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# Volume 4 Caledonia South

## Chapter 7 Marine Mammals

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# Volume 4 Chapter 7 Marine Mammals

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# Acronyms and Abbreviations

| | |
|---|---|
| **ADD** | Acoustic Deterrent Device |
| **BOWL** | Beatrice Offshore Wind Limited |
| **CES** | Coastal East Scotland |
| **CGNS** | Celtic and Greater North Sea |
| **CIA** | Cumulative Impact Assessment |
| **CTV** | Crew Transfer Vessel |
| **DAS** | Digital Aerial Survey |
| **DEB** | Dynamic Energy Budget |
| **DEFRA** | Department for Environment, Food and Rural Affairs |
| **DEPONS** | Disturbance Effect on Harbour Porpoise in the North Sea |
| **DPD** | Detection Positive Day |
| **DPH** | Detection Positive Hour |
| **ECOMMAS** | East Coast Scotland Marine Mammal Acoustic Array Surveys |
| **EDR** | Effective Deterrence Range |
| **EEA** | European Economic Area |
| **EEZ** | Exclusive Economic Zone |
| **EIA** | Environment Impact Assessment |
| **EIAR** | Environment Impact Assessment Report |
| **EMF** | Electromagnetic Field |
| **EMP** | Environmental Management Plan |
| **EPS** | European Protected Species |
| **EQT** | Effective Quiet Threshold |

| | |
|---|---|
| **ES** | East Scotland |
| **EU** | European Union |
| **FRP** | Fully Restrained Platform |
| **GNS** | Greater North Sea |
| **HF** | High Frequency |
| **HRA** | Habitats Regulations Appraisal |
| **IAMMWG** | Inter-Agency Marine Mammal Working Group |
| **iPCoD** | Interim Population Consequences of Disturbance Model |
| **JCP** | Joint Cetacean Protocol |
| **JNCC** | Joint Nature Conservation Committee |
| **kJ** | Kilojoules |
| **km** | Kilometres |
| **LF** | Low Frequency |
| **MBES** | Multi-beam Echosounder |
| **MD-LOT** | Marine Directorate Licensing Operations Team |
| **MF** | Moray Firth |
| **MHWS** | Mean High Water Springs |
| **MMMP** | Marine Mammal Mitigation Protocol |
| **MMO** | Marine Mammal Observer |
| **MORL** | Moray Offshore Renewables Limited |
| **MPA** | Marine Protected Area |
| **MPCP** | Marine Pollution Contingency Plan |
| **MU** | Management Unit |
| **MW** | Mega Watt |

| | |
|---|---|
| **NC&O** | North Coast and Orkney |
| **NCMPA** | Nature Conservation Marine Protected Area |
| **NERC** | Natural Environment Research Council |
| **NMFS** | National Marine Fisheries Service |
| **NMPI** | National Marine Plan Interactive |
| **NS** | North Sea |
| **O&M** | Operation and Maintenance |
| **OECC** | Offshore Export Cable Corridor |
| **OSP** | Offshore Substation Platform |
| **OWF** | Offshore Wind Farm |
| **PAM** | Passive Acoustic Monitoring |
| **PCW** | Phocid Carnivore in Water |
| **PEMP** | Project Environmental Monitoring Programme |
| **PS** | Piling Strategy |
| **PTS** | Permanent Threshold Shift |
| **RIAA** | Report to Inform Appropriate Assessment |
| **SAC** | Special Area of Conservation |
| **SBP** | Sub-bottom Profiler |
| **SCANS** | Small Cetaceans in European Atlantic waters and the North Sea |
| **SCOS** | Special Committee on Seals |
| **SEL** | Sound Exposure Level |
| **SG** | Scottish Government |
| **SMRU** | Sea Mammal Research Unit |
| **SMU** | Seal Management Unit |

| | |
|---|---|
| **SNH** | Scottish Natural Heritage |
| **SOV** | Service Operation Vessel |
| **SPA** | Special Protected Area |
| **SPL** | Sound Pressure Level |
| **TTS** | Temporary Threshold Shift |
| **UHRS** | Ultra high resolution seismic |
| **USBL** | Ultra-short baseline |
| **UXO** | Unexploded Ordnance |
| **VHF** | Very High Frequency |
| **VMP** | Vessel Management Plan |
| **WCA** | Wildlife and Countryside Act |
| **WTG** | Wind Turbine Generator |
| **ZoI** | Zone of Influence |

# Executive Summary

This Marine Mammals Chapter of the Caledonia South Environmental Impact Assessment Report presents an overview of the existing marine mammal baseline and identifies the potential effects on these receptors associated with the construction, operation and maintenance and decommissioning phases of Caledonia South seaward of Mean High Water Springs.

The marine mammal study area has been defined at two spatial scales; the local study area and a regional scale study area using species-specific Management Units. For all marine mammal species, the local scale study area covers the Caledonia South Site plus a 4km buffer. The local study area informed by monthly digital aerial surveys conducted by APEM Ltd. from May 2021 to April 2023. The following marine mammal species were screened into the assessment:

- Harbour porpoise (*Phocoena phocoena*);
- Bottlenose dolphin (*Tursiops truncatus*);
- White-beaked dolphin (*Lagenorhynchus albirostris*);
- Short-beaked common dolphin (*Delphinus delphis*);
- Risso’s dolphin (*Grampus griseus*);
- Minke whale (*Balaenoptera acutorostrata*);
- Humpback whales (*Megaptera noveangliae*);
- Harbour seal (*Phoca vitulina*); and
- Grey seal (*Halichoerus grypus*).

Consideration of the Design Envelope has been undertaken to identify Worst-case Scenarios with respect to marine mammal ecology. Adopting a source-pathway-receptor approach, the potential impacts associated with Caledonia South have been assessed, in accordance with the Scoping Opinion and subsequent stakeholder engagement, using a suite of methodologies which include numerical modelling, the evidence-base and expert judgement. Specifically, the following impacts have been considered:

- Auditory injury and disturbance from unexploded ordnance (UXO);
- Auditory injury and disturbance from piling;
- Auditory injury and disturbance from other construction activities;
- Auditory injury and disturbance from geophysical surveys;
- Vessel collisions and disturbance from vessels;
- Disturbance to haul-outs;
- Indirect impacts on marine mammals via changes in prey availability;
- Changes in water quality;
- Operational noise;

- Entanglement; and
- Long term displacement/habitat loss/barrier effects

The results of this impact assessment demonstrate that, given the commitment to embedded mitigation measures, Caledonia South is likely to have impacts to marine mammals of negligible to minor significance, which is considered not significant in Environmental Impact Assessment terms.

# 7 Marine Mammals

## 7.1 Introduction

7.1.1.1 This chapter of the Environmental Impact Assessment Report (EIAR) identifies the potential effects on marine mammals associated with the construction, operation and maintenance (O&M) and decommissioning of Caledonia South. For this chapter, Caledonia South includes all offshore aspects comprising up to 78 wind turbine generators (WTGs) located within the array area (Caledonia South Site), associated foundations (either bottom-fixed only, or a combination of bottom-fixed and floating), inter-array cables, interconnector cables, up to two offshore substation platforms (OSPs), up to two offshore export cables located within the Caledonia South Offshore Cable Corridor (OECC) and Landfall Site, seaward of Mean High Water Springs (MHWS).

7.1.1.2 This chapter is supported by the following Technical Appendices:

- Volume 7, Appendix 6: Underwater Noise Assessment;
- Volume 7, Appendix 14: Caledonia South Draft Marine Mammal Mitigation Protocol; and
- Volume 7, Appendix 19: Caledonia OWF Digital Aerial Surveys.

7.1.1.3 The following supporting studies relate to and should be read in conjunction with this chapter (cross-references are made throughout where relevant):

- Volume 7B, Appendix 7-1: Marine Mammals Baseline Characterisation;
- Volume 7B, Appendix 7-2: Marine Mammals Underwater Noise Assessment Methodology;
- Volume 7B, Appendix 7-3: Marine Mammals Piling Results (Auditory Injury and Disturbance); and
- Volume 7D, Appendix 7-1: Marine Mammals Population Modelling (iPCoD).

7.1.1.4 Additionally, the impacts on marine mammals as features of protected sites will be assessed within:

- Application Document 9: Marine Protected Area Assessment; and
- Application Document 14: Caledonia South Report to Inform Appropriate Assessment.

7.1.1.5 Caledonia Offshore Wind Farm Limited is the developer and the entity applying for the consents to construct and operate Caledonia South and will be hereafter referred to as 'the Applicant'.

## 7.2 Legislation, Policy and Guidance

7.2.1.1 Volume 1, Chapter 2: Legislation and Policy, of this EIAR sets out the policy and legislation associated with Caledonia South.

7.2.1.2 Legislation, policy and guidance that relate to the marine mammal assessment are identified and described in Table 7–1.

Table 7–1: Legislation, policy and guidance.

| Name | Description |
|---|---|
| **Legislation** | |
| Electricity Works (EIA) Scotland Regulations 2017 (Marine Scotland, 2017a[1]) | These regulations specify that the construction of nuclear generating stations of any capacity, thermal generating stations with a heat output in excess of 300 megawatts and overhead electrical power lines with a voltage of 220 kilovolts or more and a length of more than 15km will require an EIA. |
| The Marine Works (EIA) (Scotland) Regulations 2017(Marine Scotland, 2017b[2]) | These regulations revoke, re-enact and update, the Marine Works (Environmental Impact Assessment) Regulations 2007. They implement Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment, as amended by Directive 2014/52/EU, in relation to regulatory approvals required before certain projects may be taken forward in Scotland's marine environment. Relevant to projects from 0-12 nautical miles (nm). |
| Marine and Coastal Access Act 2009 (UK Parliament, 2009[3]) | The 2009 Act established provisions for the management and protection of the marine environment. In relation to Scotland, the Act applies to offshore waters, beyond 12nm. |
| Marine (Scotland) Act 2010 (Scottish Parliament, 2010[4]) | The Marine (Scotland) Act 2010 provides the legislative and management framework for the marine environment within Scottish Territorial Waters (from MHWS out to 12nm). Under Section 21 of the Marine (Scotland) Act 2010, Caledonia South requires a Marine Licence for marine licensable activities below MHWS.<br>The Act replaces the Conservation of Seals Act 1970 in Scottish waters. The Natural Environment Research Council (NERC) has a duty to provide scientific advice to the Scottish Government on matters related to the management of seal populations. NERC has appointed the Special Committee on Seals (SCOS) to formulate this advice. |
| Wildlife and Countryside Act 1981 (WCA) (UK Parliament, 1989[5]) | Under this Act, it is illegal to intentionally or recklessly, disturb or harass dolphins, whales and porpoises (listed under Schedule 5). It is also an offence to deliberately kill, injure or take cetaceans. |

| Name | Description |
|---|---|
| Nature Conservation (Scotland) Act 2004 (Scottish Parliament, 2004[6]) | This Act aims to conserve biodiversity and to protect and enhance the biological and geological natural heritage. This Act also provides amendments to the Wildlife and Countryside Act 1981, meaning it is illegal to intentionally or recklessly, disturb or harass cetaceans. |
| Protection of Seals (Designation of Haul-out Sites) (Scotland) Order 2014 and Amendment Order 2017 (Scottish Parliament, 2014[7]) | This legislation designates seal haul-outs (coastal locations that seals use to breed, pup, moult and rest). At designated haul-out sites, it is an offence to intentionally or recklessly harass seals, and seals are protected from adverse anthropogenic impacts. |
| Wildlife and Natural Environment (Scotland) Act 2011 (Scottish Parliament, 2011[8]) | This Act amends existing legislation in relation the protection of wildlife, biodiversity and nature conservation. |
| Habitats Regulations<br>• The Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019 (UK Parliament, 2019[9])<br>• The Conservation of Habitats and Species Regulations 2017 (UK Parliament, 2017a[10])<br>• The Conservation of Offshore Marine Habitats and Species Regulations 2017 (as amended) (UK Parliament, 2017b[11])<br>• The Conservation (Natural Habitats &c.) Regulations 1994 (UK Parliament, 1994[12]) | European Protected species (EPS) are species listed in Annex IV of the Habitat Directive (and afforded protection under the Habitats Regulations). All cetacean species found in Scottish waters are protected.<br>The inshore legislation makes it an offence to deliberately or recklessly capture, injure or kill a wild animal of an EPS. It is also an offence to deliberately or recklessly disturb any cetacean (dolphin, porpoise or whale). In terms of the disturbance offence, this is assessed at the individual level.<br>The offshore legislation makes it an offence to deliberately kill, injure or disturb a wild animal of an EPS. In relation to the disturbance offence, this is interpreted to prohibit disturbance at a level above 'trivial' disturbance. Non-trivial disturbance is considered to be disturbance that is likely to have a certain negative effect on EPS in terms of affecting their ability to forage, breed (fitness) or by significantly altering local abundance or distribution. Under this legislation it is not expected that that an activity which is predicted to disturb individual animals would amount to disturbance under the legislation.<br>Annex V of the Habitats Directive as transposed into Scottish and UK legislation, defines seals as species of community interest, meaning that any take of these species in the wild is subject to management measures. |
| The Marine (Scotland) Act 2010 and the Marine Strategy Regulations transposed EU Directive 2008/56/EC – Marine Strategy Framework Directive (MSFD) (European Parliament, 2008[13]) | Paragraph 3.7.10 in Chapter 3 sets out the legislative framework for MSFD. MSFD sets out measures for Good Environmental Status (GES) in the marine environment. Descriptors relevant to this technical assessment include:<br>Descriptor 11 outlines primary objectives that underwater anthropogenic noise not adversely affect populations of marine animals. |

| Name | Description |
|---|---|
| The Convention on the Conservation of Migratory Species of Wild Animals (the 'Bonn Convention') (United Nations Environment Programme, 1983[14]) | The Convention aims to conserve migratory species and their habitats by providing strict protection for endangered migratory species (Appendix I of the Convention) and lists migratory species which would benefit from multilateral agreements for conservation and management (Appendix II of the Convention). Marine mammal species included in the list are common dolphin, white-beaked dolphin, Risso's dolphin, bottlenose dolphin, harbour porpoise, harbour seal, grey seal, minke whale and humpback whale. |
| The Convention on the Conservation of European Wildlife and Natural Habitats (the 'Bern Convention') (Council of Europe, 1979[15]) | The Convention aims to ensure conservation and protection of wild plant and animal species and their natural habitats (listed in Appendices I and II of the Convention). Cetaceans and seals are listed under Annex II and Annex III. |
| **Policy** | |
| Scotland's Biodiversity: a route map to 2020 (Scottish Government, 2015b[16]) | This document sets out series of work needed to achieve the international Aichi targets set for biodiversity to improve the state of biodiversity in Scotland. |
| Scottish Biodiversity Strategy 2022-2045 (Scottish Government, 2023b[17]) | This document sets out strategy for Scotland to be Nature Positive by 2030 (halt biodiversity loss), and to have restored and regenerated biodiversity across the country by 2045. |
| Scotland's National Marine Plan (Scottish Government, 2015a[18]) | A Single Framework for Managing our Seas, which includes the following policies which are relevant to marine mammal receptors. The following General Policies (referred to as 'GEN' policies) of Scotland's National Marine Plan which was prepared in accordance with the UK Marine Policy Statement, apply to this assessment:<br>▪ GEN 1: General planning principle: There is a presumption in favour of sustainable development and use of the marine environment when consistent with the policies and objectives of this Plan;<br>▪ GEN 9: Natural heritage: Development and use of the marine environment must: (a) Comply with legal requirements for protected areas and protected species; (b) Not result in significant impact on the national status of PMFs; and (c) Protect and, where appropriate, enhance the health of the marine area;<br>▪ GEN 11 Marine litter: Developers, users, and those accessing the marine environment must take measures to address marine litter where appropriate. Reduction of litter must be taken into account by decision-makers;<br>▪ GEN 13 Noise: Development and use in the marine environment should avoid significant adverse effects of man-made noise and vibration, especially on species sensitive to such effects; |

| Name | Description |
|---|---|
| | ▪ GEN 19 Sound evidence: Decision making in the marine environment will be based on sound scientific and socio-economic evidence;<br>▪ GEN 20 Adaptive management: Adaptive management practices should take account of new data and information in decision-making, informing future decisions and future iterations of policy; and<br>▪ GEN 21 Cumulative impacts: Cumulative impacts affecting the ecosystem of the marine plan area should be addressed in decision making and plan implementation. |
| National Planning Framework 4 (NPF4) (Scottish Government, 2023a[19]) | This presents the national spatial strategy for Scotland including the spatial principles, national priorities a, national development and national planning policy. It replaces the previous NPF3 and Scottish Planning Policy. |
| UK Marine Policy Statement 2011 (UK Government, 2011[20]) | This statement incorporates policy covering economic growth, climate change, agriculture and biodiversity, and historic environment and landscape. |
| Aberdeenshire Council Natural Heritage Strategy (Aberdeenshire Council, 2020[21]) | The strategy provides a structured approach to service delivery from 2019-2022 which covers natural heritage work, which can be applied to the marine environment. Relevant objectives include:<br>▪ Objective 3.2 – Promote, protect and enhance natural heritage through cross-organisation partnership working; and,<br>▪ Objective 3.4 – Promote prevention and management of invasive non-native species spread in Aberdeenshire. |
| The Aichi Biodiversity Targets (United Nations, 2011[22]) | The United Nations' (UN) Convention on Biological Diversity, including the 'Aichi' biodiversity targets, has five strategic goals set to address biodiversity loss and improve status of biodiversity |
| The OSPAR Convention (OSPAR Commission, 1992[23]) | The Convention for the Protection of the Marine Environment of the North-East Atlantic (the OSPAR Convention) will be implemented through OSPAR's North-East Atlantic Environment Strategy 2030. The OSPAR Convention contains a series of Annexes with five of them addressing land-based and offshore pollution, marine environment quality and protection of marine ecosystems and biodiversity. There is one marine mammal species listed under the OSPAR Convention that is relevant to this assessment (harbour porpoise). |
| **Guidance** | |
| Priority Marine Features (PMFs), as described in NatureScot Commissioned Report 388; Strategy | Cetaceans and pinnipeds are amongst the most regularly occurring marine mammal species within Scottish waters designated as PMFs and are considered to be marine |

| Name | Description |
|---|---|
| | nature conservation priorities in Scottish waters (Tyler-Walters *et al.*, 2016[24]; NatureScot, 2020[25]). |
| The UK Post-2010 Biodiversity Framework and the Scottish Biodiversity Strategy: Revised Implementation Plan (2018-2020) (JNCC, 2018[26]) | This guidance was produced by Joint Nature Conservation Committee (JNCC) and Department for Environment, Food and Rural Affairs (Defra) in 2012[27] to set a broad enabling structure for action across the UK on behalf of the Four Countries Biodiversity Group, covering 2011-2020. |
| Marine environment: unexploded ordnance clearance joint interim position statement (DEFRA *et al.*, 2021[28]) | A joint interim position paper regarding the clearance of unexploded ordnances in the marine environment. |
| Marine Mammal Noise Exposure Criteria: Updated Scientific Recommendations for Residual Hearing Effects (Southall *et al.*, 2019[29]) | Provides updated marine mammal exposure criteria based on research by the National Marine Fisheries Service (NMFS, 2018[30]). |
| Environmental Impact Assessment Handbook (NatureScot, 2018[31]) | The handbook offers practical guidance and information on the EIA process with the aim of making the EIA a more effective process to improve decision making and subsequently environmental protection. |
| Scottish Marine Wildlife Watching Code (Scottish Natural Heritage (SNH), 2017[32]) | A code of conduct which aims to minimise disturbance to wildlife, help people enjoy watching marine wildlife, improve chances of seeing wildlife, provide a standard for the wildlife watching industry and help people stay within the law. |
| The protection of Marine European Protected Species from injury and disturbance: Guidance for Inshore Waters (July 2020 Version) (Marine Scotland, 2020[33]) | This guidance provides advice for marine users who are planning to carry out an activity in the marine environment which has the potential to kill, injure or disturb a marine EPS. The guidance can also be used by regulators, nature conservation agencies, enforcement authorities and competent authorities when considering whether an activity will cause or has caused death, injury or disturbance to a marine EPS. |
| JNCC guidelines for minimising the risk of disturbance and injury to marine mammals whilst using explosives (JNCC, 2010a[34]) | These guidelines outline measures to minimise potential injury from the use of explosives from activities such as harbour construction, well-head or platform decommissioning and unexploded ordnance clearance.If followed, risk of injury is likely to be greatly reduced. |
| JNCC guidelines for minimising the risk of injury to marine mammals from piling noise (JNCC, 2010b[35]) | This set of mitigation measures offers guidance on reducing risk of injury to marine mammals during pile driving. If followed, risk of injury is likely to be greatly reduced. The guidelines are split by survey planning, mitigation, and reporting, to increase ease of use. |

| Name | Description |
| --- | --- |
| Statutory nature conservation agency protocol for minimising the risk of injury to marine mammals from piling noise (JNCC, 2010b[36]) | These guidelines outline measures to minimise potential injury from the use of explosives from activities such as harbour construction, well-head or platform decommissioning and unexploded ordnance clearance. |
| Guidance on the Offence of Harassment at Seal Haul-out Sites (Marine Scotland, 2014[37]) | Provides guidance on seal harassment and how to avoid and offence. |
| DRAFT guidelines for minimising the risk of injury to marine mammals from unexploded ordnance clearance in the marine environment (JNCC, 2023[38]) | This draft guidance document updates the JNCC (2010a[34]) guidelines of mitigation measures to reduce the risk of injury to marine mammals during UXO clearance. If followed, risk of injury is likely to be greatly reduced. The guidelines are split by emerging technologies, mitigation, and reporting. |

## 7.3 Stakeholder Engagement

7.3.1.1 The Offshore Scoping Report (Volume 7, Appendix 2) was submitted to Marine Directorate - Licensing Operations Team (MD-LOT)[i] in September 2022, who then circulated the report to relevant consultees. A Scoping Opinion (Volume 7, Appendix 3) was received from MD-LOT on 13 January 2023. Relevant comments from the Scoping Opinion specific to Marine Mammals with associated responses are provided in Table 7–2.

7.3.1.2 Further consultation has been undertaken throughout the pre-application stage. Table 7–3 summarises the consultation activities carried out relevant to marine mammals.

[i] In 2023, Marine Scotland was renamed Marine Directorate, and thus the marine licensing and consents team is now referred to as Marine Directorate - Licensing Operations Team (MD-LOT).

Table 7–2: Scoping Opinion response.

| Consultee | Comment | Response |
| --- | --- | --- |
| NatureScot | NatureScot are content with study areas depending on species ecology, behaviour and life history. | This is noted by the Applicant. The study areas are presented in detail in Volume 7B, Appendix 7-1: Marine Mammals Baseline Characterisation and summarised in Section 7.4.1 |
| NatureScot | NatureScot are content with the list of data sources to inform the baseline characterisation. | This is noted by the Applicant. The data sources to inform the baseline characterisation are presented in detail in Volume 7B, Appendix 7-1: Marine Mammals Baseline Characterisation and summarised in Section 7.4.2. |
| NatureScot | NatureScot consider it unnecessary to include baseline PAM surveys in addition to the DAS. | This is noted by the Applicant. Passive Acoustic Monitoring (PAM) surveys were not carried out as a part of the baseline data collection. |
| NatureScot | The UK proportion of the Management Unit (MU) should be used as the reference population and provide regional context using SCANS survey blocks. | The quantitative assessment of impacts on marine mammals is presented for both the whole MU and the UK portion of the MU. See Section 7.7.1. |
| NatureScot | Potential impacts on the minke whale feature of the Southern Trench Nature Conservation Marine Protected Areas (NCMPA) should be fully assessed within the EIAR. | Potential impacts on the Southern Trench NCMPA are assessed in Application Document 9: Marine Protected Area Assessment. |
| NatureScot | Potential impacts from electromagnetic fields (EMF) should be scoped in. | Following the Scoping Opinion, in communication dated 4th November 2022, NatureScot confirmed that direct impacts of EMF could be scoped out, but that indirect impacts of EMF on marine mammal prey species should be considered (Table 7–3). For marine mammal assessment, the potential impact of EMF on marine mammal prey species is included within the assessment of "indirect impacts on marine mammals due to changes in prey availability" in Section 7.7.1. |

| Consultee | Comment | Response |
|---|---|---|
| NatureScot | Operational noise for both types of turbines (fixed and floating) should be scoped in. | Potential impacts as a result of operation of bottom-fixed and floating foundations (including cables) are addressed within the assessment of "Operational noise" in Section 7.7.2. |
| NatureScot | Indirect entanglement may be also representing a potential impact for the Fully Restrained Platform Design. | Potential impacts as a result of primary, secondary and tertiary entanglement with floating structures as well as Fully Restrained Platform (FRS) are addressed within the assessment of "Entanglement" in Section 7.7.2. |
| NatureScot | NatureScot agreed with the approach to the assessment. | This is noted by the Applicant. Assessment methodology is provided in Section 7.5 and Volume 7B, Appendix 7-2: Marine Mammals Underwater Noise Assessment Methodology. |
| NatureScot | The approach to the cumulative assessment (HRA, EIA, EPS licensing requirements) will need to be agreed in advance of submission. | The Applicant has consulted NatureScot on the approach to the cumulative assessment on 14 June 2024 (see Table 7–3). |
| NatureScot | The full range of mitigation techniques and published guidance should be considered for identified impact pathways. | Embedded mitigation commitments are identified in Section 7.5.7. Relevant guidance documents are identified Section 7.2. |
| NatureScot | The approach to noise mitigation and monitoring should be informed by best available evidence, including FTRAG and MFRAG discussion and NatureScot commissioned reports (Benjamins *et al*., 2014[39]; Todd *et al*., 2015[40]; Verfuss *et al*., 2019[41]) | This is noted by the Applicant. Detailed discussion of noise mitigation and monitoring is included in the Marine Mammal Mitigation Protocol (MMMP) (Volume 7, Appendix 14: Caledonia South Draft Marine Mammal Mitigation Protocol). |
| University of Aberdeen Lighthouse Field Station | University of Aberdeen Lighthouse Field Station identified some key references to be used: Arso Civil *et al*. (2021[42]), Cheney *et al*. (2014[43]), Fernandez-Betelu *et al*. (2021[44]), Booth *et al*. (2017[45]), Thompson *et al*. (2019[46]) | This is noted by the Applicant. All suggested references are used either in the Volume 7B, Appendix 7-1: Marine Mammals Baseline Characterisation or in this EIAR chapter. |

| Consultee | Comment | Response |
|---|---|---|
| University of Aberdeen Lighthouse Field Station | Increased vessel disturbance associated with the windfarm development should be considered in coastal areas. | The impacts of increased vessel disturbance in coastal areas is considered within the assessment of "Vessel disturbance" and "Disturbance to haul-outs" in Section 7.7.1. |
| University of Aberdeen Lighthouse Field Station | Cumulative impact assessment should consider any coastal development activities, such as harbour expansions, that are likely to occur at the same time as the windfarm construction. | Following the screening exercise of the Cumulative Impact Assessment (CIA) Longlist (Volume 7A, Appendix 7-1: Cumulative Impact Assessment Methodology) relevant coastal and offshore projects within each species Management Unit are included in Section 7.8. |
| University of Aberdeen Lighthouse Field Station | It may not be appropriate to assess the two harbour seal MUs separately, as telemetry data shows movement of breeding females between the MUs (i.e., Loch Fleet and Orkney). | Impacts have been assessed against each MU (Moray Firth MU, North Coast and Orkney MU and East Scotland MU) separately as well as combined in Section 7.7.1. |
| University of Aberdeen Lighthouse Field Station | University of Aberdeen Lighthouse Field Station are content with the impacts scoped out of the EIA for marine mammals. | This is noted by the Applicant. |
| University of Aberdeen Lighthouse Field Station | Passive acoustic monitoring methods should be considered to collect data on cetacean species. | NatureScot and MD-LOT consider it unnecessary to include baseline PAM surveys in addition to the Digital Aerial Surveys (DAS) and therefore PAM surveys were not carried out as a part of the baseline data collection. If there is a requirement to carry out passive acoustic monitoring during pre-construction, construction and/or post-construction, it will be agreed post-consent. |
| MD-LOT | The Scottish Ministers are content with the study area and broadly content with the baseline data sources identified in the Scoping Report, noting that the Developer should, however, make amendments to references identified and ensure that the citations | This is noted by the Applicant. Study areas are presented in detail in Volume 7B, Appendix 7-1: Marine Mammals Baseline Characterisation and summarised in Section 7.4.1  All suggested references are used either in the Volume 7B, Appendix 7-1: |

| Consultee | Comment | Response |
|---|---|---|
| | included in the representation from the University of Aberdeen Lighthouse Field Station are included in the EIA Report. | Marine Mammals Baseline Characterisation or in this EIAR chapter. |
| MD-LOT | The Scottish Ministers confirm, in line with the NatureScot representation that passive acoustic monitoring is not required for baseline characterisation. | This is noted by the Applicant. PAM surveys were not carried out as a part of the baseline data collection. |
| MD-LOT | The UK portion of the MU should be used as the reference population, and where appropriate, provide context on regional scale using SCANS survey blocks. | The quantitative assessment of impacts on marine mammals is presented for both the whole MU and the UK portion of the MU. See Section 7.7.1. |
| MD-LOT | Potential direct impacts from EMFs operational noise, vessel disturbance in coastal areas and indirect entanglement (for fully restrained platform design and floating) should be scoped in and considered in the EIA Report. | Following the Scoping Opinion, in communication dated 13 January 2023, NatureScot confirmed that direct impacts of EMF could be scoped out for marine mammals, but that indirect impacts of EMF on marine mammal prey species should be considered (Table 7–3). The potential impact of EMF on marine mammal prey species is included within the assessment of "indirect impacts on marine mammals due to changes in prey availability" in Section 7.7.1. The impacts of increased vessel disturbance in coastal areas are considered within the assessment of "Vessel disturbance" and "Disturbance to haul-outs" in Section 7.7.1. Potential impacts as a result of primary, secondary and tertiary entanglement with floating structures as well as Fully Restrained Platform (FRP) are addressed within the assessment of "Entanglement" in Section 7.7.1. |
| MD-LOT | The EIA Report must include consideration of the options which will be assessed in relation to UXO clearance, including a worst-case scenario of high order detonation in terms of impact and mitigation, unless there is robust supporting evidence that can be | The UXOs found within the Moray West Offshore Wind Farm (OWF) site were cleared using a low order deflagration technique, with 100% success rate (Ocean Winds, 2024[47]). As such, given that low order deflagration is a viable and effective method to be applied during UXO clearance at the Caledonia South Site and |

| Consultee | Comment | Response |
|---|---|---|
| | presented to show consistent performance of the preferred low order or deflagration method. | Caledonia South OECC, the potential effects of high order detonation were not considered further. |
| MD-LOT | Consideration of Caledonia South's effects on the minke whales of Southern Trench NCMPA should cover all impact pathways but pay particular attention to potential effects arising from the export cable corridor route. | Potential impacts on the Southern Trench NCMPA are assessed in Application Document 9: Marine Protected Area Assessment. |
| MD-LOT | Where impact pathways have been identified, a full range of mitigation techniques and published guidance should be considered in the EIA Report, including adherence to the MMMP. | Embedded mitigation commitments are identified in Section 7.5.7. Relevant guidance documents are identified Section 7.2. Detailed discussion of noise mitigation and monitoring is included in the MMMP (Volume 7, Appendix 14: Caledonia South Draft Marine Mammal Mitigation Protocol). |
| MD-LOT | The approach to cumulative impact assessments must be discussed with NatureScot, prior to the submission of the EIA Report. | The Applicant has consulted NatureScot on the approach to the cumulative assessment on 14 June 2024 (see Table 7–3). |

Table 7–3 Stakeholder engagement activities.

| Date | Consultee and Type of Consultation | Summary |
|---|---|---|
| 06 July 2023 | NatureScot, email | The Applicant agreed with NatureScot that direct impacts of EMF to marine mammals could be scoped out, but that indirect impacts of EMF on marine mammal prey species should be considered (see Section 7.7.1). |
| 06 February 2024 | NatureScot, email | NatureScot confirmed that with regards to the mitigation, only instantaneous Permanent Threshold Shift (PTS) metric requires to be mitigated (Sound Pressure Level Peak ($SPL_{peak}$)). This decision was justified by considering the fact that injury ranges based on cumulative Sound Exposure Level ($SEL_{cum}$) metric are over-precautionary due to considerable conservatism in assessments. This could lead to over-estimation of impact zones, and therefore it would be disproportionate to expect these to be fully mitigated. |
| 14 June 2024 | NatureScot, email and meeting | The Applicant consulted with NatureScot on the plans and projects selected as relevant to the CIA for marine mammals, impacts to be considered in the CIA as well as projects to be considered in the cumulative iPCoD modelling. |
| 21 June 2024 | NatureScot, email | Consultation sought with NatureScot regarding structure of the Volume 7, Appendix 6: Underwater Noise Assessment and presentation of results which link through to this chapter. Approval to reduce the number of maps in the deliverables was received on 03 July 2024. |
| 11 July 2024 | NatureScot & MD-LOT, meeting | Consultation meeting to discuss the scope of CIA. NatureScot advised that only Scottish projects should be considered in the CIA for marine mammals (rather than projects within species-specific MUs as specified in the consultation note). |
| 24 July 2024 | NatureScot, email | NatureScot confirmed they are content with using species-specific Mus to screen in projects for the CIA longlist, but to remove projects where information is not available in the public domain and those which are already operational. NatureScot also confirmed they are content with including only Scottish projects in the marine mammal CIA.<br>NatureScot advice also included recommendation to: |

| Date | Consultee and Type of Consultation | Summary |
|---|---|---|
| | | ▪ Include projects up to a year on either side of Caledonia plans<br>▪ Scope out impacts from the CIA;<br>▪ Scope in impacts to the CIA;<br>▪ Use Effective Deterrence Ranges (EDRs) and SCANS IV densities in the CIA where values from quantitative assessments are not available; and<br>▪ Use iPCoD to assess cumulative effects, ideally an updated iPCoD that include Dynamic Energy Budget (DEB) for harbour porpoise.<br>The updated iPCoD including DEB was not available in time for Caledonia South submission and therefore iPCoD version based on parameters in Sinclair *et al*. (2020[48]) was used. |

# 7.4 Baseline Characterisation

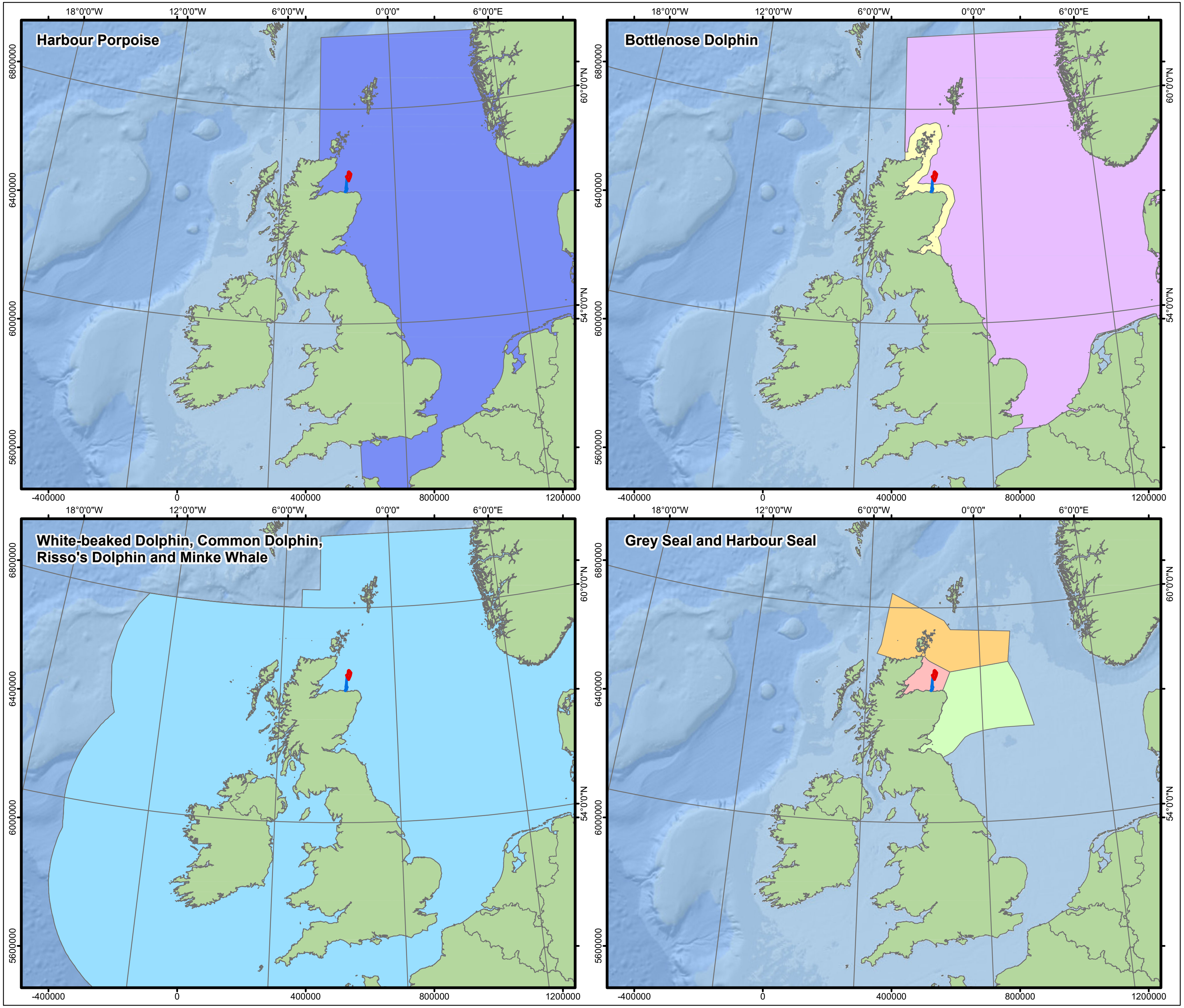
## 7.4.1 Study Area

7.4.1.1 The marine mammal study area has been defined at two spatial scales: the local study area; and a regional scale study area using species-specific MUs (IAMMWG, 2023[49]; SCOS, 2023[50]). For all marine mammal species, the local study area covers the Caledonia South Site plus a 4km buffer (see Volume 7B, Appendix 7-1: Marine Mammals Baseline Characterisation for details). The local study area is informed by monthly digital aerial surveys (DAS) (see Volume 7B, Appendix 7-1: Marine Mammals Baseline Characterisation and Volume 7, Appendix 19: Caledonia OWF Digital Aerial Surveys for more details).

7.4.1.2 The regional scale study area varies depending on the species, considering individual species ecology and behaviour. In view of the high level of mobility and wide distribution range of marine mammals, species-specific Management Units (MUs) have been identified as representative for regional marine mammal study areas (IAMMWG, 2023[49]; SCOS, 2023[50]) (Figure 7–1). The relevant MUs encompass a wider geographic context in terms of species presence and their estimated densities and abundance. This scale defines the appropriate reference populations for the assessment:

- Harbour porpoise (*Phocoena phocoena*): North Sea (NS) MU;
- Bottlenose dolphin (*Tursiops truncatus*): Coastal East Scotland (CES) and Greater North Sea (GNS) MUs;
- White-beaked dolphin (*Lagenorhynchus albirostris*): Celtic and Greater North Seas (CGNS) MU;
- Short-beaked common dolphin (*Delphinus delphis*): CGNS MU;
- Risso's dolphin (*Grampus griseus*): CGNS MU;
- Minke whale (*Balaenoptera acutorostrata*): CGNS MU;
- Harbour seal (*Phoca vitulina*): East Scotland (ES), Moray Firth (MF) and North Coast & Orkney (NC&O) Seal MUs (SMU); and
- Grey seal (*Halichoerus grypus*): ES, MF and NC&O SMUs.

7.4.1.3 In addition, humpback whales (*Megaptera noveangliae*) are assessed qualitatively within this impact assessment but have no associated MU.




Caledonia South Site
Caledonia South Offshore Export Cable Corridor
Celtic and Greater North Sea MU
North Sea MU
Greater North Sea MU
Coastal East Scotland MU
North Coast and Orkney SMU
Moray Firth SMU
East Scotland SMU




0 100 200 300 400 km

| REV | DATE | DOC STATUS | ORIGIN | REVIEW | APP |
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| 01 | 24/09/2024 | Approved | EV | BB | DH |

CALEDONIA Offshore Wind Farm
GoBe APEM Group

CONTRACTOR DRAWING NO: UKCAL1_GO_WNF_MMM_MAP_00468
CONTRACTOR REV: 01
GEODETIC PARAMETERS: WGS 84 / UTM zone 30N (EPSG: 32630)
DRAWING TITLE:

Figure 7-1: Marine Mammal Regional Scale Study Area Including the Marine Mammal MUs

STATUS: Approved
SCALE: 1:16,000,000
DRAWING NUMBER: N/A
SHEET NO: 01 of 01
REV: N/A

## 7.4.2 Data Sources

### Desk Study

7.4.2.1 A detailed description of data sources used to inform this Marine Mammals chapter of the EIAR are presented in Volume 7B, Appendix 7-1: Marine Mammals Baseline Characterisation.

### Digital Aerial Surveys

7.4.2.2 The site-specific baseline characterisation for the Caledonia South Site consisted of 24 monthly DAS conducted by APEM Ltd. from May 2021 to April 2023. The surveys were designed to encompass the Caledonia South Site plus a 4km buffer. The aim of the surveys was to collect data on the abundance and distribution of marine mammals to characterise the baseline environment to inform the EIAR. Full details of DASs are provided in the final survey report (Volume 7, Appendix 19: Caledonia OWF Digital Aerial Survey) and are summarised in Volume 7B, Appendix 7-1: Marine Mammals Baseline Characterisation.

## 7.4.3 Baseline Summary

7.4.3.1 A comprehensive characterisation of the baseline environment to understand the range of species and the abundance and the density of marine mammals that could be potentially impacted by Caledonia South are provided in Volume 7B, Appendix 7-1: Marine Mammals Baseline Characterisation.

7.4.3.2 The key marine mammal species that were determined to be common in the local study area and considered for quantitative assessment in this EIAR chapter are harbour porpoise, bottlenose dolphin, white-beaked dolphin, common dolphin, Risso's dolphin, minke whale, harbour seal and grey seal.

7.4.3.3 Qualitative consideration only is given to humpback whales as opportunistic sightings have suggested a recent increase of the encounters on the east coast of Scotland (mainly in the Firth of Forth) during winter months. However, there is a lack of defined MU, and a lack of reliable density estimates for humpback whales so there is not enough empirical data currently available to support the inclusion of a quantitative assessment of this species.

### Species-specific Densities

7.4.3.4 From all the available data sources, the most robust density estimates for each of the above species, relevant to the quantitative assessment of impacts were selected and are presented in Table 7–4.

7.4.3.5 Density estimates derived from the DAS have been presented in Volume 7B, Appendix 7-1: Marine Mammals Baseline Characterisation. It is important to note that the site-specific density estimates are not representative of animal densities across the full spatial scale of potentially wide-ranging impacts such as disturbance from piling. Additionally, there is a lack of fine-scale distribution, density and abundance data of marine mammals around the OECC available, as DAS only covered the Caledonia South Site and its 4km buffer. As such, published density estimates providing data regional scale have been used to inform the quantitative assessment of impacts as a result of piling (e.g., Carter *et al*., 2020[51]; 2022[52], Lacey *et al*., 2022[53]; Gilles et al., 2023[54]) (Table 7–4). The large-scale line transect surveys such as SCANS are not designed to collect data at a sufficiently small spatial scale necessary to generate estimates of abundance from small, coastal populations. As such, density estimates for the assessment of impacts associated with piling and bottlenose dolphins were derived based on studies with local focus. It was assumed that all bottlenose dolphins present within the Moray Firth are from the CES MU population and the probability of bottlenose dolphin occurrence within the Moray Firth (based on Thompson *et al*., 2015[55]) was scaled to the 50% of the current CES MU population size (Arso Civil *et al*., 2021; Cheney *et al*., 2024[56]). Outside of the Moray Firth, all bottlenose dolphins within 2km of the mainland coastline were assigned to CES MU (Quick *et al*., 2014[57]) and this area assumed a density of 0.142 dolphins/km$^2$ (value derived by assuming the remaining 50% of the CES population is distributed uniformly within this 2km buffer). The areas further offshore assigned bottlenose dolphins to the GNS MU and assumed a density of 0.003 dolphins/km$^2$ (IAMMWG, 2023). See Volume 7B, Appendix 7-1: Marine Mammals Baseline Characterisation for more details on how bottlenose dolphin densities were derived.

7.4.3.6 It should be noted that, for impacts associated with UXO clearance, where locations of the UXOs are unknown at the pre-consent stage, spatially explicit density surfaces are not appropriate for the assessment. As such, for the quantitative assessment of impacts associated with UXO clearance, the SCANS IV block CS-K (Gilles *et al*., 2023[54]) densities as well as average density estimates across the Caledonia South Site and OECC (Carter *et al*., 2020[51]; 2022[52]) have been used. The exception are common dolphins as this species is not included in the Gilles *et al*. (2023[54]) and as such maximum density across Caledonia South Site based on Lacey *et al*. (2022[53]) is used. For bottlenose dolphins within the CES MU, the highest density across the Caledonia South Site and OECC based on Thompson *et al*. (2015[55]) was taken forward to the quantitative assessment (0.0543 dolphins/km$^2$; Table 7–4). The bottlenose dolphin density within the GNS MU remains as for piling with 0.003 dolphins/km$^2$.

7.4.3.7 The tables with quantitative results of the impact assessment presented in Section 7.7 denote which density estimate has been used for each species.

Table 7–4: Marine mammal reference population and density taken forward to the assessment in the EIAR.

| Species | MU | MU size | UK MU size | MU source | Density (#/km²) | Density source |
|---|---|---|---|---|---|---|
| Harbour porpoise | NS | 346,601 | 159,632 | IAMMWG (2023[49]) | 0.2813 | SCANS IV CS-K (Gilles *et al.*, 2023[54]) |
| | | | | | Grid cell specific (Caledonia South Site 0.275-0.345) | SCANS III surface (Lacey *et al.*, 2022[53]) |
| Bottlenose dolphin | CES | 245 | | IAMMWG (2023[49]) | Grid cell specific within the Moray Firth (max 0.0543) | Calculated (Quick *et al.*, 2014[57]) |
| | | | | | 0.142 within 2km buffer, outside Moray Firth | |
| | GNS | 2,022 | 1,885 | IAMMWG (2023[49]) | 0.003 beyond Moray Firth and 2km coastal buffer | Calculated (IAMMWG, 2023[49]) |
| White-beaked dolphin | CGNS | 43,951 | 34,025 | IAMMWG (2023[49]) | 0.1352 | SCANS IV CS-K (Gilles *et al.*, 2023[54]) |
| | | | | | Grid cell specific (Caledonia South Site 0.009-0.019) | SCANS III surface (Lacey *et al.*, 2022[53]) |
| Common dolphin | CGNS | 102,656 | 57,417 | IAMMWG (2023[49]) | Grid cell specific (Caledonia South Site 0.0002–0.0004) | SCANS III surface (Lacey *et al.*, 2022[53]) |
| Risso's dolphin | CGNS | 12,262 | 8,687 | IAMMWG (2023[49]) | 0.0376 | SCANS IV CS-K (Gilles *et al.*, 2023[54]) |
| Minke whale | CGNS | 20,118 | 10,288 | IAMMWG (2023[49]) | 0.0116 | SCANS IV CS-K (Gilles *et al.*, 2023[54]) |
| | | | | | Grid cell specific (Caledonia South Site 0.030 - 0.039) | SCANS III surface (Lacey *et al.*, 2022[53]) |

| Species | MU | MU size | UK MU size | MU source | Density (#/km$^2$) | Density source |
|---|---|---|---|---|---|---|
| Harbour seal | ES<br>MF<br>NC&O | 364<br>958<br>1,951 | | SCOS (2023[50]) | Grid cell specific (Caledonia South Site 0.0003 – 0.0025) | Carter *et al*. (2020[51]; 2022[52]) |
| Grey seal | ES<br>MF<br>NC&O | 10,783<br>7,380<br>34,191 | | SCOS (2023[50]) | Grid cell specific (Caledonia South Site 0.141 - 0.465) | Carter *et al*. (2020[51]; 2022[52]) |
| Humpback whale | | Qualitative assessment only | | | | |

### 7.4.4 Protected Areas

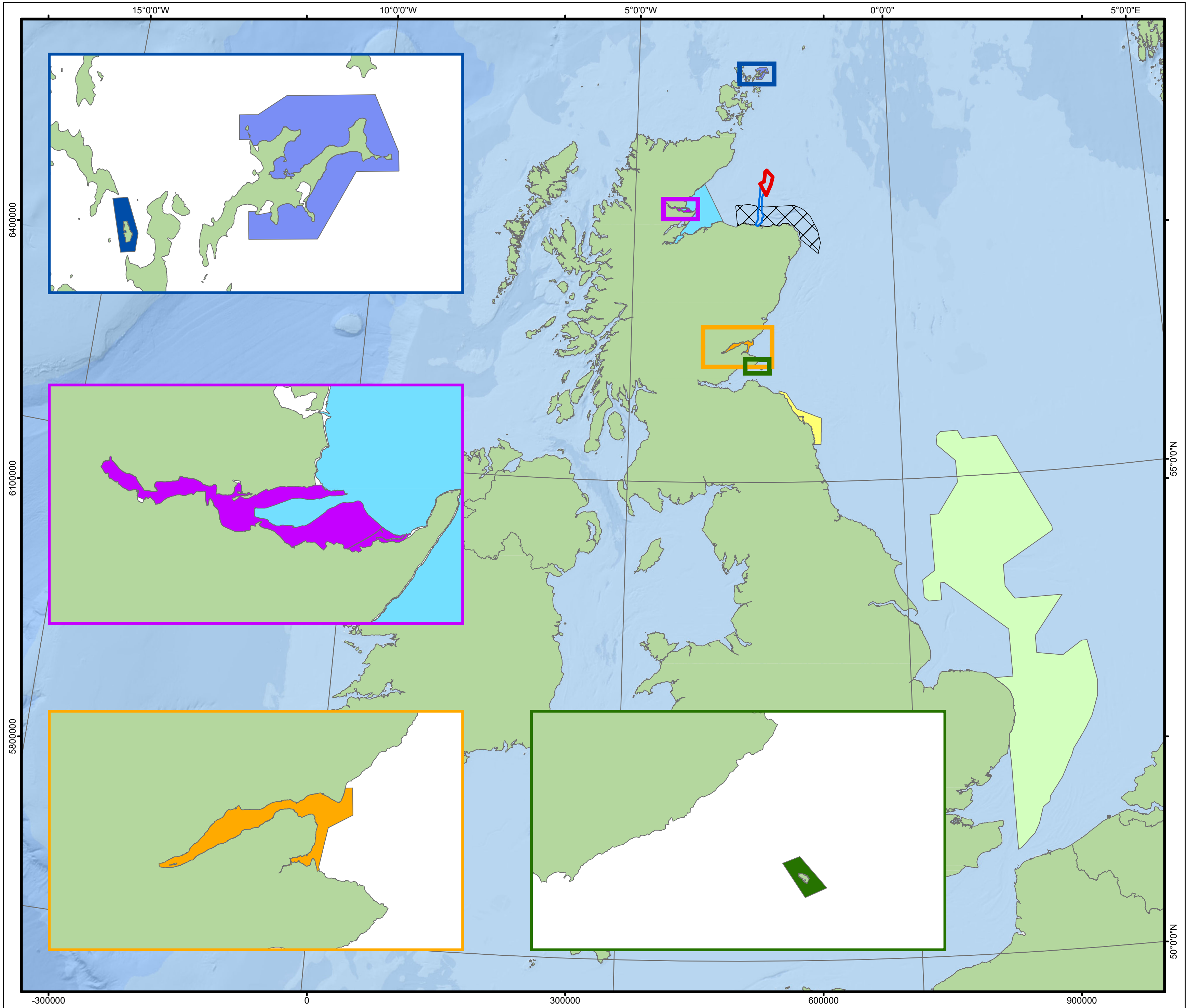
7.4.4.1 Protected areas considered for marine mammals are summarised in Table 7–5 and presented in Figure 7–2. The Caledonia South Site is not located within any protected areas. However, the Caledonia South OECC passes through the Southern Trench NCMPA, designated for the protection of minke whales.

7.4.4.2 Potential impacts to designated sites within the UK site network, comprising Special Areas of Conservation (SACs) designated under various regulations transposing the EC Habitats Directive (92/43/EEC) into domestic law, are assessed as part of the Habitats Regulations Appraisal (HRA). As such, impacts in relation to marine mammal SACs are provided in the Report to Inform Appropriate Assessment (RIAA) accompanying the EIAR (Application Document 14: Caledonia South Report to Inform Appropriate Assessment).

7.4.4.3 NCMPAs are designated under different legislation (The Marine (Scotland) Act 2010, '2010 Act' hereafter, and subsequent Orders), and, therefore, are considered separately to SACs and SPAs. Under the 2010 Act, public authorities have general duties in relation to NCMPAs which must be met when issuing authorisations (e.g., granting Section 36 Consent and Marine Licences). Specifically, the authority must not grant authorisation for an activity unless it can be demonstrated that there is no significant risk of the activity hindering the achievement of the conservation objectives for the NCMPA (see s83(4) of the 2010 Act). Therefore, the assessment of the impacts on the Southern Trench NCMPA will be assessed as an appendix to this EIAR chapter (Application Document 9: Marine Protected Area Assessment). A full assessment of any potential impacts on the minke whale feature to be provided as part of the EIAR chapter was also requested by NatureScot in their representation to the Offshore Scoping Report (see Table 7–2) and is provided in Sections 7.7 and 7.8.

Table 7–5: Protected areas and qualifying interest features considered for Marine Mammals.

| Designated Site | Qualifying Interest Feature | MU/SMU | Distance to Caledonia South Site (km) | Distance to Caledonia South OECC (km) |
|---|---|---|---|---|
| Southern Trench NCMPA | Minke whale | CGNS | 13.5 | Within |
| Moray Firth SAC | Bottlenose dolphin | CES | 57.5 | 37.6 |
| Dornoch Firth and Morrich More SAC | Harbour seal | MF | 86.7 | 81.5 |
| Sanday SAC | Harbour seal | NC&O | 106.3 | 123.3 |
| Faray and Holm of Faray | Grey seal | NC&O | 103.9 | 126.9 |
| Firth of Tay and Eden Estuary SAC | Harbour seal | MF | 200.6 | 198.6 |
| Isle of May SAC | Grey seal | ES | 225.0 | 219.8 |
| Berwickshire and North Northumberland Coast SAC | Grey seal | ES | 247.3 | 237.1 |
| Southern North Sea SAC | Harbour porpoise | NS | 341.5 | 333.6 |




Caledonia South Site
Caledonia South Offshore Export Cable Corridor
Sanday SAC
Faray and Holm of Faray SAC
Moray Firth SAC
Dornoch Firth and Morrich More SAC
Firth of Tay SAC
Isle of May SAC
Berwickshire and North Northumberland Coast SAC
Southern North Sea SAC
Southern Trench MPA




0 50 100 150 200 km

| REV | DATE | DOC STATUS | ORIGIN | REVIEW | APP |
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| 01 | 24/09/2024 | Approved | EV | BB | DH |

CALEDONIA Offshore Wind Farm

GoBe APEM Group

| | |
|---|---|
| CONTRACTOR DRAWING NO UKCAL1_GO_WNF_MMM_MAP_00469 | CONTRACTOR REV 01 |
| GEODETIC PARAMETERS WGS 84 / UTM zone 30N (EPSG: 32630) | |
| DRAWING TITLE Figure 7-2: Marine Mammal Protected Areas within the MUs of the Marine Mammal Species Assessed | |
| STATUS Approved | SCALE 1:6,000,000 |
| DRAWING NUMBER N/A | SHEET NO 01 of 01 / REV N/A |

### 7.4.5 Do Nothing Baseline

7.4.5.1 If Caledonia South does not go forward, an assessment of the future baseline conditions has also been carried out and is described within this section.

7.4.5.2 The Marine Works (Environmental Impact Assessment) (Scotland) Regulations 2017 (Scottish Parliament, 2017b[2]) require that:

*"A description of the relevant aspects of the current state of the environment (the "baseline scenario") and an outline of the likely evolution thereof without implementation of the project as far as natural changes from the baseline scenario can be assessed with reasonable effort on the basis of the availability of environmental information and scientific knowledge"*.

7.4.5.3 From the point of assessment, long-term trends mean that the condition of the baseline environment is expected to evolve. This section provides a qualitative description of the evolution of the baseline environment, on the assumption that Caledonia South is not constructed, using available information and scientific knowledge of marine mammal ecology.

7.4.5.4 It is challenging to predict the future trajectories of marine mammal populations. Some UK marine mammal populations have undergone periods of significant change in parts of their range, with a limited understanding of the driving factors responsible. For example, there is uncertainty about whether a reduction in pup mortality or an increase in fecundity is the cause of the recent exponential growth of grey seals in the North Sea (Russell *et al*., 2017[58]). Additionally, there is lack of monitoring of marine mammal populations at the biologically relevant temporal or spatial scales to understand the baseline dynamics. The results of the most recent UK assessment of favourable conservation status for each marine mammal species included in the assessment are outlined in Table 7–6.

Table 7–6: Summary of the conservation status of each marine mammal species (FV = Favourable, XX = Unknown, + = Improving, U1 = Unfavourable - Inadequate).

| Species | Range | Population | Habitat | Future Prospects | Conservation Status | Overall Trend | Reference |
|---|---|---|---|---|---|---|---|
| Harbour porpoise | FV | XX | XX | FV | XX | XX | JNCC (2019d[59]) |
| Bottlenose dolphin | FV | XX | XX | XX | XX | XX | JNCC (2019b[60]) |
| White-beaked dolphin | FV | XX | XX | XX | XX | XX | JNCC (2019h[61]) |
| Common dolphin | FV | XX | XX | XX | XX | XX | JNCC (2019c[62]) |
| Risso's dolphin | FV | XX | XX | XX | XX | XX | JNCC (2019g[63]) |
| Minke whale | FV | XX | XX | XX | XX | XX | JNCC (2019i[64]) |
| Harbour seal | FV | U1 | XX | U1 | U1 | XX | JNCC (2019f[65]) |
| Grey seal | FV | FV | FV | FV | FV | + | JNCC (2019e[66]) |
| Humpback whale | NA | NA | NA | NA | NA | NA | JNCC (2019a[67]) |

# 7.5 EIA Approach and Methodology

## 7.5.1 Overview

7.5.1.1 This section provides an overview of the methodology for assessing the likely significant effects on marine mammals from the construction, O&M and decommissioning of Caledonia South. More detailed discussion on EIA methodology can be found in the Volume 1, Chapter 7: EIA methodology. The assessment methodology for marine mammals for the EIAR is consistent with that provided in the Offshore Scoping Report (Volume 7, Appendix 2).

## 7.5.2 Impacts Scoped into the Assessment

7.5.2.1 The Offshore Scoping Report was submitted to MD-LOT in September 2022. The Scoping Report set out the overall approach to assessment and allowed for the refinement of Caledonia South over the course of the assessment. The proposed scope of the assessment is set out in Table 7–7.

Table 7–7: Marine mammals scope of assessment.

| Potential Impact | Phase | Nature of Impact |
|---|---|---|
| Auditory injury from unexploded ordnance (UXO) | Construction | Direct |
| Disturbance from UXO | Construction | Direct |
| Auditory injury from piling | Construction | Direct |
| Disturbance from piling | Construction | Direct |
| Auditory injury from other construction activities | Construction | Direct |
| Disturbance from other construction activities | Construction | Direct |
| Vessel collisions | Construction, O&M, Decommissioning | Direct |
| Disturbance from vessels | Construction, O&M, Decommissioning | Direct |
| Indirect impacts on marine mammals due to changes in prey availability | Construction, O&M, Decommissioning | Indirect |
| Changes in water quality | Construction, Decommissioning | Direct |
| Disturbance to haul-outs | Construction, O&M, Decommissioning | Direct |
| Operational noise | O&M | Direct |
| Entanglement | O&M (floating and FRP only) | Direct and Indirect |
| Long term displacement/habitat loss/barrier effects | O&M | Direct |
| Auditory injury from decommissioning activities | Decommissioning | Direct |
| Disturbance from decommissioning activities | Decommissioning | Direct |

## 7.5.4 Impacts Scoped out of the Assessment

7.5.4.1 The impacts scoped out of the assessment during EIA scoping, and the justification for this, are listed in Table 7–8.

Table 7–8: Impacts scoped out for marine mammals.

| Potential Impact | Justification |
|---|---|
| Accidental pollution (Construction, O&M, Decommissioning) | Accidental releases of pollutants may arise as a result of accidental spills from vessels or other equipment. Any release is likely to facilitate high dispersal and there will be limited interaction with marine mammals. With the implementation of an Environmental Management Plan (EMP) and Marine Pollution Contingency Plan (MPCP), accidental spillages from machinery (which may have potential to cause mortality in marine mammals) are unlikely to occur. Any impact is predicted to be of local spatial extent, short-term duration, intermittent frequency and reversible, within the context of regional marine mammal populations and therefore not significant in terms of the EIAR. |
| Electromagnetic field (EMF) (Construction, O&M, Decommissioning) | There is currently no evidence to suggest that EMFs from OWF components have any direct effect on marine mammals (Copping, 2018[68]). Although cetacean species have been found to detect and respond to EMFs, this has only been shown in non-UK species and there is currently no evidence to suggest that seals can detect or respond to EMFs. The potential impact of EMF on marine mammal prey species is included within the assessment of "Indirect impacts on marine mammals due to changes in prey availability". |

## 7.5.5 Underwater Noise

7.5.5.1 Detailed discussion about methodology for the assessment of PTS and disturbance from piling, UXO clearance, other construction activities and geophysical surveys is provided in Volume 7B, Appendix 7-2: Marine Mammals Underwater Noise Assessment Methodology. To summarise, the following assessment approaches have used in the marine mammal impact assessment for underwater noise:

- PTS: quantitative assessment using Southall *et al*. (2019[29]) dual thresholds (noting consultation with NatureScot and requirement to mitigate injury ranges based on $SPL_{peak}$ metric, see Table 7–3).
- Disturbance from UXOs: two quantitative assessment methods presented:
  - 5km EDR assumed for low-order clearance (as recommended in JNCC, 2023[69]); and
  - Temporary Threshold Shift (TTS) as a proxy for disturbance (as recommended in (Southall *et al*., 2007[70]).

- Disturbance from piling: quantitative assessment using dose-response functions:
  - Harbour porpoise dose-response function (also applied to other cetacean species) based on precautionary approach presented in Graham *et al*. (2017a[71]), taking into consideration the evidence from Graham *et al*. (2019b[72]); and
  - Harbour seal dose-response function (also applied to grey seals; Whyte *et al*., 2020[73]).
- Disturbance from operational noise, vessels, other construction activities and geophysical surveys: qualitative assessment based on evidence published in the literature.

7.5.5.2 There are some uncertainties relating to the underwater noise modelling and impact assessment for Caledonia South. Broadly, these relate to predicting exposure and the response of animals to underwater noise. Detailed discussion of limitations is set out in Volume 7B, Appendix 7-2: Marine Mammals Underwater Noise Assessment Methodology. Discussion of uncertainties with respect to potential population consequences of disturbance from underwater noise is presented in Volume 7D, Appendix 7-1: Marine Mammals Population Modelling (iPCoD).

**Auditory Sensitivity**

7.5.5.3 An essential step in assessing the potential for effects on relevant species is a consideration of their auditory sensitivities. Marine mammal hearing groups and auditory injury criteria from Southall *et al*. (2019[29]), and corresponding species of relevance to this assessment, are summarised in Table 7–9. There are no audiogram data currently available for low-frequency cetaceans; therefore, predictions are based on the hearing anatomy for each species and considerations of the frequency range of vocalisations.

Table 7–9: Marine mammal hearing groups, estimated hearing range and sensitivity and injury criteria and corresponding species relevant to this assessment (Southall *et al.*, 2019[29]).

| Hearing Group | Species | Estimated Hearing Range | Estimated Region of Greatest Sensitivity* | Estimated Peak Sensitivity* |
|---|---|---|---|---|
| Low-frequency (LF) cetaceans | Minke whale, humpback whale | 7Hz – 35kHz | 200Hz – 19kHz | - |
| High-frequency (HF) cetaceans | Bottlenose dolphin<br>White-beaked dolphin<br>Common dolphin<br>Risso's dolphin | 150Hz – 160kHz | 8.8 – 110kHz | 58kHz |
| Very high-frequency (VHF) cetacean | Harbour porpoise | 275Hz – 160kHz | 12 – 140kHz | 105kHz |
| Phocid carnivores in water (PCW) | Harbour seal<br>Grey seal | 50Hz – 86kHz | 1.9 – 30kHz | 13kHz |
| * Region of greatest sensitivity represents low-frequency (F1) and high-frequency (F2) inflection points, while peak sensitivity is the frequency at which the lowest threshold was measured (T0) (Southall *et al.*, 2019[29]). | | | | |

## Criteria for Assessment

### Impact Magnitude

7.5.5.4 The magnitude of an impact is the consideration of the spatial extent, duration, frequency and consequence of an impact from the construction, O&M or decommissioning of Caledonia South. The criteria for defining magnitude in this chapter are outlined in Table 7–10.

7.5.5.5 Where population modelling is available to inform the magnitude score, the results of the iPCoD modelling will be the main criteria for the consequence and subsequent magnitude score determination.

Table 7–10: Impact magnitude criteria for marine mammals.

| Impact Magnitude | Description |
|---|---|
| High | Extent/Duration: The impact occurs over a large spatial extent and over long-term duration, with the potential to affect a large proportion of a receptor population.<br>Probability/frequency: The effect is very likely to occur and/or will occur at a high frequency.<br>Consequence: The effect could affect a large enough proportion of the population to alter the favourable conservation status and/or the long-term trajectory of the population in the long term. |
| Medium | Extent/Duration: The impact occurs over a medium spatial extent and over medium-term duration, with potential affect a moderate proportion of a receptor population.<br>Probability/frequency: The effect is likely to occur and/or will occur at a moderate frequency.<br>Consequence: The effect could affect a moderate proportion of the population although not large enough to alter the population trajectory in the long term. |
| Low | Extent/Duration: The impact is localised and temporary or short-term, with potential to result in a noticeable effect on a small proportion of a receptor population.<br>Probability/frequency: The effect may occur but at low frequency.<br>Consequence: The effect could affect a small proportion of the population and the population trajectory would not be altered. |
| Negligible | Extent/Duration: The impact is highly localised and short-term, with potential to result in very slight or imperceptible changes to a receptor population.<br>Probability/frequency: The effect is very unlikely to occur; if it does, it will occur at a very low frequency.<br>Consequence: The effect will not alter the population trajectory. |

**Receptor Sensitivity**

7.5.5.6 The sensitivity of marine mammal receptors is defined by their potential adaptability to an impact from Caledonia South, their tolerance and recoverability of the receptor. The criteria for defining sensitivity in this chapter are outlined in Table 7–11.

7.5.5.7 Note, the value of the receptor is not included in the definition of sensitivity as all marine mammals are considered to have a high value. All marine mammals are either listed under Annex IV of the Habitats Directive as EPS of Community Interest and in need of strict protection and/or are listed in the under Annex II of the Habitats Directive as species of Community Interest. However, in the assessment provided in Sections 7.7 and 7.8, the conservation status of the population is considered when assigning the sensitivity score (e.g., proximity to the protected sites and current trajectory of a population).

Table 7–11: Receptor sensitivity criteria for marine mammals.

| Receptor Sensitivity | Description |
|---|---|
| High | Adaptability: No ability to avoid or adapt to an impact so that individual survival and reproduction rates are affected.<br>Tolerance: No tolerance – Effect will cause a change in both individual reproduction and survival rates.<br>Recoverability: No ability for the animal to recover from any impact on vital rates (reproduction and survival rates). |
| Medium | Adaptability: Limited ability to avoid or adapt to an impact so that individual survival and reproduction rates may be affected.<br>Tolerance: Limited tolerance – Effect may cause a change in both individual reproduction and survival of individuals.<br>Recoverability: Limited ability for the animal to recover from any impact on vital rates (reproduction and survival rates). |
| Low | Adaptability: Reasonable ability to avoid or adapt to an impact so that individual reproduction rates may be affected but survival rates not likely to be affected.<br>Tolerance: Some tolerance – Effect unlikely to cause a change in both individual reproduction and survival rates.<br>Recoverability: Ability for the animal to recover from any impact on vital rates (reproduction and survival rates). |
| Negligible | Adaptability: Receptor is able to avoid or adapt to an impact so that individual survival and reproduction rates are not affected.<br>Tolerance: Receptor is able to tolerate the effect without any impact on individual reproduction and survival rates.<br>Recoverability: Receptor is able to return to previous behavioural states/activities once the impact has ceased. |

## Determining Significance of Effect

7.5.5.8 The consideration of the magnitude of a potential impact and sensitivity of the receptor determines an expression for the overall significance of the adverse or positive effect. Table 7–12 below sets out how impact magnitude and receptor sensitivity interact to facilitate a judgement of significance of effect. Negligible or Minor impacts are categorised as 'not significant' in EIA terms. Major or moderate effects are categorised as 'significant' in EIA terms, as highlighted in grey in Table 7–12.

Table 7–12: Relationship between impact magnitude and receptor sensitivity to assign significance of effect.

| Significance of Effect | | Sensitivity of Receptor | | | |
|---|---|---|---|---|---|
| | | Negligible | Low | Medium | High |
| Impact Magnitude | Negligible | Negligible | Negligible | Negligible | Negligible |
| | Low | Negligible | Negligible | Minor | Minor |
| | Medium | Negligible | Minor | Moderate | Moderate |
| | High | Negligible | Minor | Moderate | Major |

7.5.5.9 In all cases, the evaluation of receptor sensitivity, impact magnitude and significance of effect has been informed by professional judgement and is underpinned by narrative to explain the conclusions reached.

### 7.5.6 Approach to Cumulative Effects

7.5.6.1 The cumulative impact assessment assesses the impact associated with Caledonia South together with other relevant plans, projects and activities. Cumulative effects are therefore the combined effect of Caledonia South with the effects from a number of different projects, on the same receptor or resource. The approach to the cumulative impact assessment for Marine Mammals follows the process outlined in Volume 1, Chapter 7: EIA Methodology. The list of relevant developments for inclusion within the CIA is outlined in Volume 7A, Appendix 7-1: Cumulative Impact Assessment Methodology.

7.5.6.2 Developments which are located within the marine mammal regional scale study area have the potential to result in a cumulative effect. The marine mammal regional scale study area for each species is defined by the extent of their MU. Therefore, the spatial extent of the species-specific MUs informed screening process of projects for the CEA longlist. However, based on advice received from NatureScot on 11 July and 24 July (Table 7–3), only projects located within Scottish waters were screened in for consideration in the marine mammal CEA presented in Section 7.8. Developments which are either operational or in the decommissioning stage are considered to be part of the baseline and are not considered within the assessment. Additionally, projects without construction timeframes available in the public domain were not considered.

### 7.5.8 Embedded Mitigation

7.5.8.1 Where possible, mitigation measures will be embedded into the design of Caledonia South. Where embedded mitigation measures have been developed into the design of Caledonia South with specific regard to marine mammals, these are described in Table 7–13. The impact assessment presented in Sections 7.7 to 7.10 take into account this embedded mitigation.

7.5.8.2 Any mitigation that may be required, beyond the examples presented in Table 7–13, will be considered as secondary mitigation.

Table 7–13: Embedded mitigation for marine mammals.

| Code | Mitigation Measure | Securing Mechanism |
|---|---|---|
| M-1 | Development of and adherence to a Cable Plan (CaP). The CaP will confirm planned cable routing, burial and any additional protection and will set out methods for post-installation cable monitoring. | To be secured as a condition of the Generation Asset and Transmission Asset Marine Licences. |
| M-8 | Development of and adherence to an Environmental Management Plan (EMP). The EMP sets out mitigation measures and procedures relevant to environmental management, including but not limited to the following topics: chemical usage, invasive non native marine species, dropped objects, pollution prevention and contingency planning, and waste management. | To be secured as a condition of the Generation Asset and Transmission Asset Marine Licences. |
| M-9 | Development of and adherence to a Marine Pollution Contingency Plan (MPCP). The MPCP identifies potential sources of pollution and associated spill response and reporting procedures. | To be secured as a condition of the Generation Asset and Transmission Asset Marine Licences. |
| M-10 | Development of and adherence to a Decommissioning Programme (DP). The DP will outline measures for the decommissioning of Caledonia South. | To be secured as a condition of the Generation Asset and Transmission Asset Marine Licences |
| M-11 | Development of and adherence to a Piling Strategy (PS) (applicable where piling is undertaken, provided post-consent). The PS will detail the method of pile installation and associated noise levels. It will describe any mitigation measures to be put in place (e.g., soft starts and ramp ups, use of Acoustic Deterrent Devices (ADDs)) pre- and during piling to manage the effects of underwater noise on sensitive receptors. | To be secured as a condition of the Generation Asset and Transmission Asset Marine Licences |
| M-12 | Development of and adherence to a Project Environmental Monitoring Programme (PEMP), which will set out commitments to environmental monitoring in pre-, during and post-construction Caledonia South phases. | To be secured as a condition of the Generation Asset and Transmission Asset Marine Licences. |

| Code | Mitigation Measure | Securing Mechanism |
|---|---|---|
| M-13 | Development of and adherence to a Vessel Management Plan (VMP). The VMP will confirm the types and numbers of vessels that will be engaged on Caledonia South, and consider vessel coordination including indicative transit route planning. | To be secured as a condition of the Generation Asset and Transmission Asset Marine Licences. |
| M-16 | Development of and adherence to Marine Mammal Mitigation Plan (MMMP). This will identify appropriate mitigation measures during offshore activities that are likely to produce underwater noise and vibration levels capable of potentially causing injury or disturbance to marine mammals. This will be developed alongside the PS and referred to in European Protected Species (EPS) licence applications. | To be secured as a condition of the Generation Asset and Transmission Asset Marine Licences. |
| M-107 | Unexploded ordnance (UXO) hazards will be avoided where practicable and appropriate. If avoidance is not possible, decision making will relate to removal, with disposal in-situ considered if avoidance or removal is not possible. If disposal is required, and where practicable and appropriate, low-order deflagration will be the preferred method. The indicative mitigation measures for UXO clearance are provided in the draft MMMP (M-16), however, licensing of UXO clearance works will be subject to a standalone Marine Licence and EPS licence application. At the post-consent stage, these applications will provide details of measures to minimising impacts on marine mammals where appropriate. | To be secured as a condition of the Marine Licence for UXO clearance and EPS Licence (not included as part of this application). |
| M-108 | Development of and adherence to an Entanglement Management Plan to reduce the potential entanglement risk to marine life. It will include suitable monitoring of mooring lines and dynamic cables during operational phase according to Caledonia South maintenance plan. Entanglement risk would be evaluated and managed as part of this process. The Entanglement Plan would be detailed within the EMP (M-8). | To be secured as a condition of the Generation Asset Marine Licence. |

## 7.6 Key Parameters for Assessment

7.6.1.1 Volume 1, Chapter 3: Proposed Development Description (Offshore) details the parameters of Caledonia South using the Rochdale Envelope approach. This section identifies those parameters during construction, O&M and decommissioning relevant to potential impacts on marine mammals.

7.6.1.2 The worst-case assumptions with regard to marine mammals are summarised in Table 7–14.

Table 7–14: Worst case assessment scenario considered for each impact as part of the assessment of likely significant effects.

| Potential Impact | Assessment Parameter | Explanation |
|---|---|---|
| **Construction** | | |
| Impact 1: Auditory injury from UXO Clearance | **Low order deflagration:**<br>▪ 0.25kg donor<br>**UXO Timeline**<br>▪ Four months; and<br>▪ Up to two clearance events within 24 hours. | The type, size and number of possible UXO items as well as exact duration of UXO clearance operations is not known at this stage. A detailed UXO survey will be completed prior to construction. It will be provided as a part of a separate licencing process post-consent when detailed survey data is available.<br>The WCS is based on Applicant experience from Moray East and Moray West. The maximum number of UXOs (to be provided post-consent) to be encountered within Caledonia South and the charge donor for low order deflagration will result in the greatest potential impact. |
| Impact 2: Disturbance from UXO Clearance | Refer to Impact 1. | Refer to Impact 1. |
| Impact 3: Auditory injury (PTS) from piling | **Piling timeline:**<br>Depending on the construction scenario, piling is anticipated to take place between 2028 and 2037.<br>**Spatial WCS:**<br>▪ 80 monopiles (78 WTGs, two OSPs)<br>▪ Max 6,600 kJ hammer energy<br>▪ 14m diameter pile<br>▪ Two monopiles installed per day | Installation of monopile foundations will require the highest hammer energy and therefore represent the worst-case spatial scenario.<br>The worst-case temporal scenario is the sequential piling of a mixture of bottom-fixed jacket and floating foundations (no concurrent piling). Within this scenario there would be up to 410 piling days for anchors associated with taut mooring lines. As such, |

| Potential Impact | Assessment Parameter | Explanation |
|---|---|---|
| | ▪ Concurrent piling at two locations (at the same time)<br>▪ **Total of 40 piling days**<br><br>**Temporal WCS (combination of bottom-fixed and floating):**<br>41 bottom-fixed foundations with pin piles for jackets (39 WTG, 2 OSPs)<br>▪ Max 4,400 kJ hammer energy<br>▪ 4 legs per jacket<br>▪ 4m diameter piles<br>▪ 4 piles per day<br>▪ 41 piling days (assuming 4 pin piles/day)<br>39 floating foundations with pin piles for anchors (WTGs only)<br>▪ Max 2,000kJ hammer energy<br>▪ Three legs with six tendons per leg<br>▪ 18 anchors per WTG<br>▪ A total of 702 anchors<br>▪ Max 4.8m diameter piled anchor<br>▪ Up to two piles per day<br>▪ 410 piling days (assuming average of 1.71 anchor/day)<br>▪ **Total of up to 451 piling days**. | it could take up to 451 days in total to install, across three years.<br><br>Note, the underwater noise modelling assumed two anchor piles to be installed per day as the worst-case spatial scenario. However, to inform the worst-case temporal scenario used in the iPCoD modelling, average number of 1.71 piles per day was used in the assessment. |
| Impact 4: Disturbance from piling | Refer to Impact 3. | Refer to Impact 3. |
| Impact 5: Auditory injury from other construction activities | **Site preparation:**<br>▪ Dredging and rock placement<br>**WTGS:**<br>▪ Pre-installation dredging, drilling, vibropiling<br>**Offshore cables:** | The WCS is informed by the type of activity and associated spatial scale of impact as well as the duration of construction. |

| Potential Impact | Assessment Parameter | Explanation |
|---|---|---|
| | ▪ Cable laying, trenching, dredging, rock placement<br>**Offshore Construction Timeline:**<br>▪ Up to three years | |
| Impact 6: Disturbance from other construction activities | Refer to Impact 5. | Refer to Impact 5. |
| Impact 7: Auditory injury from geophysical surveys | **Geophysical surveys will include (source levels provided for SPLpk):**<br>▪ Multi-beam echosounder (MBES; 210-240dB re 1μPa for multiple beams and 197dB re 1μPa for a single beam; 200 to 400kHz)<br>▪ Side-scan sonar (SSS; 210dB re 1μPa; 300 to 900kHz)<br>▪ Sub-bottom profiler (SBP; 210-220dB re 1μPa, 2 to 15kHz)<br>▪ Ultra-short baseline (USBL; 187 – 206dB re 1μPa, 19 to 34kHz)<br>▪ Ultra-high resolution seismic (UHRS; 200-226 dB re 1μPa, 100Hz to 5kHz)<br>Duration and frequency of geophysical surveys will be provided as a part of a separate licencing process post-consent. | The WCS is informed by the source level and expected sound frequency and overlap with marine mammal hearing ranges. |
| Impact 8: Disturbance from geophysical surveys | Refer to Impact 7. | Refer to Impact 7. |
| Impact 9: Vessel collisions | ▪ Max 25 vessels on site at once, including installation, cable lay and support, export cable, guard, CTV, scour installation vessels.<br>▪ Max 2,225 vessel transits. | The WCS is informed by the maximum number of vessels on site at any one time as well as the duration of construction. |

| Potential Impact | Assessment Parameter | Explanation |
|---|---|---|
| | - List of potential ports: Aberdeen City, Aberdeenshire (Peterhead, Fraserburgh), Moray (Buckie), Highland (Cromarty, Nigg, Wick, Ardersier).<br>**Offshore Construction Timeline:**<br>- Up to three years | |
| Impact 10: Vessel disturbance | Refer to Impact 9. | Refer to Impact 9. |
| Impact 11: Disturbance to haul-outs | - Max 25 vessels on site at once, including installation, cable lay and support, export cable, guard, CTV, scour installation vessels.<br>- List of potential ports: Aberdeen City, Aberdeenshire (Peterhead, Fraserburgh), Moray (Buckie), Highland (Cromarty, Nigg, Wick, Ardersier).<br>- Two vessels are anticipated to be working in the coastal areas at any one time performing activities associated with connection to landfall such as cable laying, trenching.<br>**Offshore Construction Timeline:**<br>Up to three years | The WCS is informed by the maximum number of vessels on site at any one time, location of the ports as well as the duration of construction. |
| Impact 12: Indirect impacts on marine mammals via change in prey availability | Refer to Volume 4, Chapter 5: Fish and Shellfish Ecology (Impacts 1-5) | The WCS for impacts which are specific to fish and shellfish, and which may therefore have an indirect effect on marine mammals, are presented within Volume 4, Chapter 5: Fish and Shellfish Ecology, impacts 1-5. |
| Impact 13: Changes in water quality | Refer to Volume 4, Chapter 3: Marine Water and Sediment Quality. | The WCS for impacts which are specific to water quality, and which may therefore have an indirect effect on marine mammals, are presented within Volume 4, Chapter 3: Marine Water and Sediment Quality. |

| Potential Impact | Assessment Parameter | Explanation |
|---|---|---|
| **Operation and Maintenance** | | |
| Impact 14: Operational noise | **Operational timeline:**<br>▪ 35 years<br>**Bottom-fixed WTGs:**<br>▪ 24 x 25 MW WTGs<br>▪ Geared turbine<br>**Floating WTGs:**<br>▪ 29 x 20 MW WTGs<br>**Cables:**<br>▪ 29 x inter-array cables<br>▪ 230mm diameter cables of aluminium or copper<br>**Mooring line (catenary systems):**<br>▪ 174 mooring lines<br>▪ Material: Top section is chain, Mid-section is fibre rope, Bottom section is chain | The WCS for operational noise is related to the size of the WTGs and type of turbine. As a result, fewer number of largest turbines have been selected for this assessment scenario. Tension on mooring lines is important in driving the pinging noise as well as the material used, with catenary design with chains being the worst-case scenario. |
| Impact 15: Entanglement | **Operational timeline:**<br>▪ 35 years<br>**Catenary design:**<br>▪ 39 floating WTGs<br>▪ 234 mooring lines<br>▪ Total length of moorings: 234km<br>▪ Mooring line diameter: 190mm to 297mm<br>▪ Max mooring line swept area (catenary): 45,000m$^2$<br>▪ Material: Top section is chain, Mid section is fibre rope, Bottom section is chain<br>**Inter-array cables:**<br>▪ 39 inter-array cables<br>▪ 176m length of floating cable per WTG | The WCS is informed by the mooring tension characteristics with catenary moorings representing the highest risk of entanglement. |

| Potential Impact | Assessment Parameter | Explanation |
|---|---|---|
| | ▪ Cable diameter: 144mm to 230mm | |
| Impact 16: Long term displacement/habitat loss/ barrier effects | **Operational timeline:**<br>▪ 35 years<br>▪ Total footprint of the Caledonia South Site = 204.5km$^2$<br><br>**Bottom-fixed foundations:**<br>▪ 39 WTGs (jackets with pin piles)<br>▪ Two OSPs (jackets with pin piles)<br><br>**Floating:**<br>▪ 39 floating WTGs with catenary mooring system<br>▪ Total length of moorings: 234km<br>▪ Maximum mooring line swept area: 45,000 m$^2$<br>▪ Mooring line diameter: 190 mm to 297 mm<br>▪ Max 176m length of floating cable per WTG | The spatial footprint of the Caledonia South Site, number of WTGs and OSPs and total length of cables and mooring lines in the water column is considered to represent the greatest spatial extent of any displacement or barrier effect on marine mammals. |
| Impact 17: Vessel collisions | ▪ Max five vessels on site at once, CTVs and SOVs will be used for planned activities and other type of vessels will depend on the type of unplanned activity.<br>▪ List of potential ports: Aberdeen City, Aberdeenshire (Peterhead, Fraserburgh), Moray (Buckie), Highland (Cromarty, Nigg, Wick, Ardersier).<br>**Operational timeline:**<br>▪ 35 years | The WCS is informed by the maximum number of vessels on site at any one time as well as the duration of operation and maintenance. |
| Impact 18: Vessel disturbance | Refer to Impact 17. | Refer to Impact 17. |
| Impact 19: Disturbance to haul-outs | ▪ Five vessels on site at once, CTVs and SOVs will be used for planned activities and other type of vessels will depend on the type of unplanned activity. | The WCS is informed by the maximum number of vessels within coastal areas at any one time, location of ports as well as the duration of operation and maintenance. |

| Potential Impact | Assessment Parameter | Explanation |
| --- | --- | --- |
| | ▪ List of potential ports: Aberdeen City, Aberdeenshire (Peterhead, Fraserburgh), Moray (Buckie), Highland (Cromarty, Nigg, Wick, Ardersier).<br>**Operational timeline:**<br>▪ 35 years | |
| Impact 20: Indirect impacts on marine mammals via changes in prey availability | Refer to Volume 4, Chapter 5: Fish and Shellfish Ecology (Impacts 6-11) | The WCS for impacts which are specific to fish and shellfish, and which may therefore have an indirect effect on marine mammals, are presented within Volume 4, Chapter 5: Fish and Shellfish Ecology, impacts 6-11. |
| Impact 21: Auditory injury from geophysical surveys | **Geophysical surveys will include (source levels provided for SPLpk):**<br>▪ Multi-beam echosounder (MBES; 210-240dB re 1µPa for multiple beams and 197dB re 1µPa for a single beam; 200 to 400kHz)<br>▪ Side-scan sonar (SSS; 210dB re 1µPa; 300 to 900kHz)<br>▪ Sub-bottom profiler (SBP; 210-220dB re 1µPa, 2 to 15kHz)<br>▪ Ultra-short baseline (USBL; 187 – 206dB re 1µPa, 19 to 34kHz)<br>▪ Ultra-high resolution seismic (UHRS; 200-226 dB re 1µPa, 100Hz to 5kHz)<br>▪ Duration and frequency of geophysical surveys will be provided as a part of a separate licencing process post-consent. | The WCS is informed by the source level and expected sound frequency and overlap with marine mammal hearing ranges. |
| Impact 22: Disturbance from geophysical surveys | Refer to Impact 21. | Refer to Impact 21. |

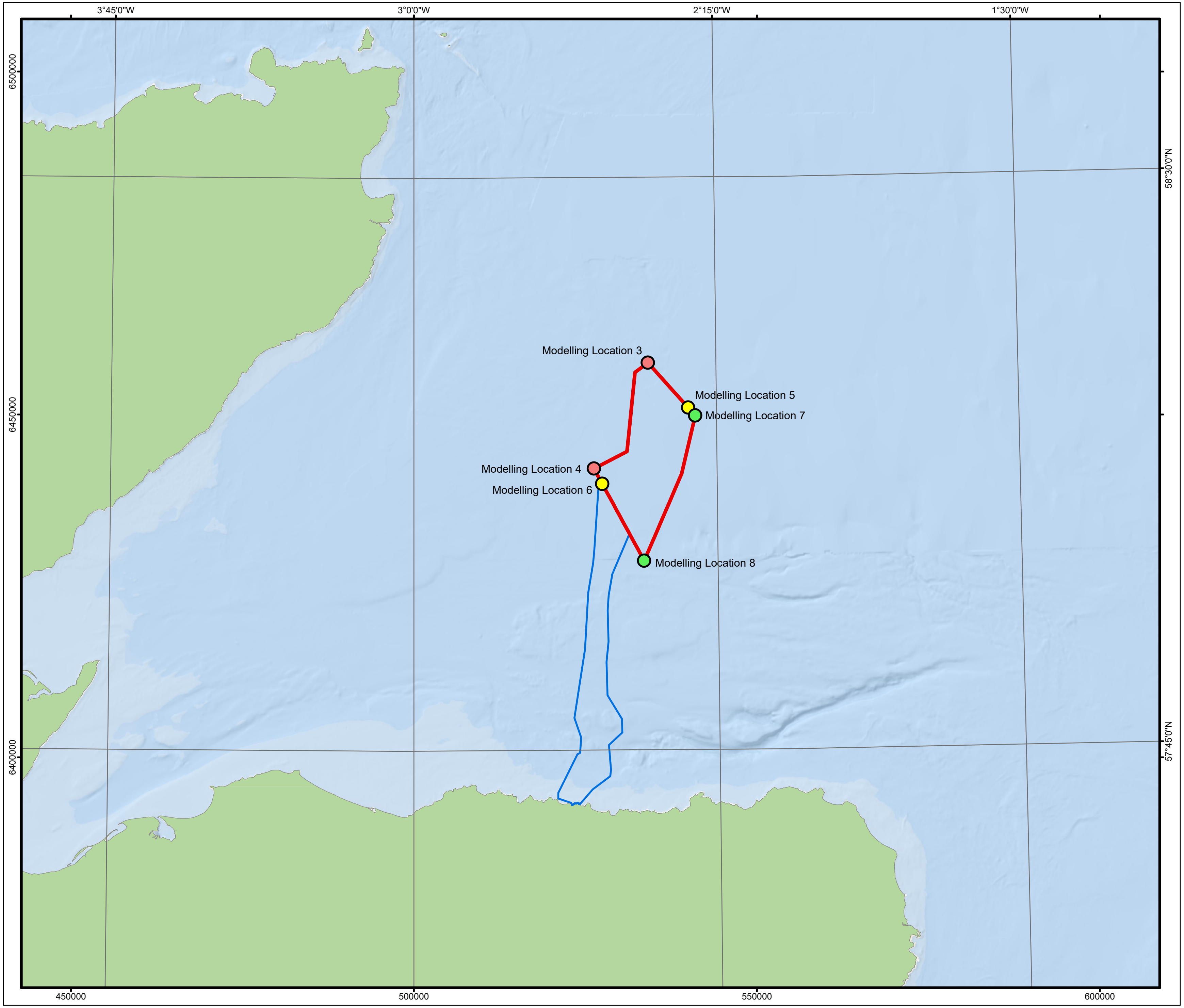
| Potential Impact | Assessment Parameter | Explanation |
|---|---|---|
| **Decommissioning** | | |
| Impact 23: Auditory injury from decommissioning activities | The worst-case design scenario will be equal to (or less than) that of the construction phase. Refer to Impacts 1, 3, 5 and 7. | At the end of the operational lifetime of Caledonia South, it is anticipated that all structures above the seabed level will be completely removed. The decommissioning sequence will be the reverse of the construction sequence and involve similar types and numbers of vessels, activities and equipment. Pile foundations would be cut at such a depth below the surface of the seabed. |
| Impact 24: Disturbance from decommissioning activities | The worst-case design scenario will be equal to (or less than) that of the construction phase. Refer to Impacts 2, 4, 6 and 8. | Refer to Impact 23. |
| Impact 25: Vessel collision | The worst-case design scenario will be equal to (or less than) that of the construction phase. Refer to Impact 9. | The decommissioning phase will involve similar types and numbers of vessels as construction. |
| Impact 26: Vessel disturbance | The worst-case design scenario will be equal to (or less than) that of the construction phase. Refer to Impact 10. | The decommissioning phase will involve similar types and numbers of vessels as construction. |
| Impact 27: Disturbance to haul-outs | The worst-case design scenario will be equal to (or less than) that of the construction phase. Refer to Impact 13. | The decommissioning phase will involve similar types and numbers of vessels as construction. |
| Impact 28: Indirect impacts on marine mammals via changes in prey availability | The worst-case design scenario will be equal to (or less than) that of the construction phase. Refer to Impact 11. | Specific decommissioning parameters are to be determined, but assumed to include the reverse of construction activities, removing all offshore infrastructure. Refer to Volume 4, |

| Potential Impact | Assessment Parameter | Explanation |
| --- | --- | --- |
| | | Chapter 5: Fish and Shellfish Ecology (Impacts 12-15). |
| Impact 29: Changes in water quality | The worst-case design scenario will be equal to (or less than) that of the construction phase. Refer to Impact 12. | Specific decommissioning parameters are to be determined, but assumed to include the reverse of construction activities, removing all offshore infrastructure. Refer to Volume 4, Chapter 3: Marine Water and Sediment Quality. |

### 7.6.2 Piling Parameters

7.6.2.1 Pile installation has the potential to generate underwater noise which could result in injury or disturbance to marine mammals during the construction stage. Underwater noise modelling has been undertaken to determine the extent of underwater sound propagation from impact piling of WTGs and OSPs from six representative location covering the full extent of Caledonia South Site, Figure 7–3). The six modelling locations include potential WTG locations within the Caledonia South Site, giving a spread of various water depths, distances to the shore and to the deeper water to the east into the North Sea and as a result different potential technology (bottom-fixed, floating).

7.6.2.2 This section summarises the results of this impact assessment, with full technical details of the underwater noise modelling available in Volume 7, Appendix 6: Underwater Noise Assessment.



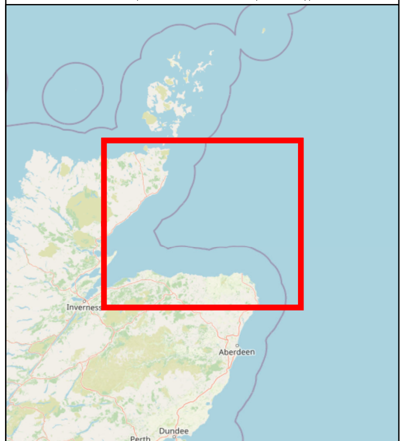

Caledonia South Site

Caledonia South Offshore Export Cable Corridor

**Modelling location type**

- Fixed Foundation
- Floating Foundation
- Fixed or Floating Foundation



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CALEDONIA Offshore Wind Farm — GoBe APEM Group

| | |
|---|---|
| CONTRACTOR DRAWING NO<br>UKCAL1_GO_WNF_MMM_MAP_00472 | CONTRACTOR REV<br>01 |
| GEODETIC PARAMETERS<br>WGS 84 / UTM zone 30N (EPSG: 32630) | |
| DRAWING TITLE<br>Figure 7-3: Representative Piling Locations Used in the Underwater Noise Modelling | |
| STATUS<br>Approved | SCALE<br>1:750,000 |
| DRAWING NUMBER<br>N/A | SHEET NO<br>01 of 01 — REV N/A |

7.6.2.3 Three foundation designs have been considered in the underwater noise modelling, including monopiles for bottom-fixed foundations, multi-leg foundations for bottom-fixed jacket foundations and anchors for floating WTGs. At this stage it is unknown if WTGs and OSPs will be installed on monopiles, multileg foundations or using anchors and floating technology (WTGs only). As such, in each case, only certain modelling locations have been considered, for the bottom-fixed monopile and multi-leg foundations, locations 3, 4, 7 and 8 have been modelled, and for floating anchor pile foundations, locations 5, 6, 7 and 8 have been modelled. The quantitative results (area and range of impact, number of animals affected) for each modelling location is presented in Volume 7B, Appendix 7-3: Marine Mammal Piling Results (Auditory Injury and Disturbance) and the assessment for worst-case results, alongside with spatial representation of impact, is provided in Section 7.7.

7.6.2.4 Assessment of injury from piling used the worst-case scenario design parameters presented in Table 7–14, which are likely to result in the greatest injury or disturbance ranges. In a 24-hour period, it is expected that up to two monopile foundations, or four multi-leg pile foundations can be installed sequentially from the same piling vessel. Where multiple sequential piles are modelled, no break has been assumed between each one, as a worst-case scenario. There is also the possibility that two piling vessels could be operational and concurrently piling across the Caledonia South Site. The maximum spatial scenario assumed that up to two anchor piles may be installed in a 24-hour period.

7.6.2.5 Full information about piling parameters, including piling profiles, which have been used to assess auditory injury and disturbance is available in Volume 7, Appendix 6: Underwater Noise Assessment.

*Population Modelling*

7.6.2.6 Piling at monopiles represent the worst-case spatial scenario due to largest hammer energy required for installation (Table 7–14). However, although the spatial extent over which marine mammals can experience behavioural disturbance due to underwater noise during piling is slightly larger for monopiles (worst-case spatial scenario, Table 7–14), the disturbance areas and ranges of effect differ only marginally from pin piles for jackets (see Section 7.7 for areas and ranges of effect). Given that one jacket foundation (e.g., four pin piles) can be installed per day compared to two monopiles a day, installation of jackets may take twice as long as piling of monopiles. Installation of floating foundations will take the longest time as on average, 1.71 pin piles may be installed per day (out of up to 18 piled anchors per foundation). As such, piling at jackets in combination with anchors represents the maximum temporal scenario with up to 451 piling days required (Table 7–14).

7.6.2.7 Considering the minor differences in the spatial extent of underwater noise generated by piling at jackets and anchors compared to monopiles, and given that the piling for jackets and anchors (451 days) can take up to 11 times longer than for monopiles (40 piling days), only the former (the worst-case temporal scenario, Table 7–14) has been used to inform the iPCoD modelling. The scenario assumes installation of a mix of bottom-fixed and floating foundations in the Caledonia South Site with four pin piles installed per day for bottom-fixed substructures (one full substructure jacket per day), and 1.71 anchor pile is installed per day for floating substructures, resulting in 451 piling days between October 2028 and September 2030, inclusive. It is important to note that, based on the DE, piling at two jacket locations concurrently is possible during installation of foundations within the Caledonia South Site. However, since the iPCoD scenarios aim to represent the worst-case temporal scenario, the modelling assumes no concurrent piling activities within the Caledonia South Site at any given time, ensuring the maximum possible installation duration is assessed.

7.6.2.8 Details regarding description of the numbers of animals taken forward to iPCoD along with the timeframes are provided in Volume 7D, Appendix 7-1: Marine Mammals Population Modelling (iPCoD).

# 7.7 Potential Effects

## 7.7.1 Construction

### Impact 1: Auditory Injury (PTS) from UXO

7.7.1.1 Once the location of any UXOs within the Caledonia South Site and OECC, a risk assessment will be undertaken and items of UXO will be either avoided by equipment micro-siting, moved, or disposed of *in situ*.

7.7.1.2 In line with the advice received in the Scoping Opinion (Table 7–2), the Applicant considered alternatives to high order detonations alongside the effectiveness of these techniques. The UXOs found within the Moray West OWF site were cleared using a low order deflagration technique, with 100% success rate (Ocean Winds, 2024[47]). As such, given that low order deflagration is a viable and effective method to be applied during UXO clearance at the Caledonia South Site and Caledonia South OECC, the potential effects of high order detonation were not considered further.

7.7.1.3 As the detailed pre-construction surveys have not yet been completed, it is not possible at this time to determine how many items of UXO will require clearance. As a result, a separate Marine Licence will be applied for post-consent for the clearance (where required) of any UXO identified. In order to define the design envelope for consideration of

UXO within the EIAR, a review of recent information has been undertaken. Current advice from the UK Statutory Nature Conservation Bodies is that the Southall *et al*. (2019[29]) criteria should be used for assessing the impacts associated with UXO clearance on marine mammals, and this advice has been followed for this assessment. However, the suitability of these criteria for UXO is under discussion due to the lack of empirical evidence from UXO clearances using these metrics, in particular the range-dependent characteristics of the peak sounds, and whether current propagation models can accurately predict the range at which these thresholds are reached.

7.7.1.4 Using both the EDR methodology and using TTS as a proxy for disturbance, a low-order clearance scenario has been modelled, assuming a donor charge of 0.25kg. The unweighted UXO clearance source levels are presented in Table 7–15. UXO detonation is defined as a single pulse and, thus, both the weighted $SEL_{ss}$ criteria and the unweighted $SPL_{peak}$ criteria from Southall *et al*. (2019[29]) have been presented and animal fleeing assumptions do not apply. Full details of the underwater noise modelling and the resulting auditory injury (PTS-onset) impact areas and ranges are detailed in Volume 7, Appendix 6: Underwater Noise Assessment.

Table 7–15: Summary of the unweighted $SPL_{peak}$ and $SEL_{ss}$ source levels used for UXO clearance modelling.

| Charge Weight | Unweighted $SPL_{peak}$ source level dB re 1 µPa @ 1m | Unweighted $SEL_{ss}$ source level dB re 1 µPa$^2$s @ 1m |
|---|---|---|
| 0.25kg | 269.8 | 215.2 |

**Summary**

7.7.1.5 A summary of the assessment of injury from UXO clearance activities during construction, presented in detail in paragraphs 7.7.1.1 to 7.7.1.19, is provided in Table 7–16. No impacts are considered significant in EIA terms.

Table 7–16: Summary of the significance of auditory injury from UXO clearance during construction phase.

| Receptor | Embedded Mitigation | Magnitude | Sensitivity | Significance | Secondary Mitigation | Residual |
|---|---|---|---|---|---|---|
| Harbour porpoise | MMMP (M-16), low order deflagration (M-107 | Negligible | Low | Negligible | None | Negligible |
| Bottlenose dolphin | MMMP (M-16), low order deflagration (M-107) | Negligible | Low | Negligible | None | Negligible |
| White-beaked dolphin | MMMP (M-16), low order deflagration (M-107) | Negligible | Low | Negligible | None | Negligible |
| Common dolphin | MMMP (M-16), low order deflagration (M-107) | Negligible | Low | Negligible | None | Negligible |
| Risso's dolphin | MMMP (M-16), low order deflagration (M-107) | Negligible | Low | Negligible | None | Negligible |
| Minke whale | MMMP (M-16), low order deflagration (M-107) | Negligible | Medium | Negligible | None | Negligible |
| Humpback whale | MMMP (M-16), low order deflagration (M-107) | Negligible | Medium | Negligible | None | Negligible |
| Harbour seal | MMMP (M-16), low order deflagration (M-107) | Negligible | Medium | Negligible | None | Negligible |
| Grey seal | MMMP (M-16), low order deflagration (M-107) | Negligible | Medium | Negligible | None | Negligible |

*Magnitude of Impact*

7.7.1.7 No quantitative assessment is provided for humpback whales due to a lack of density estimate or MU size, for other species density per species is indicated in Table 7–17. The assessment presented below include application of low-order clearance as a part of embedded mitigation (Table 7–13).

7.7.1.8 The auditory injury (PTS-onset) range for low-order clearance is small across all species and both metrics ($SPL_{peak}$ and $SEL_{ss}$) with a maximum impact range of <1km (Table 7–17).

7.7.1.9 The maximum number of animals across all species and both metrics estimated to experience PTS is up to one individual (Table 7–17). Due to very localised impact ranges, the impact would not extend beyond the Moray Firth and therefore it is anticipated that zero bottlenose dolphins from the GNS MU are at risk of experiencing PTS from UXO clearance. Similarly for both species of seals, due to the small extent of the impact ranges (max 0.19km), this impact is only assessed within the Moray Firth SMU as only animals within this SMU are expected to be impacted.

7.7.1.10 The extent and duration of the impact (underwater noise during low order UXO clearance) is expected to be localised (up to 0.99km for harbour porpoise) and short-term. The effect is unlikely to occur due to the application of embedded mitigation (specific measures to be agreed post-consent as a part of the final MMMP) that will ensure that animals are outside of the injury zone before the commencement of the clearance activities. As the consequence, it is anticipated that no animals will experience injury and therefore the impact will not alter respective population trajectories. Therefore, the magnitude of low order UXO clearance has been assessed as Negligible for all species.

Table 7–17: Summary of the auditory injury (PTS) impact ranges, densities, number of individuals and the proportion of the respective MUs impacted based on the impact ranges for UXO clearance using the impulsive, weighted $SEL_{SS}$ and unweighted $SPL_{peak}$ noise criteria from Southall *et al.* (2019[29]).

| Species | Density (#/km²) | Impact | PTS Unweighted $SPL_{peak}$ | PTS Weighted $SEL_{ss}$ |
|---|---|---|---|---|
| Harbour porpoise | 0.2813 (SCANS IV block CS-K) | Range (km) | 0.99 | 0.008 |
| | | # animals | 1 | <1 |
| | | % NS MU | <0.01% | <0.01% |
| | | % UK MU | <0.01% | <0.01% |
| Bottlenose Dolphin | 0.0543 (maximum Thompson *et al.*, 2015[55]) | Range (km) | 0.06 | <0.05 |
| | | # animals | <1 | <1 |
| | | % CES MU | <0.01% | <0.01% |
| White-beaked dolphin | 0.1352 (SCANS IV block CS K) | # animals | <1 | <1 |
| | | % CGNS MU | <0.01% | <0.01% |
| | | % UK MU | <0.01% | <0.01% |
| Common dolphin | 0.0004 (maximum Lacey *et al.*, 2022[53]) | # animals | <1 | <1 |
| | | % CGNS MU | <0.01% | <0.01% |
| | | % UK MU | <0.01% | <0.01% |
| Risso's dolphin | 0.0376 (SCANS IV block CS-K) | # animals | <1 | <1 |
| | | % CGNS MU | <0.01% | <0.01% |

| Species | Density (#/km$^2$) | Impact | PTS Unweighted $SPL_{peak}$ | PTS Weighted $SEL_{ss}$ |
|---|---|---|---|---|
| | | % UK MU | <0.01% | <0.01% |
| Minke whale | 0.0116 (SCANS IV block CS-K) | Range (km) | 0.17 | 0.23 |
| | | # animals | <1 | <1 |
| | | % CGNS MU | <0.01% | <0.01% |
| | | % UK MU | <0.01% | <0.01% |
| Humpback whale | N/A | Range (km) | 0.17 | 0.23 |
| Harbour seal | 0.006 (average Caledonia South Site and Caledonia South OECC) | Range (km) | 0.19 | <0.05 |
| | | # animals | <1 | <1 |
| | | % MF SMU | <0.01% | <0.01% |
| Grey seal | 0.368 (average Caledonia South Site and Caledonia South OECC) | Range (km) | 0.19 | <0.05 |
| | | # animals | <1 | <1 |
| | | % MF SMU | <0.01% | <0.01% |

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*Sensitivity of Receptor*

7.7.1.11 The low-order clearances, although significantly lower in level of generated noise compared to the high-order events, still demonstrate similar time spectral characteristics (Lepper *et al*., 2024[74]). Most of the acoustic energy produced by a high-order detonation is below a few hundred Hz, decreasing on average by about SEL 10 dB per decade above 100Hz, and there is a pronounced drop-off in energy levels above ~5-10kHz (von Benda-Beckmann *et al*., 2015[75]; Salomons *et al*., 2021[76]). Spectograms for low order clearance events show sharp transient time and arrival of higher frequency components first, with detectable energy up to 7kHz (Lepper *et al*., 2024). However, there is a rapid drop off to lower frequency containing most of the energy of the signal within levels up to 3kHz (Lepper *et al*., 2024).

7.7.1.12 The primary acoustic energy from the low order clearance is below the region of greatest sensitivity for VHF cetaceans, including harbour porpoise (12 to 140kHz, Table 7–9). Similarly, the primary acoustic energy from the low order clearance is below the region of greatest sensitivity for HF cetaceans such as bottlenose dolphin, common dolphin, white-beaked dolphin and Risso's dolphin (8.8 to 110kHz, Table 7–9). If PTS were to occur within this low frequency range, it would be unlikely to result in any significant impact to vital rates of VHF cetaceans and HF cetaceans. As such, harbour porpoise, bottlenose dolphin, common dolphin, white-beaked dolphin and Risso's dolphin are assessed as having a Low sensitivity to auditory injury (PTS-onset) from UXO clearance.

7.7.1.13 There is an overlap with lower frequency components of the sound produced by low order clearance and the region of greatest sensitivity for LF cetaceans, including minke whale and humpback whale (200Hz to 19kHz, Table 7–9). Given that the region of greatest hearing sensitivity for PCW species, including harbour seal and grey seal falls within 1.9 to 30kHz, there is a potential for overlap with the highest frequency components of the sound due to UXO clearance. Although animals are not at risk of loss of hearing across the entire hearing band, they may have limited ability to adapt their behaviour and tolerance to the effect. As such, minke whale, humpback whale, harbour seal and grey seal are assessed as having a Medium sensitivity to auditory injury (PTS-onset) from UXO clearance.

*Significance of Effect*

7.7.1.14 Taking the **Low** sensitivity of harbour porpoise, bottlenose dolphin, common dolphin, white-beaked dolphin and Risso's dolphin and the **Negligible** magnitude of impact, the overall effect of auditory injury (PTS) from UXO clearance during construction for these species is considered to be **Negligible and not significant in EIA terms**.

7.7.1.15 Taking the **Medium** sensitivity of minke whale, humpback whale, harbour seal and grey seal and the **Negligible** magnitude of impact, the overall effect of auditory injury (PTS) from UXO clearance during construction for these species is considered to be **Negligible and Not Significant in EIA terms**.

7.7.1.16 The Applicant has committed to low order clearance and implementing a MMMP (M-16, see Table 7–13). Indicative mitigation measures presented in the draft MMMP (see Volume 7, Appendix 14: Caledonia South Draft Marine Mammal Mitigation Protocol) include pre-clearance visual search by two MMOs over a standard mitigation zone of 1km that will continue over the duration of clearance operations and at least 15 minutes after it is finished[ii]. Although the exact mitigation measures contained with the final MMMP are yet to be determined, they will be in line with the latest relevant guidance at the time of this stage of Caledonia South. It is considered that, due to the small PTS impact ranges, the impact of auditory injury can be fully mitigated using the embedded mitigation and, therefore, no secondary mitigation measures will be required.

*Residual Significance of Effect*

7.7.1.17 With the implementation of embedded mitigation, the overall effect of auditory injury (PTS) from UXO clearance during construction is **Negligible and Not Significant in EIA terms**.

#### European Protected Species (EPS)

7.7.1.18 As European Protected Species (EPS), listed on Annex IV of the EU Habitats Directive, it is an offence to kill, injure or disturb cetaceans. An EPS risk assessment is required to assess the risk that an offence will occur, therefore assessing the need for an EPS licence(s) and providing the information required by MD-LOT in support of any such applications.

7.7.1.19 The Applicant will provide an EPS risk assessment for injury from UXO clearance at the post consent stage. The expectation is that, given the use of low-order deflagration only, and the commitment to a MMMP (M-16, see Table 7–13) to reduce the risk of auditory injury to negligible levels, no individuals that are classified as EPS will be injured, and thus an EPS license for injury is unlikely to be required.

[ii] In line with JNCC (2023[69]) draft guidance, since the modelled auditory injury zone is less than 1km for low-order deflagration, the use of acoustic deterrents and noise abatement is not considered necessary.

## Impact 2: Disturbance from UXO Clearance

### Marine Mammals

7.7.1.20 This assessment presents results for the following behavioural disturbance thresholds:

- 5km EDR for low-order clearance; and
- TTS-onset thresholds for low-order clearance.

7.7.1.21 The clearance of UXOs will usually be undertaken as part of a campaign and may result in multiple clearance events over several days. Each UXO clearance event will be of a short-term duration.

### Summary

7.7.1.22 A summary of the assessment of injury from UXO clearance activities during construction is provided in Table 7–18. No impacts are considered significant in EIA terms.

Table 7–18: Summary of the significance of disturbance from UXO clearance during construction phase.

| Receptor | Embedded Mitigation | Magnitude | Sensitivity | Significance | Secondary Mitigation | Residual |
|---|---|---|---|---|---|---|
| Harbour porpoise | Low order deflagration (M-107) | Low | Low | Negligible | None | Negligible |
| Bottlenose dolphin | Low order deflagration (M-107) | Low | Low | Negligible | None | Negligible |
| White-beaked dolphin | Low order deflagration (M-107) | Low | Low | Negligible | None | Negligible |
| Common dolphin | Low order deflagration (M-107) | Low | Low | Negligible | None | Negligible |
| Risso's dolphin | Low order deflagration (M-107) | Low | Low | Negligible | None | Negligible |
| Minke whale | Low order deflagration (M-107) | Low | Low | Negligible | None | Negligible |
| Humpback whale | Low order deflagration (M-107) | Low | Low | Negligible | None | Negligible |

| Receptor | Embedded Mitigation | Magnitude | Sensitivity | Significance | Secondary Mitigation | Residual |
|---|---|---|---|---|---|---|
| Harbour seal | Low order deflagration (M-107) | Low | Low | Negligible | None | Negligible |
| Grey seal | Low order deflagration (M-107) | Low | Low | Negligible | None | Negligible |

*Magnitude of Impact*

7.7.1.23 No quantitative assessment is provided for humpback whales due to a lack of density estimate or MU size, for other species density per species is indicated in Table 7–19. The assessment presented below include application of low-order clearance as a part of embedded mitigation (Table 7–13).

5km EDR

7.7.1.24 The greatest number of individuals estimated to be disturbed using 5km EDR has been predicted for grey seals with up to 29 individuals affected (Table 7–19). Low order clearance may also disturb up to 22 harbour porpoises and 11 white-beaked dolphins (Table 7–19).

7.7.1.25 For all other species, the maximum number of individuals potentially disturbed have been estimated as up to one animal (Table 7–19). Due to very localised impact ranges, the impact would not extend beyond the Moray Firth and therefore it is anticipated that zero bottlenose dolphins from the GNS MU are at risk of experiencing disturbance from UXO clearance. Similarly for both species of seals, due to the small extent of the impact range this impact is only assessed within the Moray Firth SMU as only animals within this SMU are expected to be impacted.

TTS-onset

7.7.1.26 TTS impact range for VHF cetaceans (harbour porpoise) was up to 1.8km. LF cetaceans (minke whale and humpback whale) was up to 3.2km. For HF cetaceans and PCW, the maximum impact ranges were 0.1km and 0.36km respectively (Table 7–19).

7.7.1.27 The maximum number of harbour porpoise estimated to experience TTS is 3 individuals (Table 7–19). For all other species, the maximum number of individuals potentially disturbed have been estimated as up to one animal (Table 7–19). No density estimates are available for humpback whales in this area, but they are considered less common than minke whales and, therefore, it is expected that the number of animals impacted would also be less. Due to very localised impact ranges, the impact would not extend beyond the Moray Firth and therefore it is anticipated that zero bottlenose dolphins from the GNS MU are at risk of experiencing disturbance from UXO clearance. Similarly for both species of seals, due to the small extent of the impact ranges (up to 0.36km) this impact is only assessed within the Moray Firth SMU as only animals within this SMU are expected to be impacted.

Table 7–19: Summary of the disturbance impact ranges, densities, number of individuals and the proportion of the respective MUs impacted based on the impact ranges for UXO clearance using the 5km EDR, TTS $SPL_{peak}$ and $SEL_{ss}$ criteria from Southall *et al*. (2019[29]).

| Species | Density (#/km$^2$) | Impact | 5km EDR | TTS unweighted $SPL_{peak}$ | TTS weighted $SEL_{ss}$ |
|---|---|---|---|---|---|
| Harbour porpoise | 0.2813 (SCANS IV block CS-K) | Range (km) | 5 | 1.8 | 0.75 |
| | | # animals | 22 | 3 | <1 |
| | | % NS MU | 0.01 | <0.01 | <0.01 |
| | | % UK MU | 0.01 | <0.01 | <0.01 |
| Bottlenose Dolphin | 0.0543 (maximum Thompson *et al.*, 2015[55]) | Range (km) | 5 | 0.1 | <0.05 |
| | | # animals | 4 | <1 | <1 |
| | | % CES MU | 1.6 | <0.01 | <0.01 |
| White-beaked dolphin | 0.1352 (SCANS IV block CS K) | Range (km) | 5 | 0.1 | <0.05 |
| | | # animals | 11 | <1 | <1 |
| | | % CGNS MU | 0.02 | <0.01 | <0.01 |
| | | % UK MU | 0.03 | <0.01 | <0.01 |
| Common dolphin | 0.0004 (maximum Lacey *et al.*, 2022[53]) | Range (km) | 5 | 0.1 | <0.05 |
| | | # animals | <1 | <1 | <1 |
| | | % CGNS MU | <0.01 | <0.01 | <0.01 |
| | | % UK MU | <0.01 | <0.01 | <0.01 |

| Species | Density (#/km$^2$) | Impact | 5km EDR | TTS unweighted $SPL_{peak}$ | TTS weighted $SEL_{ss}$ |
|---|---|---|---|---|---|
| Risso's dolphin | 0.0376 (SCANS IV block CS-K) | Range (km) | 5 | 0.1 | <0.05 |
| | | # animals | 3 | <1 | <1 |
| | | % CGNS MU | 0.02 | <0.01 | <0.01 |
| | | % UK MU | 0.03 | <0.01 | <0.01 |
| Minke whale | 0.0116 (SCANS IV block CS-K) | Range (km) | 5 | 0.32 | 3.2 |
| | | # animals | 1 | <1 | 1 |
| | | % CGNS MU | <0.01 | <0.01 | 0.01 |
| | | % UK MU | <0.01 | <0.01 | 0.01 |
| Humpback whale | N/A | Range (km) | 5 | 0.32 | 3.2 |
| Harbour seal | 0.006 (average Caledonia South Site and Caledonia South OECC) | Range (km) | 5 | 0.36 | 0.57 |
| | | # animals | <1 | <1 | <1 |
| | | % MF SMU | 0.04 | <0.01 | <0.01 |
| Grey seal | 0.368 (average Caledonia South Site and Caledonia South OECC) | Range (km) | 5 | 0.36 | 0.57 |
| | | # animals | 29 | <1 | <1 |
| | | % MF SMU | 0.39 | <0.01 | <0.01 |

Magnitude of Impact Summary

7.7.1.28 The extent and duration of impacts (underwater noise) during low order UXO clearance using both approaches, 5km EDR and TTS as a proxy for disturbance, is expected to be localised and short-term. There is potential for the behavioural disturbance effect to occur if animals are in the close vicinity of the noise source, but responses are expected to be temporary and reversible. Due to low numbers of animals potentially affected, there is a potential for behavioural disturbance during UXO clearance to affect very small proportion of the respective populations. The number of humpback whales potentially affected is unknown but given that animals are occasional visitors to the Moray Firth, it is expected that only low numbers of animals could be potentially disturbed. As such, there is a potential for behavioural disturbance during UXO clearance to affect a very limited proportion of the population of humpback whales (if any). Considering the above, no population effects are expected and therefore the magnitude of low order UXO clearance for all species has been assessed as Low.

*Sensitivity of Receptor*

7.7.1.29 It is noted in the JNCC (2020[77]) guidance that, although UXO clearance is considered a loud underwater noise source *"...a one-off explosion would probably only elicit a startle response and would not cause widespread and prolonged displacement..."*. Therefore, it is expected that disturbance from a single noise event would not be sufficient to result in any changes to the vital rates of individuals. Therefore, the sensitivity of all species for disturbance from UXO clearance is expected to be Low, irrespective of the disturbance threshold used in the assessment.

*Significance of Effect*

7.7.1.30 Taking the **Low** sensitivity of all species and the **Low** magnitude of impact, the overall effect of disturbance from UXO clearance during construction is considered to be **Negligible and Not Significant in EIA terms**.

7.7.1.31 The embedded mitigation includes the commitment to low order deflagration (see Table 7–13). Following application of this embedded measure, the effect of disturbance from UXO clearance on all species is considered to be not significant in EIA terms. Therefore, no secondary mitigation is required.

7.7.1.32 With the implementation of embedded mitigation, the overall effect of disturbance from UXO clearance during construction using both methods of assessment is **Negligible and Not Significant in EIA terms**.

### EPS

7.7.1.33 As EPS, listed on Annex IV of the EU Habitats Directive, it is an offence to kill, injure or disturb cetaceans. An EPS risk assessment is required to assess the risk that an offence will occur, therefore assessing the need for an EPS licence(s) and providing the information required by MD-LOT in support of any such applications.

7.7.1.34 The Applicant will provide an EPS risk assessment for disturbance from UXO clearance at the post consent stage. This impact assessment has concluded that disturbance from UXO clearance will not be detrimental to maintaining the species at favourable conservation status, and thus passes EPS test 3.

## Impact 3: Auditory Injury (PTS) from Piling

7.7.1.35 Pile installation has the potential to generate underwater noise which could result in injury to marine mammals during the construction stage. Underwater noise modelling has been undertaken to determine the extent of underwater sound propagation from impact piling and injury ranges (see Volume 7, Appendix 6: Underwater Noise Assessment). The worst case scenarios for auditory injury to all species presented in this section are based on modelling locations with the most precautionary impact ranges and the highest number of animals potentially impacted. For the full set of results (all modelling locations, all foundation designs and sets of densities), see Volume 7B, Appendix 7-3: Marine Mammals Piling Results (Auditory Injury and Disturbance).

7.7.1.36 It should be noted that the predictions for PTS-onset presented in this section assume that all animals within the PTS-onset range are impacted, which will overestimate the true number of impacted animals. In addition, the sound is modelled as being fully impulsive irrespective of the distance to the pile, which is highly precautionary, resulting in predictions that are unlikely to be realised. It expected that the likelihood of the pile driving sound retaining its impulsive characteristics at distances above 10km is unlikely (Matei *et al*., 2024[78]). For example, impact ranges predicted for harbour porpoise (15km), seals (14.5km) and minke whale (34km) based on $SEL_{cum}$ metric are beyond what is reasonably expected. Although auditory injury ranges based on the $SEL_{cum}$ metric are provided below as well as in the Volume 7B: Appendix 7-3: Marine Mammals Piling Results (Auditory Injury and Disturbance), these should be treated with caution. NatureScot has confirmed that only instantaneous PTS (using the $SPL_{peak}$ metric) requires mitigation (see Table 7–3). NatureScot recognise that the modelling for cumulative PTS (using the $SEL_{cum}$ metric) is overly-precautionary and could lead to an over-estimation of impact zones, and therefore it would be disproportionate to expect these to be fully mitigated. Therefore, although impact ranges for $SEL_{cum}$ are acknowledged, the magnitude conclusions are based on the instantaneous PTS ($SPL_{peak}$) impact ranges only. See Volume 7B, Appendix 7-2: Marine Mammals Underwater Noise Assessment Methodology for the discussion of assessment limitations.

**Summary**

7.7.1.37 A summary of the assessment of injury from piling during construction is provided in Table 7–20. No impacts are considered significant in EIA terms.

Table 7–20: Summary of the significance of injury from piling to marine mammals during construction phase.

| Receptor | Embedded Mitigation | Magnitude | Sensitivity | Significance | Secondary Mitigation | Residual |
|---|---|---|---|---|---|---|
| Harbour porpoise | MMMP (M-16) | Negligible | Low | Negligible | None | Negligible |
| Bottlenose dolphin | MMMP (M-16) | Negligible | Low | Negligible | None | Negligible |
| White-beaked dolphin | MMMP (M-16) | Negligible | Low | Negligible | None | Negligible |
| Common dolphin | MMMP (M-16) | Negligible | Low | Negligible | None | Negligible |
| Risso's dolphin | MMMP (M-16) | Negligible | Low | Negligible | None | Negligible |
| Minke whale | MMMP (M-16) | Negligible | Medium | Negligible | None | Negligible |
| Humpback whale | MMMP (M-16) | Negligible | Medium | Negligible | None | Negligible |
| Harbour seal | MMMP (M-16) | Negligible | Low | Negligible | None | Negligible |
| Grey seal | MMMP (M-16) | Negligible | Low | Negligible | None | Negligible |

*Magnitude of Impact*

7.7.1.38 No quantitative assessment is provided for humpback whales due to a lack of density estimate or MU size, for other species density per species is indicated in Table 7–21. The full set of results for the quantitative assessment of auditory injury to each marine mammal species are provided in Volume 7B, Appendix 7-3: Marine Mammals Piling Results (Auditory Injury and Disturbance). Due to differences in spatial distribution, different modelling locations represent the worst-case scenarios for different species.

7.7.1.39 The maximum injury range based on $SEL_{cum}$ metric as a result of piling at single location varies from less than 100m for HF cetaceans (bottlenose dolphin, white-beaked dolphin, common dolphin, Risso's dolphin) to 36km for LF cetaceans (minke whale and humpback whale). However, for most species, except harbour porpoise and minke whale, it is predicted that up to one animal may experience PTS within respective injury ranges. Up to 200 harbour porpoises and 70 minke whales were estimated to be at risk of auditory injury, however, as described in paragraph 7.7.1.36, modelling for cumulative PTS (using the $SEL_{cum}$ metric) is overly-precautionary and is likely to lead to an over-estimation of impact zones. The maximum instantaneous PTS-onset range from piling at full hammer energy across all species is 850m for harbour porpoise. There is no more than one animal at risk of experiencing auditory injury (PTS) based on $SPL_{peak}$ metric.

7.7.1.40 Data collected during wind farm construction have demonstrated that porpoise detections around the pile driving site decline several hours to days prior to the start of pile driving. It is assumed that this is due to the increase in other construction related activities and vessel presence in advance of the actual pile driving (Brandt *et al*., 2018[79]; Graham *et al*., 2019b[72]; Benhemma-Le Gall *et al*., 2021[80]; 2023[81]). Therefore, the presence of construction related vessels prior to the start of piling can act as a local-scale deterrent for harbour porpoise and therefore reduce the risk of auditory injury. Assumptions that harbour porpoise are present in the vicinity of the pile driving at the start of the soft start are therefore likely to be overly conservative.

7.7.1.41 Due to very localised impact ranges, the impact would not extend beyond the Moray Firth and therefore it is anticipated that zero bottlenose dolphins from the GNS MU are at risk of experiencing PTS from piling. Similarly, for both species of seals, due to the small extent of the impact ranges (max 60 m), this impact is only assessed within the Moray Firth SMU as only animals within this SMU are expected to be impacted.

7.7.1.42 The extent and duration of auditory injury (instantaneous PTS) is expected to be localised (up to 0.85km for harbour porpoise but doesn't exceed 60m for other species). The effect is unlikely to occur due to the application of embedded mitigation (specific measures to be agreed post-consent as a part of the final MMMP) that will ensure that animals are outside of the injury zone before the commencement of piling activities. As the consequence, it is anticipated that no animals will experience injury and, therefore, the impact will not alter the respective populations trajectories. Therefore, the magnitude of instantaneous PTS from piling for all species has been assessed as Negligible.

Table 7–21: Summary of the worst case piling noise modelling results for auditory injury across all species. N/A = there was no overlap of the PTS impact ranges during concurrent piling for HF cetaceans.

| Species | Density | Parameters | Single Piling | | Concurrent Piling |
|---|---|---|---|---|---|
| | | | $SPL_{peak}$ | $SEL_{cum}$ | $SEL_{cum}$ |
| Harbour porpoise | Lacey *et al.* (2022[53]) | Worst case | Monopile, Location 7 | | Jacket, Locations 3 and 8 |
| | | Area (km$^2$) | 2.3 | 560 | 1,700 |
| | | Range (m) | 850 | 15,000 | 15,000 |
| | | No. of animals | 1 | 200 | 570 |
| | | % MU | 0.0003 | 0.06 | 0.16 |
| | | % UK MU | 0.0006 | 0.12 | 0.36 |
| Bottlenose dolphins | Grid cell specific density and 2km coastal buffer | Worst case | All design options, Location 8 | | N/A |
| | | Area (km$^2$) | <0.01 | <0.1 | |
| | | Range (m) | <50 | <100 | |
| | | No. of animals | <1 | <1 | |
| | | % CES MU | <0.004 | <0.004 | |
| White-beaked dolphin | Lacey *et al.* (2022[53]); Gilles *et al*. (2023[54]) | Worst case | All design options, all locations | | N/A |
| | | Area (km$^2$) | <0.01 | <0.1 | |
| | | Range (m) | <50 | <100 | |
| | | No. of animals | <1 | <1 | |

| Species | Density | Parameters | Single Piling | | Concurrent Piling |
|---|---|---|---|---|---|
| | | | $SPL_{peak}$ | $SEL_{cum}$ | $SEL_{cum}$ |
| | | % CGNS MU | <0.002 | <0.003 | |
| | | % UK CGNS MU | <0.002 | <0.003 | |
| Common dolphin | Lacey *et al.* (2022[53]) | Worst case | All design options, all locations | | N/A |
| | | Area (km²) | <0.01 | <0.1 | |
| | | Range (m) | <50 | <100 | |
| | | No. of animals | <1 | <1 | |
| | | % CGNS MU | <0.001 | <0.002 | |
| | | % UK CGNS MU | <0.001 | <0.002 | |
| Risso's dolphin | Gilles *et al.* (2023[54]) | Worst case | All design options, all locations | | N/A |
| | | Area (km²) | <0.01 | <0.1 | |
| | | Range (m) | <50 | <100 | |
| | | No. of animals | <1 | <1 | |
| | | % CGNS MU | <0.008 | <0.012 | |
| | | % UK CGNS MU | <0.008 | <0.012 | |
| Minke whale | Lacey *et al.* (2022[53]) | Worst case | Jacket, location 7 | | Monopile, Locations 3 and 8 |
| | | Area (km²) | 0.01 | 2,500 | 5,300 |

| Species | Density | Parameters | Single Piling | | Concurrent Piling |
|---|---|---|---|---|---|
| | | | $SPL_{peak}$ | $SEL_{cum}$ | $SEL_{cum}$ |
| | | Range (m) | 50 | 36,000 | 34,000 |
| | | No. of animals | <1 | 70 | 156 |
| | | % CGNS MU | <0.005 | 0.35 | 0.78 |
| | | % UK CGNS MU | <0.01 | 0.67 | 1.52 |
| Harbour seal | Carter *et al.* (2020[51]) | Worst case | Monopile, Location 7 | | Monopile, Locations 3 and 8 |
| | | Area ($km^2$) | 0.01 | 5.40 | 250 |
| | | Range (m) | 60 | 1,500 | 14,500 |
| | | No. of animals | <1 | <1 | 1 |
| | | % MF MU | <0.1 | <0.1 | 0.1 |
| Grey seal | Carter *et al.* (2020[51]) | Worst case | Monopile, Location 7 | | Monopile, Locations 3 and 8 |
| | | Area ($km^2$) | 0.01 | 250 | 250 |
| | | Range (m) | 60 | 14,500 | 14,500 |
| | | No. of animals | <1 | <1 | 58 |
| | | % MF MU | <0.01 | <0.01 | 0.79 |

*Sensitivity of Receptor*

7.7.1.43 The ecological consequences of PTS for marine mammals are uncertain. At an expert elicitation workshop for the iPCoD framework several general discussion points were raised, including that PTS did not mean animals were deaf, that the limitations of the ambient noise environment should be considered and that the magnitude and frequency band in which PTS occurs are critical to assessing the effect on vital rates (Booth and Heinis, 2018[82]).

7.7.1.44 For piling noise, most energy is between approximately 30 – 500Hz, with a peak usually between 100 – 300Hz and energy extending above 2kHz (Kastelein *et al.*, 2015[83]; 2016[84]). Studies have shown that exposure to impulsive pile driving noise induces threshold shift in a relatively narrow frequency band (i.e., a 'notch') in marine mammals (reviewed in Finneran (2015[85])), with statistically significant threshold shift occurring at 4 and 8kHz (Kastelein *et al.*, 2016[137]) and centred at 4kHz (Kastelein *et al.*, 2012a[86]; 2012b[87]; 2013[88]; 2017[89]). Therefore, it is expected that any threshold shifts that occur as a result of pile driving would manifest themselves somewhere between 2 to 10kHz (Kastelein *et al.*, 2017[142]). This is considered to apply to all marine mammals. The expert elicitation found that a PTS 'notch' of 6 to 18 dB in a narrow frequency band in the 2 to 10kHz region is highly unlikely to significantly affect the fitness of individuals (ability to survive and reproduce) of the species assessed (harbour porpoise, bottlenose dolphins and seals).

7.7.1.45 The frequency where the PTS is expected is below the region of greatest sensitivity for VHF cetaceans, including harbour porpoise (12 to 140kHz, Table 7–9). There is a small overlap with the 2 to 10kHz range and region of greatest sensitivity for HF cetaceans such as bottlenose dolphin, common dolphin, white-beaked dolphin and Risso's dolphin (8.8 to 110kHz, Table 7–9). Whilst there is a potential for overlap with the region of greatest hearing sensitivity for PCW species (1.9 to 30kHz, Table 7–9), expert elicitation process concluded that auditory injury (PTS) is unlikely to have a large impact on survival or fertility of both seal species (Booth and Heinis, 2018[82]).

7.7.1.46 Whilst PTS is a permanent effect which cannot be recovered from, the evidence does not suggest that PTS from piling will cause a material impact on either survival or reproductive rates for species included in the expert elicitation process (harbour porpoise, bottlenose dolphin, harbour seal, grey seal). As such, harbour porpoise, bottlenose dolphin, harbour seal and grey seal are assessed as having a Low sensitivity to auditory injury (PTS-onset) from piling. Given that common dolphin, white-beaked dolphin and Risso's dolphin are high frequency cetaceans, the score for their sensitivity has been aligned with bottlenose dolphin and these species are also assessed as having a Low sensitivity to auditory injury (PTS) from piling.

7.7.1.47 There is an overlap with frequency at which PTS due to piling is expected to occur and the region of greatest sensitivity for LF cetaceans, including minke whale and humpback whale (200Hz to 19kHz, Table 7–9). Although animals are not at risk of loss of hearing across the entire hearing band, they may have limited ability to adapt their behaviour and tolerance to the effect. Additionally, minke whales present in the vicinity of Caledonia South may be associated with the Southern Trench MPA, where minke whales listed as protected features. As such, minke whale and humpback whale are assessed as having a Medium sensitivity to auditory injury (PTS-onset) from piling.

*Significance of Effect*

7.7.1.48 Taking the **Low** sensitivity of harbour porpoise, dolphins and seals to auditory injury due to PTS, and the **Medium** sensitivity of minke whale and humpback whale, and the Negligible magnitude of impact (for instantaneous PTS), the overall effect of auditory injury (PTS) during piling during construction is considered to be **Negligible and Not Significant in EIA terms**.

7.7.1.49 The Applicant has committed to implementing a MMMP (M-16, see Table 7–13) to ensure the risk of auditory injury (instantaneous PTS) is negligible. Indicative mitigation measures presented in the draft MMMP (see Volume 7, Appendix 14: Caledonia South Draft Marine Mammal Mitigation Protocol) include soft-start and ramp up procedure and use of ADDs. Although the exact mitigation measures contained with the final MMMP are yet to be determined, they will be in line with the latest relevant guidance at the time of this stage of Caledonia South. It is considered that, due to the small PTS impact ranges, the impact of auditory injury can be fully mitigated using the embedded mitigation and, therefore, no secondary mitigation measures will be required.

7.7.1.50 Following the application of embedded mitigation (MMMP, see Table 7–13), the residual significance of the effect of auditory injury from piling during construction is assessed as **Negligible and Not Significant in EIA terms**.

**EPS**

7.7.1.51 As EPS, listed on Annex IV of the EU Habitats Directive, it is an offence to kill, injure or disturb cetaceans. An EPS risk assessment is required to assess the risk that an offence will occur, therefore assessing the need for an EPS licence(s) and providing the information required by MD-LOT in support of any such applications.

7.7.1.52 The Applicant will provide an EPS risk assessment for injury from piling at the post consent stage, once final piling parameters are confirmed. The expectation is that given the commitment to a MMMP (M-16, see

Table 7–13) to reduce the risk of auditory injury to negligible levels, no individuals that are classified as EPS will be injured, and thus an EPS license for injury is unlikely to be required.

7.7.1.53 It is noted that NatureScot's opinion on the consideration of cumulative PTS in an EPS risk assessment is currently under review (*pers comm*). They acknowledge that cumulative PTS ranges are likely to be over-estimated and advised this in relation to EIA (Table 7–3), but suggested that cumulative PTS should be addressed in an EPS risk assessment in some way, though how is currently undecided. It is expected that this will require consultation and agreement post-consent before an EPS risk assessment is conducted.

## Impact 4: Disturbance from Piling

7.7.1.54 The worst-case scenarios for disturbance to all species presented in this section are based on modelling locations with the most precautionary impact ranges and the highest number of animals potentially impacted. For the full set of results (all modelling locations, all foundation designs and sets of densities) and more information regarding the assessment method (application of dose-response), see Volume 7B, Appendix 7-3: Marine Mammals Piling Results (Auditory Injury and Disturbance).

7.7.1.55 For more information regarding the assessment method (application of dose-response), refer to Volume 7B, Appendix 7-2: Marine Mammals Underwater Noise Methodology.

### Summary

7.7.1.56 A summary of the assessment of injury from piling during construction is provided in Table 7–22. No impacts are considered significant in EIA terms.

Table 7–22: Summary of the significance of disturbance from piling to marine mammals during construction phase.

| Receptor | Embedded Mitigation | Magnitude | Sensitivity | Significance | Secondary Mitigation | Residual |
|---|---|---|---|---|---|---|
| Harbour porpoise | None | Low | Low | Negligible | None | Negligible |
| Bottlenose dolphin | None | Low (GNS MU) | Low | Negligible | None | Negligible |
| | | Medium (CES MU) | Low | Minor | None | Minor |
| White-beaked dolphin | None | Medium | Low | Minor | None | Minor |
| Common dolphin | None | Low | Low | Negligible | None | Negligible |
| Risso's dolphin | None | Low | Low | Negligible | None | Negligible |
| Minke whale | None | Low | Medium | Minor | None | Minor |
| Humpback whale | None | Low | Low | Negligible | None | Negligible |
| Harbour seal | None | Low | Low (MF MU, ES MU)<br><br>Medium (NC&O MU) | Negligible (MF MU, ES MU)<br><br>Minor (NC&O MU) | None | Negligible to Minor |
| Grey seal | None | Low | Negligible | Negligible | None | Negligible |

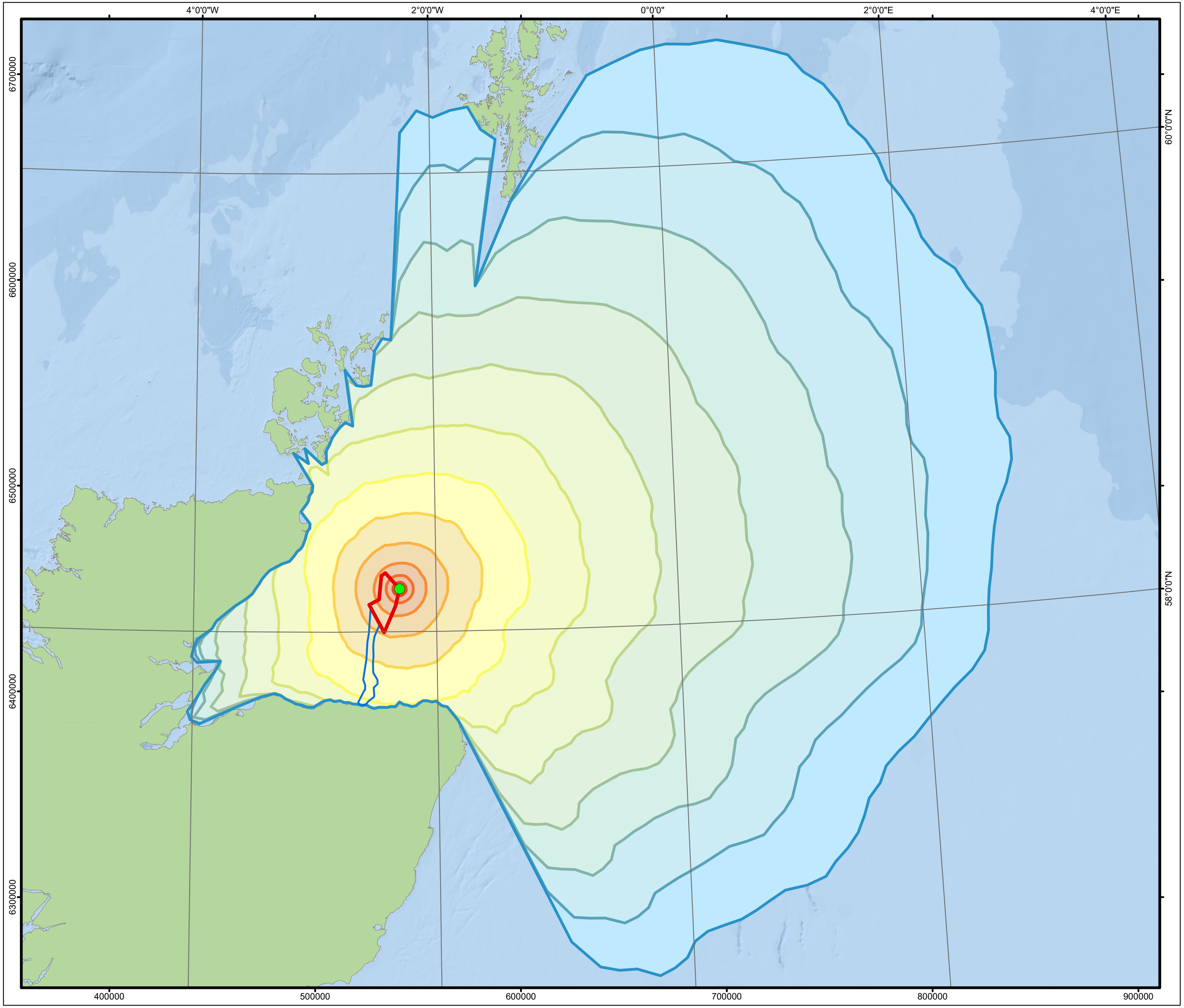
*Harbour porpoise*

Magnitude of Impact

7.7.1.57 The number of harbour porpoise predicted to be disturbed by piling of a single monopile on any given day is a maximum of 8,942 individuals (2.58% of the NS MU) (Table 7–23 and Figure 7–4). For the same modelling location, it is estimated that up to 8,827 animals may experience disturbance within the UK portion of the NS MU (5.53% of the UK NS MU). For concurrent piling, a maximum of up to 8,881 animals are predicted to be disturbed (2.56% of the NS MU). The number disturbed per day from jacket pin-piles and piled anchors are lower than for monopiles.

Table 7–23: Summary of the worst case piling underwater noise modelling results for disturbance of harbour porpoise using the dose-response function (Graham *et al.*, 2017a[71]), with results based on Gilles *et al.* (2023[54]) density.

| Foundation Design | Parameters | Single Piling | Concurrent Piling |
|---|---|---|---|
| Monopile | Worst case | Location 7 | Locations 3 and 8 |
| | No. of animals NS MU | 8,942 | 8,881 |
| | % MU | 2.58 | 2.56 |
| | No. of animals UK MU | 8,827 | 8,797 |
| | % UK MU | 5.53 | 5.51 |
| Jacket | Worst case | Location 7 | Locations 3 and 8 |
| | No. of animals NS MU | 8,201 | 8,132 |
| | % MU | 2.37 | 2.35 |
| | No. of animals UK MU | 8,111 | 8,071 |
| | % UK MU | 5.08 | 5.06 |
| Anchor | Worst case | Location 7 | Locations 5 and 8 |
| | No. of animals NS MU | 6,648 | 6,990 |
| | % MU | 1.92 | 2.02 |
| | No. of animals UK MU | 6,604 | 6,947 |
| | % UK MU | 4.14 | 4.35 |




Caledonia South Site

Caledonia South Offshore Export Cable Corridor

Modelling Location 7

**Noise Contours (SELss, dB re 1 µPa2s)**

120, 125, 130, 135, 140, 145, 150, 155, 160, 165, 170, 175, 180

**Probability of response based on Graham *et al.* 2017**

| | |
|---|---|
| 120 ≤ 125 | 1.15% |
| 125 ≤ 130 | 3.49% |
| 130 ≤ 135 | 8.78% |
| 135 ≤ 140 | 18.52% |
| 140 ≤ 145 | 33.12% |
| 145 ≤ 150 | 50.90% |
| 150 ≤ 155 | 68.49% |
| 155 ≤ 160 | 82.66% |
| 160 ≤ 165 | 91.92% |
| 165 ≤ 170 | 96.85% |
| 170 ≤ 175 | 98.98% |
| 175 ≤ 180 | 99.73% |
| 180 ≤ | 99.94% |




0 10 20 30 40 50 km

| | | | | | |
|---|---|---|---|---|---|
| 01 | 24/09/2024 | Approved | EV | BB | DH |
| REV | DATE | DOC STATUS | ORIGIN | REVIEW | APP |

CALEDONIA Offshore Wind Farm

GoBe APEM Group

| | |
|---|---|
| CONTRACTOR DRAWING NO UKCAL1_GO_WNF_MMM_MAP_00473 | CONTRACTOR REV 01 |

GEODETIC PARAMETERS
WGS 84 / UTM zone 30N (EPSG: 32630)

DRAWING TITLE
Figure 7-4: Noise Contours and Predictive Response for the Installation of a Monopile at 6,600 kJ at Location 7

| | | |
|---|---|---|
| STATUS Approved | SCALE 1:2,500,000 | |
| DRAWING NUMBER N/A | SHEET NO 01 of 01 | REV N/A |

7.7.1.58 To determine whether this level of disturbance is expected to result in population level impacts, iPCoD modelling was conducted. The results of the iPCoD modelling show, for the whole MU and the UK portion of the MU, shows that the level of disturbance is not sufficient to result in any changes at the population level (difference between impacted and un-impacted population size at all time points is less than 1.14%). The impacted population is predicted to continue at a stable trajectory, the same as the un-impacted population. Refer to Volume 7D, Appendix 7-1: Marine Mammals Population Modelling (iPCoD) for detailed iPCoD results.

7.7.1.59 The impact of disturbance from piling will occur over a large spatial extent, though it is noted that response probabilities at the lower received levels are low and less likely (Graham *et al.*, 2017a[71]; 2019b[72]). The majority of the predicted response will occur over a medium spatial extent. Although the duration of the impact is medium term (piling will occur over a maximum 451 days), since studies have shown that harbour porpoise detections return to baseline levels after the cessation of piling (Brandt *et al.*, 2011[90]; 2016[91]; 2018[79]; Dähne *et al.*, 2013[92]), the duration of the effect (disturbance from a single piling event) is considered to be low. The probability of the effect is high, since there are multiple sources of evidence that have shown displacement of porpoise in response to pile driving activities (e.g., Dähne *et al.*, 2013[92]; Brandt *et al.*, 2018[79]; Graham *et al.*, 2019a[93]). The effect will occur at a moderate frequency, intermittently across a period of up to three years. As shown by the iPCoD modelling, the impact could affect a small proportion of the population, but the population trajectory would not be altered and therefore the effect has an overall low consequence. As such, the impact of disturbance from piling is of Low magnitude.

Sensitivity of Receptor

7.7.1.60 Harbour porpoise are small cetaceans which makes them vulnerable to heat loss and requires them to maintain a high metabolic rate with little energy remaining for fat storage (Rojano-Doñate *et al.*, 2018[94]). There is a risk of starvation if they are unable to obtain sufficient levels of prey intake.

7.7.1.61 Wisniewska *et al.* (2016[95]) reported that porpoise tagged after capture in pound nets foraged on small prey nearly continuously during both the day and the night on their release (Wisniewska *et al.*, 2016[95]). The authors state that porpoise therefore are expected to have low resilience to disturbance. However, there are concerns with the methodologies used in the Wisniewska *et al.* (2016[95]) paper that bring these conclusions into question. These concerns are summarized in a rebuttal to the original paper by Hoekendijk *et al.* (2018[96]) which call for "*a cautious, critical, and rational assessment of the results and* *interpretations*". One of the key issues highlighted is that the porpoise were trapped in a pound net for 24+ hours before tagging and were not allowed to recover from stress and starvation once released (Hoekendijk *et al.*, 2018[96]). The high levels of foraging observed therefore do not necessarily represent typical foraging, but may in part be a response to being captured and held. Further to this, a subsequent paper by Booth (2020[97]) used the Wisniewska *et al.* (2016[95]) data combined with additional information on porpoise diet and the energy derived from different prey to highlight that the tagged animals likely were able to consume significant amounts of energy (well in excess of energetic requirements – based on the data available). Booth (2020[97]) disputes the conclusion that porpoise exist on an "energetic knife-edge" as Wisniewska *et al.* (2016[95]) claim but do not justify in their paper. The results from Wisniewska *et al*. (2016[95]) could also suggest that porpoises have an ability to respond to short term reductions in food intake, implying a resilience to disturbance (as long as prey items are readily available).

7.7.1.62 Previous studies have shown that harbour porpoises are displaced from the vicinity of piling events. Studies at wind farms in the German North Sea have recorded large declines in harbour porpoise detections close to the piling, with decreasing effect with increasing distance from the pile (Brandt *et al.*, 2016[91]). The detection rates revealed that harbour porpoise were only displaced from the piling area in the short term (1 to 3 days) (Brandt *et al.*, 2011[90]; 2016[91]; 2018[79]; Dähne *et al.*, 2013[92]). Monitoring of harbour porpoise activity at the Beatrice OWF within the Moray Firth during piling has indicated that harbour porpoises were displaced from the immediate vicinity of the pile driving activity with diminishing response over the construction period (Graham *et al.*, 2019b[99]). In addition, the study indicated that harbour porpoise activity recovered between pile driving days. Benhemma-Le Gall *et al.* (2021[80]) studied harbour porpoise response to pile driving at two OWFs within the Moray Firth and found that harbour porpoise were not completely displaced from the piling site: detections of clicks (echolocation) and buzzing (associated with prey capture) in the short-range (2km) did not cease in response to pile driving. Detections of both clicks (echolocation) and buzzing (associated with prey capture) increased above baseline levels with increasing distance from the pile, which suggests that those harbour porpoise that are displaced from the near-field resume foraging at a greater distance from the modelling location. Therefore, harbour porpoise that experience displacement are expected to be able to compensate for the lost foraging opportunities.

7.7.1.63 The findings of the expert elicitation workshop suggest that first year calf survival (post-weaning) and fertility were the most likely vital rates to be affected by disturbance, but that juvenile and adult survival were unlikely to be significantly affected as these life-stages were considered to be more robust (Booth *et al.*, 2019[98]). Experts agreed that the final third of the year was the most critical for harbour porpoises as they reach the end of the current lactation period and the start of new pregnancies, therefore it was thought that significant impacts on fertility would only occur when animals received repeated exposure throughout the whole year. It was also concluded that it would likely take high levels of repeated disturbance to an individual before there was any effect on that individual's fertility, and that it was very unlikely an animal would terminate a pregnancy early. The experts agreed that calf survival could be reduced by only a few days of repeated disturbance to a mother/calf pair during early lactation; however, it is highly unlikely that the same mother-calf pair would repeatedly return to the area in order to receive these levels of repeated disturbance (Booth *et al.*, 2019[98]).

7.7.1.64 The observed responsiveness to piling and expected ability to compensate for lost foraging opportunities suggest that harbour porpoise have the ability go adapt behaviour in response to stressor. As such, harbour porpoises are anticipated to be able to recover from any impact on vital rates and have been assessed as having a Low sensitivity to disturbance from piling.

Significance of effect

7.7.1.65 Taking the **Low** sensitivity of harbour porpoise and the **Low** magnitude of impact, the overall effect of disturbance from piling during construction is considered to be **Negligible and Not Significant in EIA terms**.

7.7.1.66 In the absence of any mitigation, the effect of disturbance from piling on harbour porpoise is considered to be not significant in EIA terms. Therefore, no embedded or secondary mitigation is required.

7.7.1.67 The residual significance of the effect of disturbance from piling during construction is assessed as **Negligible and Not Significant in EIA terms**.

*Bottlenose dolphin*

Magnitude of Impact

7.7.1.68 The approach to bottlenose dolphin densities for the assessment of piling is summarised in paragraph 7.4.3.5 and explained in more detail in Volume 7B, Appendix 7-1: Marine Mammals Baseline Characterisation.

7.7.1.69 The number of bottlenose dolphins predicted to be disturbed within the CES MU by single piling on any given day is a maximum of 56 individuals (22.86% of the CES MU) (Table 7–24 and Figure 7–5). During concurrent piling, up to 57 individuals may experience disturbance (23.27% CES MU). The number of bottlenose dolphins predicted to be disturbed within the GNS MU by single piling on any given day is a maximum of 39 individuals (1.93% of the GNS MU) (Table 7–25 and Figure 7–6). During concurrent piling, up to 37 individuals may experience disturbance (1.83% GNS MU).

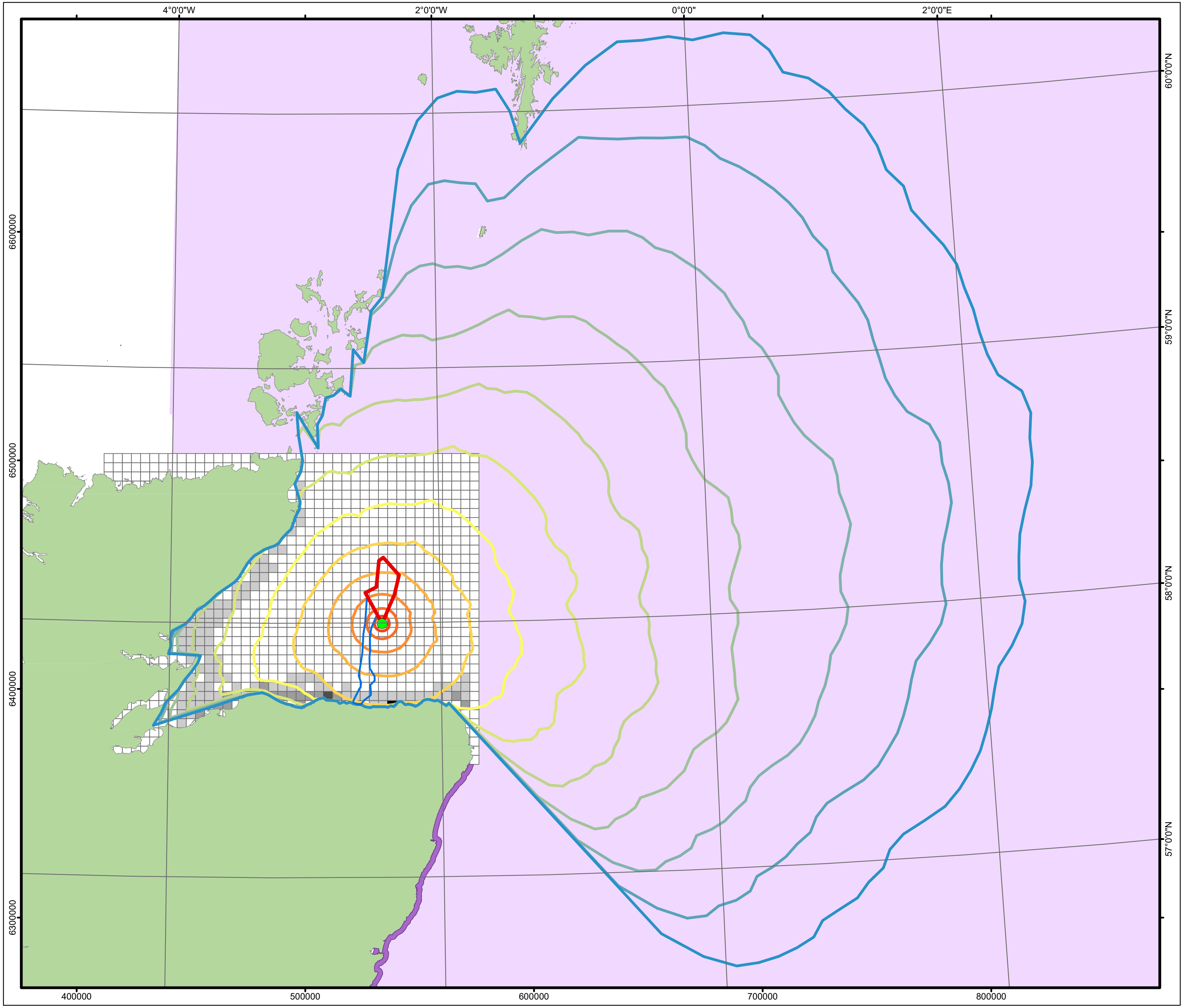
7.7.1.70 It should be noted that the assessment adopted the harbour porpoise dose-response function and is therefore considered precautionary (see Volume 7B, Appendix 7-2: Marine Mammals Underwater Noise Assessment Methodology for a discussion of assessment limitations).

Table 7–24: Summary of the worst case piling underwater noise modelling results for disturbance of bottlenose dolphin within the CES MU using the dose response function (Graham *et al.*, 2017a[71]), with results based on grid cell specific density within the Moray Firth and 2km coastal buffer.

| Foundation Design | Parameters | Single Piling | Concurrent Piling |
|---|---|---|---|
| Monopile | Worst case | Location 8 | Locations 3 and 8 |
| | No. of animals | 56 | 57 |
| | % CES MU | 22.86 | 23.27 |
| Jacket | Worst case | Location 8 | Locations 3 and 8 |
| | No. of animals | 52 | 53 |
| | % CES MU | 21.22 | 21.63 |
| Anchor | Worst case | Location 8 | Locations 5 and 8 |
| | No. of animals | 46 | 47 |
| | % CES MU | 18.78 | 19.18 |

Table 7–25: Summary of the worst case piling underwater noise modelling results for disturbance of bottlenose dolphin within the GNS MU using the dose response function (Graham *et al.*, 2017a[71]), with results based on a density of 0.003 animals per $km^2$.

| Foundation Design | Parameters | Single Piling | Concurrent Piling |
|---|---|---|---|
| Monopile | Worst case | Location 7 | Locations 3 and 8 |
| | No. of animals | 39 | 37 |
| | % GNS MU | 1.93 | 1.83 |
| Jacket | Worst case | Location 7 | Locations 3 and 8 |
| | No. of animals | 35 | 33 |
| | % GNS MU | 1.73 | 1.63 |
| Anchor | Worst case | Location 7 | Locations 5 and 8 |
| | No. of animals | 27 | 28 |
| | % GNS MU | 1.34 | 1.38 |




- Caledonia South Site
- Caledonia South Offshore Export Cable Corridor
- GNS MU (0.003 dolphin/km$^2$)
- South of Moray Firth - 0.142 dolphins/km$^2$ (CES MU)
- Modelling Location 8

**Noise Contours (SELss, dB re 1 µPa2s) - Probability of response based on Graham *et al.* (2017) in brackets**

- 120 (1.15%)
- 125 (3.49%)
- 130 (8.78%)
- 135 (18.52%)
- 140 (33.12%)
- 145 (50.90%)
- 150 (68.49%)
- 155 (82.66%)
- 160 (91.92%)
- 165 (96.85%)
- 170 (98.98%)
- 175 (99.73%)
- 180 (99.94%)

**Moray Firth Density Surface (#/km$^2$)**

**Density**

- 0.00 - 0.01
- 0.01 - 0.10
- 0.10 - 0.20
- 0.20 - 0.50
- >0.50




0 10 20 30 40 50 km

| REV | DATE | DOC STATUS | ORIGIN | REVIEW | APP |
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| 01 | 24/09/2024 | Approved | EV | BB | DH |

CALEDONIA Offshore Wind Farm

GoBe APEM Group

CONTRACTOR DRAWING NO: UKCAL1_GO_WNF_MMM_MAP_00471

CONTRACTOR REV: 01

GEODETIC PARAMETERS: WGS 84 / UTM zone 30N (EPSG: 32630)

DRAWING TITLE

Figure 7-5: Noise Contours and Predicted Response for the Installation of a Monopile at 6,600 kJ at Location 8 and Bottlenose Dolphin Distribution

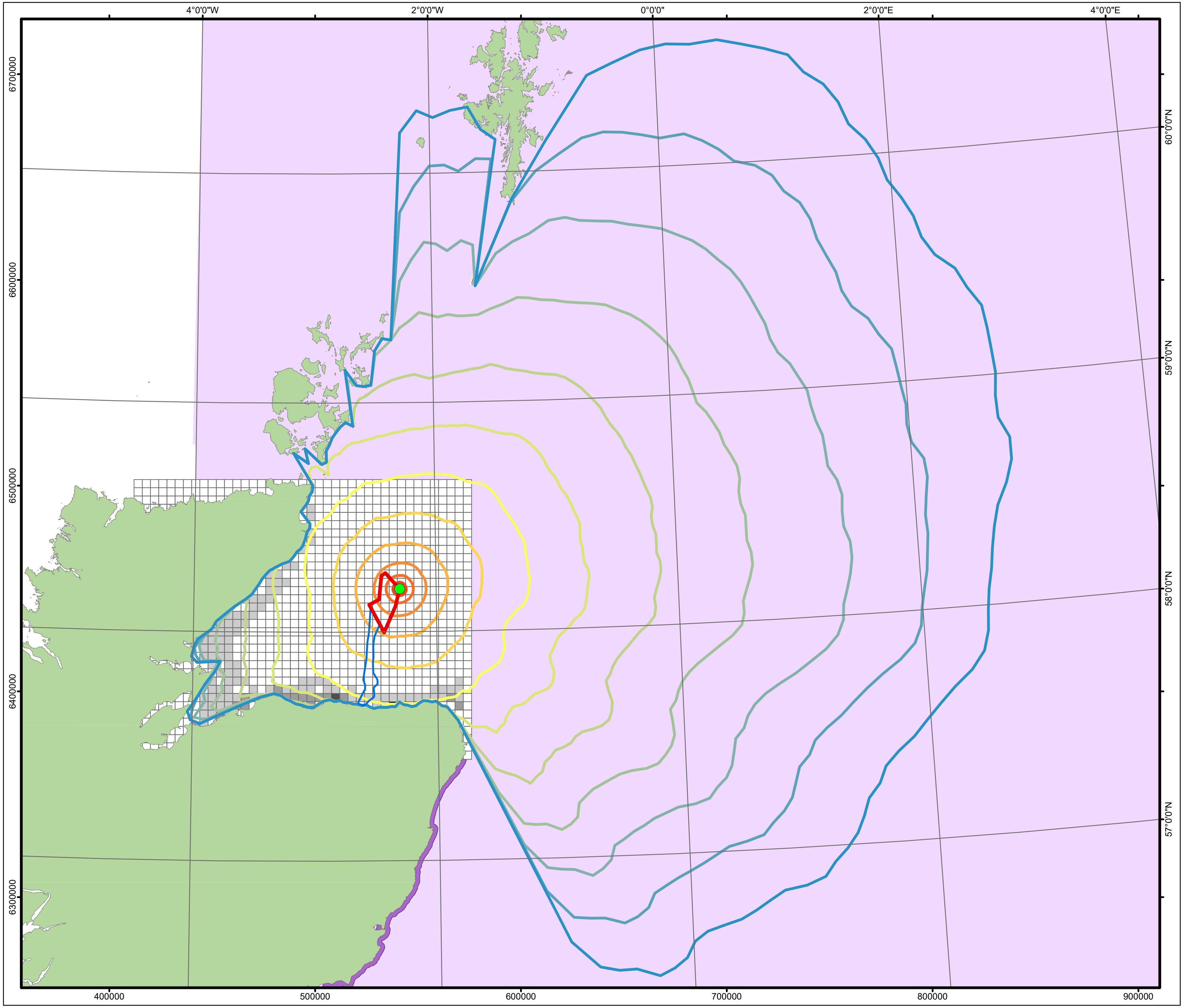
STATUS: Approved

SCALE: 1:2,250,000

DRAWING NUMBER: N/A

SHEET NO: 01 of 01

REV: N/A




Caledonia South Site

Caledonia South Offshore Export Cable Corridor

GNS MU (0.003 dolphin/km$^2$)

South of Moray Firth - 0.142 dolphins/km$^2$ (CES MU)

Modelling Location 7

**Noise Contours (SELss, dB re 1 µPa2s) - Probability of response based on Graham *et al.* (2017) in brackets**

- 120 (1.15%)
- 125 (3.49%)
- 130 (8.78%)
- 135 (18.52%)
- 140 (33.12%)
- 145 (50.90%)
- 150 (68.49%)
- 155 (82.66%)
- 160 (91.92%)
- 165 (96.85%)
- 170 (98.98%)
- 175 (99.73%)
- 180 (99.94%)

**Moray Firth Density Surface (#/km2)**

**Density**

- 0.00 - 0.01
- 0.01 - 0.10
- 0.10 - 0.20
- 0.20 - 0.50
- >0.50




0 10 20 30 40 50 km

| REV | DATE | DOC STATUS | ORIGIN | REVIEW | APP |
|---|---|---|---|---|---|
| 01 | 24/09/2024 | Approved | EV | BB | DH |

CALEDONIA Offshore Wind Farm

GoBe APEM Group

| | |
|---|---|
| CONTRACTOR DRAWING NO: UKCAL1_GO_WNF_MMM_MAP_00470 | CONTRACTOR REV: 01 |
| GEODETIC PARAMETERS: WGS 84 / UTM zone 30N (EPSG: 32630) | |
| DRAWING TITLE: Figure 7-6: Noise Contours and Predicted Response for the Installation of a Monopile at 6,600 kJ at Location 7 and Bottlenose Dolphin Distribution | |
| STATUS: Approved | SCALE: 1:2,500,000 |
| DRAWING NUMBER: N/A | SHEET NO: 01 of 01; REV: N/A |

7.7.1.71 To determine whether this level of disturbance is expected to result in population level impacts, iPCoD modelling was conducted[iii]. The results of the iPCoD modelling for the GNS MU shows that the level of disturbance is not sufficient to result in any changes at the population size or population trajectory (deviation in the proportion of the impacted to and un-impacted population size is within 1%).

7.7.1.72 For the CES MU the modelled disturbance levels showed higher levels of impacts. The impacted population size as a proportion of the un-impacted population size drops to up to 93.04% in 2030 which coincides with the end of third and final piling year at Caledonia South. Following the cessation of piling, the impacted population size reaches 94.64% of the un-impacted population size 18 years after piling ends. Although the impacted population is reduced in size compared to the un-impacted population, the impacted population continues increasing in trajectory (Figure 7–7). Refer to Volume 7D, Appendix 7-1: Marine Mammals Population Modelling (iPCoD) for detailed iPCoD results.

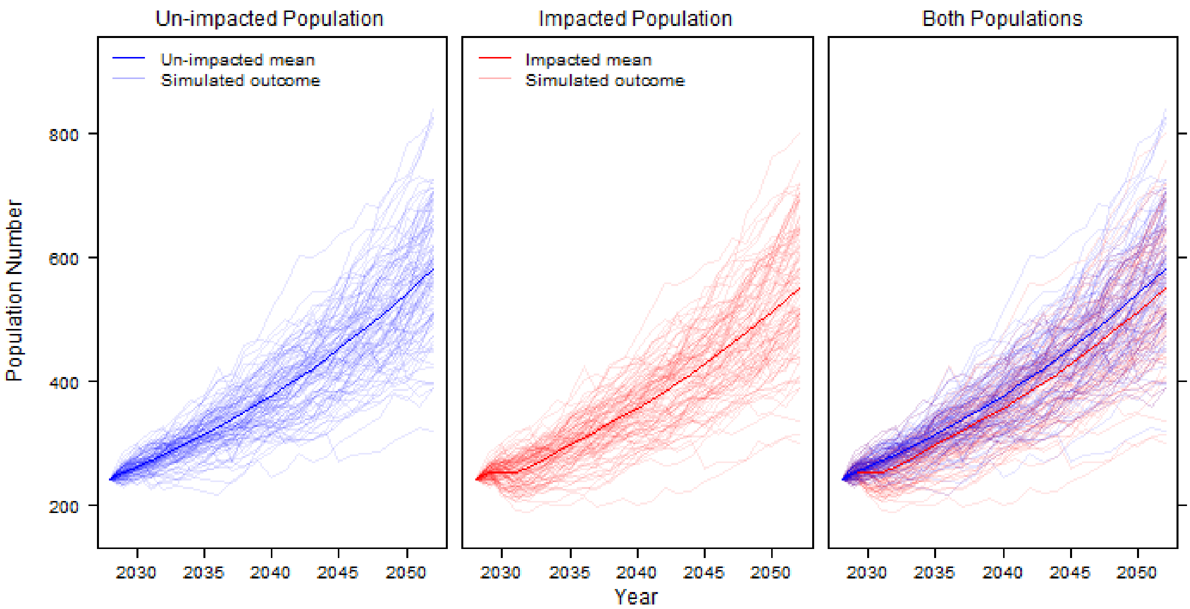



Figure 7–7: Predicted population trajectories for the un-impacted (baseline) and impacted bottlenose dolphin iPCoD simulation for the CES MU

[iii] Noting that there are caveats associated with using iPCoD for disturbance for bottlenose dolphins, as presented in Volume 7D, Appendix 7-1: Marine Mammals Population Modelling (iPCoD).

7.7.1.73 The impact of disturbance from piling will occur over a large spatial extent, though it is noted that response probabilities at the lower received levels are low and less likely (Graham *et al.*, 2017a[71]; 2019b[72]). The majority of the predicted response will occur over a medium spatial extent. The duration of the impact is medium term (piling will occur over a maximum 451 days). The probability of the effect is high, while there are limited studies on the responses of bottlenose dolphins to piling there is evidence that small spatial and temporal scale disturbance to bottlenose dolphins can occur as a result of impact piling activities (Graham *et al.*, 2017b[99]). The effect will occur at a moderate frequency, intermittently across a period of up to three years. As shown by the iPCoD modelling, the impact could affect a small proportion of the GNS MU population, but the population trajectory would not be altered and therefore the effect has an overall low consequence. However, for bottlenose dolphins within the CES MU population, behavioural disturbance as a result of piling may affect a larger proportion of the population and therefore lead to approximately 7% deviation in size when compared to un-impacted population. While the impacted CES MU population size is reduced compared to the un-impacted population size, it continues to increase in size even throughout the piling activities. This aligns with a consequence score of Medium, where the impact could affect a moderate proportion of the population, but the population trajectory would not be altered. As such, the impact of disturbance from piling is of Low magnitude for GNS MU population and Medium magnitude for CES MU population.

Sensitivity of Receptor

7.7.1.74 There is evidence in published literature that bottlenose dolphins may be displaced from an area as a result of the noise produced by offshore construction activities; for example, avoidance behaviour in bottlenose dolphins has been shown in relation to dredging activities, piling and seismic surveys (Pirotta *et al.*, 2013[100]; Graham *et al.*, 2017b[99]; Fernandez-Betelu *et al.*, 2021[44]). However, a study on bottlenose dolphin during the construction of the Nigg Energy Park in the Cromarty Firth showed that dolphins were not excluded from the vicinity of the piling activities (Graham *et al.*, 2017b[99]). The vibration piling resulted in a slight reduction of encounter durations (though only by a few minutes) for dolphins within the Cromarty Firth. These data highlight a small spatial and temporal scale disturbance to bottlenose dolphins as a result of impact piling activities.

7.7.1.75 Furthermore, the relatively dynamic social structure of bottlenose dolphins (Connor *et al*., 2001) and the fact that they have no significant predation threats and do not appear to face excessive competition for food with other marine mammal species, have potentially resulted in a higher tolerance (compared to porpoise) to perceived threats or disturbances in their environment, which may make them less sensitive to disturbance. According to the opinions of the experts, disturbance would be most likely to affect bottlenose dolphin calf survival, where: "*it exceeded 30-50 days, because it could result in mothers becoming separated from their calves and this could affect the amount of milk transferred from the mother to her calf*" (Harwood *et al.*, 2014[101]). Note, bottlenose dolphins were not included in the second (most recent) expert elicitation in 2018.

7.7.1.76 Given that the Moray Firth has been identified as important area with calves being recorded throughout the Moray Firth SAC[iv], there is the potential for behavioural disturbance and displacement to result in disruption in foraging and resting activities and an increase in travel and energetic costs. However, a study on bottlenose dolphins within the Moray Firth has shown that bottlenose dolphins have the ability to compensate for behavioural responses as a result of increased commercial vessel activity, where longer term overall activity time budget remained the same despite the immediate behavioural response to disturbance (New *et al.*, 2013[102]). Therefore, while there remains the potential for disturbance and displacement to affect individual behaviour, it is not expected that this would result in an overall change in individual energy budget since animals have been shown to compensate for time lost due to disturbance. Therefore, bottlenose dolphins are considered to have a Low sensitivity to disturbance from piling.

Significance of Effect

7.7.1.77 Taking the **Low** sensitivity of bottlenose dolphins and the **Low** (GNS MU) to **Medium** (CES MU) magnitude of impact, the overall effect of disturbance from piling during construction is considered to be **Negligible for the GNS MU and Minor for CES MU and Not Significant in EIA terms**.

7.7.1.78 In the absence of any mitigation, the effect of disturbance from piling on bottlenose dolphins is considered to be not significant in EIA terms. Therefore, no embedded or secondary mitigation is required.

7.7.1.79 The residual significance of the effect of disturbance from piling during construction is assessed as **Negligible for the GNS MU and Minor for CES MU and Not Significant in EIA terms**.

[iv] Although it should be noted that studies show that bottlenose dolphin from the Moray Firth SAC extended their distributional range southwards along the east coast of Scotland and into northeast England (Arso Civil *et al.*, 2019; Cheney *et al.*, 2024).

### *White-beaked dolphin*

#### Magnitude of Impact

7.7.1.80 The number of white-beaked dolphins predicted to be disturbed by single piling on any given day is a maximum of 3,114 individuals (7.09% of the CGNS MU) (Table 7–26 and Figure 7–4). For the same modelling location, it is estimated that up to 3,057 animals may experience disturbance within the UK portion of the CGNS MU (8.98% UK CGNS MU).

7.7.1.81 It should be noted that the assessment adopted the harbour porpoise dose-response function and is therefore considered precautionary (see Volume 7B, Appendix 7-2: Marine Mammals Underwater Noise Assessment Methodology for a discussion of assessment limitations).

Table 7–26: Summary of the worst case piling underwater noise modelling results for disturbance of white-beaked dolphin using the dose response function (Graham *et al.*, 2017a[71]), with results based on Gilles *et al.* (2023[54]) density.

| Foundation Design | Parameters | Single Piling | Concurrent Piling |
|---|---|---|---|
| Monopile | Worst case | Location 7 | Locations 3 and 8 |
| | No. of animals MU | 3,114 | 3,113 |
| | % MU | 7.09 | 7.08 |
| | No. of animals UK MU | 3,057 | 3,070 |
| | % UK MU | 8.98 | 9.02 |
| Jacket | Worst case | Location 7 | Locations 3 and 8 |
| | No. of animals MU | 2,873 | 2,871 |
| | % MU | 6.54 | 6.53 |
| | No. of animals UK MU | 2,828 | 2,839 |
| | % UK MU | 8.31 | 8.34 |
| Anchor | Worst case | Location 7 | Locations 5 and 8 |
| | No. of animals MU | 2,363 | 2,488 |
| | % MU | 5.38 | 5.66 |
| | No. of animals UK MU | 2,340 | 2,466 |
| | % UK MU | 6.88 | 7.25 |

7.7.1.82 The movement patterns of white-beaked dolphins in UK waters are poorly understood, and as such, it is not known the level of repeated disturbance an individual dolphin would be expected to receive. At one extreme, it could be assumed that there is no movement/turn-over of individuals in the area, and thus the same dolphins would be expected to be disturbed repeatedly for up to 451 piling days over up to three years. However, this is considered to be highly conservative since the limited data available of white-beaked dolphin movement patterns suggests that white-beaked dolphins have large home range areas and show low site fidelity (Bertulli *et al.*, 2015[103]). It is more likely that animals transit through the area within their large home-range (CGNS MU), and thus individuals are only available to be disturbed over a limited number of days when present in the disturbance area.

7.7.1.83 The impact of disturbance from piling will occur over a large spatial extent, though it is noted that response probabilities at the lower received levels are low and less likely (Graham *et al.*, 2017a[71]; 2019b[104]). The majority of the predicted response will occur over a medium spatial extent. The duration of the impact is medium term (piling will occur over a maximum 451 days). The probability of the effect is high, while there are limited studies on the responses of dolphins to piling there is evidence that small spatial and temporal scale disturbance to HF cetaceans (bottlenose dolphins) can occur as a result of impact piling activities (Graham *et al.*, 2017b[99]). The effect will occur at a moderate frequency, intermittently across a period of up to three years. Population modelling was not conducted for white-beaked dolphins since the iPCoD model is not parameterised for this species. Given their large home-range and low site fidelity, it is unlikely that animals would remain in the impacted area over prolonged periods of time to experience the levels of disturbance that might cause changes in vital rates. Therefore, although disturbance may affect moderate proportion of the population, there is unlikely to be any change to the population trajectory in the long term. Overall, the impact of disturbance from piling has been precautionarily assessed as Medium magnitude.

Sensitivity of Receptor

7.7.1.84 Due to the limited information on the effects of disturbance on white-beaked dolphins, bottlenose dolphins can be used as a proxy since both species are categorised as high-frequency cetaceans. Therefore, white-beaked dolphins are considered to have a Low sensitivity to disturbance from piling.

Significance of Effect

7.7.1.85 Taking the **Low** sensitivity of white-beaked dolphins and the **Medium** magnitude of impact, the overall effect of disturbance from piling during construction is considered to be **Minor and Not Significant in EIA terms**.

7.7.1.86 In the absence of any mitigation, the effect of disturbance from piling on white-beaked dolphin is considered to be not significant in EIA terms. Therefore, no embedded or secondary mitigation is required.

7.7.1.87 The residual significance of the effect of disturbance from piling during construction is assessed as **Minor and Not Significant in EIA terms**.

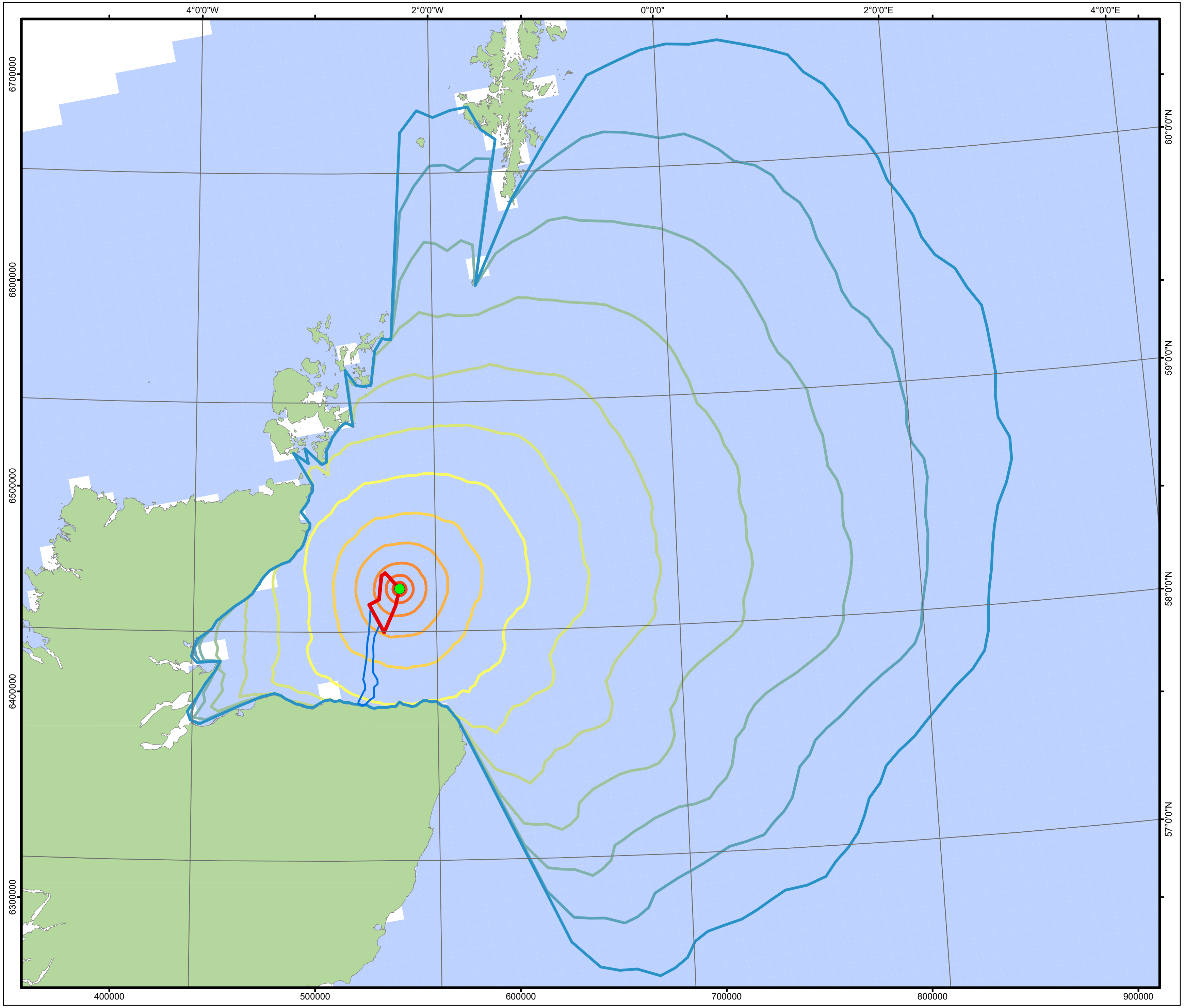
*Common dolphin*

Magnitude of Impact

7.7.1.88 Given the low expected density of common dolphins in the area, the number of animals predicted to be disturbed by single piling on any given day is low (maximum of four individuals), representing a low proportion of the MU (0.004% CGNS MU, Table 7–27 and Figure 7–8). For the same modelling location, it is estimated that the same number of animals may experience disturbance within the UK portion of the CGNS MU (0.007% UK CGNS MU).

Table 7–27: Summary of the worst case piling underwater noise modelling results for disturbance of common dolphin using dose response (Graham *et al.*, 2017a[71]).

| Foundation Design | Parameters | Single Piling | Concurrent Piling |
|---|---|---|---|
| Monopile | Worst case | Location 7 | Locations 3 and 8 |
| | No. of animals MU | 4 | 4 |
| | % MU | 0.004 | 0.004 |
| Jacket | Worst case | All locations | Locations 3 and 8 |
| | No. of animals MU | 3 | 4 |
| | % MU | 0.003 | 0.004 |
| Anchor | Worst case | All locations | Locations 5 and 8 |
| | No. of animals MU | 3 | 3 |
| | % MU | 0.003 | 0.003 |
| Note, the number of animals affected is the same for the UK proportion of the MU as for the whole MU and therefore it has not been included separately. Results are based on Lacey *et al.* (2022[105]) density. | | | |




Caledonia South Site

Caledonia South Offshore Export Cable Corridor

Modelling Location 7

**Lacey *et al.* (2022) Density for Common Dolphin**

<0.05

**Noise Contours (SELss, dB re 1 μPa2s) - Probability of response based on Graham *et al.* (2017) in brackets**

- 120 (1.15%)
- 125 (3.49%)
- 130 (8.78%)
- 135 (18.52%)
- 140 (33.12%)
- 145 (50.90%)
- 150 (68.49%)
- 155 (82.66%)
- 160 (91.92%)
- 165 (96.85%)
- 170 (98.98%)
- 175 (99.73%)
- 180 (99.94%)




0 10 20 30 40 50 km

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| 01 | 24/09/2024 | Approved | EV | BB | DH |
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CALEDONIA Offshore Wind Farm

GoBe APEM Group

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| CONTRACTOR DRAWING NO<br>UKCAL1_GO_WNF_MMM_MAP_00475 | CONTRACTOR REV<br>01 |
| GEODETIC PARAMETERS<br>WGS 84 / UTM zone 30N (EPSG: 32630) | |
| DRAWING TITLE<br>Figure 7-8: Noise Contours and Predicted Response for the Installation of a Monopile at 6,600 kJ at Location 7 and Common Dolphin Density Based on Lacey et al. (2022) | |
| STATUS<br>Approved | SCALE<br>1:2,500,000 |
| DRAWING NUMBER<br>N/A | SHEET NO 01 of 01 / REV N/A |

7.7.1.89 The impact of disturbance from piling will occur over a large spatial extent, though it is noted that response probabilities at the lower received levels are low and less likely (Graham *et al.*, 2017a[71]; 2019b[104]). The majority of the predicted response will occur over a medium spatial extent. The duration of the impact is medium term (piling will occur over a maximum 451 days). The probability of the effect is high, while there are limited studies on the responses of dolphins to piling there is evidence that small spatial and temporal scale disturbance to HF cetaceans (bottlenose dolphin) can occur as a result of impact piling activities (Graham *et al.*, 2017b[99]). The effect will occur at a moderate frequency, intermittently across a period of up to three years. Population modelling was not conducted for common dolphins since the iPCoD model is not parameterised for this species. However, given the very low numbers predicted to be disturbed, population level effects are highly unlikely to occur. Overall, the impact of disturbance from piling is of Low magnitude.

Sensitivity of Receptor

7.7.1.90 An analysis of pile driving activity in Broadhaven Bay, Ireland, found construction activity to be associated with a reduction in the presence of minke whales and harbour porpoise, but not with common dolphins (Culloch *et al.*, 2016[106]). Conversely, increased vessel presence during the construction period was associated with a decrease of common dolphins in the surrounding area. While there is little information on the impacts of pile driving on common dolphins, there are a few studies documenting the impacts of seismic activity[v]. In general, there is contrasting evidence for the response of common dolphins to seismic surveys. While some research indicates no change in the occurrence or sighting density of common dolphins when exposed to seismic activity (Stone *et al.*, 2017[107]; Kavanagh *et al.*, 2019[108]), Goold (1996[109]) found a reduction in common dolphin presence within 1km of ongoing seismic surveys near Pembrokeshire.

7.7.1.91 Due to the limited information on the effects of disturbance on common dolphins, bottlenose dolphins can be used as a proxy since both species are categorised as high-frequency cetaceans. Therefore, common dolphins are considered to have a Low sensitivity to disturbance from piling.

[v] Although the noise produced by airguns differs in its duration and cumulative acoustic energy levels, it may be similar in its frequency range to the low-frequency noise produced by pile driving.

Significance of Effect

7.7.1.92 Taking the **Low** sensitivity of common dolphins and the **Low** magnitude of impact, the overall effect of disturbance from piling during construction is considered to be **Negligible and Not Significant in EIA terms**.

7.7.1.93 In the absence of any mitigation, the effect of disturbance from piling on common dolphin is considered to be not significant in EIA terms. Therefore, no embedded or secondary mitigation is required.

7.7.1.94 The residual significance of the effect of disturbance from piling during construction is assessed as **Negligible and Not Significant in EIA terms**.

*Risso's dolphin*

Magnitude of Impact

7.7.1.95 Given the very low expected density of Risso's dolphin in the area, the number of animals predicted to be disturbed by single piling on any given day is less than one individual (<0.008% CGNS MU, <0.012% UK MU, Table 7–28 and Figure 7–4).

Table 7–28: Summary of the worst case piling underwater noise modelling results for disturbance of Risso's dolphin using the dose response function (Graham *et al.*, 2017a[71]), with results based on Gilles *et al.* (2023[54]) density.

| Foundation Design | Parameters | Single Piling | Concurrent Piling |
|---|---|---|---|
| Monopile | Worst case | All locations | Locations 3 and 8 |
| | No. of animals MU | <1 | <1 |
| | % MU | <0.008 | <0.008 |
| | No. of animals UK MU | <1 | <1 |
| | % UK MU | <0.012 | <0.012 |
| Jacket | Worst case | All locations | Locations 3 and 8 |
| | No. of animals MU | <1 | <1 |
| | % MU | <0.008 | <0.008 |
| | No. of animals UK MU | <1 | <1 |
| | % UK MU | <0.012 | <0.012 |
| Anchor | Worst case | All locations | Locations 5 and 8 |
| | No. of animals MU | <1 | <1 |

| Foundation Design | Parameters | Single Piling | Concurrent Piling |
|---|---|---|---|
| | % MU | <0.008 | <0.008 |
| | No. of animals UK MU | <1 | <1 |
| | % UK MU | <0.012 | <0.012 |

7.7.1.96 The impact of disturbance from piling will occur over a large spatial extent, though it is noted that response probabilities at the lower received levels are low and less likely (Graham *et al.*, 2017a[71]; 2019b[104]). The majority of the predicted response will occur over a medium spatial extent. The duration of the impact is medium term (piling will occur over a maximum 451 days). The probability of the effect is high, while there are limited studies on the responses of dolphins to piling there is evidence that small spatial and temporal scale disturbance to HF cetaceans (bottlenose dolphins) can occur as a result of impact piling activities (Graham *et al.*, 2017b[99]). The effect will occur at a moderate frequency, intermittently across a period of up to three years. Population modelling was not conducted for Risso's dolphins since the iPCoD model is not parameterised for this species. However, given the very low numbers predicted to be disturbed, population level effects are highly unlikely to occur. Overall, the impact of disturbance from piling is of Low magnitude.

Sensitivity of Receptor

7.7.1.97 In the absence of any species-specific data, bottlenose dolphins can be used as a proxy since both species are categorised as high-frequency cetaceans. Therefore, Risso's dolphins are considered to have a Low sensitivity to disturbance from piling.

Significance of Effect

7.7.1.98 Taking the **Low** sensitivity of Risso's dolphins and the **Low** magnitude of impact, the overall effect of disturbance from piling during construction is considered to be **Negligible and Not Significant in EIA terms**.

7.7.1.99 In the absence of any mitigation, the effect of disturbance from piling on Risso's dolphin is considered to be not significant in EIA terms. Therefore, no embedded or secondary mitigation is required.

7.7.1.100 The residual significance of the effect of disturbance from piling during construction is assessed as **Negligible and Not Significant in EIA terms**.

*Minke whale, humpback whale*

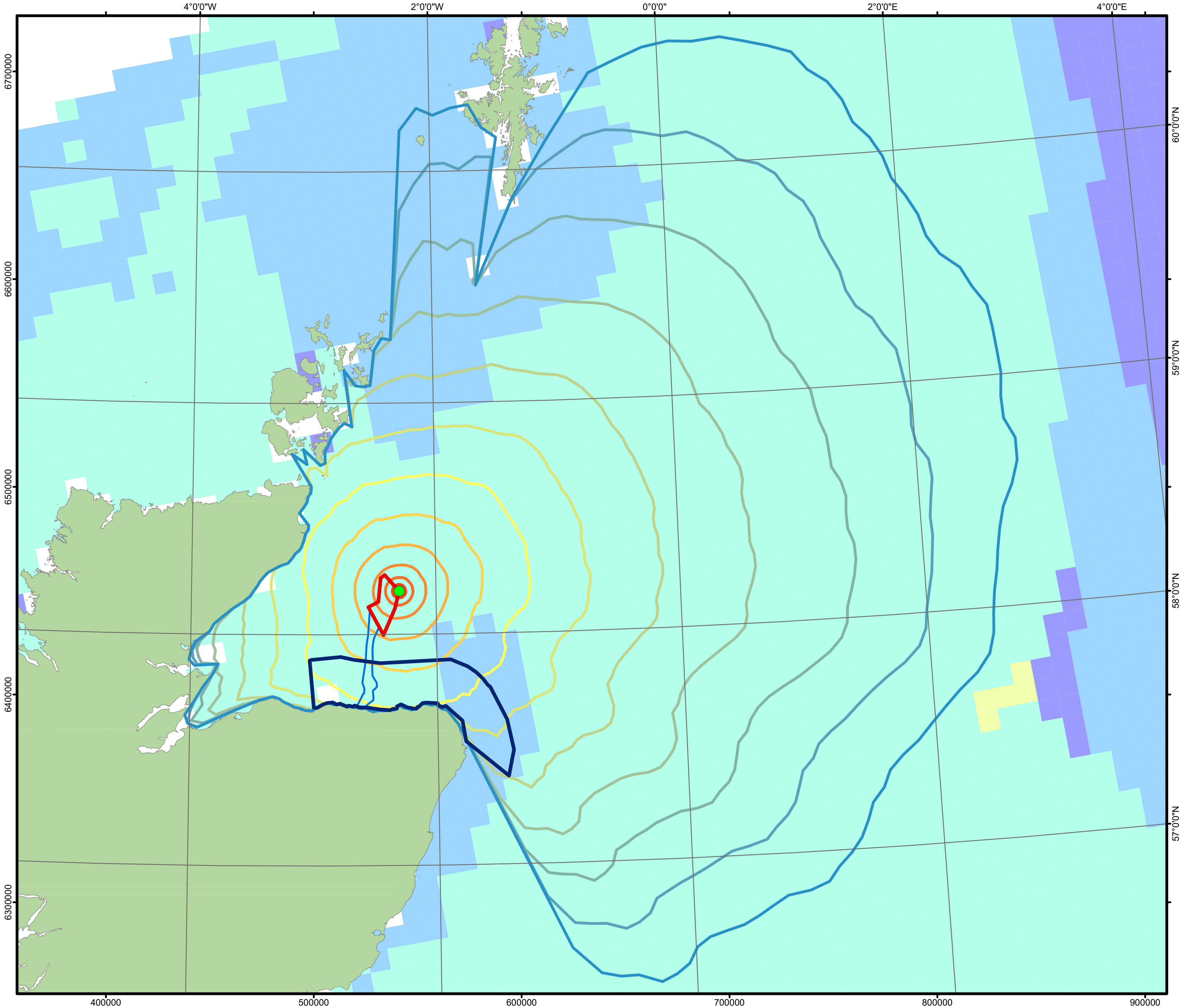
Magnitude of Impact

7.7.1.101 The number of minke whales predicted to be disturbed by single piling on any given day is a maximum of 543 individuals (2.70% of the CGNS MU) (Table 7–29 and Figure 7–9). For the same modelling location, it is estimated that up to 536 animals may experience disturbance within the UK portion of the CGNS MU (5.21% UK CGNS MU). No quantitative assessment is provided for humpback whales due to a lack of density estimate or MU size.

7.7.1.102 It should be noted that the assessment adopted the harbour porpoise dose-response function and is therefore considered precautionary (see Volume 7B, Appendix 7-2: Marine Mammals Underwater Noise Assessment Methodology for a discussion of assessment limitations).

Table 7–29: Summary of the worst case piling underwater noise modelling results for disturbance of minke whale using dose response (Graham *et al.*, 2017a[71]), with results based on Lacey *et al.* (2022[53]) density.

| Foundation Design | Parameters | Single Piling | Concurrent Piling |
|---|---|---|---|
| Monopile | Worst case | Location 7 | Locations 3 and 8 |
| | No. of animals MU | 543 | 556 |
| | % MU | 2.70 | 2.76 |
| | No. of animals UK MU | 536 | 551 |
| | % UK MU | 5.21 | 5.36 |
| Jacket | Worst case | Location 7 | Locations 3 and 8 |
| | No. of animals MU | 502 | 516 |
| | % MU | 2.50 | 2.56 |
| | No. of animals UK MU | 496 | 512 |
| | % UK MU | 4.82 | 4.98 |
| Anchor | Worst case | Location 7 | Locations 5 and 8 |
| | No. of animals MU | 415 | 448 |
| | % MU | 2.06 | 2.23 |
| | No. of animals UK MU | 413 | 445 |
| | % UK MU | 4.01 | 4.33 |




Caledonia South Site

Caledonia South Offshore Export Cable Corridor

Southern Trench MPA

Modelling Location 7

**Lacey *et al.* (2022) Density for Minke Whale**

- <0.01
- 0.01 - 0.02
- 0.02 - 0.05
- 0.05 - 0.08

**Noise Contours (SELss, dB re 1 μPa2s) - Probability of response based on Graham *et al.* (2017) in brackets**

- 120 (1.15%)
- 125 (3.49%)
- 130 (8.78%)
- 135 (18.52%)
- 140 (33.12%)
- 145 (50.90%)
- 150 (68.49%)
- 155 (82.66%)
- 160 (91.92%)
- 165 (96.85%)
- 170 (98.98%)
- 175 (99.73%)
- 180 (99.94%)

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CALEDONIA Offshore Wind Farm

GoBe APEM Group

CONTRACTOR DRAWING NO: UKCAL1_GO_WNF_MMM_MAP_00476

CONTRACTOR REV: 01

GEODETIC PARAMETERS: WGS 84 / UTM zone 30N (EPSG: 32630)

DRAWING TITLE: Figure 7-9: Noise Contours and Predictive Response for the Installation of a Monopile at 6,600 kJ at Location 7 and Minke Whale Density Based on Lacey et al. (2022)

STATUS: Approved

SCALE: 1:2,500,000

DRAWING NUMBER: N/A

SHEET NO: 01 of 01

REV: N/A

7.7.1.103 To determine whether this level of disturbance is expected to result in population level impacts, iPCoD modelling was conducted[vi]. The results of the iPCoD modelling for both the whole MU and the UK portion of the MU, shows that the level of disturbance is not sufficient to result in any changes at the population level (deviation in impacted population size to and un-impacted population size is within 1% for all scenarios). See Volume 7D, Appendix 7-1: Marine Mammals Population Modelling (iPCoD) for detailed iPCoD results.

7.7.1.104 The impact of disturbance from piling will occur over a large spatial extent, though it is noted that response probabilities at the lower received levels are low and less likely (Graham *et al.*, 2017a[71]; 2019b[104]). The majority of the predicted response will occur over a medium spatial extent. The duration of the impact is medium term (piling will occur over a maximum 451 days). The probability of the effect is high, while there are no data on the responses of minke whales and humpback whales to piling noise, they have shown temporary disturbance responses to other noise sources such as vessels, ADDs and sonar (e.g., Christiansen *et al.*, 2013a[110]; Sivle *et al.*, 2016[111]; McGarry *et al.*, 2017[112]). The effect will occur at a moderate frequency, intermittently across a period of up to three years. As shown by the iPCoD modelling, the impact could affect a small proportion of the minke whale's CGNS MU population, but the population trajectory would not be altered and therefore the effect has an overall low consequence. The number of humpback whales potentially affected is unknown but given that animals are occasional visitors to the Moray Firth, it is expected that only low numbers of animals could be potentially disturbed and therefore the effect has overall low consequence. As such, there is a potential for behavioural disturbance during piling to affect a very limited proportion of the population of humpback whales (if any). As such, the impact of disturbance from piling to both minke whale and humpback whale is of Low magnitude.

Sensitivity of Receptor

7.7.1.105 There is little information available on the behavioural responses of minke whales to underwater noise. Minke whales have been shown to change their diving patterns and behavioural state in response to disturbance from whale watching vessels; and it was suggested that a reduction in foraging activity at feeding grounds could result in reduced reproductive success in this capital breeding species (Christiansen *et al.*, 2013a[110]). Sivle *et al.* (2016[111]) reported minke whale reactions to sonar signals with behavioural response severity scores above 4 (the stage at which avoidance to a sound source first occurs) for a received

[vi] Noting that there are caveats associated with using iPCoD for disturbance for minke whales, as presented in Volume 7D, Appendix 7-1: Marine Mammals Population Modelling (iPCoD).

SPL of 146 dB re 1 µPa (score 7[vii]) and a received SPL of 158 dB re 1 µPa (score 8[viii]). There is a study detailing minke whale responses to a Lofitech Acoustic Deterrent Device (ADD) which has a source level of 204 dB re 1 µPa @ 1m, which showed minke whales within 500m and 1,000m of the source exhibiting a behavioural response. The estimated received level at 1,000m was 136.1 dB re 1 µPa (McGarry *et al.*, 2017[112]). Durbach *et al.* (2021[113]) showed that minke whale's movements became faster and more directed during sonar exposure than in baseline phases and that the mean direction of movement differed during sonar exposure. However, not all whales changed their movement patterns. Whales remaining in a slow movement state during sonar exposure were more likely to stop calling than in other exposure phases (Durbach *et al.*, 2021[113]). There are no equivalent such studies of responses to pile driving noise.

7.7.1.106 Minke whales are migratory species and inshore waters within the Southern Trench NCMPA has been recognised as important feeding location for juveniles as it provides suitable feeding grounds (Robinson *et al.*, 2023[114]). Considering that juveniles exhibit strong preference to inshore waters, they are considered more sensitive to displacement as their feeding success may not be sufficient in areas further offshore. As such, minke whales have been assessed as having a Medium sensitivity to disturbance from piling.

7.7.1.107 Humpback whale is a LF cetacean, however, the areas within the disturbance contours are not known to be particularly important for this species. As such, it is unlikely that there will be any effect on vital rates and therefore the sensitivity of this species is considered to be Low.

Significance of Effect

7.7.1.108 Taking the **Medium** sensitivity of minke whales and the **Low** magnitude of impact, the overall effect of disturbance from piling during construction is considered to be **Minor and Not Significant in EIA terms**.

7.7.1.109 Taking the **Low** sensitivity of humpback whales and the **Low** magnitude of impact, the overall effect of disturbance from piling during construction is considered to be **Negligible and Not Significant in EIA terms**.

[vii] Defined in Sivle *et al*. (2015[111]) as: Prolonged avoidance – The animal increased speed and swam directly away from the sound source throughout the rest of the exposure. Opportunistic visual observations of skim feeding at the surface before the start of the sonar exposure indicated that this response might also have involved a cessation of feeding.

[viii] Defined in Sivle *et al*. (2015[111]) as: Obvious progressive aversion (and sensitization) – The animal continued to increase its speed as the exposure progressed, swimming at such a high speed that the distance to the source ship remained constant. About halfway through the exposure, the dive pattern changed to shallower diving, which may be a way to move more effectively away from the source.

7.7.1.110 In the absence of any mitigation, the effect of disturbance from piling on minke whales and humpback whales is considered to be not significant in EIA terms. Therefore, no embedded or secondary mitigation is required.

7.7.1.111 The residual significance of the effect of disturbance from piling during construction is assessed as **Negligible to Minor and Not Significant in EIA terms**.

*Harbour seal*

Magnitude of Impact

7.7.1.112 The results for harbour seals presented in Table 7–30 are for the Moray Firth MU, North Coast and Orkney MU and East Scotland MU and are based on the overlap with the mean at-sea density grid cells from Carter *et al.* (2020[51]) and dose-response function based on mean predicted decrease in seal density (Whyte, 2021[115]). For lower and upper confidence levels see Volume 7B, Appendix 7-3: Marine Mammals Piling Results (Auditory Injury and Disturbance). For more information regarding the assessment method (application of dose-response), refer to Volume 7B, Appendix 7-2: Marine Mammals Underwater Noise Assessment Methodology.

7.7.1.113 The number of harbour seals predicted to be disturbed by single piling on any given day within the Moray Firth MU is a maximum of 71 individuals, representing 7.41% of the MU (Table 7–30 and Figure 7–10). For concurrent piling, a maximum of up to 75 animals are predicted to be disturbed (7.83% MU).

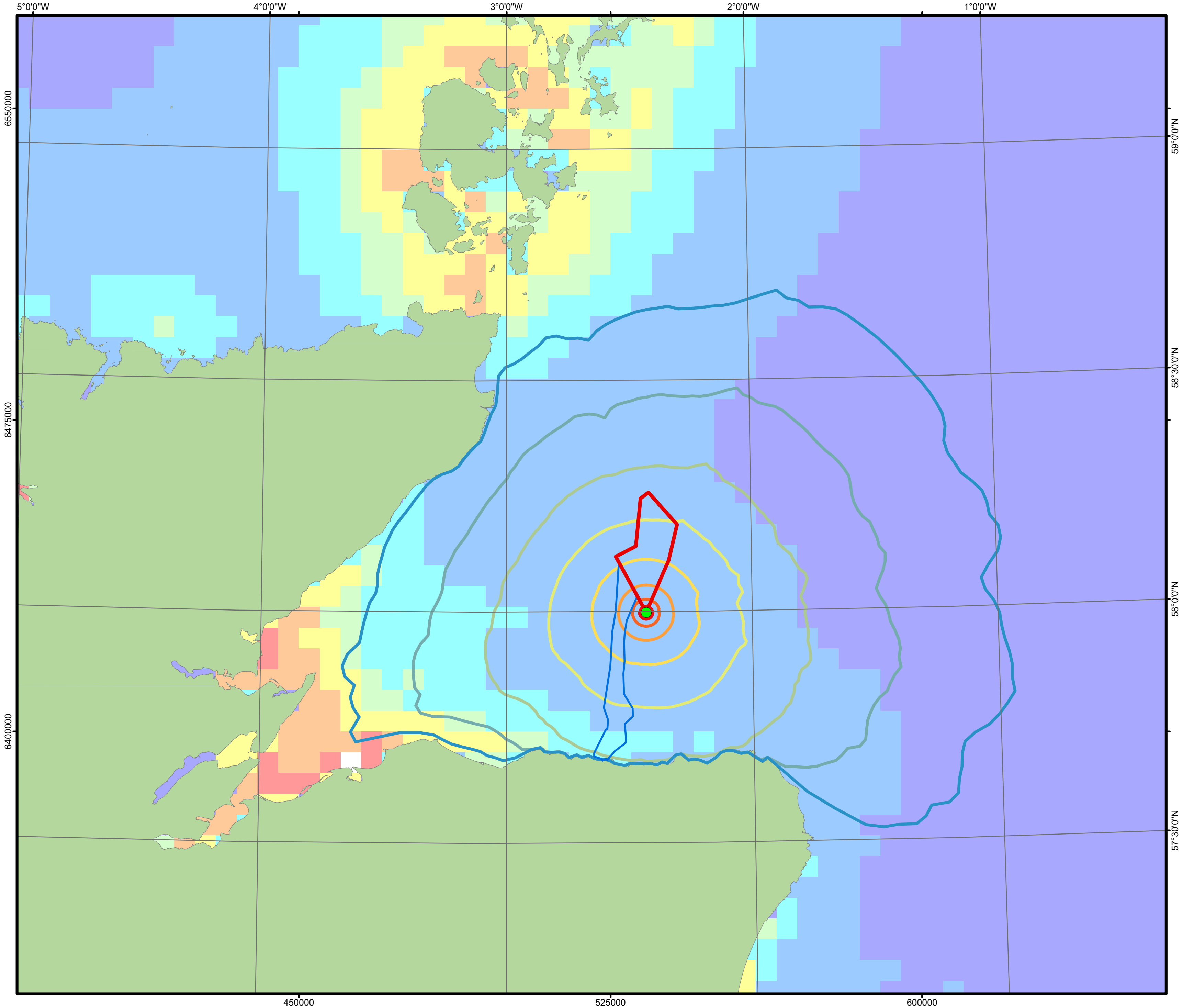
7.7.1.114 The number of harbour seals predicted to be disturbed by single and concurrent piling on any given day within the North Coast and Orkney MU is a maximum of 54 individuals, representing 3.39% of the MU (Table 7–30).

7.7.1.115 The number of harbour seals predicted to be disturbed by single and concurrent piling on any given day within the East Scotland MU is low with less than one individual, representing <0.27% of the MU (Table 7–30).

7.7.1.116 It should be noted that the noise disturbance contours do not overlap with the areas of high harbour seal density (Figure 7–10).

Table 7–30: Summary of the worst case piling underwater noise modelling results for disturbance of harbour seal for Moray East MU, North Coast and Orkney MU and East Scotland MU based on Carter *et al.* (2020[51]) density.

| Foundation Design | Parameters | Moray Firth MU | | North Coast and Orkney MU | | East Coast MU |
|---|---|---|---|---|---|---|
| | | Single | Concurrent | Single | Concurrent | Single and Concurrent |
| Monopile | Worst case | Location 8 | Locations 3 and 8 | Location 3 | Locations 3 and 8 | All locations |
| | No. of animals | 71 | 75 | 54 | 54 | <1 |
| | % MU | 7.41 | 7.83 | 3.39 | 3.39 | <0.27 |
| Jacket | Worst case | Location 8 | Locations 3 and 8 | Location 3 | Locations 3 and 8 | All locations |
| | No. of animals | 58 | 62 | 43 | 43 | 1 |
| | % MU | 6.05 | 6.47 | 2.70 | 2.70 | <0.27 |
| Anchor | Worst case | Location 8 | Locations 5 and 8 | Location 5 | Locations 5 and 8 | All locations |
| | No. of animals | 39 | 42 | 6 | 6 | 1 |
| | % MU | 4.07 | 4.38 | 0.38 | 0.38 | <0.27 |
| Note, for East Scotland MU the results for single and concurrent piling were the same and therefore presented together. | | | | | | |




Caledonia South Site

Caledonia South Offshore Export Cable Corridor

Modelling Location 8

**% of the British Isles At-Sea Population Per Cell**

- 0
- 0 - 0.001
- 0.001 - 0.005
- 0.005 - 0.01
- 0.01 - 0.025
- 0.025 - 0.05
- >0.05

**Noise Contours (SELss, dB re 1 µPa2s) - Probability of response based on Whyte *et al.* (2020) in brackets**

- 145 (36.37%)
- 150 (47.31%)
- 155 (48.72%)
- 160 (48.52%)
- 165 (54.38%)
- 170 (76.26%)
- 175 (64.8%)
- 180 (100%)

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0 10 20 30 40 km

| REV | DATE | DOC STATUS | ORIGIN | REVIEW | APP |
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| 01 | 24/09/2024 | Approved | EV | BB | DH |

CALEDONIA Offshore Wind Farm

GoBe APEM Group

| | |
|---|---|
| CONTRACTOR DRAWING NO<br>UKCAL1_GO_WNF_MMM_MAP_00477 | CONTRACTOR REV<br>01 |
| GEODETIC PARAMETERS<br>WGS 84 / UTM zone 30N (EPSG: 32630) | |
| DRAWING TITLE<br>Figure 7-10: Noise Contours and Predictive Response for the Installation of a Monopile at 6,600 kJ at Location 8 and Harbour Seal Density Based on Carter et al. (2020) | |
| STATUS<br>Approved | SCALE<br>1:1,250,000 |
| DRAWING NUMBER<br>N/A | SHEET NO 01 of 01 / REV N/A |

7.7.1.117 To determine whether the disturbance associated with piling activities at Caledonia South is expected to result in population-effect impacts, iPCoD modelling was conducted. There is a very small number of harbour seals predicted to be disturbed within the East Coast MU (Table 7–30) and as such, it is considered that adding this MU to the iPCoD model would overinflate the size of the population that the model is run. Given that the Moray Firth MU and the North Coast and Orkney MU have different population trajectories and therefore different demographic parameters recommended in Sinclair *et al.* (2020[116]), the iPCoD was ran separately for both MU populations. The population of the Moray Firth is considered to be stable. However, it is important to note when considering the iPCoD results for harbour seals, that the North Coast and Orkney MU is currently in decline with an average rate of decrease over the last 5 years of ~8.5% per year (SCOS, 2023[50]).

7.7.1.118 The results of the iPCoD modelling for both the Moray Firth MU and the North Coast and Orkney MU, shows that the level of disturbance is not sufficient to result in any changes at the population (there is no deviation in the proportion of the impacted to and un-impacted population). The Moray Firth MU is predicted to continue at a stable trajectory and at the same size as the un-impacted population, and the North Coast and Orkney population is expected to continue at a decreasing trajectory and at the same size as the un-impacted population. Refer to Volume 7D, Appendix 7-1: Marine Mammals Population Modelling (iPCoD) for detailed iPCoD results.

7.7.1.119 The impact of disturbance from piling will occur over a large spatial extent, though it is noted that response probabilities at the lower received levels are low and less likely (Whyte *et al.*, 2020[117]). The majority of the predicted response will occur over a medium spatial extent. Although the duration of the impact is medium term (piling will occur over a maximum 451 days), since studies have shown that harbour seals return to the area within 2 hours after piling ceases (Russell *et al.*, 2016a[118]), and thus the duration of the effect (disturbance from a single piling event) is considered to be low. The effect will occur at a moderate frequency, intermittently across a period of up to three years. As shown by the iPCoD modelling, there is predicted to be no change to the population trajectory of each MU (Moray Firth and North Coast and Orkney) and therefore the effect has an overall low consequence. As such, the impact of disturbance from piling is of Low magnitude.

Sensitivity of Receptor

7.7.1.120 A study of tagged harbour seals in the Wash has shown that they are displaced from the vicinity of piles during impact piling activities in the short-term, and that seals returned to non-piling distributions within two hours after the end of a piling event (Russell *et al.*, 2016b[119]).

Harbour seals store energy in a thick layer of blubber, which means that they are tolerant of periods of fasting when hauled out and resting between foraging trips, and when hauled out during the breeding and moulting periods. Therefore, they are unlikely to be particularly sensitive to short-term displacement from foraging grounds during periods of active piling.

7.7.1.121 At the expert elicitation workshop (Booth *et al.*, 2019[98]), experts agreed that harbour seals were considered to have a reasonable ability to compensate for lost foraging opportunities due to their generalist diet, mobility, life history and adequate fat stores. The survival of 'weaned of the year' animals and fertility were determined to be the most sensitive life history parameters to disturbance (i.e., leading to reduced energy intake). Juvenile harbour seals are typically considered to be coastal foragers (Booth *et al*. 2019[98]) and so less likely to be exposed to disturbances and similarly pups were thought to be unlikely to be exposed to disturbance due to their proximity to land. There was no DEB model available to simulate the effects of disturbance on seal energy intake and reserves; therefore, the opinions of the experts were less certain. Experts considered that the location of the disturbance would influence the effect of the disturbance, with a greater effect if animals were disturbed at a foraging ground as opposed to when animals were transiting through an area (note: the modelling does not show impacts to high density foraging areas). The experts agreed that for an animal in bad condition, moderate levels of repeated disturbance might be sufficient to reduce fertility; however, there was a large amount of uncertainty in this estimate.

7.7.1.122 Due to their observed responsiveness to piling the sensitivity of seals within the Moray Firth and East Scotland MU has been assessed as Low. However, given their current conservation status, declining population, higher likelihood of being in a bad condition and thus likely to be more vulnerable to additional impacts, harbour seals within the NC&O SMU have been assessed as having Medium sensitivity to disturbance during impact piling events.

Significance of Effect

7.7.1.123 Taking the **Low** sensitivity of harbour seals in the Moray Firth MU and the **Low** magnitude of impact, the overall effect of disturbance from piling during construction to the Moray Firth MU is considered to be **Negligible and Not Significant in EIA terms**.

7.7.1.124 Taking the **Medium** sensitivity of harbour seals in the NC&O SMU and the **Low** magnitude of impact, the overall effect of disturbance from piling during construction to the NC&O SMU is considered to be **Minor and Not Significant in EIA terms**.

7.7.1.125 In the absence of any mitigation, the effect of disturbance from piling on harbour seal is considered to be not significant in EIA terms. Therefore, no embedded or secondary mitigation is required.

7.7.1.126 The residual significance of the effect of disturbance from piling during construction is assessed as **Negligible to Minor and Not Significant in EIA terms**.

*Grey seal*

Magnitude of Impact

7.7.1.127 The results for grey seal presented in Table 7–31 are for the Moray Firth MU, North Coast and Orkney MU and East Scotland MU and are based on the overlap with the mean at-sea density grid cells from Carter *et al.* (2020[51]) and dose-response based on mean predicted decrease in seal density (Whyte, 2021[120]). For lower and upper confidence levels see Volume 7B, Appendix 7-3: Marine Mammals Piling Results (Auditory Injury and Disturbance). For more information regarding the assessment method (application of dose-response) refer to Volume 7B, Appendix 7-2: Marine Mammals Underwater Noise Assessment Methodology.

7.7.1.128 The number of grey seals predicted to be disturbed by single piling on any given day within the Moray Firth MU, where Caledonia South is located, is a maximum of 2,038 individuals, representing 27.62% of the MU (Table 7–31 and Figure 7–11). For concurrent piling, a maximum of up to 2,195 animals are predicted to be disturbed (29.74% MU).

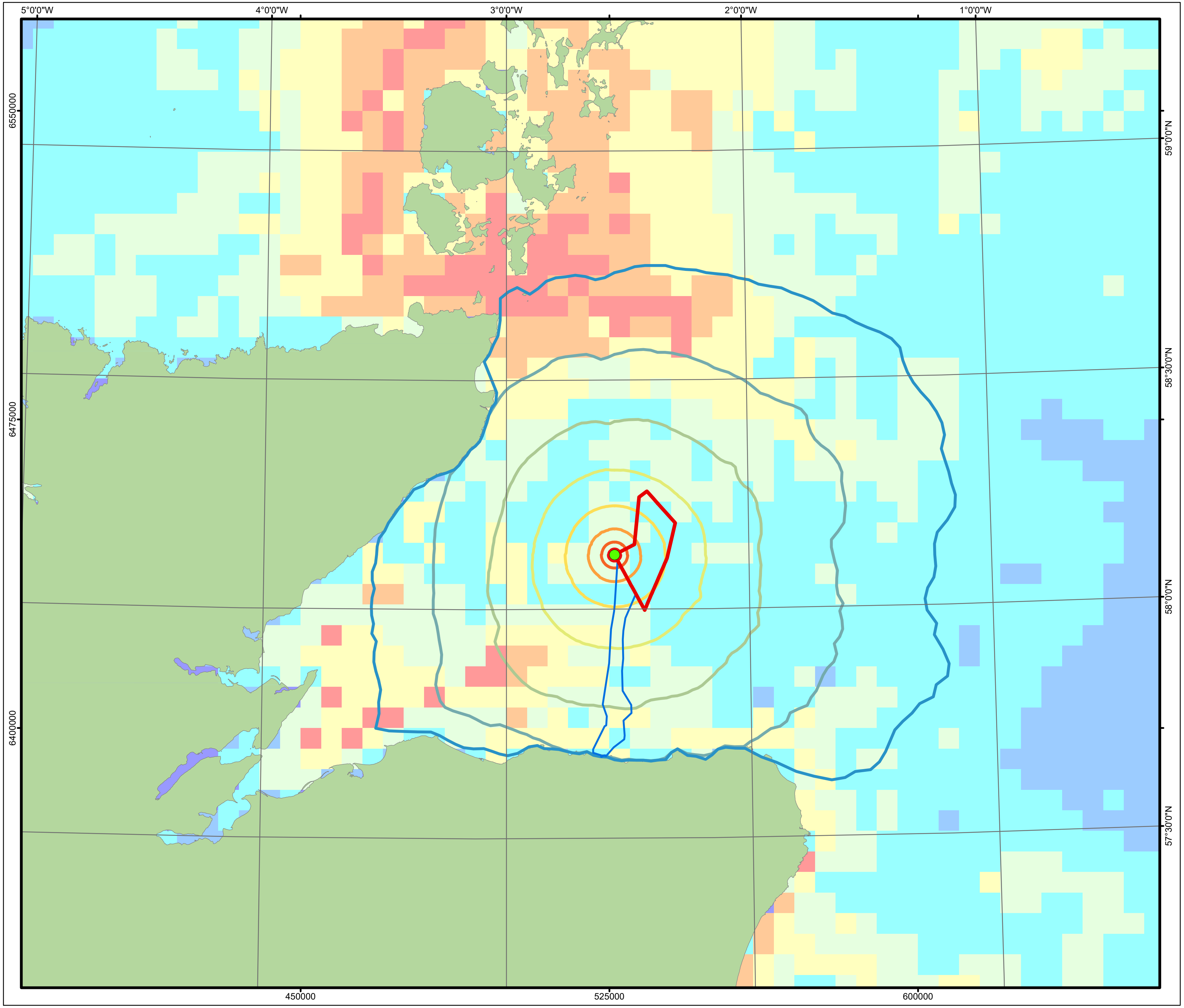
7.7.1.129 The number of grey seals predicted to be disturbed by single and concurrent piling on any given day within the North Coast & Orkney MU is a maximum of 2,835 individuals, representing 8.29% of the MU (Table 7–31).

7.7.1.130 The number of grey seals predicted to be disturbed by single piling on any given day within the East Scotland MU is a maximum of 294 individuals, representing 2.73% of the MU (Table 7–31). For concurrent piling, a maximum of up to 299 animals are predicted to be disturbed (2.77% MU).

7.7.1.131 It should be noted that most of the noise disturbance contours overlap with relatively low at-sea usage areas, except the outermost contours to the north, towards Orkney (Figure 7–11). Based on Whyte *et al.* (2020[73]) estimates, only approximately 36% of animals are anticipated to respond between 145 dB to 150 dB, which overlap with high density areas (Figure 7–11).

Table 7–31: Summary of the worst case piling underwater noise modelling results for disturbance of grey seal for Moray East MU, North Coast and Orkney MU and East Scotland MU based on Carter *et al.* (2020[51]) density.

| Foundation Design | Parameters | Moray Firth MU | | North Coast and Orkney MU | | East Coast MU | |
|---|---|---|---|---|---|---|---|
| | | Single | Concurrent | Single | Concurrent | Single | Concurrent |
| Monopile | Worst case | Location 4 | Locations 3 and 8 | Location 3 | Locations 3 and 8 | Location 8 | Location 3 and 8 |
| | No. of animals | 2,038 | 2,195 | 2,835 | 2,835 | 294 | 299 |
| | % MU | 27.62 | 29.74 | 8.29 | 8.29 | 2.73 | 2.77 |
| Jacket | Worst case | Location 4 | Locations 3 and 8 | Location 3 | Locations 3 and 8 | Location 8 | Locations 3 and 8 |
| | No. of animals | 1,921 | 2,084 | 2,558 | 2,558 | 261 | 267 |
| | % MU | 26.03 | 28.24 | 7.48 | 7.48 | 2.42 | 2.48 |
| Anchor | Worst case | Location 6 | Locations 5 and 8 | Location 5 | Locations 5 and 8 | Location 8 | Locations 5 and 8 |
| | No. of animals | 1,650 | 1,742 | 1,496 | 1,496 | 191 | 214 |
| | % MU | 22.36 | 23.60 | 4.38 | 4.38 | 1.77 | 1.98 |




Caledonia South Site

Caledonia South Offshore Export Cable Corridor

Modelling Location 4

**% of the British Isles At-Sea Population Per Cell**

- 0
- 0 - 0.001
- 0.001 - 0.005
- 0.005 - 0.01
- 0.01 - 0.025
- 0.025 - 0.05
- >0.05

**Noise Contours (SELss, dB re 1 μPa2s) - Probability of response based on Whyte *et al.* (2020) in brackets**

- 145 (36.37%)
- 150 (47.31%)
- 155 (48.72%)
- 160 (48.52%)
- 165 (54.38%)
- 170 (76.26%)
- 175 (64.8%)
- 180 (100%)




0 10 20 30 40 km

| REV | DATE | DOC STATUS | ORIGIN | REVIEW | APP |
|---|---|---|---|---|---|
| 01 | 24/09/2024 | Approved | EV | BB | DH |

CALEDONIA Offshore Wind Farm

GoBe APEM Group

CONTRACTOR DRAWING NO: UKCAL1_GO_WNF_MMM_MAP_00478

CONTRACTOR REV: 01

GEODETIC PARAMETERS: WGS 84 / UTM zone 30N (EPSG: 32630)

DRAWING TITLE: Figure 7-11: Noise Contours and Predictive Response for the Installation of a Monopile at 6,600 kJ at Location 4 and Grey Seal Density Based on Carter et al. (2020)

STATUS: Approved

SCALE: 1:1,250,000

DRAWING NUMBER: N/A

SHEET NO: 01 of 01

REV: N/A

7.7.1.132 To determine whether the disturbance associated with piling activities at Caledonia South is expected to result in population-effect impacts, iPCoD modelling was conducted. The iPCoD model was run separately for the Moray Firth MU population alone, as well as all three MUs combined (numbers of animals affected as well as the population size within three MUs were combined). The results of the iPCoD modelling for both the Moray Firth MU alone and for the three MUs combined, shows that the level of disturbance is not sufficient to result in any changes at the population level (deviation in the proportion of the impacted to and un-impacted population size is within 1%). The Moray Firth MU is predicted to continue at an increasing trajectory and at the same size as the un-impacted population, and combined population is expected to continue at an increasing trajectory and at the same size as the un-impacted population. See Volume 7D, Appendix 7-1: Marine Mammals Population Modelling (iPCoD) for detailed iPCoD results.

7.7.1.133 The impact of disturbance from piling will occur over a large spatial extent, though it is noted that response probabilities at the lower received levels are low and less likely (Whyte *et al.*, 2020[73]). The majority of the predicted response will occur over a medium spatial extent. The duration of the impact is medium term (piling will occur over a maximum 451 days). The probability of the effect is medium, since grey seals have shown large variability in responses to pile driving (Aarts *et al.*, 2018[121]). The effect will occur at a moderate frequency, intermittently across a period of up to three years. As shown by the iPCoD modelling, the impact could affect a small proportion of the population, but the population trajectory would not be altered and therefore the effect has an overall low consequence. As such, the impact of disturbance from piling is of Low magnitude.

Sensitivity of Receptor

7.7.1.134 There are still limited data on grey seal behavioural responses to pile driving. The key dataset on this topic is presented in Aarts *et al.* (2018[121]) where 20 grey seals were tagged in the Wadden Sea to record their responses to pile driving at two OWFs: Luchterduinen in 2014 and Gemini in 2015. The grey seals showed varying responses to the pile driving, including no response, altered surfacing and diving behaviour, and changes in swimming direction. The most common reaction was a decline in descent speed and a reduction in bottom time, which suggests a change in behaviour from foraging to horizontal movement. The distances at which seals responded varied significantly; in one instance a grey seal showed responses at 45km from the pile location, while other grey seals showed no response when within 12km. Differences in responses could be attributed to differences in hearing sensitivity between individuals and in sound transmission with environmental conditions or the behaviour and motivation for the seal to be in the area. The telemetry data also showed that seals returned to the pile driving area after pile driving ceased. While this evidence base is from studies of grey seals tagged in the Wadden Sea, it is expected that grey seals in waters east of Scotland would respond in a similar way, and therefore the data are considered to be applicable. Hastie *et al.* (2021[122]) found that grey seal avoidance rates in response to pile driving sounds were dependent on the quality of the prey patch, with grey seals continuing to forage at high density prey patches when exposed to pile driving sounds but showing reduced foraging success at low density prey patches when exposed to pile driving sounds. Additionally, the seals showed an initial aversive response to the pile driving playbacks (lower proportion of dives spent foraging) but this diminished during each trial. Therefore, the likelihood of grey seal response is expected to be linked to the quality of the prey patch and their previous exposure history.

7.7.1.135 Based on the expert elicitation workshop, Booth *et al.* (2019[98]) concluded that grey seals were considered to have a reasonable ability to compensate for lost foraging opportunities due to their generalist diet, mobility, life history and adequate fat stores and that the survival of 'weaned of the year' animals and fertility were determined to be the most sensitive parameters to disturbance (i.e., reduced energy intake). However, in general, experts agreed that grey seals would be much more robust than harbour seals to the effects of disturbance due to their larger energy stores and more generalist and adaptable foraging strategies. It was agreed that grey seals would require moderate-high levels of repeated disturbance before there was any effect on fertility rates. The 'weaned of the year' were considered to be most vulnerable following the post-weaning fast, and that during this time it might take ~60 days of repeated disturbance before there was expected to be any effect on weaned-of-the-year survival, however there was a lot of uncertainty surrounding this estimate.

7.7.1.136 Grey seals are capital breeders and store energy in a thick layer of blubber, which means that, in combination with their large body size, they are tolerant of periods of fasting as part of their normal life history. Grey seals are also highly adaptable to a changing environment and are capable of adjusting their metabolic rate and foraging tactics, to compensate for different periods of energy demand and supply (Beck *et al.*, 2003[123]; Sparling *et al.*, 2006[124]). Grey seals are also very wide ranging and are capable of moving large distances between different haul out and foraging regions (Russell *et al.*, 2013[125]). Therefore, they are unlikely to be particularly sensitive to displacement from foraging grounds during periods of active piling.

7.7.1.137 The observed responsiveness to piling suggest that grey seal have the ability to adapt behaviour in response to a stressor and their life-history implies that they have a high tolerance to the stressor. Grey seals are expected to be able to return to previous behavioural activities once the impact has ceased and therefore and have been assessed as having a Negligible sensitivity to disturbance from piling.

Significance of Effect

7.7.1.138 Taking the **Negligible** sensitivity of grey seals and the **Low** magnitude of impact, the overall effect of disturbance from piling during construction is considered to be **Negligible and Not Significant in EIA terms**.

7.7.1.139 In the absence of any mitigation, the effect of disturbance from piling on grey seals is considered to be not significant in EIA terms. Therefore, no embedded or secondary mitigation is required.

7.7.1.140 The residual significance of the effect of disturbance from piling during construction is assessed as **Negligible and Not Significant in EIA terms**.

**EPS**

7.7.1.141 As EPS, listed on Annex IV of the EU Habitats Directive, it is an offence to kill, injure or disturb cetaceans. An EPS risk assessment is required to assess the risk that an offence will occur, therefore assessing the need for an EPS licence(s) and providing the information required by MD-LOT in support of any such applications.

7.7.1.142 The Applicant will provide an EPS risk assessment for disturbance from piling at the post consent stage, once final piling parameters are confirmed. This impact assessment has concluded that disturbance from piling will not be detrimental to maintaining the species at favourable conservation status, and thus passes EPS test 3. The expectation is that an EPS license to disturb cetaceans may be required.

## Impact 5: Auditory Injury from Other Construction Activities

7.7.1.143 While impact piling will be the loudest noise source during the construction phase, there will also be several other construction activities that will produce underwater noise. A simple assessment of the noise impacts from other construction (i.e., excluding impact piling and UXO clearance) is presented in Volume 7, Appendix 6: Underwater Noise Assessment. This includes an assessment of the potential PTS impact ranges for:

- Cable laying: Noise from the cable laying vessel and any other associated noise during the offshore cable installation;
- Dredging: Dredging may be required on site for seabed preparation work for certain foundation options, as well as for the export cable, array cables and interconnector cable installation. Both backhoe and suction dredging have been included;
- Drilling: There is the potential for WTG foundations to installed using drilling depending on seabed type of if a pile refuses during impact piling operations.
- Vibropiling: There is the potential for a vibratory hammer to be used to install foundation piles.

- Rock placement: Potentially required on site for installation of offshore cables (cable crossings and cable protection) and scour protection around foundation structures; and
- Trenching: Plough trenching may be required during offshore cable installation.

**Summary**

7.7.1.144 A summary of the assessment of auditory injury from other construction activities is provided in Table 7–32. No impacts are considered significant in EIA terms.

Table 7–32: Summary of the significance of auditory injury from other construction activities to marine mammals during construction phase.

| Receptor | Embedded Mitigation | Magnitude | Sensitivity | Significance | Secondary Mitigation | Residual |
|---|---|---|---|---|---|---|
| Harbour porpoise | None | Negligible | Low | Negligible | None | Negligible |
| Bottlenose dolphin | None | Negligible | Low | Negligible | None | Negligible |
| White-beaked dolphin | None | Negligible | Low | Negligible | None | Negligible |
| Common dolphin | None | Negligible | Low | Negligible | None | Negligible |
| Risso's dolphin | None | Negligible | Low | Negligible | None | Negligible |
| Minke whale | None | Negligible | Medium | Negligible | None | Negligible |
| Humpback whale | None | Negligible | Medium | Negligible | None | Negligible |
| Harbour seal | None | Negligible | Low | Negligible | None | Negligible |
| Grey seal | None | Negligible | Low | Negligible | None | Negligible |

**Marine Mammals**

*Magnitude of Impact*

7.7.1.145 For all other construction activities assessed (Table 7–33), the PTS-onset impact range is <100m. As such, other construction noise sources considered will have a very local spatial extent and therefore represent a minimal risk of injury.

Table 7–33: Auditory injury impact (PTS) ranges (weighted $SEL_{cum}$) for other construction activities assuming a fleeing receptor for marine mammals.

| Activity | Source level (unweighted, RMS) | LF | HF | VHF | PCW |
|---|---|---|---|---|---|
| Cable laying | 171 dB re 1 µPa @ 1m | <100m | <100m | <100m | <100m |
| Dredging (backhoe) | 165 dB re 1 µPa @ 1m | <100m | <100m | <100m | <100m |
| Dredging (suction) | 186 dB re 1 µPa @ 1m | <100m | <100m | <100m | <100m |
| Drilling | 169 dB re 1 µPa @ 1m | <100m | <100m | <100m | <100m |
| Vibropiling | 193 dB re 1 µPa @ 1m | <100m | <100m | <100m | <100m |
| Rock placement | 172 dB re 1 µPa @ 1m | <100m | <100m | <100m | <100m |
| Trenching | 172 dB re 1 µPa @ 1m | <100m | <100m | <100m | <100m |

7.7.1.146 The extent of impact (underwater noise from other construction activities) that may result in auditory injury (effect) is expected to be localised (<100m). The impact will occur intermittently over medium term (the duration of construction, three years). The effect is unlikely to occur as associated vessel noise is anticipated to deter animals from the injury zone. Consequently, it is anticipated that no animals will experience injury and, therefore, the impact will not alter the population trajectory. Therefore, the magnitude of auditory injury (PTS) from other construction activities has been assessed as Negligible.

*Sensitivity of Receptor*

Cable Laying

7.7.1.147 Underwater noise generated during cable installation is generally considered to have a low potential for impacts to marine mammals due to the non-impulsive nature of the noise generated and the fact that any generated noise is likely to be dominated by the vessel from which installation is taking place (Genesis, 2011[126]). OSPAR (2009c[127]) summarise general characteristics of commercial vessel noise: vessel noise is continuous, and is dominated by sounds from propellers, thrusters and various rotating machinery (e.g., power generation, pumps). In general, support and supply vessels (50-100 m) are expected to have broadband source levels in the range 165-180 dB re 1µPa, with the majority of energy below 1kHz (OSPAR, 2009c[127]). Large commercial vessels (>100m) produce relatively loud and predominately low frequency sounds, with the strongest energy concentrated below several hundred Hz. For harbour porpoise, dolphins and seals, the hearing sensitivity below 1kHz is relatively poor and thus it is expected that a PTS at these low frequency ranges would result in little impact to vital rates. Therefore, the sensitivity of harbour porpoise, dolphins and seals to PTS from cable laying is assessed as Low. The low frequency noise produced during cable laying may be more likely to overlap with the hearing range of low frequency cetacean species such as minke whales. Therefore, the sensitivity of minke whales to PTS from cable laying is assessed as Medium.

Dredging

7.7.1.148 Dredging is described as a continuous broadband sound source, with the main energy below 1kHz; however, the frequency and sound pressure level can vary considerably depending on the equipment, activity, and environmental characteristics (Todd *et al.*, 2015[128]). Dredging will potentially be required for seabed preparation work for piled anchors as well as for export cable, inter-array cable and interconnector cable installations. The source level of dredging has been described to vary between SPL 172-190 dB re 1 µPa @ 1m with a frequency range of 45Hz to 7kHz (Evans, 1990[129], Thompson *et al.*, 2009[130]; Verboom, 2014[131]). It is expected that the underwater noise generated by dredging will be below the PTS-onset threshold (Todd *et al.*, 2015[128]) and thus the risk of injury is unlikely. For harbour porpoise, dolphins and seals, the hearing sensitivity below 1kHz is relatively poor and thus it is expected that a PTS at this frequency would result in little impact to vital rates. Therefore, the sensitivity of harbour porpoise, dolphins and seals to PTS from dredging is assessed as Low.

7.7.1.149 The low frequency noise produced during dredging may be more likely to overlap with the hearing range of low frequency cetacean species such as minke whale and humpback whale. Minke whale communication signals have been demonstrated to be below 2kHz (Edds-Walton, 2000[132], Mellinger *et al.*, 2000[133]; Gedamke *et al.*, 2001[269]; Risch *et al.*, 2013[134]; 2014[135]). Tubelli *et al.* (2012[136]) estimated the most sensitive hearing range (the region with thresholds within 40 dB of best sensitivity) to extend from 30 to 100Hz up to 7.5 to 25kHz, depending on the specific model used. Therefore, the sensitivity of minke whales and humpback whales to PTS from dredging is precautionarily assessed as Medium.

Drilling

7.7.1.150 The continuous sound produced by drilling has been likened to that produced by potential dredging activity; low frequency noise caused by rotating machinery (Greene, 1987[137]). Recordings of drilling at the North Hoyle OWF suggest that the sound produced has a fundamental frequency at 125Hz (Nedwell *et al.*, 2003[138]). For harbour porpoise, dolphins and seals, the hearing sensitivity below 1kHz is relatively poor and thus it is expected that a PTS at these low frequency ranges would result in little impact to vital rates.

Therefore, the sensitivity of harbour porpoise, dolphins and seals to PTS from drilling noise is assessed as Low. The low frequency noise produced during cable laying may be more likely to overlap with the hearing range of low frequency cetacean species such as minke whale and humpback whale. Therefore, the sensitivity of minke whale and humpback whale to PTS from drilling is precautionarily assessed as Medium.

Vibropiling

7.7.1.151 During pile installation, the use of vibropiling may be considered as a technical alternative to impact hammer to mitigate risk of pile run or where piles can be driven to refusal using a vibratory hammer before being driven to the required depth with an impact hammer. Although vibropiling offers lower noise levels compared to impact piling, it produces continuous noise and there is a potential acoustic impact on marine mammals (Lamoni and Tougaard, 2023[139]).

7.7.1.152 Rather than producing impulsive sound, vibropiling produces a continuous (non-impulsive) sound which is subject to different PTS-onset thresholds (173 dB re 1 µPa SEL weighted for VHF cetaceans) compared to impact piling (155 dB re 1 µPa SEL weighted for VHF cetaceans) (Lamoni and Tougaard, 2023[140]).

7.7.1.153 Low frequencies radiating from this source, usually between 20 to 40Hz, may affect low-frequency cetaceans (minke whale and humpback whale) as it would overlap with their hearing frequency range (Weilgard, 2023[141]). Therefore, given the lack of overlap with the estimated hearing ranges of VHF, HF cetaceans as well as PCW (Table 7–9), the sensitivity of harbour porpoise, dolphins and seals to PTS from vibropiling is expected to be Low, whilst the sensitivity of minke whale and humpback whale to PTS from vibropiling is precautionarily assessed as Medium.

Rock Placement

7.7.1.154 Underwater noise generation during rock placement activities is largely unknown. One study of rock placement activities in the Yell Sound in Shetland found that rock placement noise produced low frequency tonal noise from the machinery, but that measured noise levels were within background levels (Nedwell and Howell, 2004[142]). Therefore, it is highly likely that any generated noise is likely to be dominated by the vessel from which activities take place. Therefore, the sensitivity of harbour porpoise, dolphins and seals to PTS from rock placement is expected to be Low. The low frequency noise produced during rock placement may be more likely to overlap with the hearing range of low frequency cetacean species such as minke whale and humpback whale. Therefore, the sensitivity of minke whale and humpback whale to PTS from rock placement is precautionarily assessed as Medium.

Trenching

7.7.1.155 Underwater noise generation during cable trenching is highly variable and dependent on the physical properties of the seabed that is being cut. At the North Hoyle OWF, trenching activities had a peak frequency between 100Hz – 1kHz and in general the sound levels were only 10-15 dB above background levels (Nedwell *et al.*, 2003[138]). For harbour porpoise, dolphins and seals, hearing sensitivity below 1kHz is relatively poor and thus it is expected that a PTS at these low frequency ranges would result in little impact to vital rates. Therefore, the sensitivity of harbour porpoise, dolphins and seals to PTS from trenching is assessed as Low. The low frequency noise produced during trenching may be more likely to overlap with the hearing range of low frequency cetacean species such as minke whale and humpback whale. Therefore, the sensitivity of minke whale and humpback whale to PTS from trenching is precautionarily assessed as Medium.

*Significance of Effect*

7.7.1.156 Taking the **Low** sensitivity of harbour porpoise, dolphin and seal species, **Medium** sensitivity for minke whale and humpback whale and the **Negligible** magnitude of impact for all species, the overall effect of auditory injury from other construction activities during construction is considered to be **Negligible and Not Significant in EIA terms**.

7.7.1.157 There is no embedded or secondary mitigation required as the effect of auditory injury from other construction activities during construction is considered to be not significant in EIA terms.

7.7.1.158 The residual significance of the effect of auditory injury from other construction activities during construction is assessed as **Negligible and Not Significant in EIA terms**.

## Impact 6: Disturbance from Other Construction Activities

**Summary**

7.7.1.159 A summary of the assessment of behavioural disturbance from other construction activities, presented in detail in paragraph 7.7.1.161 to 7.7.1.181, is provided in Table 7–34. No impacts are considered significant in EIA terms.

Table 7–34: Summary of the significance of behavioural disturbance from other construction activities to marine mammals during construction phase.

| Receptor | Embedded Mitigation | Magnitude | Sensitivity | Significance | Secondary Mitigation | Residual |
|---|---|---|---|---|---|---|
| Harbour porpoise | None | Low | Low | Negligible | None | Negligible |
| Bottlenose dolphin | None | Low | Low | Negligible | None | Negligible |
| White-beaked dolphin | None | Low | Low | Negligible | None | Negligible |
| Common dolphin | None | Low | Low | Negligible | None | Negligible |
| Risso's dolphin | None | Low | Low | Negligible | None | Negligible |
| Minke whale | None | Low | Medium | Minor | None | Minor |
| Humpback whale | None | Low | Low | Negligible | None | Negligible |
| Harbour seal | None | Low | Negligible | Negligible | None | Negligible |
| Grey seal | None | Low | Negligible | Negligible | None | Negligible |

**Marine Mammals**

*Magnitude of Impact*

7.7.1.160 Consideration of magnitude of impact is provided for dredging, drilling and other construction activities.

Dredging

*Harbour porpoise*

7.7.1.161 Dredging at a source level of 184 dB re 1 μPa at 1m resulted in harbour porpoise avoidance up to 5km from the dredging site (Verboom, 2014[143]). Conversely, Diederichs *et al.* (2010[144]) found much more localised impacts; using Passive Acoustic Monitoring there was short term avoidance (~3 hours) at distances of up to 600m from the dredging vessel, but no significant long-term effects. Modelling potential impacts of dredging using a case study of the Maasvlatke port expansion (assuming maximum source levels of 192 dB re 1 μPa) predicted a disturbance range of 400m, while a more conservative approach predicted avoidance of harbour porpoise up to 5km (McQueen *et al.*, 2020[145]).

*Dolphin species*

7.7.1.162 Increased dredging activity at Aberdeen Harbour was associated with a reduction in bottlenose dolphin presence and, during the initial dredge operations, bottlenose dolphins were absent for five weeks (Pirotta *et al.*, 2013[100]). Based on the results of this study, Pirotta *et al.* (2015a[146]) have assumed that dredging activities exclude dolphins from a 1km radius of the dredging site. Dredging operations had no impact on sightings of Indo-Pacific bottlenose dolphins (*Tursiops aduncus*) in South Australia (Bossley *et al.*, 2022[147]). There is currently no information available on the impacts of dredging for white-beaked, common and Risso's dolphins. Localised, temporary avoidance of dredging activities is likely to take place.

*Minke whale, humpback whale*

7.7.1.163 In northwest Ireland, construction-related activity (including dredging) has been linked to reduced minke whale presence (Culloch *et al.*, 2016[106]). Minke whale distance to construction site increased and relative abundance decreased during dredging activities in Newfoundland (Borggaard *et al.*, 1999[148]). The same study reported that, humpback whale distance to construction site increased but there was no change in relative abundance during dredging (Borggaard *et al.*, 1999[148]).

*Grey and harbour seal*

7.7.1.164 Based on the generic threshold of behavioural avoidance of pinnipeds (140 dB re 1 μPa SPL) (Southall *et al.*, 2007[70]), acoustic modelling of dredging demonstrated that disturbance could be caused to individuals between 400m to 5km from site (McQueen *et al.*, 2020[145]).

Drilling

7.7.1.165 Information on the disturbance effects of drilling is limited and the majority of the research available was conducted more than 20 years ago and is focussed on baleen whales (Sinclair *et al.*, 2023[149]). For example, drilling and dredging playback experiments observed that 50% of bowhead whales exposed to noise levels of 115 dB re 1 μPa exhibited some form of response, including changes to calling, foraging and dive patterns (Richardson and Wursig, 1990[150]). More recent studies of bowhead whales also observed changes in behaviour from increased drilling noise levels, specifically an increase in call rate. However, the call rate plateaued and then declined as noise levels continued to increase, which could be interpreting as the whales aborting their attempt to overcome the masking effects of the drilling noise (Blackwell *et al.*, 2017[151]). Playback experiments of drilling and industrial noise have been undertaken with grey whales at a noise level of 122 dB re 1 μPa and recorded a 90% response from the individuals in the form of diverting their migration track (Malme *et al.*, 1984[152]). Overall, the literature indicates that the impacts of drilling disturbance on marine mammals may occur at distances of between 10-20km and will vary depending on the species (Greene Jr, 1986[153], LGL and Greeneridge, 1986[154], Richardson and Wursig, 1990[150]). Whilst information is not available for the species of concern for Caledonia South, it may be used as a proxy for baleen whales (e.g., minke and humpback whales), noting that the literature is considered slightly outdated.

Other

7.7.1.166 There is a lack of information in the literature on disturbance ranges for other construction activities such as vibropiling, cable laying, trenching or rock placement. While construction-related activities (acoustic surveys, dredging, rock trenching, pipe laying and rock placement) for an underwater pipeline in northwest Ireland resulted in a decline in harbour porpoise detections, there was a considerable increase in detections after construction-activities ended which suggests that any impact is localised and temporary (Todd *et al.*, 2020[155]).

Magnitude of Impact Summary

7.7.1.167 For all species, except baleen whales, there is evidence that the extent of impact (underwater noise during other construction activities) that may result in disturbance will be highly localised (within 5km). For baleen whales, e.g., minke and humpback whale, the evidence suggests that the impact likely to result in disturbance may occur over larger spatial range, between 10 to 20km (although noting it is highly precautionary). The impact may take place intermittently over the duration of the construction phase, e.g., a total of up to three years. Although animals in the vicinity of the construction works are likely to respond behaviourally to the underwater noise associated with drilling, dredging and other activities, they are likely to move away from the activity outside of the impact area. For all species the impact is may have a noticeable effect on a small proportion of the population, but is unlikely to lead to changes in population trajectory. Therefore, the magnitude is assessed as Low.

*Sensitivity of Receptor*

7.7.1.168 Information regarding the sensitivity of marine mammals to other construction activities is currently limited. Available studies focus primarily on disturbance from dredging and confirmed behavioural responses have been observed in cetaceans. As the disturbance impact from other construction activities is closely associated with the disturbance from vessel presence required for the activity, it is difficult to determine the sensitivity specifically to disturbance from other construction activities in isolation (Todd *et al.*, 2015[128]).

Harbour porpoise

7.7.1.169 Harbour porpoise occurrence decreased at the Beatrice and Moray East OWFs during non-piling construction periods (Benhemma-Le Gall *et al.*, 2021[80]). The probability of detecting harbour porpoise in the absence of piling decreased by 17% as the sound pressure levels from vessels during the construction period increased by 57 dB (note: vessel activity included not only windfarm construction related vessels, but also other third-party traffic such as fishermen, bulk carrier and cargo vessels). Despite this, harbour porpoise continued to regularly use both the Beatrice and Moray East sites throughout the three-year construction period. While a reduction in occurrence and buzzing was associated with increased vessel activity, this was of local scale and buzzing activity increased beyond a certain distance from the exposed areas, suggesting displaced animals resumed foraging once a certain distance from the noise source, or potential compensation behaviour for lost foraging or the increased energy expenditure of fleeing. Study on responses of cetaceans to harbour construction within the Cromarty Firth reported that the probability of harbour porpoise occurrence was reduced during periods of vibration piling (Graham *et al.*, 2017b[99]).

7.7.1.170 While harbour porpoise may be sensitive to disturbance from other construction-related activities, it is expected that they are able to compensate for any short-term local displacement, and thus it is not expected that individual vital rates would be impacted. Therefore, the sensitivity of harbour porpoise to disturbance from other construction activities is considered to be Low.

Dolphins

7.7.1.171 For dolphin species, disturbance responses to non-piling construction activity appears to vary. Increased dredging activity at Aberdeen harbour was associated with a reduction in bottlenose dolphin presence and, during the initial dredge operations, bottlenose dolphins were absent for five weeks (Pirotta *et al.*, 2013[146]). Pirotta *et al*. (2013[100]) noted that due to the consistently high presence of shipping activity all year round, the dolphins were considered to be habituated to high levels of vessel disturbance and, therefore, in this particular instance, Pirotta *et al*. (2013[146]) concluded that the avoidance behaviour was a direct result of dredging activity. In a study at an urbanised estuary in Western Australia, bottlenose dolphin responses to dredging varied between sites. At one site no bottlenose dolphins were sighted on days when backhoe dredging was present, while dolphins remained using the other site (Marley *et al.*, 2017a[156]). A study conducted in northwest Ireland concluded that construction related activity (including dredging) did not result in any evidence of a negative impact to common dolphins (Culloch *et al.*, 2016[106]).

7.7.1.172 During vibropiling within the Cromarty Firth, bottlenose dolphin showed a measurable, albeit weak, behavioural response by reducing the amount of time they spent around construction works (Graham *et al.*, 2017b[99]). During periods of vibration piling the probability of bottlenose dolphin occurrence was also reduced (Graham *et al.*, 2017b[99]).

7.7.1.173 Some construction works associated with OECC installation will be taking place within the main distributional range of bottlenose dolphins from the Moray Firth SAC. Localised avoidance of the area in the vicinity of the ECC is likely to take place intermittently during construction activities but unlikely to lead to reproduction and/or survival rates. Considering the above, the sensitivity of dolphin species to disturbance from other construction activities is assessed as Low.

Minke whale

7.7.1.174 The study conducted by Culloch *et al.* (2016[106]) found evidence that the fine-scale temporal occurrence of minke whales within the inner Broadhaven Bay in northwest Ireland was influenced by the presence of construction activity, with lower occurrence rates on these days. It should be noted that minke whales are capital breeders and therefore their reproductive success could be affected by disrupted feeding activities (Stephens *et al.*, 2009[157]; Christiansen *et al.*, 2013b[158]). Considering the importance of the Southern Trench NCMPA (which overlaps with the Caledonia South OECC) for foraging of minke whale juveniles and adults, the sensitivity of minke whales to disturbance from other construction activities is assessed as Medium.

Humpback whale

7.7.1.175 Pirotta (2017[159]) found that migrating humpback whales did not exhibit any response to underwater construction activities. The seasonality of occasional humpback whale sightings in the Firth of Forth suggests that this area may represent a migratory stopover or alternative destination for humpback whales on their southbound migration (O'Neil *et al.*, 2019[160]). However, there is lack of evidence that areas in the vicinity of Caledonia South represent important migratory route or stop-over for feeding and therefore it is anticipated that any temporary disturbance is unlikely to have any impact on vital rates (reproduction and survival). As such, the sensitivity of humpback whale to disturbance from other construction activities is assessed as Low.

Seals

7.7.1.176 While seals are sensitive to disturbance from pile driving activities, there is evidence that the displacement is limited to the piling activity period only (Russell *et al.*, 2016a[118]). There was no evidence of displacement during the overall construction period, and the authors recommended that environmental assessments should focus on short-term displacement to seals during piling rather than displacement during construction as a whole. Even during periods of piling at the Lincs OWF, individual seals travelled in and out of the Wash which suggests that the motivation to forage offshore and come ashore to haul out could outweigh the deterrence effect of piling. Caledonia South is located in a relatively low-density area for both species of seal (compared to the coastal waters within the inner Moray Firth) and thus it is not expected that any short term-local displacement, whilst seals are at sea[ix], caused by construction related activities would result in any changes to individual vital rates. Therefore, the sensitivity of both seal species to disturbance from other construction activities is considered to be Negligible.

[ix] The impacts on disturbance within the haul-out sites are considered separately in paragraph 7.7.1.263 *et seq*.

*Significance of Effect*

7.7.1.177 Taking the **Low** sensitivity of harbour porpoise, bottlenose dolphin, common dolphin, white-beaked dolphin, Risso's dolphin and humpback whale and the **Low** magnitude of impact, the overall effect of disturbance from other construction activities during construction is considered to be **Negligible and Not Significant in EIA terms**.

7.7.1.178 Taking the **Medium** sensitivity of minke whale and the **Low** magnitude of impact, the overall effect of disturbance from other construction activities during construction is considered to be **Minor and Not Significant in EIA terms**.

7.7.1.179 Taking the **Negligible** sensitivity of grey and harbour seals and the **Low** magnitude of impact, the overall effect of disturbance from other construction activities during construction is considered to be **Negligible and Not Significant in EIA terms**.

7.7.1.180 There is no embedded or secondary mitigation required as the effect of disturbance from other construction activities during construction is considered to be not significant in EIA terms.

7.7.1.181 The residual significance of the effect of auditory injury from other construction activities during construction is assessed as **Negligible to Minor and Not Significant in EIA terms**.

## Impact 7: Auditory Injury from Geophysical Surveys

7.7.1.182 A series of high-resolution geophysical surveys will be undertaken in the construction phase within the Caledonia South Site and Caledonia South OECC. High-resolution geophysical surveys are non-intrusive and will utilise towed equipment such as SSS, SBP, MBES, magnetometer, USBL and UHRS to gather detailed information on the bathymetry, seabed sediments, geology, and anthropogenic features (e.g., existing seabed infrastructure, UXO) that exist across Caledonia South.

7.7.1.183 An essential step in assessing the potential for effects on relevant species is a consideration of their auditory sensitivities. Marine mammal hearing groups and auditory injury criteria from Southall *et al.* (2019[70]), and corresponding species of relevance to this assessment, are summarised in Table 7–9.

7.7.1.184 Prior to an evaluation in relation to each item of equipment, the overlap between typical survey equipment operating characteristics and marine mammal functional hearing capability is considered in Table 7–35. Table 7–35 presents typical values for geophysical surveys for large offshore wind farms, but equipment specific values will vary between different survey contractors. Where there is no overlap between hearing capability and functional hearing, there is no potential for disturbance effects to occur. Although high magnitude pressure waves may result in physiological damage to organs regardless of hearing range overlap, i.e., blast trauma from underwater explosions, the acoustic signals from high frequency geophysical sources (e.g., MBES, SSS) which are above the hearing range of marine mammals are not impulsive enough to have the potential to result in hearing injury or other harm through such a mechanism. In the assessment it will be also required to consider PTS-onset thresholds for impulsive noise which are described in detail in Volume 7B, Appendix 7-2: Marine Mammals Underwater Noise Assessment Methodology.

Table 7–35: Comparison of typical noise emitting survey equipment operating characteristics and overlap with the estimated hearing range of different marine mammal functional hearing groups.

| Equipment | Estimated source pressure level (dB re 1µPa) | Expected Sound Frequency | LF | HF | VHF | PCW |
|---|---|---|---|---|---|---|
| MBES | 210–240 dB re 1µPa ($SPL_{peak}$) for multiple beams* (Lurton and Deruiter, 2011[161])<br>197 dB re 1µPa ($SPL_{peak}$) for a single beam at an operational frequency of 200kHz (Risch *et al.*, 2017[162]) | 200–400kHz (Hartley Anderson Ltd, 2020[163]) | Above all hearing ranges | | | |
| SSS | 210 dB re 1µPa ($SPL_{peak}$) (Crocker and Fratantonio, 2016[164], Crocker *et al.*, 2019[165]) | 300 & 900kHz (Crocker and Fratantonio, 2016[164], Crocker *et al.*, 2019[165]) | Above all hearing ranges | | | |
| SBP | 210–220 dB re 1µPa ($SPL_{peak}$) (Hartley Anderson Ltd, 2020[163]) | Frequency selectable. Typically 2–15kHz with a peak frequency of 3.5kHz (Hartley Anderson Ltd, 2020[163]) | Yes | Yes | Yes | Yes |
| USBL | 187 – 206 dB re 1 µPa (Jiménez-Arranz *et al*. 2020[166]) | 19 – 34kHz (Jiménez-Arranz *et al*. 2020[166]) | Yes | Yes | Yes | Yes |
| UHRS | 200 – 226 dB re 1 µPa (Hartley Anderson Ltd, 2020[163]) | 100Hz to 5kHz, and average approx. 1.5kHz (Hartley Anderson Ltd, 2020[163]) | Yes | Yes | Yes | Yes |
| * The higher the frequency of operation, the lower the source level tends to be. | | | | | | |

7.7.1.185 A magnetometer is used to measure the variation in the earth's total magnetic field to detect and map ferromagnetic objects on or near the sea floor along the survey's vessel tracks. Magnetometers are mounted in a gradiometer format to measure the magnetic gradient between the two sensors. The magnetometer is a passive system and, therefore, does not emit any noise, it is therefore scoped out of assessment.

**Summary**

7.7.1.186 A summary of the assessment of auditory injury from geophysical surveys during construction, presented in detail in paragraph 7.7.1.187 to 7.7.1.209, is provided in Table 7–36. No impacts are considered significant in EIA terms.

Table 7–36: Summary of the significance of auditory injury from geophysical surveys to marine mammals during construction phase.

| Receptor | Embedded Mitigation | Magnitude | Sensitivity | Significance | Secondary Mitigation | Residual |
|---|---|---|---|---|---|---|
| Harbour porpoise | MMMP (M-16, SBP & UHRS only) | Negligible | MBES, SSS – Negligible<br>SBP, USBL, UHRS – Low | Negligible | None | Negligible |
| Bottlenose dolphin | MMMP (M-16, SBP & UHRS only) | Negligible | MBES, SSS – Negligible<br>SBP, USBL, UHRS – Low | Negligible | None | Negligible |
| White-beaked dolphin | MMMP (M-16, SBP & UHRS only) | Negligible | MBES, SSS – Negligible<br>SBP, USBL, UHRS – Low | Negligible | None | Negligible |
| Common dolphin | MMMP (M-16, SBP & UHRS only) | Negligible | MBES, SSS – Negligible<br>SBP, USBL, UHRS – Low | Negligible | None | Negligible |
| Risso's dolphin | MMMP (M-16, SBP & UHRS only) | Negligible | MBES, SSS – Negligible<br>SBP, USBL, UHRS – Low | Negligible | None | Negligible |
| Minke whale | MMMP (M-16, SBP & UHRS only) | Negligible | MBES, SSS – Negligible<br>SBP, USBL, UHRS – Low | Negligible | None | Negligible |
| Humpback whale | MMMP (M-16, SBP & UHRS only) | Negligible | MBES, SSS – Negligible | Negligible | None | Negligible |

| Receptor | Embedded Mitigation | Magnitude | Sensitivity | Significance | Secondary Mitigation | Residual |
|---|---|---|---|---|---|---|
| | | | SBP, USBL, UHRS – Low | | | |
| Harbour seal | MMMP (M-16, SBP & UHRS only) | Negligible | MBES, SSS – Negligible<br>SBP, USBL, UHRS – Low | Negligible | None | Negligible |
| Grey seal | MMMP (M-16, SBP & UHRS only) | Negligible | MBES, SSS – Negligible<br>SBP, USBL, UHRS – Low | Negligible | None | Negligible |

*Magnitude of Impact*

MBES and SSS

7.7.1.187 JNCC (2017) do not advise that mitigation to avoid injury from use of MBES is necessary in shallow (<200 m) waters where the MBES used are of high frequencies (as they are planned to be here). EPS Guidance (JNCC *et al.*, 2010) for use of SSS states that *"this type of survey is of a short-term nature and results in a negligible risk of an injury or disturbance offence (under the Regulations)."* An equivalent conclusion was reached by DECC (2011[167]). Furthermore, a recent comprehensive assessment of the characteristics of acoustic survey sources proposed that MBES and SSS should be considered de minimis in terms of being unlikely to result in PTS to marine mammals (Ruppel *et al.*, 2022[168]). The extent and duration of the impact (underwater noise during MBES and SSS) is expected to be localised and short-term. As discussed in Ruppel *et al*. (2022[168]), the effect is unlikely to occur due to radiated power, exposure duration and number of pings exceeding the injury threshold. As the consequence, it is anticipated that no animals will experience injury and therefore the impact will not alter respective population trajectories. Therefore, the magnitude of auditory injury due to use of MBES and SSS has been assessed as Negligible for all species.

SBP

7.7.1.188 For dolphins (HF cetaceans), the source levels of SBP equipment are below the PTS-onset thresholds (see Volume 7B, Appendix 7-2: Marine Mammals Underwater Noise Assessment Methodology). As such, there is no risk of auditory injury (PTS) onset to any dolphin species from the use of this equipment and therefore the magnitude of auditory injury from SBP for dolphin species is assessed as Negligible.

7.7.1.189 For harbour porpoise (VHF cetacean), the predicted SBP source levels exceed the PTS-onset threshold and as such, the use of this equipment has the potential to cause PTS. BEIS (2020[169]) have indicated that for SBP, the PTS onset is likely to occur within 23m from the use of this equipment at source levels of 267 dB re 1 µPa ($SPL_{peak}$). This source level is considerably louder than those likely to be used for Caledonia South. Albeit with a high degree of uncertainty, BEIS (2019[170]) suggested that SBPs used in high-resolution geophysical surveys have a very low potential for injury.

7.7.1.190 For minke whales, humpback whale and seals (LF cetaceans and PCW), only the upper limits of predicted sources levels may exceed the PTS-onset thresholds. Whilst it is possible that the use of this equipment could operate at source levels below the PTS-onset thresholds for these species, at this stage of Caledonia South it is difficult to determine whether that will be the case. Acoustic signals from SBPs have shown slightly greater propagation from sources generating low frequencies (<10kHz), whilst some of the highest frequency sources (>50kHz) were only weakly detectable or undetected by recording equipment located a few hundred metres from the source (Halvorsen and Heaney, 2018[171]). However, noise modelling for pipeline surveys have previously indicated PTS-onset in minke whales within 5m of the source when SBP pingers operate with a sound source of 220dB re 1 µPa ($SPL_{peak}$) (Shell, 2017[172]), and approximately 10m for seals (Department for Business Energy and Industrial Strategy, 2019[173]).

7.7.1.191 The extent and duration of the impact (underwater noise during SBP) is expected to be localised and short-term. The effect (auditory injury) is unlikely to occur, but in case it does, it will be at a very low frequency. As the consequence, although it cannot be excluded that the impact could affect a small proportion of the respective populations, it is expected that the population trajectories will not be altered. Therefore, the magnitude of auditory injury from unmitigated SBP has been assessed as Low for harbour porpoise, minke whale, humpback whale and seals. This will be reduced to Negligible magnitude given the embedded mitigation measure of an MMMP (M-16, see Table 7–13) for geophysical surveys.

USBL

7.7.1.192 The source levels of USBL equipment are below the PTS-onset thresholds for minke whale, humpback whale, dolphin species, grey and harbour seals (see Volume 7B, Appendix 7-2: Marine Mammals Underwater Noise Assessment Methodology). As such, there is no risk of auditory injury (PTS) onset from the use of this equipment and therefore the magnitude of auditory injury from UHRS for minke whale, humpback whale, dolphin and seal species are assessed as Negligible.

7.7.1.193 While there is potential for USBL to be operated at a theoretical source level which exceeds the minimum threshold for instantaneous injury in a relevant marine mammal species (harbour porpoise; 202 dB) by up to 4 dB, such noise levels are unlikely to be realised. The NMFS has previously determined that USBL was unlikely to lead to incidental take and identified only Level B harassment threshold as something that could be potentially exceeded (NMFS, 2020[174]). Pace *et al.* (2021[175]) reported noise levels for a USBL operating at 25-40kHz attached to a SSS operating at a dual 300/600kHz frequency, the latter being above the recording capabilities of the noise loggers used. The effective source level was estimated as 184 dB re 1 μPa$^2$ @1m ($SPL_{rms}$). At 100m distance, broadband received levels in the 20-30kHz band were 147.9 dB re 1 μPa$^2$ ($SPL_{rms}$). When the USBL was active, the combined source was detectable above background noise at the maximum recording distance of 2km; however, at a distance of c. 1km from the source, broadband received levels were ≤ 140 dB re 1 μPa$^2$ ($SPL_{peak}$), ≤ 130 dB re 1 μPa$^2$ ($SPL_{peak}$), and application of VHF cetacean (harbour porpoise) frequency weighting indicated noise levels of < 120 dB re 1 μPa$^2$ ($SPL_{rms}$, VHF frequency-weighted).

7.7.1.194 These results illustrate no potential for instantaneous PTS-onset from the USBL source tested. As such, the extent and duration of the impact (underwater noise during USBL) is expected to be localised and short-term. The effect is unlikely to occur. As the consequence, it is expected that the population trajectory will not be altered. Therefore, the magnitude of auditory injury from USBL has been assessed as Negligible for harbour porpoise.

UHRS

7.7.1.195 The source levels of UHRS equipment are below the PTS-onset thresholds for dolphin species (see Volume 7B, Appendix 7-2: Marine Mammals Underwater Noise Assessment Methodology). As such, there is no risk of auditory injury (PTS) onset to any dolphin species from the use of this equipment and therefore the magnitude of auditory injury from UHRS for dolphin species is assessed as Negligible.

7.7.1.196 For harbour porpoise, minke whale, humpback whale and seals, the predicted UHRS source levels exceed the PTS-onset threshold and as such, the use of this equipment has the potential to cause PTS. The extent and duration of the impact (underwater noise during SBP) is expected to be localised and short-term. The effect is unlikely to occur, but in case it does, it will be at a low frequency. As the consequence, although it cannot be excluded that the impact could affect a small proportion of the respective populations, it is expected that the population trajectories will not be altered. Therefore, the magnitude of auditory injury from unmitigated UHRS has been assessed as Low for harbour porpoise, minke whale, humpback whale and seals. This will be reduced to Negligible magnitude given the embedded mitigation measure of an MMMP (M-16, see Table 7–13) for geophysical surveys.

*Sensitivity of Receptor*

MBES and SSS

7.7.1.197 The operational frequency of MBES and SSS sound sources (200 to 400kHz and 300 to 900kHz, respectively) is far above that of greatest hearing sensitivity for both porpoise (275Hz to 160kHz (peak sensitivity: 105kHz)) and seals (50Hz to 86kHz (peak sensitivity: 13kHz)). As there is no overlap between the hearing ranges of these species and the expected sound frequency of equipment, there is expected to be no reduction in the hearing abilities of either species. For dolphin species and minke whales, the operational frequency of MBES & SSS (200 to 400kHz) is far above that of the hearing range for dolphins (150Hz to 160kHz) and minke whales (7Hz to 35kHz). As such, the expected sound frequency does not overlap with the functional hearing range of these species and hence there is no potential to affect the hearing abilities of dolphins and minke whale. As such, all marine mammals are assessed as having a Negligible sensitivity to auditory injury (PTS-onset) from MBES and SSS.

SBP

7.7.1.198 While harbour porpoise and seal hearing ranges are between 275Hz to 160kHz, their peak sensitivity falls at 105kHz and 13kHz, respectively. The operational frequencies of SBP (2 to 15kHz with peak at 3.5kHz) shall mostly operate below that at which harbour porpoise and seals are most sensitive to auditory impact. Therefore, porpoise and seal sensitivity to PTS at this frequency is expected to be minimal. The operational frequency of SBP (2 to 15kHz with peak at 3.5kHz) overlaps within the hearing range for dolphins (150Hz to 160kHz) and minke whales (7Hz to 35kHz). Although the operable sound frequencies of SBP overlap with the hearing range, when the equipment is emitting higher frequency sounds, the source level tends to be lower (Lurton and Deruiter, 2011[161]), and thus is less likely to exceed the PTS-onset threshold. At the PTS-onset threshold, a 6 dB elevation of the hearing threshold somewhere within the SPB frequency range (2 to 15kHz) is likely to affect only a small region of minke whale, humpback whale and dolphin hearing, which is unlikely to result in changes to vital rates. As such, all marine mammals are assessed as having a Low sensitivity to auditory injury (PTS-onset) from SBP.

USBL

7.7.1.199 The operational frequencies of USBL (19 to 34kHz) shall mostly operate above that at which minke whale and humpback whale are most sensitive to auditory impact (200Hz to 19kHz). Therefore, whilst there is a risk of auditory injury, this risk is expected to be minimal. Additionally, the expected operable sound frequencies of USBL overlap with hearing ranges of harbour porpoise, dolphin and seal species and thus, there is a risk of injury if individuals are close enough to the sound source. Sound frequencies of USBL are outside estimated peak sensitivity for all species (Table 7–9). At the PTS-onset threshold, a 6 dB elevation of the hearing threshold somewhere within the USBL frequency range is likely to affect only a small region of animal’s hearing, which is unlikely to result in changes to vital rates. As such, all marine mammals are assessed as having a Low sensitivity to auditory injury (PTS-onset) from USBL.

UHRS

7.7.1.200 The operational frequencies of UHRS (100Hz to 5kHz) shall mostly operate below that at which harbour porpoise and dolphin species are most sensitive to auditory impact (Table 7–9). Therefore, whilst there is a risk of auditory injury, this risk is expected to be minimal.

7.7.1.201 The expected operable sound frequencies of UHRS overlap with hearing ranges of minke whale, humpback whale and seal species and thus, there is a risk of injury if individuals are close enough to the sound source. Sound frequencies of UHRS are outside estimated peak sensitivity for all species (Table 7–9). At the PTS-onset threshold, a 6 dB elevation of the hearing threshold somewhere within the UHRS frequency range is likely to affect only a small region of animal's hearing, which is unlikely to result in changes to vital rates. As such, all marine mammals are assessed as having a Low sensitivity to auditory injury (PTS-onset) from UHRS.

*Significance of effect*

7.7.1.202 Taking the **Negligible** sensitivity of all marine mammals and the **Negligible** magnitude of impact, the overall effect of auditory injury (PTS) from MBES and SSS during construction is considered to be **Negligible and Not Significant in EIA terms**.

7.7.1.203 Taking the **Low** sensitivity of all marine mammals and the **Negligible** magnitude of impact, the overall effect of auditory injury (PTS) from SBP, USBL and UHRS during construction is considered to be **Negligible and Not Significant in EIA terms**.

7.7.1.204 The Applicant has committed to implementing a MMMP (M-16, see Table 7–13). Indicative mitigation measures presented in the draft MMMP (see Volume 7, Appendix 14: Caledonia South Draft Marine Mammal Mitigation Protocol) include pre-shooting watch of the mitigation zone[x] by the MMO and PAM watch where visual observations are not possible. Although the exact mitigation measures contained with the final MMMP are yet to be determined, they will be in line with the latest relevant guidance at the time of this stage of Caledonia South. It is considered that, due to the highly localised spatial extent, the impact of auditory injury due to the operation of SBP and UHRS can be fully mitigated using the embedded mitigation and, therefore, no secondary mitigation measures will be required.

7.7.1.205 With the implementation of embedded mitigation, the overall effect of auditory injury (PTS) from geophysical surveys during construction is **Negligible and Not Significant in EIA terms**.

[x] The extent of the mitigation zone for SBP and UHRS will be defined post-consent when equipment details are available.

*European Protected Species (EPS)*

7.7.1.206 As EPS, listed on Annex IV of the EU Habitats Directive, it is an offence to kill, injure or disturb cetaceans. An EPS risk assessment is required to assess the risk that an offence will occur, therefore assessing the need for an EPS licence(s) and providing the information required by MD-LOT in support of any such applications.

7.7.1.207 The Applicant will provide an EPS risk assessment for injury from geophysical surveys at the post consent stage. The expectation is that, given the commitment to a MMMP (M-16, see Table 7–13) to reduce the risk of auditory injury, no individuals that are classified as EPS will be injured, and thus an EPS license for injury is unlikely to be required.

## Impact 8: Behavioural Disturbance from Geophysical Surveys

7.7.1.208 A summary of the geophysical survey equipment, including the overlap between operating characteristics and marine mammal functional hearing capability is considered in Table 7–35.

### Summary

7.7.1.209 A summary of the assessment of behavioural disturbance from geophysical surveys during construction, presented in detail in paragraph 7.7.1.210 to 7.7.1.220, is provided in Table 7–37. No impacts are considered significant in EIA terms.

Table 7–37: Summary of the significance of behavioural disturbance from geophysical surveys to marine mammals during construction phase.

| Receptor | Embedded Mitigation | Magnitude | Sensitivity | Significance | Secondary Mitigation | Residual |
|---|---|---|---|---|---|---|
| Harbour porpoise | None | MBES, SSS: Negligible<br>SBP, USBL, UHRS: Low | MBES, SSS: Negligible<br>SBP, USBL, UHRS: Low | Negligible | None | Negligible |
| Bottlenose dolphin | None | MBES, SSS: Negligible<br>SBP, USBL, UHRS: Low | MBES, SSS: Negligible<br>SBP, USBL, UHRS: Low | Negligible | None | Negligible |
| White-beaked dolphin | None | MBES, SSS: Negligible<br>SBP, USBL, UHRS: Low | MBES, SSS: Negligible<br>SBP, USBL, UHRS: Low | Negligible | None | Negligible |

| Receptor | Embedded Mitigation | Magnitude | Sensitivity | Significance | Secondary Mitigation | Residual |
|---|---|---|---|---|---|---|
| Common dolphin | None | MBES, SSS: Negligible<br>SBP, USBL, UHRS: Low | MBES, SSS: Negligible<br>SBP, USBL, UHRS: Low | Negligible | None | Negligible |
| Risso's dolphin | None | MBES, SSS: Negligible<br>SBP, USBL, UHRS: Low | MBES, SSS: Negligible<br>SBP, USBL, UHRS: Low | Negligible | None | Negligible |
| Minke whale | None | MBES, SSS: Negligible<br>SBP, USBL, UHRS: Low | MBES, SSS: Negligible<br>SBP, USBL, UHRS: Low | Negligible | None | Negligible |
| Humpback whale | None | MBES, SSS: Negligible<br>SBP, USBL, UHRS: Low | MBES, SSS: Negligible<br>SBP, USBL, UHRS: Low | Negligible | None | Negligible |
| Harbour seal | None | MBES, SSS: Negligible<br>SBP, USBL, UHRS: Low | MBES, SSS: Negligible<br>SBP, USBL, UHRS: Low | Negligible | None | Negligible |
| Grey seal | None | MBES, SSS: Negligible<br>SBP, USBL, UHRS: Low | MBES, SSS: Negligible<br>SBP, USBL, UHRS: Low | Negligible | None | Negligible |

*Magnitude of Impact*

MBES and SSS

7.7.1.210 As the sound levels emitted from MBES and SSS are above 200kHz and therefore above the hearing frequency range of all marine mammals likely to be present in the region, there is no potential for marine mammals to experience disturbance. The impact magnitude is therefore Negligible.

SBP

*7.7.1.211* JNCC *et al*. (2010[34]) EPS Guidance concluded that the use of SBPs could cause localised short-term impacts on behaviour such as avoidance. However, it is unlikely that this would be considered as disturbance in the terms of the EPS Regulations. SBPs are highly directional, with noise levels outside of the main beam considerably lower and therefore with limited horizontal propagation of noise levels. Any response will likely be temporary; for example, evidence from Thompson *et al*. (2013[176]) suggests that short-term disturbance caused by a commercial two-dimensional seismic survey (a much louder noise source (peak-to-peak source levels estimated to be 242–253 dB re 1μPa at 1 m) than SBP) does not lead to long-term displacement of harbour porpoises. Assessment guidance from JNCC for noise disturbance against conservation objectives of SACs designated for harbour porpoise recommends a 5km EDR for high resolution geophysical surveys, based on SBP sources (JNCC, 2020[77]). This gives an assumed worst case daily disturbance footprint of 256km$^2$ considering this is a moving sound source (JNCC, 2023[38]). BEIS (2020[169]) published noise modelling based on the maximum source levels and bandwidths obtained from a range of SBPs and indicated potential for harbour porpoise to be disturbed over a distance of 2.5km. The report concluded that there was a low risk of harbour porpoise being physically disturbed by SBPs.

USBL, UHRS

7.7.1.212 As presented for auditory injury, a sound source verification exercise carried out by Pace *et al.* (2021[175]) showed that the potential for behavioural disturbance within a limited spatial extent (i.e., a few hundred metres). It is possible that the UHRS may be audible to marine mammals and therefore their use may have the potential to cause disturbance. The majority of acoustic energy will be directed at the seabed rather than being emitted horizontally which reduces the impacts of noise emissions on nearby marine mammals. UHRS is designed to have a highly focused beam that aims directly at the seabed, meaning there is limited horizontal transmission of noise.

Magnitude of Impact Summary

7.7.1.213 Given that there is no potential for marine mammals to experience disturbance as a result of MBES and SSS, therefore the magnitude of impact for all species for MBES and SSS is assessed as Negligible.

7.7.1.214 For SBP, USBL and UHRS, it is predicted that any disturbance arising from the geophysical survey works within Caledonia South will be of localised spatial extent. The effect is likely to occur but at low frequency. Although the effect could affect a small proportion of the respective species populations, population trajectories are unlikely to be altered. Therefore, the magnitude of behavioural disturbance due to SBP, USBL and UHRS has been assessed as Low for all species.

### *Sensitivity of Receptor*

MBES and SSS

7.7.1.215 As indicated in Table 7–35, there is no potential for disturbance effects to occur through use of MBES or SSS, as the sound levels emitted are above 200kHz and therefore above the hearing frequency range of the marine mammals likely to be present in the region. The sensitivity of all marine mammals to disturbance from MBES and SSS is therefore assessed as Negligible.

SBP, USBL, UHR

7.7.1.216 As indicated in Table 7–35, the expected sound frequency for SBP falls within the functional hearing range for all relevant marine mammal species and, therefore, has the potential to result in disturbance effects. JNCC *et al.* (2010[34]) EPS Guidance concludes that the use of SBPs in geophysical surveys "*could, in a few cases, cause localised short-term impacts on behaviour such as avoidance."*

7.7.1.217 The expected sound frequency for the USBL and UHRS falls within the function hearing range for all relevant marine mammal species and, therefore, has the potential to result in disturbance effects (Table 7–35). Although the UHRS is a sparker system and is likely to cause greater disturbance, it is designed to have a highly focused beam that aims directly at the seabed, meaning there is limited horizontal transmission of noise. For both, USBL and UHRS, disturbance is likely to be of a very localised spatial extent which is unlikely to extend much beyond that of temporary avoidance associated with the concurrent presence of the survey vessel(s).

7.7.1.218 The behavioural disturbance due to SBP, USBL and UHRS is unlikely to cause change in individual reproduction and survival rates. As such, the sensitivity of marine mammals to disturbance from SBP, USBL and UHRS equipment is assessed as Low.

### *Significance of Effect*

7.7.1.219 Taking the **Negligible** sensitivity of all marine mammals and the **Negligible** magnitude of impact, the overall effect of behavioural disturbance from MBES and SSS during construction is considered to be **Negligible and Not Significant in EIA terms**.

7.7.1.220 Taking the **Low** sensitivity of all marine mammals and the **Low** magnitude of impact for all marine mammal species, the overall effect of behavioural disturbance from SBP, USBL and UHRS during construction is considered to be **Negligible and Not Significant in EIA terms**.

7.7.1.221 In the absence of any mitigation, the effect of disturbance from geophysical surveys during construction is considered to be not significant in EIA terms. Therefore, no embedded or secondary mitigation is required.

7.7.1.222 The overall effect of behavioural disturbance from geophysical surveys during construction is **Negligible and Not Significant in EIA terms**.

## Impact 9: Vessel Collisions

7.7.1.223 Given the vicinity of ports important to support oil and gas infrastructure in the North Sea, presence of operational OWFs as well as main commercial routes, the area within and surrounding Caledonia South already experiences a high density of commercial traffic (see Volume 7B, Appendix 9-1: Navigational Risk Assessment for full details). The vessel traffic movement study recorded an average of 17 unique vessels per day within the array study area[xi] during the winter survey period (January to February 2023) (range 11 to 28) and on average 11 unique vessels per day in the OECC study area[xii] (range five to 18). During the summer survey period (July to August 2023), an average of 29 to 30 unique vessel per day were recorded within the array study area (range three to 38 unique vessels in a day) and on average 11 unique vessels per day in the OECC study area (range five to 23). In the array study area, vessels comprised primarily of fishing vessels, cargo vessels and wind farm vessels (at Beatrice OWF and Moray East OWF, operating out of Fraserburgh, Wick and Buckie), whereas in the OECC study area, vessels comprised mainly of recreation vessels, fishing vessels, oil and gas vessels, cargo vessels and wind farm vessels (transiting between the Moray Firth wind farms and Fraserburgh).

7.7.1.224 The Caledonia South OECC will make landfall at Stake Ness (west of Whitehills) which is located within the Southern Trench NCMPA for minke whales and is near to the Boyne Bay and Port Soy seal haul-out sites.

7.7.1.225 There are a number of ports considered to be utilised during construction, and vessel movements in and out of the port may affect designated sites that are located in the vicinity of the ports. Buckie, Fraserburgh and Peterhead ports are located within the Southern Trench NCMPA, where minke whale is a protected feature. If the ports at Cromarty, Nigg or Ardersier are selected, the vessel traffic will overlap with the Moray Firth SAC, where bottlenose dolphin is a qualifying feature.

### Summary

7.7.1.226 A summary of the assessment of risk of vessel collisions during construction is provided in Table 7–38. No impacts are considered significant in EIA terms.

[xi] Array study area = 10nm buffer around the Caledonia OWF (noting this is larger than the Caledonia South Site).
[xii] OECC study area = 2nm buffer around the Caledonia South OECC.

Table 7–38: Summary of the significance of vessel collision to marine mammals during construction phase.

| Receptor | Embedded Mitigation | Magnitude | Sensitivity | Significance | Secondary Mitigation | Residual |
|---|---|---|---|---|---|---|
| Harbour porpoise | VMP (M-13) | Low | High | Minor | None | Minor |
| Bottlenose dolphin | VMP (M-13) | Low | High | Minor | None | Minor |
| White-beaked dolphin | VMP (M-13) | Low | High | Minor | None | Minor |
| Common dolphin | VMP (M-13) | Low | High | Minor | None | Minor |
| Risso’s dolphin | VMP (M-13) | Low | High | Minor | None | Minor |
| Minke whale | VMP (M-13) | Low | High | Minor | None | Minor |
| Humpback whale | VMP (M-13) | Low | High | Minor | None | Minor |
| Harbour seal | VMP (M-13) | Low | High | Minor | None | Minor |
| Grey seal | VMP (M-13) | Low | High | Minor | None | Minor |

*Magnitude of Impact*

7.7.1.227 During construction of the wind farm, a potential source of effect from increased vessel activity is physical trauma from collision with a boat or ship. These injuries include blunt trauma to the body or injuries consistent with propeller strikes. The risk of collision of marine mammals with vessels would be directly influenced by the type of vessel and the speed with which it is travelling (Laist *et al.*, 2001[177]) and indirectly by ambient noise levels underwater and the behaviour the marine mammal is engaged in.

7.7.1.228 There is currently a lack of information on the frequency of occurrence of vessel collisions as a source of marine mammal mortality, and there is little evidence from marine mammals stranded in the UK and Ireland that injury from vessel collisions is an important source of mortality. The UK Cetacean Strandings Investigation Programme (CSIP) documents the annual number of reported strandings and the cause of death for those individuals examined at post-mortem. The CSIP data shows that very few strandings have been attributed to vessel collisions (CSIP, 2011[178]; 2012[179]; 2013[180]; 2014[181];

2015[182]; 2016[183]; 2017[184]; 2018[185]), therefore, while there is evidence that mortality from vessel collisions can and does occur, it is not considered to be a key source of mortality highlighted from post-mortem examinations.

7.7.1.229 Predictability of vessel movement by marine mammals is known to be a key aspect in minimising the potential risks imposed by vessel traffic (Nowacek *et al.*, 2001[186]; Lusseau, 2003[187]; 2006[188]). The embedded mitigation of a VMP (M-13, see Table 7–13) will ensure that vessel traffic moves along predictable routes, set recommended speed and define how vessels should behave in the presence of marine mammals.

7.7.1.230 It is estimated that a maximum of 25 construction vessels will be utilised at any one time (Table 7–14). The majority of vessels used during construction will be large (installation vessel, cable lay and support vessels) that are stationary or slow moving throughout construction activities for significant periods of time. Therefore, the actual increase in vessel traffic moving around the Caledonia South Site and Caledonia South OECC and to/from port will occur over short periods of the offshore construction activity. Furthermore, due to the already high volume of vessel traffic already in the navigational study area (with up to 38 unique vessels in a day), the introduction of additional vessels during construction of Caledonia South is not a novel impact for marine mammals present in the area.

7.7.1.231 Although vessels will be moving across a large area (maximum distance between Caledonia South and considered ports is approximately 110km between the Caledonia South Site and Aberdeen port), the impact will be localised to within the moving vessel. The impact will occur throughout the construction period of up to three years (medium term). The adoption of a VMP during construction will minimise the potential for the collision to take place (M-13, Table 7–13). As such, the risk of a collision occurring is unlikely and if it occurs, it would be at low frequency, and it is not expected to impact enough individuals to alter the population trajectory. As such, the magnitude of the risk of vessel collisions is Low.

*Sensitivity of Receptor*

7.7.1.232 Harbour porpoise, bottlenose dolphin, white beaked dolphin, common dolphin, Risso’s dolphin, grey seal and harbour seal are highly mobile and agile and have been observed to respond to vessel noise (e.g., propellors, thrusters, geophysical survey equipment) (Erbe *et al.*, 2019[189]). These species are therefore likely to be able to detect nearby vessels and move out of the ZoI and the path of the vessel, thus avoiding collision, although this is dependent on the vessel movement being predictable (Nowacek *et al.*, 2001[186]; Lusseau *et al.*, 2009[190]). Additionally, in a study in the Moray Firth seals were shown to utilise the same areas as vessels when moving between foraging sites and haul-outs but tended to remain beyond 20m from vessels with only three instances of seals coming within 20m of vessels over 2,241 days (Onoufriou *et al.*, 2016[191]). Larger and less agile species, such as minke whales and humpback whales, may be less able to avoid moving vessels.

7.7.1.233 However, if collision occurs, it may result in serious injury to marine mammal (beyond recovery) or sudden death. Therefore, the sensitivity of marine mammals to vessel collisions is considered to be High.

*Significance of Effect*

7.7.1.234 Taking the **High** sensitivity of marine mammals and the **Low** magnitude of impact, the overall effect of risk associated with vessel collisions during construction is considered to be **Minor and Not Significant in EIA terms**.

7.7.1.235 The embedded mitigation includes the commitment to VMP (M-13), which describes current guidance such as the Scottish Marine Wildlife Watching Code that vessels need to adhere to in order to minimise the risk of collision (see Table 7–13). Following application of this embedded measure, the effect of risk of vessel collisions for all species is considered to be not significant in EIA terms. Therefore, no secondary mitigation is required.

7.7.1.236 The overall effect of vessel collisions during construction is **Minor and Not Significant in EIA terms**.

## Impact 10: Vessel Disturbance

7.7.1.237 A summary of data about vessel activity within the Caledonia South Site and Caledonia South OECC and ports likely to be utilised during the construction of Caledonia South is provided in paragraphs 7.7.1.223 to 7.7.1.225.

**Summary**

7.7.1.238 A summary of the assessment of vessel disturbance during construction is provided in Table 7–39. No impacts are considered significant in EIA terms.

Table 7–39: Summary of the significance of vessel disturbance to marine mammals during construction phase.

| Receptor | Embedded Mitigation | Magnitude | Sensitivity | Significance | Secondary Mitigation | Residual |
|---|---|---|---|---|---|---|
| Harbour porpoise | VMP (M-13) | Low | Low | Negligible | None | Negligible |
| Bottlenose dolphin | VMP (M-13) | Low | Low | Negligible | None | Negligible |
| White-beaked dolphin | VMP (M-13) | Low | Low | Negligible | None | Negligible |
| Common dolphin | VMP (M-13) | Low | Low | Negligible | None | Negligible |
| Risso's dolphin | VMP (M-13) | Low | Low | Negligible | None | Negligible |
| Minke whale | VMP (M-13) | Low | Medium | Minor | None | Minor |
| Humpback whale | VMP (M-13) | Low | Low | Negligible | None | Negligible |
| Harbour seal | VMP (M-13) | Low | Low | Negligible | None | Negligible |
| Grey seal | VMP (M-13) | Low | Low | Negligible | None | Negligible |

*Magnitude of Impact*

7.7.1.239 Vessel noise levels from construction vessels will result in an increase in non-impulsive, continuous sound in the vicinity of Caledonia South, typically in the range of 10 to 100Hz (although higher frequencies will also be produced) (Erbe *et al.*, 2019[189]) with an estimated source level of 161 and 168 $SEL_{cum}$ dB re 1 μPa@1m (RMS) for medium and large construction vessels, travelling at a speed of 10 knots (see Volume 7, Appendix 6: Underwater Noise Assessment). Vessel noise is continuous, and is dominated by sounds from propellers, thrusters and various rotating machinery (e.g., power generation, pumps) (OSPAR, 2009b[192]). In general, small boats and ships are expected to have broadband source levels in the range 160 to 180dB re 1μPa (rms), with the majority of energy below 1kHz (OSPAR, 2009a[193]). Large commercial vessels (>100 m) produce relatively loud and predominately low frequency sounds, with the strongest energy concentrated below 200Hz (OSPAR, 2009a[193]).

7.7.1.240 The area within and surrounding Caledonia South already experiences high levels of commercial vessel traffic. During the construction of Caledonia South, there will be a maximum of 25 vessels present at any one time. Vessel movements in and out of the port may affect designated sites that are located in the vicinity of the ports, including the Moray Firth SAC and the Southern Trench NCMPA. Impacts on these sites will be assessed in RIAA (Application Document 14: Caledonia South Report to Inform Appropriate Assessment) and MPA Assessment (Application Document 9: Marine Protected Area Assessment), respectively. Additionally, substantial vessel activity will take place within the Southern Trench NCMPA during export cable installation. The number of vessels present within the site will depend on how many vessels are navigating to and/or from the site (especially when ports located in the Buckie, Fraserburgh and Peterhead are utilised). It is anticipated that up to two vessels will be working in the coastal areas performing activities associated with export cable and connection to landfall (Table 7–14). Although presence of vessels and associated noise in the vicinity of Caledonia South is not a novel impact for marine mammals present in the area, additional vessels within the Caledonia South Site during the construction represent 147% and 86% increase vs the average baseline for winter and summer periods, respectively.

7.7.1.241 Vessel activity may result in localised changes in marine mammal occurrence. Animals classed within different hearing groups will have different sensitivities to vessel noise and this is discussed in more detail in the sensitivity section below (paragraph 7.7.1.244 et seq). However, for the assessment of spatial extent and probability of occurrence of the effect, the following examples are provided. Given that vessel presence is likely to affect each marine mammal species differently, the impacts of disturbance from vessel presence have been considered on a species-by-species basis:

- *Harbour porpoise*: it has been shown that beyond 4km no significant effects of construction vessels could be detected (Benhemma-Le Gall *et al.*, 2021[80]).
- *Bottlenose dolphins*: vessels within 400m of a dolphin group have been found to result in short-term changes to bottlenose dolphin behaviour through both targeted, and non-targeted approaches (Clarkson *et al.*, 2020[194]; Puszka *et al.*, 2021[195]).
- *Common dolphin*: vessels within 300m of a dolphin group have been found to result in short-term changes to common dolphin behaviour (Meissner *et al.*, 2015[196]).
- *Minke whale*: in baleen whales, observed changes in foraging behaviour were apparent when whale-watching vessels were within ~250m of an animal (Sullivan and Torres, 2018[197]).
- *Seals*: vessel disturbance studies on seals have demonstrated flushing of seals in response to large vessels can occur out as far as 1km (Young *et al.*, 2014[198]; Cates, 2017[199]).

7.7.1.242 Lusseau *et al.* (2011[200]) attempted to predict the consequences of disturbances from increased vessel traffic in the Moray Firth on the resident bottlenose dolphin population. The study modelled a number of scenarios including the development of renewable fabrication facilities at Nigg (Cromarty Firth) and/or Whiteness Point (Ardersier). The authors concluded that even if both sites were to be used simultaneously resulting in an extra 800 vessel movements, the increase in the amount of time dolphins would spend in the vicinity of vessels is unlikely to result in population level effects. It is due to the small increase in exposure predicted, combined with the fact that commercial traffic is predictable and less likely to have an effect on bottlenose dolphins than unpredictable recreational vessels (Lusseau *et al.*, 2011[201]).

7.7.1.243 Although vessels will be moving across a large area (maximum distance between Caledonia South and considered ports is approximately 110km between the Caledonia South Site and Aberdeen port), the impact is considered to be localised to the vicinity of the moving vessel (up to approximately 4km for harbour porpoise). The impact will be temporary (only then vessel is moving or stationary with the engine running) and will occur throughout the construction period of up to three years (medium term). It is likely that the effect may occur at moderate frequency, it would depend on how many animals will be encountered by vessels moving in and out of ports as well as within the Caledonia South Site and Caledonia South OECC. Although it could affect a small proportion of respective populations across the duration of the construction, it is unlikely to alter population trajectories in the long-term. It is due to the fact that it will be taking place in the area already characterised by high commercial vessel traffic and animals are likely to be habituated to vessel noise. Considering the above, the magnitude of the disturbance from vessels is assessed as Low.

*Sensitivity of Receptor*

Harbour porpoise

7.7.1.244 As previously described in paragraph 7.7.2.74, during the construction of the offshore windfarms within the Moray Firth, harbour porpoise occurrence decreased with increasing vessel presence, with the magnitude of decrease depending on the distance to the vessel (Benhemma-Le Gall *et al.*, 2021[80]). Additional studies conducted during offshore windfarm construction demonstrated that harbour porpoise detections in the vicinity of the pile driving location decline prior to a piling event (Brandt *et al.*, 2018[79]; Benhemma-Le Gall *et al.*, 2021[80]). During a study conducted at seven OWFs in the German Bight, Brandt *et al.* (2018[79]) observed a decline in harbour porpoise detections within 2km of the construction site, and continued to be reduced for 1 to 2 days after. This was considered to be attributed in part to the increased vessel activity and traffic associated with construction related activities (Brandt *et al.*, 2018[79]). Behavioural responses of harbour porpoises to vessel noise have also been observed in more controlled conditions. Dyndo *et al.* (2015[202]) conducted an exposure study using four harbour porpoise contained in a semi-natural net pen and exposed to noise from passing vessels. Behavioural responses were observed as a result of low levels of medium to high frequency vessel noise. During 80 high quality recordings of boat noise, porpoising, a stereotypical disturbance behaviour, was observed in 27.5% of cases (Dyndo *et al.*, 2015[202]).

7.7.1.245 Data examining the surfacing behaviour of harbour porpoise in relation to vessel traffic in Swansea Bay from land-based surveys found a significant correlation between harbour porpoise sightings and the number of vessels present. When vessels were up to 1km away, 26% of the interactions observed were considered to be negative (animal moving away or prolonged diving). The proximity of the vessel being an important factor, with the greatest reaction occurring just 200m from the vessel. The type of vessel was also relevant, as smaller motorised boats (e.g., jet-ski, speed boat, small fishing vessels), were associated with more negative behaviours than larger cargo ships, although this type of vessel was a less common occurrence (Oakley *et al.*, 2017[203]). Vessels associated with OWF construction are typically larger than these types of small, motorised vessels, and, therefore, it would be anticipated that the behavioural response would not be as severe. Telemetry data can also be used to identify fine-scale changes in behaviour. Between 2012-2016, seven harbour porpoises were tagged in a region of high shipping density in the inner Danish waters and Belt seas. Periods of high vessel noise coincided with erratic behaviour including 'vigorous fluking', bottom diving, interrupted foraging, and the cessation of vocalisations. Four out of six of the animals that were exposed to noise levels above 96 dB re 1 µPa (16kHz third octave levels) produced significantly fewer buzzes with high quantities of vessel noise. In one case, the proximity of a single vessel resulted in a 15 minute cessation in foraging (Wisniewska *et al.*, 2018[204]).

7.7.1.246 Behaviour-based modelling has indicated the potential for vessel disturbance to have population-level effects under certain circumstances. Nabe-Nielsen *et al.* (2014[205]) simulated harbour porpoise response to vessels did not result in further population decline when prey sources recovered fast (after two days), but if prey availability remained low then vessels were estimated to have a significant negative impact on the population. However, whilst this negative trend was estimated, when comparing the theoretical impact of vessel presence versus bycatch, the latter was found to have a greater effect on population size as it causes direct mortality and, therefore, Nabe-Nielsen *et al.* (2014[205]) suggest that conservation efforts should instead focus more closely on this issue.

7.7.1.247 In conclusion, there is some evidence that changes in harbour porpoise behaviour and presence can result from disturbance by vessel presence (Oakley *et al.*, 2017[160]; Wisniewska *et al.*, 2018[204]). Several studies have also observed an increase in vessel presence to correlate with a decrease in harbour porpoise presence (Brandt *et al.*, 2018[79]; Benhemma-Le Gall *et al.*, 2021). While disturbance from vessels can result in short term changes to porpoise behaviour, it is unlikely to result in alterations in vital rates in the longer term and no population level impacts are expected (unless there is simultaneously a significant impact to their prey species). The sensitivity of harbour porpoise to disturbance from vessel activity is therefore classified as Low.

Bottlenose dolphin, common dolphin, white-beaked dolphin, Risso's dolphin

7.7.1.248 Studies using passive acoustic monitoring suggested that vessel disturbance has been shown to negatively affect bottlenose dolphin foraging activity as the results indicated a short-term 49% reduction in foraging activity (though this did not vary with noise level) (Pirotta *et al.*, 2013[146]). However, animals resumed foraging after the vessel had travelled through the area. The susceptibility to disturbance was variable depending on the location and year, suggesting circumstantial impacts of vessel noise on bottlenose dolphins. the physical presence of vessels, and not just the noise created, plays a large role in disturbance responses (Pirotta *et al.*, 2015b). Changes in behaviour as a result of vessel presence may also include increased swimming speeds (when resting or socialising), increased travelling time (less time resting, socialising and foraging) as well as characteristics of whistles (Constantine *et al.*, 2004[206]; La Manna *et al.*, 2013[207]; Marley *et al.*, 2017b[208]; Piwetz, 2019[209]).

7.7.1.249 It is hypothesised that the quality of the habitat impacts the behavioural response to disturbance (Marley *et al.*, 2017a[210]). In Italy, bottlenose dolphins would tolerate vessel presence within certain levels and were more likely to leave an area if disturbance was persistent (La Manna *et al.*, 2013[207]). Similarly, high levels of tolerance to vessel disturbance were observed in Aberdeen harbour where vessel traffic is consistently high (Pirotta *et al.*, 2013[146]). Therefore, the degree to which an animal will be disturbed is likely linked to their baseline level of tolerance (Bejder *et al.*, 2009[211]).

7.7.1.250 New *et al.* (2013[212]) developed a mathematical model simulating the complex interactions of the coastal bottlenose dolphin population in the Moray Firth to determine if an increased rate of disturbance resulting from vessel traffic was biologically significant. The scenario modelled increased vessel traffic from 70 to 470 vessels a year to simulate the potential increase from the proposed offshore development. An increase in commercial vessel traffic only is not anticipated to result in a biologically significant increase in disturbance because the dolphins have the ability to compensate for their immediate behavioural response and, therefore, their health and vital rates are unaffected (New *et al.*, 2013[212]).

7.7.1.251 In conclusion, vessel disturbance can elicit a variety of responses in bottlenose dolphins (Constantine *et al.*, 2004[206]; La Manna *et al.*, 2013[207]; Pirotta *et al.*, 2015b[146]; Marley *et al.*, 2017a[213], 2017b[208]). However, bottlenose dolphins have been observed to display tolerance to vessel disturbance, particularly in areas where vessel traffic has always been high

(Pirotta *et al.*, 2013[146]). Furthermore, behavioural changes in bottlenose dolphins are not always considered biologically significant (New *et al.*, 2013[212]). The sensitivity of bottlenose dolphins to disturbance from vessel activity is therefore classified as Low.

7.7.1.252 Considering the evidence for potential behavioural responses of common dolphins to vessel activity, it is assumed that the sensitivity of common dolphins can be also classified as Low. The information provided above for bottlenose dolphin and common dolphins have been used as a proxy for the assessment of effects of vessel disturbance on white-beaked and Risso's dolphins due to lack of species-specific studies. The sensitivity of white-beaked and Risso's dolphins to disturbance from vessel activity has therefore been classified as Low.

Minke whale, humpback whale

7.7.1.253 There are currently limited studies available regarding the effects of vessel disturbance on minke whale and humpback whale. Of the few studies available, minke whale foraging activity has been found to decrease with increased vessel interactions (Christiansen *et al.*, 2013a[110]), exemplified by shorter dives and changes in movement patterns. In addition, by analysing the respiration rate of minke whales, energy expenditure was estimated to be 28% higher during boat interactions, regardless of swim speed. Swim speed was also found to increase with vessel presence and these combined physiological and behavioural changes are thought to represent a stress response. As noise levels were not measured within the study, behavioural responses were therefore related to vessel presence. In addition, when considering the temporal and spatial rates of individuals' exposure over an entire season, there appeared to be no potential for a population-level effect of these acute disturbances (Christiansen *et al.*, 2015[214]). Further study by Christiansen and Lusseau (2015[214]) developed a mechanistic model for minke whales to examine the bioenergetic effects of disturbance from whale watching vessels, specifically on foetal growth. The presence of whale watching vessels resulted in an immediate 63.5% reduction in net energy intake. However, the impact of disturbance was considered to be below the threshold value at which whale watching would have a significant impact on foetal growth as the number of interactions with vessels was low during the feeding season and was, therefore, of negligible impact.

7.7.1.254 There are a number of studies focused on assessing the responses of humpback whales to whale-watching vessels. Some of the studied individuals showed signs of avoidance, whilst others would remain in the area or approach vessels (Stamation *et al.*, 2010[215]; Harcourt *et al.*, 2011[216]). Stamation *et al.* (2010[217]) found that whales were more likely to avoid a vessel moving within the permitted 100m approach limit than vessels outside the limit. A number of studies reported changes in dive times (Harcourt *et al.*, 2011[216]; Schuler, 2019; Currie *et al.*, 2021[218]) and behavioural state, including deviations in linear movement, swimming speed and respiration rate

(Schuler, 2019[219]; Currie *et al.*, 2021[218]). Schuler (2019[220]) reported that feeding and traveling humpback whales were likely to maintain their behavioral state regardless of vessel presence. There is evidence that the number of vessels have an influence on the extent of the responses, as deviations in linear movements and swimming speeds were increasing and inter-breath interval was decreasing with additional vessels present (Schuler, 2019[220]). Laute *et al.* (2022[221]) found that during the Covid-19 pandemic, reduction of whale watching trips by 68.6% was correlated with 2-fold increase in the number of humpback whale call detections.

7.7.1.255 When considering the impacts of whale watching vessels to those likely to occur from construction vessel activities, they cannot be directly transposed, as disturbance effects from whale watching are direct impacts, whilst those from construction activities are indirect, and the vessel types and underwater noise produced are very different. Nevertheless, it should be noted that Southern Trench NCMPA represents important foraging grounds for minke whales. These species are capital breeders and therefore their reproductive success could be affected by disrupted feeding activities (Stephens *et al.*, 2009[222]; Christiansen *et al.*, 2013b[158]). Therefore, the sensitivity of minke whales to disturbance from vessel activity is assessed as Medium. Given that humpback whales are only occasional visitors to the area and Moray Firth is not recognised as important foraging grounds for this species during migration, the sensitivity of humpback whales to disturbance from vessel activity is assessed as Low.

Seals

7.7.1.256 On the northwest coast of Ireland, a study of vessel traffic and marine mammal presence found grey seal sightings decreased with increased vessel activity in the surrounding area, though the effect size was small (Anderwald *et al*., 2013); the authors noted that relationships between sightings and vessel numbers were weaker than those with environmental variables such as sea state.

7.7.1.257 A telemetry study that included the tagging of 28 harbour seals in the UK found high exposure levels of harbour seals to shipping noise (Jones *et al.*, 2017[223]). The overlap between seals and vessel activity most frequently occurred within 50km of the coast, and in proximity to seal haul outs. Despite the distributional overlap and high cumulative sound levels, there was no evidence of reduced harbour seal presence as a result of vessel traffic (Jones *et al.*, 2017[223]). Similarly, Mathews *et al.* (2016[224]) reported that higher vessel counts in the study area were not associated with reduced seal counts, noting that the total counts included seals in the water, and therefore they were less sensitive to vessel disturbance.

7.7.1.258 The sensitivity of harbour and grey seals to disturbance from vessel activity is classified as Low.

*Significance of Effect*

7.7.1.259 Taking the **Low** sensitivity of harbour porpoise, dolphin species, humpback whale and seal species and the **Low** magnitude of impact, the overall effect of vessel disturbance during construction is considered to be **Negligible and Not Significant in EIA terms**.

7.7.1.260 Taking the **Medium** sensitivity of minke whale and humpback whale and the **Low** magnitude of impact, the overall effect of vessel collisions during construction is considered to be **Minor and Not Significant in EIA terms**.

7.7.1.261 The embedded mitigation includes the commitment to VMP (M-13), which describes current guidance such as the Scottish Marine Wildlife Watching Code that vessels needs to adhere to in order to minimise the risk of disturbance (see Table 7–13). Following application of this embedded measure, the effect of vessel disturbance for all species is considered to be not significant in EIA terms. Therefore, no secondary mitigation is required.

7.7.1.262 The overall effect of vessel collisions during construction is **Negligible to Minor and Not Significant in EIA terms**.

## Impact 11: Disturbance to Haul-outs

### Summary

7.7.1.263 A summary of the assessment of disturbance to haul-outs is provided in Table 7–40. No impacts are considered significant in EIA terms.

Table 7–40: Summary of the significance of disturbance to haul-outs to harbour and grey seal during construction phase

| Receptor | Embedded Mitigation | Magnitude | Sensitivity | Significance | Secondary Mitigation | Residual |
|---|---|---|---|---|---|---|
| Harbour seal | VMP (M-13) | Low | Medium | Minor | None | Minor |
| Grey seal | VMP (M-13) | Low | Low (outside breeding period) | Negligible | None | Negligible |
| | VMP (M-13) | Low | Medium (during breeding period) | Minor | None | Minor |

**Magnitude of Impact**

7.7.1.264 A study on impacts of small boats on the haul-out activity of harbour seals in Canada reported that the distance at which at >50% of seals first detected boats (alert distance) occurred when the boats were up to 800m away from the animals (Henry and Hammill, 2001[225]). However, on average seals became more alert when the vessel approached to approximately 300m and no differences in alert distance were observed between seasons. The study also noted that seals were observed to enter the water (flushing distance) when boats were at distances of >200m, with an increase in the flushing rate at distances <100m (Henry and Hammill, 2001[225]). A later study on harbour seals in Denmark reported larger distances as harbour seals were alerted by approaching boats at distances between 560m to 850m and initiated flight responses at distance between 510m to 830m (Andersen *et al.*, 2012). In the same study animals exhibited weaker and shorter-lasting responses during the breeding season. They were more reluctant to flee and returned to the haul-out site immediately after being disturbed, in some cases even during the disturbance. Authors attributed this seasonal tolerance to a trade-off between fleeing and nursing during the breeding season (Andersen *et al.*, 2012). A study on a grey seal colony in Ireland showed that the vessel distance from the haul-out site (500 m) had the strongest influence on the proportion of grey seals entering the water (Pérez Tadeo *et al*., 2021[226]).

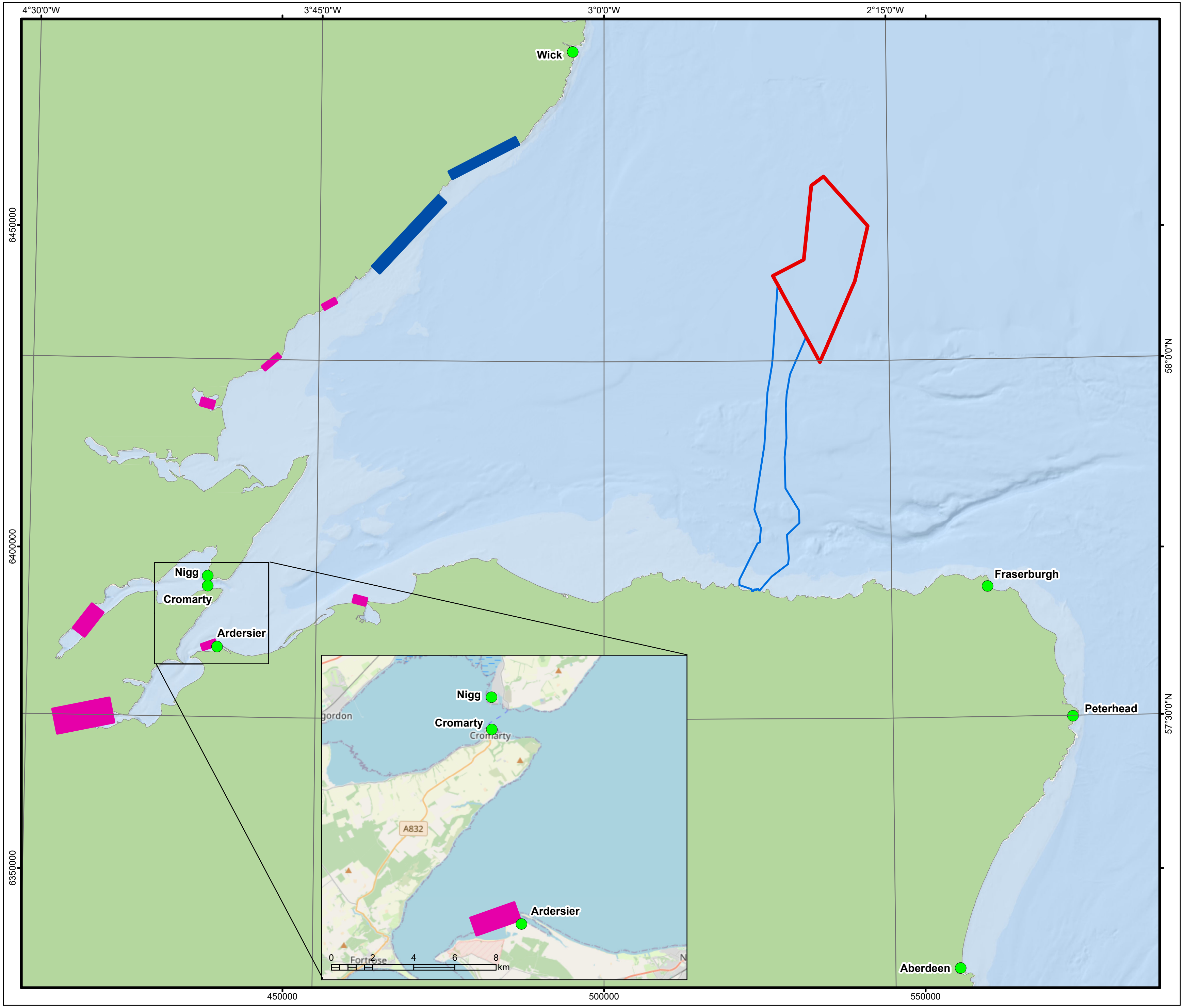
7.7.1.265 Published literature reported that the number of vessel-caused disturbances (e.g., harbour seals flushing from the haul-out site into the water) is a function of the number of vessels, the type of vessels, how they are distributed and the distance from a haul-out site (Mathews *et al*., 2016[227]; Cates and Acevedo-Gutiérrez, 2017[199]; Carpenter, 2021[228]). Paterson *et al*. (2019) studied post-disturbance haul-out behaviour of harbour seals and found that following the disturbance by boat located at a distance of 300m from the haul-out site, seals displayed a high degree of haul-out site fidelity and there was no significant effect on the probability of seals moving to a different haul-out site. Although distances at which behavioural response may occur vary, due to strong dependence on the distance of the vessel from the haul-out site, Cates and Acevedo-Gutiérrez (2017[199]) highlighted the importance of developing and enforcing buffer zones relative to the level of human activity.

7.7.1.266 Marine Scotland (2014[229]) states that:

"*The distance at which seals show such signs of agitation varies tremendously, depending on their location, how they are approached, whether the animals are used to the presence of humans and the time of year; in particular, whether or not they have pups with them*.' Further the guidance refers to '*reasonable distance*' justifying that '*there is no standard distance at which seals may react negatively*".

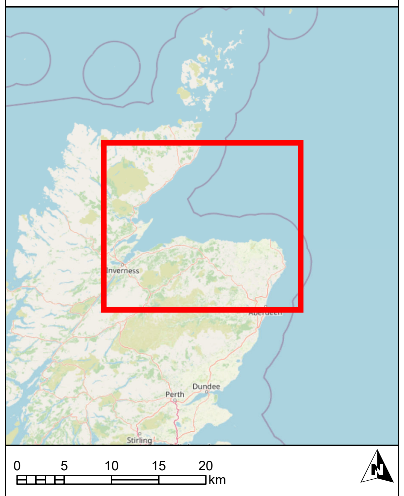
*Designated haul-out sites*

7.7.1.267 The designated haul-out sites are located more than 30km from Caledonia South and therefore activities associated with the construction within Caledonia South should not elicit any behavioural response to hauled-out seals at these sites. All ports likely to be utilised during the construction of Caledonia South (Table 7–14, Figure 7–12), except Ardersier, are located more than 20km from designated haul-out sites and therefore it is unlikely that increased vessel traffic could affect seals at the designated haul-out sites when vessels are moving in and out from these ports. In the case of Ardersier, the infrastructure to support the OWF industry is currently being developed, but it will be located approximately 0.5km from the designated haul out site (Ardersier, code MF-001 on Figure 7–12). There were a total of 84 harbour seals and 239 grey seals counted at Ardersier during the August haul-out count in 2021 (SCOS, 2023[50]). Although the designated site is located at only a short distance to the Ardersier port, construction vessels will follow a Code of Conduct and VMP (M-13, Table 7–13). The final VMP, when locations of ports are finalised, will include minimum vessel distances from seal haul-outs to minimise disturbance.




- Caledonia South Site
- Caledonia South Offshore Export Cable Corridor
- Ports
- Designated Seal Haul-Out Sites
- Seasonal Grey Seal Designated Haul-Out Sites






| REV | DATE | DOC STATUS | ORIGIN | REVIEW | APP |
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| 01 | 24/09/2024 | Approved | EV | BB | DH |

CALEDONIA Offshore Wind Farm

GoBe APEM Group

| | |
|---|---|
| CONTRACTOR DRAWING NO<br>UKCAL1_GO_WNF_MMM_MAP_00479 | CONTRACTOR REV<br>01 |
| GEODETIC PARAMETERS<br>WGS 84 / UTM zone 30N (EPSG: 32630) | |
| DRAWING TITLE<br>Figure 7-12: Caledonia South, Main Ports and Seal Haul-Out Sites (Designated and Seasonal) in the Moray Firth | |
| STATUS<br>Approved | SCALE<br>1:800,000 |
| DRAWING NUMBER<br>N/A | SHEET NO<br>01 of 01 / REV<br>N/A |

*Other haul-out sites*

7.7.1.268 The closest August haul-out site for harbour and grey seal is at Boyne Bay, located within the Caledonia South OECC and proximity to the Landfall Site. The counts within this haul-out site are relatively low, with seven harbour seals and 25 grey seals counted in 2021 (see Volume 7B, Appendix 7-1: Marine Mammals Baseline Characterisation for more details). Additionally, the nearby haul-out for grey seals at Port Soy is also located within the Caledonia South OECC. However, the most recent grey seal haul-out count at this site is from 2005 when eight individuals were recorded. As such, it is unlikely that it currently represents important haul-out site for this species.

7.7.1.269 During construction activities, seals at haul-out sites within the Caledonia South OECC may be affected by increased vessel traffic associated with cable laying within the shallow subtidal zone as vessels will be approaching closer to the coast. The exact route of the offshore export cables within the Caledonia South OECC will be determined at a later stage through a route optioneering appraisal. Landfall will be located at Stake Ness on the Aberdeenshire coast, to the west of Whitehills, approximately 3km from the Boyne Bay haul-out site, which is unlikely to be close enough to the haul-out to result in disturbance.

7.7.1.270 Additionally, vessels may transit close to seal haul-outs when moving in and out of ports. If the port at Buckie is selected, there will be increased vessel activity in close vicinity to haul-outs at Craigenroan (152 grey seals recorded in 2021) and Portgordon (78 grey and 29 harbour seals recorded in 2021). Cromarty and Nigg are also amongst ports considered and when transiting, vessels may be moving close to the Nigg haul-out site, where one grey seal and 40 harbour seals were recorded during counts in 2021. As discussed in paragraph 7.7.1.267 for designated haul-out sites, the port of Ardersier is also located in the close vicinity to the August haul out sites for both harbour and grey seals. It is expected that seals at these haul-out sites are habituated to vessel activity in and around the ports. Vessels will follow a Code of Conduct and VMP[xiii], which will aim to minimise disturbance (M-13, see Table 7–13).

7.7.1.271 The impact is considered to be localised to the vicinity of the moving vessel. The impact will be temporary (only when the vessel is moving or stationary with engine running) and will occur throughout the construction period of up to three years (medium term). Following the embedded mitigation measures, the effect may occur but at low to medium frequency. Although it could affect a small proportion of harbour and grey seal populations, almost all of the haul-out sites located in the vicinity of areas where increased vessel traffic can be anticipated are not a part of breeding colony (except Ardersier, if this port is selected). Additionally, vessel movements will be taking place in the

[xiii] The final VMP will consider disturbance controls such as minimum distance to haul-out sites prior to construction once construction ports are known and using the latest available data to inform the need for and design of these controls.

area already characterised by high commercial vessel traffic due to the presence of main ports that support oil and gas infrastructure as well as other OWFs. As such, it is unlikely that disturbance to haul-outs could alter harbour and grey seal population trajectories and magnitude of the disturbance to haul-outs is assessed as Low.

### Sensitivity of Receptor

7.7.1.272 The results of a study where Bankhead *et al.* (2023[230]) compared harbour seal responses to in-air noise at two haul-out sites with different levels of human activities showed that seals may become tolerant to in-air noise levels at sites where human activities are high. It corroborated the findings of Cates and Acevedo-Gutiérrez (2017[199]) who found that harbour seals at haul-out sites with low vessel activity flush more readily in response to boats than those at high-activity sites. Although vessel disturbance could be most detrimental during pupping season, there is evidence that seals are more reluctant to enter the water during the annual moult (Henry and Hammill, 2001[231]).

7.7.1.273 It should be noted that potential impacts of seals may be different depending on type of the year. Harbour seal breeding season occurs in June and July, followed by the moulting period in August During these periods, there is typically a greater number of harbour seals hauled-out during low tide periods than at other times of year. Grey seal breeding season occurs from August to December, followed by the annual moult occurs between December and April. During the breeding and moulting season, they will spend longer hauled-out compared to other times of year.

7.7.1.274 The sensitivity of grey seals to disturbance to haul-outs, is classified as Low outside of the breeding season and Medium during the breeding season. Due to declines in several regional harbour seal populations, this species is considered more vulnerable to pressures, including physical disturbance (SCOS, 2022[232]). Therefore, the sensitivity of harbour seal to disturbance during and outside the breeding and moult seasons at haul-outs has been assessed as Medium.

### Significance of Effect

7.7.1.275 Taking the Low sensitivity of grey seal species outside of the breeding season and the Low magnitude of impact, the overall effect of disturbance to haul-outs during construction (outside of breeding season) is considered to be **Negligible and Not Significant in EIA terms**. However, grey seal has been assessed as having Medium sensitivity during the breeding season. Considering Low magnitude of impact, the overall effect of disturbance to haul-outs during construction (during breeding season) is considered to be **Minor and Not Significant in EIA terms**.

7.7.1.276 Taking the Medium sensitivity of harbour seal and the Low magnitude of impact, the overall effect of disturbance to haul-outs during construction (during and outside breeding season) is considered to be **Minor and Not Significant in EIA terms**.

7.7.1.277 The embedded mitigation includes the commitment to a VMP[xiv] (M-13, see Table 7–13). Following application of this embedded measure, the effect of disturbance to haul-out for both seal species is considered to be not significant in EIA terms. Therefore, no secondary mitigation is required.

7.7.1.278 The overall effect of disturbance to haul-outs during construction is **Negligible to Minor and Not Significant in EIA terms**.

## Impact 12: Indirect Impacts on Marine Mammals via Changes in Prey Availability

7.7.1.279 Given that marine mammals are dependent on fish prey, there is the potential for indirect effects on marine mammals as a result of impacts upon fish species or the habitats that support them. Volume 4, Chapter 5: Fish and Shellfish Ecology assessed the following impacts on fish species during construction activities:

- Mortality, injury, behavioural impacts and auditory masking arising from increased underwater noise and vibration;
- Temporary increase in suspended sediment concentrations (SSCs);
- Temporary habitat disturbance;
- Direct and indirect seabed disturbance leading to release of sediment contaminants.

### Summary

7.7.1.280 A summary of the assessment of indirect impacts on marine mammals due to changes in prey availability during construction is provided in Table 7–39. No impacts are considered significant in EIA terms.

[xiv] The final VMP will consider disturbance controls such as minimum distance to haul-out sites prior to construction once construction ports are known and using the latest available data to inform the need for and design of these controls.

Table 7–41: Summary of the significance of indirect impacts on marine mammals due to changes in prey availability during construction phase.

| Receptor | Embedded Mitigation | Magnitude | Sensitivity | Significance | Secondary Mitigation | Residual |
|---|---|---|---|---|---|---|
| Harbour porpoise | None | Negligible | Low | Negligible | None | Negligible |
| Bottlenose dolphin | None | Negligible | Low | Negligible | None | Negligible |
| White-beaked dolphin | None | Negligible | Low | Negligible | None | Negligible |
| Common dolphin | None | Negligible | Low | Negligible | None | Negligible |
| Risso's dolphin | None | Negligible | Low | Negligible | None | Negligible |
| Minke whale | None | Negligible | Medium | Negligible | None | Negligible |
| Humpback whale | None | Negligible | Low | Negligible | None | Negligible |
| Harbour seal | None | Negligible | Low | Negligible | None | Negligible |
| Grey seal | None | Negligible | Low | Negligible | None | Negligible |

*Magnitude of Impact*

7.7.1.281 For each of the impacts listed in paragraph 7.7.1.279, the magnitude of impact was assessed as Negligible[xv] to Low[xvi] and the sensitivity of all fish and shellfish receptors were assessed as Negligible[xvii] to Medium[xviii]. The assessment found that potential impacts arising from construction of Caledonia South on fish and shellfish ecology receptors will result in a significance of negligible or minor adverse, therefore not significant in the EIA terms.

[xv] Very slight/no change to baseline conditions.
[xvi] Minor loss/divergence from baseline conditions.
[xvii] Receptor is not vulnerable to impacts regardless of value/importance. Locally important receptors with low vulnerability and medium to high recoverability.
[xviii] Regionally important receptors with high vulnerability and no ability for recovery; internationally or nationally important receptors with medium to high vulnerability and low to medium recoverability.

7.7.1.282 Benhemma-Le Gall *et al.* (2021[80]) demonstrated that harbour porpoise clicks (echolocation) and buzzing (associated with prey capture) in the short-range (2km) did not cease in response to pile driving. This implies that enough porpoise prey species remain in the area during piling activities for porpoise to continue foraging. Further, Russell *et al.* (2016a[118]) showed that seals continued to travel within 20km of the wind farm construction (piling) site, suggesting that the motivation to forage offshore could outweigh the deterrence caused by piling, attributed to short recovery times (Russell *et al.*, 2016a[118]).

7.7.1.283 Most impacts to fish during the construction phase are predicted to be temporary, but will occur repeatedly over the medium-term (three years construction phase). The risk of behavioural effects to fish from pilling is expected to be high in the near field, moderate in the intermediate field and low in the far fields. It is expected that there would be no significant impact on the distribution or quality of marine mammal prey species as a result of the construction activities. As such it is highly likely that impacts to prey species would result in only very slight or imperceptible changes to marine mammal receptors, and it is expected that this will not result in any population level change. Therefore, indirect impacts on marine mammals due to changes in prey availability during construction are most likely to be of Negligible magnitude.

*Sensitivity of Receptor*

7.7.1.284 As marine mammals are highly mobile and wide-ranging, it is expected that individuals can forage in alternative areas, if required. However, in case of displacement animals may need to forage on different prey than preferred, or increase the time spent foraging which could have adverse energetic consequences and reduce the time available for other activities such as resting or reproduction (Ransijn, 2023[233]).

7.7.1.285 Whilst their prey may be dominated by a few species, all marine mammals in this assessment, are considered to be generalist feeders, and thus are not dependent on a single prey species. Minke whales, however, specifically target sandeels within the Southern Trench NCMPA (NatureScot, 2020[25]).

7.7.1.286 Although most of the marine mammal species can likely supplement their diet with other available species if required, making them resilient to changes in prey availability, the key prey species for each marine mammal receptor are listed in Table 7–42.

Table 7–42:Key prey species of the marine mammal receptors (bold = species present within Caledonia South).

| Receptor | Site | Key Prey Species | Reference |
|---|---|---|---|
| Harbour porpoise | Scotland | **Sandeel**, **whiting, small cod (*Trisopterus spp.*)**, blue whiting, **cod**, **haddock,** saithe, rocklings, **herring,** sprat, **mackerel,** scad, cephalopods, molluscs, brown shrimp, **crabs,** isopods, amphipods, other crustaceans | Santos *et al.* (2004[234]) |
| Bottlenose dolphin | British Isles & Ireland | Catsharks, sprat, scad, conger eel, **Atlantic salmon,** blue whiting, **whiting, haddock,** saithe, **Norway pout, small cod,** silvery cod, ling, hake, **Atlantic horse mackerel, Atlantic mackerel,** gobies, sand smelt, lanternfish, flounder, plaice, dab, brill, sole, **various squid,** and octopus sp. | Santos *et al.* (2001[235]), Hernandez-Milian[236] *et al.* (2015) |
| White beaked dolphin | British Isles | **Gadidae (cod, true cod,** hake, **sole, sandeel, mackerel)**, **whiting,** goby, **haddock, squid** | Canning *et al.* (2008[237]); Jansen *et al.* (2010) |
| Common dolphin | British Isles | Seabass, goby, **cod,** cephalopods, **mackerel,** lanternfish, blue whiting | Brophy *et al.* (2009[238]) |
| Risso's dolphin | British Isles | **Squid,** cuttlefish and octopus, **haddock, whiting, gadidae** | MacLeod *et al.* (2014[239]) |
| Minke whale | British Isles | **Sandeel, herring,** sprat, **mackerel,** goby, **Norway pout** | Pierce *et al.* (2004[240]) |
| Grey seal | Scotland | Saithe, whiting, **cod, haddock,** rockling, ling, blue whiting, hake, pollock, **Norway pout, small cod, plaice, lemon sole,** sandeel, dover sole, **dab, herring,** sprat, **mackerel, salmonid,** wrasse, catfish | Hammond and Wilson (2016[241]) |
| Harbour seal | British Isles | Lamprey, eels, **herring, salmonids, haddock,** pollock, saithe, **whiting,** blue whiting, **Norway pout,** bib, rockling, ling, hake, perch, scad, wrasse, **sandeel,** goby, **mackerel,** flounder, **dab, sole,** witch, halibut, and **squid species** | Gosch *et al.* (2014[242]) |

7.7.1.287 Given the expected adaptability of most marine mammal species to find alternative prey species or locations, harbour porpoise, dolphin species, humpback whale and seal species are assessed to be of Low sensitivity.

7.7.1.288 Studies in the southern outer Moray Firth found minke whale distribution was positively correlated with areas of sandy-gravel sediments which represent suitable sandeel habitat (Robinson *et al.*, 2009[243]). Any impacts on the minke whale main prey species within the Southern Trench NCMPA may cause them to move to different areas that are less profitable for foraging and therefore have impacts on energy stores required during migration. There is therefore a risk that low magnitude change impacts on sandeels in the NCMPA could result in changes to survival and reproduction rates at this key foraging ground. Impacts on minke whale within the Southern Trench NCMPA are discussed in detail in Application Document 9: Marine Protected Area Assessment.

7.7.1.289 Given the dependence of minke whales on specific type of prey within the Southern Trench NCMPA, minke whales are assessed to be of Medium sensitivity.

*Significance of Effect*

7.7.1.290 Taking the **Low** sensitivity of harbour porpoise, dolphin species, humpback whale and seal species and the **Negligible** magnitude of impact, the overall effect of indirect impacts on marine mammals due to changes in prey availability during construction is considered to be **Negligible and Not Significant in EIA terms**.

7.7.1.291 Taking the **Medium** sensitivity of minke whale and the **Negligible** magnitude of impact, the overall effect of indirect impacts on marine mammals due to changes in prey availability during construction is considered to be **Negligible and Not Significant in EIA terms**.

7.7.1.292 In the absence of any mitigation, the effect of indirect impacts on marine mammals due to changes in prey availability is considered to be not significant in EIA terms. Therefore, no embedded or secondary mitigation is required.

7.7.1.293 The residual significance of the effect of indirect impacts on marine mammals due to changes in prey availability is assessed as **Negligible and Not Significant in EIA terms**.

## Impact 13: Changes in Water Quality

7.7.1.294 Changes in water quality as a result of construction activities can have both direct and indirect impacts on marine mammals. Direct impacts include the impairment of visibility and therefore foraging ability which might be expected to reduce foraging success. Indirect impacts include effects on prey species.

### Summary

7.7.1.295 A summary of the assessment of changes in water quality during construction is provided in Table 7–43. No impacts are considered significant in EIA terms.

Table 7–43: Summary of the significance of changes in water quality on marine mammals during construction phase.

| Receptor | Embedded Mitigation | Magnitude | Sensitivity | Significance | Secondary Mitigation | Residual |
|---|---|---|---|---|---|---|
| Harbour porpoise | None | Negligible | Negligible | Negligible | None | Negligible |
| Bottlenose dolphin | None | Negligible | Negligible | Negligible | None | Negligible |
| White-beaked dolphin | None | Negligible | Negligible | Negligible | None | Negligible |
| Common dolphin | None | Negligible | Negligible | Negligible | None | Negligible |
| Risso’s dolphin | None | Negligible | Negligible | Negligible | None | Negligible |
| Minke whale | None | Negligible | Negligible | Negligible | None | Negligible |
| Humpback whale | None | Negligible | Negligible | Negligible | None | Negligible |
| Harbour seal | None | Negligible | Negligible | Negligible | None | Negligible |
| Grey seal | None | Negligible | Negligible | Negligible | None | Negligible |

#### *Magnitude of Impact*

7.7.1.296 During construction of Caledonia South, sediment will be disturbed and released into the water column. This will give rise to suspended sediment plumes and localised changes in bed levels as material settles out of suspension. The main activities resulting in disturbance of seabed sediments, detailed in Volume 4, Chapter 3: Marine Water and Sediment Quality and assessed for the construction phase, are:

- Deterioration in water quality due to suspension of sediments;
- Release of sediment-bound contaminants from disturbed sediments; and
- Deterioration in water clarity due to the release of drilling mud.

7.7.1.297 For each of the above impacts assessed, the magnitude of impact was assessed as Low[xix] and the sensitivity of water body receptors were assessed as Negligible[xx] to Medium[xxi]. As such, the significance of all impacts were assessed as Negligible to Minor Adverse which is not significant in EIA terms.

7.7.1.298 Since there is expected to be no significant impacts on water quality during the construction phase of Caledonia South, the potential magnitude of water quality impacts on marine mammals is assessed as Negligible.

*Sensitivity of Receptor*

7.7.1.299 Marine mammals are well known to forage in tidal areas where water conditions are turbid and visibility conditions poor. For example, harbour porpoise and harbour seals in the UK have been documented foraging in areas with high tidal flows (e.g., Pierpoint, 2008[244]; Marubini *et al.*, 2009[245]; Hastie *et al.*, 2016[246]). Therefore, low light levels, turbid waters and suspended sediments are unlikely to negatively impact marine mammal foraging success. It is important to note that it is hearing, not vision that is the primary sensory modality for most marine mammals. When the visual sensory systems of marine mammals are compromised, they are able to sense the environment in other ways, for example, seals can detect water movements and hydrodynamic trails with their mystacial vibrissae; while odontocetes primarily use echolocation to navigate and find food in darkness. Short term increases in turbidity as a result of an increase in suspended sediment during the construction phase is, therefore, not anticipated to effect marine mammals which rely primarily on hearing. This results in all receptors having a Negligible sensitivity to water quality impacts.

*Significance of Effect*

7.7.1.300 Taking the **Negligible** sensitivity of all marine mammals and the **Negligible** magnitude of impact, the overall effect of changes in water quality during construction is considered to be **Negligible and Not Significant in EIA term**.

[xix] Extent: restricted to the near-field and adjacent far-field areas. Duration: temporary (i.e., lasting less than one year) to short-term (i.e., one to seven years). Frequency: will occur frequently throughout a relevant project phase. Consequences: Barely discernible/ noticeable change to key characteristics or features of the particular environmental aspect's character or distinctiveness.

[xx] Adaptability: high capacity to avoid or adapt to an impact. Tolerance: has a high capacity to accommodate the proposed form of change. Specific water quality conditions of the receptor are likely to be able to tolerate change with very little or no impact upon the baseline conditions detectable. Recoverability: anticipated to recover fully and will be temporary (i.e., lasting less than one year). Value: The receptor is not designated but may be of local importance and/ or local socio-economic value.

[xxi] Adaptability: limited capacity to avoid or adapt to an impact. Tolerance: moderate to low capacity to accommodate the proposed form of change. Recoverability: anticipated to recover fully within the medium term (i.e., seven to 15 years). Value: The water quality of the receptor supports or contributes towards the designation of an internationally or nationally important feature.

7.7.1.301 In the absence of any mitigation, the effect of changes in water quality is considered to be not significant in EIA terms. Therefore, no embedded or secondary mitigation is required.

7.7.1.302 The residual significance of the effect of changes in water quality is assessed as **Negligible and Not Significant in EIA term**.

## 7.7.2 Operation and Maintenance (O&M)

7.7.2.1 As mentioned in Volume 1, Chapter 3: Proposed Project Description (Offshore), the strategy of O&M will be finalised post-consent, depending on the location of O&M base and the final design parameters adopted for Caledonia South. It is anticipated that the operational lifespan of Caledonia South would be about 35 years. The expected O&M activities in Caledonia Site are detailed in Volume 1, Chapter 3: Proposed Project Description (Offshore).

### Impact 14: Operational Noise

7.7.2.2 A thorough review of available literature on operational underwater noise from bottom-fixed and floating WTGs (including cable snapping) is provided in Volume 7, Appendix 6: Underwater Noise Assessment. Using calculations reported by Tougaard *et al*. (2020[247]), the predicted PTS impact ranges for bottom-fixed foundations for all marine mammal species did not exceed 100m (Tougaard *et al.*, 2020[247]). Additionally, to accumulate enough energy for this effect to occur animals would need to remain stationary around the operational WTG for 24 hours and this is considered highly unlikely. A detailed assessment is also provided for underwater noise due to the operation of a floating WTG, which due to a much smaller submerged radiating area, is expected to be lower and below injurious thresholds for any marine mammals based on the Southall *et al.* (2019[29]) criteria. For mooring lines and cables, the Volume 7, Appendix 6: Underwater Noise Assessment concluded that using worst-case assumptions (e.g., all WTGs producing the maximum number of snaps in a day, equivalent noise levels from multiple locations affecting a receptor to the same degree) the underwater noise will be below any injurious criteria for marine mammals. As such, based on information above, provided in more detail in Volume 7, Appendix 6: Underwater Noise Assessment, the risk of injury (PTS) to marine mammals as a result of operating bottom-fixed and floating offshore wind WTGs if negligible. Therefore, the assessment in this section will be focussed on potential effects of disturbance as a result of operation noise.

#### Summary

7.7.2.3 A summary of the assessment of disturbance from operational noise is provided in Table 7–44. No impacts are considered significant in EIA terms.

Table 7–44: Summary of the significance of disturbance from operational noise to marine mammals during O&M phase.

| Receptor | Embedded Mitigation | Magnitude | Sensitivity | Significance | Secondary Mitigation | Residual |
|---|---|---|---|---|---|---|
| Harbour porpoise | None | Medium | Negligible | Negligible | None | Negligible |
| Bottlenose dolphin | None | Medium | Negligible | Negligible | None | Negligible |
| White-beaked dolphin | None | Medium | Negligible | Negligible | None | Negligible |
| Common dolphin | None | Medium | Negligible | Negligible | None | Negligible |
| Risso's dolphin | None | Medium | Negligible | Negligible | None | Negligible |
| Minke whale | None | Medium | Low | Minor | None | Minor |
| Humpback whale | None | Medium | Low | Minor | None | Minor |
| Harbour seal | None | Medium | Low | Minor | None | Minor |
| Grey seal | None | Medium | Low | Minor | None | Minor |

*Magnitude of Impact*

Bottom-fixed WTGs

7.7.2.4 Most studies conducted on operational noise from bottom-fixed OWFs to date were conducted at wind farms with relatively small-sized, geared WTGs (Tougaard *et al.*, 2020[247]).

7.7.2.5 Using data from bottom-fixed foundation WTGs of <1 to 6 MW capacity, Tougaard *et al.* (2020[247]) showed that as WTG size increases, the underwater sound pressure level also increases. Stöber and Thomsen (2021[248]) also noted a difference in underwater noise levels generated by geared vs direct-drive WTGs, with one example of the latter being 10 dB quieter than the average geared WTG of equivalent capacity. Tougaard *et al.* (2020[247]) present a formula, based on the published data for the operational wind farms, that allows broadband noise level to be estimated based on the application of wind speed, WTG size (by nominal power output) and distance from the WTG. As presented in the Volume 7, Appendix 6: Underwater Noise Assessment, this formula suggests that marine mammals may experience behavioural disturbance (using the precautionary 120 dB $SPL_{rms}$ criterion) within 120m from an operational 25 GW wind geared-drive WTG. This formula is largely derived from data from geared WTGs, and therefore it can be anticipated that the operation of the direct drive WTG will result in even smaller disturbance ranges.

7.7.2.6 A recent study of wind farms in German waters provides the most comprehensive assessment to date of operational noise from bottom-fixed foundation WTGs (Bellmann *et al.*, 2023[249]). Results draw upon noise measurements from 24 operational wind farms with WTGs of 2.3 to 8 MW capacity and including multiple foundation types. Background noise measurements were also collected. The authors noted the low-frequency dominance of noise emitted from operational WTGs, with tonal elements in the 25 – 160Hz range and, in some case, harmonics up to a few hundred Hz. These low frequency sounds were only dominating the broadband sound pressure level in the immediate vicinity of the WTGs (approx. 100 m) and when the WTGs were operating close to their nominal power. Mean sound pressure levels at nominal power varied between 112 and 131 dB (mean across study of 120 dB).

7.7.2.7 Bellmann *et al.* (2023[249]) did not find a strong correlation between WTG capacity and noise levels. Contrary to previous studies (Tougaard *et al.*, 2020[247]), there was a tendency for lower noise emissions from WTGs with higher nominal capacity. The authors suggested that this observation may be explained by larger, newer WTG designs generally featuring direct-drive instead of a gearbox, with direct-drive tending to be 'quieter' and with the frequency of noise emissions lower (≤80Hz) than that of geared WTGs.

7.7.2.8 From a broader spatial perspective, Bellmann *et al.* (2023[249]) reported that tonal, low-frequency components of WTG noise could usually be measured up to a few kilometres outside of wind farm arrays, albeit mixing with general background noise which was mostly dominated by non OWF related shipping traffic.

Floating WTGs

7.7.2.9 With the introduction of new floating WTG technologies and the expansion of OWFs into deeper waters, the operational noise of floating OWFs has received increased attention in recent years (Tougaard *et al.*, 2020[247], Stöber and Thomsen, 2021[250], Risch *et al.*, 2023[251])

7.7.2.10 Characterisation of operational underwater noise from floating WTGs has recently been undertaken by Risch *et al.* (2023), whereby the operational underwater noise and mooring noise from two floating OWFs currently deployed off the Scottish east coast were measured. Data were collected at the Kincardine floating wind farm from November 2021 to January 2022 (five 9.5 MW WTGs, geared, semi-submersible foundations) and at the Hywind Scotland OWF from May to June 2022 (six 6 MW WTGs, direct-drive, spar-buoy foundations). In parallel to noise measurements, F-POD autonomous echolocation click detectors were used for monitoring harbour porpoise activity in the vicinity of the WTG arrays. Source levels for operational noise (25Hz – 25kHz) increased with wind speed at both recording locations. At a wind speed of 15 m/s, source levels were found to be about 3 dB higher at Kincardine compared to Hywind Scotland (i.e., 148.8 compared to 145.4 dB re 1 µPa) (Risch et al., 2023[251]).

7.7.2.11 Most WTG operational noise is concentrated below 200Hz and median one-third octave band levels in this frequency range were between 95 and 100 dB re 1 µPa at about 600m from the closest WTG (Risch *et al.*, 2023[251]). These noise levels are above expected ambient noise levels due to wave and wind conditions (Wenz, 1962[252]) but were similar to those measured for operational noise from bottom-fixed WTGs at comparable distances (Tougaard *et al.*, 2020[247]; Stöber and Thomsen, 2021[248]; Risch *et al.*, 2023[251]).

7.7.2.12 As Caledonia South is also located within the North Sea, it is anticipated that ambient noise levels shall be similar to those in which underwater noise generation was assessed as part of the Kincardine and Hywind Scotland projects (~100 dB). This is supported by ambient noise measurements in the Moray Firth reported in Robinson *et al.* (2022[253]), with third-octave band sound energy levels between approximately 100-110 dB re 1 µPa$^2$s at frequencies ≤1kHz. Volume 7, Appendix 6: Underwater Noise Assessment estimated that an upper limit of 133 dB re 1 µPa could be reached at 150m for floating WTGs at the Caledonia South Site (20 MW), assuming average 6m/s wind speed.

Moorings and cables

7.7.2.13 Mooring lines at floating OWFs are designed to be in tension (Statoil, 2015[254]), however allowing some degree of flexibility due to wave action. It is considered that mooring lines associated with floating OWFs have the potential to produce 'snapping' noises during the operational phase of the development. 'Cable snapping' refers to impulsive noises generated by the sudden re-tension in a mooring line following a period of slackness resulting from large amplitude and/or high-frequency surface motions (Liu, 1973[255]).

7.7.2.14 Data are available for the Hywind Demonstrator project in Norway for a single WTG where noise measurements were taken in water depths of 200m at 91m off the seabed (approximately mid-depth) at 150m from the installation (Martin *et al.*, 2011[256]). During the 2-month monitoring period, up to 23 'snaps' were identified per day. Of these, less than 10 'snaps' per day exceeded an $SPL_{peak}$ of 160 dB re 1 µPa.

7.7.2.15 By contrast, analysis of sounds recorded at both Kincardine and Hywind Scotland did not reveal distinct impulsive 'snapping' sounds; instead, a range of 'transient sounds' were reported that can be described as "bangs", "creaks" and "rattles" which acoustic analysis classified as non-impulsive sound sources (Burns *et al.*, 2022[257]). Burns *et al.* (2022[257]) showed that these 'transient sounds had a broadband energy (10 – 48kHz) and were short in duration (~1 second). As it was concluded that these transient sounds could not be considered as impulsive, the application of non-impulsive frequency weighted noise threshold values for determining auditory injury risk to marine mammals is appropriate (Risch *et al.*, 2023[251]). Using the NMFS (2018[30]) thresholds for TTS-onset from non-impulsive noise sources, Burns *et al.* (2022[257]) determined potential effect ranges presented in Table 7–45. For example, high-frequency cetacean (porpoise) would need to remain within 50m of an operational WTG (assuming the wind speed was 15 knots) for 24 hours to reach the TTS-onset threshold, often associated with fleeing response.

Table 7–45: Summary of modelled maximum distances to TTS threshold levels for 15 knots wind speed (Burns *et al.*, 2022[257]).

| Auditory Group | Species | TTS Onset Level (dB re 1 μPa²s) | Maximum Distance to Weighted $SEL_{24h}$ TTS Isopleth (m) (50th percentile) |
|---|---|---|---|
| Low-frequency cetaceans | Minke whale, humpback whale | 179 | 40 |
| High-frequency cetaceans | Bottlenose dolphin, common dolphin, white-beaked dolphin, Risso's dolphin | 178 | 10 |
| Very high-frequency cetaceans | Harbour porpoise | 153 | 50 |
| Phocid pinnipeds | Harbour seal, grey seal | 181 | 20 |

7.7.2.16 It is important to note that the aforementioned examples of Hywind (Norway), Hywind Scotland and Kincardine floating wind farms all involve catenary mooring systems, which is just one of the mooring options being considered for Caledonia South (the worst-case scenario in terms of underwater noise from moorings). Taut or semi-taut mooring arrangements are expected to have significantly lower instances of 'snapping'. On the other hand, Hywind Norway, Hywind Scotland and Kincardine floating OWFs contain between five and 11 WTGs, compared to the maximum design scenario of 39 floating WTGs and a proportion of the FRPs at Caledonia South. As such, the cumulative sound field may result in larger impact ranges.

### Magnitude of Impact Summary

7.7.2.17 Considering the above, the underwater noise associated with the operational phase of Caledonia South has a potential to alter the acoustic soundscape within the immediate vicinity of the Caledonia South Site. Depending on the design of the WTG (e.g., bottom-fixed, floating, FRP) and the species-specific hearing capabilities of marine mammals, the underwater noise may be audible to marine mammals at distances varying from a few meters to a few kilometres. It should also be noted that although underwater noise as a result of all design types constitutes a continuous source, there may be differences in emitted noise among foundation types. The biggest difference between bottom-fixed and floating offshore wind WTGs in relation to underwater noise generation is mooring-related noise, as during higher wind speeds the number of impulsive sounds or transients from mooring-related structures is likely to increase (at least has been shown to be the case for catenary systems).

7.7.2.18 The presence of species such as harbour porpoise, grey seal and harbour seal around bottom-fixed foundations has been widely documented (Scheidat *et al.*, 2011[258]; Hastie *et al.*, 2017[259]; Delefosse *et al.*, 2018[260]; Fernandez-Betelu *et al.*, 2024a[261]). Additionally, presence in the vicinity of dynamic renewable energy structures was confirmed for harbour porpoise, bottlenose dolphin, grey seal and harbour seal (Evans, 2008[262]; Malinka *et al.*, 2018[263]; Tollit *et al.*, 2019[264]; Gillespie *et al.*, 2023[265]). However, recent data collected at Kincardine and Hywind Scotland showed that porpoise detections were lower at the recording site closest to the WTG compared to the site further away (600m compared to 1,500m at Kincardine, and 300m compared to 2,400m at Hywind Scotland) (Risch *et al.*, 2023[251]). While these studies lack data on harbour porpoise occurrence at the monitoring locations in the absence floating WTGs, the data suggest that the potential for floating WTGs to result in locally-reduced presence of harbour porpoise cannot be excluded. However, it is important to note that these results are preliminary, and although they might indicate longer term displacement and/or reduced vocalisation behaviours of harbour porpoises closer to floating offshore wind structures, conclusions based on final data are not available at the time of writing (Risch *et al.*, 2023[251]).

7.7.2.19 The impact of underwater noise during the operational phase of Caledonia South is considered to be localised to the immediate vicinity of the Caledonia South Site. It is unlikely to lead to the exclusion of animals within the Caledonia South Site, and therefore, at most, affecting a small proportion of receptor population and without an alteration to population trajectories. This aligns with a Low magnitude score. However, given the nature of operational noise emissions, disturbance effects may occur with moderate frequency and over the lifetime of Caledonia South (35 years). Therefore, given the duration and frequency of the effect, the magnitude has been conservatively assessed as Medium.

*Sensitivity of Receptor*

7.7.2.20 Operational noise is primarily low frequency. For bottom-fixed OWFs it was reported to be well below 1kHz (Thomsen *et al.*, 2006; Stöber and Thomsen, 2021[266]; Bellmann *et al.*, 2023[249]). Most of the acoustic energy produced by operational floating OWFs is below 200Hz (Risch *et al.*, 2023[251]) and there appears to be a continued decrease in energy levels above 300Hz (see Figures 14 - 16 in Risch *et al*., 2023[251]).

7.7.2.21 Therefore, the primary acoustic energy from operational bottom-fixed and floating WTGs at Caledonia South is likely to be below the region of greatest sensitivity for most marine mammal species considered here (harbour porpoise and dolphin species; Table 7–9) (Southall *et al.*, 2019[29]). In terms of potentially ecological effects, Bellmann *et al.* (2023[249]) highlighted the low-frequency nature of WTG noise and corroborated that such noise cannot be perceived by harbour porpoises, even at distances of 100m from the WTG. Other species with more sensitive hearing at lower frequencies, such as seals and minke whales, would be able to perceive such noise.

7.7.2.22 As such, it is expected that a disturbance at this frequency would result in limited impact to animal's vital rates. Therefore, the sensitivity of harbour porpoise and dolphin species to disturbance from operational noise is assessed as Negligible.

7.7.2.23 The low frequency noise produced during operations may be more likely to overlap with the hearing range of seals and low frequency cetacean species such as minke whale and humpback whale (Table 7–9). Minke whale communication signals have been demonstrated to be below 2kHz (Edds-Walton, 2000[267]; Mellinger *et al.*, 2000[268]; Gedamke *et al.*, 2001[269]; Risch *et al.*, 2013[134]; 2014[270]). Tubelli *et al.* (2012[271]) estimated the most sensitive hearing range (the region with thresholds within 40 dB of best sensitivity) to extend from 30 to 100Hz up to 7.5 to 25kHz, depending on the specific model used. Furthermore, since minke whales are known to forage within the Southern Trench NCMPA (located approximately 13.5km from the Caledonia South Site) in the summer months, there is the potential for displacement to impact on reproductive rates. Therefore, it has been precautionarily assumed that both species of seals, minke whale and humpback whale have a Low sensitivity to disturbance from operational noise.

*Significance of Effect*

7.7.2.24 Taking the **Negligible** (harbour porpoise, dolphin species) to **Low** (seal species, minke whale, humpback whale) sensitivity of marine mammals and the **Medium** magnitude of impact, the overall effect of disturbance from operational noise is considered to be **Negligible and Not Significant in EIA terms** for harbour porpoise, dolphin species to **Minor and Not Significant in EIA terms** for seal species, minke whale and humpback whale.

7.7.2.25 In the absence of any mitigation, the effect of disturbance from operational noise is considered to be not significant in EIA terms. Therefore, no embedded or secondary mitigation is required.

7.7.2.26 The residual significance of the effect of disturbance from operational noise is assessed as **Negligible to Minor and Not Significant**.

## Impact 15: Entanglement

7.7.2.27 Many of the newest marine renewable energy technologies, including floating OWFs, require mooring lines and/or anchors to ensure they maintain a fixed position within the development area (Copping *et al.*, 2020[272]; Garavelli, 2020[273]). In addition, conventional submarine cables, such as those used in bottom-fixed foundation OWFs, are unable to be installed for floating renewable energy developments and, as such, the cables (also known as dynamic cables) for floating offshore wind have floating components to enable them to move both with currents in the water column, and the floating structures they are attached to (Taninoki *et al.*, 2017[274]). The introduction of these new energy technologies, their mooring structures and dynamic cables into the marine environment introduces new potential risks of entanglement and thus, injury, to species such as marine mammals.

7.7.2.28 The risks of entanglement of marine mammals within marine renewable technology structures are dependent upon both the physical characteristics of the mooring lines themselves and the amount of dynamic cable that is present in the water column (Harnois *et al.*, 2015[276]). For example, mooring configurations which have taut mooring lines are likely to present a lower risk of entanglement with marine mammals than catenary systems due to greater tension in the mooring line (Benjamins *et al.*, 2014; Harnois *et al.*, 2015[276]). Similarly, developments with shorter lengths of dynamic cable are also likely to present lower risks of entanglement (Benjamins *et al.*, 2014[275]). Depending on the number of new mooring lines and the length of dynamic cable present in the water column, the risks of ghost fishing gear being caught within marine renewable energy structures can also increase.

7.7.2.29 Three different mooring configurations are currently under consideration for Caledonia South: catenary, semi-taut and taut (Table 7–14). Since the risk of entanglement is higher for catenary moorings, these are considered as the realistic worst-case scenario. As such, the impact assessment for the risk of injury resulting from entanglement with mooring lines or cables, including secondary interactions with ghost fishing gears for Caledonia South, is based upon the following project characteristics for a catenary mooring system:

- Each WTG will have a catenary mooring line system with up to six mooring lines per WTG;
- Each WTG mooring line will be a maximum length of 1km, made of: chain (top section), fibre rope (mid section) and chain (bottom section);
- Max mooring line swept area 45,000 $m^2$; and
- External mooring line diameter of 190 mm to 297 mm.

### Summary

7.7.2.30 A summary of the assessment of entanglement during operation, presented in detail in paragraph 7.7.2.31 to 7.7.2.43, is provided in Table 7–46. No impacts are considered significant in EIA terms.

Table 7–46: Summary of the significance of entanglement during O&M phase.

| Receptor | Embedded Mitigation | Magnitude | Sensitivity | Significance | Secondary Mitigation | Residual |
|---|---|---|---|---|---|---|
| Harbour porpoise | Entanglement Management Plan (M-108) | Primary: Negligible<br>Secondary: Low<br>Tertiary: Low | High | Minor | None | Minor |
| Bottlenose dolphin | Entanglement Management Plan (M-108) | Primary: Negligible<br>Secondary: Low<br>Tertiary: Low | High | Minor | None | Minor |
| White-beaked dolphin | Entanglement Management Plan (M-108) | Primary: Negligible<br>Secondary: Low<br>Tertiary: Low | High | Minor | None | Minor |
| Common dolphin | Entanglement Management Plan (M-108) | Primary: Negligible<br>Secondary: Low<br>Tertiary: Low | High | Minor | None | Minor |
| Risso's dolphin | Entanglement Management Plan (M-108) | Primary: Negligible<br>Secondary: Low<br>Tertiary: Low | High | Minor | None | Minor |
| Minke whale | Entanglement Management Plan (M-108) | Primary: Negligible<br>Secondary: Low<br>Tertiary: Low | High | Minor | None | Minor |
| Humpback whale | Entanglement Management Plan (M-108) | Primary: Negligible | High | Minor | None | Minor |

| Receptor | Embedded Mitigation | Magnitude | Sensitivity | Significance | Secondary Mitigation | Residual |
|---|---|---|---|---|---|---|
| | | Secondary: Low<br>Tertiary: Low | | | | |
| Harbour seal | Entanglement Management Plan (M-108) | Primary: Negligible<br>Secondary: Low<br>Tertiary: Low | High | Minor | None | Minor |
| Grey seal | Entanglement Management Plan (M-108) | Primary: Negligible<br>Secondary: Low<br>Tertiary: Low | High | Minor | None | Minor |

**Magnitude of Impact**

7.7.2.31 The risks of entanglement to marine mammals posed by Caledonia South are associated with primary, secondary and tertiary entanglement. Primary entanglement could involve marine mammals becoming directly entangled with the mooring lines and dynamic cables within the Caledonia South Site. Secondary entanglement is the risk of marine mammals becoming entangled in marine debris which has become caught on the lines and cables within the Caledonia South Site. Ghost fishing gear and nets wrapped around the offshore wind structures could potentially increase spatial impact ranges (considering ghost nets could be tens of metres in width) and result in relatively high bycatch rates locally. Tertiary entanglement is the risk of marine mammals that have already become entangled in marine debris in another location getting snagged on mooring lines and cables within the Caledonia South Site. The magnitude of the impact for primary, secondary and tertiary risks of entanglement are assessed below.

7.7.2.32 To predict the influence of different mooring configurations on primary entanglement risks, Benjamins *et al.* (2014[275]) and Harnois *et al.* (2015[276]) used dynamic analysis software to assess the tension characteristics and mooring line curvature of different floating offshore wind mooring types. Both Benjamins *et al.* (2014[275]) and Harnois *et al.* (2015[276]) analyses demonstrated that catenary mooring configurations present the greatest entanglement risk to marine mammals as they have the least taut lines. It is estimated that each mooring line will be a maximum of 1km in the water column (Table 7–14). Catenary mooring systems are still considered to have too much tension on these lines to generate any loops big enough that could entangle marine mammals (Benjamins *et al.*, 2014[275]; Harnois *et al.*, 2015[276]; Copping *et al.*, 2020[272]; Garavelli, 2020[273]). The same applies to dynamic cables in the water column, as these cables are prevent the creation of loops within the system (Young *et al.*, 2018[277]). That does not completely preclude entanglement risk, as in the case study presented by Benjamins *et al.* (2014[275]), during lunge or filter feeding even vertical mooring material may become wedged in the whale's opened mouth and tangle around its head (further discussed in sensitivity section in paragraph 7.7.2.36 *et seq)*. Maxwell *et al.* (2022[278]), at the time of publication, advised that no primary entanglement in mooring lines, cables or related gear has been reported for floating WTGs in Scotland since operation began in October of 2017. Primary entanglement is restricted to the extent of the Caledonia South Site so is of local spatial extent. The effect is considered to be unlikely to occur due to the design of the mooring. As the consequence, it is considered unlikely that the impact will affect the population trajectory. The risk of primary entanglement is considered to be Negligible magnitude for all species.

7.7.2.33 With respect to secondary entanglement risks, injury and even mortality of marine mammals is difficult to quantify. For example, the prevalence of ghost fishing gears which may become caught on floating offshore wind mooring lines and dynamic cables is likely influenced by the abundance of ghost fishing gears in the area, and the environmental conditions (i.e., sea state, current speed and/or direction) at the time (Stelfox *et al.*, 2016[279]). At a high level, monitoring data reported by EMODNET suggest a moderate to low relative density of fishing-related items among seabed litter in the waters off north-east Scotland compared to elsewhere in European waters. If ghost fishing gears become caught on floating offshore wind mooring lines and dynamic cables, the risk of marine mammal entanglement then becomes dependent upon the characteristics of the gear itself (Winn *et al.*, 2008[280]; Wood and Carter, 2008[281]; Northridge *et al.*, 2010[282]; Benjamins *et al.*, 2014[47]; Knowlton *et al.*, 2015[283]; Stelfox *et al.*, 2016[279]). For example, in Scotland, the most frequent type of entanglement involves long lengths of 10-15 mm diameter polypropylene ropes (which are rarely under tension), such as those used in creel fishing (MacLennan *et al.*, 2021[284]). Off the north-east coast of Scotland, creel fishing is largely restricted to inshore waters, and fishing effort with passive gears in general being much higher around Orkney and the west coast of Scotland relative to eastern Scotland (Scottish Government data presented on NMPI).

7.7.2.34 Caledonia South will be utilising large diameter lines to create the mooring system, with a minimum diameter between 190 mm to 297 mm. Cables will have a minimum diameter of 144 mm and a maximum diameter of 230 mm (Table 7–14). As reported by Maxwell *et al.* (2022[278]) and Benjamins *et al.* (2014[275]), marine mammal species are likely to be able to detect such large-diameter mooring lines typically through visual means for large whales such as minke whales (although this can be more difficult in low light conditions and due to the lateral placement of the eyes) (Kot *et al.*, 2012[285]), through echolocation for odontocetes (Nielsen *et al.*, 2012[286]) mechano-sensitivity through vibrissae and whiskers for pinnipeds (Dehnhardt *et al.*, 2001[287]; Hanke *et al.*, 2013[288]). As such, it is likely that the risks of entanglement in ghost fishing gears, consisting of nylon or monofilament which are less likely to be detected, shall be greater than those associated with entanglement directly in the mooring lines themselves (Benjamins *et al.*, 2014[275]). Should secondary entanglement take place, mooring components are likely to be sufficiently strong to restrain entangled animals (Benjamins *et al.*, 2014[275]). Although the probability of secondary entanglement is greater than that of primary entanglement, as a part of the embedded mitigations, mooring lines and floating inter-array cables will be inspected according to the maintenance plan to confirm the structural integrity of the cable systems using a risk-based adaptive management approach (see Table 7–13). During these inspections, the presence of discarded fishing gear will be evaluated for marine mammal entanglement risk and appropriate actions taken to remove if deemed necessary.

7.7.2.35 There is currently limited information available regarding the risk of tertiary entanglement for marine mammals, but it is considered unlikely to occur unless an area contains both high fishing presence and animal presence. As mentioned previously, there is considered to be a moderate to low relative density of fishing-related items among seabed litter in the waters off north-east Scotland compared to elsewhere in European waters. From examining the risk of secondary entanglement, it is known that such ghost fishing gear can be difficult for marine mammals to detect. Whilst detecting and large diameter mooring lines is considered to be easier (Benjamins *et al.*, 2014[275]; Maxwell *et al.*, 2022[278]), once entangled, these may be more difficult to avoid, depending on the length of the gear in the water column as this could cause drag and impact on swimming ability. Furthermore, the entanglement could result in injury, infection, stress response or affect an animal's ability to forage (Butterworth and Sayer, 2017[289], Dolman and Moore, 2017[290]), which in turn could affect their ability to avoid a mooring line.

7.7.2.36 The risk of secondary entanglement is restricted to the extent of the Caledonia South Site so is of local spatial extent and temporary (dynamic infrastructure will be removed from the water column at the end of the O&M phase). The risk of tertiary entanglement has an increased spatial extent as the marine mammal could become entangled outside of the Caledonia South Site. There is a risk of entanglement to take place over the lifetime of Caledonia South (35 years). Given the paucity of information about the potential risks associated with the tertiary entanglement, the secondary entanglement is considered most likely to occur. However, with the application of embedded mitigation the risk of entanglement is reduced. If the effect would occur, it would affect only a small proportion of the receptor population and without an alteration to population trajectories. Considering the above, the magnitude has been assessed as Low.

### Sensitivity of Receptor

7.7.2.37 As a result of entanglement, marine mammals can suffer from injury, and even mortality (Northridge *et al.*, 2010[291]; Song *et al.*, 2010[292]; Cassoff *et al.*, 2011[293]; Benjamins *et al.*, 2012[294]; Moore *et al.*, 2013a[295]; Ryan *et al.*, 2016[296]; Stelfox *et al.*, 2016[279]; MacLennan *et al.*, 2021[297]). Depending on the frequency of entanglements, this can pose risks to survival chances at multiple life-stages, leading to population crashes and significant conservation implications (Musick, 1997[298]; van der Hoop *et al.*, 2017[299]).

7.7.2.38 Of the species most likely the be present within the Caledonia South Site, baleen whale species (such as minke whale and, occasionally, humpback whale) are considered the most vulnerable to entanglement due to their large body size and specific modes of feeding (Cassoff *et al.*, 2011[300]; Kot *et al.*, 2012[354]; Benjamins *et al.*, 2014[47]; Ryan *et al.*, 2016[296]; Basran *et al.*, 2019[301]; Robinson *et al.*, 2023[302]). However, evidence suggests that harbour porpoise (Scheidat *et al.*, 2018[303]; Calderan and Leaper, 2019[304]; IJsseldijk *et al.*, 2022[305]), killer whales and seals (Allen *et al.*, 2012[306]; Moore *et al.*, 2013b[307]) are also susceptible to entanglement, demonstrating that all species of marine mammal are at risk of some form of entanglement (Read *et al.*, 2006[308]).

7.7.2.39 Given the fact that entanglement can potentially result in death, marine mammals are considered to have High sensitivity to entanglement risks.

### Significance of Effect

7.7.2.40 Taking the **High** sensitivity of marine mammals and the **Negligible** magnitude of primary entanglement, the overall effect of primary entanglement during operation is considered to be **Minor and Not Significant in EIA terms**.

7.7.2.41 Taking the **High** sensitivity of marine mammals, and the **Low** magnitude of secondary and tertiary entanglement, the overall effect of secondary and tertiary entanglement during operation is considered to be **Minor and Not Significant in EIA terms**.

7.7.2.42 The embedded mitigation includes the commitment to risk-based adaptive approach to the inspections of the mooring lines and cables present in the water column (see Table 7–13). Following application of this embedded measure, the effect of entanglement is considered to be not significant in EIA terms. Therefore, no secondary mitigation is required.

7.7.2.43 The residual significance of the effect of entanglement is assessed as **Minor and Not Significant in EIA terms**.

## Impact 16: Long Term Displacement, Habitat Loss and Barrier Effects

7.7.2.44 The physical presence of array infrastructure at the Caledonia South Site has the potential to either displace marine mammals through an effective loss of habitat, and/or create barrier effects, whereby the regular movements of a particular species are impacted by the presence of the wind farm (Onoufriou *et al.*, 2021[309]).

### Summary

7.7.2.45 A summary of the assessment of long term displacement, habitat loss and barrier effects during operation is provided in Table 7–47. No impacts are considered significant in EIA terms

Table 7–47: Summary of the significance of long term displacement, habitat loss and barrier effects on marine mammals during O&M phase.

| Receptor | Embedded Mitigation | Magnitude | Sensitivity | Significance | Secondary Mitigation | Residual |
|---|---|---|---|---|---|---|
| Harbour porpoise | None | Low | Negligible | Negligible | None | Negligible |
| Bottlenose dolphin | None | Low | Negligible | Negligible | None | Negligible |
| White-beaked dolphin | None | Low | Negligible | Negligible | None | Negligible |
| Common dolphin | None | Low | Negligible | Negligible | None | Negligible |
| Risso's dolphin | None | Low | Negligible | Negligible | None | Negligible |
| Minke whale | None | Medium | Low | Minor | None | Minor |
| Humpback whale | None | Medium | Low | Minor | None | Minor |
| Harbour seal | None | Low | Negligible | Negligible | None | Negligible |
| Grey seal | None | Low | Negligible | Negligible | None | Negligible |

### Magnitude of Impact

7.7.2.46 The presence of species such as harbour porpoise, grey seal and harbour seal around operational bottom-fixed foundations has been widely documented (Todd *et al.*, 2009[310]; Scheidat *et al.*, 2011[311]; Hastie *et al.*, 2017; Delefosse *et al.*, 2018[325]; Fernandez-Betelu *et al.*, 2022[312]; Iorio-Merlo *et al.*, 2023[313]). Additionally, presence in the vicinity of dynamic renewable energy structures has been confirmed for harbour porpoise, bottlenose dolphin, grey seal and harbour seal (Evans, 2008[262]; Malinka *et al.*, 2018[263]; Tollit *et al.*, 2019[314]; Gillespie *et al.*, 2023[265]). Studies on operational tidal turbines show that harbour porpoise exhibit significant avoidance of the tidal turbine when it is operating, with the effect varying spatially (Tollit *et al.*, 2019[315], Palmer *et al.*, 2021[316]). Tollit *et al.* (2019[314]) reported that the effect was strongest at the sites closest to the operating WTG (200-230 m), whilst the sites more than a kilometre away did not show a significant effect. Additionally, an increase in porpoise click detection was recorded at a third site, 1,690m from operational turbine (Tollit *et al.*, 2019[314]). There is evidence of porpoises coming close to the tidal turbine when it was stationary and navigating at a distance approximately 15m around the device when operational (Malinka *et al.*, 2018[263]).

7.7.2.47 Long-term monitoring at the Horns Rev and Nysted OWFs in Denmark showed that both harbour porpoise and harbour seals were sighted regularly within the operational OWFs, and within two years of operation, the populations had returned to levels that were comparable with the wider area (Diederichs *et al.*, 2008[317]). Similarly, a monitoring programme at the Egmond aan Zee OWF in the Netherlands reported that significantly more porpoise activity was recorded within the OWF compared to the reference area during the operational phase (Scheidat *et al.*, 2011[311]) indicating the presence of the windfarm was not adversely affecting harbour porpoise presence. Other studies at Dutch and Danish OWFs (Lindeboom *et al.*, 2011[318]) and in the Moray Firth in Scotland (Fernandez-Betelu *et al.*, 2022[261]; Iorio-Merlo *et al.*, 2023[313]) also suggest that harbour porpoise may be attracted to increased foraging opportunities within operating OWFs. In addition, Russell *et al.* (2014[319]) found that some tagged harbour and grey seals demonstrated grid-like movement patterns as these animals moved between individual WTGs, strongly suggestive of these structures being used for foraging. Sparling *et al.* (2017[320]) studied harbour seal responses to the presence of operational tidal turbine and found that seals transited approximately 250m either side of the turbine. Previous reviews have also concluded that operational wind farm noise will have negligible barrier effects (Madsen *et al.*, 2006[321]; Teilmann *et al.*, 2006a[322]; 2006b[323]; CEFAS, 2010[324]; Brasseur *et al.*, 2012[325]).

7.7.2.48 Although minke whale presence has been recorded around oil and gas structures in the central North Sea (Delefosse *et al.*, 2018[260]), there is limited understanding on whether baleen whales can successfully navigate the spaces between WTGs in the array, especially within floating offshore wind arrays where meaningful proportion of the water column is intersected by mooring lines and cables. The total anticipated extent of Caledonia South Site is over 204.5km$^2$. A complete design of the array is currently unavailable and therefore it is challenging to estimate the distances between mooring lines and dynamic cables during operation. It should be however noted that the increasing trends in humpback whale sightings in the Firth of Forth, south from Caledonia South, does not seem to be affected by the presence of operational floating OWFs off the east coast of Scotland (Hywind Scotland and

Kincardine Offshore Wind Farm are both operational since 2017 and 2021, respectively).

7.7.2.49 The Caledonia South OECC will intersect the main distributional range of bottlenose dolphin resident population (CES MU) as well as the Southern Trench NCMPA recognised as an important area for minke whales. It should be noted that the Caledonia South OECC will be buried or will include remedial cable protection where burial is not possible with only the Caledonia South Site including a proportion of dynamic cabling. Therefore, the offshore export cable infrastructure is not anticipated to limit the passage of animals.

7.7.2.50 The extent of the impact will be limited to the Caledonia South Site and the duration of the impact will be long term over the project lifetime (35 years). Given that odontocetes and pinnipeds are able to navigate around artificial structures and potentially feed around them, it is anticipated that the impact of barrier effects and consequences of long-term habitat changes will not adversely affect respective populations. Additionally, the area in the vicinity of Caledonia South is not considered as unique habitat that cannot be found elsewhere within respective MUs and, therefore, the magnitude of impact for grey seal, harbour seal, harbour porpoise, bottlenose dolphin, white-beaked dolphin, common dolphin and Risso’s dolphin is considered Low.

7.7.2.51 However, given that some adverse effects associated with long-term habitat changes and barrier effects cannot be excluded for baleen whales, the magnitude of impact for minke whale and humpback whale is assessed as Medium.

### Sensitivity of Receptor

7.7.2.52 As floating OWFs are a relatively new development in the UK, the implications of barrier effects on marine mammals and, thus, their sensitivity to barrier effects is based on the evidence presented for bottom-fixed foundation OWFs. Where available, evidence collected during studies on tidal turbines is included to provide insight on animal behaviour around dynamic structures. Although the sensitivity to collision with tidal turbine may be different to floating WTG, it provides insights whether animals are capable of navigating around structures that are not static and, therefore, are likely to be able to navigate within the Caledonia South Site comprised of floating WTGs and mooring lines/cables. Gillespie *et al.* (2021[326]) reported that porpoises are able to detect the presence of the tidal turbine and although they effectively avoid turbine rotors, they do not avoid the turbine in its entirety as there is evidence of some attraction to the turbine support structure. Thus porpoise are not considered sensitive to the presence of non-static structure in the water column.

7.7.2.53 Studies conducted by Sparling *et al.* (2017) suggest some degree of local avoidance of tidal turbines by harbour seals compared with the preinstallation result, however, the presence and operation of turbine did not prevent transit of the animals through the channel and therefore did not result in barrier effects (Sparling *et al.*, 2017). Thus seals are not considered sensitive to the presence of non-static structure in the water column. The results of passive acoustic monitoring study suggest that dolphins are able to detect tidal turbine both actively and passively and successfully navigate around the device (Malinka *et al.*, 2018[263]).

7.7.2.54 There are many observations of seals actively foraging (Russell *et al.*, 2014[125]; Arnould *et al.*, 2015[327]; Farr *et al.*, 2021[328]) and regular sightings and acoustic detections of dolphins and porpoise (Bonizzoni *et al.*, 2013[329]; Todd *et al.*, 2016[330]; Clausen *et al.*, 2021[331]) around marine infrastructure which suggests that barrier effects do not persist for pinnipeds and odontocetes. However, as discussed above, animals may exhibit localised avoidance behaviour in areas closer to the infrastructure if these are dynamic and generate noise. Man-made structures can also function as fish aggregation devices (i.e., reef structures), introducing the potential for positive associations between predators and the prey aggregating infrastructure (Degraer *et al.*, 2020[332]). The sensitivity of pinnipeds (grey and harbour seal) and odontocetes (harbour porpoise, bottlenose dolphin, white-beaked dolphin, common dolphin and Risso's dolphin) to long-term changes in habitat and barrier effects is therefore considered to be Negligible.

7.7.2.55 For more migratory species, which are reliant on the utilisation of key pathways or seasonal habitats, barrier effects could be more persistent as a result of the increased presence of marine infrastructure. In Scotland, minke whales and humpback whales are the migratory species most likely to be impacted by obstructions from marine infrastructure. Although it is unclear how human activity may influence whale migrations, Braithwaite *et al.* (2015[333]) suggested that should the total distance travelled by an individual during migration be increased (representing displacement), the increased energetic costs associated with this change could have implications on both adult and calf survival. Both minke whale adults and juveniles studied within the Southern Trench NCMPA (located 13.5 from the Caledonia South Site and overlapping with the Caledonia South OECC) have a similar foraging preference for sandy gravel sediment types (Robinson *et al.*, 2023[334]). Although minke whales exhibit flexibility in their resource preferences (Robinson *et al.*, 2023[302]), when options are limited, the installation of infrastructure in sandy habitats may affect their preferred foraging grounds. The annual movement patterns of minke whales are not fully understood and therefore it is difficult to ascertain whether marine infrastructure projects cause minke whales to deviate away from their optimal migration strategies. Considering the above, the sensitivity of baleen whales (minke whale, humpback whale) is considered to be Low.

*Significance of Effect*

7.7.2.56 Taking the **Negligible** sensitivity of porpoise, dolphin species and seals and the **Low** magnitude of impact, the overall effect of long term displacement, habitat loss and barrier effects during operation is considered to be **Negligible and Not Significant in EIA terms**.

7.7.2.57 Taking the **Low** sensitivity of minke whale and humpback whale and the **Medium** magnitude of impact, the overall effect of long term displacement, habitat loss and barrier effects during operation is considered to be **Minor and Not Significant in EIA terms**.

7.7.2.58 In the absence of any mitigation, the effect of disturbance from long term displacement, habitat loss and barrier effects is considered to be not significant in EIA terms. Therefore, no embedded or secondary mitigation is required.

7.7.2.59 The residual significance of the effect of long term displacement, habitat loss and barrier effects is assessed as **Negligible to Minor and Not Significant in EIA terms**.

## Impact 17: Vessel Collisions

7.7.2.60 During the O&M phase (35 years), a maximum of five vessels will be present within the area of Caledonia South at any one time. CTVs and SOVs will be used for planned activities and other type of vessels will depend on the type of unplanned activity (Table 7–14).

7.7.2.61 There are a number of ports considered to be utilised during O&M (Table 7–14) and vessel movements in and out of the port may affect designated sites that are located in the vicinity of the ports. Buckie, Fraserburgh and Peterhead ports are located within the Southern Trench NCMPA, where minke whale is a protected feature. If the ports at Cromarty and Nigg are selected, the vessel traffic will overlap with the Moray Firth SAC, where bottlenose dolphin is a qualifying feature. Impacts on these sites will be assessed in RIAA (Application Document 14: Caledonia South Report to Inform Appropriate Assessment) and MPA Assessment (Application Document 9: Marine Protected Area Assessment), respectively.

**Summary**

7.7.2.62 A summary of the assessment of risk of vessel collisions during operation is provided in Table 7–48. No impacts are considered significant in EIA terms.

Table 7–48: Summary of the significance of vessel collision to marine mammals during O&M phase.

| Receptor | Embedded Mitigation | Magnitude | Sensitivity | Significance | Secondary Mitigation | Residual |
|---|---|---|---|---|---|---|
| Harbour porpoise | VMP (M-13) | Low | High | Minor | None | Minor |
| Bottlenose dolphin | VMP (M-13) | Low | High | Minor | None | Minor |
| White-beaked dolphin | VMP (M-13) | Low | High | Minor | None | Minor |
| Common dolphin | VMP (M-13) | Low | High | Minor | None | Minor |
| Risso's dolphin | VMP (M-13) | Low | High | Minor | None | Minor |
| Minke whale | VMP (M-13) | Low | High | Minor | None | Minor |
| Humpback whale | VMP (M-13) | Low | High | Minor | None | Minor |
| Harbour seal | VMP (M-13) | Low | High | Minor | None | Minor |
| Grey seal | VMP (M-13) | Low | High | Minor | None | Minor |

### Magnitude of Impact

7.7.2.63 As mentioned during construction, the vessel activity could result in physical trauma from collision with a boat or ship. The risk of collision of marine mammals with vessels would be directly influenced vessel type and speed (Laist *et al.*, 2001[177]) and indirectly by ambient noise levels underwater and marine mammal behaviour. Predictability of vessel movement by marine mammals is known to be a key aspect in minimising the potential risks imposed by vessel traffic (Nowacek *et al.*, 2001[235]; Lusseau, 2003[335]; 2006[336]). The adoption of a VMP (see Table 7–13) based on best practice vessel handing protocols (e.g., following the Codes of Conduct provided by the WiSe Scheme, Scottish Marine Wildlife Watching Code or Guide to Best Practice for Watching Marine Wildlife) will minimise the potential for any impact by ensuring that vessel traffic moves along predictable routes, setting recommended speed and defining how vessels should behave in the presence of marine mammals.

7.7.2.64 The traffic at Caledonia South at any one time during O&M is five vessels, which will be less than during construction, but transits will take place over a longer period of time e.g., lifetime of Caledonia South (35 years). The maximum number of vessel (five) also assumes that all O&M activities overlap and are occurring at the same time. In reality, it is not expected that all O&M activities would be undertaken at the same time and, therefore, the peak number of vessels offshore at any one time will likely be lower than five.

7.7.2.65 The increase in vessel traffic moving around Caledonia South and to/from port will also occur over short periods during O&M. Furthermore, due to the already high volume of vessel traffic already in the array study area (with up to 38 unique vessels in a day; see Volume 4, Chapter 9: Shipping and Navigation for full details), the introduction of additional vessels during O&M is not a novel impact for marine mammals present in the area and is expected to increase traffic by no more than 13%.

7.7.2.66 Although vessels will be moving across a large area (maximum distance between considered ports is approximately 110km between the Caledonia South Site and Aberdeen port), the impact will be localised to within the vicinity of the moving vessel. The impact may occur throughout the O&M period of up to 35 years (long term). The adoption of a VMP during O&M will minimise the potential for the collision to take place (M-13, see Table 7–13), and the increase in vessel around Caledonia South is not considered a novel impact due to the current volume of vessel traffic in the area. As following the application of embedded mitigation, the risk of a collision occurring is unlikely and if it occurs, it would be at a very low frequency and it is not expected to impact enough individuals to alter the population trajectory. The magnitude of vessel collisions during O&M is assessed as Low.

#### Sensitivity of Receptor

7.7.2.67 The sensitivity of marine mammals to vessel collisions will be species dependent. The sensitivity is considered to be the same as that presented for construction (see paragraphs 7.7.1.232 to 7.7.1.233). All marine mammals are assessed to be of High sensitivity to vessel collision.

#### Significance of Effect

7.7.2.68 Taking the **High** sensitivity of and the **Low** magnitude of impact, the overall effect of risk associated with vessel collisions during O&M is considered to be **Minor and Not Significant in EIA terms**.

7.7.2.69 The embedded mitigation includes the commitment to VMP (M-13, see Table 7–13). Following application of this embedded measure, the effect of risk of vessel collisions for all species is considered to be not significant in EIA terms. Therefore, no secondary mitigation is required.

7.7.2.70 The overall effect of vessel collisions during O&M is **Minor and Not Significant in EIA terms**.

## Impact 18: Vessel Disturbance

7.7.2.71 A summary of data about vessel activity within the Caledonia South Site and Caledonia South OECC and ports likely to be utilised during the O&M phase (Offshore) is provided in paragraphs 7.7.1.223 to 7.7.1.225.

### Summary

7.7.2.72 A summary of the assessment of vessel disturbance during O&M phase is provided in Table 7–49. No impacts are considered significant in EIA terms.

Table 7–49: Summary of the significance of vessel disturbance to marine mammals during O&M phase.

| Receptor | Embedded Mitigation | Magnitude | Sensitivity | Significance | Secondary Mitigation | Residual |
|---|---|---|---|---|---|---|
| Harbour porpoise | VMP (M-13) | Low | Low | Negligible | None | Negligible |
| Bottlenose dolphin | VMP (M-13) | Low | Low | Negligible | None | Negligible |
| White-beaked dolphin | VMP (M-13) | Low | Low | Negligible | None | Negligible |
| Common dolphin | VMP (M-13) | Low | Low | Negligible | None | Negligible |
| Risso's dolphin | VMP (M-13) | Low | Low | Negligible | None | Negligible |
| Minke whale | VMP (M-13) | Low | Medium | Minor | None | Minor |
| Humpback whale | VMP (M-13) | Low | Low | Negligible | None | Negligible |
| Harbour seal | VMP (M-13) | Low | Low | Negligible | None | Negligible |
| Grey seal | VMP (M-13) | Low | Low | Negligible | None | Negligible |

### Magnitude of Impact

7.7.2.73 Disturbance to marine mammals by vessels will be driven by a combination of underwater noise and the physical presence of the vessel itself (e.g., Pirotta *et al.*, 2015b[337]; 2015c[338]). It is not simple to disentangle these drivers and thus disturbance from vessels is assessed here in general terms, covering disturbance driven by both vessel presence and underwater noise.

7.7.2.74 Vessel activity may result in localised changes in marine mammal occurrence and behaviours. Distance over which behavioural response is expected is species-dependent and provided in paragraph 7.7.1.241.

7.7.2.75 The baseline commercial vessel activity within and around Caledonia South is already considered to be high (see Volume 7B, Appendix 9-1: Navigational Risk Assessment for full details). The additional traffic at Caledonia South at any one time during O&M is five vessels, which will be less than during construction, and transits will take place over a longer period of time e.g., lifetime of Caledonia South (35 years). The maximum number of vessel (five) also assumes that all O&M activities overlap and are occurring at the same time. In reality, it is not expected that all O&M activities would be undertaken at the same time and, therefore, the peak number of vessels offshore at any one time will likely be lower than five.

7.7.2.76 Although vessels will be moving across a large area (maximum distance between considered ports is approximately 110km between the Caledonia South Site and Aberdeen port), the impact will be localised to within the vicinity of the moving vessel. The impact will be temporary (only then vessel is moving or stationary with the engine running) and may occur throughout the O&M period of up to 35 years (long term). It is likely that the effect may occur at moderate frequency, it would depend on how many animals will be encountered by vessels moving in and out of ports as well as within the Caledonia South Site and Caledonia South OECC. Although it could affect a small proportion of respective populations across the duration of the construction, it is unlikely to alter population trajectories in the long-term. It is due to the fact that it will be taking place in the area already characterised by high commercial vessel traffic and animals are likely to be habituated to vessel noise. Considering the above, the magnitude of the disturbance from vessels is assessed as Low.

### Sensitivity of Receptor

7.7.2.77 The sensitivity of marine mammals to vessel disturbance will be species dependent. The sensitivity is considered to be the same as that presented for construction (see paragraphs 7.7.1.244 to 7.7.1.258). Therefore, the sensitivity to disturbance from vessel activity is therefore classified as Low for all marine mammals, with the exception of minke whales which are considered to have Medium sensitivity to vessel disturbance.

### Significance of Effect

7.7.2.78 Taking the **Low** sensitivity of harbour porpoise, dolphin species, humpback whales and seal species and the **Low** magnitude of impact, the overall effect of vessel disturbance during construction is considered to be **Negligible and Not Significant in EIA terms**.

7.7.2.79 Taking the **Medium** sensitivity of minke whales and the **Low** magnitude of impact, the overall effect of vessel disturbance during construction is considered to be **Minor and Not Significant in EIA terms**.

7.7.2.80 The embedded mitigation includes the commitment to VMP (M-13, see Table 7–13). Following application of this embedded measure, the effect of vessel disturbance for all species is considered to be not significant in EIA terms. Therefore, no secondary mitigation is required.

7.7.2.81 The overall effect of vessel disturbance during O&M is **Negligible to Minor and Not Significant in EIA terms**.

## Impact 19: Disturbance to Haul-outs

### Summary

7.7.2.82 A summary of the assessment of disturbance to haul-outs during operation and maintenance phase is summarised in Table 7–50. No impacts are considered significant in EIA terms.

Table 7–50 Summary of the significance of disturbance to haul-outs to harbour and grey seal during the O&M phase

| Receptor | Embedded Mitigation | Magnitude | Sensitivity | Significance | Secondary Mitigation | Residual |
|---|---|---|---|---|---|---|
| Harbour seal | VMP (M-13) | Low | Medium | Minor | None | Minor |
| Grey seal | VMP (M-13) | Low | Low (outside breeding period) | Negligible | None | Negligible |
| | VMP (M-13) | Low | Medium (during breeding period) | Minor | None | Minor |

### Magnitude of Impact

7.7.2.83 As previously discussed for construction, the number of vessels, the type of vessels, how they are distributed, and the distance from a haul-out site (Mathews *et al.*, 2016[339]; Cates and Acevedo-Gutiérrez, 2017[199]; Carpenter, 2021[228]) all influence the response of seals to disturbance.

7.7.2.84 Similarly to conclusion for construction phase, given that the designated haul-out sites are located more than 30km from Caledonia South, O&M activities should not elicit any behavioural response to hauled-out seals at designated sites. Given the locations of ports being considered (Table 7–14), the closest port at Ardersier is located approximately 0.5km from the Ardersier designated haul-out site. Vessels will follow VMP to minimise disturbance (M-13, see Table 7–13). Seals may be hauled-out in proximity to the Caledonia South OECC and Landfall Site at Stake Ness, located approximately 3km from the Boyne Bay haul-out site, which is unlikely to be close enough to the haul-out to result in disturbance.

7.7.2.85 The impact is considered to be localised to the vicinity of the moving vessel. The impact will be temporary (only then vessel is moving or stationary with engine running) and will occur throughout the operational period of up to 35 years (long term). Following the embedded mitigation measures, the effect may occur but at low frequency. Although it could affect a small proportion of harbour and grey seal populations, where increased vessel traffic can be anticipated for Caledonia South is located >30km from breeding colonies. Additionally, vessel movements will be taking place in the area already characterised by high commercial vessel traffic due to the presence of main ports that support oil and gas infrastructure as well as other OWFs. As such, it is unlikely that disturbance to haul-outs could alter harbour and grey seal population trajectories and magnitude of the disturbance to haul-outs is assessed as Low.

### Sensitivity of Receptor

7.7.2.86 The sensitivity of seals to disturbance to haul-out sites is considered to be the same as that presented for construction. Due to declines in several regional harbour seal populations, this species is considered more vulnerable to pressures, including physical disturbance (SCOS, 2022). Therefore, the sensitivity of harbour seal to disturbance during and outside the breeding and moult seasons at haul-outs has been assessed as Medium. The sensitivity of grey seals to disturbance to haul-outs, is classified as Low outside of the breeding season and Medium during the breeding season.

### Significance of Effect

7.7.2.87 Taking the **Medium** sensitivity of harbour seal and the **Low** magnitude of impact, the overall effect of disturbance of haul-outs during O&M in all seasons is considered to be **Minor and Not Significant in EIA terms**.

7.7.2.88 Taking the **Low** sensitivity of grey seal species outside of the breeding season and the **Low** magnitude of impact, the overall effect of disturbance to haul-outs during construction outside the breeding season is considered to be **Negligible and Not Significant in EIA terms**. However, grey seals have been assessed as having **Medium** sensitivity during the breeding season. Considering the **Low** magnitude of impact, the overall effect of disturbance to haul-outs during O&M during the breeding season is considered to be **Minor and Not Significant in EIA terms**.

7.7.2.89 The embedded mitigation includes the commitment to VMP (M-13, see Table 7–13). The final VMP will consider disturbance controls such as minimum distance to haul-out sites prior to construction once construction ports are known and using the latest available data to inform the need for and design of these controls. Following application of this embedded measure, the effect of disturbance to haul-out for both seal species is considered to be not significant in EIA terms. Therefore, no secondary mitigation is required.

7.7.2.90 The overall effect of disturbance to seal haul-out sites during O&M is **Negligible to Minor and Not Significant in EIA terms**.

### Impact 20: Indirect Impacts on Marine Mammals via Changes in Prey Availability

7.7.2.91 For operational and maintenance activities, Volume 4, Chapter 5: Fish and Shellfish Ecology assessed the following impacts on fish species:

- Long-term loss of habitat due to the presence of turbine foundations, scour protection and cable protection;
- Increased risk of introduced and/or spread of Invasive Non-Native Species (INNS); and
- EMF effects arising from cables during the operational phase.

#### Summary

7.7.2.92 A summary of the assessment of indirect impacts on marine mammals due to changes in prey availability during construction is provided in Table 7–51. No impacts are considered significant in EIA terms.

Table 7–51: Summary of the significance of indirect impacts on marine mammals due to changes in prey availability during O&M phase.

| Receptor | Embedded Mitigation | Magnitude | Sensitivity | Significance | Secondary Mitigation | Residual |
|---|---|---|---|---|---|---|
| Harbour porpoise | None | Negligible | Low | Negligible | None | Negligible |
| Bottlenose dolphin | None | Negligible | Low | Negligible | None | Negligible |
| White-beaked dolphin | None | Negligible | Low | Negligible | None | Negligible |
| Common dolphin | None | Negligible | Low | Negligible | None | Negligible |
| Risso’s dolphin | None | Negligible | Low | Negligible | None | Negligible |
| Minke whale | None | Negligible | Medium | Negligible | None | Negligible |
| Humpback whale | None | Negligible | Low | Negligible | None | Negligible |
| Harbour seal | None | Negligible | Low | Negligible | None | Negligible |
| Grey seal | None | Negligible | Low | Negligible | None | Negligible |

### Magnitude of Impact

7.7.2.93 For each of the impacts, the magnitude of impact was assessed as Low[xxii] and the sensitivity of all fish and shellfish receptors were assessed as Negligible[xxiii] to Medium[xxiv]. As such, the significance of all impacts were assessed as Negligible to Minor Adverse on fish and shellfish receptors, which is not significant in EIA terms. However, given marine mammals are dependent on fish as prey species, there is the potential for indirect effects on marine mammals.

7.7.2.94 It is known that the presence of anthropogenic structures in the marine environment can act as fish aggregating devices and artificial reef systems (Guerin *et al.*, 2007[340]; Zawawi *et al.*, 2012[341]). Further, ongoing studies have shown increases in fish abundance near WTG sites. Initial findings as part of the ongoing multi-year PrePARED (Predators + Prey Around Renewable Energy Developments) Project have shown there to be an increase in flatfish and gadoid abundance at the Beatrice and Moray East OWFs, when compared with outside OWF reference sites (i.e., sites where data on flatfish and gadoid abundance were recorded, but located outwith of any OWF area) (PrePARED, 2024[342]).

7.7.2.95 These findings support a number of studies which have reported the increased presence of foraging marine mammals within operational OWFs and other marine structure sites. For example, Russell *et al.* (2014[319]) found that some tagged harbour and grey seals demonstrated grid-like movement patterns as these animals moved between individual WTGs, strongly suggestive of these structures being used for foraging. Further, studies at Dutch and Danish OWFs (Scheidat *et al.*, 2011[311]) and in the Moray Firth in Scotland (Fernandez-Betelu *et al.*, 2022[261]) suggest that harbour porpoise may be attracted to anthropogenic structures due to the potential for increased foraging opportunities within operating offshore windfarms. The study conducted by Fernandez-Betelu *et al.* (2022[261]) found the increased foraging activity and the occurrence of harbour porpoise happened at night, with the change in diel pattern being specifically linked to the presence of an offshore structure. There was also a significant increase in porpoise presence and foraging activity near isolated offshore structures (Fernandez-Betelu *et al.*, 2022[261]) which again, could be linked to increased foraging opportunities.

7.7.2.96 Despite there being reported links between increased foraging opportunities and the presence of anthropogenic structures, one new study suggests that the introduction of WTGs may moderate the types of prey present within OWF sites. Using modelled sandeel distribution maps to characterise spatio-temporal variation in the occurrence and foraging behaviour of harbour porpoises around OWFs, it was found that the positive relationship between

[xxii] Minor loss/divergence from baseline conditions.
[xxiii] Receptor is not vulnerable to impacts regardless of value/importance. Locally important receptors with low vulnerability and medium to high recoverability.
[xxiv] Regionally important receptors with high vulnerability and no ability for recovery; internationally or nationally important receptors with medium to high vulnerability and low to medium recoverability.

harbour porpoise presence and sandeel densities were weaker at one OWF site post-construction, and absent from another, when compared with pre-construction data. However, as aforementioned, early results from the PrePARED project suggest that the abundance of gadoids and flatfish is higher within constructed windfarms compared to outside OWF reference areas (PrePARED, 2024[342]), and therefore, such changes in prey populations may modify the positive relationship between porpoise occurrence and sandeel density observed in the pre-construction data. The authors did highlight however that definitive conclusions are constrained, as there was only a single year of post-construction data.

7.7.2.97 Overall, it is anticipated that there will be no significant indirect negative impacts to marine mammals through changes in prey abundance and distribution. Any potential habitat change as a result of fish aggregation or artificial reefs is expected to positively affect marine mammals by providing novel foraging opportunities and is therefore assessed as being of minor beneficial significance to marine mammals. Further, given the expected adaptability of most marine mammal species to find alternative prey species or locations, it is highly likely that impacts to prey species would result in only very slight or imperceptible changes to marine mammal receptors, and it is expected that this will not result in any population level change. Therefore, indirect impacts on marine mammals via changes in prey availability during operations and maintenance are most likely to be of Negligible magnitude.

### Sensitivity of Receptor

7.7.2.98 As assessed for construction phase, while there may be certain prey species that comprise the main part of marine mammals diets, all marine mammals in this assessment are considered generalist feeders and are thus not reliant on a single prey species, with the exception of minke whales in the Southern Trench MPA, which are dependent upon sandeels (NatureScot, 2020[25]). Therefore, minke whales are assessed as having Medium sensitivity, whilst all other marine mammals are assessed as having a Low sensitivity to changes in prey abundance and distribution.

### Significance of Effect

7.7.2.99 The sensitivity of minke whales from changes in prey availability has been assessed as **Medium**, whilst the sensitivity of all other marine mammals from changes in prey availability has been assessed as **Low.** The magnitude of impact has been assessed as **Negligible**. Therefore, the significance of the effect for all marine mammals is assessed as **Negligible and Not Significant in EIA terms**.

7.7.2.100 In the absence of any mitigation, the effect of changes in prey availability is considered to be not significant in EIA terms. Therefore, no embedded or secondary mitigation is required.

7.7.2.101 The residual significance of the effect of changes in prey availability is assessed as **Negligible and Not Significant in EIA terms**.

### Impacts 21 and 22: Auditory Injury and Disturbance from Geophysical Surveys

7.7.2.102 A series of high-resolution geophysical surveys will be undertaken in the O&M within the Caledonia South Site and Caledonia South OECC. The potential auditory injury impacts (Table 7–36) and disturbance impacts (Table 7–37) during the O&M phase are exactly the same as during the construction phase and thus are not repeated here (refer to Impacts 7 and 8).

## 7.7.3 Decommissioning

7.7.3.1 A Decommissioning Plan (Volume 7, Appendix 16: Caledonia South Outline Offshore Decommissioning Plan) will be developed and submitted for approval pre-construction to address the principal decommissioning measures for Caledonia South; this will be written in accordance with applicable guidance and will detail the management, environmental management and schedule for decommissioning (see Volume 1, Chapter 3: Proposed Development Description (Offshore) for more details). Prior to the commencement of any decommissioning works, the Decommissioning Plan will be reviewed and revised as required in accordance with the industry practice at that time. The decommissioning activities are expected to take a similar duration as the construction and pre-construction programme.

7.7.3.2 The worst case scenario for decommissioning of the WTGs and OSPs will be a clear seabed, where pile foundations would be cut at such a depth below the surface of the seabed that the remaining parts do not pose a danger for shipping or fishing vessels, even if sediments should become relocated. In order to preserve the marine habitat that has become established over the life of Caledonia South, it may be preferable to leave any scour or cable protection around substructures or covering cables in situ. However, these could also be removed. It is unknown at this time what types of decommissioning vessels will be available on the market at the point of decommissioning. A worst-case assumption would be the same number of vessel movements/trips as during the construction/installation phase. However, it is expected that many more efficiencies would be achievable in 30+ years' time.

7.7.3.3 Given the nature of the decommissioning activities, which will largely be a reversal of the installation process, the impacts during decommissioning are expected to be similar to or less than those assessed for the construction stage. Therefore, the magnitude of impacts assigned to marine mammal receptors during the construction stage is also applicable to the decommissioning stage. It is also assumed that the receptor sensitivities will not materially change over the lifetime of Caledonia South. Whilst significant declines in harbour seals within the North Coast and Orkney SMU have been observed since 2001 (Thompson *et al.*, 2019[176]), and may continue throughout the lifecycle of Caledonia South, the project-alone impacts to harbour seals during construction were assessed to be not significant for all impacts assessed and are expected to be similar to or less than this during the decommissioning stage. Whilst there is limited data available for other species, there is no evidence that local populations will change significantly throughout the lifetime of Caledonia South. Therefore, for all marine mammal species, the decommissioning effects are not expected to exceed those assessed for construction.

## 7.8 Cumulative Effects

### 7.8.1 Overview

7.8.1.1 Cumulative effects can be defined as effects upon a single receptor from Caledonia South when considered alongside other projects and developments. This includes all projects that result in a comparative effect that is not intrinsically considered as part of the existing environment and is not limited to offshore wind projects. A screening process has identified a number of reasonably foreseeable projects and developments which may act cumulatively with Caledonia South. The full list of such projects that have been identified in relation to the offshore environment are set out in Volume 7A, Appendix 7-1: Cumulative Impact Assessment Methodology. All projects and plans considered alongside Caledonia South have been allocated into 'tiers' reflecting their current stage within the planning and development process. An explanation of each tier is included in Table 7–52.

Table 7–52: Description of tiers considered within the marine mammal cumulative impact assessment.

| Tier | Project Type |
|---|---|
| 1 | ▪ Under construction, or will become operational following baseline characterisation.<br>▪ Permitted application(s), but not yet implemented.<br>▪ Submitted application(s), but not yet determined. |
| 2 | Projects where a scoping report has been submitted and there is sufficient detail within the scoping report to support CIA. |
| 3 | ▪ Projects where a scoping report has not been submitted.<br>▪ Projects identified in the relevant Development Plan (and emerging Development Plans – with appropriate weight being given as they move closer to adoption) recognising that there will be limited or only high level information available on the relevant proposals.<br>▪ Projects identified in other plans and programmes (as appropriate) such as other ScotWind developments, which set the framework for future development consents/approvals, where such development is reasonably likely to come forward. |
| 4 | ▪ Projects identified in other plans and programmes where such development is proposed but assessment cannot be progressed as there is limited or no information available in the public domain. |

7.8.1.2 Projects and developments included in tiers 1, 2 and 3 are considered to have sufficient data confidence to be included within the cumulative assessment. Given that it is not possible to conduct a robust CIA for projects where sufficient detail is not available (construction timelines, project design), projects and developments in tier 4 were scoped out of the assessment.

## 7.8.2 Screening Impact Pathways

7.8.2.1 Certain impacts assessed for Caledonia South alone are not considered in the marine mammal CIA due to:

- The highly localised nature of the impacts; and
- Management and mitigation measures in place at Caledonia South and on other projects that will reduce the risk of cumulative effects occurring.

7.8.2.2 The impacts excluded from the marine mammal CIA for these reasons are presented in Table 7–53.

Table 7–53: Impacts excluded from consideration in the marine mammal CIA.

| Impact | Justification |
| --- | --- |
| Auditory injury (PTS) | Where auditory injury (PTS) may result from activities such as piling, geophysical surveys and UXO clearance, as a legislative requirement, suitable mitigation must be put in place to reduce injury risk to marine mammals to negligible levels across all projects considered in the cumulative assessment (JNCC, 2010a[34]; 2010b[35]; 2017). Similarly, any risk of PTS during decommissioning will be determined via appropriate decommissioning plans and if required, mitigated. Construction noise sources considered in the assessment (Table 7–14) will have a very local spatial extent and therefore represent a minimal risk of injury. Moreover, it is anticipated that underwater noise associated with vessel activity will deter animals from the injury zone. As such, assuming application of appropriate mitigation measures, any risk of injury it is considered highly unlikely and potential for cumulative effects on marine mammals due to PTS as a result of piling, UXO, other construction activities and decommissioning was not considered further. |
| Disturbance from UXOs | In line with the DEFRA *et al*. (2021[27]) joint interim position statement, it is expected that, where feasible, across all projects, UXO clearance campaigns will be conducted using low-order deflagration techniques. These techniques are now considered to have 100% success rate (X). Moreover, it is expected that the clearance of a UXO would elicit a startle response and potentially very short-duration behavioural responses and would therefore not be expected to cause widespread and prolonged displacement (JNCC 2020[77]). Given that behavioural disturbance is considered negligible in the context of UXO clearance as the duration of the impact (underwater noise) is extremely short, the potential for cumulative effects is considered unlikely and this impact was not considered further. |

| Impact | Justification |
|---|---|
| Disturbance from other construction activities | Disturbance from other construction activities is anticipated to be highly localised and is closely associated with the disturbance from vessel presence required for the activity. As such, cumulative effects have been assessed under "disturbance from vessels" impact and potential for cumulative effects due to other construction activities was not considered further. |
| Collision with vessels | It is expected that across all project's vessel movements will be managed through the implementation of vessel codes of conduct that will mitigate the negative impacts to marine mammals (e.g., limited vessel speeds, adherence to vessel transit routes), following relevant guidance to minimise the risks of injury to marine mammals. As such, the potential for significant cumulative effects is minimal and this impact was not considered further. |
| Changes in water quality | The changes in water quality are expected to be highly localised across all projects. As such, the potential for significant cumulative effects is minimal and therefore this impact was not considered further. |
| Indirect impacts on marine mammals due to changes in prey availability | The changes in prey availability are expected to be highly localised across all projects. As such, the potential for significant cumulative effects is minimal and therefore this impact was not considered further. |
| Long term displacement/ habitat loss/barrier effects | The potential risks associated with long term displacement and barrier effects are expected to be highly localised across floating projects. The habitat loss is considered to be temporary during construction only. As such, the potential for significant cumulative effects is minimal and therefore this impact was not considered further. |

7.8.2.3 The impacts that are considered in the marine mammal CIA are as follows:

- The potential for disturbance from underwater noise from piling during construction of OWFs (where data are available) and the construction of other projects and developments;
- The potential for disturbance from vessel activity during construction, operation and decommissioning of projects and developments;
- The potential for disturbance to seal haul-outs;
- The potential for disturbance from operational noise; and
- The risk of secondary entanglement.

## 7.8.3 Caledonia South Construction Timeline

7.8.3.1 The worst-case temporal scenario was considered for the installation of Caledonia South, resulting in 451 piling days between October 2028 and September 2030, inclusive.

### 7.8.4 Screening Projects

7.8.4.1 In line with advice from NatureScot (Table 7–3), the time period considered in the CIA for marine mammals includes projects constructing up to a year on either side of Caledonia South construction (e.g., 2027 to 2031 inclusive). This allows for the quantification of impacts to the MUs both prior to and post construction of Caledonia South and during the period when piling at Caledonia South is anticipated (2028 and 2030).

7.8.4.2 The projects and plans selected as relevant to the assessment of impacts to marine mammals are based upon an initial screening exercise undertaken on a CIA long list (Volume 7A, Appendix 7-1: Cumulative Impact Assessment Methodology). To create the CIA longlist, a Zone of Influence (ZOI) has been applied to screen in relevant offshore projects. The ZOI for marine mammals is based on the species-specific MUs (noting only Scottish projects with these MUs were taken forward to the quantitative assessment):

- NS MU for harbour porpoise;
- CES and GNS MUs for bottlenose dolphin;
- CGNS MU for white-beaked dolphin, common dolphin, Risso's dolphin and minke whale; and
- MF and NC&O MUs for harbour seal; and
- MF, NC&O and ES MUs for grey seal.

7.8.4.3 Each project, plan or activity has been considered and screened in or out based on effect–receptor pathway, data confidence and the temporal and spatial scales involved. The CIA long-list of projects was screened to remove all projects that have:

- No temporal overlap; and
- No effect-receptor pathway.

7.8.4.4 The following projects were screened out of the marine mammal CIA short list:

- all projects that are located outside of the relevant species MU; and
- all projects that are already operational/active as they are considered to be existing impacts included within the baseline (this includes all shipping ports, shipping routes and oil and gas pipelines).

7.8.4.5 Given that CES MU has a very limited spatial extent, projects located outside of this MU, with assessments available in the public domain suggesting that animals may experience disturbance within the MU, were considered further (Ossian, Berwick Bank, Salamander).

7.8.4.6 Additionally, in line with NatureScot advice (Table 7–3), the final marine mammal CIA short list includes only projects within Scottish waters. All projects where no construction data was available were scoped out due to low data confidence.

## Tiers

7.8.4.7 In undertaking the CIA for Caledonia South, it is important to consider that other projects and developments shortlisted and included in the marine mammal CIA will have a differing potential for proceeding to the construction stage and hence a differing potential to contribute to a cumulative impact alongside Caledonia South. A tiered approach provides a framework for placing relative weight upon the potential for each project/plan to be included in the CIA, based upon the project/development current stage of maturity and certainty in the projects' parameters (Table 7–52).

### Tier 1

7.8.4.8 Tier 1 includes projects that are already under construction or will become operational following baseline characterisation and therefore are associated with the highest certainty in the assessment. Additionally, Tier 1 include projects that are permitted, but not implemented and submitted, but not determined applications (Table 7–52). As such, Tier 1 projects have a quantitative assessment within the submission documents available in the public domain. For all offshore projects that had a quantitative impact assessment for piling available, the maximum number of animals predicted to be disturbed per day was obtained from the project-specific assessment and used in this CIA for that specific project. This approach provides the most realism as the numbers of animals disturbed are presented using project-specific parameters (where possible, information is provided about the species-specific density source and method used to obtain numbers of animals disturbed). Note, some projects provided numbers of animals disturbed only for certain marine mammal species. As such, where the project did not include a quantitative assessment of a species in consideration, it has not been considered further in that species-specific assessment.

### Tier 2 and Tier 3

7.8.4.9 Tier 2 projects include projects with a scoping report submitted, whilst Tier 3 projects have not submitted a scoping report yet but were identified in relevant plans and programmes (Table 7–52). As such, at the time of writing, Tier 2 and Tier 3 projects do not have a quantitative assessment within the submission documents available in the public domain. In order to allow for a quantitative CIA, an indicative number of animals disturbed per day for Tier 2 and Tier 3 has been calculated based on fixed EDRs and species-specific densities as presented in Table 7–54.

Table 7–54: Parameters used to assess number of animals potentially disturbed for projects without a quantitative assessment available in the public domain.

| Parameters | Cetaceans | Pinnipeds |
|---|---|---|
| Area of Impact | ▪ Bottom-fixed OWF in the UK: 26km EDR (impact area of 2,124km$^2$)[1]<br>▪ Floating OWF in the UK: 15km EDR (impact area of 707km$^2$)[2] | ▪ Bottom-fixed OWF in the UK: 25km EDR (impact area of 1,964km$^2$)[3]<br>▪ Floating OWF in the UK: 15km EDR (impact area of 707km$^2$)[2] |
| Density | ▪ Species-specific SCANS IV block density (Gilles *et al.*, 2023[54]) | ▪ OWF projects - the average at-sea seal density across the array areas (Carter *et al.*, 2022[52]) |
| [1] Based on JNCC (2020) guidance for piling of monopiles.<br>[2] Based on JNCC (2020) guidance for piling of pin piles.<br>[3] Based on disturbance ranges from Russell *et al.* (2016b[343]). | | |

## Projects Screened In

7.8.4.10 The projects screened into the CIA for marine mammals and the detail on the offshore construction period (denoted as "C") as well as piling period (where available, denoted as "P") for each is presented in Table 7–55. The timeline information is based on Volume 7A, Appendix 7-1: Cumulative Impact Assessment Methodology. Projects screened into the CIA are also shown in Figure 7–13.

7.8.4.11 Table 7–55 also includes information about projects screened into the quantitative assessment of impacts due to piling for each species (Yes = project is screened in; No = project is screened out). This is a result of screening exercise, where following steps were taken:

- Project must fall within species-specific MU (due to localised spatial extent of the GNS MU, project with no spatial overlap of the array area with the MU but with potential overlap of noise contours during piling (Ossian, Berwick Bank, Salamander) are also considered);
- If a project has submission documents available in the public domain and provided the quantitative assessment for relevant species, it is included; however, if a project screened out a relevant species it is not considered further for this species;
- In the case of cetaceans, if a project doesn't have submission documents available in the public domain, it has been assigned to a SCANS IV block that it overlaps with; if the density of the relevant species is not provided for a SCANS IV block that the project is assigned to (e.g., there were no sightings of relevant species in this block), it is not considered further for

Table 7–55: List of projects and developments considered in the marine mammal CIA.

| Project | Technology | Tier | 2027 | 2028 | 2029 | 2030 | 2031 | HP (NS MU) | BND (CES MU) | BND (GNS MU) | WBD (CGNS MU) | CD (CGNS MU) | RD (CGNS MU) | MW (CGNS MU) | HS (MF, NC&O | GS (MF, ES, NC&O |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Caledonia South | Mixed | - | - | P | P | P | - | - | - | - | - | - | - | - | - | - |
| Berwick Bank | Bottom-fixed | 1 | P | C | C | C | P | Yes | Yes | Yes | Yes | No | No | Yes | No | Yes |
| Green Volt | Floating | 1 | P | - | - | - | - | Yes | No | Yes | Yes | No | Yes | Yes | No | Yes |
| Inch Cape* | Bottom-fixed | 1 | Operational from 2026 | | | | | No | No | No | No | No | No | No | No | No |
| Moray West* | Bottom-fixed | 1 | Operational from 2025 | | | | | No | No | No | No | No | No | No | No | No |
| Neart Na Gaoithe* | Bottom-fixed | 1 | Operational from 2025 | | | | | No | No | No | No | No | No | No | No | No |
| Ossian | Floating | 1 | - | - | - | - | C | Yes | Yes | No | Yes | No | No | Yes | No | Yes |
| Pentland Floating* | Floating | 1 | Operational from 2027 | | | | | No | No | No | No | No | No | No | No | No |
| Salamander | Floating | 1 | - | P | C | - | - | Yes | Yes | Yes | Yes | No | No | Yes | No | Yes |

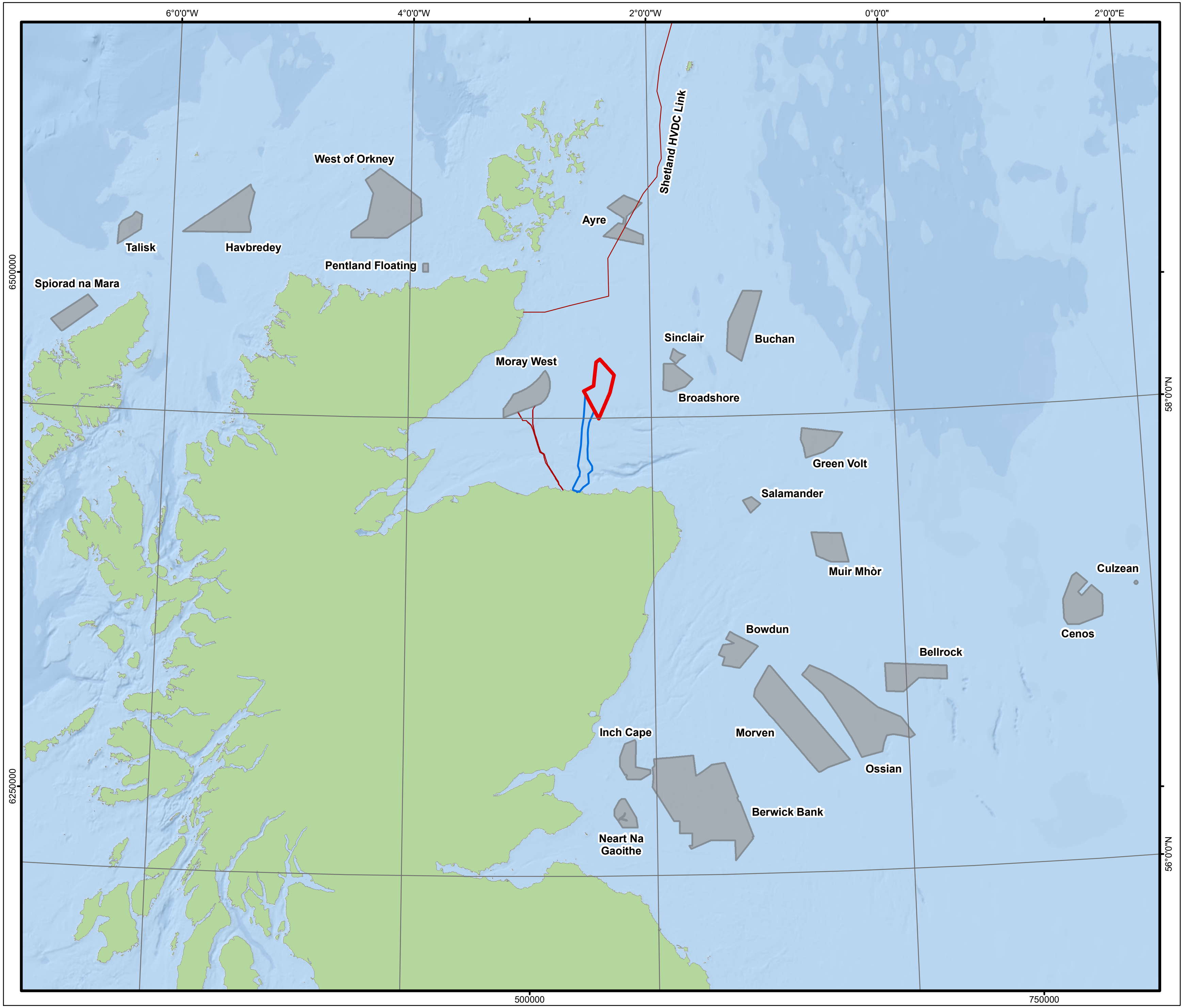
| Project | Technology | Tier | 2027 | 2028 | 2029 | 2030 | 2031 | HP (NS MU) | BND (CES MU) | BND (GNS MU) | WBD (CGNS MU) | CD (CGNS MU) | RD (CGNS MU) | MW (CGNS MU) | HS (MF, NC&O | GS (MF, ES, NC&O |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| West of Orkney | Bottom-fixed | 1 | - | P | P | P | C | No | No | No | Yes | Yes | Yes | Yes | Yes | Yes |
| Shetland HVDC Link* | Cable | 1 | Operational from 2026 | | | | | No | No | No | No | No | No | No | No | No |
| Moray West Export Cable* | Cable | 1 | Operational from 2026 | | | | | No | No | No | No | No | No | No | No | No |
| Culzean* | Floating | 1 | Operational from 2026 | | | | | No | No | No | No | No | No | No | No | No |
| Ayre | Floating | 2 | - | - | C | C | C | Yes | No | No | Yes | No | Yes | Yes | Yes | Yes |
| Bowdun | Floating | 2 | - | C | C | C | C | Yes | No | No | Yes | No | | Yes | No | Yes |
| Broadshore | Floating | 2 | - | C | C | C | C | Yes | No | No | Yes | No | Yes | Yes | Yes | Yes |
| Buchan | Floating | 2 | | C | C | C | C | Yes | No | No | Yes | No | Yes | Yes | Yes | Yes |
| Cenos | Floating | 2 | - | - | C | C | C | Yes | No | No | Yes | No | No | Yes | No | Yes |
| Morven | Bottom-fixed | 2 | C | C | C | C | C | Yes | No | No | Yes | No | No | Yes | No | Yes |
| Muir Mhòr | Floating | 2 | C | C | C | C | - | Yes | No | No | Yes | No | No | Yes | No | Yes |

| Project | Technology | Tier | 2027 | 2028 | 2029 | 2030 | 2031 | HP (NS MU) | BND (CES MU) | BND (GNS MU) | WBD (CGNS MU) | CD (CGNS MU) | RD (CGNS MU) | MW (CGNS MU) | HS (MF, NC&O | GS (MF, ES, NC&O |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sinclair | Floating | 2 | - | C | C | C | C | Yes | No | No | Yes | No | Yes | Yes | Yes | Yes |
| Bellrock | Floating | 3 | - | C | C | C | C | Yes | No | No | Yes | No | No | Yes | No | Yes |
| Spiorad na Mara | Bottom-fixed | 3 | - | C | C | C | C | No | No | No | Yes | Yes | Yes | Yes | No | No |
| Talisk | Floating | 3 | - | C | C | C | - | No | No | No | Yes | No | Yes | Yes | No | No |

Yes/No indicates whether a project has been considered in quantitative assessment of impacts due to piling, following screening exercise.

* These projects are considered in the CIA as they became operational following the collection of baseline data for Caledonia South.

HP = harbour porpoise, BND = bottlenose dolphin; WBD = white-beaked dolphin, CD = common dolphin, RD = Risso's dolphin, MW = minke whale; HS = harbour seal, GS = grey seal.




Caledonia South Site
Caledonia South Offshore Export Cable Corridor
Offshore Wind Developments
Power Cables




0 10 20 30 40 50 km

| REV | DATE | DOC STATUS | ORIGIN | REVIEW | APP |
|---|---|---|---|---|---|
| 01 | 24/09/2024 | Approved | EV | BB | DH |

CALEDONIA Offshore Wind Farm

GoBe APEM Group

| | |
|---|---|
| CONTRACTOR DRAWING NO: UKCAL1_GO_WNF_MMM_MAP_00480 | CONTRACTOR REV: 01 |
| GEODETIC PARAMETERS: WGS 84 / UTM zone 30N (EPSG: 32630) | |
| DRAWING TITLE: Figure 7-13: Caledonia South and Projects Screened Into Cumulative Effect Assessment | |
| STATUS: Approved | SCALE: 1:2,500,000 |
| DRAWING NUMBER: N/A | SHEET NO: 01 of 01; REV: N/A |

## 7.8.5 Precaution in the CIA

7.8.5.1 A combination of uncertainties in project timelines and the need to apply precautionary assumptions leads to numerous levels of precaution within this CIA which results in highly precautionary estimates of effects. The main areas of precaution in the assessment include:

- The number of developments undertaking construction at the same time. For example, the assessment assumes that up to 12 offshore windfarm developments could all be constructing on the same day within Scottish waters. This is considered to be unlikely.
- The inclusion of lower tier developments. In reality, the best information in terms of construction timeline is available for Tier 1 projects as these have quantitative assessment available in the public domain and have the highest likelihood of being constructed.
- The assumption that piling can occur at any point throughout the construction window for the developments without piling schedules available in the public domain. As such, most projects have piling activities occurring over multiple consecutive years and subsequently result in disturbance levels that are far greater than would ever occur in reality.

## 7.8.6 Construction

### Disturbance from underwater noise during piling

7.8.6.1 It should be noted that in the assessment of cumulative impacts due to piling, for projects for which indicative piling schedules were provided within the submission documents, these were used in the CIA. For example, construction of Berwick Bank is expected to take place between 2025 and 2033, however, based on information provided in the Berwick Bank EIA iPCoD Appendix (Berwick Bank, 2022[344]), piling can be anticipated only between April to December in 2026, 2027 and 2031. For projects without indicative construction timeframes available within the public domain, it was assumed that piling can take place at any point within the construction timeframe.

7.8.6.2 The number of animals disturbed during piling at Caledonia South presented in this section is based on the maximum number of animals affected across all modelling locations for jackets and/or anchors (whichever is the highest). However, in the cumulative iPCoD modelling, the maximum number of animals was used for jackets and anchors and aligned with assigned days of piling for each, based on the piling schedules provided by the Applicant. For more details about the number of animals taken forward to the cumulative iPCoD see Volume 7D, Appendix 7-1: Marine Mammals Population Modelling (iPCoD).

7.8.6.3 It should be noted that humpback whales were not considered quantitatively in any of the assessments for projects screened into the cumulative assessment and there is also no density estimate available for this species. As such, this species was not considered in the cumulative assessment of disturbance due to underwater noise during piling.

### Summary

7.8.6.4 A summary of the cumulative assessment of disturbance from underwater noise during piling, presented in detail in paragraphs 7.8.6.5 to 7.8.6.86, is provided in Table 7–56. No impacts are considered significant in EIA terms.

Table 7–56: Summary of the significance of cumulative disturbance from underwater noise during piling.

| Receptor | Embedded Mitigation | Magnitude | Sensitivity | Significance | Secondary Mitigation | Residual |
|---|---|---|---|---|---|---|
| Harbour porpoise | None | Medium | Low | Minor | None | Minor |
| Bottlenose dolphin | None | Medium | Low | Minor | None | Minor |
| White-beaked dolphin | None | High | Low | Minor | None | Minor |
| Common dolphin | None | Low | Low | Negligible | None | Negligible |
| Risso’s dolphin | None | Low | Low | Negligible | None | Negligible |
| Minke whale | None | Low | Moderate | Minor | None | Minor |
| Harbour seal | None | Low | Low (MF SMU)<br>Medium (NC&O SMU) | Minor | None | Minor |
| Grey seal | None | Low | Low | Negligible | None | Negligible |

### Harbour porpoise

*Magnitude of Impact*

Tier 1

7.8.6.5 Across all Tier 1 projects constructing between 2027 and 2031, the number of harbour porpoise predicted to be disturbed per day ranges between 6,962 individuals (2.01% NS MU) in 2027 to 20,567 individuals (5.93% NS MU) in 2028, during the first year of piling at Caledonia South (Table 7–57). In 2028, the result assumes piling activities at Caledonia South and Salamander on the same day.

Tier 2

7.8.6.6 Across all Tier 2 projects constructing between 2027 and 2031, the number of harbour porpoise predicted to be disturbed per day ranges between 8,656 (2.50% NS MU) in 2027 to 23,776 individuals (6.86% NS MU) in 2028 (Table 7–57). This assumes piling activities at nine OWFs taking place over one day.

Tier 3

7.8.6.7 Across all Tier 3 projects constructing between 2027 and 2031, the number of harbour porpoise predicted to be disturbed per day ranges between 8,656 (2.50% NS MU) in 2027 to 24,199 individuals (6.98% NS MU) in 2028 (Table 7–57). This assumes piling activities at nine OWFs taking place over one day. Tier 3 projects include these at early stages of development and therefore there is limited confidence in accuracy of the construction timeframes presented in Table 7–55.

Table 7–57: Number of harbour porpoise potentially disturbed by underwater noise from Tier 1 to Tier 3 projects.

| Project | Technology | Tier | 2027 | 2028 | 2029 | 2030 | 2031 |
|---|---|---|---|---|---|---|---|
| Caledonia South | Mixed | - | | 8,201 | 8,201 | 8,201 | |
| Berwick Bank | Bottom-fixed | 1 | 1,754 | | | | 1,754 |
| Green Volt | Floating | 1 | 5,208 | | | | |
| Ossian | Floating | 1 | | | | | 7,309 |
| Salamander | Floating | 1 | | 12,366 | | | |
| Ayre | Floating | 2 | | | 199 | 199 | 199 |
| Bowdun | Floating | 2 | | 423 | 423 | 423 | 423 |
| Broadshore | Floating | 2 | | 364 | 364 | 364 | 364 |
| Buchan | Floating | 2 | | 364 | 364 | 364 | 364 |
| Cenos | Floating | 2 | | | 735 | 735 | 735 |
| Morven | Bottom-fixed | 2 | 1,271 | 1,271 | 1,271 | 1,271 | 1,271 |
| Muir Mhòr | Floating | 2 | 423 | 423 | 423 | 423 | |
| Sinclair | Floating | 2 | | 364 | 364 | 364 | 364 |
| Bellrock | Floating | 3 | | 423 | 423 | 423 | 423 |

Table 7–58: Summary of number of harbour porpoise potentially disturbed by underwater noise from Tier 1 to Tier 3 projects.

| | 2027 | 2028 | 2029 | 2030 | 2031 |
|---|---|---|---|---|---|
| **Tier 1** | | | | | |
| # of animals | 6,962 | 20,567 | 8,201 | 8,201 | 9,063 |
| % NS MU | 2.01% | 5.93% | 2.37% | 2.37% | 2.61% |
| **Tier 2** | | | | | |
| # of animals | 8,656 | 23,776 | 12,344 | 12,344 | 12,783 |
| % NS MU | 2.50% | 6.86% | 3.56% | 3.56% | 3.69% |
| **Tier 3** | | | | | |
| # of animals | 8,656 | 24,199 | 12,767 | 12,767 | 13,206 |
| % NS MU | 2.50% | 6.98% | 3.68% | 3.68% | 3.81% |

Cumulative iPCoD

7.8.6.8 To determine whether this level of cumulative disturbance is expected to result in population level impacts, iPCoD modelling was conducted. The results of the cumulative iPCoD modelling show that the size of the impacted population as a proportion of the un-impacted population deviates by up to 1.82%. Refer to Volume 7D, Appendix 7-1: Marine Mammals Population Modelling (iPCoD) for detailed cumulative iPCoD results.

Harbour porpoise population modelling published studies

7.8.6.9 Previous population modelling (using iPCoD) of OWFs in eastern English waters has demonstrated low probabilities of population-level impacts, even when 16 piling operations were modelled over a 12-year period (disturbing up to a total of 34,396 porpoise per day) (Booth *et al*., 2017[45]). In a recent report to Defra, the iPCoD model was used to investigate the potential population-level effects of disturbance for the Southern North Sea SAC and the Bristol Channel Approaches SAC (Brown *et al.*, 2023[345]). For the Southern North Sea SAC: This study provided a wide range of iPCoD simulations including disturbance to harbour porpoise over a 10-year period at the scale of the North Sea MU. One of the most extreme disturbance scenarios assumed a seasonally variable base-level daily disturbance of c. 3,500 - 7,000 porpoise throughout the MU, in addition to disturbance at up to twice the Southern North Sea SAC seasonal disturbance thresholds (up to c. 16,000 porpoise disturbed per day in summer, averaging c. 8,000 disturbed across the season). Even at these persistently high disturbance levels, the predicted declines were low, generally ≤5% after 10 years of disturbance and, in each case, the population remained at a stable size once piling disturbance ended, indicating no long-term effect on the population trajectory (it is important to note here that iPCoD does not allow for density dependence and as such the population cannot increase back to baseline levels after disturbance has ceased).

7.8.6.10 The DEPONS model has been used to predict the potential population level effects of cumulative OWF construction in the North Sea. Nabe-Nielsen *et al.* (2018[346]) showed that the North Sea porpoise population was unlikely to be significantly impacted by the construction of 60 wind farms each with 65 WTGs resulting in 3,900 disturbance days between 2011-2020, unless impact ranges were assumed to be much larger (exceeding 50km) than that indicated by existing studies. Even at these extreme disturbance scenarios, which exceed that predicted in this CIA, the modelled North Sea population showed a quick recovery to baseline size (within 6-7 years) despite up to a 20% decline in population size.

Magnitude of Impact Summary

7.8.6.11 The previous large-scale cumulative population modelling studies consider cases of persistent and high levels of disturbance, which are larger than these predicted for Caledonia South cumulatively with other projects, and suggest that disturbance may result in temporary population declines but is unlikely to have long-term effects on the population trajectory due to the expected population recovery. The results of the cumulative iPCoD modelling show that the impacted harbour porpoise NS MU population size will not be reduced beyond approximately 2% compared to un-impacted population and it will continue on stable trajectory after the impact ends.

7.8.6.12 The impact will occur intermittently over a large spatial extent and medium-term duration. The effect of behavioural disturbance is likely to occur and will occur at moderate frequency (different projects piling at different times). The level of disturbance predicted to occur within the NS MU between 2027 and 2031 is expected to result in temporary changes in behaviour and/or distribution of individuals at a scale that could result in reductions to lifetime reproductive success to some individuals. As shown by the cumulative iPCoD modelling, a small decline in the harbour porpoise NS MU population cannot be discounted, though the population trajectory will remain stable in the long-term following the end of the impact. The iPCoD model doesn't allow for population recovery back to the size of un-impacted population (due to lack of density dependence), but as predicted in Nabe-Nielsen *et al.* (2018[346]), it is anticipated that the population would be able to recover from this level of cumulative disturbance and return to baseline levels. As such, this aligns with a consequence score of Medium, where the impact could affect a proportion of the population, but the population trajectory would not be altered in the long term. Overall, precautionarily, the cumulative impact of behavioural disturbance from piling is considered to be a Medium magnitude.

### *Sensitivity of Receptor*

7.8.6.13 As per the project alone assessment, the sensitivity of harbour porpoise to behavioural disturbance as a result of piling is Low.

### *Significance of Effect*

7.8.6.14 Taking the **Low** sensitivity of harbour porpoise and the **Medium** magnitude of impact, the cumulative effect of behavioural disturbance from piling during construction is considered to be **Minor and Not Significant in EIA terms**.

7.8.6.15 In the absence of any mitigation, the cumulative effect of disturbance from piling on harbour porpoise is considered to be not significant in EIA terms. Therefore, no embedded or secondary mitigation is required.

7.8.6.16 The residual significance of the cumulative effect of disturbance from piling during construction is assessed as **Minor and Not Significant in EIA terms**.

### Bottlenose dolphin

*Magnitude of Impact*

7.8.6.17 Following the screening exercise, across the CES and GNS MU only a few Tier 1 projects will be potentially piling between 2027 and 2031. No Tier 2 and Tier 3 projects were screened in as most of them are located within SCANS IV blocks where there were no sightings of bottlenose dolphins.

Tier 1

7.8.6.18 The number of bottlenose dolphin predicted to be disturbed within the CES MU per day ranges between five (2.04% CES MU) in 2027 to 79 individuals (32.24% CES MU) in 2028 (Table 7–59). This assumes piling activities at Caledonia South and Salamander on the same day.

7.8.6.19 With respect to the GNS MU, considering all Tier 1 projects constructing between 2027 and 2031, the number of bottlenose dolphins predicted to be disturbed per day ranges between 35 (1.73% GNS MU) in 2030 to 306 individuals (15.13% GNS MU) in 2027 (Table 7–59). This assumes piling activities at Berwick Bank and Green Volt on the same day in the year prior to piling commencing at Caledonia South. During piling at Caledonia South, the maximum number of dolphins predicted to be disturbed is 101 individuals (5.00% GNS MU) in 2028 and 2029, when Caledonia South and Salamander are both piling (Table 7–59).

7.8.6.20 It should be noted that assessments for Salamander, Berwick Bank and Ossian used the harbour porpoise dose-response function, and therefore are likely to overestimate dolphin response.

Table 7–59: Number of bottlenose dolphins potentially disturbed by underwater noise from Tier 1 projects (CES and GNS MUs).

| Project | Technology | 2027 | 2028 | 2029 | 2030 | 2031 |
|---|---|---|---|---|---|---|
| **CES MU** | | | | | | |
| Caledonia South | Mixed | | 52 | 52 | 52 | |
| Berwick Bank | Bottom-fixed | 5 | | | | 5 |
| Ossian | Floating | | | | | 4 |
| Salamander | Floating | | 27 | | | |
| **GNS MU** | | | | | | |
| Caledonia South | Mixed | | 35 | 35 | 35 | |
| Berwick Bank | Bottom-fixed | 102 | | | | 102 |
| Green Volt | Floating | 204 | | | | |
| Salamander | Floating | | 66 | 66 | | |

Table 7–60: Summary of number of bottlenose dolphins potentially disturbed by underwater noise (Tier 1 only).

| | 2027 | 2028 | 2029 | 2030 | 2031 |
|---|---|---|---|---|---|
| **CES MU** | | | | | |
| # of animals | 5 | 79 | 52 | 52 | 9 |
| % MU | 2.04% | 32.24% | 21.22% | 21.22% | 3.67% |
| **GNS MU** | | | | | |
| # of animals | 306 | 101 | 101 | 35 | 102 |
| % MU | 15.13% | 5.00% | 5.00% | 1.73% | 5.04% |

Cumulative iPCoD

7.8.6.21 To determine whether this level of disturbance is expected to result in population level impacts, cumulative iPCoD modelling was conducted.

7.8.6.22 The results of the cumulative iPCoD modelling for GNS MU show the size of the impacted population as a proportion of the un-impacted population size deviates by more than 1% (up to 2.31%). The population trajectory is predicted as stable in the long term (Figure 7-14).

7.8.6.23 For the CES MU the modelled cumulative disturbance levels showed higher levels of impacts. The impacted population size was predicted to be 92.41% of the un-impacted population size in 2031, following the completion of piling at Caledonia South (final year is 2030) and when two other projects are expected to pile (Table 7–59). Following the cessation of piling at all projects considered in the CIA, the population size fluctuates and at the end of 2050 it is at 93.82% of the un-impacted population size. Although the impacted CES MU population is reduced in size compared to the un-impacted population, the impacted population continues increasing in trajectory.

7.8.6.24 Refer to Volume 7D, Appendix 7-1: Marine Mammals Population Modelling (iPCoD) for detailed cumulative iPCoD results.

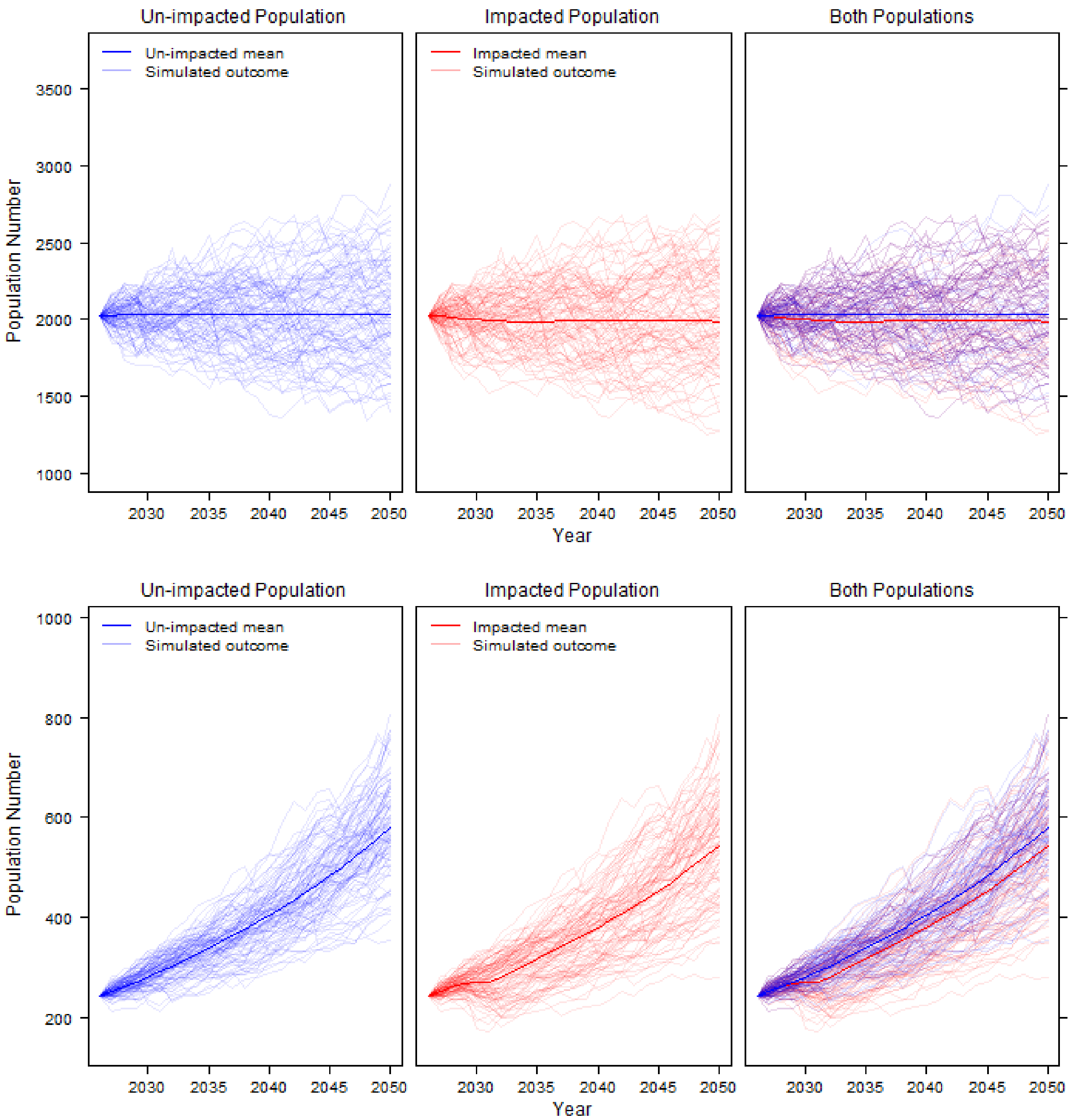



Figure 7–14: Predicted population trajectories for the un-impacted (baseline) and impacted bottlenose dolphin cumulative iPCoD simulations (top graph – GNS MU and bottom graph – CES MU)

Magnitude of Impact Summary

7.8.6.25 The impact will occur intermittently over large spatial extent and medium-term duration. The effect of behavioural disturbance is likely to occur and will occur at moderate frequency (different projects piling at different times). The level of disturbance predicted to occur within the CES and GNS MUs between 2027 and 2031 is expected to result in temporary changes in behaviour and/or distribution of individuals at a scale that could result in reductions to lifetime reproductive success to some individuals. As shown by the cumulative iPCoD modelling, the impacted GNS MU population size remains within 2.31% of the un-impacted population size, and continues on a stable trajectory. The impacted CES MU population size is reduced compared to the un-impacted population size, but continues to increase in size even throughout the piling years. As such, this aligns with a consequence score of Medium, where the impact could affect a proportion of the population, but the population trajectory would not be altered in the long term. Overall, the cumulative impact of behavioural disturbance from piling is considered to be a Medium magnitude.

*Sensitivity of Receptor*

7.8.6.26 As per the project alone assessment, the sensitivity of bottlenose dolphin to behavioural disturbance as a result of piling is Low.

*Significance of Effect*

7.8.6.27 Taking the **Low** sensitivity of bottlenose dolphins and the **Medium** magnitude of impact, the cumulative effect of behavioural disturbance from piling during construction is considered to be **Minor and Not Significant in EIA terms**.

7.8.6.28 In the absence of any mitigation, the cumulative effect of disturbance from piling on bottlenose dolphins is considered to be not significant in EIA terms. Therefore, no embedded or secondary mitigation is required.

7.8.6.29 The residual significance of the cumulative effect of disturbance from piling during construction is assessed as **Minor and Not Significant in EIA terms**.

**White-beaked dolphin**

*Magnitude of Impact*

Tier 1

7.8.6.30 Across all Tier 1 projects constructing between 2027 and 2031, the number of white-beaked dolphins predicted to be disturbed per day ranges between 1,863 (4.24% GNS MU) in 2031 to 10,279 individuals (23.39% CGNS MU) in 2028 (Table 7–61). This assumes piling activities at Caledonia South, West of Orkney and Salamander taking place on the same day.

7.8.6.31 It should be noted that assessments for Salamander, Berwick Bank, Green Volt and Ossian used the harbour porpoise dose-response function and therefore are likely to overestimate dolphin response.

Tier 2

7.8.6.32 Across all Tier 2 projects constructing between 2027 and 2031, the number of white-beaked dolphins predicted to be disturbed per day ranges between 2,407 (5.48% CGNS MU) in 2027 to 10,936 individuals (24.88% CGNS MU) in 2028 (Table 7–61). This assumes piling activities at nine OWFs taking place on the same day within Scottish waters.

Tier 3

7.8.6.33 Across all Tier 3 projects constructing between 2027 and 2031, the number of white-beaked dolphins predicted to be disturbed per day ranges between 2,407 (5.48% CGNS MU) in 2027 to 11,718 individuals (26.66% CGNS MU) in 2028 (Table 7–61). This assumes piling activities at 12 OWFs taking place on the same day within Scottish waters. Tier 3 projects include these at early stages of development and therefore there is limited confidence in accuracy of the construction timeframes presented in Table 7–55.

Table 7–61: Number of white-beaked dolphins potentially disturbed by underwater noise from Tier 1 to Tier 3 projects.

| Project | Technology | Tier | 2027 | 2028 | 2029 | 2030 | 2031 |
|---|---|---|---|---|---|---|---|
| Caledonia South | Mixed | - | | 2,873 | 2,873 | 2,873 | |
| Berwick Bank | Bottom-fixed | 1 | 516 | | | | 516 |
| Green Volt | Floating | 1 | 1,665 | | | | |
| West of Orkney | Bottom-fixed | 1 | | 1,709 | 1,709 | 1,709 | |
| Salamander | Floating | 1 | | 5,697 | | | |
| Ossian | Floating | 1 | | | | | 1,347 |
| Broadshore | Floating | 2 | | 125 | 125 | 125 | 125 |
| Buchan | Floating | 2 | | 125 | 125 | 125 | 125 |
| Cenos | Floating | 2 | | | 74 | 74 | 74 |
| Morven | Bottom-fixed | 2 | 170 | 170 | 170 | 170 | 170 |
| Muir Mhòr | Floating | 2 | 56 | 56 | 56 | 56 | |
| Sinclair | Floating | 2 | | 125 | 125 | 125 | 125 |
| Ayre | Floating | 2 | | | 96 | 96 | 96 |
| Bowdun | Floating | 2 | | 56 | 56 | 56 | 56 |
| Bellrock | Floating | 3 | | 56 | 56 | 56 | 56 |
| Spiorad na Mara | Bottom-fixed | 3 | | 545 | 545 | 545 | 545 |
| Talisk | Floating | 3 | | 181 | 181 | 181 | |

Table 7–62: Summary of number of white-beaked dolphin potentially disturbed by underwater noise from Tier 1 to Tier 3 projects.

| | 2027 | 2028 | 2029 | 2030 | 2031 |
|---|---|---|---|---|---|
| **Tier 1** | | | | | |
| # of animals | 2,181 | 10,279 | 4,582 | 4,582 | 1,863 |
| % MU | 4.96% | 23.39% | 10.43% | 10.43% | 4.24% |
| **Tier 2** | | | | | |
| # of animals | 2,407 | 10,936 | 5,409 | 5,409 | 2,634 |
| % MU | 5.48% | 24.88% | 12.31% | 12.31% | 5.99% |
| **Tier 3** | | | | | |
| # of animals | 2,407 | 11,718 | 6,191 | 6,191 | 3,235 |
| % MU | 5.48% | 26.66% | 14.09% | 14.09% | 7.36% |

Magnitude of Impact Summary

7.8.6.34 The impact will occur intermittently over large spatial extent and medium-term duration. The effect of behavioural disturbance is likely to occur and will occur at moderate frequency (different projects piling at different times). The level of disturbance predicted to occur within the CGNS MU between 2027 and 2031 is expected to result in temporary changes in behaviour and/or distribution of individuals. Given their large home-range and low site fidelity, it is unlikely that white-beaked dolphins would remain in the impacted area over prolonged periods of time to experience the levels of disturbance that might cause changes in vital rates. Disturbance may affect moderate proportion of the population, and since the iPCoD model is not parameterised for this species, there are no means to confirm whether the population trajectory would be impacted. As such, the cumulative impact of behavioural disturbance from piling is precautionary considered to be a High magnitude.

*Sensitivity of Receptor*

7.8.6.35 As per the project alone assessment, the sensitivity of white-beaked dolphin to behavioural disturbance as a result of piling is Low.

*Significance of Effect*

7.8.6.36 Taking the **Low** sensitivity of white-beaked dolphin and the **High** magnitude of impact, the cumulative effect of behavioural disturbance from piling during construction is considered to be **Minor and Not significant in EIA terms**.

7.8.6.37 In the absence of any mitigation, the cumulative effect of disturbance from piling is considered to be not significant in EIA terms. Therefore, no embedded or secondary mitigation is required.

7.8.6.38 The residual significance of the cumulative effect of disturbance from piling during construction is assessed as **Minor and Not Significant in EIA terms**.

**Common dolphin**

*Magnitude of Impact*

7.8.6.39 Following the screening exercise, only one Tier 1 project and one Tier 3 were screened into the cumulative assessment for common dolphins. It is due to the fact that many Tier 1 projects screened out common dolphins from consideration in their submission documents and therefore no quantitative data is available. Additionally, many Tier 2 and 3 projects are located within SCANS IV blocks where there were no sightings of common dolphins.

Tier 1

7.8.6.40 Across Tier 1 projects constructing between 2027 and 2031, the number of common dolphins predicted to be disturbed per day ranges between zero in 2027 and 2031 to 93 individuals (0.09% CGNS MU) between 2028 and 2030 (Table 7–63). It assumes piling activities at Caledonia South and West of Orkney taking place on the same day.

Tier 3

7.8.6.41 Across Tier 3 projects constructing between 2027 and 2031, the number of common dolphins predicted to be disturbed per day ranges between zero in 2027 to 449 individuals (0.44% CGNS MU) between 2028 and 2030 (Table 7–63). This assumes piling activities at Caledonia South, West of Orkney and Spiorad na Mara taking place on the same day. Tier 3 project (Spiorad na Mara) is at early stages of development and therefore there is limited confidence in accuracy of the construction timeframe (Table 7–55). Additionally, it is located on the west coast of Scotland and therefore any potential for cumulative effects is limited.

Table 7–63: Number of common dolphin potentially disturbed by underwater noise from Tier 1 and Tier 3 projects.

| Project | Technology | Tier | 2027 | 2028 | 2029 | 2030 | 2031 |
|---|---|---|---|---|---|---|---|
| Caledonia South | Mixed | - | | 3 | 3 | 3 | |
| West of Orkney | Bottom-fixed | 1 | | 90 | 90 | 90 | |
| Spiorad na Mara | Bottom-fixed | 3 | | 356 | 356 | 356 | 356 |

Table 7–64: Summary of number of common dolphins potentially disturbed by underwater noise from Tier 1 and Tier 3 projects.

| | 2027 | 2028 | 2029 | 2030 | 2031 |
|---|---|---|---|---|---|
| **Tier 1** | | | | | |
| # of animals | 0 | 93 | 93 | 93 | 0 |
| % MU | 0.00% | 0.09% | 0.09% | 0.09% | 0.00% |
| **Tier 3** | | | | | |
| # of animals | 0 | 449 | 449 | 449 | 356 |
| % MU | 0.00% | 0.44% | 0.44% | 0.44% | 0.35% |

Magnitude of Impact Summary

7.8.6.42 The impact will occur intermittently over large spatial extent and medium-term duration. The effect of behavioural disturbance is likely to occur and will occur at moderate frequency (different projects piling at different times). The level of disturbance predicted to occur within the CGNS MU between 2027 and 2031 is expected to result in temporary changes in behaviour and/or distribution of individuals. However, given that projects considered in the CIA overlap with areas of low common dolphin density and considering the wide extent of habitat available within the CGNS MU, the cumulative disturbance from piling is unlikely to be at a scale that could result in reductions to lifetime reproductive success to individuals. Population modelling was not conducted for common dolphins since the iPCoD model is not parameterised for this species. However, given the low proportion of the population predicted to be disturbed, population level effects are highly unlikely to occur. Overall, the cumulative impact of disturbance from piling is of Low magnitude.

*Sensitivity of Receptor*

7.8.6.43 As per the project alone assessment, the sensitivity of white-beaked dolphin to behavioural disturbance as a result of piling is Low.

*Significance of Effect*

7.8.6.44 Taking the **Low** sensitivity of common dolphin and the **Low** magnitude of impact, the cumulative effect of behavioural disturbance from piling during construction is considered to be **Negligible and Not Significant in EIA terms**.

7.8.6.45 In the absence of any mitigation, the cumulative effect of disturbance from piling is considered to be not significant in EIA terms. Therefore, no embedded or secondary mitigation is required.

7.8.6.46 The residual significance of the cumulative effect of disturbance from piling during construction is assessed as **Negligible and Not Significant in EIA terms**.

**Risso's dolphin**

*Magnitude of Impact*

Tier 1

7.8.6.47 Across all Tier 1 projects constructing between 2027 and 2031, the number of Risso's dolphins predicted to be disturbed per day ranges between zero in 2031 to 122 individuals (0.99% CGNS MU) between 2028 and 2030 (Table 7–65). This assumes piling activities at Caledonia South and West of Orkney taking place on the same day.

Tier 2

7.8.6.48 Across all Tier 2 projects constructing between 2027 and 2031, the number of Risso's dolphins predicted to be disturbed per day ranges between 12 (0.10% CGNS MU) in 2027 to 299 individuals (2.44% CGNS MU) in 2029 and 2030 (Table 7–65). This assumes piling activities at six OWFs taking place on the same day in Scottish waters.

Tier 3

7.8.6.49 Across all Tier 3 projects constructing between 2027 and 2031, the number of Risso's dolphins predicted to be disturbed per day ranges between 12 (0.10% CGNS MU) in 2027 to 380 individuals (3.10% CGNS MU) in 2029 and 2030 (Table 7–65). This assumes piling activities at eight OWFs taking place on the same day in Scottish waters. Tier 3 projects include these at early stages of development and therefore there is limited confidence in accuracy of the construction timeframes presented in Table 7–55.

Table 7–65: Number of Risso's dolphin potentially disturbed by underwater noise from Tier 1 to Tier 3 projects.

| Project | Technology | Tier | 2027 | 2028 | 2029 | 2030 | 2031 |
|---|---|---|---|---|---|---|---|
| Caledonia South | Mixed | - | | 1 | 1 | 1 | |
| Green Volt | Floating | 1 | 12 | | | | |
| West of Orkney | Bottom-fixed | 1 | | 121 | 121 | 121 | |
| Broadshore | Floating | 2 | | 50 | 50 | 50 | 50 |
| Buchan | Floating | 2 | | 50 | 50 | 50 | 50 |
| Sinclair | Floating | 2 | | 50 | 50 | 50 | 50 |
| Ayre | Floating | 2 | | | 27 | 27 | 27 |
| Spiorad na Mara | Bottom-fixed | 3 | | 61 | 61 | 61 | 61 |
| Talisk | Floating | 3 | | 20 | 20 | 20 | |

Table 7–66: Summary of number of Risso's dolphin potentially disturbed by underwater noise from Tier 1 to Tier 3 projects.

| | 2027 | 2028 | 2029 | 2030 | 2031 |
|---|---|---|---|---|---|
| **Tier 1** | | | | | |
| # of animals | 12 | 122 | 122 | 122 | 0 |
| % MU | 0.10% | 0.99% | 0.99% | 0.99% | 0.00% |
| **Tier 2** | | | | | |
| # of animals | 12 | 272 | 299 | 299 | 177 |
| % MU | 0.10% | 2.22% | 2.44% | 2.44% | 1.44% |
| **Tier 3** | | | | | |
| # of animals | 12 | 353 | 380 | 380 | 238 |
| % MU | 0.10% | 2.88% | 3.10% | 3.10% | 1.94% |

Magnitude of Impact Summary

7.8.6.50 The impact will occur intermittently over large spatial extent and medium-term duration. The effect of behavioural disturbance is likely to occur and will occur at moderate frequency (different projects piling at different times). The level of disturbance predicted to occur within the CGNS MU between 2027 and 2031 is expected to result in temporary changes in behaviour and/or distribution of individuals. The cumulative disturbance may be at a scale that could result in reductions to lifetime reproductive success to some individuals, although due to relatively low proportion of the MU affected, likely not enough to affect the population trajectory in the long-term. Overall, the cumulative impact of behavioural disturbance from piling is considered to be a Low magnitude.

*Sensitivity of Receptor*

7.8.6.51 As per the project alone assessment, the sensitivity of Risso's dolphin to behavioural disturbance as a result of piling is Low.

*Significance of Effect*

7.8.6.52 Taking the **Low** sensitivity of Risso's dolphin and the **Low** magnitude of impact, the cumulative effect of behavioural disturbance from piling during construction is considered to be **Negligible and Not Significant in EIA terms**.

7.8.6.53 In the absence of any mitigation, the cumulative effect of disturbance from piling is considered to be not significant in EIA terms. Therefore, no embedded or secondary mitigation is required.

7.8.6.54 The residual significance of the cumulative effect of disturbance from piling during construction is assessed as **Negligible and Not Significant in EIA terms**.

**Minke whale**

*Magnitude*

Tier 1

7.8.6.55 Across all Tier 1 projects constructing between 2027 and 2031, the number of minke whales predicted to be disturbed per day ranges between 338 (1.68% CGNS MU) in 2027 to 2,127 individuals (10.57% CGNS MU) in 2028 (Table 7–67). This assumes piling activities at Caledonia South, West of Orkney and Salamander taking place on the same day.

Tier 2

7.8.6.56 Across all Tier 2 projects constructing between 2027 and 2031, the number of minke whales predicted to be disturbed per day ranges between 457 (2.27% CGNS MU) in 2027 to 2,303 individuals (11.45% CGNS MU) in 2028 (Table 7–67). This assumes piling activities at nine OWFs taking place on the same day in Scottish waters.

Tier 3

7.8.6.57 Across all Tier 3 projects constructing between 2027 and 2031, the number of minke whales predicted to be disturbed per day ranges between 457 (2.27% CGNS MU) in 2027 to 2,412 individuals (11.99% CGNS MU) in 2028 (Table 7–67). This assumes piling activities at 12 OWFs taking place on the same day in Scottish waters. Tier 3 projects include these at early stages of development and therefore there is limited confidence in accuracy of the construction timeframes presented in Table 7–55.

Table 7–67: Number of minke whale potentially disturbed by underwater noise from Tier 1 to Tier 3 projects.

| Project | Technology | Tier | 2027 | 2028 | 2029 | 2030 | 2031 |
|---|---|---|---|---|---|---|---|
| Caledonia South | Mixed | - | | 502 | 502 | 502 | |
| Berwick Bank | Bottom-fixed | 1 | 82 | | | | 82 |
| Green Volt | Floating | 1 | 256 | | | | |
| West of Orkney | Bottom-fixed | 1 | | 90 | 90 | 90 | |
| Salamander | Floating | 1 | | 1,535 | | | |
| Ossian | Floating | 1 | | | | | 318 |
| Broadshore | Floating | 2 | | 9 | 9 | 9 | 9 |
| Buchan | Floating | 2 | | 9 | 9 | 9 | 9 |
| Cenos | Floating | 2 | | | 7 | 7 | 7 |
| Morven | Bottom-fixed | 2 | 89 | 89 | 89 | 89 | 89 |
| Muir Mhòr | Floating | 2 | 30 | 30 | 30 | 30 | |
| Sinclair | Floating | 2 | | 9 | 9 | 9 | 9 |
| Ayre | Floating | 2 | | | 8 | 8 | 8 |
| Bowdun | Floating | 2 | | 30 | 30 | 30 | 30 |
| Bellrock | Floating | 3 | | 30 | 30 | 30 | 30 |
| Spiorad na Mara | Bottom-fixed | 3 | | 63 | 63 | 63 | 63 |
| Talisk | Floating | 3 | | 16 | 16 | 16 | |

Table 7–68: Summary of number of minke whale potentially disturbed by underwater noise from Tier 1 to Tier 3 projects.

| | 2027 | 2028 | 2029 | 2030 | 2031 |
|---|---|---|---|---|---|
| **Tier 1** | | | | | |
| # of animals | 338 | 2,127 | 592 | 592 | 400 |
| % MU | 1.68% | 10.57% | 2.94% | 2.94% | 1.99% |
| **Tier 2** | | | | | |
| # of animals | 457 | 2,303 | 783 | 783 | 561 |
| % MU | 2.27% | 11.45% | 3.89% | 3.89% | 2.79% |
| **Tier 3** | | | | | |
| # of animals | 457 | 2,412 | 892 | 892 | 654 |
| % MU | 2.27% | 11.99% | 4.43% | 4.43% | 3.25% |

Cumulative iPCoD

7.8.6.58 The results of the cumulative iPCoD modelling show that the level of disturbance is not sufficient to result in any changes at the CGNS MU population level (deviation in the proportion of the impacted to and un-impacted population size is within 0.01%). See Volume 7D, Appendix 7-1: Marine Mammals Population Modelling (iPCoD) for detailed cumulative iPCoD results.

Magnitude of Impact Summary

7.8.6.59 The impact will occur intermittently over large spatial extent and medium-term duration. The effect of behavioural disturbance is likely to occur and will occur at moderate frequency (different projects piling at different times). The level of disturbance predicted to occur within the CGNS MU between 2027 and 2031 is expected to result in temporary changes in behaviour and/or distribution of individuals. As shown by the cumulative iPCoD modelling, there will be no impact on CGNS MU population size. As such, this aligns with a consequence score of Low, where the impact could affect a proportion of the population, but the population trajectory would not be altered. Overall, the cumulative impact of behavioural disturbance from piling is considered to be a Low magnitude.

*Sensitivity of Receptor*

7.8.6.60 As per the project alone assessment, the sensitivity of minke whale to behavioural disturbance as a result of piling is Moderate.

*Significance of Effect*

7.8.6.61 Taking the **Medium** sensitivity of minke whale and the **Low** magnitude of impact, the cumulative effect of behavioural disturbance from piling during construction is considered to be **Minor and Not Significant in EIA terms**.

7.8.6.62 In the absence of any mitigation, the cumulative effect of disturbance from piling on minke whale is considered to be not significant in EIA terms. Therefore, no embedded or secondary mitigation is required.

7.8.6.63 The residual significance of the cumulative effect of disturbance from piling during construction is assessed as **Minor and Not Significant in EIA terms**.

**Harbour seal**

*Magnitude of Impact*

7.8.6.64 It should be noted that due to very limited scale of potential impacts associated with piling predicted for Caledonia South alone (see Table 7–30), with less than one individual impacted within the ES SMU (<0.27% ES SMU), the ES SMU is not considered in the cumulative assessment for harbour seal. The number of animals potentially impacted is provided for the MF SMU and NC&O SMU separately, given that each population have different conservation status and population trajectories.

7.8.6.65 There are a small number of projects located in the MF and NC&O SMUs with construction timeframes overlapping with Caledonia South. As such, for the MF SMU, only two Tier 2 projects were considered. Similarly for the NC&O SMU, only one Tier 1 and two Tier 2 projects are considered. As such, no Tier 3 projects were considered for harbour seals for cumulative impacts within the MF SMU and NC&O SMU.

Tier 1

7.8.6.66 The maximum cumulative number of harbour seals disturbed within the NC&O SMU by Tier 1 projects is 219 individuals (11.23% NC&O SMU) between 2028 and 2030 (Table 7–69). This assumes piling activities at Caledonia South and West of Orkney taking place on the same day.

Tier 2

7.8.6.67 Across all Tier 2 projects constructing between 2027 and 2031, the maximum cumulative number of harbour seal predicted to be disturbed per day within the MF SMU is 60 individuals (6.26% MF SMU) between 2028 to 2030 (Table 7–69). This assumes piling activities at three OWFs taking place on the same day.

7.8.6.68 The maximum cumulative number of harbour seals disturbed within the NC&O SMU by Tier 2 projects is 233 individuals (11.94% NC&O SMU) between 2029 and 2030 (Table 7–69). This assumes piling activities at four OWFs taking place on the same day.

Table 7–69: Number of harbour seal potentially disturbed by underwater noise from Tier 1 and Tier projects (MF and NC&O SMUs).

| Project | Technology | Tier | 2027 | 2028 | 2029 | 2030 | 2031 |
|---|---|---|---|---|---|---|---|
| **MF SMU** | | | | | | | |
| Caledonia South | Mixed | - | | 58 | 58 | 58 | |
| Broadshore | Floating | 2 | | 1 | 1 | 1 | 1 |
| Sinclair | Floating | 2 | | 1 | 1 | 1 | 1 |
| **NC&O SMU** | | | | | | | |
| Caledonia South | Mixed | - | | 43 | 43 | 43 | |
| West of Orkney | Bottom-fixed | 1 | | 176 | 176 | 176 | |
| Buchan | Floating | 2 | | 1 | 1 | 1 | 1 |
| Ayre | Floating | 2 | | | 13 | 13 | 13 |

Table 7–70: Summary of number harbour seal potentially disturbed by underwater noise from Tier 1 and Tier 2 projects (MF and NC&O SMUs).

| | 2027 | 2028 | 2029 | 2030 | 2031 |
|---|---|---|---|---|---|
| **MF SMU - Tier 2** | | | | | |
| # of animals | 0 | 60 | 60 | 60 | 2 |
| % MU | 0.00% | 6.26% | 6.26% | 6.26% | 0.21% |
| **NC&O - Tier 1** | | | | | |
| # of animals | 0 | 219 | 219 | 219 | 0 |
| % MU | 0.00% | 11.23% | 11.23% | 11.23% | 0.00% |
| **NC&O - Tier 2** | | | | | |
| # of animals | 0 | 220 | 233 | 233 | 14 |
| % MU | 0.00% | 11.28% | 11.94% | 11.94% | 0.72% |

Cumulative iPCoD

7.8.6.69 The results of the cumulative iPCoD modelling for both the Moray Firth MU and the North Coast and Orkney MU, shows that the level of disturbance is not sufficient to result in any changes at the population (there is no deviation in the proportion of the impacted to and un-impacted population size beyond 0.09%). The Moray Firth MU is predicted to continue at a stable trajectory and at the same size as the un-impacted population, and the North Coast and Orkney population is expected to continue at a decreasing trajectory and at the same size as the un-impacted population. Refer to Volume 7D, Appendix 7-1: Marine Mammals Population Modelling (iPCoD) for detailed cumulative iPCoD results.

Magnitude of Impact Summary

7.8.6.70 The impact will occur intermittently over large spatial extent and medium-term duration. The effect of behavioural disturbance is likely to occur and will occur at moderate frequency (different projects piling at different times).

7.8.6.71 The level of disturbance predicted to occur within the CGNS MU between 2027 and 2031 is expected to result in temporary changes in behaviour and/or distribution of individuals. As shown by the cumulative iPCoD modelling, there will be no impact on MF and NC&O SMUs population size. As such, this aligns with a consequence score of Low, where the impact could affect a proportion of the population, but the population trajectory would not be altered. Overall, the cumulative impact of behavioural disturbance from piling is considered to be a Low magnitude.

*Sensitivity of Receptor*

7.8.6.72 As per the project alone assessment, the sensitivity of harbour seals in the NC&O SMU to behavioural disturbance as a result of piling is Medium and for harbour seals in the MF SMU is Low.

*Significance of Effect*

7.8.6.73 Taking the **Low** sensitivity of harbour seal within the MF SMU and the **Low** magnitude of impact, the cumulative effect of behavioural disturbance from piling during construction is considered to be **Negligible and Not Significant in EIA terms**.

7.8.6.74 Taking the **Medium** sensitivity of harbour seal within the NC&O SMU and the **Low** magnitude of impact, the cumulative effect of behavioural disturbance from piling during construction is considered to be **Minor and Not Significant in EIA terms**.

7.8.6.75 In the absence of any mitigation, the cumulative effect of disturbance from piling on harbour seal is considered to be not significant in EIA terms. Therefore, no embedded or secondary mitigation is required.

7.8.6.76 The residual significance of the cumulative effect of disturbance from piling during construction is assessed as **Negligible to Minor and Not Significant in EIA terms**.

### Grey seal

*Magnitude of Impact*

7.8.6.77 The assessment of cumulative effect of disturbance from piling for grey seal is provided for Tier 1, Tier 2 and Tier 3 projects identified within the MF, NC&O and ES SMUs. As such, the impacts for projects arranged in tiers are compared against a total combined population size of 52,354 individuals across the three SMUs.

Tier 1

7.8.6.78 Across all Tier 1 projects constructing between 2027 and 2031, the number of grey seals predicted to be disturbed per day ranges between 1,041 (1.99% MF, NC&O, ES SMUs) in 2027 to 7,185 individuals (13.72% MF, NC&O, ES SMUs) in 2028 (Table 7–71). This assumes piling activities at Caledonia South, West of Orkney and Salamander taking place on the same day.

Tier 2

7.8.6.79 Across all Tier 2 projects constructing between 2027 and 2031, the number of grey seals predicted to be disturbed per day ranges between 1,720 (3.29% MF, NC&O, ES SMUs) in 2027 to 9,282 individuals (17.73% MF, NC&O, ES SMUs) in 2029 and 2030 (Table 7–71). This assumes piling activities at ten OWFs taking place on the same day in Scottish waters.

Tier 3

7.8.6.80 Across all Tier 3 projects constructing between 2027 and 2031, the number of grey seals predicted to be disturbed per day ranges between 1,720 (3.29% MF, NC&O, ES SMUs) in 2027 to 9,337 individuals (17.83% MF, NC&O, ES SMUs) in 2029 and 2030 (Table 7–71). This assumes piling activities at 11 OWFs taking place on the same day in Scottish waters. Tier 3 projects include these at early stages of development and therefore there is limited confidence in accuracy of the construction timeframes presented in Table 7–55.

Table 7–71: Number of grey seals potentially disturbed by underwater noise from Tier 1 to Tier 3 projects.

| Project | Technology | Tier | 2027 | 2028 | 2029 | 2030 | 2031 |
|---|---|---|---|---|---|---|---|
| Caledonia South | Mixed | - | | 4,225 | 4,225 | 4,225 | |
| Berwick Bank | Bottom-fixed | 1 | 705 | | | | 705 |
| Green Volt | Floating | 1 | 336 | | | | |
| West of Orkney | Bottom-fixed | 1 | | 2,887 | 2,887 | 2,887 | |
| Salamander | Floating | 1 | | 73 | | | |
| Ossian | Floating | 1 | | | | | 343 |
| Broadshore | Floating | 2 | | 138 | 138 | 138 | 138 |
| Buchan | Floating | 2 | | 232 | 232 | 232 | 232 |
| Cenos | Floating | 2 | | | 6 | 6 | 6 |
| Morven | Bottom-fixed | 2 | 519 | 519 | 519 | 519 | 519 |
| Muir Mhòr | Floating | 2 | 160 | 160 | 160 | 160 | |
| Sinclair | Floating | 2 | | 178 | 178 | 178 | 178 |
| Ayre | Floating | 2 | | | 610 | 610 | 610 |
| Bowdun | Floating | 2 | | 327 | 327 | 327 | 327 |
| Bellrock | Floating | 3 | | 55 | 55 | 55 | 55 |

Table 7–72: Summary of number of grey seals potentially disturbed by underwater noise from Tier 1 to Tier 3 projects.

| | 2027 | 2028 | 2029 | 2030 | 2031 |
|---|---|---|---|---|---|
| **Tier 1** | | | | | |
| # of animals | 1,041 | 7,185 | 7,112 | 7,112 | 1,048 |
| % MU | 1.99% | 13.72% | 13.58% | 13.58% | 2.00% |
| **Tier 2** | | | | | |
| # of animals | 1,720 | 8,739 | 9,282 | 9,282 | 3,058 |
| % MU | 3.29% | 16.69% | 17.73% | 17.73% | 5.84% |
| **Tier 3** | | | | | |
| # of animals | 1,720 | 8,794 | 9,337 | 9,337 | 3,113 |
| % MU | 3.29% | 16.80% | 17.83% | 17.83% | 5.95% |

Cumulative iPCoD

7.8.6.81 The results of the cumulative iPCoD modelling show that the level of disturbance is not sufficient to result in any changes at the population level (when considering ES, MF and NC&O SMUs together; there is no deviation in the proportion of the impacted to and un-impacted population size beyond 0.09%). See Volume 7D, Appendix 7-1: Marine Mammals Population Modelling (iPCoD) for detailed cumulative iPCoD results.

Magnitude of Impact Summary

7.8.6.82 The impact will occur intermittently over large spatial extent and medium-term duration. The effect of behavioural disturbance is likely to occur and will occur at moderate frequency (different projects piling at different times). The level of disturbance predicted to occur within the MF, ES and NC&O SMUs between 2027 and 2031 is expected to result in temporary changes in behaviour and/or distribution of individuals. As shown by the cumulative iPCoD modelling, there will be no impact on the total population size (ES, MF and NC&O SMUs). As such, this aligns with a consequence score of Low, where the impact could affect a proportion of the population, but the population trajectory would not be altered. Overall, the cumulative impact of behavioural disturbance from piling is considered to be a Low magnitude.

*Sensitivity of Receptor*

7.8.6.83 As per the project alone assessment, the sensitivity of grey seal to behavioural disturbance as a result of piling is Low.

*Significance of Effect*

7.8.6.84 Taking the **Low** sensitivity of grey seal and the **Low** magnitude of impact, the cumulative effect of behavioural disturbance from piling during construction is considered to be **Negligible and Not Significant in EIA terms**.

7.8.6.85 In the absence of any mitigation, the cumulative effect of disturbance from piling is considered to be not significant in EIA terms. Therefore, no embedded or secondary mitigation is required.

7.8.6.86 The residual significance of the cumulative effect of disturbance from piling during construction is assessed as **Negligible and Not Significant in EIA terms**.

## Disturbance from Vessels

**Summary**

7.8.6.87 A summary of the cumulative assessment of vessel disturbance during construction phase, presented in detail in paragraph 7.8.6.88 to 7.8.6.96, is provided in Table 7–73. No impacts are considered significant in EIA terms.

Table 7–73: Summary of the significance of cumulative vessel disturbance to marine mammals during construction phase.

| Receptor | Embedded Mitigation | Magnitude | Sensitivity | Significance | Secondary Mitigation | Residual |
|---|---|---|---|---|---|---|
| Harbour porpoise | VMP or similar | Low | Low | Negligible | None | Negligible |
| Bottlenose dolphin | VMP or similar | Low | Low | Negligible | None | Negligible |
| White-beaked dolphin | VMP or similar | Low | Low | Negligible | None | Negligible |
| Common dolphin | VMP or similar | Low | Low | Negligible | None | Negligible |
| Risso's dolphin | VMP or similar | Low | Low | Negligible | None | Negligible |
| Minke whale | VMP or similar | Low | Medium | Minor | None | Minor |
| Humpback whale | VMP or similar | Low | Low | Negligible | None | Negligible |
| Harbour seal | VMP or similar | Low | Low | Negligible | None | Negligible |
| Grey seal | VMP or similar | Low | Low | Negligible | None | Negligible |

### Magnitude of Impact

7.8.6.88 It is challenging to reliably quantify the level of increased disturbance to marine mammals resulting from increased vessel activity on a cumulative basis, given the large degree of temporal and spatial variation in vessel movements between projects and regions, coupled with the spatial and temporal variation in marine mammal movements across the region.

7.8.6.89 Although some OWF vessels (such as crew transport and supply vessels) may transit to and from the wind farm at higher speeds, they often travel in repeated/predictable routes within the site. Many other vessels (e.g., jack-up vessels and pilot or attending vessels) travel more slowly within the wind farm site or spend long periods of time jacked-up, at anchor (minimising movement and acoustic signature from engines) or using dynamic positioning systems (minimising movement, although still generating noise). Unfortunately, there are very few species-specific studies covering these vessel types that capture vessel movement patterns as well as their acoustic signatures and the corresponding response of marine mammals.

7.8.6.90 Vessel routes to and from offshore windfarms and other offshore projects will, for the majority, use existing vessel routes for pre-existing vessel traffic which marine mammals will be accustomed to. They may also have become habituated to the volume of regular vessel movements and therefore the additional risk is predominantly confined to construction sites. The vessel movements for OWFs are likely to be limited and slow, resulting in less risk of disturbance to marine mammal receptors. In addition, most projects are likely to adopt VMPs and/or comply with the existing Marine Wildlife Watching Codes such as SNH (2017b[32]) and SNH (2017a[347]) to minimise any potential effects on marine mammals.

7.8.6.91 It is likely that projects will have their highest number of vessels on site at any one time during the construction phase. Although construction vessels will be moving across a large area (considering the number of projects anticipated to be constructing off the east coast of Scotland), the impact is considered to be localised to the vicinity of the moving vessel. The impact will be temporary (only when the vessel is moving or stationary with engine running) and will occur throughout the construction period of up to three years (medium term). It is likely that the effect will occur at moderate frequency. However, although it could affect a small proportion of respective populations across the duration of the construction, it is unlikely to alter population trajectories in the long-term due to the fact that it will be taking place in areas already characterised by high levels of commercial vessel traffic. It is anticipated that any animals displaced from the area will return once vessels leave. As such, the magnitude of the cumulative disturbance from vessels during construction is assessed as Low.

### Sensitivity of Receptor

7.8.6.92 As assessed for Caledonia South alone, sensitivity of all marine mammals, except minke whale, to disturbance from vessel activity is assessed as Low. The sensitivity of minke whales to vessel disturbance is Medium.

### Significance of Effect

7.8.6.93 Taking the **Low** sensitivity of harbour porpoise, dolphin species, seal species and humpback whale and the **Low** magnitude of impact, the cumulative effect of behavioural disturbance from vessels is considered to be **Negligible and Not Significant in EIA terms**.

7.8.6.94 Taking the **Medium** sensitivity of minke whale and the **Low** magnitude of impact, the cumulative effect of behavioural disturbance from vessels is considered to be **Minor and Not Significant in EIA terms**.

7.8.6.95 It is expected that all projects considered in the cumulative impact assessment will adopt VMPs and/or comply with the existing Marine Wildlife Watching Codes such as SNH (2017b[32]) and SNH (2017a[347]) to minimise any potential vessel disturbance effects on marine mammals. Given this, the effect of cumulative behavioural disturbance from vessels is considered to be not significant in EIA terms. Therefore, no secondary mitigation is required.

7.8.6.96 The overall cumulative effect of vessel disturbance during construction is **Negligible to Minor and Not Significant in EIA terms**.

## Disturbance to Haul-outs

### Summary

7.8.6.97 A summary of the assessment of cumulative disturbance to haul-outs is provided in Table 7–74. No impacts are considered significant in EIA terms.

Table 7–74: Summary of the significance of cumulative disturbance to haul-outs to harbour and grey seal during construction phase

| Receptor | Embedded Mitigation | Magnitude | Sensitivity | Significance | Secondary Mitigation | Residual |
|---|---|---|---|---|---|---|
| Harbour seal | VMP or similar | Low | Medium | Minor | None | Minor |
| Grey seal | VMP or similar | Low | Low (outside breeding period) | Negligible | None | Negligible |
| | | Low | Medium (during breeding period) | Minor | None | Minor |

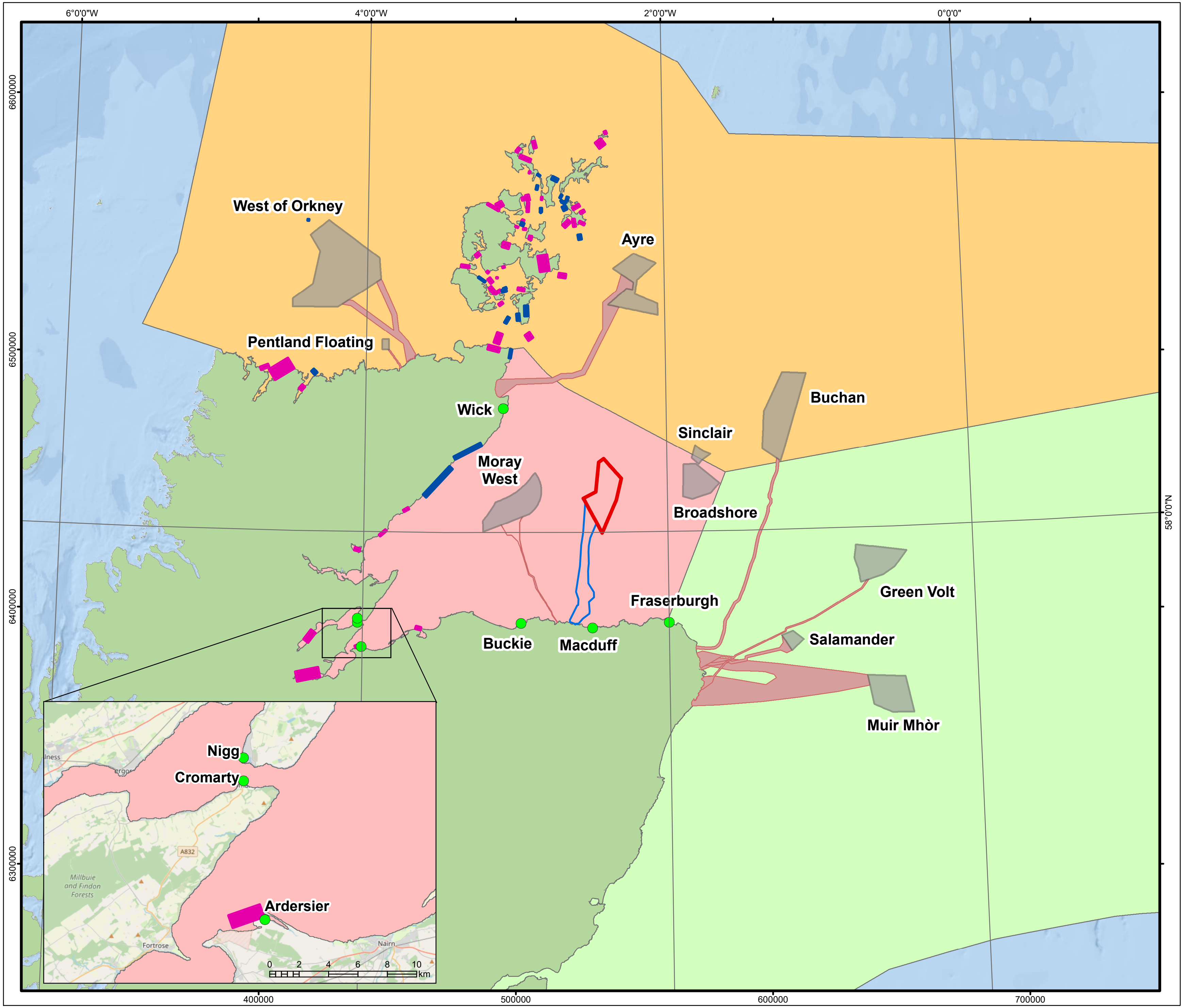
### Magnitude of Impact

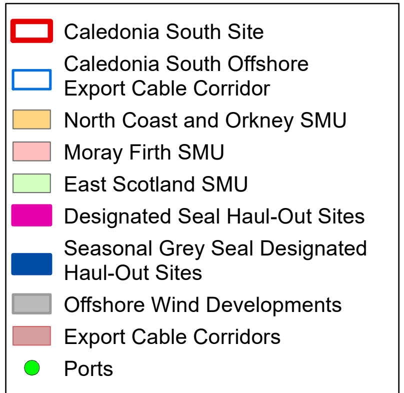
7.8.6.98 As previously discussed in the vessel disturbance section (see paragraph 7.8.6.88), it is also difficult to reliably quantify the level of increased disturbance to seals resulting from increased vessel activity around haul-out sites on a cumulative basis, given the large degree of temporal and spatial variation in vessel movements between projects and regions, coupled with the spatial and temporal variation in seal haul-outs across the region.

7.8.6.99 It is also not known at this stage which ports the OWFs are considering using during construction. However, it is expected that the greatest additive effect to disturbance at haul-out sites would come from the projects located within and in close proximity to the Moray Firth including Moray West, Broadshore, Sinclair and Buchan OWFs (Figure 7–15) as these developments are considered more likely to use the major ports within the Moray Firth (Wick, Macduff, Buckie, Fraserburgh, Cromarty Firth, Nigg and Ardersier). Projects on the periphery of the Moray Firth such as Green Volt, Muir Mhor and Salamander OWFs to the south also have the potential to use ports within the

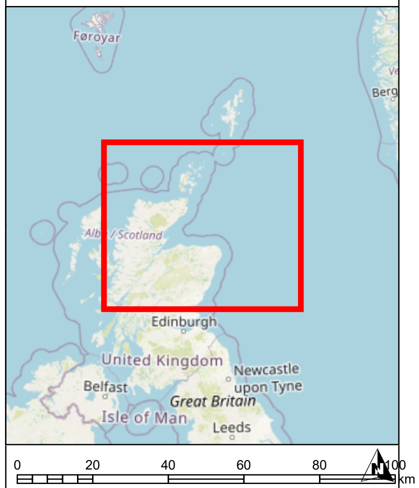
Moray Firth but are considered more likely to use ports at closer locations e.g., Peterhead, Aberdeen and Stonehaven. The most northerly port being considered for Caledonia South is Wick. Therefore, projects in the northwest of Scotland (e.g., Spiorad na Mara and Talisk) are highly unlikely to be using any of the ports being considered for Caledonia South and are considered to have no cumulative effect on disturbance to haul-out sites.

7.8.6.100 In the Moray Firth, there are seven designated haul-out sites based on August counts and three seasonal grey seal breeding sites (Figure 7–15) and, therefore, vessel traffic near these haul-out sites could be increased as a result of activities from these OWFs which has the potential to increase the level of disturbance.






| REV | DATE | DOC STATUS | ORIGIN | REVIEW | APP |
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| 01 | 24/09/2024 | Approved | EV | BB | DH |

CALEDONIA Offshore Wind Farm

GoBe APEM Group

CONTRACTOR DRAWING NO: UKCAL1_GO_WNF_MMM_MAP_00481
CONTRACTOR REV: 01

GEODETIC PARAMETERS: WGS 84 / UTM zone 30N (EPSG: 32630)

DRAWING TITLE:

Figure 7-15: Projects Considered in the CEA, Main Ports and Seal Haul-Out Sites (Designated and Seasonal) in the Moray Firth

STATUS: Approved
SCALE: 1:2,000,000
DRAWING NUMBER: N/A
SHEET NO: 01 of 01
REV: N/A

7.8.6.101 All major ports within the Moray Firth are located >10km from the designated seal haul-out sites, except Ardersier (Table 7–75 and Figure 7–12), so in most cases increased vessel traffic is unlikely to have any cumulative impact on designated sites. As discussed in paragraph 7.7.1.267, the port of Ardersier is located approximately 0.5km from the Ardersier designated haul-out site (Figure 7–15) and therefore cumulative disturbance to this haul-out site cannot be excluded.

7.8.6.102 There are many seal haul-out sites at various locations outside these designated sites within the Moray Firth. Seals hauled-out at these non-designated sites also have the potential be disturbed by vessels transiting to and from the OWF located within the Moray Firth. All major ports, except Ardersier, are located approximately 1km or further from locations where haul-out counts have been made (Table 7–75). Both Cromarty and Nigg are in close proximity to multiple haul-out locations: those at Nigg are the closest but there are also several more in the Cromarty Firth and Jemminaville (primarily grey seals) and at Ardersier (primarily harbour seals). However, vessel traffic will not be a novel occurrence in major port areas and, therefore, it is expected that seals in these areas are habituated to vessel movements nearby. The August haul-out site at Ardersier is located approximately 0.5km from the Ardersier port and therefore cumulative disturbance at this site cannot be excluded.

Table 7–75: Proximity of ports main ports within the Moray Firth to designated seal haul-out sites, seasonal grey seal haul-out sites and August haul-out sites.

| Port | Designated Site | | Harbour Seal August Haul-out Data | | Grey Seal August Daul-out Data | |
|---|---|---|---|---|---|---|
| | Location | Distance | Location | Distance | Location | Distance |
| Wick | Duncansby-Wick | 20km | Wick | 4km | Noss Head | 4km |
| MacDuff | Ardersier | 68km | Boyne Bay | 7km | Boyne Bay | 7km |
| Buckie | Findhorn | 41km | Buckie | 2.5km | Craigenroan | 2km |
| Fraserburgh | Ardersier | 98km | Sandhaven | 2.5km | Sandhaven | 2km |
| Cromarty | Ardersier | 11km | Nigg | 3km | Nigg | 2km |
| Nigg | Ardersier | 12km | Nigg | 2km | Nigg | 1km |
| Ardersier | Ardersier | 0.5km | Ardersier | 0.5km | Ardersier | 0.5km |

7.8.6.103 The landfall locations of the OECCs for OWF projects considered in the CIA may also result in a cumulative impact to disturbance of haul-out sites (Figure 7–15). There are no designated seal haul-out sites in proximity to these expected landfall locations but there is a potential for landfalls to be developed in proximity to the August haul-out sites. At all potential landfall locations, the majority of August haul-out locations in close proximity are for grey seals. Only Caledonia South itself is, at present, expected to overlap with known harbour seal August haul-out locations. The Caledonia South OECC will make landfall at Stake Ness (west of Whitehills) which is on the southern coast of the Moray Firth. The Moray West OECC landfall is located approximately 5km to the west, around Portsoy; potential vessel activity along this OECC during it's operational and maintenance phase may result in a cumulative disturbance effect. Further away (>35km) to the east will be the Buchan OECC and landfall between Fraserburgh and Peterhead. The landfall location for the Broadshore OECC is not confirmed but expected to be around Peterhead, and as the Sinclair OWF is also part of the Broadshore Offshore Hub Development area it is likely to use the same OECC. Activities around these landfall locations are, therefore considered unlikely to result in a cumulative disturbance effects to seal haul-outs with Caledonia South.

7.8.6.104 The vessel movements for OWFs are likely to be limited and slow, resulting in less risk of disturbance to seal haul-outs. In addition, most projects are likely to adopt VMPs and/or comply with the existing Marine Wildlife Watching Codes such as SNH (2017b[32]) and SNH (2017a[347]) to minimise any potential effects on marine mammals. The final VMP for Caledonia South will assess a minimum distance that the vessel should keep from the seal haul-out sites (M-13, see Table 7–13), and it is likely that VMPs adopted by other OWFs will contain a similar distance restriction, which will further limit the disturbance to seal haul-outs. As a result, seals are not expected to experience cumulative behavioural disturbance when hauled-out.

7.8.6.105 During construction, vessel transits to and from the Caledonia South Site will be relatively frequent (e.g., 2,225 movements over up to three years for Caledonia South). The impact is considered to be localised to the vicinity of the moving vessel, and it is expected that all projects, like Caledonia South will commit to a VMP to limit the disturbance to haul-outs (M-13, see Table 7–13). The impact will be temporary (only when the vessel is moving or stationary with engine running) and will occur throughout the construction (medium term). Following the embedded mitigation measures, the effect may occur but at low to medium frequency. It is estimated that an additional four OWFs may be using ports within the Moray Firth and, therefore, result in an additive effect to disturbance to haul-out sites. The proximity to these haul-out sites is unknown, and will depend on the ports selected for use. Additionally, vessel movements will be taking place in the area already characterised by high levels of commercial vessel traffic. As such, it is unlikely that cumulative disturbance to haul-outs could alter harbour and grey seal population trajectories and magnitude of the disturbance to haul-outs is assessed as Low during construction.

#### Sensitivity of Receptor

7.8.6.106 As assessed for Caledonia South alone, the sensitivity of harbour seal to disturbance during and outside the breeding and moult seasons at haul-outs has been assessed as Medium. The sensitivity of grey seals to disturbance to haul-outs, is classified as Low outside of the breeding season and Medium during the breeding season.

#### Significance of Effect

7.8.6.107 Taking the **Medium** sensitivity of harbour seals throughout the year and grey seals during the breeding season and the **Low** magnitude of impact, the cumulative effect of disturbance to haul-out sites is considered to be **Minor and Not Significant in EIA terms**.

7.8.6.108 Taking the **Low** sensitivity of grey seals outside of the breeding season and the **Low** magnitude of impact, the cumulative effect of disturbance to haul-out sites is considered to be **Negligible and Not Significant in EIA terms**.

7.8.6.109 It is expected that all projects considered in the cumulative impact assessment will adopt VMPs and/or comply with the existing Marine Wildlife Watching Codes such as SNH (2017b[32]) and SNH (2017a[347]) and set a minimum distance to keep from the haul-out sites to minimise any potential disturbance effects to hauled-out seals. Given this, the effect of cumulative disturbance to haul-out sites is considered to be not significant in EIA terms. Therefore, no secondary mitigation is required.

7.8.6.110 The residual significance of the cumulative disturbance to haul-out sites is assessed as **Negligible to Minor and Not Significant in EIA terms**.

### Disturbance from Geophysical Surveys

#### Summary

7.8.6.111 A summary of the assessment of cumulative behavioural disturbance from geophysical surveys during construction is provided in Table 7–76. No impacts are considered significant in EIA terms.

Table 7–76: Summary of the significance of cumulative behavioural disturbance from geophysical surveys to marine mammals during construction phase.

| Receptor | Embedded Mitigation | Magnitude | Sensitivity | Significance | Secondary Mitigation | Residual |
|---|---|---|---|---|---|---|
| Harbour porpoise | None | MBES, SSS: Negligible<br>SBP, USBL, UHRS: Low | MBES, SSS: Negligible<br>SBP, USBL, UHRS: Low | Negligible | None | Negligible |
| Bottlenose dolphin | None | MBES, SSS: Negligible<br>SBP, USBL, UHRS: Low | MBES, SSS: Negligible<br>SBP, USBL, UHRS: Low | Negligible | None | Negligible |
| White-beaked dolphin | None | MBES, SSS: Negligible<br>SBP, USBL, UHRS: Low | MBES, SSS: Negligible<br>SBP, USBL, UHRS: Low | Negligible | None | Negligible |
| Common dolphin | None | MBES, SSS: Negligible<br>SBP, USBL, UHRS: Low | MBES, SSS: Negligible<br>SBP, USBL, UHRS: Low | Negligible | None | Negligible |
| Risso's dolphin | None | MBES, SSS: Negligible<br>SBP, USBL, UHRS: Low | MBES, SSS: Negligible<br>SBP, USBL, UHRS: Low | Negligible | None | Negligible |
| Minke whale | None | MBES, SSS: Negligible<br>SBP, USBL, UHRS: Low | MBES, SSS: Negligible<br>SBP, USBL, UHRS: Low | Negligible | None | Negligible |
| Humpback whale | None | MBES, SSS: Negligible<br>SBP, USBL, UHRS: Low | MBES, SSS: Negligible<br>SBP, USBL, UHRS: Low | Negligible | None | Negligible |
| Harbour seal | None | MBES, SSS: Negligible<br>SBP, USBL, UHRS: Low | MBES, SSS: Negligible | Negligible | None | Negligible |

| Receptor | Embedded Mitigation | Magnitude | Sensitivity | Significance | Secondary Mitigation | Residual |
|---|---|---|---|---|---|---|
| | | | SBP, USBL, UHRS: Low | | | |
| Grey seal | None | MBES, SSS: Negligible<br>SBP, USBL, UHRS: Low | MBES, SSS: Negligible<br>SBP, USBL, UHRS: Low | Negligible | None | Negligible |

#### Magnitude of Impact

7.8.6.112 Geophysical surveys are anticipated to take place during the construction of all OWF projects included in the CIA (Table 7–55). As discussed in the Caledonia South alone section (see paragraph 7.7.1.210 to 7.7.1.220), the expected sound frequency during operation of MBES and SSS is above 200kHz and therefore above the hearing frequency range all marine mammals. However, it is unlikely that this would be considered as disturbance in the terms of the EPS Regulations. As such, the magnitude of behavioural disturbance to SSS and MBES is considered negligible.

7.8.6.113 JNCC *et al*. (2010[34]) EPS Guidance concludes that the use of SBPs in geophysical surveys "*could, in a few cases, cause localised short-term impacts on behaviour such as avoidance*." For SBP, USBL and UHRS, it is predicted that any disturbance arising from the geophysical survey works within the respective project's footprint will be of localised spatial extent (up to a maximum of 5km EDR, as per (JNCC, 2023[69]). The effect is likely to occur but at low frequency. Although the effect could affect a small proportion of the respective species populations, population trajectories are unlikely to be altered. Therefore, the magnitude of behavioural disturbance due to SBP, USBL and UHRS has been assessed as Low for all species.

#### Sensitivity of Receptor

7.8.6.114 As assessed for Caledonia South alone, the sensitivity of all marine mammals to MBES and SSS is Negligible, and the sensitivity to SBP, USBL and UHRS is Low.

#### Significance of Effect

7.8.6.115 Taking the **Negligible** sensitivity of all marine mammals and the **Negligible** magnitude of impact, the overall effect of cumulative behavioural disturbance from MBES and SSS during construction of OWFs cumulatively is considered to be **Negligible and Not Significant in EIA terms**.

7.8.6.116 Taking the **Low** sensitivity of all marine mammals and the **Low** magnitude of impact for all marine mammal species, the overall effect of cumulative behavioural disturbance from SBP, USBL and UHRS during construction is considered to be **Negligible and Not Significant in EIA terms**.

7.8.6.117 In the absence of any mitigation, the effect of cumulative disturbance from geophysical surveys during construction is considered to be not significant in EIA terms. Therefore, no embedded or secondary mitigation is required.

7.8.6.118 The overall effect of cumulative behavioural disturbance from geophysical surveys during construction is **Negligible and Not Significant in EIA terms**.

## 7.8.7 Operation

### Operational Noise

#### Summary

7.8.7.1 A summary of the assessment of cumulative disturbance from operational noise, presented in detail in paragraph 7.8.7.2 to 7.8.7.9, is provided in Table 7–77. No impacts are considered significant in EIA terms.

Table 7–77: Summary of the significance of cumulative disturbance from operational noise to marine mammals during O&M phase.

| Receptor | Embedded Mitigation | Magnitude | Sensitivity | Significance | Secondary Mitigation | Residual |
|---|---|---|---|---|---|---|
| Harbour porpoise | None | Medium | Negligible | Negligible | None | Negligible |
| Bottlenose dolphin | None | Medium | Negligible | Negligible | None | Negligible |
| White-beaked dolphin | None | Medium | Negligible | Negligible | None | Negligible |
| Common dolphin | None | Medium | Negligible | Negligible | None | Negligible |
| Risso's dolphin | None | Medium | Negligible | Negligible | None | Negligible |
| Minke whale | None | Medium | Low | Minor | None | Minor |
| Humpback whale | None | Medium | Low | Minor | None | Minor |
| Harbour seal | None | Medium | Low | Minor | None | Minor |
| Grey seal | None | Medium | Low | Minor | None | Minor |

### Magnitude of Impact

7.8.7.2 As presented in Section 7.7.2 for operational noise at Caledonia South, it is anticipated that behavioural disturbance is likely to be localised. For bottom-fixed and floating WTGs, the maximum range where the behavioural disturbance may occur has been estimated as 120m to 150m, respectively (see paragraphs 7.7.2.5 and 7.7.2.12). For cables and moorings, Burns *et al*. (2022[257]) determined maximum TTS-onset range due to non-impulsive noise as 50m for harbour porpoise (Table 7–45). However, it should be noted that Bellmann *et al*. (2023[249]) reported that low-frequency components of WTG noise could be measured up to a few kilometres outside of wind farm arrays.

7.8.7.3 While operational noise from wind farms is likely to be audible to marine mammals within array areas, it is noted that marine mammals have been recorded as present within the array areas of bottom-fixed OWFs (Scheidat *et al*., 2011[258]; Hastie *et al*., 2017[259]; Delefosse *et al*., 2018[260]; Fernandez-Betelu *et al*., 2024[261]). Additionally, presence in the vicinity of dynamic renewable energy structures was confirmed for harbour porpoise, bottlenose dolphin, grey seal and harbour seal (Evans, 2008[262]; Malinka *et al.*, 2018[263]; Tollit *et al.*, 2019[314]; Gillespie *et al.*, 2023[265]). While preliminary data from demonstrator-scale floating projects suggest that harbour porpoise presence may be locally-reduced in the vicinity of WTGs, porpoise were still regularly recorded within 600m of WTGs (Risch *et al*., 2023[348]). Overall, these data suggest a lack of displacement and spatially-limited extent of potential behavioural disturbance to marine mammals by operational windfarms.

7.8.7.4 Based on the CIA shortlist and since the collection of the baseline data at Caledonia South (Figure 7–13), it is anticipated that by 2031 there will be four new operational OWFs in the Moray Firth (Moray West, Caledonia, Broadshore and Sinclair). Further offshore, there will be an additional three new projects (Ayre, Buchan, Green Volt). Alongside the east coast of Aberdeenshire, projects such as Salamander, Buchan and Bowdun will be located within approximately 35km to 50km from the coast and Muir Mhor, Bellrock, Ossian, Morven and Cenos will be developed further offshore.

7.8.7.5 Based on information summarised in paragraphs 7.8.7.2 and 7.8.7.3 above, it is anticipated that any potential behavioural response arising from exposure to operational noise will be limited to the array area of respective projects, and will not result in complete exclusion of animals from the array. Therefore, despite an increase in the footprint of operational windfarms up to 2031, the cumulative impact of operational noise is anticipated to affect only a small proportion of the receptor population and unlikely to have any result on population trajectories. Given the nature of operational noise emissions, disturbance effects may occur with moderate frequency and over the lifetime of Caledonia South and respective projects screened into the CIA. Therefore, given the duration and frequency of the effect, the magnitude has been conservatively assessed as Medium.

### Sensitivity of Receptor

7.8.7.6 As per the project alone assessment, the sensitivity of harbour porpoise and dolphin species to disturbance from operational noise is assessed as Negligible. Both species of seals, minke whale and humpback whale were assessed as having a Low sensitivity to disturbance from operational noise.

### Significance of Effect

7.8.7.7 Taking the **Negligible** (harbour porpoise, dolphin species) to **Low** (seal species, minke whale, humpback whale) sensitivity of marine mammals and the **Medium** magnitude of impact, the overall cumulative effect of disturbance from operational noise is considered to be **Negligible and Not Significant in EIA terms** for harbour porpoise and dolphin species to **Minor and Not Significant in EIA terms** for seal species, minke whale and humpback whale.

7.8.7.8 In the absence of any mitigation, the cumulative effect of disturbance from operational noise is considered to be not significant in EIA terms. Therefore, no embedded or secondary mitigation is required.

7.8.7.9 The residual significance of the cumulative effect of disturbance from operational noise is assessed as **Negligible to Minor and Not Significant in EIA terms**.

## Secondary Entanglement

### Summary

7.8.7.10 A summary of the assessment of cumulative secondary entanglement during operation, presented in detail in paragraph 7.8.7.10 to7.8.7.19, is provided in Table 7–78. No impacts are considered significant in EIA terms.

Table 7–78: Summary of the significance of cumulative secondary entanglement during O&M phase.

| Receptor | Embedded Mitigation | Magnitude | Sensitivity | Significance | Secondary Mitigation | Residual |
|---|---|---|---|---|---|---|
| Harbour porpoise | Mooring lines and dynamic cables inspections | Low | High | Minor | None | Minor |
| Bottlenose dolphin | Mooring lines and dynamic cables inspections | Low | High | Minor | None | Minor |
| White-beaked dolphin | Mooring lines and dynamic cables inspections | Low | High | Minor | None | Minor |
| Common dolphin | Mooring lines and dynamic cables inspections | Low | High | Minor | None | Minor |

| Receptor | Embedded Mitigation | Magnitude | Sensitivity | Significance | Secondary Mitigation | Residual |
|---|---|---|---|---|---|---|
| Risso’s dolphin | Mooring lines and dynamic cables inspections | Low | High | Minor | None | Minor |
| Minke whale | Mooring lines and dynamic cables inspections | Low | High | Minor | None | Minor |
| Humpback whale | Mooring lines and dynamic cables inspections | Low | High | Minor | None | Minor |
| Harbour seal | Mooring lines and dynamic cables inspections | Low | High | Minor | None | Minor |
| Grey seal | Mooring lines and dynamic cables inspections | Low | High | Minor | None | Minor |

**Magnitude of Impact**

7.8.7.11 There are a number of floating OWF projects being developed in Scottish waters, including Green Volt, Ossian, Pentland Floating, Salamander, Ayre, Bowdun, Broadshore, Buchan, Cenos, Culzean, Muir Mhor, Sinclair, Bellrock and Talisk (Figure 7–13). All projects identified that the accumulation of marine debris on floating lines and cables has the potential to generate adverse interactions between mobile marine species and project infrastructure.

7.8.7.12 Out of all projects listed in the paragraph above, no project-specific details were identified in the public domain (e.g., Scoping Report or EIAR) for Bowdun, Sinclair, Havbredey and Talisk. The Culzean project scoped out the risk of entanglement to marine mammals from further consideration at the scoping stage (Total Energies, 2023[349]).

7.8.7.13 Projects with the EIA submission documents in the public domain provided details of monitoring plans for entanglement risk, including monitoring of large strains on mooring lines, remotely operated vehicle surveys, removal of debris from project infrastructure and reporting (Royal HaskoningDHV, 2023[350], Pentland Floating Offshore Wind Farm, 2022[351], Salamander Offshore Wind Farm, 2023[352]; Ossian, 2023[353]).

7.8.7.14 Most of the scoping reports identified periodic inspections, including visual surveys and identification of debris, as a measure necessary to reduce the risk of entanglement (Broadshore Hub, 2024[354], Buchan Offshore Wind, 2023[355], Bellrock Offshore Wind, 2024[356], Muir Mhor, 2023[357], Thistle Wind Partners, 2024[358]). Cenos identified a risk of entanglement to marine mammals as potential impacts but did not provide details about potential mitigation at the scoping stage. However, since the scoping represents early stage of the project development, it cannot be excluded that these measures will be included in the EIA submission documents (Flotation Energy, 2023[359]).

7.8.7.15 The summary provided above suggest that there is awareness across the industry about mitigation measures that need to be applied in order to reduce the risk of the entanglement. The risk of secondary entanglement is restricted to the respective array areas so is of local spatial extent and temporary (dynamic infrastructure will be removed from the water column at the end of the O&M phases of respective projects). There is a risk of entanglement to take place over the lifetime of the projects (long term). If the effect would occur, it is anticipated that it would affect a small proportion of the receptor population and therefore is unlikely to alter population trajectories. Considering the above, the magnitude has been assessed as Low.

#### Sensitivity of Receptor

7.8.7.16 As per the project alone assessment, the sensitivity of marine mammals to entanglement is considered to be High.

#### Significance of Effect

7.8.7.17 Taking the **High** sensitivity of marine mammals and the **Low** magnitude, the overall cumulative effect of secondary entanglement during operation is considered to be **Minor and Not Significant in EIA terms**.

7.8.7.18 It is expected that all projects considered in the cumulative impact assessment will commit to risk-based adaptive approach to the inspections of the mooring lines and cables present in the water column. Following application of this embedded measure, the cumulative effect of secondary entanglement is considered to be not significant in EIA terms. Therefore, no secondary mitigation is required.

7.8.7.19 The residual significance of the cumulative effect of secondary entanglement is assessed as **Minor and Not Significant in EIA terms**.

### Disturbance from Vessels

#### Summary

7.8.7.20 A summary of the cumulative assessment of vessel disturbance during O&M phase, presented in detail in paragraphs 7.8.7.21 to 7.8.7.27, is provided in Table 7–79. No impacts are considered significant in EIA terms.

Table 7–79: Summary of the significance of cumulative vessel disturbance to marine mammals during O&M phase

| Receptor | Embedded Mitigation | Magnitude | Sensitivity | Significance | Secondary Mitigation | Residual |
|---|---|---|---|---|---|---|
| Harbour porpoise | VMP or similar | Low | Low | Negligible | None | Negligible |
| Bottlenose dolphin | VMP or similar | Low | Low | Negligible | None | Negligible |
| White-beaked dolphin | VMP or similar | Low | Low | Negligible | None | Negligible |
| Common dolphin | VMP or similar | Low | Low | Negligible | None | Negligible |
| Risso's dolphin | VMP or similar | Low | Low | Negligible | None | Negligible |
| Minke whale | VMP or similar | Low | Medium | Minor | None | Minor |
| Humpback whale | VMP or similar | Low | Low | Negligible | None | Negligible |
| Harbour seal | VMP or similar | Low | Low | Negligible | None | Negligible |
| Grey seal | VMP or similar | Low | Low | Negligible | None | Negligible |

**Magnitude of Impact**

7.8.7.21 Information about potential cumulative disturbance from vessels is discussed for construction phase in paragraph 7.8.6.88 *et seq.* and is also applicable to the O&M phase.

7.8.7.22 During the O&M phase, the number of vessels associated with respective projects at any one time is likely to decrease compared to the construction phase (e.g., during O&M phase of Caledonia South up to five vessels are anticipated to be onsite at any one time, compared to 25 vessels during the construction phase). As such, considering current levels of traffic on the east coast of Scotland associated with various industries, such increase will be localised and barely discernible from the baseline traffic. The impact will be temporary (only when the vessel is moving or stationary with engine running) and will occur throughout the 35 year operation and maintenance phase (long term). It is likely that the effect will occur at moderate frequency. However, although it could affect a small proportion of respective populations across the duration of the O&M, it is unlikely to alter population trajectories in the long-term due to the fact that it will be taking place in the area already characterised by high levels of commercial vessel traffic. It is anticipated that any animals displaced from the area will return once vessels leave. As such, the magnitude of the cumulative disturbance from vessels during O&M phase is assessed as Low.

#### Sensitivity of Receptor

7.8.7.23 As assessed for Caledonia South alone, sensitivity of all marine mammals, except minke whale, to disturbance from vessel activity is assessed as Low. The sensitivity of minke whales to vessel disturbance is Medium.

#### Significance of Effect

7.8.7.24 Taking the **Low** sensitivity of harbour porpoise, dolphin species, seal species and humpback whale and the **Low** magnitude of impact, the cumulative effect of behavioural disturbance from vessels is considered to be **Negligible and Not Significant in EIA terms**.

7.8.7.25 Taking the **Medium** sensitivity of minke whale and the **Low** magnitude of impact, the cumulative effect of behavioural disturbance from vessels is considered to be **Minor and Not Significant in EIA terms**.

7.8.7.26 It is expected that all projects considered in the cumulative impact assessment will adopt VMPs and/or comply with the existing Marine Wildlife Watching Codes such as SNH (2017b[32]) and SNH (2017a[347]) to minimise any potential vessel disturbance effects on marine mammals. Given this, the effect of cumulative behavioural disturbance from vessels is considered to be not significant in EIA terms. Therefore, no secondary mitigation is required.

7.8.7.27 The overall cumulative effect of vessel disturbance during O&M phase is **Negligible to Minor and Not Significant in EIA terms**.

### Disturbance to Haul-outs

#### Summary

7.8.7.28 A summary of the assessment of cumulative disturbance to haul-outs is provided in Table 7–80. No impacts are considered significant in EIA terms.

Table 7–80: Summary of the significance of cumulative disturbance to haul-outs to harbour and grey seal during O&M phase.

| Receptor | Embedded Mitigation | Magnitude | Sensitivity | Significance | Secondary Mitigation | Residual |
|---|---|---|---|---|---|---|
| Harbour seal | VMP or similar | Low | Medium | Minor | None | Minor |
| Grey seal | VMP or similar | Low | Low (outside breeding period) | Negligible | None | Negligible |
| | | Low | Medium (during breeding period) | Minor | None | Minor |

### Magnitude of Impact

7.8.7.29 Information about potential cumulative disturbance to haul-outs discussed for construction phase is also applicable to the O&M phase.

7.8.7.30 During the O&M phase, the number of vessels transits will be spread out over a longer time period (e.g., 35 years for Caledonia South). The impact is considered to be localised to the vicinity of the moving vessel, and it is expected that all projects, like Caledonia South will commit to a VMP to limit the disturbance to haul-outs (M-13, see Table 7–13). The impact will be temporary (only when the vessel is moving or stationary with engine running) and will occur throughout the O&M phase (long-term term). Following the embedded mitigation measures, the effect may occur but at low to medium frequency. It is estimated that an additional four OWFs may be using ports within the Moray Firth and, therefore, result in an additive effect to disturbance to haul-out sites. The proximity to these haul-out sites is unknown, and will depend on the ports selected for use. Additionally, vessel movements will be taking place in the area already characterised by high levels of commercial vessel traffic. As such, it is unlikely that cumulative disturbance to haul-outs could alter harbour and grey seal population trajectories and magnitude of the disturbance to haul-outs is assessed as Low during O&M phase.

### Sensitivity of Receptor

7.8.7.31 As assessed for Caledonia South alone, the sensitivity of harbour seal to disturbance during and outside the breeding and moult seasons at haul-outs has been assessed as Medium. The sensitivity of grey seals to disturbance to haul-outs, is classified as Low outside of the breeding season and Medium during the breeding season.

#### Significance of Effect

7.8.7.32 Taking the **Medium** sensitivity of harbour seals throughout the year and grey seals during the breeding season and the **Low** magnitude of impact, the cumulative effect of disturbance to haul-out sites is considered to be **Minor and Not Significant in EIA terms**.

7.8.7.33 Taking the **Low** sensitivity of grey seals outside of the breeding season and the **Low** magnitude of impact, the cumulative effect of disturbance to haul-out sites is considered to be **Negligible and Not Significant in EIA terms**.

7.8.7.34 It is expected that all projects considered in the cumulative impact assessment will adopt VMPs and/or comply with the existing Marine Wildlife Watching Codes such as SNH (2017b[32]) and SNH (2017a[347]) and set a minimum distance to keep from the haul-out sites to minimise any potential disturbance effects to hauled-out seals. Given this, the effect of cumulative disturbance to haul-out sites is considered to be not significant in EIA terms. Therefore, no secondary mitigation is required.

7.8.7.35 The residual significance of the cumulative disturbance to haul-out sites is assessed as **Negligible to Minor and Not Significant in EIA terms**.

### Disturbance from Geophysical Surveys

7.8.7.36 The potential cumulative disturbance impacts during the O&M phase at Caledonia South cumulatively with other projects are exactly the same as during the construction phase (Table 7–76) and thus are not repeated here.

## 7.9 In-combination Effects

7.9.1.1 In-combination impacts may occur through the inter-relationship with another EIA Report topic that may lead to different or greater environmental effects than in isolation. There is also the potential for in-combination impacts resulting from onshore and offshore works.

7.9.1.2 The potential in-combination effects for marine mammal receptors resulting from effects between offshore Caledonia South works are described below.

7.9.1.3 The potential in-combination effects resulting from effects between offshore Caledonia South works are described below. These effects are considered at two different levels:

- Project lifetime effects: Assessment of the scope for effects that occur throughout more than one phase of Caledonia South (construction, O&M and decommissioning); to interact to potentially create a more significant effect on a receptor than if just assessed in isolation in these three key project stages; and
- Receptor led effects: Assessment of the scope for all effects to interact, spatially and temporally, to create inter-related effects on a receptor. Effect may interact to produce different, or greater effect on this receptor than when the effects are considered in isolation. Receptor-led effects may be

short-term, temporary or transient effects, or incorporate longer term effects.

7.9.1.4 The likely inter-related effects arising from Caledonia South on marine mammals receptors are as follows and detailed in Table 7–14:

- Vessel collisions;
- Disturbance from vessels;
- Indirect impacts on marine mammals due to changes in prey availability;
- Changes in water quality; and
- Disturbance to haul-outs.

7.9.1.5 The effects of the impacts listed above have been assessed as **Negligible to Minor significance and, therefore, Not Significant in EIA terms**. Overall, no inter-relationships have been identified where an accumulation of residual impacts on marine mammal receptors and the relationship between those impacts gives rise to a need for additional mitigation beyond the embedded mitigation already considered.

## 7.10 Transboundary Effects

7.10.1.1 A transboundary effect assessment assesses the effects from Caledonia South upon the interests of European Economic Areas (EEA States) for marine mammals.

7.10.1.2 Transboundary effects may occur from Caledonia South alone, or cumulatively with other plans or projects. This assessment will consider the potential for transboundary effects of the residual effects of the project (i.e., after mitigation measures have been applied for the project).

7.10.1.3 There may be behavioural disturbance or displacement of marine mammals from Caledonia South as a result of underwater noise. Behavioural disturbance resulting from underwater noise during construction could occur over large ranges (tens of kilometres) and, therefore, there is the potential for transboundary effects to occur where subsea noise arising from Caledonia South could extend into waters of other EEA states. However, given the location of the Project relative to the nearest waters of other states – over 220km to the UK/Norway median line – the potential for disturbance of animals in waters of other EEA states is considered to be small.

7.10.1.4 The mobile nature of marine mammals also results in the potential for transboundary effects to occur. Whilst each species has been assessed within the relevant MU for Caledonia South, the MUs under which each species has been assessed varies greatly in the area covered. Furthermore, the respective MUs do not represent closed populations. This means that impacts, whilst localised, could potentially affect other MUs if mixing between the assessed populations occurs.

7.10.1.5 In addition, any transboundary impacts that do occur as a result of Caledonia South are predicted to be short-term and intermittent, with the recovery of marine mammal populations to affected areas following the completion of construction activities. For example, disturbance to prey species from loss of fish spawning and nursery habitat and suspended sediments and deposition may occur. However, the effects of reduction in prey availability are predicted to be limited in extent to within a few kilometres from Caledonia South and are, therefore, not predicted to extend into the waters of other EEA states. Therefore, the impact of a reduction in prey ability will not lead to a significant effect.

7.10.1.6 Therefore, the magnitude of the impact has been assessed as Negligible and the sensitivity of receptors as Negligible. The effect will, therefore, be **Negligible and Not Significant in EIA terms**.

## 7.11 Mitigation Measures and Monitoring

7.11.1.1 No additional or secondary mitigation for marine mammals is considered necessary, as all project-alone impacts have been assessed as **Not Significant in EIA terms** (Section 7.7), with embedded mitigation relevant to marine mammals detailed in Table 7–13. In addition, the cumulative and in-combination effects identified in Sections 7.8 and 7.9 are all assessed as **Not Significant in EIA terms**.

7.11.1.2 Because no significant effects were concluded there is no requirement for additional monitoring.

## 7.12 Residual Effects

7.12.1.1 All project-alone and cumulative impacts for marine mammals have been assessed as **Not Significant in EIA terms** following the implementation of embedded mitigation. The residual effects are therefore also considered to be **Not Significant in EIA terms**.

## 7.13 Summary of Effects

7.13.1.1 Table 7–81 present a summary of the significant effects assessed for Marine Mammals respectively within this EIA Report, any mitigation required, and the residual effects are provided.

Table 7–81: Summary of Effects for Marine Mammals.

| Potential Impact | Embedded Mitigation | Magnitude | Sensitivity of Receptor | Significance | Secondary Mitigation | Residual Effect |
|---|---|---|---|---|---|---|
| **Construction** | | | | | | |
| Impact 1: Auditory injury from UXO clearance | MMMP (M-16), Low order deflagration (M-107) | Negligible | Low to Medium | Negligible | None | Negligible |
| Impact 2: Disturbance from UXO clearance | Low order deflagration | Low | Low | Negligible | None | Negligible |
| Impact 3: Auditory injury (PTS) from piling | MMMP (M-16) | Negligible | Low to Medium | Negligible | None | Negligible |
| Impact 4: Disturbance from piling | None | Low to Medium | Negligible to Medium | Negligible to Minor | None | Negligible to Minor |
| Impact 5: Auditory injury from other construction activities | None | Negligible | Low to Medium | Negligible | None | Negligible |
| Impact 6: Disturbance from other construction activities | None | Low | Negligible to Medium | Negligible to Minor | None | Negligible to Minor |

| Potential Impact | Embedded Mitigation | Magnitude | Sensitivity of Receptor | Significance | Secondary Mitigation | Residual Effect |
|---|---|---|---|---|---|---|
| Impact 7: Auditory injury from geophysical surveys | MMMP (M-16, SBP & UHRS only) | Negligible | Negligible to Low | Negligible | None | Negligible |
| Impact 8: Disturbance from geophysical surveys | None | Negligible to Low | Negligible to Low | Negligible | None | Negligible |
| Impact 9: Vessel collisions | VMP (M-13) | Low | High | Minor | None | Minor |
| Impact 10: Vessel disturbance | VMP (M-13) | Low | Low to Medium | Negligible to Minor | None | Negligible to Minor |
| Impact 11: Disturbance to haul-out | VMP (M-13) | Low | Low to Medium | Negligible to Minor | None | Negligible to Minor |
| Impact 12: Indirect impacts on marine mammals due to changes in prey availability | None | Negligible | Low to Medium | Negligible | None | Negligible |
| Impact 13: Changes in water quality | None | Negligible | Negligible | Negligible | None | Negligible |

| Potential Impact | Embedded Mitigation | Magnitude | Sensitivity of Receptor | Significance | Secondary Mitigation | Residual Effect |
|---|---|---|---|---|---|---|
| **Operation and Maintenance** | | | | | | |
| Impact 14: Disturbance from operational noise | None | Medium | Negligible to Low | Negligible to Minor | None | Negligible to Minor |
| Impact 15: Entanglement | Entanglement Management Plan (M-108) | Negligible to Low | High | Minor | None | Minor |
| Impact 16: Long term displacement, habitat loss and barrier effects | None | Low to Medium | Negligible to Low | Negligible to Minor | None | Negligible to Minor |
| Impact 17: Vessel collision | VMP (M-13) | Low | High | Minor | None | Minor |
| Impact 18: Vessel disturbance | VMP (M-13) | Low | Low to Medium | Negligible to Minor | None | Negligible to Minor |
| Impact 19: Disturbance to haul-out | VMP (M-13) | Low | Low to Medium | Negligible to Minor | None | Negligible to Minor |
| Impact 20: Indirect impacts on marine mammals due to changes in prey availability | None | Negligible | Low to Medium | Negligible | None | Negligible |

| Potential Impact | Embedded Mitigation | Magnitude | Sensitivity of Receptor | Significance | Secondary Mitigation | Residual Effect |
|---|---|---|---|---|---|---|
| Impact 21: Auditory injury from geophysical surveys | MMMP (M-16, SBP & UHRS only) | Negligible | Negligible to Low | Negligible | None | Negligible |
| Impact 22: Disturbance from geophysical surveys | None | Negligible to Low | Negligible to Low | Negligible | None | Negligible |
| **Decommissioning** | | | | | | |
| Decommissioning effects are not expected to exceed those assessed for construction. | | | | | | |

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