



Bellrock Offshore Wind Farm

Wind Farm Development Area

Environmental Impact Assessment Report - Volume II

Chapter 17: Greenhouse Gas Assessment

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Appendix 17.1: Greenhouse Gas Assessment Methodology

Glossary of Terminology

Term	Definition
Applicant	Bellrock Offshore Wind Farm Limited, the legal entity submitting Section 36 Consent and Marine Licence applications for Bellrock Wind Farm Development Area.
Bellrock Offshore Wind Farm (or the Bellrock Project)	<p>An offshore wind farm capable of exporting up to 1.8 GW of renewable energy to the National Electricity Transmission System.</p> <p>The Wind Farm Development Area is located 120 km east of Stonehaven, and will connect to the National Electricity Transmission System at the proposed SSEN Transmission Hurlie substation, west of Stonehaven in Aberdeenshire. The Bellrock Offshore Wind Farm comprises of the following Development Areas:</p> <ul style="list-style-type: none"> ▪ Wind Farm Development Area; ▪ Offshore Transmission Development Area; and ▪ Onshore Transmission Development Area.
Blue carbon	Carbon captured by the world's oceans and coastal ecosystems.
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.
Carbon Dioxide Equivalent	Carbon dioxide equivalent is a term for describing different greenhouse gases in a common unit. The unit takes into account the different global warming potentials of greenhouses gases. CO _{2e} signifies the amount of CO ₂ which would have the equivalent global warming impact.
Climate change	A change in global or regional climate patterns. Within this Chapter this usually relates to any long-term trend in mean sea level, wave height, wind speed etc, due to climate change.
Development Area	<p>For consenting purposes, the area for which separate consents and/or Marine Licences will be sought by the Applicant, comprising:</p> <ul style="list-style-type: none"> ▪ Wind Farm Development Area; ▪ Offshore Transmission Development Area; and ▪ Onshore Transmission Development Area.
Floating offshore unit	The combined wind turbine generator and floating substructure.
Greenhouse gas	A greenhouse gas is a gaseous constituent of the atmosphere, both natural and anthropogenic that absorbs and re-emits infrared radiation causing the greenhouse effect.
Inter-array cables	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.
Intergovernmental Panel on Climate Change	A United Nations body responsible for assessing the science related to climate change and providing policymakers with regular scientific assessments.

Term	Definition
Lifecycle module	Different stages or phases involved in evaluating the environmental impacts of a product, process, or service through its entire lifecycle.
Net Zero	Net Zero is achieved when anthropogenic emissions of greenhouse gases to the atmosphere are balanced by anthropogenic removal over a specific period.
Onshore export cables	Electrical and fibre optic cables between the transition joint bay(s) and the onshore substation which may be laid directly within a trench or laid within cable ducts or protective covers.
Onshore export cable route	The area within the onshore export cable corridor where construction and commissioning of the onshore export cables will be undertaken, and which may include (but not limited to) the onshore export cables and trench(es); link boxes and associated fencing; temporary haul road; spoil, material and equipment laydown and/or storage; drainage infrastructure; wheel washing facilities; lighting, fencing and security; and environmental mitigation area(s).
Onshore substation	Onshore substation which will be fenced and house electrical equipment (such as transformers, switchgear, and protection and control systems), thereby enabling renewable electricity from the wind farm to be received via the onshore export cables and exported to the National Electricity Transmission System.
Onshore Transmission Development Area	The boundary within which the Onshore Transmission Infrastructure will be constructed, operated and maintained, and decommissioned.
Onshore Transmission Infrastructure	Infrastructure located within the Onshore Transmission Development Area including transition joint bay(s); onshore export cables; onshore substation; temporary construction compounds; temporary working areas; environmental mitigation areas; drainage/irrigation infrastructure; access works; and any other associated infrastructure (including activities associated with the Onshore Transmission Infrastructure construction, operation and maintenance, and decommissioning).
Offshore export cable	Armoured cable containing electrical and fibre optic cores between the offshore substation(s) and the transition joint bay(s).
Offshore reactive compensation station	An offshore platform located along high voltage alternating current offshore export cables that accommodates reactive compensation equipment used to control reactive power flows and maintain acceptable voltage levels in the high voltage alternating current transmission system.
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).
Offshore Transmission Infrastructure	Infrastructure located within the Offshore Transmission Development Area including fixed bottom and/or floating offshore substations, offshore reactive compensation station(s) and associated scour protection; interconnector cables and associated cable protection;

Term	Definition
	and offshore export cables and associated cable protection (including activities associated with the Offshore Transmission Infrastructure construction, operation and maintenance, and decommissioning).
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.
Remineralisation Potential	The ability of organic carbon stored in coastal ecosystems to be broken down and converted back into carbon dioxide by microbial activity.
Site preparation works	<p>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):</p> <ul style="list-style-type: none"> ▪ 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.
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.
Station keeping system	The system (including mooring lines and anchors) used to hold a floating offshore unit within its excursion limit and maintain the intended orientation of the floating offshore unit.
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 cables 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
BaU	Business as usual
BSH	Broad-scale habitat
CCC	Climate Change Committee
CCR	Climate change risk
CCS	Carbon Capture and Storage
CEA	Cumulative Effects Assessment
CH ₄	Methane
CMS	Construction Method Statement
CO ₂	Carbon dioxide
CO _{2e}	Carbon dioxide equivalent
COP	Conference of the Parties
DESNZ	Department for Energy Security and Net Zero
DP	Decommissioning Programme
EEA	European Economic Area
EEZ	Exclusive Economic Zone
EIA	Environmental impact assessment
EIA Report	Environmental Impact Assessment Report
EMP	Environmental Management Plan
EMS	Environmental Management System
EUNIS	European Nature Information System
FOU	Floating offshore unit
FSS	Floating substructure
GHG	Greenhouse gas
GIS	Geographic Information System
GloMEEP	Global Maritime Energy Efficiency Partnerships Project
GWh	Gigawatt hour
GWP	Global warming potential

Term	Definition
HFC	Hydrofluorocarbons
IAC	Inter-array cables
ICE	Inventory of Carbon and Energy
IEMA	Institute of Environmental Management and Assessment
IUCN	International Union for Conservation of Nature
JNCC	Joint Nature Conservation Committee
kg	kilogram
LAT	Lowest astronomical tide
LCA	Lifecycle assessment
MarLIN	Marine Life Information Network
MARPOL	International Convention for the Prevention of Pollution from Ships
MD-LOT	Marine Directorate Licensing and Operations Team
Mt	Million tonnes
MW	Megawatt
MWh	Megawatt hour
N ₂ O	Nitrous oxide
NDC	Nationally determined contribution
NETS	National Electricity Transmission System
NF ₃	Nitrogen trifluoride
NMP	Scotland's National Marine Plan
NPF4	National Planning Framework 4
O&M	Operations and maintenance
OC	Organic carbon
OfTDA	Offshore Transmission Development Area
OMP	Operation and Maintenance Plan
OnTDA	Onshore Transmission Development Area
PFC	Perfluorocarbons
PMF	Priority Marine Features

Term	Definition
PSD	Particle size distribution
SF ₆	Sulphur hexafluoride
SKS	Station keeping system
UK	United Kingdom
UNFCCC	United Nations Framework Convention on Climate Change
VMNSP	Vessel Management and Navigational Safety Plan
WFDA	Wind Farm Development Area
WTG	Wind turbine generator

17 Greenhouse Gas Assessment

17.1 Introduction

1. This Chapter of the Bellrock Wind Farm Development Area (WFDA) Environmental Impact Assessment (EIA) Report presents an assessment of potential effects on greenhouse gases (GHG) 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; subsea cable hubs; and ancillary infrastructure including buoys. 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 effect(s) of the Wind Farm Infrastructure and the Bellrock Project¹ on the global atmosphere as a receptor.
4. This Chapter presents an assessment on the following climate change topics:
 - A **GHG assessment** which evaluates the impact of the Wind Farm Infrastructure on climate change. This assessment quantifies the GHG emissions released from activities during the construction, O&M, and decommissioning phases of the Wind Farm Infrastructure. In addition, the assessment evaluates the contribution of the Wind Farm Infrastructure to national and regional GHG emissions in Scotland and the UK and compares its net effect against a 'Business as Usual' (BaU) baseline scenario. The main focus of the GHG assessment is the Wind Farm Infrastructure, however; the Offshore Transmission Infrastructure and Onshore Transmission Infrastructure associated with the Offshore Transmission Development Area (OfTDA) and Onshore Transmission Development Area (OnTDA) respectively, are required to supply renewable energy and contribute to the decarbonisation of the UK's electricity sector. Therefore, GHG emissions associated with the Bellrock Project (i.e. the Bellrock WFDA, OfTDA and OnTDA combined) in its entirety requires consideration, in addition to GHG emissions associated with the Bellrock WFDA alone. Information on the Bellrock OfTDA and OnTDA will be provided in the respective Scoping Reports and EIA Reports which are not yet available. Therefore, an estimation of GHG emissions from the Offshore Transmission Infrastructure and Onshore Transmission Infrastructure is presented as part of a whole project assessment in **Section 17.8.1.5**. Additional iterations of the whole Bellrock Project GHG emissions assessments will be undertaken and presented in the OfTDA and OnTDA EIA Reports, which will incorporate up-to-date information related to each component of the Bellrock Project; and

¹ The Bellrock Project comprises the Bellrock Wind Farm Development Area, the Bellrock Offshore Transmission Development Area, and the Bellrock Onshore Transmission Development Area.

- A **blue carbon assessment** of the Wind Farm Infrastructure, which assesses the potential effects on blue carbon habitats and the release of stored carbon, or changes to carbon sequestration rates caused by disturbance or loss of seabed habitat/sediments.
5. This Chapter should be read in conjunction with the following Chapters of the Bellrock WFDA EIA Report:
- **Chapter 7: Benthic Ecology (Volume II)**; and
 - **Chapter 18: Climate Change Risk (Volume II)**.
6. The GHG assessment is likely to have key inter-relationships with the above Chapters, which will be considered appropriately throughout this Bellrock WFDA EIA Report.
7. Additional information to support the GHG assessment includes:
- **Appendix 7.2: Bellrock WFDA Environmental Baseline Survey 2023 Report (Volume IV)**;
 - **Appendix 7.3: Bellrock WFDA Benthic Characterisation Survey 2023 Report (Volume IV)**; and
 - **Appendix 17.1: Greenhouse Gas Assessment Methodology (Volume IV)**.
8. This Chapter was prepared by Haskoning.

17.2 Legislation, Policy and Guidance

9. **Table 17.1** 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)**.
10. 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 17.1: Summary of Relevant Legislation, Policy and Guidance for Climate Change

Relevant Legislation, Policy and Guidance	Relevance to the Assessment
Legislation	
The United Nations Framework Convention on Climate Change (UNFCCC), 1992	<p>The UNFCCC is an international treaty which established a global climate governance framework and solidified climate change as an agenda item for future agreements and policies. The UNFCCC facilitated intergovernmental climate change negotiations such as the Conference of the Parties (COP).</p> <p>The UK's obligation under the UNFCCC is implemented through the Climate Change Act 2008, which outlines commitments to reducing GHG emissions.</p> <p>A summary of the Climate Change Act 2008 is provided below. The contribution of the Wind Farm Infrastructure to the UK's statutory commitments in respect of GHG emissions is assessed in this Chapter.</p>

Relevant Legislation, Policy and Guidance	Relevance to the Assessment
Kyoto Protocol 1997	<p>Following the UNFCCC, the Kyoto Protocol committed industrialised countries to limit and reduce their GHG emissions in accordance with individual targets to reduce the rate and extent of global warming. Annex A of the Kyoto Protocol defined the key GHGs, as follows:</p> <ul style="list-style-type: none"> ▪ Carbon dioxide (CO₂); ▪ Methane (CH₄); ▪ Nitrous oxide (N₂O); ▪ Hydrofluorocarbons (HFC); ▪ Perfluorocarbons (PFC); ▪ Sulphur hexafluoride (SF₆); and ▪ Nitrogen trifluoride (NF₃).
Paris Agreement (Conference of Parties; COP 21), 2015	<p>The Paris Agreement entered into force in 2016 and was ratified by the UK Government at COP22. It is a legally binding international treaty with an overarching goal of “<i>holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels</i>”.</p> <p>The Paris Agreement requires countries to submit national climate action plans known as Nationally Determined Contributions (NDC), with each successive NDC reflecting increasing decarbonisation ambitions.</p> <p>The commitment to the Paris Agreement was reaffirmed at most recent COP29 in Baku, Azerbaijan.</p>
Climate Change Act 2008 Climate Change Act 2008 (2050 Target Amendment) Order 2019	<p>The Climate Change Act 2008 provides the legal basis for the UK’s long-term response to tackling climate change. The 2050 Target Amendment Order, introduced in 2019 revised the UK’s target to net zero by 2050, with an interim target of 78% emission reduction by 2035 compared to 1990 levels.</p> <p>The Act requires the UK Government to set legally binding Carbon Budgets to limit GHG emissions in a given time period. These budgets are set by the Climate Change Committee (CCC) in five-year periods and are presented in Table 17.2.</p>
Climate Change (Scotland) Act 2009 Climate Change (Emissions Reduction Targets) (Scotland) Act 2019 Climate Change (Emissions Reduction Targets) (Scotland) Act 2024 Climate Change (Scotland) Act 2009 (Scottish Carbon Budgets) Amendment Regulations 2025	<p>Scotland has its own distinct climate change legislation – the Climate Change (Scotland) Act 2009 was implemented to reduce the greenhouse gas emissions in Scotland by at least 80% by 2050. The Climate Change (Annual Targets) (Scotland) Order 2011 outlines the targets for 2023-2027.</p> <p>The Climate Change (Scotland) Act 2009 and the Climate Change (Emissions Reduction Targets) (Scotland) Act 2019 accelerates Scotland’s overall target in the 2009 Act to net zero by 2045.</p> <p>In November 2024, the Climate Change (Emissions Reduction Targets) (Scotland) Act 2024 modifies the Climate Change (Scotland) Act 2009 to introduce limits on the amount of GHGs emitted in Scotland over a five-year period. This replaces the requirements for annual targets as outlined in the Climate Change (Emissions Reduction Targets) (Scotland) Act 2019 with a system of targets based on carbon budgets. However, the overall target of net zero by 2045 will remain in place.</p>
Energy Act 2023	<p>The Energy Act 2023 aims to transform the UK’s energy system by strengthening energy security, supporting the delivery of net zero, and ensuring household bills are affordable in the long term.</p>

Relevant Legislation, Policy and Guidance	Relevance to the Assessment
	The Act aims to assist the Government to deliver net zero by 2050 in a pragmatic, proportionate, and realistic way.
Policy	
National Planning Framework 4 (Scottish Government, 2023a)	<p>Scotland's fourth National Planning Framework (NPF4) sets out the national spatial strategy up to 2045, which guides infrastructure projects on principles and priorities.</p> <p>NPF4 supports developments that enable decarbonisation through the provision of renewable, low-carbon and zero emission technologies (Policies 1 and 11).</p> <p>In addition, NPF4 requires developments to minimise their lifecycle GHG emissions as far as possible (Policy 2).</p>
Scotland's Climate Change Plan	<p>The Scottish Government publishes Climate Change Plans to set out the pathway to achieving its GHG emission reduction targets per the Climate Change (Scotland) Act 2009.</p> <p>The most recent version, the 2018-2032 Update, includes the Offshore Wind Policy Statement (Scottish Government, 2018)) that supports the development of between 8 to 11 GW of offshore wind capacity by 2030). The Climate Change Plan: 2026-2040 is under consultation at the time of the assessment. The updated Climate Change Plan will make reference to the updated Offshore Wind Policy Statement (Scottish Government, 2026).</p>
The UK Net Zero Strategy 2021 and British Energy Security Strategy, 2022	<p>The UK Net Zero Strategy and British Energy Security Strategy apply to Scotland and provide a national commitment to the provision of low-carbon, secure and affordable energy sources, including an ambition to deliver up to 50 GW of offshore wind capacity by 2030.</p> <p>This is considered as part of the GHG assessment presented in Section 17.8.1.</p>
UK Climate Change Strategy 2021 to 2024 (Her Majesty's (HM) Government, 2021)	<p>The latest UK Climate Change Strategy aids UK exporters and suppliers through the transition to net zero by increasing support to clean growth and climate adaptation, reducing GHG emissions and understanding and mitigating climate-related financial risks.</p> <p>The Strategy highlights the importance of transforming the financial system to boost innovation and transition away from high carbon sectors.</p> <p>This is considered as part of the GHG assessment presented in Section 17.8.1.</p>
Scotland's National Marine Plan (NMP) (Scottish Government, 2015)	<p>Scotland's NMP was adopted to implement the Marine (Scotland) Act 2010 and covers the management of Scottish inshore waters (out to 12 nm) and offshore waters (12 to 200 nm). It provides an overarching framework for the sustainable use of Scotland's marine area.</p> <p>The plan includes the general planning principle, GEN 5 Climate change, which requires that marine planners and decision makers act in a way that mitigates and adapts to climate change.</p> <p>This includes seeking to facilitate the transition to a low carbon economy and giving sufficient regard to the impacts of climate change through considering ways to reduce GHG emissions.</p> <p>It also outlines the consideration for reducing human pressure and safeguarding ecosystem services such as coastal protection and natural carbon sinks (e.g. seagrass beds, kelp and salt marsh).</p> <p>The GHG and blue carbon assessments presented in Sections 17.8.1 and 17.8.2, consider the impact of the Wind Farm Infrastructure to climate change and the impacts on natural carbon sinks respectively.</p>

Relevant Legislation, Policy and Guidance	Relevance to the Assessment
	<p>The Scotland NMP is currently being updated, transitioning to the Scottish National Marine Plan 2, with the aim of delivering a plan that considers the changes to the policy and legislative landscape, rapid developments in technology and the need to achieve a green recovery from the COVID-19 pandemic, as well as reflecting the improved understanding of the marine environment and the successful delivery of the Blue Economy Approach (Marine Scotland, 2022).</p> <p>Consultation on the Scotland NMP ran from 5 November 2024 to 7 February 2025 and a consultation analysis report has been produced by the Scottish Government (2025).</p>
<p>Scottish Blue Carbon Action Plan (Scottish Government, 2025b)</p>	<p>This action plan sets out how the Scottish Government will integrate consideration of blue carbon habitats, including seabed sediments, into marine policy and decision-making, recognising their role as long-term natural carbon stores and nature-based solutions for climate change mitigation and adaptation.</p> <p>Potential impacts to blue carbon stores within marine habitats are evaluated in the Blue Carbon Assessment in Section 17.8.2.</p>
<p>Guidance</p>	
<p>Institute of Environmental Management and Assessment (IEMA): Assessing Greenhouse Gas Emissions and Evaluating their Significance (2022)</p>	<p>The guidance document presents guidelines for undertaking GHG assessments, evaluating the significance of a development's GHG emissions in an EIA context, and approach to mitigation.</p>
<p>PAS2080: Carbon Management in Buildings and Infrastructure (British Standards Institution, 2023)</p>	<p>The guidance document provides specifications for the management of whole-life carbon in built environment projects and best practice measures to enable further emission reductions.</p>
<p>The Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard (World Resource Institute and World Business Council for Sustainable Development, 2015)</p>	<p>The guidance document provides requirements for the preparation of GHG emission inventories and the consideration of direct and indirect GHG emissions (Scope 1, 2 and 3 emissions).</p>
<p>The Offshore Wind Industry Product Carbon Footprinting Guidance (The Carbon Trust, 2024)</p>	<p>This guidance document provides specific guidelines for assessing the product-level carbon footprint of an offshore wind development, considering different lifecycle modules of infrastructure developments and enabling a consistent GHG calculation approach within the industry. These defined lifecycle modules are used in the GHG Assessment presented in Section 17.8.1 and support the identification of emission "hotspots".</p>
<p>Global Maritime Energy Efficiency Partnerships Project (GloMEEP): Port Emissions Toolkit (2018)</p>	<p>The guidance document provides a methodology for calculating vessel emissions during various operating modes such as in transit and manoeuvring.</p>

- As discussed in **Table 17.1**, the UK has established Carbon Budgets, which provide a legally binding five-year limit for GHG emissions in the UK. There are currently six UK Carbon Budgets that have been adopted as legislation and will run up to 2037 as outlined in **Table 17.2** The UK is currently in the fourth Carbon Budget period. The CCC recommended the limit for the 7th Carbon

Budget in May 2025, but at the time of writing this has not been legally adopted by the UK Government (Climate Change Committee, 2025a).

Table 17.2: UK Carbon Budgets (2008 to 2037)

Budget	Period	Carbon Budget Level (Mt CO ₂ e)	Reduction Below 1990 Levels	
			UK Targets	Achieved by the UK
1 st Carbon Budget	2008 to 2012	3,018	25%	30%
2 nd Carbon Budget	2013 to 2017	2,782	32%	38%
3 rd Carbon Budget	2018 to 2022	2,544	38% by 2020	44%
4 th Carbon Budget	2023 to 2027	1,950	52% by 2025	-
5 th Carbon Budget	2028 to 2032	1,725	58% by 2030	-
6 th Carbon Budget	2033 to 2037	965	78% by 2035	-
7 th Carbon Budget	2038 to 2042	535	87% by 2040	-
Net Zero Target by 2050			100%	-
Notes:				
¹ The 7 th Carbon Budget has been recommended by the CCC, but at the time of writing has not been legally adopted by the UK Government.				

12. As discussed in **Table 17.1**, Scotland has also established its own Carbon Budgets, which run up to 2045. There are currently four Scottish Carbon Budgets, enforced through the Climate Change (Scotland) Act 2009 (Scottish Carbon Budgets) Amendment Regulations 2025, which are outlined in **Table 17.3**.

Table 17.3: Proposed Scottish Carbon Budget (2026 to 2045)

Budget	Period	Carbon Budget Level (Mt CO ₂ e)	Reduction Below 1990 Levels
1 st Carbon Budget	2026 to 2030	175	57%
2 nd Carbon Budget	2031 to 2035	126	69%
3 rd Carbon Budget	2036 to 2040	81	80%
4 th Carbon Budget	2041 to 2045	24	94%

17.3 Consultation

13. Consultation undertaken to date for the Bellrock WFDA relevant to climate change has been in line with the general process described in **Chapter 5: EIA Methodology (Volume II)**. The Bellrock Project update consultation letter, emailed to 210 stakeholders outlining key updates to the Bellrock Project since the Bellrock WFDA Scoping Report (**Appendix 1.1 (Volume IV)**). The letter also notified these stakeholders of the virtual consultation event that was held in November 2025 (**Chapter 5: EIA Methodology (Volume II)**).
14. Key consultation pertinent to this Chapter is provided in **Table 17.4** below. This includes details of additional consultation on the methodology for the GHG, blue carbon and the whole project assessment presented in this GHG Chapter with MD-LOT, NatureScot and Aberdeenshire Council through letters issued in July 2025.

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Table 17.4: Consultation Relevant to Climate Change

Consultee	Date/Document	Comment	How/Where Comment is Addressed
MD-LOT	Bellrock WFDA Scoping Opinion (2024)	<p>The Scottish Ministers advised that they are largely content with the Developer’s approach in assessing Green House Gases (“GHG”) and climate change effects within Section 17 of the Scoping Report, noting that the IEMA EIA Guide “Assessing Greenhouse Gas Emissions and Evaluating Their Significance” provides further insight on this matter.</p> <p>The Scottish Ministers also advised that they have considered this together with the Climate Change (Emissions Reduction Targets) (Scotland) Act 2019 and the requirement of the EIA Regulations to assess significant effects from the Proposed Development on climate.</p> <p>The Scottish Ministers highlight that the GHG assessment should include the pre-construction, construction, operation and decommissioning phases, including consideration of the supply chain as well as benefits beyond the life cycle of the Proposed Development. The NatureScot representation regarding climate change and carbon costs should be fully addressed by the Developer within the EIA Report.</p>	<p>The GHG assessment, provided in Section 17.8.1, calculates emissions during the pre-construction (referred to in this assessment as site preparation works), construction, O&M and decommissioning phases.</p> <p>Upstream emissions from the supply chain, particularly from activities which encompass ‘embodied’ carbon in materials have been accounted for in the assessment.</p> <p>The benefits of the Bellrock Project, in terms of avoiding emissions from other forms of electricity generation, have also been calculated in Section 17.8.1.5.</p>
MD-LOT	Bellrock WFDA Scoping Opinion (2024)	<p>The Scottish Ministers directed the Applicant to the NatureScot representation in relation to blue carbon assessment. The Scottish Ministers advise that consideration should be given to impacts on blue carbon as a result of the Proposed Development as well as an expanded assessment for benthic ecology focusing on potential impacts on marine sediments.</p>	<p>The blue carbon assessment, presented in Section 17.8.2 considers potential impacts on blue carbon habitats and sediment from the Wind Farm Infrastructure.</p>
NatureScot	Representation on the Bellrock WFDA Scoping Report (2024)	<p>NatureScot noted that Section 3.9 of the Bellrock WFDA Scoping Report states the Bellrock project is at an early stage of development with project timelines provided as being indicative. Paragraph 184 states that construction works for the Bellrock WFDA may start up to seven years after consent (if awarded) and that further details will be provided in the EIA Report.</p> <p>NatureScot highlighted that within that seven-year timeframe further relevant information is likely to emerge from post-consent</p>	<p>Based on the indicative Bellrock WFDA construction programme, construction works within the Bellrock WFDA may commence up to five years after consent is awarded, with a seven years’ s.36 Consent validity date being sought to provide necessary flexibility in light of uncertainties over the Contract for Difference process and supply chain capacity (as presented in Chapter 4: Project Description (Volume II)). The Bellrock WFDA EIA Report takes account of the latest information available on climate change. Where new information becomes available within a sufficient time</p>

Consultee	Date/Document	Comment	How/Where Comment is Addressed
		monitoring and/or data associated with both offshore wind farms and climate change. It is not clear how this will be accounted for, given such a lengthy gap.	to be considered within the detailed design of the Wind Farm Infrastructure, such information will be considered as appropriate.
NatureScot	Representation on the Bellrock WFDA Scoping Report (2024)	<p>Climate change and carbon costs:</p> <p>NatureScot advised that the impact of climate change effects should be considered, both in future proofing the project design and how certain climate stressors may work in combination with potential effects from the proposed wind farm.</p> <p>The EIA Report should also consider the carbon cost of the wind farm (including supply chain) and to what extent this is offset through the production of green energy. We recognise that some aspects of this are addressed in Section 17 (Climate Change).</p>	<p>The impacts of climate change effects to Wind Farm Infrastructure is considered in Chapter 18: Climate Change Risk (Volume II).</p> <p>The carbon cost of the Wind Farm Infrastructure is presented in Section 17.8.1 and is considered relative to the UK's and Scotland's Carbon Budgets. The extent it is offset through the production of green energy is presented in Section 17.8.1.3.1.2 and Section 17.8.1.5, considering the scenario as described in Section 17.6.3.1.</p> <p>A whole project assessment of the Bellrock WFDA, OfTDA and OnTDA is also presented in Section 17.4.4 which provides further context on the carbon cost of the Bellrock Project, including supply chain considerations.</p>
NatureScot	Representation on the Bellrock WFDA Scoping Report (2024)	<p>Blue carbon:</p> <p>In addition to the climate change assessments outlined in Section 17 of the Bellrock Scoping Report, NatureScot recommended that consideration is given to impacts on blue carbon and whether or not an assessment can be undertaken. This should expand on the information and assessment conducted for benthic ecology to focus on the potential impacts of the proposed development on marine sediments and coastal habitats. NatureScot recognised that some aspects of this are addressed in Section 17 (Climate Change).</p>	The blue carbon assessment, presented in Section 17.8.2 considers potential impacts on blue carbon habitats and sediment from the Wind Farm Infrastructure.
Aberdeenshire Council	28 July 2025, Email	Aberdeenshire Council agreed with the proposed approach for the GHG and Climate Change Risk (CCR) assessments.	Noted. The methodology for the GHG assessment is set out in Section 17.4 . ¹
MD-LOT	1 August 2025, Email	MD-LOT had no further comment to provide on the GHG and CCR assessments.	Noted. The methodology for the GHG assessment is set out in Section 17.4 . ¹

Consultee	Date/Document	Comment	How/Where Comment is Addressed
NatureScot	18 August 2025, Email	NatureScot supported the inclusion of the Blue Carbon Assessment in the EIA; and advised it was in general content with the proposed approach.	Noted. The methodology for the blue carbon assessment is set out in Section 17.4.1.2 .
NatureScot	18 August 2025, Email	NatureScot advised the study area defined for blue carbon should mirror the advice for benthic ecology and/or physical processes.	The study area for blue carbon is defined by the Bellrock WFDA, as presented in Section 17.5.1.2 .
NatureScot	18 August 2025, Email	NatureScot advised the baseline characterisation for Blue Carbon should expand on the information and assessment conducted for benthic ecology, as well as making links to the physical processes chapter where appropriate. It also provided a range of recommended data sources for the assessment.	The baseline characterisation for blue carbon builds on the assessment conducted for benthic ecology, as presented in Section 17.6.2 . Where appropriate, the recommended data sources have been used in the assessment.
NatureScot	18 August 2025, Email	NatureScot advised that impact pathways for blue carbon should be similar to those for benthic ecology, with an emphasis on direct disturbance to sediment in particular. As the fate of disturbed sedimentary organic carbon is currently unknown, as a precautionary approach, it should be assumed that 100% of the disturbed volume will result in CO ₂ emissions to the atmosphere. For intertidal habitats that may be disturbed by activities (for instance cabling connections to land), indirect impacts such as smothering may be an issue.	The blue carbon assessment, presented in Section 17.8.2 considers potential impacts on blue carbon habitats and sediment from the Wind Farm Infrastructure, and considers the impacts discussed in Chapter 7: Benthic Ecology (Volume II) .
NatureScot	18 August 2025, Email	NatureScot advised that assessments should also consider the impact of the cable corridor on sedimentary carbon and its potential for spatial overlap with kelp beds, subtidal and intertidal seagrass beds, and saltmarsh where it comes ashore.	The impacts of the offshore export cable corridor will be considered in the Bellrock OfTDA EIA Report and considered in within the Cumulative Effects Assessments (CEA) for the Bellrock WFDA, presented in Section 17.9 .
NatureScot	18 August 2025, Email	NatureScot advised that changes in physical processes resulting from the presence of the subsea infrastructure associated with the proposal are scoped in, e.g. scour effects, changes in wave/tidal current regimes and resulting effects on sediment transport. Blue carbon assessments should also include this as an impact pathway where relevant, as sediment and associated carbon accumulation may result from the proposal. This could be further impacted at decommissioning stage, although the impact is likely to be negligible given relatively low sediment	Impacts on physical processes are considered in Chapter 6: Marine Geology, Oceanography and Physical Processes (Volume II) . Impacts on blue carbon are presented in Section 17.8.2 , and in particular impacts during decommissioning are presented in Section 17.8.2.4.1 . As noted in this section, it is anticipated that impact is likely to be negligible during decommissioning stage.

Consultee	Date/Document	Comment	How/Where Comment is Addressed
		accumulation rates in the North Sea, noting that this does vary spatially.	
NatureScot	18 August 2025, Email	NatureScot highlighted that most sedimentary carbon stocks are calculated for the surficial 10 cm because this is where the majority of the evidence has been collected, however, that the assessment should acknowledge that there will be additional disturbance to carbon that is buried deeper from foundations, anchors, etc.	The assessment methodology acknowledges the current limitations in data availability and evidence of blue carbon in sediments deeper than 10 cm, presented in Section 17.4.1.2.2 .
NatureScot	18 August 2025, Email	NatureScot highlighted that the vulnerability and recoverability of blue carbon should be considered when assessing the sensitivity, magnitude and overall significance of any impact. In general, NatureScot has assessed that <i>'The receptor is deemed to be of high vulnerability, low recoverability, and high value. The sensitivity of the receptor is therefore, considered to be high.'</i> This is because sediment accumulation on the seabed can be very low and recovery therefore is slow.	The sensitivity and magnitude are presented in Section 17.8.2 .
NatureScot	18 August 2025, Email	NatureScot advised that previous assessments have included comparisons to overall Scottish carbon emissions or extent of habitat within Scotland to assess the significance of impact.	The carbon emissions quantified in the assessment were compared to the extent of habitat within Scotland, presented in Section 17.8.2 .
NatureScot	18 August 2025, Email	NatureScot advised that to convert carbon stocks to CO ₂ emissions, a factor of 3.67 should be used. It is not appropriate for inorganic carbon stocks to be converted to CO ₂ emissions.	The conversion of carbon stocks to CO ₂ are presented in Section 17.8.2.1.2 , where a conversion factor of 3.67 was used for organic carbon stocks.
NatureScot	18 August 2025, Email	NatureScot advised that assessments should consider the cumulative impacts of disturbance from other developments, including on longer-term carbon stores buried deeper.	Cumulative impacts assessed in Chapter 7: Benthic Ecology (Volume II) are also assessed for blue carbon, presented in Section 17.9 .
NatureScot	18 August 2025, Email	NatureScot advised that typically, specific mitigation and monitoring for blue carbon is unlikely to be required. However, any mitigation required for benthic or coastal habitats is likely to be beneficial for blue carbon.	Mitigation as set out in Chapter 7: Benthic Ecology (Volume II) applies to blue carbon.

Consultee	Date/Document	Comment	How/Where Comment is Addressed
NatureScot	18 August 2025, Email	NatureScot highlighted that transboundary impacts are unlikely to be identified for blue carbon, but that this should mirror advice provided for benthic ecology or physical processes.	Transboundary impacts were scoped out for benthic ecology, and therefore the same approach was adopted for blue carbon, as presented in Section 17.4.3 .
<p>Notes:</p> <p>¹ A whole project assessment is not required for the CCR assessment (Chapter 18: Climate Change Risk (Volume II)).</p>			

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17.4 Assessment Methodology

17.4.1 Impact Assessment Methodology

15. **Chapter 5: EIA Methodology (Volume II)** provides a summary of the general impact assessment methodology applied in the Bellrock WFDA EIA Report. The assessment uses 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 methodologies for the GHG and blue carbon assessments are detailed in the following sections.

17.4.1.1 GHG Assessment

16. In this assessment the term ‘GHG’ or ‘carbon’ encompasses CO₂ and the six other gases as referenced in the Kyoto Protocol (CH₄, N₂O, HFCs, PFCs, SF₆ and NF₃). The results in the assessment are expressed in carbon dioxide equivalent (CO₂e), which recognises that different gases have notably different global warming potentials (GWP²).
17. GHG emissions arising from the construction, O&M and decommissioning phases of the Wind Farm Infrastructure are predicted within a defined ‘study area/project boundary’, as described in **Section 17.4**. GHG emissions are quantified using a standard calculation-based methodology, which involves multiplying activity data gathered for the Bellrock WFDA with the relevant emission factors, and where applicable, calorific and GWP factors. Where full details of activity data are not available, industry benchmarks and assumptions using professional judgement are utilised.
18. GHG emissions were calculated from the following source groups:
- Embodied carbon in materials;
 - Marine vessels;
 - Helicopters;
 - Fugitive emissions; and
 - Decommissioning.
19. The approach to calculating emissions for each of these source groups is provided in **Appendix 17.1: Greenhouse Gas Assessment Methodology (Volume IV)**.
20. The GHG emissions results are presented in line with the lifecycle modules established in the Carbon Trust’s Guidance (2024), which defines a standard boundary for activities associated with an offshore wind farm, including construction (for the purpose of the assessment this includes site preparation works), O&M, decommissioning, and end-of-life.

² GWP of a GHG is a measure of how much heat is trapped by a certain amount of gas in the atmosphere relative to carbon dioxide.

21. To assist with the determination of the significance of the Wind Farm Infrastructure in relation to GHG emissions (as discussed in **Section 17.8**), the following parameters are calculated to contextualise the outcomes of the assessment:
- GHG emissions avoided by the Wind Farm Infrastructure:
 - Where the level of avoided emissions during the O&M phase as a result of the provision of renewable energy from the Wind Farm Infrastructure is calculated.
 - Comparison to the UK and Scotland Carbon Budgets:
 - The estimated proportion of emissions arising from the Wind Farm Infrastructure relative to the UK and Scotland Carbon Budgets, calculated over the construction and O&M phases where applicable.
22. In addition, the overall GHG intensity of electricity produced by the Bellrock Project is calculated in the whole project assessment, which considers the volume of GHGs released per unit of electricity generated, expressed as kg of CO₂e per MWh.

17.4.1.1.1 Definitions of Sensitivity and Magnitude

23. The characterisation of the existing environment helps to determine the receptor sensitivity in order to assess the potential impacts upon it.
24. Sensitivity is defined with regard to the ability of a receptor to adapt to change, tolerate, and/or recover from potential effects. In addition, for some assessments the value of a receptor may also be an element to add to the assessment where relevant. Receptor value considers whether, for example, the receptor is rare, has protected or threatened status, importance at local, regional, national or international scale.
25. The receptor for the GHG assessment is the global atmosphere. As such, it is affected by all global sources of GHGs and is therefore considered to be of high sensitivity to additional emissions, given the cumulative contributions of all GHG emissions and their widespread impact (IEMA, 2022).
26. The magnitude of impact is not defined, as the effect significance for the GHG assessment is not determined by the magnitude of GHG emissions alone (IEMA 2022). However, the magnitude of GHG emissions is calculated individually for the construction, O&M and decommissioning phases as part of the assessment and combined over the Wind Farm Infrastructure's whole lifecycle and the Bellrock Project.
27. The impact of GHG emissions is, by nature, global and long term, with low reversibility, owing to the long atmospheric lifetime of GHGs and their prolonged effect on the climate system.

17.4.1.1.2 Effect Significance

28. The IEMA guidance (IEMA, 2022) recognises *“when evaluating significance, all new GHG emissions contribute to a negative environmental impact; however, some Projects will replace existing development or baseline activity that has a higher GHG profile. The significance of a project's emissions should therefore be based on its net impact over its lifetime, which may be positive, negative or negligible”*.

29. The IEMA guidance (IEMA, 2022) recommends that significance criteria align with Paris Agreement, the UK's Carbon Budgets up to 2042 and Scotland and the UK's net zero commitments: *"the crux of significance is not whether a project emits GHG emissions, nor even the magnitude of GHG emissions alone, but whether it contributes to reducing GHG emissions relative to a comparable baseline consistent with a trajectory towards net zero by 2050"*.
30. The IEMA guidance (2022) provides significance descriptions to assist assessments of GHG emissions specifically in an EIA context. Section VI of the guidance describes five distinct levels of significance which are not solely based on whether a project emits GHG emissions alone, but how the project makes a relative contribution towards achieving a decarbonisation trajectory towards net zero. These are presented below in **Table 17.5** (adapted from IEMA, 2022).

Table 17.5: Effect Significance Criteria for the Greenhouse Gas Assessment

Significance	Definition
Major adverse	GHG impacts are not mitigated or are only compliant with do-minimum standards set through regulation, and do not provide further reductions required by existing local and national policy for projects of this type. A project with major adverse effects is locking in emissions and does not make a meaningful contribution to the UK's trajectory towards net zero.
Moderate adverse	GHG impacts are partially mitigated and may partially meet the applicable existing and emerging policy requirements but would not fully contribute to decarbonisation in line with local and national policy goals for projects of this type. A project with moderate adverse effects falls short of fully contributing to the UK's trajectory towards net zero.
Minor adverse	GHG impacts would be fully consistent with applicable existing and emerging policy requirements and good practice design standards for projects of this type. A project with minor adverse effects is fully in line with measures necessary to achieve the UK's trajectory towards net zero.
Negligible	GHG impacts would be reduced through measures that go well beyond existing and emerging policy and design standards for projects of this type, such that radical decarbonisation or net zero is achieved well before 2050. A project with negligible effects provides GHG performance that is well 'ahead of the curve' for the trajectory towards net zero and has minimal residual emissions.
Beneficial	Net GHG impacts are below zero and it causes a reduction in atmospheric GHG concentration, whether directly or indirectly, compared to the without-project baseline. A project with beneficial effects substantially exceeds net zero requirements with a positive climate impact.

31. The effect significance of the Bellrock WFDA's GHG emissions is firstly evaluated for each phase of the Wind Farm Infrastructure.
32. For the construction phase (for the purpose of the assessment, this includes site preparation works), the magnitude of emissions is compared to the UK's 5th and 6th Carbon Budgets (2028 to 2032 and 2033 to 2037, respectively), and Scotland's 1st, 2nd and 3rd Carbon Budgets (2026 to 2030, 2031 to 2035 and 2036 to 2040, respectively). Significance is then determined by evaluating whether the Wind Farm Infrastructure would affect the UK's and Scotland's ability to meet future Carbon Budgets and, by proxy, the emission reduction needed to achieve its international climate commitments and its long-term net zero target.

33. For the O&M and decommissioning phases, the Wind Farm Infrastructure's operational lifetime extends beyond the latest year of the UK and Scotland's Carbon Budgets, and 2050, the year which the UK commits to achieving net zero. Therefore, effect significance for these phases is determined by considering the Wind Farm Infrastructure's effects on the UK's and Scotland's ability to achieve and maintain their net zero status in the long-term. The O&M phase is expected to commence in 2038, therefore the first five years of the Wind Farm Infrastructure's O&M phase aligns with the UK's 7th Carbon Budget (2038 to 2042), and the first eight years aligns with Scotland's 3rd and 4th Carbon Budget periods (2036 to 2040 and 2041 to 2045, respectively). GHG emissions over these budget periods have also been compared to provide further context.
34. In addition to evaluating effect significance by project phase, overall effect significance is also determined by considering the Wind Farm Infrastructure's whole lifecycle emissions. Total emissions released across the lifecycle of the Wind Farm Infrastructure, and the avoided emissions enabled by its implementation are considered together to evaluate the net contribution to climate change.
35. Likely significant effects identified in the GHG assessment as major/moderate adverse or beneficial are deemed to be significant in EIA terms. Whilst only one level of significance criteria is provided where there is a net reduction in emissions, further context on the avoided emissions and the associated carbon benefits is provided in the assessment.

17.4.1.2 Blue Carbon Assessment

36. The main threat to long-term carbon storage is disturbance to sediment top layers. Resuspension of sediment allows rapid consumption of buried carbon by organisms, reducing the carbon burial rate and blue carbon storage. The assessment has therefore been undertaken to assess the effects of the Wind Farm Infrastructure on blue carbon habitats and sediments, including:
- Direct blue carbon benthic habitat loss/disturbance as a result of the Wind Farm Infrastructure; and
 - Direct blue carbon loss through the release of CO₂ from disturbed sediments.

17.4.1.2.1 Blue Carbon Habitats – Assessment Methodology

37. The assessment for blue carbon habitats evaluates the potential loss of carbon sequestering or donating habitats associated with each phase of the Wind Farm Infrastructure. The assessment builds upon the methodology and results presented in **Chapter 7: Benthic Ecology (Volume II)** and **Appendix 7.2: Benthic Characterisation Report (Volume IV)** and focuses on the potential impact of the Wind Farm Infrastructure on identified blue carbon habitats.
38. The assessment was informed by data in the Marine Life Information Network (MarLIN) database, which offers comprehensive data on UK marine species and habitats. It provides detailed information on species distribution, sensitivity, and ecology, which helps assess the impacts of offshore activities. Information presented in **Appendix 7.2: Benthic Characterisation Report (Volume IV)** provides details on the sediment types identified in the Bellrock WFDA. Sediment types are compared to literature that evaluates Scotland's sedimentary carbon stocks (Smeaton *et. al*, 2020) to identify potential blue carbon habitats.

17.4.1.2.1.1 Definitions of Sensitivity and Magnitude

39. The assessment combines the sensitivity of each identified blue carbon habitat (the receptors) with the impact magnitude to determine the overall significance of effect. Sensitivity and magnitude criteria have been derived using professional judgement and the MarLIN database, as detailed in **Table 17.6** and **Table 17.7**.
40. The sensitivity of a receptor is a function of its capacity to accommodate change and reflects its ability to recover if it is affected, and is defined by the following factors:
- Adaptability – the degree to which a receptor can avoid, adapt to or recover from an effect;
 - Tolerance – the ability of a receptor to accommodate temporary or permanent change; and
 - Recoverability – the temporal scale over and extent to which a receptor will recover following an effect.

Table 17.6: Definition of Sensitivity Levels for the Blue Carbon Assessment

Sensitivity	Definition
High	Receptor has very limited or no capacity to accommodate physical or chemical changes or influences, with a low ability to recover or adapt. The receptor has a very high carbon stock or sequestration rates.
Medium	Receptor has a limited or low capacity to accommodate physical or chemical changes or influences, with a low ability to recover or adapt. The receptor has a moderate carbon stock or sequestration rates.
Low	Receptor has a limited tolerance to accommodate physical or chemical changes or influences or will be able to recover or adapt. The receptor has a low carbon stock or sequestration rates.
Negligible	Receptor is generally tolerant of and can accommodate physical or chemical changes or influences, without the need to recover or adapt. The receptor has a negligible carbon stock or sequestration rates.

41. The magnitude and probability of an impact occurring is established through consideration of:
- Scale or spatial extent (small scale to large scale or a few individuals to most of the population);
 - Duration (short term to long term);
 - Likelihood of impact occurring;
 - Frequency; and
 - Nature of change relative to the baseline.

Table 17.7: Definition of the Magnitude Levels for the Blue Carbon Assessment

Value	Definition
High	The impact occurs over a large spatial extent, resulting in widespread, long-term, or permanent changes in baseline conditions. It is very likely to occur and/or will occur at a high frequency or intensity, leading to the loss of resource and/or quality of the resource and permanent or irreplaceable change, which is likely to occur.
Medium	The impact occurs over a local to medium extent with a short- to medium-term change to baseline conditions. It is likely to occur at a moderate frequency or intensity, leading to a minor loss of, or alteration to, a resource and/or quality of the resource. This results in a long-term but reversible change, that is likely to occur.
Low	The impact is localised and short-term, leading to a detectable change in baseline conditions or a noticeable effect on a small proportion of a receptor population. It is unlikely to occur or may occur at a low frequency or intensity, resulting in a very minor loss of, or alteration to, a resource and/or quality of the resource. This causes a noticeable short- to medium-term but reversible change, that could possibly occur.
Negligible	The impact is highly localised and short-term, with full rapid recovery expected, resulting in very slight or imperceptible changes to baseline conditions. It is very unlikely to occur; if it does, it will be at a very low frequency or intensity. This leads to a temporary or intermittent very minor loss of, or alteration to, a resource and/or quality of the resource. The change is short-term, intermittent, and reversible, and is unlikely to occur.
No change	No measurable or discernible change from baseline conditions. The impact does not result in any alteration to the receptor.

42. The magnitude levels for assessment on blue carbon habitats are determined based on the impacts assessed in **Chapter 7: Benthic Ecology (Volume II)**.

17.4.1.2.1.2 Effect Significance

43. The potential significance of an effect defined in **Table 17.9**, is determined by combining the predicted magnitude of the impact with the sensitivity of the receptor presented in **Table 17.8**, as defined in Table 5.7 and Table 5.8, respectively, of **Chapter 5: EIA Methodology (Volume II)**. Where the matrix identifies a significance level that falls between levels, the final determination of significance is made using professional judgement based on context-specific factors. Impacts are considered to be significant in the context of EIA regulations if they are assessed as 'moderate' or above.

Table 17.8: Blue Carbon Impact Assessment Matrix

Receptor Sensitivity	Magnitude of Impact				
	High	Medium	Low	Negligible	No Change
High	Major	Major/Moderate	Moderate	Minor	No effect
Medium	Moderate/Major	Moderate	Minor/Moderate	Minor/ Negligible	No effect
Low	Moderate	Minor/ Moderate	Minor	Negligible	No effect
Negligible	Minor/Moderate	Minor/ Negligible	Negligible	Negligible	No effect

Table 17.9: 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.
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.

17.4.1.2.2 Blue Carbon Loss – Assessment Methodology

44. The assessment also identifies and, where possible, quantifies the blue carbon stock that may be lost or disturbed as a result of the installation of Wind Farm Infrastructure.
45. The calculations for the release of blue carbon from disturbed sediments have been undertaken using a combination of publicly available data and scientific literature (i.e. Smeaton et al. 2021a) and (Smeaton et al. 2021b).
46. For sediment carbon content calculations, organic carbon (OC) content data was extracted from Smeaton et al. (2021b) and overlaid with the location of the Bellrock WFDA. Further information on this database is provided in **Section 17.6.2**. Not all disturbed blue carbon reserves have remineralisation potential; therefore, a conservative approach was adopted, which assumes 100% of disturbed sedimentary OC ends up as a CO₂ flow to the atmosphere, and that the total area of the Bellrock WFDA would be disturbed. It is not appropriate to convert inorganic carbon to units of CO_{2e}, as inorganic carbon in blue carbon ecosystems is not readily released as CO₂ to the atmosphere during ecosystem degradation (Turrell et al. 2023). Therefore, only the release of OC in sediments in the Bellrock WFDA was considered in the assessment.
47. Utilising the data from Smeaton et al. (2021b), an estimate for the mass of OC within the surficial sediments (top 10 cm) of the Bellrock WFDA was calculated. Geographic Information System (GIS) carbon data from Smeaton et al. (2021b) was extracted and overlaid with the Bellrock WFDA boundaries. The data was then clipped, and the total OC values summed to calculate the blue carbon stock in the Bellrock WFDA.
48. Blue carbon loss is estimated by calculating the total amount of OC in the top 10 cm of sediment, within areas of seabed take associated with the Wind Farm Infrastructure and disturbance caused by construction and O&M activities. While it is likely that there will be additional disturbance to carbon buried deeper than 10 cm, most available data that has been collected in relation to blue carbon stocks is for the top 10 cm of sediment.

49. The areas of seabed take associated with the Wind Farm Infrastructure and disturbance caused by construction and O&M activities are summarised in **Table 17.17**. Further details of the specific infrastructure and activities during construction and O&M are provided in **Table 7.15** of **Chapter 7: Benthic Ecology (Volume II)**.
50. The receptor for the assessment is the global atmosphere. Therefore, the same significance criteria as the GHG assessment (**Section 17.4.1.1.2**) was adopted for the loss of blue carbon through sediment disturbance. Blue carbon is not currently represented in the UK GHG inventory (CCC, 2025a). The loss of blue carbon is therefore compared to the carbon stocks in the surficial sediments of Scotland as presented in **Section 17.6.2.1.1**, in place of the Carbon Budgets.

17.4.2 Cumulative Effects Assessment Methodology

17.4.2.1 Greenhouse Gases and Blue Carbon Loss

51. Due to the nature of the receptor, the global atmosphere, the CEA for the GHG assessment and blue carbon loss assessment differs from the general approach to the CEA presented in **Chapter 5: EIA Methodology (Volume II)**. All developments which emit, avoid or sequester GHG emissions affect global atmospheric concentrations irrespective of their location. Therefore, the effects of GHG emissions arising from or avoided by the Bellrock WFDA and the Bellrock Project are global and cumulative by nature. This is taken into account in defining the receptor sensitivity of the global atmosphere as 'high'. The IEMA guidance (2022) states that the cumulative effects of GHG emissions from other plans and projects should therefore not be individually assessed, as there is no basis for selecting which plan or project to assess cumulatively over any other. Therefore, no additional consideration of cumulative effects is required for the GHG assessment or blue carbon loss assessment.

17.4.2.2 Blue Carbon

52. The CEA will consider the impacts arising from the Wind Farm Infrastructure and associated activities with the Bellrock WFDA, as well as cumulatively with other relevant plans, projects and activities (including the Bellrock OFTDA). The general approach to the CEA includes identifying potential cumulative effects, identifying a short list of plans and projects for consideration and evaluating the significance of cumulative effects. **Chapter 5: EIA Methodology (Volume II)** provides further details on the general approach to the CEA. The CEA for the blue carbon assessment is undertaken in line with this approach, drawing on **Chapter 7: Benthic Ecology (Volume II)**.

17.4.3 Transboundary Effects Assessment Methodology

53. The transboundary effect assessment considers the potential for effects to occur within the Exclusive Economic Zone (EEZ) of other European Economic Area (EEA) member states, or other interests of EEA member states.
54. As noted above in relation to the CEA, the receptor for the GHG assessment is the global atmosphere, and therefore GHG emissions have an indirect transboundary effect. As GHG emissions are assessed in context of the UK and Scotland Carbon Budgets and long-term net zero targets, and therefore, aspirations to reduce emissions in line with international climate agreements, the Wind Farm Infrastructure's effects on the climate commitments of other EEA

Member States are inherently considered in the GHG assessment. In addition, it is likely that some of the emission activities considered in the assessment, such as embodied carbon in materials, and the movement of marine vessels, will take place outside of the UK's territorial boundary. Emission values have however been contextualised in relation to the UK and Scotland's emission reduction targets, and therefore the assessment is inherently transboundary in nature.

55. Similarly, any loss of blue carbon will impact the global atmosphere receptor and will also have an indirect transboundary effect.
56. For benthic ecology, there is no potential for impacts on transboundary receptors, and therefore, transboundary effects are scoped out. This has been agreed with MD-LOT (see Table 7.2 of **Chapter 7: Benthic Ecology (Volume II)**) as part of the Scoping Opinion (**Appendix 1.2 (Volume IV)**). Therefore, transboundary effects for the blue carbon habitats assessment have also been scoped out.

17.4.4 Whole Project Assessment

57. The infrastructure included as part of the indicative scenario considered in the whole project assessment has been detailed in **Table 17.10**. As the EIA applications for the OfTDA and OnTDA progress and additional information becomes available, the whole project assessment will be updated with more recent and accurate information which will be presented in the applications for the OfTDA and the OnTDA. It is noted that at the time of this assessment, a Scoping Report is not available for either the OfTDA or the OnTDA, therefore the information available to inform this whole project assessment is limited.

Table 17.10: Whole Project Assessment Scenario

Area	Infrastructure	Comments and Rationale
Whole Project Assessment		
OfTDA	<ul style="list-style-type: none"> ▪ Up to six offshore substations¹; ▪ Up to two reactive compensation stations; ▪ Maximum length of total offshore export cabling: 1,200 km (up to six cables of 200 km length each); and ▪ Maximum length of interconnector cables: 125 km (up to five cables of 25 km length each). 	Based on the indicative information provided by the Applicant and estimates available at the time of the assessment, to be confirmed in the Bellrock OfTDA EIA Report.
OnTDA	<ul style="list-style-type: none"> ▪ One onshore substation; and ▪ Onshore export cable route of up to 30 km length (up to six cable trenches), including associated temporary construction compounds, site accesses and trenchless crossing points. 	All onshore components are assumed to account for 5% of total whole project emissions, based on indicative details available for the Onshore Transmission Infrastructure, proxy information from previous projects and professional judgement, to be confirmed in the Bellrock OnTDA EIA Report.
<p>Notes:</p> <p>¹ Offshore substations will be consented as part of the OfTDA and will be assessed as part of the Bellrock OfTDA EIA Report. The OfTDA is also considered within the Bellrock WFDA EIA's cumulative effects assessments.</p>		

17.5 Scope of the Assessment

17.5.1 Study Area

17.5.1.1 Greenhouse Gas Assessment

58. All GHG emissions will affect the same receptor, the global atmosphere, as opposed to directly affecting any specific local receptor. Emissions which are released or avoided due to the Wind Farm Infrastructure will have the same global effect on atmospheric GHG concentration, and its net effect on climate change regardless of where they occur, therefore the study area of the GHG assessment is not geographically defined (IEMA, 2022).
59. The scope of the Bellrock WFDA GHG assessment includes quantifying direct and indirect GHG emissions arising from the Wind Farm Infrastructure over its full lifecycle: site preparation works, construction (including 'upstream' emissions associated with embodied carbon from materials used to construct the Wind Farm Infrastructure), O&M and decommissioning. As the Bellrock Project will supply renewable energy to the National Electricity Transmission System (NETS), the GHG assessment also accounts for emissions avoided from the displacement of electricity which would have otherwise been generated from an alternative source. Downstream emissions beyond the provision of the UK NETS are outside of the system boundary for the assessment, as there are no prescribed end users of electricity generated by the Bellrock Project. Therefore, emissions associated with activities from the consumption of any electricity generated by the Bellrock Project have not been considered in the assessment.
60. The study area for the Bellrock WFDA GHG assessment therefore encompasses GHG emitting activities across each phase, including carbon benefits beyond the infrastructure system, such as avoided emissions from exported electricity.

17.5.1.2 Blue Carbon Assessment

61. The study area for the blue carbon assessment is limited to the boundary of the Bellrock WFDA. The Bellrock OfTDA and Bellrock OnTDA are outside the scope of this blue carbon assessment and will be considered separately (within their respective EIA Reports) where applicable.
62. The blue carbon assessment considers the following:
- The impact of the Wind Farm Infrastructure on blue carbon habitats; and
 - The release of emissions associated with the disturbance of sediments resulting in the release of blue carbon.
63. The Bellrock WFDA defines the study area for the blue carbon assessment. The Bellrock WFDA covers 280 km² (**Figure 1.1 in Volume III**) and is located 120 km east of Stonehaven, and 116 km southeast of Peterhead.

17.5.2 Data and Information Sources

64. **Table 17.11** sets out the key desk-based information and data sources that have been used to inform the GHG assessment.

Table 17.11: Key Data and Information Sources for Climate Change

Dataset	Year(s)	Description
GHG Assessment		
Department for Energy Security and Net Zero's (DESNZ) Greenhouse Gas Reporting Conversion Factors	2025	Emission factors suitable for UK-based operations for various activities such as fuel consumption.
DESNZ's Digest of UK Energy Statistics	2025	Up-to-date statistics for the UK power sector, including the operational GHG intensity of each fuel or generation source and load factors for renewable electricity generation.
CCC's UK Carbon Budgets	Various, most recent publication in 2025	National Carbon Budgets used to contextualise the Wind Farm Infrastructure's GHG emissions.
CCC's Scotland Carbon Budgets	2025	Scotland Carbon Budgets used to contextualise the Wind Farm Infrastructure's GHG emissions.
CCC's Reducing the UK's Carbon Footprint Report	2013	Estimated lifecycle carbon intensity of various forms of electricity generation.
Inventory of Carbon and Energy (ICE) Database v4.0	2024	Emission factors for embodied carbon in materials used during construction and replacement or repair activities.
Dolan and Heath, Life Cycle Greenhouse Gas Emissions of Utility Scale Wind Power	2012	GHG emission benchmarks for offshore wind projects to inform assumptions used in the GHG assessment regarding the likely contribution of emission sources to the Wind Farm Infrastructure's GHG footprint.
Thompson and Harrison, Life Cycle Costs and Carbon Emissions of Offshore Wind Power	2015	
DESNZ's UK Territorial Greenhouse Gas Emissions National Statistics	2023	Estimates of annual GHG emissions from activities occurring within the UK's borders.
Scottish Greenhouse Gas and Energy Statistics (Scottish government, 2023b)	2023	Statistical publications relating to energy and GHG emissions in Scotland.
Blue Carbon Assessment		
The Scottish Parliament and Scottish Natural Heritage's Blue Carbon Reports	Various	Research on the blue carbon potential of Scotland's coastal and marine environment, including the carbon sequestration rate by habitats.

Dataset	Year(s)	Description
NatureScot (previously Scottish Natural Heritage) (Cunningham & Hunt, 2023)	Various	Scottish Blue Carbon – a literature review of the current evidence for Scotland’s blue carbon habitats.
NatureScot (previously Scottish Natural Heritage) (Burrows, et al. 2014)	2014	Assessment of Carbon Budgets and potential blue carbon stores in Scotland's coastal and marine environment.
NatureScot (previously Scottish Natural Heritage) (Burrows, et al. 2017)	2017	Assessment of Blue Carbon Resources in Scotland's Inshore Marine Protected Area Network.
The Wildlife Trusts, World Wide Fund, and the RSPB (Burrows, et al. 2024)	2024	The United Kingdom’s Blue Carbon inventory: Assessment of Marine Carbon Storage and Sequestration Potential in UK Seas (Including Within Marine Protected Areas).
Scottish Government (Smeaton, et al. 2017)	2017	Re-Evaluating Scotland’s Sedimentary Carbon Stocks.
Smeaton et al. (Smeaton, et al. 2021a)	2021	Marine Sedimentary Carbon Stocks of the United Kingdom's EEZ.
Smeaton et al. (Smeaton, et al. 2021b)	2021	Supporting documentation: Sediment type and surficial sedimentary carbon stocks across the United Kingdom’s EEZ and the territorial waters of the Isle of Man and the Channel Islands.

17.5.2.1 Site-specific Surveys

65. No site-specific surveys have been undertaken for the GHG assessment. This is because receptor information and data related to these assessments are readily collected through desktop study, consultation with relevant stakeholders, and is currently available due to suitable data throughout the east Scotland region.
66. The blue carbon assessment was informed by the **Chapter 7: Benthic Ecology (Volume II)**; specifically, the benthic habitat and sediment results as presented in **Appendix 7.3: Benthic Characterisation Report (Volume IV)**. The survey was conducted in 2023 to characterise the benthic environment of the Bellrock WFDA, including grab sampling, water and sediment eDNA sampling, and seabed imagery. This allowed species abundance, richness, diversity, sediment composition and habitat type to be characterised across the benthos for the Bellrock WFDA.
67. This data was then supplemented by carbon figures from Smeaton et al. (2021b), which is discussed further in **Section 17.6.2.1**.

17.5.2.2 Assumptions and Limitations

68. A number of assumptions are made in the GHG assessment, as set out in **Table 17.12**. Further details on the methodology adopted to quantify GHG emissions from the Bellrock WFDA are presented in **Appendix 17.1: Greenhouse Gas Assessment Methodology (Volume IV)**.

Table 17.12: Assumptions and Limitations of the Greenhouse Gas Assessment

Assumption/Limitation	Further Detail/Discussion
Availability and quality of activity data used for GHG emission calculations	<p>Due to the maturity of the design at the time of the assessment, precise details regarding the activities that will take place during the construction, O&M, and decommissioning phases are not fully known. Where information gaps exist, conservative assumptions are made based on preliminary design information for the Bellrock WFDA or proxy information from previous projects, professional judgment and/or published literature.</p> <p>The design process is ongoing and will continue between the submission of the application and during detailed design post-consent.</p>
Lifecycle Assessment (LCA)	<p>Based on the project design envelope presented in Chapter 4: Project Description (Volume II), this assessment is considered appropriate and proportionate for the purposes of this Bellrock WFDA EIA Report. This GHG assessment should not however be considered a comprehensive, detailed LCA of the Bellrock WFDA or Bellrock Project due to limitations in fully defining the supply chain, detailed design and material and technology specifications for the Bellrock Project as might be required for a detailed LCA. Therefore, assumptions appropriate for this Bellrock WFDA EIA report and simplifications to the emission calculation methodology are made in certain areas.</p>
Lack of emission factors for future year activities, such as fuel consumption and material extraction	<p>The most recent and available emissions factors are used in the assessment, which likely provides a precautionary assessment, as it is likely that fuel consumption and material extraction will become less carbon intensive in future years.</p>
Quantities for all materials to be used during construction were not available at the time of the assessment	<p>High volume and high embodied carbon content materials are included in the GHG assessment, and where project-specific information is not available, proxy data from other similar developments or industry benchmarks are used. Furthermore, conservative assumptions are adopted for quantities of known materials (i.e. using the maximum quantity within the design envelope of the Bellrock WFDA).</p>
Operation and maintenance emissions	<p>Many sectors are anticipated to decarbonise over the period of the operation and maintenance phase of the Bellrock WFDA, it is likely that the emissions intensity of producing materials, and the movement of marine vessels, would be less than the present day. Therefore, emissions predicted in this assessment for the operation and maintenance phase of the Bellrock WFDA and the Bellrock Project are likely to be an overestimation.</p>
Decommissioning emissions	<p>Decommissioning emissions are quantified based on an assumed percentage derived from the literature, which was considered the best available data at the time of the assessment.</p>
The recycled content of construction materials is unknown	<p>As an example, it has been assumed that all steel used on the Bellrock Project is virgin steel to provide a conservative assessment of emissions. It is however likely that materials that will be used in construction will have a high recycled content, and thus a lower embodied carbon content than has been assumed in this assessment.</p>

Assumption/Limitation	Further Detail/Discussion
Electricity displaced by the Bellrock Project would otherwise be generated using natural gas with carbon capture (Scenario 1)	This assumption is used to determine the Bellrock Project's avoided emissions from the supply of renewable energy to the UK electricity transmission network. This aligns with national energy policies, which is further explained in Section 17.6.3.1 .
Uncertainty regarding the remineralisation potential for the potentially disturbed sediment in the blue carbon assessment	As not all disturbed blue carbon reserves have remineralisation potential, a worst-case scenario has been adopted, which assumes that 100% of disturbed sedimentary carbon ends up as CO ₂ flow to the atmosphere.
Blue carbon loss during construction and O&M phases	The blue carbon assessment assumes that, where the same area is affected by activities in the O&M phase as in the construction phase, any disturbed surficial sediments have recovered and re-accumulated carbon stocks by the time the impact occurs during the O&M phase. This is unlikely given the long timescales required for accumulation (see Section 17.6), however given the uncertainties in the specific areas of disturbance, this assumption has been adopted to ensure a worst-case estimate of CO ₂ flow to the atmosphere.
Whole project assessment	As stated in Section 17.4.4 , as the Offshore Transmission Infrastructure and Onshore Transmission Infrastructure is subject to separate consent applications and separate EIA Reports, the whole project assessment is undertaken using indicative information provided by the Applicant and estimates available at the time of this assessment, and professional judgement. This is considered appropriate given the early development stage of the OFTDA and OnTDA.

17.6 Existing Environment

17.6.1 Greenhouse Gases

69. As discussed in **Chapter 14: Marine Infrastructure and Other Users (Volume II)**, oil and gas operations within the UK territorial waters are managed through awarding of licence blocks that enable licensees to explore areas of seabed. There are five licensed blocks that overlap with the Bellrock WFDA, however there are no oil or gas fields located within the Bellrock WFDA, and no overlap with any existing or decommissioned oil and gas infrastructure. As such, there is unlikely to be significant activity taking place within the Bellrock WFDA that is resulting in GHG emissions.
70. In accordance with IEMA's guidance (2022), if a project is situated in an area which currently has no development or significant activity, the current baseline can be considered to have zero GHG emissions.

17.6.2 Blue Carbon

71. Blue Carbon is the term for carbon captured by the world's ocean and coastal ecosystems (NOAA, n.d.). The International Union for Conservation of Nature (IUCN) defines blue carbon as "*carbon stored in coastal and marine ecosystems*" (IUCN, 2017). The Scottish Blue Carbon Forum sets out

a broad definition of blue carbon (Scottish Blue Carbon Forum, n.d.) as “the carbon captured and stored in marine and coastal ecosystems that accumulates over long timescales through natural processes.”

72. Plants, calcifying organisms, and sediments store and sequester carbon over short-term and long-term periods, with disturbances to sediment top layers posing a major threat. A carbon stock or store is the quantity of carbon held in a habitat at any given time, and the rate at which the carbon is stored is known as the carbon sequestration rate.

17.6.2.1 Blue Carbon Habitats

73. A total of three European Nature Information System (EUNIS) defined habitats were determined to be present from the sedimentary data available in **Appendix 7.3: Benthic Characterisation Report (Volume IV)** undertaken within the survey area (**Section 17.5.2.1**). The EUNIS habitat classification is a comprehensive system to facilitate the description and collection of data across Europe, through the use of criteria for habitat identification.
74. The three EUNIS broad-scale habitat (BSH) classification groups which were identified were ‘A5.2 – Sand and Muddy Sand’, ‘A5.3 – Mud and Sandy Mud’ and ‘A5.4 – Mixed Sediment’, all of which are identified as areas that support blue carbon storage or sequestration based on the sediment type, presented along with their corresponding Joint Nature Conservation Committee (JNCC) classification in **Table 17.13** (see **Appendix 7.3: Benthic Characterisation Report (Volume IV)**).

Table 17.13: Identified Blue Carbon Benthic Habitats Within the Bellrock WFDA

EUNIS Classification	JNCC Classification	Distribution
A5.272 <i>Owenia fusiformis</i> and <i>Amphiura filiformis</i> in deep circalittoral sand or muddy sand	SS.SSa.OSa.OfusAfil <i>Owenia fusiformis</i> and <i>Amphiura filiformis</i> in offshore circalittoral sand or muddy sand	This habitat was observed at 91 of the 113 grab sampling stations.
A5.371 <i>Ampharete falcata</i> turf with <i>Parvicardium ovale</i> on cohesive muddy sediment near margins of deep stratified seas	SS.SMu.OMu.AfalPpin <i>Ampharete falcata</i> turf with <i>Parvicardium pinnulatum</i> on cohesive muddy sediment near margins of deep stratified seas	Part of a mosaic habitat observed at 7 stations with high mud content.
A5.376 <i>Paramphinome jeffreysii</i> , <i>Thyasira</i> spp., and <i>Amphiura filiformis</i> in offshore circalittoral sandy mud	SS.SMu.OMu.PjefThyAfil <i>Paramphinome jeffreysii</i> , <i>Thyasira</i> spp. and <i>Amphiura filiformis</i> in offshore circalittoral sandy mud	
Notes: Additionally, four more areas of the habitats A5.371/A5.376 were identified based on acoustic data alone, though confidence in these data are low due to the lack of ground-truthing data. These habitats were therefore discounted from the assessment. See Appendix 7.3: Benthic Characterisation Report (Volume IV) for full details.		

75. The majority of the Bellrock WFDA is characterised by sandy sediments (A5.272), representing the offshore subtidal sands and gravels Priority Marine Features (PMF) habitat. Small areas of mud in deeper waters were characterised as the mosaic habitat of A5.371 and A5.376. In the eastern reaches of the Bellrock WFDA, this mosaic habitat overlapped with areas of burrowed mud, suggesting a combination of the PMF habitats burrowed mud and offshore deep sea muds.
76. A Particle Size Distribution (PSD) analysis was undertaken which involved a total of 113 sediment samples. Classification was undertaken using the Folk triangle (Folk, 1954) and then converted to BSH Type (EUNIS Level 3) using the adapted Folk triangle (Long, 2006). The sediments across the survey area were heterogeneous, with sand dominating across all stations and variable contributions of mud and gravel. Out of the 113 sampling stations:
- 103 stations represented **A5.2 (Sand and Muddy Sand)**, including Sand (S), Muddy Sand (mS), Slightly Gravelly Muddy Sand ((g)mS), and Slightly Gravelly Sand ((g)S);
 - Six stations represented **A5.3 (Mud and Sandy Mud)**, including mS, and;
 - Four stations represented **A5.4 (Mixed Sediment)**, including gmS.
77. For continental shelf sediments, those highest in sand or gravel content generally have the lowest OC content, and those with larger quantities of mud have the highest. For example, gravelly sand has an OC concentration of 0.32%, whereas mud has an OC concentration of 1.10% (Smeaton et al. 2021).
78. Given these habitats were identified as areas that support blue carbon storage or sequestration, they were taken for assessment in the blue carbon assessment.

17.6.2.1.1 Organic Carbon Storage in Sediments

79. Smeaton et al. (2021a) provided updated figures on marine sedimentary carbon stocks of the UK's EEZ in 2021, which are the most up to date figures on carbon stored within Scottish marine sediments. As part of this study, a bespoke seabed map of sediment types was devised, based on a modified Folk classification scheme (Folk, 1954) (Kaskela, et al. 2019).
80. The results of the spatial mapping in Smeaton et al. (2021a) revealed distinct differences in the national and regional sedimentary composition of the UK EEZ. Sand is the dominant sediment type within the UK EEZ. After sand, muddy sediments constitute a large proportion of the seabed, with approximately 75% of all muddy sediments within the UK EEZ being located within Scottish waters.
81. The surficial sediments of Scotland (457,926 km²) store 382.6 ± 34.2 Mt OC, which is largely as a result of the abundant OC-rich, muddy sediments in Scottish waters. The OC held within Scotland's sediment represent approximately 64% of the total held within the UK EEZ as shown in **Table 17.14**, derived from Smeaton et al. (2021a).

Table 17.14: Organic Carbon Stock in Scotland’s EEZ Surficial Sediments

	Slope and Deep Sea	Fjords	Coastal & Inshore	Outer Shelf	Scotland Total	Percentage of UK Stock
Average OC stock [Mt] ± standard deviation	186.41 ± 20.05	3.92 ± 0.55	41.68 ± 5.05	150.63 ± 8.56	382.64 ± 34.21	64%

17.6.3 Predicted Future Baseline

17.6.3.1 Greenhouse Gas Assessment

82. To help determine the significance and contextualise the outcomes of the assessment, the derivation of a baseline or a BaU scenario, which assumes the Wind Farm Infrastructure is not constructed, is required.
83. The UK’s electricity generation mix is made up from energy generated from a number of different sources, including gas, nuclear, onshore and offshore wind, bioenergy, solar and hydroelectric. It is however recognised that the growth of renewable energy is key to achieving both Scotland’s and the UK’s Energy Strategy and net-zero targets.
84. Therefore, two BaU scenarios for the GHG assessment are established on the basis of likely forms of electricity generation during the operational and maintenance phase of the Bellrock Project, in accordance with adopted energy and climate policies. These policies include the adoption of renewable energy to replace fossil fuel sources, such as NPF4, the UK Net Zero Strategy 2021 and British Energy Security Strategy, 2022.
- Scenario 1 assumes that the electricity generated by the Wind Farm Infrastructure would otherwise be generated using natural gas. The approach used by RenewableUK (2024) to calculate avoided emissions uses the operational GHG intensity of electricity generated using “all non-renewable fuels” (i.e., 448 tonnes CO₂ per Gigawatt hour (GWh) electricity (DESNZ, 2025e)). However, the operational GHG intensity of electricity generated by natural gas is lower (382 tonnes CO₂ per GWh electricity) (DESNZ, 2025e), which provides a more conservative assessment of the emissions avoided by the Wind Farm Infrastructure. Therefore, to evaluate the impact of the Bellrock Project, it is assumed that the electricity produced displaces generation from ‘natural gas’ sources, as this is the most common form of new fossil fuel generation plants (DESNZ, 2025d). It is recognised that all new combustion power stations (at or above 300 MW) need to be constructed Carbon Capture Ready. Therefore, it was assumed that the natural gas generating sources were equipped with Carbon Capture and Storage (CCS); and
 - Scenario 2 assumes that the electricity generated by the Wind Farm Infrastructure would have otherwise been generated using all forms of generation sources considered as part of the future NETS mix, including renewables such as offshore wind energy, represented by the long-run marginal emission factors (DESNZ, 2023). The long-run marginal factor accounts for the adoption of renewable energy schemes such as the Bellrock Project becoming fully operational and decarbonising the UK’ electricity generation mix. Furthermore, the long-run marginal factor

is derived from modelling using a Dynamic Dispatch Model to analyse the impact of power sector decarbonisation. It is therefore indicative of what the future electricity mix may look like rather than being a prescriptive forecast.

85. The consideration of Scenario 1 is in line with the UK energy policy, which requires a step change in the decarbonisation of the UK's energy system, and to “*decarbonise by switching from fossil fuels to low carbon electricity*” (DESNZ, 2026). It is noted however that this approach uses a static emission factor and does not account for future UK electricity generation mix decarbonisation.
86. The model scenarios utilised in Scenario 2 are subject to a level of uncertainty, influenced by the pace of innovation in the market, technological feasibility, demand levels and investment decisions (DESNZ, 2023b). These uncertainties increase into the 2030s and 2040s, which covers a portion of the time when the Bellrock Project would be operational. Scenario 2 is inconsistent with policy and energy transition (or at least contains an internal circularity), as it presents a situation whereby renewable energy generated by the Bellrock Project is displacing future generation from renewable sources, and for that future generation to be from renewable sources, then projects such as the Bellrock Project need to be developed. This approach is therefore considered to be highly conservative, as the decline in GHG intensity of electricity evident under this scenario, accounts for growth in renewables such as the Bellrock Project becoming operational.
87. To determine the level of avoided emissions, the anticipated electricity produced by the Bellrock Project, both annually and over the 35-year operational and maintenance phase, has been quantified in accordance with the approach outlined in The Carbon Trust's guidance (The Carbon Trust, 2024). This method is similar to the approach advocated in RenewableUK (2024) for offshore wind farms. **Equation 1** and
88. **Equation 2** provide the methodology for quantifying the net electricity generated by the Bellrock Project over its lifetime and delivered to the UK's NETS.

Equation 1:

$$\begin{aligned} & \text{Energy produced per year (MWh)} \\ & = \text{Installed Capacity (MW)} \times 8,760 \text{ (hours per year)} \times \text{Capacity Factor (\%)} \end{aligned}$$

Equation 2:

$$\begin{aligned} & \text{Energy produced over lifetime (MWh)} \\ & = \text{Electricity produced per year (MWh)} \times 35 \text{ years (lifetime)} \end{aligned}$$

89. In accordance with **Equation 1** and **Equation 2**, the total electricity generated by the Bellrock Project is predicted to be:

$$\begin{aligned} & \text{Electricity produced per year:} \\ & 1,800 \text{ MW} \times 8,760 \text{ hours} \times 39.2\% = 6,181,056 \text{ MWh} \end{aligned}$$

$$\begin{aligned} & \text{Electricity produced over lifetime:} \\ & 6,181,056 \times 35 \text{ years} = 216,336,960 \text{ MWh} \end{aligned}$$

90. For the purposes of the assessment, the capacity factor for the Bellrock WTGs is anticipated to be 39.2%. This is based on the average annual capacity factor from the years 2022 to 2024 for all existing offshore wind farm projects in the United Kingdom (DESNZ, 2025a). This is a conservative approach, as the current portfolio of offshore wind farms in the UK includes those commissioned up to 20 years ago. There have been significant technological and design improvements since the first offshore wind farms in the UK were established, which means that the capacity factor for the Bellrock Project is likely to be higher than this figure.
91. GHG emissions produced from the generation of electricity in the BaU scenarios are presented in **Table 17.15**. This has been quantified by multiplying the proportion of anticipated electricity generated by the Bellrock WTGs by the estimated CO₂ emission under the BaU scenarios, that is, from gas supplied electricity (Scenario 1) or using the long-run marginal factors (Scenario 2). The emission factor used under Scenario 1 was derived from the Net Zero Teesside project, as this reflects the operational emissions intensity (i.e. excluding construction and decommissioning GHG emissions) of a recently consented gas-fired power plant (20.7 kg CO₂e per MWh electricity) (Net Zero Teesside Power Limited, 2021). This is a precautionary approach, which assumes a 95% carbon capture efficiency rate for all operating gas-fired power plants in the UK over the O&M phase of the Bellrock Project.
92. It should be noted that this emission factor represents the use of gas at source and is not representative of lifecycle emissions which would include the extraction, processing and transportation of gas to a power station.

Table 17.15: BaU Predicted Future Baseline – GHG Emissions

Timeframe	Anticipated Energy Produced by the Bellrock Project (GWh)	Scenario 1: GHG Emissions from Electricity Generated by Natural Gas with CCS (Tonnes CO ₂ e)	Scenario 2: GHG Emissions from Electricity Generated from Long-run Marginal Factor (Tonnes CO ₂ e)
Per year	6,181	127,948	Variable – average over 35 years: 15,718
Lifetime of Bellrock Project (35 years)	216,337	4,478,175	550,114

17.6.3.2 Blue Carbon Assessment

93. It is not anticipated that the future blue carbon baseline within the Bellrock WFDA with respect to carbon storage and sequestration would differ when compared to the current baseline. Sediment accumulation rates within the study area are likely to be low (Diesing et. al, 2021), therefore it is unlikely that there would be any significant changes (positive or negative) to the blue carbon habitats or stocks in the future baseline in absence of the Wind Farm Infrastructure. Therefore, the future baseline in relation to the blue carbon assessment is assumed to remain the same as the current baseline discussed in **Section 17.6.2**.

17.7 Potential Impacts

17.7.1 Scope

94. **Table 17.16** sets out the impacts that have been scoped in to and out of the Bellrock WFDA EIA Report, in line with the Scoping Opinion (**Appendix 1.2: Bellrock WFDA Scoping Opinion in Volume IV**).

Table 17.16: Potential Impacts Scoped In and Out of the EIA for the GHG Assessment

Potential Impact	Construction	Operation and Maintenance	Decommissioning
	Advised within the Bellrock WFDA Scoping Opinion		
Whole lifecycle GHG impacts	✓	✓	✓
Blue carbon	✓	✓	✓
Transboundary impacts	x	x	x

17.7.2 Realistic Worst-case Scenario

95. The final design of the Wind Farm Infrastructure will be confirmed during detailed design phase, post-consent. To inform a robust and precautionary impact assessment, the realistic worst-case design scenario has been defined. Realistic worst-case scenarios (i.e., those that have the potential to cause the greatest impact) are derived from the project design envelope 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.
96. The realistic worst-case scenario for the GHG assessment is summarised in **Table 17.17** below. These are based on the project design as described in **Chapter 4: Project Description (Volume II)**. Details of the individual components and activities that constitutes the total area of disturbance and habitat loss during construction and O&M are provided in **Table 7.15** of **Chapter 7: Benthic Ecology (Volume II)**.

Table 17.17: Realistic Worst-case Scenario for Impacts on Climate Change

Impact	Realistic Worst-case Scenario	Rationale
Construction		
GHG emissions	<p>Indicative construction phase: 2031 to 2037 (total construction duration of up to seven years, plus up to one year of site preparation¹ works (2030) undertaken prior to the commencement of construction). Installation of Wind Farm Infrastructure:</p> <ul style="list-style-type: none"> ▪ Up to 132 WTGs with FSSs (together termed 'floating offshore unit' (FOU)) built out to the maximum extent of the Bellrock WFDA (280 km²); ▪ A SKS for each FOU (132 in total); ▪ Up to 9 mooring lines and 9 anchors per FOU; ▪ Static IACs (on the seabed) and dynamic IACs (in the water column) (300 km total); ▪ 18 subsea cable hubs; and ▪ Scour and cable protection: 4,897,094 m³. <p>Vessels:</p> <p>Anticipated maximum duration of vessels on site at the Bellrock WFDA during site preparation and construction:</p> <ul style="list-style-type: none"> ▪ Site preparation works: 2,604 days; ▪ Pre-installation surveys: 392 days; ▪ Pre-lay grapnel run: 392 days; ▪ Anchor, mooring line and scour protection installation: 2,262 days; ▪ FOU tow and hook up: 1,424 days; ▪ IAC installation and cable burial (including post-burial survey): 1,230 days; ▪ IAC termination and testing: 966 days; ▪ WTG electrical completion: 1,932 days; ▪ Guard vessel: 4,732 days; and ▪ Subsea cable hubs: 168 days. 	<p>Based on the maximum likely number of vessels required and maximum likely number of round trips ² during construction.</p> <p>Additional details on the vessel types and vessel movements are provided in Appendix 17.1: Greenhouse Gas Assessment Methodology (Volume IV).</p>

Impact	Realistic Worst-case Scenario	Rationale
	<p>In summary:</p> <ul style="list-style-type: none"> ▪ Up to 34 vessels within the Bellrock WFDA at any one time; and ▪ Up to 816 annual helicopter round trips. 	
<p>Blue carbon habitats and loss</p>	<p>Total area of disturbance and habitat loss (temporary and permanent) = 6.57 km²</p> <ul style="list-style-type: none"> ▪ Total area of physical disturbance and temporary habitat loss = 3.64 km²; and ▪ Total area of permanent habitat loss: 2.93 km². <p>For blue carbon calculations, a worst-case scenario has been adopted, which assumes that 100% of disturbed sedimentary carbon ends up as CO₂ flow to the atmosphere.</p>	<p>The blue carbon loss relates to the total area of physical disturbance and temporary and permanent habitat loss, caused by seabed preparation and installation of infrastructure on and in the seabed, and the permanent loss of seabed habitat resulting from the continuous physical footprint of fixed infrastructure that occupies the seabed for the lifetime of the Bellrock Wind Farm Infrastructure. These areas correspond to the realistic worst case scenarios for Impact C1 and Impact O4 presented in Table 7.15 of Chapter 7: Benthic Ecology (Volume II). While Impact O4 is considered under O&M in the benthic ecology assessment, the blue carbon loss that occurs as a result of disturbance and habitat loss is assumed to occur instantaneously on installation, and has therefore been presented as part of the construction phase.</p> <p>As stated in Table 17.12 there is uncertainty regarding the remineralisation potential for the potentially disturbed sediment. Therefore, although all disturbed blue carbon reserves have remineralisation potential, a conservative estimate has been taken.</p>
<p>Operation and Maintenance</p>		
<p>GHG emissions</p>	<p>Operational life of up to 35 years for up to 132 WTGs.</p> <p>Vessels</p> <p>Maximum duration of vessels on site at the Bellrock WFDA during O&M per year:</p> <ul style="list-style-type: none"> ▪ WTG minor maintenance: 657 days; ▪ WTG major maintenance: 248 days; 	<p>Vessel movements are based on the maximum likely number of vessels required and maximum likely number of round trips during operation. Additional details on the vessel types and vessel movements are provided in Appendix 17.1: Greenhouse Gas Assessment Methodology (Volume IV).</p> <p>Helicopter movements are based on the maximum likely number of round trips required.</p>

Impact	Realistic Worst-case Scenario	Rationale
	<ul style="list-style-type: none"> ▪ BoP maintenance: 1,121 days; and ▪ IAC survey and repair: 50 days. <p>In summary:</p> <ul style="list-style-type: none"> ▪ Maximum duration of vessels on site at the Bellrock WFDA during O&M period (35 years) = (2,076 * 35 years) = 72,660 days; ▪ Maximum number of helicopters round trips during O&M: 986 per year = 34,510 total trips during 35 year operational lifetime; and ▪ Up to 21 vessels on site at any one time. 	<p>Spare parts information derived from literature is used in the absence of alternative data, and is considered the best available data at the time of the assessment.</p>
<p>Blue carbon habitats and loss</p>	<p><u>Total area of physical disturbance and temporary habitat loss: 47.46 km²</u></p> <p>For blue carbon calculations, a worst-case scenario has been adopted, which assumes that 100% of disturbed sedimentary carbon ends up as CO₂ flow to the atmosphere.</p>	<p>The blue carbon loss relates to the total area of physical disturbance and temporary habitat loss, caused by O&M activities. This area corresponds to the realistic worst case scenario for Impact O1 presented in Table 7.15 of Chapter 7: Benthic Ecology (Volume II).</p> <p>As stated in Table 17.2 there is uncertainty regarding the remineralisation potential for the potentially disturbed sediment. Therefore, although all disturbed blue carbon reserves have remineralisation potential, a conservative estimate has been taken.</p>
<p>Decommissioning</p>		
<p>GHG emissions</p>	<p>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.</p> <p>It is expected that the Bellrock Wind Farm Infrastructure will be fully removed at the end of its operational life.</p>	<p>Specific details and activity data surrounding decommissioning activities are not known at this stage. Information derived from literature is used in the absence of alternative data, and is considered the best available data at the time of the assessment. Additional details are provided in Appendix 17.1: Greenhouse Gas Assessment Methodology (Volume IV).</p>

Impact	Realistic Worst-case Scenario	Rationale
<p>Blue carbon habitats and loss</p>	<p>The removal and dismantling of the FOU will largely be a reversal of the installation process. Generally, the FOU will be towed from the Bellrock WFDA to a suitable port for decommissioning.</p> <p>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.</p> <p>Subsea cable hubs are expected to be fully removed from the seabed.</p> <p>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.</p> <p>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.</p>	<p>The detail and scope of the decommissioning works would be determined by the relevant legislation and guidance at the time.</p> <p>Decommissioning impacts are related to removal of infrastructure on or within the seabed, such as anchors, IACs, subsea cable hubs, and scour and cable protection. It is anticipated that decommissioning impacts would be equal to or lesser than those of construction.</p>
<p>Notes:</p> <p>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.</p> <p>² One round trip comprises two movements (i.e. one to and one from the Bellrock WFDA).</p>		

17.7.3 Embedded Mitigation Measures

97. This section outlines the embedded mitigation relevant to the GHG assessment (as shown in **Table 17.18** below). Where additional mitigation measures are proposed, these are detailed in the impact assessment (**Section 17.8**).

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Table 17.18: Embedded Mitigation Measures Relevant to Climate Change

Measure ID	Embedded Mitigation Measure(s)	Mitigation Type	Means of Implementation
WFDA-34	<p>Adherence to the following international and national regulations and guidance, namely:</p> <ul style="list-style-type: none"> ▪ 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	<p>Secured in the s.36 Consent and Marine Licence via a condition requiring a Vessel Management and Navigational Safety Plan (VMNSP) to be developed and submitted to the Scottish Ministers for approval before commencement of construction.</p> <p>An Outline VMNSP (Volume V) is submitted alongside the s.36 Consent application and Marine Licence application for the Bellrock Wind Farm Infrastructure.</p>
WFDA-47	<p>Development of, and adherence to, a Decommissioning Programme (DP).</p> <p>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.</p> <p>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.</p> <p>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.</p>	Tertiary	<p>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.</p>

Measure ID	Embedded Mitigation Measure(s)	Mitigation Type	Means of Implementation
WFDA-59	<p>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.</p>	Primary	<p>Secured in the s.36 Consent and Marine Licence via a condition requiring a Construction Method Statement (CMS) and Development Specification and Layout Plan (DSLIP) to be developed and submitted to the Scottish Ministers for approval before commencement of construction.</p>
WFDA-60	<p>Development of, and adherence to, a CMS.</p> <p>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.</p> <p>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:</p> <ul style="list-style-type: none"> ▪ Monitoring of site-specific weather and metocean conditions, including use of recognised forecasting and severe weather alert services; ▪ 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. <p>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.</p>	Tertiary	<p>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.</p>

Measure ID	Embedded Mitigation Measure(s)	Mitigation Type	Means of Implementation
WFDA-61	<p>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).</p> <p>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.</p> <p>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).</p>	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-63	<p>Should any SF₆ containing equipment be required, a gas leakage monitoring and detection system will be implemented to minimise operational leakages. In the rare event of a leakage occurring, the fault will be repaired as soon as reasonably practicable.</p> <p>The Applicant will consider SF₆-free electrical equipment during detailed design and procurement where alternatives are deemed suitable.</p>	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.
WFDA-64	<p>The Applicant will implement an Environmental Management System adhering to International Standards Organisation 14001:2015 (International Standards Organisation, 2015), which includes a requirement for the reduction of greenhouse gas emissions.</p> <p>The implementation of the Environmental Management System will support the Bellrock Project to systematically identify, manage and reduce its greenhouse gas emissions.</p>	Primary	<p>Secured in the s.36 Consent and Marine Licence via a condition requiring an Environmental Management Plan (EMP) to be developed and submitted to the Scottish Ministers for approval before commencement of construction.</p> <p>An Outline EMP (Volume V) is submitted alongside the s.36 Consent application and Marine Licence application for the Bellrock Wind Farm Infrastructure.</p>

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17.8 Assessment of Effects

98. The potential effects to climate change 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 17.4** and is based on the realistic worst-case scenarios defined in **Section 17.7.2**, with consideration of embedded mitigation measures identified in **Section 17.7.3**.

17.8.1 Greenhouse Gas Assessment

99. This section presents the GHG emissions associated with the construction, O&M and decommissioning phases of the Bellrock WFDA, as well as the whole lifecycle. The carbon benefits of the whole Bellrock Project are presented, including the quantity of the GHG emissions avoided through the supply of renewable energy to the NETS.

17.8.1.1 Sensitivity

100. All GHG emissions will affect the same receptor, the global atmosphere, as opposed to directly affecting any specific local receptor.

101. As detailed in **Section 17.5.1.1**, the global atmosphere is affected by all global sources of GHGs and is therefore considered to be of **high sensitivity** to additional emissions through all development phases.

17.8.1.2 Construction

17.8.1.2.1 Magnitude of Impact

102. The emission sources considered for the construction phase of the Wind Farm Infrastructure are detailed in this section and include lifecycle modules A0, A1, A2, A3, A4, and A5, as defined in the Carbon Trust guidance. GHG emissions are quantified in accordance with the methodology outlined in **Section 17.4.1.1** and **Appendix 17.1: Greenhouse Gas Assessment Methodology (Volume IV)**.

103. Based on the worst-case scenario outlined in **Section 17.7.2**, emissions predicted to be released during the construction phase are estimated to be approximately 4,462,851 tonnes CO₂e. Full details are presented in **Table 17.19** and are listed by lifecycle module and source group.

Table 17.19: Construction GHG Emissions

Lifecycle Module	Emission Source Group	GHG Emissions (Tonnes CO ₂ e)	Percentage of Construction Phase Emissions (%)
A0 (Site preparation works)	Marine vessels (transit)	1,120	0.03%
	Marine vessels (on site)	31,279	0.70%
A1 to A3 (Embodied Carbon)	Embodied carbon in materials	4,183,294	93.74%

Lifecycle Module	Emission Source Group	GHG Emissions (Tonnes CO ₂ e)	Percentage of Construction Phase Emissions (%)
A4 (Transportation)	Marine vessels (transit)	43,943	0.98%
	Helicopters	1,058	0.02%
A5 (Construction)	Marine vessels (on site)	202,157	4.53%
Total (over the construction phase, including site preparation works)		4,462,851	

104. Embodied carbon in material is expected to be the largest emission source during construction, contributing approximately 94% of emissions during this phase. The next largest emission source is marine vessels, comprising approximately 6% of total construction emissions.
105. The construction phase of the Wind Farm Infrastructure is due to commence in 2031 and last for a duration of seven years until end 2037 (plus up to one year of site preparation works, commencing from 2030). It would therefore fall within the UK's 5th and 6th Carbon Budget periods (2028 to 2032 and 2033 to 2037, respectively). Estimated emissions during construction would constitute around 0.26% of the 5th Carbon Budget and 0.46% of the 6th Carbon Budget, which forms a relatively small proportion, and GHG emissions during construction would occur over a short duration as a single occurrence.
106. The construction phase of the Wind Farm Infrastructure would fall within Scotland's 1st, 2nd and 3rd Carbon Budget periods (2026 to 2030, 2031 to 2035 and 2036 to 2040 respectively). Estimated emissions during construction would constitute around 2.55% of the 1st Carbon Budget, 3.54% of the 2nd Carbon Budget and 5.51% of the 3rd Carbon Budget.
107. It should be noted that some of the emission sources, particularly embodied carbon and materials, and the delivery of materials to site would take place outside of Scotland and the UK. However, all emissions associated with construction of the Wind Farm Infrastructure have been compared to the established Carbon Budgets in the UK and Scotland to provide a conservative assessment.
108. Based on their small contribution to the Carbon Budgets, GHG emissions arising from the installation of the Wind Farm Infrastructure are unlikely to adversely affect the UK's and Scotland's ability to meet future Carbon Budgets and progress towards achieving their long-term net zero targets. It should also be noted that emissions during construction are required to enable the development of the Wind Farm Infrastructure and the supply of renewable energy to decarbonise the UK electricity generation mix in the long run (see **Section 17.6.3.1**).
109. In addition, through the adoption of whole lifecycle carbon management principles and practices in line with the PAS 2080 guidance (see **Table 17.1**), which are considered as best practice in the delivery of infrastructure developments, opportunities for further reductions in GHG emissions during construction can be considered as the Wind Farm Infrastructure develops and implemented where reductions can be feasibly achieved.

17.8.1.2.2 Significance of Effect

110. Therefore, construction GHG emissions from the Wind Farm Infrastructure are considered to have a **minor adverse** effect and is **not significant** in EIA terms.

17.8.1.3 Operation and Maintenance

17.8.1.3.1 Magnitude of Impact

17.8.1.3.1.1 Emissions

111. The emission sources considered for the O&M phase of the Bellrock WFDA include lifecycle modules B1, B2, B3 and B4, as defined in the Carbon Trust guidance. GHG emissions were quantified in accordance with the methodology outlined in **Section 17.4** and **Appendix 17.1: Greenhouse Gas Assessment Methodology (Volume IV)**.
112. Based on the worst-case scenario outlined in **Section 17.7.2**, emissions predicted to be released during the O&M phase are estimated to be approximately 978,455 tonnes CO_{2e}. Full details are presented in **Table 17.20** and are listed by lifecycle module and source group.

Table 17.20: Operation and Maintenance GHG Emissions

Lifecycle Module	Emission Source Group	GHG emissions (Tonnes CO _{2e})	Percentage of Operation and Maintenance Phase Emissions (%)
B1 (Use)	SF ₆	84,200	9%
B2 (Maintenance) B3 (Repair)	Embodied carbon – spare parts	201,320	21%
B4 (Replacement)	Marine vessel movements and O&M activities	648,194	66%
	Helicopter movements	44,741	4%
Total (over the Operation and Maintenance phase)		978,455	

113. Marine vessel movements are expected to form the largest emission source during O&M, contributing approximately 66% of emissions during this phase. The next largest emission source is embodied carbon from spare parts, comprising approximately 21% of total O&M emissions.
114. While emissions from SF₆ leakage are estimated to contribute approximately 9%, it is noted that this is a worst-case scenario. As discussed in **Table 17.18** the Bellrock WFDA (and the Bellrock Project as a whole) will consider SF₆-free electrical equipment as an alternative where feasible. Where it is not feasible to use SF₆-free equipment, measures will be implemented to reduce the leakage of SF₆, which would result in a lower emissions value than that presented in **Table 17.20**.

115. The O&M phase is expected to commence in 2038, and therefore the first five years would fall within the 7th UK Carbon Budget period (2038 to 2042). O&M emissions over this period would account for 0.03% of the 7th UK Carbon Budget. Although the O&M of the Wind Farm Infrastructure would occur continually over its lifetime, the emissions form a relatively small proportion of the Carbon Budgets.
116. Similarly, the first eight years of the O&M phase would fall within Scotland's 3rd and 4th Carbon Budget periods (2036 to 2040 and 2041 to 2045 respectively). O&M emissions over this period would account for 0.17% and 0.58% of the 3rd and 4th Scottish Carbon Budgets respectively, which also represents a relatively small proportion.
117. Based on their negligible contribution to the Carbon Budgets, GHG emissions arising from the O&M of the Wind Farm Infrastructure are unlikely to adversely affect the UK's and Scotland's ability to meet future Carbon Budgets and progress towards achieving their long-term net zero target. In addition, when considering the Wind Farm Infrastructure's supply of renewable energy to the UK electricity transmission network over its operational lifetime (see **Section 17.6.3.1**), any O&M emissions released associated with the Wind Farm Infrastructure would be offset by the avoided emissions it enables.
118. In addition, similarly to the construction phase, whole lifecycle carbon management principles and practices are also applicable to O&M activities (see **Table 17.18**), which will allow opportunities for further reductions in O&M GHG emissions to be considered as the Wind Farm Infrastructure develops and implemented where reductions can be feasibly achieved.

17.8.1.3.1.2 Avoided Emissions

119. The avoided emissions phase of the Wind Farm Infrastructure include lifecycle module D2, which considers the benefits of supplying renewable energy to the UK NETS. Electricity generated by the WTGs is less GHG intensive than other forms of generation such as natural gas or alternative non-renewable energy sources considered in the future UK electricity mix, resulting in avoided emissions over the Wind Farm Infrastructure's operational lifetime.
120. **Table 17.21** presents the quantity of GHG emissions which would have otherwise been produced under the BaU scenarios (see **Section 17.6.3.1**). This figure is used to determine the level of avoided emissions as result of the Bellrock WFDA's operations, accounting for the O&M emissions released over its operational lifetime. Avoided emissions are further discussed in **Section 17.8.1.5** in the context of the whole project assessment.

Table 17.21: Avoided GHG Greenhouse Gas Emissions

Lifecycle Module D2 (Displacement of Non-renewable Electricity)	Lifetime Operation and Maintenance GHG Emissions (Tonnes CO ₂ e)	Lifetime GHG Emissions Produced under the 'BaU' Scenarios (Tonnes CO ₂ e)	Avoided Emissions (Tonnes CO ₂ e)
Scenario 1	978,455	4,478,175	3,499,720
Scenario 2		550,114	-428,341

121. Under BaU Scenario 1, assuming electricity generated by the WTGs displaces electricity that would have otherwise been generated using natural gas (fitted with CCS), approximately 3,499,720 million tonnes CO₂e would be avoided with the Bellrock WFDA in operation. In addition, the operational GHG intensity used to establish the BaU Scenario 1 (Net Zero Teesside Power Limited, 2021) does not account for emissions related to maintenance activities and the fuel supply chain. Therefore, **Table 17.21** is considered to provide a conservative assessment of the emissions avoided by the Bellrock WFDA during the operation phase. Based on the Bellrock WFDA's anticipated lifetime electricity output and O&M GHG emissions, the operational phase GHG intensity per unit of electricity generated by the Wind Farm Infrastructure is estimated to be 4.52 g CO₂e/kWh.
122. There is not predicted to be any avoided GHG emissions under BaU Scenario 2. As discussed in **Section 17.6.3.1**, Scenario 2 is considered to be highly conservative, as it calculates avoided emissions based on predictions of the future intensity of the NETS, which is forecast to decarbonise to 1.0-2.0 g CO₂e/kWh beyond 2045. This scenario inherently relies on the rollout and adoption of renewable energy sources in the UK such as the Bellrock Project, therefore there are inherent limitations associated with the use of Scenario 2. Given this, it is likely that the true value of avoided emissions would be higher.

17.8.1.3.2 Significance of Effect

123. The Bellrock WFDA would contribute to the UK meeting the projected increase in electricity demand over the years due to population and economy growth (DESNZ, 2024b), as well as ensuring the supply of renewable energy to decarbonise the energy sector and support emission reductions in other economic sectors. Given the low operational GHG intensity of the electricity generated by the Bellrock WTGs, and alignment with the UK and Scotland's energy policies, the Bellrock WFDA's operations are considered to have a **beneficial** effect, which **is significant** in EIA terms.

17.8.1.4 Decommissioning

17.8.1.4.1 Magnitude of Impact

124. The emission sources considered for the decommissioning phase of the Bellrock Wind Farm Infrastructure include lifecycle modules C1 - C4, as defined in the Carbon Trust guidance. GHG emissions were quantified in accordance with the methodology outlined in **Section 17.4.1** and **Appendix 17.1: Greenhouse Gas Assessment Methodology (Volume IV)**.
125. The final decommissioning strategy for the Wind Farm Infrastructure has not yet been decided at this stage, and a detailed quantification of GHG emissions from decommissioning activities and end-of-life processes associated with the Wind Farm Infrastructure has not been undertaken. However, decommissioning emissions are likely to arise from plant and vessels used in the disassembly of infrastructure, transport of waste to its reuse or end-of-life destinations, waste processing and disposal.
126. An industry benchmark obtained from literature (Thomson and Harrison, 2015) has therefore been used to estimate the Wind Farm Infrastructure's decommissioning emissions, which represent approximately 1.2% of the whole lifecycle emissions, as presented in **Table 17.22**.

Table 17.22: Decommissioning GHG Emissions

Lifecycle Module	Emission Source Group	GHG Emissions (Tonnes CO2e)	Percentage of Decommissioning Phase Emissions (%)
C1-C4 (Decommissioning)	Decommissioning activities and end-of-life processes	66,112	100% <i>(1.2% of total lifecycle emissions)</i>

127. It is recognised that regulatory requirements and industry best practice with respect to the decommissioning of offshore wind developments change over time. It is anticipated that a large proportion of wind farm components would be recycled, re-used or incinerated for energy recovery at the end-of-life stage, as opposed to being sent to landfill, with current estimates for wind turbine recyclability ranging from 85% to 90% (Schmid et al. 2020). There are also alternatives to decommissioning of offshore wind farms with potentially lower GHG emissions (Spyroudi et al. 2021), such as repowering and life extension strategies, that could be explored as part of determining the final decommissioning strategy for the Wind Farm Infrastructure.
128. Decommissioning GHG emissions estimated for the Wind Farm Infrastructure at this stage are likely to be an overestimate, as they do not account for high levels of economy-wide decarbonisation that would be achieved in the future, with the UK's net zero target being 2050 and Scotland's net zero target being 2045, as well as new end-of-life strategies that may become commercially available.
129. Decommissioning would result in a single occurrence of GHG emissions and is an inherent process in the lifecycle of offshore wind developments. However, as the UK and Scotland economies are likely to decarbonise over the Bellrock WFDA's operational lifetime, actual GHG emissions at the time of decommissioning are unlikely to adversely affect the UK's or Scotland's ability to maintain their net zero status in the long-term.
130. Similar to the construction phase, whole lifecycle carbon management measures are also applicable to decommissioning activities, which will allow opportunities for further reductions in decommissioning GHG emissions to be considered and implemented where they can be feasibly achieved.

17.8.1.4.2 Significance of Effect

131. Therefore, decommissioning GHG emissions from the Bellrock WFDA are considered to have a **minor adverse** effect and is **not significant** in EIA terms.

17.8.1.5 Potential Effects During the Whole Bellrock Project

132. GHG emissions associated with the whole Bellrock Project based on the information available at the time of assessment are presented in **Table 17.23**.

Table 17.23: Whole Project GHG Emissions

Project Phase	Lifecycle Phase	GHG Emissions (Tonnes CO ₂ e)	Percentage of WFDA Lifecycle Emissions (%)	Percentage of Phase Emissions (%)
WFDA (Total)	Construction	4,462,851	81.0%	-
	Operation and maintenance	978,455	17.8%	-
	Decommissioning	66,112	1.20%	-
	Sub-total	5,507,418	-	88%
OfTDA (Indicative)	N/A	467,316	N/A	7%
OnTDA (Indicative)	N/A	314,460	N/A	5%
Total		6,289,194		100%

133. The total GHG emissions resulting from the construction, O&M and decommissioning of the Wind Farm Infrastructure were estimated to be 5,507,418 tonnes CO₂e. Construction emissions contributed to the largest proportion of lifecycle emissions, accounting for 88% of the total.
134. GHG emissions resulting from the whole Bellrock Project are estimated to be 6,289,194 tonnes CO₂e. The Bellrock WFDA is expected to contribute the largest proportion to the overall emissions of the Bellrock Project, therefore it is noted that most emissions have been accounted for in the detailed GHG assessment presented in this Chapter.
135. The GHG intensity of the whole project were calculated to contextualise the outcomes of the assessment.
136. The indicative GHG intensity of electricity generated by the whole Bellrock Project was estimated to be 29.1 kg CO₂e per MWh. compares favourably with other forms of fossil fuel electricity generation (CCC, 2013), as listed below:
- Unabated Combined Cycle Gas Turbine: 380 to 500 kg CO₂e per MWh; and
 - Gas with CCS: 20 to 245 kg CO₂e per MWh.
137. The indicative GHG intensity of the Bellrock Project is based on conservative assumptions adopted to calculate emissions. While the reference project used under Scenario 1 of the future baseline scenario considers a value of 20.7 kg CO₂e per MWh electricity produced, this value considers only the operational emissions associated with the electricity generation (i.e. excluding construction and decommissioning GHG emissions), whereas the GHG intensity for the Bellrock Project considers the whole lifecycle emissions³ (i.e. including construction and decommissioning GHG

³ At the time of assessment, operational emissions related to the OnTDA and OfTDA were not available to undertake a direct comparison to the reference project used under Scenario 1.

emissions). Additionally, as discussed in **Section 17.6.3.1** the Scenario 1 reference value assumes a carbon capture rate of 95%, which is considered an optimistic carbon capture rate.

17.8.1.6 Summary of Significance of Effect

138. Overall, the Bellrock Project would enable the provision of renewable energy to the UK NETS and contribute positively to Scotland and the UK's progress in meeting their net zero targets.
139. The construction and decommissioning phases of the Wind Farm Infrastructure results in **minor adverse** effects based on conservative assumptions throughout the impact assessment, however due to the beneficial impact during O&M whereby the Bellrock Project provides 35 years of renewable energy, the overall significance of effect is considered to be **beneficial**, which is **significant** in EIA terms.

17.8.2 Blue Carbon Assessment

140. This section contains the blue carbon assessment for the Wind Farm Infrastructure. The assessment evaluates the potential impacts on blue carbon habitats, the release of stored carbon or changes to carbon sequestration rates due to the disturbance or loss of seabed habitats and sediments.

17.8.2.1 Sensitivity

17.8.2.1.1 Blue Carbon Habitats

141. The sensitivity of the blue carbon habitats was determined by consideration of the OC stores of the sediments identified in the Bellrock WFDA, as presented in **Section 17.6.2**. The assessment of sensitivity presented in **Chapter 7: Benthic Ecology (Volume II)** was also considered, which determined the blue carbon habitats to range from low to medium sensitivity to the impact of physical disturbance and increased suspended sediment. The results of the sensitivity analysis are summarised in **Table 17.24**.

Table 17.24: Sensitivity of Blue Carbon Habitats to the Disturbance of Blue Carbon

Blue Carbon Habitat	Blue Carbon Stock	Sensitivity
A5.272 <i>Owenia fusiformis</i> and <i>Amphiura filiformis</i> in deep circalittoral sand or muddy sand	Moderate (sand or muddy sand)	Medium
A5.371 <i>Ampharete falcata</i> turf with <i>Parvicardium ovale</i> on cohesive muddy sediment near margins of deep stratified seas	Moderate (muddy sediment)	Medium
A5.376 <i>Paramphinome jeffreysii</i> , <i>Thyasira spp.</i> and <i>Amphiura filiformis</i> in offshore circalittoral sandy mud	Moderate (sandy mud)	Medium

17.8.2.1.2 Blue Carbon Loss

142. As with the GHG assessment and detailed in **Section 17.5.1**, the global atmosphere is affected by all global sources of GHGs and is therefore considered to be of **high sensitivity** to additional emissions.

17.8.2.2 Construction

17.8.2.2.1 Magnitude of Impact

17.8.2.2.1.1 Blue Carbon Habitats

143. As discussed in **Chapter 7: Benthic Ecology (Volume II)**, due to the localised spatial extent of the activities, over a short duration, occurring periodically throughout the seven-year construction period, and the expected high reversibility of impacts, the magnitude of impact to the identified blue carbon habitats from the construction of the Wind Farm Infrastructure is considered to be **low**. Additionally, the embedded mitigation measures which are included in **Chapter 7: Benthic Ecology (Volume II)**, will further reduce any potential disturbance or damage. These measures include, but are not limited to, micro-siting to avoid sensitive habitats and reducing localised habitat loss. Impacts are unlikely to affect the long-term functioning of the identified blue carbon habitats.

17.8.2.2.1.2 Blue Carbon Loss

144. An estimation for the mass of carbon released from sediment disturbance during construction activities has been made using existing survey data, as shown in **Table 17.25**. The potential release of blue carbon was then determined by applying the areas of seabed disturbance, which was derived based on the worst case scenario for the construction phase (see **Table 17.17**). The results of the assessment are presented in **Table 17.25**.

Table 17.25: Blue Carbon Loss from Sediment Disturbance During Construction

	Blue Carbon Within the Bellrock WFDA (Tonnes)	Area of Disturbance to Seabed (%)	Blue Carbon Released from Disturbed Sediments (Tonnes)	CO ₂ e (Tonnes) ¹
Organic Carbon	123,426	2.34%	2,892	10,612
Notes:				
¹ The carbon stock loss for OC was multiplied by 3.67 (44/12) to convert to units of CO ₂ e, where 12 is the atomic mass of carbon and 44 is the molecular mass of CO ₂ .				

145. The assessment predicted that there could be 2,892 tonnes of OC, or 10,612 tonnes CO₂e, released from the disturbance of sediment associated with construction of the Bellrock WFDA. This is less than 0.05% of the carbon store contained within the surficial sediments in Scotland (see **Table 17.14**).

146. Due to the conservative assumptions adopted (i.e. assuming 100% of disturbed surficial sediments are liberated and end up as CO₂ flow to the atmosphere), the uncertainty around the ultimate

repository of the emitted blue carbon, and implementation of embedded mitigation measures, as summarised in **Section 17.8.2.2.1**, the Bellrock WFDA is unlikely to affect the long-term function of these sediments. In addition, the total area of disturbance and habitat loss during construction as identified in **Table 17.17** is formed by activities that do not result in permanent occupation of the seabed by infrastructure, and the seabed therefore retains the potential to recover once the activity ceases, rather than representing permanent loss of seabed habitat.

147. Given the low percentage of the total carbon store within surficial sediments in Scotland, and considering the conservative assumptions adopted, the resulting impact is considered to have negligible effects on the UK's and Scotland's trajectory towards net zero.

17.8.2.2.2 Significance of Effect

17.8.2.2.2.1 Blue Carbon Habitats

148. Based on a medium sensitivity of receptors, and low magnitude of impact, the impact assessment matrix (**Table 17.8**) indicates that the effect on blue carbon habitats during construction would be within the minor to moderate adverse range. In reaching the significance of effect conclusion, particular weight has been given to the highly localised spatial extent of activities, short duration of activities which occur periodically through the construction period, the reversibility of impacts and the application of embedded mitigation measures as noted in **Section 17.8.2.2.1** and set out in **Chapter 7: Benthic Ecology (Volume II)**. Embedded mitigation measures minimise disturbance and habitat loss, thereby reducing impacts on blue carbon habitats. The overall effect on blue carbon habitats from loss and disturbance during construction is therefore considered to be **minor adverse**, which is **not significant** in EIA terms.

17.8.2.2.2.2 Blue Carbon Loss

149. The overall effect on the loss of blue carbon from sediment disturbance during construction is considered to be **negligible**, which is **not significant** in EIA terms.

17.8.2.3 Operation and Maintenance

17.8.2.3.1 Magnitude of Impact

17.8.2.3.1.1 Blue Carbon Habitats

150. As discussed in **Chapter 7: Benthic Intertidal Ecology (Volume II)**, due to the highly localised spatial extent of the activities occurring over short durations periodically throughout the 35-year operational life of the Bellrock WFDA, the magnitude of impact to blue carbon habitats from the O&M activities is considered to be **low**. Additionally, the embedded mitigation measures which are included in **Chapter 7: Benthic Ecology (Volume II)**, will further reduce any potential disturbance or damage. Impacts are unlikely to affect the long-term functioning of the identified blue carbon habitats.

17.8.2.3.1.2 Blue Carbon Loss

151. During the O&M phase, routine activities may cause some disturbance to benthic habitats and sediments, potentially releasing stored blue carbon. However, the impact will be localised, occurring over short durations and would be infrequent throughout the 35-year operational life of

the Bellrock WFDA. An estimation of the mass of carbon released from sediment disturbance during the O&M activities has been made using existing survey data.

152. The potential release of blue carbon was determined by applying the areas of seabed disturbance, which was derived from the worst case scenario for the O&M phase (see **Section 17.7.2**). The results of the assessment are presented in **Table 17.26**.

Table 17.26: Blue Carbon Loss from Sediment Disturbance During Operation and Maintenance

	Blue Carbon within the Bellrock WFDA (Tonnes)	Area of Disturbance to Seabed (%)	Blue Carbon Released from Disturbed Sediments (Tonnes)	CO ₂ e (Tonnes) ¹
Organic Carbon	123,426	16.95	20,921	76,781
Notes:				
¹ The carbon stock loss for OC was multiplied by 44/12 to convert to units of CO ₂ e, where 12 is the atomic mass of carbon and 44 is the molecular mass of CO ₂ .				

153. The assessment predicted that there could be a total of 20,921 tonnes of OC, or 76,781 tonnes CO₂e, released from the disturbance of sediment associated with the O&M of the Bellrock WFDA, over its 35-year operational life. This is less than 0.05% of the carbon store contained within the surficial sediments in Scotland (see **Table 17.14**).
154. Due to the conservative assumptions adopted (i.e. assuming 100% of disturbed surficial sediments are liberated and end up as CO₂ flow to the atmosphere), the uncertainty around the ultimate repository of the emitted blue carbon, the localised and infrequent O&M activities, and implementation of embedded mitigation measures, outlined in **Chapter 7: Benthic Ecology (Volume II)**, the Bellrock WFDA is unlikely to affect the long-term function of these sediments. In addition, the total area of disturbance and habitat loss during O&M as identified in **Table 17.17** is formed by activities that do not result in permanent occupation of the seabed by infrastructure, and the seabed therefore retains the potential to recover once the activity ceases. Furthermore, the affected areas considered in the O&M phase may already be disturbed during the construction phase. Therefore, as noted in **Table 17.12**, this approach assumes that any surficial sediments disturbed during construction have recovered and re-accumulated carbon stocks by the time the impact occurs during the O&M phase, which is unlikely given the long timescales required for accumulation (see **Section 17.6**). This also results in a conservative estimate for blue carbon loss during the O&M of the Bellrock WFDA, that may have already been captured in the estimate for the construction phase.
155. Given the low percentage of the total carbon store within surficial sediments in Scotland, the resulting impact is considered to have negligible effects on the UK's and Scotland's trajectory towards net zero.

17.8.2.3.2 Significance of Effect

17.8.2.3.2.1 Blue Carbon Habitats

156. Based on the medium sensitivity of receptors and low magnitude of impact, the significance of impact assessment matrix (**Table 17.8**) indicates that the effect on blue carbon habitats during construction would be within the minor to moderate adverse range. As per the approach outlined for construction, in reaching the significance of effect conclusion, particular weight has been given to highly localised spatial extent of the activities, which occur periodically and infrequently over short durations throughout the 35-year operational life of the Bellrock WFDA, and the application of embedded mitigation measures as noted in **Section 17.8.2.3.1** and set out in **Chapter 7: Benthic Ecology (Volume II)**. The overall effect on blue carbon habitats from loss and disturbance during O&M of the Bellrock WFDA is considered to be **minor adverse**, which is **not significant** in EIA terms.

17.8.2.3.2.2 Blue Carbon Loss

157. The overall effect on the loss of blue carbon from sediment disturbance during O&M of the Bellrock WFDA is considered to be **negligible**, which is **not significant** in EIA terms.

17.8.2.4 Decommissioning

17.8.2.4.1 Magnitude of Impact

158. The decommissioning phase will involve the dismantling and removal of the Wind Farm Infrastructure. This process is expected to utilise advanced techniques and equipment that will minimise impacts to sediments and blue carbon habitats. The impacts and emissions from decommissioning are expected to be lower than those from the construction phase, as the process is expected to be more streamlined and less resource-intensive. However, the removal of Wind Farm Infrastructure may disturb blue carbon habitats and sediments, potentially leading to the release of stored carbon. Careful planning and execution of decommissioning activities will aim to minimise these disturbances and support the restoration of marine habitats, thereby promoting the re-sequestration of blue carbon.

159. At the time of writing, it is anticipated that the majority of Wind Farm Infrastructure will be removed (see **Table 17.17**), as per regulatory guidance. However, it is acknowledged that this plan may be updated in the future. The methodology and Decommissioning Programme area will be updated to reflect this and industry best practice at the time of decommissioning.

160. Activities associated with the Bellrock WFDA are unlikely to have an impact on the carbon sequestration potential of the immediate seabed and associated habitats. As such, in accordance with the impacts assessed on benthic habitats in **Chapter 7: Benthic Ecology (Volume II)**, the magnitude of impact on blue carbon habitats and the loss of blue carbon is considered to be **negligible** during decommissioning of the Bellrock WFDA.

17.8.2.4.2 Significance of Effect

161. The overall effect on blue carbon habitats and the loss of blue carbon during decommissioning is considered to be **negligible**, which is **not significant** in EIA terms.

17.9 Cumulative Effects Assessment

162. As noted in **Section 17.4.2**, the GHG assessment, whole project assessment and blue carbon loss assessment are considered to be inherently cumulative, and no additional consideration of specific cumulative effects with other plans or projects is required with respect to GHG emissions.
163. The projects and plans considered within the CEA for benthic ecology are presented in **Table 7.23** and **Table 7.24** of **Chapter 7: Benthic Ecology (Volume II)**, and resulted in the Bellrock OFTDA as the only project or plan screened into the CEA for all impacts. The cumulative impacts are assessed in **Section 7.9.2** of **Chapter 7: Benthic Ecology (Volume II)**, which shows there are no significant cumulative impacts anticipated as a result of each phase of the Bellrock WFDA in association with the Bellrock OFTDA. As a result, the magnitude of impact on blue carbon habitats is considered **negligible or low**, making the overall effect **minor adverse** and **not significant** in EIA terms for cumulative effects.

17.10 Inter-related and Interacting Impacts

17.10.1 Inter-relationships

164. The receptor for the GHG assessment and blue carbon loss is the global atmosphere. As there are no other topics that have a direct effect on this receptor, there are no inter-relationships with this topic.
165. The assessment on blue carbon habitats focuses on marine ecosystems and sediments that play a crucial role in carbon sequestration and storage. The health and biodiversity of ecosystems directly influence their capacity to sequester carbon, and so disturbance to these habitats can reduce their effectiveness as carbon sinks. Therefore, there are inter-related effects with **Chapter 7: Benthic Ecology (Volume II)**.
166. **Table 17.27** below provides a summary of the key inter-relationships between climate change and other technical Chapters and indicates where those issues have been addressed in the relevant chapters.

Table 17.27: Blue Carbon Inter-relationships

Topic and Description	Related Chapter(s)	Where Addressed in this Chapter	Rationale
Blue carbon habitats	Chapter 7: Benthic Ecology (Volume II)	Section 17.8.2	Ecosystems' health and biodiversity directly influence their capacity to sequester carbon and so disturbances to these habitats can reduce their effectiveness as carbon sinks. The effects in Chapter 7: Benthic Ecology (Volume II) have been considered in the blue carbon assessment, and therefore there are no further inter-related effects.

17.10.2 Interactions

167. The impacts identified and assessed in this Chapter do not have the potential to interact with each other, summarised in **Table 17.28**, **Table 17.29** and **Table 17.30** below. 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.
168. Due to the number of uncertainties regarding the release of stored carbon in sediments, the emissions total for the blue carbon assessment, reported in **Table 17.25** have not been added to the whole project GHG emissions in **Section 17.8.1.5**. The inclusion of any release of blue carbon from sediments in the whole project emissions total would not affect the outcomes of the GHG assessment.
169. 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 17.31**).

Table 17.28: Potential Interaction Between Impacts – Construction

Potential Interaction Between Construction Impacts			
Impact	C1: GHG emissions	C2: Disturbance to blue carbon habitats	C3: Loss of blue carbon
C1: GHG emissions		No	No
C2: Disturbance to blue carbon habitats	No		No
C3: Loss of blue carbon	No	No	

Table 17.29: Potential Interaction Between Impacts – Operation and Maintenance

Potential Interaction Between Operation and Maintenance Impacts			
Impact	O1: GHG emissions	O2: Disturbance to blue carbon habitats	O3: Loss of blue carbon
O1: GHG emissions		No	No
O2: Disturbance to blue carbon habitats	No		No
O3: Loss of blue carbon	No	No	

Table 17.30: Potential Interaction Between Impacts – Decommissioning

Potential Interaction Between Decommissioning Impacts			
Impact	D1: GHG emissions	D2: Disturbance to blue carbon habitats	D3: Loss of blue carbon
D1: GHG emissions		No	No
D2: Disturbance to blue carbon habitats	No		No
D3: Loss of blue carbon	No	No	

Table 17.31: Potential Interactions Between Impacts – Phase and Lifetime Assessment

Highest Significance of Effect Level					
Receptor	Construction	Operation and Maintenance	Decommissioning	Phase Assessment	Lifetime Assessment
GHG Assessment					
Global atmosphere	Minor adverse	Beneficial	Minor adverse	<p>No greater than individually assessed impact for each phase.</p> <p>The impacts are considered to have an overall beneficial effect on the receptor. It is considered that effects would not, when considered together, result in an appreciably greater impact than assessed individually.</p>	<p>No greater than individually assessed impact.</p> <p>The impacts are considered to have an overall beneficial effect on the receptor. Potential adverse impacts are non-significant, limiting the potential for different impacts to interact across the different phases.</p>
Blue Carbon Assessment					
Blue carbon habitats	Minor adverse	Minor adverse	Minor adverse	<p>No greater than individually assessed impact for each phase.</p> <p>The impacts are considered to have a minor adverse effect on the receptor. Given that each impact is localised, it is considered that effects would not, when considered together, result in appreciably greater impact than assessed individual.</p>	<p>No greater than individually assessed impact for each phase.</p> <p>As with the phase assessment, all potential impacts are non-significant and localised in nature, limiting the potential for different impacts to interact across the different phases.</p>
Global atmosphere	Negligible	Negligible	Negligible	<p>No greater than individually assessed impact for each phase.</p> <p>The impacts are considered to have a negligible adverse effect on the receptor. It is considered that effects would not, when considered together, result in appreciably greater impact than assessed individual.</p>	<p>No greater than individually assessed impact for each phase.</p> <p>As with the phase assessment, all potential impacts are non-significant, limiting the potential for different impacts to interact across the different phases.</p>

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17.11 Summary

170. **Table 17.32** presents a summary of the assessment of potential effects on climate change during the construction, O&M and decommissioning phases of the Bellrock Wind Farm Infrastructure.
171. The GHG assessment, which considers the GHG emissions associated with the Wind Farm Infrastructure and compared this to the emissions that would otherwise be generated from gas-fired power stations with CCS (Scenario 1), and the emissions that would be generated based on forecasts of the long-run marginal emissions factor (Scenario 2). Overall, it was found that while the construction and decommissioning phases of the Wind Farm Infrastructure result in minor adverse effects, due to the beneficial impact during O&M whereby the Bellrock WFDA provides 35 years of renewable energy generation, the overall significance of effect is considered to be **beneficial**, which is **significant** in EIA terms. The GHG assessment also considered emissions associated with the whole Bellrock Project and compared these outcomes to the relevant UK and Scotland's recommended Carbon Budgets. The methodology for the GHG assessment is detailed in, **Appendix 17.1 Greenhouse Gas Assessment Methodology (Volume IV)**.
172. The blue carbon assessment evaluated the impact of the Bellrock Wind Farm Infrastructure on the carbon storage or sequestration potential of the immediate seabed and associated habitats and the loss of blue carbon. The assessment has established that the Wind Farm Infrastructure would result in **minor adverse effects**, which is **not significant** in EIA terms.

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Table 17.32: Summary of Potential Effects for Climate Change

Potential Impact	Receptor(s)	Sensitivity	Magnitude of Impact	Significance of Effect	Secondary Mitigation	Residual Significance of Effect	Cumulative Residual Significance of Effect ¹
Construction							
C1: GHG emissions	Global atmosphere	High	N/A	Minor adverse (not significant)	None	Minor adverse (not significant)	N/A
C2: Disturbance to blue carbon habitats	Blue carbon habitats	High	Negligible	Negligible (not significant)	None	Negligible (not significant)	Minor adverse (not significant)
C3: Blue carbon loss	Global atmosphere	High	N/A	Negligible (not significant)	None	Negligible (not significant)	N/A
Operation and Maintenance							
O1: GHG emissions	Global atmosphere	High	N/A	Beneficial (significant)	None	Beneficial (significant)	N/A
O2: Disturbance to blue carbon habitats	Blue carbon habitats	High	Negligible	Negligible (not significant)	None	Negligible (not significant)	Minor adverse (not significant)
O3: Blue carbon loss	Global atmosphere	High	N/A	Negligible (not significant)	None	Negligible (not significant)	N/A

Potential Impact	Receptor(s)	Sensitivity	Magnitude of Impact	Significance of Effect	Secondary Mitigation	Residual Significance of Effect	Cumulative Residual Significance of Effect ¹
Decommissioning							
D1: GHG emissions	Global atmosphere	High	N/A	Minor adverse (not significant)	None	Minor adverse (not significant)	N/A
D2: Disturbance to blue carbon habitats	Blue carbon habitats	High	Negligible	Negligible (not significant)	None	Negligible (not significant)	Minor adverse (not significant)
D3: Blue carbon loss	Global atmosphere	High	N/A	Negligible (not significant)	None	Negligible (not significant)	N/A
<p>Notes:</p> <p>¹ The cumulative residual significance of effect is not applicable for GHG emissions or blue carbon loss, which are considered inherently cumulative. This is due to the nature of the global atmosphere receptor, which is impacted by all GHG emissions, regardless of the location (see Sections 17.4.1.1.1 and 17.4.2), as well as the whole project assessment approach for GHG emissions, which considers emissions from the Bellrock OfTDA and Bellrock OnTDA.</p>							

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