

Bellrock Offshore Wind Farm

Wind Farm Development Area

Environmental Impact Assessment Report - Volume II

Chapter 9: Marine Mammals

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Glossary of Terminology

Term	Definition
Applicant	Bellrock Offshore Wind Farm Limited, the legal entity submitting Section 36 Consent and Marine Licence applications for the Bellrock Wind Farm Development Area.
Bellrock Offshore Wind Farm (Bellrock Project)	An offshore wind farm capable of supplying up to 1.8 GW of renewable energy to the National Electricity Transmission System. The Wind Farm Development Area is located 120 km east of Stonehaven, and will connect to the National Electricity Transmission System at the SSEN Transmission proposed Hurlie substation, west of Stonehaven in Aberdeenshire. The Bellrock Offshore Wind Farm comprises of the following Development Areas: ▪ Wind Farm Development Area; ▪ Offshore Transmission Development Area; and ▪ Onshore Transmission Development Area.
Broadshore Hub (or Broadshore Hub Offshore Wind Farms)	The collective term for the Broadshore Offshore Wind Farm, the Sinclair Offshore Wind Farm and the Scaraben Offshore Wind Farm.
Cable protection	Protective measure to minimise the effects of scour and hazards along the inter-array cables, and protecting these cables at infrastructure crossing points.
Commencement of construction	Commencement of construction to install the Wind Farm Infrastructure as authorised by the Wind Farm Development Area Section 36 Consent and Marine Licence (excluding site preparation works), being the earlier of: ▪ Intrusive pre-installation surveys; ▪ Placement on or installation in the seabed of anchors and associated scour protection, and mooring lines; ▪ Trench excavation for inter-array cables; or ▪ Trenching for, or laying of inter-array cables on or in the seabed.
Construction port	Port that may be used during the construction of the Wind Farm Infrastructure and includes integration port(s) and assembly port(s).
Construction works	Works to install the Wind Farm Infrastructure as authorised by the Wind Farm Development Area Section 36 Consent/Marine Licence, such as: ▪ Site preparation works undertaken after commencement of construction; ▪ Pre-installation surveys (intrusive and/or non-intrusive); ▪ Placement on or installation in the seabed of anchors and associated scour protection, and mooring lines, and associated scour protection; ▪ Towing or transportation of the floating offshore unit to the Wind Farm Development Area from a port or wet storage facility; ▪ Floating offshore unit installation and commissioning, including hooking-up to the pre-installed mooring system; ▪ Trench excavation for inter-array cables; ▪ Laying of inter-array cables in or on the seabed and, associated cable protection; ▪ Installation of subsea cable hubs, including placing of associated foundation; ▪ Final commissioning following cable connections and snagging; and ▪ Post installation surveys.

Term	Definition
Development Area	For consenting purposes, the area for which separate consents and/or Marine Licences will be sought by the Applicant, comprising: ▪ Wind Farm Development Area; ▪ Offshore Transmission Development Area; and ▪ Onshore Transmission Development Area.
Floating offshore unit	The combined wind turbine generator and floating substructure.
Floating substructure	A floating structure which provides buoyancy and, in conjunction with the station keeping system, supports a superstructure (e.g. wind turbine generator or offshore substation), and maintaining its position within the structure's excursion limit.
Inter-array cable	Armoured cable containing electrical and fibre optic cores, which link the wind turbine generators to each other and to the subsea cable hubs and/or the offshore substations and include dynamic inter-array cable and static inter-array cable sections.
Lowest Astronomical Tide	The lowest level that can be expected to occur under average meteorological conditions and under any combination of astronomical conditions.
Offshore substation	An offshore platform which houses electrical equipment such as transformers, switchgear, and protection and control systems, enabling the wind farm's renewable electricity to be received via inter-array cables and exported via the offshore export cables.
Offshore Transmission Development Area	The boundary within which the Offshore Transmission Infrastructure will be constructed, operated and maintained, and decommissioned (and includes the whole of the Wind Farm Development Area).
Operational life	The expected operational life of the Wind Farm Infrastructure from the Commercial Operation Date to the first floating offshore unit being decommissioned.
Project design envelope	Includes all relevant technical, spatial and temporal elements of the Wind Farm Infrastructure, and the proposed methodology to be employed for construction, operations and maintenance, and decommissioning.
Ramp-up	Ramp-up follows on from the soft-start piling procedure. It comprises a specified minimum period of piling, starting at the highest low-energy blow level achieves in the soft start and gradually increasing in hammer energy. The maximum hammer energy required (operational power for that specific pile) must not be reached within the ramp-up period.
Safety Zone	An area of water around or adjacent to a floating offshore unit which is to be constructed, extended, operated or decommissioned, from which certain or all classes of vessels are excluded and within which activities can be regulated for the purpose of securing safety of the floating offshore unit or vessel in that vicinity, and individuals on the floating offshore unit and vessel, in line with Section 95 of the Energy Act 2004.
ScotWind	A Crown Estate Scotland leasing round for offshore wind projects in which the process enabled developers to apply for seabed rights to plan and build wind farms in Scottish waters.
Scour protection	Protective material positioned around anchors to avoid sediment being eroded as a result of the flow of water.
Site preparation works	Preparatory activities undertaken within the Wind Farm Development Area prior to the commencement of construction of the Wind Farm Infrastructure, which may comprise (and which may require separate consents):

Term	Definition
	▪ Geophysical surveys, geotechnical surveys and non-archaeological/archaeological diver/ remotely operated vehicle surveys; ▪ Seabed preparation including sand wave levelling, slope levelling for gravity based anchors (if selected), boulder clearance, and pre-lay grapnel runs; ▪ Unexploded ordnance survey and/or clearance; ▪ Debris clearance; and ▪ Out of service cable/pipeline removal.
Soft start	The procedure used to commence piling at a low hammer energy. The soft start procedure consists of low-energy blows which are followed by the ramp-up procedure.
SSEN Transmission Hurlie substation	The onshore substation to be developed by SSEN Transmission, which will receive renewable electricity from the Bellrock Project onshore substation and allow supply of renewable electricity from the wind farm to the National Electricity Transmission System.
Subsea cable hub	A subsea device, with a gravel pad foundation, which allows the connection of multiple inter-array cables.
Wind Farm Development Area	The boundary within which the Wind Farm Infrastructure will be constructed, operated and maintained, and decommissioned.
Wind Farm Infrastructure	Infrastructure located within the Wind Farm Development Area including wind turbine generators; floating substructures, station keeping systems and associated scour protection; inter-array cables and associated cable protection; subsea cable hubs; and ancillary infrastructure including buoys (including activities associated with the Wind Farm Infrastructure construction, operation and maintenance, and decommissioning).
Wind turbine generator	A wind turbine generator converts wind energy into electrical energy. The main components include rotor assembly (composed of three blades and a hub); nacelle (containing the generator, shaft and gearbox, power electronic converter and transformer); and a tower (containing lifting equipment and switchgear).

Glossary of Abbreviations

Term	Definition
AA	Appropriate Assessment
ADD	Acoustic deterrent devices
AIS	Automatic Identification System
ASCOBANS	Agreement on the Conservation of Small Cetaceans of the Baltic, North-East Atlantic, Irish and North Seas
BEIS	Department for Business, Energy and Industrial Strategy (now the Department for Energy Security and Net Zero)
CEA	Cumulative Effects Assessment
Cefas	Centre for Environment, Fisheries and Aquaculture
CES	Crown Estate Scotland
CGNS	Celtic and Greater North Seas
CoES	Coastal East Scotland
CIEEM	Chartered Institute of Ecology and Environmental Management
CMS	Construction Method Statement
DAERA	Department of Agriculture, Environment and Rural Affairs
DAS	Digital aerial surveys
dB	Decibels
Defra	Department for Environment, Food and Rural Affairs
DOWL	Dudgeon Offshore Windfarm Limited
DP	Decommissioning Programme
DRC	Dose-Response Curve
DSLIP	Development Specification and Layout Plan
EC	European Commission
EDR	Effective Deterrent Range
EcIA	Ecological Impact Assessment
EIA	environmental impact assessment
EMF	Electromagnetic field
EMODnet	European Marine Observation and Data Network

Term	Definition
EMP	Environmental Management Plan
EPS	European Protected Species
ES	Environmental Statement
EU	European Union
FCS	Favourable Conservation Status
FOU	Floating offshore unit
FSS	Floating substructure
FV	Favourable
GNS	Greater North Sea
HF	High frequency
HM	His Majesty
HRA	Habitats Regulations Appraisal
IAC	Inter-array cable
IAMMWG	Inter-Agency Marine Mammal Working Group
INNS	Invasive non-native species
INNSMP	Invasive Non-native Species Mitigation Plan
iPCoD	Interim Population Consequences of Disturbance
IWC	International Whaling Commission
JNCC	Joint Nature Conservation Committee
kHz	Kilohertz
kJ	Kilojoule
LAT	Lowest astronomical tide
LF	Low frequency
MARPOL	International Convention for the Prevention of Pollution from Ships
MBES	Multi-beam echo sounder
MCZ	Marine Conservation Zone
MD-LOT	Marine Directorate - Licensing and Operations Team
ML	Marine Licence

Term	Definition
MMMP	Marine Mammal Mitigation Protocol
MMOb	Marine Mammal Observers
MPA	Marine Protected Area
MPCP	Marine Pollution Contingency Plan
MPS	Marine Policy Statement
MSFD	Marine Strategy Framework Directive
MS-LOT	Marine Directorate-Licensing Operations Team
MUs	Management Units
MW	Megawatt
NAMMCO	North Atlantic Marine Mammal Commission
NAS	Noise abatement system
NEQ	Net Explosive Quantity
NMFS	National Marine and Fisheries Service
NRW	Natural Resources Wales
NS	North Sea
NSP	Navigational Safety Plan
OFTDA	Offshore Transmission Development Area
OMP	Operation and Maintenance Plan
OSPAR	Oslo and Paris Convention for the Protection of the Marine Environment 1992
OWF	Offshore wind farm
PAM	Passive acoustic monitoring
PCW	Phocid carnivore in water
PDE	Project Design Envelope
PNMP	Piling Noise Mitigation Plan
PTS	Permanent threshold shift
RaDIN	Range-dependent nature of impulsive noise
RIAA	Report to Inform Appropriate Assessment

Term	Definition
RoC	Review of consents
RMS	Root mean square
ROV	Remotely operated vehicle
SAC	Special Areas of Conservation
SBES	Single beam echosounder
SBP	Sub bottom profiler
SCANS	Small Cetaceans of the Atlantic and the North Sea
SCOS	Special Committee on Seals
SEL	Sound exposure level
SKS	station keeping systems
SMRU	Sea Mammal Research Unit
SNCBs	Statutory Nature Conservation Bodies
SNH	Scottish Natural Heritage
SPL	Sound pressure level
SSS	Side Scan Sonar
TTS	Temporary threshold shift
USBL	Ultra-Short Baseline
UXO	Unexploded ordnance
VHF	Very high frequency
VMNSP	Vessel Management and Navigational Safety Plan
VMP	Vessel Management Plan
WFDA	Wind Farm Development Area
WTG	Wind turbine generator

9 Marine Mammals

9.1 Introduction

1. This Chapter of the Bellrock Wind Farm Development Area (WFDA) Environmental Impact Assessment (EIA) Report presents an assessment of potential effects on marine mammals from the construction, operation and maintenance, (O&M) and decommissioning phases of the Bellrock Wind Farm Infrastructure.
2. The Bellrock Wind Farm Infrastructure comprises wind turbine generators (WTGs); floating substructures (FSSs), station keeping systems (SKSs) and associated scour protection; inter-array cables (IACs) and associated cable protection; and subsea cable hubs. Further detail on the Bellrock Wind Farm Infrastructure is provided in **Chapter 4: Project Description (Volume II)**.
3. This Chapter of the Bellrock WFDA EIA Report has been prepared to provide the Marine Directorate - Licensing and Operations Team (MD-LOT) (on behalf of the Scottish Ministers) and stakeholders with sufficient information to determine the potential effects of the Bellrock Wind Farm Infrastructure on marine mammal receptors.
4. This Chapter should be read in conjunction with the following chapters of the Bellrock WFDA EIA Report:
 - **Chapter 8: Fish and Shellfish Ecology (Volume II); and**
 - **Chapter 12: Shipping and Navigation (Volume II).**
5. This marine mammals assessment is likely to have key inter-relationships with the above chapters, which will be considered appropriately throughout this Bellrock WFDA EIA Report.
6. Additional information to support this marine mammals assessment includes:
 - **Appendix 9.1: Marine Mammals Technical Report (Volume IV);**
 - **Appendix 9.2: Underwater Noise Modelling Report (Volume IV);**
 - **Appendix 9.3: Marine Mammals Unexploded Ordnance Assessment (Volume IV);**
 - **Appendix 9.4: Marine Mammals Cumulative Effects Assessment Screening (Volume IV);**
and
 - **Appendix 9.5: Marine Mammals Information and Modelling Methods for Disturbance (Volume IV).**
7. This Chapter was prepared by Haskoning.

9.2 Legislation, Policy and Guidance

8. **Table 9.1** describes the legislation, policy and guidance which have been considered in the preparation of this Chapter. The overarching policy and legislation relevant to the Bellrock WFDA is described in **Chapter 2: Policy and Legislative Context (Volume II)**.
9. Any Legislation referred to in this EIA Report is as subsequently amended and as currently in force as at the date of this EIA Report.

Table 9.1: Summary of Relevant Legislation, Policy and Guidance for Marine Mammals

Relevant Legislation, Policy or Guidance	Relevance to the Assessment
Scottish and UK Legislation	
Nature Conservation (Scotland) Act 2004	The Nature Conservation (Scotland) Act 2004 sets out a series of measures designed 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 specifically for Scottish inshore region (within 12nm), adding that it is an offence to disturb cetacean species (either recklessly or intentionally). This Act also enacts requirements under the Bern Convention 1979.
Marine and Coastal Access Act 2009	Marine Protected Areas (MPAs) existing beyond the 12 nm limit in Scottish Waters and Marine Conservation Zones (MCZs) in English waters are designated under the Marine and Coastal Access Act 2009. These sites (MPAs and MCZs) are areas that have been designated for the purpose of conserving – marine flora and fauna; marine habitat or types of marine habitat; or features of geological or geomorphological interest.
Marine (Scotland) Act, 2010 Protection of Seals (Designation of Haul-Out Sites) (Scotland) Order 2014	This Act provides a framework for the sustainable management of Scotland's marine area and one of its key aims is to streamline and simplify the licensing and consenting process for marine projects. Under the Marine (Scotland) Act, the Conservation of Seals Act 1970 have been re-enacted, providing designation of specific seal haul-out sites for protection from intentional or reckless harassment. Under Part 6 of the new Act, it is an offence to kill, injure or take a seal at any time of year, except to alleviate suffering or where a licence has been issued by MD-LOT to do so.
The Conservation of Offshore Marine Habitats and Species Regulations, 2017 The Conservation of Habitats and Species Regulations 2017	The Habitats Regulations place an obligation on 'competent authorities' to carry out an Appropriate Assessment (AA) of any proposal likely to have a significant effect on a European site, to seek advice from Statutory Nature Conservation Bodies (SNCBs) and to reject an application that would have an adverse effect on the integrity of a European Site except where conditions are met. Under the Habitats Regulations, all cetacean species are defined as European Protected Species (EPS). All seals are listed under Schedule 3 (animals which may not be captured or killed in certain ways).
The Wild and Countryside Act 1981	Under the Wild and Countryside Act 1981, it is an offence to intentionally or recklessly disturb any wild animal included under Schedule 5 of the Act.

Relevant Legislation, Policy or Guidance	Relevance to the Assessment
International Legislation	
Marine Strategy Framework Directive (MSFD)	Annex I of the MSFD states that to ensure that good environmental status is met the following must be considered: ▪ Biological diversity should be maintained; ▪ The quality and occurrence of habitats, as well as the distribution and abundance of species are in line with prevailing physiographic, geographic, and climatic conditions; ▪ All elements of the marine food web, to the extent that they are known, occur at normal abundance and diversity levels capable of ensuring the long-term abundance of the species and the retention of their full reproductive capacity; ▪ Concentrations of contaminants are at levels not giving rise to pollution effects; ▪ Properties and quantities of marine litter do not cause harm to the coastal and marine environment; and ▪ Introduction of energy, including underwater noise, is at levels that do not adversely affect the marine environment.
Agreement on the Conservation of Small Cetaceans of the Baltic, North-East Atlantic, Irish and North Seas (ASCOBANS)	Formulated in 1992, this Agreement has been signed by eight European countries bordering the Baltic and North Seas (NS) (including the English Channel) and includes the United Kingdom (UK). Under the Agreement, provision is made for the protection of specific areas, monitoring, research, information exchange, pollution control and increasing public awareness of small cetaceans (odontocetes).
The Bonn Convention 1979	Protects migratory wild animals (including all cetaceans) across all, or part of their natural range, through international cooperation, and relates particularly to those species in danger of extinction. One of the measures identified is the adoption of legally binding agreements, including ASCOBANS.
Oslo and Paris Convention for the Protection of the Marine Environment 1992 (OSPAR)	OSPAR has established a list of threatened and/or declining species in the North-East Atlantic. These species have been targeted as part of further work on the conservation and protection of marine biodiversity under Annex V of the OSPAR Convention. The list seeks to complement, but not duplicate, the work under the European Commission (EC) Habitats and Birds Directives and measures under the Bern Convention and the Bonn Convention. The following species are considered: Bowhead whale <i>Balaena mysticetus</i>, northern right whale <i>Eubalaena glacialis</i>, blue whale <i>Balaenoptera musculus</i>, and harbour porpoise <i>Phocoena phocoena</i>.

Relevant Legislation, Policy or Guidance	Relevance to the Assessment
Conservation of Seals Act 1970, as amended 2021	The legislative changes in England and Wales, amends the Conservation of Seals Act 1970, prohibiting the intentional or reckless killing, injuring or taking of seals and removing the provision to grant licences for the purposes of protection, promotion or development of commercial fisheries or aquaculture activities. These changes were enacted to ensure compliance with the US Marine Mammal Protection Act Import Provision Rule. As of 1 March 2021, a person commits an offence if they intentionally or recklessly kill, injure or take a seal.
Policy	
Scotland's National Marine Plan, 2015	The purpose of the National Marine Plan is to set out strategic policies for the sustainable development of Scotland's marine resources out to 200 nm. Of relevance to marine mammals is the strategic priority: "Biodiversity is protected, conserved and, where appropriate, recovered, and loss has been halted." The SNMP is currently being updated, transitioning to the Scottish National Marine Plan 2. Consultation on the SNMP ran from 5 November 2024 to 7 February 2025 and a consultation analysis report has been produced by the Scottish Government (2025).
Priority Marine Features in Scotland's Seas (NatureScot, 2020)	PMFs are habitats and species that have been identified as being conservation priorities in Scottish waters. These include 16 species of marine mammals.
Sectoral Marine Plan for Offshore Wind Energy (Scottish Government, 2020c)	The Sectoral Marine Plan for Offshore Wind Energy (2020) seeks to minimise the potential adverse effects on other marine users, economic sectors and the environment resulting from further commercial scale offshore wind development. Offshore Wind and Marine Renewable Energy Policies require consideration of regional cumulative effects, including the potential for negative effects on bird populations, benthic habitats, cetaceans, navigational safety, seascape/landscape and commercial fisheries. The Sectoral Marine Plan includes measures to mitigate potential impacts at various scales. The 2020 SMP is undergoing review to reflect the ScotWind and Innovation and Targeted Oil and Gas (INTOG) leasing rounds and is anticipated to be published in summer 2026.
Scottish Biodiversity Strategy (Scottish Government, 2024)	Sets out a vision for 2045 explaining how the Scottish Government will conserve biodiversity for the people of Scotland now and in the future, with the objective to halt the loss of biodiversity.
Marine Environment: 'Unexploded Ordnance Clearance Joint Position Statement' (UK Government et al. 2025)	This position statement sets out how the signatories expect to approach Marine Licensing for these activities and provides guidance to potential applicants as to how best to undertake applications for such Marine Licences, in the context of this general approach.

Relevant Legislation, Policy or Guidance	Relevance to the Assessment
	Provides the stance by UK regulators and Statutory Nature Conservation Bodies (SNCBs) on minimising environmental harm from UXO clearance. It promotes low-impact techniques and strategic planning to reduce acoustic trauma to marine mammals. Its inclusion in EIAs demonstrates regulatory alignment and commitment to best practice in high-risk operations.
UK Marine Policy Statement (HM Government, 2011)	The UK Marine Policy Statement ensures a sustainable marine environment which promotes healthy, functioning marine ecosystems and protects marine habitats, species and our heritage assets. It recognises that the marine environment plays an important role in mitigating climate change. It seeks to ensure that biodiversity is protected, conserved and where appropriate recovered and loss has been halted. The UK Marine Policy Statement places duties on public bodies in relation to the conservation of biodiversity and strengthens wildlife enforcement legislation. Wild animal protection is extended to include reckless as well as intentional acts. The policy makes it an offence to disturb or harass cetaceans and amends the provisions for enforcement.
Guidance	
The Protection of Marine EPS from Injury and Disturbance – Guidance of Scottish Inshore Waters (Marine Scotland, 2020)	This guidance seeks to provide advice for marine users who are planning to carry out an activity in the marine environment which has the potential to deliberately or recklessly kill, injure or disturb a marine EPS. It also provides useful information on mitigation for marine mammals.
The Protection of Marine EPS from Injury and Disturbance – Guidance for the Marine Area in England and Wales and the UK Offshore Marine Area (Joint Nature Conservation Committee (JNCC) et al. 2010)	The guidance seeks to provide a resource for marine users, regulators, advisors and the enforcement authorities when considering whether an offence of disturbing or injuring/killing a marine EPS is likely to occur or to have occurred as a result of an activity.
JNCC Guidelines for Minimising the Risk of Injury to Marine Mammals from UXO Clearance in the Marine Environment (JNCC, 2025a)	These guidelines outline measures to minimise potential injury and disturbance from UXO clearance activities.
Statutory Nature Conservation Agency Protocol for Minimising the Risk of Injury to Marine Mammals from Piling Noise (JNCC, 2010)	These guidelines outline a protocol for the mitigation of potential underwater noise impacts arising from pile driving during offshore wind farm (OWF) construction.
Scottish Marine Wildlife Watching Code (Scottish Natural Heritage (SNH) [now NatureScot], 2017)	The wildlife watching code provides guidelines on the best practice measures for reducing disturbance to marine mammals by all marine users.

Relevant Legislation, Policy or Guidance	Relevance to the Assessment
JNCC Guidelines for Minimising the Risk of Injury to Marine Mammals from Geophysical Surveys (Seismic Survey Guidelines) (JNCC, 2017) ¹	These guidelines outline a protocol for the mitigation of potential underwater noise impacts due to geophysical surveys.
Marine licensing – unexploded ordnance clearance: application guidance (Marine Directorate, 2025)	Guidance on Marine Licence application requirements for UXO clearance.
Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine (Chartered Institute of Ecology and Environmental Management (CIEEM) 2024)	Guidance on EIAs and provides a structured framework for assessing potential impacts on marine mammals from offshore developments, such as the Bellrock WFDA.
Approaches to Marine Mammal Monitoring at Marine Renewable Energy Developments Final Report (Sea Mammal Research Unit Ltd (SMRU Ltd) on behalf of The Crown Estate 2010)	Guidance on designing and implementing marine mammal monitoring programmes around OWFs. It outlines methodologies for baseline data collection, impact detection, and post-construction monitoring, with an emphasis on species-specific behaviours and spatial use. Its relevance lies in supporting robust EIA frameworks that can detect and interpret ecological changes attributable to development activities, ensuring that mitigation and adaptive management are evidence-led.
Guidelines for Data Acquisition to Support Marine Environmental Assessments of Offshore Renewable Energy Projects (Centre for Environment, Fisheries and Aquaculture (Cefas), 2011)	Sets out best practice for acquiring environmental data to inform offshore wind farm EIAs, including parameters critical to marine mammal assessments such as acoustic profiles, habitat mapping, and biological presence. The guidance ensures data quality, consistency, and relevance, enabling accurate impact prediction and regulatory compliance. It also supports integration with broader marine spatial planning and cumulative impact assessments.
A review of noise abatement systems (NAS) for Offshore Wind Farm (OWF) construction noise, and the potential for their application in Scottish Waters (Verfuss et al. 2019)	Evaluates the effectiveness of various NAS in reducing construction-related acoustic impacts, particularly from pile-driving. It assesses technologies such as bubble curtains, cofferdams, and hydro sound dampers, with a focus on their applicability in Scottish waters. This document is critical in informing mitigation design and demonstrating best available techniques to minimise injury and behavioural disturbance.
Reducing Underwater Noise (NIRAS, SMRU Consulting, and The Crown Estate, 2019)	Guidance on synthesises practical strategies for reducing underwater noise during offshore wind development, including operational modifications, spatial planning, and technology deployment. It highlights the importance of early-stage noise modelling and stakeholder engagement. In marine mammal EIAs, it supports proactive mitigation planning and helps developers meet regulatory thresholds for disturbance and injury risk.

Relevant Legislation, Policy or Guidance	Relevance to the Assessment
JNCC guidance for the use of Passive Acoustic Monitoring in UK waters for minimising the risk of injury to marine mammals from offshore activities (JNCC, 2023)	Provides technical protocols for deploying Passive Acoustic Monitoring (PAM) to detect marine mammal presence and activity, particularly in relation to noise-generating offshore operations. It outlines equipment standards, deployment strategies, and data interpretation methods. This guidance is essential for EIAs requiring real-time mitigation (e.g. shutdown protocols) and for validating impact predictions through empirical monitoring.
UK Marine Noise Registry Disturbance Tool: Description and Output Generation. April 2025 (JNCC, 2025c)	Describes the UK Marine Noise Registry's disturbance tool, which quantifies potential acoustic impacts on marine mammals from anthropogenic sources. It enables spatial and temporal analysis of noise exposure, supporting cumulative impact assessments. For EIAs, it provides a transparent and standardised approach to evaluating disturbance risk, enhancing consistency across regulatory submissions.
Department for Environment, Food & Rural Affairs (Defra) Guidance Supporting minimising environmental impacts from UXO clearance (Defra, 2025)	Guidance that provides operational detail on UXO clearance methods, mitigation hierarchies, and monitoring requirements. It emphasises risk assessment and stakeholder coordination. For marine mammal EIAs, it supports the development of site-specific mitigation plans and ensures that explosive-related activities are ecologically justified and minimised.
Offshore Renewables Joint Industry Programme (ORJIP) for Offshore Wind's range-dependent nature of impulsive noise (RaDIN) (Matei et al. 2024)	Advances understanding of how impulsive noise propagates in marine environments, with implications for species-specific exposure thresholds. It provides modelling tools and empirical data to refine impact predictions. In EIAs, it enhances the accuracy of acoustic assessments and supports the justification of mitigation distances and timing restrictions.
Natural England Offshore Wind Marine Environmental Assessments: Best Practice Advice for Evidence and Data Standards Phase I-V (Parker et al. 2022)	Guidance that sets out evidence and data standards for offshore wind farm EIAs, covering survey design, data quality, and reporting. It promotes consistency, transparency, and scientific rigour across ecological assessments. For marine mammals, it ensures that population-level impacts are assessed using robust methodologies and that mitigation is proportionate and defensible.
Notes: ¹ Draft JNCC guidelines for minimising the risk of injury to marine mammals from geophysical surveys was issued in February 2025 and any new requirements will be taken into account at the time of future surveys.	

9.2.1 European Protected Species and Marine Wildlife Licence Guidance

10. All cetacean species are listed as EPS under Annex IV of the European Union (EU) Council Directive 92/43/EEC (Habitats Directive) and are therefore protected from the deliberate killing (or injury), capture and disturbance throughout their range. Within the UK, the Habitats Directive is implemented through various pieces of legislation. Of particular relevance to the Bellrock WFDA application are the Conservation of Habitats and Species Regulations 2017 and the Conservation of Offshore Marine Habitats and Species Regulations 2017 (collectively the 'Habitats Regulations'). Under the Habitats Regulations, it is an offence to:
 - Deliberately capture, injure or kill any cetacean species;
 - Deliberately disturb them; or
 - Damage or destroy a breeding site or resting place.
11. Unlike cetaceans, phocid seals are not listed on Annex IV of the Habitats Directive and are therefore not an EPS. However, both grey and harbour seal are listed on Annex II (animal and plant species of community interest whose conservation requires the designation of Special Areas of Conservation (SACs)) and Annex V (animal and plant species of community interest whose taking in the wild and exploitation may be the subject of management measures) of the Habitats Directive.
12. In addition, harbour and grey seals are UK Biodiversity Action Plan (BAP) priority species. Grey and harbour seal are also protected under the Habitats Regulations, as well as the Marine (Scotland) Act 2010 and the Protection of Seals (Designation of Haul-Out Sites) (Scotland) Order 2014. Any designations for seals would therefore need to be considered in the assessment for an EPS licence.
13. In Scottish waters, a marine wildlife (EPS) licence is required where an activity is likely to cause disturbance or injury to an EPS animal, therefore the EPS licence is required to undertake the activity legally. It is an offence if the activity deliberately captures, injures, or kills any EPS wild animal.
14. The Habitats Regulations 1994 (as amended in Scotland) provided the protection given to EPS in Scottish territorial waters, which was updated in The Conservation of Offshore Marine Habitats and Species Regulations (2017). This protection is afforded in Scottish territorial waters (out to 12 nm) under Regulation 39(1) which make it an offence to:
 - Deliberately or recklessly capture, injure or kill a wild animal of an EPS; and
 - Deliberately or recklessly:
 - Harass a wild animal or group of wild animals of an EPS;
 - Disturb such an animal while it is occupying a structure or place which it uses for shelter or protection;
 - Disturb such an animal while it is rearing or otherwise caring for its young;

- Obstruct access to a breeding site or resting place of such an animal, or otherwise to deny the animal use of the breeding site or resting place;
 - Disturb such an animal in a manner that is, or in circumstances which are, likely to significantly affect the local distribution or abundance of the species to which it belongs;
 - Disturb such an animal in a manner that is, or in circumstances which are, likely to impair its ability to survive, breed, or reproduce, or rear or otherwise care for its young; or
 - Disturb such an animal while it is migrating or hibernating.
15. For activities taking place in Scottish waters beyond 12 nm, EPS are protected under The Conservation of Offshore Marine Habitats and Species Regulations 2017. MD-LOT (on behalf of the Scottish Ministers) is the licensing authority for all activities relevant to the renewable energy developments.
16. Further protection is afforded through an additional disturbance offence given under Regulation 39(2) which states that “*it is an offence to deliberately or recklessly disturb any dolphin, porpoise or whale (cetacean)*”.
17. If required, marine wildlife (EPS) licence application(s) would be submitted post consent. At that point in time, the project design envelope (PDE) would have been further refined through detailed design and procurement activities, and further detail would be available on the techniques selected for the construction of the Wind Farm Infrastructure, as well as the mitigation measures that would be in place following the development of the Marine Mammal Mitigation Protocol (MMMP) for piling.

9.3 Consultation

18. Consultation undertaken to date for the Bellrock WFDA relevant to marine mammals has been in line with the general process described in **Chapter 5: EIA Methodology (Volume II)**. Key consultation pertinent to this Chapter is provided in **Table 9.2** below.

Table 9.2: Consultation Relevant to Marine Mammals

Consultee	Date/Document	Comment	How/Where Comment is Addressed
NatureScot and MD-LOT (MS-LOT at the time)	February to March 2022, consultation on Method Statements for offshore aerial surveys	Advice was given on the focal species and alignment of survey approaches with those for adjacent lease option awards, to facilitate future cumulative effects assessment (CEA).	Comments from NatureScot and MD-LOT have been considered in the scope of works for the offshore aerial survey.
NatureScot	30 October 2023, Bellrock WFDA Scoping Workshop (email post-workshop 20 th December 2023)	NatureScot recommend for fin whale, due the lack of data to allow quantitative analysis, that they are assessed qualitatively. This is because, although the Small Cetaceans in European Atlantic waters and the North Sea (SCANS) IV data include a density estimate for fin whales within block NS-D, this was based on a single sighting in this region. Previously, none had been recorded within the equivalent Block R in SCANS III. Thus, we advise a Management Unit (MU) estimate of numbers is not required.	Noted, Fin whale in the assessments in Section 9.8 are conducted qualitatively using minke whale assessments as a proxy. For further information on fin whales in relation to the Bellrock WFDA, see Appendix 9.1: Marine Mammals Technical Report (Volume IV) .
NatureScot	30 October 2023, Bellrock WFDA Scoping Workshop	NatureScot confirmed that the North Atlantic Marine Mammal Commission (NAMMCO) (2020) source is appropriate for use in considering fin whale reference populations.	
NatureScot	30 October 2023, Bellrock WFDA Scoping Workshop	NatureScot confirmed that the proposed approach to characterising the baseline for seal species and the study area was appropriate.	Noted. The final seal population for the seals study area is presented in Table 9.12 . Further information can be found in Appendix 9.1: Marine Mammals Technical Report (Volume IV) .
NatureScot	30 October 2023, Bellrock WFDA Scoping Workshop	NatureScot agreed that for buried cables, direct effects from EMF can be scoped out but that indirect effects (e.g. on prey species) should be scoped in.	Noted. The final impacts scoped in and out of the assessment are presented in Table 9.14 .
NatureScot	30 October 2023, Bellrock WFDA Scoping Workshop	NatureScot advised that using Temporary Threshold Shift for disturbance proxy is only recommended for UXO clearance but is not recommended for piling.	Noted.

Consultee	Date/Document	Comment	How/Where Comment is Addressed
			This approach has been applied in the UXO assessment in Appendix 9.3: Marine Mammals Unexploded Ordnance Assessment (Volume IV) and has not been applied to the piling assessment.
NatureScot	30 October 2023, Bellrock WFDA Scoping Workshop	NatureScot noted that they do not agree with the Effective Deterrent Range (EDR) approach as it is specific enough to account for differences in the location of different offshore wind farms and was produced as guidance for harbour porpoise designated sites. NatureScot prefer the dose response curve to be used.	Noted. The dose response curve approach has been applied to the disturbance assessment in Section 9.8.1.3.2.2.1 rather than the EDR approach.
NatureScot	30 October 2023, Bellrock WFDA Scoping Workshop	NatureScot advised that the harbour porpoise dose response curve should be used for minke whales and dolphins as a precautionary approach.	
NatureScot	30 October 2023, Bellrock WFDA Scoping Workshop	NatureScot asked for information on the basis of the percentage of the reference population and each magnitude level to be provided in the upcoming Scoping Report.	Noted. This was presented in the Scoping Report as requested based on a scientific background (peer-reviewed literature). The information on the percentage of the reference population each magnitude level is presented in Section 9.4.1.1 .
NatureScot	30 October 2023, Bellrock WFDA Scoping Workshop	NatureScot noted that the proposed approach to the cumulative effects assessment appeared to be a conventional approach and highlights that pre-construction activities should also be included (e.g. UXO clearance, sandwave levelling).	Noted. The cumulative effects assessment includes geophysical surveys, other construction activities and potential UXO clearance, see Section 9.9 .
MD-LOT	Bellrock WFDA Scoping Opinion (2024), Paragraph 5.5.1	The Scottish Ministers are content with the study areas as described in Section 8.4.1 of the Scoping Report and highlight the advice included in the representation from NatureScot regarding reference populations and Management Units which should be used in the EIA Report.	Noted. Information on reference populations and MUs is provided in Section 9.6 and Appendix 9.1: Marine Mammals Technical Report (Volume IV) .
MD-LOT	Bellrock WFDA Scoping Opinion	The Scottish Ministers are content with the data sources presented in Section 1.3 and Table 1.2 of Appendix 4 – Marine Mammals Existing Environment (of the Scoping Report),	

Consultee	Date/Document	Comment	How/Where Comment is Addressed
	(2024), Paragraph 5.5.2	however would like to highlight the additional data source as suggested within the NatureScot representation which should be included within the EIA. With regard to the baseline information discussed in Section 8.4 of the Scoping Report, the Scottish Ministers draw attention to the advice provided by NatureScot in relation to where species are recorded in low numbers and their request that this is implemented by the Developer in the EIA Report. In addition, the Scottish Ministers would highlight NatureScot comments regarding reference populations and density estimates which should be fully implemented within the EIA Report.	
MD-LOT	Bellrock WFDA Scoping Opinion (2024), Paragraph 5.5.3	In line with the representation from NatureScot, the Scottish Ministers generally agree with the impacts to be scoped in and out as detailed in Sections 8.6.1 and 8.6.2 in the Scoping Report, however, they would agree with the NatureScot representation that potential impacts from pre-construction works (referred to as site preparation works with this EIA Report) may also require consideration alongside construction phase impacts. The Scottish Ministers draw attention to the representation from NatureScot on entanglement and indirect impacts from EMF on prey availability and request the Developer fully considers these comments and they are implemented in the EIA Report.	Noted. The cumulative effects assessment includes an assessment for all phases of the Wind Farm Infrastructure and takes note of the project specific assessments which also included all phase (including site preparation works), see Section 9.9. Final impacts scoped in and out of the assessment are presented in Section 9.7.1.
MD-LOT	Bellrock WFDA Scoping Opinion (2024), Paragraph 5.5.4	The Scottish Ministers are content with the approach to the assessment as detailed in the Scoping Report and highlight the advice included in the representation from NatureScot with regards to sensitivity scoring. The Scottish Ministers request that this must be fully considered and implemented in the EIA Report.	Noted. Information on the sensitivity scoring is provided in Section 9.4.1.1.
MD-LOT	Bellrock WFDA Scoping Opinion (2024), Paragraph 5.5.5	In terms of mitigation and monitoring, the Scottish Ministers have reviewed Section 8.5.1 in the Scoping Report which presents embedded mitigation measures and advise the full range of mitigation measures and published guidance must be included in the EIA Report along with further information on proposed marine mammal monitoring. The Scottish Ministers advise that geophysical surveys (and appropriate mitigation) must be included in the EIA Report. This is in line with the NatureScot representation.	The enhancement, mitigation and monitoring measures proposed are listed in Section 9.7.3 and all relevant legislation and guidance is listed in Section 9.2. The need/inclusion of any detailed monitoring of environmental effects during the construction and O&M of the Bellrock Wind Farm Infrastructure will be determined post consent and would be designed to monitor impacts and also understand knowledge gaps at the time commencement. If monitoring is included, this may be through contribution to a

Consultee	Date/Document	Comment	How/Where Comment is Addressed
			strategic/regional programme or undertaken at a Project level and will be captured in a PEMP (secured as part of the s.36 Consent). In partnership with SAMS, and part-funded with other ScotWind developers, NatureScot and CES, the Bellrock Project is part of a two year Minke Whale Passive Acoustic Monitoring (PAM) study in the Moray Firth region, with a particular focus on the Southern Trench. Results will increase understanding of the seasonal presence of minke whales at the proposed development sites and near the Southern Trench MPA.
MD-LOT	Bellrock WFDA Scoping Opinion (2024), Paragraph 5.5.6	With regard to the approach to the cumulative assessment as described in Section 8.7.6 of the Scoping Report, the Scottish Ministers are broadly content. However, the Scottish Ministers draw attention to the NatureScot representation regarding use of Interim Population Consequences of Disturbance ("iPCoD") and use of Natural Resource Wales guidance and request that this must be fully addressed in the EIA Report. Scottish Ministers recommend in order to assess cumulative impacts, the Developer uses the Cumulative Effects Framework when compiling the EIA Report.	Noted. The cumulative effects assessment is presented in Section 9.9. At the time of writing the Cumulative Effects Framework has yet to be finalised and published and therefore has not been used.
MD-LOT	Bellrock WFDA Scoping Opinion (2024), Paragraph 5.5.7	The Scottish Ministers have reviewed Section 8.6.4 in the Scoping Report in regard to potential transboundary effects. The Developer has proposed to scope in transboundary effects for assessment in the EIA Report for marine mammal receptors. The Scottish Ministers disagree with this approach and, in line with the NatureScot representation, consider that, provided the assessment is carried out against the UK marine mammal MUs, transboundary effects can be scoped out for marine mammals at this stage.	Consideration of transboundary effects has been given in Section 9.4.3 and has subsequently been scoped out of the EIA based on the opinions of the NatureScot representation and the Scottish Ministers advice.
MD-LOT	Bellrock WFDA Scoping Opinion (2024), Paragraph 5.5.8	In regard to the MPA Screening Report, the Scottish Ministers refer to the representation from NatureScot and are generally content with the proposed impacts to be scoped in and out for minke whale.	Noted. The ncMPA assessment is presented in Nature Conservation Marine Protected Area Assessment (Volume VII).

Consultee	Date/Document	Comment	How/Where Comment is Addressed
MD-LOT	Bellrock WFDA Scoping Opinion (2024), Paragraph 5.5.9	In regard to the HRA Screening Report, the Scottish Ministers refer to the representation from NatureScot regarding Moray Firth SAC; Berwickshire & North Northumberland Coast and Isle of May SAC; and Firth of Tay and Eden Estuary SAC and advise that these comments are fully addressed in the EIA Report. The Scottish Ministers also refer the Developer to the representation from Natural England who confirm that they do not expect to provide further comments or advice on marine mammal receptors unless the project changes substantially. The Developer should also note the standing advice provided by Natural England.	Noted. Further information can be found in the RIAA – Part 2: Special Areas of Conservation: Marine Mammals (Volume VI) .
NatureScot	Representation on the Bellrock WFDA Scoping Report (2024)	NatureScot note that increasingly, there is a need to understand potential impacts holistically at a wider ecosystem scale in addition to the standard set of discrete individual receptor assessments. This assessment should focus on potential impacts across predator prey interactions. This will enable a better understanding of the consequences (positive or negative) of any potential changes in prey distribution and abundance from the development of the wind farm on bird and mammal (and other top predator) interests and what influence this may have on population level impacts. We recognise that the role of biological receptors in ecosystem function is noted in paragraph 281 of Section 4.5.3.2 (of the Scoping Report), which sets out the approach to determining receptor sensitivity and value.	The assessment of changes of prey availability has been assessed in Section 9.8 for all phases of the Wind Farm Infrastructure.
NatureScot	Representation on the Bellrock WFDA Scoping Report (2024)	The study area is discussed in Section 1.1 of Appendix 4 - Marine Mammals Existing Environment (of the Scoping Report) and outlined further in Section 1.4 and 1.5. NatureScot agree with the Management Units (MUs) listed for each species and advise that the UK portion of the MU should be used in the EIA Report.	Noted. The UK portions have been used throughout where a quantitative assessment is possible, see Section 9.8 .
NatureScot	Representation on the Bellrock WFDA Scoping Report (2024)	NatureScot advise that they are content with the proposed data sources and guidance documents, as per Section 1.3 and Table 1.2 of Appendix 4 - Marine Mammals Existing Environment [of the Scoping Report]. NatureScot advise the following additional data sources should be included: National Marine Fisheries Service. 2018. 2018 Revisions to: Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing.	Noted. The National Marine Fisheries Service (2018) dataset has been utilised when assessing effects for noise in marine mammals, see Section 9.8 .
NatureScot	Representation on the Bellrock WFDA Scoping Report (2024)	NatureScot advise that at this stage they are content with the marine mammal species scoped in for further assessment (as per Section 8.4 of the Scoping Report) and agree with the proposal to include other species if they are recorded during site-specific DAS surveys. Where species are recorded in low numbers, NatureScot advise that the assessment can	Noted. Where possible all species that can be assessed in a quantitative manner have been,

Consultee	Date/Document	Comment	How/Where Comment is Addressed
		be qualitative and should include humpback whale. NatureScot also welcome the Applicant's commitment to apply any mitigation measures to all marine mammal species, not just those listed, as stated in paragraph 572.	depending on the available data, see Section 9.8 for the full assessments.
NatureScot	Representation on the Bellrock WFDA Scoping Report (2024)	NatureScot note that for some species, the Inter-Agency Marine Mammal Working Group (IAMMWG) MUs is very large. For the impact assessment NatureScot advise the use of population estimates for the UK portion of the MU, rather than the full MU. The reasoning for this is to try and present the most realistic assessment of the number of animals affected by the potential impact pathway(s). The use of population estimates for the full MUs are still useful for context and baseline characterisation. NatureScot advise stating the total MU population and the UK portion for context, and then assessing impacts against the UK portion of the MU. For species with smaller MUs, such as bottlenose dolphin in the Coastal East Scotland MU, and seals, the entire MU should be used in the assessment.	Noted. The UK portions have been used throughout where a quantitative assessment is possible, see Section 9.8 .
NatureScot	Representation on the Bellrock WFDA Scoping Report (2024)	NatureScot note that a summary of the density estimates to be used in the impact assessment is included in Table 8.3 (Section 8.4.1 of the Bellrock WFDA Scoping Report). For cetacean species, NatureScot agree with the densities presented in Table 8.3. For seals, NatureScot note that in paragraph 574 it is stated that " <i>Seal density estimates will be based on the worst-case densities from the Carter et al. (2022) density mapping (Table 1.4 in Appendix 4), or the site-specific [DAS] surveys if there is sufficient data.</i> " NatureScot do not agree that seal densities from site-specific surveys DAS should be used, as we consider DAS to be poor at detecting and identifying seals. NatureScot therefore advise the use of densities from Carter et al. (2022) alone.	Noted. The DAS data has not been used for seals in this assessment. All seal assessments have been updated to the Carter et al. (2025) data, further information can be found in Appendix 9.1: Marine Mammals Technical Report (Volume IV) .
NatureScot	Representation on the Bellrock WFDA Scoping Report (2024)	NatureScot note that Section 8.5 of the Scoping Report identifies potential impacts from the Bellrock WFDA during the construction, O&M, and decommissioning phases, and that potential impacts from pre-construction works (i.e. site preparation works) may also require consideration alongside construction phase impacts. NatureScot are content with the potential impacts to be scoped in during construction, as discussed in Section 8.6.1 of the Scoping Report.	Noted. See Section 9.7.1 for an overview of impacts scoped into the assessment.
NatureScot	Representation on the Bellrock WFDA Scoping Report (2024)	NatureScot note that it is proposed that entanglement is scoped in for the O&M phase. However, NatureScot advise that distinction is required when considering potential impact pathways whether that be secondary entanglement (which is ghost fishing gear being caught on the inter-array cables/mooring lines), or the potential for primary entanglement and/or barrier effects should mooring lines share anchor points (as outlined in Section 3.5.1.5).	Noted. Primary entanglement is scoped out and the assessment in this Chapter is for secondary entanglement. See further information of the

Consultee	Date/Document	Comment	How/Where Comment is Addressed
			reasoning behind scoping and the secondary entanglement assessment in Section 9.8.2.5 .
NatureScot	Representation on the Bellrock WFDA Scoping Report (2024)	NatureScot note that electromagnetic field (EMF) effects are to be scoped in, however as there is currently no evidence that marine mammals are sensitive to the direct effects of EMF, NatureScot advise that this can be scoped out for marine mammals. However, NatureScot advise that indirect effects of EMF, via prey availability, should be scoped in.	Noted. Direct effects of EMF on marine mammals has been scoped out and not assessed, whereas secondary effects of EMF from prey availability is assessed further in Sections 9.8.1.8, 9.8.2.8 and 9.8.3.6 .
NatureScot	Representation on the Bellrock WFDA Scoping Report (2024)	NatureScot advise that at this stage we are generally content with the impacts to be scoped in during decommissioning, as per Section 8.6.1.3 of the Scoping Report. NatureScot agree that these are likely to be similar to construction impacts, however welcome the commitment to carry out further assessment in order to take account of information available at the time of decommissioning.	Noted. Decommissioning impacts are assessed in Section 9.8.3 .
NatureScot	Representation on the Bellrock WFDA Scoping Report (2024)	NatureScot consider the noise modelling approach and the thresholds described for the noise modelling, as described in Section 2 of Appendix 5 - Approach to Marine Mammals and Underwater Noise Modelling (of the Scoping Report), to be appropriate at this stage.	Noted.
NatureScot	Representation on the Bellrock WFDA Scoping Report (2024)	NatureScot note that the proposed approach to assessing the potential for disturbance from underwater noise is discussed in Section 2 of Appendix 5 - Approach to Marine Mammals and Underwater Noise Modelling (of the Scoping Report). We are content that the noise modelling approach, and the thresholds described for this modelling, are appropriate at this stage.	Noted.
NatureScot	Representation on the Bellrock WFDA Scoping Report (2024)	NatureScot note that sensitivity levels for marine mammals is discussed in Section 8.7.2 of the Scoping Report, and the approach to receptor sensitivity is also outlined in Section 4.5.3.2 within the Assessment Methodology. Regarding sensitivity scoring, NatureScot agree that this should take their ability to tolerate, recover and adapt behaviour to maintain vital rates in response to assessed pressures into account. NatureScot also expect sensitivity scoring to take conservation value into account as is the case for the other ecological receptor assessments (e.g. ornithology and benthic interests). As such, NatureScot welcome the inclusion of value within paragraph 702 and Section 8.7.3 – ecological value and Section 4.5.3.2.	Noted. Ecological value has been included and utilised for this assessment (see Section 9.4.1).

Consultee	Date/Document	Comment	How/Where Comment is Addressed
NatureScot	Representation on the Bellrock WFDA Scoping Report (2024)	NatureScot note that in Section 3.2 of Appendix 5 of the Bellrock WFDA Scoping Report, it is stated that iPCoD will be used to assess population level effects “where a potential for a significant disturbance impact is identified” (as summarised in paragraph 717 of the Scoping Report). However, NatureScot advise that iPCoD should be used to help determine whether there is significant, long-term disturbance – not the other way around. The Applicant has presented a broad project design envelope, the worst-case scenario for which will need to be reviewed as the project develops. If piling is needed, it is likely that we would require use of iPCoD.	Noted. iPCoD has been utilised within the assessments, see Appendix 9.5: Marine Mammals Information and Modelling Methods for Disturbance (Volume IV) for further information.
NatureScot	Representation on the Bellrock WFDA Scoping Report (2024)	NatureScot note that in Section 3.2.1 of Appendix 5 of the Bellrock WFDA Scoping Report, it is proposed that guidance from Natural Resources Wales (NRW) will be used to determine the potential for significant population effects. NatureScot however advise that they are not currently in a position to adopt this guidance. While NatureScot review the NRW guidance and consider its applicability in Scotland, NatureScot continue to advise that if a decline is predicted by the population modelling, then the significance of this decline should be considered on a case-by-case, species-by-species basis.	Noted.
NatureScot	Representation on the Bellrock WFDA Scoping Report (2024)	NatureScot welcome the identification of “embedded mitigation measures” described in Section 8.5.1 (Table 8.4) of the Bellrock WFDA Scoping Report and summarised in Appendix 3 - Mitigation Register. Section 8.5.1 states that “additional mitigation may be implemented as appropriate to reduce the potential for effects from underwater noise during geophysical surveys” (paragraph 585). NatureScot is aware that geophysical surveys of the WFDA have been conducted for baseline characterisation, however, further surveys are likely to be required pre-construction and also during O&M. Thus, NatureScot would expect geophysical surveys (and appropriate mitigation) to be included in the EIA Report. No specific monitoring for marine mammals is mentioned in the Scoping Report. Further information on proposed marine mammal monitoring should be also discussed in the EIA Report.	Geophysical surveys as an impact has been assessed, see Sections 9.8.1, 9.8.2.1 and 9.8.3.1 . A PEMP will be secured as part of the Section 36 Consent prior to commencement of the development, see Table 9.16 .
NatureScot	Representation on the Bellrock WFDA Scoping Report (2024)	NatureScot note that potential transboundary impacts are briefly discussed in Section 8.6.4 of the Bellrock WFDA Scoping Report and they note that the applicant has acknowledged that impacts from the proposed development could have the potential to affect the transboundary integrity of European Sites. At this stage NatureScot do not consider it a necessity to consider transboundary effects for marine mammals, provided the assessment is made against the UK Marine Mammal Management Unit.	Noted. As discussed above, the assessments will be made against the UK portions of MUs where possible.

Consultee	Date/Document	Comment	How/Where Comment is Addressed
Department of Agriculture, Environment and Rural Affairs (DAERA) – Marine Conservation Branch	Representation on the Bellrock WFDA Scoping Report (2024)	DAERA Marine and Fisheries Division welcomed the opportunity to comment on this proposal. As the location of the Bellrock WFDA is in excess of 500 km from the nearest Marine Protected Area within the Northern Ireland inshore area, they are content that sites designated for marine mammals will not be impacted and therefore do not need to be screened into any assessment.	Noted.
Natural England	Representation on the Bellrock WFDA Scoping Report (2024)	Natural England advises that the potential impact of the proposal upon features of nature conservation interest and opportunities for habitat creation/enhancement should be included within this assessment in accordance with appropriate guidance on such matters. Guidelines for Ecological Impact Assessment (EclA) have been developed by the CIEEM and are available on their website. EclA is the process of identifying, quantifying and evaluating the potential impacts of defined actions on ecosystems or their components. EclA may be carried out as part of the EIA process or to support other forms of environmental assessment or appraisal.	Noted. These guidelines have been taken into account and applied to the assessments on marine mammals, see Table 9.1 for information on the relevant legislation, policy and guidance used.
Natural England	Representation on the Bellrock WFDA Scoping Report (2024)	Natural England note that the National Planning Policy Framework sets out guidance in S.174-177 on how to take account of biodiversity interests in planning decisions and the framework that the responsible authority should provide to assist developers.	Noted. All applicable policies and guidance have been taken into account and applied to the assessments on marine mammals, see Table 9.1 for information on the relevant legislation, policy and guidance used.
Natural England	Representation on the Bellrock WFDA Scoping Report (2024)	Natural England advise that the environmental statement (ES) should thoroughly assess the potential for the proposal to affect designated sites. Internationally designated sites (e.g. designated SAC and SPA) fall within the scope of the Conservation of Habitats and Species Regulations 2017. In addition, paragraph 176 of the National Planning Policy Framework requires that potential Special Protection Areas, possible Special Areas of Conservation, listed or proposed Ramsar sites, and any site identified as being necessary to compensate for adverse impacts on classified, potential or possible SPAs, SACs and Ramsar sites be treated in the same way as classified sites.	Noted.

Consultee	Date/Document	Comment	How/Where Comment is Addressed
Natural England	Representation on the Bellrock WFDA Scoping Report (2024)	Natural England advise that the ES should include a full assessment of the direct and indirect effects of the development on the features of special interest within these sites, and should identify such mitigation measures as may be required in order to avoid, minimise or reduce any adverse significant effects.	Noted. See Section 9.8 for the impact assessments, including mitigation measures for each impact. Mitigation measures are also presented in Table 9.16 .
Natural Resources Wales	Representation on the Bellrock WFDA Scoping Report (2024)	NRW note that no Welsh Marine Mammal Management Units cross to the east coast of Scotland, so do not expect any population level effects to be linked to Welsh populations and Special Areas of Conservation	Noted. The Welsh MPAs have been screened out and not assessed in the Bellrock WFDA RIAA: Part 2: Special Areas of Conservation: Marine Mammals (Volume VI) .
NatureScot	6 June 2025, Email	NatureScot confirm that there is no requirement to <u>fully</u> mitigate the modelled cumulative permanent threshold shift (PTS) (SELcum) ranges as it is generally acknowledged that these are likely to be over-precautionary given current modelling methods and it considers that there will be some mitigation provided for cumulative PTS, through the measures secured for instantaneous PTS.	Noted. The assessment for acoustic deterrent devices (ADDs) in relation to cumulative and instantaneous PTS is in Section 9.8.1.3.2.2.2 .
NatureScot	6 June 2025, Email	NatureScot advise that clarity on what is meant by 'soft start' would be helpful. NatureScot tend to see 'soft-start' and 'ramp-up' described separately. Our understanding is that 'soft-start' refers to a period at the start of piling where the lowest energy is used (often around 10% of full power, or as low an energy as practically possible) – as well as acting as a mitigation measure for marine mammals, this allows for checking of the hammer operation and initially embedding the pile. 'Ramp-up' is then a period of increasing power until a suitable energy level is reached to maintain a steady rate of pile penetration (not necessarily maximum power, as the piling may proceed for some time at this sustained level before going up to maximum power (if needed)). So, if there is a period of at least 20 minutes of 'soft start', before the power levels start to 'ramp-up' to full operating power (and sometimes then to maximum power), then we agree this provides time, in addition to the pre-piling mitigation (MMOb & PAM), 'ramp-up' and ADD periods, for animals to move away from the noise source before it reaches levels that could cause injury.	Details of the soft-start and ramp-up definitions and timings can be found in Table 9.23 and in the Glossary of Terminology. The Mitigation Measures Relevant to Marine Mammals are presented in Table 9.16 , and implementation of soft start and ramp-up measures for piling (which will reduce underwater noise effects), will be set out in a Piling Noise Mitigation Plan (PNMP) and part of the MMMP for piling activities (see Outline Marine Mammal Mitigation Protocol, Volume V).
NatureScot	2 May 2025, Email	"In-line with the updated policy in relation to UXO clearance, low noise methods of clearance should be the default method used to clear any type of UXO in the marine	Mitigation measures in line with policy and guidance are noted in Table 9.16 and in

Consultee	Date/Document	Comment	How/Where Comment is Addressed
		environment. Whilst there is evidence to show that low-order approaches are effective in some locations there is not yet enough evidence to rule-out the need for high-order detonations in all eventualities. As such, for the EIA we advise that both high-order and low-order clearance should be modelled to ensure the worst-case scenario is assessed. From your list below this would be a combination of options a) and c) – i.e. option c as a worst-case scenario and assessment of low-order clearance as the most likely scenario. Should there be extraordinary circumstances meaning that low noise clearance cannot be undertaken, Applicants should engage with MD-LOT at the earliest opportunity."	Appendix 9.3: Marine Mammals Unexploded Ordnance Assessment (Volume IV).
NatureScot	6 November 2025, Email	NatureScot followed up regarding the use of the deterrence function for the Bellrock WFDA Marine Mammals EIA. In earlier communication it was mentioned that NatureScot and MD-SEDD would be meeting to discuss use of the deterrence function. At this point these discussions are ongoing and are not yet finalised. Should there be any changes to NatureScot advice following these discussions NatureScot will provide an update to developers accordingly. Whilst NatureScot welcome the studies referred to below, their advice has not changed at this stage. The dose-response currently remains their preferred approach for assessing disturbance from piling as this is the more precautionary method. Given this, NatureScot advise the assessment is based on the numbers calculated from the dose-response approach but that you also present the numbers calculated from the deterrence function and the dose-response for comparison.	Noted, the dose-response method has been used for calculating disturbance and the results are shown in Section 9.8.1.3.2.2.1 . These results have also been used for the CEA in Section 9.9.3 .

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9.4 Assessment Methodology

9.4.1 Impact Assessment Methodology

19. **Chapter 5: EIA Methodology (Volume II)** provides a summary of the general impact assessment methodology applied in the Bellrock WFDA EIA Report. The assessment will use the conceptual ‘source-pathway-receptor’ model. The model identifies potential impacts resulting from the proposed activities on the environment and sensitive receptors within it. The marine mammal specific EIA methodology is described further in the following sections.

9.4.1.1 Definitions of Sensitivity and Magnitude

20. The characterisation of the existing environment helps to determine the receptor sensitivity in order to assess the potential impacts upon it.
21. Sensitivity is defined with regard to the ability of a receptor to adapt to change, tolerate, and/or recover from potential effects, as given in **Table 9.3**. In addition, for some assessments the value of a receptor may also be an element to add to the assessment where relevant.
22. The sensitivity level of marine mammals to each type of impact is justified within the impact assessment and is dependent on the following factors:
- **Adaptability** – The degree to which a receptor can avoid or adapt to an impact;
 - **Tolerance** – The ability of a receptor to accommodate temporary or permanent change without a significant adverse effect;
 - **Recoverability** – The temporal scale over and extent to which a receptor will recover following an impact; and
 - **Value** – A measure of the receptor importance, rarity and worth.

Table 9.3: Definition of Sensitivity Levels for Marine Mammals Receptors

Sensitivity	Definition
High	Individual receptor has very limited or no capacity to avoid, adapt to, accommodate or recover from the anticipated impact.
Medium	Individual receptor has limited capacity to avoid, adapt to, accommodate or recover from the anticipated impact.
Low	Individual receptor has some tolerance to accommodate, adapt to or recover from the anticipated impact.
Negligible	Individual receptor is generally tolerant to and can accommodate or recover from the anticipated impact.

23. In addition, for some assessments the ‘value’ of a receptor may also be an element to add to the assessment where relevant – for instance if the receptor is designated or has an economic value.

24. The 'value' of the receptor forms an important element within the assessment, for instance, if the receptor is a protected species or habitat it is considered to be of higher value than a habitat or species that is not protected. It is important to understand that high value and high sensitivity are not necessarily linked within a particular effect. A receptor could be of high value but have a low or negligible physical/ecological sensitivity to an effect. Similarly, low value does not equate to low sensitivity and is judged on a receptor-by-receptor basis.
25. Most species of marine mammals are protected by a number of international legislations, as well as European and UK law and policy. All cetaceans in UK waters are EPS and, therefore, are internationally important. Harbour porpoise, bottlenose dolphin, minke whale, grey seal and harbour seals are also afforded international protection through the designation of protected sites. As such, all species of marine mammal can be considered to be of high value. When assessing sensitivity for each species relating to the impacts assessed in **Section 9.8**, this high value will be taken into account with the individual species sensitivities to a certain receptor.
26. **Table 9.4:** provides definitions for the value afforded to a receptor based on its legislative importance. The value will be considered, where relevant, as a modifier for the sensitivity assigned to the receptor, based on expert judgement.

Table 9.4: Definition of the Value Levels for Marine Mammals Receptors

Value	Definition
High	Internationally or nationally important. Internationally protected species that are listed as a qualifying interest feature of an internationally protected site (i.e. Annex II protected species designated feature of a designated site) and protected species (including EPS) that are not qualifying features of a designated site.
Medium	Regionally important or internationally rare. Protected species that are not qualifying features of a designated site but are recognised as a priority species either alone or under a grouped action plan and are listed on the local action plan relating to the marine mammal study area.
Low	Locally important or nationally rare. Protected species that are not qualifying features of a designated site and are occasionally recorded within the marine mammal study area. in low numbers compared to other regions.
Negligible	Not considered to be particularly important or rare. Species that are not qualifying features of a designated site and are never or infrequently recorded within the study area in very low numbers compared to other regions.

27. Determining the magnitude of an impact considers several factors, including:
- Type of activity (i.e. would the impacts be permanent, long-term, or temporary);
 - Duration and frequency of the activity;
 - Extent of the activity; and
 - Timing and location of the activity.

28. As presented in the Bellrock WFDA Scoping Report (**Appendix 1.1, Volume IV**), the thresholds for defining the potential magnitude of impact that could occur from a particular impact will be determined using expert judgement, current scientific understanding of marine mammal population biology, and the draft guidance on disturbance to EPS species by JNCC et al. (2010) and the Marine Scotland (2020) Guidance for Scottish Inshore Water for the protection of Marine EPS from injury and disturbance. This guidance suggests definitions for a 'significant group' of individuals or proportion of the population for EPS species. Consequently, this guidance has been considered in defining the thresholds for magnitude of impact (**Table 9.5**).
29. The JNCC et al. (2010) draft guidance provides some indication on how many animals may be 'removed' from a population without causing detrimental effects to the population at favourable conservation status (FCS). It also provides limited consideration of temporary effects, with guidance reflecting consideration of permanent displacement.
30. Temporary effects are considered to be of medium magnitude at greater than 5% of the reference population. JNCC et al. (2010) draft guidance considered 4% as the maximum potential growth rate in harbour porpoise, and the 'default' rate for cetaceans. Therefore, beyond natural mortality, up to 4% of the population could theoretically be permanently removed before population growth could be halted. In assigning 5% to a temporary impact in this assessment, consideration is given to uncertainty of the individual consequences of temporary disturbance.
31. Permanent effects with a greater than 1% of the reference population being affected within a single year are considered to be high in magnitude in this assessment. This is based on ASCOBANS and Department for Environment, Food and Rural Affairs (Defra) advice relating to impacts from fisheries by-catch (i.e. a permanent effect) on harbour porpoise. A threshold of 1.7% of the relevant harbour porpoise population above which a population decline is inevitable has been agreed with Parties to ASCOBANS, with an intermediate precautionary objective of reducing the impact to <1% of the population (Defra, 2003) (ASCOBANS, 2015).
32. To determine the magnitude of an impact for any quantitative impact assessments, the number of individuals that could be impacted is put into the context of the relevant reference population (based on the definitions of magnitude shown in **Table 9.5**). For all assessments where the results show that more than one individual is at risk, the number has been rounded up to a whole number to ensure the result of the assessment is biologically relevant. The reference populations will use the UK portions of the MUs if available and use the entire MU if there is not a UK portion.

Table 9.5: Definition of the Magnitude Levels for Marine Mammals Receptors

Value	Definition	Criteria for Quantitative Assessments	
		Approximate Duration of Impact	% of Reference Population Exposed to Impact
High	A change in the behaviour or size and extent of distribution of the relevant biogeographic population or the population that is the interest feature of a specific protected site that is predicted to irreversibly alter the population in the short-to-long term and to alter the long-term viability of the population and/or the integrity of the protected site. The effect, which may be either reversible or irreversible in individuals, would be of sufficient severity to affect the long term viability of the relevant population over a generational scale.	Permanent	>1%
		Long-term	>5%
		Temporary	>10%
Medium	A change in the behaviour or size and extent of distribution of the relevant biogeographic population or the population that is the interest feature of a specific protected site that occurs in the short and long-term, but which is not predicted to alter the long-term viability of the population and/or the integrity of the protected site. The effect, which may be either reversible or irreversible in individuals, could result in some population-level effects, but not a level that would alter the relevant population trajectory over a generational scale.	Permanent	0.1% - 1%
		Long-term	1% - 5%
		Temporary	5% - 10%
Low	A change in the behaviour or size and extent of distribution of the relevant biogeographic population or the population that is the interest feature of a specific protected site that is sufficiently small-scale or of short duration to cause no long-term harm to the feature/population. Whilst there may be effects at an individual level which may be either reversible or irreversible, these would not be at a scale that would lead to any population-level effects.	Permanent	0.001% - 0.1%
		Long-term	0.1% - 1%
		Temporary	1% - 5%
Negligible	Very slight change from the behaviour or size and extent of distribution of the relevant biogeographic population or the population that is the interest feature of a specific protected site. Effects are likely to be reversible and highly unlikely to result in any population-level effects.	Permanent	< 0.001%
		Long-term	< 0.1%
		Temporary	< 1%
No change	No loss of, or gain in, size or extent of distribution of the relevant biogeographic population or the population that is the interest features of a specific protected site.	N/A	N/A
Notes: Permanent: Impacts of any duration leading to lasting effects. Long-term: Impacts are expected to occur throughout the lifetime of the Bellrock Wind Farm Infrastructure either continuously or intermittently with recoverable effects. Temporary: Impacts lasting a short duration and/or occurring intermittently with recoverable effects.			

9.4.1.2 Effect Significance

33. The potential significance of effect for a given impact, is a function of the overall sensitivity and the magnitude of the impact (see **Chapter 5: EIA Methodology (Volume II)** for further details). A matrix is used (**Table 9.6**) as a framework to determine the significance of an effect. Definitions of each level of significance are provided in **Table 9.7**. Impacts and effects may be either positive (beneficial) or negative (adverse). Impacts that are moderate or major are considered to be significant in EIA terms.
34. It is important that the matrix (and indeed the definitions of sensitivity and magnitude) is seen as a framework, to aid understanding of how a judgement has been reached from the narrative of each effect assessment and it is not a prescriptive formulaic method. Assessments of significance and results will be based on conservative worst-case scenarios or probable effects depending on the impact and receptor in question.
35. Potential effects are described, followed by a statement of whether the effect is significant in terms of the EIA Regulations. Whilst minor effects (or below) are not significant in EIA terms in their own right, it is important to distinguish these, as they may contribute to significant effects cumulatively or through interactions with other projects. Each impact has been considered using a range of assessment methods, including quantitative and qualitative methods, and has taken into account the effects of each impact over the operational life of the Wind Farm Infrastructure. Consequently, the overall significance has regard to the full evidence base.
36. Following initial assessment, if the effect does not require additional mitigation (or none is possible), the residual effect would remain the same. If, however, additional mitigation is proposed, an assessment of the post-mitigation residual effect is provided.
37. Further assessment, including population modelling using iPCoD, has been undertaken for piling at the marine mammal MU and SAC level, where relevant. NRW guidance (2023a) states that if, as a result of PTS, a population shows a continued decline of >1% per year (versus a modelled un-impacted reference population) over a set period of time (e.g. the first 6 years, based on the former FCS reporting period), then there is a high likelihood that a significant effect cannot be ruled out. NRW has acknowledged that this threshold could be used as one possible method to determine the significance of behavioural disturbance on a population, based on the iPCoD outputs. However, this guidance is intended for consideration of PTS and remains under development. In absence of other guidance, the 1% threshold for iPCoD outputs remains a valid way to review results of population modelling to inform overall significance of effect. Therefore, this approach has been applied to the assessments and if a decline is predicted by the population modelling, then the significance of this decline will be considered on a case-by-case, species-by-species basis.

Table 9.6: Matrix for Evaluating the Significance of an Effect

Sensitivity	Magnitude				
	High	Medium	Low	Negligible	No Change
High	Major	Major	Moderate	Minor	No effect
Medium	Major	Moderate	Minor	Negligible	No effect
Low	Moderate	Minor	Minor	Negligible	No effect
Negligible	Minor	Negligible	Negligible	Negligible	No effect

Table 9.7: Definitions of Effect Significance

Effect Significance	Definition
Major	Very large or large change in receptor condition, both adverse or beneficial, which are likely to be important considerations at a regional or district level because it contributes to achieving national, regional or local objectives, or could result in exceedance of statutory objectives and/or breaches of legislation.
Moderate	Intermediate change in receptor condition, which are likely to be important considerations at a local level.
Minor	Small change in receptor condition, which may be raised as local issues but are unlikely to be important in the decision-making process.
Negligible	No discernible change in receptor condition.
No Effect	No change in receptor condition; therefore, no effect.

9.4.2 Cumulative Effects Assessment Methodology

38. The Cumulative Effects Assessment (CEA) considers the likely significant effects of impacts arising from the Wind Farm Infrastructure cumulatively with other relevant plans, projects and activities. The general approach to the CEA for marine mammals includes identifying potential cumulative effects, identifying a short list of plans and projects for consideration and evaluating the significance of cumulative effects. The screening for this Chapter has been based on a six-month cut off period for other projects and plans. MD-LOT were consulted during the screening process as part of ongoing consultation in the pre-application phase. **Chapter 5: EIA Methodology (Volume II)** provides further details on the general approach to the CEA, including for the Bellrock Offshore Transmission Development Area (OfTDA) and Bellrock Onshore Transmission Development Area (OnTDA).
39. The plans and projects selected as relevant to the CEA for marine mammals are based upon the results of a screening exercise (see **Appendix 5.3: Cumulative Effect Assessment Long List of Projects (Volume IV)** for details). Each plan or project has been considered on a case-by-case

basis for screening in or out of this assessment based upon data confidence, impact-receptor pathways and the spatial/temporal scales involved.

40. **Appendix 9.4: Marine Mammals Cumulative Effects Assessment Screening (Volume IV)** sets out the screening for plans, projects and activities considered in the CEA alongside the methodology to be used for the marine mammal assessment.
41. Commercial fishing activity and shipping (noise and vessel collision) are not considered in the marine mammal CEA due to being part of the baseline environment. Further information and justification for this decision is provided in the CEA screening, which is set out in **Appendix 9.4: Marine Mammals Cumulative Effects Assessment Screening (Volume IV)**.
42. The CEA considers plans, projects and activities which have sufficient information publicly available to undertake the assessment. Insufficient information would preclude a meaningful quantitative assessment, and it is not appropriate to make assumptions about the detail of future projects in such circumstances. Accordingly, projects which do not have sufficient publicly available information have not been cumulatively assessed.
43. The likely significant effects of the Bellrock Wind Farm Infrastructure together with the Bellrock Offshore Transmission Infrastructure and Bellrock Onshore Transmission Infrastructure, so far as these can be ascertained at this stage, are assessed as part of this Bellrock WFDA EIA Report.
44. Further assessment of the effects of the Bellrock Project as a whole will be included within the Bellrock OfTDA EIA Report and Bellrock OnTDA EIA Report, which will include updated assessments of cumulative environmental impacts of the different components of the Bellrock Project.
45. In line with the methodology set out in **Chapter 5: EIA Methodology (Volume II)**, three tiers have been applied to the Bellrock WFDA CEA. As the site selection process for the Bellrock OfTDA (see **Chapter 4: Project Description (Volume II)** for details), activities and infrastructure associated with the Bellrock OfTDA will be treated as 'other projects' for the purposes of the CEA, but have been considered within Tier 1 where relevant, due to their essential requirement for the function of the Bellrock Project. It is important to note that onshore projects, such as the Bellrock OnTDA are not considered due to this being an offshore application.
46. The three tiers for CEA are:
- Tier 1 assessment: The Bellrock WFDA plus plans/projects which are operational, under construction, those with consent or a consent application submitted but not yet determined, plus the Bellrock OfTDA and Bellrock OnTDA; and
 - Tier 2 assessment: The Bellrock WFDA plus all plans/projects assessed under Tier 1, plus projects with a Scoping Report and/or Scoping Opinion; and
 - Tier 3 assessment: The Bellrock WFDA plus all plans/projects assessed under Tier 1 and Tier 2, plus those projects likely to come forward where a Crown Estate Scotland Option to Lease Agreement or equivalent has been granted.

9.4.3 Transboundary Effects Assessment

47. Potential transboundary effects could occur where elevations in underwater sound, particularly during construction piling, could fill large areas with sound causing wide-ranging disturbance of marine mammals. The closest transboundary state, Norway, is 125 km away from the WFDA and therefore would not overlap with the zone of influence predicted from the Wind Farm Infrastructure.
48. Therefore, there is expected to be no potential for significant transboundary effects from the Wind Farm Infrastructure on marine mammals receptors within the exclusive economic zone of other European Economic Area member states or other interests of European Economic Area member states. Therefore, transboundary effects have been scoped out of the EIA, in line with the Scoping Opinion (**Table 9.2** and **Appendix 1.2: Bellrock WFDA Scoping Opinion (Volume IV)**).
49. The assessment of effects on transboundary designated sites is presented in the **Bellrock WFDA RIAA Part 2 (Volume VI)**.

9.4.4 Underwater Noise

9.4.4.1 Thresholds and Criteria

50. Sound measurements underwater are usually expressed using the decibels (dB) scale, which is a logarithmic measure of sound. For example, equal increments of sound levels do not have an equal increase in the perceived sound. Instead, each doubling of sound level will cause a roughly equal increase of loudness (further details are provided in **Appendix 9.2: Underwater Noise Modelling Report (Volume IV)**).
51. The sound pressure level (SPL) is normally used to characterise noise and vibration of a continuous nature. The variation in sound pressure can be measured over a specific time period, to determine the root mean square (RMS) level of the time varying acoustic pressure. Therefore, SPL (i.e. SPL_{RMS}) can be considered as a measure of the average unweighted level of the sound over the measurement period.
52. SPL_{peak} is often used to characterise sound transients from impulsive sources, such as percussive impact piling. The SPL_{peak} is calculated using the maximum variation of the pressure, from positive or negative to zero, within the wave. This represents the maximum change in positive pressure (differential pressure from positive or negative to zero) as the transient pressure wave propagates.
53. The sound exposure level (SEL) is the constant sound level acting for one second. It sums up the acoustic energy over a measurement period, and effectively takes account of both the SPL of the sound source, and the duration the sound is present in the acoustic environment (further details are provided in **Appendix 9.2: Underwater Noise Modelling Report (Volume IV)**).
54. SEL_{ss} is the sound exposure level from a single strike of the hammer, i.e. one hammer strike at the starting hammer energy or maximum hammer energy applied.
55. SEL_{cum} is the cumulative sound exposure level throughout the duration of piling, including the soft-start, ramp-up and time required to complete the installation of the pile (**Table 9.23**). To determine SEL_{cum} ranges for marine mammals, a fleeing animal model has been used. This assumes that the

animal exposed to high noise levels would swim away from the noise source at the following speeds:

- 2.1 metres/second (m/s) for low-frequency cetaceans (LF) (SNH, 2016);
- 1.52 m/s for high-frequency cetaceans (HF) (Bailey and Thompson, 2006);
- 1.4 m/s for very high-frequency cetaceans (VHF) (SNH, 2016); and
- 1.8 m/s for phocid carnivores in water (PCW) (SNH, 2016).

56. When reviewing the underwater noise modelling results for SEL_{cum} exposures, it is important to keep in mind that an individual is at risk of injury only if they are within the identified range at the onset of the noise. Further details on how SEL_{cum} is modelled is provided in **Appendix 9.2: Underwater Noise Modelling Report (Volume IV)**.
57. At the time of writing, the metrics and criteria that have been used to assess the potential effect of underwater noise on marine mammals are based on recommended guidance and discussions during consultation meetings (see consultation in **Table 9.2**).
58. Southall et al. (2019) categorised marine mammal species into hearing groups and applied filters to the unweighted noise in order to approximate the hearing sensitivities of the species. This allowed the specific hearing abilities and sensitivities of each group to be approximated. This provides the weighted SEL criteria, which corrects the sound level based on the sensitivity of the receiver; for example, harbour porpoise is less sensitive to LF sound than minke whales. Marine mammals hearing group ranges are summarised in **Table 9.8**.

Table 9.8: Southall et al. (2019) Marine Mammals Hearing Ranges

Species Hearing Group	Generalised Hearing Range
Harbour porpoise (VHF cetaceans)	275 Hz to 160 kilohertz (kHz)
Bottlenose dolphin, common dolphin, white-beaked dolphin, killer whale (HF cetaceans)	150 Hz to 160 kHz
Minke whale, fin whale, humpback whale (LF cetaceans)	7 Hz to 35 kHz
Grey seal, harbour seal (PCW)	50 Hz to 86 kHz

59. Southall et al. (2019) presented unweighted peak criteria (SPL_{peak}) for single strike, weighted sound exposure criteria for single strike (SEL_{ss}) and cumulative (i.e. more than a single sound impulse) weighted sound exposure criteria (SEL_{cum}) for PTS, where unrecoverable reduction in hearing sensitivity may occur.

60. Southall et al. (2019) also included criteria based on SPL_{peak} , which are unweighted and do not take species sensitivity into account. It is important to note that they are different criteria and, as such, should not be compared directly. Assessments have been based on the criteria with the greatest predicted impact ranges.
61. It should be noted that the Marine Mammal Noise Exposure Criteria as outlined by Southall et al. (2019), are identical to those of the National Marine and Fisheries Service (NMFS) (2018). The Southall et al. (2019) thresholds and criteria for PTS (Permanent Threshold Shift) and Temporary Threshold Shift (TTS) impacts to the species groups used in the assessments are summarised in **Table 9.9**.

Table 9.9: Southall et al. (2019) Thresholds and Criteria Used in the Underwater Noise Modelling and Assessments

Species	Species Group	Impact	Unweighted SPL_{peak} (dB re 1 μ Pa) impulsive	Weighted SEL_{ss} and SEL_{cum} (dB re 1 μ Pa ² s)	
				Impulsive	Non-impulsive
Harbour porpoise	VHF	PTS	202	155	173
		TTS	196	140	153
Dolphin species	HF	PTS	230	185	198
		TTS	224	170	178
Baleen whales	LF	PTS	219	183	199
		TTS	213	168	179
Grey seal and harbour seal	PCW	PTS	218	185	201
		TTS	212	170	181

62. The likelihood of individual animals experiencing PTS is dependent on both the intensity of the sound and also time of the exposure, as PTS can occur as a result of prolonged exposure to increased noise levels, for example as for the duration of pile installation (SEL_{cum}).
63. It should be noted that the predicted impact ranges are the distances which represent the 'onset' stage, which is the minimum exposure that could potentially lead to the start of an impact and may only be marginal. In most hearing groups, the noise levels are low enough that there is negligible risk.

9.4.4.2 Impulsive and Non-impulsive Noise

64. Noise sources are categorised as either impulsive or non-impulsive (Southall et al. 2019):
- Impulsive (single or multiple pulse): High peak sound pressure, short duration, fast rise-time and broad frequency content at source. Explosives, impact piling and seismic airguns are considered impulsive noise sources; and

- Non-impulsive (or continuous non-pulsed sound): Vessel engines, sonars, vibro-piling, drilling and other low-level continuous noises are considered non-impulsive. However, a non-impulsive noise does not necessarily have to have a long duration.

65. As sound pulses propagate through the environment and dissipate, they lose their most injurious characteristics (e.g. rapid pulse rise time and high peak sound pressure) and become more like a “non-impulsive” noise at greater distances. Active research is currently underway into the identification of the distance at which the pulse can be considered effectively non-impulsive (see **Appendix 9.2: Underwater Noise Modelling Report (Volume IV)**). Both impulsive and non-impulsive criteria from Southall et al. (2019) have been included in the underwater noise modelling. However, assessments presented in this Chapter have been based on the criteria with the greatest predicted impact range.

9.5 Scope of the Assessment

66. The following sections establish the basis of the assessment of likely significant effects, which is defined by the study area(s), assessment scope and realistic worst-case scenario.

9.5.1 Study Areas

67. The marine mammal study areas have been defined on the basis of marine mammals being highly mobile and transitory in nature. Therefore, it is necessary to examine species occurrence not only within the Bellrock WFDA, but also over the wider area. For each species of marine mammal, the following study areas have been defined based on the relevant MUs (see **Appendix 10.1: Marine Mammal Technical Report (Volume IV)**), as well as the current knowledge and understanding of the biology of each species (see **Table 9.10**). In line with NatureScot’s representation on the Bellrock WFDA Scoping Report and the Scoping Opinion, the UK portions of MUs are used to inform the quantitative assessments (see **Section 9.8**) (rather than full MUs), with the total MU populations presented for context only (see **Table 9.2**).

Table 9.10: Relevant MUs and Associated Study Areas for Cetaceans and Phocids

Species	Management Unit(s) Relevant to the Bellrock WFDA and Associated Study Areas	Source
Harbour porpoise	NS MU	IAMMWG (2023)
Bottlenose dolphin	Greater North Sea (GNS) and Coastal East Scotland (CoES) MUs	IAMMWG (2023) and Cheney et al. (2024)
Common dolphin	Celtic and Greater North Seas (CGNS) MU	IAMMWG (2023)
White-beaked dolphin	CGNS MU	IAMMWG (2023)
Killer whale	Northeast Atlantic	NAMMCO (2019)
Minke whale	CGNS MU	IAMMWG (2023)
Fin whale	European Atlantic Waters	Gilles et al. (2023); Leonard and Øien (2020); Rogan et al. (2018)
Humpback whale	North Atlantic – Iceland and Faroe Islands	NAMMCO (2019)
Grey seal	Moray Firth MU, East Scotland MU and Northeast England MU	SCOS (2024)
Harbour seal	East Scotland MU	

9.5.2 Data and Information Sources

9.5.2.1 Desk Study

68. A desk study has been undertaken to compile baseline information in the previously defined marine mammals study area(s) (see **Section 9.5.1**) using the sources set out in Section 3.2 and Table 3.6 in **Appendix 9.1: Marine Mammals Technical Report (Volume IV)** including SCANS surveys and other sources including density mapping, surveys and sightings data.

9.5.2.2 Site-specific Surveys

69. Site-specific DAS have been undertaken by HiDef to support the desk-study by providing accurate and detailed environmental information. Further detail of the survey method is provided in **Appendix 9.1: Marine Mammals Technical Report (Volume IV)**. **Table 9.11** summarises the site-specific surveys relevant to marine mammals undertaken to date.
70. The survey methodology utilised by HiDef is considered standard. Consultation was undertaken with NatureScot and MD-LOT in February/March 2022 (**Table 9.2**) on the method statements for the site-specific DAS.

Table 9.11: Summary of Site-specific Surveys for Marine Mammals

Survey	Spatial Coverage	Year(s)	Description
HiDef DAS	Bellrock WFDA plus 4 km buffer	March 2022 – February 2024	Monthly DAS for marine mammals and seabirds over the Bellrock WFDA

9.5.2.3 Assumptions and Limitations

71. There is a good understanding of the baseline environment due to the large amount of available data and information that has been reviewed for marine mammals within the region, including the site-specific DAS (**Section 9.5.2.2**).
72. Throughout **Appendix 9.2: Underwater Noise Modelling Report (Volume IV)**, any assumptions and limitations with regards to underwater noise modelling have been detailed.

9.5.2.3.1 Publicly Available Survey Data

73. The majority of the publicly available, non-site-specific surveys utilised for the assessments (such as the SCANS), are typically carried out in summer months, which can result in seasonal gaps. However, the site-specific DAS were conducted every month during a two-year survey period, with data collected over the two-year period analysed (see **Appendix 9.1: Marine Mammals Technical Report (Volume IV)**). Therefore, taking into account the site-specific DAS, and given the number of surveys and data collected from other surveys for different months, seasons and years, there is good coverage to provide information on the species likely to be present at the Bellrock WFDA and surrounding areas.
74. Limitations of the use of distribution maps developed by Waggitt et al. (2019) emphasise that their use should only illustrate the general, broad-scale distributions of species. Using these densities for fine-scale distributions should be avoided due to the following caveats:
 - Small and isolated sub-populations have very little influence on models, such as white-beaked dolphins in southwest England and Risso's dolphins in North Wales/Isle of Man;
 - Substantial changes in specifically harbour porpoise movements from north to south in the NS took place across the study period;
 - Seasonal movements were detected by the modelling but have not produced changes in seasonal changes in densities; and
 - The densities for bottlenose dolphins represent the offshore ecotype only, excluding regionally important inshore populations (e.g. Moray Firth, Cardigan Bay).
75. While the Waggitt et al. (2019) data has been used to allow a more accurate comparison of the species densities across the different data sets, the average for seasonal and annual periods across the area has been calculated for each species (see **Appendix 9.1: Marine Mammals Technical Report (Volume IV)** for further information on how the SCANS data has been used). The area used is the SCANS block where the Bellrock WFDA is located (SCANS Block NS-D in Gilles et al. 2023)). As a precautionary approach, density estimates for each marine mammal

species used in the assessments are based on the highest density for the area, based on available data sources. These densities were agreed with NatureScot in their representation on the Bellrock WFDA Scoping Report (**Table 9.2**).

9.5.2.3.2 *Site-specific DAS*

76. There are some limitations to the data collected by marine mammal surveys. Primarily being due to the highly mobile nature of marine mammals and, therefore, the potential variability in usage of the Bellrock WFDA.
77. It is essential to acknowledge that the single survey day per month provides only a snapshot of marine mammal distribution, making it challenging to assess the impact of environmental conditions on sighting rates, with consideration given only to seasonal changes. Detection probability may also be constrained by weather conditions, impacting the ability to record marine mammals, particularly distinguishing between grey sea and harbour seal at-sea. Due to the difficulty in identifying seal species from DAS, NatureScot advised in their representation on the Bellrock WFDA Scoping Report that DAS numbers for seals were not to be used for the purposes of the baseline, which has been followed for this assessment (see **Table 9.2**).
78. In order to ensure that bias is not introduced to the site-specific DAS modelling results (see **Appendix 9.1: Marine Mammals Technical Report (Volume IV)**), data from broader non-species-specific classifications were not assigned to species categories¹. As such, sightings classed as ‘cetacean species’, ‘dolphin species’, ‘seal/small cetacean species’ and ‘seal species’ are not considered in species-specific analyses.
79. Despite the aforementioned limitations for DAS, the baseline assessment is supplemented with information reported in published literature and therefore offers a comprehensive account of marine mammals within the Bellrock WFDA’s marine mammal study area. The presented baseline provides a robust and suitable characterisation of the study area against which this assessment is conducted. Consequently, it is concluded that the identified data limitations are not anticipated to impact the assessment’s conclusions.

9.5.2.3.3 *General DAS*

80. There are acknowledged limitations in the detectability of marine mammals from DAS, including the inability to detect submerged individuals and those not available to count. To address these limitations, a correction factor is used.
81. For harbour porpoise, these correction factors are based on Teilmann et al. (2013), with different correction factors applied for different months, times of day, and for whether individuals would be at the surface or within the top 2 m of the water column. This methodology determines the absolute density estimates from the site-specific DAS (details in Section 4.1 in **Appendix 9.1: Marine Mammals Technical Report (Volume IV)**).

¹ This approach is in line with NatureScot’s representation presented within the Broadshore Hub WFDAs Scoping Opinion (MD-LOT, May 2024), which stated “*We do not agree with this approach and advise that unidentified marine mammals are recorded as unidentified with the highest understanding of animal grouping possible, i.e. “unidentified seal species”.*”

82. For grey and harbour seal, a correction factor (derived by SCOS-BP 21/02 in SCOS, 2021 for grey seal and Lonergan et al. (2013) for harbour seal) is applied to the haul-out counts from SCOS (2024), to take account of the number of seals that were not available to count during the surveys (**Section 4.9 and 4.10 of Appendix 9.1: Marine Mammals Technical Report (Volume IV)**).

9.5.2.3.4 Population Modelling

83. Further assumptions and limitations with regards to population modelling and the application of dose-response curves in assessments are detailed in **Appendix 9.5: Marine Mammals Information and Modelling Methods for Disturbance (Volume IV)**.

9.6 Existing Environment

9.6.1 Existing Baseline

84. As outlined in **Section 9.5.1**, the key marine mammal species relevant to this Chapter are:
- Harbour porpoise;
 - Bottlenose dolphin;
 - Common dolphin;
 - White-beaked dolphin;
 - Killer whale;
 - Minke whale;
 - Fin whale;
 - Humpback whale;
 - Grey seal; and
 - Harbour seal.
85. **Appendix 9.1: Marine Mammals Technical Report (Volume IV)** provides further information that is relevant for the assessments for each of the above species, including details from the site-specific DAS, desk-based research, density estimates, abundance estimates, distribution, diet, and seal haul-out sites.
86. **Table 9.12** provides a summary of the reference populations and the density estimates for marine mammal species used in the impact assessments described in this Chapter.
87. To determine the magnitude of an impact, the number of individuals that could be impacted by the Wind Farm Infrastructure were put into the context of the relevant reference population (see **Table 9.12** for definitions of magnitude).
88. For humpback whale and killer whale, qualitative assessments were provided since robust densities were lacking for the Bellrock WFDA (see **Table 9.2** for NatureScot's representation on the Scoping Report).

89. Throughout the assessment, marine mammals are broken down into defining groups where there is a unique characteristic within that group and they are known to react the same way to a specific stressor. The defining groups are as follows:
- Baleen whales (also known as mysticetes or just whales):
 - Minke whale, fin whale and humpback whale.
 - Toothed whales (also known as odontocetes), which can be broken down into:
 - Harbour porpoise; and
 - Dolphins which consist of bottlenose dolphin, common dolphin, white-beaked dolphin and killer whale.
 - Phocids and pinnipeds:
 - Grey seals and harbour seals.
90. Given the lack of population data in the area for fin whale, humpback whale and killer whale, a proxy species or subset of species has been used to allow for a qualitative assessment of these species. For fin whale and humpback whale this is baleen whale species and for killer whale this is toothed whales, and more specifically, dolphins.

Table 9.12: Summary of Marine Mammal Densities and Reference Populations Used in the Bellrock WFDA Assessment

Species	Density (Animals/km ²)	Source	Reference Population	Management Unit	Source
Harbour porpoise	1.273	Site-specific + 4 km buffer HiDef DAS	159,632 346,601	NS (UK portion) NS MU	IAMMWG, 2023
Bottlenose dolphin	0.0298	SCANS-III; block R (Hammond et al. 2021)	1,885 2,022	GNS (UK portion) GNS MU	IAMMWG, 2023
			226	CES	Cheney et al. 2024
Common dolphin	0.026	Waggitt et al. (2019) over SCANS-IV block NS-D	57,417 102,656	CGNS (UK portion) CGNS MU	IAMMWG, 2023
White-beaked dolphin	0.243	SCANS-III; block R (Hammond et al. 2021)	34,025 43,951	CGNS (UK portion) CGNS MU	IAMMWG, 2023
Killer whale	-	-	15,056	Northeast Atlantic	Leonard and Øien, 2020
Minke whale	0.0419	SCANS-IV; block NS-D (Gilles et al. 2023)	10,288 20,118	CGNS (UK portion) CGNS MU	IAMMWG, 2023

Species	Density (Animals/km ²)	Source	Reference Population	Management Unit	Source
Fin whale	-	-	24,932	Combined Regions = NS, Barents Sea, Greenland Sea, Ireland, European Atlantic waters	Rogan et al. 2018; Leonard and Øien, 2020; Gilles et al. 2023
Humpback whale	-	-	10,708	Eastern North Atlantic	Leonard and Øien, 2020
Grey seal	0.02	Carter et al. (2025)	33,336	Combined MUs = Moray Firth, East Scotland and North East (NE) England	SCOS (2024)
Harbour seal	0.00000002	Carter et al. (2022)	383	East Scotland	SCOS (2024)

9.6.2 Predicted Future Baseline

91. **Appendix 9.1: Marine Mammals Technical Report (Volume IV)** provides further information on the individual species and predicted future baseline. For marine mammals, as noted in **Section 5** in **Appendix 9.1: Marine Mammals Technical Report (Volume IV)**, there have been some changes in population distribution and abundance evident due to climate change and anthropogenic pressures, and it is reasonable to expect further such changes in the future.
92. This section provided a qualitative description of the evolution of the baseline environment, on the assumption that the Wind Farm Infrastructure is not constructed, using available information and scientific knowledge of marine mammal ecology.
93. 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 NS (Russell et al. 2017). Additionally, assumptions and limitations on data sources apply to the future baseline (**Section 9.5.2.3**).
94. The results of the most recent UK assessment of FCS for each marine mammal species included in the assessment are outlined in **Table 9.13** (Mitchell et al. 2026a; Mitchell et al. 2026b).

Table 9.13: Summary of the Conservation Status of Each Marine Mammal Species

Species	Range	Population	Habitat	Future Prospects	Conservation Status	Overall Trend
Harbour porpoise	FV	U1	XX	U1	U1	Stable
Bottlenose dolphin	FV	FV	XX	FV	FV	Stable
White-beaked dolphin	FV	FV	XX	XX	XX	Stable
Common dolphin	FV	FV	XX	FV	FV	Stable
Killer whale	FV	XX	XX	XX	XX	XX
Minke whale	FV	U1	XX	XX	U1	XX
Fin whale	FV	XX	XX	XX	XX	XX
Humpback whale	NFV	XX	XX	XX	XX	XX
Grey seal	FV	FV	XX	FV	FV	Stable
Harbour seal	FV	U1	XX	U1	U1	Stable
Notes: FV = Favourable. U1 = Unfavourable-inadequate. XX = Unknown.						

9.7 Potential Impacts

9.7.1 Scope

95. **Table 9.14** sets out the impacts that have been scoped in to and scoped out of the Bellrock WFDA EIA Report, in line with the Scoping Opinion (**Appendix 1.2: Bellrock WFDA Scoping Opinion in Volume IV**).

Table 9.14: Potential Impacts Scoped In and Scoped Out of the EIA for Marine Mammals as Agreed in the Bellrock WFDA Scoping Opinion (Appendix 1.2 (Volume IV))

Potential Impact	Construction	Operation and Maintenance	Decommissioning
	Advised Within the Bellrock WFDA Scoping Opinion		
Underwater noise during UXO clearance	✓	x	x
Underwater noise during geophysical surveys ¹	✓	✓	✓
Underwater noise during piling	✓	x	x
Underwater noise from other activities	✓	✓	✓
Underwater noise and presence of vessels	✓	✓	✓
Underwater noise from operational WTGs and moorings on the seabed	x	✓	x
Primary entanglement	x	x	x
Secondary entanglement	x	✓	x
Collision risk with vessels	✓	✓	✓
Disturbance at seal haul-out sites	✓	✓	✓
EMF – direct effects on marine mammals	x	x	x
Changes in water quality	x	x	x
Changes to prey availability (including EMF effects on prey)	✓	✓	✓
Transboundary impacts	x	x	x
Notes: Geophysical surveys may be undertaken as site preparation works and/or construction works but are assessed as construction works to ensure a full and conservative assessment is undertaken.			

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9.7.2 Realistic Worst-case Scenario

96. The final design of the Wind Farm Infrastructure will be confirmed during detailed engineering studies post consent. To undertake a robust and precautionary impact assessment, the realistic worst-case design scenario has been defined. Realistic worst-case scenarios (i.e. the combination of project parameters that have potential to cause the greatest impact) are derived from the PDE to ensure that all other design scenarios would have equal or less impact. Please see **Chapter 5: EIA Methodology (Volume II)** for further details on the design envelope approach.
97. The realistic worst-case scenario for the marine mammal assessments is summarised in **Table 9.15** below. These are based on the project design as described in **Chapter 4: Project Description (Volume II)**.

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Table 9.15: Realistic Worst-case Scenario for Impacts on Marine Mammals

Impact	Realistic Worst-case Scenario	Rationale
Construction		
Impact C1: Underwater noise during UXO clearance	A realistic worst-case is UXO with a Net Explosive Quantity (NEQ) of 750 kg (based on the Natural England Guidance (Parker et al. 2025)) (Appendix 9.3: Marine Mammals Unexploded Ordnance Assessment (Volume IV)). Types and sizes of UXO: Various possible types and sizes of UXO, ranging from 0.25 kg to 750 kg. Underwater modelling and assessments based high-order detonation of UXO with NEQ of 750 kg (including donor charge). Low-order clearance would be the default method for UXO that require clearance. Underwater modelling and assessments include low-order deflagration with shaped charge of 0.25 kg NEQ. As a worst-case, assessments are based on contingency high-order detonation without mitigation.	The specific type, size and number of possible detonations and duration of UXO clearance operations is not known at this stage. A detailed UXO survey would be completed prior to commencement of construction to inform an assessment to be completed later as part of the marine licence that will be associated with UXO clearance. An assessment to inform the worst-case scenario for Impacts of underwater noise during UXO clearance on Marine Mammals is presented in Appendix 9.3: Marine Mammals Unexploded Ordnance Assessment (Volume IV).
Impact C2: Underwater noise during geophysical surveys	Up to 18 round trips for geophysical survey vessels, for up to 504 days on site. Expected to include the following surveys: ▪ Multi-beam echo sounder (MBES); ▪ Ultra-Short Baseline (USBL); ▪ Single-beam echo sounder (SBES); ▪ Side Scan Sonar (SSS); and ▪ Sub-bottom profiler (SBP).	A more defined assessment based on the actual equipment used to be completed later as part of the marine licence associated with geophysical surveys.
Impact C3: Underwater noise during piling	Indicative construction duration: site preparation works¹ to commence 2030, construction to occur from 2031 – 2037 inclusive (8 years of activity for Bellrock Wind Farm Infrastructure). No piling works will be undertaken during site preparation works. Number of FOU driven piles for maximum 132 floating offshore units (FOUs) = 1,188 (9 anchors per FOU x 132).	The spatial and temporal worst-case scenario is based on the largest hammer energy which is required for anchors for a FOU.

Impact	Realistic Worst-case Scenario	Rationale
	Maximum hammer energy = 3000 kJ. Maximum FOU driven pile diameter = 6 m. Duration of anchor installation for single FOU = 3 days (3 FOU driven piles per 24 hours, for up to 9 anchors). Maximum total active piling time per FOU (including soft-start and ramp-up): = 2.99 hours per FOU driven pile, up to 8.97 hours piling per day. Total piling time for 132 FOU = 3,552.12 hours.	Full hammer energy is unlikely to be required on all piles but is assessed for all piles as a worst-case scenario. The assessment also considers concurrent piling at two WTG locations within the WFDA. For the concurrent modelling scenario three sequentially installed FOU driven piles at the NW location and three piles sequentially installed at E-midpoint location within a 24-hour period (equating to a maximum of six piles installed over both locations in a 24-hour period) have been considered (see details in Appendix 9.2 Underwater Noise Modelling Report (Volume IV)).
Impact C4: Underwater noise from other activities	The construction phase is expected to take place between: 2031 to 2037 (total construction duration of up to seven years, in addition to one year of site preparation works undertaken prior to the commencement of construction (2030)). Boulder clearance may be required as part of site preparation works. Cable and cable protection installation methods considered include: ▪ Ploughing; ▪ Trenching; ▪ Jetting; and ▪ Rock placement. Subsea cable hubs will be installed by placement on gravel pad on the seabed. Installation of gravity, drag embedment or suction piles. Number of anchors for max. 132 FOU = 1,188 (9 anchors per FOU * 132)).	Underwater noise during the placement of subsea cable hubs is expected to be minimal and far less than that of the other activities, therefore, other activities are used as a worst-case for it in the assessments. Underwater noise during non-piled anchor installation is anticipated to be comparable or less than modelled impact ranges for cable trenching/cutting. Therefore, modelled impact ranges for cable trenching/cutting are considered worst-case. The duration of the mooring installation within the construction period will be dependent on anchor type but will be within the worst-case scenario.
Impact C5: Underwater noise and presence of vessels	For detailed information on construction vessel presence see below for Impact C7.	

Impact	Realistic Worst-case Scenario	Rationale
Impact C6: Collision risk with vessels	A range of vessel types will be required across site preparation and construction, please see Chapter 4: Project Description (Volume II) for further details. Maximum total number of construction vessels on site at any one time = up to 34 vessels. Maximum total number of round trips² over construction period (inclusive of site preparation) = 1615	Due to construction sequencing, not all vessel types will be on site at the same time. The number of vessels would vary depending on activities taking place within the Bellrock WFDA. Assessments are based on the worst-case scenario for the maximum number of vessels on site at any one time during the construction period. Construction port(s) will be confirmed post consent.
Impact C7: Disturbance at seal haul-out sites	The number of vessel trips are as outlined above for Impact C7 which details information on construction vessel presence.	Construction port(s) will be confirmed post consent. However, the assessment considers the potential for in-transit vessels in proximity to the seal haul-out sites in the marine mammal study area. Movements of construction vessels could occur throughout the year. See Appendix 9.1: Marine Mammals Technical Report (Volume IV) for details on seal haul-out sites. Section 8 of the Outline VMNSP (Volume V) will describe the indicative vessels transit corridors as detailed in the context of the environmental sensitivities.
Impact C8: Changes to prey availability	Total Area of Disturbance = 3.64 km² (3,635,158 m²). Total SSC released due to construction activities (including site preparation) = 0.0014 km³ (1,394,530 m³).	The worst-case scenario for changes to prey availability for marine mammals is based on the worst-case scenario table (Table 8.3) and conclusions of the assessments presented in Chapter 8: Fish and Shellfish Ecology (Volume II): ▪ Physical disturbance and temporary habitat loss; ▪ Increased SSCs and sediment re-deposition; ▪ Underwater noise and vibration; and ▪ Changes in fishing activity.

Impact	Realistic Worst-case Scenario	Rationale
Operation and Maintenance		
Impact O1: Underwater noise during geophysical surveys	Expected to include the following surveys: ▪ MBES; ▪ USBL; ▪ SBES; ▪ SSS; and ▪ SBP.	Indicative only.
Impact O2: Underwater noise from other activities	Cable repair and replacement activities during the O&M phase could include: ▪ Trenching; ▪ Ploughing; ▪ Cable laying; and ▪ Rock placement. Operational life = 35 years.	
Impact O3: Underwater noise and presence of vessels	A range of vessel types will be required across O&M, please see Chapter 4: Project Description (Volume II) for further details. Maximum number of O&M vessels at site at any one time: 21 Maximum total number of round trips per year = 211	Assessments are based on the worst-case scenario for the maximum number of vessels on site at any one time during O&M. Due to O&M requirements, not all vessel types will be on site at the same time. The number of vessels would vary depending on activities taking place within the Bellrock WFDA.
Impact O4: Underwater noise from operational WTGs and moorings on the seabed	Up to 132 FOU's. 132 SKSs, with up to 1,188 mooring lines. Please see underwater noise modelling parameters as provided in Appendix 9.2: Underwater Noise Modelling Report (Volume IV) . Operational life of the Wind Farm Infrastructure = 35 years.	Assessment (and underwater noise modelling) based on the largest number of FOU's and capacity per WTG.

Impact	Realistic Worst-case Scenario	Rationale
Impact O5: Secondary entanglement	Mooring lines: - Maximum number of mooring lines = 1,188 for 132 FOUs (up to 9 mooring lines per FOU); - Maximum mooring touchdown distance from FOU = 1,300 m; - Maximum length of each mooring line within the water column during normal operation = 920 m; - Maximum length of each mooring line on the seabed during normal operation = 770 m; and - Mooring line material: Chain, nylon, polyester, high modulus polyethylene. IACs: - Maximum external cable diameter = 270 mm; - Maximum length of dynamic cable in the water column (free hanging, lazy s wave, steep wave) per IAC connection to each FSS = 350 m; and - Total maximum length of dynamic cable in the water column for all FSS (1 – 2 connection points per FSS) = 92.4 km.	The maximum length of mooring line and dynamic IACs in the water column is assessed as the worst case.
Impact O6: Collision risk with vessels	A range of vessel types will be required across O&M, please see Chapter 4: Project Description (Volume II) for further details. Maximum of O&M vessels at site at any one time: 21. Maximum total number of round trips per year = 211	Assessments are based on the worst-case scenario for the maximum number of vessels on site at any one time during O&M. Due to O&M requirements, not all vessel types will be on site at the same time. The number of vessels would vary depending on activities taking place within the Bellrock WFDA. O&M port(s) will be confirmed post consent.
Impact O7: Disturbance at seal haul-out sites	A range of vessel types will be required across O&M, please see Chapter 4: Project Description (Volume II) for further details. Maximum of O&M vessels at site at any one time: 21, Maximum total number of round trips per year = 211.	O&M port(s) will be confirmed post consent.

Impact	Realistic Worst-case Scenario	Rationale
Impact O8: Changes to prey availability	Maximum O&M Disturbance Footprint for the Bellrock WFDA = 47.46 km² (47,461,080 m²) - Maximum catenary drag seabed footprint (swept area) of all mooring lines = 46,200,000 m² (350,000 m² per FOU). - IAC repair due to failure: Maximum seabed disturbance footprint (per year) = 27,720 m² (970,200 m² over lifetime (35 yrs)); and - Remedial IAC burial due to exposure: Maximum seabed disturbance footprint (per year) = 2,880 m² per year (100,800 m² overtime lifetime (35 years)). - Maximum jack-up vessel seabed footprint (for all jack-up positions) = 190,080 m² (1,440 m² x 132). Total SSC released due to O&M activities = 0.0255 km³ (25,525,500 m³) Total Area of permanent habitat loss = 2.93 km² (2,926,659 m²)	The worst-case scenario for marine mammals is based on the conclusions of the assessments presented in Chapter 8: Fish and Shellfish Ecology for all possible effects on prey: - Physical disturbance and temporary habitat loss; - Increased SSCs and sediment re-deposition; - Underwater noise and vibration; - EMFs; - Permanent habitat loss; - Introduction of hard substrate; and - Changes in fishing activity.
Decommissioning		
Impact D1: Underwater noise during geophysical surveys	The sequence of decommissioning is likely to be the reverse of the construction sequence, taking around seven years, with similar types and numbers of vessels and equipment expected to be involved.	The detail and scope of the decommissioning works would be determined by the relevant legislation and guidance at the time. The impacts of decommissioning are primarily linked to the removal of infrastructure from the seabed, such as anchors, IACs, subsea cable hubs, and scour and cable protection. These activities may cause temporary disturbances to the seabed and surrounding marine environment. However, it is anticipated that the overall environmental impacts associated with decommissioning will be equal to, or potentially less than, those experienced during the construction phase. This is due to the fact that much of the infrastructure will have already settled into
Impact D2: Underwater noise from other activities	It is expected that the Bellrock Wind Farm Infrastructure will be fully removed at the end of its operational life.	
Impact D3: Underwater noise and presence of vessels	The removal and dismantling of the FOU's will largely be a reversal of the installation process. Generally, the FOU's will be towed from the Bellrock WFDA to a suitable port for decommissioning.	
Impact D4: Collision risk with vessels	Mooring lines and anchors will be recovered and removed from the WFDA. For FOU driven pile anchors, these are expected to be either fully removed or cut off below seabed level with a proportion remaining in-situ (due to anticipated excessive cost in their complete removal) following good practice and consideration of environmental conditions and sensitivities.	
Impact D5: Disturbance at seal haul-out sites		

Impact	Realistic Worst-case Scenario	Rationale
Impact D6: Changes to prey availability	Subsea cable hubs are expected to be fully removed from the seabed. The dynamic sections of the IACs within the water column will be cut at the connector with the static IAC and fully removed. The approach for decommissioning the static IACs on the seabed is yet to be determined, however, this will be reviewed throughout the lifetime of the Bellrock WFDA and good practice guidance at time of decommissioning will be followed. Subject to the material used and environmental sensitivities, it may be preferable to leave scour protection in-situ to preserve the marine habitat that may have developed over the life of the Bellrock WFDA. The approach for decommissioning cable protection will be similar to scour protection. Relevant stakeholders and regulators will be consulted to establish the best approach. Good practice guidance at time of decommissioning will be followed.	place, and the removal process will likely be more controlled and less intrusive. Additionally, any disturbance will be short-term and localised, with appropriate mitigation employed to minimise harm to marine habitats and ecosystems.
Notes: ¹ Site preparation works will commence up to one year before commencement of construction (year 0), at which point they may continue albeit as construction works (rather than site preparation works) these activities have been considered in the assessments of this Chapter, for completeness. ² One round trip comprises two movements (i.e. one to and one from the Bellrock WFDA).		

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9.7.3 Embedded Mitigation Measures

98. The marine mammals assessment in **Section 9.8** is, in the first instance, undertaken without consideration of mitigation measures. Where mitigation measures have subsequently been applied to reduce the residual effect significance, this is explained in the text throughout the assessment. The following tertiary mitigation measures considered in the assessment are:
- Implementation of soft-start and ramp-up measures for piling (which are applied as part of the underwater noise modelling in **Appendix 9.2: Underwater Noise Modelling Report (Volume IV)**); and
 - Minimum spacing of 1,150 m between FOU's to reduce possibility of secondary entanglement.
99. Mitigation measures presented are later applied to reduce the residual effect significance, and include those given in **Table 9.16**. **Table 9.16** only lists mitigation that directly affects marine mammal species – mitigation that affects prey species is listed in **Chapter 8: Fish and Shellfish Ecology (Volume II)**.

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Table 9.16: Embedded Mitigation Measures Relevant to Marine Mammals

Measure ID	Embedded Mitigation Measure(s)	Mitigation Type	Means of Implementation
WFDA-1	Minimum spacing of 1,150 m between FOU's (centre to centre) to reduce possibility of secondary entanglement	Primary	Secured in the s.36 Consent and Marine Licence via a condition requiring a Development Specification and Layout Plan (DSLPL) to be developed and submitted to the Scottish Ministers for approval prior to commencement of construction.
WFDA-4	Where seabed preparation is required (e.g. seabed levelling), methods and equipment that have been designed to minimise the potential for sediment suspension and dispersal will be adopted as far as is reasonably practicable.	Primary	Secured in the s.36 Consent and Marine Licence via a condition requiring a Construction Method Statement (CMS) to be developed and submitted to the Scottish Ministers for approval prior to commencement of construction.
WFDA-12	The PNMP will be submitted to MD-LOT for approval prior to the commencement of piling, outlining mitigation and management measures that will be implemented during pile installation.	Tertiary	Secured in the s.36 Consent and Marine Licence via a condition requiring a PNMP to be developed and submitted to the Scottish Ministers for approval before commencement of construction.
WFDA-18	A Vessel Management and Navigational Safety Plan (VMNSP) will be developed and implemented for the construction and O&M phases of the Bellrock Wind Farm Infrastructure. The VMNSP will set out the types and anticipated numbers of vessels to be deployed, together with indicative transit corridors between the Bellrock WFDA and the relevant construction ports. The VMNSP will be aligned with the Scottish Marine Wildlife Watching Code (Scottish Natural Heritage, 2017a) and the associated Guide to Best Practice for Watching Marine Wildlife (Scottish Natural Heritage, 2017b). As such, vessel operations will incorporate recognised good practice measures to reduce the risk of disturbance to, and collision with, marine mammals, seabirds, and other marine megafauna. Where practicable, vessel movements will follow defined transit corridors, thereby concentrating activity within established navigation corridors and reducing the spatial extent of potential disturbance and collision risk. The number of vessel movements will be limited to those necessary for safe and efficient delivery of the works.	Tertiary	Secured in the s.36 Consent and Marine Licence via a condition requiring a Vessel Management Plan (VMP) and Navigational Safety Plan (NSP) to be developed and submitted to the Scottish Ministers for approval before commencement of construction. An Outline VMNSP (Volume V) is submitted alongside the s.36 Consent application and Marine Licence application for the Bellrock Wind Farm Infrastructure.

Measure ID	Embedded Mitigation Measure(s)	Mitigation Type	Means of Implementation
WFDA-19	Development of and adherence to a Marine Pollution Contingency Plan (MPCP) outlining the approach for managing and reducing risk of pollution and procedures to protect personnel and to be followed in the event of a pollution incident.	Tertiary	Secured in the s.36 Consent and Marine Licence, via a condition requiring a MPCP to be developed and submitted to the Scottish Ministers for approval before commencement of construction. A MPCP (Volume V) is submitted alongside the s.36 Consent application and Marine Licence application for the Bellrock Wind Farm Infrastructure.
WFDA-21	An Environmental Management Plan (EMP) will be prepared and implemented to set out the procedures to avoid, reduce, and manage potential environmental effects arising across the construction and O&M of the Bellrock Wind Farm Infrastructure, in accordance with relevant international and national legislation and guidance.	Tertiary	Secured in the s.36 Consent and Marine Licence via a condition requiring an EMP to be developed and submitted to the Scottish Ministers for approval before commencement of construction. An Outline EMP (Volume V) is submitted alongside the s.36 Consent application and Marine Licence application for the Bellrock Wind Farm Infrastructure.
WFDA-23	Implementation of soft start and ramp-up measures for piling (which would reduce underwater noise effects), to be set out in the PNMP and part of the MMMP for piling activities. Each piling event would commence with a soft start at a lower hammer energy followed, by a gradual ramp-up for at least 20 minutes to the maximum hammer energy required. The soft start and ramp-up allows mobile species to move away from the area before the maximum hammer energy with the greatest noise impact area is reached.	Primary	Secured in the s.36 Consent and Marine Licence via a condition requiring an PNMP to be developed and submitted to the Scottish Ministers for approval before commencement of construction. An Outline MMMP (Volume V) is submitted alongside the s.36 Consent application and Marine Licence application for the Bellrock Wind Farm Infrastructure.

Measure ID	Embedded Mitigation Measure(s)	Mitigation Type	Means of Implementation
WFDA-24	Development of, and adherence to, a MMMP. The MMMP for piling will be developed prior to commencement of construction and based upon best available information, methodologies, industry best practice, latest scientific understanding, current guidance and detailed project design. The MMMP for piling will be developed in consultation with MD-LOT and NatureScot, and will detail the proposed mitigation measures to reduce the risk of any physical or permanent auditory injury/change in hearing sensitivity (PTS) to marine mammals and impacts of disturbance during all piling operations. This will include details of designed-in mitigation, for the soft-start and ramp-up, as well as details of the mitigation zone and any additional mitigation measures required in order to minimise potential impacts of any physical injury or PTS, for example, the activation of ADD for a maximum of 30 minutes¹ prior to the soft-start.	Tertiary	Secured in the s.36 Consent and Marine Licence via a condition requiring an PNMP to be developed and submitted to the Scottish Ministers for approval before commencement of construction. An Outline MMMP (Volume V) is submitted alongside the s.36 Consent application and Marine Licence application for the Bellrock Wind Farm Infrastructure.
WFDA-25	Development of, and adherence to, a PNMP. The PNMP will be developed in consultation with MD-LOT and NatureScot and prepared in accordance with the Marine Directorate guidance on mitigation and monitoring plans (Marine Directorate, 2025), which sets out prescriptive requirements for what the PNMP should cover.	Tertiary	Secured in the s.36 Consent and Marine Licence via a condition requiring a PNMP to be developed and submitted to the Scottish Ministers for approval before commencement of construction. An Outline MMMP (Volume V) is submitted alongside the s.36 Consent application and Marine Licence application for the Bellrock Wind Farm Infrastructure.
WFDA-26	A detailed MMMP will be prepared for UXO clearance. The MMMP for UXO clearance will ensure there are adequate mitigation measures to minimise the risk of any physical or permanent auditory injury to marine mammals as a result of UXO clearance. The most suitable mitigation measures, based upon best available information and methodologies at that time will be utilised. The MMMP for UXO clearance will be prepared in consultation with MD-LOT and NatureScot. The MMMP for UXO clearance will include details of all the required mitigation measures to minimise the potential risk of PTS as a result of underwater noise during UXO clearance. This would consider the options, suitability and effectiveness of mitigation measures such as, but not limited to:	Tertiary	The Applicant will seek consent for UXO clearance activities via a separate Marine Licence application process. Secured in the UXO MMMP as part of a Marine Licence prior to construction. An Outline MMMP (Volume V) is submitted alongside the s.36 Consent application and Marine Licence

Measure ID	Embedded Mitigation Measure(s)	Mitigation Type	Means of Implementation
	- Avoidance of UXO if practicable; - Use of low-order clearance techniques, such as deflagration; - The potential use of noise abatement if any high-order detonation is required (taking into consideration the environmental limitations); - Monitoring requirements for marine mammal observers; - Requirements for ADDs; and Other UXO clearance techniques, or relocation of UXO. If more than one high-order detonation is required, other measures such as the use of scare charges; or multiple detonations, if UXO are located in close proximity, will also be considered.		application for the Bellrock Wind Farm Infrastructure.
WFDA-27	If required, mitigation for geophysical surveys will follow the Joint Nature Conservation Committee (2017) 'Guidelines for Minimising the Risk of Injury to Marine Mammals from Geophysical Surveys.	Tertiary	Secured through the EPS Risk Assessment and EPS Licence.
WFDA-28	Development of UXO Threat and Risk Assessment. All UXO detonations will be subject to a risk assessment undertaken in accordance with relevant guidance such as publication C754 Assessment and Management of UXO Risk in the Marine Environment (Construction Industry Research and Information Association, 2015).	Tertiary	A UXO Threat and Risk Assessment has been developed to support an indicative assessment of UXO clearance in the Bellrock WFDA EIA Report and will inform separate Marine Licence application(s) for UXO clearance.
WFDA-33	Preparation of an Invasive Non-native Species Mitigation Plan (INNSMP) to include provisions for Invasive non-native species (INNS) management. The INNSMP would implement biosecurity measures in line with international and national regulations and guidance, namely: - International Convention for the Prevention of Pollution from Ships (MARPOL), which sets out requirements, including appropriate vessel maintenance; - The International Convention for the Control and Management of Ships' Ballast Water and Sediments, which provides an international framework for the control of transfer of potentially INNS from ballast water; and - Consideration of guidance from the International Maritime Organisation (IMO, 2023) on the control and management of ships' biofouling to minimise the transfer of invasive aquatic species.	Tertiary	Secured in the s.36 Consent and Marine Licence via a condition requiring an INNSMP to be developed and submitted to the Scottish Ministers for approval before commencement of construction. The INNSMP (Volume V) is submitted alongside the s.36 Consent application and Marine Licence application for the Bellrock Wind Farm Infrastructure.

Measure ID	Embedded Mitigation Measure(s)	Mitigation Type	Means of Implementation
WFDA-34	Adherence to the following international and national regulations and guidance, namely: - International Convention for the Prevention of Pollution from Ships (MARPOL), which sets out requirements, including appropriate vessel maintenance; - The International Convention for the Control and Management of Ships' Ballast Water and Sediments, which provides an international framework for the control of transfer of potentially invasive species from ballast water; and - Consideration of guidance from the International Maritime Organisation (IMO, 2023) on the control and management of ships' biofouling to minimise the transfer of invasive aquatic species.	Tertiary	Secured in the s.36 Consent and Marine Licence via a condition requiring a VMNSP to be developed and submitted to the Scottish Ministers for approval before commencement of construction. An Outline VMNSP (Volume V) is submitted alongside the s.36 Consent application and Marine Licence application for the Bellrock Wind Farm Infrastructure.
WFDA-43	The Applicant will ensure compliance with the Regulatory Expectations on Moorings for Floating Wind and Marine Devices (MCA and Health and Safety Executive, 2017).	Tertiary	Secured in the s.36 Consent and Marine Licence via a condition requiring a NSP to be developed and submitted to the Scottish Ministers for approval before commencement of construction. An Outline VMNSP (Volume V) is submitted alongside the s.36 Consent application and Marine Licence application for the Bellrock Wind Farm Infrastructure.
WFDA-47	Development of, and adherence to, a Decommissioning Programme (DP). The DP will set out the framework for the safe, orderly, and environmentally acceptable decommissioning and removal of the Bellrock Wind Farm Infrastructure, in the interests of safety and environmental protection. Climate change risk measures will be included in the DP to be developed prior to the commencement of construction and will include a review of site-specific weather and metocean conditions, recent extreme weather events and up-to-date climate change projection data will be undertaken to ensure risk assessments, H&S protocols and guidelines on safe working practices are suitable for future climate conditions at the time of decommissioning works. The DP will be refreshed prior to decommissioning activities commencing.	Tertiary	Secured in the s.36 Consent and Marine Licence, via a condition requiring a DP to be developed and submitted to the Scottish Ministers for approval before commencement of construction.

Measure ID	Embedded Mitigation Measure(s)	Mitigation Type	Means of Implementation
	The DP will mitigate the risk of climate change impacts on decommissioning site personnel, plant and equipment and other assets and the risk of delays to the decommissioning programme due to extreme weather events, which are becoming more frequent and intense due to climate change.		
WFDA-50	No more than two non-rotating FOU's will be towed together at once and will not exceed a velocity of 10 knots.	Primary	Secured in the s.36 Consent and Marine Licence via a condition requiring a Vessel Management Plan (VMP) and NSP to be developed and submitted to the Scottish Ministers for approval before commencement of construction. An Outline VMNSP (Volume V) is submitted alongside the s.36 Consent application and Marine Licence application for the Bellrock Wind Farm Infrastructure.
WFDA-59	Seabed contacting infrastructure will be micro-sited, where practicable, to avoid sensitive seabed habitats, low or limited mobility benthic species, such as Annex I habitats and Priority Marine Features. Micro-siting will be informed by surveys prior to the commencement of construction which will identify the location and extent of habitats and species.	Primary	Secured in the s.36 Consent and Marine Licence via a condition requiring a CMS and DSLP to be developed and submitted to the Scottish Ministers for approval before commencement of construction.
WFDA-60	Development of, and adherence to, a CMS. The CMS will describe the methods for construction for all consented Wind Farm Infrastructure and set out the measures to be implemented to avoid or reduce adverse effects on the environment and legitimate users of the sea during the construction phase. This will include a clear definition of roles and responsibilities and reference to relevant H&S protocols. In relation to climate change, the CMS will incorporate measures to ensure construction activities are resilient to current and projected extreme weather and metocean conditions. This will include, as appropriate: Monitoring of site-specific weather and metocean conditions, including use of recognised forecasting and severe weather alert services;	Tertiary	Secured in the s.36 Consent and Marine Licence via a condition requiring a CMS to be developed and submitted to the Scottish Ministers for approval before commencement of construction.

Measure ID	Embedded Mitigation Measure(s)	Mitigation Type	Means of Implementation
	▪ Programming and phasing of construction activities with regard to seasonality and short- to medium-term forecasts; ▪ Definition of safe working limits for vessel, lifting, and installation operations and procedures for suspension of works where thresholds are exceeded; ▪ Measures to secure plant, equipment, and materials during adverse weather; and ▪ Risk assessments and safety procedures that account for site-specific extreme weather risks. Through these measures, the CMS will mitigate risks to construction personnel, plant, and equipment, and reduce the potential for programme disruptions arising from extreme weather events.		
WFDA-61	Regular and periodic inspections and maintenance of all components of the Wind Farm Infrastructure will be undertaken over their operational lifetime to identify and remediate any damage and deterioration and maintain good working conditions. These will be included in the Operation and Maintenance Plan (OMP). Monitoring of site-specific weather and metocean conditions, recent extreme weather events and up-to-date climate change projection data will be undertaken to provide a dynamic risk assessment of climate change impacts and inform operation and maintenance planning. The OMP will mitigate the risks of climate change impacts on the conditions and performance of the Wind Farm Infrastructure and ensures that it is adaptable to future climate conditions and remains resilient over its operational life. The O&M strategy will be adaptive, with the frequency of maintenance, repair and replacement activities being adjusted based on need (i.e. increasing planned O&M visits for components with higher deterioration rates than anticipated).	Tertiary	Secured in the s.36 Consent and Marine Licence via a condition requiring an OMP to be developed and submitted to the Scottish Ministers for approval prior to the commissioning of the first WTG.
WFDA-62	Regular and periodic inspections and maintenance of the Wind Farm Infrastructure will be undertaken over its operational life to identify and remediate any damage and deterioration and maintain good working conditions (including any debris entangled with the Wind Farm Infrastructure). This will include but not be limited to surveys of subsea infrastructure.	Primary	Secured in the s.36 Consent and Marine Licence via a condition requiring an OMP to be developed and submitted to the Scottish Ministers for approval prior to the commissioning of the first WTG.
Notes: ¹ Anything additional to 30-minutes ADD activation is considered secondary mitigation and therefore not a designed in measure.			

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9.8 Assessment of Effects

100. The potential effects to marine mammals that may occur during construction, O&M and decommissioning of the Wind Farm Infrastructure are assessed in the following sections. The assessment follows the methodology set out in **Section 9.4.1** and is based on the realistic worst-case scenario defined in **Section 9.7.2**, with consideration of embedded mitigation measures identified in **Section 9.7.3**.

9.8.1 Potential Impacts During Construction

9.8.1.1 Impact C1: Underwater Noise During UXO Clearance

101. Prior to and during construction, there is the potential for UXO clearance to be required. While any identified UXO will either be avoided or removed and disposed of in a designated place, there is the potential that underwater detonation could be required where it is necessary and unsafe to remove the UXO.
102. In order to undertake any UXO clearance works, a Marine Licence (ML) is required under the Marine and Coastal Access Act 2009 (for activities more than 12 nm offshore). This is separate to the ML required for the construction and operation of the Wind Farm Infrastructure. In addition, the clearance of UXO by detonation will require a risk assessment and potentially an EPS Licence under the Conservation of Offshore Marine Habitats and Species Regulations 2017. A ML application will be submitted when a detailed UXO survey has been completed prior to construction and a detailed assessment based on the latest available information has been undertaken.
103. The number of possible UXOs that may require clearance and the duration of UXO clearance operations are currently unknown. It is important to note, therefore, that the assessments for UXO clearance is provided and based on a realistic worst-case scenario. Further information on UXO and the sensitivities and magnitudes for each receptor is provided in **Appendix 9.3: Marine Mammals Unexploded Ordnance Assessment (Volume IV)**.
104. The significance of effect from the assessment is highlighted in **Appendix 9.3: Marine Mammals Unexploded Ordnance Assessment (Volume IV)** and the summary of potential effects for underwater noise during UXO clearance is shown in **Table 9.17**.
105. It is important to note that low-order clearance would be the default method used. However, if high-order was required at any clearance location then appropriate mitigation would be utilised, therefore making the residual effect for both auditory injury and disturbance as **minor adverse** for all marine mammal species.

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Table 9.17: Summary of Potential Effects to Marine Mammals Due to UXO Clearance

Potential Impact	Receptor	Sensitivity	Magnitude	Pre-mitigation Effect	Mitigation Measures	Residual Effect
Impact 1: Permanent auditory injury from underwater noise associated with UXO clearance						
PTS for UXO high-order clearance	Harbour porpoise	High	Medium	Significant (Major adverse)	MMMP for UXO clearance.	Not Significant (Minor adverse)
	All other marine mammals	High	Negligible	Not Significant (Minor adverse)	None required, but MMMP for UXO clearance would reduce potential for effect.	Not Significant (Minor adverse)
PTS for UXO low-order clearance	All marine mammals	High	Negligible	Not Significant (Minor adverse)	None required, but MMMP for UXO clearance would reduce potential for effect.	Not Significant (Minor adverse)
Impact 2: Disturbance from underwater noise associated with UXO clearance						
Disturbance from high-order clearance	Minke whale	Medium	Medium	Significant (Moderate adverse)	MMMP for UXO clearance would reduce potential for effect.	Not Significant (Minor adverse)
	Harbour porpoise, fin whale and humpback whale	Medium	Negligible	Not Significant (Minor adverse)	None required, but MMMP for UXO clearance would reduce potential for effect.	Not Significant (Minor adverse)
	Dolphin and seal species	Low	Negligible	Not Significant (Negligible adverse)		Not Significant (Negligible adverse)
Disturbance from low-order clearance	Harbour porpoise and baleen whales	Medium	Negligible	Not Significant (Negligible adverse)	None required	Not Significant (Negligible adverse)

Potential Impact	Receptor	Sensitivity	Magnitude	Pre-mitigation Effect	Mitigation Measures	Residual Effect
	Dolphin and seal species	Low	Negligible	Not Significant (Negligible adverse)		Not Significant (Negligible adverse)
Disturbance from ADD activation	All species	Medium/Low	Negligible	Not Significant (Negligible adverse)	None required	Not Significant (Negligible adverse)
Impact 3: Changes to prey availability as a result of underwater noise from UXO clearance activities						
Changes to prey availability as a result of underwater noise from UXO clearance activities	Harbour porpoise and minke whale	Low to Medium	Negligible	Not Significant (Negligible adverse)	None required, but MMMP for UXO clearance would reduce potential for effect.	Not Significant (Negligible adverse)
	Bottlenose dolphin, common dolphin, white-beaked dolphin, fin whale, humpback whale, grey seal and harbour seal	Low	Negligible			
	Killer whale	Medium	Negligible			

9.8.1.2 Impact C2: Underwater Noise during Geophysical Surveys

106. Geophysical surveys may be required to be undertaken to inform project design, to enable responsible project design decisions and to inform technical design and micro-siting.
107. It is important to note that prior to any geophysical surveys, an EPS Risk Assessment will be conducted to determine if the proposed geophysical survey could have a potential risk of disturbance or auditory injury to cetacean species. All cetacean species (porpoise, dolphin and whale species) are EPS. The EPS Risk Assessment will be undertaken based on the geophysical survey specification, including equipment to be used, number of survey vessels, area(s) to be surveyed, duration of surveys, time of year and consulted on with MD-LOT and NatureScot, as noted in **Appendix 9.1: Marine Mammals Technical Report (Volume IV)**.
108. The information provided in this assessment for the Bellrock WFDA EIA Report, is based on a precautionary worst-case scenario. Geophysical surveys could involve different types of survey equipment, these are summarised in **Table 9.18**. **Table 9.19** presents a summary of examples of the frequency ranges and sound levels for geophysical survey equipment and potential risk to marine mammals based on the information presented in **Table 9.8** and **Table 9.9**.

Table 9.18: Geophysical Survey Equipment

Type of Survey Equipment	Description
Sub-bottom profiler (SBP)	SBP systems are used to identify and characterise layers of sediment or rock under the seafloor. A transducer emits a sound pulse vertically downwards towards the seafloor, and a receiver records the return of the pulse once it has been reflected off the seafloor.
Multi-beam echo sounder (MBES)	MBES are used to obtain detailed maps of the seafloor which show water depths. They measure water depth by recording the two-way travel time of a high frequency pulse emitted by a transducer. The beams produce a fanned arc composed of individual beams (also known as a swathe). MBES can typically carry out 200 or more simultaneous measurements.
Single-beam echo sounder (SBES)	Like MBES, SBES determine water depth by measuring the travel time of a short sonar pulse. Unlike the MBES, which produces a fanned arc of a number of individual beams, the SBES emits a single wide beam.
Ultra-Short Baseline (USBL) system	USBL systems are used to determine the position of subsea survey items, including ROVs, towed sensors, etc. This involves the emission of sound from a hull-mounted transducer to a subsea transponder, thereby introducing sound into the marine environment. A complete USBL system consists of a small transducer array, which is mounted under a ship, and a transponder attached to the subsea unit. An acoustic pulse is transmitted by the transducer, travels through the water and is detected by the shipboard transducer on an onboard computer calculates the time from the transmission of the initial acoustic pulse until the reply is detected and is measures by the USBL system. This is converted into a range and bearing, and thus the position of the subsea unit/sampling equipment is determined. These systems can either be used continuously or intermittently through the operation they are supporting.
Side Scan Sonar (SSS)	SSS is used to generate an accurate image of the seabed. An acoustic beam is used to obtain an accurate image of a narrow area of seabed to either side of the instrument by measuring the amplitude of back-scattered return signals. The instrument can either be towed behind a ship at a specified depth or mounted on to a ROV. The higher frequency systems provide higher resolution, but shorter-range measurements.

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Table 9.19: Frequency Ranges and Sound Levels for Geophysical Survey Equipment and Potential Risk to Marine Mammals

Type of Survey Equipment	Predicted Source Levels and Frequencies	Marine Mammal Species Relevance	Notes	Potential Risk to Marine Mammal
SBP – Parametric Pinger	Primary = 85 – 115 kHz RMS source level: 232 dB re 1 uPa @ 1 m	Auditory injury = all Disturbance = all	Although source levels are likely to be too low to result in injury, they will be audible to most species and thus have the potential to result in disturbance.	Frequency ranges of the SBP can be within marine mammal hearing range and will be audible to all marine mammal species that could be present in the geophysical survey area. Therefore, there is potential for disturbance impacts to occur.
SBP – Single Channel Sparker	400 Hz – 5 kHz SPL _{peak} : 203 dB re 1.0 V/uPa	Auditory injury = VHF Disturbance = all		Most of the sound energy generated by the SBP equipment will be directed towards the seabed and the pulse duration is extremely short, with the continuous movement of the survey. Auditory injury effects are not predicted, as an animal would need to remain in the very small zone of ensonification for a prolonged period, which is highly unlikely (Department for Business, Energy and Industrial Strategy (BEIS, 2020)).
SBP – Single Channel Boomer	100 Hz – 5 kHz 205 (SL _{rms} (dB re 1 µPa @ 1 m) 211 SL0-pk (dB re 1 µPa @ 1 m)	Auditory injury = VHF Disturbance = all		
MBES	200 - 450 kHz SPL: 191 - 221 dB re 1 µPa @ 1 m	Auditory injury = VHF, LF, PCW Disturbance = None	Source levels have a minimum peak pressure level which has been identified as having the potential to cause injury to harbour porpoise (202 dB re 1 µPa) and could be audible to marine mammal species in the geophysical survey area.	BEIS, 2020 assessed MBES system to have the potential to emit sound sources of up to 236 dB re 1 µPa @ 1 m, with frequencies of between 10 and 200 kHz. Due to the high amplitude of MBES, there is the potential for auditory injury to marine mammal species. However, this is highly unlikely as an animal would need to be within very close proximity of the source. BEIS, 2020 also determined that it is also unlikely that the MBES could cause disturbance when active for a short period due to the operating frequencies being outside the audible range of all marine mammals MBES surveys that are carried out in waters of less than 200 m in depth are not considered to be a risk to marine mammals, as it is thought that the higher frequencies typically used (200 to 400 kHz) fall outside of their hearing ranges, and the sounds are likely to attenuate quickly due to the high frequencies used. JNCC therefore advise that mitigation is unlikely to be required for MBES surveys in shallow (less than 200 m water depth) surveys (JNCC, 2017). MBES is not assessed further.

Type of Survey Equipment	Predicted Source Levels and Frequencies	Marine Mammal Species Relevance	Notes	Potential Risk to Marine Mammal
SBES	200 kHz SPL: 221.6 dB re 1 μ Pa @ 1 m	Auditory injury = VHF, LF and PCW Disturbance = None	Source levels have a minimum peak pressure level which has been identified as having the potential to cause injury to harbour porpoise (202 dB re 1 μ Pa).	SBES generally operate at high frequencies. These frequencies are generally beyond the hearing range of most cetaceans, including high-frequency sensitive species such as harbour porpoise. Given the increased attenuation associated with these high frequencies, it can be concluded that use these surveys present a negligible risk (BEIS, 2020); (DECC, 2011) and is not assessed further.
USBL system	18 – 32 kHz SPL: 192 dB re 1 μ Pa @ 1 m	Auditory injury = None Disturbance = all	Source levels have a minimum peak pressure level which has been identified as having the potential to cause injury to harbour porpoise (202 dB re 1 μ Pa) and are audible to marine mammal species in the area increasing the risk of disturbance.	Since low frequency emissions propagate further than high frequency sounds, cetaceans may be exposed to these noise emissions over a greater spatial area than they would higher frequency sounds (such as those from MBES or SSS). The USBL system is likely to be employed intermittently, with time in-between noise emissions, allowing animals to move away from the source and avoid continuous exposure. Considering that the surveys themselves will be transient (i.e. the vessel will be moving while the USBL is employed), the cumulative exposure level from the USBL system will be low, as marine mammals are highly unlikely to follow the noise source. Therefore, the potential risk of auditory injury is low. The low noise frequency sound emissions generated by the USBL system are within the hearing range of the cetacean species anticipated to be within the Bellrock WFDA area. For this reason, there is potential for USBL survey activities to potentially elicit a disturbance response in animals that are present during the surveys (Majewska et al. 2025). The worst case of effects from SBP has been assessed and would be considered a proxy for disturbance for USBL.

Type of Survey Equipment	Predicted Source Levels and Frequencies	Marine Mammal Species Relevance	Notes	Potential Risk to Marine Mammal
SSS	300 – 500 kHz (low) 500 – 900 kHz (high) SPL: 220 – 230 dB re 1uPa @ 1 m (Peak)	Auditory injury = All Disturbance = None	Source levels have a minimum peak pressure level which has been identified as having the potential to cause injury to harbour porpoise (202 dB re 1 µPa) and a maximum peak pressure level which has been identified as having the potential to cause injury to bottlenose dolphin (230 dB re 1 µPa).	The frequencies used by SSS are generally very high and outside of the main hearing range of all marine species (BEIS, 2020). As for MBES, the sounds are likely to attenuate quickly due to the high frequencies used. Therefore, as for the MBES, mitigation in shallow waters (less than 200 m) is not required (JNCC, 2017). SSS is not assessed further.

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109. The review of potential survey equipment in **Table 9.19** identified the potential for PTS from SBP and disturbance from the audible equipment. For disturbance assessments the SBP has been considered as a proxy for USBL. An initial desk-based review of impact ranges for SBP was conducted, to determine potential worst-case for geophysical surveys (**Table 9.20**). This includes the Review of Consents (RoC) Habitats HRA for the Southern NS SAC (BEIS², 2020) which undertook underwater noise modelling to determine the potential impact ranges of geophysical surveys for harbour porpoise.
110. The BEIS (2020) assessment was undertaken using the maximum source levels that could be expected from geophysical equipment, a SBP with a maximum source noise level of 267 dB re 1 µPa-m. The noise modelling indicates that the PTS in harbour porpoise could occur within a maximum of 23 m (an area of 0.0017 km²) from the source location. This is based on the PTS cumulative threshold of 155 dB SEL weighted (Southall et al. 2019). The modelling for BEIS (2020) predicted a maximum impact range of 3.77 km (44.65 km²) for possible behavioural disturbance of harbour porpoise, based on a threshold of 140 dB re 1 µPa SPL unweighted.

Table 9.20: Summary of the Desk-Based Review of Potential Impact Ranges for SBP

Equipment	Species	Potential Effect	Threshold	Reported Range of Effect (m)	Reference
SBP	Harbour porpoise	PTS	155 SEL _{cum} dB re 1 µPa	23	BEIS (2020)
		Behavioural	140 SPL _{RMS} dB re 1 µPa unweighted	3,770	
SBP (220 dB re 1 µPa @ 1 m peak)	Harbour porpoise	PTS	Not reported	32	Neart na Gaiithe Offshore Wind (2019)
	Dolphin species	PTS	Not reported	0	
	Whale species	PTS	Not reported	5	
	Cetaceans	Disturbance	Not reported	1,500	
SBP (215 dB re 1 µPa @ 1 m SPL _{peak})	Dolphin species	PTS	230 dB peak/185 dB SEL _{cum}	0	Wieting (2019)
	Whale species	PTS	219 dB peak, 183 dB SEL _{cum}	<1	
	Harbour porpoise	PTS	202 dB peak/155 dB SEL _{cum}	<3	

² Now known as the Department for Energy Security and Net Zero.

Equipment	Species	Potential Effect	Threshold	Reported Range of Effect (m)	Reference
SBP (247 dB re 1 μ Pa @ 1 m (rms))	Harbour porpoise	PTS	247 dB re 1 μ Pa @ 1 m (rms)	330	Green Volt (2023)
	Dolphin species	PTS	247 dB re 1 μ Pa @ 1 m (rms)	125	
	Whale species	PTS	247 dB re 1 μ Pa @ 1 m (rms)	125	
	Pinnipeds	PTS	247 dB re 1 μ Pa @ 1 m (rms)	120	
	All marine mammals	Disturbance	247 dB re 1 μ Pa @ 1 m (rms)	1,425	

9.8.1.2.1 Sensitivity

9.8.1.2.1.1 Auditory Injury

111. For geophysical surveys, the maximum range for PTS (SBP) is 330 m (**Table 9.20**). Frequency ranges of the SBP to be used in surveys can vary from 85 – 115 kHz or 0.1 – 5 kHz for single channel seismic sparkers and boomers (**Table 9.19**). Most of the sound energy generated by the SBP equipment will be directed towards the seabed and the pulse duration is extremely short, with the continuous movement of the survey. Auditory injury effects are not predicted to be significant, as an animal would need to remain in the very small zone of ensonification for a prolonged period, which is highly unlikely (JNCC et al. 2010).
112. Ruppel et al. (2022) categorised marine acoustic sources into four tiers based on their potential to injure marine mammals using physical criteria about the sources (e.g. source level, transmission frequency, directionality, beamwidth, and pulse repetition rate):
 - Tier 1 refers to high-energy airgun surveys with a total volume larger than 1500 in³ or arrays with more than 12 airguns;
 - Tier 2 covers the remaining low/intermediate energy airgun;
 - Tier 3 covers most non-airgun seismic sources, which either have characteristics that do not meet the de minimis category or could not be fully evaluated in Ruppel et al. (2022) (e.g. bubble guns and some boomers); and
 - Tier 4 includes most high-resolution geophysical, oceanographic, and communication / tracking sources, which are considered unlikely to result in incidental take of marine mammals and therefore termed de minimis.
113. Those in Tier 4 were considered unlikely to result in 'incidental take' (i.e. loss of individuals) of marine mammals and therefore termed de minimis, which included most high-resolution geophysical sources (MBES, SSS, SBP). For context. The study also suggested surveys that

simultaneously deploy multiple, non-impulsive de minimis sources are unlikely to result in incidental take of marine mammals.

114. All marine mammal receptors are deemed to have limited resilience to PTS, low recoverability and high international value. Therefore, the sensitivity of all marine mammal receptors is considered to be **high**.

9.8.1.2.1.2 Behavioural Disturbance

115. It is widely recognised that the transmission frequencies of commercial sonar systems (approximately 12 kHz to 1,800 kHz) overlap with the hearing ranges of numerous marine mammal species (Richardson et al. 1995). Many frequencies associated with sonar systems are very high and have peak frequencies well above marine mammal hearing ranges. Although it is possible that relatively high levels of sound are also produced as sidebands at lower frequencies (Hayes and Gough, 1992) and therefore may result in behavioural responses.
116. In a study undertaken by MacGillivray et al. (2014) seven acoustic sources (including SBP, MBES and SSS) were compared and documented, showing that the sound level above hearing threshold is a function of horizontal distance. Weighting sounds according to hearing sensitivity allows assessment of relative risks associated with exposure and whilst this analysis did not directly relate to potential for behavioural responses, it allowed comparison of modelled acoustic sources. The modelling undertaken in MacGillivray et al. (2014) suggested that toothed whales were most likely to hear sounds from mid-frequency sources (such as fisheries, communication, and hydrographic systems), whilst baleen whales, were most likely to hear sounds from low frequency sources (SBPs), and seals from both mid and low frequency sources. For all species included within the study, modelled sensation levels were lowest for the high frequency sources (e.g. SSS and MBES) which operate at the upper limits of the audible spectrum.
117. A recent study by Kates Varghese et al. (2021) on MBES surveys showed that the only marine mammal metric that was identified as changing was vocalisation rate, with neither changes in displacement nor foraging being observed. It was stated that the range of behaviours exhibited could not be directly attributed to SBES operation, and that changes in behaviour were unlikely to be biologically significant. A study by Cholewiak et al. (2017) investigated the impact of MBES on toothed whales and reported that fewer beaked whale vocalisations were recorded when the source was actively transmitting. This suggested that animals either move away from the area or reduced foraging activity (although findings were not statistically significant).
118. Whilst evidence on the behavioural responses to MBES is limited, an Independent Scientific Review Panel deemed a 12 kHz MBES to be the most plausible trigger for an extreme behavioural response in melon-headed whale *Peponocephala electra* (a toothed whale), which resulted in a mass group stranding in a shallow lagoon in Madagascar in 2008 (Southall et al. 2013). Whilst an unequivocal cause and effect relationship between MBES and the strandings cannot be concluded, the paper states that intermittent, repeated sounds of this nature could present a salient and potential aversive stimulus and suggests potential for such behavioural responses (or indirect injury) from MBES should be considered in environmental assessments (Southall et al. 2013).
119. Regarding grey seal, behavioural response tests to two sonar systems (200 kHz and 375 kHz systems) have been carried out on grey seal at the SMRU seal holding facility (Hastie et al. 2014). Results showed that both systems had significant effects on seal behaviour, with significantly more

time spent hauled out during the 200 kHz sonar operation and although animals remained swimming during operation of the 375 kHz sonar, they were distributed further from the sonar.

120. Aside from displacement or avoidance, other behavioural responses have been demonstrated (Wright and Cosentino, 2015). In some cases, behavioural responses may lead to greater effects, such as strandings (Tyack et al. 2006) or interruptions to migration (Heide-Jørgensen et al. 2013). However, such responses are highly context-dependent and variable, contingent on factors such as the activity of the animal at the time (Robertson, 2014), prior experience to exposure (Andersen et al. 2012), extent or type of disturbance (Melcón et al. 2012), environment in which they inhabit (Heide-Jørgensen et al. 2013), and the type of survey.
121. It is expected that, to some extent, marine mammals will be able to withstand temporary elevated levels of underwater sound during geophysical surveys and behavioural responses are highly species and context specific. Therefore, all marine mammal receptors are deemed to have some resilience to behavioural disturbance, high recoverability and high international value. The sensitivity of the receptor is therefore considered to be **medium**.

9.8.1.2.2 *Magnitude of Impact*

122. The magnitude of impact for underwater noise during geophysical surveys will have the same assessment for all phases of the Wind Farm Infrastructure. It is based on an indicative assessment as at this stage it is yet to be confirmed how many geophysical stages will be needed for construction, O&M, and decommissioning activities. Therefore, the outcomes of the assessment will hold true for all phases as a worst-case.

9.8.1.2.2.1 *Auditory Injury (PTS)*

123. The proposed SBP threshold as noted in **Table 9.20** for the geophysical surveys is expected to operate at a peak level of 247 dB re 1 μ Pa @ 1 m. This exceeds the permanent auditory injury/changes in hearing sensitivity (PTS) thresholds as defined by Southall et al. (2019) for harbour porpoise (202 dB SPL_{peak}), whale species (219 dB SPL_{peak}), dolphin species (230 dB SPL_{peak}), and pinnipeds (218 dB SPL_{peak}).
124. The PTS maximum impact range as a worst-case is used in the assessments (see **Table 9.19**). This is based on underwater noise modelling undertaken for the Green Volt OWF (2023) for an SBP, with a maximum source noise level of 247 dB re 1 μ Pa-m. As a worst-case, the maximum number of marine mammals (percentage of reference population) that could be at risk of PTS from one vessel deploying the geophysical equipment is presented in **Table 9.21**.
125. Given the very slight change in each marine mammal population assessed quantitatively, alongside the temporary nature and limited area of the activity; the magnitude for all marine mammal species is assessed as being **negligible** for auditory injury (PTS) (see **Table 9.21**). Given the limited population and density information for killer whales, fin whales and humpback whales, these are assessed qualitatively, using dolphin species results and minke whale results respectively. Therefore, killer whale, fin whale and humpback whale are also assessed as having a magnitude of **negligible** for auditory injury.

Table 9.21: PTS Assessment for Marine Mammals for a Sub-bottom Profiler Quantitatively

Species	Maximum Number of Individuals (% of Reference Population) – One SBP	Maximum Number of Individuals (% of Reference Population) – Two SBP	Magnitude (Permanent Effect ¹)
Harbour porpoise	0.4 (0.00013% of the NS MU) (0.00027% of the UK portion)	1 (0.0003% of the NS MU) (0.0006% of the UK portion)	Negligible (negligible)
Bottlenose dolphin	0.001 (0.00007% of the GNS MU) (0.00008% of the UK portion)	0.003 (0.0001% of the GNS MU) (0.0002% of the UK portion)	Negligible (negligible)
	0.001 (0.00065% of the CES MU)	0.003 (0.0013% of the CES MU)	Negligible
Common dolphin	0.01 (0.000001% of the CGNS MU) (0.000002% of the UK portion)	0.003 (0.000002% of the CGNS MU) (0.000004% of the UK portion)	Negligible (negligible)
White-beaked dolphin	0.012 (0.00003% of the CGNS MU) (0.00004% of the UK portion)	0.024 (0.00005% of the CGNS MU) (0.00007% of the UK portion)	Negligible (negligible)
Minke whale	<0.0001 (0.00001% of the CGNS MU) (0.00002% of the UK portion)	<0.0001 (0.00002% of the CGNS MU) (0.00004% of the UK portion)	Negligible (negligible)
Grey seal	0.0009 (<0.0001% of Combined MUs)	0.002 (<0.0001% of the Combined MUs)	Negligible
Harbour seal	<0.0001 (<0.0001% of the East Scotland MU)	<0.0001 (<0.0001% of the East Scotland MU)	Negligible
Notes: ¹ Based on the permanent criteria detailed in Table 9.5 .			

9.8.1.2.2.2 Behavioural Disturbance

126. The disturbance maximum impact range as a worst-case is used in the assessments (see **Table 9.19**). This is based on underwater noise modelling undertaken for the Green Volt OWF (2023) for an SBP, with a maximum source noise level of 247 dB re 1 µPa-m. As a worst-case, the maximum number of marine mammals (percentage of reference population) that could be at risk of disturbance from one vessel deploying the geophysical equipment is presented in **Table 9.22**.
127. Given the very slight change in each marine mammal population assessed quantitatively, alongside the temporary nature and limited area of the activity; the magnitude for all marine mammal species

is assessed as being **negligible** for disturbance (see **Table 9.5**). Given the limited population and density information for killer whales and humpback whales, these will be assessed qualitatively, using dolphin species results for killer whales and minke whale results for fin whale and humpback whales. Therefore, killer whale, fin whale and humpback whale are also assessed as having a magnitude of **negligible** for disturbance.

Table 9.22: Disturbance Assessment for Marine Mammals for a Sub-Bottom Profiler

Species	Maximum Number of Individuals (% of Reference Population) – One SBP	Maximum Number of Individuals (% of Reference Population) – Two SBP	Magnitude (Temporary Effect)
Harbour porpoise	8 (0.002% of the NS MU) (0.005% of the UK portion)	16 (0.005% of the NS MU) (0.01% of the UK portion)	Negligible (negligible)
Bottlenose dolphin	0.1901 (0.009% of the GNS MU) (0.010% of the UK portion)	0.3802 (0.019% of the GNS MU) (0.020% of the UK portion)	Negligible (negligible)
	0.1901 (0.08% of the CES MU)	0.3802 (0.17% of the CES MU)	Negligible
Common dolphin	0.1659 (0.0002% of the CGNS MU) (0.0003% of the UK portion)	0.3318 (0.0004% of the CGNS MU) (0.0006% of the UK portion)	Negligible (negligible)
White-beaked dolphin	2 (0.004% of the CGNS MU) (0.006% of the UK portion)	4 (0.009% of the CGNS MU) (0.012% of the UK portion)	Negligible (negligible)
Minke whale	1 (0.005% of the CGNS MU) (0.0097% of the UK portion)	1 (0.005% of the CGNS MU) (0.0097% of the UK portion)	Negligible (negligible)
Grey seal	0.128 (0.0004% of the Combined MUs)	0.336 (0.0008% of the Combined MUs)	Negligible
Harbour seal	<0.0001 (<0.0001% of the East Scotland MU)	<0.0001 (<0.0001% of the East Scotland MU)	Negligible

9.8.1.2.3 Significance of Effect

128. Overall, it is predicted that sensitivity for all marine mammal species is **high** for auditory injury (PTS) and **medium** for disturbance. The magnitude of impact for all marine mammal species is **negligible** for both auditory injury (PTS) and disturbance. The effect is therefore of **minor adverse** significance for auditory injury (PTS) and **negligible adverse** for behavioural disturbance, where both are **not significant** in EIA terms.

9.8.1.2.3.1 Mitigation

129. No additional mitigation is considered necessary because the likely effect in the absence of additional mitigation is **not significant** in EIA terms, however, any geophysical surveys will be undertaken with mitigation in place (subject to a ML where relevant) as required in the JNCC (2017)

guidance (see **Table 9.16**) and all mitigation measures will be listed in the risk assessment to support the EPS licence application.

9.8.1.3 Impact C3: Underwater Noise during Piling

9.8.1.3.1 Impact C3a: Auditory Injury during Piling

9.8.1.3.1.1 Underwater Noise Modelling

130. Underwater noise modelling was carried out by Subacoustech Environmental Limited to predict the noise levels likely to arise during impact piling. The modelled impact ranges were used to determine the potential effects on marine mammals (see **Appendix 9.2: Underwater Noise Modelling Report (Volume IV)** for further details).
131. The underwater noise modelling was undertaken using the Impulsive Noise Propagation and Impact Estimator (INSPIRE) v5.2 subsea noise propagation model. The INSPIRE model is a semi-empirical noise propagation model, based on the use of a combination of numerical modelling and actual measured underwater noise data. It is designed to calculate the propagation of noise in shallow, mixed water, typical of both conditions around the UK (see **Appendix 9.2: Underwater Noise Modelling Report (Volume IV)** for further details).
132. The modelling considered a wide array of input parameters, including variations in bathymetry and source frequency content, to ensure the results were of sufficient quality. It should also be noted that the results presented in this assessment are precautionary, as the worst-case parameters have been selected for:
- Piling hammer blow energies;
 - Soft-start, ramp-up profile and strike rate;
 - Duration of piling; and
 - Receptor swim speeds.
133. A detailed review of the modelling confidence is provided in Section 3.1 of **Appendix 9.2: Underwater Noise Modelling Report (Volume IV)**.

9.8.1.3.1.1.1 Methodology

9.8.1.3.1.1.1.1 Piling locations

134. Modelling was undertaken at three representative locations covering the extents of the Bellrock WFDA. This included deeper locations within the Bellrock WFDA, which tends to give greater noise propagation (**Appendix 9.2 Underwater Noise Modelling Report (Volume IV)**):
- Northwest (NW) corner with a water depth of 71.4 m below lowest astronomical tide (LAT);
 - Southwest (SW) corner with a water depth of 73.0 m below LAT; and
 - East (E) boundary midpoint (E-midpoint) location with a water depth of 82.5 m below LAT.

135. The worst-case scenario anchor type is considered to be a FOU driven pile, was derived from the maximum impact range modelled at the worst-case location (E-midpoint). These were used to inform the assessment of the maximum potential effect on receptor groups in order to provide a conservative assessment.

9.8.1.3.1.1.1.2 Hammer Energy, Soft-start and Ramp-up

136. The underwater noise modelling was based on three sequential FOU driven piles, with maximum diameter of up to 6 m, maximum hammer energy of up to 3,000 kilojoule (kJ), maximum starting energy of 277 kJ and a piling duration of up to 3 hours (2.99 hours).
137. To determine the potential for PTS from SEL_{cum} , the soft-start, ramp-up, hammer energy, total duration and strike rate were all taken into account. **Table 9.23** summarises the soft-start, ramp-up and piling duration used to assess SEL_{cum} for both pile types.
138. As a worst-case scenario, it was assumed that the maximum hammer energy would be required and applied for the remaining duration of the pile installation. However, in practice, the maximum hammer energy is only likely to be required for a small proportion of the piling installations and for shorter periods of time. Therefore, the modelling and assessments are considered conservative and precautionary.

Table 9.23: Summary of Hammer Energy, Soft Start and Ramp-up Used for Piling Modelling for FOU Driven Piles

Parameter	Starting Hammer Energy	Ramp-up	Maximum Hammer Energy
Hammer energy (%)	277 kJ (9%)	Gradual ramp-up	3,000 kJ (100%)
Number of strikes	95	4,672	150
Strikes per minute	6	10 – 30	30
Duration	15 mins, 50 seconds	158 minutes	5 minutes

9.8.1.3.1.1.1.3 Concurrent Piling

139. The underwater noise modelling also included a scenario for concurrent piling at two WTG locations within the WFDA. For the concurrent modelling scenario three sequentially installed FOU driven piles at the NW location and three piles sequentially installed at E-midpoint location within a 24-hour period (equating to a maximum of six piles installed over both locations in a 24-hour period) was considered.
140. The modelling was based on the worst-case of these two locations having the largest separation distance from one another (i.e. NW corner and E-midpoint) (**Appendix 9.2: Underwater Noise Modelling Report (Volume IV)**).

9.8.1.3.1.1.1.4 Noise Source Levels

141. Underwater noise modelling requires knowledge of the source level, which is the theoretical noise level at 1 m from the noise source. The INSPIRE noise propagation model assumes that the noise acts as a single point source. The source level is estimated based on the pile diameter and the hammer energy imparted on the pile by the hammer. This is then adjusted, depending on the water depth at the modelling location, to allow for the length of pile in contact with the water, which can affect the amount of noise that is transmitted from the pile into its surroundings (see **Appendix 9.2 Underwater Noise Modelling Report (Volume IV)** for further information).
142. The unweighted peak sound pressure level (SPL_{peak}) and single strike sound exposure level (SEL_{ss}) source levels estimated for this assessment are summarised in **Table 9.24**. All decibel (dB) SPL values are referenced to 1 μPa and all SEL values are referenced to 1 μPa^2s . Predicted noise levels at 750 m from the piling locations are also provided in **Table 9.24**.

Table 9.24: Unweighted Source Levels Used in Underwater Noise Modelling for FOU Driven Piles

Source Level	FOU Driven Pile (3,000 kJ)	FOU Driven Pile (3,000 kJ) at 750 m
SPL_{peak} (dB re 1 μPa @ 1 m)	245.5 dB re 1 μPa @ 1 m	202.6 dB re 1 μPa
SEL_{ss} (dB re 1 μPa^2s @ 1 m)	217.2 dB re 1 μPa^2s @ 1 m	180.1 dB re 1 μPa^2s

9.8.1.3.1.1.1.5 Environmental Conditions

143. The inclusion of measured data for similar offshore piling operations in UK waters allows the INSPIRE noise propagation model to intrinsically account for various environmental conditions. This includes the differences that can occur with the temperature and salinity of water, as well as the sediment type surrounding the Bellrock WFDA. The majority of the Bellrock WFDA is characterised by sandy sediments assigned to the biotope MD5212 (see **Section 3.2.5 in Appendix 7.1: Benthic Baseline (Volume IV)**). For the modelling, digital bathymetry, from the European Marine Observation and Data Network (EMODnet, 2025) has also been used. Mean sea level has been used throughout.

9.8.1.3.1.1.1.6 Assumptions and Considerations

144. It should be noted, and considered, that the underwater noise modelling and assessment is based on worst-case scenarios and precautionary approaches. This includes assumptions for both the noise source, and the marine mammal themselves.
145. In terms of the noise source, the maximum hammer energy to be applied and maximum piling duration for each scenario was assumed for all piling locations. However, it is unlikely that applying maximum hammer energy throughout the maximum duration would be required at the majority of piling locations. In addition, the maximum predicted impact ranges were based on the location with the greatest potential noise propagation range and this was assumed as the worst-case for each piling location.

146. The assumption that animals are submerged 100% of the time does not account for any time that an individual may spend at the surface. Compared to SELs in the water column, noise levels near the surface are lower, so when cetaceans surface to breathe, or when seals have their head out of the water, the animal would be exposed to lower noise levels.
147. Underwater noise modelling assumes that marine mammals would travel in the mid-water column, where SPLs are greatest. However, in reality, animals would not be subjected to these high SPL at all times, since they are likely to move up and down through the water column. In order to breathe, the animals would have to regularly surface, where the sound pressure would be lower compared to the mid-water column. A study by Teilmann et al. (2007) on diving behaviour of harbour porpoise in Danish waters suggested that animals spent 55% of their time in the upper 2 m of the water column from April to August, and over the whole year, they spent 68% of their time in less than 5 m depth. However, it should be noted that this study was conducted for “undisturbed” animals, which could show a different behaviour.
148. The swimming patterns of harbour porpoise undertaking direct travel are typically characterised by short submergence periods, compared to feeding animals (Watson and Gaskin, 1983). These short duration dives, with horizontal travel, suggest that travelling animals, such as harbour porpoise moving away from pile driving noise, would swim in the upper part of the water column. It would be anticipated that, during a fleeing response from a loud underwater noise (such as piling), that their swimming behaviour may change with a reduction in deep dives. For example, during pile driving playback sounds to examine TTS, harbour porpoise showed behaviour response during the exposure periods which included increased swimming speeds and jumping out of the water more (Kastelein et al. 2016).
149. Noise impact assessments assume that all animals within the noise contour may be affected to the same degree for the maximum worst-case scenario. For example, all animals exposed to noise levels that induce behavioural avoidance would be displaced, or all animals exposed to noise levels that are predicted as above PTS onset levels would suffer permanent, or temporary, auditory injury, respectively.
150. Further work by Thompson et al. (2013) has adopted a Dose-Response Curve (DRC) to produce a theoretical dose-response for PTS in harbour seal, by scaling up Finneran et al. (2005) DRC for changes in levels of TTS at different SEL. In this assessment framework, the probability of seals experiencing PTS was assumed to increase from an SEL of 186, up to 240 dB re 1 $\mu\text{Pa}^2\text{s}$; the point at which all animals are predicted to have PTS.
151. Soft-start and ramp-up periods have been included as tertiary mitigation (**Section 9.7.3**). The soft-start begins with a lower hammer energy, before ramping-up to the maximum hammer energy, with the assumption that marine mammals would move out of the area as the hammer energy is increased.

9.8.1.3.1.1.2 Modelling Results

152. The modelling results showed that, among all modelled locations, the largest impact ranges at the E-midpoint location were the worst-case for the FOU driven pile. Therefore, the PTS assessment will be based on FOU driven piles at the E-midpoint location, as this presents the absolute worst-case due to its high hammer energy.

153. Any predicted ranges smaller than 50 m and areas less than 0.01 km² for single strike criteria and ranges smaller than 100 m and areas less than 0.1 km² for cumulative criteria, have not been presented and are given as “N/A”. At ranges this close to the noise source, the modelling processes are unable to model to a sufficient level of accuracy due to complex acoustic effects present near the source.
154. **Table 9.25** presents the underwater noise modelling results for the predicted PTS impact ranges and areas at the Bellrock WFDA (for the worst-case E-midpoint) from:
- A single strike from the maximum hammer energy;
 - Cumulative SEL (over a 24-hour period) for:
 - Three sequential FOU driven piles per 24-hours;
 - Three sequentially installed FOU driven piles at NW location and three sequentially installed at E-midpoint location within a 24-hour period.

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Table 9.25: Predicted PTS Impact Ranges (and Areas) at the Bellrock WFDA from a Single Strike and from Cumulative Exposure for Maximum Hammer Energy (3,000 kJ)

Species	Impact	Criteria and Threshold	Maximum Impact Range and Area	
			3x FOU Driven Piles at E-midpoint	3x FOU Driven Piles at NW Corner and 3x FOU Driven Piles at E-midpoint in a 24-hour Period
Harbour porpoise (VHF)	PTS from single strike (without mitigation)	SPL _{peak} Unweighted (202 dB re 1 µPa) Impulsive	0.77 km (1.9 km ²)	-
	PTS from cumulative SEL (including soft-start and ramp-up)	SEL _{cum} Weighted (155 dB re 1 µPa ² s) Impulsive	3.7 km (37 km ²)	600 km ²
Dolphin species (HF)	PTS from single strike (without mitigation)	SPL _{peak} Unweighted (230 dB re 1 µPa) Impulsive	N/A	-
	PTS from cumulative SEL (including soft-start and ramp-up)	SEL _{cum} Weighted (185 dB re 1 µPa ² s) Impulsive	N/A	N/A
Baleen whales (LF)	PTS from single strike (without mitigation)	SPL _{peak} Unweighted (219 dB re 1 µPa) Impulsive	0.06 km (0.01 km ²)	-
	PTS from cumulative SEL (including soft-start and ramp-up)	SEL _{cum} Weighted (183 dB re 1 µPa ² s) Impulsive	2.5 km (1,500 km ²)	3,400 km ²
Grey and harbour seal (PCW)	PTS from single strike (without mitigation)	SPL _{peak} Unweighted (218 dB re 1 µPa) Impulsive	0.07 km (0.01 km ²)	-
	PTS from cumulative SEL (including soft-start and ramp-up)	SEL _{cum} Weighted (185 dB re 1 µPa ² s) Impulsive	N/A	70 km ²

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9.8.1.3.1.2 Sensitivity

155. All species of cetaceans rely on sonar for navigation, finding prey and communication, and are therefore highly sensitive to permanent hearing damage (Southall et al. 2007). Any PTS would be permanent and marine mammals within the potential impact area are considered to have very limited capacity to avoid such effects and considered unable to recover from the effects.
156. However, when considering the effect that any auditory injury has on an individual, the frequency range over which the auditory injury occurs must be considered. PTS would normally only be expected in the critical hearing bands, in and around the critical band of the fatiguing sound (Kastelein et al. 2012). Auditory injury resulting from sound sources like piling (where most of the energy occurs at lower frequencies) is unlikely to negatively affect the ability of high-frequency cetaceans to communicate or echolocate. PTS would not result in an individual being unable to hear but could result in some permanent change to hearing sensitivity.
157. Pinnipeds use sound in both air and water for social and reproductive interactions (Southall et al. 2007), but not for finding prey. Therefore, Thompson et al. (2012) suggested damage to hearing in pinnipeds may not be as sensitive as it could be in cetaceans. Pinnipeds also have the ability to hold their heads out of the water during exposure to loud noise, and potentially avoid PTS during piling. As such, sensitivity to PTS in harbour seal and grey seal is expected to be lower than in cetacean species, such as harbour porpoise, with the individual showing some tolerance to avoid, adapt to or accommodate or recover from the effect (for example, Russell et al. 2016).
158. However, the sensitivity for all marine mammal receptors to PTS is considered to be **high** as a precautionary approach.

9.8.1.3.1.3 Magnitude of Impact

9.8.1.3.1.3.1 Permanent Threshold Shift from Single Strike at Maximum Hammer Energy

159. The maximum predicted impact range for PTS from a single strike of a FOU driven pile, with maximum hammer energy of 3,000 kJ, without any mitigation, is up to 0.77 km for harbour porpoise (**Table 9.25**).
160. An assessment of the maximum number of marine mammals that could be at risk of instantaneous PTS from a single strike of a FOU driven pile (at the maximum hammer energy) is presented in **Table 9.26**. This assessment assumed the maximum hammer energy without any mitigation, based on the worst-case E-midpoint location, whereby less than 0.001% of the reference populations are exposed to a permanent effect (**Table 9.26**). As no impact range for PTS from a single strike was produced for dolphin species due to the noise frequency falling outside of the hearing ranges, a conservative approach has been used, and a **negligible** magnitude has been assigned. Fin whale and Humpback whale are baleen whale species and part of the LF hearing group; therefore, the magnitude of impact is **negligible** in line with minke whale assessment due to the similar low density.
161. The magnitude is therefore considered to be **negligible** for all marine mammal species.

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Table 9.26: Maximum Number of Individuals (and % of Reference Population) That Could be at Risk of PTS From a Single Strike of a FOU Driven Pile at the Maximum Hammer Energy (3,000 kJ) Without Mitigation, Based on the Worst-case Location Within the Bellrock WFDA

Species	Criteria and Threshold	Maximum Number of Individuals (% of Reference Population)	Magnitude (Permanent Effect)
Harbour porpoise	SPL _{peak} Unweighted (202 dB re 1 µPa) Impulsive	<3 (0.0009% of the NS MU) (0.0017% of the UK portion)	Negligible (negligible)
All dolphin species	SPL _{peak} Unweighted (230 dB re 1 µPa) Impulsive	N/A	Negligible
Minke whale	SPL _{peak} Unweighted (219 dB re 1 µPa) Impulsive	0.0013 (<0.0001% of the CGNS MU) (<0.0001% of the UK portion)	Negligible (negligible)
Grey seal	SPL _{peak} Unweighted (218 dB re 1 µPa) Impulsive	0.0002 (<0.0001% of Combined MUs)	Negligible
Harbour seal	SPL _{peak} Unweighted (218 dB re 1 µPa) Impulsive	0.0000000002 (<0.0001% of East Scotland MU)	Negligible

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9.8.1.3.1.3.2 *Permanent Threshold Shift from Cumulative Exposure for Sequential Pile Installation*

162. The two largest maximum predicted impact ranges for PTS from cumulative exposure (SEL_{cum}) during the sequential installation of three FOU driven piles, with a maximum hammer energy of 3,000 kJ, in the absence of any additional mitigation, is up to 3.7 km for harbour porpoise and 25 km for minke whale (**Table 9.25**).
163. The SEL_{cum} is a measure of the total received noise over the whole piling operation and the SEL_{cum} range indicates the distance from the piling location an individual would need to be at the onset of piling to avoid exposure to PTS. If the receptor were to start fleeing in a straight line from the noise source, starting at a range closer than the modelled range, it could receive a noise exposure in excess of the criteria threshold. If the receptor were to start fleeing from a range further than the modelled range, it would receive a noise exposure below the criteria threshold (see **Appendix 9.2: Underwater Noise Modelling Report (Volume IV)** for further details).
164. An assessment of the maximum number of individuals that could be at risk of PTS from cumulative exposure during sequential installation of three FOU driven piles is presented in **Table 9.27**. This assessment assumes a maximum hammer energy of 3,000 kJ for a FOU driven pile, without any additional mitigation, and is based on the worst-case E-midpoint location for the maximum impact area (as set out in **Table 9.25**).
165. The magnitude of impact for three FOU driven piles installed at the E-midpoint is therefore considered to be **medium** for harbour porpoise and minke whale (**Table 9.27**). As no impact range for PTS from cumulative exposure was produced for dolphin and seal species a conservative approach has been used, a **negligible** magnitude has been assigned. Fin whale and humpback whale magnitude of impact is **medium** in line with the minke whale assessment.
166. For the concurrent scenario, the magnitude of impact for three FOU driven piles installed at the E-midpoint and three FOU driven piles installed at the NW corner in a 24-hour period is considered to be **high** for minke whale (and therefore **high** for fin and humpback whale), **medium** for harbour porpoise, **low** for grey seal, and **negligible** for dolphin species and harbour seal. No impact range for PTS from cumulative exposure was produced for dolphin species and therefore the conservative approach of a **negligible** magnitude has been assigned.
167. It is important to note that the assessment for PTS from cumulative exposure is highly precautionary. There is some variation in the potential impact ranges for SEL_{cum} at each location and between locations, therefore in many cases less individuals would be at risk of exposure than presented here (as the assessments are based on the worst-case location). It is also unlikely that the maximum hammer energy would be required at all piling locations for the entire duration of the piling activity.

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Table 9.27: Maximum Number of Individuals (and % of Reference Population) That Could be at Risk of PTS From Cumulative SEL of Sequential Installation of Three FOU Driven Piles at the Maximum Hammer Energy (3,000 kJ), Based on the Worst-case Locations at the Bellrock WFDA

Species	Criteria and Threshold	3x FOU Driven Piles at E-midpoint		3x FOU Driven Piles at NW Corner and 3x FOU Driven Piles at E-midpoint in a 24-hour Period	
		Maximum Number of Individuals (% of Reference Population)	Magnitude (Permanent Effect)	Maximum Number of Individuals (% of Reference Population)	Magnitude (Permanent Effect)
Harbour porpoise	SEL _{cum} Weighted (155 dB re 1 μ Pa ² s) Impulsive	<48 (0.01% of NS MU) (0.03% of UK portion)	Low (Low)	<764 (0.22% of NS MU) (0.48% of UK portion)	Medium (Medium)
Dolphin species	SEL _{cum} Weighted (185 dB re 1 μ Pa ² s) Impulsive	N/A	Negligible	N/A	Negligible
Minke whale	SEL _{cum} Weighted (183 dB re 1 μ Pa ² s) Impulsive	<63 (0.31% of CGNS MU) (0.61% of UK portion)	Medium (Medium)	<143 (0.71% of CGNS MU) (1.39% of UK portion)	Medium (High)
Grey species	SEL _{cum} Weighted (185 dB re 1 μ Pa ² s) Impulsive	N/A	Negligible	<2 (0.01% of the combined MUs)	Low
Harbour seal	SEL _{cum} Weighted (185 dB re 1 μ Pa ² s) Impulsive	N/A	Negligible	0.000001 (<0.0001% of the East Scotland MU)	Negligible

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9.8.1.3.1.4 *Significance of Effect*

168. For PTS from a single strike of the maximum hammer energy for FOU driven piles, the effect significance for any permanent changes in hearing sensitivity (PTS) has taken into account the high marine mammal sensitivity and the potential magnitude of the impact. The latter was based on the number of individuals as a percentage of the reference population, as set out in **Table 9.26**. Where no impact range for PTS was produced for dolphin or seal species a conservative approach has been used.
169. The PTS from a single strike of the maximum hammer energy for FOU driven piles, in the absence of any additional mitigation, has been assessed as **Minor adverse** for all marine mammal species which **is not significant** in EIA terms.
170. For PTS from cumulative exposure for the sequential piling of three FOU driven piles at E-midpoint in the absence of any additional mitigation, the effect significance has been assessed as:
- **Major adverse** for baleen whales which is **significant** in EIA terms;
 - **Moderate adverse** for harbour porpoise, which is **significant** in EIA terms; and
 - **Minor adverse** for all dolphin and seal species which is **not significant** in EIA terms.
171. For PTS from cumulative exposure for the concurrent piling of three FOU driven piles at NW corner and three FOU driven piles in a 24-hour period at the E-midpoint in the absence of any additional mitigation, the effect significance has been assessed as:
- **Major adverse** for harbour porpoise and baleen whales and which is **significant** in EIA terms;
 - **Moderate adverse** for grey seal which is **significant** in EIA terms; and
 - **Minor adverse** for all dolphin species and harbour seal which is **not significant** in EIA terms.

9.8.1.3.1.4.1 *Mitigation*

172. The development and implementation of a Piling Noise Mitigation Plan (PNMP) and MMMP for piling (as described in **Table 9.16**) would reduce the risk of PTS from the cumulative exposure for the sequential piling of three FOU driven piles at E-midpoint and for the concurrent piling of three FOU driven piles at NW corner and three FOU driven piles at E-midpoint in a 24-hour period.
173. The MMMP for piling would be developed post -consent, in consultation with the MD-LOT and other relevant organisations, and would be based on the latest information, scientific understanding and guidance, and detailed project design. The MMMP will include further details of the mitigation measures to be adopted in the development of the Bellrock Wind Farm Infrastructure and will be in the **Outline MMMP (Volume V)** submitted alongside the Bellrock WFDA application.
174. Mitigation to reduce the risk of PTS would include establishing a monitoring protocol and ADD activation prior to the soft-start commencing, as required, to be agreed through the MMMP.

175. ADDs have proven to be effective mitigation for harbour porpoise, dolphin species, baleen whales, and seals (Sparling et al. 2015); (McGarry et al. 2017); (McGarry et al. 2020) and have been widely used as mitigation to deter marine mammals during OWF piling.
176. It is important to note that Brandt et al. (2018) found that, at seven German OWFs, in the vicinity (up to 2 km) of the construction sites, harbour porpoise detections declined several hours before the start of piling as a result of increased construction related activities and vessels. Similarly, studies in the Moray Firth, during piling of the Beatrice OWF, indicate higher vessel activity within 1 km was associated with an increased probability of response in harbour porpoise (Graham et al. 2019; Benhemma-Le Gall et al. 2023). This disturbance from vessels of marine mammals from the area around the construction site, prior to piling, would also reduce the risk of PTS.
177. The mitigation measures set out in the MMMP to reduce the risk of PTS could also reduce the number of marine mammals at risk of disturbance. Although it is important to note the trade off with some measures which can also increase disturbance due to also producing noise themselves (for example ADD), see Thompson et al. (2020).

9.8.1.3.1.4.2 *Residual Significance of Effect*

178. Taking into account additional mitigation which would reduce the magnitude (as set out in **Table 9.16**), the residual significance of effect of the potential risk of PTS to marine mammals due to underwater noise during piling, would be **minor adverse**, which is **not significant** in EIA terms, for all species.

9.8.1.3.2 *Impact C3b: Behavioural Impacts Resulting from Piling*

179. There is currently no common agreement on noise thresholds, or criteria, for the behavioural response and disturbance of marine mammals (Southall et al. 2021). A review of current information in relation to the potential disturbance and impact ranges of marine mammals from underwater noise during piling has been included to provide an understanding of the associated potential effects and support the marine mammal assessment (**Appendix 9.5: Marine Mammals Information and Modelling Methods for Disturbance (Volume IV)**).
180. However, current advice from NatureScot is to use a dose-response function based upon data collected, which is detailed further in **Section 9.8.1.3.2.2.1**.
181. It should be noted that a behavioural response does not mean that the individuals would avoid the area. Additionally, the maximum predicted ranges for behavioural response from piling are based on the maximum hammer energy. In reality, the duration of any piling at maximum energy would be less (if this energy is reached at all) and noise propagation would vary considerably with location (i.e. be less than the worst-case modelled).

9.8.1.3.2.1 *Sensitivity*

182. Marine mammals may exhibit varying intensities of behavioural response at different noise levels. The response can vary due to exposure level, the hearing sensitivity of the individual, context, previous exposure history or habituation, motivation and ambient noise levels (e.g. Southall et al. 2007).

183. The response of individuals to a noise stimulus would vary, and not all individuals would respond. However, for the purpose of some of the following assessment approaches, it has been assumed that at the disturbance range, 100% of the individuals exposed to the noise stimulus would respond and be displaced from the area. This is a highly precautionary approach given that it is unlikely that all individuals would be displaced from the potential disturbance area.
184. Harbour porpoise have been shown to be sensitive to construction activities and there is an increased potential for disturbance. Due to the broadband frequencies emitted during construction and the LF hearing spectrum of baleen whales there is also an increased probability of disturbance. Marine mammals within the potential disturbance area are considered to have the capacity to avoid such effects, and any disturbance to marine mammals would be temporary and they would be expected to return to normal behaviour once the disturbance had ceased.
185. Dolphin species are not thought to be as vulnerable to disturbance as harbour porpoise; with larger body sizes and lower metabolic rates, the necessity to forage frequently is lower in comparison. Limited information is available regarding the specific sensitivities of dolphins to disturbance from piling noise as most studies have concentrated on harbour porpoise. A study of the response of bottlenose dolphin to piling noise during harbour construction works at the Nigg Energy Park in the Cromarty Firth (north-east Scotland) found that there was a measurable (albeit weak) response to impact and vibration piling with animals reducing the amount of time they spent in the vicinity of the construction works (Graham et al. 2017; Fernandez-Betelu et al. 2021).
186. The Southall (2021) severity spectrum applies across all marine mammals and therefore it is expected that, as described for harbour porpoise, strong disturbance in the near field could result in displacement whilst mild disturbance over greater ranges would result in other, less severe behavioural responses. Therefore, dolphins are deemed to have some resilience to behavioural disturbance, high recoverability and high international value.
187. Empirical studies have shown that seal behaviour is affected by OWF installation, particularly during pile driving. Harbour seals exhibited significant avoidance behaviour, with reduced abundance up to 25 km from the piling site, although they returned to normal activity within two hours after the noise ceased (Russell et al. 2016). Grey seals displayed varied responses, including changes in diving and swimming patterns, though some showed no reaction at all (Aarts et al. 2018; Hastie et al. 2021). The evidence suggests that seals may weigh the risks of disturbance against the benefits of foraging, with some individuals returning to impacted areas despite exposure to underwater noise.
188. Disturbance from OWF activities may have broader implications for seal fitness and reproductive success. Female seals rely heavily on energy reserves built through increased foraging before breeding and lactation, particularly in late pregnancy when blubber accumulation is critical for milk production. While grey seals fast onshore during a 17-day lactation period and may tolerate some disturbance, they must resume intensive foraging afterward to replenish energy. Displacement from foraging grounds during these sensitive periods could lead to energetic costs, potentially reducing fecundity and survival rates (Mellish et al. 1999; Ailsa et al. 2001; Sparling et al. 2006; Hall and Thompson, 2009).
189. The sensitivity of marine mammals is therefore considered to be **medium** for harbour porpoise and baleen whale species (minke whale, humpback whale and fin whale), and **low** for dolphin species

(bottlenose dolphin, common dolphin, white-beaked dolphin, killer whale) and seal species (grey seal and harbour seal).

9.8.1.3.2.2 *Magnitude of Impact*

190. Potential disturbance of marine mammals from underwater noise during piling has been assessed using different methods for each species (**Table 9.28**).

Table 9.28: Overview of Available and Applied Disturbance Methods for Marine Mammal Species Considered for the Disturbance Assessment

Method	Harbour Porpoise	Dolphin Species	Baleen Whale Species	Seal Species
DRC	✓	✓ (using the harbour porpoise DRC as a proxy)	✓ (using the harbour porpoise DRC as a proxy)	✓
Interim population consequences of disturbance (iPCoD)	✓	✓ (bottlenose dolphin only)	✓ (minke whale only)	✓
ADD	✓	✓	✓	✓

191. For population modelling (iPCoD) available for harbour porpoise, bottlenose dolphin, minke whale, grey seal and harbour seal, the worst-case numbers of animals disturbed will be taken forward. These numbers are derived through the DRC assessment (see final model parameters in **Appendix 9.5: Marine Mammals Information and Modelling Methods for Disturbance (Volume IV)**).

9.8.1.3.2.2.1 *Dose-response Curve Assessment*

192. The application of a DRC allows for an evidence-based estimate of the number of animals disturbed, which accounts for the fact that the likelihood of an animal exhibiting a response to a stressor, or stimulus, will vary according to the dose of stressor or stimulus received (Dunlop et al. 2017). Therefore, unlike the traditional threshold assessments commonly used, a dose-response analysis assumes that not all animals in an impacted area will respond (with behavioural disturbance response in this case).
193. For the purposes of this assessment, the dose was the received single-strike SEL (SEL_{ss}). The use of SEL_{ss} in a dose-response analysis, where possible, is considered best practice in the latest guidance provided by Southall et al. (2021). It accounts for the actual behavioural response (i.e. not all individuals would respond to the same level of noise) and is therefore considered to be a more realistic approach to assessing the potential for disturbance.
194. The dose-response methodology is outlined in **Appendix 9.5: Marine Mammals Information and Modelling Methods for Disturbance (Volume IV)**. The dose-response approach has been undertaken for all piling locations, with the highest resultant number of individuals disturbed presented in this assessment.

195. The estimated numbers of harbour porpoise, dolphin spp. minke whale, grey seal, and harbour seal, and the corresponding percentage of the relevant MU populations that could be disturbed as a result of underwater noise during piling, based on the worst-case FSS type and location, are presented in **Table 9.29**, and **Figure 9.1** to **Figure 9.4 (Volume II)**.
196. As outlined in **Appendix 9.5: Marine Mammals Information and Modelling Methods for Disturbance (Volume IV)**, the application of DRCs developed for the hearing sensitive harbour porpoise is considered conservative for dolphin or baleen whale species. Dolphins are considered HF and baleen whales are considered LF cetaceans and therefore have a different hearing range to those of VHF cetaceans. Further, it should be noted that, this dose-response analysis was carried out in relation to pile driving noise only, and, therefore, does not account for the use of ADDs which may reduce localised marine mammal densities prior to piling. This assessment can therefore be considered conservative.
197. Acoustic recordings of the piling noise were utilised alongside harbour porpoise monitoring to derive a threshold for harbour porpoise reactions to the noise from piling. Declines were found at sound levels exceeding an unweighted SEL_{ss} of 143 dB re 1 μPa^2s and up to 17 km from piling. This means that harbour porpoises may react with avoidance only when exposure exceeds a threshold value of 143 dB re 1 μPa^2s . The unweighted noise threshold value of 143 dB re 1 μPa^2s SEL_{ss} was recently recommended in the position statement on assessing behavioural disturbance of harbour porpoise from underwater sound published by (NRW, 2023b). It is worth noting that the noise threshold of 143 re 1 μPa^2s was derived from modelled average of six different studies of full-scale pile driving operation and thereby represents a large amount of empirical data (Tougaard, 2021). As such, this threshold is also referred to in this assessment to provide context.
198. The CES MU lies approximately 93 km from the Bellrock WFDA site boundary and at this distance the received level from piling will have lost much of its impulsive characteristics (**Figure 9.2**). The outermost noise contours reach the coastal areas and therefore may overlap with the key inshore distribution of bottlenose dolphin in the CES MU (**Figure 9.2**). The modelled noise contours that overlap with the CES MU are above the sound levels exceeding an unweighted SEL_{ss} of 143 dB re 1 μPa^2s . According to the behavioural response severity matrix suggested by Southall et al. (2021) such low level disturbance (scoring between 0 to 3 on a 0 to 9 scale) could lead to mild disruptions of normal behaviours, but prolonged or sustained behavioural effects, including displacement are unlikely to occur. Based on the dose-response presented in Graham et al. (2019) (see **Appendix 9.5: Marine Mammals Information and Modelling Methods for Disturbance (Volume IV)**), from 1% to 10% of animals are likely to respond within noise contours (120 to 135 dB SEL_{ss}) that overlap with the CES MU (**Figure 9.2**). Due to this, disturbance to the bottlenose dolphin population of the CES MU from piling in the Bellrock WFDA has not been considered further.
199. In addition, recent research from Thompson et al. (2025), suggested that even dose-response modelling is likely to be unrealistically conservative, based on new data collected from Moray West's installation of larger monopiles than had previously been studied. However, comparisons of the predictions from the alternative Beatrice response functions provides evidence that distance from source is a better predictor of porpoise responses to piling. For comparison purposes for piling in the Bellrock WFDA, the deterrence function was applied for harbour porpoise, resulting in a drastically lower disturbance estimate when compared to the dose response function. Further information and the comparison between the dose response and distance-based deterrence

function is provided in **Appendix 9.5: Marine Mammals Information and Modelling Methods for Disturbance (Volume IV)**. As a worst-case scenario, the dose-response assessment will still be utilised and noted.

200. As discussed in **Appendix 9.1: Marine Mammals Technical Report (Volume IV)**, the assessments are unable to assess killer whale and humpback whale quantitatively due to the lack of data available in the area. However, dolphin spp. will be used as a proxy for killer whale and minke whale will be used as a proxy for fin and humpback whale. Therefore, as a worst-case, killer whale, fin whale and humpback whale have a magnitude of **low**.

Table 9.29: Number of Individuals (and % of Reference Population) that could be Disturbed During Piling of FOU Driven Piles Based on the Dose-Response Approach

Species	Maximum Number of Individuals Impacted (% Of Reference Population) for FOU driven piles	Magnitude (Temporary Effect)
Harbour porpoise	8,554 (2.5% of NS MU) (5.4% of UK portion)	Low (Medium)
Bottlenose dolphin	<32 (1.6% of GNS MU) (1.7% of the UK portion)	Low (Low)
Common dolphin	642 (0.6% of CGNS MU) (1.1% of the UK portion)	Negligible (Low)
White-beaked dolphin	1,091 (2.5% of CGNS MU) (3.2% of the UK portion)	Low (Low)
Minke whale	504 (2.5% of CGNS MU) (4.9% of the UK portion)	Low (Low)
Grey seal	200 (0.6% of Combined MUs)	Negligible
Harbour seal	0.002 (<0.0001% of East Scotland MU)	Negligible

9.8.1.3.2.2.2 Disturbance During Acoustic Deterrent Device Activation

201. To reduce the risk of PTS, piling could include activation of ADDs prior to the soft-start commencing. Assessment of the potential disturbance during any ADD activation is indicative only at this time as the final requirements for mitigation would be determined in the MMMP prior to construction and would be based upon best available information and methodologies at that time, in consultation with the relevant SNCBs.
202. Based on the worst-case maximum predicted PTS peak impact ranges (SPL_{peak}) during installation of FOU driven piles at full power (see **Table 9.25**), ADD activation would be a necessary mitigation to deter animals out of the impact ranges. Considering known swimming speeds for cetaceans (see bottom of **Table 9.30**) from scientific literature, it was established how far animals would have to swim to flee beyond the modelled PTS (SPL_{peak}) impact ranges.

203. A minimum of 10 minutes ADD activation would be necessary to deter all marine mammals (based on a precautionary swimming speed of 2.1 m/s for minke whale and 1.4 m/s for harbour porpoise with dolphins and seals falling in between this range (SNH, 2016) from the impact area during three FOU driven piles installation required to reach the modelled piling PTS SPL_{peak} impact ranges.
204. However, based on scientific evidence and experiences from other OWF constructions (see **Appendix 9.5: Marine Mammals Information and Modelling Methods for Disturbance (Volume IV)** for more details), an upper boundary has been identified for when ADD activation time appears to become ineffective, thereby becoming an unnecessary additional noise source to the marine environment. This upper limit was identified as approximately 30-minutes, during which marine mammals would swim at least 3.8 km away (see **Table 9.30**). The final Wind Farm Infrastructure design, determined post consent, would define which hammer energies are likely to be used, and for what duration, and may be below the maximum hammer energy assessed. Thus, the impact ranges could be smaller, and the 30-minute ADD duration would also be reduced accordingly.
205. While the PTS SPL_{peak} range for sequential piles is shown as 0.06 km for baleen whales and 0.77 km for harbour porpoise (in **Table 9.25**), this is based on the modelled piling location with the highest effect area (E-midpoint). Therefore, 0.77 km has been used as the maximum PTS SPL_{peak} range which the ADDs must cover. See **Appendix 9.2: Underwater Noise Modelling Report (Volume IV)**. Noting the smaller ranges, a 30-minutes ADD duration is deemed as overly precautionary and a worst-case scenario.

Table 9.30: Effect Ranges of ADD Activation for FOU Driven Piles with the PTS SPL_{peak} Impact Ranges

Species	Baleen Whale (LF)	Dolphins (HF)	Harbour Porpoise (VHF)	Seals (PCW)
Maximum PTS SPL _{peak} impact range (km)	0.06	N/A	0.77	0.07
ADD effect range only (km) (ADD on for 30 min)	3.80 ¹	2.74 ²	2.52 ³	3.24 ⁴
Notes: ¹ Based on a swimming speed of 2.1 m/s (SNH, 2016). ² Based on a swimming speed of 1.52 m/s (Bailey and Thompson, 2006). ³ Based on a swimming speed of 1.4 m/s (SNH, 2016). ⁴ Based on a swimming speed of 1.8 m/s (SNH, 2016).				

206. Based on the above presented information, the assessments for disturbance effects during ADD activation are based on a 30-minute ADD activation for FOU driven piles. The magnitude of the potential impact was assessed as **negligible** for all marine mammal species, with less than 1% of the relevant reference populations anticipated to be temporarily disturbed (**Table 9.31**).

207. Since sightings of killer whales or humpback whales are rare within the Bellrock WFDA, the effect of ADD to these species is considered to be **negligible** in line with the majority of the dolphin species and minke whale.

Table 9.31: Maximum Number of Individuals (and % of Reference Population) that could be Disturbed During 30-minute ADD Activation Prior to Piling

Species	Maximum Number of Individuals (% of Reference Population) Impacted During Driven Installation	Magnitude (Temporary Effect)
Harbour porpoise	<26 (0.0075% of NS MU) (0.0159% of the UK portion)	Negligible (Negligible)
Bottlenose dolphin	<1 (0.035% of GNS MU) (0.037% of the UK portion) (0.442% of the CES MU)	Negligible (Negligible) Negligible
Common dolphin	<1 (0.001% of CGNS MU) (0.002% of the UK portion)	Negligible (Negligible)
White-beaked dolphin	<6 (0.014% of CGNS MU) (0.018% of the UK portion)	Negligible (Negligible)
Minke whale	<2 (0.0099% of CGNS MU) (0.0194% of the UK portion)	Negligible (Negligible)
Grey seal	<1 (0.003% of the Combined MUs)	Negligible
Harbour seal	0.000001 (<0.0001% of East Scotland MU)	Negligible

9.8.1.3.2.2.3 Duration of Piling and Acoustic Deterrent Device Activation

208. The installation period for the FOU driven piles is expected to be carried out over a period of up to seven years with piling occurring up to 50% of the time (**Table 9.15**). This would include transit of the SKS components in batches to the Bellrock WFDA, and installation of piles.
209. Piling would not be constant during the construction period. There would be gaps between the installation of individual piles and, if installed in groups, there would be time periods when piling is not taking place, accounting for vessel transit to and from and within the Bellrock WFDA. There are also likely to be potential breaks for example due to weather.
210. There is also the potential for up to two vessels to be within the WFDA at the same time to install piles concurrently. This would potentially reduce the duration of the installation phase due to the potential overlap but not the duration of noise produced per pile. **Table 9.32** summarises the worst-case scenarios for the duration of piling (including soft-start, ramp-up and ADD activation), based on:
- Maximum number of FOU; and
 - Maximum number of piles.

211. For FOU driven pile installation, including ADD activation, there will be up to 148 days of active piling within the seven-year offshore construction period. Note that the actual active piling period will be less than this, as piling will not be required for the full 2.99 hours per pile at all locations.
212. The duration of piling identified in **Table 9.32** to inform the assessment is based on a very precautionary approach. As demonstrated through experience at other OWFs, the duration can be considered to be overestimated. For example, for the installation of monopile foundations at Dudgeon OWF, the impact assessment estimated a piling period of 93 days, time to install each monopile was estimated to be up to 4.5 hours and the estimated duration of active piling was 301.5 hours (approximately 13 days). However, the actual total duration of active piling was 65 hours (approximately three days) with the average time for installation per monopile of 71 minutes (Dudgeon OWF Limited (DOWL), 2016). Therefore, the actual piling duration was approximately 21% of the predicted maximum piling duration, with similar effects noticed at multiple other OWFs (Dudgeon OWF Limited (DOWL), 2016; Beatrice OWF Limited, 2018; Dogger Bank Offshore Windfarm, 2024).
213. Harbour porpoises exhibit short-term avoidance behaviour in response to OWF piling activities, with exclusion periods lasting up to three days near the noise source. Data from Horns Rev showed porpoises vacated areas within 0.5 to 6 km for a median of 16.6 hours and up to 74.2 hours, with activity significantly reduced within 3 km for 40 hours post-piling (Brandt et al. 2009, Brandt et al. 2011). Effects diminished with distance, returning to normal within 1 – 2.6 hours beyond 9 km. A separate study in the German NS (Brandt et al. 2016) found similar short-term impacts, with porpoise detections reduced for 20 – 31 hours within 2 km of piling and even prior to construction due to increased shipping. However, no long-term population-level effects were observed. It is noted that in some cases noise mitigation measures were employed.
214. The duration of any potential displacement impact would differ depending on the distance of the individual from the piling activity and the noise level the animal is exposed to. Furthermore, for those individuals that are distant from the activity that do not respond, and therefore are not affected, they would continue with their normal behaviour which may involve approaching the Bellrock WFDA.

Table 9.32: Maximum Duration of Piling, Based on Worst-case Scenarios for the Impact Ranges, Including Soft-start, Ramp-up and ADD Activation

Parameter	Number of Piles	Maximum Active Piling Time per Pile	Total Piling Time	ADD Activation ¹
Up to 132 FOUs	9 pin piles per FOUs x 132 = 1,188 piles	2.99 hours including soft-start and ramp-up	3,552.12 hours (148 days)	30 minutes ADD activation prior to each installation = 198 hours
Notes:				
¹ Based on one ADD activation per day of piling.				

9.8.1.3.2.3 *Effect Significance*

215. The effect significance of behavioural impacts resulting from piling is based on the conservative dose-response modelling is:
- **Moderate adverse Effect Significance** for harbour porpoise which is **significant** in EIA terms;
 - **Minor adverse Effect Significance** for bottlenose dolphin, white-beaked dolphin, minke whale, fin whale and humpback whale which is **not significant** in EIA terms; and
 - **Negligible adverse Effect Significance** for common dolphin, killer whale, grey seal and harbour seal which is **not significant** in EIA terms.
216. The quantitative assessments provide a precautionary snapshot of the number of animals disturbed and the percentage of their reference population at a single point in time, which forms the basis for determining the magnitude of impact. Although this assessment quantifies a single event, the duration of effects is also considered. The potential impact of disturbance given further consideration of through the use of population modelling shown below in **Section 9.8.1.3.2.3.1**.

9.8.1.3.2.3.1 *Modelled Population Level Consequences Due to Disturbance*

217. Population modelling has been conducted for harbour porpoise, bottlenose dolphin, minke whale, harbour seal and grey seal. The iPCoD framework (Harwood et al. 2013, King et al. 2015) was used to predict the potential medium- and long-term population consequences of the predicted amount of disturbance resulting from piling at the Bellrock WFDA.
218. The model only has capacity to run simulations for species that have sufficient data on population-specific demographic rates and have undergone the expert elicitation process (Harwood et al. 2013). This is essential in capturing how disturbance modifies the demographic rates and underpins the functioning of the model. The iPCoD modelling methods, including key assumptions and chosen model inputs, are detailed in **Appendix 9.5: Marine Mammals Information and Modelling Methods for Disturbance (Volume IV)**.
219. Regarding interpreting significance through population modelling, there are currently no specific potential biological removal limits in place in UK waters, therefore there are currently no specific thresholds to determine whether a population level effect would be significant in EIA terms.
220. Evans and Arvela (2012) advise that an annual population decline of more than 1% on average over a 12-year period represents unfavourable conservation status. Booth et al. (2016) undertook a study into the use of the iPCoD model for assessing population level effects of OWF piling in the NS. The study assumed that the harbour porpoise population could already be experiencing an annual decline of 1% (in reference to the Evans and Arvela (2012) threshold noted above), and therefore a threshold of an additional 1% annual decline could be used to determine whether the construction works of offshore wind would result in a disturbed population.
221. If, as a result of PTS, a population shows a continued decline of >1% per year (versus a modelled un-impacted reference population) over a set period of time (e.g. the first six years, based on the former FCS reporting period), then there is a high likelihood that a significant effect cannot be ruled out (NRW, 2023a). In the absence of agreed guidance for UK waters, the NRW guidance will be used to inform the potential for a significant population level effect at the Bellrock WFDA. Therefore,

this approach has been applied to the assessments and if a decline is predicted by the population modelling, then the significance of this decline will be considered on a case-by-case, species-by-species basis. It should also be noted that the results of the population modelling inform the significance of a population level of effect, rather than a magnitude.

222. For context, for each species assessed, the estimated number of animals disturbed for each FOU driven pile event are set out in **Appendix 9.5: Marine Mammals Information and Modelling Methods for Disturbance (Volume IV)**. The number of disturbed animals has been determined based on the worst-case assessment presented in **Section 9.8.1.3.2**. The worst-case disturbance assessments for harbour porpoise, bottlenose dolphin, grey seal and harbour seal are based on the dose-response assessment, and for minke whale is based on the known disturbance ranges assessment.

9.8.1.3.2.3.1.1 *Harbour Porpoise*

223. Assuming a precautionary worst-case of 8,554 harbour porpoises disturbed (**Table 9.29**) on every piling day (**Table 9.27**), the iPCoD model estimated there to be only the slightest discernible impact to the harbour porpoise population (**Plate 9.1** and **Table 9.33**).
224. The results from the effects of piling at the Bellrock WFDA has been presented as mean and median ratios of impacted: un-impacted population sizes (**Table 9.33**). The results show **no significant effect** across all time points and a less than 1% population decline over the first six and 25-year period for both the mean and median, with a resultant effect significance of **negligible adverse**.

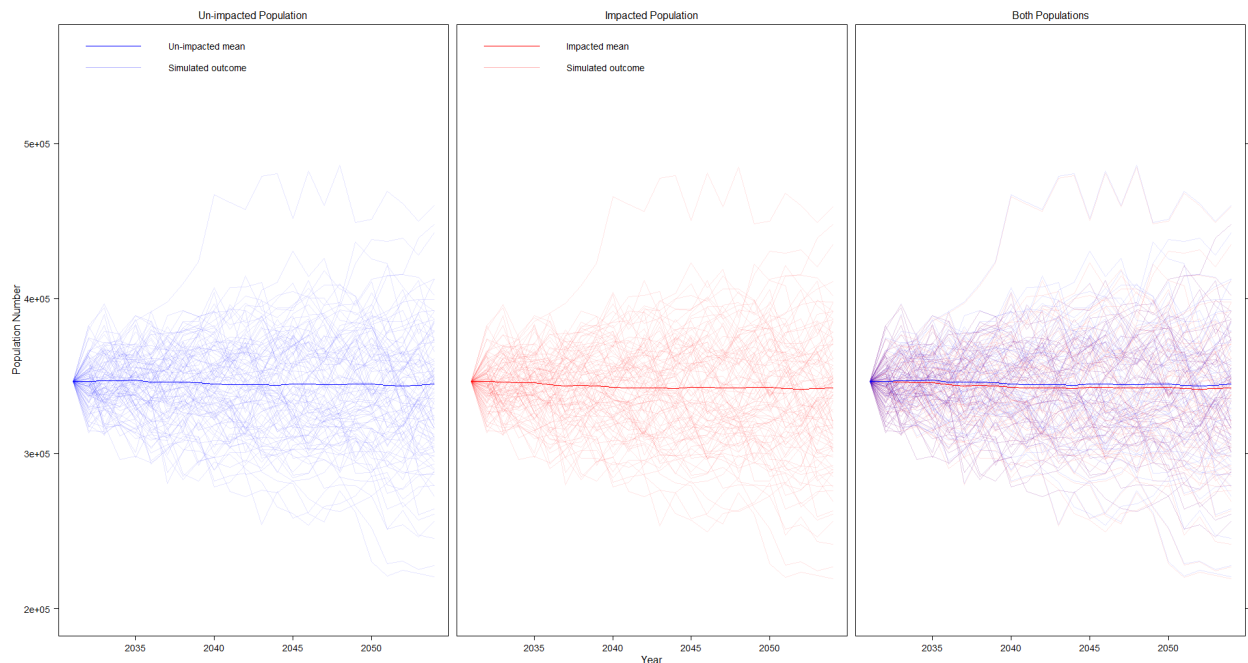
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Table 9.33: Results of the iPCoD Modelling for the Bellrock WFDA, Giving the Mean Population Size for the Harbour Porpoise Population (NS MU) for Years up to 2056 for Both Impacted and Un-impacted Populations, in Addition to the Mean and Median Ratio Between Their Population Sizes

Time Point	Year	Mean			Median			95% Confidence Intervals	
		Un-impacted Population	Impacted Population	Impacted as % of Un-impacted	Un-impacted Population	Impacted Population	Impacted as % of Un-impacted	Un-impacted Population	Impacted Population
1	2031	346,600	346,600	100%	346,600	346,600	100%	346,600 – 346,600	346,600 – 346,600
2	2032	346,768	346,565	99.94%	347,459	347,303	99.99%	317,472 – 373,334	317,460 – 373,334
3	2033	347,005	346,235	99.77%	347,484	346,883	99.92%	309,505 – 378,525	309,049 – 377,295
7	2037	345,985	343,810	99.37%	344,885	342,562	99.77%	294,740 – 401,634	291,339 – 398,592
13	2043	344,590	342,480	99.39%	342,566	340,634	99.79%	276,089 – 426,221	274,814 – 422,312
19	2049	345,053	342,944	99.39%	342,740	340,885	99.79%	262,047 – 438,426	258,108 – 438,426
26	2056	344,697	342,591	99.39%	341,803	340,072	99.79%	247,217 – 454,710	244,833 – 451,394

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Plate 9.1: Simulated Worst-case Harbour Porpoise Population Sizes for Both the Un-impacted and the Impacted Population



9.8.1.3.2.3.1.2 Bottlenose Dolphin

225. Assuming a worst-case of 32 disturbed bottlenose dolphin (**Table 9.29**) on every piling day (**Table 9.27**), the IPCoD model estimated there to be no discernible impact on bottlenose dolphin of the GNS population (**Table 9.7** and **Table 9.34**).
226. The results from the effects of piling at the Bellrock WFDA has been presented as mean and median ratios of impacted: un-impacted population sizes (**Table 9.34**). The results show **no significant effect** across all time points and no change in the population over the first six years and the 25-year period for both the mean and median, with a resultant effect significance of **negligible adverse**.

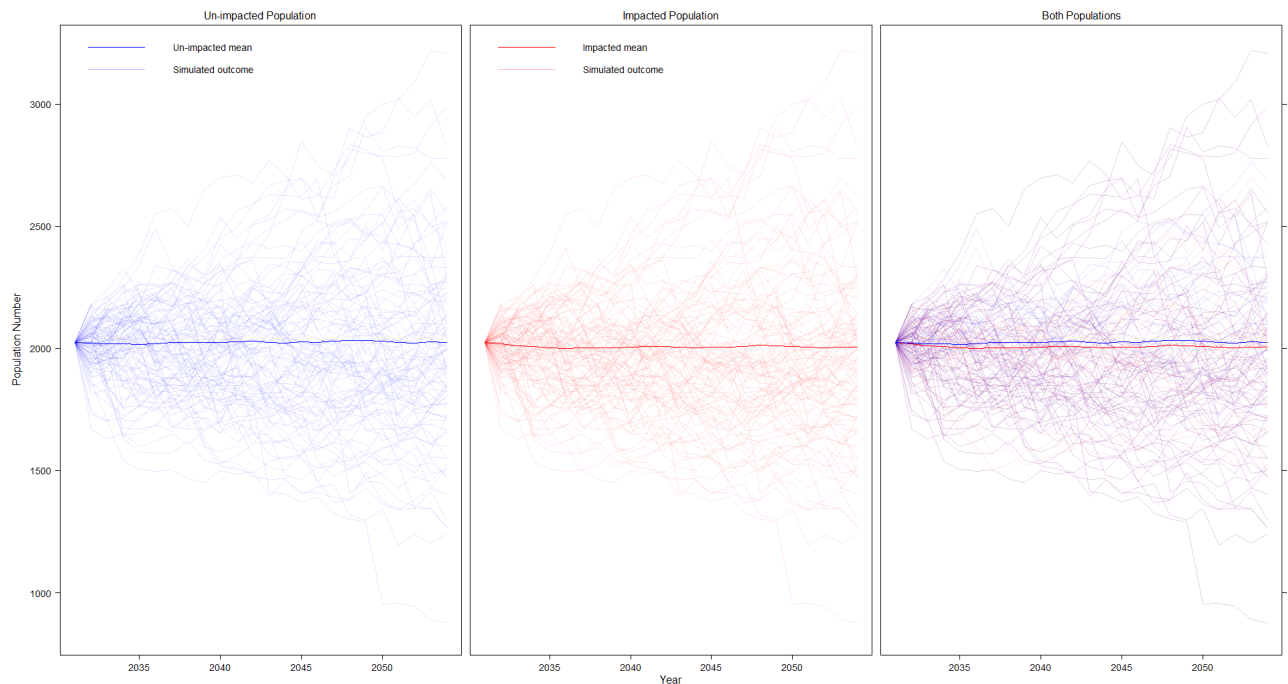
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Table 9.34: Results of the iPCoD Modelling for the Bellrock WFDA, Giving the Mean Population Size for the Bottlenose Dolphin Population (GNS MU) for Years up to 2056 for both Impacted and Un-impacted Populations, in Addition to the Mean and Median Ratio Between Their Population Sizes

Time Point	Year	Mean			Median			95% Confidence Intervals	
		Un-impacted Population	Impacted Population	Impacted as % of Un-impacted	Un-impacted Population	Impacted Population	Impacted as % of Un-impacted	Un-impacted Population	Impacted Population
1	2031	2,024	2,024	100%	2024	2024	100%	2,024 – 2,024	2,024 – 2,024
2	2032	2,021	2,019	99.92%	2,030	2,028	100%	1,826 – 2,164	1,826 – 2,162
3	2033	2,018	2,010	99.64%	2,029	2,022	100%	1,760 – 2,214	1,750 – 2,210
7	2037	2,025	2,002	98.90%	2,036	2,014	100%	1,658 – 2,330	1,614 – 2,310
13	2043	2,026	2,006	99.06%	2,032	2,008	100%	1,536 – 2,524	1,516 – 2,506
19	2049	2,031	2,011	99.02%	2,030	2,012	100%	1,422 – 2,650	1,416 – 2,650
26	2056	2,020	2,000	99.02%	2,002	1,986	100%	1,380 – 2,728	1,368 – 2,710

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Plate 9.2: Simulated Worst-case Bottlenose Dolphin Population Sizes (for GNS MU) for both the Un-impacted and the Impacted Population



9.8.1.3.2.3.1.3 Minke Whale

227. Assuming a worst-case of 504 disturbed minke whale (**Table 9.29**) on every piling day the iPCoD model estimated there to be a significant impact on minke whale of the UK portion of the CGNS population (**Table 9.37** and **Plate 9.3**).
228. The results from the effects of piling at the Bellrock WFDA has been presented as mean and median ratios of impacted: un-impacted population sizes (**Table 9.37**). The results show **no significant effect** across all time points and no change in the population over the first six years and the 25-year period for both the mean and median, with a resultant effect significance of **negligible adverse**.

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Table 9.35: Results of the iPCoD Modelling for the Bellrock WFDA, Giving the Mean Population Size for the Minke Whale Population (CGNS MU) for Years up to 2056 for both Impacted and Un-impacted Populations, in Addition to the Mean and Median Ratio Between their Population Sizes

Time point	Year	Mean			Median			95% Confidence Intervals	
		Un-impacted Population	Impacted Population	Impacted as % of Un-impacted	Un-impacted Population	Impacted Population	Impacted as % of Un-impacted	Un-impacted Population	Impacted Population
1	2031	20,120	20,120	100%	20,120	20,120	100%	20,120 – 20,120	20,120 – 20,120
2	2032	20,069	20,069	100%	20,162	20,162	100%	17,972 – 21,784	17,972 – 21,784
3	2033	20,098	20,096	99.99%	20,148	20,148	100%	17,326 – 22,580	17,325 – 22,568
7	2037	20,052	20,048	99.99%	20,086	20,086	100%	16,712 – 23,604	16,708 – 23,604
13	2043	20,160	20,159	99.99%	19,988	19,988	100%	16,024 – 25,192	16,007 – 25,192
19	2049	20,170	20,169	99.99%	19,968	19,968	100%	14,945 – 26,682	14,945 – 26,682
26	2056	20,146	20,145	99.99%	19,976	19,976	100%	14,256 – 27,534	14,256 – 27,534

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Plate 9.3: Simulated Worst-case Minke Whale Population Sizes for Both the Un-impacted and the Impacted Population



9.8.1.3.2.3.1.4 Grey Seal

229. Assuming a worst-case of 200 disturbed grey seal (**Table 9.29**) on every piling day (**Table 9.27**), the iPCoD model estimated there to be only the slightest discernible impact on grey seal of the Combined MU population (**Plate 9.4** and **Table 9.36**).
230. The results from the effects of piling at the Bellrock WFDA has been presented as mean and median ratios of impacted: un-impacted population sizes (**Table 9.36**). The results show **no significant effect** across all time points and there is no population decline over the first six years and the 25-year period for both the mean and median, with a resultant effect significance of **negligible adverse**.

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Table 9.36: Results of the iPCoD Modelling for the Bellrock WFDA, Giving the Mean Population Size for the Grey Seal Population (Combined MU) for Years up to 2056 for both Impacted and Un-impacted Populations, in Addition to the Mean and Median Ratio Between their Population Sizes

Time Period	Year	Mean			Median			95% Confidence Intervals	
		Un-impacted Population	Impacted Population	Impacted as % of Un-impacted	Un-impacted Population	Impacted Population	Impacted as % of Un-impacted	Un-impacted Population	Impacted Population
1	2031	33,336	33,336	100%	33,336	33,336	100%	33,336 – 33,336	33,336 – 33,336
2	2032	33,619	33,619	100%	33,736	33,736	100%	30,830 – 35,824	30,830 – 35,824
3	2033	34,038	34,038	100%	34,203	34,203	100%	30,281 – 36,778	30,281 – 36,778
7	2037	35,362	35,362	100%	35,347	35,347	100%	29,874 – 40,569	29,874 – 40,569
13	2043	37,649	37,649	100%	37,302	37,302	100%	30,071 – 45,959	30,071 – 45,959
19	2049	39,958	39,958	100%	39,675	39,675	100%	30,019 – 51,103	30,019 – 51,103
26	2056	42,727	42,727	100%	42,350	42,350	100%	30,140 – 56,721	30,140 – 56,721

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Plate 9.4: Simulated Worst-case Grey Seal Population Sizes for Both the Un-impacted and the Impacted Population



9.8.1.3.2.3.1.5 Harbour Seal

231. Assuming a worst-case of 0.002 disturbed harbour seal (**Table 9.29**) on every piling day (**Table 9.27**), the iPCoD model estimated there to be no impact on harbour seal of the East Scotland MU population (**Table 9.39** and **Plate 9.5**).
232. The results from the effects of piling at the Bellrock WFDA has been presented as mean and median ratios of impacted: un-impacted population sizes (**Table 9.39**). The results show **no significant effect** across all time points and that there is no population decline over the first six years and the 25-year period for both the mean and median, with a resultant effect significance of **negligible adverse**.

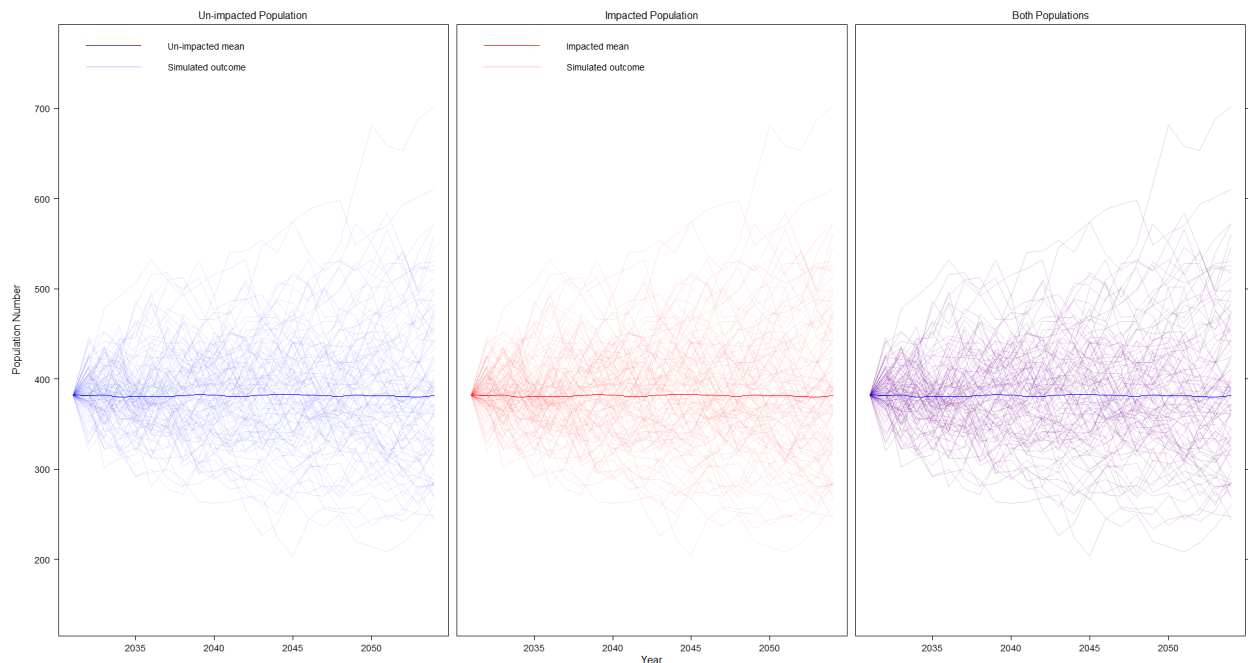
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Table 9.37: Results of the iPCoD Modelling for the Bellrock WFDA, Giving the Mean Population Size for the (Stable) Harbour Seal Population (East Scotland MU) for Years up to 2056 for both Impacted and Un-impacted Populations, in Addition to the Mean and Median Ratio Between their Population Sizes

Time Period	Year	Mean			Median			95% Confidence Intervals	
		Un-impacted Population	Impacted Population	Impacted as % of Un-impacted	Un-impacted Population	Impacted Population	Impacted as % of Un-impacted	Un-impacted Population	Impacted Population
1	2031	382	382	100%	382	382	100%	382 - 382	382 – 382
2	2032	381	381	100%	382	382	100%	330 - 434	330 – 434
3	2033	382	382	100%	382	382	100%	320 - 448	320 – 448
7	2037	381	381	100%	378	378	100%	290 - 488	290 – 488
13	2043	382	382	100%	378	378	100%	280 - 508	280 – 508
19	2049	382	382	100%	374	374	100%	248 - 536	248 – 536
26	2056	381	381	100%	374	374	100%	238 - 570	238 - 570

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Plate 9.5: Simulated Worst-case Harbour Seal (Stable) Population Sizes for Both the Un-impacted and the Impacted Population



233. Reports on declining populations in the East Scotland MU (SCOS, 2024) led to the use of population modelling using the East Coast MU parameters which indicate a declining population (see **Appendix 9.5: Marine Mammals Information and Modelling Methods for Disturbance (Volume IV)** for details and parameters). Regardless of whether piling at the Bellrock WFDA took place, it is estimated that there is a significant impact to the harbour seal East Scotland MU population (see **Table 9.38** and **Plate 9.6**).
234. There is no additional decline in the harbour seal population as a result of the Bellrock WFDA. As outlined in **Appendix 9.1: Marine Mammals Technical Report (Volume IV)**, harbour seal are unlikely to be present in the Bellrock WFDA and therefore not affected by piling. Given that the population is already experiencing declines (SCOS, 2024), it is considered that there would not be an additional decline as a result of construction of Bellrock WFDA infrastructure. Consequently, the resultant effect significance is assessed as **negligible adverse**.

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Table 9.38: Results of the iPCoD Modelling for the Bellrock WFDA, Giving the Mean Population Size for the (declining) Harbour Seal Population (East Scotland MU) for Years up to 2056 for both Impacted and Un-impacted Populations, in Addition to the Mean and Median Ratio Between their Population Sizes

Time Period	Year	Mean			Median			95% Confidence Intervals	
		Un-impacted Population	Impacted Population	Impacted as % of Un-impacted	Un-impacted Population	Impacted Population	Impacted as % of Un-impacted	Un-impacted Population	Impacted Population
1	2031	386	386	100%	386	386	100%	386 - 386	386 - 386
2	2032	317	317	100%	316	316	100%	272 - 360	272 - 360
3	2033	261	261	100%	260	260	100%	216 - 314	216 - 314
7	2037	117	117	100%	116	116	100%	76 - 164	76 - 164
13	2043	36	36	100%	36	36	100%	12 - 66	12 - 66
19	2049	11	11	100%	10	10	100%	0 - 28	0 - 28
26	2056	3	3	100%	0	0	100%	0 - 12	0 - 12

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Plate 9.6: Simulated Worst-case Harbour Seal (Declining) Population Sizes for Both the Un-impacted and the Impacted Population



9.8.1.3.2.3.1.6 Summary of Significance of Effect

235. The iPCoD modelling for all species assessed for the Bellrock WFDA showed no significant population decline across any of the timepoints when comparing the impacted and un-impacted population level effects. For all species, the impact of piling at the Bellrock WFDA was modelled to show no decline in population that would be considered significant over the first six years or 25 years for the population modelling period has been assessed as **negligible adverse** and is **not significant** in EIA terms.
236. The declining population of harbour seals showed significant modelled losses in their population. Although the decline is steep, the results show that there is no difference in the un-impacted vs the impacted population, with no additional decline as a result of the Bellrock WFDA.
237. Repeated disturbance events are not expected to have a sustained significant effect on the wider population. This is shown in the results of the iPCoD modelling that consider piling disturbance over time. However, it is important to note that animals may incur some energetic cost during the construction period (e.g. Williams et al. 2006; Hastie et al. 2021; Frankish et al. 2023). The results of the iPCoD modelling indicate that there would be no effect at the population level for any of the modelled species.
238. The overall significance has been considered on a precautionary approach based on professional analysis of the overall evidence base of available literature on disturbance, the precautionary approach of applying the DRC assessment and the iPCoD modelling. The potential significance of effect from disturbance is:

- **Minor adverse** for harbour porpoise, bottlenose dolphin, white-beaked dolphin, minke whale, fin whale and humpback whale which is **not significant** in EIA terms; and
- **Negligible adverse** for common dolphin, killer whale, grey seal and harbour seal which is **not significant** in EIA terms.

239. Disturbance during ADD activation had a potential magnitude of temporary impact (e.g. number of individuals as a percentage of the reference population) assessed as negligible for all scoped in species (**Table 9.32**). Consequently, the significance of effect for disturbance during ADD activation, has been assessed as **negligible adverse** and is **not significant** in EIA terms (**Table 9.30**).

9.8.1.3.2.3.2 *Mitigation*

240. The measures discussed in **Table 9.16**, including a PNMP and MMMP can also be applicable to reduce behavioural impacts resulting from piling. Therefore, the residual significance of effect for behavioural impacts resulting from piling at Bellrock WFDA would have a reduced magnitude following on from the mitigation and would be **negligible** to **minor adverse** (i.e. **not significant** in EIA terms).

9.8.1.3.2.3.3 *Residual Significance of Effect*

241. Overall, it is concluded that the significance of effect for harbour porpoise, bottlenose dolphin, white-beaked dolphin, minke whale, fin whale and humpback whale taking into account both methods (i.e. DRC and iPCoD) is **minor adverse** and for common dolphin, killer whale, grey seal and harbour seal the significance of effect is **negligible adverse** which are **not significant** in EIA terms.

9.8.1.4 **Impact C4: Underwater Noise from non-piling Construction Other Activities**

242. Potential sources of underwater noise during construction activities, other than driven piling and substructure installation, include:

- Boulder clearance;
- Cable and cable protection installation methods:
 - Ploughing;
 - Trenching;
 - Jetting; and
 - Rock placement.
- Subsea cable hubs installation and
- Other anchor installation activities:
 - Gravity based anchors;
 - FOU Driven piles Drive-Drill-Drive process;
 - Suction piles; and
 - Drag embedment anchors.

243. The current cable installation methods being considered for use within the Bellrock WFDA include ploughing, trenching and jetting. Additionally, surface laying with cable protection is being considered where burial is not feasible.
244. There are no clear indications that underwater noise caused by the installation of subsea cables poses a high risk of harming marine mammals (OSPAR, 2009). However, behavioural responses of marine mammals to dredging, an activity emitting comparatively higher underwater noise levels, are predicted to be similar to those during cable installation (OSPAR, 2009).
245. Reviews of published sources of underwater noise during cable installation activities (e.g. Thomsen et al. 2006; Theobald et al. 2011; Todd et al. 2014), indicated that the sound levels that marine mammals may be exposed to, although they vary, are typically below auditory injury thresholds (PTS) exposure criteria (as defined in Southall et al. 2019). Therefore, the potential risk of any auditory injury in marine mammals due to dredging activity is highly unlikely. Underwater noise during non-piled substructure installation is anticipated to be comparable or less than modelled impact ranges for cable trenching/cutting.

9.8.1.4.1 Underwater Noise Modelling

246. Site-specific underwater noise modelling was undertaken to determine the potential risk for PTS and disturbance from underwater noise from noise sources other than piling.
247. The underwater noise propagation modelling was conducted using a simple modelling approach, using measured sound source data from Subacoustech's breadth of data, scaled to relevant parameters for the Wind Farm Infrastructure. To account for the weightings required for modelling using the Southall et al. (2019) criteria, reductions in source level were applied to the various noise sources (see **Appendix 9.2: Underwater Noise Modelling Report (Volume IV)** for further information). **Table 9.39** shows the assessed activities and their source levels.

Table 9.39: Estimated Source Levels from Construction Activities (Other than Driven Piling)

Activity	Source level (SPL)
Trenching	172 dB re 1 μ Pa @ 1 m
Cable laying	171 dB re 1 μ Pa @ 1 m
Rock placement	166 dB re 1 μ Pa @ 1 m

248. The non-impulsive thresholds for PTS onset in harbour porpoise (as the most sensitive species) is 173 dB SEL_{cum} (dB re 1 μ Pa²s), as shown in **Table 9.40**. This means that construction activities are unlikely to exceed this threshold. For all other species groups, the noise levels from the activities listed in **Table 9.39** are below the non-impulsive PTS onset thresholds. Marine mammals would have to be at very close range at the start of the activity to experience PTS. It is also important to note that given the maximum impact range of 1.1 km, there is increasing evidence that harbour porpoise will be deterred from this area simply by the presence of vessels (Benhemma-Le Gall et al. 2023; Fernandez-Betelu et al. 2024). The impact ranges were modelled to be below the PTS hearing thresholds and are therefore not presented or taken forward to assessment (see

Section 5.1 in **Appendix 9.2: Underwater Noise Modelling Report (Volume IV)** details further information).

249. It should be noted that the modelling results showed that all marine mammals would not experience PTS assuming they would flee when the activity begins considering the vessel noise disturbance (Fernandez-Betelu et al. 2024). An exception to this is the sound exposure during rock placement, which poses a potential risk of disturbance for harbour porpoise up to 800 m from the source (Table 5-4 in **Appendix 9.2: Underwater Noise Modelling Report (Volume IV)**).
250. Consequently, the following assessment is based on a worst-case scenario, whereby a 'stationary' marine mammal would be less than 100 m from the continuous noise source at the onset of the activity. The result of the underwater noise modelling are shown in **Table 9.40**.
251. It should be noted that the predicted impact ranges are the distances which represent the 'onset' stage, which is the minimum exposure that could potentially lead to the start of an impact and may only be marginal. In most hearing groups, the noise levels are low enough that there is negligible risk.
252. For SEL_{cum} calculations, it is important to account for the duration of the noise. To provide a worst-case scenario (in terms of impact range), all noise sources are presumed to operate continuously for 24-hours. This, however, presents an unlikely case, and as such the presented impact ranges are conservative with best available collected noise data using Subacoustech's dataset at the time of writing.

Table 9.40: Predicted Impact Ranges (and Areas) for PTS from 24- hour Cumulative Exposure During Other Construction Activities (Assuming a Stationary Receptor)

Activity	Harbour Porpoise (VHF)	Dolphin Species (HF)	Baleen Whale Species (LF)	Grey and Harbour Seal (PCW)
	SEL_{cum} Weighted (173 dB re 1 μ Pa) Non-impulsive	SEL_{cum} Weighted (198 dB re 1 μ Pa) Non-impulsive	SEL_{cum} Weighted (199 dB re 1 μ Pa) Non-impulsive	SEL_{cum} Weighted (201 dB re 1 μ Pa) Non-impulsive
Trenching	N/A	N/A	N/A	N/A
Cable laying	N/A	N/A	N/A	N/A
Drilling	N/A	N/A	N/A	N/A
Rock placement	1.1 km (3.8 km ²)	N/A	N/A	N/A

9.8.1.4.2 Sensitivity

253. All species of marine mammals are considered to have a **high** sensitivity to PTS due to construction activities if they are within the potential effect ranges for physical injury or PTS. Marine mammals within the potential effect area are considered to have very limited capacity to avoid such effects, and unable to recover from physical injury or auditory injury.

254. The sensitivity of marine mammals to disturbance as a result of underwater noise during construction activities, other than driven piling, is considered to be **medium** for harbour porpoise and baleen whale species and **low** for dolphin species and seal species (**Section 9.8.1.3.2.1**). Marine mammals within the potential disturbance area are considered to have limited capacity to avoid such effects, although any disturbance to marine mammals would be temporary and they would be expected to return to normal behaviour once the disturbance had ceased, or they had become habituated to the sound.

9.8.1.4.3 *Magnitude of Impact*

9.8.1.4.3.1 *Auditory Injury*

255. As noted in **Table 9.40**, harbour porpoise (VHF) is the only species which could experience PTS, this has been the only species assessed for auditory injury, with all other marine mammal species given a magnitude of **no change**.
256. As also shown in **Table 9.40**, the only other activity which could bring about the onset of auditory injury in a stationary harbour porpoise is rock placement. With the distance of 1.1 km modelled for rock placement, the maximum number that could be affected is five individuals, which is 0.003% of the UK portion of the NS MU and 0.0014% of the whole NS MU. This gives a magnitude of impact as **low** for harbour porpoise.
257. It should be noted that ranges for stationary animals are theoretical only and will be over-conservative as there is strong empirical evidence (e.g. Fernandez-Betelu et al. 2024) for the assumption that receptors remain stationary in relation to the noise source for the entire assessment period (24-hours) is likely to be unrealistic.

9.8.1.4.3.2 *Disturbance*

258. Underwater noise as a result of cable installation activities has the potential to disturb or result in behavioural responses in marine mammals (Pirrotta et al. 2013; Todd et al. 2014; Southall et al. 2007).
259. Studies undertaken during the construction of two Scottish OWFs (Beatrice OWF and Moray East OWF) (Benhemma-Le Gall et al. 2021), found that there was a reduction in porpoise presence detected at up to 12 km from pile driving, and up to 4 km from construction activities. With construction activities 2 km from Cetacean Porpoise Detectors locations, harbour porpoise activity decreased by up to 35.2%; with construction activities 3 km from the Cetacean Porpoise Detectors, there was a decrease of up to 24%. At 4 km from construction activities, there was an increase of harbour porpoise detection by 7.2%. This implies that harbour porpoise activity decreases within a 4 km radius from the distance to the activity. At the time of the detections, there were multiple construction activities being undertaken with a variety of support vessels present. Outside of the piling period, the study found that the presence of harbour porpoise decreased by 17%, with SPLs of 57 dB (above ambient noise). While the study did not define which activities were taking place to cause the disturbance, the study occurred whilst a number of construction vessels were on site (Benhemma-Le Gall et al. 2021).
260. Fernandez-Betelu et al. (2024) found that in relation to decommissioning activities, harbour porpoise was only displaced up to 2 km, in line with Benhemma-Le Gall et al. (2021). Observations have shown that harbour porpoises returned to baseline levels immediately after vessel departed

following decommissioning activities at oil and gas structures (Fernandez-Betelu et al. 2024). Although the study did not specify which noisy activities were conducted, the immediate recovery time serves as a useful indicator for the expected impact of similar or potentially less noisy activities.

261. Brandt et al. (2018) found that harbour porpoise detections declined several hours before piling began at seven German OWFs due to increased construction-related activity and vessel presence within a 2 km vicinity of the construction sites. Similarly, studies in the Moray Firth during piling at the Beatrice OWF linked higher vessel activity within 1 km to a greater likelihood of harbour porpoise responses (Graham et al. 2019).
262. The following assessments are based on the precautionary approach of 4 km disturbance distance for construction activities that could be on site during the construction period (Benhemma-Le Gall et al. 2021).
263. Harbour porpoise are the most sensitive marine mammal species to this type of noise. Therefore, this 4 km potential disturbance range (with a potential impact area of 50.27 km²) has been used for all species assessed, due to the absence of any other data to inform an assessment (**Table 9.41**).
264. As a precautionary approach, the potential disturbance from four activities occurring at the same time was also assessed, based on a maximum impact area of 201.1 km² (**Table 9.41**). This was considered a conservative impact range as the original 4 km disturbance range was based on multiple activities and vessels ongoing at any one given time.
265. All related construction activities were considered to be moving sources, and therefore, once the activity/vessel moved past a certain area, the marine mammals would return to normal behaviour after the activity.
266. The potential for disturbance that could result from underwater noise during other construction activities, would be temporary in nature, not consistent throughout the offshore construction period (up to seven years; **Table 9.15**), and would be limited to only part of the overall construction period and area at any one time.
267. The magnitude of impact is therefore considered to be **negligible** for all species for individual activities and four activities together (**Table 9.41**), apart from bottlenose dolphins from the CES MU, which has a magnitude of **low**.

Table 9.41: Maximum Number of Individuals (and % of Reference Population) That Could be at Risk of Disturbance as a Result of Underwater Noise Associated with Other (Non-driven Piling) Construction Activities at the Bellrock WFDA

Species	Maximum Number of Individuals (% of Reference Population) That Could be Disturbed for One Activity (50.27 km ²)	Magnitude (Temporary)	Maximum Number of Individuals (% of Reference Population) That Could be Disturbed for Four Activities (201.1 km ²)	Magnitude (Temporary)
Harbour porpoise	64 (0.018% of NS MU) (0.040% of the UK portion)	Negligible (Negligible)	256 (0.07% of NS MU) (0.16% of the UK portion)	Negligible (Negligible)
Bottlenose dolphin	<2 (0.099% GNS MU) (0.106% of the UK portion)	Negligible (Negligible)	6 (0.30% of GNS MU) (0.32% of the UK portion)	Negligible (Negligible)
	<2 (0.885% of CES MU)	Negligible	6 (2.65% of the CES MU)	Low
Common dolphin	<2 (0.002% of CGNS MU) (0.003% of the UK portion)	Negligible (Negligible)	6 (0.01% of CGNS MU) (0.01% of the UK portion)	Negligible (Negligible)
White-beaked dolphin	<13 (0.030% of CGNS MU) (0.038% of the UK portion)	Negligible (Negligible)	49 (0.11% of CGNS MU) (0.14% of the UK portion)	Negligible (Negligible)
Minke whale	<3 (0.015% of CGNS MU) (0.029% of the UK portion)	Negligible (Negligible)	9 (0.04% of CGNS MU) (0.09% of the UK portion)	Negligible (Negligible)
Grey seal	2 (0.006% of combined MUs)	Negligible	5 (0.01% of combined MUs)	Negligible
Harbour seal	<0.0001 (<0.0001% of East Scotland MU)	Negligible	<0.0001 (<0.0001% of East Scotland MU)	Negligible

9.8.1.4.4 Significance of Effect

268. It is predicted that for auditory injury (PTS) the sensitivity of marine mammal receptors is **high**, the magnitude of impact for harbour porpoise is **low** and all other marine mammals is **negligible**. Therefore, the effect significance is **moderate adverse** for harbour porpoise; however this is based on a stationary individual which is highly unrealistic; therefore as a precautionary approach based on a professional analysis of the overall evidence base, including the number of animals impacted at any one time and the duration of effects the final effect significance is **minor adverse** significance, which is **not significant** in EIA terms. For other all marine mammal receptors, as a conservative approach, the effect significance is deemed as **negligible adverse** significance, which is **not significant** in EIA terms.
269. It is predicted that for disturbance the sensitivity is **medium** for harbour porpoise and baleen whales and **low** for dolphins and seals. The magnitude for bottlenose dolphin of the CES MU is **low**, with all other marine mammal receptors having a magnitude of **negligible**. Therefore, the effect significance is **minor adverse** for bottlenose dolphin and **negligible adverse** for all of marine mammal receptors, both are **not significant** in EIA terms.

9.8.1.4.4.1 Mitigation

270. No additional mitigation is considered necessary because the likely effect in the absence of additional mitigation is not significant in EIA terms. General measures set out in **Table 9.16** will apply.

9.8.1.5 Impact C5: Underwater Noise and Presence of Vessels

271. There would be an increase in the number of vessels in the Bellrock WFDA and in transit from port during construction. The number, type and size of vessels would vary, depending on the activities taking place, at any one time. **Chapter 12: Shipping and Navigation (Volume II)** provides a baseline for shipping activity in the shipping and navigation study area (Bellrock WFDA plus 10 nm buffer).
272. As the vessels undertaking work in the Bellrock WFDA are relatively slow moving or even stationary, most noise emitted by the vessel itself is likely to be of a low frequency. This is because stationary vessels emit less propulsion noise and experience reduced cavitation compared to moving vessels (Hildebrand, 2009; Ainslie, 2010). Noise levels reported by Malme et al. (1989) and Richardson et al. (1995) for transiting large surface vessels indicate that physiological damage to auditory sensitive marine mammals is unlikely. The potential risk of PTS in marine mammals caused by vessel noise is highly unlikely, as the sound levels are well below the threshold for PTS (Southall et al. 2019; Trigg et al, 2020).
273. A behavioural response to underwater noise from vessel noise is displacement from the area. It is predicted that marine mammals would return once the vessel have left the area therefore, any impacts from underwater noise would be both localised and temporary.
274. To conduct a quantitative assessment of disturbance, displacement as a metric of disturbance was used to present the worst-case behavioural scenario for marine mammals. However, other behavioural responses may occur that do not involve moving away from an area but are not quantifiable. These include changes in breathing patterns and diving behaviour, cessation of echolocation, or alterations in typical foraging behaviour. Although there may be the possibility of animals altering their behaviour (other than being displaced), it would only be short term.
275. There is limited data on the potential for a behavioural response or disturbance from other construction activities (or other continuous noise sources), but a few studies provide relevant evidence. For example, the results of tagged harbour seal in the Wash in 2012 (Russell, 2016) indicated foraging activity during offshore construction activities at Sheringham Shoal and found that there was no significant displacement during construction.
276. A study of the noise source levels from several different vessels (Jones et al. 2017) indicated that, for a cargo vessel of 126 m in length (on average), travelling at a speed of 11 kt (on average), would generate a mean sound level of 160 dB re 1 μ Pa @ 1 m (with a maximum sound level recorded of 187 dB re 1 μ Pa @ 1 m). These levels could be sufficient to cause local disturbance to marine mammals in the immediate vicinity of the vessel, depending on ambient noise levels.
277. Thomsen et al. (2006) reviewed the effects of ship noise on harbour porpoise and harbour seal. Ship noise at around 0.25 kilohertz (kHz) could be detected by harbour porpoise at distances of 1 km and for harbour seal at about 20 km distance, while ship noise at around 2 kHz could be detected up to 3 km away for both species.

278. The distance at which animals may react to vessels is challenging to predict, as behavioural responses can vary widely depending on factors such as species, location, vessel type and size, speed, noise levels and frequency, ambient noise levels, and environmental conditions (see **Appendix 9.5: Marine Mammals Information and Modelling Methods for Disturbance (Volume IV)**, for more details).
279. In coastal waters of SW Wales, vessel type and speed, rather than mere presence, appeared to be critical factors in harbour porpoise reactions to vessel traffic (Oakley et al. 2017). A significant correlation was observed between vessel numbers and porpoise sightings. Over 729 hours of survey (268 total surveys), there were 39 instances of neutral or negative porpoise responses to vessels, with 75% of negative reactions triggered by high-speed, planing-hulled vessels.
280. As described in **Appendix 9.1: Marine Mammals Technical Report (Volume IV)**, modelling by Heinänen and Skov (2015) indicated that ship traffic density plays a notable role in determining harbour porpoise density in the NS during summer. Specifically, higher traffic levels are linked to lower porpoise densities, with a threshold impact level of approximately 15,000 ships per year (around 50 vessels per day within a 5 km grid cell; or approximately 2 vessels/km²). For context, the maximum of 34 vessels expected on-site during construction would remain below this threshold (34 vessels over the 280 km² Bellrock WFDA would amount to approximately 0.1 vessels per km²).
281. As detailed in length in **Section 9.8.1.4**, a precautionary approach has been adopted based on the studies by Brandt et al. (2018) and Benhemma-Le Gall et al. (2021). Consequently, the following disturbance from vessel assessment (see **Table 9.43**) utilises the 4 km disturbance range for all marine mammal receptors (with a disturbance area of 50.27 km²). This is considered very precautionary for the following reasons:
- Dolphin, whales and seals are less sensitive to underwater noise disturbance than harbour porpoise, therefore assuming all species will react in the same way is precautionary;
 - As presented by Benhemma-Le Gall et al. (2021), much less than a 100% decrease in harbour porpoise activity was observed within 4 km of construction activity (see **Section 9.8.1.4.259**). Therefore, assuming that all marine mammals will respond within a 4 km radius is over-precautionary, as it is likely that only a small proportion would respond at up to 4 km;
 - Benhemma-Le Gall et al. (2021) do not differentiate between vessels that are undertaking activities, and those that are transiting. Therefore, assuming the harbour porpoise response is the same in both cases may be overestimating the effect where vessels are transiting only;
 - Other research has reported smaller disturbance ranges for vessels, either transiting or undertaking works (e.g. Diederichs et al. (2010) found that dredging can disturb harbour porpoise up to 600 m, and Frankish et al. (2023) found that harbour porpoise deterrence was mostly observed at close distance to vessels only (<300 m), while deterrence of 5-9% of individuals was still recorded for vessels at 2 km away); and
 - The assessments are undertaken based on the maximum number of vessels being present at any one time, which is only likely to occur occasionally.

282. Vessel movements to and from any port would be incorporated into existing vessel routes as much as possible. Therefore, the assessment focused on the increased disturbance from underwater noise caused by construction vessels within the Bellrock WFDA.

9.8.1.5.1 Sensitivity

283. Marine mammals within the potential disturbance area from the presence of vessels are considered to have the capacity to avoid such effects. Any disturbance would be temporary, with the expectation to return to normal behaviour once the disturbance had ceased, or they have become habituated to the sound or presence of vessels (doing activities).
284. The sensitivity for marine mammal receptors to disturbance is considered to be **medium** for harbour porpoise and baleen species and **low** for dolphins and seal species.
285. The sensitivity for marine mammal receptors to PTS is considered to be **high** for all marine mammal receptors (see details in **Section 9.8.1.3.1.2**).

9.8.1.5.2 Magnitude of Impact

9.8.1.5.2.1 Underwater Noise Modelling

286. Site-specific underwater noise modelling was undertaken to determine the potential risk for PTS from underwater noise due to the presence of vessels.
287. The underwater noise propagation modelling was conducted using a simple modelling approach, using measured sound source data, scaled to relevant parameters for the Wind Farm Infrastructure. To account for the weightings required for modelling using the Southall et al. (2019) criteria, reductions in source level were applied to the various noise sources (see **Appendix 9.2: Underwater Noise Modelling Report (Volume IV)** for further information).
288. **Table 9.42** shows the assessed activities and their source levels.

Table 9.42: Estimated Source Levels from Vessels

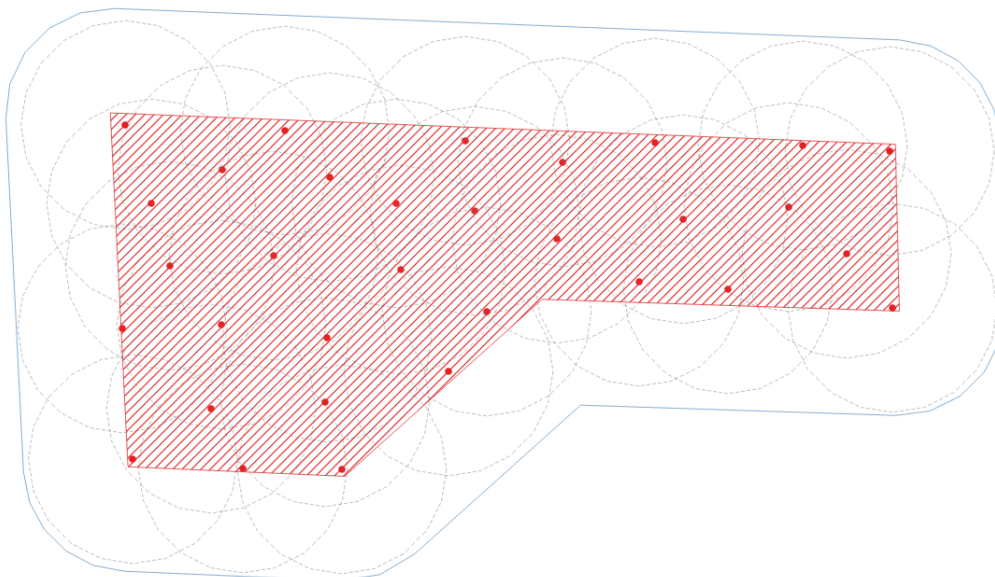
Activity	Source Level (SPL)
Large vessels (>100 m length; 10 kt speed)	168 dB re 1 µPa @ 1 m
Medium vessel (<100 m length; 10 kt speed)	161 dB re 1 µPa @ 1 m

289. The noise levels from medium or large vessels are below non-impulsive thresholds for PTS onset for all species groups, as shown in **Table 9.9** and **Appendix 9.2: Underwater Noise Modelling Report (Volume IV)**. Note that this finding is in line with Southall et al (2019) and Trigg et al (2020).
290. It should be noted that the predicted impact ranges are the distances which represent the 'onset' stage, which is the minimum exposure that could potentially lead to the start of an impact and may only be marginal. In most hearing groups, the noise levels are low enough that there is negligible risk. Therefore, the noise levels are low enough so that marine mammals would only be exposed to minimal risk. This section will therefore not investigate the risk to auditory injury any further.

9.8.1.5.2.1.1 Disturbance

291. The disturbance assessment based on one vessel in the Bellrock WFDA has been presented in **Table 9.43** and is considered to be **negligible** for all species. While the maximum number of vessels within the WFDA at any one time is 34, this unrealistic scenario would not take into consideration any potential overlap of the 4 km disturbance ranges with other nearby vessels. Therefore, an alternative approach to determining the potential disturbance area for multiple vessels has been provided as discussed below.
292. Assuming the disturbance caused by 34 vessels within the Bellrock WFDA would not overlap with that of other vessels, the total disturbed area would be 2,214 km². This is significantly larger than the Bellrock WFDA itself, which has a total area of 280 km². Therefore, the actual maximum area of effect would be the Bellrock WFDA plus a 4 km buffer (equating to an area of 657.2 km²), as all vessels would be within the WFDA.
293. **Plate 9.7** illustrates that the disturbance areas would not exceed a 4 km buffer around the Bellrock WFDA. Therefore, the assessment in **Table 9.43** represents the maximum possible disturbance area of the Bellrock WFDA, including a 4 km buffer. As noted in **Section 9.8.1.4** above, the use of the 4 km buffer is considered to be over-precautionary, particularly in the case of species other than harbour porpoise.
294. The magnitude of the potential disturbance impact of 34 vessels (with a maximum potential disturbance area of 657.2 km²) in the Bellrock WFDA plus 4 km buffer is considered to be **negligible** for all marine mammal species with the exception of bottlenose dolphin of the CGNS MU UK portion, with a **low** magnitude.

Plate 9.7: Bellrock WFDA (Hatched in Red), With 4 km Buffer (Blue), and 34 Construction Vessels (Red Dots) and their 4 km Buffer (Grey Dotted Lines) Randomly Allocated within the Bellrock WFDA



295. Considering that **Table 9.43** is representative of all hearing groups, it can therefore be considered that both killer whale and humpback whales are represented and thus assigned a **negligible** magnitude due to their rare presence in the Bellrock WFDA.

Table 9.43: Maximum Number of Individuals (and % of Reference Population) That Could be Disturbed as a Result of Underwater Noise Associated with Construction Vessels at the Bellrock WFDA

Species	Maximum Number of Individuals (% of Reference Population) for One Vessel in the Bellrock WFDA at any One Time	Magnitude (Temporary Effect)	Maximum Number of Individuals (% of Reference Population) for Bellrock WFDA, Including a 4 Km Buffer (657.2 km ²)	Magnitude (Temporary Effect)
Harbour porpoise	64 (0.018% of NS MU) (0.040% of the UK portion)	Negligible (Negligible)	837 (0.24% of NS MU) (0.52% of the UK portion)	Negligible (Negligible)
Bottlenose dolphin	2 (0.099% of GNS MU) (0.106% of the UK portion)	Negligible (Negligible)	20 (0.99% of GNS MU) (1.06% of the UK portion)	Negligible (Low)
	2 (0.885% of CES MU)	Negligible	-	-
Common dolphin	2 (0.002% of CGNS MU) (0.003% of the UK portion)	Negligible (Negligible)	18 (0.02% of CGNS MU) (0.03% of the UK portion)	Negligible (Negligible)
White-beaked dolphin	13 (0.030% of CGNS MU) (0.038% of the UK portion)	Negligible (Negligible)	160 (0.36% of CGNS MU) (0.47% of the UK portion)	Negligible (Negligible)
Minke whale	3 (0.015% of CGNS MU) (0.029% of the UK portion)	Negligible (Negligible)	28 (0.14% of CGNS MU) (0.27% of the UK portion)	Negligible (Negligible)
Grey seal	2 (0.0045% of combined MUs)	Negligible	14 (0.036% of combined MUs)	Negligible
Harbour seal	0.0000007 (<0.0001% of East Scotland MU)	Negligible	0.000009 (<0.0001% of East Scotland MU)	Negligible

9.8.1.5.3 Significance of Effect

296. For disturbance, the sensitivity for marine mammal receptors is **medium** for harbour porpoise and baleen whales and **low** for dolphins and seals, and the magnitude is **negligible** for all marine mammal species apart from bottlenose dolphin which has a **low** magnitude. Therefore, the effect significance for disturbance from underwater noise from the presence of vessels is **minor adverse** for bottlenose dolphin and **negligible adverse** for all other marine mammals which is **not significance** in EIA terms for all species.

9.8.1.5.3.1 Mitigation

297. No marine mammal mitigation is considered necessary because the likely effect in the absence of mitigation is **not significant** in EIA terms. General mitigation measures set out in **Table 9.15** will apply.

9.8.1.6 Impact C6: Collision Risk with Vessels

298. During the construction of the Wind Farm Infrastructure there will be an increase in vessel traffic as a result of vessels transiting to and from the WFDA and undertaking construction activities within the WFDA. However, it is anticipated that vessels would follow an agreed indicative transit corridor to the relevant ports, where this retains compliance with the Convention on International Regulations for Preventing Collisions at Sea (COLREGS), to minimise vessel volume in the areas outside of the agreed indicative transit corridor (see the **Outline VMNSP** provided in **Volume V**).

9.8.1.6.1 Sensitivity

299. Larger whale species, such as the baleen whales, are at a greater risk of vessel collisions compared to smaller cetaceans (discussed below in **Section 9.8.1.6.2**). Evidence shows a lower incidence of physical trauma in strandings of smaller species, like dolphins and seals, which often display normal behaviour around vessels or even habituate to their presence. In contrast, harbour porpoises exhibit strong avoidance behaviour due to their sensitivity to noise and movement. However, minke whales, being less agile and more prone to ship strikes, do not demonstrate the same avoidance capabilities. Given their size, behaviour, and the documented increase in collisions among baleen whales, such as minke whales, they should be considered to have a higher sensitivity to vessel strikes than dolphins, seals, or porpoises.
300. Harbour porpoises, being small and highly mobile, are generally expected to avoid vessels due to their responses to vessel noise (e.g. (Thomsen et al. 2006), (Polacheck and Thorpe, 1990)). Predictive modelling indicated a negative relationship between the number of ships and the distribution of harbour porpoises in the Irish and Celtic Seas, and NS during summer. This suggests that harbour porpoises may exhibit avoidance behaviour (Heinänen and Skov, 2015); (Dyndo et al. 2015), (Frankish et al. 2023), observed even at long ranges (2-9 km; Dyndo et al. 2015), (Benhemma-Le Gall et al. 2021), (Pigeault et al. 2024), thereby reducing the risk of collisions with vessels. In a study by Robbins (2022), the relative collision risk was calculated using Automatic Identification System (AIS) vessel density data overlaid on the cetacean distribution maps by Waggitt et al. (2019). The study found that harbour porpoise in the southern NS is exposed to high shipping traffic year-round, exposing them to a significant risk of potential ship strikes.
301. In a telemetry study of harbour and grey seals, alongside vessel AIS data information across the British Isles, data indicated vessel and seal co-occurrence was high and that spatial overlap with ships occurred within 50 km of the coast close to haul-out sites (Jones et al. 2017). Areas with high risk of vessel exposure include 11 SACs. In seeking to determine the likelihood of harbour seal injury occurring due to co-presence with large vessels within the Moray Firth, there appeared to be no relationship between areas in high co-occurrence and incidences of injury (Onoufriou et al. 2016). In fact, seals were observed not to react to close passing vessels.
302. The sensitivity of marine mammals is therefore considered to be **medium** for baleen whales and **low** for all other marine mammal receptors.

9.8.1.6.2 *Magnitude of Impact*

303. An analysis of the International IWC Ship Strike Database reveals that baleen whales, specifically fin and humpback whales, followed closely by right whales, constitute the majority of ship strike victims (Winkler et al. 2020). However, a significant proportion of reported cases (12.1%) lacked species identification. Reports of collisions involving smaller cetacean species are generally scarce due to reporting biases, such as unnoticed collisions, quickly sinking carcasses, or less concern for smaller species (Schoeman et al. 2020). The IWC report underscores that the lack of species identification and the mis- or underreporting of ship strikes remain global issues, leading to uncertainties in the numbers and species affected (Van Waerebeek et al. 2007), (Winkler et al. 2020).
304. In the UK, approximately 4 – 6% of stranded small cetaceans (i.e. harbour porpoise, common dolphin, white-beaked dolphin, etc.) showed evidence of physical trauma during postmortem examinations, potentially attributable to ship strikes. This is compared to 15 – 20% of stranded whales, based on data from the Cetacean Strandings Investigation Programme database (1990-2010) (Evans et al. 2011).
305. A review on disturbance from vessels, detailed in **Appendix 9.5: Marine Mammals Information and Modelling Methods for Disturbance (Volume IV)**, indicated that most marine mammals are affected by vessel noise. The discussion below highlights that these animals typically respond to noise by exhibiting avoidance or fleeing behaviours, particularly observed in harbour porpoise (as described in Dyndo et al. 2015; Benhemma-Le Gall et al. 2021; Benhemma-Le Gall et al. 2023; Frankish et al. 2023), or by co-existing with ships, which can lead to collision risks.
306. For bottlenose dolphin and common dolphin, the estimated collision risk rate with vessel traffic in the NS was relatively low compared to that of harbour porpoise (Robbins, 2022). In contrast, however, white-beaked dolphin was modelled to have high levels of spatial co-occurrence with vessels in the NS, although data for the NE coast of England shows this to be mainly in the winter months (October to April), (Robbins, 2022).
307. The maximum number of vessels that could be within the Bellrock WFDA at any one time has been estimated to be 34 vessels. The number, type and size of vessels would vary, depending on the activities taking place at any one time.
308. The magnitude of impact is therefore considered to be **low** for all marine mammal species.

9.8.1.6.3 *Significance of Effect*

309. Overall, it is predicted that the sensitivity for minke whale, humpback, and fin whale and is **medium** and the magnitude of impact is **low**. The effect is therefore of **minor adverse** significance, which is **not significant** in EIA terms.
310. Overall, it is predicted that the sensitivity for harbour porpoise, dolphins and seals is **low** and the magnitude of impact is **low**. The effect is therefore of **minor adverse** significance, which is **not significant** in EIA terms.

9.8.1.6.3.1 Mitigation

311. No additional marine mammal mitigation is considered necessary because the likely effect in the absence of additional mitigation is **not significant** in EIA terms.
312. Marine mammals in the relevant study area(s) are already accustomed to vessels. All vessel movements would be kept to the minimum number that is required to develop the Wind Farm Infrastructure. Additionally, vessel operators would use industry best practice to reduce any risk of collisions with marine mammals. The VMNSP and EMP will provide a protocol for minimising collision risk of marine mammals with vessels (see **Table 9.16**). An **Outline VMNSP** and **Outline EMP** are both provided in **Volume V**.

9.8.1.7 Impact C7: Disturbance at Seal Haul-out Sites

313. Grey seal and harbour seal are known to be sensitive to disturbance at haul-out sites from anthropogenic sources such as vessel traffic, construction activities (including piling), and approaches from land (Cates and Acevedo-Gutierrez, 2017), (Paterson et al. 2019), (Machernis et al. 2018). Given the Bellrock WFDA is situated 120 km and 116 km from the coastline (at Stonehaven and Peterhead respectively), disturbance at seal haul-out sites would only occur from transiting vessels to and from the Bellrock WFDA.

9.8.1.7.1 Sensitivity

314. Disturbance to seals from vessel noise and presence has been demonstrated to be up to 500 m away at haul-out sites in the UK (Cates and Acevedo-Gutierrez, 2017). In a similar study, harbour seals were 25 times more likely to flee into the water when cruise ships passed 100 m from haul-out sites than when ships passed within 500 m (Jansen et al. 2010). Beyond 600 m, there was no discernible effect on the behaviour of harbour seal.
315. Land-based disturbance has been shown to cause higher levels of disturbance compared to marine sources, and smaller, quiet vessels like kayaks can cause the highest levels of flushing behaviour. However, some level of habituation has been seen where vessel traffic is high, and disturbance behaviours are generally reduced over time (Strong et al. 2010).
316. The sensitivity of grey and harbour seal is therefore considered to be **medium**.
317. This assessment takes a precautionary approach, acknowledging that both grey and harbour seal have some capacity to avoid, adapt to, tolerate, or recover from the anticipated impacts.

9.8.1.7.2 Magnitude of Impact

318. The number of vessels relating to the construction of the Wind Farm Infrastructure is expected to peak at a maximum of 34 vessels. Depending on the ports used, and the vessel routes to and from the Bellrock WFDA, there could be the potential for vessels to pass seal haul-out sites. The vessels transiting to and from the port would use the indicative transit corridors established through the VMNSP and endeavour to stay at least 1 km from the coast where this retains compliance with the COLREGs (see the **Outline VMNSP** provided in **Volume V**).
319. A study carried out by the SMRU (Paterson et al. 2015) involved a series of controlled disturbance tests at harbour seal haul-out sites. These tests included regular disturbances (every three days) through direct vessel approaches, effectively 'chasing' the seals into the water. Seal behaviour was

recorded via Global Positioning System tags, and it was found that even intense levels of disturbance did not cause seals to abandon their haul-out sites more than what would be considered normal (e.g. seals travelling between sites). The seals were observed to haul-out at nearby sites or to undertake foraging trips in response to the disturbance, but they would later return.

320. Further studies on the effects of disturbance from vessels on hauled-out harbour seals suggest that even with repeated disturbance events severe enough to cause individuals to flee into the water, the likelihood of harbour seals moving to a different haul-out site does not increase. Additionally, this disturbance appears to have little effect on their movements and foraging behaviour (Paterson et al. 2019).
321. The magnitude of impact is therefore considered to be **low** for seal species.

9.8.1.7.3 *Significance of Effect*

322. Overall, it is predicted that the sensitivity of grey and harbour seal is **medium** and the magnitude of impact is **low**. The effect is therefore of **minor adverse** significance, which is **not significant** in EIA terms.

9.8.1.7.3.1 *Mitigation*

323. No additional marine mammal mitigation is considered necessary because the likely effect in the absence of additional mitigation is **not significant** in EIA terms.
324. Marine mammals in the relevant study area(s) are already accustomed to vessels. All vessel movements would be kept to the minimum number that is required to develop the Wind Farm Infrastructure. Additionally, vessel operators would use industry best practice to reduce any risk of collisions with marine mammals and adhere to a VMNSP (see **Table 9.16**).

9.8.1.8 Impact C8: Changes to Prey Availability

325. Any impacts on prey species have the potential to indirectly affect marine mammals. As outlined in **Chapter 8: Fish and Shellfish (Volume II)**, the potential impacts on fish species during construction can result from:
- Physical disturbance and temporary habitat loss;
 - Increased suspended sediment and sediment re-deposition;
 - Underwater noise and vibration; and
 - Changes in fishing activity.
326. Due to the interaction between prey and marine mammals, the effect significances on fish receptors have been extracted from **Chapter 8: Fish and Shellfish Ecology (Volume II)** and form the basis of the magnitude assessment for marine mammals.

9.8.1.8.1 Sensitivity

327. Information on the diet of marine mammal species is provided in **Appendix 9.1: Marine Mammals Technical Report (Volume IV)**.
328. In summary, harbour porpoise have a diverse diet that varies geographically and seasonally, reflecting changes in available food resources. They have relatively high daily energy demands and need to capture enough prey to meet these requirements. It has been estimated that, depending on the environmental conditions, harbour porpoise can rely on stored energy (primarily blubber) for three to five days, depending on body condition (Kastelein et al. 1997). The sensitivity of harbour porpoise is therefore considered to be **low** to **medium**.
329. All dolphin species considered in the assessment have a broad diet, feeding on a wide range of prey species and are considered to have large foraging ranges. The sensitivity of dolphin species is therefore considered to be **low**.
330. Baleen whales feed on a variety of prey species, but in some areas, they have been found to prey upon specific species. The sensitivity of baleen whales is therefore considered to be **low** to **medium**.
331. Grey and harbour seal are opportunistic feeders, feeding on a wide range of prey species. They are able to forage in other areas and have relatively large foraging ranges. The sensitivity of grey seal and harbour seal is therefore considered to be **low**.

9.8.1.8.2 Magnitude of Impact

332. **Table 9.44** sets out the impacts assessed in **Chapter 8: Fish and Shellfish ecology (Volume II)** and the magnitude of impact for fish and shellfish receptors. The magnitude of impact for marine mammals (in terms of changes to prey availability) is given with a rationale.

Table 9.44: Construction Magnitude of Impact for Changes to Prey Availability

Fish and Shellfish Ecology Impact	Receptor(s)	Magnitude of Impact for Fish and Shellfish Ecology Receptors	Magnitude of Impact for Marine Mammals (Changes to Prey Availability)
Physical disturbance and temporary habitat loss	Spawning Grounds	Negligible	Negligible
	Nursery Grounds	Negligible	Negligible
	Diadromous Fish	Negligible	Negligible
	Elasmobranchs	Negligible	Negligible
	Marine Demersal Fish	Negligible	Negligible
	Marine Pelagic Fish	Negligible	Negligible
	Cephalopods	Negligible	Negligible
	Crustaceans	Negligible	Negligible
	Molluscs	Negligible	Negligible

Fish and Shellfish Ecology Impact	Receptor(s)	Magnitude of Impact for Fish and Shellfish Ecology Receptors	Magnitude of Impact for Marine Mammals (Changes to Prey Availability)
Increased suspended sediment and re-deposition	Spawning Grounds	Negligible	Negligible
	Nursery Grounds	Negligible	Negligible
	Diadromous Fish	Negligible	Negligible
	Elasmobranchs	Negligible	Negligible
	Marine Demersal Fish	Negligible	Negligible
	Marine Pelagic Fish	Negligible	Negligible
	Cephalopods	Negligible	Negligible
	Crustaceans	Negligible	Negligible
	Molluscs	Negligible	Negligible
Underwater noise and vibration	Spawning Grounds	Low (negligible for herring spawning)	Low (negligible for herring spawning)
	Nursery Grounds	Negligible to low	Negligible to low
	Diadromous Fish	Negligible to low	Negligible to low
	Elasmobranchs	Negligible to low	Negligible to low
	Marine Demersal Fish	Negligible to low	Negligible to low
	Marine Pelagic Fish	Negligible to low	Negligible to low
	Cephalopods	Negligible to low	Negligible to low
	Crustaceans	Negligible to low	Negligible to low
	Molluscs	Negligible to low	Negligible to low
Changes in fishing activity	Spawning Grounds	Negligible	Negligible
	Nursery Grounds	Negligible	Negligible
	Diadromous Fish	Negligible	Negligible
	Elasmobranchs	Negligible	Negligible
	Marine Demersal Fish	Negligible	Negligible
	Marine Pelagic Fish	Negligible	Negligible
	Cephalopods	Negligible	Negligible
	Crustaceans	Negligible	Negligible
	Molluscs	Negligible	Negligible

9.8.1.8.3 *Significance of Effect*

333. Overall, it is predicted that sensitivity of harbour porpoise and baleen whales is low to medium and the magnitude of impact is negligible to low. The effect is therefore of **negligible to minor adverse** significance, which is **not significant** in EIA terms for both harbour porpoise and baleen whales.
334. Overall, it is predicted that sensitivity of dolphin and seal species is low and the magnitude of impact is negligible to low. The effect is therefore of **negligible to minor adverse** significance, which is **not significant** in EIA terms for all dolphin and seal species.

9.8.1.8.3.1 *Mitigation*

335. No additional marine mammal mitigation is considered necessary because the likely effect in the absence of additional mitigation is **not significant** in EIA terms. General measures set out in **Table 9.16** will apply.

9.8.2 **Potential Impacts During Operation and Maintenance**

9.8.2.1 **Impact O1: Underwater Noise during Geophysical Surveys**

336. Elevated underwater noise generated during geophysical surveys may lead to injury and/or disturbance to marine mammals during the O&M phase. The worst-case scenario comprises of routine geophysical surveys during the O&M phase, similar to that undertaken during the site preparation and construction phase, such as MBES and SBP (**Table 9.18** and **Table 9.15**). There is no defined frequency, and the surveys will depend on site conditions. During the first 5-years of operation it is likely to be more frequent to confirm cable burial and monitor anchor points. The frequency and scope of further monitoring will be proportional to the risk of future cable exposure and determined based on the outcome of the first 5-years.

9.8.2.1.1 *Sensitivity*

337. The potential impacts from auditory injury due to elevated underwater noise during geophysical surveys will be the same as that assessed for the construction phase (**Section 9.8.1.2**) and has not been reiterated here for the O&M phase. In addition, all surveys will be undertaken with mitigation measures in place as required in the JNCC (2017) guidance (**Table 9.16**) and all measures will be listed in the risk assessment to support a future EPS licence application. Therefore, the sensitivity is likely to be the same or less (due to highly targeted short surveys), than the impact assessed in the construction phase, meaning the sensitivity is assessed as **high** for PTS and **medium** for behavioural disturbance for all marine mammal species (see **Section 9.8.1.2.1**).

9.8.2.1.2 *Magnitude of Impact*

338. For injury, the impact (elevated underwater noise during the geophysical surveys) is predicted to be of local spatial extent within the relevant geographic range of reference, short term duration, intermittent and the effect of PTS is permanent. It is predicted that the impact will affect the receptor directly. Since the injury is assumed to be fully mitigated via designed in measures there is considered to be no residual risk of injury and therefore no population-level effects. The magnitude for PTS was therefore considered to be **negligible**.

339. For the behavioural disturbance, the impact is predicted to be the same as that of the construction phase where it is of a local to regional spatial extent within the relevant geographic range of reference, short term duration, intermittent and the effect of behavioural disturbance is reversible (see **Section 9.8.1.2.2.2**). The magnitude was therefore considered to be **negligible**.

9.8.2.1.3 Significance of Effect

340. Overall, it is predicted that sensitivity for all marine mammal species is **high** for auditory injury (PTS) and **medium to low** for disturbance. The magnitude of impact for all marine mammal species is negligible for both auditory injury (PTS) and disturbance. The effect is therefore of **minor adverse** significance for auditory injury (PTS) and **negligible adverse** for behavioural disturbance, where both are **not significant** in EIA terms.

9.8.2.1.3.1 Mitigation

341. No additional marine mammal mitigation is considered necessary because the likely effect in the absence of additional mitigation is **not significant** in EIA terms. General measures set out in **Table 9.16** will apply.

9.8.2.2 Impact O2: Underwater Noise from Operation and Maintenance Activities

342. Currently available data indicates that there is no lasting disturbance or exclusion of harbour porpoise or seals around OWFs during operation (Lindeboom et al. 2011; Marine Scotland, 2012; McConnell et al. 2012; Scheidat et al. 2011). Data collected suggests that any behavioural responses for harbour porpoise and seal may only occur up to a few hundred metres away (McConnell et al. 2012).
343. Monitoring studies at Nysted and Rødsand have also indicated that operational activities have had no impact on regional seal populations (McConnell et al. 2012). Tagged harbour seals have been recorded within two OWFs (Alpha Ventus in Germany and Sheringham Shoal in UK) with the movement of several of the seals suggesting foraging behaviour around WTGs fixed foundation structures (Russell et al. 2014).
344. Both harbour porpoise and seals have been shown to forage within operational OWFs (e.g. Lindeboom et al. 2011; Russell et al. 2014; Iorio-Merlo et al. 2023), indicating no restriction to movements in operational OWF. There is currently limited information for other marine mammal species, however, bottlenose dolphin is frequently observed in and around the Aberdeen Offshore Wind Farm (European Offshore Wind Deployment Centre; pers. comm.).
345. Although the worst-case scenario in terms of noise from other activities and vessels during the O&M is being assessed in this section and **Section 9.8.2.3**, marine mammals have been observed in and around OWFs during operational activities (e.g. Lindeboom et al. 2011; Marine Scotland, 2012; McConnell et al. 2012; Scheidat et al. 2011). Therefore, the below assessments in these sections are deemed precautionary.

9.8.2.2.1 Sensitivity

346. The sensitivity for other activities (for example cable reburial) would be the same as that assessed for the construction phase. Therefore, all species of marine mammals are considered to have a **high** sensitivity to PTS due to maintenance activities if they are within the potential effect ranges for physical injury or PTS. Marine mammals within the potential effect area of the activity are

considered to have very limited capacity to avoid such effects, and unable to recover from physical injury or auditory injury (see **Section 9.8.1.4**).

347. The sensitivity of all species of marine mammals to disturbance as a result of underwater noise during construction activities, other than piling, is considered to be **medium** in this assessment as a precautionary approach (**Section 9.8.1.4.2**). Marine mammals within the potential disturbance area are considered to have limited capacity to avoid such effects, although any disturbance to marine mammals would be temporary and they would be expected to return to normal behaviour once the disturbance had ceased, or they had become habituated to the sound.

9.8.2.2.2 ***Magnitude of Impact***

348. During the O&M phase, there is the potential for additional rock placement or cable re-burial activities to take place. Although the full scope and requirements of the work would be ascertained at the time such activities require to be undertaken, the associated effects to marine mammals would be the same or less than those activities assessed to occur during construction (**Section 9.8.1.4**).

9.8.2.2.2.1 ***Auditory Injury (PTS)***

349. The effects on marine mammals from these activities have already been provided in **Section 9.8.1.4.3.1**, and have therefore not been repeated here.

9.8.2.2.2.2 ***Disturbance***

350. The discussion on using a 4 km disturbance range for construction activities and an assessment of disturbance effects on marine mammals from one and four activities (as noted in **Section 9.8.1.4** and **Table 9.41**) has already been conducted in **Section 9.8.1.4.3.2**, and has therefore not been repeated here. In summary of **Table 9.41**, the magnitude of impact is considered to be **negligible** for all marine mammal species apart from bottlenose dolphin which has a **low** magnitude for the CES MU.
351. The duration of maintenance activities would not be underway constantly but periodically throughout the operational life of the Wind Farm Infrastructure.

9.8.2.2.3 ***Significance of Effect***

352. In summary, it is predicted that for auditory injury (PTS) the sensitivity of marine mammal receptors is **high**, the magnitude of impact for harbour porpoise is **low** and all other marine mammals is **no change**. Therefore, the effect significance in line with construction is **minor adverse** for harbour porpoise and **negligible adverse** significance for all other marine mammal receptors, which are **not significant** in EIA terms.
353. It is predicted that for disturbance the sensitivity of all marine mammal receptors is **medium** or **low** and the magnitude for bottlenose dolphin for the CES is **low**, with all other marine mammal receptors having a magnitude of **negligible**. Therefore, the effect significance is **minor adverse** for bottlenose dolphin and **negligible adverse** for all of marine mammal receptors, both are **not significant** in EIA terms.

9.8.2.2.3.1 *Mitigation*

354. No additional marine mammal mitigation is considered necessary because the likely effect in the absence of additional mitigation is **not significant** in EIA terms. General measures set out in **Table 9.16** will apply.

9.8.2.3 **Impact O3: Underwater Noise and Presence of Vessels**

355. As per the underwater noise modelling (**Appendix 9.2 Underwater Noise Modelling Report (Volume IV)**), the noise levels are low enough that they fall below marine mammal hearing thresholds so that marine mammals would only be exposed to minimal risk. Therefore, this section will not investigate the risk to auditory injury (PTS) and focuses on disturbance only.

9.8.2.3.1 *Sensitivity*

356. Marine mammals within the potential disturbance area were considered to have the capacity to avoid such effects. Any disturbance would be temporary, with the expectation to return to normal behaviour once the disturbance had ceased, or they have become habituated to the sound or presence of vessels (doing activities).
357. Noting the information provided in **Section 9.8.1.5**, which is considered to be the same as that for the O&M phase, although to a lesser degree, the sensitivity for marine mammal receptors to disturbance is considered to be **medium** for harbour porpoise and baleen species and **low** for dolphins and seal species.
358. The sensitivity for marine mammal receptors to PTS is considered to be **high** for all marine mammal receptors (see details in **Section 9.8.1.3.1.2**).

9.8.2.3.2 *Magnitude of Impact*

359. During O&M of the Wind Farm Infrastructure, vessels will be transiting and conducting maintenance activities within the Bellrock WFDA. A maximum of 21 vessels may be present within the WFDA at any one time during O&M, less than those assessed during construction (**Section 9.8.1.5.2.1.1**).
360. Vessel movements to and from the O&M port (to be decided post consent) would follow an agreed indicative transit corridor to the relevant ports, this retains compliance with the COLREGs. The vessels conducting the maintenance work would be slow moving or stationary at times.
361. Similarly, as discussed in **Section 9.8.1.5.2.1.1**, there is the potential for 21 vessels to be present within the Bellrock WFDA for maintenance activities. However, it is unlikely that all 21 vessels would be present simultaneously and engaging in noisy activities, alongside there being less vessels on Bellrock WFDA in general at any one time than during the construction phase. Thus, the same rationale for disturbance assessment as outlined for construction vessels. However, the magnitude of this impact was presumed to have a long-term effect, as the vessels are often present throughout the operational life of the Wind Farm Infrastructure.
362. **Table 9.43** has been repeated below as **Table 9.45**, highlighting that levels of magnitude have now changed, since the duration of the effect is not just temporary but considered long term.

Table 9.45: Maximum Number of Individuals (and % of Reference Population) That Could be Disturbed as a Result of Underwater Noise Associated with Operation and Maintenance Vessels at the Bellrock WFDA

Species	Maximum Number of Individuals (% of Reference Population) for One Vessel in the Bellrock WFDA at Any One Time	Magnitude (Long-term Impact)	Maximum Number of Individuals (% of Reference Population) for Bellrock WFDA, Including a 4 km Buffer (657.2 km ²)	Magnitude (Long-term Impact)
Harbour porpoise	64 (0.018% of NS MU) (0.04% of the UK portion)	Negligible (Negligible)	837 (0.24% of NS MU) (0.52% of the UK portion)	Low (Low)
Bottlenose dolphin	2 (0.099% of GNS MU) (0.106% of the UK portion)	Low (Low)	20 (0.99% of GNS MU) (1.06% of the UK portion)	Low (Medium)
	2 (0.885% of CES MU)	Low	-	-
Common dolphin	2 (0.002% of CGNS MU) (0.003% of the UK portion)	Negligible (Negligible)	18 (0.02% of CGNS MU) (0.03% of the UK portion)	Negligible (Negligible)
White-beaked dolphin	13 (0.03% of CGNS MU) (0.038% of the UK portion)	Negligible (Negligible)	160 (0.36% of CGNS MU) (0.47% of the UK portion)	Low (Low)
Minke whale	3 (0.015% of CGNS MU) (0.029% of the UK portion)	Negligible (Negligible)	28 (0.14% of CGNS MU) (0.27% of the UK portion)	Low (Low)
Grey seal	2 (0.0045% of combined MUs)	Negligible	14 (0.036% of combined MUs)	Negligible
Harbour seal	0.0000007 (<0.0001% of East Scotland MU)	Negligible	0.000009 (<0.0001% of East Scotland MU)	Negligible

363. Considering the rare presence of killer whale and humpback whale in the Bellrock WFDA, similar to fin whales, it is unlikely that these species would experience any disturbance from O&M vessels within the WFDA. It is considered a **low** magnitude for all three species.
364. As described in **Section 9.8.1.5**, assuming that all marine mammals that are within 4 km of a vessel, particularly for species other than harbour porpoise, would be disturbed from the entire area, is very precautionary. It is expected that the assessment of a low/medium magnitude for bottlenose dolphin, low magnitude for harbour porpoise, white-beaked dolphin, and minke whale (as per **Table 9.45**) is unlikely, as it is not expected that all vessels will be present in the Bellrock WFDA at the same time. However, there is still the possibility of this and therefore, this has been assessed as a precautionary worst-case.

365. The duration of maintenance activities would not be underway constantly but periodically throughout the operation life of the Wind Farm Infrastructure.

9.8.2.3.3 *Significance of Effect*

366. For disturbance caused by O&M activities, the sensitivity for marine mammal receptors to disturbance is considered to be **medium** for harbour porpoise and baleen species and **low** for dolphins and seal species.

367. The magnitude of impact is **medium** for bottlenose dolphin and **low** for harbour porpoise, white-beaked dolphin, killer whale, and baleen whales. For disturbance caused by O&M vessels and activities, the magnitude of impact is **negligible** for common dolphin, grey seal and harbour seal.

368. The effect significance is therefore as follows:

- Harbour porpoise, bottlenose dolphin, white-beaked dolphin, baleen whales and killer whales, are **minor adverse** which is **not significant** in EIA terms; and
- Common dolphin, grey seal and harbour seal are **negligible adverse** which is **not significant** in EIA terms.

9.8.2.3.3.1 *Mitigation*

369. No additional marine mammal mitigation is considered necessary because the general measures set out in **Table 9.16**, including the adherence to a VMNSP, will apply and are sufficient to mitigate the non-significant impact.

9.8.2.4 **Impact O4: Underwater Noise from Operational WTGs and Moorings on the Seabed**

370. There is a potential for mooring lines as well as the WTGs to generate underwater noise during the operational life of the Bellrock Wind Farm Infrastructure. It is noted that little empirical data exists for the operational noise produced by floating WTGs and **Section 5.2 in Appendix 9.2: Underwater Noise Modelling Report (Volume IV)** notes how floating WTGs radiating area source is limited to the weighted and buoyant section that rests beneath the sea surface, which is expected to be a smaller area than that of a fixed-bottom WTG substructure. However, noise modelling has been conducted and compared against the marine mammal impact thresholds of fixed WTG substructures where adequate data is available.

371. The mooring line noise could result from a “snapping” noise when the chains in the water column as they move with the currents, this has been assessed and discussed below.

9.8.2.4.1 *Sensitivity*

9.8.2.4.1.1 *Floating WTG Noise*

372. Compared to increasing robust scientific literature on fixed-foundation WTGs, very little is known about floating WTGs, even less so on the impacts of noise generated during operation (Maxwell et al. 2022). Therefore, as discussed above, assessing the responses of marine mammal receptors to these more novel impacts means the assessment is based on highly conservative assumptions

linked to fixed WTG substructures. Farr et al. (2021) conducted a systematic review to estimate potential effects of deepwater floating OWFs during operation, which included potential effects of underwater noise on marine species. Impact magnitudes were determined using a four-level classification scheme (negligible, minimal, moderate, and major, and suggested noise effects on marine mammals were classified as 'minimal'. Farr et al. (2021) also stated that empirical measurements are still needed for floating OWFs. Noise effects are unlikely to pose a risk to marine species as the operation noise is low frequency (with dominant frequencies of ~1 kHz or less) and at low levels (Madsen et al. 2006), (Thomsen et al. 2015b).

373. While operational noise is continuous, it is unlikely that these noise levels would result in physiological damage (Madsen et al. 2006), (Marmo et al. 2013), (Tougaard et al. 2009a). Early measurements of underwater noise due to operational WTGs concluded that the underwater noise from operating WTGs is limited to low frequencies (below 1 kHz) and of low intensity and therefore unlikely to affect marine mammals with main hearing sensitivities at higher frequencies (i.e. VHF and HF cetaceans and PCW) (Madsen et al. 2006). However, behavioural responses by marine species to operational WTG noise appears to be minimal. Modelling predictions by Marmo et al. (2013) suggested that only a small proportion (<10%) of minke whales and harbour porpoises would display behavioural responses up to 18 km away from an OWF. The majority of animals studied would not show a behavioural response, indicating low potential for displacement.
374. Field measurements and modelling efforts to estimate operational noise levels have predominantly focused on fixed-bottom OWFs (as noted in Section 5.2 in **Appendix 9.2: Underwater Noise Modelling Report (Volume IV)**). Analysis of noise measurements from two Danish (Middelgrunden and Vindeby) and one Swedish (Bockstigen-Valar) fixed-bottom OWFs, concluded that operational noise levels are unlikely to harm or mask acoustic communication in harbour porpoises and harbour seals (Tougaard et al. 2009b).
375. Tougaard et al. (2009a) reported at 100 m distance from 1.5 MW WTGs, underwater sound would be audible to both harbour porpoise and harbour seal. However, at a greater distance of 1,000 m the signal to ambient sound ratio is too low for detection in harbour porpoise as a VHF cetacean (detection by harbour seal might be possible). Furthermore, the authors caveat these results, as ambient sound values used in this study were extrapolated from measurements obtained in the Baltic and the ambient sound in most parts of the NS is much higher, decreasing the radius of detection significantly. The study concluded that the sound is unlikely to exceed injury thresholds at any distance from the WTGs and was considered incapable of masking acoustic communication by harbour porpoise. It is also important to note that these WTGs are significantly smaller than those within the Bellrock Offshore Wind Farm PDE.
376. Studies using long term frequency data from OWFs with 5 MW WTGs, found that whilst operational sound can be identified, levels barely exceed beyond ambient sound levels in areas near main shipping traffic routes (Stober and Thomsen, 2021). Therefore, marine mammals in high traffic areas may not be able to discern operational WTG sound from background levels. Analysis of individual frequencies predicted a correlation between SPLs and the operational status of the WTGs, as well as the wind speed, but the total impact of the operational sound was mostly negligible (Stober and Thomsen, 2021).

377. Risch et al. (2023) collected acoustic data from two floating OWFs (Kincardine and Hywind) and found recorded porpoise detections were reduced at the recording site closest to the WTG compared to the site further away for both floating offshore wind locations.
378. The study by Baldachini et al. (2024) models the sound radiated by three planned floating OWFs in the Strait of Sicily (Italy), an area of significant interest for such developments. Results indicate that sound from operating OWFs could reach a broadband sound pressure level (L_p) of 100 dB re 1 μ Pa as far as 67 km from the OWF. Nevertheless, this sound level is generally lower than the ambient sound in areas with intense shipping traffic.

9.8.2.4.1.2 Mooring Line “Snapping” Noise

379. As well as relatively low noise levels from the operational machinery in a variety of conditions (see the previous section), measurements taken by Jasco (2011) for Statoil at Hywind Demonstrator in Norway identified what appeared to be a “snapping” noise. A subsequent more detailed study at Hywind Scotland (Burns et al. 2022) showed a lower level of somewhat different (and less impulsive) noises, but transients identified were associated with strain and friction in the mooring system (steel cables, chains or wired ropes), and they became increasingly frequent with increasing wave height.
380. It is understood that the Hywind Demonstrator mooring lines are designed to be permanently in tension such that no line should ever go into slack, even in extreme conditions, partly to avoid the risk of entanglement of marine mammals (Statoil, 2015), although they may be subject to periodic tension releases (Risch et al. 2023). As the mooring lines appear to be the source of the noise, this may be caused by the specific circumstances at the Hywind Demonstrator or Scottish projects: that is, the specific type of mooring, depth of water, length of mooring lines in use, tidal range, current and current fluctuations. More recent studies at Hywind Tampen (Welch et al. 2025) showed very few transient noises, far less than those at Hywind Scotland. The findings at the earlier Hywind projects were therefore isolated, and it does not necessarily follow that this will occur at the Bellrock WFDA, but it cannot exclude the potential for it either.
381. There are no reliable noise thresholds that would be recommended to identify disturbance for rare/intermittent impulses of this type. As any transients occurred at an average rate of less than one per hour, disturbance leading to avoidance behaviour is considered unlikely.

9.8.2.4.1.3 Summary

382. Since there is limited empirical information on responses of marine mammals to floating WTGs and mooring line noise, it has been assumed that the sensitivity of marine mammal receptors to PTS and behavioural disturbance is the same or less than as a result underwater noise during piling (Sections 9.8.1.3.1.2 and 9.8.1.3.2.1). Therefore, all receptors are deemed to have limited resilience to PTS, low recoverability and high international value. All receptors are deemed to have some resilience to behavioural disturbance, high recoverability and high international value. The sensitivity of the receptor is therefore considered to be **high** for PTS and **medium** for behavioural disturbance.

9.8.2.4.2 *Magnitude of Impact*

9.8.2.4.2.1 *Permanent Threshold Shift*

383. The periods of mooring line slackening and tensioning have the potential to produce transient snapping noise during the operational life of the Bellrock Wind Farm Infrastructure. As described in **Appendix 9.2: Underwater Noise Modelling Report (Volume IV)**, the presence of snapping transient noise was identified during acoustic underwater noise measurements at the Hywind Demonstrator Project in Norway in 2011 (Martin et al. 2011). The data was subsequently analysed and Stephenson (2015) extrapolated results from a single WTG to a theoretical array and it was found that with up to 115 snapping events per day, the resultant potential cumulative SEL over a 24-hour period was 156 dB re 1 $\mu\text{Pa}^2\text{s}$ at 150 m from the WTGs. This value is below the PTS onset acoustic thresholds detailed in **Sections 9.8.1.3.1.2 and 9.8.1.3.2.1** (Southall et al. 2019).
384. Underwater noise measurements were also taken at the completed Hywind Scotland OWF (Burns et al. 2022), with analysis of data recorded at 14 km from the OWF to determine different sound signatures from the structures. The study reported three distinct transient sounds from mooring systems, characterised as 'bang', 'creak' and 'rattle', and their presence was found to be positively correlated with wave height, and to a limited extent with wind speed. Burns et al. (2022), thought that transient occurrence was related to the greater influence of waves rather than wind speed on the heave motion of the structure (which may lead to a dynamic response of the mooring system). The sounds were shown to originate from close to the WTG as opposed to further down a mooring line. There was little evidence of the sharp and impulsive "snap" noise that was found in the Hywind Demonstrator system recordings from 2011, and this is possibly explained by the lack of ballast weight on catenary chains (to add tension) at the Hywind Scotland OWF, compared to the Hywind Demonstrator system.
385. A quantitative analysis of the impulsiveness of the soundscape at Hywind Scotland showed that sounds generated by floating OWFs should be considered as non-impulsive and continuous (Burns et al. 2022). Analysis of the combination of tonal, WTG and mooring transient noises for different wind speeds resulted in the lowest derived broadband source level of 156.7 dB re 1 $\mu\text{Pa}^2\text{m}^2$ (and occurred in 10 kn wind speed). The highest (95th percentile) was 172.0 dB re 1 $\mu\text{Pa}^2\text{m}^2$ in 25 kn wind speed. The dominant WTG-related tonal noise was measured at 24 Hz and 71 Hz. These source levels were then used to define a noise field across the array to determine the potential impact on marine mammals.
386. As the mooring lines appear to be the source of the noise, this may be caused by the specific circumstances at the Hywind Scotland OWF: that is, the specific type of mooring, depth of water, length of cables in use, tidal range, current and current fluctuations. The findings at Hywind were isolated, and it does not necessarily follow that this will occur at the Bellrock WFDA, but it cannot exclude the potential for it either. Further evidence is required to investigate whether other floating WTG moorings are shown to create similar transient noises.
387. As the source of noise is unclear and Burns et al. (2022) showed it to be somewhat variable, its distance from the monitor cannot be ascertained and thus a prediction of the noise closer to the source is not possible for estimation of PTS in terms of $L_{p,pk}$. Analysis of the Hywind Demonstrator data by Xodus (2015) for the Hywind Scotland Project predicted a potential $L_{E,p,24h}$ of up to 157 dB re 1 $\mu\text{Pa}^2\text{s}$ at 150 m caused by snapping chains from six WTGs; the equivalent for ten would (in theory) be approximately 160 dB re 1 $\mu\text{Pa}^2\text{s}$. This prediction makes a series of 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) and this level is below any PTS or injury criteria to marine mammals. Also as noted, the subsequent study by Burns et al. (2022) did not identify the snapping noise so this is likely to be moot.

388. There are no reliable noise thresholds that would be recommended to identify disturbance for rare/intermittent impulses of this type. As any transients occurred at an average rate of less than one per hour, disturbance leading to avoidance behaviour is considered unlikely.
389. As discussed in **Appendix 9.2: Underwater Noise Modelling Report (Volume IV)**, though existing empirical studies on operational noise from floating WTGs of any substructure type are limited, there is a general consensus that the risk of injury to marine mammals from both structure-borne noise (regardless of substructure type) and additional noise such as those by moving mooring lines, is very low.
390. The impact (elevated underwater noise from floating WTGs and mooring lines) is predicted to be of local spatial extent in the context of the geographic frame of reference, long term duration, continuous and high reversibility (the elevation in underwater sound occurs only during the O&M phase of the Bellrock Wind Farm Infrastructure). The effect of injury, which is highly unlikely to occur, would be of low (PTS) reversibility. It is predicted that the impact will affect the receptor directly. Given that animals are highly unlikely to stay within the injury ranges continuously for 24 hours, and therefore population level effects are highly unlikely to occur. The magnitude is therefore considered to be **negligible**.

9.8.2.4.2.2 *Behavioural Disturbance*

391. Although the underwater noise study carried out at completed Hywind Scotland makes no attempt to quantify the disturbance (Burns et al. 2022), the semi-qualitative assessment provided in **Appendix 9.2: Underwater Noise Modelling Report (Volume IV)** concluded that the areas of disturbance are unlikely to extend further than those for fixed WTG substructures.
392. The underwater noise from operational WTGs comes from vibration in the gear box and generator, which is transmitted down the tower and radiated from the tower wall. Given that there is a paucity of qualitative data on sound radiation from the floating OWFs, a qualitative assessment is presented with respect to previous data from WTGs with fixed-bottom substructures. The desktop review carried out in **Appendix 9.2: Underwater Noise Modelling Report (Volume IV)** suggests that although sound levels are likely to be audible within the hundreds of metres from the WTGs, these will not be at levels sufficient to cause behavioural changes in marine mammals.
393. However, these findings are based on data collected for WTGs with capacity between 2 MW to 5 MW and a hub height of up to 95 m. The WTGs within the Bellrock WFDA will be larger than those in the desktop review and it is likely that there will be an increase of a few dB compared to the smaller WTGs. However, considering that the Bellrock WFDA is located in the NS with shipping traffic, the difference in ambient sounds is anticipated to be minimal.
394. The impact (elevated underwater noise from WTGs and mooring lines) is predicted to be of a local spatial extent, long term duration, continuous and the effect of behavioural disturbance is of high reversibility. It is predicted that the impact will affect the receptor directly. Although noise levels are likely to be audible to marine mammals, animals are unlikely to experience behavioural disturbance

including displacement as a result of the increased underwater noise during operational phase. The magnitude is therefore considered to be **negligible**.

9.8.2.4.3 *Significance of Effect*

395. The magnitude is deemed to be **negligible** for both auditory injury and behavioural disturbance and the sensitivity of all species is considered **high** for auditory injury and **medium** for behavioural disturbance. Therefore, the significance of effect will be **minor adverse** for auditory injury and **negligible adverse** for behavioural disturbance for all species which is **not significant** in EIA terms.

9.8.2.4.3.1 *Mitigation*

396. No additional marine mammal mitigation is considered necessary because the likely effect in the absence of additional mitigation is **not significant** in EIA terms. General measures set out in **Table 9.16** will apply.

9.8.2.5 *Impact O5: Secondary Entanglement*

397. Depending on the method used, there is the perceived potential for entanglement in the mooring lines of the SKSs for FSSs, as well as the dynamic IACs. To date, there have been no recorded instances of marine mammal entanglement from mooring systems of renewable devices (Sparling et al. 2013; Isaacman and Daborn, 2011), or for anchored floating production storage and offloading (FPSO) vessels in the oil and gas industry (Benjamins et al. 2014) with similar mooring lines as proposed for FSSs. However, entanglement in fishing gear is known to occur in Scottish waters and therefore resulting in the potential for a risk of secondary entanglement (i.e. entanglement in ghost fishing gears entangled in the subsea infrastructure).
398. The risk of secondary entanglement from the Wind Farm Infrastructure is therefore the consideration and assessed in this section. This secondary entanglement can occur when marine mammals become ensnared in marine debris, such as lost or abandoned (ghost) fishing gear that has accumulated on mooring lines and dynamic IACs associated with the Wind Farm Infrastructure (see diagram in **Chapter 4: Project Description (Volume II)**). The presence of ghost fishing gear wrapped around SKS could extend the spatial impact range of the mooring lines or dynamic IACs, as ghost nets can span tens of metres, potentially leading to higher local bycatch rates.

9.8.2.5.1 *Sensitivity*

399. The impacts of entanglement on marine mammals can include fatalities from drowning, as well as injuries such as infections and tissue damage if the animal manages to escape. Additionally, entanglement may lead to emaciation if it restricts the animal's ability to feed properly, or increased energy expenditure and drag if the animal remains mobile while entangled. The risk of entanglement for these species is likely influenced by the type of marine debris (nets, lines, fishing gear, etc.), the characteristics of the mooring components, and the overall configuration of the array which could lead to an increase in secondary entanglement (Farr et al. 2021).
400. Benjamins et al. (2014) provided a qualitative assessment of relative entanglement risk across various marine megafauna groups, factoring in biological aspects such as body size, sensory abilities, and feeding behaviours, alongside physical attributes of mooring systems like flexibility, pre-tension, and footprint. The findings suggest that baleen whales are at the highest risk due to their large size and unique feeding strategies, particularly lunge feeding, which involves rapidly

engulfing dense prey aggregations (Johnson et al. 2005). This feeding behaviour may increase their vulnerability to entanglement. In contrast, small-toothed cetaceans face a lower risk, largely due to their smaller size and greater manoeuvrability. Seal species exhibit a similar level of risk to small-toothed cetaceans, benefiting from even greater manoeuvrability (Benjamins et al. 2014).

401. The Scottish Marine Animal Stranding Scheme (SMASS) has documented entanglements of marine mammals in fishing gear as part of its strandings program. Between 2009 and 2020, a total of 29 minke whales were reported to have died as a result of entanglement, out of 70 cases where the cause of death was determined. This indicates that entanglement in fishing gear accounted for approximately 41.4% of known minke whale deaths. Since 1992, minke whale and humpback whale are the most commonly reported entangled species (MacLennan et al. 2021). However, also smaller species are no exception: entanglement was the cause of death for 17 grey seals (out of 470 known deaths) and four harbour seals (out of 180 known deaths), representing 3.6% and 2.2% of fatalities for these species, respectively. One harbour porpoise and one short-beaked common dolphin were also reported to have died due to entanglement. All of these entanglements were linked to fishing gear. Based on these reports, in Scottish waters, entanglement is now the largest identified cause of death in baleen whales (MacLennan et al. 2021).
402. The overall secondary entanglement risk for marine mammals in relation to floating OWFs remains relatively uncertain due to the limited number of dedicated studies and monitoring efforts, particularly regarding the potential for ghost fishing gear to accumulate on mooring lines or dynamic IAC. Given that no cases of marine mammal entanglement have been recorded involving marine debris stuck with the mooring systems or dynamic IACs of marine renewable energy devices or similar infrastructure (Copping et al. 2020), the primary entanglement risk from the Wind Farm Infrastructure is considered **medium** for all marine mammals, except for baleen whales, which are assessed as having a **high** sensitivity to entanglement.

9.8.2.5.2 *Magnitude of Impact*

403. Key factors which could influence secondary entanglement risk include the amount of fishing gear or debris, the detectability of the moorings and debris by marine mammals, the behaviour of animals in the Bellrock WFDA, the range and movement of the mooring lines and dynamic IACs, the design, material and length and number of moorings and dynamic IACs within the site and the layout and level of biofouling on the moorings and other subsea infrastructure (Harris et al. 2025), (Benjamins et al. 2014)
404. The prevalence of abandoned or lost fishing gear in the area of the Bellrock WFDA is influenced by local oceanographic conditions, fishing gear losses and their drift rates once lost. These unknowns make secondary entanglement very difficult to quantify. Benjamins et al. (2014) are currently evaluating the secondary entanglement risk among offshore renewable structures. Primary findings identify significant knowledge gaps, such as the lack of in-situ observations of fishing gear stuck on infrastructure and insufficient information on species abundance and behaviour around floating OWF structures. It should be noted that large fishing nets are not expected to be used within the Bellrock WFDA due to the presence of floating infrastructure (once constructed). Instead, static fishing gear (e.g. fish traps, crab and prawn creels, and electronic jiggers) could be used, as it has been trialled at the Hywind Scotland floating OWF (Wright et al. 2023). The tests indicated the viability of deploying static gear under suitable sea and weather conditions. During the four trial trips, no gear was lost or snagged in the structures.

405. Marine mammals have some ability to detect cables or mooring lines using echolocation, vision, and hearing. However, fishing gear made out of nylon or monofilament is less likely to be detected, posing a greater risk of entanglement compared to, e.g. mooring lines (Benjamins et al. 2014).
406. The magnitude of impact of secondary entanglement is therefore considered to be **low** for all marine mammals

9.8.2.5.3 *Significance of Effect*

407. Overall, it is predicted that sensitivity of harbour porpoise, dolphins and seals is **medium**, and the magnitude of impact is **low**. The effect is therefore of **minor adverse** significance, which is **not significant** in EIA terms.
408. Overall, it is predicted that sensitivity of baleen whales is **high** and the magnitude of impact is **low**. The effect is therefore of **moderate adverse** significance, which is **significant** in EIA terms.

9.8.2.5.3.1 *Mitigation*

409. Mitigation measures to monitor the risk of entanglement will be implemented in the MMMP and OMP:
- Monitoring for large strains on mooring lines:
 - It is expected that a similar method of monitoring would be undertaken as per Kincardine Offshore Windfarm. On Kincardine Offshore Windfarm this has to date been undertaken by load cells attached to the mooring devices and subsea cables, designed to alert the operator if there is unexpected load on the devices which can then be examined. The monitoring method is in the process of changing to using position monitoring system, which will identify the associated drag function on the structures outside the normal operating range (Risch et al. 2023); and
 - Surveys: SKSs and dynamic IACs will be regularly checked by ROV:
 - This would ensure that there was no material such as discarded nets, ropes or other debris which could increase the risk of entanglement for marine mammals and marine turtles.

9.8.2.5.3.2 *Residual Significance of Effect*

410. Taking into account additional mitigation which would reduce the magnitude (as set out in **Table 9.16**), the residual significance of effect of the potential risk of secondary entanglement to marine mammals, would be **minor adverse**, which is **not significant** in EIA terms, for all species.

9.8.2.6 *Impact O6: Collision Risk with Vessels*

9.8.2.6.1 *Sensitivity*

411. The sensitivity to collision risk with vessels for marine mammals during the O&M phase will be the same as that assessed for the construction phase. The sensitivity of marine mammals is therefore considered to be **medium** for baleen whales and **low** for all other marine mammal receptors (see **Section 9.8.1.6**).

9.8.2.6.2 *Magnitude of Impact*

412. A detailed literature review regarding vessel collision risk with marine mammals is outlined in **Section 9.8.1.6** and would be unchanged for O&M vessels.
413. The magnitude of impact is therefore considered to be **low** for all marine mammal species.

9.8.2.6.3 *Significance of Effect*

414. Overall, it is predicted that the sensitivity of baleen whale species is **medium** and all other marine mammal species is **low**. The magnitude of impact is considered to be **low** for all marine mammal species. The effect is therefore of **minor adverse** significance for all marine mammal species, which is **not significant** in EIA terms.

9.8.2.6.3.1 *Mitigation*

415. No additional marine mammal mitigation is considered necessary because the likely effect in the absence of additional mitigation is **not significant** in EIA terms. General measures set out in **Table 9.16**Table 9.15 will apply.

9.8.2.7 Impact O7: Disturbance at Seal Haul-out Sites

9.8.2.7.1 *Sensitivity*

416. The sensitivity of seals during the O&M phase for impact of disturbance at seal haul-out sites would be the same as that of the construction phase. Therefore, the sensitivity of grey and harbour seal is considered to be **medium**. This assessment takes a precautionary approach, acknowledging that both grey and harbour seal have some capacity to avoid, adapt to, tolerate, or recover from the anticipated impacts (see **Section 9.8.1.7**).

9.8.2.7.2 *Magnitude of Impact*

417. During construction (see **Section 9.8.1.7.2** which is the worst-case for noise impacts), it was assessed that underwater noise and other activities in the Bellrock WFDA would not directly impact seals at haul-out sites due to the significant distance to shore 116 km to Peterhead. It should also be noted that noise generated during O&M activities would be lower compared to the construction period. However, vessel traffic to and from the Bellrock WFDA will potentially have an impact.
418. Similarly, the annual vessel traffic that could potentially be passing seal haul-out sites during the O&M phase is projected to be lower than that during the construction period (see **Section 9.8.2.6** and **Table 9.15**).
419. The evidence presented in **Sections 9.8.2.3** and **9.8.2.6** indicates that the likelihood of seals at their haul-out sites to be disturbed from O&M activities and vessels is unlikely and that vessels have to be in very close proximity (several hundred metres) to the haul-out to induce disturbance behaviours, which again is unlikely to occur from vessels from the Bellrock WFDA given its distance from shore.
420. The magnitude of impact is therefore considered to be **low**.

9.8.2.7.3 *Significance of Effect*

421. Overall, it is predicted that the sensitivity of grey and harbour seal is **medium** and the magnitude of impact is **low**. The effect is therefore of **minor adverse** significance, which is **not significant** in EIA terms.

9.8.2.7.3.1 *Mitigation*

422. No additional marine mammal mitigation is considered necessary because the likely effect in the absence of additional mitigation is **not significant** in EIA terms. General measures set out in **Table 9.16** will apply.

9.8.2.8 *Impact O8: Changes to Prey Availability*

423. Any impacts on prey species have the potential to indirectly affect marine mammals. As outlined in **Chapter 8: Fish and Shellfish (Volume II)**, the potential impacts on fish species during O&M can result from:

- Physical disturbance and temporary habitat loss;
- Increased suspended sediment and sediment re-deposition;
- Underwater noise and vibration;
- Permanent habitat loss;
- EMF;
- Introduction of hard substrate; and
- Changes in fishing activity.

9.8.2.8.1 *Sensitivity*

424. The sensitivity for all marine mammals during the O&M phase in relation to changes to prey availability is considered to be similar to that of the construction phase. The summary of sensitivities, as shown in **Section 9.8.1.8**, is the following:

- Harbour porpoise = **low to medium**;
- Dolphin species (including killer whale) = **low**;
- Whale species = **low to medium**; and
- Grey and harbour seals = **low**.

9.8.2.8.2 *Magnitude of Impact*

425. **Table 9.46** sets out the impacts assessed in **Chapter 8: Fish and Shellfish Ecology (Volume II)** and the magnitude of impact for fish and shellfish receptors. The magnitude of impact for marine mammals (in terms of changes to prey availability).

Table 9.46: Operation and Maintenance Magnitude of Impact for Changes to Prey Availability

Fish and Shellfish Ecology Impact	Receptor(s)	Magnitude of Impact for Fish and Shellfish Ecology Receptors	Magnitude of Impact for Marine Mammals (Changes to Prey Availability)
Physical disturbance and temporary habitat loss	Spawning Grounds	Negligible	Negligible
	Nursery Grounds	Negligible	Negligible
	Diadromous Fish	Negligible	Negligible
	Elasmobranchs	Negligible	Negligible
	Marine Demersal Fish	Negligible	Negligible
	Marine Pelagic Fish	Negligible	Negligible
	Cephalopods	Negligible	Negligible
	Crustaceans	Negligible	Negligible
	Molluscs	Negligible	Negligible
Increased suspended sediment and re-deposition	Spawning Grounds	Negligible	Negligible
	Nursery Grounds	Negligible	Negligible
	Diadromous Fish	Negligible	Negligible
	Elasmobranchs	Negligible	Negligible
	Marine Demersal Fish	Negligible	Negligible
	Marine Pelagic Fish	Negligible	Negligible
	Cephalopods	Negligible	Negligible
	Crustaceans	Negligible	Negligible
	Molluscs	Negligible	Negligible
Underwater noise and vibration	Spawning Grounds	Low (negligible for herring spawning)	Low (negligible for herring spawning)
	Nursery Grounds	Negligible	Negligible
	Diadromous Fish	Negligible	Negligible
	Elasmobranchs	Negligible	Negligible
	Marine Demersal Fish	Negligible	Negligible
	Marine Pelagic Fish	Negligible	Negligible
	Cephalopods	Negligible	Negligible
	Crustaceans	Negligible	Negligible
	Molluscs	Negligible	Negligible

Fish and Shellfish Ecology Impact	Receptor(s)	Magnitude of Impact for Fish and Shellfish Ecology Receptors	Magnitude of Impact for Marine Mammals (Changes to Prey Availability)
EMF	Spawning Grounds	Negligible	Negligible
	Nursery Grounds	Negligible	Negligible
	Diadromous Fish	Negligible	Negligible
	Elasmobranchs	Negligible	Negligible
	Crustaceans	Negligible	Negligible
	All other receptor groups	Negligible	Negligible
Permanent habitat loss	Spawning Grounds	Negligible	Negligible
	Nursery Grounds	Negligible	Negligible
	Diadromous Fish	Negligible	Negligible
	Elasmobranchs	Negligible	Negligible
	Marine Demersal Fish	Negligible	Negligible
	Marine Pelagic Fish	Negligible	Negligible
	Cephalopods	Negligible	Negligible
	Crustaceans	Negligible	Negligible
	Molluscs	Negligible	Negligible
Introduction of hard substrate	Spawning Grounds	No Change	Negligible
	Nursery Grounds	No Change	Negligible
	Diadromous Fish	No Change	Negligible
	Elasmobranchs	No Change	Negligible
	Marine Demersal Fish	No Change	Negligible
	Marine Pelagic Fish	No Change	Negligible
	Cephalopods	Negligible	Negligible
	Crustaceans	Negligible	Negligible
	Molluscs	No Impact	Negligible
Changes in fishing activity	Spawning Grounds	Negligible	Negligible
	Nursery Grounds	Negligible	Negligible
	Diadromous Fish	Negligible	Negligible
	Elasmobranchs	Negligible	Negligible
	Marine Demersal Fish	Negligible	Negligible

Fish and Shellfish Ecology Impact	Receptor(s)	Magnitude of Impact for Fish and Shellfish Ecology Receptors	Magnitude of Impact for Marine Mammals (Changes to Prey Availability)
	Marine Pelagic Fish	Negligible	Negligible
	Cephalopods	Negligible	Negligible
	Crustaceans	Negligible	Negligible
	Molluscs	Negligible	Negligible

9.8.2.8.3 Significance of Effect

426. Overall, it is predicted that the sensitivity for dolphins and seals is low, and the magnitude of impact is negligible in all cases. Therefore, for dolphin and seal species, the overall effect is **negligible adverse** which is **not significant** in EIA terms.
427. For harbour porpoise and minke whale, the sensitivity is low to medium and the magnitude of impact is negligible. The effect is therefore of **negligible adverse** significance, which is **not significant** in EIA terms.

9.8.2.8.3.1 Mitigation

428. No additional marine mammal mitigation is considered necessary because the likely effect in the absence of additional mitigation is **not significant** in EIA terms. General measures set out in **Table 9.16** will apply.

9.8.3 Potential Impacts During Decommissioning

429. The sequence of decommissioning is likely to be the reverse of the construction sequence, taking around seven years, with similar types and numbers of vessels and equipment expected to be involved. It is expected that the Bellrock Wind Farm Infrastructure will be fully removed at the end of its operational life. The removal and dismantling of the FOU's will largely be a reversal of the installation process. Generally, the FOU's will be towed from the Bellrock WFDA to a suitable port for decommissioning. Mooring lines and anchors will be recovered and removed from the WFDA. For FOU driven pile anchors, these are expected to be either fully removed or cut off below seabed level with a proportion remaining in-situ (due to anticipated excessive cost in their complete removal) following good practice and consideration of environmental conditions and sensitivities. Subsea cable hubs are expected to be fully removed from the seabed. The dynamic sections of the IACs within the water column will be cut at the connector with the static IAC and fully removed. The approach for decommissioning the static IACs on the seabed is yet to be determined, however, this will be reviewed throughout the lifetime of the Bellrock WFDA and good practice guidance at time of decommissioning will be followed.
430. Subject to the material used and environmental sensitivities, it may be preferable to leave scour protection in-situ to preserve the marine habitat that may have developed over the life of the Bellrock WFDA. The approach for decommissioning cable protection will be similar to scour protection. Relevant stakeholders and regulators will be consulted to establish the best approach. Good practice guidance at time of decommissioning will be followed.

431. Whilst a detailed assessment of decommissioning impacts cannot be undertaken at this stage, for this assessment, it is expected overall that decommissioning is likely to operate within the parameters identified for construction (i.e. any activities are likely to occur within the temporary construction working areas and require no greater amount or duration of activity than assessed for construction).
432. As presented in **Appendix 5.1: Mitigation and Monitoring Register (Volume IV)** a Decommissioning Programme setting out the decommissioning procedures, including environmental management measures, will be secured by condition of the S36 Consent and submitted for approval of Scottish Ministers prior to commencement of development and requirements under s.105 of the Energy Act 2004.

9.8.3.1 Impact D1: Underwater Noise during Geophysical Surveys

433. As noted above, decommissioning impacts of underwater noise during geophysical surveys are expected to be less than that as assessed for construction and O&M (see **Sections 9.8.1.2** and **9.8.2.1**).

9.8.3.1.1 Sensitivity

434. The sensitivity for all marine mammal species is predicted to be **high** for auditory injury (PTS) and **medium** to **low** for disturbance.

9.8.3.1.2 Magnitude of impact

435. The magnitude of impact for all marine mammal species is **negligible** for both auditory injury (PTS) and disturbance.

9.8.3.1.3 Significance of Effect

436. The effect is of **minor adverse** significance for auditory injury (PTS) and **negligible adverse** for behavioural disturbance, where both are **not significant** in EIA terms.
437. No additional marine mammal mitigation is considered necessary because the likely effect in the absence of additional mitigation is **not significant** in EIA terms. All surveys will be undertaken with mitigation in place as required in the JNCC (2017) guidance and all measure will be listed in the risk assessment to support the EPS licence application.

9.8.3.2 Impact D2: Underwater Noise from Decommissioning Activities

438. Underwater noise from other activities would be similar to those activities assessed for the construction phase (see **Section 9.8.1.4**), although to a lesser degree. However, there has not been any specific modelling for removal activities as the specific methods used are not currently known and technologies are likely to have advanced by the time decommissioning occurs.

9.8.3.2.1 Sensitivity

439. All species of marine mammals are considered to have a **high** sensitivity to PTS due to decommissioning activities if they are within the potential effect ranges for physical injury or PTS. Marine mammals within the potential effect area are considered to have very limited capacity to avoid such effects, and unable to recover from physical injury or auditory injury.

440. The sensitivity of marine mammals to disturbance as a result of underwater noise during construction activities, other than piling, is considered to be **medium** in this assessment as a precautionary approach. Marine mammals within the potential disturbance area are considered to have limited capacity to avoid such effects, although any disturbance to marine mammals would be temporary and they would be expected to return to normal behaviour once the disturbance had ceased, or they had become habituated to the sound.
441. All related decommissioning activities were considered to be moving sources, and therefore, once the activity/vessel moved past a certain area, the marine mammals would return to normal behaviour. The magnitude of impact is therefore considered to be **negligible** for all species for individual activities and four activities together (see **Table 9.41**).

9.8.3.2.2 *Magnitude of Impact*

442. During decommissioning, there is the potential for rock or cable removal and cutting activities to take place. Although the full scope and requirements of the work is currently unknown, the associated effects to marine mammals would be the same or less than those activities assessed to occur during construction (**Section 9.8.1.4**).

9.8.3.2.2.1 *Underwater Cutting*

443. It is anticipated that maximum levels of underwater noise during the decommissioning phase would originate from underwater cutting required to remove structures. This is likely to be much less than pile driving and therefore impacts are likely to be less than as assessed during the construction phase. Given that the types of vessels used to remove infrastructure (and hence their size and outputs) are expected to be similar to those used for installation, the potential impacts from elevated underwater noise due to vessel use and other (non-piling) noise producing activities is expected to result in a similar maximum design spatial scenario as the construction phase. As such, the magnitude of the impact of the decommissioning phase for both auditory injury and behavioural disturbance for all marine mammal receptors, is not expected to differ or be greater than that assessed for the construction phase (see **Section 9.8.1.5**).

9.8.3.2.2.2 *Auditory Injury (PTS)*

444. An overview of potential impacts from elevated underwater noise due to vessel use and other (non-piling) noise producing activities as well as associated effects (auditory injury) are described in **Section 9.8.1.5** for the construction phase and have not been reiterated here for the decommissioning of the Bellrock Wind Farm Infrastructure.
445. The impact (elevated underwater noise during vessel activity and other noise producing activities) is predicted to be of local spatial extent, medium term duration, intermittent and, although the impact itself is reversible (i.e. the elevation in underwater noise only occurs during vessel activity and other noise producing activities), the effect of PTS is permanent. It is predicted that the impact will affect the receptor directly. Given very small potential injury ranges, there is considered to be no residual risk of injury and therefore no population-level effects. The magnitude was therefore considered to be **negligible**.

9.8.3.2.2.3 *Disturbance*

446. The discussion on using a 4 km disturbance range for construction activities and an assessment of disturbance effects on marine mammals from one and four activities (**Table 9.41**) has already been conducted in **Section 9.8.1.4.3.2**, and has therefore not been repeated here. In summary of **Table 9.41**, the magnitude of impact is considered to be **negligible** for all marine mammal species apart from bottlenose dolphin which has a **low** magnitude for the CES MU.

9.8.3.2.3 *Significance of Effect*

447. Overall, it is predicted that the sensitivity of marine mammal receptors to auditory injury from other activities during decommissioning is **high**, and the magnitude of impact is **negligible**. Therefore, the effect significance is **minor adverse** significance for all other marine mammal receptors which is **not significant** in EIA terms.
448. For disturbance, the sensitivity for all marine mammal receptors is **medium** for harbour porpoise and baleen whales and **low** for dolphins and seals and the magnitude of impact is **negligible**, apart for bottlenose dolphin CES MU which has a **low** magnitude. Therefore, the effect significance for disturbance from underwater noise from other activities is **negligible adverse** which is **not significant** in EIA terms, and **minor adverse** for the bottlenose dolphin CES MU which is **not significant** in EIA terms.

9.8.3.2.3.1 *Mitigation*

449. No additional marine mammal mitigation is considered necessary because the likely effect in the absence of additional mitigation is **not significant** in EIA terms. General measures set out in **Table 9.16** will apply.

9.8.3.3 *Impact D3: Underwater Noise and Presence of Vessels*

450. During the decommissioning of the Bellrock Wind Farm Infrastructure, the increased levels of vessel activity will contribute to background underwater noise levels. Vessel types which will be required during the decommissioning phase include those used during removal of FSSs and SKSs, cables and cable protection, however the exact number of vessels and round trips is unknown at this stage.

9.8.3.3.1 *Sensitivity*

451. The sensitivity of marine mammal receptors to auditory injury has been considered in detail in **Section 9.8.1.5.1** and therefore is not reiterated here. PTS ranges that are a result of vessels involved in the decommissioning phase (non-impulsive sound) are lower than PTS ranges for piling (impulsive sound) and the numbers of animals potentially injured are very low for all species.
452. All marine mammals are deemed to have limited resilience, low recoverability and high international value for auditory injury. The sensitivity of the receptor in regard to auditory injury is therefore considered to be **high**.
453. The sensitivity of the receptors in regards to disturbance during the decommissioning phase is not expected to differ from the sensitivity of the receptors during the construction phase, which is described previously in **Section 9.8.1.5.1** and is deemed to be **medium to low**.

9.8.3.3.2 *Magnitude of Impact*

454. An overview of potential impacts from elevated underwater noise due to vessel use and other (non-piling) noise producing activities as well as associated effects (behavioural disturbance) are described in **Section 9.8.1.5.2.1.1** for the construction phase and have not been reiterated here for the decommissioning of the Bellrock Wind Farm Infrastructure.
455. The impact (elevated underwater noise during vessel use and other noise producing activities) is predicted to be of local to regional spatial extent, medium-term duration, intermittent and the effect of behavioural disturbance is of high reversibility (with animals returning to baseline levels soon after they moved from the impact zone). It is predicted that the impact will affect the receptors directly. Whilst there may be effects at an individual level, these are not predicted to be at a scale that would lead to any population-level effects. The magnitude was therefore considered to be **low**.

9.8.3.3.3 *Significance of Effect*

456. For disturbance, the sensitivity is **medium** for harbour porpoise and baleen whales and **low** for dolphins and seals and the magnitude of impact is **negligible**. Therefore, the effect significance for disturbance from underwater noise from the presence of vessels is **negligible adverse** which is **not significant** in EIA terms.

9.8.3.3.3.1 *Mitigation*

457. No additional marine mammal mitigation is considered necessary because the likely effect in the absence of additional mitigation is **not significant** in EIA terms. General measures set out in **Table 9.16** will apply.

9.8.3.4 *Impact D4: Collision Risk with Vessels*

458. Vessel use during decommissioning of the Wind Farm Infrastructure may lead to injury to marine mammals due to collision with vessels. Vessels will be required for activities such as removal of anchors/moorings, cables and cable protection (**Table 9.15**).

9.8.3.4.1 *Sensitivity*

459. The sensitivity of the receptors during the decommissioning phase is not expected to differ from the sensitivity of the receptors during the construction phase. Therefore, the sensitivity of marine mammal receptors to collision risk is as described previously in **Section 9.8.1.6.1**, where it has been assessed as **medium** for baleen whales and **low** for all other marine mammal receptors.

9.8.3.4.2 *Magnitude of Impact*

460. The impact is predicted to be of local spatial extent, medium term duration, intermittent and, whilst the risk will only occur during vessel transits, the effect of collision on sensitive receptors is of medium to low reversibility (depending on the extent of injuries). It is predicted that the impact will affect the receptor directly. The magnitude is therefore considered to be **low**.

9.8.3.4.3 *Significance of Effect*

461. The magnitude of the impact is deemed to be **low** and the sensitivity of the receptor is considered to be **medium** for baleen whales and **low** for all other marine mammal receptors. The effect will therefore be of **minor adverse** significance for baleen whales and **negligible adverse** for all other marine mammal receptors, both of which are **not significant** in EIA terms.

9.8.3.4.3.1 *Mitigation*

462. No additional marine mammal mitigation is considered necessary because the likely effect in the absence of additional mitigation is **not significant** in EIA terms. However, all vessel movements would be kept to the minimum number that is required to develop the Wind Farm Infrastructure. Additionally, vessel operators would use industry best practice to reduce any risk of collisions with marine mammals and adhere to an approved VMNSP (see **Table 9.16**).

9.8.3.5 **Impact D5: Disturbance at Seal Haul-out Sites**

463. Vessels transiting to and from the Bellrock WFDA during the decommissioning phase may lead to disturbance of seals at seal haul-out sites. This impact is assumed to be similar to the activities described for the construction phase, with an overview of the potential impacts described in **Section 9.8.1.7**, and therefore have not been reiterated here for the decommissioning phase.

9.8.3.5.1 *Sensitivity*

464. As noted in **Section 9.8.1.7.1**, this assessment takes a precautionary approach, acknowledging that both grey and harbour seal have some capacity to avoid, adapt to, tolerate, or recover from the anticipated impacts. The sensitivity of grey and harbour seal is therefore considered to be **medium**.

9.8.3.5.2 *Magnitude of Impact*

465. The vessel routes for the decommissioning phase are currently unknown but they are considered to be similar to that of the routes used for the construction phase. The magnitude of impact and further information on how it is assessed is provided in **Section 9.8.1.7.2** and has not been reiterated further here. Therefore, the magnitude of impact is therefore considered to be **low**.

9.8.3.5.3 *Significance of Effect*

466. Overall, it is predicted that the sensitivity of grey and harbour seal is **medium** and the magnitude of impact is **negligible to low**. The effect is therefore of **negligible to minor adverse** significance, which is **not significant** in EIA terms.

9.8.3.5.3.1 *Mitigation*

467. No additional marine mammal mitigation is considered necessary because the likely effect in the absence of additional mitigation is **not significant** in EIA terms. General measures set out in **Table 9.16** will apply.

9.8.3.6 **Impact D6: Changes to Prey Availability**

468. Potential impacts on marine mammal prey species during the decommissioning phase have been assessed in **Chapter 8: Fish and Shellfish Ecology (Volume II)** using the appropriate maximum design scenarios for these receptors. These impacts include temporary subtidal habitat loss/disturbance, long-term subtidal habitat loss and increased SSCs and associated sediment deposition.

9.8.3.6.1 *Sensitivity*

469. The sensitivity of marine mammal receptors during the decommissioning phase is not expected to differ from the sensitivity of the receptors during the construction phase described in **Section 9.8.1.8.1**. The sensitivity of the receptor is therefore, considered to be **low**.

9.8.3.6.2 *Magnitude of Impact*

470. Magnitude of impacts are as described for the construction phase in **Section 9.8.1.8.2**. The impact on marine mammal receptors is therefore predicted to be of local spatial extent, medium term duration, intermittent and of high reversibility. The magnitude is therefore, considered to be **low**.

9.8.3.6.3 *Significance of Effect*

471. The magnitude of the impact is deemed to be **low** and the sensitivity of the receptor is considered to be **low**. Given that marine mammals can exploit a wide range of prey species but travelling longer distances may be associated with higher rate of energy expenditure, the effect will therefore be of **minor adverse** significance, which is **not significant** in EIA terms.

9.8.3.6.3.1 *Mitigation*

472. No additional marine mammal mitigation is considered necessary because the likely effect in the absence of additional mitigation is **not significant** in EIA terms.

9.9 Cumulative Effects Assessment

473. In order to undertake the CEA, the potential for cumulative effects has been established considering each Bellrock WFDA-alone effect and the potential Zone of Influence alongside the list of plans, projects and activities that could potentially interact. These stages are detailed further in **Appendix 9.4: Marine Mammals Cumulative Effects Assessment Screening (Volume IV)**.
474. The goal of the approach for evaluating the potential cumulative effects to marine mammals is to minimise uncertainties and complexities associated with utilising various assessments from EIAs of projects considered in the CEA process. Differences in noise models, thresholds, criteria, and methods for estimating density among these assessments often create challenges.

9.9.1 Screening of Potential Cumulative Impacts

475. Part of the cumulative assessment process was the identification of which individual impacts assessed for the Bellrock WFDA have the potential for a cumulative effect on receptors (impact screening). This information is set out in **Table 9.47**. Impacts for which the significance of effect was assessed in the Bellrock WFDA alone assessment as 'negligible adverse' or above, are considered in the CEA impact screening (i.e. those assessed as 'no change' are not taken forward as there is no potential for them to contribute to a cumulative effect).

476.

Appendix 9.4: Marine Mammals Cumulative Effects Assessment Screening (Volume IV)

provides detailed information on the CEA project screening process. It further outlines the types of activities and industries that may contribute to the potential for cumulative effects during construction and O&M. The following impacts were considered:

- Auditory injury from underwater noise;
 - UXO clearance;
 - Geophysical surveys;
 - Piling;
 - Other substructure installation activities (other than impact piling);
 - Other activities (for example rock placement and IAC laying);
 - Presence of vessels; and
 - Operational WTGs and floating turbine substructure moorings on the seabed.
- Disturbance from underwater noise:
 - Same activities as above for auditory injury from underwater noise;
- Disturbance from vessel and collision risk;
- Secondary entanglement; and
- Changes to prey availability.

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Table 9.47: Summary of Potential Cumulative Effects (Impact Screening)

Impact	WFDA-alone Residual Effects Significance	Potential for Cumulative Effects	Rationale
Auditory injury from underwater noise	Not Significant (Minor adverse)	Yes	PTS can occur as part of piling activities during OWF installation, pile driving during O&G platform installation, and underwater explosives (used occasionally during the removal of underwater structures and UXO clearance) (JNCC, 2010; 2017; 2025). However, if there is the potential for any PTS, from any project, suitable mitigation would be required to be in place to reduce any risk to marine mammals. Other activities such as dredging, drilling, rock placement, vessel activity, operational OWFs, oil and gas installations or, wave and tidal sites will emit broadband noise in lower frequencies and PTS from these activities is very localised and cumulative effects are unlikely.
Disturbance from underwater noise	Not Significant (Minor adverse)	Yes	Disturbance is a short-term behavioural change that is caused by noise exposure and typically resolves within hours to days after the exposure ends. Disturbance is likely to have greater effect ranges and areas than the modelled PTS. The effects of disturbance in marine mammals are temporary. Therefore, the potential for disturbance to marine mammals from underwater noise has been screened into the CEA.
Disturbance from underwater noise from operational wind farms	Not Significant (Negligible adverse)	No	During operation, low level continuous underwater noise may be produced. However, sound levels attenuate rapidly with distance and are typically indistinguishable from background noise within a few hundred metres of the source. Any potential disturbance effects would therefore be highly localised, with no potential for cumulative impact.
Vessel collision risk	Not Significant (Minor adverse)	Yes	There is a pathway for cumulative effects and the increase in vessel collision risk due to an increase in vessels has been considered further in Section 9.8.1.6 for the full assessment.
Secondary entanglement	Not Significant (Minor adverse)	Yes	There is a pathway for cumulative effects from the increased risk of secondary entanglement due to an increase in mooring lines and dynamic IACs in the water column and has been considered further in Section 9.8.2.5 for the full assessment.
Changes to prey availability	Not significant (Negligible to Minor adverse)	Yes	There is a pathway for cumulative effects and changes to prey resources, it has been considered further in Section 9.8.1.8 .

Impact	WFDA-alone Residual Effects Significance	Potential for Cumulative Effects	Rationale
Disturbance at seal haul-outs	Not Significant (Minor adverse)	Yes	As described further in Appendix 9.4: Marine Mammals Cumulative Effect Assessment Screening (Volume IV) , no significant impacts with regards to disturbance at seal haul-out sites is expected for the Bellrock Wind Farm Infrastructure. Any disturbance at seal haul out sites as a result of other projects would be localised and temporary. However, given the minor adverse significance this has been screened into the CEA.

9.9.2 Screening of Other Plans, Projects and Activities

477. The identification and review of the other plans, projects and activities that may result in cumulative effects for inclusion in the CEA (described as ‘project screening’) was undertaken alongside an understanding of Wind Farm Infrastructure-alone effects.
478. The temporary mooring of FSSs and/or FOU’s at dedicated locations (known as ‘wet storage’) for the Bellrock Project will be considered through separate consenting process(es) as required. The Applicant is not seeking consent for wet storage within this application, and it has not been included within the scope of this EIA Report. Any proposed projects in the public domain for wet storage facilities on the east coast of Scotland have been considered within the cumulative assessment along with other projects and plans (**Appendix 5.3: Cumulative Effect Assessment Long List of Projects (Volume IV)**).
479. The plans and projects screened into the CEA are located in the relevant marine mammal reference population areas. Further information on the CEA screening (the screening of plans, projects and activities) is provided in **Appendix 9.4: Marine Mammals Cumulative Effects Assessment Screening (Volume IV)**.
480. All projects considered for CEA across all topics have been identified within **Appendix 5.3: Cumulative Effects Assessment Long List of Projects (Volume IV)**, which forms an exhaustive list of plans, projects and activities relevant to the Bellrock WFDA. Specific screening and a summary of projects screened in for marine mammals is provided in **Appendix 9.4: Marine Mammals Cumulative Effects Assessment Screening (Volume IV)**.
481. The short-list provided in **Table 9.47** has been produced specifically to assess cumulative effects on marine mammal receptors. The screening exercise has been undertaken based on available information on each plan or project as of October 2025.
482. Each plan or project in **Table 9.47** has been considered on a case-by-case basis. Only plans and projects with potential for significant cumulative effects with the Bellrock WFDA are taken forward to a detailed assessment, which are screened based on the following criteria:
- There is potential that a pathway exists whereby an impact could have a cumulative effect on a receptor;
 - The impact on a receptor from the Bellrock WFDA and the plan or project in consideration has a spatial overlap (i.e. occurring over the same area);
 - The impact on a receptor from the Bellrock WFDA and the plan or project in consideration has a temporal overlap (e.g. occurring at the same time);
 - There is sufficient information available on the plan or project in consideration and moderate to high data confidence to undertake a meaningful assessment; and
 - There is some likelihood that the residual effect (i.e. after accounting for mitigation measures) of the Bellrock Wind Farm Infrastructure could result in significant cumulative effects with the plan or project in consideration.

483. The CEA for marine mammals has identified a total of 18 plans and projects where significant cumulative effects could arise in combination with the Bellrock Wind Farm Infrastructure. A detailed assessment of cumulative effects is provided in the sections below.

Table 9.48: Short List of Plans/Projects Screened In for the Marine Mammals CEA

Project/Plan	Development Type (i.e. Application, Consented, Under Construction or Operational ¹)	Status	CEA Tier	Construction Period	Operational	Closest Distance to Bellrock WFDA (km)	Potential for Significant Cumulative Effects	Rationale
Inner Dowsing 481/1-2	Aggregate and Dredging	Operational	1	Licence Start: 03/01/2023	Licence End: 02/01/2038	380	Yes	Potential for cumulative disturbance with piling activities at the Bellrock WFDA.
West Bassurelle 458	Aggregate and Dredging	Operational	1	Licence Start: 18/09/2022	Licence End: 17/09/2037	735	Yes	Potential for cumulative disturbance with piling activities at the Bellrock WFDA.
West Bassurelle 464	Aggregate and Dredging	Operational	1	Licence Start: 18/09/2022	Licence End: 17/09/2037	735	Yes	Potential for cumulative disturbance with piling activities at the Bellrock WFDA.
Arven	Offshore Wind	Scoping	2	2030 – 2035	2036	362	Yes	Potential for spatial and temporal overlap of construction activities.
Ayre	Offshore Wind	Application	2	2030 – 2034	2035	235	Yes	Potential for spatial and temporal overlap of construction activities.
Aspen	Offshore Wind	Application	1	2028 – 2031	2032	82	Yes	Potential for spatial and temporal overlap of construction activities.
Bellrock OfTDA	Offshore Wind	Concept / Early Planning	1	2031 – 2036	2036	Overlapping	Yes	Potential for spatial and temporal overlap of construction activities.
Berwick Bank	Offshore Wind	Application	1	2028 – 2031	2031	86	Yes	Potential for spatial and temporal overlap of construction activities.
Bowdun	Offshore Wind	Scoping	2	2031 – 2032	2032	60	Yes	Potential for spatial and temporal overlap of construction activities.

Project/Plan	Development Type (i.e. Application, Consented, Under Construction or Operational ¹)	Status	CEA Tier	Construction Period	Operational	Closest Distance to Bellrock WFDA (km)	Potential for Significant Cumulative Effects	Rationale
Broadshore Hub	Offshore Wind	Scoping	2	2029 – 2031	2031	165	Yes	Potential for spatial and temporal overlap of construction activities.
Buchan	Offshore Wind	Application	1	2029 – 2032	2033	161	Yes	Potential for spatial and temporal overlap of construction activities.
Cedar	Offshore Wind	Concept / Early Planning	3	2027 – 2029	2028	21	Yes	Potential for spatial and temporal overlap of construction activities.
Cenos	Offshore Wind	Application	1	2030 – 2034	2035	61	Yes	Potential for spatial and temporal overlap of construction activities.
Dogger Bank D	Offshore Wind	Scoping	1	2029 – 2033	2033	236	Yes	Potential for spatial and temporal overlap of construction activities.
Dogger Bank South (East & West)	Offshore Wind	Application	1	2027 – 2032	2032	240	Yes	Potential for spatial and temporal overlap of construction activities.
Havbredey	Offshore Wind	Scoping	2	2032 – 2036	2036	373	Yes	Potential for spatial and temporal overlap of construction activities.
Morven	Offshore Wind	Scoping	2	2028 - 2030	Unknown	35	Yes	Potential for spatial and temporal overlap of construction activities.
Muir Mhor	Offshore Wind	Application	1	2027 – 2030	2034	52	Yes	Potential for spatial and temporal overlap of construction activities.
Normandie	Offshore Wind	Concept / Early Planning	3	2026 – 2031	2031	750 (straight line ²)	Yes	Potential for spatial and temporal overlap of construction activities.
North Falls	Offshore Wind	Application	1	2027 – 2032	2032	545	Yes	Potential for spatial and temporal overlap of construction activities.

Project/Plan	Development Type (i.e. Application, Consented, Under Construction or Operational ¹)	Status	CEA Tier	Construction Period	Operational	Closest Distance to Bellrock WFDA (km)	Potential for Significant Cumulative Effects	Rationale
Ossian	Offshore Wind	Application	1	2031 – 2038	2037	9	Yes	Potential for spatial and temporal overlap of construction activities.
Seagreen Phase 1a	Offshore Wind	Application	1	2029 - 2032	2033	96	Yes	Potential for spatial and temporal overlap of construction activities.
Sheringham Shoal Extension	Offshore Wind	Post consent	1	2028 – 2032	2032	339	Yes	Potential for spatial and temporal overlap of construction activities.
Stoura	Offshore Wind	Scoping	2	2030 – 2034	2034	392	Yes	Potential for spatial and temporal overlap of construction activities.
Stromar	Offshore Wind	Scoping	2	2029 – 2033	2033	200	Yes	Potential for spatial and temporal overlap of construction activities.
West of Orkney	Offshore Wind	Post consent	1	2027 – 2029	2032	313	Yes	Potential for spatial and temporal overlap of construction activities.

Notes:

¹ Correct as of October 2025.

² 'Straight line' infers going across land instead of around the coast, therefore the distance would be increased considerably if sticking to the seas.

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9.9.3 Assessment of Cumulative Effects

484. Having established the residual effects from the Bellrock Wind Farm Infrastructure with the potential for a cumulative effect, along with the other relevant plans, projects and activities, the following sections provide an assessment of the level of cumulative effect that may arise. These are detailed below per impact where the potential for cumulative effects has been identified (in line with **Table 9.47**).
485. Based on the impacts in **Table 9.47**, plans and projects identified where there is the potential for cumulative effects (see **Appendix 9.4: Marine Mammals Cumulative Effects Assessment Screening (Volume IV)**), where required, a detailed cumulative assessment was undertaken considering all relevant information from the Bellrock Wind Farm Infrastructure and the other plans and projects.
486. During the EIA process for some projects, assessment information has evolved. It is considered that any refinements post submission in these assessments would not impact the overall conclusions of the Bellrock WFDA's CEA. A review of newly available information confirms the robust approach to capture potential effects within the CEA which remain valid.
487. The following quantitative assessments present numbers of animals predicted to be affected or disturbed at a single point in time. However, the magnitude also considers the duration of effects. With regard to disturbance, it is further noted that not all animals within these potential disturbance areas would be uniformly displaced. While some animals would flee there may be other disturbances in other areas of the MU. Others might remain in the area of effect but additionally (or again) be disturbed by other noise sources.
488. Precise assessments of repeated disturbances over a period of time are currently not available. In lack thereof, a qualitative approach has been taken whereby the CEA of repeated disturbance events was investigated. It is also acknowledged that the noisy activities would not just occur simultaneously but rather intermittently over time and have the ability to both overlap and cause repeated disturbance events over the length of the Bellrock Wind Farm Infrastructure. These interactions or additive effects of multiple disturbance pathways are further discussed in **Section 9.10.2**.

9.9.3.1 Cumulative Effect 1: Auditory Injury and Behavioural Impacts from Underwater Noise

489. The below impacts have the potential to result in cumulative auditory injury and disturbance from underwater noise and are therefore assessed below:
- Underwater noise during UXO clearance;
 - Underwater noise during geophysical surveys;
 - Underwater noise during construction activities (other than piling) at other OWFs;
 - Underwater noise and presence of vessels; and
 - Underwater noise from other industries and activities.

490. All other effects that were assessed in **Section 9.8** for auditory injury from underwater noise had an outcome of negligible adverse and are therefore not assessed further for cumulative effects as noted in **Section 9.4.2**.
491. The sensitivity for all marine mammal species with regard to auditory injury due to underwater noise was **high**. The potential risk of (residual) PTS from piling at other OWF projects has not been considered further in the cumulative assessment due to all projects required to have mitigation in place to ensure any effects would be negligible.
492. PTS is considered to be localised to each project with regard to the modelled impact ranges. The potential magnitude of cumulative impact for PTS to marine mammals as a result of cumulative underwater noise impacts was assessed to be negligible given the short PTS impact ranges, the distance to other OWFs and activities, and the mitigation that each project has committed to.

9.9.3.1.1 ***CE1a: Indicative Assessment of Underwater Noise Impacts from Clearance of UXOs at Other OWFs***

493. Given the vast extent of available habitat, the fact that marine mammals are wide-ranging species and the low percentage of the population disturbed as a result of UXO clearance at respective projects, the likelihood of cumulative effects with projects located at large distances (e.g. >100 km) from the Bellrock WFDA is considered to be low. There were four projects within 100 km identified with potential for cumulative effects associated with this impact:
- Aspen OWF;
 - Bellrock OFTDA;
 - Berwick Bank OWF;
 - Cenoss OWF;
 - Morven OWF;
 - Muir Mhòr OWF; and
 - Ossian OWF.
494. Potential impacts of underwater noise from UXO detonations on marine mammals include mortality, physical injury or auditory injury. The risk of injury in terms of PTS to marine mammal receptors as a result of underwater noise during UXO clearance would be expected to be localised to the vicinity around the boundaries of the respective projects. It also is anticipated that standard offshore wind industry mitigation methods (which include visual and acoustic monitoring of marine mammals as standard and additional mitigation in form of ADDs and low-order clearance) will be applied based on UXO specific risk assessments. If any residual risk of injury remains it will be mitigated further post consent, thereby reducing the magnitude of impact with respect to auditory injury. However, the potential for a residual risk of injury was investigated based on the UXO clearance technique and mitigation proposed for each project.
495. Projects screened in for this cumulative assessment are expected to involve similar construction activities to those described for the Bellrock Wind Farm Infrastructure, including UXO clearance activities. It is anticipated that, for all projects, impacts associated with these activities will require additional assessment under EPS licensing. However, such applications are not yet available in the public domain.

496. Five of the projects listed above have submitted an EIA. Ossian OWF based their assessment on 15 UXOs requiring clearance (RPS, 2024) (**Table 9.49**) The EIA stated the precise details and locations of potential UXOs was unknown at the time of assessment. For the purposes of the Ossian UXO assessment, it was assumed that the worst-case scenario is UXO size up to 698 kg. Ossian OWF stated low order techniques will be applied as the intended methodology for clearance of UXO (in which case cumulative effects would be further reduced). However, they highlighted there is a small risk that a low order clearance could result in high order detonation of UXO, and some UXOs may need to be cleared with high order methods and therefore whilst both low and high order clearance was assessed, the WCS was therefore based upon high order clearance (698 kg).
497. Muir Mhòr OWF also stated the precise locations of potential UXOs was unknown at the time of assessment. They also stated the same for number of UXOs. It was assumed that the worst-case scenario is UXO size up to 750 kg, alongside stating that low order techniques will be applied and is the intended methodology. Cenòs stated the same as Ossian and Muir Mhòr, their worst-case scenario is a UXO size up to 227 kg.

Table 9.49: UXO Clearance Parameters for PTS for the Bellrock WFDA and Other OWF Projects

Project	UXO Clearance Method	Maximum UXO Size
Aspen OWF	High order detonation	907 kg
Bellrock WFDA	High order detonation	750 kg
Bellrock OfTDA*	High order detonation	
Berwick Bank OWF	High order detonation	300 kg
Ossian OWF	High order detonation	698 kg
Muir Mhòr OWF	High order detonation	750 kg
Cenòs OWF	High order detonation	227 kg
Notes: * Bellrock WFDA charge size has been used as worst-case due to limited information currently for the Bellrock OfTDA.		

9.9.3.1.1.1.1 Sensitivity

498. The sensitivities of marine mammals to cumulative disturbance from UXO are as previously described in **Appendix 9.3: Marine Mammals Unexploded Ordnance Assessment (Volume IV)** for the assessment of the Bellrock Wind Farm Infrastructure alone and therefore not repeated here.
499. The sensitivity of marine mammals to underwater UXO detonations is considered to be **low** for dolphins and seals, but **medium** for harbour porpoise and baleen whales. Marine mammals within the potential impact area for TTS/disturbance are considered to have limited capacity to avoid such effects, although any impacts on marine mammals from TTS and disturbance would be temporary and they would be expected to return to normal behaviour once the activity had ceased.

9.9.3.1.1.1.2 Magnitude of Impact

500. It was not possible to estimate the number of potential UXO clearance events that could be undertaken at the same time as construction and potential piling activity at the Bellrock WFDA.
501. A more detailed assessment of potential injury and disturbance arising from UXO clearances at the Bellrock WFDA can be found in **Appendix 9.3: Marine Mammals Unexploded Ordnance Assessment (Volume IV)**. A separate Marine Licence application for any required UXO clearance for the Bellrock WFDA would be submitted prior to any planned activities and would consider any potential cumulative effects.
502. Mitigation measures required for UXO clearance include the use of low-order clearance techniques, which could include a small donor charge, rather than full high-order detonation which is only used as a last resort.
503. It is therefore highly unlikely that more than one UXO high-order detonation would occur at exactly the same time or on the same day as another UXO high-order detonation, even if they had overlapping UXO clearance operation durations.
504. The assessment is therefore based on potential for disturbance from one UXO high-order detonation (worst-case), as well as one low-order clearance event. However, the likelihood of this and temporal overlap with piling for the Bellrock Wind Farm Infrastructure is low.
505. The magnitude of the potential disturbance from UXO clearance has been estimated based on the following shown in **Sections 9.9.3.1.1.1.2.1 to 9.9.3.1.1.1.2.2**.

9.9.3.1.1.1.2.1 Harbour Porpoise

506. The potential impact area of 1,256.64 km² per project for harbour porpoises, based on 20 km EDR for unmitigated UXO high order detonation, and 78.54 km² for low-order detonation, following the current SNCB guidance for the assessment of impact to harbour porpoise in the Southern NS SAC (JNCC, 2025a) guidance (**Table 9.50**).

Table 9.50: Quantified CEA for the Potential Disturbance of Harbour Porpoise at a Single Point in Time During UXO Clearance at OWF Projects

Project	Harbour Porpoise Density (/km ²)	Impact Area (km ²)	Maximum Number of Individuals Potentially Disturbance at Single Point in time
Bellrock WFDA - Piling	1.273	DRC	8,554
Disturbance from high-order UXO clearance	0.599	1,256.64	753
Disturbance from low-order UXO clearance	0.599	78.54	48
Total number of harbour porpoise			9,355
(without the Bellrock WFDA)			801

Project	Harbour Porpoise Density (/km ²)	Impact Area (km ²)	Maximum Number of Individuals Potentially Disturbance at Single Point in time
Percentage of NS MU (without the Bellrock WFDA)			2.7%
			0.23%
Magnitude of cumulative effect (without the Bellrock WFDA)			Low
			Negligible

9.9.3.1.1.2.2 Dolphins, Baleen Whales and Seals

507. The potential disturbance impact area during UXO clearance using TTS as a proxy, based on the modelled worst-case impact range at the Bellrock WFDA for dolphin species, baleen whales and seals is shown in Table 9.4 in **Appendix 9.3: Marine Mammals UXO Assessment (Volume IV)**. The assessment, utilising this potential impact area during UXO clearance on these species, taking into account an unmitigated high-order and a low-order clearance is shown in **Table 9.51** to **Table 9.56**.

Table 9.51: Quantified CEA for the Potential Disturbance of Bottlenose Dolphins at a Single Point in Time During UXO Clearance at OWF Projects

Project	Species Density (/km ²)	Impact Area (km ²)	Maximum Number of Individuals Potentially Disturbance at Single Point in time
Bottlenose dolphin			
Bellrock WFDA - Piling	0.0298	DRC	<32
Disturbance from high-order UXO clearance		7.1	<1
Disturbance from low-order UXO clearance		0.03	0.00089
Total number of bottlenose dolphin (without the Bellrock WFDA)			33
			1
Percentage of GNS MU (without the Bellrock WFDA)			1.63%
			0.0495%
Magnitude of cumulative effect (without the Bellrock WFDA)			Low
			Negligible

Table 9.52: Quantified CEA for the Potential Disturbance of White-beaked dolphin at a Single Point in Time During UXO Clearance at OWF Projects

Project	Species Density (/km ²)	Impact Area (km ²)	Maximum Number of Individuals Potentially Disturbance at Single Point in time
White-beaked dolphin			
Bellrock WFDA - Piling	0.243	DRC	1,091
Disturbance from high-order UXO clearance		7.1	<2
Disturbance from low-order UXO clearance		0.03	0.00729
Total number of white-beaked dolphin (without the Bellrock WFDA)			1,092
			2
Percentage of CGNS MU (without the Bellrock WFDA)			2.48%
			<0.001%
Magnitude of cumulative effect (without the Bellrock WFDA)			Low
			Negligible

Table 9.53: Quantified CEA for the Potential Disturbance of Common Dolphin at a Single Point in Time During UXO Clearance at OWF Projects

Project	Species Density (/km ²)	Impact Area (km ²)	Maximum Number of Individuals Potentially Disturbance at Single Point in time
Common dolphin			
Bellrock WFDA - Piling	0.026	DRC	642
Disturbance from high-order UXO clearance		7.1	<1
Disturbance from low-order UXO clearance		0.03	0.00078
Total number of common dolphin (without the Bellrock WFDA)			643
			1
Percentage of CGNS MU (without the Bellrock WFDA)			0.63%
			<0.001%

Project	Species Density (/km ²)	Impact Area (km ²)	Maximum Number of Individuals Potentially Disturbance at Single Point in time
Magnitude of cumulative effect (without the Bellrock WFDA)			Negligible
			Negligible

Table 9.54: Quantified CEA for the Potential Disturbance of Minke whale at a Single Point in Time During UXO Clearance at OWF Projects

Project	Species Density (/km ²)	Impact Area (km ²)	Maximum Number of Individuals Potentially Disturbance at Single Point in Time
Minke whale			
Bellrock WFDA - Piling	0.0419	DRC	504
Disturbance from high-order UXO clearance		38,013	1,593
Disturbance from low-order UXO clearance		32.2	<2
Total number of minke whale (without the Bellrock WFDA)			2,099
			1,595
Percentage of CGNS MU (without the Bellrock WFDA)			10.43%
			7.93%
Magnitude of cumulative effect (without the Bellrock WFDA)			High
			Medium

Table 9.55: Quantified CEA for the Potential Disturbance of Grey Seal at a Single Point in Time During UXO Clearance at OWF Projects

Project	Species Density (/km ²)	Impact Area (km ²)	Maximum Number of Individuals Potentially Disturbance at Single Point in Time
Grey seal			
Bellrock WFDA - Piling	0.024	DRC	200
Disturbance from high-order UXO clearance		1,521	37

Project	Species Density (/km ²)	Impact Area (km ²)	Maximum Number of Individuals Potentially Disturbance at Single Point in Time
Disturbance from low-order UXO clearance		1	0.024
Total number of grey seal (without the Bellrock WFDA)			237
			37
Percentage of combined MUs (without the Bellrock WFDA)			0.71%
			0.01%
Magnitude of cumulative effect (without the Bellrock WFDA)			Negligible
			Negligible

Table 9.56: Quantified CEA for the Potential Disturbance of Harbour Seal at a Single Point in Time During UXO Clearance at OWF Projects

Project	Species Density (/km²)	Impact Area (km²)	Maximum Number of Individuals Potentially Disturbance at Single Point in Time
Harbour seal			
Bellrock WFDA - Piling	0.000000014	DRC	0.002
Disturbance from high-order UXO clearance		1,521	0.000021
Disturbance from low-order UXO clearance		1	0.000000014
Total number of harbour seal (without the Bellrock WFDA)			0.002021014
			0.000021014
Percentage of East Coast MU (without the Bellrock WFDA)			<0.001
			<0.001
Magnitude of cumulative effect (without the Bellrock WFDA)			Negligible
			Negligible

508. As outlined in the BEIS (2020) RoC HRA, due to the nature of the sound arising from the detonation of UXO (i.e. each blast lasting for a very short duration), marine mammals, except minke whale, were not predicted to be significantly displaced from an area. Any changes in behaviour, if they

occur, would be an instantaneous response and short-term. Existing guidance suggested that disturbance behaviour was not predicted to occur from UXO clearance, if undertaken over a short period of time (JNCC, 2025a).

509. Mitigation measures required for UXO clearance include the use of low-order clearance techniques as the default method, which could include a small donor charge, rather than full high-order clearance, which is only used as a last resort. There is also the potential under the new policy that for any high-order clearance to use noise abatement measures which would further reduce the impact (UK Government et al. 2025).
510. For UXO clearance (two clearance events) occurring at the same time as piling on the Bellrock WFDA, with no other cumulative activities, the magnitude of impact would be **high** for minke whale, **low** for bottlenose dolphin and white-beaked dolphin, and **negligible** for all other species. Killer whale will have the same magnitude as that of bottlenose dolphin and white-beaked dolphin (**low**) as a worst-case, and fin and humpback whale would be the same as minke whale (**high**).

9.9.3.1.1.1.3 Significance of Effect

511. Considering that it is currently unknown how many UXOs require clearing cumulatively from Tier 1 projects and a worst-case of one high-order and one low-order has been assessed, it is expected that UXO clearance would not manifest to population-level effects due to the small proportion of the NS MU potentially affected. In addition, projects will apply further mitigation to reduce their contribution to the cumulative effect assessment.
512. Overall, the following cumulative effect significance are:
- Baleen whales have a high magnitude and medium sensitivity mean a cumulative impact effect significance of **major adverse** (which is **significant** in EIA terms);
 - Bottlenose dolphin, white-beaked dolphin and killer whale, a low magnitude and low sensitivity mean a cumulative impact effect significance of **minor adverse** (which is **not significant** in EIA terms);
 - Harbour porpoise has a negligible magnitude and medium sensitivity mean a cumulative effect significance of **negligible adverse** (which is **not significant** in EIA terms); and
 - Common dolphin, grey seal and harbour seal, a negligible magnitude and low sensitivity mean a cumulative effect significance of **negligible adverse** (which is **not significant** in EIA terms).

9.9.3.1.1.1.4 Mitigation

513. The assessment above is undertaken without consideration of mitigation, in line with guidance received from NatureScot (see email comment in **Table 9.2**).
514. A MMMP for UXO clearance will be produced post -consent in consultation with MD-LOT and NatureScot and will be based on the latest scientific understanding and guidance, results of pre-construction UXO surveys in the Bellrock WFDA, as well as detailed project design.

515. For high-order clearance without noise mitigation (for a worst-case 750 kg + donor charge weight), an ADD would need to be activated for approximately 167 minutes, based on the variable estimated swimming speeds. However, a maximum of up to 80 minutes of ADD use would be applied. For the default method of low-order clearance, ADD use would only be required for up to 12 minutes. The ADD activation time is calculated based on the highest PTS impact range of 1 km and swim speed for harbour porpoise and would cover the highest PTS impact range for all dolphins, baleen whales, and grey seal and harbour seal (see **Appendix 9.3: Marine Mammals UXO Assessment (Volume IV)**).
516. If not possible to wholly mitigate the potential for auditory injury, a marine wildlife EPS licence for injury would be applied for in relation to all EPS at risk, at the time of the ML application. An updated assessment will be undertaken for the ML application based on the actual type, weight, and number of UXO identified for clearance.

9.9.3.1.1.1.5 *Residual Significance of Effect*

517. Given each project is expected to also have low-order clearance as the intended methodology laid out in their MMMPs as mitigation (secured via conditions attached to potential marine licences and EPS licences for UXO clearance), the residual effect significance is expected to be **minor adverse** to **negligible adverse** (which is **not significant** in EIA terms) for all marine mammal species.

9.9.3.1.2 ***CE1b: Indicative Assessment of Underwater Noise Impacts from Geophysical Surveys at Other OWFs***

518. The risk of injury in terms of PTS to marine mammal receptors as a result of underwater noise due to geophysical surveys would be expected to be localised to within the boundaries of the respective projects. The assessment for the Bellrock WFDA found that the maximum impact range was 23 m for geophysical surveys (based on harbour porpoise, **Table 9.20**). With this highly localised effect, the numbers of animals impacted will be extremely low and the magnitude of the impact with respect to auditory injury occurring in marine mammals has been assessed as **negligible**.
519. Furthermore, any risk of injury will be mitigated via the current guidance (JNCC, 2017) and no potential for cumulative impacts for injury is expected and therefore not considered further in the cumulative assessment. The cumulative assessment provided in the following sections (**9.9.3.1.2.1 - 9.9.3.1.2.2.2**) focuses on disturbance only.

9.9.3.1.2.1 *Sensitivity*

520. The sensitivities of marine mammals to cumulative disturbance from site-investigation surveys are as previously described above for the assessment of the Bellrock Wind Farm Infrastructure for the construction phase and therefore is not repeated here (see **Section 9.8.1.2.1**). It is expected that, to some extent, marine mammals will be able to withstand temporary elevated levels of underwater sound during site-investigation surveys and behavioural responses are highly species and context specific.
521. All receptors are deemed to have some resilience to cumulative behavioural disturbance, high recoverability and adaptability and high international value. The sensitivity of the receptor is therefore considered to be **medium**.

9.9.3.1.2.2 *Magnitude of impact*

522. The potential to experience disturbance by marine mammal receptors is expected to be localised to the respective projects. Therefore, the cumulative assessment has focussed only on site-investigation surveys for those projects within the close vicinity (up to 50 km) from the Bellrock WFDA and whose construction phase temporally overlaps with the Bellrock Wind Farm Infrastructure. For the construction phase, where surveys are known to have been completed, this impact has been screened out of the CEA. Four projects were identified with potential for cumulative effects associated with this impact within a 50 km buffer, within the marine mammal study area:
- Bellrock OfTDA;
 - Cedar OWF;
 - Ossian OWF; and
 - Morven OWF.
523. Of the four projects within 50 km, only Ossian has submitted an EIA, with the other two having submitted a scoping report and the Bellrock OfTDA being at site selection stage. Therefore, there is uncertainty of the final design and location details of the projects, and it is not possible to provide a quantitative assessment of the impact from site-investigation surveys for all of them. It can be reasonably assumed the extent of the impacts for the project are expected to be similar to those of the Bellrock Wind Farm Infrastructure, as, whilst the geographical location of the geophysical survey areas of other projects will differ, the extent of the disturbance per survey equipment at any one point will likely be very similar.
524. The construction phase (and associated pre-construction surveys) of all four projects overlaps with that of the Bellrock Wind Farm Infrastructure and therefore there is the potential for temporal overlap in site-investigation surveys. However, it should be noted that site-investigation survey equipment will not be operating continuously, it will be used when required for investigations of particular areas of the seabed where additional information is required to inform the construction. Site-investigation surveys are likely to be carried out at the start of the construction phase for all four projects and therefore direct overlap with the site-investigation surveys for the Bellrock WFDA is unlikely (particularly given the need for limited resource to undertake site-investigation surveys).
525. For the Bellrock WFDA, the maximum disturbance range across all geophysical surveys was estimated as 3,770 m (SBP activity) for harbour porpoise. Given that the distance between the Bellrock WFDA and project is less than the estimated disturbance ranges from geophysical surveys there is no potential for spatial overlap. However, the likelihood of temporal overlap of site investigation surveys at these projects is very low, and it is therefore unlikely, due to the temporal separation, that site-investigation surveys at the Bellrock WFDA and project will spatially overlap at any one time given the small disturbance ranges and no application of dose-response.
526. Surveys are anticipated to be short term in nature (weeks to a few months) and occur intermittently over the construction phase. It is not currently possible to estimate the location, or number, of potential geophysical surveys that could be undertaken at the same time as construction and potential piling activity at the Bellrock WFDA, however, it is estimated that there could be up to two taking place at any one time.

527. Geophysical surveys are a moving source of noise, rather than a stationary one (i.e. the distance at which a survey vessel could travel in one day, with the species relevant buffer area).
528. It is difficult to determine what the potential area of effect would be when taking into account geophysical surveys as a moving source (as it is difficult to predict how far a vessel may survey in a day). Based on survey vessels travelling at a speed of 4.5 to 5 kt, up to 199 km could be surveyed in one day. However, this does not take into account the survey downtime for line changes, weather, or other technical reasons. Approximately only 52% of the surveying time was spent surveying, as per review of seismic surveys within the UK (BEIS, 2020). These assumptions have been applied to geophysical surveys due to their similarity in approach. Taking these into account, then up to 103.5 km could be surveyed in one day by one geophysical survey vessel.
529. **Table 9.57** summarises the total impact area for each marine mammal species, taking into account the recommended disturbance ranges as discussed separately for each species below. It must be noted that this approach was highly precautionary as it is unlikely that the whole geophysical survey transect area would cause disturbance to marine mammal species, as animals would return once the vessel had passed, and the disturbance had ceased.

Table 9.57: Impact Area of Geophysical Surveys Calculated for the Marine Mammal Species Based on a 103.5 km Survey Length

Species	Survey Length (km)	Disturbance Buffer (km)	Total Geophysical Survey Area Including Turning Area (km ²)	
			One Survey	Two Surveys
Harbour porpoise	103.5	5.0	1,113.5	2,227.0
Dolphin species and baleen whales		4.22	929.5	1,859.0
Seal species		3.12	353.5	707.0

9.9.3.1.2.2.1 *Harbour Porpoise*

530. The potential disturbance ranges used in the cumulative assessment are based on the SNCB guidance for assessment for harbour porpoise. Assessments for the BEIS RoC HRA for the SNS SAC (BEIS, 2020), modelled the potential for disturbance in harbour porpoise due to the use of a SBP, and results indicate that there is the potential for a possible behavioural response in harbour porpoise at up to 3.77 km from the source. However, the most recent guidance for assessing the significance of noise disturbance for harbour porpoise SACs (JNCC, 2025b) recommended the use of an EDR of 5 km for geophysical surveys.
531. Based on the potential impact area using a 5 km EDR and the worst-case scenario of two geophysical surveys coinciding with piling activities on the Bellrock WFDA, less than 2% of the harbour porpoise reference population could be temporarily disturbed (**Table 9.58**). The magnitude of impact is therefore considered to be **low**.

Table 9.58: Indicative Quantified CEA for the Potential Disturbance of Harbour Porpoise During Geophysical Surveys at OWF Projects

Project	Harbour Porpoise Density (/km ²)	Impact Area (km ²)	Maximum Number of Individuals Potentially Disturbance at Single Point in Time
Bellrock WFDA - Piling	1.273	DRC	8,554
Disturbance from two geophysical surveys	0.599	2,227.0	1,334
Total number of harbour porpoise (without the Bellrock WFDA)			9,888
			1,334
Percentage of NS MU (without the Bellrock WFDA)			2.85%
			0.38%
Magnitude of cumulative effect (without the Bellrock WFDA)			Low
			Negligible

9.9.3.1.2.2.2 Dolphins and Baleen Whales

532. Assessments for the EPS Protected Sites and Species Risk Assessment (SHEPD, 2020) modelled the potential for a possible behavioural response in marine mammals up to 3.12 km from the source in water depths at 10 m, and 4.22 km in water depths at 100 m. Given the slightly deeper depths in the Bellrock WFDA (69.51 – 120.80 m below LAT), the disturbance distance of 4.22 km has been taken forward and applied to the approach described above (**Section 9.9.3.1.2.2.1**), resulting in an impact area of 1,859 km² for dolphins and baleen whales.
533. Based on the potential impact area using a 4.22 km disturbance range and the worst-case scenario of two geophysical surveys coinciding with piling activities on the Bellrock WFDA, less than 5% of the bottlenose dolphin, white-beaked dolphin and minke whale could be disturbed, with a resultant magnitude of **low** (**Table 9.59**).
534. Less than 1% of the common dolphin reference population could be temporarily disturbed (**Table 9.59**); the magnitude of impact is therefore considered to be **negligible**. As a worst-case, killer whale will share the same magnitude as bottlenose dolphin and white-beaked dolphin (**low**), and fin and humpback whale will share the same magnitude as minke whale (**low**).

Table 9.59: Indicative Quantified CEA for the Potential Disturbance of Dolphins and Baleen Whales During the Geophysical Surveys at Other OWF Projects

Project	Density (/km ²)	Impact Area (km ²)	Maximum Number of Individuals Potentially Disturbance at Single Point in Time
Bottlenose dolphin			
Bellrock WFDA - Piling	0.0298	DRC	<32
Disturbance from two geophysical surveys		1,859	56
Total number of bottlenose dolphin (without the Bellrock WFDA)			88
			56
Percentage of GNS MU (without the Bellrock WFDA)			4.35%
			2.77%
Magnitude of cumulative effect (without the Bellrock WFDA)			Low
			Low
White-beaked dolphin			
Bellrock WFDA - Piling	0.243	DRC	1,091
Disturbance from two geophysical surveys		1,859	452
Total number of white-beaked dolphin (without the Bellrock WFDA)			1,543
			452
Percentage of CGNS MU (without the Bellrock WFDA)			3.51%
			1.03%
Magnitude of cumulative effect (without the Bellrock WFDA)			Low
			Low
Common dolphin			
Bellrock WFDA - Piling	0.026	DRC	642
Disturbance from two geophysical surveys		1,859	49

Project	Density (/km ²)	Impact Area (km ²)	Maximum Number of Individuals Potentially Disturbance at Single Point in Time
Total number of common dolphin (without the Bellrock WFDA)			691
			49
Percentage of CGNS MU (without the Bellrock WFDA)			0.67%
			<0.001%
Magnitude of cumulative effect (without the Bellrock WFDA)			Negligible
			Negligible
Minke whale			
Bellrock WFDA - Piling	0.0419	DRC	504
Disturbance from two geophysical surveys		1,859	78
Total number of minke whale (without the Bellrock WFDA)			582
			78
Percentage of CGNS MU (without the Bellrock WFDA)			2.89%
			0.39%
Magnitude of cumulative effect (without the Bellrock WFDA)			Low
			Negligible

9.9.3.1.2.2.3 Seals

535. Based on the potential impact area using a 3.12 km disturbance range (BEIS, 2020) and the worst-case scenario of two geophysical surveys coinciding with piling activities on the Bellrock WFDA, less than 1% of the grey and harbour seal reference population could be temporarily disturbed (**Table 9.60**). The magnitude of impact is therefore considered to be **negligible**.

Table 9.60: Indicative Quantified CEA for the Potential Disturbance of Seals During the Geophysical Surveys at Other OWF Projects

Project	Density (/km ²)	Impact Area (km ²)	Maximum Number of Individuals Potentially Disturbance at Single Point in Time
Grey seal			
Bellrock WFDA - Piling	0.024	DRC	200
Disturbance from two geophysical surveys		707	17
Total number of grey seal (without the Bellrock WFDA)			217
			17
Percentage of combined MUs (without the Bellrock WFDA)			0.65%
			<0.01%
Magnitude of cumulative effect (without the Bellrock WFDA)			Negligible
			Negligible
Harbour seal			
Bellrock WFDA - Piling	0.000000014	DRC	0.002
Disturbance from two geophysical surveys		707	0.0000099
Total number of harbour seal (without the Bellrock WFDA)			0.0020099
			0.0000099
Percentage of East Coast MU (without the Bellrock WFDA)			<0.001
			<0.001
Magnitude of cumulative effect (without the Bellrock WFDA)			Negligible
			Negligible

9.9.3.1.2.3 Significance of Effect

536. Overall, the magnitude of the cumulative impact magnitude is deemed to be **low** for harbour porpoise, bottlenose dolphin, white-beaked dolphin, killer whale and baleen whales and **negligible** for all other species. The sensitivity of all marine mammal receptors is considered to be **medium**. Therefore, the cumulatively effect will be of **minor adverse** significance (which is **not significant**).

in EIA terms) for harbour porpoise, bottlenose dolphin, white-beaked dolphin and killer whale, and **negligible adverse** significance (which is **not significant** in EIA terms) for all other marine mammal species assessed.

9.9.3.1.3 *CE1c: Indicative Assessment of Underwater Noise Impacts from Non-piling Construction Activities at Other OWFs*

537. All OWFs with construction dates that have the potential to overlap with the construction phase for the Bellrock Wind Farm Infrastructure have the potential for cumulative effects. Construction activities (such as seabed preparation, cable installation and protection) could occur at the same time as piling activities (worst-case impact) at the Bellrock WFDA. Projects where piling overlap was considered have not been included in regard to other construction noise as piling is the worst case even though other construction activities may be taking place at the same time.
538. OWFs screened in for other construction activities that could have potential cumulative impacts with piling at the Bellrock WFDA were screened with a 100 km buffer (for further information, see **Appendix 9.4: Marine Mammals Cumulative Effects Assessment Screening (Volume IV)** and are shown in **Table 9.61**.

Table 9.61: Summary of Projects Screened in for Overlap with Other Construction Activities (Other than Piling) at the Bellrock WFDA and Relevant Species Assessed within Each Project's EIA Report

Project	Marine Mammal Species Screened In						
	Harbour Porpoise	Bottlenose Dolphin	Common Dolphin	White-Beaked Dolphin	Minke Whale	Grey Seal	Harbour Seal
Bellrock WFDA	✓	✓	✓	✓	✓	✓	✓
Bellrock OfTDA ¹	✓	✓	✓	✓	✓	✓	✓
Aspen	✓	✓	✓	✓	✓	✓	✓
Berwick Bank	✓	✓	✓	✓	✓	✓	✓
Bowdun ²	✓	✓	✓	✓	✓	✓	✓
Cedar ²	✓	✓	✓	✓	✓	✓	✓
Cenos	X	X	X	X	X	X	X
Morven ²	✓	✓	✓	✓	✓	✓	✓
Muir Mhor	X	X	X	X	X	X	X
Ossian	X	X	X	X	X	X	X
Seagreen Phase 1a	✓	✓	X	✓	✓	✓	✓
Notes: ¹ At this time, other construction activities at the Bellrock OfTDA have been assessed cumulatively, further consideration to piling will be considered within the Bellrock OfTDA EIA Report as required. ² No EIA Report available, only scoping. ✓ = Included in Quantified CEA.							

9.9.3.1.3.1 Sensitivity

539. As outlined in **Section 9.8.1.4.2**, all marine mammals were assessed as having **medium** for harbour porpoise and baleen whale species and **low** for dolphin species and seal species. Marine mammals within the potential disturbance area are considered to have limited capacity to avoid such effects, although any disturbance to marine mammals would be temporary and they would be expected to return to normal behaviour once the disturbance had ceased, or they had become habituated to the sound.

9.9.3.1.3.2 Magnitude

9.9.3.1.3.2.1 Construction

540. During the construction of the Bellrock WFDA, there is the potential for overlap with impacts from non-piling construction activities at other OWFs. Noise sources which could cause potential disturbance impacts during OWF construction activities, other than pile driving, can include vessels, mooring installation, seabed preparation, cable installation works and rock placement.
541. Based on the Wind farm Infrastructure-alone assessments of auditory injury and disturbance from construction activities other than piling in **Section 9.8.1.4**, the impact and disturbance ranges are significantly lower than those for piling. The expected effect, from construction activities ongoing at potentially seven different projects would be much more localised and confined to the immediate vicinity of the noise source.
542. The CEA included all projects that could have non-piling construction activities during the Bellrock WFDA construction period. It is noted that these are all Tier 2 or 3 projects and the certainty on scheduling, and thus temporal overlap, is low.
543. The potential impact area for harbour porpoise was based on the worst-case disturbance range of 4 km (50.27 km²), which was based on a study where various construction activities and vessels occurred simultaneously at different locations within the wind farm study area (Benhemma-Le Gall et al. 2021).
544. For harbour porpoise, based on the worst-case scenario, for all OWFs that could be constructing at the same time as piling at the Bellrock WFDA, the potential magnitude of the temporary effect was assessed as **low**, with between 1 – 5% of the reference population potentially temporarily disturbed at any one time (**Table 9.62**). This was considered precautionary given the limited and intermittent duration of piling activities at the Bellrock WFDA.
545. For bottlenose dolphin based on the worst-case scenario, for all OWFs that could be constructing at the same time as piling at the Bellrock WFDA, the potential magnitude of the temporary effect was assessed as **medium**. For white-beaked dolphin and minke whale the magnitude was **low**. For common dolphin, grey seal and harbour seal, the magnitude was **negligible** (**Table 9.62**). As a precaution, killer whales will have the same assessment as white-beaked dolphin (**low** magnitude), and fin and humpback whale will have the same as minke whale (**low** magnitude).
546. This was considered precautionary given the limited and intermittent duration of piling activities at the Bellrock WFDA. Noted should be also the rather cautious estimation of disturbed animals as the dose-response curves are based on harbour porpoise. Seals were assessed using the MUs from the wider reference population in which the projects are situated. The magnitude was

assessed as **negligible** for piling at the Bellrock WFDA and the activities at each of the other projects together (see **Table 9.62**).

Table 9.62: Quantified CEA for the Potential Disturbance at a Single Point in Time of Marine Mammals During the Other Construction Activities at OWF Projects at the Same Time as Piling at the Bellrock WFDA

Project	Species Density (/km²)	Impact Area (km²)	Maximum Number of Individuals Potentially Disturbance at Single Point in Time
Harbour porpoise			
Bellrock WFDA - Piling	1.273	DRC	8,554
Aspen	0.5444	50.27	26
Bellrock OfTDA	0.5985		31
Berwick Bank	0.826		42
Bowdun	0.5985		31
Cedar	0.5985		31
Morven	0.5985		31
Seagreen Phase 1a	0.5985		31
Total number of harbour porpoise (without the Bellrock WFDA)			8,777
			223
Percentage of NS MU (without the Bellrock WFDA)			2.53%
			<0.06%
Magnitude of cumulative effect (without the Bellrock WFDA)			Low
			Negligible
Bottlenose dolphin – GNS MU			
Bellrock WFDA - Piling	0.0298	DRC	<32
Aspen	0.0023	50.27	1
Bellrock OfTDA	0.0298		15
Berwick Bank	0.0298		15
Bowdun	0.0298		15
Cedar	0.0298		15
Morven	0.0298		15
Seagreen Phase 1a	0.0298		15

Project	Species Density (/km²)	Impact Area (km²)	Maximum Number of Individuals Potentially Disturbance at Single Point in Time
Total number of bottlenose dolphin (without the Bellrock WFDA)			123
			91
Percentage of GNS MU (without the Bellrock WFDA)			6.1%
			4.5%
Magnitude of cumulative effect (without the Bellrock WFDA)			Medium
			Low
White-beaked dolphin			
Bellrock WFDA - Piling	0.243	DRC	1,091
Aspen	0.2047	50.27	11
Bellrock OfTDA	0.0799		4
Berwick Bank	0.243		13
Bowdun	0.0799		4
Cedar	0.0799		4
Morven	0.0799		4
Seagreen Phase 1a	0.0799		4
Total number of white-beaked dolphin (without the Bellrock WFDA)			1,135
			40
Percentage of CGNS MU (without the Bellrock WFDA)			2.58%
			0.10%
Magnitude of cumulative effect (without the Bellrock WFDA)			Low
			Negligible
Common dolphin			
Bellrock WFDA - Piling	0.026	DRC	642
Aspen	-	50.27	-
Bellrock OfTDA	0.026		<2
Berwick Bank	-		-
Bowdun	0.026		<2

Project	Species Density (/km ²)	Impact Area (km ²)	Maximum Number of Individuals Potentially Disturbance at Single Point in Time
Cedar	0.026		<2
Morven	0.026		<2
Seagreen Phase 1a	-		-
Total number of common dolphin (without the Bellrock WFDA)			650
			8
Percentage of CGNS MU (without the Bellrock WFDA)			0.63%
			<0.001%
Magnitude of cumulative effect (without the Bellrock WFDA)			Negligible
			Negligible
Minke whale			
Bellrock WFDA - Piling	0.0419	DRC	504
Aspen	0.0769	50.27	<1
Bellrock OfTDA	0.0419		<3
Berwick Bank	0.0387		<2
Bowdun	0.0419		<3
Cedar	0.0419		<3
Morven	0.0419		<3
Seagreen Phase 1a	0.0419		<3
Total number of minke whale (without the Bellrock WFDA)			522
			18
Percentage of CGNS MU (without the Bellrock WFDA)			2.59%
			0.10%
Magnitude of cumulative effect (without the Bellrock WFDA)			Low
			Negligible

Project	Species Density (/km ²)	Impact Area (km ²)	Maximum Number of Individuals Potentially Disturbance at Single Point in Time
Grey seal			
Bellrock WFDA - Piling	0.024	DRC	200
Aspen	0.004	50.27	<1
Bellrock OfTDA	0.024*		<2
Berwick Bank	0.276		14
Bowdun	0.024*		<2
Cedar	0.024*		<2
Morven	0.024*		<2
Seagreen Phase 1a	0.024*		<2
Total number of grey seal (without the Bellrock WFDA)			225
			25
Percentage of combined MUs (without the Bellrock WFDA)			0.67%
			0.07%
Magnitude of cumulative effect (without the Bellrock WFDA)			Negligible
			Negligible
*Project density based on Carter et al. (2025) is used			
Harbour seal			
Bellrock WFDA - Piling	0.000000014	DRC	0.002
Aspen	0.000008	50.27	0.0004
Bellrock OfTDA	0.000000014*		0.0000007
Berwick Bank	0.002		0.1
Bowdun	0.000000014*		0.0000007
Broadshore Hub	0.000000014*		0.0000007
Cedar	0.000000014*		0.0000007
Morven	0.000000014*		0.0000007
Seagreen Phase 1a	0.000000014*		0.0000007

Project	Species Density (/km ²)	Impact Area (km ²)	Maximum Number of Individuals Potentially Disturbance at Single Point in Time
Total number of harbour seal (without the Bellrock WFDA)			0.102
			0.100
Percentage of East Coast MU (without the Bellrock WFDA)			0.03%
			0.03%
Magnitude of cumulative effect (without the Bellrock WFDA)			Negligible
			Negligible
*Project density based on Carter et al. (2022) is used			

9.9.3.1.3.2.2 Operation and Maintenance

547. This section assessed the potential for cumulative impact arising from the piling noise at the Bellrock WFDA, in conjunction with operational noise generated by the screened in cumulative projects. As disturbance ranges were not known, a qualitative approach has been taken to assess this cumulative impact.
548. The disturbance effect of the operational WTGs was assessed as having a residual effect of minor adverse. Initial literary evidence (in **Section 9.8.2.4**) focused on specific noise level measurements at different and predictions regarding the impact area and potential responses of marine mammals.
549. Considering the aforementioned evidence, the geographical spread of the projects in Scottish waters that will become operational prior to construction at the Bellrock WFDA and the short impact ranges arising from operational WTGs (determined through the underwater noise modelling), the magnitude of the impact would be temporary and limited to the Bellrock OWF timeframe. Consequently, the magnitude was assessed as **low** for all marine mammal species.
550. Vessels associated with offshore wind farm operation are likely to undertake similar activities to those for construction, albeit with much lower frequency. Russel (2016) found that harbour seal foraged within an area undergoing offshore wind farm construction, and Benhemma-Le Gall et al. (2021) found that harbour porpoise could be disturbed up to 4 km from construction related vessels, although a higher proportion are disturbed at 2 km.
551. Maintenance activities at OWFs, such as such as additional rock placement or cable re-burial, would be very localised, short in duration and temporary.
552. Once on-site, OWF vessels would be stationary or slow moving, as they undertake the activity they are associated with, and therefore the potential for disturbance would be minimal. The potential for disturbance is considered to be localised and temporary, and marine mammals are expected to return to the project areas shortly after vessels have completed their works and left the area.

553. The potential for disturbance due to maintenance activities was assessed as minor adverse for the Bellrock WFDA alone, and it is considered that the potential for disturbance from all other OWFs that are operational at the same time as the Bellrock WFDA would have an equally low potential for effect. Therefore, a **low** magnitude (as a precautionary basis) is appropriate for all marine mammal species.

9.9.3.1.3.2.3 *Decommissioning*

554. Given their age and expected operational lifetime, the decommissioning of existing UK and European OWFs could overlap with the Bellrock WFDA duration. There is also potential for overlap of decommissioning with oil and gas infrastructure in the vicinity of the WFDA.
555. Based on currently available information, underwater noise during decommissioning of oil and gas installations would be less than levels for PTS to occur and any disturbance would be localised and not be significantly greater than that arising from vessels (Fernandez-Betelu et al. 2024). Therefore, potential cumulative effects from decommissioning activities, such as cutting equipment are not considered to have any potential for significant levels of disturbance.
556. There is currently limited information available on the potential for underwater noise and disturbance effects to marine mammals as a result of OWF decommissioning activities, as very few OWFs have yet to undertake this stage. However, it is expected that activities required would be similar to that undertaken for the decommissioning of oil and gas infrastructure as described above, and therefore it is not expected that there would be any risk of PTS onset, and that any disturbance would be localised and in line with noise levels associated with vessel presence. Any underwater noise levels due to the decommissioning of OWFs would be less than that of construction (as pile driving noise and UXO clearance, the most significant activities in terms of underwater noise levels, would not occur).

9.9.3.1.3.3 *Significance of Effect*

557. If all included OWFs were constructing at the same time as piling in the Bellrock WFDA, there was the potential for a medium magnitude of impact for bottlenose dolphin, a **low** magnitude of impact for harbour porpoise, white-beaked dolphin and minke whale, and **negligible** for all other marine mammal receptors. This also means there will be a **low** magnitude for killer whale (due to bottlenose and white-beaked dolphin) and **low** magnitude for fin and humpback whale (due to minke whale).
558. Taking into account the receptor sensitivity of the relevant marine mammal species (see **Section 9.9.3.1.3.1**), the overall cumulative effect for disturbance to marine mammals from construction activities at other OWF (at same time as Bellrock WFDA piling activities) was **minor adverse** for harbour porpoise, bottlenose dolphin, white-beaked dolphin, killer whale, minke whale, fin whale and humpback whale (which is **not significant** in EIA terms), and **negligible adverse** for the remaining marine mammal species (which is **not significant** in EIA terms).
559. As stated previously, it is important to highlight that the harbour porpoise density used in these assessments was much higher than what was known for the surrounding area and was not representative of the wider area when comparing it to other OWFs in the area and other data sources. Furthermore, it should be noted that the baleen whale and dolphin disturbance impacts for piling at the Bellrock WFDA were based on the dose-response curves for harbour porpoise, and

thus was overly precautionous and in reality, numbers of disturbed animals would be expected to be less as these receptors is less sensitive to noise.

560. It should be noted that the projects included within the cumulative assessment for disturbance from other OWFs constructing at the same time were done so based on knowledge at the time of writing of their possible construction or activity windows. Additionally, it is very unlikely that all activities would be taking place on the same day, or in the same season.
561. For disturbance from O&M activities the potential effect with the sensitivity of **medium/low** for all marine mammal receptors, and a worst case magnitude of **low** would result in an overall **minor adverse** effect which **is not significant** in EIA terms.
562. The potential magnitude of effect due to the construction of the Bellrock WFDA at the same time as decommissioning activities is not expected to be higher than the worst-case of the Bellrock WFDA under construction, as it is not expected that there would be any kind of materially additive effect when considered together. Therefore, the magnitude of effect is considered to be **low** to **negligible** as noted above, and with a sensitivity of **medium** due to disturbance, the overall effect is **minor adverse** to **negligible adverse** which is **not significant** in EIA terms.

9.9.3.1.4 ***CE1d: Indicative Assessment of Underwater Noise from Other Industries and Activities***

563. The cumulative assessment considered effects from other industries and activities that could occur at the same time as Bellrock WFDA construction. It is noted that there was low certainty on the schedule of these activities, but the assessment has been based on the most up to date information available in terms of predicted temporal overlap.
564. The cumulative disturbance assessment considered the following activities occurring at the same time as piling for the Bellrock WFDA:
- Aggregate extraction and dredging; and
 - Seismic surveys

9.9.3.1.4.1 ***Sensitivity***

565. As outlined in **Section 9.8.1.4**, all marine mammals were assessed as having **medium** sensitivity to disturbance from underwater noise sources.

9.9.3.1.4.2 ***Magnitude of Impact***

9.9.3.1.4.2.1 ***Potential for Disturbance from Aggregate Extraction and Dredging***

566. Taking into account the small potential impact ranges and the distances of the aggregate extraction and dredging projects from the Bellrock WFDA, the potential for contribution to cumulative effects is very small. Therefore, risk of PTS for all marine mammal species from aggregate extraction and dredging has been screened out from further consideration in the CEA.

567. Four aggregate/dredging projects have been screened in that could have potential cumulative disturbance impacts with piling taking place at the Bellrock WFDA (see **Appendix 9.4: Marine Mammals Cumulative Effects Assessment Screening (Volume IV)**):
- Inner Dowsing 481/1-2 for cetacean species;
 - West Bassurelle 458 for cetacean species; and
 - West Bassurelle 464 for cetacean species.
568. As outlined in the BEIS (2020) RoC HRA for the SNS SAC, studies have indicated that harbour porpoise may be displaced by dredging operations within 600 m of the activities (Diederichs et al. 2010). This would result in a potential disturbance area of 1.13 km² for each project, or up to 2.26 km² for two aggregate projects. The Inner Dowsing aggregate/dredging project lies on the East coast of England, near Lincolnshire and the other two aggregate/dredging projects lie next to each other in the English Channel. To represent the animals disturbed, the densities from SCANS-IV Block NS-C were used for Inner Dowsing and Block NS-A for the two West Bassurelle projects. This was the best available data for this area.
569. The cumulative effect of piling at the Bellrock WFDA in combination with three aggregate projects in the NS resulted in a magnitude of **low** for harbour porpoise, bottlenose dolphin, white-beaked dolphin and minke whale with under 5% of the reference population affected. For common dolphin and fin whale, the magnitude was assessed as negligible (**Table 9.63**). Killer whale will have the same magnitude as bottlenose dolphin and white-beaked dolphin (**low**) as a precautionary case, and fin and humpback whale will have the same magnitude as minke whale (**low**).

Table 9.63: Quantified CEA for the Potential Disturbance of Harbour Porpoise, Dolphins, Minke Whale and Grey Seal during Extraction and Dredging Activities at Single Point in Time

Project	Species density (/km²)	Impact area (km²)	Maximum Number of Individuals Potentially Disturbance at Single Point in time
Harbour porpoise			
Bellrock WFDA - Piling	1.273	1,256.64	8,554
Inner Dowsing 481/1-2	0.6027	2.26	<2
West Bassurelle 458	0.1045		<1
West Bassurelle 464			<1
Total number of harbour porpoise (without the Bellrock WFDA)			8,558
			4
Percentage of NS MU (without the Bellrock WFDA)			2.47%
			<0.01%

Project	Species density (/km²)	Impact area (km²)	Maximum Number of Individuals Potentially Disturbance at Single Point in time
Magnitude of cumulative effect (without the Bellrock WFDA)			Low
			Negligible
Bottlenose dolphin			
Bellrock WFDA - Piling	0.0298	DRC	<32
Inner Dowsing 481/1-2	0.0419	2.26	0.095
West Bassurelle 458	0.0029		0.007
West Bassurelle 458			0.007
Total number of bottlenose dolphin (without the Bellrock WFDA)			<32
			<1
Percentage of GNS MU (without the Bellrock WFDA)			1.58%
			<0.01%
Magnitude of cumulative effect (without the Bellrock WFDA)			Low
			Negligible
White-beaked dolphin			
Bellrock WFDA - Piling	0.243	DRC	1,091
Inner Dowsing 481/1-2	0.0149	2.26	0.034
West Bassurelle 458	0.0027		0.006
West Bassurelle 458			0.006
Total number of white-beaked dolphin (without the Bellrock WFDA)			<1,092
			<1
Percentage of CGNS MU (without the Bellrock WFDA)			2.48%
			<0.01%
Magnitude of cumulative effect (without the Bellrock WFDA)			Low
			Negligible

Project	Species density (/km ²)	Impact area (km ²)	Maximum Number of Individuals Potentially Disturbance at Single Point in time
Common dolphin			
Bellrock WFDA - Piling	0.026	DRC	642
Inner Dowsing 481/1-2	0.0032	2.26	0.007
West Bassurelle 458	0.0139		0.031
West Bassurelle 458			0.031
Total number of common dolphin (without the Bellrock WFDA)			<643
			<1
Percentage of CGNS MU (without the Bellrock WFDA)			0.63%
			<0.01%
Magnitude of cumulative effect (without the Bellrock WFDA)			Negligible
			Negligible
Minke whale			
Bellrock WFDA - Piling	0.0419	DRC	504
Inner Dowsing 481/1-2	0.0068	2.26	0.015
West Bassurelle 458	0.0419*		0.095
West Bassurelle 458			0.095
Total number of minke whale (without the Bellrock WFDA)			<505
			<1
Percentage of CGNS MU (without the Bellrock WFDA)			2.51%
			<0.01%
Magnitude of cumulative effect (without the Bellrock WFDA)			Low
			Negligible
Notes:			
* No density for minke whale was observed in SCANS-IV, therefore density for NS-D, where the Bellrock WFDA is located, has been used.			

9.9.3.1.4.2.2 Potential for Disturbance from Seismic Surveys

570. It was not possible to estimate the location, or number, of potential seismic surveys that could be undertaken at the same time as construction and potential piling activity for the Bellrock WFDA.
571. As a precautionary approach, the potential for cumulative impacts from seismic surveys has been screened into the CEA for further consideration. It was assumed, as a worst-case scenario, that there could potentially be two seismic surveys in the NS at any one time during construction (piling) in the Bellrock WFDA. To date, it is unknown how many other licences or licence applications with an overlapping time period with Bellrock WFDA construction was available at the time of writing. Therefore, the following assessment for two seismic surveys has been included for information at this stage.
572. Seismic surveys are a moving source, travelling up to 199 km in one day (based on a speed of 4.5 knots), of which 52% (103.5 km) is active survey time. **Table 9.64** summarises the total impact area for each marine mammal species, taking into account the recommended disturbance ranges, and which are discussed in the relevant species assessment section below.
573. It must be noted that this approach was highly precautionary as it is unlikely that the whole seismic survey transect area would cause disturbance to marine mammal species, as animals would return once the vessel had passed, and the disturbance had ceased.

Table 9.64: Impact area of Seismic Surveys Calculated for the Marine Mammal Species in the study areas based on a 103.5 km Survey Length

Species	Survey Length (km)	Disturbance Buffer (km)	Total Area of One Seismic Survey Including Turning Area (km ²)	Total Area of Two Seismic Surveys Including Turning Area (km ²)
All marine mammal species	103.5	10	2,384.16	4,768.32

574. For seismic surveys, if undertaken at the same time as piling for the Bellrock WFDA, with no other cumulative activities, the magnitude of impact would be **medium** for bottlenose dolphin and white-beaked dolphin medium, **low** for harbour porpoise and minke whale, and **negligible** for common dolphin and seals (see **Sections 9.9.3.1.4.2.2.1 to 9.9.3.1.4.2.2.4**). Killer whale will have the same magnitude as bottlenose dolphin and white-beaked dolphin (**medium**) as a precautionary case, and fin and humpback whale will have the same magnitude as minke whale (**low**).

9.9.3.1.4.2.2.1 Harbour Porpoise

575. The potential impact area during seismic surveys, was based on a buffer of 10 km, following the current JNCC disturbance guidance (JNCC, 2025b) (**Table 9.65**).

Table 9.65: Quantified CEA for the Potential Disturbance of Harbour Porpoise during the Length of One Seismic Survey at a Single Point in Time

Project	Harbour Porpoise Density (/km ²)	Impact Area (km ²)	Maximum Number of Individuals Potentially Disturbance at Single Point in Time
Bellrock WFDA - Piling	1.273	DRC	8,554
Disturbance from two seismic surveys	0.599	4,768.32	2,856
Total number of harbour porpoise (without the Bellrock WFDA)			11,410
			2,856
Percentage of NS MU (without the Bellrock WFDA)			3.29%
			0.82%
Magnitude of cumulative effect (without the Bellrock WFDA)			Low
			Negligible

9.9.3.1.4.2.2.2 Dolphins

576. Strong avoidance of bottlenose dolphin from a 2D seismic survey (with 470 cubic inch airguns, and a peak sound source level of 243 dB re 1 µPa @1m) was modelled at between 1.8 km and 11 km (based on site-specific underwater noise modelling using the dBht method; DECC, 2011). Assuming the largest potential disturbance range of 10 km and a survey length of 103.5 km, the impact area for two seismic survey was suggested to be 4,768.32 km² (**Table 9.66**). The CES MU for bottlenose dolphin was not assessed due to being a nearshore MU and seismic activities predominately happening offshore.

Table 9.66: Quantified CEA for the Potential Disturbance of Dolphins during the Length of Two Seismic Surveys at a Single Point in Time

Project	Bottlenose Dolphin Density (/km ²)	Impact Area (km ²)	Maximum Number of Individuals Potentially Disturbance at Single Point in Time
Bottlenose Dolphin			
Bellrock WFDA (piling)	0.0298	DRC	<32
Disturbance from two seismic surveys	0.0298	4,768.32	141
Total number of bottlenose dolphin (without the Bellrock WFDA)			173
			141

Project	Bottlenose Dolphin Density (/km ²)	Impact Area (km ²)	Maximum Number of Individuals Potentially Disturbance at Single Point in Time
Percentage of GNS MU (without the Bellrock WFDA)			8.56%
			6.98%
Magnitude of cumulative effect (without the Bellrock WFDA)			Medium
			Medium
White-Beaked Dolphin			
Bellrock WFDA (piling)	0.243	DRC	1,091
Disturbance from two seismic surveys	0.243	4,768.32	1,159
Total number of white-beaked dolphin (without the Bellrock WFDA)			2,250
			1,159
Percentage of CGNS MU (without the Bellrock WFDA)			5.12%
			2.64/9%
Magnitude of cumulative effect (without the Bellrock WFDA)			Medium
			Low
Common Dolphin			
Bellrock WFDA (piling)	0.026	DRC	642
Disturbance from two seismic surveys	0.026	4,768.32	124
Total number of common dolphin (without the Bellrock WFDA)			766
			124
Percentage of CGNS MU (without the Bellrock WFDA)			0.75%
			0.12%
Magnitude of cumulative effect (without the Bellrock WFDA)			Negligible
			Negligible

9.9.3.1.4.2.2.3 Baleen Whales

577. There was little available information on the potential for disturbance to minke whales from seismic surveys. However, based on a radius of 10 km (Macdonald et al. 1995) and a survey length of 103.5 km, the impact area for two seismic survey was suggested to be 4,768.32 km² (**Table 9.67**).

Table 9.67: Quantified CEA for the Potential Disturbance of Minke Whale during the Length of Two Seismic Survey at a Single Point in Time

Project	Minke Whale Density (/km ²)	Impact Area (km ²)	Maximum Number of Individuals Potentially Disturbance at Single Point in Time
Minke Whale			
Bellrock WFDA (piling)	0.0419	DRC	504
Disturbance from two seismic surveys	0.0419	4,768.32	200
Total number of minke whale (without the Bellrock WFDA)			704
			200
Percentage of CGNS MU (without the Bellrock WFDA)			3.50%
			0.99%
Magnitude of cumulative effect (without the Bellrock WFDA)			Low
			Negligible

9.9.3.1.4.2.2.4 Seals

578. There was little information on the potential for disturbance from seismic surveys for either grey seal or harbour seal. Therefore, a potential disturbance range of 10 km (or impact area of 4,768.32 km² for two survey) was therefore applied to both grey seal and harbour seal, due to a lack of species-specific information (**Table 9.68**).

Table 9.68: Quantified CEA for the Potential Disturbance of Grey Seal and Harbour Seal during the Length of One Seismic Survey at a Single Point in Time

Project	Grey Seal Density (/km ²)	Impact Area (km ²)	Maximum Number of Individuals Potentially Disturbance at Single Point in Time
Grey Seal			
Bellrock WFDA (piling)	0.024	DRC	200
Disturbance from two seismic surveys	0.024	4,768.32	115
Total number of grey seal (without the Bellrock WFDA)			315
			115
Percentage of combined MUs (without the Bellrock WFDA)			0.94%
			0.34%

Project	Grey Seal Density (/km ²)	Impact Area (km ²)	Maximum Number of Individuals Potentially Disturbance at Single Point in Time
Magnitude of cumulative effect (without the Bellrock WFDA)			Negligible
			Negligible
Harbour Seal			
Bellrock WFDA (piling)	0.000000014	DRC	0.002
Disturbance from two seismic surveys	0.000000014	4,768.32	0.00007
Total number of harbour seal (without the Bellrock WFDA)			0.00207
			0.00007
Percentage of East Scotland MU (without the Bellrock WFDA)			<0.01%
			<0.01%
Magnitude of cumulative effect (without the Bellrock WFDA)			Negligible
			Negligible

9.9.3.1.4.3 Significance of Effect

579. Overall, the magnitude of the cumulative impact magnitude is deemed to be **medium** as a worst-case for bottlenose dolphin, **low** for harbour porpoise, white-beaked dolphin, killer whale and baleen whales, and **negligible** for all other species. The sensitivity of all marine mammal receptors is considered to be **medium**. Therefore, the cumulative effect will be of **moderate adverse** significance (which **is significant** in EIA terms) for bottlenose dolphin, **minor adverse** significance (which **is not** significant in EIA terms) for harbour porpoise, white-beaked dolphin, killer whale and baleen whales, and **negligible adverse** significance (which is not significant in EIA terms) for all other marine mammal species assessed. A Summary of all the cumulative noise effects and potential mitigation is discussed in **Section 9.9.3.7**.

9.9.3.1.5 CE1e: Assessment of Noise Disturbance from Operational Offshore Developments

580. The cumulative assessment considered disturbance effects from operational turbine generators associated with wind, wave or tidal projects in the CEA area. Plans and projects that have already been assessed in phases other than operation were not repeated here.

581. The screened in projects (**Table 9.48**) have either become operational since the Bellrock WFDA site-specific DAS surveys commenced in March 2022 or would become operational during the construction phase of the Bellrock WFDA (**Appendix 9.4: Marine Mammals Cumulative Effects Assessment Screening (Volume IV)**).
582. This section assessed the potential for cumulative impact arising from the piling noise at the Bellrock WFDA, in conjunction with operational turbine noise generated by the screened in projects. As disturbance ranges to operational turbines were not known, a qualitative approach has been taken to assess this cumulative impact.
583. For Bellrock Wind Farm Infrastructure-alone, the disturbance effect of the operational WTGs was assessed as having a **negligible adverse** effect. Initial literary evidence (in **Section 9.8.2.4**) focused on specific noise level measurements at different OWFs and predictions regarding the impact area and potential responses of marine mammals.
584. Following this, more evidence has been laid out below, emphasising the low noise levels emitted during WTG operation, highlighting the absence of expected physiological injury to marine mammals but potential behavioural reactions if they are in close proximity to the WTGs.

9.9.3.1.5.1.1 *Fixed-bottom Substructure Wind Farms*

585. The main sources of sound generated during the operation of WTGs are aerodynamic and mechanical. The mechanical noise is from the nacelle at the top of the wind turbine tower. As the wind turbine blades rotate, vibrations are generated that travel down the turbine tower and radiate into the surrounding water column and seabed (Tougaard et al. 2009a), (Tougaard et al. 2020), (Nedwell et al. 2003).
586. Noise levels associated with operational OWFs are relatively low, with recorded levels between 141 and 146 dB re 1 μ Pa-m (RMS SPL) at four UK OWFs (MMO, 2015; Cheesman, 2016), and levels of 106 and 126 dB re 1 μ Pa-m (RMS SPL) at three operational OWFs in Sweden and Denmark, which could not be audible for harbour porpoise at a distance of 70 m from the WTG locations (Tougaard et al. 2009b). It has also been predicted that within a few hundred metres of a WTG, noise would be comparable to background noise levels (MMO, 2015; Cheesman, 2016).
587. If the ambient background noise was masking the sound of operational WTGs, then it is not expected for an animal to change their behaviour. In Marmo et al. (2013) the results showed that neither seals nor bottlenose dolphin were predicted to exhibit a behavioural response to operational OWF noise. Approximately 10% of harbour porpoise and minke whale were predicted to behaviourally respond to operational noise up to ranges of ~18 km (particularly at wind speeds of 15 ms^{-1}). However, the majority (50% or 90%) of harbour porpoise and minke whale would not respond to operational wind farm noise (Marmo et al. 2013).
588. In fact, there was an overall increase in acoustic activity of harbour porpoise inside the operating wind farm, compared to pre-construction surveys at the Egmond aan Zee OWF (Scheidat et al. 2011). The reason for this may have been the reef effect, attracting more prey species, and/or the sheltering effect of the turbines from heavy ship traffic.

589. The underwater noise levels emitted during the operation of the WTGs are low and not expected to cause physiological injury to marine mammals but could cause behavioural reactions if the animals are in the immediate vicinity of the wind turbine (Tougaard et al. 2009a), (Sigray and Andersson, 2011).
590. Measurements made at three different OWFs in Denmark and Sweden at ranges between 14 m and 40 m from the turbine substructure found that the sound generated due to turbine operation was only detectable over underwater ambient noise at frequencies below 500 Hz (Tougaard et al. 2009a).
591. Tougaard et al. (2020), reviewed the available measurements of underwater noise from different WTGs during operation and found that source levels were at least 10 – 20 dB lower than vessel noise in the same frequency range. A simple multi-turbine model indicated that cumulative noise levels could be elevated up to a few kilometres from a wind farm under very low ambient noise conditions. However, the noise levels were well below ambient levels unless very close to the individual turbines in locations with high ambient noise from shipping or high wind speeds (Tougaard et al. 2020).
592. An underwater noise study from a Chinese OWF in Shanghai found that the noise of ebb and flow around the wind farm was louder than the WTGs (Yang et al. 2018). It must be noted that the capacity of the OWFs in this study are between 3 – 6 MW only, therefore smaller than those within the Bellrock WFDA PDE.
593. The trend of larger turbines sizes leads to the projection of elevated source levels. In particular, this extrapolation suggested a modelled source level of 177 dB re 1 μ Pa for a 10 MW turbine and the subsequent increase in impact areas for behavioural disruption in marine mammals (Stöber and Thomsen, 2021). While there are limitations in extrapolation for larger turbines, it is also important to note that larger turbines are spaced further apart than smaller ones.
594. In a separate study envisioning the deployment of large-scale turbine arrays across the NS using 5 MW turbines with source levels reaching 167.6 dB re 1 μ Pa, predictions were made (van der Molen et al. 2014). Within this hypothetical OWF array comprising 60 No. 5 MW turbines, the anticipated noise levels were estimated to range between 113 – 115 dB re 1 mPa (RMS) within 400 m of a WTG. The expected noise levels would diminish below 102 dB re 1 μ Pa (RMS) in the spaces between two such farms with a 5 km separation. It was noted that under specific sea-states, the noise levels might decrease even further, potentially falling below the typical ambient noise. This scenario would enable animals to travel through quieter corridors.

9.9.3.1.5.1.2 *Floating Wind Farms*

595. The aerodynamically produced noise generally does not influence underwater noise levels due to the reflection off the water surface (Marmo et al. 2013), (Tougaard et al. 2020), but the partially submerged turbine tower may radiate noise into the water column.
596. Operational noise levels that were measured from fixed offshore WTGs were comparable to noise emissions from floating offshore WTGs at Kincardine and Hywind Scotland at comparable distances (Risch et al. 2023). Noise emissions were concentrated in the frequencies below 200 Hz and showed distinct tonal features, likely related to rotational speed, between 50 and 80 Hz at Kincardine and 25 and 75 Hz at Hywind Scotland.

597. The report further highlighted that the overall effect of the operational noise and the ability of marine mammals to perceive this noise would be largely dependent on ambient noise levels and wind speed. As opposed to fixed structures, the mooring structures generated noise too, particularly during higher wind speeds when impulsive ‘snaps’ were perceived more often than usual. Measurements of noise levels above the median (median = 100 dB noise contour) were recorded at distances up to 4 km from the turbine array (Risch et al. 2023).
598. Harbour porpoise click detection reduced at the sites closest to the WTG compared to the site furthest away, the report, however, indicated the preliminary nature of this particular result and highlighted that behavioural effects need to be studied in more detail whilst this industry is growing (Risch et al. 2023).

9.9.3.1.5.1.3 *Wave and Tidal Projects*

599. The noise that is generated from devices harvesting wave energy, derives from the moving parts in the wave energy convertors and the hydraulic pumps. In an underwater noise study by Tougaard (2015), the noise recorded from the Wavestar converter was barely detectable above the ambient nearshore noise, which was relatively high compared to offshore noise), although the hydraulic pumps caused noise of 20 – 25 dB above ambient. Based on marine mammal audiogram, harbour porpoise should not hear any noise, whereas seals would hear the hydraulic pump clearly.
600. Extensive wildlife observations around the European Marine Energy Centre (EMEC) wave and tidal energy test sites in Orkney have found little evidence of any long-term effects such as avoidance. There was no clear relationship between harbour porpoise, harbour seal and grey seal abundance and the operational sites (Long, 2017).
601. The same report found the influence of the test site on other cetacean species difficult to assess due to the varying sizes (i.e. unusually large pods) and sporadic sightings in and around the site during the surveys. However, a slight reduction in density was modelled when the site became operational.
602. It was suggested that vessel movement could be influencing marine mammal abundance, rather than the test site itself and Long (2017) stated that for seals beyond 1km there appeared to be little change from baseline abundances.

9.9.3.1.5.2 *Sensitivity*

603. As outlined in **Section 9.8.2.4.1.3**, all marine mammals were assessed as having **medium** sensitivity to disturbance from operational WTGs.

9.9.3.1.5.3 *Magnitude of Impact*

604. If all noise from the operational OWF projects were taking place at the same time as piling at the Bellrock WFDA, the potential for overlap with the operational noise from other operational OWF projects which could cause potential disturbance impacts was identified.
605. Considering the aforementioned evidence, the geographical spread of the projects in the wider NS region and the short impact ranges arising from operational turbines (determined through the Bellrock WFDA underwater noise modelling), the magnitude of the impact would be temporary and

limited to the Bellrock WFDA's operational phase. Consequently, the magnitude was assessed as **low** for all marine mammal species.

9.9.3.1.5.4 Significance of Effect

606. Taking into account the **medium** receptor sensitivity for all marine mammal species, the overall cumulative effect for disturbance from noise from operational offshore turbine generators and wave sites when Bellrock WFDA piling activities are ongoing, was determined as **minor adverse**, which is **not significant** in EIA terms.

9.9.3.1.6 CE1f: Assessment of Underwater Noise and Presence of Vessels

607. It is difficult to 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 marine mammal study area.
608. However, vessel routes to and from offshore wind farms and other offshore projects will, for the majority of time, use existing vessel routes for pre-existing vessel traffic which marine mammals will be accustomed to. They may also have become to some extent habituated to the volume of regular vessel movements and therefore the additional risk is predominantly confined to the Bellrock WFDA. The vessel movements in OWFs are likely to be limited and slow, resulting in less risk of disturbance to marine mammal receptors. In addition, projects are required to adopt measures to minimise any potential effects on marine mammals, as this is considered standard mitigation across the offshore wind industry.
609. Of all the screened in projects with construction and O&M phases overlapping with the Bellrock WFDA, **Table 9.69** presents the number of vessels at any one time and vessel trips for other OWF projects in the vicinity of the Bellrock WFDA. The projects listed are located in relatively close proximity to shipping routes to and from port. Outside of 100 km from the Bellrock WFDA, effects would be dispersed and localised. Although being within 100 km of the Bellrock WFDA, the Bellrock O&TDA is currently at site-selection stage and details on vessel numbers are not yet available. For Seagreen Phase 1a information on the number of vessels and transits is not available in the updated application.

Table 9.69: Summary of Number of Construction/O&M Vessels for the Screened In Projects (<100 km Distance from the Bellrock WFDA) that Overlap with the Bellrock WFDA Construction

Project	Phase Screened In	Maximum Number of Vessels at Any One time	Vessel Transfers	Distance to Bellrock WFDA (km)
Bellrock WFDA	Construction and Operation	Construction: 34 Operation: 21	1,573 over construction phase 305 operation trips each year	0
Ossian OWF	Construction and Operation	Construction: 97 Operation: 31	7,902 over construction phase 508 operation trips each year	8

Project	Phase Screened In	Maximum Number of Vessels at Any One time	Vessel Transfers	Distance to Bellrock WFDA (km)
Muir Mhòr OWF	Construction and Operation	Construction: 21 Operation: 12	1,711 over construction phase 259 operation trips each year	52
Cenos OWF	Construction and Operation	Construction: 22 Operation: 10	319 over construction phase 190 operation trips each year	60

9.9.3.1.6.1 Sensitivity

610. The sensitivity for marine mammals to disturbance to vessels is considered to be **medium** for harbour porpoise and baleen species and **low** for dolphins and seal species as outlined in **Section 9.8.1.5.1**.

9.9.3.1.6.2 Magnitude

9.9.3.1.6.2.1 Construction

611. While the numbers presented reflect the absolute worst-case scenario of vessel presence, the actual number of vessels is likely to be much smaller. The data in **Table 9.69** indicates that for projects with available data (and within 100 km of the Bellrock WFDA), the number of construction vessels on-site at any given time could range from 21 to 97 per project, with construction round trips ranging from 319 to 7,902.
612. It is unrealistic to assume that the maximum number of vessels at each project would be present at the construction site simultaneously with all 34 vessels at the Bellrock WFDA. Therefore, providing a quantified assessment is not representative. This snapshot would give an unreasonable estimate of the total number of vessels, not accounting for any potential overlap in disturbance ranges.
613. While there is evidence that marine mammals can become habituated to vessel traffic to some degree (Nowacek et al. 2007; Hudson, 2014; Onoufriou et al. 2016; Jones et al. 2017; Koroza and Evans, 2022), a possible response to vessels is temporary displacement from the area. Marine mammals will be exposed to a short-term fluctuation of vessel traffic during the respective project construction phase but will return once the vessel has passed. Therefore, a **low** magnitude was assigned to construction vessel effects, as any impact from vessel presence will be both localised, temporary and limited to the 7-year construction phase.

9.9.3.1.6.2.2 Operation and Maintenance

614. During the operational period of the Bellrock Wind Farm Infrastructure, there is the potential for projects to be overlapping in their operational phase, meaning that an increase in vessel traffic is likely to disturb marine mammals in the area.
615. The data in **Table 9.69** indicates that for projects with available data (and within 100 km of the Bellrock WFDA), the number of vessels on-site at any given time could range from 10 to 31 per

project, with round trips ranging from 190 to 508. As described above during 'Construction', the total number of vessels expected to be transiting or on site at any one time at each project would not reflect the actual number of vessels. Firstly, the numbers represent the maximum worst-case for each project, and secondly, vessels conducting maintenance will be temporally spaced within each year over the operational period. The potential for all O&M vessels to be at sea working on the Bellrock Wind Farm Infrastructure on the same day is unlikely.

616. While the disturbance from vessels during construction is considered a temporary impact (as assessed for Bellrock WFDA alone in **Section 9.8.2.3**, vessels during O&M are a long-term impact. This means that marine mammals could be affected by repetitive exposure to disturbance from vessel over the lifetime of the individual project. However, the literary evidence, highlights that the long-term effects of shipping disturbance is difficult to quantify but that short-term effects are likely to occur and recovery has been observed (Wisniewska et al. 2018), (New et al. 2020), (Hao et al. 2024).
617. Currently available monitoring studies for operational wind farms suggest that marine mammals are not significantly disturbed by vessel traffic, and that any impact is localised and temporary (e.g. Diederichs et al. 2008; Teilmann et al. 2006; McConnell et al. 2012). Harbour porpoise and seals have also been found to continue to forage within operational wind farm sites (Lindeboom et al. 2011; Russell et al. 2014; Leemans and Fijn, 2023). These monitoring studies suggest that there is no significant disturbance from operational wind farms, which may have a number of vessels present at any one time.
618. Vessels associated with operation are likely to undertake similar activities to those for construction, albeit with much lower frequency. Russel (2016) found that harbour seal foraged within an area undergoing OWF construction. It is expected that the vessel movements to the screened in projects, and from any port, will be largely incorporated within existing vessel routes and therefore to areas where marine mammals may already be accustomed to their presence.
619. General best practice measures, as implemented for the Bellrock WFDA (see **Table 9.16**), would be in place for all other projects considered, further limiting the potential for disturbance.
620. Once on-site, vessels would be stationary or slow moving while undertaking their activities, minimising the potential for disturbance. However, in a worst-case scenario, projects' array areas could become areas of disturbance if several vessels were to be present simultaneously. The space between the individual projects and corridors within the array sites would allow sufficient space for marine mammals to travel in between turbines to reach their foraging grounds, haul-out sites or migration routes.
621. The magnitude of impact is therefore considered to be **low** but is considered a long-term impact due to the presence of operation vessels as a continuous impact.

9.9.3.1.6.3 *Significance of Effect*

9.9.3.1.6.3.1 *Construction*

622. Available measures to reduce the potential level of disturbance from vessels are included in the VMNSP and **Outline EMP (Volume V)** which will be secured in the Section 36 Consent and Marine Licence. Best practice measures are also outlined for other projects as further detailed in **Section 9.9.3.3**.
623. The effect of cumulative disturbance from vessels on marine mammals during the 7-year construction phase of the Bellrock WFDA with a **medium to low** sensitivity and a **low** magnitude would result in a **minor adverse** effect for all marine mammal receptors, which is **not significant** in EIA terms.

9.9.3.1.6.3.2 *Operation and Maintenance*

624. Available measures to reduce the potential level of disturbance from vessels are included in the **Outline EMP (Volume V)**.
625. The effect of cumulative disturbance from vessels on marine mammals during the 35-year operational phase of the Bellrock WFDA with a **medium to low** sensitivity and a **low** magnitude would result in a **minor adverse** effect, which is **not significant** in EIA terms.

9.9.3.1.6.3.3 *Decommissioning*

626. A detailed Offshore Decommissioning Programme will be developed individually for the Bellrock WFDA and other projects, detailing the vessels required. Until then, the impact from decommissioning is expected to be the same or less than as the effect assessed during the construction phase. As such, the effect of cumulative disturbance from vessels on marine mammals with a **medium to low** sensitivity would result in a **minor adverse** effect for all marine mammal receptors, which is **not significant** in EIA terms.

9.9.3.1.7 *Combined Disturbance from Underwater Noise from All Other Industries and Activities*

627. **Table 9.70** lists all noisy activities that could coincide with piling at the Bellrock WFDA, including construction activities at other OWFs, as well as any other potential noisy activities that can have a quantified assessment. It should be noted that other noisy activities such as geophysical surveys, seismic surveys, dredging and UXO clearance are indicative as it is difficult to know when these projects/activities may occur. Impacts of these activities would need to be licensed separately, taking account of the Bellrock WFDA's consented activities in their licence applications.
628. Therefore, taking this indicative approach determines the associated potential magnitude of cumulative effect of the listed noisy activities should they all occur at the same time. **Table 9.70** presents the magnitude of the potential for cumulative disturbance taking account of all of the other OWF construction activities and aggregate or dredging projects as well as other indicatively activities (i.e. seismic, geophysical, UXO clearance and aggregates and dredging).

Table 9.70: Quantitative Assessment for Construction at Other OWFs, as well as Other Industry Noisy Activities with the Potential for Cumulative Disturbance Effects for Marine Mammals. The Numbers Presented Represent a Single Point in Time

Impact	Number of individuals						
	Harbour Porpoise	Bottlenose Dolphin	White-Beaked Dolphin	Common Dolphin	Minke Whale	Grey Seal	Harbour Seal
Worst-case disturbance from the Bellrock WFDA (Piling)	8,554	32	1,091	642	504	200	0.002
UXO clearance	801	1	2	1	1,593	37	<0.001
Geophysical surveys	1,334	56	452	49	78	17	<0.001
Construction activities at other OWFs (excluding piling)	223	91	44	8	18	25	0.1
Aggregates and dredging	4	1	1	1	1	-	-
Seismic surveys	2,856	141	1,159	124	200	115	<0.001
Total number of individuals	13,772	322	2,749	825	2,394	394	0.1
<i>(without indicative activities)</i>	8,781	124	1,136	651	523	225	0.1
Percentage of MU	3.97%	15.%	6.25%	0.80%	11.90%	1.18%	0.027%
<i>(without indicative activities)</i>	2.53%	6.13%	2.58%	0.63%	2.60%	0.67%	0.027%
Magnitude of cumulative effect	Low	High	Medium	Negligible	High	Low	Negligible
<i>(without indicative activities)</i>	Low	Medium	Low	Negligible	Low	Negligible	Negligible
Activities in grey are indicative only; No formal application has been made.							
Magnitude levels based on the percentage of the reference population affected, as set out in Table 9.10 .							

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9.9.3.1.8 *Significance of Effect - Cumulative Effect 1*

629. The significance of effect for these noise generating activities has been evaluated and includes all disturbance assessments provided in the cumulative effects assessment.
630. **Table 9.70** includes an assessment of magnitudes, if the preparatory activities (geophysical and seismic surveys, and UXO clearance) are removed from the overall assessment. These activities are included on a worst-case and precautionary approach. However, none are currently consented or applied for, and therefore their inclusion represents a currently unrealistic future prediction of activities happening at the same time (within 100 km).
631. Based on the worst-case sensitivity of **medium** for all receptors and the assessment using other projects' published information (**Appendix 9.4: Marine Mammals Cumulative Effects Assessment Screening (Volume IV)** and **Table 9.70**) the results of the CEA for disturbance piling activities at the Bellrock WFDA are:
- **Major adverse** for bottlenose dolphin, and minke whale (which is **significant** in EIA terms);
 - Fin whale and humpback are also assessed as having a **major adverse** significance of effect (which is **significant** in EIA terms) due to the proxy of minke whale;
 - **Moderate adverse** for white-beaked dolphin and used as a proxy for killer whale (which is **significant** in EIA terms);
 - **Minor adverse** for harbour porpoise and grey seal (which is **not significant** in EIA terms); and
 - **Negligible adverse** for common dolphin and harbour seal (which is **not significant** in EIA terms).
632. However, for all major and moderate adverse effected species, a large proportion of the individuals potentially disturbed would be from piling at the Bellrock WFDA alongside preparatory activities (geophysical and seismic surveys, and UXO clearance) without any mitigation applied. If this were to be removed from the assessments (the no mitigation assessment), the resultant significance would be reduced to **minor adverse** to **negligible adverse** (which is **not significant** in EIA terms) for all marine mammal species (**Table 9.70**).
633. Taking into account factors such as; not having all activities occurring at the same time, the precautionary number of animals disturbed by piling in the Bellrock WFDA, and the level of significance of effect not including any mitigation all requires further consideration. The resultant magnitudes (taking into account all other activities except piling) indicate that the overall significance of effect would be assessed as having a **minor adverse** significance (which is **not significant** in EIA terms).
634. The quantitative assessments provide a snapshot of the number of animals disturbed and the percentage of their reference population at a single point in time, which forms the basis for determining the magnitude of effect. Although this assessment quantifies a single event, the duration of effects is also considered. Repeated disturbance events are expected to have **no significant effect** on the wider population, as the effects of disturbance are not permanent and are recoverable over time.

635. The confidence in this CEA is considered medium, as it was deemed precautionary enough to comfortably encompass the likely uncertainty and variability. Throughout the assessment, it has been made clear where multiple and compounding precautionary assumptions have been made. Where possible, the uncertainty in the data which is typically used to inform CEAs, as well as the quantification of impacts have been removed. Instead, a standard impact range for disturbance and the same source for density estimates (e.g. SCANS-IV (2023) and Carter et al. (2022, 2025) seal-at sea density estimates) has been used when calculating effects for each given impact. However, consideration has been given to a number of plans or projects/activities and the likelihood of temporal overlap of all these activities is low.

9.9.3.2 Cumulative Effect 2: Auditory Injury and Behavioural Impacts of Underwater Noise Impacts from Piling at Other OWFs

636. Following the initial screening of UK and European OWFs, further screening was undertaken to identify those OWF projects that have the potential for overlapping construction phases with the Bellrock WFDA. This screening considered known construction periods of UK and European OWF projects, including known piling activities and/or construction timings, to determine a more realistic, but still worst-case, list of UK and European OWF projects that may have the potential for overlapping piling activities within the Bellrock WFDA (see **Appendix 9.4: Marine Mammals Cumulative Effects Assessment Screening (Volume IV)** for further details).
637. The sensitivity for all marine mammal species with regard to auditory injury due to underwater noise was **high**. The potential risk of (residual) auditory injury (PTS) from piling at other OWF projects has not been considered further in the cumulative assessment due to all projects required to have mitigation in place to ensure any effects would be negligible and within a small area located near their own array areas.
638. PTS is considered to be localised to each project with regard to the modelled impact ranges. Effects would be mitigated with the measures secured in the PNMP and the MMMP, which will be developed post consent and pre-construction and with consideration of the latest guidance (Matei et al. 2024;). Furthermore, all other projects that were screened in for an overlap in piling, committed to mitigate PTS with measures detailed in their respective MMMPs.
639. Potential disturbance from underwater noise during piling activities has been assessed based on the dose-response curves (Wind Farm Infrastructure-alone) which presented the worst-case numbers of animals disturbed (refer to **Section 9.8.1.3.2** for disturbance assessment).
640. Of the UK and European OWFs screened in as having a construction period that could potentially overlap with the construction of the Bellrock WFDA, 16 OWFs could be undertaking piling activities at the same time (**Table 9.71**). As noted above in the Wind Farm Infrastructure-alone assessment (**Section 9.8**), killer whale fin whale and humpback whale are assessed qualitatively due to lack of relevant data, and therefore will be assessed qualitatively for the CEA.

Table 9.71 Summary of Projects Screened in for Overlap with Piling at the Project and Relevant Species Assessed within Each Project's EIA Report

Project	Marine Mammal Species Screened In						
	Harbour Porpoise	Bottlenose Dolphin	Common Dolphin	White-Beaked Dolphin	Minke Whale	Grey Seal	Harbour Seal
Bellrock WFDA	✓✓	✓✓	✓	✓	✓✓	✓✓	✓
Bellrock OfTDA**	X	X	X	X	X	X	X
Arven*	X	X	X	X	X	X	X
Ayre*	X	X	X	X	X	X	X
Aspen	X	X	X	X	X	X	X
Berwick Bank	X	X	X	X	X	X	X
Bowdun*	X	X	X	X	X	X	X
Broadshore Hub*	X	X	X	X	X	X	X
Buchan	✓✓	✓✓	X	✓	✓✓	X	X
Cedar*	X	X	X	X	X	X	X
Cenos	✓✓	✓✓	X	✓	✓✓	✓✓	X
Dogger Bank D	✓✓	✓✓	✓	✓	✓✓	X	X
Dogger Bank South (East & West)	✓✓	✓✓	✓	✓	✓✓	X	X
Havbredey*	X	X	X	X	X	X	X
Morven*	X	X	X	X	X	X	X
Muir Mhor	✓✓	✓✓	X	✓	✓✓	✓✓	✓
Normandie*	X	X	X	X	X	X	X
North Falls	✓✓	X	X	X	✓✓	X	X
Ossian	✓✓	✓✓	X	✓	✓✓	✓✓	X
Sheringham Shoal Extension	✓✓	✓✓	X	✓	✓✓	✓	✓
Stoura*	X	X	X	X	X	X	X

Project	Marine Mammal Species Screened In						
	Harbour Porpoise	Bottlenose Dolphin	Common Dolphin	White-Beaked Dolphin	Minke Whale	Grey Seal	Harbour Seal
Stromar*	X	X	X	X	X	X	X
West of Orkney	✓✓	X	✓	✓	✓✓	✓	X
Notes: * No EIA available, only scoping. ** If required, underwater noise modelling for the offshore substation(s) within the OFTDA will be assessed cumulatively with the WFDA piling in the Bellrock OFTDA EIA. ✓ = Included in Quantified CEA. ✓✓ = Included in Quantified CEA and iPCoD population modelling.							

641. Given the stage of the above projects, limitations and constraints to project delivery and uncertainty on scheduling, a more realistic short list of OWF projects that could be undertaking piling activities at the same time as the Bellrock WFDA will be considered as projects develop, but this is the best available information at the time of writing, taking a precautionary approach.

9.9.3.2.1 Sensitivity

642. As outlined in **Section 9.8.1.3.2**, all marine mammal receptors were assessed as having a **medium** sensitivity to disturbance from underwater noise from piling at OWFs.

9.9.3.2.2 Magnitude

643. The magnitude of the potential disturbance from Bellrock WFDA piling activities has been based on the worst-case disturbance ranges for each marine mammal species that has been assessed in **Section 9.8.1.3.2**.
644. For all other projects, the worst-case disturbance numbers were taken from the relevant EIAs for the cumulative assessment. It should be noted that the potential areas of disturbance assumed that there would be no spatial overlap in the areas of disturbance between different projects and were therefore highly conservative. Not all animals within the effect radius would be uniformly displaced. While some animals would flee, others might remain in the area of effect from piling but additionally (or again) be disturbed by other noise sources.
645. There is a potential for additive effects for multiple sources of noisy activities. However, displacement of animals from activities such as piling can potentially reduce their exposure to other noisy activities from the Bellrock WFDA. Disturbance events could also be occurring elsewhere across the MU and CEA screening area. The effects of these repeated and additive disturbances that could be ongoing during the lifetime of the Bellrock WFDA are considered in iPCoD modelling and further considered in **Section 9.9** considering all activities. Piling at the Bellrock WFDA has been included in the CEA as a worst-case scenario. It was also assumed that all OWF projects would be 100% piled, as a worst-case, if piled foundations was an option.

646. The approach to the CEA for piling at OWFs was based on the potential for piling activity at each wind farm at the same time as piling activity at the Bellrock WFDA. This approach allowed for some of the OWFs to not be undertaking piling activities at the same time, while others could be simultaneously undertaking piling activities (further information is available **Appendix 9.4: Marine Mammals Cumulative Effects Assessment Screening (Volume IV)**). This was considered to be the most realistic worst-case scenario, as it is highly unlikely that all other wind farms would be simultaneously undertaking piling activities at exactly the same time as piling activity at the Bellrock WFDA, especially given the limited active piling time. The application of iPCoD modelling allows for the full piling schedule of each project to be considered, allowing for overlapping and sequential piling (repeated disturbances) events over the construction period.
647. It is important to note the actual duration for active piling (based on 2.99 hrs per pile for the Bellrock WFDA) which could disturb marine mammals is only a very small proportion of the potential construction period, based on the estimated maximum duration to install individual piles (**Table 9.15**). This means that there would be a limited window for any simultaneous impact to occur but could occur repeatedly over time.

9.9.3.2.2.1 Harbour Porpoise

648. **Table 9.72** provides a quantified assessment of magnitude of cumulative disturbance due to piling overlap with other OWFOWFs, utilising project-specific data from published EIAs as outlined in **Appendix 9.5: Marine Mammals Information and Modelling Methods for Disturbance (Volume IV)**. With or without the Bellrock WFDA, the magnitude for harbour porpoise is **high**.

Table 9.72 Quantified CEA for the Potential Disturbance at a Single Point in Time for Harbour Porpoise During Single Piling at the OWF Projects Which Could be Piling at the Same Time as the Bellrock WFDA

Project	Harbour Porpoise Density (Individuals/km ²)	Source of Project Specific Information	Maximum Number of individuals Potentially Disturbed at a Single Point in Time During Piling
Bellrock WFDA	1.273	DRC	8,554
Buchan	0.5156	EIA	11,527
Cenos	1.0398	EIA	8,863
Dogger Bank D	N/A	Preliminary Environmental Impact Report (PEIR)	5,014
Dogger Bank South (East & West)	0.66	EIA	10,196
Muir Mhor	0.5985	EIA	14,630
North Falls	N/A	EIA	6,832
Ossian	0.651	EIA	8,309
Sheringham Shoal Extension	N/A	EIA	1,338
West of Orkney	N/A	EIA	1,349

Project	Harbour Porpoise Density (Individuals/km ²)	Source of Project Specific Information	Maximum Number of individuals Potentially Disturbed at a Single Point in Time During Piling
Total number of harbour porpoise (Without Bellrock WFDA)			76,612 (68,058)
Percentage of NS MU (Without Bellrock WFDA)			22.10% (19.64%)
Magnitude of cumulative effect (Without Bellrock WFDA)			High (High)

9.9.3.2.2.2 Bottlenose Dolphin

649. **Table 9.73** provides a quantified assessment of disturbance to bottlenose dolphin due to piling overlap with other OWF, utilising project-specific data from EIAs as outlined in **Appendix 9.5: Marine Mammals Information and Modelling Methods for Disturbance (Volume IV)** and shows that a high percentage of bottlenose dolphins would be at risk of potential disturbance, for which a **high** magnitude was assigned.

650. **Table 9.73** presents the significance of effect from cumulative disturbance due to piling for bottlenose dolphin. It is considered that using the DRC assessments from all projects is over precautionary, as these assessments are not specifically designed for dolphin species. Furthermore, the population modelling incorporated the worst-case numbers of disturbance and provided data on how that could impact the bottlenose dolphin populations.

Table 9.73: Quantified CEA for the Potential Disturbance at a Single Point in Time for Bottlenose Dolphin During Single Piling at the OWF Projects Which Could be Piling at the Same Time as the Bellrock WFDA

Project	Bottlenose Dolphin Density (Individuals/km ²)	Source of Project Specific Information	Maximum Number of Individuals Potentially Disturbed at a Single Point in Time During Piling
Bellrock WFDA	0.0298	DRC	32
Buchan	0.0037	EIA	87
Cenos	0.0298	EIA	254
Dogger Bank D	N/A	PEIR	67
Dogger Bank South (East and West)	0.0419	EIA	9
Muir Mhor	0.003	EIA	74
Ossian	0.003	EIA	5
Sheringham Shoal Extension	N/A	EIA	0.009

Project	Bottlenose Dolphin Density (Individuals/km ²)	Source of Project Specific Information	Maximum Number of Individuals Potentially Disturbed at a Single Point in Time During Piling
Total number of bottlenose dolphin (Without the Bellrock WFDA)			528 (496)
Percentage of GNS MU (Without the Bellrock WFDA)			26.11% (24.53%)
Magnitude of cumulative effect (Without the Bellrock WFDA)			High (High)

9.9.3.2.2.3 Common and White-Beaked Dolphin

651. The cumulative impact for common dolphin and white-beaked dolphin for OWFs that could be undertaking piling activities at the same time as Bellrock WFDA piling is provided in **Table 9.74**. The potential magnitude for the cumulative impacts of piling activities was assessed as **high** for white-beaked dolphin and **low** for common dolphin.

Table 9.74: Quantified CEA for the Potential Disturbance at a Single Point in Time for Common Dolphin and White-beaked Dolphin During Single Piling at the OWF Projects Which Could be Piling at the Same Time as the Bellrock WFDA

Project	Species Density (Individuals/km ²)	Source of Project Specific Information	Maximum Number of Individuals Potentially Disturbed at a Single Point in Time During Piling
White-beaked Dolphin			
Bellrock WFDA	0.243	DRC	1,091
Buchan	0.1775	EIA	3,886
Cenos	0.1051	EIA	896
Dogger Bank D	N/A	PEIR	184
Dogger Bank South (East and West)	0.041	EIA	9
Muir Mhor	0.1775	EIA	6,750
Ossian	0.12	EIA	1,531
Sheringham Shoal Extension	N/A	EIA	0.0018
West of Orkney	N/A	EIA	1,709

Project	Species Density (Individuals/km ²)	Source of Project Specific Information	Maximum Number of Individuals Potentially Disturbed at a Single Point in Time During Piling
Total number of white-beaked dolphin (Without the Bellrock WFDA)			16,056 (14,965)
Percentage of CGNS MU (Without the Bellrock WFDA)			36.53% (34.05%)
Magnitude of cumulative effect (Without the Bellrock WFDA)			High (High)
Common Dolphin			
Bellrock WFDA	0.026	DRC	642
Dogger Bank D	N/A	PEIR	111
Dogger Bank South (East and West)	0.017	EIA	4
West of Orkney	N/A	EIA	90
Total number of common dolphin (Without the Bellrock WFDA)			847 (205)
Percentage of CGNS MU (Without the Bellrock WFDA)			0.83% (0.20%)
Magnitude of cumulative effect (Without the Bellrock WFDA)			Negligible (Negligible)

9.9.3.2.2.4 *Minke Whale*

652. **Table 9.75** provides a quantified assessment of disturbance to minke whale due to piling overlap with other OWF, utilising project-specific data from EIAs as outlined in **Appendix 9.5: Marine Mammals Information and Modelling Methods for Disturbance (Volume IV)**, and results in a **high** magnitude.

Table 9.75: Quantified CEA for the Potential Disturbance at a Single Point in Time for Minke Whale During Single Piling at the OWF Projects Which Could be Piling at the Same Time as the Bellrock WFDA

Project	Minke Whale Density (Individuals/km ²)	Source of Project Specific Information	Maximum Number of Individuals Potentially Disturbed at a Single Point in Time During Piling
Bellrock WFDA	0.0419	DRC	504
Buchan	0.0121	EIA	376
Cenos	0.0419	EIA	358
Dogger Bank D	0.0153	PEIR	44
Dogger Bank South (East and West)	0.02	EIA	324
Muir Mhor	0.0419	EIA	735
North Falls	N/A	EIA	37
Ossian	0.028	EIA	362
Sheringham Shoal Extension	N/A	EIA	8
West of Orkney	N/A	EIA	90
Total number of minke whale (Without the Bellrock WFDA)			2,439 (1,935)
Percentage of CGNS MU (Without the Bellrock WFDA)			12.12% (9.62%)
Magnitude of cumulative effect (Without the Bellrock WFDA)			High (Medium)

9.9.3.2.2.5 Grey Seal

653. **Table 9.76** provides a quantified assessment of disturbance to grey seal due to piling overlap with other OWF, utilising project-specific data from EIAs as outlined **Appendix 9.5: Marine Mammals Information and Modelling Methods for Disturbance (Volume IV)** and results in a **medium** magnitude.

Table 9.76: Quantified CEA for the Potential Disturbance at a Single Point in Time for Grey Seal During Single Piling at the OWF Projects Which Could be Piling at the Same Time as the Bellrock WFDA

Project	Grey Seal Density (Individuals/km ²)	Source of Project Specific Information	Maximum Number of Individuals Potentially Disturbed at a Single Point in Time During Piling
Bellrock WFDA	0.024	DRC	200
Cenos	0.2	EIA	127
Muir Mhor	N/A	EIA	1,156
Ossian	0.18	EIA	436
Total number of grey seal (Without the Bellrock WFDA)			1,919 (1,719)
Percentage of combined MUs (Without the Bellrock WFDA)			7.70% (6.89%)
Magnitude of cumulative effect (Without the Bellrock WFDA)			Medium (Medium)

9.9.3.2.2.6 Harbour Seal

654. **Table 9.77** provides a quantified assessment of cumulative disturbance to harbour seal due to piling overlap with other OWFs, utilising project-specific data from EIAs as outlined in **Appendix 9.5: Marine Mammals Information and Modelling Methods for Disturbance (Volume IV)** and results in a **negligible** magnitude.

Table 9.77: Quantified CEA for the Potential Disturbance at a Single Point in time of Harbour Seal During Single Piling at the OWF Projects Which Could be Piling at the Same Time as the Bellrock WFDA

Project	Harbour Seal Density (Individuals/km ²)	Source of Project Specific Information	Maximum Number of Individuals Potentially Disturbed at a Single Point in Time During Piling
Bellrock WFDA	0.000000014	DRC	0.002
Muir Mhor	N/A	EIA	1
Total number of harbour seal (Without the Bellrock WFDA)			1.002 (1)
Percentage of East Scotland MU (Without the Bellrock WFDA)			0.26% (0.26%)
Magnitude of cumulative effect (Without the Bellrock WFDA)			Negligible (Negligible)

9.9.3.2.3 *Population Modelling for Cumulative Disturbance from OWF Projects*

655. To show if the results indicated a significantly disturbed population, the decline is considered, in the context of a threshold of a 1% annual population decline per year, compared to the modelled unimpacted reference population is used to inform the overall significance of effect. This approach has been applied to the assessments and if a decline is predicted by the population modelling, then the significance of this decline will be considered on a case-by-case, species-by-species basis.

9.9.3.2.3.1.1 *Harbour Porpoise*

656. It is important to note that the harbour porpoise density used for the Bellrock WFDA was derived from two years of site-specific DAS surveys. The resulting density used was much higher than what was known for the surrounding area. As shown in **Appendix 9.1: Marine Mammals Technical Report (Volume IV)**, the density of 1.273 animals per km² is to be used for the wider area.

657. In practice, the potential temporary effects would be less than those predicted in this assessment, as there is likely to be a great deal of variation in timing, duration and hammer energies used throughout the various OWF project construction periods. In addition, not all individuals would be displaced over the entire potential disturbance range used within the assessments. For example, the study of harbour porpoise at Horns Rev (Brandt et al. 2011), indicated that, at closer distances (2.5 to 4.8 km), there was 100% avoidance. However, this proportion decreased significantly moving away from the pile driving activity and at distances of 10 km to 18 km avoidance was 32% to 49%, and at 21 km the abundance was reduced by just 2%.

658. For the cumulative scenario assessed within the NS MU, the iPCoD model predicts a slight decrease in harbour porpoise population size over time (**Plate 9.8** and **Table 9.78**).

659. For harbour porpoise, iPCoD modelling resulted in **no significant effect** on the population (**Table 9.78**). Whether the mean or median value is used to inform the results, the results show a less than 1% average annual decline over the first six years and over the 25-year period for both. Taking in to account the sensitivity of harbour porpoise to disturbance, the highly precautionary number of animals included in the assessment and the recoverability of the effect disturbance from cumulative underwater noise from piling is assessed as **minor adverse** which is **not significant** in EIA terms. There would be **no significant effect** on the harbour porpoise population due to cumulative effects of piling.

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Table 9.78: Results of the iPCoD Modelling for the Cumulative Assessment, Giving the Mean and Median Population Size of the Harbour Porpoise. Population (NS MU) for Years up to 2056 for Both Impacted and Un-impacted Populations in Addition to the Mean and Median Ratio Between Their Population Sizes

Time Point	Year	Mean			Median			95% Confidence Intervals	
		Un-impacted Population	Impacted Population	Impacted As % of Un-impacted	Un-impacted Population	Impacted Population	Impacted As % of Un-impacted	Un-impacted Population	Impacted Population
1	2031	338,918	338,918	100%	338,918	338,918	100%	338,918 – 338,918	338,918 – 338,918
2	2032	338,603	337,888	99.79%	339,328	338,473	99.86%	311,602 – 362,716	310,497 – 361,782
3	2033	338,766	336,441	99.31%	338,847	336,129	99.48%	305,455 – 371,148	302,593 – 368,981
7	2037	338,384	335,669	99.20%	337,972	335,259	99.43%	285,820 – 391,627	284,059 – 388,527
13	2043	339,650	336,693	99.13%	338,731	336,003	99.36%	273,230 – 411,921	271,107 – 408,647
19	2049	339,137	336,061	99.10%	337,715	334,560	99.33%	260,057 – 428,056	255,890 – 426,899
26	2056	339,046	335,831	99.06%	335,850	332,347	99.29%	249,224 – 450,664	246,960 – 446,003

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Plate 9.8: Simulated Worst-case Harbour Porpoise NS Population Sizes for Both the Un-impacted and the Impacted Populations for the Cumulative Assessment (Scientific Notation Used in These Charts, e.g. $4e+04 = 40,000$)



9.9.3.2.3.1.2 Bottlenose Dolphin

660. For the cumulative scenario assessed within the GNS MUs (see **Appendix 9.5: Marine Mammals Information and Modelling Methods for Disturbance (Volume IV)** for details of projects considered, and their parameters), the iPCoD model predicted a slight decrease in bottlenose dolphin population size over time (**Table 9.79** and **Plate 9.9**).
661. Whether the mean or median value is used to inform the results, the results show a less than 1% average annual decline over the first six years and over the 25-year period for both. However, over 25 years there is a minor change in the mean population of 4.4% which is not reflected in the median. Bottlenose dolphin are wide ranging species which are less sensitive to disturbance than harbour porpoise as outlined in **Section 9.8.1.3.2.1**. The number of animals potentially disturbed included in the modelling is highly precautionary as it has been based on the DRC for harbour porpoise. Taking all this into account, with the level of effect illustrated in the iPCoD modelling (**Table 9.79**) disturbance from cumulative underwater noise from piling is assessed as **minor adverse** and not significant in EIA terms. There would be **no significant effect** on the bottlenose dolphin population due to cumulative effects of piling.

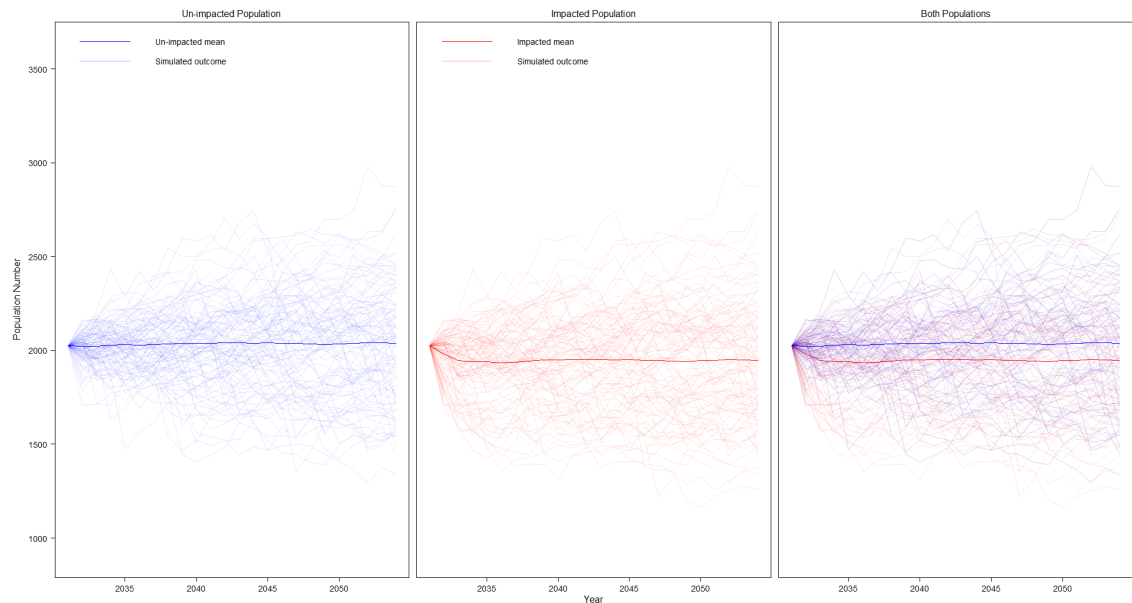
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Table 9.79: Results of the iPCoD Modelling for the Cumulative Assessment, Giving the Mean and Median Population Size of the Bottlenose Dolphin Population (GNS MUs) for Years up to 2056 for Both Impacted and Un-impacted Populations in Addition to the Mean and Median Ratio Between Their Population Sizes

Time Point	Year	Mean			Median			95% Confidence Intervals	
		Un-impacted Population	Impacted Population	Impacted as % of Un-impacted	Un-impacted Population	Impacted Population	Impacted as % of Un-impacted	Un-impacted Population	Impacted Population
1	2031	2,024	2,024	100%	2,024	2,024	100%	2,024 – 2,024	2,024 – 2,024
2	2032	2,021	1,982	98.04%	2,030	2,006	100%	1,824 – 2,148	1,736 – 2,144
3	2033	2,022	1,947	96.28%	2,032	1,981	99.65%	1,782 – 2,212	1,592 – 2,194
7	2037	2,031	1,936	95.35%	2,038	1,964	99.75%	1,658 – 2,344	1,458 – 2,316
13	2043	2,039	1,951	95.77%	2,044	1,950	99.78%	1,548 – 2,512	1,406 – 2,474
19	2049	2,030	1,939	95.64%	2,029	1,932	99.8%	1,464 – 2,620	1,344 – 2,570
26	2056	2,041	1,950	95.63%	2,020	1,930	99.82%	1,380 – 2,802	1,274 – 2,721

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Plate 9.9: Simulated Worst-case Bottlenose Dolphin GNS MU Population Sizes for both the Un-impacted and the Impacted Populations for the Cumulative Assessment



9.9.3.2.3.1.3 Minke Whale

662. For the cumulative scenario assessed within the CGNS MU (**Appendix 9.5: Marine Mammals Information and Modelling Methods for Disturbance (Volume IV)** for details of projects considered, and their parameters), the iPCoD model predicted a slight decrease in minke whale population size over time (**Table 9.80** and **Plate 9.10**).
663. For minke whale, iPCoD modelling resulted in **no significant** effect on the population (**Table 9.80**). Whether the mean or median value is used to inform the results, the results show a less than 1% average annual decline over the first six years and over the 25-year period for both the mean and median. Minke whales are sensitive to more broadband noise frequencies than dolphins and seals and have a similar sensitivity as harbour porpoise but at differing frequencies. Although sensitivity to disturbance from piling might be similar to harbour porpoise, the dose response curve assessment used by all OWF assessments is highly precautionary and likely to overestimate the number of animals effected. Disturbance from cumulative underwater noise from piling based on all the information presented is assessed as **minor adverse** and not significant in EIA terms. There would be **no significant effect** on the minke whale population due to cumulative effects of piling.

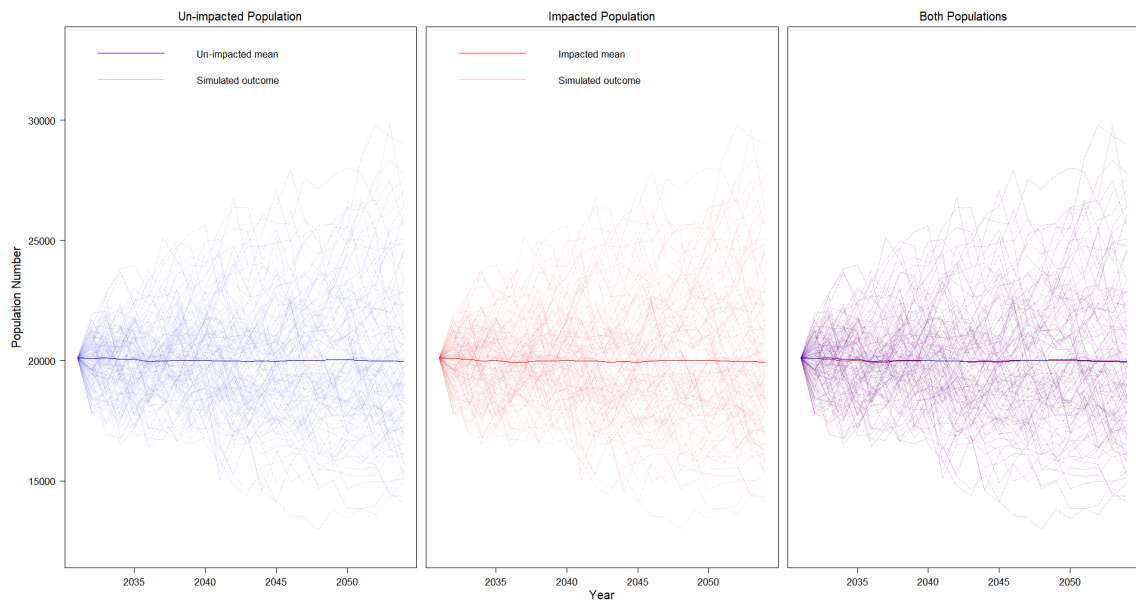
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Table 9.80: Results of the iPCoD Modelling for the Cumulative Assessment, Giving the Mean and Median Population Size of the Minke Whale Population (CGNS MU) for Years up to 2056 for Both Impacted and Un-impacted Populations in Addition to the Mean and Median Ratio Between Their Population Sizes

Time point	Year	Mean			Median			95% Confidence Intervals	
		Un-impacted Population	Impacted Population	Impacted as % of Un-impacted	Un-impacted Population	Impacted Population	Impacted as % of Un-impacted	Un-impacted Population	Impacted Population
1	2031	20,120	20,120	100%	20,120	20,120	100%	20,120 – 20,120	20,120 – 20,120
2	2032	20,096	20,081	99.93%	20,183	20,174	100%	17,913 – 21,793	17,890 – 21,782
3	2033	20,116	20,066	99.76%	20,173	20,127	100%	17,401 – 22,606	17,214 – 22,523
7	2037	19,986	19,945	99.82%	19,926	19,872	100%	16,705 – 23,533	16,646 – 23,383
13	2043	19,957	19,944	99.94%	19,836	19,822	100%	15,861 – 24,848	15,816 – 24,848
19	2049	20,034	20,018	99.92%	19,816	19,812	100%	15,270 – 25,855	15,190 – 25,855
26	2056	19,970	19,954	99.93%	19,692	19,671	100%	14,560 – 26,880	14,560 – 26,880

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Plate 9.10: Simulated Worst-case Minke Whale Population Sizes for Both the Un-impacted and the Impacted Populations for the Cumulative Assessment



9.9.3.2.3.1.4 Grey Seal

664. For the cumulative scenario assessed for the wider reference population (see **Appendix 9.5: Marine Mammals Information and Modelling Methods for Disturbance (Volume IV)** for details of projects considered, and their parameters) the iPCoD model predicted no discernible decrease in grey seal population size over time (**Table 9.81** and **Plate 9.11**).
665. For grey seal, iPCoD modelling resulted in **no significant effect** on the wider reference population (**Table 9.81**). Whether the mean or median value is used to inform the results, the results show a less than 1% average annual decline over the first six years and over the 25-year period for both the mean and median. Although sensitivity to disturbance from piling might be similar to harbour porpoise, the dose response curve assessments used by all OWF assessments have been shown to be highly precautionary (see **Appendix 9.5: Marine Mammals Information and Modelling Methods for Disturbance (Volume IV)**) and likely to overestimate the number of animals effected. Hence, disturbance from cumulative underwater noise from piling is assessed as a **minor adverse** effect which is not significant in EIA terms. There would be **no significant effect** on the grey seal population due to cumulative effects of piling.

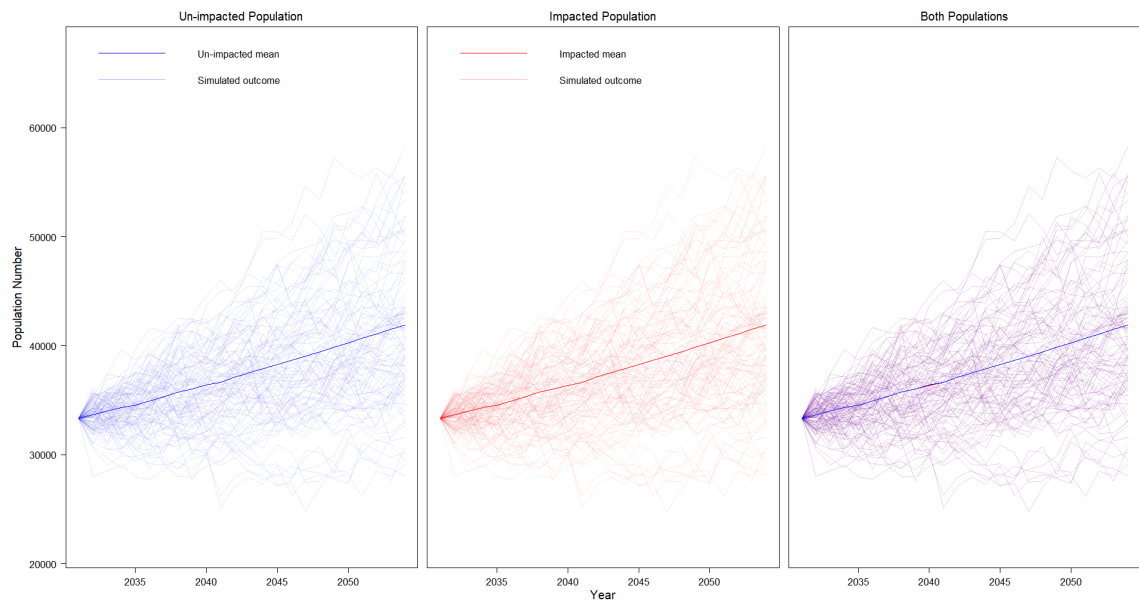
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Table 9.81: Results of the iPCoD Modelling for the Cumulative Assessment, Giving the Mean and Median Population Size of the Grey Seal Population (Combined Population (see Section 9.6) for Years up to 2056 for Both Impacted and Un-impacted Populations in Addition to the Mean and Median Ratio Between Their Population Sizes)

Time Period	Year	Mean			Median			95% Confidence Intervals	
		Un-impacted Population	Impacted Population	Impacted As % of Un-impacted	Un-impacted Population	Impacted Population	Impacted As % of Un-impacted	Un-impacted Population	Impacted Population
1	2031	33,336	33,336	100%	33,336	33,336	100%	33,336 – 33,336	33,336 – 33,336
2	2032	33,647	33,647	99.99%	33,775	33,775	100%	30,863 – 35,674	30,863 – 35,674
3	2033	33,973	33,973	99.99%	34,124	34,124	100%	30,302 – 36,827	30,302 – 36,827
7	2037	35,313	35,313	99.99%	35,380	35,380	100%	29,540 – 40,714	29,540 – 40,714
13	2043	37,523	37,522	99.99%	37,418	37,418	100%	30,020 – 45,823	30,020 – 45,823
19	2049	39,853	39,852	99.99%	39,545	39,545	100%	30,116 – 51,102	30,116 – 51,102
26	2056	42,767	42,767	99.99%	42,421	42,421	100%	30,683 – 56,510	30,683 – 56,510

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Plate 9.11: Simulated Worst-case Grey Seal Population sizes for both the Un-impacted and the Impacted Populations for the Cumulative Assessment



9.9.3.2.3.1.5 Harbour Seal

666. For the cumulative scenario assessed for the wider reference population (see **Appendix 9.5: Marine Mammals Information and Modelling Methods for Disturbance (Volume IV)** for details of projects considered, and their parameters), the iPCoD model predicted no discernible decrease in harbour seal population size over time (**Table 9.82, Plate 9.12 and Plate 9.13**).
667. For harbour seal, iPCoD modelling resulted in **no significant effect** on the population (**Table 9.82**). Whether the mean or median value is used to inform the results, the results show a less than 1% average annual decline over the first six years and over the 25-year period for both the mean and median. Although sensitivity to disturbance from piling might be similar to harbour porpoise, the dose response curve assessments used by all OWF assessments has been shown to be highly precautionary (see **Appendix 9.5: Marine Mammals Information and Modelling Methods for Disturbance (Volume IV)**) and likely to overestimate the number of animals effected. Hence, disturbance from cumulative underwater noise from piling is assessed as **minor adverse**, which is not significant in EIA terms. There would be **no significant effect** on the harbour seal population due to cumulative effects of piling.

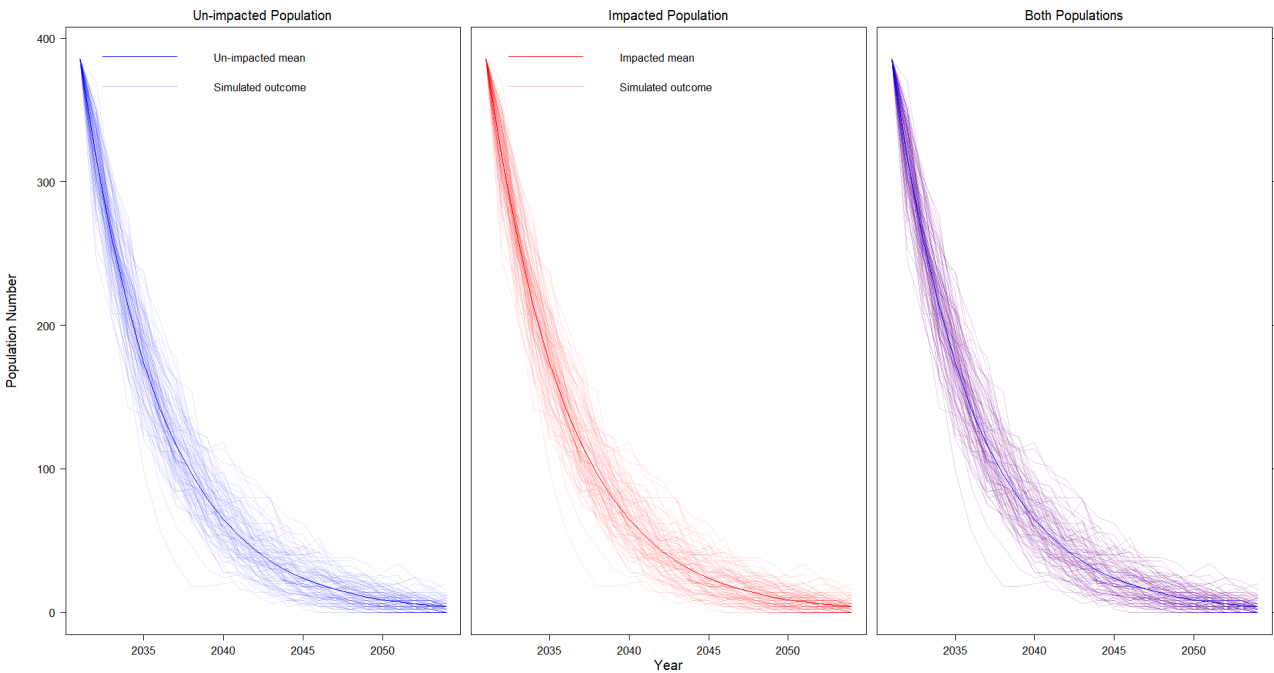
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Table 9.82: Results of the iPCoD Modelling for the Cumulative Assessment, Giving the Mean and Median Population Size of the Harbour Seal Declining Population for Years up to 2056 for Both Impacted and Un-impacted Populations in Addition to the Mean and Median Ratio Between Their Population Sizes

Time Period	Year	Mean			Median			95% Confidence Intervals	
		Un-impacted Population	Impacted Population	Impacted As % of Un-impacted	Un-impacted Population	Impacted Population	Impacted As % of Un-impacted	Un-impacted Population	Impacted Population
1	2031	386	386	100%	386	386	100%	386 - 386	386 - 386
2	2032	317	317	100%	318	318	100%	268 - 360	268 - 360
3	2033	260	260	100%	260	260	100%	210 - 310	210 - 310
7	2037	117	117	100%	116	116	100%	76 - 164	76 - 164
13	2043	36	36	100%	34	34	100%	14 - 68	14 - 68
19	2049	11	11	100%	10	10	100%	0 - 28	0 - 28
26	2056	3	3	100%	0	0	100%	0 - 12	0 - 12

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Plate 9.12: Simulated Worst-case Harbour Seal (Declining) Population Sizes for Both the Un-impacted and the Impacted Populations for the Cumulative Assessment



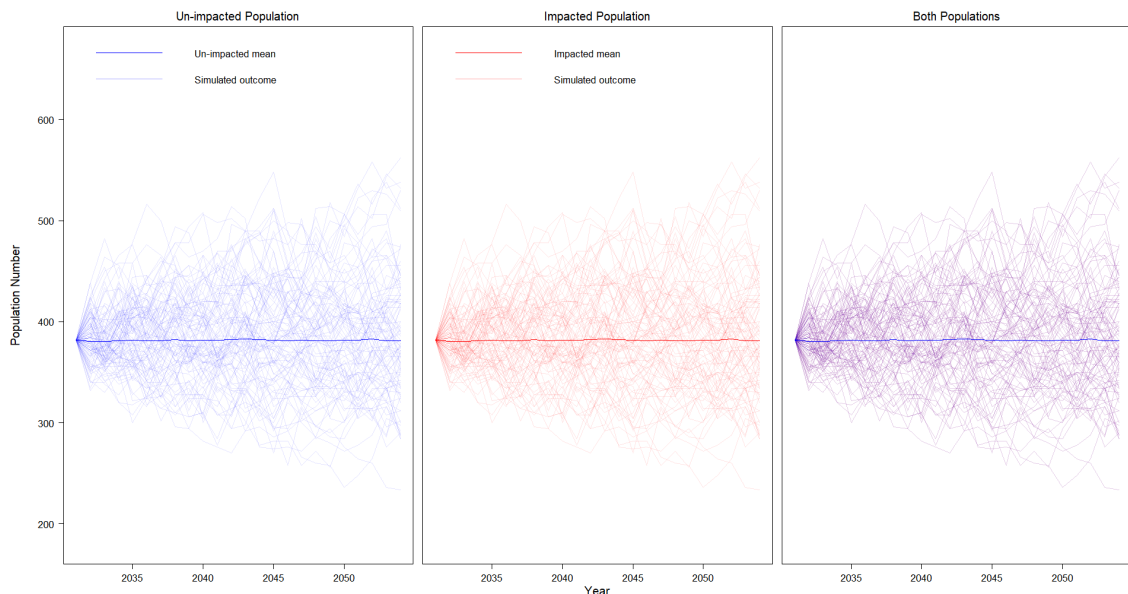
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Table 9.83: Results of the iPCoD Modelling for the Cumulative Assessment, Giving the Mean and Median Population Size of the Harbour Seal Stable Population for Years up to 2056 for both Impacted and Un-impacted Populations in Addition to the Mean and Median Ratio Between Their Population Sizes

Time Period	Year	Mean			Median			95% Confidence Intervals	
		Un-impacted Population	Impacted Population	Impacted as % of Un-impacted	Un-impacted Population	Impacted Population	Impacted as % of Un-impacted	Un-impacted Population	Impacted Population
1	2031	382	382	100%	382	382	100%	382 – 382	382 – 382
2	2032	380	380	100%	380	380	100%	336 – 424	336 – 424
3	2033	380	380	100%	380	380	100%	332 - 438	332 - 438
7	2037	381	381	100%	378	378	100%	306 - 462	306 - 462
13	2043	383	383	100%	382	382	100%	282 - 496	282 - 496
19	2049	381	381	100%	380	380	100%	262 - 510	262 - 510
26	2056	380	380	100%	374	374	100%	250 - 526	250 - 526

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Plate 9.13 Simulated Worst-case Harbour Seal (Stable) Population sizes for both the Un-impacted and the Impacted Populations for the Cumulative Assessment



9.9.3.2.3.2 Significance of Effect

668. A large number of animals could be at risk of potential disturbance, although the assessment does not consider the unlikelihood of all activities occurring simultaneously, nor the distances between the piling activities. Factors such as project schedules, vessel availability, technical and mechanical issues, port calls, and varying weather conditions affecting vessels and equipment contribute to this. All marine mammal species have a sensitivity of **medium** as a result of disturbance from underwater noise.
669. The overly conservative quantitative impact assessment using an additive approach for disturbance to harbour porpoise, bottlenose dolphin, white-beaked dolphin and minke whale from piling activities at OWFs, including the Bellrock WFDA was major adverse (**significant** in EIA terms). For grey seal the assessment outcome was moderate adverse (**significant** in EIA terms). For common dolphin and harbour seal the assessment outcome was negligible adverse (**not significant** in EIA terms).
670. Killer whale, fin whale and humpback whales are assessed qualitatively due to a lack of representative data for the species from the projects and plans screened in. The cumulative effect significance for killer whale will be based off effect to all dolphin species and fin whale, and humpback whales will be based off minke whale. Therefore, the assessment for killer whale is moderate adverse (**significant** in EIA terms), and fin whale and humpback whale is major adverse (**significant** in EIA terms).
671. As a result of the quantified assessment, applied assumptions and potentially inflated numbers of animals, this has been demonstrated through the application of the deterrence function for harbour porpoise showing a more realistic disturbance effect which is 10 times lower than the DRC assessment (see **Appendix 9.5: Marine Mammals Information and Modelling Methods for Disturbance (Volume IV)**). This is particularly the case for dolphin and baleen whale species, as

a harbour porpoise based curve has been applied and they have very different hearing function groups which leads to the overall disturbance impact assessment being very conservative, and any interpretations made need to have these caveats in mind. Furthermore, none of the projects included any mitigation measures in their assessments which have the potential to reduce the number of individuals at risk.

672. As a consequence of the potential significant effects identified, population modelling was used, which incorporates detailed demographic information and an understanding of the relationship between days of disturbance and individual survival and reproductive rates (Sinclair et al. 2023). This method is considered appropriate for assessing potential cumulative disturbance from piling and its population consequences for harbour porpoise, bottlenose dolphin, minke whale, grey seal and harbour seal. The outcome of the population modelling for all species taking into account the quantitative assessment and methods used to inform the modelling conclude that the significance of effect is minor adverse which is **not significant** in EIA terms.
673. Taking into account the population modelling results, whereby the iPCoD takes the worst-case numbers for disturbance along with detailed demographic information, it is deemed as the most representative method. Considering a professional analysis of the overall evidence base, including the number of animals impacted at any one time and the duration of effects, in addition to the indicative nature of some activities, and that it is unlikely that all activities would take place at the same time, the overall effect significance for piling cumulatively at all projects for all species would be **minor adverse** (which is **not significant** in EIA terms).
674. Further, while commitment to specific additional mitigation is yet to be fully confirmed for other all projects, it is noted that the Bellrock WFDA has committed to additional mitigation to ensure that the potential PTS effects would be fully mitigated and disturbance reduced by the methods employed. It is also expected for this to be the case for other projects, although a worst-case of this not happening has been assessed. Measures have been secured in the **Outline MMMP (Volume V)**, considering both design refinement and noise reduction methods as appropriate; these can be used as a mechanism to secure further potential measures when details for the other cumulative projects have been further developed.

9.9.3.3 Cumulative Effect 3: Vessel Collision Risk

675. As outlined in **Section 9.8.1.6** and **Section 9.8.2.6**, the increased collision risk due to construction and the O&M phase vessels related Bellrock WFDA had an effect significance of **minor adverse** (**not significant** in EIA terms) and best practice measures to reduce the risk of collision with vessels were also identified for all species.
676. To reduce any marine mammal collision risk, vessel movements, where possible, would be incorporated into recognised vessel routes and hence to areas where marine mammal species are accustomed to vessels. All vessel movements would be kept to the minimum number that is required to reduce any potential for collision risk, and vessel speeds will be minimised, where practicable, whilst transiting. Additionally, vessel operators would use best practice to reduce any risk of collisions with marine mammals. Such best practice measures are set out in the **Outline VMNSP (Volume V)**. It is expected that other offshore projects and industries would follow similar measures in order to reduce the potential for collision risk of marine mammals with vessels.

677. As vessel movements to and from any port would be incorporated within existing vessel routes as far as possible, there would be no increased collision risk as the increase in the number of OWF vessels would be relatively small compared to the baseline levels of vessel movements in these areas. Once on-site, OWF vessels and other construction related vessels would be stationary or slow moving, as they undertake the activity they are associated with. Therefore, the risk of any increased collision risk for cumulative projects for marine mammals would be negligible.
678. Vessels associated with aggregate extraction and dredging are large and typically slow moving, using established transit routes to and from ports. Therefore, the potential increased collision risk with vessels was considered to be extremely low or negligible. Increased collision risk from aggregate extraction and dredging has therefore been screened out from further consideration in the CEA.
679. Considering the above, the expected cumulative magnitude level of effect during the construction phase was identified as **low** (at worst) with best practice measures being applied. Taking into account the **low** sensitivity for harbour porpoise, dolphins, and seals, and **medium** sensitivity for baleen whales, the residual effect significance would therefore be **minor adverse**, which is **not significant** in EIA term, for all marine mammals. The significance of effect would be the same or less during the O&M phase.
680. Best practice measures, as implemented for the Bellrock WFDA, would ensure that any risk of vessels colliding with marine mammals is avoided as far as practicable.
681. No additional mitigation has been identified as being required for the potential for cumulative collision risk due to the offshore construction activities associated with other OWFs at the same time as the Bellrock WFDA.

9.9.3.4 Cumulative Effect 4: Disturbance at Seal Haul-out Sites

682. The sensitivity of grey seal and harbour seal to disturbance at haul-out sites was **medium** (see **Section 9.8.1.7.1**).
683. Due to baseline vessel traffic being relatively high, and the closest distance of the Bellrock WFDA to any seal haul-out site being over 120 km, it was not expected that the Bellrock Wind Farm Infrastructure would have any significant effect to seal at haul-out sites, with an effect significance of negligible to minor adverse. In addition, best practice measures would be implemented for the Bellrock Wind Farm Infrastructure, such as reducing vessel transit speeds, wherever possible, and the avoidance of transiting within 1 km (outside of established navigation routes) of any seal haul-out site.
684. It has been assumed that all other projects would follow the similar best practice measures with regards to avoiding disturbance at haul-out sites if deemed required, unless within an established navigation route where seal haul-out sites are near to a vessel corridor (where seals present in that area would be used to vessels transiting past the area). It was therefore assessed that there would be limited potential for any cumulative disturbance effect at any seal haul-out site, and the cumulative effect magnitude would be **low**.

685. Considering the sensitivity of **medium** for both seal species, and the expected magnitude level of **low**, the effect significance for cumulative disturbance at seal haul-out sites would therefore be **minor adverse (not significant)** in EIA terms).

686. No additional mitigation has been identified as being required for the potential for cumulative disturbance at seal haul-out sites.

9.9.3.5 Cumulative Effect 5: Secondary Entanglement

687. As assessed for the secondary entanglement at the Bellrock Wind Farm Infrastructure alone in **Section 9.8.2.5.1**, the sensitivity is considered **medium** for all marine mammals, except for baleen whales, which are assessed as having a **high** sensitivity to entanglement.

688. There are a number of floating offshore wind projects being developed in Scottish waters, including Green Volt, Pentland Floating, Broadshore Hub, Caledonia, Cenoss, Culzean, Salamander, Buchan, Aspen, Muir Mohr, Ossian and Bowdun.

689. The Culzean project scoped out the risk of entanglement to marine mammals from further consideration at the scoping stage (Total Energies, 2023). 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 (i.e. marine mammals) and project infrastructure.

690. Some projects with EIA Reports in the public domain provided detailed account on the monitoring plans of the entanglement risk, including monitoring of large strains on mooring lines, remotely operated vehicle (ROV) surveys, removal of debris from project infrastructure, as well as reporting on entanglement (Pentland Floating Offshore Wind Farm, 2022, Muir Mhor, 2025, Salamander Offshore Wind Farm, 2023). Most of the Scoping or EIA reports identified periodic inspections, including visual surveys and identification of debris, as a measure necessary to reduce the risk of entanglement (Buchan Offshore Wind, 2023; Broadshore Hub, 2024; Muir Mhor, 2025; Caledonia, 2024).

691. As such, there is awareness across the industry about mitigation measures that needs to be applied in order to reduce the risk of the entanglement. The risk of secondary entanglement is restricted to the respective WFDA's 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 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**.

692. The magnitude of the cumulative impact is deemed to be **low** and the sensitivity of the receptor is **medium** for all marine mammals apart from baleen whales which has a **high** sensitivity. Therefore, the cumulative effect will be of **minor significance** for all marine mammals apart from baleen whales, which is **not significant** in EIA terms. Whereas baleen whales will have a cumulative effect of **moderate significance**, which is **significant** in EIA terms.

693. The additional mitigation proposed in **Section 9.8.2.5.3.1** will be implemented to reduce the significance of effect on baleen whales which is deemed adequate to reduce the significance of effect for baleen whales down to **minor adverse**, which is **not significant** in EIA terms.

9.9.3.6 Cumulative Effect 6: Changes to Prey Availability

694. As per **Chapter 8: Fish and Shellfish Ecology (Volume II)**, the cumulative effects of piling noise are deemed not to be greater than the Bellrock WFDA effects (minor adverse to negligible). For any potential changes to prey resources, it has been assumed that any potential effects on marine mammal prey species from underwater noise, including piling, would be the same, or less, than those for marine mammals. Therefore, there would be no additional cumulative effects other than those assessed for marine mammals, i.e. if prey are disturbed from an area as a result of underwater noise, marine mammals would be disturbed from the same or greater area. As a result, any changes to prey resources would not affect marine mammals, as they would already have been disturbed from the area.
695. Any effects to prey species (such as seabed disturbance and associated SSCs) are likely to be intermittent, temporary and highly localised, with potential for recovery following cessation of the disturbance activity. Any permanent loss or changes of prey habitat would typically represent a small percentage of the potential habitat for prey species in the surrounding area.
696. Taking into account the assessment for the Bellrock WFDA, and assuming similar effects for other projects and activities, along with the range of prey species taken by marine mammals and the extent of their foraging ranges, there would be no potential for cumulative effect on marine mammal populations as a result of changes to prey resources. Therefore, the cumulative magnitude was considered to be **negligible to low**.
697. Harbour porpoise have a diverse diet that varies geographically and seasonally, reflecting changes in available food resources. They have relatively high daily energy demands and need to capture enough prey to meet these requirements. It has been estimated that, depending on the environmental conditions, harbour porpoise can rely on stored energy (primarily blubber) for three to five days, depending on body condition (Kastelein et al. 1997). The sensitivity of harbour porpoise is therefore considered to be **low to medium**.
698. All dolphin species considered in the assessment have a broad diet, feeding on a wide range of prey species and are considered to have large foraging ranges. The sensitivity of dolphin species is therefore considered to be **low**.
699. Baleen whales feed on a variety of prey species, but in some areas, they have been found to prey upon specific species. The sensitivity of baleen whales is therefore considered to be **low to medium**.
700. Grey and harbour seal are opportunistic feeders, feeding on a wide range of prey species. They are able to forage in other areas and have relatively large foraging ranges. The sensitivity of grey seal and harbour seal is therefore considered to be **low**.

9.9.3.6.1 Significance of Effect

701. Overall, it is predicted that sensitivity of harbour porpoise and baleen whales is low to medium and the magnitude of impact is negligible to low. The effect is therefore of **negligible to minor adverse** significance, which is **not significant** in EIA terms for both harbour porpoise and baleen whales.

702. Overall, it is predicted that sensitivity of dolphin and seal species is low and the magnitude of impact is negligible to low. The effect is therefore of **negligible** to **minor adverse** significance, which is **not significant** in EIA terms for all dolphin and seal species.

9.9.3.6.1.1 *Mitigation*

703. No additional mitigation has been identified as being required for the potential for cumulative effects to prey species.

9.9.3.7 Summary of Cumulative Effect of Repeated Disturbance Events

704. A scenario of cumulative disturbance events over the long term for noisy activities other than piling can be caused by:
- Seismic surveys and geophysical surveys;
 - UXO clearance;
 - Offshore Wind Farms;
 - Piling events throughout six of the seven year construction period (has already been assessed using iPCoD modelling (see **Cumulative Effect 2**);
 - Construction, O&M, or decommissioning activities (other than piling) throughout the 35-year lifetime;
 - Operational turbine noise throughout the 35-year lifetime (has been assessed in **Cumulative Effect 1e**); and
 - Presence of vessels throughout the 35-year lifetime (has been assessed in **Cumulative Effect 1f**).
 - Other offshore projects (such as subsea cables, disposal activities, and aggregates and dredging projects).
705. From the list of disturbance impacts, piling represents the worst-case disturbance scenario for marine mammals during construction. Consequently, activities that produce much lower levels of noise, such as other construction activities, are expected to have comparatively less impact on marine mammal populations.
706. With regard to repeated disturbance from cumulative activities, **Section 9.9.3.1** in Cumulative Effect 1, present a quantitative assessment of effects from all overlapping construction at other OWFs, as well as other industry noisy activities occurring simultaneously to piling at the Bellrock WFDA. The result of this assessment presents a snapshot of the Cumulative Effect on the marine mammal populations, but the assessment in Cumulative Effect 1 (**Table 9.70**) highlights that the likelihood of this effect to occur on the same day is very low. However, throughout the Bellrock WFDA duration, any of these activities may occur at any one point. The effect would therefore be spatially and temporally dispersed.

9.9.3.7.1 *Seismic Surveys and Geophysical Surveys*

707. Longer-term consequences of exposure to noise from activities other than piling, such as shipping or seismic surveys, have not been well studied and are difficult to quantify (Gordon et al. 2003). For example, the effects from seismic surveys are more evidenced than those from other construction activities. Literary evidence highlights that the long-term effects of shipping disturbance is difficult to quantify but that short-term effects are likely to occur and recovery has been observed (Wisniewska et al. 2018; New et al. 2020; Hao et al. 2024). As for piling, the evidence of cumulative effects, which may be biologically significant, is poorly researched.
708. Continuous exposure to any noise source could lead to chronic stress in marine mammals, potentially weakening their immune systems and making them more susceptible to diseases (Gordon et al. 2003). The study suggests potential implications for social organisation among marine mammals, for social bonds and survival. Disruptions can affect communication and cohesion within groups, potentially leading to effects on population dynamics.
709. In contrast, Thompson et al. (2013) found that seismic surveys cause short-term disturbances, but these effects were minor compared to natural variation. Porpoises were detected at affected sites within a few hours of a seismic survey ceasing, indicating that the seismic survey did not result in long-term displacement into suboptimal or higher-risk habitats. The animals typically returned to impacted sites shortly after the disturbance, and their response to the noise decreased over the 10-day survey period.
710. The evidence provided above suggests that disturbance from seismic surveys is unlikely to have a significant long-term impact on any marine mammal populations.

9.9.3.7.2 *UXO Clearance*

711. UXO clearances are by their nature single pulse events, with limited potential for ongoing disturbance. In January 2025, an updated joint position statement was issued (UK Government et al. 2025) which strengthened this position, stating that:
- Low noise methods of clearance should be the default method used to clear any type of UXO in the marine environment; and
 - High-order methods should always be the last resort and used only in extraordinary circumstances where:
 - Low noise methods cannot be attempted or have failed following $\geq$ three attempts;
 - All best practice has been demonstrably applied; and
 - There is prior agreement with the licensing authority.
712. The supporting guidance (Marine Directorate, 2025) notes that for any high-order UXO clearance licensed, applicants should expect noise abatement to be required.
713. As a result of the latest position statement and guidance, low-order method is anticipated to account for a large majority of future UXO clearances, with any high-order clearances likely to be accompanied by a noise abatement system. Unmitigated high order clearance has been considered as the worst-case in this assessment and are now expected to be a last resort.

714. Despite high-order clearance involving the detonation of the full explosive material estimated within the UXO, studies did not report a strong correlation between estimated UXO NEQ and measured noise levels (Majewska et al. 2025). There is uncertainty over how much of the UXO does detonate, with many measurements appearing to be consistent with the levels for the donor charge alone. Further, it has been suggested that the seabed may reduce the radiated sound compared to that predicted for a mid-water explosion, with models based on the latter generally overestimating noise levels at large ranges (Majewska et al. 2025).
715. There are a few studies for which distance to TTS-onset threshold for high order detonation is smaller than 15 – 20 km, with reported distances ranging between 1.5 – 12 km and 2.0 – 15 km for unweighted SPL_{pk} and VHF-weighted SEL, respectively (Majewska et al. 2025). Additionally, distances to aversive behavioural reaction threshold of SPL_{pk} 168 dB re 1 μ Pa inferred from data in Lepper et al. (2024) for UXO charge weight of 34 – 344 kg NEQ suggest potential for behavioural disturbance within that range.
716. The evidence provided suggests that disturbance from UXO clearance through high or low order methods is unlikely to have a significant long-term impact on any marine mammal population.

9.9.3.7.3 Offshore Wind Farms

9.9.3.7.3.1 Piling

717. As quantitative methods on long-term effects are lacking, the iPCoD model was used, which simulates the changes in a population, following disturbance from piling over time, for both a disturbed and an undisturbed population as described in **Section 9.9.3.2 (Cumulative Effect 2)**. The population that has been used is the relevant MU that is presented in **Table 9.12**. This provides a comparison of the type of changes that could occur resulting from natural environmental variation, demographic stochasticity (i.e. variability in population growth rates) and disturbance from piling (Harwood et al. 2014; King et al. 2015).
718. The potential for prolonged exposure to noisy activities to affect marine mammals is not well understood, with a limited number of studies mainly focusing on harbour porpoise. Nabe-Neilson et al. (2018) found that harbour porpoise densities returned to normal levels between two and six hours following piling, and Brandt et al. (2011) found that porpoise densities recovered between 2.5 and 11.5 hours post piling.
719. Graham et al. (2019) found that the level of response from harbour porpoise to piling reduced over time (i.e. as the piling campaign continued, the response and recovery time of harbour porpoise reduced). At the beginning of the piling campaign (in the Moray Firth), there was more than a 50% chance of harbour porpoise responding to piling in the 24 hours directly following the cessation of piling up to 7.4 km (95% CI = 5.7 – 9.4). By the middle of the piling campaign, this 50% response distance had decreased to 4.0 km (95% CI = 2.7 – 5.2) and decreased to 1.3 km (95% CI = 0.2 – 2.8) by the end of the piling campaign. This demonstrates that for this piling campaign, harbour porpoise recovery was within 24 hours at a closer range to the piling itself by the end of the piling, indicating a level of habituation, and of decreased disturbance over time.

9.9.3.7.3.2 *Construction, Operation and Maintenance, and Decommissioning Activities (Other Than Piling)*

720. During the lifetime of the Bellrock WFDA and other projects, maintenance activities will be required and are likely to be conducted using vessels. The effect of repeated and cumulative disturbance from vessels has already been discussed in **Cumulative Effect 1c**. The evidence provided in these sections found that while repeated disturbance events are likely to occur, there would be no long-term effect on marine mammals. This is because individual events such as maintenance work or vessel presence would be temporary and intermittent and not continuously present throughout the 35 years of operation.
721. As the worst-case disturbance impacts from piling at several projects within the same time window have shown no significant effects on the relevant marine mammal populations, it can be expected that any noisy activity (other than piling) that is quieter, and/or non-impulsive would result in even less numbers of disturbed marine mammals. Further, the Bellrock WFDA has outlined mitigation measures to reduce its contribution to cumulative effects in the MMMP and PNMP.
722. While seismic surveys are not a good proxy for construction noise, due to their comparatively high levels of underwater noise, the evidence (included below) shows that marine mammals returned to natural behaviour shortly after the noise had dissipated, similar to observations for piling.
723. In contrast to loud activities such as seismic surveys and piling, one study by Taormina et al. (2018) concluded that the effects of cable-laying activities were insignificant, as the noise is likely to be masked by the noise emitted from the vessels conducting the work. Taormina et al. (2018) stated that noise from submarine cable installation has a negligible to weak impact on marine mammals, as the underwater noise associated with installation of undersea cables remains low. Cable installation is a spatially localised, temporary event, so the impact of noise on marine communities is expected to be minor and brief.
724. While the long-term effects of construction activities (other than piling) are unknown, the evidence provided above and below (sub-section: oil and gas seismic surveys and geophysical surveys) suggests that disturbance from comparatively loud sources such as piling or seismic surveys is unlikely to have a significant long-term impact, and therefore is it considered unlikely that other construction activities would have a long-term impact on any marine mammal population.

9.9.3.7.3.3 *Operational Noise*

725. During the 35-year operational lifetime of the project, there is the possibility that recurring disturbances have the potential to affect marine mammal populations. Piling activities and other construction noise from all screened in projects would have ceased, with the operational WTG noise commencing following turbine commissioning at the Bellrock WFDA and the other screened in projects. This effect has been assessed quantitatively in **Cumulative Effect 1e** and concluded a **minor adverse** effect (**not significant** in EIA terms).
726. In addition to the literary evidence provided, **Cumulative Effect 1e**, disturbance at operational wind farms would be limited to the WFDAs themselves (Leemans and Fijn, 2023), and as such there would be no overlapping areas of disturbance with other projects.
727. However, even within the WFDAs themselves, marine mammals are not excluded as several studies have shown (Diederichs et al. 2008; Lindeboom et al. 2011; Marine Scotland, 2012;

McConnell et al. 2012; Russell et al. 2014; Scheidat et al. 2011; Teilmann et al. 2006; Tougaard et al. 2005; Tougaard et al. 2009a; Tougaard et al. 2009b). The level of noise from the WTGs has not been shown to disturb animals, in contrast, harbour porpoise and seals have been recorded foraging within operational wind farm sites (e.g. Lindeboom et al. 2011; Russell et al. 2014; Leemans and Fijn, 2023).

728. It can therefore be concluded that operational noise from WTGs is not likely to have a repeated effect to marine mammals as the evidence suggests that operational noise minimally affects them.

9.9.3.7.3.4 *Decommissioning*

729. Currently the exact timings and end-of-life procedures for decommissioning offshore infrastructures are unknown. Consequently, any anticipated cumulative disturbance events are also currently unknown. It can however be expected that some decommissioning activities such as cutting, as well as increased vessel traffic have the potential to cause a repeated disturbance effect. As construction is considered to be the worst-case phase of a project, it can be presumed for now that it would be the same as assessed for this phase.

730. **Cumulative Effect 1** provides a more detailed assessment of cumulative decommissioning activities with the Project.

731. For cumulative effects, residual **minor adverse** which is **not significant** in EIA terms effects have been identified, based on the noise sources where detailed variables were known (piling at other OWFs), in conjunction with piling within the Bellrock WFDA for all marine mammal receptors.

732. It is noted for the CEA that:

- The assessment assumed the worst-case impact range for all projects and activities with no mitigation;
- The effect of the Bellrock Wind Farm Infrastructure on harbour porpoise was based on the worst-case density from two years of site-specific DAS surveys in which harbour porpoise sightings were consistently high and also skewed by a single month with exceptionally high numbers. The resulting density used was over two times higher than would be expected from use of SCANS-IV (2023);
- The number of baleen whales and dolphin species potentially disturbed by the Bellrock Wind Farm Infrastructure-alone has been calculated based on the harbour porpoise dose response curve which was a highly conservative approach due to the difference function hearing groups and in the species sensitivity and has likely over-estimated the number of individuals affected;
- There was no impact overlap with any key areas (e.g. designated sites);
- Not all individuals would be displaced over the entire potential disturbance range used within the assessments;
- Behavioural effects from UXO clearance, if they occur, would be an instantaneous response and short-term. Guidance suggested that disturbance behaviour was not predicted to occur from UXO clearance if undertaken over a short period of time (JNCC, 2025a); and
- It is noted that there would be repeated disturbance over the marine mammal study areas from a number of projects over time. Outside of population modelling for piling there is no quantitative method to present repeated impacts and the long-term effects of multiple disturbance events. The quantitative methods (noting the precaution built into this), iPCoD

modelling, and review of available literature, all inform the overall evidence base to determine the overall significance of effects.

733. This cumulative assessment has included information from other projects to the best of knowledge up until the October 2025 cut-off date. The final MMMP and PNMP would more realistically inform the potential mitigation requirements.

9.10 Inter-related and Interacting Impacts

9.10.1 Inter-relationships

734. **Table 9.84** below provides a summary of the key inter-relationships between marine mammals and other Bellrock EIA Report technical chapters and indicates where those issues have been addressed in the relevant chapters.

Table 9.84: Marine Mammals Inter-relationships

Topic and Description	Related Chapter(s)	Where Addressed in this Chapter	Rationale
All Phases			
Impact C6, O3 and D3: Underwater noise and presence of vessels	Chapter 12: Shipping and Navigation (Volume II)	Section 9.8.1.5, 9.8.2.3 and 9.8.3.3	Increased vessel traffic associated with the construction, O&M and decommissioning of the Wind Farm Infrastructure could affect the level of disturbance for marine mammals.
Impact C7, O6 and D4: Collision risk with vessels	Chapter 12: Shipping and Navigation (Volume II)	Section 9.8.1.6, 9.8.2.6 and 9.8.3.4	Increased vessel traffic associated with the construction, O&M and decommissioning of the Wind Farm Infrastructure could affect the level of collision risk for marine mammals.
Impact C9, O8 and D6: Changes to prey availability	Chapter 8: Fish and Shellfish Ecology (Volume II)	Section 9.8.1.8, 9.8.2.8 and 9.8.3.6	Potential effects from construction, O&M and decommissioning of the Wind Farm Infrastructure on fish species could affect the prey resource for marine mammals.

9.10.2 Interactions

735. The impacts identified and assessed in this Chapter have the potential to interact with each other. Areas of potential interaction between impacts are presented in **Table 9.85** to **Table 9.88** below.
736. The worst-case impacts assessed within this Chapter took these interactions into account and therefore the impact assessments were considered conservative and robust. The potential combined effects of disturbance from piling, other construction activities and vessels at the Bellrock WFDA (Impacts C3, C4, C5 and C6; **Table 9.85**) may cause an additive disturbance pathway. The

presented impact ranges and assessment outcomes do not include any additional mitigation. The potential number of animals disturbed during piling at the Bellrock WFDA and the level of effect were therefore highly conservative. Recent research indicated that harbour porpoise can leave the area a few days before piling begins, coinciding with increased vessel traffic near the wind farm site (Benhemma-Le Gall et al. 2023). This suggested that the potential effect of piling had also been overestimated due to some animals potentially vacating the area prior to the start. Therefore, any additive effect of these impacts would have already been accounted for within the piling assessment.

737. The significance of each individual impact is determined by the sensitivity of the receptor and the magnitude of impact; the sensitivity is constant whereas the magnitude may differ. Therefore, when considering the potential for impacts to be additive it is the magnitude of impact which is important – the magnitudes of the different effects are combined upon the same sensitivity receptor.
738. The impacts are assessed relative to each development phase (i.e. construction, O&M or decommissioning) to see if (for example) multiple construction impacts affecting the same receptor could increase the magnitude of impact upon that receptor.
739. A subsequent lifetime assessment has been undertaken which considers the impact interactions identified and the potential for impacts to effect receptors relevant to this Chapter across all development phases (**Table 9.88**).

Table 9.85: Potential Interaction Between Impacts - Construction

Potential Interaction Between Construction Impacts								
Impact	Impact C1: Underwater noise during UXO clearance	Impact C2: Underwater noise during geophysical surveys	Impact C3: Underwater noise during piling	Impact C4: Underwater noise from non-piling construction activities	Impact C5: Underwater noise and presence of vessels	Impact C6: Collision risk with vessels	Impact C7: Disturbance at seal haul-out sites	Impact C8: Changes to prey availability
Impact C1: Underwater noise during UXO clearance		Yes	Yes	Yes	Yes	Yes	No	No
Impact C2: Underwater noise during geophysical surveys	Yes		Yes	Yes	Yes	Yes	No	No
Impact C3: Underwater noise during piling	Yes	Yes		Yes	Yes	Yes	No	No
Impact C4: Underwater noise from non-piling construction activities	Yes	Yes	Yes		Yes	Yes	No	No
Impact C5: Underwater noise and presence of vessels	Yes	Yes	Yes	Yes		Yes	Yes	No
Impact C6: Collision risk with vessels	Yes	Yes	Yes	Yes	Yes		Yes	No
Impact C7: Disturbance at seal haul-out sites	No	No	No	No	Yes	Yes		No
Impact C8: Changes to prey availability	No	No	No	No	No	No	No	

Table 9.86: Potential Interaction Between Impacts - Operation and Maintenance

Potential Interaction Between O&M Impacts								
Impact	Impact O1: Underwater noise during geophysical surveys	Impact O2: Underwater noise from operation and maintenance activities	Impact O3: Underwater noise and presence of vessels	Impact O4: Underwater noise from operational WTGs and moorings on the seabed	Impact O5: Secondary entanglement	Impact O6: Collision risk with vessels	Impact O7: Disturbance at seal haul-out sites	Impact O8: Changes to prey availability
Impact O1: Underwater noise during geophysical surveys		Yes	Yes	Yes	No	No	No	No
Impact O1: Underwater noise from operation and maintenance activities	Yes		Yes	Yes	No	No	No	No
Impact O3: Underwater noise and presence of vessels	Yes	Yes		Yes	No	Yes	No	No
Impact O4: Underwater noise from operational WTGs and moorings on the seabed	Yes	Yes	Yes		Yes	No	No	No
Impact O5: Secondary entanglement	No	No	No	Yes		No	No	No
Impact O6: Collision risk with vessels	No	No	Yes	No	No		No	No
Impact O7: Disturbance at seal haul-out sites	No	No	No	No	No	No		No
Impact O8: Changes to prey availability	No	No	No	No	No	No	No	

Table 9.87: Potential Interaction Between Impacts - Decommissioning

Potential Interaction Between Decommissioning Impacts						
Impact	Impact D1: Underwater noise during geophysical surveys	Impact D2: Underwater noise from decommissioning activities	Impact D3: Underwater noise and presence of vessels	Impact D4: Collision risk with vessels	Impact D5: Disturbance at seal haul-out sites	Impact D6: Changes to prey availability
Impact D1: Underwater noise during geophysical surveys		Yes	Yes	No	No	No
Impact D2: Underwater noise from decommissioning activities	Yes		Yes	No	No	No
Impact D3: Underwater noise and presence of vessels	Yes	Yes		Yes	No	No
Impact D4: Collision risk with vessels	No	No	Yes		No	No
Impact D5: Disturbance at seal haul-out sites	No	No	No	No		No
Impact D6: Changes to prey availability	No	No	No	No	No	

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Table 9.88: Potential Interactions Between Impacts - Phase and Lifetime Assessment

Highest Residual Significance of Effect Level					
Receptor	Construction	O&M	Decommissioning	Phase Assessment	Lifetime Assessment
Very high frequency cetaceans - Harbour porpoise	Minor adverse	Minor adverse	Assumed no greater than construction due to the removal and dismantling of the Wind Farm infrastructure will largely be a reversal of the installation process.	Construction: No greater than individually assessed impact. The MMMP and PNMP would reduce the risk of injury (PTS) for marine mammals, and therefore during UXO clearance or piling there would be no pathway for interaction of potential injury (PTS) with disturbance effects (i.e. all individuals are assumed to be disturbed if within range and excluded from the injury footprint). Marine mammals that would receive the noise are also likely to be disturbed from the same noise. This effect of unmitigated piling has already been assessed as major adverse, representing the worst-case scenario for disturbance and noise. Therefore, the effect from both effects would not be greater than that.	No greater than individually assessed impact.
High Frequency cetaceans - Common dolphin, bottlenose dolphin, white-beaked dolphin, killer whale	Minor adverse	Minor adverse			The greatest magnitude of impact would be the spatial footprint of construction noise (i.e. piling). Once this disturbance impact has ceased all further impact during construction and O&M would be small scale, highly localised and episodic. There is no evidence of long-term displacement of marine mammals from operational OWFs. It was therefore considered that over the operational life of the Wind Farm Infrastructure these impacts would not combine and represent an increase in the individually assessed impacts.
Low frequency cetaceans – Minke whale, fin whale and humpback whale	Minor adverse	Minor adverse			
Phocids – Grey seal and harbour seal	Minor adverse	Minor adverse		Likewise, there are limited pathways for vessel interaction or effects on prey resource to interact with noise impacts as it is assumed that individuals could be excluded from the disturbance footprint (i.e. there cannot be a vessel interaction if the individual is excluded from the vicinity of the construction works). Once noise generating activities have ceased the footprint of disturbance and changes to prey resource will be highly localised. It is therefore considered that the interaction of these impacts would not represent an increase in the significance level. O&M: No greater than individually assessed impact.	It was therefore considered that over the operational life of the Wind Farm Infrastructure these impacts would not combine and represent an increase in the significance level (see Section 9.10.2.1 for additional information)

Highest Residual Significance of Effect Level					
Receptor	Construction	O&M	Decommissioning	Phase Assessment	Lifetime Assessment
				Operational noise impacts from WTGs would be highly localised for each WTG. Any changes to habitat for prey species would also be confined to the immediate footprint of WTG. The magnitude of impact was negligible and relates to largely the same spatial footprint. Therefore, there was no greater impact from any interaction between these impacts. There is potential for interaction with noise from maintenance activities and vessels interaction but given the negligible magnitude of impacts and episodic nature of these impacts it was not considered that the interaction of these impacts would represent an increase in the significance level. Any potential effects during O&M from underwater noise, changes in prey resources or water quality would be localised, temporary and negligible. Decommissioning: No greater than individually assessed impact. Although the exact removal techniques are unknown, it is expected that the effect would be similar to those assessed during construction (except for piling).	

9.10.2.1 Lifetime Assessment - Additional Information

740. The following sections serve as additional information to the Wind Farm Infrastructure-alone and cumulative assessment.

9.10.2.1.1 *Disturbance from all Construction, Operation and Maintenance, and Decommissioning Activities*

741. For the Bellrock Wind Farm Infrastructure-alone, and cumulatively, it is expected that the highest level of disturbance would be generated during the construction phase due to the potential impacts from piling, but these effects would be intermittent. There would also be a lower level, with more continuous effect of disturbance, from other construction activities and the increased number of vessels throughout the construction period. It is not expected that this additional stressor load to the wider population would have a higher significance of effect than the assessment presented for piling. With the appropriate mitigation measures (as outlined in **Section 9.7.3**) the overall level of significance of effect for the Wind Farm Infrastructure and cumulatively during construction is considered to be **minor adverse (not significant in EIA terms)**.
742. During decommissioning, the potential effects on marine mammals are anticipated to be similar, or less, than the worst-case assessment for the construction phase, noting no piling (or UXO clearance) would be required and therefore have an equivalent level of effect. During the 35-year O&M phase for the Bellrock Wind Farm Infrastructure individual impacts are more intermittent in nature and shorter in duration than during construction, but they would be repeated throughout that timeframe. Overall, the level of significance of effect for the Bellrock Wind Farm Infrastructure-alone and cumulatively during the O&M phase is considered to be **minor adverse (not significant in EIA terms)**.
743. While quantitative assessments have been undertaken for the impacts for each phase, they only provided a snapshot of the number of animals disturbed and the percentage of their reference population at a single point in time. This has formed the basis for determining the magnitude and significance of effect for the Bellrock WFDA, and cumulatively, throughout its lifetime. Although this assessment quantifies single events, the magnitude also considers the duration of effects. Repeated disturbance events are not expected to have a sustained effect on the wider reference population, as the effects of disturbance are not considered permanent and are recoverable over time. However, recoverability may reduce with repeated exposure to disturbance events, particularly when the duration between events is short. It is important to note that animals may incur some energetic cost during this period (e.g. Williams et al. 2006), (Hastie et al. 2021), (Frankish et al. 2023). It is also noted that cumulatively, there would be a wider number of sources impacting the reference populations that could be occurring at the same time and/or sequentially alongside activities associated with the Bellrock WFDA.
744. Taken all together, the construction of the Bellrock Wind Farm Infrastructure at the same time as the operation of other OWFs, and any decommissioning activities is not expected to generate any additive effect over and above what has been assessed for the construction of the Bellrock Wind Farm Infrastructure itself. This is also the case during the O&M phase and decommissioning phase of the Bellrock Wind Farm Infrastructure (where noise disturbance for the Wind Farm Infrastructure is less). This is due to the minimal potential for disturbance at a population level from these activities and noise sources individually, as well as the distance between each potential project considered. In addition, it is expected that all projects would have mitigation measures in place, which would

ensure disturbance is kept at the minimal level practicable. Based on the above, the potential magnitude of impact due to the construction of Bellrock Wind Farm Infrastructure at the same time as both the operation and decommissioning of other OWFs is not expected to be higher than the worst-case of the Bellrock Wind Farm Infrastructure under construction, as it is not expected that there would be any kind of additive significant effect when considered together.

745. Considering a professional analysis of the overall evidence base, the significance of effect for the lifetime of the Bellrock WFDA (both alone and cumulatively) is considered to be **minor adverse (not significant in EIA terms) (Table 9.88)** which is deemed appropriate and proportional in context of the MU's assessed for marine mammals.

9.10.2.1.2 Vessels

746. Vessels will be used throughout all phases of the Bellrock Wind Farm Infrastructure and therefore the impact from elevated underwater sound due to vessel activities throughout all phases could cause additional disturbance to marine mammals compared to each stage separately. However, for all phases of the Wind Farm Infrastructure, associated vessel movements will primarily be located within the WFDA and travelling at a reduced speed. Vessels will also follow the measures to minimise disturbance to marine mammals, which will be detailed within the EMP. This is also the case for other offshore wind projects. Across the lifetime of the Wind Farm Infrastructure, the effects on marine mammal receptors are not anticipated to interact in such a way as to result in combined effects of greater significance than the assessments presented for each individual phase.

9.10.2.1.3 Additive Effects of Multiple Pathways of Disturbance

747. Activities such as geophysical surveys, seismic surveys, aggregate extraction, dredging, and UXO clearance are considered the realistic worst-case scenario at this date, as it is challenging to determine when these projects/activities may occur. This uncertainty supports the conclusion that it is unlikely for all activities to occur simultaneously. Such activities would likely require separate licensing, which would take into account the consented activities of the Bellrock WFDA during their own application processes and determine appropriate mitigation.
748. It is not anticipated that the cumulative impacts' overall significance of would be elevated beyond the levels assessed individually. While individual activities may extend the overall duration of elevated underwater noise across the area and occur throughout the construction period independently of piling; the spatial extent of the most significant disturbance (i.e. piling) will remain limited to the maximum disturbance ranges identified for each species. Once piling is completed, any other construction, or O&M activities will be more localised to the WFDA and intermittent throughout the lifetime of the Wind Farm Infrastructure. It is concluded that over this timeframe, the impacts will not exceed the significance of the individual impacts alone.
749. Furthermore, animals are likely to be disturbed from the loudest source of noise, which could lead to the displacement for the Bellrock WFDA area where disturbance is expected to take place. As mentioned, piling is the worst-case impact with regard to disturbance, and therefore additive effects from less noisy activities at the same Bellrock WFDA may affect areas that animals have already vacated. Temporally, animals may return to normal behaviour between periods of noise, resulting in repeated exposures. However, due to the intervals between activities, it is not anticipated that

this would result in effects of greater significance than those from individual impacts considered in isolation.

750. With the implementation of the MMMP and PNMP, PTS is not predicted to occur in any marine mammal species. With respect to disturbance, the potential for spatially inter-related effects is considered to be minimal as individual animals are likely to be disturbed over a range dictated by the 'loudest' sound (i.e. leading to the greatest disturbance range) such that the potential for secondary (additive) effects from other activities that result in smaller ranges is reduced, as animals are already disturbed and have moved away from the area of highest ensonification. Temporally, animals may return to normal behaviour between sound generating activities leading to repeated exposure to sound over extended duration, however it is not predicted that this will result in effects of greater significance than the individual impacts in isolation due to intervals between activities.
751. Across the lifetime of the Bellrock Wind Farm Infrastructure, the effects on marine mammal receptors are not anticipated to interact in such a way as to result in combined effects of greater significance than the assessments presented for each individual phase including when considered cumulative effects with other projects.
752. When looking at the effects on the wider MUs on a cumulative basis, individual projects and activities would add repeated disturbance events throughout the lifetime of the Wind Farm Infrastructure. While there is the potential for this to have an additive effect on the overall population, in most cases these effects will be localised to the source. This could add to the stress load experienced by individual animals leading to increased level of expended energetic cost. However, due to the size of the MUs and reference populations the potential impacts would not alter the overall significance of effect that has been presented in the cumulative assessment (see **Section 9.9**). This considers the mitigation developed for the Wind Farm Infrastructure and other projects but acknowledges that there would be spatially and temporally repeated disturbances.

9.11 Summary

753. **Table 9.89** presents a summary of the assessment of potential effects on marine mammals during the construction, O&M and decommissioning of the Bellrock Wind Farm Infrastructure.
754. The methodology has been based on the best available techniques and professional analysis of the information presented. This approach has been used to derive conclusions whilst also considering the limitations where appropriate.
755. This cumulative assessment has included information from other projects to the best of knowledge up until the agreed six-month cut-off date prior to submission.
756. Taking into account the proposed mitigation measures, where required, the worst-case residual significance of effect during the construction, O&M and decommissioning of the Wind Farm Infrastructure were assessed as **minor adverse** which is **not significant** in EIA terms.

Table 9.89: Summary of Potential Effects for Marine Mammals

Potential Impact	Receptor(s)	Sensitivity	Magnitude of Impact	Significance of Effect	Mitigation (Primary and Tertiary)	Residual Significance of Effect	Cumulative Residual Significance of Effect
Construction							
C1: Underwater Noise During UXO Clearance <i>PTS for Unmitigated High-order Clearance</i>	Harbour porpoise	High	Medium	Major adverse	Implementation and compliance with the Bellrock WFDA MMMP for UXO clearance.	Minor adverse (not significant)	N/A
	All other marine mammal receptors	High	Negligible	Minor adverse	None required, but MMMP for UXO clearance would reduce potential for effect.	Minor adverse (not significant)	N/A
C1: Underwater Noise During UXO Clearance PTS for Low-order Clearance	All marine mammal receptors	High	Negligible	Minor adverse	None required, but MMMP for UXO clearance would reduce potential for effect.	Minor adverse (not significant)	N/A
C1: Underwater Noise During UXO Clearance Disturbance from High-order UXO Clearance	Baleen whales	Medium	Medium	Moderate adverse	MMMP for UXO clearance would reduce potential for effect.	Minor adverse (not significant)	N/A
	All other marine mammal receptors	Medium/Low	Negligible	Negligible adverse	None required	Negligible adverse (not significant)	N/A
C1: Underwater Noise During UXO Clearance Disturbance from ADD activation	All marine mammal receptors	Medium/Low	Negligible	Negligible adverse	None required	Negligible adverse (not significant)	N/A
C2: Underwater Noise During Geophysical Surveys Auditory injury (PTS)	All marine mammal receptors	High	Negligible	Minor adverse	None required, but mitigation measures in line with the JNCC (2017) guidance will be in place.	Minor adverse (not significant)	N/A
C2: Underwater Noise During Geophysical Surveys Behavioural Disturbance	All marine mammal receptors	Medium	Negligible	Negligible adverse	None required, but mitigation measures in line with the JNCC (2017) guidance will be in place.	Negligible adverse (not significant)	N/A
C3a: Underwater Noise during Piling Auditory injury	Harbour porpoise and baleen whales	High	Medium	Major adverse	Implementation and compliance with the Bellrock WFDA PNMP and MMMP for piling would reduce potential for effect which would include ADD activation.	Minor adverse (not significant)	N/A
	Dolphin species and harbour seal	High	Negligible/N/A	Minor adverse	Implementation and compliance with the Bellrock WFDA PNMP and MMMP for piling would reduce potential for effect which would include ADD activation.	Minor adverse (not significant)	N/A
C3b: Underwater Noise during Piling Disturbance	Harbour porpoise	Medium	Low ¹	Minor adverse	None required, but PNMP and MMMP for piling would reduce potential for effect.	Minor adverse (not significant)	N/A
	Baleen whales	Medium	Low	Minor adverse	None required, but PNMP and MMMP for piling would reduce potential for effect.	Minor adverse (not significant)	N/A
	Bottlenose dolphin and white-beaked dolphin	Low	Low	Minor adverse	None required, but PNMP and MMMP for piling would reduce potential for effect.	Minor adverse (not significant)	N/A

Potential Impact	Receptor(s)	Sensitivity	Magnitude of Impact	Significance of Effect	Mitigation (Primary and Tertiary)	Residual Significance of Effect	Cumulative Residual Significance of Effect
	Common dolphin, killer whale and seal species	Low	Negligible	Negligible adverse	None required, but PNMP and MMMP for piling would reduce potential for effect.	Minor adverse (not significant)	N/A
C4: Underwater Noise from Non-Piling Construction Activities Auditory injury	Harbour porpoise	High	Low	Minor adverse	None required	Minor adverse (not significant)	N/A
	All other marine mammal receptors	High	No change	Negligible adverse	None required	Negligible adverse (not significant)	N/A
C4: Underwater Noise from Non-Piling Construction Activities Disturbance	Bottlenose dolphin (CES MU)	Low	Low	Minor adverse	None required	Minor adverse (not significant)	N/A
	All other marine mammal receptors	Medium/Low	Negligible	Negligible adverse	None required	Negligible adverse (not significant)	N/A
C5: Underwater Noise and Presence of Vessels Disturbance	Bottlenose dolphin (CES MU)	Low	Low	Minor adverse	None required	Minor adverse (not significant)	N/A
	Harbour porpoise and baleen whales	Medium	Negligible	Negligible adverse	None required	Negligible adverse (not significant)	N/A
	All other dolphins and seal species	Low	Negligible	Negligible adverse	None required	Negligible adverse (not significant)	N/A
C6: Collision Risk with Vessels	Baleen whales	Medium	Low	Minor adverse	None required, but best practice measures for vessels will be in place in the EMP and VMNSP.	Minor adverse (not significant)	N/A
	All other marine mammal receptors	Low	Low	Minor adverse	None required, but best practice measures for vessels will be in place in the EMP and VMNSP.	Minor adverse (not significant)	N/A
C7: Disturbance at Seal Haul-Out Sites	Seals species	Medium	Low	Minor adverse	None required	Minor adverse (not significant)	N/A
C8: Changes to Prey Availability	Harbour porpoise, baleen whales	Low to Medium	Negligible to Low	Negligible to Minor adverse	None required	Negligible to Minor adverse (not significant)	N/A
	Dolphins, seals	Low	Negligible to Low	Negligible to Minor adverse	None required	Negligible to Minor adverse (not significant)	N/A
Operation and Maintenance							
O1: Underwater Noise During Geophysical Surveys Auditory injury	All marine mammal receptors	High	Negligible	Minor adverse	None required, but mitigation measures in line with the JNCC (2017) guidance will be in place.	Minor adverse (not significant)	N/A
O1: Underwater Noise During Geophysical Surveys Disturbance	All marine mammal receptors	Medium to Low	Negligible	Negligible adverse	None required, but mitigation measures in line with the JNCC (2017) guidance will be in place.	Negligible adverse (not significant)	N/A

Potential Impact	Receptor(s)	Sensitivity	Magnitude of Impact	Significance of Effect	Mitigation (Primary and Tertiary)	Residual Significance of Effect	Cumulative Residual Significance of Effect
O2: Underwater Noise from Operation and Maintenance Activities Auditory injury	Harbour Porpoise	High	Low	Minor adverse	None required	Minor adverse (not significant)	N/A
	All other marine mammal receptors	High	No change	Negligible adverse	None required	Negligible adverse (not significant)	N/A
O2: Underwater Noise from Operation and Maintenance Activities Disturbance	Bottlenose dolphin (CES MU)	Low	Low	Minor adverse	None required	Minor adverse (not significant)	N/A
	All other marine mammal receptors	Medium to Low	Negligible	Negligible adverse	None required	Negligible adverse (not significant)	N/A
O3: Underwater Noise and Presence of Vessels Disturbance	Bottlenose dolphin	Low	Medium	Minor adverse	None required, but best practice measures for vessels will be in place in the EMP.	Minor adverse (not significant)	N/A
	Harbour porpoise, white-beaked dolphin, killer whale and baleen whales	Medium to Low	Low	Minor adverse	None required, but best practice measures for vessels will be in place in the EMP.	Minor adverse (not significant)	N/A
	Grey seal and harbour seal	Medium to Low	Negligible	Negligible adverse	None required, but best practice measures for vessels will be in place in the EMP.	Negligible adverse (not significant)	N/A
O4: Underwater Noise from Operational WTGs and Moorings on the Seabed Auditory injury	All marine mammal receptors	High	Negligible	Minor adverse	None required	Minor adverse (not significant)	N/A
O4: Underwater Noise from Operational WTGs and Moorings on the Seabed Disturbance	All marine mammal receptors	Medium	Negligible	Negligible adverse	None required	Negligible adverse (not significant)	N/A
O5: Secondary Entanglement	Harbour porpoise, dolphin and seals species	Medium	Low	Minor adverse	None required	Minor adverse (not significant)	N/A
	Baleen whales	High	Low	Moderate adverse	Regular and periodic inspections and maintenance of all components of the wind farm infrastructure.	Minor adverse (not significant)	N/A
O6: Collision Risk with Vessels	Baleen whales	Medium	Low	Minor adverse	None required	Minor adverse (not significant)	N/A
	All other species	Low	Low	Minor adverse	None required	Minor adverse (not significant)	N/A
O7: Disturbance at Seal Haul-Out Sites	Seal species	Medium	Low	Minor adverse	None required	Minor adverse (not significant)	N/A

Potential Impact	Receptor(s)	Sensitivity	Magnitude of Impact	Significance of Effect	Mitigation (Primary and Tertiary)	Residual Significance of Effect	Cumulative Residual Significance of Effect
O8: Changes to Prey Availability	Harbour porpoise and baleen whales	Low to Medium	Negligible	Negligible to Minor adverse	None required	Negligible to minor adverse (not significant)	N/A
	Dolphin and seal species	Low	Negligible	Negligible adverse	None required	Negligible adverse (not significant)	N/A
Decommissioning							
D1: Underwater Noise During Geophysical Surveys Auditory injury	All marine mammal receptors	High	Negligible	Minor adverse	None required, but mitigation measures in line with the JNCC (2017) guidance will be in place.	Minor adverse (not significant)	N/A
D1: Underwater Noise During Geophysical Surveys Disturbance	All marine mammal receptors	Low to Medium	Negligible	Negligible adverse	None required, but mitigation measures in line with the JNCC (2017) guidance will be in place.	Negligible adverse (not significant)	N/A
D2: Underwater Noise from Decommissioning Activities Auditory injury	All marine mammal receptors	High	Negligible	Minor adverse	None required	Minor adverse (not significant)	N/A
D2: Underwater Noise from Decommissioning Activities Disturbance	Bottlenose dolphin	Low	Low	Minor adverse	None required	Minor adverse (not significant)	N/A
	All other species	Medium to Low	Negligible	Negligible adverse	None required	Negligible adverse (not significant)	N/A
D3: Underwater Noise and Presence of Vessels Disturbance	All marine mammal receptors	Medium	Negligible	Negligible adverse	None required, but best practice measures for vessels will be in place in the EMP.	Negligible adverse (not significant)	N/A
D4: Collision Risk with Vessels	Baleen whales	Medium	Low	Minor adverse	None required, but best practice measures for vessels will be in place in the EMP and VMNSP.	Minor adverse (not significant)	N/A
	All other marine mammal receptors	Low	Low	Negligible adverse	None required, but best practice measures for vessels will be in place in the EMP and VMNSP.	Negligible adverse (not significant)	N/A
D5: Disturbance at Seal Haul-Out Sites	Seal species	Medium	Negligible to Low	Not Significant (Negligible to Minor adverse)	None required	Negligible to minor adverse (not significant)	N/A
D6: Changes to Prey Availability	Harbour porpoise, baleen whales	Low to Medium	Negligible to Low	Negligible to Minor adverse	None required	Negligible to minor adverse (not significant)	N/A
	Dolphins, seals	Low	Negligible to Low	Negligible to Minor adverse	None required	Negligible to minor adverse (not significant)	N/A

Potential Impact	Receptor(s)	Sensitivity	Magnitude of Impact	Significance of Effect	Mitigation (Primary and Tertiary)	Residual Significance of Effect	Cumulative Residual Significance of Effect
Cumulative Effect Assessment							
CE1a: Indicative Assessment of Underwater Noise Impacts from Clearance of UXOs at Other OWFs	Baleen whales	Medium	High	Major adverse	Implementation and compliance with the Bellrock WFDA MMMP would reduce effects at the Project. All other projects would have mitigation measures in place for UXO clearance.	Minor adverse (not significant)	Minor to negligible adverse (not significant)
	Bottlenose dolphin, white-beaked dolphin and killer whale	Low	Low	Minor adverse	None required, but MMMP for Bellrock would reduce potential for effect.	Minor adverse (not significant)	Minor to negligible adverse (not significant)
	Harbour porpoise	Medium	Negligible	Negligible adverse	None required, but MMMP for Bellrock would reduce potential for effect.	Minor adverse (not significant)	Minor to negligible adverse (not significant)
	Common dolphin and seals	Low	Negligible	Negligible adverse	None required, but MMMP for Bellrock would reduce potential for effect.	Minor adverse (not significant)	Minor to negligible adverse (not significant)
CE1b: Indicative Assessment of Underwater Noise Impacts from Geophysical Surveys at other OWFs	harbour porpoise, bottlenose dolphin, white-beaked dolphin and killer whale	Medium	Low	Minor adverse	None required, but mitigation measures in line with the JNCC (2017) guidance will be in place for all projects.	Minor adverse (not significant)	Minor adverse (not significant)
	All other marine mammal receptors	Medium	Negligible	Negligible adverse	None required, but mitigation measures in line with the JNCC (2017) guidance will be in place for all projects.	Minor adverse (not significant)	Negligible adverse (not significant)
CE1c: Indicative Assessment of Underwater Noise Impacts from non-piling Construction Activities at other OWFs	harbour porpoise and baleen whales	Medium	Low	Minor adverse	None required	Minor adverse (not significant)	Minor adverse (not significant)
	Bottlenose dolphin	Low	Medium	Minor adverse	None required	Minor adverse (not significant)	Minor adverse (not significant)
	White-beaked dolphin and killer whale	Low	Low	Minor adverse	None required	Minor adverse (not significant)	Minor adverse (not significant)
	All other marine mammal receptors	Low	Negligible	Negligible adverse	None required	Minor adverse (not significant)	Negligible adverse (not significant)
CE1d: Indicative Assessment of Underwater Noise from Other Industries and Activities	Bottlenose dolphin	Medium	Medium	Moderate adverse	Implementation and compliance with the Bellrock WFDA PNMP and MMMP for piling would reduce potential for effect from the Project	Minor adverse (not significant)	Minor adverse (not significant)
	Harbour porpoise, white-beaked dolphin, killer whale and baleen whales	Medium	Low	Minor adverse	None required	Minor adverse (not significant)	Minor adverse (not significant)
	All other marine mammal receptors	Medium	Negligible	Negligible adverse	None required	Minor adverse (not significant)	Negligible adverse (not significant)

Potential Impact	Receptor(s)	Sensitivity	Magnitude of Impact	Significance of Effect	Mitigation (Primary and Tertiary)	Residual Significance of Effect	Cumulative Residual Significance of Effect
CE1e: Assessment of Disturbance from Operational Offshore Turbines Generators	All marine mammal receptors	Medium	Low	Minor adverse	None required	Minor adverse (not significant)	Minor adverse (not significant)
CE1f: Assessment of Underwater Noise and Presence of Vessels	All marine mammal receptors	Low to Medium	Low	Minor adverse	None, but best practice measures for vessels will be in place in the EMP.	Minor adverse (not significant)	Minor adverse (not significant)
CE2: Auditory Injury and Behavioural Impacts of Underwater Noise Impacts from Piling at Other OWFs	All marine mammal receptors	Medium	Low	Minor adverse	Implementation and compliance with the Bellrock WFDA PNMP and MMMP for piling would reduce potential for effect for the Project.	Minor adverse (not significant)	Minor adverse (not significant)
CE3: Vessel Collision Risk	Harbour porpoise, dolphins and seal species	Low	Low	Minor adverse	None required, but best practice measures for vessels will be in place in the EMP and VMNSP.	Minor adverse (not significant)	Minor adverse (not significant)
	Baleen whales	Medium	Low	Minor adverse	None required, but best practice measures for vessels will be in place in the EMP and VMNSP.	Minor adverse (not significant)	Minor adverse (not significant)
CE4: Disturbance at Seal Haul-Out Sites	Seal species	Low	Low	Minor adverse	None required	Minor adverse (not significant)	Minor adverse (not significant)
CE5: Secondary Entanglement	Harbour porpoise, dolphins and seal species	Medium	Low	Minor adverse	None required	Minor adverse (not significant)	Minor adverse (not significant)
	Baleen whales	High	Low	Moderate adverse	Regular and periodic inspections and maintenance of all components of the wind farm infrastructure.	Minor adverse (not significant)	Minor adverse (not significant)
CE6: Changes to Prey Availability	Harbour porpoise, baleen whales	Low to Medium	Negligible to Low	Negligible to Minor adverse	None required	Negligible to minor adverse (not significant)	Negligible to minor adverse (not significant)
	Dolphins, seals	Low	Negligible to Low	Negligible to Minor adverse	None required	Negligible to minor adverse (not significant)	Negligible to minor adverse (not significant)
Notes: ¹ Magnitude has been defined by considering the full evidence base of literature available, DRC assessment and outcome of the iPCoD modelling.							

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