Environmental Impact Assessment Report
Volume 1 Chapter 32: Inter-Related Effects

MarramWind Offshore Wind Farm

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MarramWind

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32. Inter-Related Effects

32.1 Introduction

32.1.1.1 This inter-related effects Chapter of this Environmental Impact Assessment (EIA) Report presents the results of the assessment of the likely significant inter-related effects that may arise from the construction, operation and maintenance (O&M) and decommissioning of the Project. It should be read in conjunction with the project description provided in **Chapter 4: Project Description**.

32.1.1.2 Inter-related effects can be either project lifetime inter-related, or receptor led. These are described below:

- **Project-lifetime inter-related effects**: These arise through more than one stage of the Project's lifetime (construction, O&M and decommissioning) to interact to potentially create a more significant effect on a receptor than if just one stage were assessed in isolation. For example, increases in suspended sediment concentrations (SSC) across all three Project stages may have a greater significance than the effects of each Project stage considered alone.
- **Receptor-led inter-related effects**: These arise where effects interact, spatially and / or temporally, to create inter-related effects on a receptor (or group of receptors). Receptor-led effects might be short term, temporary or transient effects, or incorporate longer term effects. For example, when combined, the effects of increased noise and reduced air quality during construction could be of greater significance to a residential receptor than when considered separately.

32.1.1.3 The inter-related effects assessment does not include effects on receptors as a result of the Project and 'other developments', which are assessed within **Chapter 33: Cumulative Effects Assessment**.

32.1.1.4 The assessments presented within this Chapter have drawn upon individual chapters' relevant assessments of effects and their associated Appendices in this EIA Report, these include the following:

- **Chapter 6: Marine Geology, Oceanography and Physical Processes**;
- **Chapter 7: Marine Water and Sediment Quality**;
- **Chapter 10: Benthic, Epibenthic and Intertidal Ecology**;
- **Chapter 11: Marine Mammals**;
- **Chapter 12: Offshore and Intertidal Ornithology**;
- **Chapter 13: Fish Ecology**;
- **Chapter 14: Commercial Fisheries**;
- **Chapter 15: Shipping and Navigation**;
- **Chapter 16: Marine Archaeology and Cultural Heritage**;
- **Chapter 17: Seascape, Landscape and Visual**;
- **Chapter 18: Infrastructure and Other Marine Users**;
- **Chapter 19: Ground Conditions and Contamination**;
- **Chapter 20: Water Resources and Flood Risk**;

- **Chapter 21: Air Quality**;
- **Chapter 22: Land Use**;
- **Chapter 23: Terrestrial Ecology and Ornithology**;
- **Chapter 24: Onshore Archaeology and Cultural Heritage**;
- **Chapter 25: Onshore Noise and Vibration**;
- **Chapter 26: Traffic and Transport**;
- **Chapter 27: Landscape and Visual**;
- **Chapter 28: Climate Resilience**;
- **Chapter 29: Greenhouse Gases**;
- **Chapter 30: Socio-economics**; and
- **Chapter 31: Civil and Military Aviation**.

32.1.1.5 This Chapter describes:

- the legislation, planning policy, guidance and other documentation that has informed the assessment (**Section 32.2: Relevant legislation, policy context and technical guidance**);
- the outcome of consultation and engagement that has been undertaken to date, including how matters relating to inter-related effects have been addressed (**Section 32.3: Consultation and engagement**);
- the approach and methodology used for the inter-related assessment (**Section 32.4: Approach and methodology**);
- the assessment of inter-related effects (**Section 32.5: Assessment of effects**);
- summary of the inter-related effects (**Section 32.6: Summary of inter-related effects assessment**);
- an ecosystem-level assessment has been provided (**Section 32.7: Ecosystem-level assessment**);
- a reference list is provided in **Section 32.8: References**; and
- a glossary of terms and abbreviations is provided in **Section 32.9: Glossary of terms and abbreviations**.

32.2 Relevant legislative, policy context and technical guidance

32.2.1 Relevant legislative and policy context

32.2.1.1 This Section identifies the relevant legislation and policy context that has informed the scope of the inter-related effects assessment. Further information on policies relevant to the Environmental Impact Assessment (EIA) and their status is set out in **Chapter 2: Legislative and Policy Context**, which provides an overview of the relevant legislation and policy context for the Project. **Chapter 2: Legislative and Policy Context** is supported by **Volume 3: Appendix 2.1: Planning Policy Framework**, which provides a detailed summary of national, marine and local planning policies of relevance to the EIA. Individual

policies of specific relevance to this assessment and associated appendices have been taken into account.

32.2.1.2 This summary provides a foundation for understanding the specific requirements that this Chapter must address in terms of assessing and mitigating impacts on receptors and relevant environmental issues.

32.2.1.3 The legislation and international agreements relevant to inter-related effects include:

- Environmental Authorisations (Scotland) Regulations 2018;
- Regulation 4(2) The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017;
- Regulation 5(2) of The Marine Works (Environmental Impact Assessment) (Scotland) Regulations 2017;
- Regulation 4(2) of The Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017;
- Air Navigation Order 2016;
- The Air Quality (Scotland) Amendment Regulations 2016;
- The Rules of the Air Regulations 2015;
- Pollution Prevention and Control (Scotland) Regulations 2012 (as amended);
- Wildlife and Natural Environment (Scotland) Act 2011;
- The Marine Strategy Regulations 2010;
- Marine (Scotland) Act 2010;
- EC Directive (2009/147/EC) on the Conservation of Wild Birds (the 'Birds Directive');
- Marine and Coastal Access Act 2009;
- Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive (MSFD));
- Schedule 3 sub-paragraph 2(d) of The Marine Works (Environmental Impact Assessment) Regulations 2007;
- The European Landscape Convention 2006;
- Environmental Noise (Scotland) Regulations 2006;
- Nature Conservation (Scotland) Act 2004;
- Water Environment and Water Services (Scotland) Act 2003;
- Land Reform (Scotland) Act 2003;
- Planning (Listed Buildings and Conservation Areas) (Scotland) 1997
- Convention for the Protection of the Marine Environment of the North East Atlantic (OSPAR) 1992;
- Convention on Biological Diversity 1992;
- Electricity Act 1989;

- The Convention on the Conservation of Migratory Species of Wild Animals (the 'Bonn Convention') 1983;
- Civil Aviation 1982;
- Wildlife and Countryside Act 1981;
- The Convention on the Conservation of European Wildlife and Natural Habitats (the 'Bern Convention') 1979;
- Control of Pollution Act 1974;
- International Regulations for the Safety of Life at Sea (SOLAS) (IMO, 1974);
- Convention on International Regulations for the Prevention of Collisions at Sea (COLREGS) (International Maritime Organisation (IMO), 1972/1977); and
- Convention on Wetland of International Importance especially as Waterfowl Habitat 1971 (the 'Ramsar Convention').

32.2.1.4 The policies relevant to inter-related effects include:

- Draft Updated Sectoral Marine Plan for Offshore Wind Energy (Scottish Government, 2025a);
- Aberdeenshire Community Wealth Building Strategy and Charter for Energy Developments (Aberdeenshire Council, 2025);
- National Planning Framework 4 2023 (Scottish Government, 2023a);
- Aberdeenshire Council Natural Heritage Strategy 2019-2022 (Aberdeenshire Council, 2020); and
- Sectoral Marine Plan for Offshore Wind Energy (Scottish Government, 2020).

32.2.2 Relevant technical guidance

32.2.2.1 This assessment of inter-related effects has been informed by current best practice and technical guidance relevant to EIA in Scotland and the UK. Key technical guidance include:

- Planning Advice Note (PAN) 1/2013: Environmental Impact Assessment (Scottish Government, 2017), which outlines the principles and procedures for conducting EIAs, including the need to consider the interaction of effects across Project stages and environmental technical aspects.
- Planning Inspectorate Advice Note Nine: Rochdale Envelope (Planning Inspectorate, 2018), which provides guidance on the use of flexible project description in EIA and the importance of assessing a reasonable worst-case scenario, including the potential for inter-related effects.

32.2.2.2 In addition to these core documents, the assessment draws on aspect-specific guidance and feedback from stakeholders, particularly regarding the need for holistic, ecosystem-scale consideration of impacts. Where formal methodologies for ecosystem-level assessment are lacking, the approach has been guided by professional judgment and the latest sectoral expectations, as reflecting in recent Scoping Opinions and best practice examples.

32.2.2.3 The technical guidance referenced above ensures that the assessment of inter-related effects is robust, transparent, and aligned with current regulatory and policy expectations.

32.3 Consultation and engagement

32.3.1.1 This Section describes the consultation and stakeholder engagement undertaken on the Project in relation to inter-related effects. This also includes the outcome of and response to the Scoping Opinions (Scottish Government, 2023b; Aberdeenshire Council 2023) in relation to the inter-related effects assessment. An overview of engagement undertaken for the Project as a whole can be found in Section 5.5 of **Chapter 5: Approach to the EIA**.

32.3.1.2 A summary of the key issues raised during consultation and engagement, specific to inter-related effects is outlined in **Table 32.1**, together with how these issues have been considered in the production of this EIA Report.

Table 32.1 Stakeholder issues responses - inter-related effects

Stakeholder	Stakeholder issue ID	Date, document, forum	Stakeholder comment	How is this addressed in the EIA Report
NatureScot	130	22 March 2023, Aberdeenshire Council's Scoping Opinion (Aberdeenshire Council, 2023).	*"We advise that the EIA Report should explore fully any impacts arising from in-combination and cumulative effects with any other relevant plans or projects."*	This EIA Report addresses these environmental issues within **Chapter 32: Inter-Related Effects** and **Chapter 33: Cumulative Effects Assessment**.
NatureScot	210	29 September 2022, Scoping Workshop Meeting.	*"NatureScot asked if the Project could look at the effect that development will have on the entirety of the ecosystem as well as individual receptors. NatureScot cannot provide guidance on how to do this but NatureScot will be looking for it going forward on future projects. NatureScot also raised concern that in the past impacts can be considered in silo without addressing cascading impacts between chapters.* *On 19th April NatureScot commented "We note that this was addressed in the inter-related effects section of the EIA Scoping Report (sections 4.2.65-68) and that each topic-specific section of the report made links to other relevant sections. However, there was no unified chapter on Ecosystem Effects or similar."*	The ecosystem-level assessment is provided in **Section 32.7**
NatureScot	445	12 May 2023, Marine Directorate – Licensing Operations Team (MD-LOT) Scoping Opinion Appendix 1: Consultation Responses and Advice (Scottish	***"Ecosystem assessment*** *Increasingly, there is a need to understand potential impacts holistically at a wider ecosystem scale in addition to the standard set of discrete individual receptor assessments. This assessment should focus on potential impacts across key trophic levels particularly in relation to the availability of prey species. This will enable a better understanding of the consequences (positive or negative) of any potential changes in prey distribution and abundance from the development of the wind farm on seabird and marine mammal (and other top predator) interests and what influence this may have on population level impacts."*	The ecosystem-level assessment is provided in **Section 32.7**.

Stakeholder	Stakeholder issue ID	Date, document, forum	Stakeholder comment	How is this addressed in the EIA Report
		Government, 2023b).		
NatureScot	527	12 May 2023, MD-LOT Scoping Opinion Appendix 1: Consultation Responses and Advice (Scottish Government, 2023b).	***"Changes in prey species availability*** *More consideration is required in the EIA Report to ensure that impacts to key prey species (such as sandeel, herring, mackerel and sprat) and their habitats are considered for this development and in combination with other wind farms. As mentioned above we recognise that most EIA Reports concentrate on receptor specific impacts. However, increasingly we need to understand impacts at the ecosystem scale. Therefore, consideration across key trophic levels will enable better understanding of the consequences (positive or negative) of any potential changes in prey distribution and abundance on marine mammal (and other top predator) interests and how this may influence population level impacts. Consideration of how this loss and or disturbance may affect the recruitment of key prey (fish) species through impacts to important spawning or nursery ground habitats should also be assessed. In addition, the PrePARED (Predators and Prey Around Renewable Energy Developments) project (2024) will also assist in the understanding of predator-prey relationships in and around offshore wind farms which started in 2022 and will run for five years."*	The ecosystem-level assessment is provided in **Section 32.7**.
NatureScot	974	12 June 2025, Email.	*"Increasingly, there is a need to understand potential impacts holistically at a wider ecosystem scale in addition to the standard set of discrete individual receptor assessments. This need extends also to changes in prey species availability (such as sandeel, herring, mackerel and sprat) and their habitats. However, as we are at an early stage of requesting this be incorporated into EIAs for offshore wind developments, we understand that the lack of clear guidance and insufficient spatial data at this moment in time, makes an assessment like this challenging."*	The ecosystem-level assessment is provided in **Section 32.7**.
NatureScot	975	12 June 2025, Email.	The Project asked NatureScot - Could NatureScot provide detailed guidance or examples of best practices from other projects?	The ecosystem-level assessment is provided in **Section 32.7.**

Stakeholder	Stakeholder issue ID	Date, document, forum	Stakeholder comment	How is this addressed in the EIA Report
			"*At this early stage we are not able to share a methodology or guidance/example of how to conduct ecosystem assessments. However, we are happy with the Applicant's proposal to produce a qualitative assessment looking at HPAI, and anthropogenic activities such as fishing.* *With regards to other developers, Muir Mhòr submitted an Ecosystem Assessment as part of their EIAR. We were satisfied with the standard of their assessment, however felt that the sensitivity conclusions were too low*."	In developing the ecosystem assessment, the Project has reviewed the approaches taken by other offshore wind projects including Muir Mhòr and others. This identified that the approaches taken, and the level of detail presented has varied between projects. In the absence of a clear standard of industry best-practice, the Project has followed the approach presented to NatureScot in June 2025 and agreed to by NatureScot as confirmed via the email indicated from 12 June 2025.
NatureScot	976	12 June 2025, Email.	The Project asked NatureScot – Are there specific methodologies that NatureScot recommends for conducting ecosystem assessments in offshore wind projects? "*We are not at the stage where we can recommend a specific methodology for ecosystem assessments in offshore wind projects. However, we advise that the assessment should focus on potential impacts across key trophic levels, particularly in relation to the availability of prey species.* *A recent OFW Section 36 Application contained an ecosystem assessment as an appendix to the EIAR. This assessment focused primarily on stratification and primary producers, prey species, seabirds and marine mammals and megafauna. A baseline for each of these groups was presented, before an assessment of ecosystem level impacts from the proposed development. This assessment went on to include cumulative and inter-related effects for each identified receptor. Changing baseline and future trends were addressed within the assessment,*	The ecosystem-level assessment is provided in **Section 32.7**. In the absence of formal guidance or an established methodology for the ecosystem assessment, the Project has taken a proportional and qualitative approach that has considered key trophic levels and the availability of prey species as requested by NatureScot. This has drawn upon the conclusions of wider EIA chapters but sought to avoid repetition of inter-related cumulative effects that area already assessed in this Chapter and **Chapter 33: Cumulative**

Stakeholder	Stakeholder issue ID	Date, document, forum	Stakeholder comment	How is this addressed in the EIA Report
			including climate change, commercial fisheries, offshore wind development, INNS [Invasive Non-Native Species], pollution and HPAI. A stratification report investigating the impacts of floating turbine structures on shelf sea stratification, nutrient fluxes and primary production was also submitted to support the ecosystem assessment."	**Effects Assessment** respectively.

32.4 Approach and methodology

32.4.1 Overview

32.4.1.1 Understanding how different parts of a large project like MarramWind Offshore Wind Farm might interact is important for protecting the environment and local communities. This section looks at how the various effects of the Project, such as noise, changes to water quality, or impacts on wildlife, might combine or overlap, rather than just considering each effect on its own.

32.4.1.2 Sometimes, effects that seem small when looked at separately can add up or interact in ways that make them more important. For example, construction noise and increased traffic might each have a minor impact, but together they could cause more disturbance to people or wildlife. By carefully examining these combined effects, we can better predict and manage any risks, ensuring the Project is developed responsibly and with as little negative impact as possible.

32.4.1.3 This Section sets out the approach and methodology for the inter-related effects assessment. This scope has been developed as the Project design has evolved and responds to feedback received to date as set out in **Section 32.3**.

32.4.1.4 Inter-related effects are assessed by considering all effects on a receptor and assessing whether these effects interact spatially or temporally, resulting in inter-related effects on that receptor.

32.4.1.5 The EIA process takes a holistic approach to ensuring environmental assessments are comprehensive and assess all relevant likely significant effects upon relevant receptors. It should be noted that some elements of the assessment inherently consider inter-related effects. For example:

- **Chapter 10: Benthic, Epibenthic and Intertidal Ecology** addresses effects on benthic species and habitats arising from changes to physical processes (as described in **Chapter 6: Marine Geology, Oceanography and Physical Processes**);
- **Chapter 11: Marine Mammals** and **Chapter 12: Offshore and Intertidal Ornithology** assess the effects on marine mammal and ornithological receptors respectively, arising from potential changes in the distribution of fish (as described in **Chapter 13: Fish Ecology**);
- **Chapter 14: Commercial Fisheries** assesses the effects on commercial fisheries receptors arising from potential impacts as a result of a combination of effects, such as, suspended sediments, underwater noise, electromagnetic fields (EMF), and habitat alteration / loss (described in **Chapter 6: Marine Geology, Oceanography and Physical Processes**; **Chapter 8: Underwater Noise and Vibration**; **Chapter 9: Electromagnetic Fields**; and **Chapter 10: Benthic, Epibenthic and Intertidal Ecology** respectively; and
- **Chapter 23: Terrestrial Ecology and Ornithology** considers the potential for multiple impacts affecting particular features such as disturbance effects on faunal receptors resulting from noise and vibration, visual disturbance and lighting. Where this is the case, this is described within the chapter.

32.4.1.6 This Chapter summarises the consideration of inter-related effects on linked receptors already discussed in the specific chapters.

32.4.2 Assessment methodology

32.4.2.1 To undertake the inter-related effects assessment, the findings of the chapters have been reviewed to identify and interpret potential additional effects that may have the potential to result in a significant effect on a receptor (or group), when considered in combination, compared to individual effects acting in isolation. Where such potentially significant additional effects are identified, these are considered using expert judgement. The proposed approach is summarised in the following steps for each chapter:

- **Step 1: Review and identification** of relevant receptors from assessments undertaken for each chapter of this EIA Report. This stage involves individual assessments of the impacts on receptors throughout each stage (construction, O&M and decommissioning) for the Project;
- **Step 2: Source-pathway-receptor** identification of the potential inter-related effect receptors, along with the description and assessment of the associated pathways; and
- **Step 3: Production of a tabulated inter-related effects assessment** within this Chapter for both project-lifetime and receptor-led effects.

32.4.2.2 When combined with other impacts, effects that have no impact pathway to a receptor and / or cause no change to the baseline (for instance no impact) are unlikely to have inter-related effects, thus they can be scoped **out** from the inter-related effect assessment. However, where and impact pathway exists and impacts are assessed as negligible or greater, there is potential for interactions that could result in a significant effect when considered in combination. Inter-related effects are only considered where multiple impacts act upon the same receptor; the existence of an impact pathway alone does not constitute an inter-related effect. In such cases, professional judgment by the EIA technical team has been applied to determine whether these combined effects warrant further assessment.

32.4.2.3 In terms of project-lifetime effects, impacts that only occur in one stage of the Project (for example, just the construction stage) have no interaction potential with impacts of the same nature across multiple stages and are therefore not assessed further. Effects that may occur in the construction and decommissioning stages (but not the intermediate O&M stage) are considered to be isolated and therefore recovery between these two stages is expected. Where this situation arises, expert judgement is applied on a case-by-case basis as to whether there is a possibility of inter-related effects.

32.4.2.4 The Project is based on a three-phased approach for the installation and energisation of the Project, there is therefore the potential for construction of one phase to overlap with the operation of another phase. For example, the construction of the onshore substation in Phase 3 will take place when the onshore substations for Phase 1 and 2 are already operational. An example from the offshore environment is that the seabed preparation and offshore installation of Phase 2 and Phase 3 will take place when the wind turbine generators (WTGs) from Phase 1 are operational. Consequently, where appropriate, the inter-related assessments in **Section 32.5** will acknowledge this potential when assessing project-lifetime effects.

32.4.2.5 This assessment encompasses maximum design scenarios and implementation of any further embedded environmental measures where appropriate.

32.5 Assessment of inter-related effects

32.5.1 Overview

32.5.1.1 This Section systematically assesses the potential for inter-related effects across all environmental aspects considered in the EIA Report. For each receptor group, both project-lifetime and receptor-led inter-related effects have been evaluated, drawing on the findings of individual technical chapters and applying professional judgement.

32.5.2 Marine geology, oceanography and physical processes

32.5.2.1 For marine geology, oceanography and physical processes, a Project-lifetime inter-related effects and receptor-led inter-related effects assessment is presented in **Table 32.2**.

Table 32.2 Marine geology, oceanography and physical processes project-lifetime and receptor-led inter-related effects

Impact	Inter-related effects
Project-lifetime inter-related effects	
Potential changes to SSC, bed levels and sediment type (construction and decommissioning)	This change relates to a pathway, rather than an impact on a receptor. Accordingly, no statement is made with regards to the likelihood of significant inter-related effects. The effects of increased SSC caused by seabed disturbance will primarily occur during the construction and decommissioning stages of the Project, although some change to SSC, bed levels and sediment type may occur during the O&M stage as a result of remedial works. The Project will be delivered in phases, which are reflected in the indicative construction programme as shown in **Chapter 4: Project Description.** This is expected to result in the possibility of changes to SSC, bed levels and sediment type occurring during a construction phase overlapping (in time) with similar changes associated with O&M stage remedial works. In theory, this could potentially lead to project-lifetime inter-related effects over the phases. However, the inter-related effects of the impact over the Project lifetime are not expected to be greater than those assessed separately, either for the construction, O&M or decommissioning stage. The spatial extent of meaningful seabed disturbance and associated increase of SSC and deposition is expected to be localised, mainly within the near-field and intermediate impact zones of the activity (i.e. up to 250 metres (m) from the disturbance location).
Potential impacts to seabed morphology (construction, O&M and decommissioning)	The morphology of designated areas of seabed and the coast could theoretically be subject to Project lifetime inter-related effects, with direct seabed disturbance occurring in the construction and decommissioning stage and indirect disturbance occurring during the O&M stage due to hydrodynamic, wave and sediment transport blockage related effects. However, in all cases the extent of change is expected to be **very low** and even if combined over the Project lifetime, the magnitude of change (and therefore overall significance of effect) would be no greater than if
Potential impacts to coastal morphology (construction, O&M and decommissioning)	

Impact	Inter-related effects
	assessed in isolation. Therefore, **No Significant** Project-lifetime inter-related effects are expected.
Potential changes to the tidal regime (O&M)	This change relates to a pathway, rather than an impact on a receptor. Accordingly, no statement is made with regards to the likelihood of significant inter-related effects. Changes to the tidal, wave and sediment regime will be greatest when all Project infrastructure is in place. Although some change may occur during the construction and decommissioning stage (when the Project is partially built / decommissioned), the cumulative effects of the impact over the Project lifetime are not expected to be greater than those assessed separately.
Potential changes to the wave regime (O&M)	
Potential changes to the sediment transport regime (O&M)	
Scour (O&M)	This change relates to a pathway, rather than an impact on a receptor. Accordingly, no statement is made with regards to the likelihood of significant inter-related effects. The greatest scour footprint will likely occur when all Project infrastructure is in place. Although scour may occur during the construction and decommissioning stage (when the Project is partially built / decommissioned), the inter-related effects of the impact over the Project lifetime are not expected to be greater than those assessed separately.
Potential changes to stratification and frontal systems (O&M)	Changes to stratification will be greatest when all Project infrastructure is in place. Although some change may occur during the construction and decommissioning stage (when the Project is partially built / decommissioned), the cumulative effects of the impact over the Project lifetime are not expected to result in greater significance than those assessed separately. Therefore, **No Significant** Project lifetime inter-related effects are expected.
Receptor-led inter-related effects	
No potential inter-related receptor led effects for physical processes, as each receptor relates to one impact pathway.	

32.5.3 Marine water and sediment quality

32.5.3.1 For marine water and sediment quality, a project-lifetime inter-related effects and receptor-led inter-related effects assessment is presented in **Table 32.3**.

32.5.3.2 The majority of impacts to sediment and water quality have been assessed as negligible with minor significance (see **Chapter 7: Marine Water and Sediment Quality**). The scope for interaction of such impacts, and the generation of inter-related effects is therefore very limited.

Table 32.3 Marine water and sediment quality project-lifetime and receptor-led inter-related effects

Impact	Inter-related effects
Project-lifetime inter-related effects	
Potential changes to SSC and re-settlement (construction and decommissioning)	The effects of increased SSC caused by seabed disturbance will primarily occur during the construction and decommissioning stages of the Project. The spatial extent of meaningful seabed disturbance and associated increase of SSC and water quality is expected to be localised, mainly within the near-field and intermediate impact zones of the activity. The effects of the impact over the Project lifetime are not expected to be greater than those assessed separately.
Mobilisation of sediment associated contaminants (construction, O&M and decommissioning)	The direct and indirect disturbances of the seabed associated with the construction, O&M, and decommissioning stages of the Project may lead to the release of sediment contaminants into the water column. Suspended sediments will be briefly mobilised to the water column and where they contain contaminants, these may potentially be mobilised under certain conditions. However, baseline characterisation indicates sediment contaminant concentrations are low and not considered to be of ecological concern. Furthermore, any mobilisation events will be highly localised, short-term and rapidly diluted within the dynamic marine environment. Mobilisation events at different project stages are also temporally separated and therefore there is unlikely to be accumulative interaction. Therefore, **No Significant** project-lifetime inter-related effect is anticipated.
Receptor-led inter-related effects	
Combination of seabed disturbance during construction and release of drilling mud & cuttings on water quality (SSC)	The limited spatial extent and duration of each of these impacts is such that they do not have a greater significance than the effects considered alone. Therefore, for these impacts, **No Significant** receptor-led inter-related effects are expected.

32.5.4 Benthic, epibenthic and intertidal ecology

32.5.4.1 For benthic, epibenthic and intertidal ecology, a project-lifetime inter-related effects and receptor-led inter-related effects assessment is presented in **Table 32.4**.

32.5.4.2 Impacts related to EMF, Invasive Non-Native Species (INNS), underwater noise and vibration and introduction of hard substrate are either specific to a single stage (for example, EMF is limited to the O&M stage) or not expected to have a greater significance than the effects of each Project stage considered alone. Therefore, for these impacts, no significant Project-lifetime inter-related effects are expected.

Table 32.4 Benthic, epibenthic and intertidal ecology project-lifetime and receptor-led inter-related effects

Impact	Inter-related effects
Project-lifetime inter-related effects	
Potential increases in SSC and subsequent deposition (construction, O&M and decommissioning)	The impacts of increased SSC and deposition during the construction, O&M and decommissioning stages are expected to be short-term, intermittent and of localised extent. The interaction of this impact across construction, O&M and decommissioning stages of the development is not predicted to result in an impact of any greater significance than those assessed in the individual project stages. Impacts were assessed as being not significant in the construction, O&M and decommissioning stages. Therefore, **No Significant** project-lifetime inter-related effect is anticipated.
Potential habitat disturbance (construction, O&M and decommissioning)	The construction, O&M and decommissioning stages are expected to lead to habitat disturbance. However, these events are spatially limited and temporally separated. Given the small scale of disturbance relative to available habitat (for example, the total maximum area of temporary habitat disturbance as a result of construction activities is 8.73% of the substrate present within the Offshore Red Line Boundary), the temporal spacing between project stages, and the application of embedded environmental measures such as micro-siting. Therefore, **No Significant** project-lifetime inter-related effect is anticipated.
Mobilisation of sediment associated contaminants (construction, O&M and decommissioning)	The direct and indirect disturbances of the seabed associated with the construction, O&M and decommissioning stages of the Project may lead to the release of sediment contaminants into the water column. Suspended sediments will be briefly mobilised to the water column and where they contain contaminants, these may potentially be mobilised under certain conditions. However, baseline characterisation indicates sediment contaminant concentrations are low and not considered to be of ecological concern. Furthermore, any mobilisation events will be highly localised, short-term and rapidly diluted within the dynamic marine environment. Mobilisation events at different project stages are also temporally separated and therefore there is unlikely to be accumulative interaction. Therefore, **No Significant** inter-related effect is anticipated.
Long-term habitat loss	Long-term habitat loss will only occur during the O&M stage of the Project and therefore, **No Significant** project-lifetime inter-related effect is anticipated.
Receptor-led inter-related effects	
Combination of temporary habitat disturbance and an increase in suspended sediment and subsequent sediment deposition	When acting in combination with one another, the greatest potential for spatial and temporal interactions arising from the Project are associated with temporary habitat disturbance and an increase in suspended sediment and subsequent sediment deposition which will occur during the construction, O&M and decommissioning stages of the Project. There is potential for inter-receptor effects between trophic levels as effects on benthic species and therefore food sources change as a result of activities associated with the Project. Changes in benthic prey availability

Impact	Inter-related effects
	on marine mammals is considered in **Section 32.5.5**, for fish in **Section 32.5.7,** and for seabirds in **Section 32.5.17**. Each of the individual impacts were assessed as being **Not Significant** following the implementation of embedded environmental measures, for example, avoidance of key sensitive habitats, where known, through pre-construction surveys and micro-siting of proposed offshore Project infrastructure. As such, the significance of the receptor-led effects is not anticipated to increase beyond those already assessed.

32.5.5 Marine mammals

32.5.5.1 For marine mammals, a project-lifetime inter-related effects and receptor-led inter-related effects assessment is presented in **Table 32.5**.

32.5.5.2 Impacts related to EMF and injury or mortality from primary or secondary entanglement in lines and cables are specific to the O&M stage. Therefore, for these impacts, no significant Project-lifetime inter-related effects are expected.

Table 32.5 Marine mammals project-lifetime and receptor-led inter-related effects

Impact	Inter-related effects
Project-lifetime inter-related effects	
Potential for injury or disturbance from underwater noise (pre-construction, construction and decommissioning)	The potential for auditory injury from underwater noise could arise during the construction (for example, geophysical pre-construction surveys), unexploded ordnance (UXO) clearance, pile driving or other construction activities; Sections 11.9.2, 11.9.3, 11.9.4 and 11.9.11 within **Chapter 11: Marine Mammals**) or decommissioning stages (for example, during removal of driven piles by processes such as diamond-wire cutting or water jetting; Section 11.11.1 within **Chapter 11: Marine Mammals**). However, any instantaneous injury impact ranges will be mitigated as part of the following embedded environmental measures committed to by the Project: ● a Marine Mammal Mitigation Protocol (MMMP) with the intention to minimise the risk of injury and disturbance to marine mammals from piling, UXO clearance, and pre-construction surveys (M-032); ● an UXO management plan to mitigate any potential for UXO within the offshore construction area and also disposal once encountered (M-115); and ● an Environmental Management Plan (EMP) that includes further mitigation protocols to minimise the risk of injury to marine mammals from piling, UXO clearance, and pre-construction surveys (M-121). Measures for decommissioning activities have not yet been stipulated; however, the Project commits that the approach to decommissioning of the offshore infrastructure will be completed in line with relevant guidance and legislation at the time of decommissioning. The assessment of decommissioning impacts has been assumed to be similar to, or likely less

Impact	Inter-related effects
	than, those of the construction stage (including pre-construction) with an overall **negligible** significance of residual effect. As auditory injury is not expected during the O&M stage, there is no inter-related effect of auditory injury throughout the lifetime of the project. Underwater noise-related disturbance to marine mammals is possible throughout all stages of the Project (construction, O&M and decommissioning), resulting in a potential inter-related effect across the Project's lifetime. While some level of disturbance may persist throughout the Project's duration, the largest impact of underwater noise disturbance associated with the Project will occur from impact pile driving in the construction stage. However, additional sources of underwater noise across all stages include: ● construction stage: ▸ pre-construction surveys; ▸ UXO clearance; ▸ vessel activity; and ▸ other construction activities such as dredging and / or drilling; ● O&M stage: ▸ operational floating WTGs; and ▸ vessel activity; ● decommissioning stage: ▸ removal of structures; and ▸ vessel activity. Underwater noise during construction (including pre-construction), UXO clearance and maintenance activities will be intermittent and temporary, and no displacement or barrier effect would be expected to persist in the long term as a result of these activities. Therefore, there is considered to be a limited potential for an interaction between the underwater noise during the construction (including pre-construction), O&M and decommissioning stages to result in a greater effect than when each stage is assessed in isolation. In conclusion, the significance of the inter-related effect of injury and disturbance from underwater noise across the Project's stages is not expected to exceed the magnitude of change (and therefore overall significance of effect) would be no greater than if assessed in isolation. Therefore, **No Significant** project-lifetime inter-related effects are expected.
Potential for disturbance to marine mammals from increased vessel presence and traffic (construction, O&M and decommissioning)	The potential for impacts to marine mammals from vessel disturbance could occur at all stages of the Project, construction, O&M and decommissioning; however, these are assessed to be localised, temporary, and short-term effects and were not deemed to be significant as standalone impacts. Further, to manage and minimise these impacts, a Vessel Management and Safety Plan (VMP) (M-039) will be implemented. This plan is designed to ensure that vessel-related disturbance and injury risk remains of **negligible** to **low** magnitude. In summary, the combined inter-related effects of vessel disturbance across the various stages of the Project are not anticipated to result in a greater magnitude of change (and therefore overall significance of effect) than if each

Impact	Inter-related effects
	stage were assessed independently. As such, **No Significant** project-lifetime inter-related effects are expected.
Potential for injury to marine mammals from vessel collisions (construction, O&M and decommissioning)	The risk of marine mammal injury or mortality from collision with vessels will be present throughout the construction, O&M, and decommissioning stages of the Project. This results in a potential inter-related effect spanning the entire Project lifecycle. The Project is committed to embedded environmental measures to reduce the likelihood and frequency of vessel collisions (M-039). Given the implementation of these measures (M-039) and that the Project alone (see Sections 11.9.9, 11.10.3 and 11.11.4 of **Chapter 11: Marine Mammals**) assessment concluded that the significance of residual effect from vessel collision with marine mammals is **negligible**. In conclusion, the significance of the inter-related effects from vessel collision risk across the Project's stages is not expected to exceed the magnitude of change (and therefore overall significance of effect) would be no greater than if assessed in isolation. Therefore, **No Significant** project-lifetime inter-related effects are expected.
Potential for long term displacement / barrier effects due to offshore wind farm structures (O&M)	Potential impacts associated with displacement or barrier effects from the WTGs are limited to the O&M stage of the Project. These types of impacts will not occur during the construction (including pre-construction) or decommissioning stages. As a result, there is no potential for combined effects between these stages and the O&M stage. In assessing the O&M stage, a distinction was made between two potential sources of impact: the operational noise generated by the wind farm and the physical presence of the WTGs. However, due to the difficulty in determining whether any observed effects are primarily caused by noise or by the physical structures themselves, both factors have been considered together in the assessment to ensure a precautionary and comprehensive approach. The Project alone assessment (see Sections 11.10.5 and 11.10.7 of **Chapter 11: Marine Mammals**) concluded that the significance of both long-term displacement or barrier effects and operational noise was **Negligible** for all marine mammal species except baleen whales, for which the effect was assessed as **Minor**. Importantly, neither outcome was considered significant. Based on these findings, it is concluded that the inter-related effects, resulting from the combination of operational noise and physical presence of the WTGs, do not exceed the magnitude of change identified in the individual assessments. Therefore, the overall significance of effect remains unchanged, and **No Significant** project-lifetime inter-related effects are expected.
Potential for indirect impacts to marine mammals via changes in prey species (construction, O&M and decommissioning)	Potential indirect impacts to marine mammals via changes in prey species have been assessed across all stages of the Project (for instance, construction, O&M, and decommissioning stages). As such, there is potential for inter-related effects over the lifetime of the Project; however, chapters assessing marine mammal prey species (for example, **Chapter 10: Benthic Epibenthic and Intertidal Ecology** and **Chapter 13: Fish Ecology**) determined that there would be no likely significant effects during any stage of the Project. Therefore, the indirect impacts to marine mammals via changes in prey species was assessed as being of **negligible** significance throughout each of the construction, O&M and decommissioning stages of the Project.

Impact	Inter-related effects
	In conclusion, the significance of the inter-related effects from indirect impacts to marine mammals via changes in prey species across the Project's stages is not expected to exceed the magnitude of change (and therefore overall significance of effect) would be no greater than if assessed in isolation. Therefore, **No Significant** project-lifetime inter-related effects are expected.
Receptor-led inter-related effects	
Potential for the combination of injury and disturbance from underwater noise, the presence of vessels and the indirect impact to marine mammal via changes to prey species	The greatest potential for interaction between different impact pathways affecting marine mammal ecology occurs during the construction stage, when the most significant pressure (for instance, underwater noise during pile driving) may coincide with other stressors. This creates the highest likelihood of inter-related effects, particularly through the combined influence of underwater noise, vessel interactions, and changes to prey species. Each of these individual impacts (underwater noise, vessel presence, and changes to prey species) has been assessed as having **Negligible** to **Minor** (**Not Significant**) when considered in isolation. Although combined effects may occur, many of these activities are mutually exclusive in practice. For example, while construction activities and vessel presence within the Option Agreement Area (OAA) may occur simultaneously, their combined impact on marine mammals is not expected to exceed the significance levels already assessed. In some cases, vessel activity prior to piling may already disturb and displace marine mammals (Benhemma-Le Gall *et al.,* 2023), thereby reducing the additional disturbance they might otherwise experience from underwater noise from pile driving alone. Equally, underwater noise may displace animals from the area, limiting their exposure to vessel interactions. Many impacts assessed (for example, pre-construction surveys, UXO clearance, other construction activities) are anticipated to be intermittent, temporary, short-term and localised. Therefore, whilst there is potential for these activities to occur simultaneously, there is not expected to be potential for any significant adverse effect from these activities in combination. Furthermore, any disturbance to prey species may be offset by the concurrent displacement of both predators and prey, meaning marine mammal prey items may remain accessible in adjacent areas. However, considering the highly localised extent of these effects, the combined effect of these impacts is not expected to result in a greater effect than the assessment of these impacts in isolation. In conclusion, the significance of receptor-led inter-related effects to marine mammals is not anticipated to exceed the magnitude of change (and therefore overall significance of effect) and would be no greater than if assessed in isolation. Therefore, **No Significant** receptor-led inter-related effects are expected.

32.5.6 Offshore and intertidal ornithology

32.5.6.1 For offshore and intertidal ornithology, a project-lifetime inter-related effects and receptor-led inter-related effects assessment is presented in **Table 32.6**.

Table 32.6 Offshore and intertidal ornithology project-lifetime and receptor-led inter-related effects

Impact	Inter-related effects
Project-lifetime inter-related effects	
Indirect impacts due to effects on prey species and habitats (construction, O&M and decommissioning)	Indirect impacts due to effects on prey species and habitats during the construction, O&M and decommissioning stages are expected to be short-term and intermittent, and of localised extent. The interaction of these impacts across all stages of the development is not predicted to result in an impact of any greater significance than those assessed in the individual project stages. Impacts were assessed as being **Not Significant** project-lifetime inter-related effects are expected.
Receptor-led inter-related effects	
Combination of distributional response effects and collision risk	In accordance with NatureScot's Guidance Note 8 (NatureScot, 2023) for receptors assessed for both distributional response effects and collision risk, the impact of both effect pathways should be considered in an additive manner. With respect to the Project, both kittiwake (*Rissa tridactyla*) and gannet (*Morus Bassanus*) are assessed for both effect pathways. A quantitative assessment of these effected pathways combined is provided within Section 12.10.4 of **Chapter 12: Offshore and Intertidal Ornithology**. For both kittiwake and gannet, the effect of both impacts combined was concluded as **Not Significant**.

32.5.7 Fish ecology

32.5.7.1 For fish ecology, a project-lifetime inter-related effects and receptor-led inter-related effects assessment is presented in **Table 32.7**.

32.5.7.2 Impacts related to EMF, heat, secondary entanglement, INNS, changes in water quality, underwater noise, and introduction of hard substrate are either specific to a single stage (for example, EMF is limited to the O&M stage) or not expected to have a greater significance than the effects of each Project stage considered alone. Therefore, for these impacts no significant Project-lifetime inter-related effects are expected.

Table 32.7 Fish ecology project-lifetime and receptor-led inter-related effects

Impact	Inter-related effects
Project-lifetime inter-related effects	
Habitat loss and disturbance, increased SSC and deposition, and release of contaminants (construction, O&M and decommissioning)	Long-term and short-term impacts to the seabed and associated fish habitats during the O&M stage will occur in the same areas as construction and decommissioning. However, the majority of habitat disturbance and loss (and associated impacts, such as increased SSC and deposition) during the construction stage will be temporary and localised, with a recovery of the seabed once construction activities have ceased. The interaction of these impacts across construction, O&M and decommissioning stages of the development is not predicted to result in an impact of any greater significance than those assessed in the individual project stages. Impacts on fish receptor groups were assessed as being **Not Significant** project-lifetime inter-related effects are expected.

Impact	Inter-related effects
Receptor-led inter-related effects	
Combination of temporary habitat disturbance and an increase in SSC and subsequent sediment deposition	When acting in combination with one another, the greatest potential for spatial and temporal interactions arising from the Project are associated with temporary habitat disturbance and an increase in SSC and subsequent sediment deposition which will occur during the construction, O&M and decommissioning stages of the Project. Each of the individual impacts were assessed as being **Not Significant** following the implementation of embedded environmental measures, for example minimising adverse effects on water and sediment quality, control of turbidity during construction, minimising potential for creation of temporary barriers to fish migration, and avoidance of key sensitive habitats, where known, through pre-construction surveys and micro-siting of proposed offshore Project infrastructure. As such, the significance of the receptor-led effects is not anticipated to increase beyond those already assessed, and no receptor led inter-related effects are anticipated.
Potential impacts across key trophic levels particularly in relation to the availability of prey species	There is potential for inter-receptor effects between trophic levels as effects on prey species or food sources change as a result of activities associated with the Project. Changes in fish (prey) availability on marine mammals is considered in **Section 32.5.5** and for seabirds in **Section 32.5.6** and **Section 32.5.17**. There is potential for inter-receptor effects on larger fish predators or species reliant on benthic habitats or shellfish food sources. However, considering no significant effects are expected on benthic habitats or shellfish receptors, and no significant effects are expected on fish prey-species, negligible change in prey availability and therefore for species higher up the trophic level, inter-receptor impacts are expected to be **Not Significant**.
Reduced fishing effort within the OAA	There is potential for an effect on fish receptor groups as a result of reduced fishing effort within the OAA. The reduction in take may benefit local fish populations within the OAA, although this is likely to be negligible on wider regional populations as fishing efforts will focus elsewhere in the region. Therefore, inter-receptor impacts are expected to be **Not Significant**.

32.5.8 Commercial fisheries

32.5.8.1 For commercial fisheries, a project-lifetime inter-related effects and receptor-led inter-related effects assessment is presented in **Table 32.8**.

Table 32.8 Commercial fisheries project-lifetime and receptor-led inter-related effects

Impact	Inter-related effects
Project-lifetime inter-related effects	
Reduction in access to, or exclusion from established fishing grounds within the OAA (construction, O&M and decommissioning)	Loss or restricted access to fishing grounds is considered to be temporary during construction and decommissioning and long-term during the O&M stage. A buoyed construction area is likely to be in place around the entirety of the OAA during the construction stage, to indicate the boundary limits of the OAA for mariners and on navigational charts. While this does not create a physical barrier to vessel movements between individual buoys, the presence of buoys may discourage access up to the point of commissioning in the O&M stage when it is also assumed the entirety of the OAA will not be accessed for fishing. The effects on commercial fisheries across the Project stages for the duration of the Project are not anticipated to interact in such a way as to result in combined effects of greater significance than the assessments presented for each individual stage.
Reduction in access to, or exclusion from established fishing grounds within the offshore export cable corridor (construction, O&M and decommissioning)	
Displacement leading to gear conflict and increased fishing pressure on adjacent grounds (construction, O&M and decommissioning)	Fishing may be disrupted and displaced into other areas due to the loss of access during all stages of the Project. Similar to loss of access in the OAA, the level of displacement experienced is expected to dissipate as fishers adapt to the presence of the Project. Therefore, effects on commercial fisheries are not anticipated to interact in such a way as to result in combined effects of greater significance than the assessments presented for each individual stage.
Disturbance of commercially important fish and shellfish resources leading to displacement or disruption of fishing activity (construction, O&M and decommissioning)	Project lifetime inter-related effects are unlikely as the nature of potential impact is different during construction (underwater noise) and O&M stages (EMF, loss of habitat, and increased SSC). Temporary and long-term habitat loss that occurs across all stages is expected to be proportionally small in relation to habitat availability in the commercial fisheries regional study area. Across the Project lifetime, the effects on commercial fisheries are not anticipated to interact in such a way as to result in combined effects of greater significance than the assessments presented for each individual stage.
Increased vessel traffic associated with the Project within fishing grounds leading to interference with fishing activity (construction, O&M and decommissioning)	With the successful implementation of embedded environmental measures (for instance, issue of Notice to Mariners (NtMs)), preparation of an Outline Commercial Fisheries Mitigation, Monitoring and Communication Plan (M-048), close liaison with the local vessels (M-052), no significant effects are predicted for the construction, O&M, and decommissioning stages of the Project. The majority of vessel traffic (resulting in interference with fishing) is predicted to peak during construction and decommissioning with reduced potential for interference during the O&M stage. Therefore, across the Project lifetime, the effects on commercial fisheries are not anticipated to interact in such a way as to result in combined effects of greater significance than the assessments presented for each individual stage.
Additional transit times to alternative fishing grounds for	Impacts on transit times are expected to be highest during construction and decommissioning when areas undergoing

Impact	Inter-related effects
vessels that would otherwise fish within the Project (construction, O&M and decommissioning)	installation / decommissioning activities will be avoided. Vessels may also choose to avoid transiting through the OAA during O&M stage. Therefore, across the Project lifetime, the effects on commercial fisheries are not anticipated to interact in such a way as to result in combined effects of greater significance than the assessments presented for each individual stage.
Increased snagging risk, which could result in loss or damage to fishing gear (construction, O&M and decommissioning)	Impacts due to gear snagging may occur during the construction and O&M stages due to the presence of floating units and associated moorings and anchoring. At the end of the operational lifetime of the Project, it is expected that all structures above the seabed will be fully removed where feasible (with the possible exception of scour protection and cable protection, which may be left in situ if deemed beneficial to preserve marine habitats that have developed during the Project's lifespan). Environmental conditions and sensitivities will also be considered since removal of structures may result in greater environmental impacts in comparison to leaving in situ. However, across the Project lifetime, the effects on commercial fisheries are not anticipated to interact in such a way as to result in combined effects of greater significance than the assessments presented for each individual stage.
Receptor-led inter-related effects	
An inter-related receptor led effect may occur from the combination of the reduction in access to fishing grounds and the subsequent displacement and increased pressure on adjacent grounds	While these two effects may act together, given the proposed additional mitigation, it is considered that any inter-related effect will not be of any greater significance than those already assessed in isolation.

32.5.9 Shipping and navigation

32.5.9.1 For shipping and navigation, a project-lifetime inter-related effects and receptor-led inter-related effects assessment is presented in **Table 32.9**. No project-lifetime inter-related effects were identified. Familiarity with the presence of the Project will increase over time for third-party vessels, potentially reducing the likelihood of impacts arising as the stages progress.

Table 32.9 Shipping and navigation project-lifetime and receptor-led inter-related effects

Impact	Inter-related effects
Receptor-led inter-related effects	
Displacement of commercial fishing vessels from fishing grounds leading to increased	As noted in **Table 32.8**, a buoyed construction area is likely to be in place around the entirety of the OAA during the construction stage, to indicate the boundary limits of the OAA for mariners and on navigational charts. While this does not create a physical

Impact	Inter-related effects
collision risk with other vessel types	barrier to vessel movements between individual buoys, the presence of buoys may discourage access up to the point of commissioning in the O&M stage. The presence of the buoyed construction / decommissioning area may lead to displacement of commercial fishing vessels from fishing grounds and this may coincide with displacement from regular transits by all vessel types, resulting in increased collision risk for commercial fishing vessels. However, given that all vessels are expected to comply with the COLREGs) (International Maritime Organization (IMO), 1972/77), the effects are not anticipated to be significant. Therefore, **No Significant** receptor-led inter-related effects as expected.
Displacement of all third-party vessels leading to increased allision risk with nearby oil and gas infrastructure	The presence of the buoyed construction / decommissioning area and the OAA may result in reduced passing distances from nearby oil and gas infrastructure including the Golden Eagle oil field, which includes a surface platform and pipeline. Subsequently, there may be an increased allision risk for the platform. However, given that surface platforms in the region have statutory safety zones and vessels are already familiar with the presence of this infrastructure, the effects are not anticipated to be significant.

32.5.10 Marine archaeology and cultural heritage

32.5.10.1 No significant inter-related effects have been identified on marine archaeology and cultural heritage receptors. Although the potential exposure or burial of marine archaeology receptors from increased SSC and deposition during the construction, O&M and decommissioning stages have been identified, the interaction of these impacts across construction, O&M and decommissioning stages of the development is not predicted to result in an impact of any greater significance than those assessed in the individual project stages. Impacts were assessed as **Not Significant** in all stages.

32.5.11 Seascape, landscape and visual

32.5.11.1 The offshore components of the Project have been scoped out and would not make a significant contribution to any inter-related effects arising from the onshore elements of the Project.

32.5.12 Infrastructure and other marine users

32.5.12.1 For infrastructure and other marine users, a project-lifetime inter-related effects and receptor-led inter-related effects assessment is presented in **Table 32.10**.

Table 32.10 Infrastructure and other marine users project-lifetime and receptor-led inter-related effects

Impact	Inter-related effects
Project-lifetime inter-related effects	
Obstruction to offshore wind farms (construction, O&M and decommissioning)	The presence of the Project construction, O&M and decommissioning vessels, and installation of offshore infrastructure has the potential to be a navigational hazard to shipping associated with other offshore wind farms. This may result in the diversion of vessels when in transit. Impacts relating to vessel displacement are assessed in **Chapter 15: Shipping and Navigation**.
Obstruction to subsea cables and utilities (construction, O&M and decommissioning)	The presence of the Project construction, O&M and decommissioning vessels, and installation of offshore infrastructure has the potential to be a navigational hazard to shipping associated with subsea cables and utilities. This may result in the diversion of vessels when in transit. Impacts relating to vessel displacement are assessed in **Chapter 15: Shipping and Navigation**. Existing cables may be affected where they are crossed with the Project's offshore infrastructure. In addition, the presence of the offshore infrastructure, safety zones and passing distances may restrict access to existing cables during construction, O&M and decommissioning activities. Cable crossing proximity agreements (M-186) will be developed and implemented with each relevant cable and pipeline operator to minimise the potential for any impact. Crossing agreements will include the ability of a cable operator to access their infrastructure as far as practical during the construction and decommissioning stages and the crossing agreements will ensure close communication and planning between the affected parties to ensure minimal disruption of activities. Therefore, across the project-lifetime of the Project, the effects on infrastructure and other marine users are not anticipated to interact in such a way as to result in inter-related effects of greater significance than the assessments presented for each individual stage (see **Chapter 18: Infrastructure and Other Marine Users**).
Obstruction of licensed disposal sites (construction, O&M and decommissioning)	The presence of the Project construction, O&M and decommissioning vessels, and installation of offshore infrastructure has the potential to be a navigational hazard to shipping associated with licensed disposal sites. This may result in the diversion of vessels when in transit. Impacts relating to navigational hazards assessed in **Chapter 15: Shipping and Navigation** and **Volume 3, Appendix 15.1: Navigational Risk Assessment**.
Disturbance of UXO within identified areas or discovery of unexpected UXO (construction and decommissioning)	It is anticipated that it will be possible to avoid UXO through micro-siting / micro-routeing. However, where UXO are identified within the Offshore Red Line Boundary that cannot be avoided or pose a genuine threat to safe completion of construction works, clearance will be undertaken as necessary. Any required clearance, whilst deemed unlikely, would be subject to a separate marine licence application and associated environmental assessment to be determined by MD-LOT in consultation with relevant stakeholders. Therefore, across the lifetime of the Project, the effects on infrastructure and other marine users are not anticipated to interact in such a way as to result in inter-related effects of greater significance

Impact	Inter-related effects
	than the assessments presented for each individual stage (see **Chapter 18: Infrastructure and Other Marine Users**).
Receptor-led inter-related effects	
There is no potential for receptor-led significant inter-related effects on infrastructure and other marine users' receptors. The potential impact on each receptor are identified above, and the assessment through stages incorporates the only potential interaction on each receptor group. Cross technical aspect inter-relationships have also been considered, and these are found to be fully assessed within other relevant chapters, including **Chapter 14: Commercial Fisheries; Chapter 15: Shipping and Navigation; Chapter 30: Socio-Economics**; and **Chapter 31: Civil and Military Aviation**.	

32.5.13 Ground conditions and contamination

32.5.13.1 The assessment of potential effects of the Project on agricultural land and soils and land contamination receptors, as presented in **Chapter 19: Ground Conditions and Contamination**, has considered potential receptor-led inter-related effects. Consideration has been given to potential interactions between designated ecological sites, land contamination, soils and agricultural land, and changes to land use, with reference to the assessments in **Chapter 20: Water Resources and Flood Risk**, **Chapter 22: Land Use**, and **Chapter 23: Terrestrial Ecology and Ornithology**. This assessment is based on the implementation of the embedded environmental measures, notably M-067 in relation to compliance with Land Contamination Risk Management (Environment Agency, 2020) and M-021 in relation to compliance with the Health and Safety at Work Act. 1974 and regulations made under the Act, and the Construction (Design and Management) Regulations 2015, to protect land contamination receptors and ensure compliance with contaminated land legislation, and M-070 in relation to the implementation of an Outline Soil Management Plan included in **Volume 4: Outline Construction Environmental Management Plan** (CEMP).

32.5.13.2 Consideration of project-lifetime effects is included in the assessment in **Chapter 19: Ground Conditions and Contamination** and the cumulative effects of the impact over the Project lifetime are not expected to be greater than those assessed separately for agricultural land and soils or land contamination receptors.

32.5.13.3 The operational and maintenance, and decommissioning stage impacts have been scoped out of the assessment of soils and agriculture (see Table 19.3**, Chapter 19: Ground Conditions and Contamination**). Where effects could occur during the construction stage these are considered to be geographically discrete. Impacts were assessed as being not significant in the construction stage.

32.5.13.4 No inter-related effects of greater significance compared to the effects considered alone in **Chapter 19: Ground Conditions and Contamination** were identified for ground conditions and contamination receptors during the construction, O&M, and decommissioning stages of the Project.

32.5.14 Water resources and flood risk

32.5.14.1 The potential for project-lifetime inter-related effects on water resources and flood risk are inherently considered in **Chapter 20: Water Resources and Flood Risk**.

32.5.14.2 The assessment of potential effects of the Project on water resources and flood risk as presented in **Chapter 20: Water Resources and Flood Risk** has also considered receptor

led inter-related effects. Consideration has been given to potential interactions between ground disturbance, mobilisation of sedimentation and ground contaminants, and designated water dependent conservation sites, with reference to the assessments in **Chapter 19: Ground Conditions and Contamination** and **Chapter 23: Terrestrial Ecology, and Ornithology**.

32.5.14.3 No significant project lifetime or receptor led inter-related effects of greater significance compared to the effects considered alone were identified for water resources and flood risk receptors during the construction, O&M, and decommissioning stages of the Project. Therefore, inter-related effects are not given further consideration in this Chapter.

32.5.15 Air quality

32.5.15.1 For air quality, receptor-led inter-related effects assessment is presented in **Table 32.11**.

32.5.15.2 The operational and maintenance stage impacts have been scoped out of the assessment of air quality. Where effects could occur during the construction and decommissioning stages these are isolated and recovery between the two stages is expected. Therefore, project-lifetime inter-related effects are not given further consideration in this Chapter.

Table 32.11 Air quality project-lifetime and receptor-led inter-related effects

Impact	Inter-related effects
Receptor-led inter-related effects	
Effects on human health due to emissions from air pollutants at human receptors, such as residential properties, schools, medical facilities, prisons, and commercial properties **Loss of amenity due to dust at human receptors, such as residential properties, schools, medical facilities, prisons, and commercial properties**	The construction stage has the highest likelihood of receptor-led effects, as several activities take place during this stage. Receptor-led effects from noise, transport and air quality will likely be short term and temporary depending on works being completed in vicinity of a receptor. A commitment to implement an Outline CEMP (M-063) (see **Volume 4: Outline Construction Environmental Management Plan** for further details) and other embedded environmental measures have been considered within the individual aspect assessments, which conclude **Not Significant** effects for onshore noise and vibration, and air quality. A commitment to implement an Outline Construction Traffic Management Plan (CTMP) (M-095, M-096) (see **Volume 4: Outline Construction Traffic Management Plan** for further details), Outline CEMP (M-063) (see **Volume 4: Outline Construction Environmental Management Plan** for further details) and Outline Core Path Management Plan (CPMP) (M-094) (see **Volume 4: Outline Core Path Management Plan** for further details) has been considered within **Chapter 26: Traffic and Transport**, which concluded **Not Significant** effects for traffic and transport. Overall, some inter-related effects on residents may arise at some locations on a temporary basis. However, embedded environmental measures are designed to reduce these effects and it is considered unlikely that any inter-related effects will exceed the significance reported in the individual chapters for onshore noise and vibration, air quality, transport or landscape and visual effects.

Impact	Inter-related effects
Effects on designated ecological receptors	**Chapter 21: Air Quality** has assessed effects on ecological receptors, including the Ancient Woodland along the River Ugie, and the Rattray Head Local Nature Conservation Site, concluding with the implementation of an Outline CEMP (M-063) (see **Volume 4: Outline Construction Environmental Management Plan** for further details) and other embedded environmental measures, effects during the construction stage are **Not Significant**. Impacts have been considered further on ecological receptors, where appropriate, in **Chapter 23: Terrestrial Ecology and Ornithology,** which also conclude **Not Significant** effects. Overall, some inter-related effects on ecological receptors may arise at a temporary basis. However, embedded environmental measures are designed to reduce these effects and it is considered unlikely that any inter-related effects will exceed the significance reported in the individual chapters for air quality and terrestrial ecology and ornithology.

32.5.16 Land use

32.5.16.1 The Project's onshore infrastructure avoids settlements, open space and land used by the community that might be directly affected or severed. Fragmentation of woodland, semi-natural land or sensitive habitats is also avoided through sensitive routing of the onshore export cable corridor and the use of horizontal directional drilling (HDD) (or similar trenchless technique) to avoid disturbance of / change to land cover. In relation to trenchless crossings, HDD has been presented in the EIA. Whilst other trenchless methods are available, HDD is presented herein as it is likely to have the largest construction footprint. Development on prime agricultural land (Class 1, 2 or 3 Land Capability for Agricultural (LCA) grades) is also avoided by the Project with the aim of preserving the best quality agricultural land for its future food / biomass production capability. The main land use with potential for significant project lifetime inter-related effects and receptor-led inter-related effects is agriculture, mainly in land of LCA class 3.2, which is suitable for a mixture of arable and grazing use.

32.5.16.2 No inter-related effects of greater significance compared to the effects considered alone in **Chapter 22: Land Use** were identified for land use receptors during the construction, O&M, and decommissioning stages of the Project.

32.5.17 Terrestrial ecology and ornithology

32.5.17.1 The assessment of potential effects for terrestrial ecology and ornithology inherently considered receptor-led inter-related effects as presented in **Chapter 23: Terrestrial Ecology and Ornithology,** (with consideration of potential interactions, including inter-relationship between intersections of habitats at Mean High Water Springs (MHWS), bird species in terrestrial habitats, emissions and dust, overlap of priority habitats, disturbance of fauna from noise and vibration, designated sites, and the close association between ecological features and hydrology with **Chapter 9: Electromagnetic Fields**, **Chapter 12: Offshore and Intertidal Ornithology**, **Chapter 21: Air Quality, Chapter 25: Onshore Noise and Vibration**, **Chapter 24: Onshore Archaeology and Cultural Heritage**, **Chapter 20: Water Resources and Flood Risk,** where relevant. **Chapter 23: Terrestrial Ecology and Ornithology** has considered the inter-related effects from these chapters'

effects on the terrestrial ecology and ornithology receptors identified. No receptor-led inter-related effects were identified.

32.5.17.2 Project-lifetime inter-related effects have also been considered in **Chapter 23: Terrestrial Ecology and Ornithology** of this EIA Report. The approach taken for the terrestrial ecology and ornithology assessment has been to consider the potential effects on ecological features (taking account of the project-lifetime effects), as opposed to the outcomes of individual actions during the construction, O&M, and decommissioning stages. No significant project-lifetime effects were identified.

32.5.17.3 Therefore, project-lifetime inter-relationships on terrestrial ecology and ornithology are not considered further in this Chapter.

32.5.18 Onshore archaeology and cultural heritage

32.5.18.1 For onshore archaeology and cultural heritage, the potential for project-lifetime inter-related effects and receptor-led inter-related effects are inherently considered, where relevant, in **Chapter 24: Onshore Archaeology and Cultural Heritage**. This considered the potential interactions between onshore archaeology and cultural heritage and the following environmental aspects:

- **Chapter 16: Marine Archaeology and Cultural Heritage**;
- **Chapter 25: Onshore Noise and Vibration**; and
- **Chapter 27: Landscape and Visual**.

32.5.18.2 No inter-related effects of greater significance compared to the effects considered alone were identified for onshore archaeology and cultural heritage receptors during the construction, O&M, and decommissioning stages of the Project. As such, inter-related effects are not given further consideration in this Chapter.

32.5.19 Onshore noise and vibration

32.5.19.1 For onshore noise and vibration, a project-lifetime inter-related effects and receptor-led inter-related effects assessment are considered where relevant in is presented in **Table 32.12**. These effects consider the potential interactions between onshore noise and vibration and the following environmental aspects:

- **Chapter 21: Air Quality**;
- **Chapter 26: Traffic and Transport**; and
- **Chapter 27: Landscape and Visual**.

32.5.19.2 For onshore noise and vibration, a project-lifetime inter-related effects and receptor-led inter-related effects assessment is presented in **Table 32.12**.

Table 32.12 Onshore noise and vibration project-lifetime and receptor-led inter-related effects

Impact	Inter-related effects
Project-lifetime inter-related effects	

Impact	Inter-related effects
Combination of effects from the construction, O&M and decommissioning stage noise and vibration on residential receptors	There is the potential for project-lifetime inter-related effects due to the phasing of construction of the onshore export cable corridor and the onshore substations and the operation of the onshore substations. However, the interaction of effects across construction and O&M stages of the development are not anticipated to result in an effect of any greater significance than those assessed in the individual stages assessed as **Not Significant**. There is no potential for project-lifetime inter-related effects between the construction stage and the decommissioning stage.
Receptor-led inter-related effects	
Combination of noise and vibration, air quality, transport and visual effects on residential receptors	During the construction stage, some inter-related effects on residents may arise at some locations on a temporary basis. However, embedded environmental measures are designed to reduce these effects and it is considered unlikely that any inter-related effects will exceed the significance reported in the individual chapters for noise and vibration, air quality, transport, or visual effects. Operation and maintenance effects for noise and vibration are expected to be limited to maintenance works. This is expected to result in effects that are **Not Significant** in EIA terms, and they are unlikely to produce significant inter-related receptor-led effects. The operation of the onshore substations, with embedded measures is predicted to result in negligible noise effects and therefore no inter-related effects with landscape and visual would be anticipated. Decommissioning stage receptor-effects are expected to be broadly similar to the construction stage. Therefore, it is considered unlikely that any inter-related effects will exceed the significance reported in the individual chapters for noise and vibration, air quality, transport, or landscape and visual effects.

32.5.20 Traffic and transport

32.5.20.1 For traffic and transport, a project-lifetime inter-related effects and receptor-led inter-related effects assessment is presented in **Table 32.13**. These effects consider the potential interactions between onshore traffic and transport and the following environmental aspects:

- **Chapter 21: Air Quality**;
- **Chapter 25: Onshore Noise and Vibration**; and
- **Chapter 27: Landscape and Visual**.

Table 32.13 Traffic and transport project-lifetime and receptor-led inter-related effects

Impact	Inter-related effects
Project-lifetime inter-related effects	
Combination of effects from construction, O&M and decommissioning related traffic on road and core path users	The Project will be delivered in phases, which are reflected in the indicative construction programme as shown in **Chapter 4: Project Description**. This is expected to result in the possibility of operational traffic from an earlier phase overlapping with the construction traffic from a following phase, potentially leading to project-lifetime inter-related effects. However, based on the indicative construction programme, it is not considered that the impact from construction traffic from one phase overlapping with operational traffic from a latter phase will exceed the impact of peak construction traffic as assessed within **Chapter 26: Traffic and Transport**. Therefore, is not considered that any project-lifetime inter-related effects will exceed the significance reported within the main traffic and transport chapter, which is at worst temporary and **Minor Adverse** and therefore **Not Significant**.
Receptor-led inter-related effects	
Combination of visual, noise and air quality effects from construction traffic on road and core path users	The Project's construction stage has the highest likelihood of receptor-led effects; although, receptor-led effects are anticipated to be short term and temporary depending on works being undertaken. There is a potential for users of the road network and core paths, as a result of increased construction traffic, to experience a combination of visual, noise and air quality effects as they are considered inherently linked; however, the spatial and temporal effects vary with aspects like air quality lasting longer than temporary noise and landscape and visual effects from construction traffic movements. Effects from the above environmental aspects, notably landscape and visual and noise, are most likely to affect fear and intimidation, non-motorised user delay and non-motorised amenity impacts with these considered to be minor adverse at worst on road links with the highest sensitivity of receptors. Some aspects of these effects are already incorporated within **Chapter 26: Traffic and Transport** assessment methodology of fear and intimidation thresholds and the significance is therefore deemed similar to that identified within **Chapter 26: Traffic and Transport**. While the combined impact of the above environmental effects is considered greater on smaller roads with lower levels of traffic where receptor sensitivity is considered higher, the receptor-led inter-related effects are not expected to be significant. The implementation of embedded environmental measures such as an Outline CTMP (M-095, M-096) (see **Volume 4: Outline (CTMP** for further details), Outline CEMP (M-063) (see **Volume 4: Outline CEMP** for further details), and Outline CPMP (M-094) (see **Volume 4: Outline CPMP** for further details), is likely to result in

Impact	Inter-related effects
	inter-related effects on road users similar to that of the traffic and transport assessment, which is at worst short to medium-term and **Minor Adverse** and **Not Significant** effect on the most sensitive links within the study network.

32.5.21 Landscape and visual

32.5.21.1 For landscape and visual, the potential for project-lifetime inter-related effects and receptor-led inter-related effects are inherently considered, where relevant, in **Chapter 27: Landscape and Visual**. This considered the potential interactions between landscape and visual effects and the following environmental aspects:

- **Chapter 23: Terrestrial Ecology and Ornithology** (including Arboriculture as reported in **Volume 3, Appendix 23.10: Arboricultural Impact Assessment** – noting for example that trees are also assessed as landscape elements within the Landscape and Visual Assessment in **Chapter 27: Landscape and Visual;**
- **Chapter 24: Onshore Archaeology and Cultural Heritage** – noting for example that some heritage receptors may have a landscape character role and / or feature as tourist receptors;
- **Chapter 25: Onshore Noise and Vibration** – noting for example that sounds can also contribute to the perceptual experience of the landscape; and
- **Chapter 26: Traffic and Transport** – noting for example that moving traffic is part of the landscape baseline and this can affect the sensitivity of landscape and visual receptors to changes in movement in the landscape.

32.5.21.2 No inter-related effects of greater significance compared to the effects considered alone were identified for landscape and visual receptors during the construction, O&M, and decommissioning stages of the Project. As such, inter-related effects are not given further consideration in this Chapter.

32.5.22 Climate resilience

32.5.22.1 The impact of climate change will occur throughout the project lifetime, and the climate resilience assessment has considered the impacts for the construction, O&M and decommissioning stages. Due to the different activities and impacts occurring at each stage, there is no potential for the assessment of effects to alter should the Project lifetime stages interact.

32.5.22.2 The climate resilience assessment is different to other technical aspects reported upon in the EIA as the receptor assessed is the Project, and not receptors within the environment. As such, there are no receptor-led inter-related effects.

32.5.23 Greenhouse gases

32.5.23.1 Emissions of greenhouse gases to the atmosphere have the potential to contribute to climate change, and therefore the effects are global and cumulative in nature. This is considered in defining the receptor (the global atmosphere) as **high** sensitivity.

32.5.23.2 On this basis, inter-related effects are inherently considered, since all significant activities contributing to greenhouse gas emissions associated with the Project are accounted for in

the overall assessment (**Chapter 29: Greenhouse Gases**). No inter-related effects are therefore identified.

32.5.24 Socio-economics

32.5.24.1 The effects identified in chapters from other technical aspects which lead to effects on socio-economics effects are covered in **Chapter 30: Socio-Economics**. The technical aspects and inter-related effects considered are:

- **Chapter 14: Commercial Fisheries:** effects on employment, ancillary businesses and the wider supply chain.
- **Chapter 15: Shipping and Navigation:** vessel movements in relation to the use of ports by the Project.
- **Chapter 17: Seascape, Landscape and Visual:** the connection between landscape amenity and recreational activities.
- **Chapter 18: Infrastructure and Other Marine Users:** coastal tourism and use of infrastructure.
- **Chapter 22: Land Use**: disruption to community access to recreational, tourism and other amenity resources.
- **Chapter 26: Traffic and Transport**: indirect socio-economic effects on nearby residents and visitors from additional Project traffic.
- **Chapter 27**: **Landscape and Visual:** Considers visual impacts affecting recreational receptors and visitor attractions in the Onshore Red Line Boundary.

32.5.24.2 There are no inter-related effects identified in which there are secondary environmental effects as a result of socio-economic effects.

32.5.25 Civil and military aviation and telecommunications

32.5.25.1 For civil and military aviation, a project-lifetime inter-related effects and receptor-led inter-related effects assessment is presented in **Table 32.14**.

Table 32.14 Civil and military aviation project-lifetime and receptor-led inter-related effects

Impact	Inter-related effects
Project-lifetime inter-related effects	
Impacts on civil and military aviation from the creation of offshore aviation obstacles (construction, O&M and decommissioning)	The spatial extent of the aviation obstacle environment would gradually increase during the construction stage as infrastructure is installed within the OAA. The obstacle environment would then remain constant until the decommissioning stage. The effects during the different stages are not anticipated to interact in such a way as to generate an effect of greater significance than those assessed for the individual stages.
Impacts of onshore infrastructure on civil and military aviation (construction, O&M and decommissioning)	Any effects would be of local spatial extent and the durations confined to the different stages. The effects during the different stages are not anticipated to interact in such a way as to generate an effect of greater significance than those assessed for individual stages.

Impact	Inter-related effects
Receptor-led inter-related effects	
Combination of impacts from WTGs on civil and military radar and impacts on civil and military aviation from the creation of offshore aviation obstacles	Radar clutter from WTGs could compromise the safe and effective provision of civil and military air traffic services in the vicinity of the OAA. This impact in combination with the impact from the creation of an aviation obstacle environment could increase the overall significance of effects on onshore helicopters, search and rescue missions and military low flying training operations. However, with suitable additional / secondary technical mitigations in place the radar effects would be of minor significance. As such, the significance of the effect on civil and military aviation is not anticipated to increase beyond that already assessed.

32.6 Summary of inter-related effects assessment

32.6.1.1 There are **No Significant** project-lifetime or receptor-led inter-related effects expected for the Project across all technical aspects, except for the following:

- Commercial fisheries:
  - No inter-related effects of greater significance compared to the effects considered alone were identified for commercial fisheries receptors during the construction, O&M and decommissioning stages of the Project. **Chapter 14: Commercial Fisheries** identifies **Moderate Adverse** (**Significant**) effects on the reduction in access to, or exclusions from established fisheries for UK demersal otter trawl (construction and O&M).
- Landscape and visual:
  - No inter-related effects of greater significance compared to the effects considered alone were identified for landscape and visual receptors during the construction, O&M, and decommissioning stages of the Project. **Chapter 27: Landscape and Visual** identifies **Significant Adverse** effects.

32.6.1.2 It is expected that the combined ecosystem effect from the Project is **Minor Adverse** (**Not Significant**).

32.7 Ecosystem-level assessment

32.7.1 Overview and context

32.7.1.1 The Scoping Opinion from MD-LOT requested that the EIA Report considers impacts at an ecosystem level (see **Table 32.1**). This section is provided to respond to that request.

32.7.1.2 Impacts on ecosystems are not explicitly mentioned in the Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017, or the Marine Works (Environmental Impact Assessment) (Scotland) Regulations 2017. There is no formal guidance or well-established industry best-practice on what constitutes, defines or delineates an ecosystem in this context, nor that defines the methodology in assessing impacts to ecosystems from an offshore wind project.

32.7.1.3 Given that the request for an ecosystem assessment formed part of the offshore Scoping Opinion from MD-LOT, the term “ecosystem” is taken to relate to the marine environment. For the purposes of this assessment, this relates to the northern North Sea, below Mean

High Water Springs. This marine area includes waters off the east and northeast coasts of Scotland and the northeast coast of England, extending east to the west coast of Norway. The northern North Sea can be differentiated from the southern North Sea in broad terms, by deeper and colder waters.

32.7.1.4 Given the connectivity (in both hydrological and ecological terms) of the northern North Sea with the southern North Sea and the Atlantic Ocean, the ecosystem under consideration is not delineated by latitude or national / international jurisdictional boundaries.

32.7.1.5 This ecosystem-level assessment evaluates the ecological context of how species are connected through interactions with one another (for example, as part of a food web) and how these connections and relationships might be affected by the Project. This assessment has taken a holistic view of the individual effects reported in the individual technical aspect chapters of this EIA Report. This ecosystem assessment highlights how impacts upon one component of the ecosystem can have cascading effects on other dependent species, including those where there is a predator-prey relationship.

32.7.1.6 Whilst the individual technical aspect chapters have assessed how the Project could impact prey species and prey availability and the subsequent effect on other species within the ecosystem; this section considers the impact of the Project at a wider level by considering the potential magnification of inter-related effects identified in this Chapter and the effects reported in the following chapters:

- **Chapter 10: Benthic, Epibenthic and Intertidal Ecology**;
- **Chapter 11: Marine Mammals**;
- **Chapter 12: Offshore and Intertidal Ornithology**; and
- **Chapter 13: Fish Ecology**.

32.7.1.7 There is currently no methodology or guidance for conducting an ecosystem assessment. However, as per the NatureScot's request (see **Table 32.1**), this will be a qualitative assessment that considers the impacts of Highly Pathogenic Avian Influenza (HPAI), and anthropogenic activities in addition to other impacts identified in this EIA Report.

32.7.1.8 Section 4.5 of **Volume 3, Appendix 5.3: Marine Strategy Framework Directive Assessment** assesses the food web structure in relation to Good Environmental Status in relation to the Marine Strategy Regulations 2010.

32.7.2 Key trophic levels

32.7.2.1 The food web can be described as a trophic pyramid, with primary producers such as phytoplankton and seaweed at the bottom. These primary producers are consumed by primary consumers (for example, zooplankton), which in turn are consumed by secondary consumers (for example, small fish or crustaceans), followed by tertiary consumers (for example, large fish) and finally by top predators (for example, shark). It is possible for there to be fewer or further trophic levels within the food web.

32.7.2.2 A number of lower trophic level marine species (for example secondary consumers) have been identified in this EIA Report such as shellfish including Norway lobster, brown crab, velvet crab, cuttlefish and king scallop, molluscs such as ocean quahog, marine invertebrates such as edible sea urchin, corals such as northern sea fan, sponge communities, and sea anemones such as timid burrowing anemone (see **Chapter 10: Benthic, Epibenthic and Intertidal Ecology** and **Chapter 13: Fish Ecology** for scientific names and additional detailed baseline information).

32.7.2.3 Middle trophic level species include pelagic species (such as Atlantic herring, Atlantic mackerel, European sprat, Atlantic bluefin tuna, and horse mackerel), demersal species

(such as European plaice, lemon sole, sandeel, Norway pout, Atlantic cod, and whiting), and diadromous fish (Atlantic salmon, sea trout, European eel, and sea lamprey) (see **Chapter 13: Fish Ecology** for scientific names and additional detailed baseline information).

32.7.2.4 The middle to higher trophic levels are represented by elasmobranchs (such as spurdog, tope shark, common skate complex, spotted ray, and thornback ray), marine mammals (such as harbour porpoise, bottlenose dolphin, short-beaked common dolphin, Risso's dolphin, grey seal, harbour seal, and minke whale), and bird species (such as guillemot, fulmar, gannet, puffin, great black-backed gull, gadwall, eider, common scoter, oystercatcher, golden plover, and sandwich tern). In some cases, these species also represent top predators. See **Chapter 13: Fish Ecology, Chapter 11: Marine Mammals**, and **Chapter 12: Offshore and Intertidal Ornithology** for scientific names and additional detailed baseline information.

32.7.3 Drivers of trophic level change

32.7.3.1 Though the future baseline for the marine environment is uncertain, the marine / offshore ecology and ornithology assessments in this EIA Report conclude that climate change, prey availability, INNS, disease (for example, HPAI), pollution and the cumulative effects of other projects are key considerations. As a result of these impacts, the abundance and distribution of marine species populations are likely to change through time. It is difficult to predict exactly the extent to which the wider ecosystem will be changed by these factors, but the chapters have indicated that studies show certain species may be more affected within the ecosystem than others. For example, sandeel is considered less likely to be able to adapt to increasing temperatures than other fish species due to specific habitat requirements. This change has already been linked to the decline in overwintering kittiwake as a result of lower prey availability and quality (Carroll *et al.,* 2017).

32.7.3.2 Wider regional ecosystem-level research is ongoing around the UK to develop a robust scientific understanding of the ecological consequences of the offshore wind industry. This includes research programmes such as the Scottish Marine Energy Research (ScotMER) Programme (Scottish Government, 2025b)[1], ECOWind (2025)[2], and PrePARED (2024)[3]. These research programmes are wide reaching and consider such complex ecosystem-level interactions as oceanic responses to wind farm wake effects on phytoplankton blooms, the dynamics of fisheries stocks and how this influences seabird populations, and the effectiveness of compensatory measures for seabirds.

Invasive non native species

32.7.3.3 INNS pose significant ecological, economic and social threats, particularly in marine environments. INNS directly impact native species through competition, predation and disease, and indirectly disrupt nutrient cycling, ecosystem functions and trophic dynamics (Joint Nature Conservation Committee, 2024).

32.7.3.4 Climate change and increased global trade are expected to accelerate INNS spread and alter distribution, especially as novel climatic conditions emerge that foster unprecedented ecological communities (Department for Environment, Food and Rural Affairs (DEFRA), 2023). Marine developments like offshore wind farms heighten the risk of the INNS

[1] ScotMER research programmes began in 2019, holding annual symposia to showcase results to support the Scottish Government's commitment to Net Zero. All research projects and results are available at Scottish Government (2025).
[2] ECOWind research projects began in 2022 and are running to 2026. Findings from the individual research projects (ACCELERATE, ECOWINGS, BOWIE and PELAgIO) that make up the broader ECOWind programme are being published when available at ECOWind (2025).
[3] PrePARED research projects began in 2022, with major data collection occurring in 2022, the project has been extended into 2027. The final results for workstream B: Moray Firth will be available at the project's conclusion.

introduction via ballast water and hull fouling, while artificial substrates can facilities the spread through a 'stepping-stone effect' (DEFRA, 2023). The North Sea already hosts a range of established INNS, including *Goniadella gracilis* and *Monocorophium sextonae*, which were identified in the marine surveys of the offshore export cable corridor.

Climate change

32.7.3.5 Climate change is significantly impacting marine ecosystems, particularly in the North Sea. Rising sea surface temperatures can intensify water column stratification, which hinders the mixing of nutrient-rich deep waters with the upper photic zone. This limits nutrient availability for phytoplankton, the primary producers that form the base of the food web. Larger phytoplankton species, which requires more nutrients are especially affected. This can lead to a decline in overall biomass and a shift toward smaller, less productive species. This change reduces the food quality and availability for higher trophic levels, disrupting the food web (Käse and Geuer, 2018).

32.7.3.6 As stated in **paragraph 32.7.3.1,** climate change can further affect the lifecycles of fish and shellfish, by altering spawning and migration timings. These changes, combined with shifts in predator-prey dynamics, such as between sandeels and copepods, are already influencing recruitment patterns. Warmer conditions are also linked to changes in species dominance, with sardines thriving in warm winters and herring populations decline (Ottersen *et al*., 2023). These fluctuations in prey availability and timing are causing temporal misalignments for seabirds, negatively impacting their populations dynamics.

32.7.3.7 Looking ahead, the continued warming of oceans is expected to drive a northward shift of species like sandeels and increase the presence of warmer-water species such as sardines. While these changes may not immediately overhaul community structures, they are likely to alter the relative abundances of species in the near to medium term, reshaping the marine baseline and ecosystem dynamics. Therefore, climate change is driving the ecosystem change in the North Sea.

Highly pathogenic avian influenza

32.7.3.8 The outbreak of the HPAI began in 2020, initially affecting gulls and gannets with minimal impact. However, by spring 2022 it had spread widely among marine and coastal birds, causing a 25% decline in UK gannet colonies between 2022 and 2023 (DEFRA, 2025). The virus transmits through bird bodily fluids and contaminated materials such as nesting debris, and can remain viable in cold water for months, increasing the risk of waterborne transmission.

32.7.3.9 Migratory birds are considered to be key vectors for the spread of HPAI into the UK via established routes. Although not well adapted to mammals, HPAI has infected seals in the UK, and caused mass mortalities in marine mammals globally. It has also been detected in various dolphin species and link to unusual mortality events in harbour and grey seals (Webby and Uyeki, 2024).

32.7.3.10 HPAI reduces predation pressure on mid-trophic species (for example small fish), potentially altering population balances and competitive dynamics. These disruptions could lead to trophic misalignments, where timing and availability of prey no longer align with predator needs. Over time, such imbalances may shift species composition, reduce biodiversity and impact ecosystem resilience.

Pollution

32.7.3.11 Pollution in the marine environment affects organisms at every level of the ecosystem. Heavy metals such as mercury, lead and cadmium have entered the North Sea primarily

through industrial discharge and land run-off. These toxic substances can bioaccumulate in marine organisms like mussels and fish, disrupting food chains and exceeding nature background levels (Cambridge Earth Sciences, 2022). Persistent organic and synthetic pollutants including polychlorinated biphenyls and dichloro-diphenyl-trichloroethane (DDT) are long-lasting contaminants that remain in the environment for decades. They accumulate in the fatty tissues of marine mammals, impairing reproduction and immune function (Government Office for Science, 2017).

32.7.3.12 Marine litter, especially plastics and discarded fishing gear, is another major threat. Marine species often ingest or become entangled in this debris, leading to injury or death. Climate change exacerbates the issue by accelerating plastic degradation through heat and storm activity, increasing the spread of microplastics and their ecological impact

32.7.4 Ecosystem-level effects on receptors

Overview

32.7.4.1 It is important to consider the extent to which the Project may exacerbate current and future trends on species populations and the wider ecosystem. This should be considered within a context of wider offshore wind development and other marine users (for example fishing, oil and gas) however, as the Project alone is unlikely to drive ecosystem-level change.

Benthic, epibenthic and intertidal ecology

32.7.4.2 The assessment of benthic, epibenthic and intertidal ecology identifies the potential for changes in benthic prey availability as a result of the Project, which is expected to produce inter-receptor effects between trophic levels, given the change to the availability of a food source for marine mammals, fish and seabirds. However, given significant effects are not expected on benthic habitats, shellfish receptors or fish prey-species, it is predicted that any changes to benthic availability will be negligible and therefore, inter-receptor effects on higher trophic level species are expected to be **Not Significant**.

Marine mammals

32.7.4.3 The assessment of marine mammals does not identify a particular separation between marine receptors in respect to the level of effect via changes in prey availability. In most instances, other impacts on marine mammals are also considered to result in a **negligible** effect. However, some impacts are considered to have a different level of effect depending on the receptor. These impacts (particularly for floating offshore wind farms) are indirect and cascading rather than straight forward (Harris *et al.*, 2025) For example, the effect significance of Impact O4 (long term displacement / habitat change / barrier effects due to offshore wind farm structures) is **Minor** for minke and humpback whale, and **Negligible** for other marine mammal receptors. On a trophic level, this could result in a slight difference to prey availability depending on its predator. For instance, prey that are commonly consumed by minke whale and humpback whale may experience slight increases in numbers (assuming that all other factors remain unchanged), compared to prey commonly consumed by other marine mammals. However, given the initial effect is **Not Significant**, any consequent effect is likely to be limited, particularly toward the bottom of the trophic level. Therefore, the effect on the ecosystem is expected to be **negligible**.

32.7.4.4 The Project may also cause disturbance to prey species through displacement, but this could be offset by the concurrent displacement of both predators and prey, meaning marine mammal prey items may remain accessible in adjacent areas. However, considering the highly localised extent of these effects and the broad scale of the ecosystem, the combined

effect of these impacts is not expected to result in a greater effect than the assessment of these impacts in isolation. Therefore, the effect on the wider ecosystem is expected to be **Negligible**.

Offshore and intertidal ornithology

32.7.4.5 The assessment of offshore and intertidal ornithology does not identify a separation of effect between different ornithological species during the construction and decommissioning stages, with all impacts for all species assessed as **Not Significant**. There are slight differences in effect depending on the species and impact during the O&M stage. Distribution responses (OAA) (Impact O2) for gannet is considered to have **Moderate Adverse** (**Potentially Significant**) in EIA terms. This assessment conclusion has considered the magnitude of impact and the evidence that guillemot individuals were shown to have decreased 6% when comparing to pre-HPAI record to counts conducted in 2023 after the start of the outbreak (Tremlett *et al.,* 2024). All other ornithological species is considered **Not Significant**. The following O&M impacts for all ornithological species are considered **Not Significant**, indirect impacts due to effects on prey species (Impact O1); collision risk (Impact O3); combined collision risk and distributional responses; and entanglement with mooring lines (Impact O4).

32.7.4.6 Given that indirect effects on prey species and other operational impacts (for example collision risk and entanglement) are not predicted to significantly affect ornithological populations, the overall influence on trophic interactions and ecosystem function is expected to be minimal. This supports the broader conclusion that the Project is unlikely to result in meaningful disruption to marine ecosystem dynamics from an ornithological perspective.

Fish ecology

32.7.4.7 The assessment of fish ecology does not identify a separation of effect between different fish species during the O&M stage and the decommissioning stage. There are some slight differences in effect depending on the species during the construction stage. For example, Impact C3 (temporary localised increases in suspended sediment concentrations and smothering) is considered to have a **Minor** effect on Atlantic herring, sandeel, and spawning and nursery groups whereas it is **Negligible** for diadromous fish and all other marine fish. On the other hand, Impact C4 (effects resulting from underwater noise, vibration and particle motion) is considered to have a **Negligible** effect on Group 1 (for example, Atlantic halibut, sandeels, and all sharks), Group 2 (Atlantic salmon, sea trout, Atlantic bluefin tuna) and Group 5 (fish eggs and larvae) but **Minor** effect on Group 3 (gadoids and eels) and Group 4 (herring, sprat and shads). This difference in effect on different species indicates that there could be a slight difference in the impacts on other species within the food web in terms of prey availability and predator numbers. As mentioned above, sandeel is considered more vulnerable to rising temperatures than other species, which combined with impacts from the Project could result in additional effects across trophic levels. However, the impact of the Project is not expected to result in such a magnification of effects that it would be significant at an ecosystem level, given the temporary nature of these impacts and the minor effect currently reported.

32.7.4.8 Similarly, it is possible that there could be a combined effect from anthropogenic activities such as fishing with the Project but given that all effects reported in the assessment of fish ecology were **Not Significant**, it is not predicted that any magnification of impacts would result in a significant effect on fish species and consequently, across trophic levels. Conversely, a reduction in fishing effort within the OAA during the O&M stage could offer ecological benefits. By reducing fishing pressure, prey species may experience population recovery or increased abundance, which could enhance food availability for higher trophic

level predators such as marine mammals and seabirds. These positive effects, whilst secondary to the Project itself, may contribute to localised improvements in ecosystem function and resilience.

Summary

32.7.4.9 Based upon consideration of the ecological assessments mentioned in this assessment, it is likely that the Project may have impacts across trophic levels and therefore, there is potential for impacts to be recognised across the wider ecosystem of the northern North Sea. These impacts may include slight changes in prey availability and predator abundance, arising from both direct interactions with the Project and indirect effects on associated species throughout all lifecycle stages. However, it is important to note that not all impacts are negative. For example, a reduction in fishing effort within the OAA during the O&M stage may lead to localised ecological benefits, such as increase prey biomass and reduced disturbance, which could enhance food availability for higher trophic level predators.

32.7.4.10 In addition, climate change remains the overarching driver of ecosystem-level change in marine environments, influencing species distribution, reproductive success and food web dynamics at a global scale. In this context, the development of renewable energy infrastructure, such as offshore wind farms, contribute positively by supporting decarbonisation efforts and reducing reliance on fossil fuels. The North Sea is already subject to high levels of industrial activity, including oil and gas extraction, shipping and commercial fishing, which have historically exerted pressure on its ecological integrity. While the Project may introduce new interactions within the ecosystem, its overall contribution is small, particularly when considering the potential for positive effects and its role in mitigating climate change. Therefore, it is expected that the combined ecosystem effect from the Project is **Minor Adverse** (**Not Significant**).

32.8 References

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32.9 Glossary of terms and abbreviations

32.9.1 Abbreviations

Acronym	Definition
CEA	Cumulative Effects Assessment
CEMP	Construction Environmental Management Plan
COLREGs	Convention on the International Regulations for Preventing Collisions at Sea
CPMP	Core Path Management Plan
CTMP	Construction Traffic Management Plan
EIA	Environmental Impact Assessment
EMF	Electromagnetic Fields
EMP	Environmental Management Plan
HDD	Horizontal directional drilling
HPAI	Highly Pathogenic Aviation Influenza
INNS	Invasive non-native species
LCA	Land Capability for Agricultural
MD-LOT	Marine Directorate Licencing Operations Team
MMMP	Marine Mammal Mitigation Protocol
NtMs	Notice to Mariners
O&M	Operation and maintenance
OAA	Option Agreement Area
PAN	Planning Advice Note
PrePARED	Predators and Prey Around Renewable Energy Developments
SSC	Suspended sediment concentration
UXO	Unexploded ordnance
WTG	Wind turbine generator

32.9.2 Glossary of terms

Term	Definition
Cumulative effects	Additional changes caused by the Project in conjunction with other similar developments or as a combined effect of a set of developments, taken together.
Electromagnetic Fields	An electric and magnetic force field that surrounds a moving electrical charge.
Project lifetime inter-related effects	Those arising throughout more than one stage of the Project (construction, O&M and decommissioning) to interact to potentially create a more significant effect on a receptor than if just one stage were assessed in isolation. For example, increases in suspended sediment concentrations across all three Project stages may have a greater significance than the effects of each Project stage considered alone.
Receptor-led inter-related effects	Assessment of the scope for all effects to interact, spatially and temporally, to create inter-related effects on a receptor (or group). Receptor-led effects might be short term, temporary or transient effects, or incorporate longer term effects. For example, when combined, the effects of increased noise and poorer air quality during construction could be of greater significance to a residential receptor than when considered separately. A receptor-led effect assessment also considers whether an impact is predicted to be an inter-related effect over a project lifetime.
Safety zone	A statutory marine zone demarcated for the purposes of safety around a possibly hazardous installation or works / construction area.
Source-pathway-receptor	Identification for the potential inter-related effect receptors and where those pathways are described and assessed. This process involves cross referencing to all chapters and the impact assessed to understand if the aspect(s) has inherently assessed the potential effect and reported within the chapter(s). This process also determines whether there is potential for project-lifetime inter-cumulative effects from the same impact across the project stages.

MarramWind