoise spatial variation in predicted densities (individuals/km2) in January and July (Source: Waggit et al., 2019)

REFERENCE
SEGL2_M_EAR_10-2_v2_20220614

SHEET NUMBER
1 of 1

DATE
14/06/2022

The only site designated for harbour porpoise, located within 50 km[4] of the Marine Installation Corridor is the Southern North Sea SAC, located entirely in English waters (Figure 10-1) (JNCC, 2021a). This site is located 19 km to the southeast of the Marine Installation Corridor, in close proximity to the English landfall. See Section 10.5.3 for further information on relevant designated sites.

The harbour porpoise was considered to be 'threatened and declining' in the Greater North Sea by the OSPAR commission (2008). However, in the UK the range and future prospect of the harbour porpoise is considered to be of 'favourable' conservation status although the overall trend in the conservation status of this species is unknown (JNCC, 2019). Globally this species is considered 'least concern' by the International Union of Conservation of Nature (IUCN), despite previously being considered vulnerable (IUCN, 2021).

10.5.1.2 Bottlenose Dolphin

The bottlenose dolphin is a large species reaching 2.5 m to 4.0 m in length and weighing up to 275 kg (Sea Watch Foundation, 2021a). There are two distinct ecotypes of bottlenose dolphin in UK waters – a wide-ranging offshore type, and an inshore type that tends to stay within 30 km of the coast and demonstrates habitat fidelity (Hague, Sinclair, & Sparling, 2020). There are several inshore groups in UK waters, with limited interchange between them (Robinson, et al., 2012; Cheney, et al., 2013; IAMMWG, 2015). There is relatively little known about the offshore ecotype compared with the coastal ecotype (Waggitt, et al., 2019). The coastal ecotype is resident to Scottish waters, found throughout the year, mostly in waters less than 150 m deep (Hague, Sinclair, & Sparling, 2020). However, numbers generally peak between July and October. Resident populations include those found in areas such as the Moray Firth SAC. The bottlenose dolphin has highly diverse and flexible feeding techniques, often displaying cooperative feeding, where dolphin pods work together to tightly pack fish shoals from opposite sides, consuming the fish from either side (Taylor & Saayman, 1972).

The study area falls within two IAMMWG MUs: the Coastal East Scotland MU and the Greater North Sea MU (Figure **10-3**). For the UK portion of the Greater North Sea MU the most recent abundance estimate was 1,885 individuals (95% CI = 476 – 7,461) (IAMMWG, 2021). However, very few bottlenose dolphins have actually been observed within the Greater North Sea MU (Thompson, et al., 2011).

A summary of SCANS-III abundance data for bottlenose dolphin is provided in Figure **10-3** and Table 10-2. In Scottish waters, Block S just to the north of the Marine Scheme, which includes the Moray Firth populations, had an abundance of 151 individuals (95% CL = 0 – 527) with a density of 0.0037 individuals per km^2 (Hammond, et al., 2021). There were no data recorded for bottlenose dolphin in Block T, much of which covers offshore waters. Block R had the highest abundance, with 1,924 individuals (95% CL = 0 – 5,048) (Figure **10-3**). This block had the highest abundance and covers the largest proportion of the Marine Installation Corridor including the Scottish landfall. Pods of bottlenose dolphin within Block R had a mean group size of 5.25 individuals. No bottlenose dolphins were recorded in Block O in English waters.

The findings of the SCANS-III surveys are consistent with long-term data sets (1980 – 2018) used by Waggitt et al. (2019) to predict densities of bottlenose dolphin across the northeast Atlantic. These data have shown that there is very little variation offshore in bottlenose dolphin density in the North Sea throughout the year, with densities remaining low (Figure **10-3**). There were no data reported for coastal bottlenose dolphins in these predictions as coastal ecotypes were excluded.

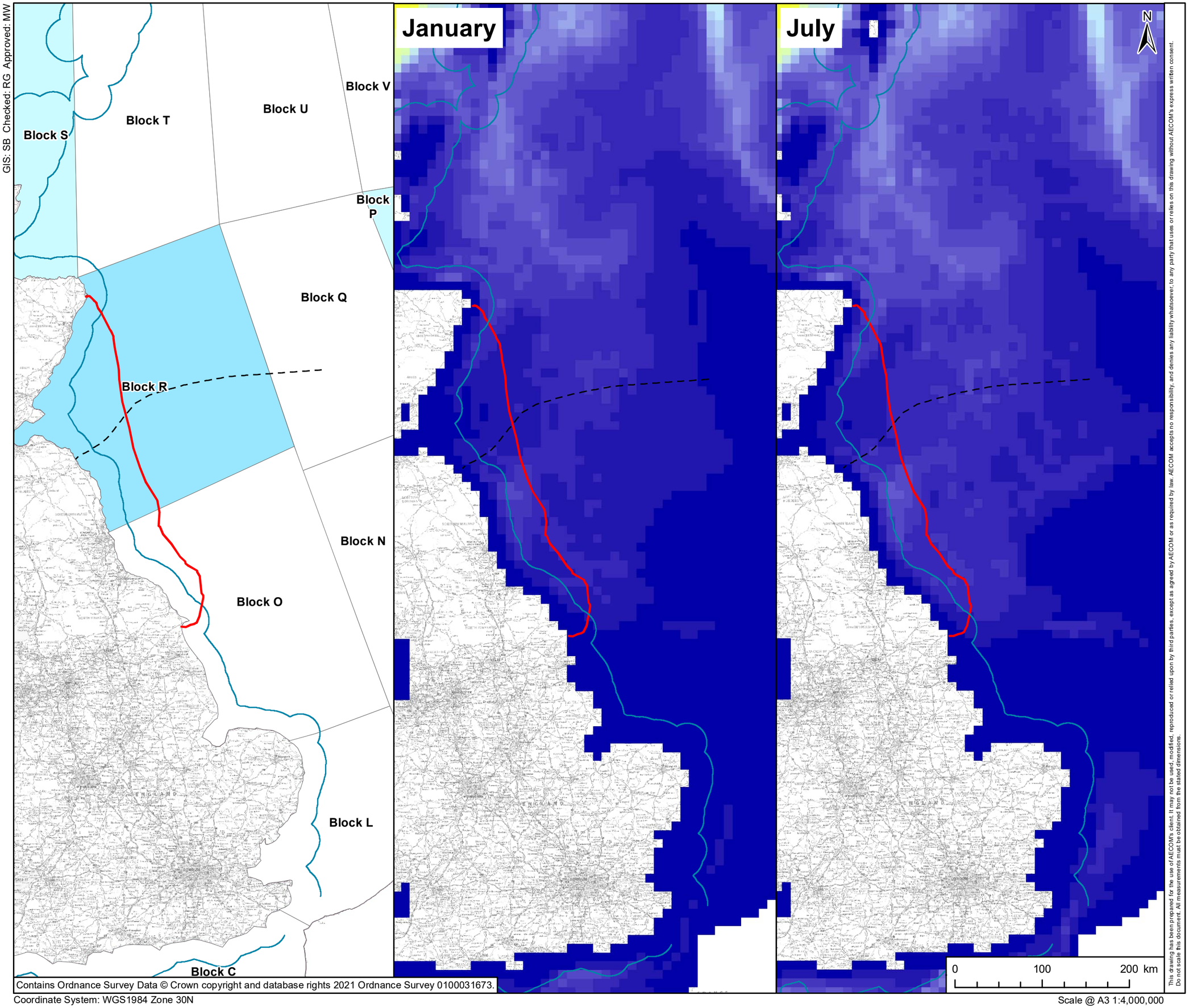
The Coastal East Scotland MU, which is entirely in UK waters has an estimated abundance of 189 individuals (95 % CL = 155-216) (IAMMWG, 2021). The Coastal East Scotland MU includes the resident bottlenose dolphin population in the Moray Firth SAC (Thompson, et al., 2011). The latest population estimate for the Moray Firth SAC bottlenose dolphins was taken in 2016 where 103 individuals were recorded (95% CI = 93 – 115). Although inter-annual variability has been observed, the number of bottlenose dolphins using the SAC has remained stable (Cheney, Graham, Barton, Hammond, & Thompson, 2018).

[4] A distance of 50 km has been selected as the distance within which SACs for cetaceans should be considered. This is based on SAC impact buffer zones agreed for the 'Habitat Regulations Assessment for the North East, North West, South East and South West Marine Plans' and guidance by the JNCC.

However, the bottlenose dolphin population along the eastern coast of Scotland and England has been increasing in size and expanding in range, with future expansion and distribution shifts likely to occur (ArsoCivil, et al., 2019).

In particular, since the data collected on bottlenose dolphin to inform the designation of the Moray Firth SAC, prior to 2005, the range of this population has extended south beyond the boundary of the SAC, as far south as the Firth of Forth and Berwick-upon-Tweed (Hague, Sinclair, & Sparling, 2020; ArsoCivil, et al., 2021), around 300 km away (Hague, Sinclair, & Sparling, 2020). In recent years, the Firth of Tay and Tay Estuary, and St Andrews Bay, have been identified as important areas for Moray Firth bottlenose dolphins (Hague, Sinclair, & Sparling, 2020; ArsoCivil, et al., 2021), particularly in the summer months, with an estimated 52% of the Moray Firth population found here (ArsoCivil, et al., 2019).

GIS: SB Checked: RG Approved: MW



Coordinate System: WGS1984 Zone 30N

Scale @ A3 1:4,000,000

nationalgrid
Scottish & Southern Electricity Networks

PROJECT
Eastern Green Link 2

KEY

- Marine Installation Corridor
- UK Territorial Sea Limit
- Scottish/English Water Border

SCANS-III Bottlenose Dolphin Density (Hammond et el., 2021)

(animals per sq km)

- 0
- 0 - 0.025
- 0.025 - 0.050

Distribution of Bottlenose Dolphin (Waggit 2019)

(animals per square km)

- High : 0.5
- Low : 0

TITLE
Figure 10-3
Bottlenose Dolphin Density and Distribution

REFERENCE
SEGL2_M_EAR_10-3_v1_20220614

SHEET NUMBER
1 of 1

DATE
14/06/2022

The five-year population average of bottlenose dolphins on the east coast of Scotland using the Tay estuary and adjacent waters (2015-2019) is 224 individuals (95% = 214 – 234) (ArsoCivil, et al., 2021) suggesting the number of bottlenose dolphins moving along the east coast of Scotland between Moray Firth and the Tay Estuary is high. Movement rates have been found to be highest from the Tay estuary and adjacent waters towards the Moray Firth SAC in early summer. Movement rates are also high for individuals travelling in the opposite direction during late summer. However, males exhibit more frequent movement between each site than females, suggesting they are more likely to be present in the Marine Installation Corridor. Differences between individuals of the same sex have also been observed.

These coastal movement patterns indicate the bottlenose dolphin, of the coastal ecotype, may be in vicinity of the section of the Marine Installation Corridor from the Scottish landfall, up to about 30 km from the coast. However, on the basis of the low density off the offshore ecotype (Waggitt, et al., 2019), and the coastal ecotype remaining within 30 km of the coast, the density of bottlenose dolphin within the offshore areas of the Marine Installation Corridor, which comprises most of the route, will be relatively low.The range of bottlenose dolphin is considered to be at ‘favourable’ conservation status in UK waters (JNCC, 2019) and is of ‘least concern’ globally (IUCN, 2021).

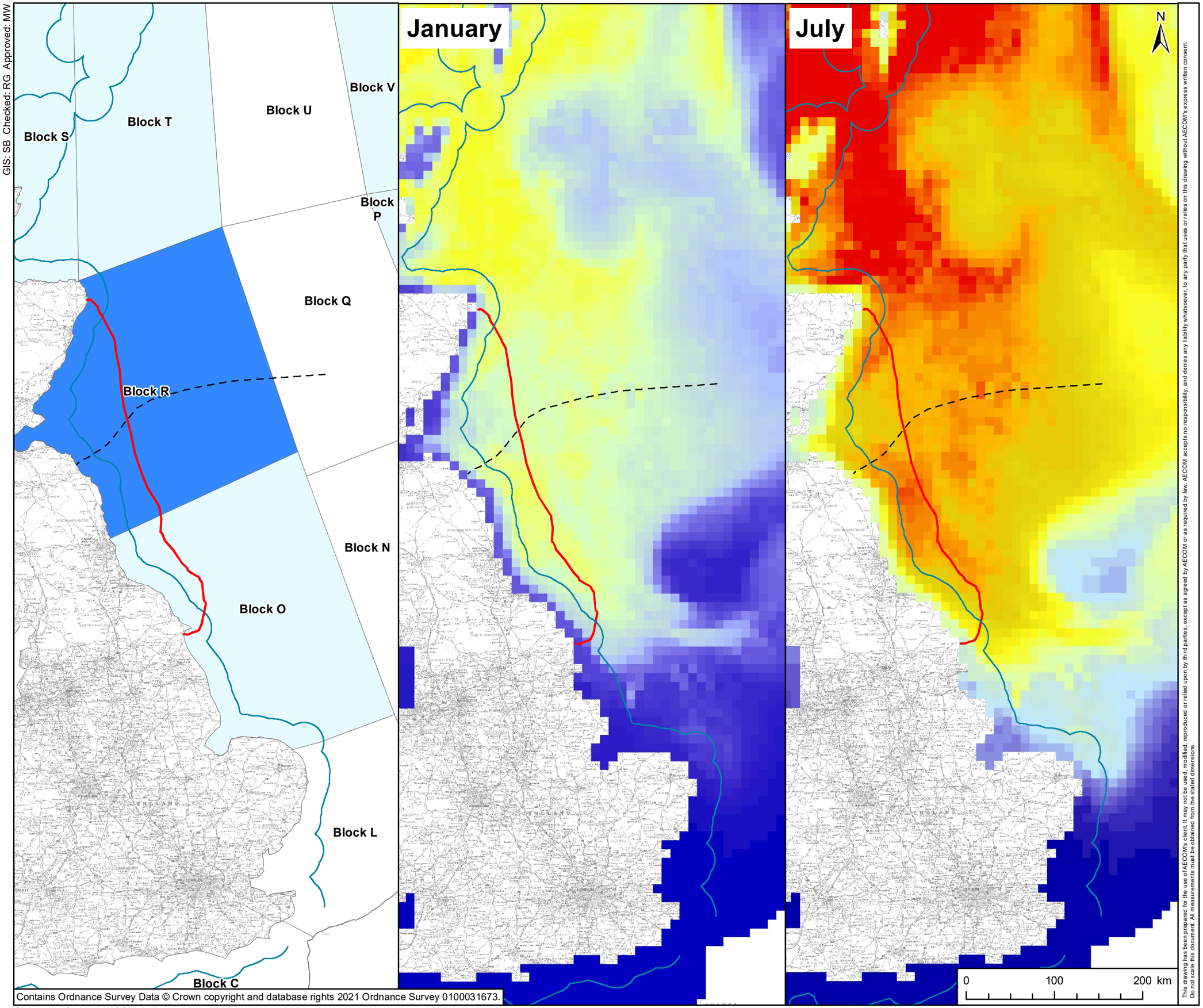
10.5.1.3 White-Beaked Dolphin

The white-beaked dolphin is endemic to the North Sea (Sea Watch Foundation, 2012b), with around 36,000 individuals thought to be in the population (IJsselddijk, et al., 2018). This species prefers waters less than 200 m deep and is present year-round in Scottish waters but is most frequently observed during the summer months, peaking in August (Hague, Sinclair, & Sparling, 2020). This is indicated by increases in density in the northern and central North Sea during the summer (Waggitt, et al., 2019). Prey of the white-beaked dolphin comprises of 95% fish, with haddock and whiting being the most important (Canning, et al., 2008), though they also feed on cephalopods and crustaceans (Sea Watch Foundation, 2012b).

Based on both survey data and modelling, the density of white-beaked dolphin close to the coast is very low (Hammond, et al., 2021) and provides a summary of SCANS-III data for white-beaked dolphin. During the SCANS-III survey, high estimated densities were recorded in the northern North Sea (Hammond, et al., 2021). In Block S, in north-eastern Scottish waters, estimated abundance was 868 individuals (95% CL = 0 – 2,258) with a density of 0.021 individuals per km^2 (Hammond, et al., 2021). Data also show there is a high-density hotspot of white-beaked dolphin in eastern Scottish offshore water, mostly in Blocks T and R (Hague, Sinclair, & Sparling, 2020). A small proportion of the Marine Installation Corridor overlaps with the highest density area Block T, with a reported abundance of 2,417 individuals (95% CL = 593 – 5,091) and density of 0.037 individuals per km^2 (Hammond, et al., 2021). In Block R, a total of 15,694 individuals (95% CL = 3,022 – 33,340) with a density of 0.243 individuals per km^2 were recorded (Figure 10-4).

In English territorial waters and within the EEZ, from approximately KP218 to the English landfall at KP436, which falls within Block O density was very low (Hague, Sinclair, & Sparling, 2020). In this block a total of 143 white-individuals (95% CL = 0 – 490) were estimated, with a density of 0.002 individuals per km^2 (Hammond, et al., 2021).

GIS: SB Checked: RG Approved: MW



Coordinate System: WGS1984 Zone 30N

Scale @ A3 1:4,000,000

nationalgrid
Scottish & Southern Electricity Networks

PROJECT
Eastern Green Link 2

KEY

- Marine Installation Corridor
- UK Territorial Sea Limit
- Scottish/English Water Border

SCANS-III White-beaked Dolphin Density (Hammond et el., 2021)

(animals per sq km)

- 0
- 0 - 0.05
- 0.20 - 0.25

Distribution of White-Beaked Dolphin (Waggit 2019)

(animals per square km)

- High : 0.21
- Low : 0

TITLE
Figure 10-4
White-Beaked Dolphin Density and Distribution

REFERENCE
SEGL2_M_EAR_10-4_v2_20220614

SHEET NUMBER
1 of 1

DATE
14/06/2022

Recent model predictions indicate reasonably high densities of white-beaked dolphin within the whole of the north western region of the North Sea, particularly around the coast of north east England and northern Scotland, with densities persisting in the latter region during the winter (Waggitt J. , et al., 2019). There have also been reports of sightings around Flamborough Head (WWT Consulting, 2009), located approximately 5 km to the north of the English landfall. However, modelling data indicate density in this region is low (Waggitt, et al., 2019). Modelling also shows the region of higher density expands southwards during the summer months towards the southern North Sea (Waggitt J. , et al., 2019) and the region in which the Marine Installation Corridor and the Scottish and English landfalls sit. This suggests that while it is likely that white-beaked dolphins will be present around the Marine Installation Corridor in Scottish waters throughout the year, their presence in English waters is less likely but may increase in the summer months.

The IAMMWG MU for white-beaked dolphin is the Celtic and Greater North Sea MU. The most recent estimated abundance for white-beaked dolphins in the Celtic and Greater North Seas MU is 43,951 individuals (95% CI=28,439 – 67,924). Of these, 34,025 individuals (95% CI=20,026 – 57,807) are believed to occur in the UK portion. The estimate was derived from the updated SCANS-III abundance estimates for continental shelf waters, representing the core range for this species (Hammond, et al., 2021). (IAMMWG, 2021; Hammond, et al., 2021).

At present this species is considered to have a ‘favourable’ conservation status in UK waters (JNCC, 2019) and globally it is of ‘least concern’ (IUCN, 2021).

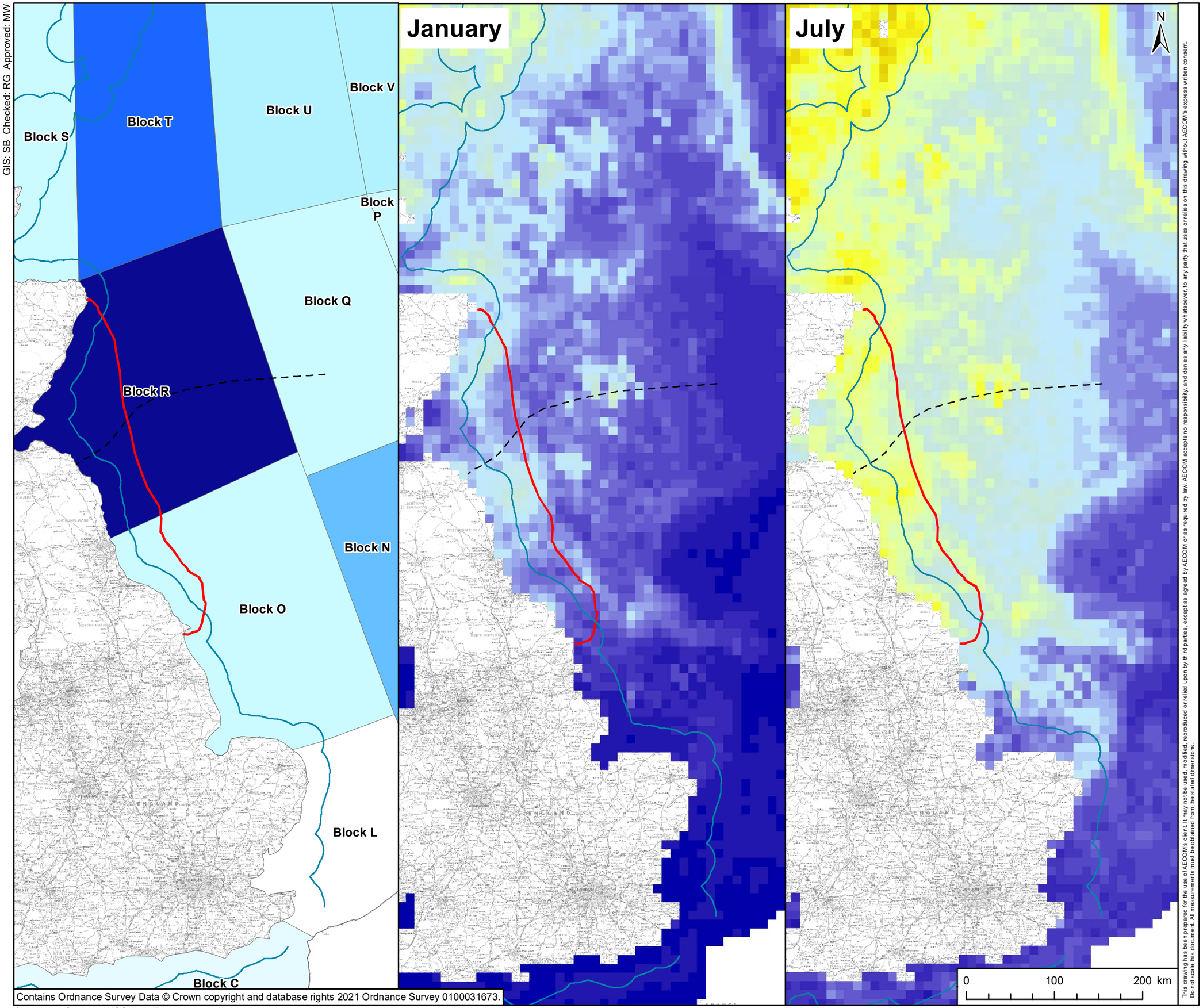
10.5.1.4 Minke Whale

The minke whale is relatively common in UK waters, concentrated in coastal waters around Scotland with most sightings between June and August (Hammond, et al., 2021). They are also present in offshore areas of the North Sea indicating the density of this species within the Marine Installation Corridor will be high. It has been suggested there are three different foraging behaviours exhibited by minke whales: using fast movements in different directions, associating their foraging with seabird feeding activity (particularly in late summer (Evans, Anderwald, & Hepworth, 2008), and using lunge feeding (de Boer, 2010). The dominant prey item is sandeel, however they also feed on other fish species including herring, haddock, and mackerel (Olsen & Holst, 2001).

Figure 10-5 provides a summary of SCANS-III data for minke whale. Hague et al. (2020) state that density predictions for the minke whale are high in the north and east of Scotland. Hodgson (2014) reports that minke whales show preference for areas with high primary productivity and photosynthetically active radiation, as well as euphotic depth and suggests that they require high densities of prey for effective foraging. They are commonly spotted in the outer Moray Firth SAC (Robinson & Tetley, 2007) located in Block S, with 383 individuals (95% CL = 0 – 1,364) recorded and a population density of 0.0095 individuals per km^2 (Hammond, et al., 2021). Block S also encompasses much of the Southern Trench MPA, designated in 2020 for the protection of minke whale and seabed habitats. Despite this, Block T, which covers a smaller area of the MPA, has a much higher abundance of 2,068 individuals (95% CL = 290 – 6,960) with a higher density of 0.03 individuals per km^2 (Hammond, et al., 2021).

Predicted SCANS-III density data shown in Hague et al. (2020) displays a hotspot of minke whale located in Block R ranging from the coastal waters of Berwick-upon-Tweed and Northumberland to offshore waters into the Marine Installation Corridor, starting around KP182. Block R exhibited the highest abundance of all the survey blocks (Hague, Sinclair, & Sparling, 2020) with 2,498 individuals (95% CL = 604 – 6,791) recorded and a population density of 0.039 individuals per km^2. The average group size was 1.18 (Hammond, et al., 2021). The hotspot also extends south offshore into Block O to approximately KP296 where 603 individuals (95% CL = 109 – 1,670) were recorded (Figure 10-5). The population density was estimated to be 0.010 individuals per km^2 and the average group size was 1.0 (Hammond, et al., 2021). However, in the location of the English landfall in Block O, data shows that density is much reduced despite an increase abundance (Hague, Sinclair, & Sparling, 2020). Block S and Block O have very similar densities of minke whale, suggesting that although there are differences in abundance, these blocks are very similar in terms of minke whale presence (Table 10-4).

GIS: SB Checked: RG Approved: MW



Coordinate System: WGS1984 Zone 30N

Scale @ A3 1:4,000,000

nationalgrid
Scottish & Southern Electricity Networks

PROJECT

Eastern Green Link 2

KEY

- Marine Installation Corridor
- UK Territorial Sea Limit
- Scottish/English Water Border

SCANS-III Minke Whale Density (Hammond et al., 2021)

(animals per sq km)

- 0
- 0 - 0.005
- 0.005 - 0.010
- 0.010 - 0.015
- 0.020 - 0.025
- 0.030 - 0.035
- 0.035 - 0.040

Distribution of Minke Whale (Waggit 2019)

(animals per square km)

- High : 0.11
- Low : 0

TITLE

Figure 10-5
Minke Whale Density and Distribution

REFERENCE

SEGL2_M_EAR_10-5_v2_20220614

SHEET NUMBER: 1 of 1

DATE: 14/06/2022

There is a small southward trend in density observed in the summer months extending from the northern North Sea into the central North Sea (Waggitt J. , et al., 2019) (Figure 10-5). Density also increases in the northern North Sea in Block S, particularly around the north-east coast of Scotland during this time (Hague, Sinclair, & Sparling, 2020; Waggitt J. , et al., 2019). Minke whale presence has been observed to increase in the Moray Firth SAC around June and July, related to the location of aggregations of suitable prey, particularly sandeels, as predicted by the environmental variables underlying these groupings, such as increased photosynthetically active radiation associated with increased productivity (Hodgson, 2014). This increase suggests it is likely minke whales will also be present around the Scottish landfall during the summer months and the offshore regions of the Marine Installation Corridor from approximately KP28 to KP397.

The IAMMWG MU for minke whale is the Celtic and Greater North Sea MU. The most recent estimated abundance is 20,118 individuals, of which 10,288 individuals (95% CI=6,210-17,042) are believed to occur in the UK EEZ (Hammond, et al., 2021). The Southern Trench Marine Protected Area (MPA) is in place to protect the minke whale, as well as other biodiversity features (see Section 0 for further information). This MPA is located 1.96 km north from the Marine Installation Corridor.

This species is considered to have a 'favourable' conservation status in UK waters with respect to its range (JNCC, 2019) and is of 'least concern' globally (IUCN, 2021).

10.5.1.5 Other Cetacean Species

In addition to the four most common species, an additional five cetaceans may occur within the study area at times. These species are:

- Atlantic white-sided dolphin;
- Short-beaked common dolphin;
- Long-finned pilot whale;
- Orca; and
- Risso's dolphin.

Atlantic white-sided dolphin

Atlantic white-sided dolphins prefer deeper, cool waters (7 ºC to 12ºC), and are often found along the edges of continental shelves at water depths of 100 m to 500 m (Reid, Evans, & Northridge, S.P, 2003). In UK waters this species is distributed in a broad zone from the west of Ireland to the north and northwest of Britain. They are found in low numbers in deep offshore waters around the north of Scotland and northern North Sea during the summer (Hague, Sinclair, & Sparling, 2020) but are rare in the central and north eastern North Sea (Reid, Evans, & Northridge, 2003; Waggitt, et al., 2019). Modelling by Waggitt et al. (2019) shows very low densities around the UK in both summer and winter months (Hague, Sinclair, & Sparling, 2020). The most recent estimated abundance for white-sided dolphins in the Celtic and Greater North Seas MU is 18,128 individuals (95% CI=6,049-54,323), with 12,293 of these individuals (95% CI=3,891-38,841) occurring in the UK portion (IAMMWG, 2021). There are only density estimates for Block R and T. Block R had an abundance of 644 individuals (95% CI=0-2,069) and a density of 0.01 individuals per km^2 (Hammond, et al., 2021). The mean group size reported is 3 individuals. In Block T, an abundance of 1,366 individuals (95% CL = 0 – 5,031) was recorded with a density of 0.493 individuals per km^2.

Short-beaked common dolphin

The short-beaked common dolphin is often found in continental shelf waters, particularly in the Celtic Sea and Western Approaches to the Channel, and off southern and western Ireland (Waggitt, et al., 2019), in average group sizes of 14 individuals (Reid, Evans, & Northridge, S.P, 2003). It has been observed occasionally in the North Sea, mainly in summer (June to September) (Reid, Evans, & Northridge, 2003), with distribution more concentrated offshore and to the west of Scotland (Hague, Sinclair, & Sparling, 2020). There are estimated to be a total of 56,556 individuals (95% CI=33,014-96,920) within the Celtic and Greater North Seas MU (IAMMWG, 2021). Of these, 13,607 individuals (95% CI=8,720-21,234) are predicted to occur within the UK proportion of the MU. There are no abundance or density estimates available for Blocks S, T, R or O for this species.

Long-finned pilot whale

The long-finned pilot whale is a deep-water species (greater than 200 m), rarely sighted in the shallower waters around northern Scotland, the northern North Sea and the Channel (Reid, Evans, & Northridge, 2003; Waggitt, et al., 2019; Hague, Sinclair, & Sparling, 2020). This species tends to be found to the west of the UK, however densities are still low (Hague, Sinclair, & Sparling, 2020; Waggitt, et al., 2019). There are no abundance or density estimates available for the relevant SCANS blocks for this species, or for the MU.

Orca

In UK waters, orca are most common off northern and western Scotland and to a lesser extent west and south of Ireland. They are usually seen as solo individuals or in groups of eight individuals maximum (Evans, Anderwald, & Baines, 2003). They are rarely observed in the central North Sea (Reid, Evans, & Northridge, S.P, 2003). Modelling by Waggitt et al. (2019) shows that there are low densities of orca in the northern North Sea and eastern Scottish waters, and around much of the UK throughout the year, with very little seasonal variation (Hague, Sinclair, & Sparling, 2020; Waggitt, et al., 2019). Abundance or density estimates for orca were not reported in SCANS data (Hague, Sinclair, & Sparling, 2020).

Risso's dolphin

Risso's dolphin is a continental shelf species (Frantzis & Herzing, 2002; Reid, Evans, & Northridge, 2003). The coastal ecotype is present throughout the year in Scottish waters, with densities increasing during the summer months (Hague, Sinclair, & Sparling, 2020). Most sightings in UK waters are in western Scotland, with the waters surrounding the Outer Hebrides forming a hotspot (IUCN, 2021). There are other clusters of sightings in the southern Irish Sea and off southwest Ireland. There are few records of this species within the central and southern North Sea (Reid, Evans, & Northridge, 2003). There have been some sightings reported in winter of the northeast coast of Scotland. There are no abundance or density estimates from SCANS data for this species. There are estimated to be a total of 12,262 individuals (95% CI=5,227 - 28,764) within the Celtic and Greater North Seas MU (IAMMWG, 2021). Of these, 8,687 individuals (95% CI=2,810 – 26,852) are predicted to occur within the UK portion of the MU.

10.5.1.6 Summary of Cetacean Abundance and Density Estimates

Approximate abundances and densities for the four key cetacean species known to be present within the vicinity of the Marine Installation Corridor are provided in Table 10-2 with a summary of protection measures in place for other cetaceans found in the study area and abundance of the four key cetacean species by MU in Table 10-3 and Table 10-4 respectively.

Table 10-2: Summary of abundance and density estimates for the four key cetacean species by SCANS-III survey block

SCANS-III Survey Block	Species	Density (Individuals/km^2)	Total Population Size per Block
S (North-east of Scotland)	Harbour porpoise	0.152	6,147
	Bottlenose dolphin	0.0037	151
	White-beaked dolphin	N/A	N/A
	Minke whale	0.0095	383
T (North-east of Scotland - Offshore)	Harbour porpoise	0.402	26,309
	Bottlenose dolphin	N/A	N/A
	White-beaked dolphin	0.037	2,417
	Minke whale	0.03	2,068
R (North-east of England and east of Scotland)	Harbour porpoise	0.599	38,646
	Bottlenose dolphin	0.030	1,924
	White-beaked dolphin	0.243	15,694
	Minke whale	0.039	2,498
O	Harbour porpoise	0.888	53,485

SCANS-III Survey Block	Species	Density (Individuals/km^2)	Total Population Size per Block
(East coast of England)	Bottlenose dolphin	0	0
	White-beaked dolphin	0.002	143
	Minke whale	0.010	603
Source: Hammond et al. (2021)			

Table 10-3: Summary of protection measures in place for the other cetaceans potentially present in the study area

Common Name	Latin Name	Wildlife and Countryside Act, 1981	EC Habitats Directive (Annex)	Bonn Convention (Appendix)	Bern Convention (Appendix)	ASCOBANS	Priority Marine Features (Scotland)
Atlantic white-sided common dolphin	*Lagenorhynchus acutus*	✓	IV	II[3]	II	✓	✓[4]
Short-beaked common dolphin	*Delphinus delphis*	✓	II, IV	II[2]	II	✓	✓[6]
Long-finned pilot whale	*Lagenorhynchus albirostris*	✓	IV	II[3]	II	✓	✓[4]
Killer whale	*Orcinus orca*	✓	IV	II	II	✓	✓[6]
Risso's dolphin	*Grampus griseus*	✓	IV	II[2]	II	✓	✓[6]

Bonn Convention:
[1] North and Baltic Sea, western North Atlantic, Black Sea and North West African populations
[2] North and Baltic Sea populations
[3] Only North and Baltic Sea populations

Priority Marine Features:
[4] Offshore waters
[5]Territorial waters
[6]Both

Table 10-4: Summary of abundance of the four key cetacean species by MU

Species	MU	Total Abundance in MU	Total abundance in UK portion of MU
Harbour porpoise	North Sea MU	346,601	159,632
Bottlenose dolphin	Greater North Sea MU	2,022	1,885
	Coastal East Scotland MU#	224	224
White-beaked dolphin	Celtic and Greater North Sea MU	43,951	34,025
Minke whale	Celtic and Greater North Sea MU	20,118	10,288
Source: IAMMWG (2021) *# Bottlenose dolphin population estimate taken from Arso Civil (2021)*			

10.5.2 Pinnipeds

Two seal species live and breed in UK waters: the harbour (or common) seal *Phoca vitulina* and the grey seal *Halichoerus grypus*.

10.5.2.1 Harbour Seal

Approximately 32% of European harbour seals are found in the UK (SCOS, 2020). The estimated total population of harbour seals for the UK from most recent counts during the moulting season (2016-2019) is 44,000 individuals (95% CL = 36,000-58,700) (SCOS, 2020). Around 85% of the total UK population of harbour seals are located in Scotland (SCOS, 2020). On the east coast of Scotland, their distribution is restricted with individuals concentrated in major estuaries including the Firth of Tay and the Moray Firth (Carter, et al., Habitat-based predictions of at-sea distribution for grey and harbour seals in the British Isles. Sea Mammal research Unit, University of St Andrews, Report to BEIS, OESEA-16-76/OESEA-17-78, 2020) (Figure 10-6). The Marine Installation Corridor falls within the East Scotland Seal MU and the North East England Seal MU. Recent summer mean harbour seal counts (2016-2019) identified 343 and 79 individuals within these two MUs, respectively (SCOS, 2020).

As an Annex II species of the EU Habitats Directive, the harbour seal is a designating feature of a total of 16 SACs in the UK (SCOS, 2020). Three of these, the Firth of Tay and Eden Estuary SAC in eastern Scotland and the Wash and North Norfolk Coast SAC in East Anglia, occur in the North Sea. Both SACs support nationally important breeding colonies of harbour seal (~7% of the total UK population). The Firth of Tay and Eden Estuary SAC is located 93.5 km to the west of the Marine Installation Corridor, whilst the Wash and North Norfolk Coast SAC is located over 100 km south of the Marine Installation Corridor and beyond any zone of influence.

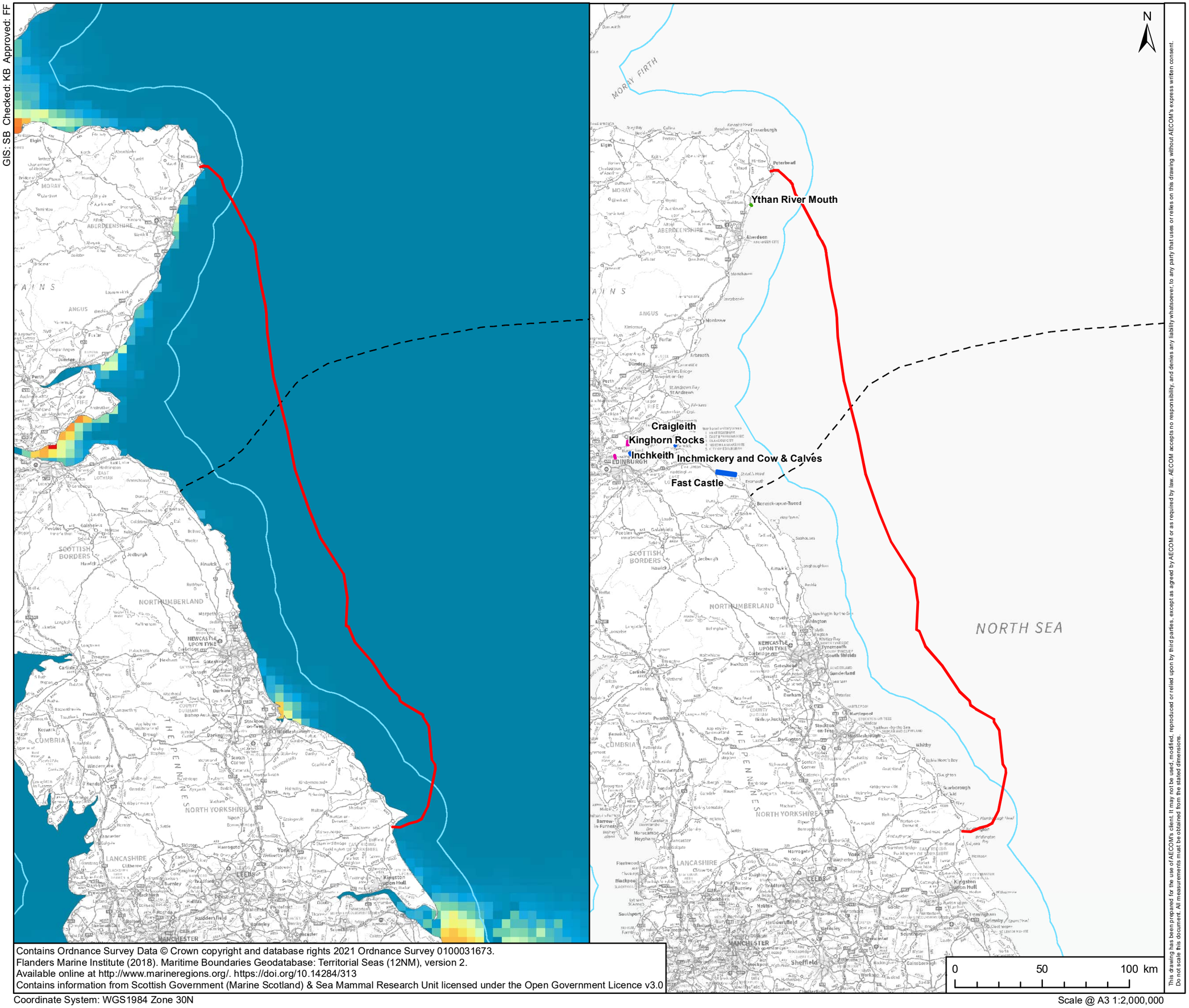
The mean at-sea usage of harbour seals (i.e., the mean count of seals in the water at any point) is concentrated within the immediate vicinity of these SACs with very little offshore presence (Russell, Jones, & Morris, 2017; Carter, et al., 2020). Harbour seals persist in discrete regional populations, usually staying within 50 km of the coast (Russell, Jones, & Morris, 2017; Russell & McConnell, 2014). Harbour seals use haul-out sites to give birth and moult, leaving the haul-out site to forage (SCOS, 2020), during which they can spend up to 12 hours in the water (Thompson, Mackay, Tollit, Enderby, & Hammond, 1998). The highest abundance of hauled-out harbour seals appears to occur during the moulting season in the late summer months (August to September), with a slightly lower number of hauled-out seals during the pupping season of the early summer months (June to July) (Wilson, 2001). There is also variation between sexes, with females spending more time hauled-out in June and September compared to males, and less time in October to May (Cunningham, et al., 2009). However, it appears that time spent hauled-out is dependent on prey availability, with harbour seals in areas of high prey availability spending more time foraging and feeding (Härkönen, 1987).

When harbour seals leave haul-out sites to forage, they normally travel distances between 10 km and 60 km (Thompson, Mackay, Tollit, Enderby, & Hammond, 1998). This suggests that harbour seals from haul-out sites in both Scotland and England are unlikely to forage in the Marine Installation Corridor. Although some foraging trips have been recorded up to 144 km from haul-out locations (Cunningham, et al., 2009), these are rare and a 50 km screening distance for harbour seal activity is considered to be appropriate for this species.

Within the entire Marine Installation Corridor, the mean at-sea usage for harbour seals is low, reported to be between 0 and <1 individuals (Russell, Jones, & Morris, 2017; Carter, et al., 2020) (Figure 10-6). Carter et al. (2020) show a small increase in at-sea usage around the east coast of Scotland, particularly in the Firth of Forth, but these areas are not located within the Marine Installation Corridor.

The overall UK population of harbour seal has increased from 25,600 individuals in the 2007-2009 period to 31,700 individuals in the 2016-2019 period (SCOS, 2020). However, in the East Scotland MU, harbour seal counts have stayed fairly low, with some decline (SCOS, 2020). Populations are declining in the Firth of Tay and Eden Estuary SACs and fluctuating in the Moray Firth (SCOS, 2020). The East Scotland Seal MU has the lowest count of harbour seals compared to all other Scottish Seal MUs (SCOS, 2020). However, the global conservation status of harbour seal is of ‘least concern’ (IUCN, 2021).

GIS: SB Checked: KB Approved: FF



Coordinate System: WGS1984 Zone 30N

Scale @ A3 1:2,000,000

nationalgrid
Scottish & Southern Electricity Networks

PROJECT
Eastern Green Link 2

KEY

- Marine Installation Corridor
- Scottish/English Water Border
- UK Territorial Sea Limit

Designated Haul-out Site for Seals

- Grey Seal - Breeding Colony Seal Haul Out
- Grey Seal - Seal Haul Out
- Harbour/Common Seal - Seal Haul Out
- Harbour/Common and Grey Seal - Seal Haul Out

Harbour Seals

Percentage of at-sea population

High : 0.1

Low : 0

TITLE

Figure 10-6
Mean percentage of at-sea population (estimated to be present in each 5 km x 5 km grid cell at any one time) of harbour seals from haulouts in the British Isles (Source: Carter et al., 2020).

REFERENCE

SEGL2_M_EAR_10-6_v2_20220614

SHEET NUMBER: 1 of 1

DATE: 14/06/2022

10.5.2.2 Grey Seal

Approximately 36% of the world's grey seal population breeds in the UK. The main concentration of grey seals around the UK are in the Inner and Outer Hebrides and in Orkney (Duck, 2010) and Scottish waters are home to 86% of the total UK population (SCOS, 2020).

The east coast of Scotland and England is also home to a number of breeding populations (SCOS, 2020). The most recent data, for 2019, estimate the UK grey seal population size to be approximately 149,700 individuals (95% CI = 120,000 – 174,900) (SCOS, 2020). Regional pup production estimates for North Sea colonies within proximity to the study area are presented in Table 10-5.

Table 10-5: Recent grey seal pup production estimates from 2019 for colonies in proximity to the Marine Installation Corridor (SCOS, 2020)

Location	Haul-out locations	2019 Pup Production Estimate	Distance of colony to nearest point of Marine Installation Corridor
Firth of Forth	May Fast Castle Inchkeith	6,894 (across all three sites)	May – 90 km Fast Castle – 74 km Inchkeith – 131 km
Farne Islands	1 haul-out	2,737	50

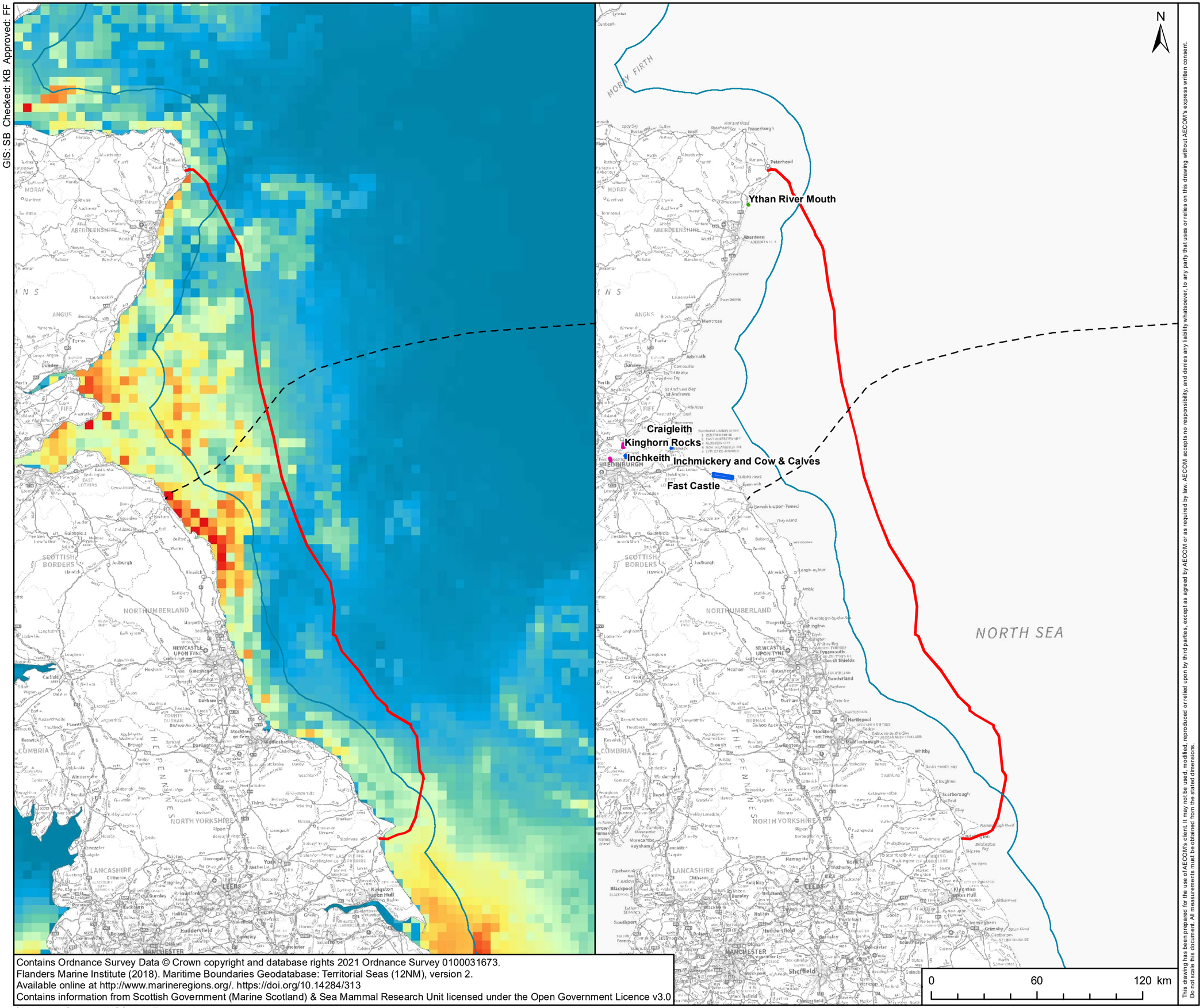
As an Annex II species of the EU Habitats Directive, the grey seal is the designating feature of a total of 13 SACs in the UK. Two of these, the Isle of May SAC and the Berwickshire and North Northumberland Coast SAC are located approximately 90 km and 38 km to the west of the Marine Installation Corridor respectively. Both sites support important grey seal breeding colonies. The grey seal is also a qualifying feature, but not the primary reason for designation of the Humber Estuary SAC (located approximately 51 km southeast from the Marine Installation Corridor).

Grey seals use haul-out sites for breeding, resting and moulting (SCOS, 2020). There is a designated grey seal haul-out site located at Ythan River Mouth approximately 25 km south from the Marine Installation Corridor, which provides protection to around 2,000 grey seals throughout the year (Marine Scotland, 2017), which represents around 26% of the Scottish east coast grey seal population (River Ythan, 2021; NatureScot, 2017). Modelling by Carter et al. (2020) shows grey seal mean at-sea usage to be high around the Ythan River Mouth. For seals using haul-out sites to be affected by Marine Scheme activities, the activities would need to be occurring very close to the haul-out site, approximately within 2 km. There are however no designated grey seal haul-out sites located within 2 km of the Marine Installation Corridor so potential reckless harassment, as per the Conservation of Seals under the Marine (Scotland) Act 2010 (Scottish Government, 2014) is not expected to occur at this site. A summary of designated haul-out sites is presented in Section 10.5.3.1.

Grey seals can however forage over distances of up to 135 km without returning to the haul-out site, over periods of one to thirty days (SCOS, 2020). They typically forage along the seabed reaching depths of 100 m (SCOS, 2020). McConnell et al. (2001) tagged seals in the North Sea and estimated that seals in this location spend 43% of their time within 10 km of a haul-out site. Modelling by Russel et al. (2017) and Carter et al. (2020) (Figure 10-7) shows that grey seals forage along the majority of the eastern England and Scotland coast, and north eastern North Sea.

Mean at-sea usage of grey seals varies along the route of the Marine Installation Corridor (Carter, et al., 2020). There are hotspots of high grey seal density close to the Scottish landfall (approximately KP0 to KP8), extending eastwards into the Marine Installation Corridor. Russell et al. (2017) shows higher at-sea usage on the Northumberland coast. South of these areas mean at-sea usage is much lower, in the portion of the Marine Installation Corridor offshore of Sunderland approximately KP288 to KP349, until density increases to a hotspot around the Humber Estuary. From KP417 to KP435.7, in close vicinity to the English landfall there is an increased density of grey seals (Russell, Jones, & and Morris, 2017; Carter, et al., 2020) (Figure 10-7).

GIS: SB Checked: KB Approved: FF



Coordinate System: WGS1984 Zone 30N

Scale @ A3 1:2,000,000

nationalgrid
Scottish & Southern Electricity Networks

PROJECT
Eastern Green Link 2

KEY

- Marine Installation Corridor
- UK Territorial Sea Limit
- Scottish/English Water Border

Designated Haul-out Site for Seals

- Grey Seal - Breeding Colony Seal Haul Out
- Grey Seal - Seal Haul Out
- Harbour/Common Seal - Seal Haul Out
- Harbour/Common and Grey Seal - Seal Haul Out

Grey Seals

Percentage of at sea population (Source: Carter et al., 2020).

High : 0.1
Low : 0

TITLE
Figure 10-7
Mean percentage of at-sea population (estimated to be present in each 5 km x 5 km grid cell at any one time) of grey seals from haulouts in the British Isles (Source: Carter et al., 2020) and Relevant Designated Haul-out Sites for Seals in Scotland

REFERENCE
SEGL2_M_EAR_10-7_v2_20220614

SHEET NUMBER
1 of 1

DATE
14/06/2022

Given the foraging distances of up to 135 km in much of the eastern and northern North Sea, and modelling data (Russell, Jones, & Morris, 2017; Carter, et al., 2020), it is highly likely that grey seals could be frequently travelling through the Marine Installation Corridor. Greys seals particularly from the Isle of May SAC, Berwickshire and North Northumberland SAC, and Humber Estuary SAC are likely to forage in the Marine Installation Corridor, given the high at-sea usage in this area (Russell, Jones, & and Morris, 2017; Carter, et al., 2020). Grey seals have also been recorded to repeat the same foraging trip from haul-out sites (SCOS, 2020), and return to the same haul-out site 88% of the time (McConnell, Fedak, Lovell, & Hammond, 2001), making possible interactions with the Marine Scheme even more likely.

The UK grey seal population is considered to be stable and increasing, particularly within the eastern England colonies (SCOS, 2020). Pup production at the Isle of May SAC has reached an asymptote, which has been the case since late 1990s. In the Berwickshire and North Northumberland Coast SAC, pup production is increasing. Overall, this species is at 'favourable' conservation status in the UK (JNCC, 2019). Globally, populations are also considered to be increasing and therefore the conservation status of this species is of 'least concern' (IUCN, 2021).

10.5.3 Relevant Designated Sites

Key sites designated for the protection of marine mammals have been screened in using the relevant MUs defined by IAMMWG (2021) for each species, MUs indicate the spatial scales suited to each species in which impacts should be assessed.

For cetaceans, the designated sites which have been considered within the MUs are restricted to a distance of approximately 50 km from the Marine Installation Corridor. This reflects a buffer of 50 km which is recommended by the JNCC for disturbance from underwater sound in harbour porpoise[5] (see MMO (2019)). However, given the mobile nature of cetaceans, consideration has also been made for known seasonal movements of some cetacean populations between designated sites. For example, the population of bottlenose dolphin protected by the Moray Firth SAC are known to undertake southwards migration to the Firth of Forth and Berwick-upon-Tweed (Hague, Sinclair, & Sparling, 2020; ArsoCivil, et al., 2021). For more information, see Appendix 8.2: Habitat Regulations Assessment.

For pinnipeds, screening distances have been selected based on accepted foraging ranges (see MMO (2019)). For harbour seals, a screening distance of 50 km is considered appropriate as this species forages close to their haul-out sites (Thompson, Mackay, Tollit, Enderby, & Hammond, 1998). Grey seals are known to forage over much larger distances up to 135 km from their haul-out sites (SCOS, 2020). Therefore, a screening distance of 135 km is considered appropriate for this species.

Table 10-6 below presents the relevant designated sites for marine mammals and their proximity to the Marine Installation Corridor. Marine mammal species named as designated biodiversity features are highlighted in **green.**

Table 10-6: Relevant designated sites for marine mammals

Site Name (Country)	Designation	Relevant Qualifying Biodiversity Features	Approximate Distance from Marine Installation Corridor (km)
Southern Trench (Scotland)	MPA	• Designated for the protection of the **minke whale**, amongst other features	1.96 km
Southern North Sea (England)	SAC	Annex II species that are a primary reason for site selection: • **harbour porpoise.**	18.78 km

[5] Harbour porpoise is the cetacean species with the highest sensitivity to underwater sound and this distance has been used as a reasonable worst-case scenario.

Site Name (Country)	Designation	Relevant Qualifying Biodiversity Features	Approximate Distance from Marine Installation Corridor (km)
Berwickshire and North Northumberland Coast (Scotland and England)	SAC	Annex I habitats that are a primary reason for site selection: • mudflats and sandflats not covered by seawater at low tide; and, • large shallow inlets and bays. Annex II species that are a primary reason for site selection: • **grey seal**	36.43 km
Humber Estuary	SAC	The **grey seal** is a qualifying feature, but not the primary reason for designation	34.69 km
Isle of May (Scotland)	SAC	Annex II species that are a primary reason for site selection: • **grey seal**	88.38 km
Moray Firth (Scotland)	SAC	Designated for the protection of **bottlenose dolphin.**	92.51 km

10.5.3.1 Designated haul-out sites for pinnipeds

The Protection of Seals (Designated Sea Haul-out Sites) (Scotland) Order 2014 introduced additional protection for seals at 194 designated haul-out sites across Scotland: locations on land where seals come ashore to rest, moult or breed. For an activity at sea to impact a seal haul-out site, it would need to occur very close to that haul-out site, within approximately 2 km. There are no designated haul-out sites located within 20 km of the Marine Installation Corridor and therefore potential reckless harassment, as per the Conservation of Seals under the Marine (Scotland) Act 2010 is not expected to occur, and no further assessment is required.

10.5.4 Summary of Receptors

The marine mammal receptors taken forward for consideration in the appraisal, have been determined based upon the potential activity / receptor interactions (i.e., impact pathways) identified during the scoping phase. These are presented in Table 10-7.

Table 10-7: Marine mammal receptors considered in this appraisal

Receptor group	Species	Rationale	Value
Cetaceans	All porpoise, dolphin and whale species present in UK waters	• Cetaceans are of international conservation importance e.g., all species are EPS and protected under WCA, 1981; and • A total of 13 species of cetacean also considered PMF in Scotland	High
Pinnipeds	Harbour and grey seal	• Seals of national conservation importance • Both seal species considered PMF in Scotland	Medium

10.6 Appraisal of Potential Impacts

This section discusses the potential impacts of the Marine Scheme on marine mammals during Installation, Operation and Maintenance, and Decommissioning Phases (see Chapter 2: Marine Scheme Description for full description of Marine Scheme phases). The appraisal has been undertaken in accordance with CIEEM (CIEEM, 2018) and the methodology presented in Chapter 4: Approach to Environmental Appraisal.

The potential impact pathways shown in Table 10-8 have been scoped into the EAR according to the Scoping report and subsequent scoping opinion from the regulators (Chapter 6: Consultation and Stakeholder Engagement).

Table 10-8: Potential impacts of the Marine Scheme on marine mammals

Potential impact	Zone of influence (ZOI)
Route preparation and cable installation	
Underwater sound	Maximum effective deterrence range of 5 km
Changes to marine water quality effects from the use of HDD drilling fluids and accidental leaks and spills from vessels, including loss of fuel oils	Footprint of the proposed works plus 1.5 km buffer; based on professional judgement and consideration of worst-case for fine particulates (Chapter 7: Physical Environment).
Vessel presence and marine mammal collision risk	<1 m for collisions.
Cable operation and maintenance	
Maintenance the same as route preparation and cable installation	See route preparation and cable installation, noting that durations and extents of activities will be significantly reduced.
Decommissioning	
Potential effects the same as route preparation and cable installation	Anticipated to be analogous to route preparation and cable installation.

10.6.1 Embedded Mitigation

The following embedded mitigation have been incorporated into the Marine Scheme (as described fully in Chapter 2: Project Description), to avoid and/or minimise impacts to marine mammal ecology receptors

Table 10-9 Marine mammal embedded mitigation

Activity / Issue	Embedded mitigation commitment
All phases	
Ecological mitigation	Given the potential for injury from the use of SBP, mitigation measures recommended in the JNCC 2017 guidelines for minimising the risk of injury to marine mammals from geophysical surveys (JNCC, 2017) will be adopted during SBP operations; and All vessels will comply with the following codes to protect ecological receptors: The Scottish Marine Wildlife Watching Code (SMWWC) (available from: https://www.nature.scot/sites/default/files/2017-06/Publication%202017%20-%20The%20Scottish%20Marine%20Wildlife%20Watching%20Code%20SMWWC%20-%20Part%201%20-%20April%202017%20%28A2263518%29.pdf); and The Basking Shark Code of Conduct (available from: https://www.sharktrust.org/Handlers/Download.ashx?IDMF=6137b1a1-8518-4327-9922-7b280acb8336).
Marine Scheme vessel requirements	• All vessels will follow the International Regulations for Preventing Collisions at Sea 1972 (COLREGS) and International Convention for the Safety of Life at Sea 1974 (SOLAS); • All vessels will comply with the International Convention for the Prevention of Pollution from Ships (MARPOL) regulations and will therefore be equipped with waste disposal facilities onboard. The discharging of contaminants is not permitted within 12 nm from the coast to preserve bathing waters; • Control measures and shipboard oil pollution emergency plans (SOPEP) will be in place and adhered to under MARPOL Annex I requirements for all vessels; • Ballast water discharges from all vessels will be managed under International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004 (BWM Convention); • All vessels will adhere to the IMO guidelines for the control and management of ships' biofouling to minimise the transfer of invasive aquatic species (Biofouling Guidelines) (resolution MEPC.207(62);

Activity / Issue	Embedded mitigation commitment
	• Where possible, vessels will operate with dynamic positioning which will minimise anchor disturbance on the seabed; • All vessels will display appropriate lights and shapes; • All applicable vessels will broadcast their status on AIS at all times; • All vessels will follow Port bylaws and General Directions, including VTS communications from ports (Peterhead); • Guard vessels will use RADAR with Automatic RADAR Plotting Aid (ARPA) to monitor vessel activity and predict possible interactions, will be employed to work alongside the installation vessel(s) during installation and maintenance work (which will also minimise anchor disturbance on the seabed); • A temporary 500 m Recommended Clearance Zone will be established around all vessels associated with the works; • Piloting of large vessels when entering or leaving Peterhead Harbour Area; • Limits to wave height / wind speed conditions for operations / activities will be followed by all vessels; and • Lighting on-board the vessels will be kept to the minimum level required to ensure safe operations and directed towards working areas. This will minimise disturbance to seabird species.
Installation Phase	
Route selection	The Marine Installation Corridor has been selected to optimise the balance of environmental, technical, commercial and financial considerations, such as avoiding designated sites, known archaeological sites, recreational activities, key fishing grounds and third-party infrastructure as far as possible.
Micro-routeing / detailed design post-consent	Detailed route development and micro-routeing will be undertaken within the Marine Installation Corridor, informed by pre-installation evaluation of site-specific survey data to avoid or minimise localised engineering and environmental constraints. This will include minimising the footprint as much as possible; Navigational features such as charted or known anchorages, maintained channel depths and prohibited regions will be avoided; Changes to the sedimentary and metocean environments will be minimised by careful route selection and the use of appropriate burial techniques and cable protection methods such as fall pipes for the laying of rock placement; Cable configuration will be optimised to minimise EMF during detailed design; Reduction in charted water depth to LAT will be limited to less than 5% where possible; and A Cable Burial and Protection Plan will be submitted to include detailed micro-routeing, trenching methods and external protection measures for the final design of the Marine Scheme prior to commencement of Installation Phase activities.
Construction Environmental Management Plan (CEMP)	Prior to cable installation activities commencing, a CEMP, including an Emergency Spill Response Plan (ESRP), Waste Management Plan, Marine Mammal Management Plan, Marine Non-Native Species (MNNS) Plan, Fisheries Liaison and Co-existence Plan[6]will be developed and agreed with relevant stakeholders in accordance with the coastal and marine environment site guide; and A commitment will be included with the CEMP and implemented via the SMWWC, to ensure that transiting vessels move at low speeds allowing any rafts of birds to disperse naturally well in advance of an approaching vessel. This will minimise the energy expended and avoid unnecessary flushing, which is especially important during the immediate post breeding dispersal periods of auks from early July to mid-September.
Landfall installation	Horizontal Directional Drilling (HDD) will be used at both landfalls for the installation of the cables in the transition zone between the Onshore Schemes and the Marine Scheme which avoids any works in the intertidal environment; and This will keep sediment disturbance to a minimum, minimising the use of cable protection measures inshore of the 11 m depth contour at Sandford Bay and the 5 m depth contour at Fraisthorpe Sands. This avoids direct impacts on sensitive coastal and intertidal habitats and features.
Drilling fluids	Drilling fluids for HDD operations will be biologically inert and selected from the OSPAR List of Substances/Preparations Used and Discharged Offshore which are Considered to Pose Little or No Risk to the Environment (PLONOR);

[6] Note that this will be a single document that will perform the role of other fisheries liaison plans, for instance, a Fisheries Management and Mitigation Strategy.

Activity / Issue	Embedded mitigation commitment
	During drilling, drilling fluids will be recycled, treated, and reused as far as possible, and any waste drilling fluid will be transported offsite for treatment and disposal; and Losses of drilling fluids are unavoidable; however they will be minimised insofar as practicable through the implementation of industry best practice for example, clearing runs or reducing the volume of drilling fluids in the borehole prior to breakout to the marine environment.

10.6.2 Installation Phase

10.6.2.1 Effects of underwater sound

Marine Scheme Underwater Sound Sources

A number of activities undertaken during the Installation Phase of the Marine Scheme will generate underwater sound, a summary is provided below with further detail available in Chapter 2: Project Description:

- Geophysical parameters during pre-installation and installation comprising Multibeam Echo Sounder (MBES), Sidescan Sonar (SSS), sub-bottom profiling (SBP) and Ultra-Short Baseline (USBL) acoustic positioning;
- Cable trenching - likely to include a number of methods (including ploughing, jet trenching and mechanical trenching) depending on seabed conditions;
- Rock placement on the seabed;
- Horizontal Directional Drilling (HDD) at the landfalls; and
- Vessel movements including cable lay vessels operating with dynamic positioning (DP).

Sound can be either impulsive in nature, such as that generated by high-resolution seabed imaging sources like MBES, seismic surveys, impact piling or explosions; or non-impulsive (also called continuous) from activities such as cable trenching, rock placement, and sound from vessel movements, including as a consequence of the use of DP. The impact of anthropogenic sound on marine mammals depends on a range of factors including the frequency and intensity of the sound source, the duration of the sound and normal background levels as well as the sensitivity and behaviour of the receiving animal and possible habituation to background sound sources.

For underwater sound impact appraisals, the applied metrics are sound pressure level (SPL) and sound exposure levels (SEL). The SPL is a measure of the amplitude or intensity of a sound and, for impulsive sound sources, is typically measured as a peak or root-mean-square (rms) value. In contrast, the SEL is a time-integrated measurement of the sound energy, which takes account of the level of sound as well as the duration over which the sound is present in the marine environment.

The sound characteristics of the Marine Scheme activities have been determined on the basis of equipment specifications and literature values (Table 10-10). Where a range of sound source levels was found in the literature a reasonable but realistic worst-case level has been assumed.

Table 10-10: Characteristics of underwater sound sources generated by the Marine Scheme Installation Phase

Survey or cable installation activity	Operating Frequency (kHz)	Sound Pressure Level# (dB re 1µPa@1m)	Sound Source Data Reference	Screened into appraisal?
Swathe or multi-beam echo sounder (MBES)	170 - 450	221 235 (peak)	Genesis Oil and Gas Consultants, 2011	×
Side scan sonar (SSS) (e.g., EdgeTech 4200 Series)	300 - 600	210 - 226	Genesis (2011) and equipment specification sheet	×

Survey or cable installation activity	Operating Frequency (kHz)	Sound Pressure Level# (dB re 1µP a@1m)	Sound Source Data Reference	Screened into appraisal?
Sub-bottom profiling (SBP) (e.g., Innomar SES-2000, Edgetech Chirp & Applied Acoustics 201 boomer)	0.5 – 12	238 (peak)	Equipment specification sheets	✓
USBL (e.g., Kongsberg HiPAP 502)	21 - 31	207 (peak)	Equipment specification sheet	✓
Cable installation (e.g., jet trenching, mechanical trenching)	1 - 15	178	(Nedwell, Langworthy, & Howell, 2003); Nedwell et al., (2008); Hale (2018)	×
Rock placement.	n/a	~172	Vessel Rollingstone (Orsted, 2019)	×
HDD (e.g., break-out)	n/a	129.5	Nedwell et al. (2012)	×
Cable lay vessel (~140 m in length operating with DP)	0.005 - 3.2	180 - 197	Ross (1993) AT&T (2008)	×
Project support vessels including medium (50 m to 100 m) and small (<50) boats	Low to high frequency	160 – 180	Genesis (2011) Richardson *et al.*(1995) OSPAR commission (2009)	×

Sound Pressure Level metrics in rms unless indicated.

A number of the above sound sources can be screened out of the appraisal either directly on the basis of their inherent acoustic characteristics, or have such low sound source intensity that they are effectively masked by, and so can be appraised with, sound from other elements of the Installation Phase activities, as explained below:

- **MBES** – the MBES operates at high frequencies that fall outside the hearing range of marine mammals and the sounds produced will be inaudible to marine mammals, so does not have the potential to result in injury or disturbance;
- **SSS** – operates at high frequency, producing sound that is outside the range of hearing of marine mammals;
- **Rock placement –** in four studies of rock placement, it was possible to faintly hear rocks falling through a fall tube to the seabed but the underwater sound from the operations was dominated by the sound of the vessel (Nedwell, Brooker, & Barham, 2012). A SPL_{rms} of 172 dB re. 1µPa was measured during the operation of the fall pipe vessel MV Rollingstone (Orsted, 2019). Thus, the SPLs associated with this activity are not of a magnitude which poses a risk of disturbance or injury to marine mammals, and is screened out of the assessment;
- **HDD** – sound measurements made during a generic HDD operation, in shallow riverine waters, recorded in the absence of vessel noise, a maximum unweighted SPL_{rms}, of 129.5 dB re. 1µPa (Nedwell, Brooker, & Barham, 2012). The Marine Scheme HDD breakout points will also be in sediment habitats where some sound will be absorbed. Thus, underwater sound generated by HDD will not be of a level where injury or disturbance of marine mammals is expected;
- **Ploughing, jet trenching and mechanical trenching cable installation** – Studies have found that underwater sound from cable trenching have a SPL_{RMS} of 178 dB re. 1µPa. This is below the level where risks of injury or disturbance of marine mammal could be expected, hence this activity is screened out; and
- **Vessel movements** – there will be a limited number of vessels associated with the installation works. In comparison to background vessel activity in the North Sea (Chapter 13: Shipping and

Navigation) the additional vessels operating to install the Marine Scheme is not considered to be a deviation from baseline conditions. As such, sound emissions from the installation vessels will not constitute a substantive change from the baseline soundscape including existing vessel sound, and hence there is not potential for adverse effects on marine mammals. Thus, underwater sounds resulting from vessel movements are screened out of the assessment.

The only activities associated with the Marine Scheme that are within hearing range of marine mammals and have the potential to have adverse effects, are the operation of the USBL and the SBP.

Hearing in Marine Mammals

Sound from anthropogenic activities can negatively impact marine mammals as it influences their ability to echolocate, communicate and it can cause physical harm (through disorientation leading to beaching, and in extreme cases, trauma to the auditory apparatus) (Southall, et al., 2007). Sound can cause certain cetacean species to change their behaviour and may result in increased alertness, modification of vocalisations, interruption or cessation of feeding or social interactions, alteration of movement or diving behaviour, and temporary or permanent habitat abandonment. In severe cases, animal responses may include panic, flight, or stranding, which could sometimes result in indirect injury or death.

Cetaceans produce and receive sound over a wide range of frequencies for communication, orientation, predator avoidance and foraging (Tyack, 2008). For the determination of the impact of underwater sound on cetaceans they have been classified into three functional hearing groups (low, high and very high frequency[7]) based on their peak hearing range (Southall, et al., 2007) (Table 10-11). Different species will be sensitive to different project activities and the VHF harbour porpoise, the most common species around the Marine Scheme is known to be particularly sensitive to underwater sound. There will be high frequency hearing dolphin species also present, but these are generally much less sensitive to underwater sound.

Seals (and other pinnipeds) also produce a diversity of sounds, though generally over a lower and more restricted bandwidth (generally from 100 Hz to several tens of kHz). Their sounds are used primarily in social and reproductive interaction, both in water and air (Southall, et al., 2007).

Table 10-11: Functional marine mammal hearing groups, auditory bandwidth and potential species within the study area

Functional Hearing Group#	Auditory band width	Species	Species potentially present in study area
Low frequency cetaceans (LF)	7 Hz to 35 kHz	Baleen whales	Minke whale
High frequency cetaceans (HF)	150 Hz to 160 kHz	Dolphins, toothed and beaked whales	Bottlenose dolphin Common dolphin
Very high frequency cetaceans (VHF)	275 Hz to 160 kHz	True porpoise and some small whales	Harbour porpoise
Pinnipeds in water (PW)	75 Hz to 100 kHz	Seals	Grey seal Harbour seal
Source: Southall et al. (2007); NMFS (2018); Southall et al. (2019).			

There are four species of cetacean occurring in the SCANS III study areas around the Marine Scheme at an abundance high enough for animal density estimates to have been determined (Hammond, et al., 2021) (see Section 10.5.1). These are the harbour porpoise (VHF), the white beaked dolphin (HF), the bottlenose dolphin (HF) and the minke whale (LF). There is, therefore, potential for animals in each of three functional hearing groups to be present in the vicinity of the Marine Scheme during installation.

The impact of underwater sound in marine mammals is generally split into the following categories:

- **Auditory injury** - a consequence of damage to the inner ear of marine mammals, the organ system most directly sensitive to sound exposure, can result in hearing loss, also known as Permanent Threshold Shift (PTS);

[7] These were previously described, by Southall et al., 2007, as low, mid and high frequency functional hearing groups.

- **Behavioural responses** – are highly variable and context-specific ranging from increased alertness, altering vocal behaviour, interruption to feeding or social interaction, alteration of movement or diving behaviour, temporary or permanent habitat abandonment. In some circumstances, sound from explosions or military sonar, have been associated with animal responses such as panic, flight, or stranding, sometimes resulting in indirect injury or death could occur. Minor or temporary behavioural responses are often simply evidence that an animal has heard a sound. Anthropogenic underwater sound may also partially or entirely reduce the audibility of signals of interest such as those used for communication and prey detection.

Underwater Sound Impact Threshold Criteria

The most up to date sound exposure criteria for auditory injury in marine mammals have been published by the US National Marine Fisheries Service (NMFS), often referred to as the NOAA criteria (NMFS, 2018), and updated in a recent peer-reviewed academic paper (Southall, et al., 2019). The thresholds for PTS are based on dual criteria of unweighted, instantaneous peak sound pressure levels (SPL_{peak}) and M-weighted cumulative Sound Exposure Levels (SEL_{cum}) (Table 10-12).

Table 10-12: Quantitative thresholds for auditory effects (PTS) in marine mammals

Marine Mammal Hearing Group	Impulsive Sound Sources	
	PTS	PTS
	SEL_{cum}	SPL_{peak}
LF cetaceans	183	219
HF cetaceans	185	230
VHF cetaceans	155	202
PW	185	218

SPL thresholds are unweighted peak SPL in dB re 1 µPa. Cumulative SEL thresholds are weighted for marine mammal hearing range and the units are dB re 1 $\mu Pa^2 s$

Sound Propagation Calculations

Sound attenuates as it propagates through water and the local oceanographic conditions will affect both the path of the sound into the water column and how much sound is transmitted. A standard geometric spreading calculation was used to determine the propagation of underwater sound from the USBL and SBP activities. The spreading model assumes that sound is spread geometrically away from the source with an additional frequency-dependent absorption loss; it therefore provides conservative estimates. It also does not take into consideration the conditions within the area, such as detailed bathymetry, water column structure or sediment type and thickness. The standard formula used for estimating the transmission loss from underwater sound sources is:

$$TL = A \log(r) + B r + C$$

Where:

TL is the transmission loss at a distance r from the source.

A is the wave mode coefficient. For spherical waves A = 20, and cylindrical waves A = 10.

B is an attenuation factor that is dependent on water depth and sea bottom conditions.

C is a fixed attenuation due to acoustic screening. In open water this will be 0.

Note that use of cylindrical spreading (A=10) is generally suited to shallow-to-mid water depths, and spherical spreading (A=20) is generally applicable to deep water depths. Although the definition of deep vs. shallow is somewhat dependent on wavelength, Richardson (1995) suggests that depths <200 m are commonly regarded as “shallow” and >2000 m are commonly regarded as “deep” regardless of source wavelength.

Cylindrical spreading (A=10) is more conservative (i.e., further sound propagation distances for a given source level) but is likely to be overly conservative for this assessment. Richardson (1995) suggests using A=15 for underwater transmission in shallow water conditions where the depth is greater than five

times the wavelength. For low frequency, longer wavelength sound this is going to tend toward A=20. For high frequency, shorter wavelength sound this is going to tend toward A=10.

For the purposes of this assessment and to provide a conservative but reasonably realistic estimate of sound propagation, an empirical wave mode coefficient A = 15 has been used to determine the distance at which SPL thresholds for PTS and TTS, are met.

The dual-metric modelling approach has been used to identify impacts based on the peak sound pressure level (SPL_{peak}) and the cumulative sound exposure level (SEL_{cum}) provided in Table 10-12. The SPL_{peak} criteria is defined as those peak SPLs above which tissue injury is predicted to occur, irrespective of exposure duration. The SEL_{cum} represents the total energy produced by a noise-generating activity standardised to a one second interval. This enables a comparison of the total energy attributed to different pulsed sound sources with different time intervals. The SEL_{cum} impact zones have been determined using the M-weightings that account for the specific hearing range of each of the functional hearing groups of marine mammals.

Table 10-13: Maximum estimated distance (m) from USBL and SBP at which the sound level will exceed the SPL_{peak} and SEL_{cum} PTS injury threshold

Acoustic source	Sound Source Level (SPL_{peak})	LF Cetaceans		HF Cetaceans		VHF Cetaceans		Phocids in Water	
		SPLpeak	SELcum	SPL_peak	SELcum	SPL_peak	SELcum	SPL_peak	SELcum
USBL	207 dB	<10	<10	<10	<10	<10	<10	<10	<10
SBP	238 dB	18	116	<10	<10	251	138	22	62

Note: SPL_{peak} units are dB re 1 µPa and SEL_{cum} are dB re 1 µPa2s

Auditory Injury Impacts

The predictive injury impact zone from USBL sound, based on both the SPL_{peak} and SEL_{cum} thresholds indicates that injury is only likely to occur for any animal that is in very close proximity to the sound source. In effect, for injury to occur a marine mammal would need to be within a few metres of the acoustic equipment (Table 10-13). Considering the highly mobile nature of marine mammals, the low density of all species identified in the vicinity of the Marine Installation Corridor, and the constant movement of the survey and installation vessels, the presence of animals this close to the acoustic equipment is highly unlikely. Also, for some of the works the USBL equipment may be deployed from a towed device only a few metres above the seabed. Therefore, injury from the operation of the USBL during geophysical and installation activities is considered highly unlikely, and no marine mammal mitigation is required for this equipment.

The injury impact distances for SBP, as expected considering the significantly higher SPL, are larger, particularly for low frequency and very high frequency cetaceans. The impact distances in relation to high frequency cetaceans indicate injury is not expected for the key dolphin species that could be present, largely the bottlenose and white beaked dolphin.

The injury distance estimated for seals is up to 62 m, although this does not account for the directionality of the equipment, which reduces the impact range and subsequent injury distance. The very low density of seals along the entire Marine Installation Corridor, and the unlikely presence of animals directly beneath the sound source, indicates auditory injury in seals is also unlikely.

The greatest distance relates to harbour porpoise, the most abundant marine mammal species in the North Sea. Available survey data indicates the density of harbour porpoise around the Marine Installation Corridor is relatively low. The most important region of the North Sea for this species is the southern North Sea, as defined by the area protected by the Southern North Sea SAC, approximately 19 km east of the Marine Installation Corridor. Nevertheless, harbour porpoise are widespread across the North Sea and sound propagation calculations indicate injury is possible in harbour porpoise, albeit in low numbers. Auditory injury is also possible in minke whale, though to a lesser extent based on smaller estimated zones of impact and the low density of this species, even in the Southern Trench MPA, a recognised hot spot for this species.

Given the potential for injury from the use of the SBP, embedded mitigation measures recommended in the JNCC guidelines for minimising the risk of injury in marine mammals (JNCC, 2017) will be adopted. The measures below will be included in a Marine Mammal Protection Plan (MMPP), as part of the CEMP developed for the Marine Scheme.

The JNCC guidance minimises the potential for injury to cetaceans from the SBP activities through the use of marine mammal observation. Thus, before the SBP is activated, there will be a period of observation by a qualified Marine Mammal Observer (or passive acoustic monitoring in the case of operations during the hours of darkness). Thus, the likelihood that any animals are within 500 m of the source, the standard observation zone, at the point at which the SBP is activated is very low. Following the observation period, SBP survey activities will only commence after a period when no animals have been seen. A soft start procedure can form part of the mitigation measures, but this process is not possible for SBP. However, these measures reduce the risk of injury to any marine mammals by minimising presence in close proximity to the noise source.

Behavioural Disturbance in Marine Mammals

Behavioural disturbance may occur, particularly in relation to the operation of the SBP, which is the sound source with the highest intensity. There are no widely agreed quantitative thresholds for behavioural disturbance, reflecting both a lack of empirical evidence and a high level of variability in behavioural responses, which are often unrelated to the sound level received (Gomez, et al., 2016) (Southall, et al., 2021). Nevertheless, a threshold of 160 dB SPL_{rms} is still adopted by NOAA in relation to behavioural disturbance from impulsive sounds[8]. To account for the directionality of the acoustic sound source[9] (Landrø & Amundsen, 2010) a conservative reduction in source level of 20 dB SPL_{rms} has been assumed for behavioural disturbance, which takes place at some distance from the source. The disturbance ranges, estimated using non-weighted geometric spreading formula as described above, are 63 m for USBL and 4,642 m for SBP.

The higher zone of influence for SBP is comparable with observations of behavioural disturbance in harbour porpoise in relation to geophysical surveys (Thompson, et al., 2013) and the 'effective deterrent range' (EDR) of 5 km recommended by JNCC (2020). The EDR applies specifically to harbour porpoise only, as this species is known to be highly sensitive to underwater sound and for which there is a greater body of evidence regarding behavioural disturbance.

Several field studies around wind farm installation activities and geophysical and seismic surveys, have shown that harbour porpoise demonstrate strong behavioural reactions to underwater sound. The density of animals and vocalisations are reduced temporarily for several kilometres around the noise source with gradually less of an effect the further away the observations are made e.g., Lucke, Lepper, Blanchet, & Siebert (2009), Stone & Tasker (2006) and Dahne (2013).

The estimated number of individuals which may experience disturbance during SBP operations, based on the worst-case scenario of a 5 km radius disturbance zone, has been calculated in Table 10-14, based on the estimated population data in Table 10-2. In these calculations, the impact range of 5 km results in a potential disturbance area of 79 km^2. The calculations assume the same disturbance zone for all species, recognising this is an overestimate of effect, likely in all other marine mammal species, but particularly in relation to the high frequency dolphin species and seals.

For cetaceans the proportion of animals potentially disturbed by the SBP is less than 1% of the total populations estimated to present in the SCANS III survey blocks to which the density estimates apply (Section 10.5.1). The percentage of cetaceans as a proportion of the total Marine Mammal Management unit population will be even lower, a maximum of 0.01% (Table 10-14). For seals, the total number of

[8] See: https://www.fisheries.noaa.gov/west-coast/endangered-species-conservation/esa-section-7-consultation-tools-marine-mammals-west

[9] Sound pressure is released in all directions, but not in a symmetrical and uniform way. Sound levels are highest directly below the source by design, to provide optimal energy. In addition, high frequencies are more directional than low frequencies. In the horizontal plane sound levels can be between 12 and 48 dB lower, depending on the nature of the sound source (Landrø and Amundsen, 2010). Each underwater sound source has its own specific radiation pattern depending on frequency and tow depth and the source pulse attenuation varies depending on the angle from the vertical. Data from seismic arrays (a lower frequency source) showed amplitude levels emitted horizontally to be 18-29 dB lower than the vertical. In the absence of data for SBP a reduction of 20 dB has been selected as a conservative estimate of the reduction from the high directionality of the source and the higher frequency.

animals disturbed is also a very small proportion of both the UK populations and the Scottish Seal Management Unit (Section 0).

Table 10-14: Summary of estimates of daily number of individual cetaceans within an assumed 5 km of the geophysical survey

Species	Density range (individuals/km$^{2)}$	No. of Individuals (79 km^2)	Proportion of MU population (%)	Location
Harbour porpoise	0.152 – 0.888	12 – 71	<0.01	Depending on Marine Installation Corridor location – highest density off English east coast in the central North Sea
Bottlenose dolphin	0 – 0.03	0 – 3	<0.01	Low density along the whole Marine Installation Corridor, highest value around southern Scotland/NE England and allows for increased estimates for Moray Firth SAC population.
White-beaked dolphin	0.002 - 0.243	1 - 19	<0.01	Density decreases north to south along Marine Installation Corridor
Minke whale	0.01 – 0.04	1 - 4	<0.01	Higher density estimates offshore Scotland and southern Scotland/NE England

However, to determine the resulting effect of the SBP related sound disturbance consideration of the duration of the disturbance and the importance of the affected area to the species concerned is particularly relevant. The SBP will not be operating continuously, it will be activated used as and when required for investigations of particular areas of the seabed where additional information is required to inform installation. Therefore, SBP sound disturbance will be intermittent, short-term and temporary, particularly considering the SBP will not be continuously moving along the Marine Installation Corridor. Thus, any one area is subject to ensonification for a short period of time.

The most common species in the Study Area, by far, is the harbour porpoise and it is also the species with the highest sensitivity to sound. The density of animals is higher around the southern region of the Marine Scheme but the most important area for harbour porpoise, designated by the Southern North Sea SAC, is approximately 19 km away, to the east / south east. The area around the Marine Installation Corridor is lower in density.

An understanding of the importance of the areas where disturbance could occur will play a key role in the overall impact of SBP underwater sound. The harbour porpoise is thought to have a very high metabolic rate compared to terrestrial animals of a similar size (Rojano-Doñate, et al., 2018), requiring individuals to forage almost constantly (Wisniewska, et al., 2016). Thus, temporary disturbance of harbour porpoise from key foraging grounds could affect individual harbour porpoise's ability to eat enough to meet their energy requirements, with consequences for survival and reproduction (Kastelein, Hardeman, & Boer, 1997).

The harbour porpoise is found throughout the North Sea, indicating there are extensive foraging grounds, with alternative feeding locations readily available. They are also highly mobile and wide ranging and whilst the SBP may temporarily disturb some individuals, animals will not be displaced from any key areas, they will also have extensive alterative areas, suitable for foraging and socialising, to move into, such that any impact on foraging or other behaviours is expected to be negligible.

There are four MPAs designated for minke whale. Three are on the west coast of the UK but the Southern Trench MPA, on the east coast of Scotland is approximately 2 km to the north of the Marine Installation Corridor, close to the Scottish landfall. Thus, a small portion of the MPA falls within the underwater sound effective deterrent range of 5 km which has been adopted for all cetacean species. The density of minke whale in the MPA area is estimated to be 0.03 individuals per km^2. Considering this, the distance to the MPA and the very short period of time the SBP will be in the vicinity of the MPA

(probably hours rather than days), the number of animals potentially disturbed is low and the behavioural responses will be at a low level. An appraisal of the effect of the Marine Scheme generated sound sources, on the conservation objectives of the MPA can be found in Appendix 8.3: MPA and MCZ Assessment.

Bottlenose and white beaked dolphin, both high-frequency hearing specialists, may be present at very low density, most likely in the northern region of the Marine Scheme. These species have much lower sensitivity to underwater sound compared to species such as harbour porpoise. The Scottish landfall is located between the Moray Firth and Firths of Tay and Forth, bottlenose dolphins transiting between these areas will have to cross the Marine Installation Corridor near the Scottish landfall. However, the SAC population is the coastal ecotype, so only are likely to be encountered nearshore of the Scottish landfall.

The closest seal haul-out location to the Marine Installation Corridor is the Ythan Estuary (grey seal), 25 km to the south of the Scottish landfall, also significantly beyond any potential zone of influence. Grey seals in particular forage over extensive distances and so there may be individuals in the vicinity of the Marine Installation Corridor, particularly in area closest to the Farne Islands where there is a very high density of seals. However, any disturbance would be short-term, temporary and limited to very few individuals. This is particularly the case when considering that the vessel is continuously moving and interactions with seals will be of short duration. Disturbance to seals foraging offshore will be limited and is not considered likely to have an adverse impact on foraging ability, with alternative areas for foraging widely available.

To conclude, with the inclusion of the embedded mitigation measures for SBP operations, there is no potential for injury to marine mammals as a result of underwater sound generated by the project activities. There will be some behavioural disturbance however, particularly from the operation of the SBP, but with the inclusion of the embedded mitigation measures this will be reduced, and as the vessel is continuously moving any impacts are transient. The duration is considered to be short-term, intermittent and temporary, and the extent of the effect limited in terms of the number of individuals and the level of behavioural response. EPS licences may be required due to potential for disturbance, particularly in Scottish waters.

Such disturbance is not predicted to interfere with any important habitat or foraging areas, behaviours or life stages and so the magnitude of the impact is predicted to be negligible**.** Combined with the medium to high value and sensitivity of this receptor, the effect is appraised as **minor** and therefore, **not significant**.

10.6.2.2 Reduction in Water Quality due to Discharges and Unplanned, Releases, Accidental Leaks and spills from Vessels

The accidental release of pollutants (e.g., oil, fuels, lubricants, chemicals) and planned release of wastewater could occur from any of the vessels associated with the cable lay operations and any support vessels present during cable installation and has the potential to reduce water quality. Vessels involved in cable lay operations could have cleaning fluids, oils, and hydraulic fluids onboard (as well as fuels), which could be accidentally discharged, releasing hydrocarbons and chemical pollutants into the surrounding seawater, which could then settle on the seabed with consequences marine mammals.

To ensure the risk of accidental spills is as low as reasonably practicable, the project will adhere to relevant guidance (e.g., Pollution Prevention Guidance). A CEMP including an Emergency Spill Response Plan and Waste Management Plan will be implemented during the Installation Phase of the Marine Scheme to minimise releases (Chapter 2: Project Description). Appropriate Health, Safety, and Environment (HSE) procedures (identified in the CEMP) will also be implemented, with strict weather and personnel limits to reduce any risk of accidental spillage. Furthermore, preparedness and swift response is essential for effective spill management and as such, response plans will be in place should an incident occur. Control measures and shipboard oil pollution emergency plans (SOPEP) will be in place and adhered to under MARPOL Annex I requirements for all vessels. Planned effluent dischargers will be compliant with MARPOL Annex IV ‘Prevention of Pollution from Ships’ standards.

The likelihood of an accidental spillage occurring, considering the control measures outlined above, is appraised as unlikely. Should an accident occur, any release of pollutants is expected to be small, such as release of oils or fuels from vessel engines or deck works and so the impact is expected to be highly

localised. Any releases will be rapidly dispersed and diluted by wave and tidal movements, and thus the impact to marine mammals is expected to be minor. Therefore, combined with a likelihood of unlikely of accidental spillage, effects on marine mammals are appraised as **minor** risk and therefore **not significant**.

10.6.2.3 Vessel Presence and Marine Mammal Collision Risk

The installation of the Marine Scheme will involve the deployment of a number of vessels including survey vessels, cable laying vessels, guard vessels, rock placement vessel, and additional specialised support vessels such as a jack up barge and dive support vessels for the works at the HDD breakout point in the nearshore.

Larger marine mammals, such as whales, are typically considered most at risk of vessel collision, but a recent review indicated that many other species, including smaller mammals like dolphins, porpoises, and seals may also be at risk (Schoeman, Patterson-Abrolat, & Plon, 2020). Many marine mammal species have been reported as involved in vessel strikes in the North Sea and wider Atlantic (Winkler, Panigada, Murphy, & Ritter, 2020). Large marine mammals with thick layers of blubber appear less likely to sustain serious injury compared to smaller cetaceans, although more study is needed regarding the relationship between species and injury severity (Schoeman, Patterson-Abrolat, & Plon, 2020). Marine mammals are highly manoeuvrable and studies of marine mammals including harbour porpoise and minke whale have identified avoidance behaviour to vessel presence (Palka & Hammond, 2001; Wisniewska, et al., 2018; Roberts, Collier, Law, & Gaion, 2019).

Pinnipeds are similarly at risk of injury and death from vessel collisions, although this risk is considered to be generally lower than that for cetaceans (Jones, et al., 2017). A study of pinniped presence during pipeline installation suggested avoidance of construction sites altogether, but this is thought to be a result of the underwater sound emitted during operations, as pinnipeds also hear at lower frequencies (Anderwald, et al., 2013).

Vessel speed and draft depth are thought to be two of the biggest factors concerning collision risk and severity, as higher speeds produce a greater impact force and larger drafts have been associated with increased mortality (Rockwood, Calambokidis, & Jahncke, 2017; Schoeman, Patterson-Abrolat, & Plon, 2020; Winkler, Panigada, Murphy, & Ritter, 2020). Although species-specific relationships of collision risk require further research, several behavioural factors have still been identified that may play an important role, including amount of time spent at the surface and avoidance behaviours (Schoeman, Patterson-Abrolat, & Plon, 2020).

Cable lay and geophysical survey vessels typically operate at low speeds of four to six knots and transit at slightly greater speeds of 10 to 14 knots. At these speeds, it is unlikely that vessels pose a significant risk to marine mammals, particularly to the harbour porpoise, as studies have indicated that serious injuries to marine mammals occur at speeds >14 knots (Winkler, Panigada, Murphy, & Ritter, 2020). There will be smaller vessels present during operations, but these will be accompanying, and thus travelling at similar speeds, to the larger vessels and so unlikely to represent a significant collision risk. There will be a small number of vessels involved in the Installation Phase and so are unlikely to significantly increase the risk of collision. Some studies have correlated avoidance behaviour with sustained or increased vessel traffic (Culloch, et al., 2016; Erbe, et al., 2019), and marine mammals are likely habituated to some vessel presence in the North Sea.

During the Marine Scheme, there will be no substantive change from baseline vessel activity in the Marine Installation Corridor. This notwithstanding the Scottish Marine Wildlife Wating Code (embedded mitigations) will be adhered to as a matter of best practice

Although the occurrence of any collisions could cause injury or death, which would be considered a moderate or major impact, the likelihood of vessel collision with marine mammals in the Marine Installation Corridor is appraised as unlikely when considering the manoeuvrability of marine mammals, the slow vessel operation speeds, and adherence to the Scottish Marine Wildlife Watching Code. Therefore, the effect of an impact, the risk of which is appraised to be minor is considered **not significant.**

10.6.3 Operation and Maintenance Phase

10.6.3.1 Maintenance and Cable Repair Effects

Maintenance activities and cable repair, where required, will be carried out using the same or similar methods as cable installation, and therefore the potential pathways for impact to marine mammals would be the same as those identified for the Installation Phase of the Marine Scheme.

Repair works are likely to be highly localised to the area of concern and therefore the spatial extent of any impacts would be highly limited in extent. Furthermore, any maintenance or repairs works would be of a significantly shorter duration.

Maintenance and unforeseen cable repair (although unlikely) are routine, and the procedures and processes are well defined and common in the industry. Impacts of maintenance and cable repair works would be of smaller magnitude than the Installation Phase, and the effect is predicted to be **negligible** and therefore **not significant**.

10.6.4 Decommissioning Phase

10.6.4.1 Effects of Underwater Sound During Decommissioning

At the end of the Operation and Maintenance Phase of the Marine Scheme, the options for decommissioning will be evaluated and taking into consideration with other Project constraints (e.g., safety and liability), with the least environmentally damaging option chosen if possible.

The principal options for decommissioning described in Chapter 2: Project Description are:

- Leave the cable *in-situ*, trenched;
- Leave *in-situ* and provide additional protection;
- Remove sections of the cable that present a risk; or
- Remove the entire cable.

Should full removal from the seabed be required, this would have the potential to cause similar impacts to the Installation Phase of the Marine Scheme.

Thus, as a worst-case scenario, impacts during decommissioning may be of a similar magnitude to Installation Phase activities, depending upon the decommissioning option selected. Therefore, as a worst case, the effects to marine mammals are predicted to be **negligible / minor** and therefore **not significant**.

10.7 Mitigation and Monitoring

Aside from the embedded mitigation measures described in Section 10.6.1, no additional mitigation measures or monitoring have been identified as required following the appraisal.

10.8 Residual Impacts

As no additional mitigation was required because there were no likely significant effects on benthic ecology identified, the residual effects of the Marine Scheme remain as reported in Section 10.6.

10.9 Summary of Appraisal

Table 10-15: Summary of Environmental Appraisal

Phase	Potential Impact	Receptor	Sensitivity	Magnitude / Likelihood	Significance	Project Specific Mitigation	Magnitude after Mitigation	Significance of Residual Effect
Installation	Underwater sound disturbance during geophysical activities (USBL and SBP)	Cetaceans and Pinnipeds	Medium to High	Negligible	Minor	None required	Negligible	Not significant
	Vessel collision risk	Cetaceans and Pinnipeds	High	Unlikely	Minor	None required	Unlikely	Not significant
	Reduction in water quality due to discharges and unplanned releases, accidental leaks and spills from Vessels	Cetaceans and Pinnipeds	High	Unlikely	Minor	None required	Unlikely	Not significant
Operation and Maintenance	Underwater sound (USBL and the SBP)	Cetaceans and Pinnipeds	Medium to High	Negligible	Minor	None required	Negligible	Not significant
Decommissioning	Potential effects of decommissioning are the same as the Installation Phase							

10.10 References

Anderwald, P., Brandecker, A., Coleman, M., Collins, C., Denniston, H., Haberlin, M. D., . . . Walshe, L. (2013). Displacement responses of a mysticete, an odontocete, and a phocid seal to construction-related vessel traffic. *Endangered Species Research, 21*, 231-240.

ArsoCivil, M., Quick, N., Cheney, B., Pirotta, E., Thompson, P., & Hammond, P. (2019). Changing distribution of the east coast of Scotland bottlenose dolphin population and the challenges of area-based management. *Aquatic Conservation: Marine and Freshwater Ecosystems, 29*(S1), 178-196.

ArsoCivil, M., Quick, N., Mews, S., Hague, E., Cheney, B., Thompson, P., & Hammond, P. (2021). *Improving understanding of bottlenose dolphin movements along the east coast of Scotland. Final report. Report number SMRUC-VAT-2020-10 provided to European Offshore Wind Deployment Centre (EOWDC), March 2021 (unpublished).* Retrieved from https://group.vattenfall.com/uk/contentassets/c65a13553f864f599431d69c8c6a57b4/bottlenose-dolphin-monitoring---final-report-2021.pdf

Canning, S., Begona Santos, M., Reid, R., Evans, P., Sabin, R., Bailey, N., & Pierce, G. (2008). Seasonal distribution of white-beaked dolphins (Lagenorhyncus albirostrius) in UK waters with new information on diet and habitat use. *Journal of the Marine Biological Association of the United Kingdom, 88*(6), 1159-1166.

Carter, M., Boehme, L., Duck, C., Grecian, W., Hastie, G., McConnell, B., . . . Russell, D. (2020). *Habitat-based predictions of at-sea distribution for grey and harbour seals in the British Isles.* Report to BEIS, OESEA-16-76/OESEA-17-78: Sea Mammal Research Unit, University of St Andrews.

Carter, M., Boehme, L., Duck, C., Grecian, W., Hastie, G., McConnell, B., . . . Russell, D. (2020). *Habitat-based predictions of at-sea distribution for grey and harbour seals in the British Isles. Sea Mammal research Unit, University of St Andrews, Report to BEIS, OESEA-16-76/OESEA-17-78.* St. Andrews, Fife: Sea Mammal Research Unit.

Cheney, B., Graham, I., Barton, T., Hammond, P., & Thompson, P. (2018). *Site Condition Monitoring of bottlenose dolphins within the Moray Firth Special Area of Conservation: 2014-2016. Scottish Natural Heritage Research report No. 1021.*

Cheney, B., Thompson, P., Ingram, S., Hammond, P., Stevick, P., Durban, J., . . . Wilson, B. (2013). Integrating multiple data sources to assess the distribution and abundance of bottlenose dolphins Tursiops truncatus in Scottish waters. *Mammal Review, 43*(1), 71-88.

CIEEM. (2018, and updated September 2019). *Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine. Version 1.1.* Winchester: artered Institute of Ecology and Environmental Management.

CSIP. (2015). *Annual Report for the period 1st January - 31st December 2015.*

Culloch, R. M., Anderwald, P., Brandecker, A., Haberlin, D., McGvern, B., Pinfield, R., . . . Cronin, M. (2016). Effect of construction-related activities and vessel traffic on marine mammals. *Marine Ecology Progress Series, 549*, 231-242.

Cunningham, L., Baxter, J., Boyd, I., Duck, C., Lonergan, M., Moss, S., & McConnell, B. (2009). Harbour seal movements and haul-out patterns: implications for monitoring and management. *Aquatic Conservation: Marine and Freshwater Ecosystems, 19*, 398-407.

de Boer, M. (2010). Spring distribution and density of minke whale Balaenoptera acutorostrata along an offshore bank in the central North Sea. *MARINE ECOLOGY PROGRESS SERIES, 408*, 265-274.

Duck, C. (2010). *Charting Progress 2 Healthy and Biological Diverse Seas Feeder Report: Section 3.5: Seals. Published by Department for Environment Food and Rural Affairs on behalf of UKMMAS.. P506-539. In: UKMMAS. Frost, M and Hawkridge, J. (Eds.).*

Erbe, C., Marley, S. A., Shoerman, R. P., Smith, J. N., Trigg, L. E., & Embling, C. B. (2019). The effects of ship noise on marine mammals - a reivew. *Frontiers in Marine Science, 6*(606). doi:10.3389/fmars.2019.00606

Evans, P., Anderwald, P., & Baines, M. (2003). *UK Cetacean Status Review. Report to English Nature & Countryside Council for Wales.*

Evans, P., Anderwald, P., & Hepworth, K. (2008). *Cetaceans in the vicinity of Aberdeen and adjacent seas.* Oxford: SeaWatch Foundation.

Frantzis , A., & Herzing, D. (2002). Mixed-species associations of striped dolphins (Stenella coeruleoalba), short-beaked common dolphins (Delphinus delphis), and Risso's dolphins (Grampus griseus) in the Gulf of Corinth (Greece, Mediterranean Sea). *Aquatic Mamamals, 28*(2), 188-197.

Gomez, C., Lawson, J., Wright, A., Buren, A., Tollit, D., & Lesage, V. (2016). A systematic review on the behavioural responses of wild marine mammals to noise: The disparity between science and policy. *Canadian Journal of Zoology, 94*, 801-819. doi:10.1139/cjz-2016-0098

Hague, E., Sinclair, R., & Sparling, C. (2020). Regional baselines for marine mammal knowledge across the North Sea and Atlantic areas of Scottish waters. *Scottish Marine and Freshwater Series, 11*(12), 309.

Hammond, P., Lacey, C., Gilles, A., Viquerat, S., Börjesson, P., Herr, H., . . . and Øien, N. (2021). *Estimates of cetacean abundance in European Atlantic waters in summer 2016 from the SCANS-III aerial and shipboard surveys.* 40 pp.

Hammond, P., Macleod, K., Berggren, P., Borchers, D., Burt, L., Canadas, A., . . . Vazquez, J. (2013). Cetacean abundance and distribution in European Atlantic shelf waters to inform conservation and management. *Biological Conservation, 164*, 107-122.

Härkönen, T. (1987). Seasonal and regional variations in the feeding habits of the harbour seal, Phoca vitulina, in the Skagerrak and the Kattegat. *Journal of Zoology, 213*(3), 535-543.

Heinänen, S., & Skov, H. (2015). *The identification of discrete and persistent areas of relatively high harbour porpoise density in the wider UK marine area. JNCC Report No.544, Issue JNCC.* Peterborough: JNCC.

Hiby, L., & Lovell, P. (1998). Using Aircraft in Tandem Formation to Estimate Abundance of Harbour Porpoise. *Biometrics, 54*, 1280-1289.

Hodgson, I. (2014). *The role of fine-scale environmental variables in predicting the distribution of minke whales (Balaenoptera acutorostrata) in the Moray Firth, North East Scotland. Master of Science (MSci) Thesis. University of Aberdeen.*

IAMMWG. (2015). *Management Units for cetaceans in UK waters (January 2015).* Peterborough: JNCC Report No. 547.

IAMMWG. (2021). *Updated abundance estimates for cetacean Management Units in UK waters.* Peterborough: JNCC.

ICES. (2019). Working Group on Marine Mammal Ecology (WGMME). . *ICES Scientific Reports.*(1(22), 142 pp.).

IJsselddijk, L., Brownlow, A., Davison, N., Deaville, R., Haelters, J., Keijl, G., . . . ten Doeschate, M. (2018). Spatiotemporal trends in white-beaked dolphin strandings along the North Sea coast from 1991-2017. *Lutra, 61*(1), 153-163.

IUCN. (2021). *The IUCN Red List of Threatened Species. Version 2021-2*. Retrieved from http://www.iucnredlist.org

JNCC. (1994). *UK Biodiversity Action Plan (UK BAP) 1994.* Retrieved February 03, 2022, from https://hub.jncc.gov.uk/assets/cb0ef1c9-2325-4d17-9f87-a5c84fe400bd

JNCC. (2017). *Guidelines for minimising the risk of injury to marine mammals from geophysical surveys*. Retrieved 02 19, 2022, from https://data.jncc.gov.uk/data/e2a46de5-43d4-43f0-b296-c62134397ce4/jncc-guidelines-seismicsurvey-aug2017-web.pdf

JNCC. (2017). *JNCC guidelines for minimising the risk of injury to marine mammals from geophysical surveys (seismic survey guidelines).* Retrieved from https://hub.jncc.gov.uk/assets/e2a46de5-43d4-43f0-b296-c62134397ce4

JNCC. (2019). *Article 17 Habitats Directive Report 2019: Species Conservation Status Assessments 2019*. Retrieved from https://jncc.gov.uk/our-work/article-17-habitats-directive-report-2019-species/

JNCC. (2019). *Article 17 Habitats Directive Report 2019: Species Conservation Status Assessments 2019.* Retrieved from https://jncc.gov.uk/our-work/article-17-habitats-directive-report-2019-species/

JNCC. (2020). *Guidance for assessing the significance of noise disturbance against Conservation Objectives of harbour porpoise SACs.* Peterbourgh: JNCC.

JNCC. (2021a). *Southern North Sea MPA*. Retrieved December 08, 2021, from https://jncc.gov.uk/our-work/southern-north-sea-mpa/#:~:text=The%20Southern%20North%20Sea%20SAC%20lies%20along%20the,for%20the%20protection%20of%20harbour%20porpoise%20Phocoena%20phocoena.

JNCC, Natural England, & Countryside Council for Wales. (2010). *The protection of marine European Protected Species from injury and disturbance. Guidance for the marine area in England and Wales and the UK offshore marine area.* Retrieved from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/850708/Draft_Guidance_on_the_Protection_of_Marine_European_Protected_Species_from_Injurt_and_Disturbance.pdf

Jones, E. L., Hastie, G. D., Smout, S., Onoufriou, J., Merchant, N. D., Brookes, K. L., & Thompson, D. (2017). Seals and shipping: quantiyfying population risk and individual exposure to vessel noise. *Journal of Applied Ecology, 54*(6), 1930-1940.

Kastelein, R., Hardeman, J., & Boer, H. (1997). Food consumption and body weight of harbour porpoises (Phocoena phocoena). In A. Read, P. Wiepkema, & P. Nachtigall (Eds.), *The Biology of the Harbour Porpoise* (pp. 217-233). Woerden, The Netherlands: De Spil Publishers.

Landrø, M., & Amundsen, L. (2010). *Marine Seismic Sources Part II*. Retrieved from GEOExPro: https://www.geoexpro.com/articles/2010/02/marine-seismic-sources-part-ii

MacLoed, C., Begona Santos, M., Reid, R., Scott, B., & Pierce, G. (2007). Linking sandeel consumption and the likelihood of starvation in harbour porpoises in the Scottish North Sea: could climate change mean more starving porpoises? *Biology Letters, 3*(2), 185-188.

Maeda, S., Sakurai, K., Akamatsu, T., Matsuda, A., Yamamura, O., Kobayashi, M., & Matsuishi, T. (2021). Foraging activity of harbour porpoises around a bottom-gillnet in a coastal fishing ground, under the risk of bycatch. *PLoS ONE, 16*(2), e0246838.

Marine Scotland. (2017). *Designated haul-out sites for seals (Protection of Seals Orders)*. Retrieved October 25th, 2021, from https://marine.gov.scot/maps/446

McConnell, B., Fedak, M., Lovell, P., & Hammond, P. (2001). Movements and foraging areas of grey seals in the North Sea. *Journal of Applied Ecology, 36*(4), 573-590.

MMO. (2019). *Habitat Regulations Assessment for the North East, North West, South East and South West Marine Plans - Appropriate Assessment Information Report, including Screening Report. A report produced for the Marine Management Organisation by AECOM, pp 232.* MMO Project No: 1188.

NatureScot. (2017). *SNH advice on keeping seal pups safe at Ythan*. Retrieved 02 23, 2022, from https://presscentre.nature.scot/news/snh-advice-on-keeping-seal-pups-safe-at-ythan

NatureScot. (2017a). *The Scottish Marine Wildlife Watching Code - Part 1.* Retrieved January 24, 2022, from https://www.nature.scot/sites/default/files/2017-06/Publication%202017%20-%20The%20Scottish%20Marine%20Wildlife%20Watching%20Code%20SMWWC%20-%20Part%201%20-%20April%202017%20%28A2263518%29.pdf

NatureScot. (2017b). *A Guide to Best Practice for Watching Marine Wildlife SMWWC - Part 2.* Retrieved January 24, 2022, from https://www.nature.scot/doc/guide-best-practice-watching-marine-wildlife-smwwc-part-2

NatureScot. (2020). *The Protection of Marine EPS from Injury and Disturbance for the Marine Area in Scottish Inshore Waters Guidance for Scottish Inshore Water.* Retrieved from https://www.gov.scot/binaries/content/documents/govscot/publications/advice-and-guidance/2020/07/marine-european-protected-species-protection-from-injury-and-disturbance/documents/marine-european-protected-species-guidance-july-2020/marine-european-protec

Nedwell, J., Brooker, A., & Barham, R. (2012). *Assessment of underwater noise during the installation of export power cables at the Beatrice Offshore Windfarm. Subacoustech. Envrionmental Report No. E318R0106.* Retrieved 02 19, 2022, from http://marine.gov.scot/datafiles/lot/bowl/ES/ES%20Volume%204%20-%20Annexs/7B%20OfTW%20Underwater%20Noise/Annex%207B%20OfTW%20Underwater%20Noise.pdf

Nedwell, J., Langworthy, J., & Howell, D. (2003). *Assessment of sub-sea acoustic noise and vibration from offshore wind turbines and its impact on marine wildlife; initial measurements of underwater noise during construction of offshore windfarms, and comparison with background noise.* The Crown Estates. Retrieved from www.subacoustech/information/downloads/reports/544R0424.pdf

Olsen, E., & Holst, J. (2001). A note on common minke whale (Balaenoptera acutorostrata) diets in the Norwegian Sea and the North Sea. *Journal of Cetacean Research and Management, 3*(2), 179-183.

OSPAR Commission. (2008). *Case Reports for the OSPAR List of Threatened and/or Declining Species and Habitats.* Retrieved from https://www.ospar.org/site/assets/files/44267/harbour_porpoise.pdf

Palka, D. L., & Hammond, P. S. (2001). Account for responsive movement in line transect estimates of abundance. *Canadian Journal of Fisheries and Aquantic Sciences, 58*(4).

Reid, J., Evans, P., & Northridge, S. (2003). *Atlas of Cetacean Distribution in north-west European Waters.* Peterborough: Joint Nature Conservation Committee.

Reid, J., Evans, P., & Northridge, S.P. (2003). *Atlas of Cetacean Distribution in north-west European Waters.* Peterborough: Joint Nature Conservation Committee.

Richardson, W., Greene, C., Malme, C., & Thomson, D. (1995). *Marine mammals and noise.* San Diego: Academic Press.

River Ythan. (2021). *Seal population*. Retrieved 02 23, 2022, from https://www.riverythan.org/river-projects/seal-population.html

Roberts, L., Collier, S., Law, S., & Gaion, A. (2019). The impact of marine vessels on the presence and behaviour of harbour porpoise (Phocoena phocoena) in the waters off Berry Head, Brixham (South West England). *Ocean and Coastal Management, 179*. doi:10.1016/j.ocecoaman.2019.104860

Robinson, K., & Tetley, M. (2007). Behavioural observations of foraging minke whales. *Journal of the Marine Biological Association of the United Kingdom, 87*(1), 85-86.

Robinson, K., O'Brien, J., Berrow, S., Cheney, B., Costa, M., Eisfield, S., . . . Whooley, P. (2012). Discrete or not so discrete: Long distance movements by coastal bottlenose dolphins in UK and Irish waters. *Journal of Cetacean Research and Management, 12*(3), 365-371.

Rockwood, R. C., Calambokidis, J., & Jahncke, J. (2017). High mortality of blue, humpback and fin whales from modeling of vessel collisions on the U.S. West Coast suggests population impacts and insufficient protection. *Plos One*. doi:10.1371/journal.pone.0183052

Rojano-Doñate, L., McDonald, B., Wisniewska, D., Johnson, M., Teilmann, J., Wahlberg, M., . . . Madsen, P. (2018). High field metabolic rates of wild harbour porpoises. *Journal of Experimental Biology, 221*. doi:10.1242/jeb.185827

Russell, D., & McConnell, B. (2014). *Seal at-sea distribution, movements and behaviour. Report to UK Department of Energy and Climate Change (DECC). Issue URN: 14D/085. .*

Russell, D., Jones, E., & Morris, C. (2017). *Updated Seal Usage Maps: The Estimated at-sea Distribution of Grey and Harbour Seals. Scottish Marine and Freshwater Science Report Vol 8 No 25.* St. Andrews, Fife: Marine Science Scotland.

Schoeman, R. P., Patterson-Abrolat, C., & Plon, S. (2020). A global review of vessel collision with marine mammals. *Frontiers in Marine Science, 7*. doi:10.3389/fmars.2020.00292

SCOS, S. C. (2020). *Scientific Advice on Matters Related to the Management of Sea Populations.*

Scottish Government. (2014). *Marine Scotland - Guidance on the Offence of Harrassment of Seal Haul-out Sites.* Marine Scotland.

Sea Watch Foundation. (2012a). *CETACEANS OF EAST SCOTLAND*. Retrieved from https://seawatchfoundation.org.uk/wp-content/uploads/2012/07/EasternScotland.pdf

Sea Watch Foundation. (2012b). *THE WHITE BEAKED DOLPIN IN UK WATERS*. Retrieved from https://seawatchfoundation.org.uk/wp-content/uploads/2012/07/White-beaked_Dolphin.pdf

Sea Watch Foundation. (2021). Retrieved from https://www.seawatchfoundation.org.uk/

Sea Watch Foundation. (2021a). *Cetaceans of Eastern England.* Retrieved from https://seawatchfoundation.org.uk/wp-content/uploads/2012/07/EasternEngland.pdf

Southall, B., Bowles, A., Ellison, W., Finneran, J., Gentry, R., Greene Jr, C., . . . Tyack, P. (2007). Marine mammal noise exposure criteria: initial scientific recommendations. *Aquatic Mammals, 33*(4), 411-522.

Southall, B., Nowacek, D., Bowles, A., Senigaglia, V., Bejder, L., & Tyack, P. (2021). Marine Mammal Noise Exposure Criteria: Assessing the Severity of Marine Mammal Behavioral Responses to Human Noise. *Aquatic Mammals*.

Southall, L., Finneran, J., Reichmuth, C., Nachtigall, E., Kettem, R., Bowles, E., . . . Tyack, L. (2019). Marine Mammal Noise Exposure Criteria: Updated Scientific Recommendations for Residual Hearing Effects. *Aquatic Mammals, 45*(2), 125-232.

Taylor, C., & Saayman, G. (1972). The social organization and behaviour of dolphins (Tursiops aduncus) and baboons (Papio ursinus): some comparisons and assessments. *Annals of the Cape provincial Museum , 9*(Part 2), 11-49.

Thompson, P., Brookes, K., Graham, I., Barton, T., Needham, K., Bradbury, G., & Merchant, N. (2013). Short-term disturbance by a commercial two-dimensional seismic survey does not lead to long-term displacement of harbour porpoises. *Proceedings of the Royal Society of B*.

Thompson, P., Cheney, B., Ingram, S., Stevick, P., Wilson, B., & Hammond, P. (2011). *Distribution, abundance and population structure of bottlenose dolphins in Scottish waters. Scottish Government and Scottish Natural Heritage funded report. Scottish Natural Heritage Commissioned Report No 354.*

Thompson, P., Mackay, A., Tollit, D., Enderby, S., & Hammond, P. (1998). The influence of body size and sex on the characteristics of harbour seal foraging trips. *Canadian Journal of Zoology, 76*(6), 1044-1053.

Tyack, P. (2008). Implications for marine mammals of large-scale changes in the marine acoustic environment. *Journal of Mammalogy, 89*(3), 549-558.

Waggitt, J., Evans, P., Hiddink, J. G., Andrade, J., Banks, A., Boisseau, O., . . . Wanless, S. (2019). Distribution maps of cetacean and seabird populations in the North-East. *Journal of Applied Ecology, 57*(2), 105 pp.

Williamson, L., Brookes, K., Scott, B., Graham, I., & Thompson, P. (2017). Diurnal variation in harbour porpoise detection - potential implications for management. *Marine Ecology Progress Series, 570*, 223-232.

Wilson, S. (2001). *Population growth, reproductive rate and neo-natal morbidity in a re-establishing harbour seal-colony. .* Valencia, Spain.: Seal Workshop, 13th European Cetacean Society Annual Conference, 5 April 1999.

Winkler, C., Panigada, S., Murphy, S., & Ritter, F. (2020). *Global numbers of ship strikes: an assessment of collisions between vessels and cetaceans using available data in the IWC ship strike database.* Galway, Ireland: Galway-Mayo Institute of Technology .

Wisniewska, D. M., Johnsons, M., Teilmann, J., Siebert, U., Galatius, A., Dietz, R., & Madsen, P. T. (2018). High rates of vessel noise disrupt foraging in wild harbour porpoises (Phocoena phocoena). *The Proceedings of the Royal Society B Biological Sciences, 285*.

Wisniewska, D., Johnson, M., Teilmann, J., Rojano-Doñate, L., Shearer, J., & Sveegaard, S. (2016). Ultra-high foraging rates of harbour porpoises make them vulnarable to anthropogenic disturbance. *Current Biology, 26*, 1441-1446. doi:10.1016/j.cub.2016.03.069

WWT Consulting. (2009). *Distributions of Cetaceans, Seals, Turtles, Sharks and Ocean Sunfish recorded from Aerial Surveys 2001-2008. Report to Department of Energy and Climate Change.*