SEA of Sectoral Marine Plan for Offshore Wind Energy

Strategic Environmental Assessment Environmental Report

December 2019

Scottish Government
Riaghaltas na h-Alba
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SEA of Sectoral Marine Plan for Offshore Wind Energy

Strategic Environmental Assessment
Environmental Report

December 2019

Report prepared by:

For:

Draft Sectoral Marine Plan for Offshore Wind Energy consultation

This document forms part of the consultation on the draft Sectoral Marine Plan for Offshore Wind Energy. The draft plan is accompanied by many supporting assessments under a Sustainability Appraisal. These documents are all available online at:

https://consult.gov.scot/marine-scotland/draft-sectoral-marine-plan-for-offshore-wind/

They can also be found individually at the links below:

Draft Sectoral Marine Plan for Offshore Wind Energy
http://www.gov.scot/ISBN/9781839603747

Social and Economic Impact Assessment
http://www.gov.scot/ISBN/9781839603792

Strategic Habitat Regulations Appraisal (HRA): Screening and Appropriate Assessment Information Report
http://www.gov.scot/ISBN/9781839603754

Draft Regional Locational Guidance
http://www.gov.scot/ISBN/9781839603778

Sustainability Appraisal
http://www.gov.scot/ISBN/9781839603785

Strategic Environmental Assessment Environmental Report (this report)
http://www.gov.scot/ISBN/9781839603761

Non-Technical Summary

Introduction

The Scottish Government is developing a plan for future commercial offshore wind development in Scottish waters in the period to 2050. The plan builds on the previous draft plan for offshore wind published in 2013[1] and seeks to provide opportunities for deep water wind technologies which may become commercially viable over this time period as well as further opportunities for fixed bottom technologies.

The offshore environment in Scotland has significant opportunity for future commercial offshore wind both in the short and long term. As part of the identification of potentially preferred areas for future development, Marine Scotland is now inviting views on the findings of the Strategic Environmental Assessment.

What is Strategic Environmental Assessment?

Strategic Environmental Assessment identifies the likely significant environmental impacts of plans and policies and proposed reasonable alternatives to them. Strategic Environmental Assessment also identifies mitigation measures that are required to avoid or minimise any significant adverse effects and highlights opportunities for enhancements of beneficial effects. Taking place at an early stage in the plan or policy preparation process, it ensures that decision-making is informed by relevant environmental information. Strategic Environmental Assessment provides opportunities for the public to consider this information and use it to inform their views on the draft plan or policy.

In accordance with the requirements of the Environmental Assessment (Scotland) Act 2005, a scoping exercise on the development of the Sectoral Marine Plan for Offshore Wind was undertaken by Marine Scotland, whereby the proposed scope, methodology and consultation period of the assessment were identified. In response to the scoping, Consultation Authorities[2] confirmed the need for a Strategic Environmental Assessment (SEA) due to the potential for significant environmental effects to occur. They also provided comment on the proposed scope and methodology of the assessment and consultation period for the Environmental Report. Their views are taken into account in this Environmental Report, as per the requirements of the 2005 Act.

What is the Plan?

Significant cost reductions in the offshore wind sector in recent years, together with the emergence of floating technology for offshore wind substructures, has encouraged

[1] http://marine.gov.scot/information/sectoral-marine-plan-offshore-wind-energy-2019-draft-plan-options
[2] Historic Environment Scotland, Scottish Environment Protection Agency and Scottish Natural Heritage.

Marine Scotland, as planning authority for Scotland's Seas, to undertake a new strategic planning exercise to inform the spatial development of any future leasing round. The output of this activity will provide guidance and support to the Crown Estate Scotland, which has announced its intention to run a new leasing round (ScotWind) for commercial scale offshore wind technologies in Scottish Waters, in selecting areas for release.

The plan establishes 17 new Draft Plan Option (DPO) areas potentially suitable for wind energy generation in Scotland that are assessed in a SEA (this document), Socio-Economic Impact Assessment (SEIA) and strategic Habitats Regulations Appraisal (HRA). The DPOs (Figure NTS1 and Table NTS1) have varying capacities, based on larger or smaller areas of sea identified, and include both shallow (less than 60 m) and deep-water sites (greater than 60m depth).

Table NTS1 Realistic maximum scale of development within each DPO under the plan

Region	DPO	Area km²	Potential Installed Capacity (GW)	Realistic Maximum Development Scenario for DPO (GW) Under the Plan
East	E1	3816	19.1	3
	E2	1287	6.4	2
	E3	474	2.4	1
North East	NE1	776	3.9	2
	NE2	464	2.3	1
	NE3	339	1.7	1
	NE4	440	2.2	1
	NE5	495	2.5	1
	NE6	699	3.5	2
	NE7	1027	5.1	3
	NE8	400	2	1
North	N1	1163	5.8	2
	N2	560	2.8	2
	N3	1106	5.5	2
	N4	200	1.0	1
West	W1	1107	5.5	2
South West	SW1	292	1.5	1

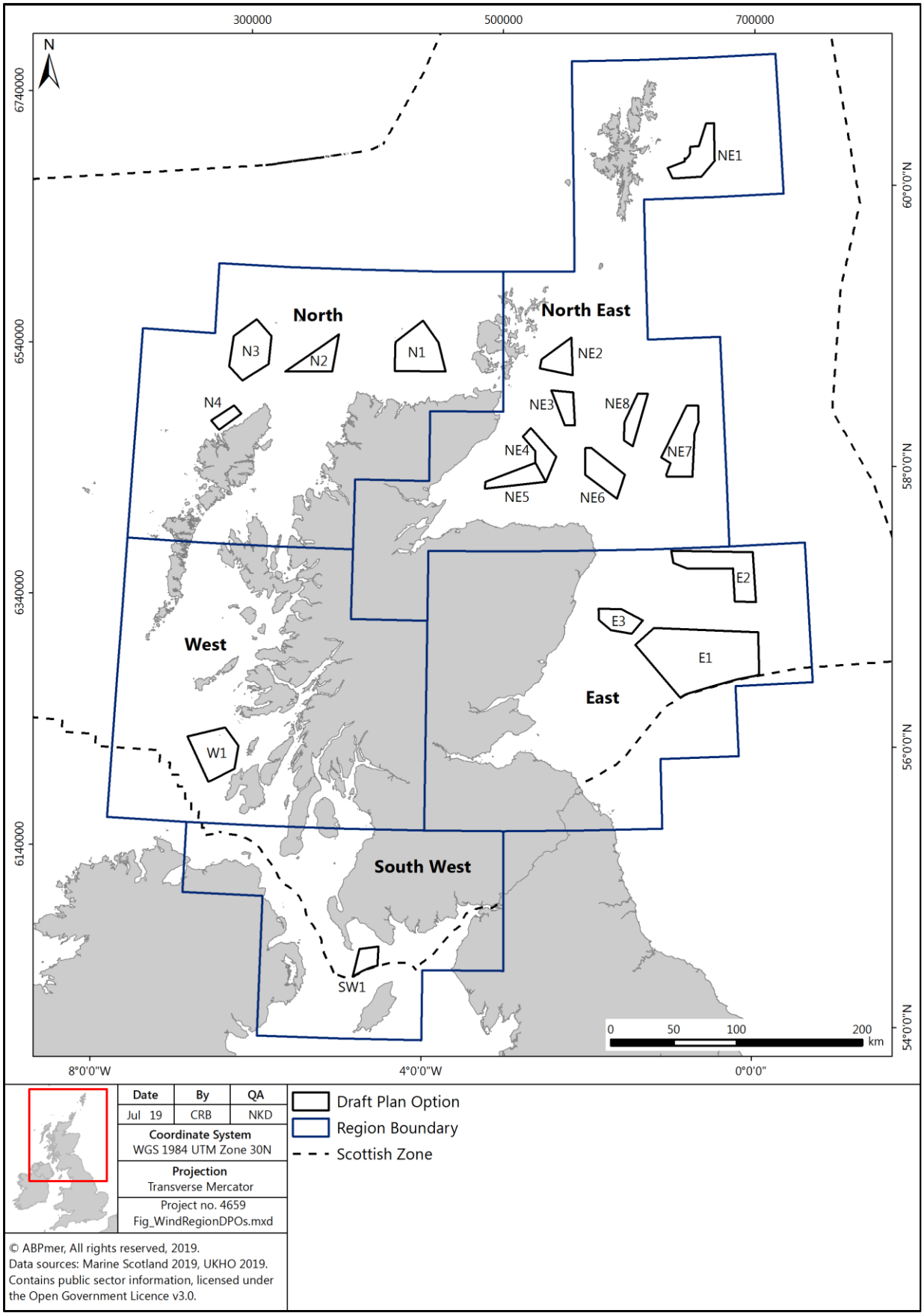

Figure NTS1 Draft Plan Option areas

What is the relationship between the Plan and its SEA?

The determination of the DPO areas that are to be included in the Sectoral Marine Plan has been undertaken in parallel with the development of the SEA. This has therefore supported modification to the areas under consideration as a result of a review of the potential environmental constraints. In this sense the SEA process has already informed the development of the DPO areas which are subsequently assessed herein.

The conclusions of the assessment reported in the SEA will provide an opportunity for consultees (the public) to consider the information contained herein and use it to inform their views on the DPO areas and scale of potential development outlined within the draft Sectoral Marine Plan for Offshore Wind.

How was the Strategic Environmental Assessment undertaken?

SEA provides a high-level and qualitative assessment of the potential environmental effects that are likely to result from the development of offshore wind within the DPO areas. The DPO areas represent reasonable alternatives in themselves (see below), as only a very limited proportion of the overall DPO areas are likely to be developed under the plan and some DPOs may not be developed at all.

The assessment identifies the individual and overall (cumulative) effects of the DPO areas on the SEA topics that are scoped into the assessment, specifically Biodiversity, Flora and Fauna; Population and Human Health; Soil (Marine Geology and Coastal Processes); Water Quality; Climatic Factors; Cultural Heritage and Landscape / Seascape. At a cumulative level the assessment considers differing scales of development under the Sectoral Marine Plan, both regionally and nationally. These represent further reasonable alternatives assessed within this SEA.

The assessment also considers the effects of development on a series of key statements (‘Strategic Environmental Assessment objectives’). These objectives reflect the scope of the assessment as well as the environmental protection objectives from relevant legislation.

Economic and social impacts, including those on other users of the marine environment, are assessed in a SEIA which is reported separately. The Sustainability Appraisal, which is also reported separately, considers the potential environmental, economic and social effects of development under the Sectoral Marine Plan for Offshore Wind, drawing on information contained in the SEA and SEIA.

Which reasonable alternatives have been assessed?

The iterative process undertaken in the development of the DPOs was based upon the scoping Areas of Search[3] supported by informal post-scoping engagement with stakeholders and interim SEA, HRA and SEIA. Some areas were removed from the Areas of Search during this process where they did not meet the SEA objectives or had other significant constraints.

Within this draft Sectoral Marine Plan for Offshore Wind the DPOs themselves represent the reasonable alternatives, as only a very limited proportion of the areas is likely to be developed.

Furthermore, at a regional and national level, the assessment has considered low, medium and high scenarios for assessment, as defined in Table NTS2.

Table NTS2 Assumptions on scale of development at national and regional scales

Region	Low Development Scenario	Medium Development Scenario	High Development Scenario
National	3 GW (4% of total capacity in DPOs)	5 GW (7% of total capacity in DPOs)	10 GW (14% of total capacity in DPOs)
SW	0.3 GW (21% of total capacity in DPOs)	0.6 GW (41% of total capacity in DPOs)	1 GW (68% of total capacity in DPOs)
W	0.5 GW (9% of total capacity in DPOs)	1 GW (18% of total capacity in DPOs)	2 GW (36% of total capacity in DPOs)
N	1 GW (7% of total capacity in DPOs)	2 GW (13% of total capacity in DPOs)	3 GW (20% of total capacity in DPOs)
NE	1.5 GW (6% of total capacity in DPOs)	3 GW (13% of total capacity in DPOs)	4.5 GW (19% of total capacity in DPOs)
E	1 GW (4% of total capacity in DPOs)	2 GW (7% of total capacity in DPOs)	3 GW (11% of total capacity in DPOs)

These different assessment scenarios have been used to understand the capacity of individual DPOs and regional clusters of DPOs to accommodate offshore wind development at different scales.

[3] https://www.gov.scot/publications/scoping-areas-search-study-offshore-wind-energy-scottish-waters-2018/

What is the current state of the environment?

Scotland's marine environment supports a diverse complex of different habitats, which in turn support a wide range of marine plants and animals. Estimates suggest that there are around 6,500 species of animals and plants (excluding microbial flora and seabirds) in Scotland's seas. Marine habitats within the Scottish marine environment can be characterised into three broad groups: intertidal habitats; subtidal (inshore and shelf sea); and deep-sea habitats.

The importance of Scotland's marine ecosystems is reflected in the range of designations which protect them at international and national levels. All designations are included within Scotland's Marine Protected Area (MPA) network, covering approximately 22% of Scottish seas. The designations protect a diverse range of features, including habitat types, marine mammals (cetaceans, seals and otter), birds and fish. A further 81 species are designated as Priority Marine Features, identified as being of conservation importance to Scotland, which are safeguarded under the National Marine Plan (policy GEN 9).

Scotland has a wide range of geological (rocks, minerals, fossils and structures), geomorphological (landforms and processes) and soil features that make up the marine and coastal landscape. The condition of these features influences the quality of habitats and in turn the viability and health of both flora and fauna populations.

Scotland's seas are mostly classed as being of high or good ecological status under the Water Framework Directive. The key pressures to the quality of the marine environment are from modifications to physical condition, rural diffuse pollution and waste water discharges. Marine and freshwater environments around Scotland are used for a variety of industrial and recreational activities including salmon and sea trout fisheries, recreational sea angling, sailing, cruising, bathing and recreational tourism. Coastal recreation opportunities make an important contribution to human health and wellbeing as well as coastal economies.

Within the marine environment, habitats and processes capable of carbon fixation and sequestration are defined as 'blue carbon sinks'. Multiple habitats across Scottish seas and coastal areas can store or sequester carbon including kelp forests, other seaweed communities, saltmarsh, shellfish and marine sediments. Their effectiveness as carbon sinks is highly dependent upon their long-term capacity to store carbon.

There are a number of pressures on the marine environment in Scotland, such as human activities (including from infrastructure development, oil and gas exploration, fishing, aquaculture, wastewater discharges) and climate change.

What are the likely significant environmental effects of the Plan?

When assessed individually, there is the potential for significant adverse effects within each of the DPOs. Each DPO has therefore been assessed against the baseline for each of the SEA topics, and the potentially moderate or major effects identified are defined in Table NTS3, alongside potential mitigation (actions to reduce/offset adverse effects).

Across all DPOs, there is potential for significant effects from installation of export cables. However, these cannot be meaningfully assessed at the plan level, and any potential effects will need to be managed through cable route selection and further mitigation at a project level.

Within all DPOs the development of offshore wind also has the potential to lead to significant (major) beneficial (positive) effects from the de-carbonisation of the energy sector and development of a secure energy supply.

Table NTS3 Summary of likely negative significant effects per DPO

DPO	Likely Significant Effects
SW1	There is potential for significant negative effects on birds, navigational safety, sediment transport and coastal processes, and visual effects. All these effect pathways have the potential to be mitigated at a project level, either through spatial planning or turbine design. In addition potential impacts and mitigation on harbour porpoise from the North Channel SAC should be considered. However, due to the proximity of the DPO to land, visual effects have the potential to be a constraining factor.
W1	There is potential for significant negative effects on seabed habitats, marine mammals, fish, sediment transport and coastal processes, and visual effects. All of these pathways have the potential to be mitigated at a project level, either through spatial planning, array design or through turbine design.
N1	There is potential for significant negative effects on bird populations from the Sule Skerry and Sule Stack SPA and on navigational safety. Both effect pathways have the potential to be mitigated through spatial planning within the DPO as the degree of impact varies considerably across the area.
N2	N2 has no significant negative effects identified.
N3	There is potential for a significant negative effect on bird species foraging in the DPO, including from colonies in the North Rona and Sula Sgeir SPA. This potential effect has the potential to be mitigated at a project level through appropriate monitoring and subsequent spatial planning to avoid areas of high risk.

DPO	Likely Significant Effects
N4	There is potential for significant effects on population (noise impacts), navigational safety and visual effects. There is some potential for mitigation of the above pathways through foundation and turbine design at the project level. However, any development in N4 may increase risk to commercial ships using the recommended deep water route in storm conditions.
NE1	There is potential for significant effects on seabed habitat, spawning fish, marine mammals and sediment transport and coastal processes. These pathways could be managed at a project level, particularly by avoidance of the eastern boundary of the DPO which borders the Pobie Bank SAC designated for benthic habitats. Further mitigation may include avoiding piling activities at key fish spawning times.
NE2	There is potential for significant effects on bird species, for which previous wind farm consultations have raised significant concerns. The conclusion of these consultations based on potential risk to bird populations, specifically Kittiwake, Great Black-backed Gull, Razorbill, Gannet and Guillemot is that currently there may be very limited capacity for further development on the east coast of Scotland. It is, however, recognised that there is uncertainty in this conclusion, which has the potential to be addressed once sufficient evidence is available. At a plan level, there is therefore proposed mitigation (discussed further below) that no development should be consented until sufficient evidence is available to demonstrate that such development will not cause a significant effect. In addition, within NE2 there is potential for a significant effect on spawning fish, which has the potential to be mitigated through avoidance of piling activities during key spawning periods.
NE3	There is potential for significant effects on bird species, for which previous wind farm consultations have raised significant concerns. The conclusion of these consultations based on potential risk to bird populations, specifically Kittiwake, Great Black-backed Gull, Razorbill, Gannet and Guillemot is that currently there may be very limited capacity for further development on the east coast of Scotland. It is, however, recognised that there is uncertainty in this conclusion, which has the potential to be addressed once sufficient evidence is available. At a plan level, there is therefore proposed mitigation (discussed further below) that no development should be consented until sufficient evidence is available to demonstrate that such development will not cause a significant effect. In addition, within NE3 there is potential for a significant effect on spawning fish, which has the potential to be mitigated through avoidance of piling activities during key spawning periods.

DPO	Likely Significant Effects
NE4	There is potential for significant effects on bird species, for which previous wind farm consultations have raised significant concerns. The conclusion of these consultations based on potential risk to bird populations, specifically Kittiwake, Great Black-backed Gull, Razorbill, Gannet and Guillemot is that currently there may be very limited capacity for further development on the east coast of Scotland. It is, however, recognised that there is uncertainty in this conclusion, which has the potential to be addressed once sufficient evidence is available. At a plan level, there is therefore proposed mitigation (discussed further below) that no development should be consented until sufficient evidence is available to demonstrate that such development will not cause a significant effect. Furthermore, NE4 has the potential to significantly affect navigational safety, as it overlaps almost entirely with the key route around Scotland. There is limited potential to mitigate this within the DPO, and therefore development within NE4 would likely necessitate a diversion of that route.
NE5	There is potential for significant effects on bird species, for which previous wind farm consultations have raised significant concerns. The conclusion of these consultations based on potential risk to bird populations, specifically Kittiwake, Great Black-backed Gull, Razorbill, Gannet and Guillemot is that currently there may be very limited capacity for further development on the east coast of Scotland. It is, however, recognised that there is uncertainty in this conclusion, which has the potential to be addressed once sufficient evidence is available. At a plan level, there is therefore proposed mitigation (discussed further below) that no development should be consented until sufficient evidence is available to demonstrate that such development will not cause a significant effect. Furthermore, NE5 has the potential to significantly affect visual receptors, depending on the technology deployed, and navigational safety, as it overlaps with some routes crossing the Moray Firth. There is potential to mitigate this within the DPO at project level through spatial planning to allow for safe transit through the arrays.

DPO	Likely Significant Effects
NE6	There is potential for significant effects on bird species, for which previous wind farm consultations have raised significant concerns. The conclusion of these consultations based on potential risk to bird populations, specifically Kittiwake, Great Black-backed Gull, Razorbill, Gannet and Guillemot is that currently there may be very limited capacity for further development on the east coast of Scotland. It is, however, recognised that there is uncertainty in this conclusion, which has the potential to be addressed once sufficient evidence is available. At a plan level, there is therefore proposed mitigation (discussed further below) that no development should be consented until sufficient evidence is available to demonstrate that such development will not cause a significant effect. Furthermore, NE6 has the potential to significantly affect navigational safety, as it overlaps with multiple key routes around Scotland, including lifeline ferry routes linking the mainland to the Shetland Islands. There is limited potential to mitigate this within the DPO, and therefore development within NE6 would likely necessitate a diversion of some or all of these routes, or a concentration of traffic into a smaller area.
NE7	There is potential for significant effects on birds within NE7, which may migrate through the DPO or use the area for foraging. Further research and consideration of mitigation may be used at a project level to determine and subsequently avoid areas of higher risk.
NE8	There is potential for significant effects on birds within NE8, which may migrate through the DPO or use the area for foraging. Further research and consideration of mitigation may be used at a project level to determine and subsequently avoid areas of higher risk.
E1	There is potential for development in E1 to have an effect on bird species, for which previous wind farm consultations have raised significant concerns. The conclusion of these consultations based on potential risk to bird populations, specifically Kittiwake, Great Black-backed Gull, Razorbill, Gannet and Guillemot is that currently there may be very limited capacity for further development on the east coast of Scotland, although these concerns are recognised to be more applicable to the inshore sites and risks are reduced in this case by the distance of E1 offshore. In addition, within E1 there is potential for a significant effect on spawning fish, which has the potential to be mitigated through avoidance of piling activities during key spawning periods.

DPO	Likely Significant Effects
E2	There is potential for significant effects on bird species, for which previous wind farm consultations have raised significant concerns. The conclusion of these consultations based on potential risk to bird populations, specifically Kittiwake, Great Black-backed Gull, Razorbill, Gannet and Guillemot is that currently there may be very limited capacity for further development on the east coast of Scotland, although these concerns are recognised to be more applicable to the inshore sites and risks are reduced in this case by the distance of E1 offshore. In addition, within E2 there is potential for a significant effect on spawning fish and navigational safety. Effects on spawning fish have the potential to be mitigated through avoidance of piling activities during key spawning periods, whilst effects on navigational safety can be managed through appropriate spatial planning within the DPO.
E3	There is potential for significant effects on bird species, for which previous wind farm consultations have raised significant concerns. The conclusion of these consultations based on potential risk to bird populations, specifically Kittiwake, Great Black-backed Gull, Razorbill, Gannet and Guillemot is that currently there may be very limited capacity for further development on the east coast of Scotland. It is, however, recognised that there is uncertainty in this conclusion, which has the potential to be addressed once sufficient evidence is available. At a plan level, there is therefore proposed mitigation (discussed further below) that no development should be consented until sufficient evidence is available to demonstrate that such development will not cause a significant effect. In addition, within E3 there is potential for a significant effect on spawning fish and navigational safety. Effects on spawning fish have the potential to be mitigated through avoidance of piling activities during key spawning periods, whilst effects on navigational safety can be managed through appropriate spatial planning within the DPO.

What are the cumulative effects of the Plan?

Cumulatively the SEA has considered effects at both a regional and a national level. The regional cumulative effects are summarised in Table NTS4. Regional cumulative effects include potential for negative effects on bird populations, cetaceans, visual impacts and navigation.

Nationally, the DPOs are spatially distinct between regions, and therefore there is limited potential for cumulative negative effects, however, those that are present predominantly relate to bird collision risk. At a national scale the potential cumulative positive effect is most significant, with a significant contribution to the decarbonisation of the energy sector in Scotland and the establishment of a secure energy supply.

Table NTS4 Summary of cumulative effects per region

Region	Key Potential Cumulative Effects
SW	There is only one DPO within the South West region, therefore there is no potential for cumulative effects on a regional scale with other DPOs within this plan.
W	There is only one DPO within the West region, therefore there is no potential for cumulative effects on a regional scale with other DPOs within this plan .
N	There are four key cumulative effects in the North region. Firstly, there is potential for significant cumulative effects on mobile species, including birds and cetaceans. Bird species have migration pathways or foraging areas which intersect DPOs within the North region. Development of areas across all DPOs therefore has the potential to cause a greater barrier effect to the migration routes, or displace birds from key foraging grounds, leading to increased collision risk or increased energetic requirements for bird species to divert around developments. Furthermore, there is the potential for significant effects on marine mammals. Cetaceans are primarily affected during construction activities, therefore concurrent construction within the DPOs in the North region has the potential to either cause physical injury or more likely displace species from these areas, which could cause a barrier effect preventing movement of cetaceans. There is also significant potential for cumulative effects on visual, seascape and landscape receptors, particularly regarding development within N2, N3 and N4, all of which may be visible from land around North East Lewis.
NE	There are six key cumulative effects in the North East region. Firstly, there is potential for cumulative effects on mobile species, principally on bird species. One pathway of concern is regarding effects on bird populations, specifically Kittiwake, Razorbill and Guillemot, through collision risk and displacement from foraging areas. Furthermore, development of areas across multiple DPOs has the potential to form a barrier to species movement, leading to increased collision risk or increased energetic requirements for bird species to divert around developments. Concurrent construction within the DPO's could cause physical damage or displace marine mammals and spawning fish from the area. There is also potential for cumulative effects on benthic receptors from sediment transport. There are many key navigational routes throughout the region and cumulative effects could cause traffic to divert or concentrate traffic into smaller areas, increasing navigational risk. Finally, there is potential for cumulative visual impacts, although the impact will be dependent on turbine size and spatial planning.

Region	Key Potential Cumulative Effects
E	There are three key cumulative effects in the East region. Firstly, there is potential for cumulative effects on mobile species, principally on bird species. Within the East region the pathway of greatest concern is regarding effects on bird populations, specifically Kittiwake, Razorbill and Guillemot, through collision risk and displacement from foraging areas. Furthermore, development of areas across multiple DPOs has the potential to form a barrier to species movement, leading to increased collision risk or increased energetic requirements for bird species to divert around developments. There are also many key navigational routes throughout the region and cumulative effects could cause traffic to divert or concentrate traffic into smaller areas, increasing navigational risk.

In addition to the above consideration of cumulative effects of development under the plan, project level assessment of cumulative effects will be required, including for birds, cetaceans, migratory fish, visual impacts and navigation. The SEA identifies current reasonably foreseeable developments, including current offshore wind and marine renewable developments, that will require consideration. It is not considered possible to assess the magnitude of the cumulative effect due to the significant uncertainty as to the scale, location or technology of future developments.

How will significant environmental effects be mitigated?

In addition to the selection process undertaken to determine the DPOs, which mitigated a number of potential significant effects by avoiding areas of highest concern, there are a number of potential plan and project level mitigation measures that may be implemented.

Project level mitigations include consultation with local stakeholders, spatial planning, use of Statutory National Conservation Body (SNCB) piling/construction protocols, noise abatement measures, radar and survey studies to identify areas of risk, adherence to pollution, marine archaeology and biosecurity management plans, hydrodynamic and sediment studies.

Plan level mitigation measures identified include limiting the scale of development under the plan, placing requirements on developments for spatial planning and EIA, implementation of a temporal delay to development where sufficient data is currently unavailable, collaboration between organisations to improve baseline and impact assessment knowledge and to implement national environmental enhancement schemes, and management of project sequencing.

How will the Plan be implemented and monitored?

Once the final Plan has been adopted and published by Scottish Ministers, the Plan will be subject iterative plan management. This means that the Plan will be kept under review and it is currently anticipated that the Plan will be revised two years after adoption. This will ensure that the Plan remains reflective of current scientific knowledge and understanding, as well as prevailing market conditions. The Plan will also need to be revised to inform future Crown Estate Scotland seabed leasing rounds.

In addition, an Advisory Group will meet on an annual basis to consider recent research and developments and potential implications of such research and changes for the Plan. The Advisory Group will be made up of a wide range of stakeholders, including members of the Scottish Government Marine Strategy Forum, statutory consultees and academics with relevant expert knowledge.

Responding to this Consultation?

We are inviting responses to this consultation by **25 March 2020**.

Please respond to this consultation using the Scottish Government's consultation hub, Citizen Space (http://consult.gov.scot). You can access and respond to this consultation online at https://consult.gov.scot/marine-scotland/draft-sectoral-marine-plan-for-offshore-wind/. You can save and return to your responses while the consultation is still open. Please ensure that consultation responses are submitted before the closing date of 25 March 2020.

If you are unable to respond using our consultation hub, please complete the Respondent Information Form to:

Sectoral Marine Plan for Offshore Wind Energy Consultation
Scottish Government
Marine Planning and Policy Division
Area GB North
Victoria Quay
Edinburgh EH6 6QQ

Handling your response

If you respond using the consultation hub, you will be directed to the About You page before submitting your response. Please indicate how you wish your response to be handled and, in particular, whether you are content for your response to published. If you ask for your response not to be published, we will regard it as confidential, and we will treat it accordingly.

All respondents should be aware that the Scottish Government is subject to the provisions of the Freedom of Information (Scotland) Act 2002 and would therefore have to consider any request made to it under the Act for information relating to responses made to this consultation exercise.

If you are unable to respond via Citizen Space, please complete and return the Respondent Information Form included in this document.

To find out how we handle your personal data, please see our privacy policy: https://beta.gov.scot/privacy/

Next steps in the process

Where respondents have given permission for their response to be made public, and after we have checked that they contain no potentially defamatory material, responses will be made available to the public at http://consult.gov.scot. If you use the consultation hub to respond, you will receive a copy of your response via email.

Following the closing date, all responses will be analysed and considered along with any other available evidence to help us. Responses will be published where we have been given permission to do so. An analysis report will also be made available.

Comments and complaints

If you have any comments about how this consultation exercise has been conducted, please send them to the contact address above or at sectoralmarineplanning@gov.scot.

Scottish Government consultation process

Consultation is an essential part of the policymaking process. It gives us the opportunity to consider your opinion and expertise on a proposed area of work.

You can find all our consultations online: http://consult.gov.scot. Each consultation details the issues under consideration, as well as a way for you to give us your views, either online, by email or by post.

Responses will be analysed and used as part of the decision making process, along with a range of other available information and evidence. We will publish a report of this analysis for every consultation. Depending on the nature of the consultation exercise the responses received may:

- indicate the need for policy development or review
- inform the development of a particular policy
- help decisions to be made between alternative policy proposals
- be used to finalise legislation before it is implemented

While details of particular circumstances described in a response to a consultation exercise may usefully inform the policy process, consultation exercises cannot address individual concerns and comments, which should be directed to the relevant public body.

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Consultation on the draft Sectoral Marine Plan for Offshore Wind Energy
RESPONDENT INFORMATION FORM

Please Note this form **must** be completed and returned with your response.

To find out how we handle your personal data, please see our privacy policy: https://beta.gov.scot/privacy/

Are you responding as an individual or an organisation?

☐ Individual

☐ Organisation

Full name or organisation's name

Phone number

Address

Postcode

Email

The Scottish Government would like your permission to publish your consultation response. Please indicate your publishing preference:

☐ Publish response with name

☐ Publish response only (without name)

☐ Do not publish response

Information for organisations:

The option 'Publish response only (without name)' is available for individual respondents only. If this option is selected, the organisation name will still be published.

If you choose the option 'Do not publish response', your organisation name may

We will share your response internally with other Scottish Government policy teams who may be addressing the issues you discuss. They may wish to contact you again in the future, but we require your permission to do so. Are you content for Scottish Government to contact you again in relation to this consultation exercise?

☐ Yes

☐ No

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Figures

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1 Introduction

1.1 Background

1.1.1 The Scottish Government is developing a plan for future commercial (defined as >100 MW arrays) offshore wind development in Scottish waters in the period to 2050. The plan builds on the previous draft plan for offshore wind published in 2013[4] and seeks to provide opportunities for deep water wind technologies which may become commercially viable over this time period as well as further opportunities for fixed bottom technologies.

1.1.2 The geographical scope of the plan covers Scottish Waters (0-200 nautical miles). This includes Scottish Territorial Waters (0-12 nautical miles) and the Scottish Offshore Marine Area (12-200 nautical miles) which is executively devolved to Scottish Ministers under the Marine and Coastal Access Act 2009 (Figure 1). The plan is being developed in accordance with Marine Scotland's sectoral marine planning process (Figure 2). The National Marine Plan refers to this process in plan policy RENEWABLES 1. Once adopted, it is intended that the plan will also be reflected in the preparation or revision of relevant Regional Marine Plans.

1.1.3 An informal public consultation on the initial stages of development of the draft Plan was held in June 2018[5]. This included consultation on the following scoping documents:

- Context Report[6];
- Social and Economic Impact Assessment scoping report[7];
- Habitats Regulations Appraisal Pre-screening Report[8];
- Strategic Environmental Assessment Screening and Scoping Report[9]; and
- Areas of Search Scoping Report[10].

[4] Scottish Government, 2013. Draft Sectoral Marine Plans for Offshore Renewable Energy in Scottish Waters; 2013; https://www.gov.scot/publications/draft-sectoral-marine-plans-offshore-renewable-energy-scottish-waters-consultation/pages/7/

[5] Scottish Government, 2018. Offshore Wind Sectoral Marine Plan Scoping Consultation. Available at https://consult.gov.scot/marine-scotland/offshore-wind-scoping/.

[6] Scottish Government, 2018. Sectoral marine plan for offshore wind energy: context report. Available at https://www.gov.scot/publications/sectoral-marine-plan-offshore-wind-energy-encompassing-deep-water-plan/.

[7] Scottish Government, 2018. Sectoral marine plan for offshore wind energy: social and economic impact assessment scoping report. Available at https://www.gov.scot/publications/sectoral-marine-plan-offshore-wind-energy-encompassing-deep-waterplan-options/ .

[8] Scottish Government, 2018. Sectoral marine plan for offshore wind energy: strategic habitat regulations appraisal pre-screening report. Available at https://www.gov.scot/publications/sectoral-marine-plan-offshore-wind-energy-encompassing-deep-water-plan-9781788519632/.

[9] Scottish Government, 2018. Sectoral marine plan for offshore wind energy: strategic environmental assessment screening and scoping report. Available at https://www.gov.scot/publications/sectoral-marine-plan-offshore-wind-energy-encompassing-deep-water-options/.

[10] Scottish Government, 2018. Search areas for offshore wind energy: scoping study. Available at https://www.gov.scot/publications/scoping-areas-search-study-offshore-wind-energy-scottish-waters-2018/.

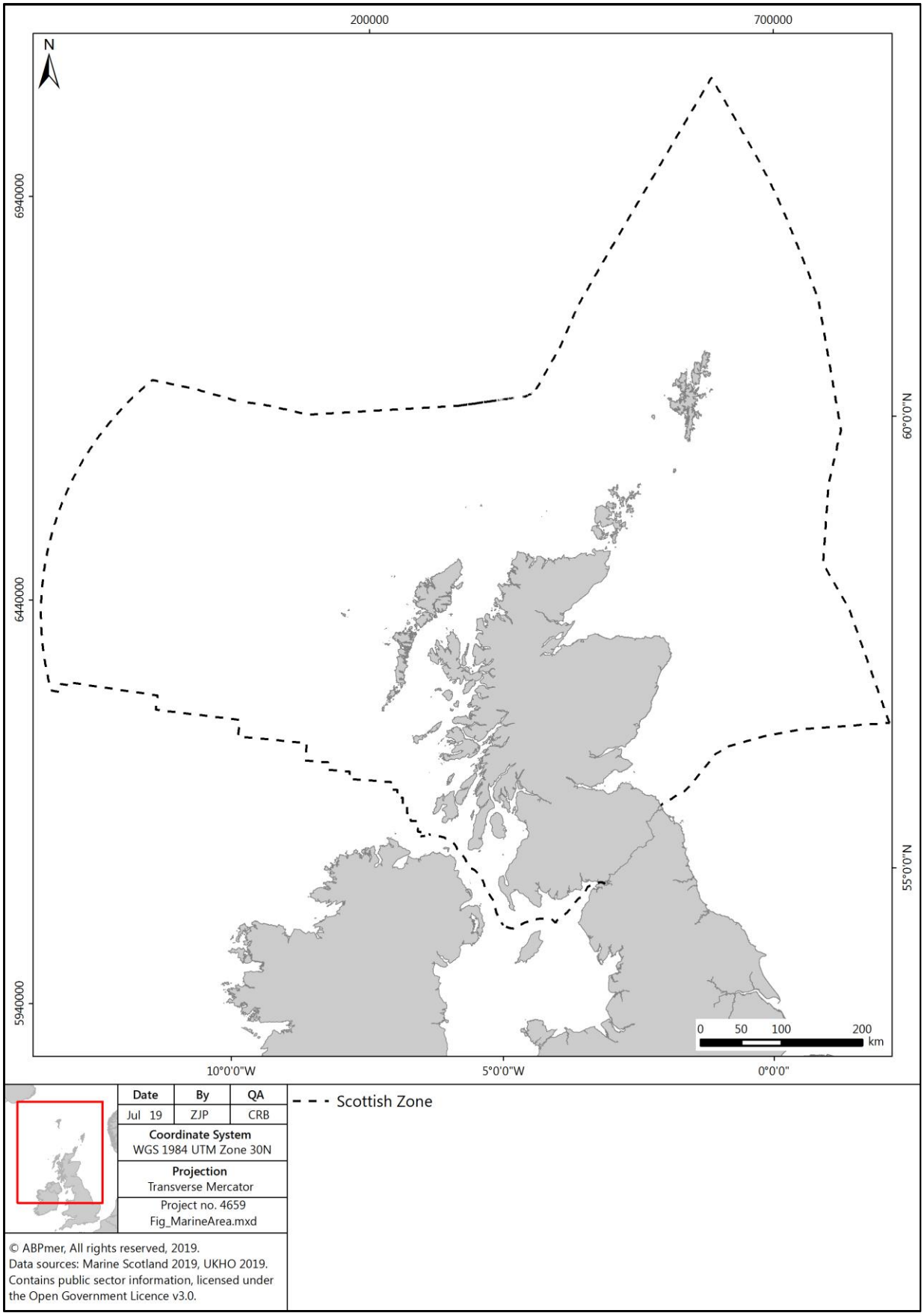

Figure 1 Map of Scottish zone

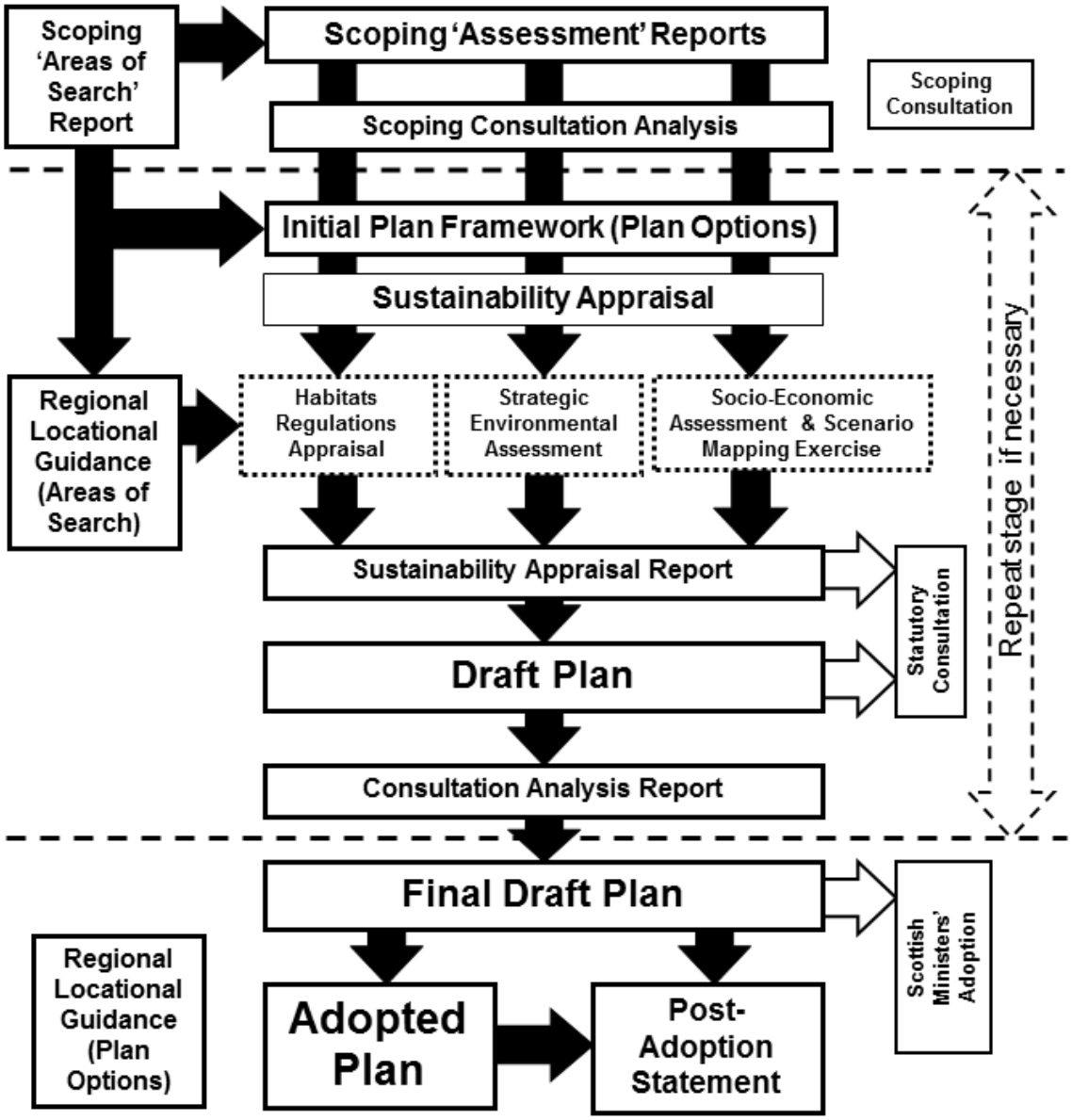

Figure 2 Marine Scotland's sectoral marine planning process

1.1.4 Currently the majority of offshore wind farms have been built using conventional fixed bottom substructure technology. The maximum depth considered economically and technically feasible for these to be installed is approximately up to 60 m of depth[11]. This depth requirement significantly limits the amount of seabed space that can be exploited in Scottish waters. New floating wind turbine technology attached to the seabed by chains and anchors can potentially open up new areas of sea as they are theoretically not limited by depth. At present the maximum depth considered for offshore deployment is 800 m as expressed by Statoil in reference to its Hywind technology[12]. Construction and deployment prices of floating foundations may eventually compete with those of fixed bottom technologies[13], if floating wind sees a similarly rapid cost reduction to that which has taken placed in the fixed foundation wind industry.

1.1.5 In order to provide space for the potential development of fixed bottom and deep water offshore wind options, the Areas of Search Scoping study considered the full range of water depths down to 800 m. Full details on the criteria applied in the development of the Areas of Search are provided in the Scoping report[14].

1.1.6 The Scoping report identified an initial 24 Areas of Search (AoS) (Figure 3) that could provide suitable locations for conventional and deep-water wind options. These 24 AoS were subsequently reviewed and updated, resulting in the identification of 17 Draft Plan Options (DPO) taken forwards for further assessment (Figure 3 and reproduced to provide increased detail in a larger image in Figure 4). A full description of the process undertaken to identify the 17 DPOs is included in Section 1.2 below.

1.1.7 As part of the plan development process, draft Regional Locational Guidance (RLG) has been prepared to provide a baseline for environmental, technical, socio-economic and planning issues in relation to the DPOs. The draft RLG grouped the DPOs into five broad geographic regions (South West, West, North, North East and East)[15].

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[11] The Carbon Trust (2015) Floating Offshore Wind : Market and Technology Review. Available at: https://www.carbontrust.com/resources/reports/technology/floating-offshore-wind-market-technology-review/

[12] Statoil (2015) Hywind Scotland Pilot Park - Environmental Statement. doi:http://www.statoil.com/en/EnvironmentSociety/Environment/impactassessments/NewEnergy/IntWind/Pages/HywindScotland.aspx.

[13] The Carbon Trust (2015) Floating Offshore Wind : Market and Technology Review. Available at: https://www.carbontrust.com/resources/reports/technology/floating-offshore-wind-market-technology-review/

[14] Scottish Government, 2018. Search areas for offshore wind energy: scoping study. Available at https://www.gov.scot/publications/scoping-areas-search-study-offshore-wind-energy-scottish-waters-2018/.

[15] These areas have been updated for the final draft of the RLG to include South West, West, North, North East and East only), and the RLG updated to reflect the updated DPOs as reviewed below and taken forwards into the assessment process.

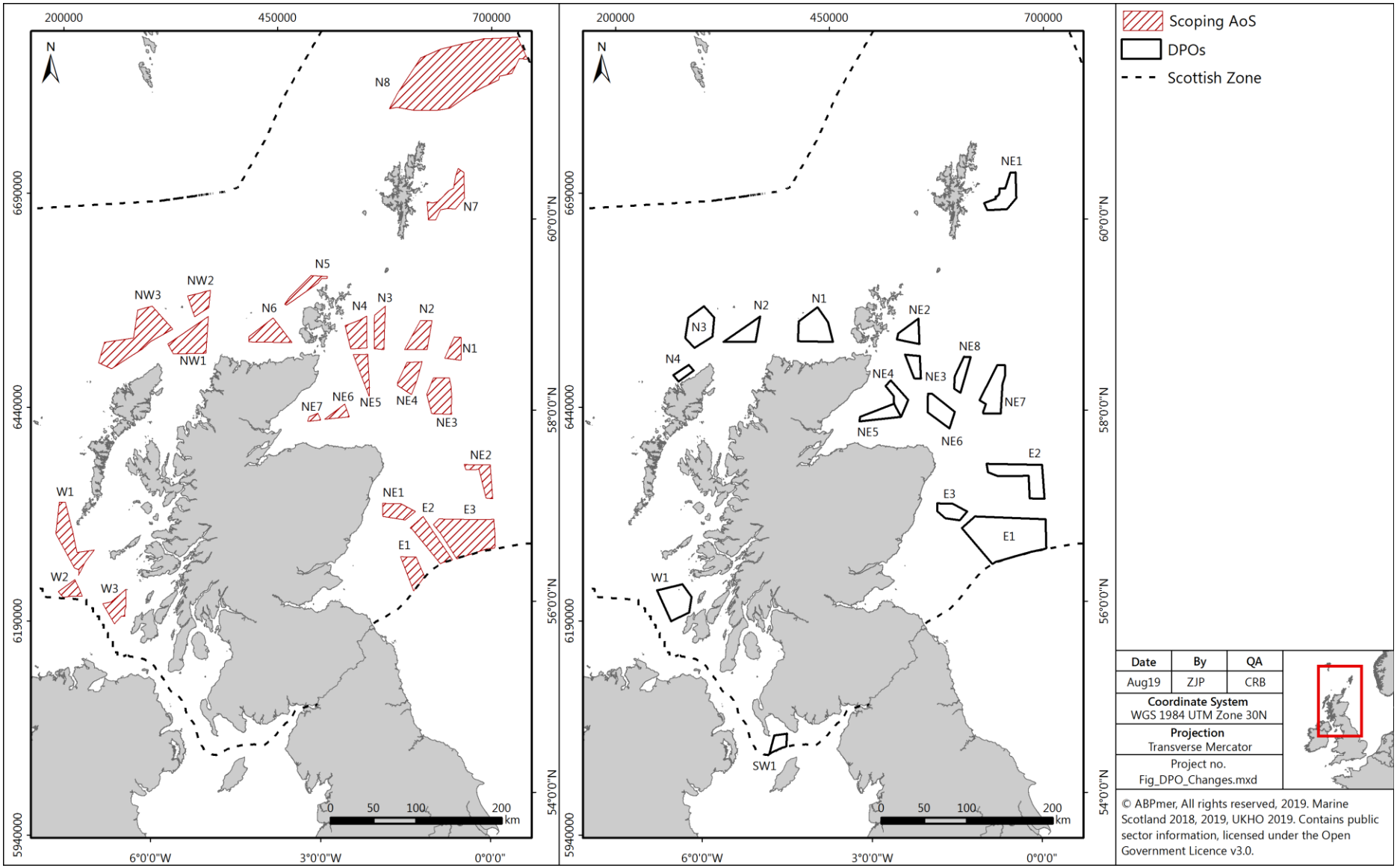

Figure 3 Evolution of AoS to DPOs

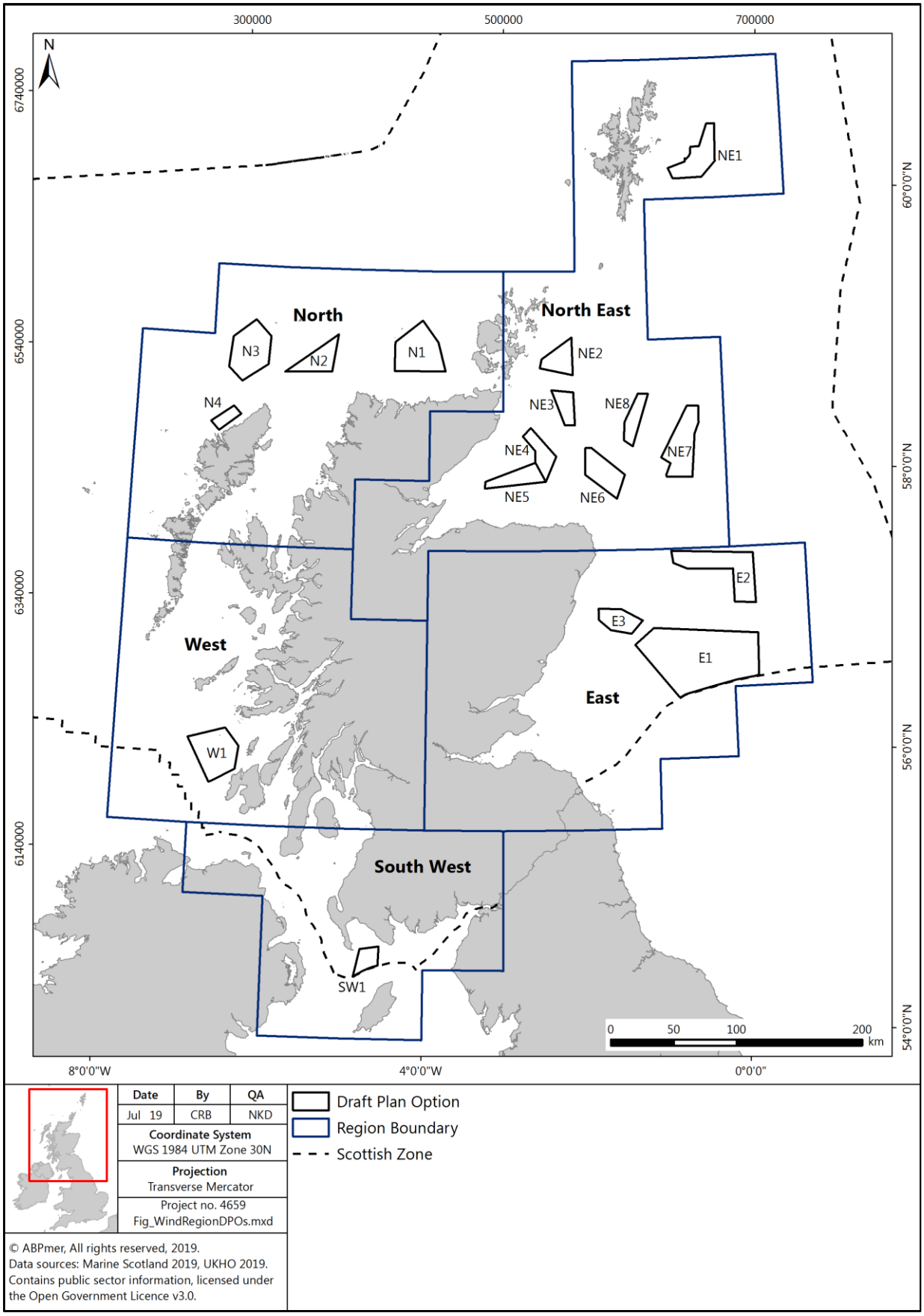

Figure 4 RLG offshore wind regions and draft plan option areas

1.2 Identification of Draft Plan Options

1.2.1 The sectoral marine planning process (as shown in Figure 2) is an iterative process, informed through stakeholder engagement and evidence from the related social, economic and environmental assessments. All of the information and consultation feedback gathered supports the Scottish Ministers in identifying Draft Plan Options (DPOs) to progress to the next phase of the plan process.

1.2.2 The DPOs have emerged through an examination of spatial data considerations in addition to advice and other related information provided by members of the Steering Groups, as well as stakeholders

1.2.3 The key stages of the planning process in relation to the identification of the Draft Plan Options, described in greater detail below, are:

- Opportunity and Constraint (O&C) Analysis – Iteration 1.
- Opportunity and Constraint (O&C) Analysis – Iteration 2 - Single Issue Constraint Analysis.
- Scoping Consultation.
- Opportunity and Constraint (O&C) Analysis – Iteration 3.
- Identification of Draft Plan Options.
- Next Steps.

Opportunity and Constraint (O&C) Analysis – Iteration 1

1.2.4 The identification of initial Areas of Search (AoS) was carried out through the use of an O&C analysis. It built upon previous work carried out by Marine Scotland Science in 2011 and the production of draft regional locational guidance for potential deep water floating offshore wind test sites in 2014. The analysis was iterative, so updates could be incorporated as required in order to reflect stakeholder feedback.

1.2.5 Full details of the O&C analysis can be found in the AoS scoping report published for consultation in 2018. The O&C analysis sought to identify areas of opportunity for the future development of offshore wind, whilst also identifying areas that minimised potential negative impacts to the environment, other sectors and users of the sea. This analysis was completed through the use of GIS and numerous spatial data resources.

Opportunity and Constraint (O&C) Analysis – Iteration 2

1.2.6 Sectoral engagement workshops were held in spring 2018. The AoS were then refined with consideration to specific spatial issues and feedback from the workshops.

1.2.7 This refinement process identified a range of distinct AoS (Figure 3). As the draft Plan is technology neutral, no commercial or technology specific information was used in this refinement process.

Scoping Consultation – Screening and Scoping Reports

1.2.8 Scottish Ministers then consulted on the screening and scoping stages of the Plan process during June and July 2018. Screening and scoping reports were prepared and published online for the SEA, HRA and SEIA alongside the AoS scoping study.

Opportunity and Constraint (O&C) Analysis – Iteration 3

1.2.9 Iteration 3 of the O&C analysis was undertaken, which considered the responses received during the Scoping Consultation. For more details see the Consultation Analysis.

1.2.10 The AoS were refined with consideration to the outputs of the Iteration 3 O&C Analysis. As a result, certain AoS were either removed or refined to avoid/incorporate certain areas of Scottish Waters.

1.2.11 This stage also considered the areas of seabed proposed by stakeholders via the scoping consultation. A number of the areas proposed overlapped with existing AoS, while others overlapped with areas with higher levels of constraint or entirely new areas. This information was provided to Scottish Ministers to inform their decision on the selection of DPOs.

1.2.12 Upon review of the above information, Scottish Ministers identified areas to move forward in the plan process. It should be noted that some additional areas were included at this stage, where there was significant stakeholder interest, but also increased constraint. The Sustainability Appraisal stage will assess these areas in greater detail.

Identification of Draft Plan Options

1.2.13 The 22 revised Areas of Search were made available to the Sectoral Marine Plan Project Board and two Project Steering Groups for consideration and comment.

1.2.14 Responses from both the Board and Steering Groups, together with the outputs of the initial assessments, were presented to Scottish Ministers to inform their decision on which AoS should progress to the Sustainability Appraisal for more detailed assessment.

1.2.15 Seventeen revised AoS were selected as DPOs (Figure 4).

Next Steps

1.2.16 Following the statutory consultation, the responses received will be subject to consultation analysis. This analysis will be considered by Scottish Ministers and inform their decision on which Options to take forward in the Final Plan.

1.2.17 It should be noted that if significant changes are required as a result of the consultation feedback, further assessment and consultation may be required prior to adoption and publication of the Final Plan. The Post Adoption Statement (to be published with the Final Plan) will detail any changes made to the Plan as a result of consultation feedback.

1.3 Strategic Environmental Assessment

1.3.1 The Environmental Assessment (Scotland) Act 2005 ('the 2005 Act') requires that certain public plans, programmes and strategies be assessed for their potential effects on the environment[16]. Strategic Environmental Assessment (SEA) is the process used to fulfil this requirement and includes consultation with both the public and the Consultation Authorities[17]. The 2005 Act also sets out the information that is required to be provided in this Environmental Report.

1.3.2 A screening and scoping exercise on the development of the Sectoral Marine Plan for Offshore Wind was undertaken by Marine Scotland, in accordance with the requirements of the 2005 Act. A combined Screening and Scoping Report was published in June 2018, setting out the proposed approach to the SEA, including the proposed scope and level of detail. Comments were invited from the Scottish Consultation Authorities.

1.3.3 The outcome of the screening exercise and the consultation responses confirmed the need for a SEA due to the likelihood for significant environmental effects to arise. The proposed scope of the assessment and methodology was broadly accepted by the Scottish Consultation Authorities (see Section 3).

1.3.4 Marine Scotland commissioned ABP Marine Environmental Research Ltd. (ABPmer) to undertake the assessment stage of the SEA and prepare this Environmental Report.

1.4 Purpose of this Environmental Report

1.4.1 The purpose of this Environmental Report is to document the findings of the SEA on the implementation of the Sectoral Marine Plan for Offshore Wind. A Socio-Economic Impact Assessment (SEIA) has also been undertaken and is reported separately. The key findings of both the SEA and the SEIA are summarised in an overall Sustainability Appraisal (SA) document.

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[16] Scottish Government (2005) Environmental Assessment (Scotland) Act 2005, asp 15 [online] Available at: https://www.legislation.gov.uk/asp/2005/15/introduction

[17] Historic Environment Scotland (HES), Scottish Environment Protection Agency (SEPA) and Scottish Natural Heritage (SNH).

1.4.2 The views of the public and the Consultation Authorities on the plan and the findings of this Environmental Report are now being sought.

1.5 Report Structure

1.5.1 The remainder of this Environmental Report is structured as follows:

- Section 2 provides information on the Draft Plan and its policy context;
- Section 3 presents the approach to the SEA and the methods used;
- Section 4 describes the relevant components of the environment that could be affected by the Draft Plan;
- Section 5 sets out the results of the assessment;
- Section 6 presents the recommendations for the Draft Plan, including mitigation and proposed monitoring; and
- Section 7 considers the next steps in the implementation of the Draft Plan and the SEA process.

1.5.2 The Non-Technical Summary precedes Section 1.

2 Offshore Wind Energy Around Scotland

2.1 Background

2.1.1 Scotland currently has five operational offshore wind sites with a total capacity of over 900 MW: the Beatrice demonstrator project (two 5 MW turbines), the Beatrice offshore wind farm (588MW) (from mid 2019) the Hywind Scotland Pilot Park project (floating wind, 30 MW capacity), Robin Rigg (180 MW capacity), Levenmouth Demonstration Turbine (one 7 MW turbine), the European Offshore Wind Deployment Centre deployed 11 turbines, with a total capacity of 93 MW and Kincardine Offshore Wind (with one 2 MW floating turbine currently operational). Furthermore, there are several projects in Scotland which are consented but not yet built or are in planning. Ongoing offshore wind developments are captured in Table 1.

2.1.2 As 2020 targets for renewable energy generation near[18], and Scotland pursues more ambitious reductions in its greenhouse gas emissions, the focus has broadened to consider the potential to expand offshore wind energy, including both shallow (suitable for fixed bottom turbines) and deep waters. The term 'deep waters' in this context typically refers to depths greater than 60 m.

2.1.3 There is limited sea area with water depths less than 60 m in Scottish waters suitable for the development of fixed bottom offshore wind, particularly on the west coast where water depth shelves rapidly beyond 100 m. Areas of shallower water are restricted generally to inshore waters, or around major firths (Firth of Forth, Moray Firth, Solway Firth).

2.1.4 It is estimated that over 80% of Europe's wind energy passes over waters deeper than 60m in depth, with a potential yield of 4000 gigawatts (GW)[19]. Deep waters are particularly common in the Atlantic Ocean and areas of the North Sea[20] and it is estimated that the energy that could be derived from deep water turbines in the North Sea alone could exceed the EU's electricity requirements four times over[21]. Scotland possesses a significant proportion of Europe's total offshore wind resource[22] and as such, deep waters around Scotland may hold considerable potential for offshore wind energy development.

[18] Amongst other targets, Scottish Ministers have committed to generating 100% of Scotland's gross annual electricity demand from renewable sources by 2020.
[19] WindEurope (2017) Floating Offshore Wind Vision Statement – June 2017 [online] Available at: https://windeurope.org/wp-content/uploads/files/about-wind/reports/Floating-offshore-statement.pdf
[20] European Wind Energy Association (2013) Deep water – The next step for offshore wind energy [online] Available at: http://www.ewea.org/fileadmin/files/library/publications/reports/Deep_Water.pdf
[21] ibid
[22] Scottish Government (2015) Scotland's National Marine Plan – 11. Offshore Wind and Marine Renewable Energy [online] Available at: http://www.gov.scot/Publications/2015/03/6517/12

2.1.5 Scotland has an abundance of deep water resources located close to land[23], particularly off the west coast where the shelf edge drops off fairly near to shore[24]. Sea depths off the west coast vary considerably but generally fall between 10-320m with an average depth of roughly 60m[25]. Waters off the east coast tend to be shallower and more uniform in depth, with a gradual downward slope towards the North Sea, but also include localised trenches and deeper areas of up to 200m depth such as the southeast Moray Firth[26]. Towards the northern reaches of the east coast, average depths tend to increase and past the Shetland Islands, depths of around 110m are found inshore of the shelf[27].

2.1.6 Sea areas outside Scottish Territorial Waters (i.e. past 12 nautical miles) are generally deeper than territorial waters, with large expanses of water at depths of 80-120m[28]. Such areas are particularly extensive in the Scottish portion of the North Sea. Additional areas of water of 120-300m depth are found in regions like the Fladen Ground in the North Sea[29]. The shelf edge west of Scotland presents very considerable challenges to development[30] and installation of developments in this area may benefit from more mature technology and experience from projects tested in other areas.

2.1.7 Waters past the territorial boundary have the potential for lower levels of constraint due to fewer competing environmental, commercial, and heritage interests. For example, at greater distances from shore, noise and visual effects may be reduced[31]. In some instances, this can make such areas particularly suited to accommodating deep water wind energy technologies. In addition, wind resources tend to be stronger and less variable further offshore[32] where deep water is likely to be found, enabling turbines to be more consistently in operation and reducing turbulence.

[23] Carbon Trust (2015) Floating Offshore Wind: Market and Technology Review [online] Available at: https://www.carbontrust.com/media/670664/floating-offshore-wind-market-technology-review.pdf
[24] Scottish Government (2019) Draft Regional Locational Guidance – Offshore Wind in Scottish Waters.
[25] Scottish Government (2019) Draft Regional Locational Guidance – Offshore Wind in Scottish Waters.
[26] Scottish Government (2019) Draft Regional Locational Guidance – Offshore Wind in Scottish Waters.
[27] ibid
[28] Scottish Government (2011) Scottish Marine and Freshwater Science Report Volume 2 Number 13: Scoping Study for Offshore Wind Farm Development in Scottish Waters [online] Available at: https://tethys.pnnl.gov/sites/default/files/publications/Davies-Watret-2011.pdf
[29] ibid
[30] ibid
[31] WindEurope (2017) Floating Offshore Wind Vision Statement – June 2017 [online] Available at: https://windeurope.org/wp-content/uploads/files/about-wind/reports/Floating-offshore-statement.pdf
[32] ibid

Table 1 Offshore wind projects (operational and non-operational) in Scotland

Energy Type	Name/ Location	Company (Project Website)	Status	Capacity (MW)
Wind	Robin Rigg	E.ON https://www.eonenergy.com/About-eon/our-company/generation/our-current-portfolio/wind/offshore/robin-rigg	Fully operational since September 2010.	174
Wind	Beatrice Demonstrator	SSE Renewables / Talisman	Fully operational - entering decommissioning phase (2024 – 2027)	10
Wind	Levenmouth Turbine	ORE Catapult https://ore.catapult.org.uk/press-releases/levenmouth-turbine-offers-unrivalled-opportunity-for-renewable-energy-rd/	Fully operational	7
Wind	Hywind	Equinor / Masdar http://www.statoil.com/en/environmentsociety/environment/impactassessments/newenergy/intwind/pages/hywindscotland.aspx	Fully operational	30
Wind	Aberdeen Bay (EOWDC)	Vattenfall https://group.vattenfall.com/uk/what-we-do/our-projects/european-offshore-wind-deployment-centre	Fully operational	93.2
Wind	Beatrice	SSE Renewables / SDIC / Copenhagen Infrastructure Partners http://sse.com/whatwedo/ourprojectsandassets/renewables/Beatrice	Fully operational	588
Wind	Neart na Gaoithe	EDF Renewables http://www.neartnagaoithe.com	Consented December 2018 (Varied June 2019).	450

Energy Type	Name/ Location	Company (Project Website)	Status	Capacity (MW)
Wind	Firth of Forth 1 (Seagreen Alpha and Bravo)	SSE Renewables http://www.seagreenwindenergy.com	Consent granted October 2014 (varied August 2018 to remove maximum capacity). Updated application for optimised project submitted September 2018. Construction anticipated to commence no later than 2022.	1050 (1500 for optimised project)
Wind	Moray East	EDPR http://www.morayoffshorerenewables.com/Home.aspx	Consent granted in March 2014. Delivery expected early 2020s.	1116
Wind	Inch Cape	SDIC http://www.inchcapewind.com	New application submitted August 2018.	700
Wind	Kincardine	Atkins / Pilot Offshore Renewables http://pilot-renewables.com/	Consent received 2017. Currently under construction (one turbine operational)	49.6
Wind	Dounreay Tri Demonstration Project	Hexicon https://www.hexicon.eu/dounreay-tri/	Currently on hold, delivery expected 2020 (company in administration)	12

Energy Type	Name/ Location	Company (Project Website)	Status	Capacity (MW)
Wind	Firth of Forth 2 (Charlie)	SSE Renewables http://www.seagreenwindenergy.com	In planning	1800
Wind	Firth of Forth 3 (Delta)	SSE Renewables http://www.seagreenwindenergy.com	In planning	800
Wind	Moray Firth Western Development Area	EDPR http://www.morayoffshorerenewables.com/Home.aspx	Consented June 2019. Delivery potential in mid 2020s	850
Wind	Forthwind OWF, Methil	Forthwind Ltd	Consented, (Consent varied May 2019 to increase capacity)	29.9

Blue Seas Green Energy – A Sectoral Marine Plan for Offshore Wind in Scottish Territorial Waters

2.1.8 In 2009, the Crown Estate Commissioners (CEC) undertook the first stage of lease bidding and awarded Exclusivity Agreement awards (the first step towards securing a commercial lease) for 10 sites in Scottish Territorial Waters:

- Solway Firth;
- Wigtown Bay;
- Kintyre;
- Islay;
- Argyll Array;
- Beatrice;
- Inch Cape;
- Neart na Gaoithe;
- Forth Array; and
- Bell Rock.

2.1.9 In response to the CEC leasing round and to support the sustainable delivery of the potential for offshore wind around Scotland, the Scottish Government made a commitment to produce a SEA of the potential for offshore wind development in Scottish Territorial Waters, to include the 10 site options. A draft plan was developed to accompany the SEA Environmental Report, and thereby ensure

that those reviewing the assessment findings during statutory consultation were clear about the emerging proposals.

2.1.10 In addition to the sites identified by CEC, the Scottish Government commissioned a further constraint and opportunity mapping exercise in order to identify additional medium term options, within which there could be further potential for development beyond 2020. The marine spatial planning model, Marine Resource System (MaRS), was used to identify options by mapping environmental and technical constraints as well as resource opportunities. This model identified 30 medium term options (Areas of Search). The 30 medium term options were then subject to a SEA, based on a set of strategic environmental objectives developed with the Consultation Authorities. This resulted in 5 options being ruled out, including South West Option 2 (SW2), due to its proximity to the Beaufort's Dyke munitions dump. As a result, 25 medium term options (Areas of Search) were taken forward in the Sectoral Marine Plan.

2.1.11 In addition to the SEA, a Habitats Regulations Appraisal (HRA) for the site and medium term options and Socio-Economic Impact Assessment (SEIA) for the regional implications of the site options were also prepared. A consultation analysis report of all the consultation responses received for the SEA and Plan development process was produced.

2.1.12 In March 2011, Scottish Ministers, following consideration of the key findings from the SEA, HRA, Socio-economic Assessment and consultation analysis, decided that 6 short term sites would be progressed.

- Islay;
- Argyll Array;
- Beatrice;
- Inch Cape;
- Neart na Gaoithe;
- Forth Array.

2.1.13 In addition, Scottish Ministers' recognised the 25 medium term options within the Plan as the starting point for the next strategic planning exercise to support offshore wind energy around Scotland

Draft Sectoral Marine Plan for Offshore Wind Energy in Scottish Waters 2013

2.1.14 As per its commitment to a two-year review, Blue Seas – Green Energy was reviewed in 2013 alongside the Sectoral Marine Plans for Wave and Tidal Energy[33]. The review included a re-evaluation of the previous selection of medium term development areas and broadened the geographic scope of

[33] Scottish Government (2013) Draft Sectoral Marine Plans for Offshore Renewable Energy in Scottish Waters – Strategic Environmental Assessment: Environmental Report and Appendix A [online] Available at: http://www.gov.scot/Publications/2013/07/2403/0)

consideration to include waters beyond the territorial limit (i.e. out to 200nm). The latter involved identifying both additional medium term Areas of Search as well as areas of deeper water that could become suitable as turbine structure technologies progress and become commercially deliverable at greater depths.

2.1.15 To help refine the potential Areas of Search, Regional Locational Guidance (RLG) was prepared which considered detailed environmental, technical, socio-economic and planning issues in relation to the offshore renewable energy regions of Scotland[34]. This led to the development of an Initial Plan Framework comprising Draft Plan Options which were intended to guide developers towards suitable areas when planning projects to go through a marine licensing process[35]. This Initial Plan Framework was subject to an iterative series of assessments including SEA, an HRA, and a socio-economic assessment, which informed a public consultation on the Draft Plan for Offshore Wind Energy 2013. This Plan contained 10 draft Plan Options which were subsequently reflected in the publication of Scotland's National Marine Plan in 2015.

2.1.16 However, due to the challenges faced by the offshore wind industry during this period, resulting from the change in subsidy mechanism from ROCs (renewables obligations certificates) to Contracts for Difference, the Draft Plan was never formally adopted by Scottish Ministers'.

National Marine Plan

2.1.17 The National Marine Plan sets out strategic policies for the sustainable development of Scotland's marine resources out to 200 nautical miles. It incorporates plans for the development of a range of sectors, including fisheries, aquaculture, oil and gas, carbon capture and storage, recreation and tourism, shipping, ports, harbours and ferries, submarine cables, defence, aggregates, and offshore wind and marine renewable energy.

2.1.18 It sets out the environmental requirements that constrain development within Scottish waters, and draws out general planning policies (GEN 1 to GEN 21) which are considered when assessing development in the marine environment:

- **GEN 1 General planning principle:** There is a presumption in favour of sustainable development and use of the marine environment when consistent with the policies and objectives of the National Marine Plan.
- **GEN 2 Economic benefit:** Sustainable development and use which provides economic benefit to Scottish communities is encouraged when consistent with the objectives and policies of this Plan.

[34] Scottish Government (2012) Offshore Wind – Regional Locational Guidance – Part 2 – Introduction – Scottish Overview [online] Available at: http://www.gov.scot/Topics/marine/marineenergy/Planning/windrlg
[35] Scottish Government (2013) Offshore Wind Energy in Scottish Waters – Initial Plan Framework (Draft Plan Options) [online] Available at: http://www.gov.scot/Resource/0042/00423948.pdf

- **GEN 3 Social benefit:** Sustainable development and use which provides social benefits is encouraged when consistent with the objectives and policies of this Plan.
- **GEN 4 Co-existence:** Proposals which enable coexistence with other development sectors and activities within the Scottish marine area are encouraged in planning and decision making processes, when consistent with policies and objectives of this Plan.
- **GEN 5 Climate change:** Marine planners and decision makers must act in the way best calculated to mitigate, and adapt to, climate change.
- **GEN 6 Historic environment:** Development and use of the marine environment should protect and, where appropriate, enhance heritage assets in a manner proportionate to their significance.
- **GEN 7 Landscape/seascape:** Marine planners and decision makers should ensure that development and use of the marine environment take seascape, landscape and visual impacts into account.
- **GEN 8 Coastal process and flooding:** Developments and activities in the marine environment should be resilient to coastal change and flooding, and not have unacceptable adverse impact on coastal processes or contribute to coastal flooding.
- **GEN 9 Natural heritage:** Development and use of the marine environment must: (a) Comply with legal requirements for protected areas and protected species. (b) Not result in significant impact on the national status of Priority Marine Features. (c) Protect and, where appropriate, enhance the health of the marine area.
- **GEN 10 Invasive non-native species:** Opportunities to reduce the introduction of invasive non-native species to a minimum or proactively improve the practice of existing activity should be taken when decisions are being made.
- **GEN 11 Marine litter:** Developers, users and those accessing the marine environment must take measures to address marine litter where appropriate. Reduction of litter must be taken into account by decision makers.
- **GEN 12 Water quality and resource:** Developments and activities should not result in a deterioration of the quality of waters to which the Water Framework Directive, Marine Strategy Framework Directive or other related Directives apply.
- **GEN 13 Noise:** Development and use in the marine environment should avoid significant adverse effects of man-made noise and vibration, especially on species sensitive to such effects.

- **GEN 14 Air quality:** Development and use of the marine environment should not result in the deterioration of air quality and should not breach any statutory air quality limits.
- **GEN 15 Planning alignment A:** Marine and terrestrial plans should align to support marine and land-based components required by development and seek to facilitate appropriate access to the shore and sea.
- **GEN 16 Planning alignment B:** Marine plans should align and comply where possible with other statutory plans and should consider objectives and policies of relevant non-statutory plans where appropriate to do so.
- **GEN 17 Fairness:** All marine interests will be treated with fairness and in a transparent manner when decisions are being made in the marine environment.
- **GEN 18 Engagement:** Early and effective engagement should be undertaken with the general public and all interested stakeholders to facilitate planning and consenting processes.
- **GEN 19 Sound evidence:** Decision making in the marine environment will be based on sound scientific and socio–economic evidence.
- **GEN 20 Adaptive management:** Adaptive management practices should take account of new data and information in decision making, informing future decisions and future iterations of policy.
- **GEN 21 Cumulative impacts:** Cumulative impacts affecting the ecosystem of the marine plan area should be addressed in decision making and plan implementation.

Other Offshore Wind Planning/Developments in Scotland

2.1.19 In addition to the strategic planning exercises administered by Scottish Ministers', two additional development zones in Scottish waters were identified by Crown Estate Round 3 in 2010 and have received consent: Moray Firth Eastern Development[36] and Seagreen Alpha and Bravo[37]. The Moray Firth site has since progressed further and obtained a contract for difference.

2.1.20 Furthermore, a number of demonstration projects have been developed or are in the process of development within Scottish Waters. The first of these, Beatrice Demonstration, served as an industry trial of deep water bottom-fixed foundations. The Levenmouth Demonstration Turbine[38] provided research opportunities to help drive cost reduction in offshore wind, whilst the Forthwind project[39] will allow 2B Energy to test turbine technology. In addition, Dounreay Trì[40], Hywind Scotland Pilot Park (later opened as Hywind Scotland), and Kincardine[41] were designated as Scottish Floating Demonstrations to further test and refine floating technologies. In addition, the European Offshore Wind Deployment Centre is an offshore deployment centre allowing offshore wind developers and supply chain companies to demonstrate technologies in a representative environment before commercial deployment[42] It has 11 turbines with a capacity of 93.2MW. One of the initial demonstration offshore wind projects, Robin Rigg[43], was developed in Solway Firth and has been operational for around a decade, with an installed capacity of 174MW.

[36] Moray Offshore Renewable Power (2018) Moray East – The Project [online] Available at: http://www.morayoffshore.com/moray-east/the-project/
[37] Seagreen Wind Energy Limited (2018) Home page [online] Available at: https://www.seagreenwindenergy.com/
[38] Levenmouth Demonstration Turbine (2018) [online] Available at https://ore.catapult.org.uk/testing-validation/facilities/levenmouth/
[39] 2B Energy Forthwind Project [online] Available at https://ciercoenergy.com/projects/
[40] Hexicon AB (2017) Dounreay Trì [online] Available at: http://www.hexicon.eu/dounreay-tri/
[41] 4C Offshore (2017) Kincardine Offshore Windfarm Project Offshore Wind Farm [online] Available at: http://www.4coffshore.com/windfarms/windfarms.aspx?windfarmId=UK2H
[42] Vattenfall (2016) European Offshore Wind Deployment Centre [online] Available at: https://group.vattenfall.com/uk/what-we-do/our-projects/european-offshore-wind-deployment-centre
[43] e-on (2017) Robin Rigg East and West [online] Available at: https://www.eonenergy.com/About-eon/our-company/generation/our-current-portfolio/wind/offshore/robin-rigg

2.2 Draft Sectoral Marine Plan for Offshore Wind Energy – 2019

2.2.1 Significant cost reductions in the offshore wind sector in recent years, together with the emergence of floating technology for offshore wind substructures, has encouraged Marine Scotland, as planning authority for Scotland's Seas, to undertake a new strategic planning exercise to inform the spatial development of any future leasing round. The output of this activity will provide guidance and support to the Crown Estate Scotland, which has announced its intention to run a new leasing round (ScotWind) for commercial scale offshore wind technologies in Scottish Waters, in selecting areas for release.

2.2.2 The plan establishes new Draft Plan Option (DPO) areas potentially suitable for wind energy generation in Scotland that are assessed in a SEA (this document), SEIA and HRA. The DPOs (Figure 4) include both shallow and deep water sites. The process undertaken to develop the DPOs assessed within this document is contained in Section 1.2 above.

2.3 Policy Context Overview for Marine Planning and Offshore Wind Energy in Scotland

2.3.1 The 2005 Act and the Environmental Assessment of Plans and Programmes Regulations 2004 ("2004 Regulations") require Responsible Authorities to identify the broader policy context and environmental protection objectives relevant to the plan, programme, or strategy (PPS) that is being assessed. This section sets out the broader policy environment in terms of relationships and interactions that could emerge between the Draft Plan and other PPS. The policy context is also summarised within Figure 5.

2.3.2 It is also a requirement of the 2005 Act and 2004 Regulations that Responsible Authorities provide details of the character of the environment which may be affected, including any existing pressures and the likely evolution of the environment in the absence of the PPS. The baseline information is intended to help demonstrate how the receiving environment may be affected by the implementation of the Draft Plan. An overview of existing environmental protection objectives of relevance to the Draft Plan is provided in Appendix A.

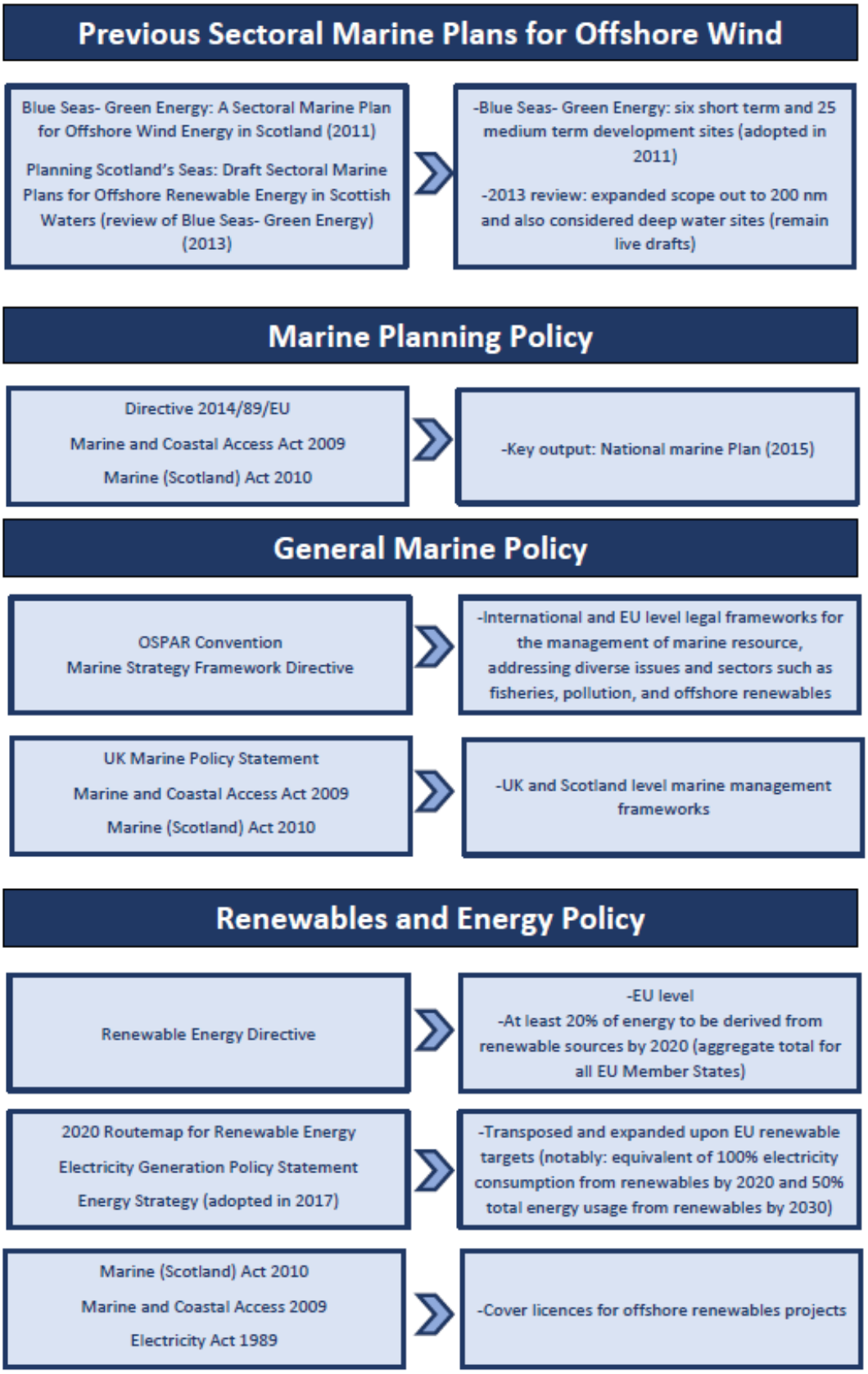

Figure 5 Policy context of the sectoral marine plan

2.4 Marine Policy

2.4.1 At an international level, the OSPAR Convention for the Protection of the Marine Environment of the North East Atlantic integrated and updated the 1972 Oslo and 1974 Paris Conventions on land-generated sources of marine pollution[44]. Specifically, it added an annex covering the protection and conservation of marine ecosystems and biodiversity[45].

2.4.2 The EU Marine Strategy Framework Directive obligates Member States to develop adaptive management strategies to bring their marine environments to Good Environmental Status by 2020 as well as to safeguard the marine resources that underlie key economic and social activities[46]. It allocates responsibility for the marine environment via a regional approach that in the case of the UK, makes use of the existing cooperative framework of the OSPAR Convention[47]. The Directive is implemented within the UK via a three part Marine Strategy[48].

2.4.3 European Directive 2014/89/EU serves as a common framework for maritime spatial planning across Europe[49]. It recognises that a comprehensive and consistent approach to maritime planning can prevent conflicts between sectors, increase cross-border cooperation, and protect the environment by identifying potential effects early and pursuing opportunities for multiple uses of space[50]. Within Scotland, the principles of the Directive are enacted through the National Marine Plan.

2.4.4 The UK Marine Policy Statement provides a vision of 'clean, healthy, safe, productive, and biologically diverse oceans and seas' that is shared by all UK countries and used to guide their respective marine management strategies[51].

2.4.5 The Marine (Scotland) Act 2010 strives to help balance competing demands on Scotland's inshore seas[52]. It introduced a duty to protect and enhance the marine natural and historic environment while at the same time streamlining the

[44] OSPAR Commission (2017) OSPAR Convention. Available at: https://www.ospar.org/convention
[45] ibid
[46] See further, European Commission (2017) Our Oceans, Seas and Coasts Available at: https://ec.europa.eu/environment/marine/index_en.htm
[47] JNCC (2013) The Convention for the Protection of the Marine Environment of the North East Atlantic (the OSPAR Convention) Available at: http://jncc.defra.gov.uk/page-1370 [accessed 09/01/2019]
[48] JNCC (2016) EU Marine Strategy Framework Directive Available at: http://jncc.defra.gov.uk/page-5193 [accessed 09/01/2019]
[49] European Commission (2014) Directive 2014/89/EU of the European Parliament and of the Council of 23 July 2014 establishing a framework for maritime spatial planning. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32014L0089 [accessed 21/01/2020]
[50] European Commission (2017) Maritime spatial planning Available at: https://ec.europa.eu/maritimeaffairs/policy/maritime_spatial_planning_en [accessed 09/01/2019]
[51] Scottish Government (2015) UK Marine Policy Statement. Available at: http://www.gov.scot/Topics/marine/seamanagement/international/MPS [accessed 09/01/2019]
[52] Scottish Government (2017) Marine (Scotland) Act. Available at: http://www.gov.scot/Topics/marine/seamanagement/marineact [accessed 09/01/2019]

marine planning and licensing system[53]. It also contains measures intended to boost growth in areas such as marine renewables[54].

2.4.6 The Marine and Coastal Access Act 2009 devolved new marine planning and conservation powers to Scottish Ministers in the offshore region (12-200nm), in addition to providing a framework for cooperative management of the marine environment between Scottish Ministers and UK Government[55].

2.4.7 Scotland's National Marine Plan fulfils joint requirements under the Marine (Scotland) Act 2010 and Marine and Coastal Access Act 2009 to prepare marine plans, providing a cohesive approach to the management of both inshore and offshore waters[56] in accordance with EU Directive 2014/89/EU[57] on maritime spatial planning. It seeks to promote development in a way that is compatible with the protection and enhancement of the marine environment[58].

2.4.8 In the context of offshore wind, the National Marine Plan lists several objectives and policies to serve as considerations in marine planning and decision making[59]. Among these are the sustainable development of offshore wind in the most suitable locations; consideration of Regional Locational Guidance and the Pentland Firth and Orkney Waters Marine Spatial Plans; and the sustainable development and expansion of test and demonstration facilities for offshore wind and marine renewable devices[60] (Renewable Policies 1-3). The development of the Sectoral marine plan therefore seeks to apply these policies.

2.4.9 Regional marine plans are currently in the process of being prepared by Regional Marine Planning Partnerships within the eleven Scottish Marine Regions (which extend out to 12 nautical miles). Regional marine plans are required to be developed in accordance with the National Marine Plan (unless relevant considerations indicate otherwise) and will be required to take into account the Plan Options identified via the sectoral marine planning process, as well as co-ordination with the CES leasing regime and grid requirements and initiatives.

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[53] Scottish Government (2017) Marine (Scotland) Act. Available at: http://www.gov.scot/Topics/marine/seamanagement/marineact [accessed 09/01/2019]
[54] ibid
[55] Marine and Coastal Access Act 2009, 2009/Chapter 23. Available at: https://www.legislation.gov.uk/ukpga/2009/23/introduction [accessed 09/01/2019]
[56] Scottish Government (2014) Scotland's National Marine Plan – A Single Framework for Managing Our Seas Available at: http://www.gov.scot/Resource/0047/00475466.pdf [accessed 09/01/2019]
[57] European Commission (2014) Directive 2014/89/EU of the European Parliament and of the Council of 23 July 2014 establishing a framework for maritime spatial planning. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32014L0089 [accessed 21/02/2020]
[58] Scottish Government (2014) Scotland's National Marine Plan – A Single Framework for Managing Our Seas Available at: http://www.gov.scot/Resource/0047/00475466.pdf [accessed 09/01/2019]
[59] Scottish Government (2015) Scotland's National Marine Plan – 11. Offshore Wind and Marine Renewable Energy. Available at: http://www.gov.scot/Publications/2015/03/6517/12 [accessed 09/01/2019]
[60] ibid

2.5 Offshore Wind and Renewables Policy

2.5.1 The EU Renewable Energy Directive 2009/28/EC states that 20% of Europe's energy usage must derive from renewable sources by 2020. The 20% figure is an aggregate total made up of individual Member State targets that differ according to each State's starting point and capacity to pursue additional renewable energy generation[61]. Mechanisms and timelines for meeting these targets are detailed in each country's national renewable energy action plan. In November 2016, proposals for a framework of new targets including a 2030 target of at least 27% of energy supplied by renewables, was introduced[62].

2.5.2 Scotland initially committed to obtaining 20% of its energy needs from renewables by 2020[63], surpassing the 15% target set for the UK as a whole. This target was later increased from 20% to at least 30% by the 2020 Route Map for Renewable Energy[64] in light of a complementary increase in the 2020 target for renewable electricity[65].

2.5.3 The Scottish Energy Strategy[66], published in December 2017, set a target of securing 50% of total energy usage from renewable sources as well as a 30% increase in the productivity of energy use across the Scottish economy by 2030. The Strategy lists renewables and low carbon solutions as a strategic priority, including exploring new opportunities for floating offshore wind, as taken forwards into the development of the Sectoral Marine Plan assessed within this SEA.

2.5.4 The Committee for Climate Change has recently published a report, recommending new emissions targets for Scotland and the UK as a whole. In this context there is a recommendation to achieve net-zero emissions by 2045. Achievement of this will require the expansion of renewable energy in Scotland, of which offshore wind is likely to form a significant contribution.

2.5.5 Proposals for offshore wind development within the DPOs will be subject to the standard leasing, licensing and consenting processes and the need for further project-level assessment (in accordance with the Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017 (as amended) and the Marine Works (Environmental Impact Assessment)

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[61] European Commission (2009) Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32009L0028 [accessed 21/02/2020]

[62] European Commission (2014) Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions – A policy framework for climate and energy in the period from 2020 to 2030. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52014DC0015 [accessed 21/01/2020]

[63] Scottish Government (2009) Renewables Action Plan. Available at: http://www.gov.scot/Publications/2009/07/06095830/0 [accessed 09/01/2019]

[64] Scottish Government (2011) 2020 Routemap for Renewable Energy. Available at: http://www.gov.scot/Publications/2011/08/04110353/0 [accessed 09/01/2019]

[65] Scottish Government (2013) Electricity Generation Policy Statement – 2013. Available at: http://www.gov.scot/Publications/2013/06/5757 [accessed 09/01/2019]

[66] Scottish Government (2017) Scottish Energy Strategy: The future of energy in Scotland. Available at: http://www.gov.scot/Resource/0052/00529523.pdf [accessed 09/01/2019]

(Scotland) Regulations 2017 (as amended) and the Habitats Directive. Licence decisions must also be taken in accordance with the National Marine Plan.[67] Further detail on these processes are contained in the Licensing and Consenting Manual.[68]

2.5.6 Licences for offshore wind energy developments are covered by the Marine (Scotland) Act 2010 for those components located within territorial sea limits (i.e. to 12 NM from shore)[69], the Marine and Coastal Access Act 2009 for those lying outside the territorial boundary (i.e. beyond 12 NM from shore)[70]. Onshore aspects such as cable connections are regulated by the Town and Country Planning (Scotland) Act 1997, with applications administered by the relevant planning authority[71]. Section 36 of the Electricity Act 1989 mandates that the construction, extension, and operation of any offshore wind and water driven developments with a generating capacity of at least 1MW in UK territorial waters must receive Ministerial approval.

2.5.7 Offshore renewable energy installations will need to be decommissioned at the end of their operational life. From 1 April 2017, Scottish Ministers have powers under the Energy Act 2004 (Part II Chapter 2), to require developers of offshore renewable energy projects in Scottish Waters and the Scottish part of a Renewable Energy Zone, to prepare a decommissioning programme, detailing how they intend to remove the installation when it comes to the end of its useful life and how the costs of doing so will be funded. This programme should include a base case of all infrastructure being removed, alongside any alternatives that the operator proposes, backed up by evidence and reasoning for the preferred option. It is accepted decommissioning methods and processes will vary according to the individual projects.

2.5.8 Developers are required to assess potential decommissioning impacts in their EIA report and decommissioning programmes must be approved prior to the commencement of construction activities. Marine Scotland will be consulting on draft guidance for the decommissioning of offshore renewable energy installations in the final quarter of 2019 and into 2020. However, until that guidance is finalised developers should ensure that they have fully read and followed the current UK Government guidance on decommissioning offshore renewable energy installations, which clearly sets out the presumption in favour of full removal and the relevant international and national standards and legislation which must be adhered

[67] Marine (Scotland) Act 2010, s. 15

[68] Scottish Government, *Offshore wind, wave and tidal energy applications: consenting and licensing manual* (October 2018). Available at: https://www.gov.scot/publications/marine-scotland-consenting-licensing-manual-offshore-wind-wave-tidal-energy-applications/ (Last accessed: 17/09/19)

[69] Scottish Government (2017) Marine (Scotland) Act. Available at: http://www.gov.scot/Topics/marine/seamanagement/marineact [accessed 09/01/2019]

[70] Marine and Coastal Access Act 2009, 2009/Chapter 23. Available at: https://www.legislation.gov.uk/ukpga/2009/23/introduction [accessed 09/01/2019]

[71] Town and Country Planning (Scotland) Act 1997, 1997/Chapter 8. Available at: https://www.legislation.gov.uk/ukpga/1997/8 [accessed 09/01/2019]

3 Approach to the Assessment

3.1 Purpose of the Assessment

3.1.1 The purpose of this SEA is to assess the potential for likely significant environmental effects that may arise from adoption of the Draft Plan. This will allow corresponding mitigation measures to be identified where necessary and highlight opportunities for enhancement in cases where beneficial effects are likely.

3.2 Relationship Between this SEA and Previous Assessments

3.2.1 A considerable amount of work has already been undertaken to explore the potential wider environmental effects of activities associated with offshore wind development. Of particular relevance are the SEAs that were previously undertaken for the 2011[72] and 2013[73] Sectoral Marine Plans for Offshore Wind. This SEA builds upon the assessment methodology, information and findings of the respective Environmental Reports that were produced as part of these assessments. This is to help ensure consistency in the strategic assessment of offshore wind energy development in Scotland.

3.2.2 The latest evidence regarding environmental effects of offshore wind farm development and mitigation of effects from available research and monitoring results has also informed this assessment. These include outputs from the ScotMER (formerly SpORRAn) process and other research programmes, such as ORJIP and the DECC/BEIS Offshore Energy SEA[74].

3.2.3 Other relevant sources of information include the SEAs that have been prepared to assess the designation and management of four MPAs[75], the designation of marine pSPAs[76], proposed fisheries management measures in MPAs and SACs[77], and Wild Seaweed Harvesting[78], as well as the ongoing

[72] Scottish Government (2010) Strategic Environmental Assessment (SEA) of Draft Plan for Offshore Wind Energy in Scottish Territorial Waters: Volume 1: Environmental Report [online] Available at: https://www2.gov.scot/Publications/2010/05/14155353/0 (accessed 21/02/2020)

[73] Scottish Government (2013) Planning Scotland's Seas: SEA of Plans for Wind, Wave and Tidal Power in Scottish Marine Waters Environmental Report [online] Available at: https://www2.gov.scot/Topics/marine/marineenergy/Planning (accessed 20/09/2018)

[74] DECC (2016) UK Offshore Energy Strategic Environmental Assessment OESEA3 Environmental Report Future Leasing/Licensing for Offshore Renewable Energy, Offshore Oil & Gas, Hydrocarbon Gas and Carbon Dioxide Storage and Associated Infrastructure [online] Available at: https://www.gov.uk/government/consultations/uk-offshore-energy-strategic-environmental-assessment-3-oesea3 (accessed 20/09/2018)

[75] Scottish Government (2019), A consultation on proposals to designate four Marine Protected Areas in Scottish waters [online] Available at: https://consult.gov.scot/marine-scotland/four-new-marine-protected-areas/ (accessed 07/08/2019)

[76] Marine Scotland (2018) SEA of Marine Proposed Special Protection Areas Strategic Environmental Assessment Environmental Report. [online] Available at: https://consult.gov.scot/marine-scotland/sea-for-15-proposed-special-protection-areas/supporting_documents/Marine%20SPA%20SEA%20%20Consultation%20document%20%20September%202018.pdf (accessed 28/09/2018)

[77] Document not yet publicly available.

[78] Scottish Government (2016) Wild Seaweed Harvesting Strategic Environmental Assessment Environmental Report [online] Available at: http://www.gov.scot/Publications/2016/11/6869/0 (accessed 01/02/2018).

SEA of the plan to improve protection given to Priority Marine Features (PMFs) outside the MPA network[79] and the SEA of the plan to designate a deep sea marine reserve in Scottish waters[80].

3.3 Scope of the Plan to be Assessed

3.3.1 Marine Scotland will deliver an overarching Sustainability Appraisal (SA) through four key, complementary initiatives: the SEA; a Habitats Regulations Appraisal (HRA); a socio-economic impact assessment (SEIA); and public consultation on the Draft Plan.

3.3.2 The SEA and development of the Draft Plan have been undertaken alongside each other in order for the results of the SEA, together with the results of the HRA and SEIA, to inform the development of the final Draft Plan.

3.4 Scope of the Assessment

3.4.1 Following a review of previous offshore wind plan SEAs[81, 82], as well as relevant academic and grey literature, the Screening and Scoping Report[83] proposed that the following SEA topics should be scoped into the assessment:

- Biodiversity, Flora, and Fauna;
- Population and Human Health;
- Soil (namely, Marine Geology and Coastal Processes);
- Water Quality;
- Climatic Factors;
- Cultural Heritage; and
- Landscape, Seascape, and Visual Amenity.

3.4.2 Consultation responses on the Screening and Scoping Report have been reviewed and where appropriate have been built into the assessment scope and methodology.

3.4.3 The assessment has included consideration of the likely significant effects resulting from the Draft Plan on the marine and coastal environments where relevant. The potential effects associated with all offshore wind development stages, including pre-construction (e.g. UXO survey/clearance) and

[79] SEA of Proposed Inshore PMF Management Measures Strategic Environmental Assessment Screening and Scoping Report [online] Available at: https://consult.gov.scot/marine-scotland/priority-marine-features/ (accessed 20/09/2018)
[80] Document not publicly available.
[81] Scottish Government (2010) Strategic Environmental Assessment (SEA) of Draft Plan for Offshore Wind Energy in Scottish Territorial Waters: Volume 1: Environmental Report [online] Available at: https://www2.gov.scot/Publications/2010/05/14155353/0 (accessed 21/02/2020)
[82] Scottish Government (2013) Planning Scotland's Seas: SEA of Plans for Wind, Wave and Tidal Power in Scottish Marine Waters Environmental Report [online] Available at: https://www2.gov.scot/Topics/marine/marineenergy/Planning (accessed 20/09/2018)
[83] Marine Scotland (2018) Sectoral Marine Plan for Offshore Wind Encompassing Deep Water Options Strategic Environmental Assessment Screening and Scoping Report [online] Available at: https://www.gov.scot/Publications/2018/06/3524 (accessed 20/09/2018)

decommissioning phases, have also been assessed. As a broad assumption, decommissioning phases have been assumed to be of the same magnitude as construction impacts for all receptors unless specified otherwise.

3.4.4 At this stage, it is considered that significant environmental effects on 'Air Quality' are unlikely to arise through the implementation of the Draft Plan. As such, this topic has been scoped out of the assessment.

3.4.5 The SEA topic of 'Material Assets' encompasses a broad range of subtopics that include both built and natural assets and relevant issues have been assessed under corresponding SEA topic areas. For example, potential effects that relate to nursery and spawning grounds of commercial fish have been covered under the topic of 'Biodiversity, Flora, and Fauna'. Similarly, infrastructure with regard to the promotion of a diverse and decarbonised energy sector has been given consideration under the topic of 'Climatic Factors'. SEPA advised that the potential re-use of existing energy infrastructure, particularly in relation to North Sea Oil and Gas Rig Decommissioning should be assessed by this SEA. This issue is not possible to assess in detail at this stage due to the uncertainty around project locations and for the most part existing infrastructure has been excluded from the areas under assessment. However, it is recognised as a potential opportunity that will need to be considered in the future. 'Material Assets' has therefore been scoped out of the assessment. This reflects the approach taken in previous offshore wind plan SEAs[84, 85].

3.4.6 The effects on other marine users, such as the potential displacement of commercial fishing activity, recreational boating, and tourism, have been considered by the accompanying SEIA. Issues of navigational safety and collision risk for vessels have been covered, as far as possible, within the topic of 'Population and Human Health'.

3.4.7 A summary of the scope of the assessment and associated potential effects is presented in Table 2.

[84] Scottish Government (2010) Strategic Environmental Assessment (SEA) of Draft Plan for Offshore Wind Energy in Scottish Territorial Waters: Volume 1: Environmental Report [online] Available at: https://www2.gov.scot/Publications/2010/05/14155353/0 (accessed 21/02/2020)

[85] Scottish Government (2013) Planning Scotland's Seas: SEA of Plans for Wind, Wave and Tidal Power in Scottish Marine Waters Environmental Report [online] Available at: https://www2.gov.scot/Topics/marine/marineenergy/Planning (accessed 20/09/2018)

Table 2 SEA topics scoped into the assessment

SEA Topic	Potential Effects
Biodiversity, Flora, and Fauna	▪ Loss of and/or damage to marine and coastal habitats, including benthic and intertidal habitats (for example, due to smothering of benthic habitats and substratum loss); ▪ Effects on key receptors and prey species, including disturbance, noise effects, EMF exposure, collision risk, habitat exclusion, and barriers to wildlife movement; ▪ Positive effects arising from habitat enhancement, such as the creation of artificial reefs, new roosting structures and exclusion of habitat damaging activity; ▪ Effects of pollution releases on both species and habitats; and ▪ Effects from introduction and spread of Invasive Non-Native Species (INNS).
Population and Human Health	▪ Effects arising from noise, vibration, light, dust and shadow flicker effects from all phases of development; ▪ Effects on residential amenity stemming from construction/installation/operational activities; ▪ Issues of navigational and aviation safety and collision risk; and ▪ Effects on marine and coastal recreation and access
Soil (Marine Geology and Coastal Processes)	▪ Effects on subsea geology, sediments, and coastal processes arising from changes in hydrodynamics and the existing wave regime.
Water Quality	▪ Effects on ecological status; ▪ Effects on water quality (for example, due to increases in suspended sediment loads and turbidity as well as an increase in pollution incidents); and ▪ Effects of the presence of structures on local currents, wave regimes, and water column mixing, as well as secondary effects on sedimentation and erosion beyond the sites.

SEA Topic	Potential Effects
Climatic Factors	▪ Contribution to supporting a diverse and decarbonised energy sector; and ▪ Coastal facilities may be at risk from climate change.
Cultural Heritage	▪ Loss of and/or damage to historic environment features and their settings, including coastal and marine archaeology and historic MPAs.
Landscape/Seascape	▪ Both temporary and longer term effects on landscape and coastal character and visual receptors arising from the presence of structures including any ancillary infrastructure.

3.5 Consideration of Reasonable Alternatives

3.5.1 The development of the draft Plan has been an iterative process that has been informed throughout by relevant environmental information and has given regular consideration to reasonable alternatives. These alternatives are confined to the consideration of alternative offshore wind opportunities, in line with the focus of the draft Plan.

3.5.2 The initial Areas of Search scoping work identified prospective Areas of Search, in line with the objective of the plan to identify locations for potential future offshore wind development in the period up to 2050 in Scottish waters, through a consideration of multiple constraints that would restrict potential for sustainable offshore wind development or where offshore wind development would be likely to negatively affect the environment, other sectors or users of the sea. These initial AoS have been refined following consideration of feedback received through the initial consultation on the AoS, extended engagement with key stakeholders, preparation of the RLG, cross-sectoral steering group feedback and updated analysis resulting in the identification of 17 DPO areas in which offshore wind energy could potentially be sustainably pursued. Section 1.2 above describes how these areas were identified and where others were removed from the process.

3.5.3 An assessment of reasonable alternatives has been undertaken at each of the assessment stages described in detail in Section 3.6. The first stage of the assessment has involved setting out the potential environmental effects associated with a range of alternative offshore wind technologies that could be implemented in Scottish marine waters.

3.5.4 The second stage has been to apply the potential environmental effects identified in the first stage to spatial and locational constraints identified in the baseline data for each of the DPOs. The DPOs (see Figure 4) themselves constitute reasonable alternatives as they represent different options for fulfilling the objectives of the Draft Plan, based on varying levels of constraint and opportunity as described above.

3.5.5 The third stage in the assessment has been to determine the potential cumulative environmental effects associated with development in multiple DPOs at a regional and national scale. For the assessment of cumulative effects at regional and national scales, three scenarios, relating to different realistic scales of possible future offshore wind development within the DPOs, have been considered. These three scenarios give indicative low, medium and high development scenarios of installed capacity within the DPOs at a regional and subsequently national scale. The SEA and SEIA use these scenarios to inform the assessment of a broad range of impact scenario.

3.6 Assessment Methodology

3.6.1 The assessment has involved the following stages:

- Stage 1: Identify the range of environmental effects associated with alternative offshore wind technologies;
- Stage 2: Identify environmental effects of applying the range of effects identified in Stage 1 to the alternative DPOs; and
- Stage 3: Assessment of potential cumulative effects, including those associated with the alternative scenarios for different scales of possible future offshore wind development within the DPOs.

Stage 1: Identify the Range of Environmental Effects Associated with Alternative Offshore Wind Technologies

3.6.2 Stage 1 of the assessment has been to identify the range of potential environmental effects that could result from alternative offshore wind technologies and subsea cables during all project phases of offshore wind development (i.e. pre-construction, construction, operation and maintenance, and decommissioning).

3.6.3 This initial stage has drawn on a number of different sources of information, including the results of previous assessment work highlighted in Section 3.2, research studies including those undertaken for Marine Scotland and by the offshore wind energy industry, guidance for the environmental assessment of offshore wind projects, general findings from available environmental impact assessments (EIAs) of offshore wind development projects and emerging monitoring information from existing installations where relevant. The evidence base and outcomes of this initial assessment stage are documented in Appendix B.

Stage 2: Identify Environmental Effects of Applying the Range of Effects Identified in Stage 1 to the Alternative DPOs

3.6.4 Stage 2 of the assessment has been to assess each of the alternative DPOs and possible subsea cable routes against the environmental baseline, reflecting on the sensitivity of environmental features within these areas and the potential environmental pressures associated with offshore wind farm development identified in the Stage 1 assessment, to determine the likely significance of any environmental effects. The second stage in the assessment has involved developing evidence-based assumptions on how the wider environment might be affected by such development and then describing and quantifying any likely significant positive or negative environmental effects associated with the realistic maximum scale of development in each DPO.

3.6.5 The particular importance of accessing the best available spatial data on mobile species' distribution and functional use of the sea space (e.g. seabirds and marine mammals) is recognised as these have been significant issues for

previous offshore wind projects. Focused reviews on these topics have been undertaken to inform both the SEA and HRA of the Draft Plan. These reviews have drawn on best available information, including outputs from the ScotMER process, ORJIP and the DECC/BEIS Offshore Energy SEA[86].

3.6.6 Stage 2 of the assessment has comprised a combination of desk-based review and Geographic Information System (GIS) analysis. The outcomes have been presented in tables for each DPO, as illustrated in Table 3. The first column presents the SEA topic scoped into the assessment. The second column highlights the key relevant headline baseline information for a DPO, rather than all of the detail considered in the assessment. This provides a means for the relevant environmental baseline and problems to be a key component of the assessment. This approach is known as a 'baseline-led assessment' and sets the context of the DPO within their receiving environment.

Table 3 Example assessment table

SEA Topic	Key Baseline Evidence	Potential for Effects	Characteristics	Mitigation Available and Potential Residual Effects
Biodiversity,				
Etc.				

3.6.7 The third column discusses the potential effects of offshore wind development on the receiving environment. This is based on the realistic maximum scale of development within each DPO taking account of the likely scale of overall development under the Plan. Table 4 sets out the likely scale of maximum development at each DPO. These assumptions are consistent with those used in the accompanying SEIA. For individual DPOs, in line with the broad parameters for the Plan, it has been assumed that the minimum scale of development within any DPO is 100 MW.

3.6.8 The fourth column describes the characteristic of the effect. This provides a summary of the relevant dimensions of effects set out in Schedule 3 (6) of the Environmental Assessment (Scotland) Act 2005. This includes the timescale of effects, whether effects are permanent or temporary, positive or negative, and whether there are particular secondary, cumulative or synergistic effects where these could be determined and relevant to the assessment of significance.

3.6.9 The final column considers the potential mitigation that might be available to prevent, reduce and as fully as possible offset any significant adverse effects, and assesses the residual risk to environmental receptors through the application of judgement informed by the criteria in Table 5. i.e. judgement is

[86] DECC (2016) UK Offshore Energy Strategic Environmental Assessment OESEA3 Environmental Report Future Leasing/Licensing for Offshore Renewable Energy, Offshore Oil & Gas, Hydrocarbon Gas and Carbon Dioxide Storage and Associated Infrastructure [online] Available at: https://www.gov.uk/government/consultations/uk-offshore-energy-strategic-environmental-assessment-3-oesea3 (accessed 20/09/2018)

used to balance where partial criteria for a magnitude level is met. The results of these assessments are set out in Appendix C.

Table 4 Realistic maximum scale of development within each DPO

Region	DPO	Area km²	Potential Installed Capacity (GW)	Realistic Maximum Development Scenario for each DPO (GW)
East	E1	3816	19.1	3
	E2	1287	6.4	2
	E3	474	2.4	1
North East	NE1	776	3.9	2
	NE2	464	2.3	1
	NE3	339	1.7	1
	NE4	440	2.2	1
	NE5	496	2.5	1
	NE6	699	3.5	2
	NE7	1027	5.1	3
	NE8	401	2.0	1
North	N1	1163	5.8	2
	N2	560	2.8	2
	N3	1106	5.5	2
	N4	200	1.0	1
West	W1	1107	5.5	2
South West	SW1	292	1.5	1

Table 5 Assessment criteria

Type	Magnitude	Indicative Criteria
Negative/Positive	Major	Large spatial scale (size/number); Major intensity (level/magnitude); Long-term (duration/frequency); High sensitivity of features; and/or Low tolerance/reversibility of features.
	Moderate	Medium spatial scale; Moderate intensity; Medium-term; Moderate sensitivity of features; and/or

Type	Magnitude	Indicative Criteria
		Moderate tolerance/reversibility of features.
	Minor	Small spatial scale; Low intensity; Short-term; Low sensitivity of features; and/or High tolerance/reversibility of features.
Adverse/Beneficial	Negligible	There is likely to be a change, but the level will be indiscernible from baseline conditions.

Stage 3: Assessment of Potential Cumulative Effects, including those Associated with the Scenarios for Different Scales of Possible Future Offshore Wind Development within the DPOs

3.6.10 The third stage of the assessment has been the cumulative assessment. This has firstly identified the potential effects of development in multiple DPOs at a regional scale and determining where these may have significant environmental effects, taking account of the likely scales of development under the plan at a regional level. Three scenarios have been reviewed against each region (Table 6), taking into account the potential for a greater or lesser proportion of the total (national, see Section 3.6.11) scale of development to be present in a particular region.

Table 6: Regional scenarios

Region	Total DPO Area (km²)	Maximum Potential Installed Capacity (GW)	Low Development Scenario (GW)	Medium Development Scenario (GW)	High Development Scenario (GW)
East	5577	27.9	1	2	3
North East	4641	23.2	1.5	3	4.5
North	3030	15.1	1	2	3
West	1107	5.5	0.5	1	2
South West	292	1.5	0.3	0.6	1

3.6.11 A national scale assessment of the potential effects of possible future offshore development within the DPOs in the period 2020 to 2050 has also been undertaken by considering the following three scenarios at a national level:

- Low Development Scenario: 3 GW Installed Capacity;
- Medium Development Scenario: 5 GW Installed Capacity; and

- High Development Scenario: 10 GW Installed Capacity.

3.6.12 This is to help to identify possible capacity constraints and how different scales of development within DPOs might give rise to differing levels of environmental effect at a national scale. These scenarios enable the assessment to consider whether the magnitude of an effect is altered by smaller or larger areas of development, or whether an effect is related simply to the presence of devices and independent of the areas of development. It should be noted that although Scottish Government provided direction, the scenarios used are hypothetical and are not a formal commitment or statement of policy. The reasoning behind the selection of 10 GW as the high development scenario is discussed in the Draft Plan.

3.6.13 The cumulative assessment has then investigated the combined effects of the Plan at a regional and national scale alongside other plans and projects. Consideration has been given to the competition for space between different sectors and within sectors. Given the significant uncertainty regarding the scale or design of development, this stage has not sought to quantify impacts, rather it has identified current and future developments that would require integration into a cumulative assessment at a project level.

3.6.14 The cumulative effects assessment has been qualitative in nature and has assessed the potential for cumulative effects. However, recognising the uncertainties of where and when development might occur under the plan, there will also be a requirement for a more detailed cumulative assessment to be undertaken at a project level, at which point there is likely to be additional information on other development locations and timings.

3.6.15 The final stage of the assessment has also involved summarising the overall effects of the Draft Plan against the SEA objectives set out in Table 7.These objectives, which are based on those which were developed for previous offshore wind plan SEAs[87, 88], have been updated following advice from the Consultation Authorities during the scoping phase of the Draft Plan (Section 1.3). This 'objective led approach' provides a useful measure to draw together and comment on the combined performance of the Draft Plan.

[87] Scottish Government (2010) Strategic Environmental Assessment (SEA) of Draft Plan for Offshore Wind Energy in Scottish Territorial Waters: Volume 1: Environmental Report [online] Available at: https://www2.gov.scot/Publications/2010/05/14155353/0 (accessed 21/01/2020)

[88] Scottish Government (2013) Planning Scotland's Seas: SEA of Plans for Wind, Wave and Tidal Power in Scottish Marine Waters Environmental Report [online] Available at: https://www2.gov.scot/Topics/marine/marineenergy/Planning (accessed 20/09/2018)

Table 7 SEA objectives

SEA Topic	SEA Objective
Biodiversity, Flora, and Fauna	▪ To safeguard marine and coastal ecosystems, including species, habitats, and their interactions; ▪ To avoid adverse effects on both designated and non-designated habitats and species (note: this work has been developed in parallel with the HRA work); and ▪ To avoid the introduction and spread of INNS.
Population and Human Health	▪ To maintain the accessibility of natural areas for recreation; ▪ To minimise or prevent the discharge of pollutants into the natural environment; and ▪ To avoid adverse effects on human health and safety.
Soil (Marine Geology and Coastal Processes)	▪ To avoid exacerbating coastal erosion and maintain the integrity of coastal processes; ▪ To maintain and protect the character and integrity of the seabed, including avoiding the pollution of seabed strata/bottom sediments; and ▪ To avoid significant adverse physical damage to coastal geodiversity sites from coastal infrastructure.
Water Quality	▪ To avoid pollution of the coastal and marine water environment; and ▪ To maintain or work towards achieving good ecological status.
Climatic Factors	▪ To contribute to a diverse and decarbonised energy sector; ▪ To ensure that adaptation to predicted climate change impacts are taken into account (for example, through consideration of resilience and changing environmental sensitivity); and ▪ To preserve marine carbon stocks and carbon sequestration potential (note: this objective is closely linked to the SEA topic of 'Biodiversity, Flora, and Fauna').
Cultural Heritage	▪ To protect and, where appropriate, enhance, the historic marine environment; ▪ To avoid damage to known and unknown coastal and marine archaeology; and ▪ To avoid adverse effects on the character and setting of historic sites and buildings.
Landscape/Seascape	▪ To avoid or minimise adverse effects on landscape, seascape, and visual amenity, including designated sites; ▪ To promote the protection of seascape and coastal landscapes; and ▪ To avoid or minimise adverse visual effects.

3.7 Identifying Mitigation and Monitoring Proposals

3.7.1 Potential measures to mitigate adverse effects or enhance benefits associated with the Draft Plan and development within the DPOs have been identified. This has built on the recommendations that were made in the previous offshore wind plan SEAs[89,90], and strategic work undertaken to fill data gaps and uncertainties, and to assist with mitigating potentially significant adverse environmental effects.

3.7.2 In identifying potential regional environmental sensitivities associated with development within the DPOs and requirements for mitigation measures, alternative technology (and construction method) choices have been identified as key mitigation measures. The 'avoid/ reduce (or minimise)/ offset' hierarchy has also been applied to the consideration of appropriate mitigation measures.

3.7.3 Monitoring proposals have focused on the significant environmental effects that have been identified during the course of the work undertaken to develop DPOs, as well as following implementation of mitigation measures where appropriate. Where possible, existing data sources and indicators will be linked with relevant indicators to minimise resourcing requirements for additional data collection.

3.8 Assumptions, Data Gaps and Limitations

3.8.1 Where data gaps or a lack of evidence exist, then uncertainty is introduced into the Draft Plan and into the prediction of environmental effects. Given these uncertainties, a clear and transparent approach has been adopted for the assessment, documenting any assumptions, data gaps and limitations. Many of these gaps, limitations and difficulties have informed the development of recommendations as set out in Section 6.

Understanding of Scotland's Marine Environment

3.8.2 Whilst a great deal of research has been undertaken on Scotland's marine and coastal environments through public bodies, and by academic institutions and the offshore wind sector, it is widely acknowledged that significant data gaps remain in the understanding of the current and future marine environment. For example, the spatial and temporal distributions of mobile features are not fully characterised, and there are uncertainties regarding the presence of submerged marine structures and buried assets, including underwater archaeology features. Key data gaps and issues are highlighted in the environmental baseline review (Section 4).

[89] Scottish Government (2010) Strategic Environmental Assessment (SEA) of Draft Plan for Offshore Wind Energy in Scottish Territorial Waters: Volume 1: Environmental Report [online] Available at: https://www2.gov.scot/Publications/2010/05/14155353/0 (accessed 21/02/2020)

[90] Scottish Government (2013) Planning Scotland's Seas: SEA of Plans for Wind, Wave and Tidal Power in Scottish Marine Waters Environmental Report [online] Available at: https://www2.gov.scot/Topics/marine/marineenergy/Planning (accessed 20/09/2018)

Consideration of Possible Technologies

3.8.3 There is uncertainty concerning the nature of potential future technologies for offshore wind that will be deployed which creates uncertainties for the assessment of potentially significant effects. The DPOs provide space both for conventional fixed bottom installations in shallower water (<60 m) and for deeper water (floating) technologies. It is currently unclear how quickly and to what extent deep water technologies might become cost competitive and thus what the balance between technologies might be.

3.8.4 There is also uncertainty concerning construction methods, particularly for deep water technologies, where a variety of options for foundation substructures, might be considered. For example, deep water wind projects may require less percussive piling (and less intensive piling) than some existing offshore wind technologies (monopiles, jackets) and thus underwater noise during construction could be less of an issue compared to conventional projects. However, construction methods for some deep-water technologies could still entail some level of piling.

3.8.5 In order to account for these uncertainties within the assessment, a 'Design Envelope' approach has been adopted to the consideration of potential effects associated with alternative offshore wind technologies, recognising that this will be conservative.

Consideration of Supporting Activities

3.8.6 There remains a degree of uncertainty surrounding the potential effects of some supporting activities as a result of the precise location of activities being unknown. For example, the location of any dredging that might be required to provide fill for gravity base foundations.

3.8.7 Where possible, the potential and general environmental effects of these activities have been identified through a review of the outcomes from the consenting process for past and present projects but have a limited spatial focus as acknowledged in the appropriate sections of this report.

Taking Account of Cable Routes

3.8.8 There is currently a high level of uncertainty concerning the possible location and number of export cables associated with potential development within the DPOs. These requirements will depend on the scale and location of development within the DPOs and the future development of grid connection points (both onshore and possibly offshore). Some information is available from National Grid[91] on potential and planned grid reinforcement which indicates locations where capacity may be available in the future, but this only extends to

[91] National Grid, 2018. Network Options Assessment 2017/18. https://www.nationalgrideso.com/sites/eso/files/documents/Network-Options-Assessment-2017-18.pdf

the medium term and does not take into account potential further offshore wind development in Scottish waters. It remains challenging to predict the precise routes for export cable corridors.

3.8.9 Given these uncertainties, the approach adopted in this study has not considered in detail the potential cable corridors but has more broadly considered the environmental sensitivities of inshore areas. Where sensitive features need to be avoided, this has been identified as a potential mitigation requirement.

Cumulative Effects Assessment

3.8.10 Cumulative effects assessments present significant methodological challenges owing to limitations of data availability from other plans and projects, and uncertainties in the manner in which the DPOs will be developed. The approach to assessing the cumulative effects of the Plan alone and in combination with other plans and projects is set out in Section 3.6.

4 Environmental Baseline

4.1 Introduction

4.1.1 This section of the report describes the character of the environment which may be affected by the implementation of the Draft Plan. It provides an overview of the national baseline environment that encompasses those topics agreed for consideration within for the SEA (see Section 3.4).

4.1.2 To provide a further understanding of the baseline at a regional level, the Regional Locational Guidance (RLG)[92] document has been developed in parallel with this SEA and is intended to support the SEA, SEIA and the HRA. Consequently, several topics covered within the RLG are not encompassed by this document (e.g. Commercial Fisheries, Tourism and Recreation etc.) but are considered within the other assessments as relevant.

4.1.3 The topics covered by the SEA are:

- Biodiversity, Flora, and Fauna;
- Population and Human Health;
- Soil (namely, Marine Geology and Coastal Processes);
- Water Quality;
- Climatic Factors;
- Cultural Heritage; and
- Landscape, Seascape, and Visual Amenity.

4.1.4 In addition to providing a baseline overview of these topics, consideration is also given to the likely future evolution of these over the next 40 years in the absence of the Draft Plan.

4.1.5 The baseline indicates the current state of the environment and therefore incorporates offshore wind developments which have been constructed. the RLG contains a more detailed review of current activity within each region. In addition, where relevant to development in a DPO all current and potential future developments, including those not yet consented, are highlighted in the cumulative effects section below (Section 0) for assessment at a project level.

4.2 Biodiversity Flora and Fauna

4.2.1 Scotland’s marine environment supports a diverse complex of different habitats, which in turn support a wide range of marine plants and animals. Estimates suggest that there are around 6,500 species of animals and plants (excluding microbial flora and seabirds) in Scotland’s seas[93]. There are a number of pressures on biodiversity within Scottish seas, linked to the development of

[92] Scottish Government (2019) Draft Regional Locational Guidance – Offshore Wind in Scottish Waters.
[93] Marine Scotland (2011) Scotland's Marine Atlas: Information for The National Marine Plan.

industry in the marine environment. The Feature Activity Sensitivity Tool (FEAST) provides more comprehensive information on the relevant pressures associated with a range of marine activities and the sensitivity of MPA protected features to these activities and pressures[94].

4.2.2 Key pressures to species and habitats include climate change, coastal developments, dredging, pollution, marine litter, seabed abrasion, invasive non-native species. The effect of these pressures is dependent on their intensity and the vulnerability of marine and coastal species and habitats to these pressures.

Broadscale Habitats

4.2.3 Benthic (seafloor) habitats are vital natural resources, as many marine species rely, directly or indirectly, on the seafloor to feed, hide, rest or reproduce. Generally benthic habitats are characterised by low mobility species[95]. Marine habitats within the Scottish marine environment can be characterised into three broad groups: intertidal habitats; subtidal (inshore and shelf sea); and deep-sea habitats. These broad groups can be further broken down by substrate type.

4.2.4 The latest information presented in Figure 6 on predicted seabed habitats is provided by the National Marine Plan Interactive (NMPi)[96] and EMODnet Seabed Habitats Phase 2 mapping (EUSeaMap, 2016). The layer is a predictive European Nature Information System (EUNIS) seabed habitat map for the UK continental shelf, which has been created using five pre-processed input datasets: substrate, biological zone, energy, salinity and biogeographic region.

4.2.5 Overall, mud, sand and coarse sediment are found in the North Sea and to the west of the Hebrides. The seabed in the far west and far north of Scotland is characterised by mud and fine clay, with coarser sediments in shallower water and on banks and seamounts[97]. There are areas of rock and hard substrate within Scottish waters, principally to the west and south of the outer Hebridean islands, or in inshore waters closer to the coastline.

[94] The Scottish Government (2013) FEAST – Feature Activity Sensitivity Tool. [online] Available at: http://www.marine.scotland.gov.uk/feast/ (accessed 20/12/18)
[95] OSPAR. 2017. Condition of Benthic Habitat Communities: Subtidal habitats of the Southern North Sea. Available at https://oap.ospar.org/en/ospar-assessments/intermediate-assessment-2017/biodiversity-status/habitats/condition-of-benthic-habitat-defining-communities/subtidal-habitats-southern-north-sea/.
[96] National Marine Plan interactive (NMPi). Available at http://www.scotland.gov.uk/topics/marine/seamanagement/nmpihome (accessed 25/01/2018)
[97] UK Marine Monitoring and Assessment Strategy (UKMMAS) (2010) Charting Progress 2: An assessment of the state of UK seas.

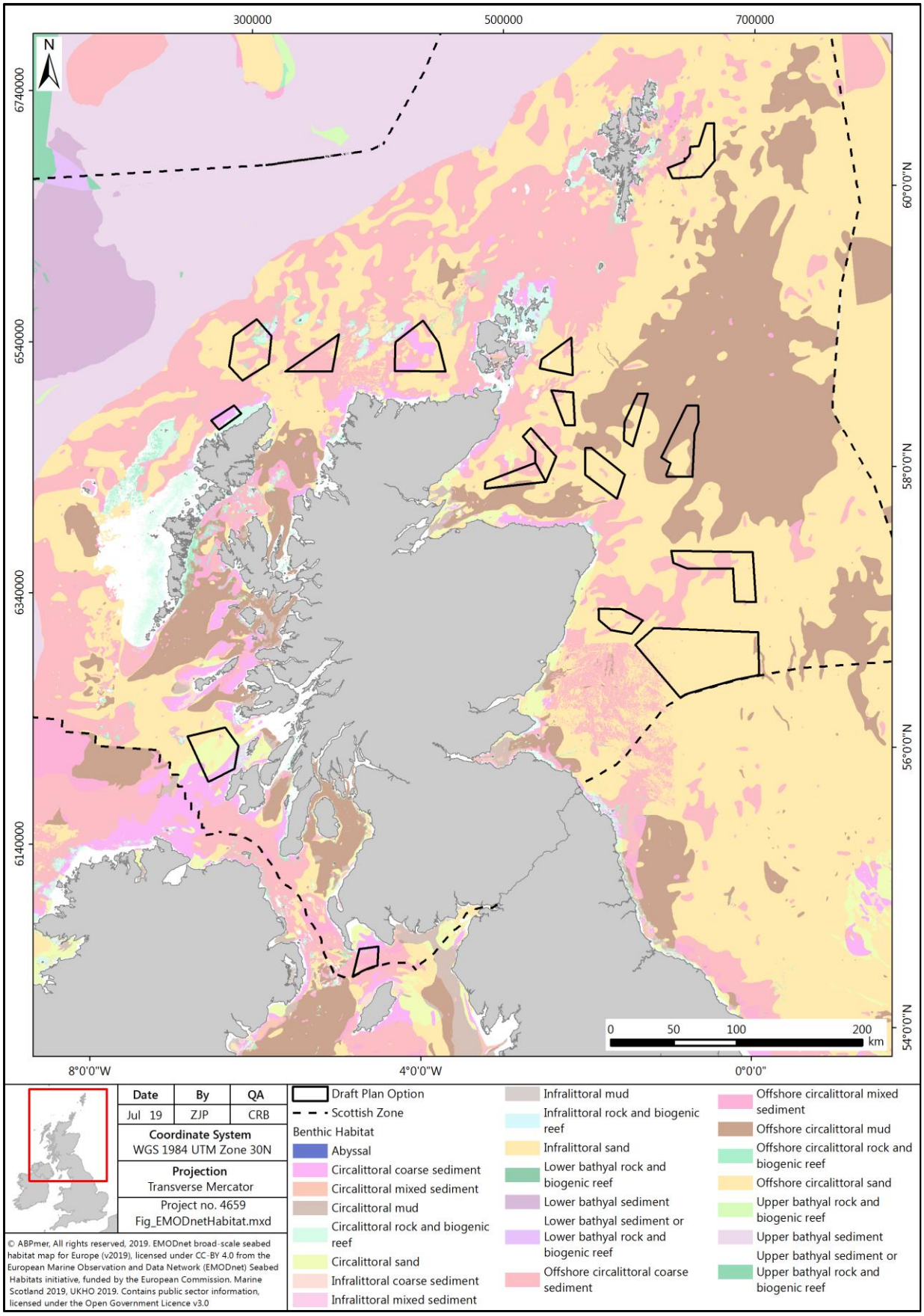

Figure 6 EMODnet seabed habitats

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Designated Features

Protected habitats and species

4.2.6 The importance of Scotland's marine ecosystems is reflected in the range of designations which protect them at international and national levels. All designations are included within Scotland's MPA network, covering approximately 22% of Scottish seas[98]. The conservation designations include:

- Special Areas of Conservation (SAC): These include both inshore, offshore and riverine SAC (included for the purposes of migratory fish) and cover eleven different marine habitat types which occur in Scotland (sandbanks which are slightly covered by seawater all the time; estuaries; mudflats and sandflats not covered by seawater at low tide; coastal lagoons; large shallow inlets and bays; reefs; submarine structures made by leaking gases; and submerged or partially submerged sea caves). Seven species that occur in Scotland's marine environment are also protected (bottlenose dolphin, harbour porpoise, grey seal, harbour seal, sea lamprey, Atlantic salmon and otter).
- Special Protection Areas (SPAs): These sites are of international importance for birds (e.g. seabirds, waders, ducks, geese).
- Nature Conservation MPAs (NCMPAs): These sites protect habitats and species of national importance such as maerl beds, coral gardens, and common skate.
- Sites of Specific Scientific Interest (SSSI): These are nationally designated sites which protect species such as seabirds and seals, and habitats such as sea caves and rocky shores.

4.2.7 In addition, Ramsar sites are designated for their internationally important wetlands. Existing and proposed Nature Conservation MPAs, SACs, SPAs and Ramsar sites are shown in Figure 7.

4.2.8 Currently there are 18 MPAs designated for nature conservation purposes under the Marine (Scotland) Act 2010 and 37 SACs designated under the EU Habitats Directive located within territorial waters (i.e. within 12 NM of the territorial baseline) (Figure 7). A further 13 MPAs and 11 SACs are designated in the offshore environment (i.e. from 12 NM from the territorial baseline, or within non-territorial waters) There is one additional MPA designated for demonstration and research purposes, Fair Isle D&R MPA, designated in 2016. The Scottish Government is considering plans for the designation of four additional NCMPAs around the Scottish coast, for which a consultation has been undertaken, and there is potential for an additional deep sea MPA.

[98] Scottish Government (2019) Website: MPA Network [online] available at https://www2.gov.scot/Topics/marine/marine-environment/mpanetwork

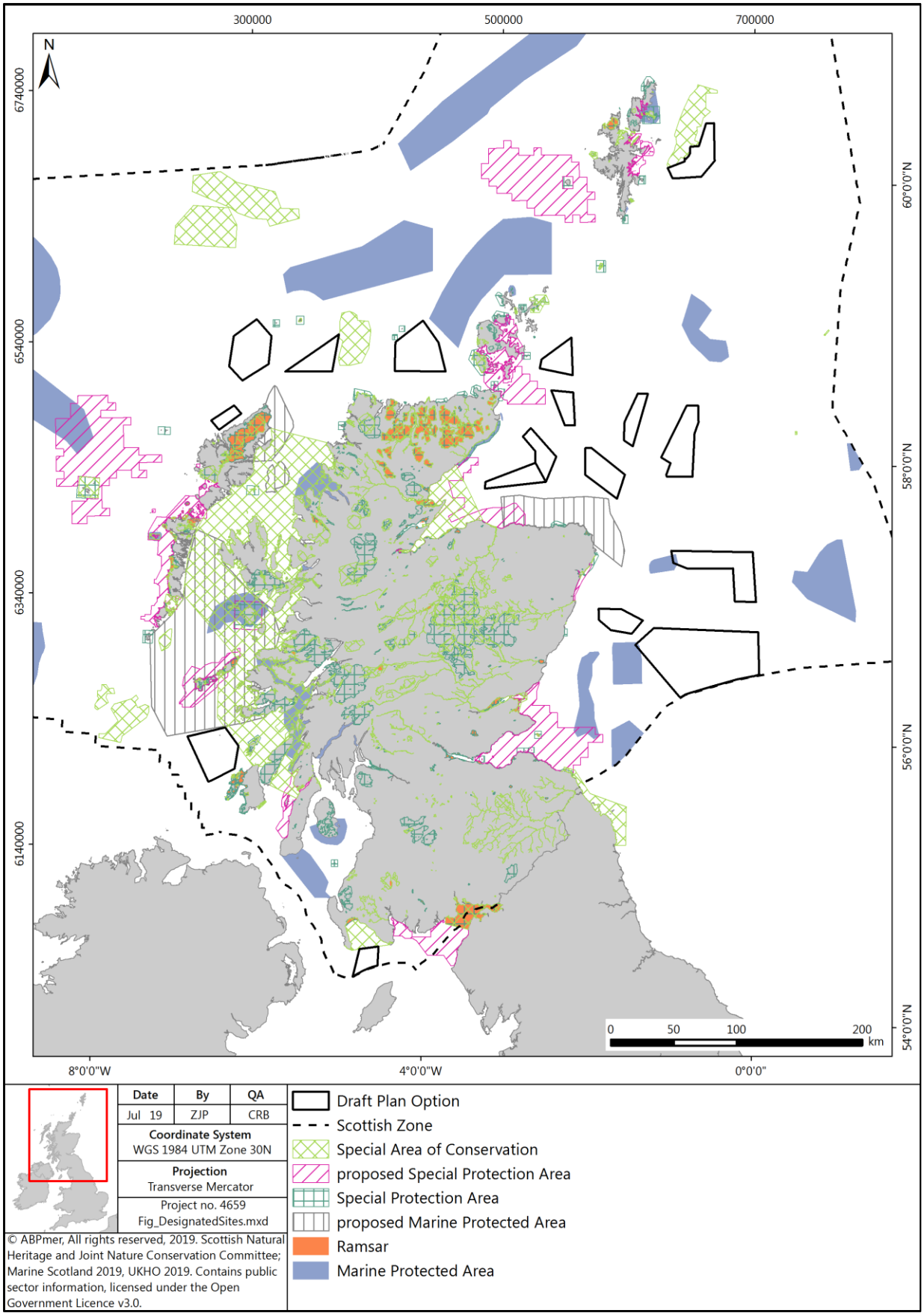


Figure 7 Designated sites in Scotland's marine environment

4.2.9 There are 47 current SPAs in Scotland with marine or coastal components, 31 of which are extensions to seabird colony SPAs designated under the EU Birds Directive to protect a range of vulnerable breeding, overwintering or migratory bird species and assemblages. The Scottish Government has consulted on a further 15 proposed SPA which are identified for designation in the marine environment (consultation closed 9 November 2018).

4.2.10 There are 66 SSSI for the further protection of species such as seabirds and seals and habitats ranging from sea caves and rocky shores. There are also 16 Ramsar sites designated as internationally important wetlands, covering a total area of about 313,000 hectares.

4.2.11 The Habitats Directive also affords protection to certain habitats (Annex I habitats), and species of plants and animals (European Protected Species). In the marine environment these include cetaceans and otters. The OSPAR List of Threatened and/or Declining Species and Habitats also identifies species and habitats of concern that should be considered when assessing the impact of development on the environment.

Priority marine features

4.2.12 In July 2014, Scottish Ministers adopted a list of 81 PMFs. PMFs are species and habitats which have been identified as being of conservation importance to Scotland[99]. Most are a subset of species and habitats identified on national, UK or international lists. The National Marine Plan includes a policy (GEN 9 Natural Heritage) for safeguarding PMFs whereby "*Development and use of the marine environment must not result in significant impact on the national status of PMFs*" [100].

4.2.13 The list of 81 PMFs comprises 26 broad habitats (e.g. burrowed mud), seven low or limited mobility species (e.g. ocean quahog), and 48 mobile species, including fish (both marine (e.g. cod) and diadromous (e.g. Atlantic Salmon)) and marine mammals (e.g. minke whale).

4.2.14 Although many PMFs are protected within the MPA network, further management measures have been proposed for 11 of the most vulnerable PMFs and these are currently being assessed as part of a separate SEA (see Section 3.2).

Mobile Features

4.2.15 Scotland's marine environment supports a wide range of mobile species with a number of populations considered to be either of international or national importance. Many mobile species within Scottish seas are protected through

[99] Scottish Natural Heritage, 2018. Priority marine features in Scotland's seas. [online] Available at: https://www.nature.scot/professional-advice/safeguarding-protected-areas-and-species/priority-marine-features-scotlands-seas (accessed 02/05/2018)

[100] The Scottish Government, 2015. Scotland's National Marine Plan. A single framework for managing our seas. [online] Available at: http://www.gov.scot/Publications/2015/03/6517/5 (02/05/2018)

designation or classification of areas within Scottish waters or around Scottish coastlines. Mobile species in Scottish seas include the following groups:

- Seals (grey and harbour seals);
- Cetaceans (23 species have been recorded in Scottish waters over the last 25 years; of these, 11 are regularly sighted);
- Birds (both breeding seabirds and overwintering waterbirds);
- Fish, incorporating marine and diadromous species, including sharks, rays and skates; and
- European otter (inshore waters only).

Marine mammals (seals and cetaceans)

4.2.16 Marine mammals are widely distributed throughout Scottish waters. Species distributions are a function of prey availability, habitat distribution and species life cycles. Eleven species of cetacean are regularly sighted around Scottish seas. These comprise species with important resident populations, such as harbour porpoise, alongside more migratory species passing through Scottish seas, such as sperm whale. Key marine mammal species in Scottish seas include:

- Grey seal;
- Harbour seal;
- Harbour porpoise;
- Bottlenose dolphin;
- White-beaked dolphin;
- Fin whale;
- Minke whale;
- Short-beaked common dolphin;
- Atlantic white-sided dolphin;
- Risso’s dolphin;
- Long-finned pilot whale;
- Killer whale; and
- Sperm whale.

4.2.17 All of the above species are designated as PMFs.

4.2.18 Grey seals are distributed widely around Scottish coastlines with important populations in the Orkney Islands. Harbour seal populations are also distributed

widely around Scotland, although they have undergone a general decline in numbers since 2001[101,102].

4.2.19 The pattern of decline is not universal, with populations growing significantly around the Hebridean Islands[103], suggesting that these areas are important for this species. Figure 8 to Figure 10 shows the Grey and Harbour seal haul-out sites and at sea distributions around the Scottish coastline.

4.2.20 Figure 11 to Figure 15 illustrate the distribution of some of the most commonly seen cetacean species in Scottish waters, including those which are currently included or proposed for inclusion in the MPA network. The results from the SCANS III surveys also provide knowledge of the distribution and abundance of cetacean species in Scotland[104]. A consideration of marine mammal distribution at a regional level is included within the RLG[105]. It is recognised that there are some limitations in the data presented, particularly regarding recording bias, whereupon areas which are more regularly surveyed may exhibit higher numbers of records and hence abundance.

4.2.21 In addition to the species discussed above, there is potential for humpback whales to be present throughout Scottish waters, with increasing records year on year[106]. It is recognised that the majority of migrating individuals remain in deep water off the continental shelf[107] and therefore the exact distribution or number of individuals frequenting more inshore Scottish waters with potential to overlap with DPOs remains unknown, however there are records of humpback whales in more inshore waters both on the east and west coasts[108].

[101] Duck, C.D. & Morris, C.D. 2016. Surveys of harbour and grey seals on the south-east (border to Aberlady Bay) and south-west (Sound of Jura to Solway Firth) coasts of Scotland, in Shetland, in the Moray Firth and in the Firth of Tay in August 2015. Scottish Natural Heritage Commissioned Report No. 929. Available at http://marine.gov.scot/data/snh-commissioned-report-929-surveys-harbour-and-grey-seals-south-east-border-aberlady-bay-and.

[102] Arso Civil, M., Smout, S., Thompson, D., Brownlow, A., Davison, N., Doeschate, M., Duck, C., Morris, C., Cummings, C., McConnell, B. and Hall, A. J. (2018) Harbour Seal Decline – vital rates and drivers. Report to Scottish Government HSD2. Available at https://risweb.st-andrews.ac.uk/portal/en/researchoutput/harbour-seal-decline--vital-rates-and-drivers(e63c0fbe-b5dd-44ef-b341-457c7bdda315).html.

[103] SCOS (2017) Scientific Advice on Matters Related to the Management of Seal Populations: 2017. Available at: http://www.smru.st-andrews.ac.uk/files/2018/01/SCOS-2017.pdf. Accessed 15/06/2018.

[104] SCANS III (2017). Estimates of cetacean abundance in European Atlantic waters in summer 2016 from the SCANS-III aerial and shipboard surveys. University of St Andrews, UK. Available at: https://synergy.st-andrews.ac.uk/scans3/files/2017/05/SCANS-III-design-based-estimates-2017-05-12-final-revised.pdf. (Accessed 26/03/19).

[105] Scottish Government (2019) Draft Regional Locational Guidance – Offshore Wind in Scottish Waters.

[106] O'Neil, Katie E. Cunningham, Emily G. Moore, Daniel M.2019 Sudden seasonal occurrence of humpback whales Megaptera novaeangliae in the Firth of Forth, Scotland and first confirmed movement between high-latitude feeding grounds and United Kingdom waters- Marine Biodiversity Records- 12 - 1

[107] Whaletrack. UiT (2018). In: The Arctic University of Norway; [online]. https://en.uit.no/prosjekter/prosjekt?p_document_id=505966. Accessed 30/09/2019.

[108] Hebridean Whale and Dolphin Trust (2019) Sightings map [online] available at https://whaletrack.hwdt.org/sightings-map/. Accessed 30/09/2019.

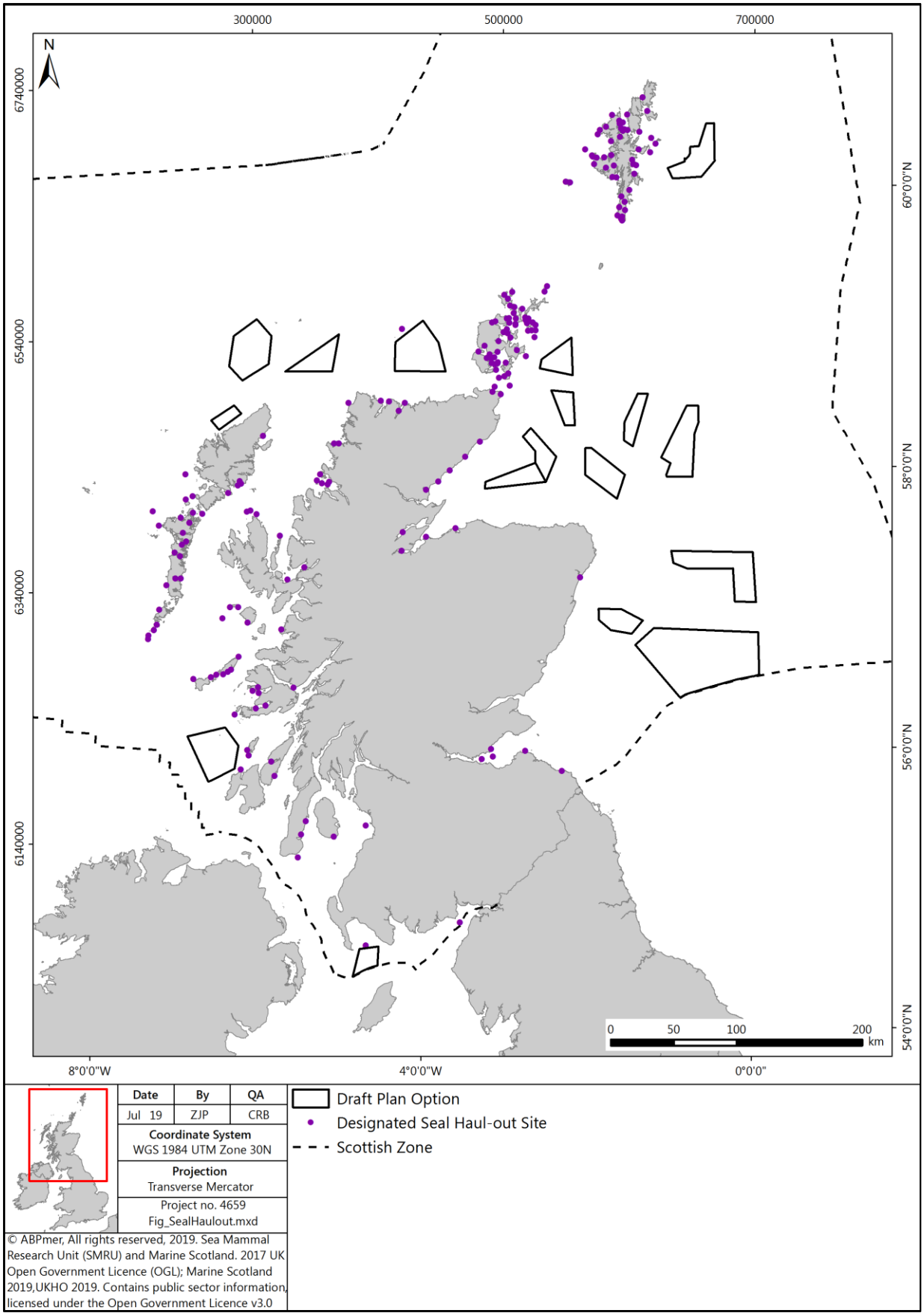


Figure 8 Grey and harbour seal designated haul-out sites

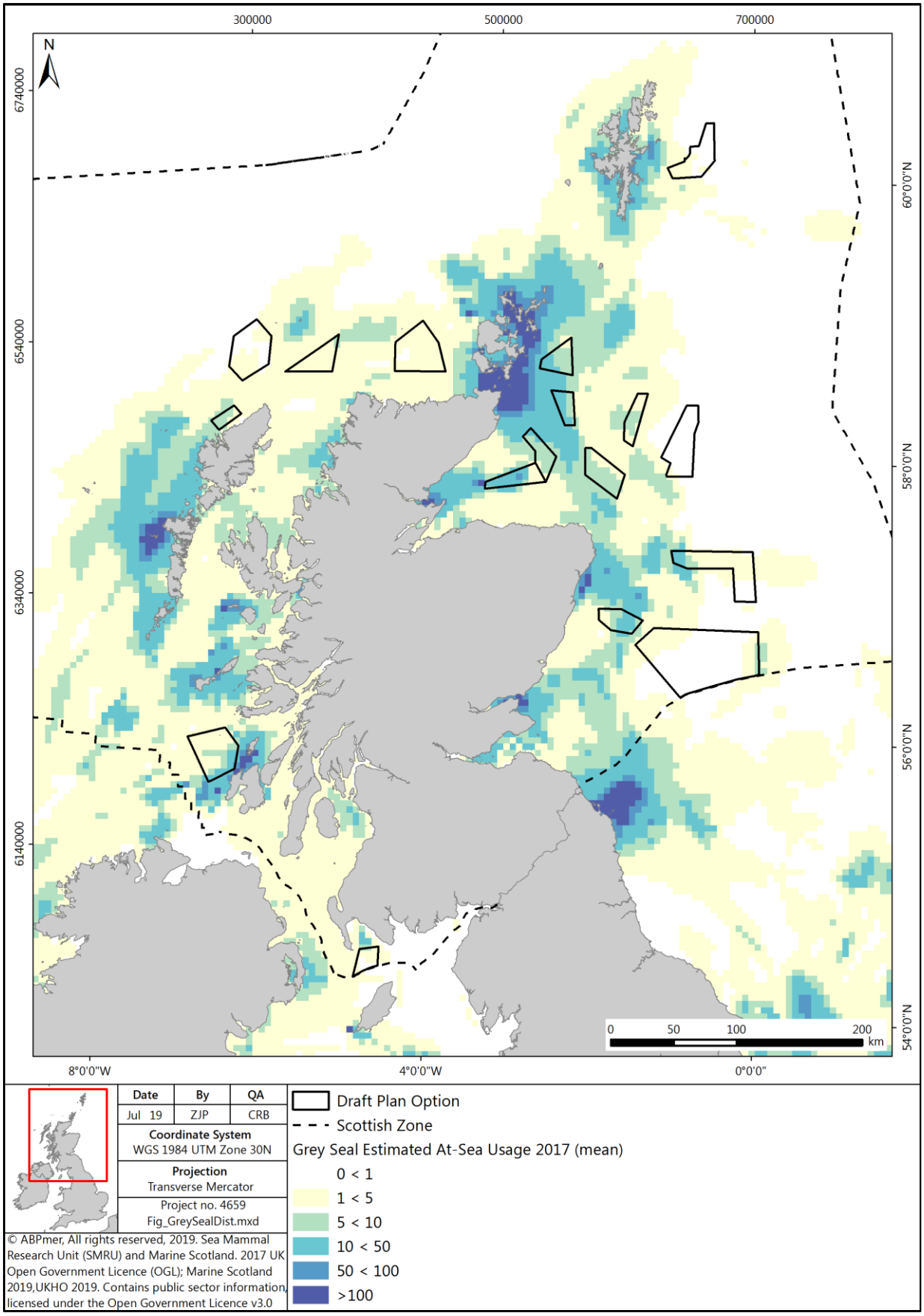


Figure 9 Grey Seal at sea distribution

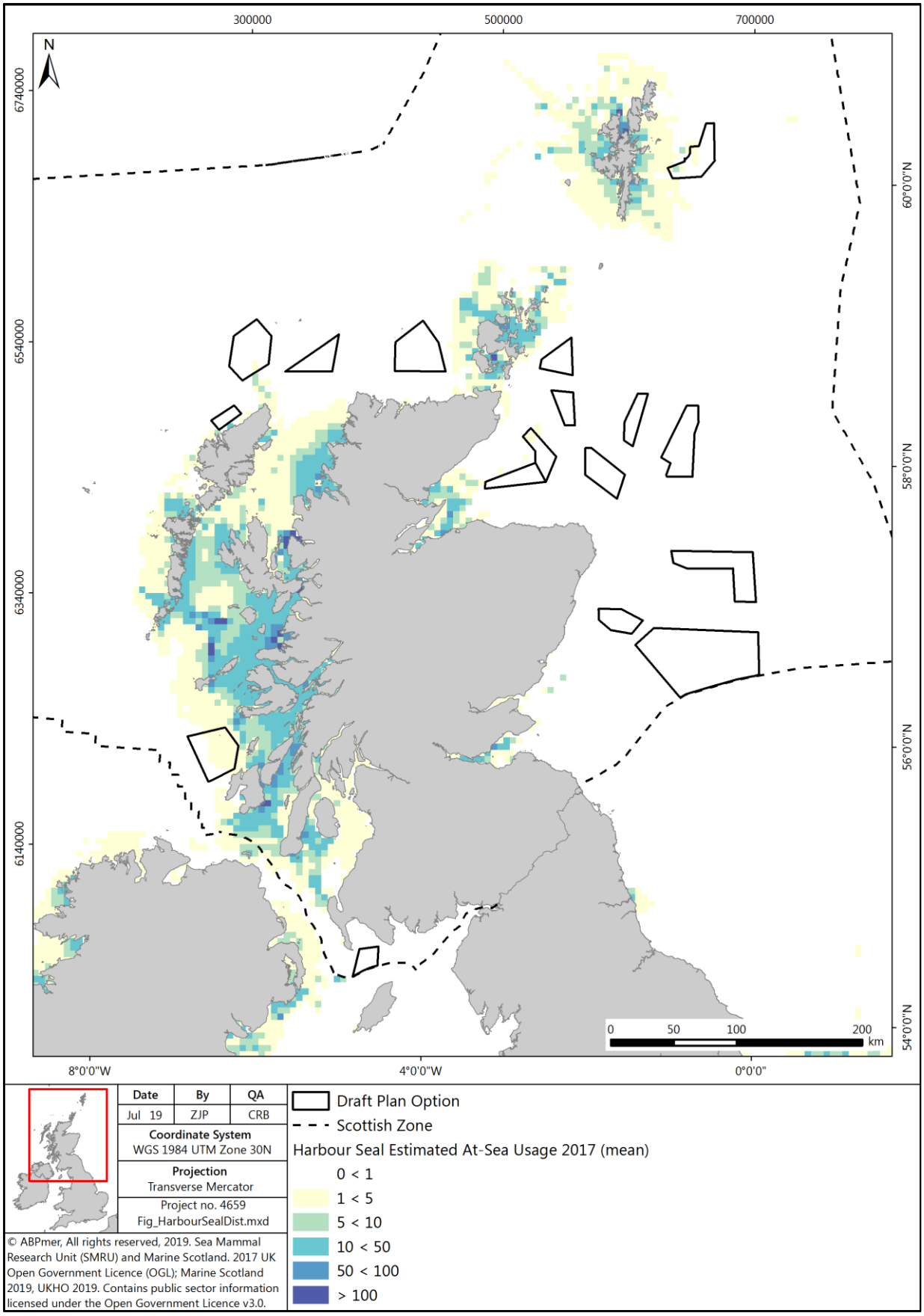


Figure 10 Harbour Seal at sea distribution

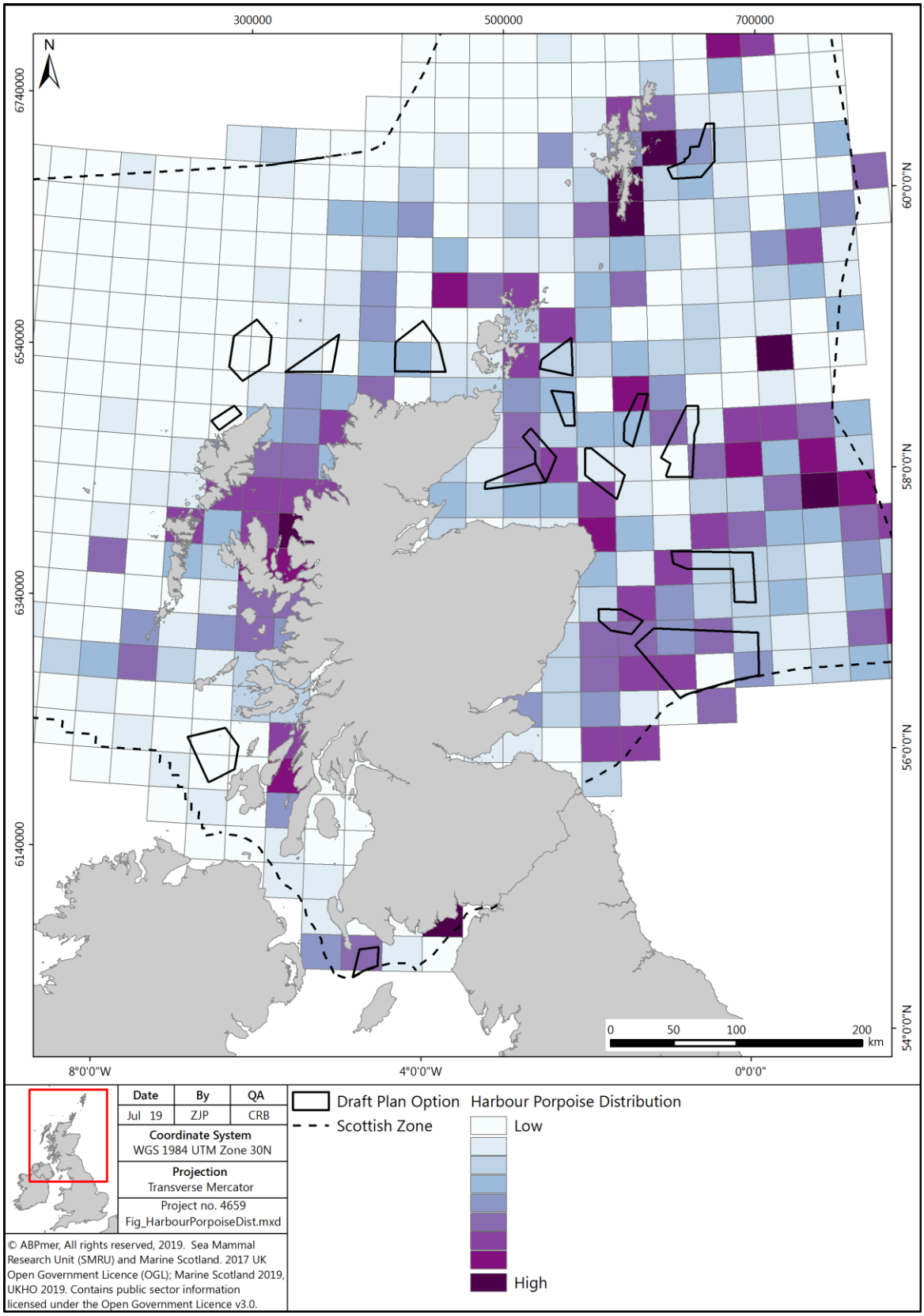


Figure 11 Harbour porpoise distribution in Scottish waters[109]

[109] Annual distribution and relative abundance of Harbour porpoise (Phocoena phocoena) (1979 - 1997) (Priority Marine Feature) (SNH WMS)

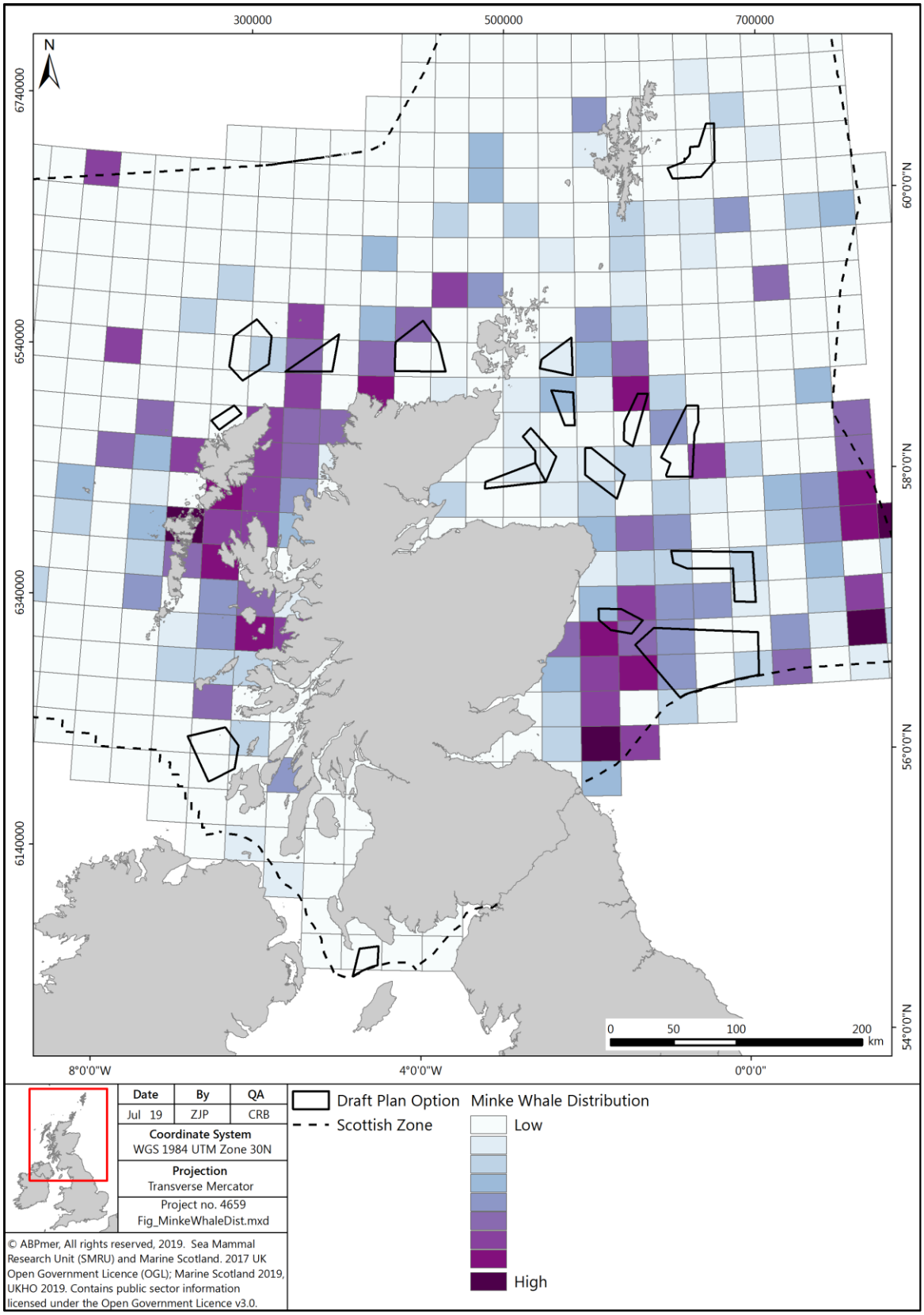


Figure 12 Minke whale distribution in Scottish waters[110]

[110] Annual distribution and relative abundance of Minke whale (Balaenoptera acutorostrata) (1979 - 1997) (Priority Marine Feature) (SNH WMS)

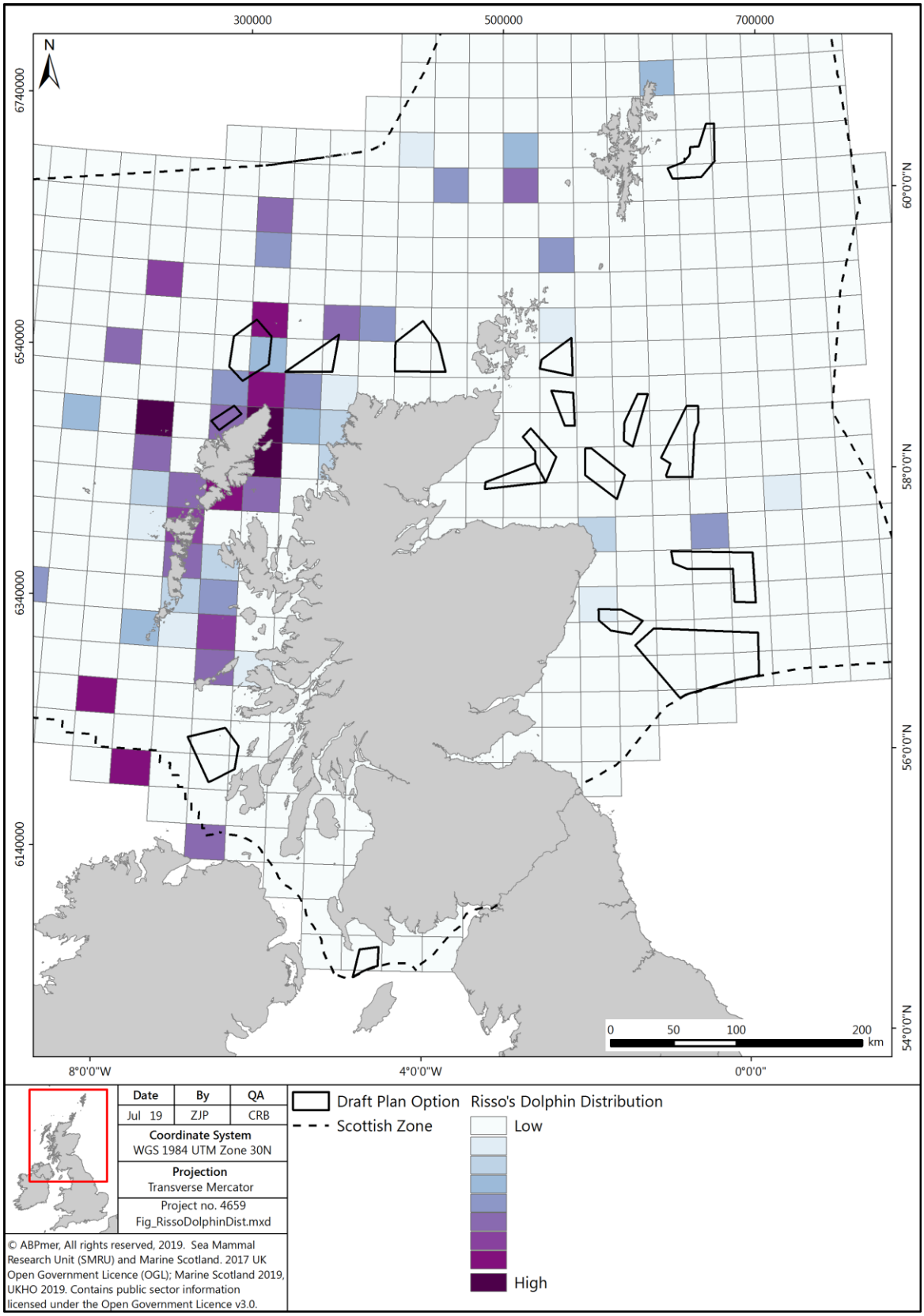


Figure 13 Risso's dolphin distribution in Scottish waters[111]

[111] Annual distribution and relative abundance of Risso's dolphin (Grampus griseus) (1979 - 1997) (Priority Marine Feature) (SNH WMS)

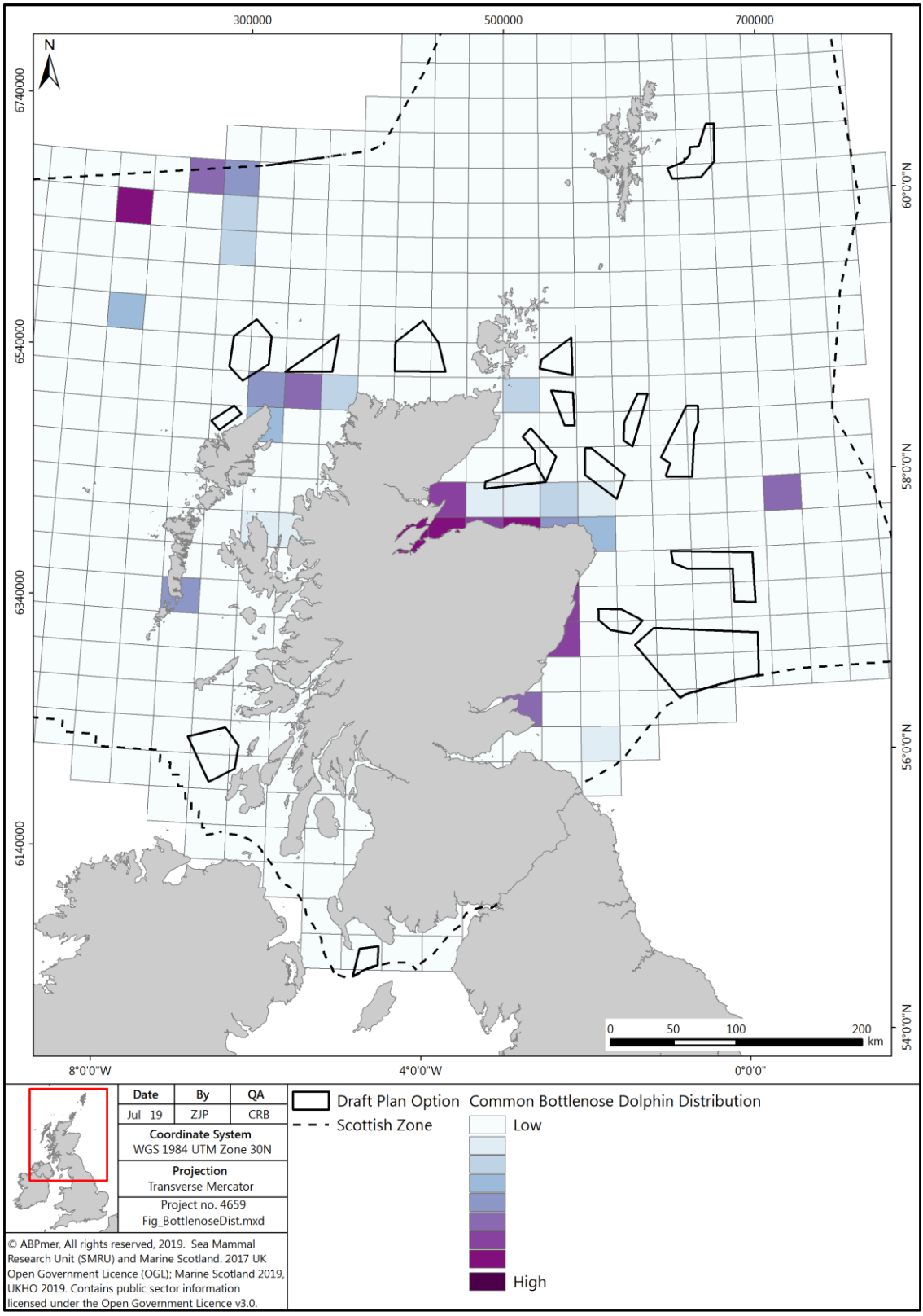


Figure 14 Bottlenose dolphin distribution in Scottish waters[112]

[112] Annual distribution and relative abundance of Bottlenose dolphin (Tursiops truncatus) (1979 - 1997) (Priority Marine Feature) (SNH WMS)

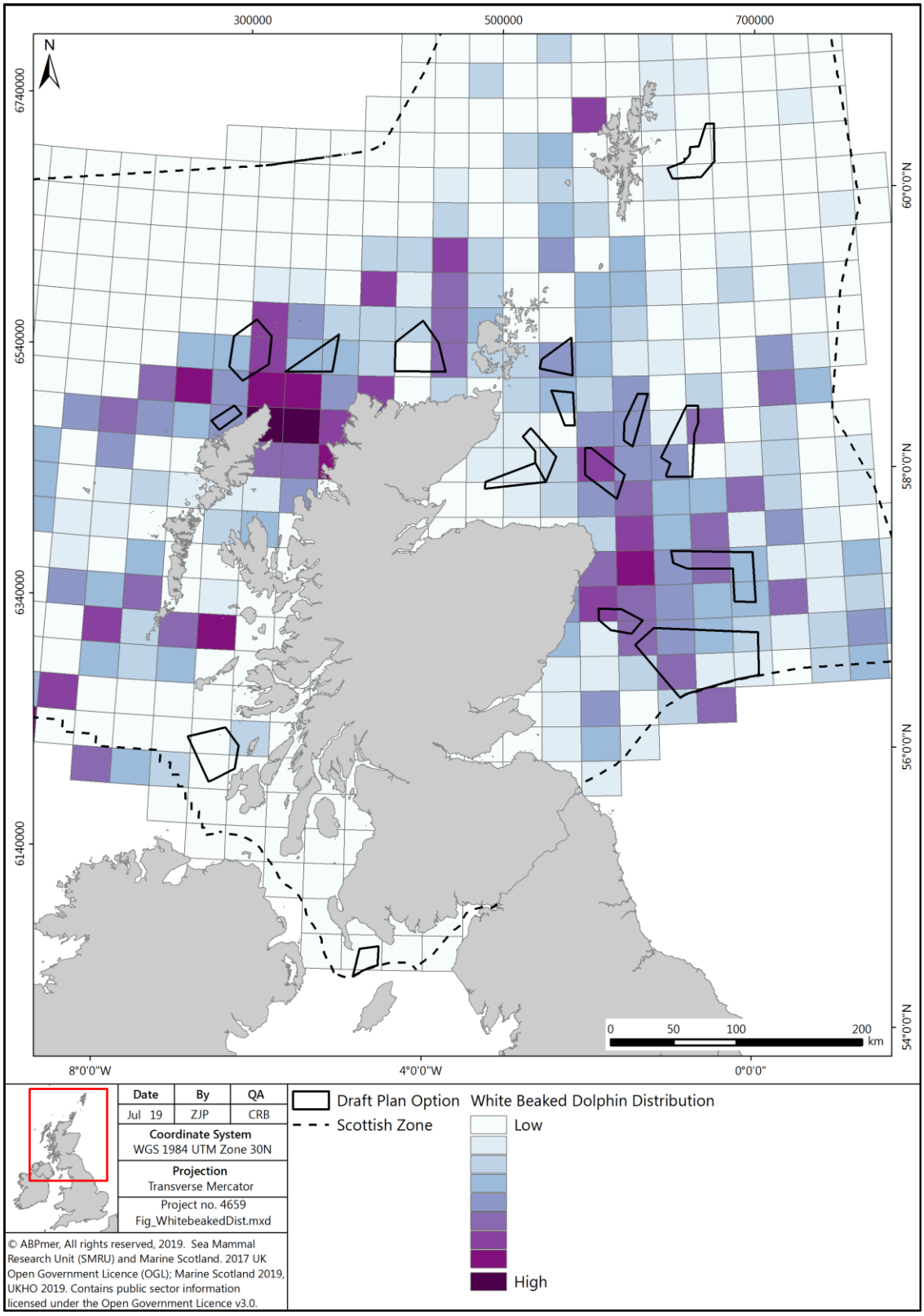


Figure 15 White beaked dolphin distribution in Scottish waters[113]

[113] Annual distribution and relative abundance of White-beaked dolphin (Lagenorhynchus albirostris) (1979 - 1997) (Priority Marine Feature) (SNH WMS)

Birds

4.2.22 Scotland, and its coastline, is important for marine and coastal birds, including seabirds, seaducks, divers, grebes, waders and waterfowl. Scotland provides an essential feeding station for migrating birds, a safe winter haven for ducks, geese and shorebirds, and provides nesting sites for seabird species. It sustains internationally significant numbers of 24 species of breeding seabirds, with additional migratory species of waterbird overwintering along Scotland's coasts and in estuaries (e.g. Moray Firth, Firth of Forth).

4.2.23 Scotland is also important for large numbers of terrestrial bird species, several of which are known to migrate over long distances, including over areas of sea, particularly around the Hebridean Islands.

4.2.24 In recent years White Tailed Sea Eagles have been re-introduced to Scotland, and a breeding population is now established on the west coast and in the Western Isles[114]. More recently a pair has started breeding on Hoy in Orkney. Sea Eagles, particularly juveniles, have large foraging areas and are known to fly long distances.

4.2.25 Scotland's Marine Atlas[115] reported that seabird populations are increasing in some areas (Solway Firth and the Firth of Clyde, for example) and (in some cases significantly) decreasing in others for certain species. In East and West Shetland and along the North Scotland coast, this decrease is most probably related to a shortage of prey species resulting from changes in oceanographic conditions. For example, pressures on sandeel populations have been linked to major declines in Kittiwake and Arctic Skua, discussed further below. Like seabirds, waterbirds (wildfowl and waders) are also both increasing and decreasing year on year, depending on the species and location. For example, Common Shelduck and Northern Pintail have shown increases, whereas Tufted Duck and Common Eider have undergone significant population decline. The reasons for the changes remain to be fully explained but may in part be due to redistribution of wintering birds across northwest Europe due to climate change effects[116].

4.2.26 A recent assessment of seabird trends between 1986 and 2016 found that the mean numbers of 12 species of breeding seabirds in Scotland had declined by 62% compared to the 1986 baseline level[117]. Out of the 12 species assessed for breeding numbers, Arctic Skua had experienced the largest declines (77%). The Northern Isles are their key breeding area and there have been declines in

[114] RSPB, undated. Bird guide, white-tailed eagle. [online] available at https://www.rspb.org.uk/birds-and-wildlife/wildlife-guides/bird-a-z/white-tailed-eagle/

[115] Baxter, J.M., Boyd, I.L., Cox, M., Donald, A.E., Malcolm, S.J., Miles, H., Miller, B., Moffat, C.F. 2011. Scotland's Marine Atlas: Information for the national marine plan. Marine Scotland, Edinburgh. Available at https://www.gov.scot/Publications/2011/03/16182005/0.

[116] Maclean, Ilya & Austin, Graham & Rehfisch, Mark & Blew, Jan & Crowe, Olivia & Delany, Simon & DEVOS, KOEN & DE-CEUNINCK, BERNARD & Günther, Klaus & Laursen, Karsten & ROOMEN, MARC & Wahl, Johannes. (2008). Climate change causes rapid changes in the distribution and site abundance of birds in winter. Global Change Biology. 14. 2489 - 2500. 10.1111/j.1365-2486.2008.01666.x.

[117] SNH. 2018. Biodiversity Indicator: The numbers and breeding success of seabirds, S005, July 2018.

the availability of sandeels, which they obtain from other seabirds, such as Kittiwake, by chasing them to make them release their food. Similar patterns of decline have occurred for the species they parasitise, particularly Kittiwakes and terns. Increased predation from Great Skua has also been linked to their decline. Some species trends, although less prominent, appear to be stabilising possibly at a new level which differs from the 1986 baseline. Numbers of Common Terns increased in 2016, which may reflect a rapid response to favourable breeding conditions.

4.2.27 The assessment found that seabird breeding productivity between 1986 and 2016 varied for the 12 species analysed. Breeding success in 2016 was above the long-term average (1986 to 2015) for Arctic Tern; Black-legged Kittiwake; common tern; little tern; Northern Gannet and Sandwich Tern. Great Skua and Herring Gull had lower breeding success. All other species were around the long-term average.

4.2.28 The European Seabirds At Sea database (Figure 16) shows the areas of comparatively high bird sightings, which can be used as an indicator of high bird density. Areas on the east coast, particularly in the Moray Firth and Firth of Forth, are of specific importance, alongside some areas around the Hebrides, Orkney and Shetland Islands[118]. Whilst this data gives a good indication of the seabird distribution, there is likely to be bias in the reporting based on the effort in an area. This bias has been accounted for and additional data incorporated into maps produced for the Marine Ecosystems Research Programme (MERP), for the 12 most common seabirds which have separately been consulted during the assessment but for which the data is not currently publicly available. For further information, the maps are available on the MERP website[119].

4.2.29 The RSPB has produced distribution maps for four key species; Black-legged Kittiwake, Guillemot, Shag and Razorbill (Figure 17). These maps show areas of high at sea usage, mostly concentrated on the east coast for Kittiwake and Guillemot, with some hotspots around breeding colonies (often designated as SPAs) on the north and west coasts. In addition, Wakefield et al (2013)[120] identify foraging areas for Gannets from breeding colonies, indicating that much of the Scottish continental shelf sea is frequented by foraging Gannet.

4.2.30 A more detailed review of bird distribution in relation to the DPOs is presented within the RLG[121].

[118] Kober, K., Webb, A., Win, I., Lewis, M., O"Brien, S., Wilson, L.J., Reid, J.B. 2010. An analysis of the numbers and distribution of seabirds within the British Fishery Limit aimed at identifying areas that qualify as possible marine SPAs. JNCC report No. 431.
[119] https://www.marine-ecosystems.org.uk/getattachment/Top_predators/Top_predator_distribution_map_2.png
[120] Wakefield, ED, Bodey, TW, Bearhop, S et al. (19 more authors) (2013) Space Partitioning Without Territoriality in Gannets. Science, 341 (6141). 68 - 70. ISSN 0036-8075
[121] Scottish Government (2019) Draft Regional Locational Guidance – Offshore Wind in Scottish Waters.

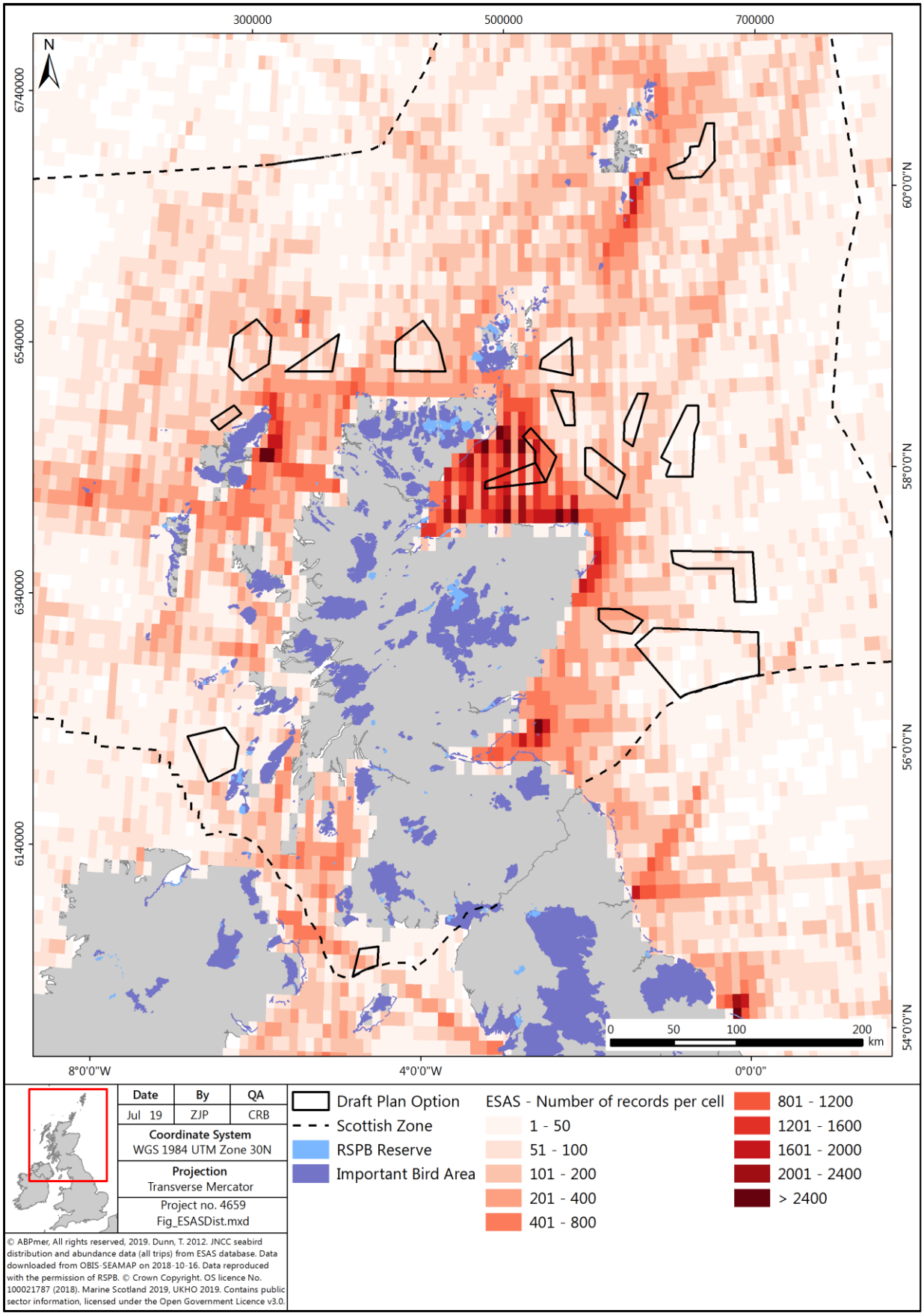


Figure 16 ESAS records distribution

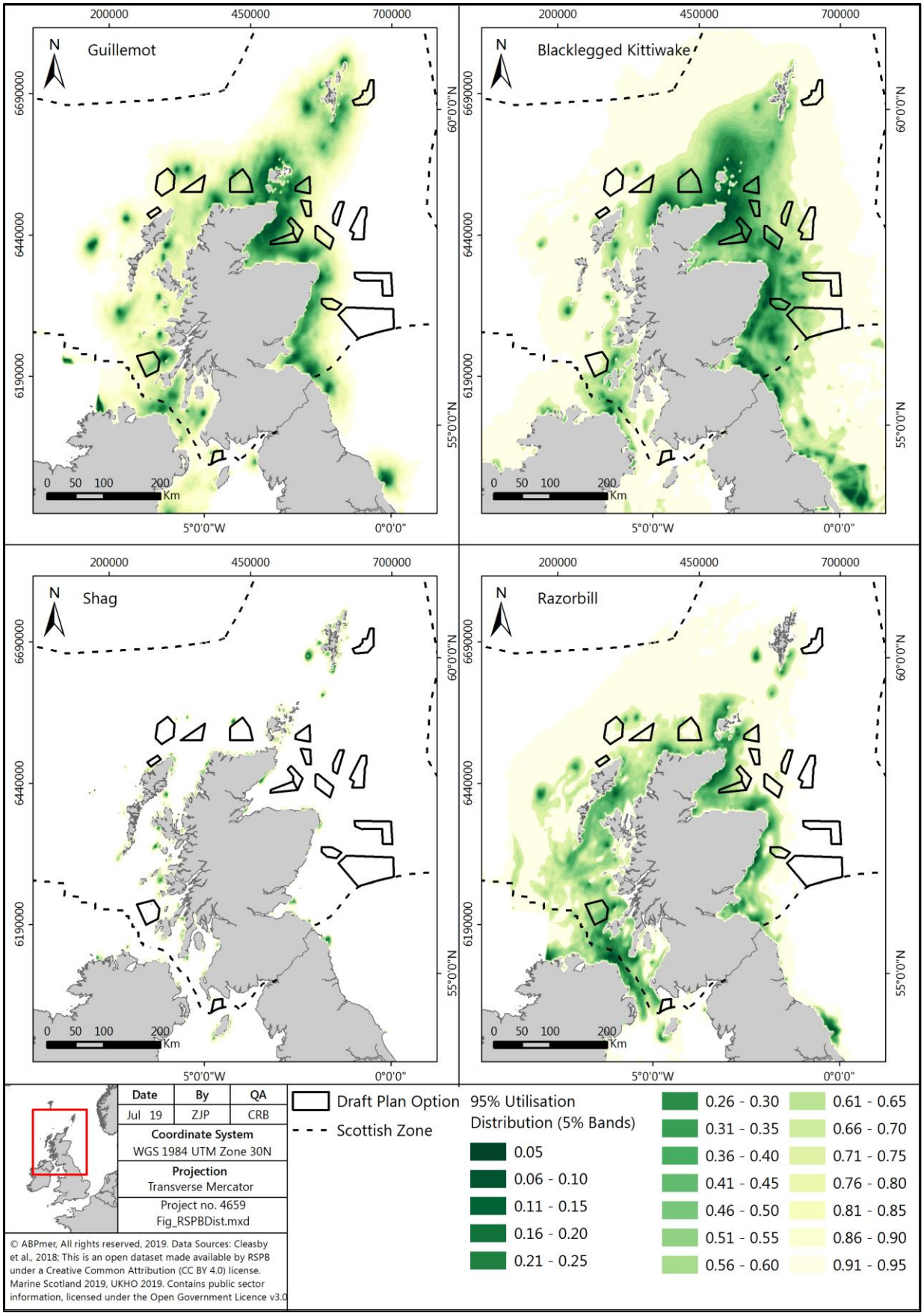


Figure 17 RSPB bird distribution maps

Fish

4.2.31 Scotland's territorial waters support approximately 250 different species of fish, with additional species occurring in deeper waters within the Scottish Offshore Marine area. Some species are commercially important to the Scottish fishing industry, and others, such as sandeel, are key prey species for seabirds, marine mammals and larger fish species, including some shark species. There are several diadromous fish species within Scottish waters which use Scottish rivers, including Atlantic salmon, sparling, European eel, sea trout; and sea and river lamprey.

4.2.32 Of the approximately 250 species identified in Scottish waters, 40 are cartilaginous fish (Chondrichthytes), incorporating species of shark, rays and skates[122]. There are approximately 30 species of fish identified as PMFs within Scottish waters[123].

4.2.33 Within Scottish seas, there are nationally important populations of basking sharks with sightings concentrated around the Inner Hebridean islands of Coll, Tiree, Canna and Hyskeir. These areas have been highlighted as potential breeding grounds[124].

4.2.34 Scottish seas are of particular importance as spawning and nursery grounds for a number of fish species[125], some of which are of commercial importance. Figure 17 shows the distribution of herring spawning and nursery grounds. Further national and regional detail on herring and other key species spawning and nursery grounds, is contained within the RLG. There are a number of overlaps between the DPOs and either spawning or nursery grounds. This includes areas recognised by Coull *et al*[126] and Ellis *et al*[127] as high priority for herring and sandeel.

4.2.35 There is potential for migratory fish, including Atlantic Salmon, Sea and River Lamprey, Shad and Trout species to be present throughout Scottish waters and hence within any of the identified DPOs. However, there is still uncertainty about local densities. The fish present may be at different life stages, and hence of varying sensitivity to potential impacts.

[122] Davidson. 1996. An estimation of the total number of marine species that occur in Scottish coastal waters. Available at https://www.nature.scot/snh-review-63-estimation-total-number-marine-species-occur-scottish-coastal-waters [accessed 21/0/2020]
[123] Tyler-Walters, H., James, B., Carruthers, M. (eds.), Wilding, C., Durkin, O., Lacey, C., Philpott, E., Adams, L., Chaniotis, P.D., Wilkes, P.T.V., Seeley, R., Neilly, M., Dargie, J. & Crawford-Avis, O.T. 2016. Descriptions of Scottish Priority Marine Features (PMFs). Scottish Natural Heritage Commissioned Report No. 406. Available at https://www.nature.scot/sites/default/files/Publication%202016%20-%20SNH%20Commissioned%20Report%20406%20-%20Descriptions%20of%20Scottish%20Priority%20Marine%20Features%20%28PMFs%29.pdf [accessed 12/11/2018].
[124] ibid.
[125] Ellis, J.R., Milligan, S.P., Readdy, L., Taylor, N. and Brown, M.J. 2012. Spawning and nursery grounds of selected fish species in UK waters. Sci. Ser. Tech. Rep., Cefas Lowestoft, 147: 56 pp
[126] Coull, K.A., Johnstone, R., and Rogers, S.I. 1998. Fisheries Sensitivity Maps in British Waters. Published and distributed by UKOOA Ltd., v + 58 pp.
[127] Ellis, J.R., Milligan, S.P., Readdy, L., Taylor, N. and Brown, M.J. 2012. Spawning and nursery grounds of selected fish species in UK waters. Sci. Ser. Tech. Rep., Cefas Lowestoft, 147: 56 pp

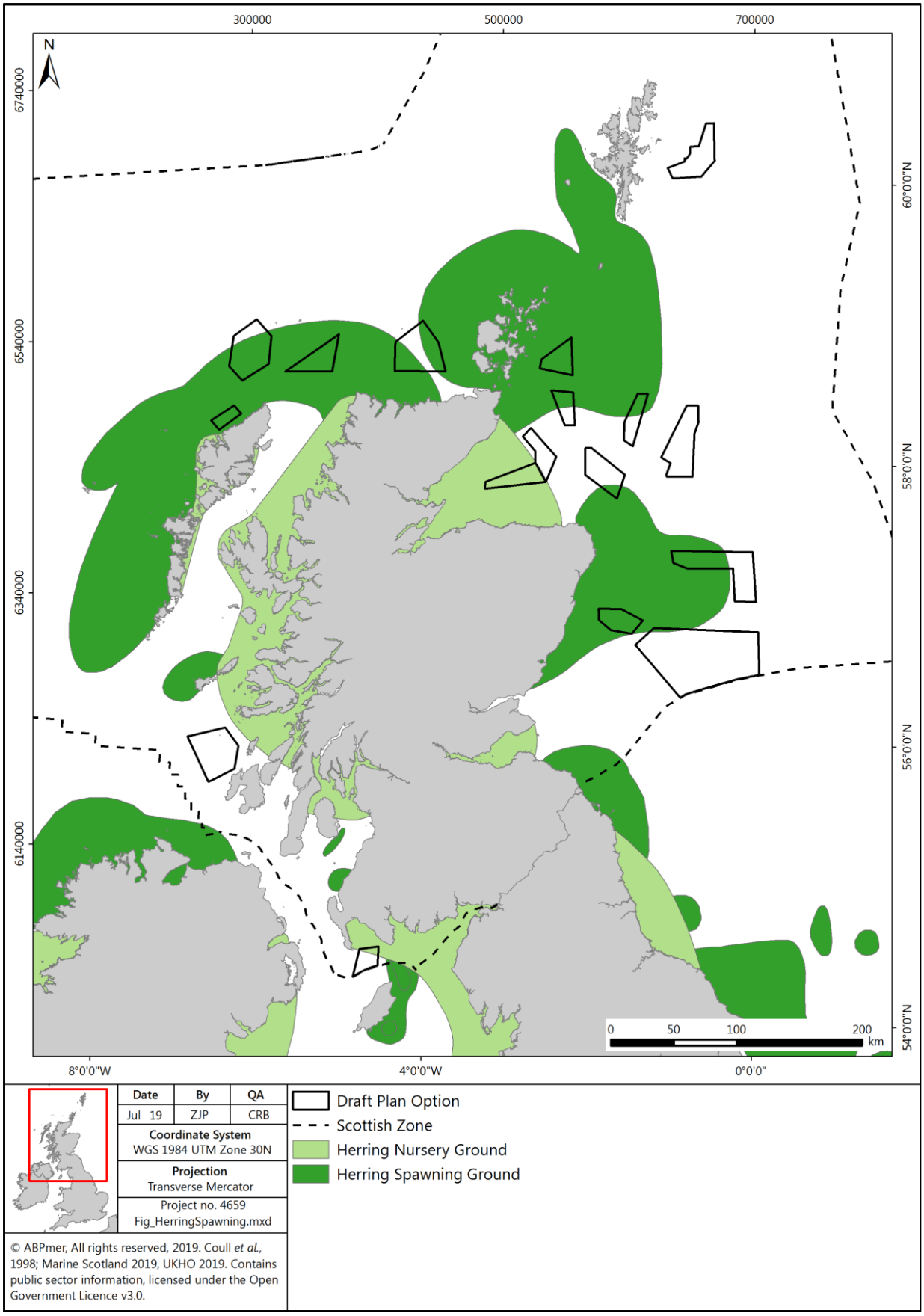


Figure 18 Herring spawning and nursery grounds

Otters

4.2.36 Otters are present around the Scottish coast, with the most recent population (including both coastal and riverine populations) estimated at approximately 8,000 individuals[128]. They are protected through the designation of coastal and riverine sites throughout Scotland, as protected species under the Wildlife and Countryside Act and are designated as a PMF, with particularly significant populations on the west coast and the islands[129], generally in sheltered inshore waters. Foraging distances for otters are not well understood, however they are known to remain close to the coast and in relatively shallow water depths.

Future Evolution of Baseline

4.2.37 The future baseline for biodiversity in Scottish seas is likely to be driven, certainly in the short term, by the current trends discussed above. However, there is currently very limited evidence to inform possible future trends, therefore this is an area of significant uncertainty.

4.2.38 In the longer term, continuing pressures from development of marine industry, human activities and climate change are likely to be the key factors in driving changes from the current baseline. This includes effects from fishing practices, coastal development and other activities in the marine environment (recreation, anchoring, commercial shipping, dredging etc). These have the potential to affect biodiversity through a wide range of pathways including collision risk, bycatch, depletion of prey species, pollution events and damage to benthic habitats. Climate change is likely to lead to changes in the distribution of species, driven by changes in water temperature (see Section 4.6). This may include the spread northwards of warmer water species currently restricted to the more southern areas of the UK. The seas around the UK are projected to be 1.5–4ºC warmer, depending on location, with warming most pronounced in the Celtic, Irish and southern North Sea areas. The seas are also projected to become less saline by the end of the 21st century, particularly in the North Sea areas[130]. In addition, potential increased ocean acidification may inhibit the growth organisms with shells (containing calcium carbonate) or with carbonate exoskeletons (coral, sea fans).

4.2.39 Several habitats and species within Scottish waters are considered to be in decline, including seagrass, maerl, flame shell and horse mussel beds as well as fan mussel and fireworks anemone aggregations.

4.2.40 Changes in marine industry have the potential to affect species in several different ways. For example, some bird species have adapted to scavenge on

[128] Jefferies, D.J., Strachan, C. & Strachan, R. 2003. Estimated numbers of the three interacting riparian mammals in Britain using survey data. In: Jefferies, D.J. (Ed) The water vole and mink survey of 1996–1998 with a history of the long-term changes in the status of both species and their causes, pp. 188–197. Vincent Wildlife Trust, Ledbury.
[129] Scottish Natural Heritage. 2015. Trend Note: Trends of Otters in Scotland. Available at https://www.nature.scot/trend-notes-trends-otters-scotland.
[130] MCCIP. 2009. UKCP09 Marine and coastal projections summary. Available at: http://www.mccip.org.uk/media/1410/summary.pdf. (Accessed 21/03/19).

fisheries' discarded bycatch, therefore a reduction in fishing activity can lead to a reduction in the population of these species. Conversely, where fisheries deplete prey, such as sandeel, for bird species, a reduction in fishing activity can lead to a recovery of the prey species and drive a recovery in the bird populations.

4.2.41 In addition to changes in the baseline itself, there is potential for our understanding of the baseline to continue to develop. This is particularly pertinent with regard to understanding the effect of offshore wind farms on Kittiwake populations, as the current baseline in the East and North East regions suggests that the installed offshore wind farms have the potential to affect Kittiwake populations foraging from SPA in the region. However, emerging evidence may reduce the effects of offshore wind farms in collision risk assessments[131].

4.2.42 Similarly, changes in prey species distributions could affect marine mammal populations. Therefore, Marine Scotland is currently considering further protection of prey populations, such as sandeel, which support both birds and cetaceans in Scottish seas, through the MPA network. The continued development and management of the MPA network has the potential to support the maintenance of biodiversity, and potentially allow recovery of some species where current pressures are eliminated or reduced.

4.3 Population and Human Health

4.3.1 Human health consists of a person's physical, mental and social wellbeing and the environment in which they live has an important influence on these factors. Scotland still has significant public health challenges to overcome.

4.3.2 Socio-economics are a significant influence on population and human health. Detail on socio-economics is encompassed within the SEIA[132].

4.3.3 There is an east - west split in the rural characteristics of coastal communities in Scotland. The islands and the north and west coasts typically have smaller populations and experience greater distances to services. Communities on the west coast and islands typically have a greater reliance on marine businesses and related industries as part of their local economy.

4.3.4 The marine and freshwater environments around Scotland are used for a variety of industrial and recreational activities including salmon and sea trout fisheries, recreational sea angling, sailing, cruising, bathing and recreational tourism. Coastal recreation opportunities make an important contribution to human health as well as coastal economies. Offshore energy generation could interfere with existing recreational activities.

[131] Skov, H., Heinänen, S., Norman, T., Ward, R.M., Méndez-Roldán, S. & Ellis, I. 2018. ORJIP Bird Collision and Avoidance Study. Final report – April 2018. The Carbon Trust. United Kingdom. 247 pp

[132] Scottish Government (2019) Sectoral Marine plan for Offshore Wind Energy, Social and Economic Impact Assessment Report.

4.3.5 A positive sense of place is important to people living in many rural and coastal areas, and the importance of the quality of the environment raises concerns that detrimental effects on amenity could lead to decreasing populations and adversely affect property values and businesses.

4.3.6 The main risks to human health in the marine environment are from accidents because of collisions of vessels with each other and with any offshore structures which could impact on the risks of accidents and related mortality rates. Additionally, the health benefits of undertaking recreational activities could be compromised if activity is displaced or discontinued.

Population Dynamics

4.3.7 Coastal communities, living within 5 km of the coast, account for an estimated 41%[133] of Scotland's total population and regional analysis shows that the characteristics of these coastal communities varies significantly between different regions.

4.3.8 Different parts of the Scottish coast experience different types of pressures. Some areas are sparsely populated and have fragmented communities, and others are more densely populated city regions.

4.3.9 The Scottish Index of Multiple Deprivation (SIMD) highlights that coastal communities have varying levels of access to employment, education and services. The views on quality of life also vary between coastal communities. Regions such as the north, north east and east show positive trends, whereas the west and north west are experiencing a decline[134].

4.3.10 The profile of key employment sectors varies between regions. There is a high dependence on the service economy, but other industries such as agriculture, forestry and fishing account for a greater portion of jobs in the more remote, rural regions than in communities closer to the urban and accessible parts of the coast.

Navigation

4.3.11 Shipping is important for both coastal and general populations within Scotland, with shipping movements related to the movement of cargo, ferry lifeline services and oil and gas operations alongside ship building centres in the Clyde and Firth of Forth.

4.3.12 AIS density grid data indicates key transport routes up the west coast of Scotland through the North Channel (or Straits of Moyle) and the Minches, and east–west between the northern coast of the mainland and Orkney, from where vessels access the North Sea (Figure 19). In addition, there are routes

[133] The James Hutton Institute. 2010. Scotland's Coastal Assets. Available at https://www.hutton.ac.uk/sites/default/files/files/publications/hutton_coast_booklet_web.pdf. Accessed 24/10/2018.
[134] Scottish Government, 2018. The Scottish Index of Multiple Deprivation (SIMD). Available at: https://www.gov.scot/Topics/Statistics/SIMD. Accessed 15/10/2018.

transiting through Scottish waters, such as to the north of Shetland connecting Denmark to the Faroe Islands and onwards to Iceland and routes crossing the Atlantic to America.

4.3.13 Some of the areas showing the highest intensity of vessel movement include ferry routes (e.g. between Northern Ireland and Loch Ryan, between the Outer Hebrides and Oban via the Sound of Mull and between the Shetland Islands, Orkney and the Scottish mainland) and within the Clyde.

4.3.14 There are two International Maritime Organisation (IMO) Traffic Separation Schemes (TSS), designed to ensure safe shipping in areas of particularly high density, one in the North Channel between the Mull of Kintyre and Northern Ireland, and the other in the Minches between Skye and the Outer Hebrides. There is additionally one IMO recommended deep water route to encourage deep drafted vessels to the west of the Outer Hebrides to reduce traffic in the Minches.

4.3.15 Ferry services to the Scottish islands are considered lifeline services, in that they provide key connections between communities on the islands and mainland Scotland, allowing for transport of key commodities and people, including supporting the tourism trade. The key ferry routes are of high importance to the Scottish population.

4.3.16 Oil and gas related traffic is concentrated on the east coast of Scotland, with hubs around Aberdeen, Peterhead and Fraserburgh contributing to the high density of maritime traffic in that area.

4.3.17 There are Areas To Be Avoided (ATBA) within Scottish waters, with large areas around the Shetland Islands, Fair Isle, and the Orkney Islands aimed at reducing risks associated with high traffic density around the islands. ATBA are defined as areas within defined limits in which navigation is particularly hazardous and should be avoided by certain classes of ships. ATBA are voluntary measures however previous experience suggests compliance with such voluntary measures is very high.

4.3.18 Navigational safety is essential for the continued growth and economic success provided by ports and harbours and all the sectors that they support. Most of port and harbour operations are administered by statutory Harbour Authorities, who have a range of duties for improving, maintaining or managing a harbour and for ensuring safety of navigation. The Northern lighthouse board is an authority which works to deliver a reliable and efficient aid to navigation services for the benefit and safety of all mariners in Scotland. It is responsible for the management of all lights, buoys and beacons within the area.

4.3.19 Search and Rescue teams and the Maritime and Coastguard Agency both work to prevent the loss of lives at sea.

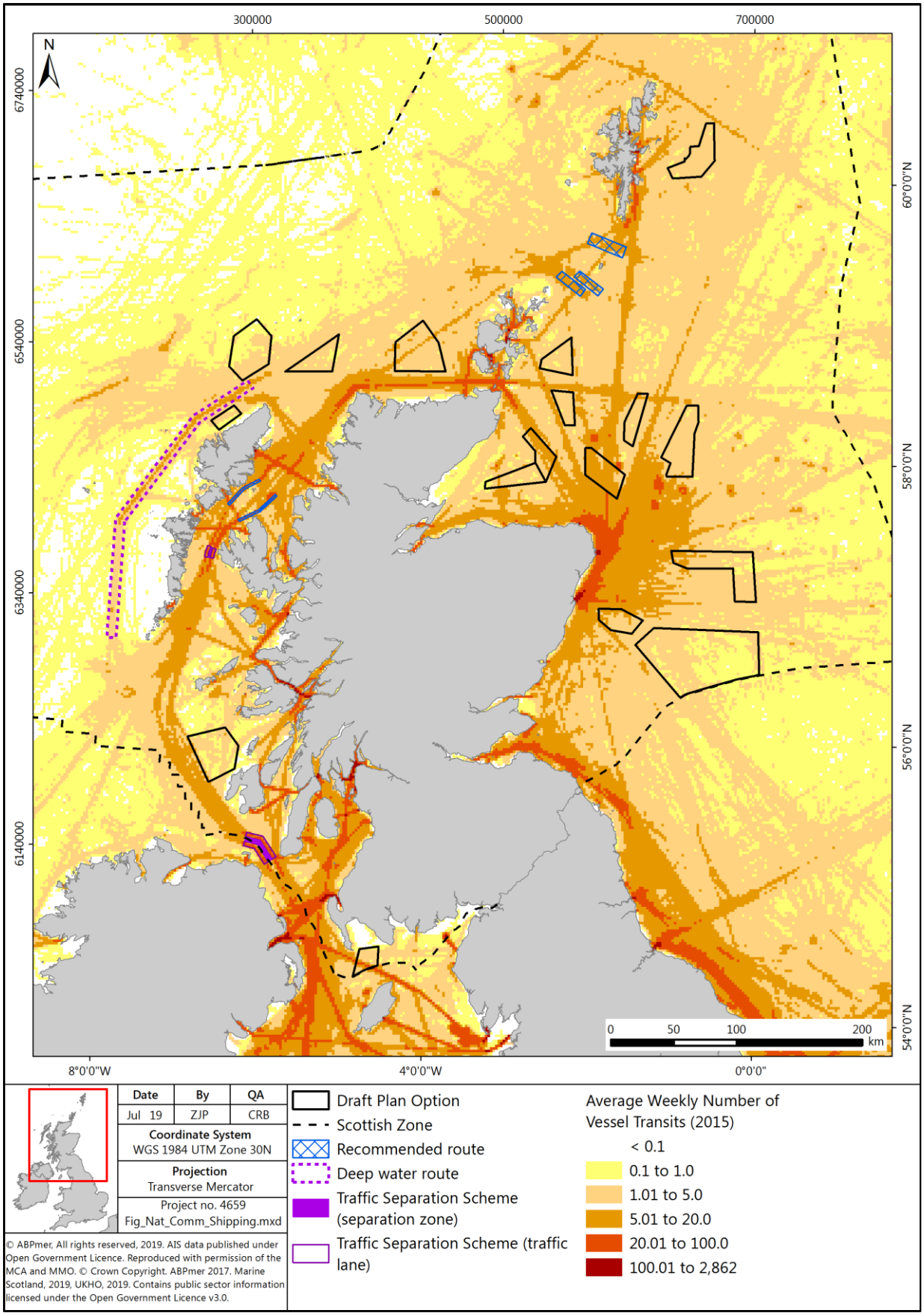


Figure 19 AIS shipping density

Aviation

4.3.20 Aviation forms a critical component of Scotland's economy by providing both direct access to markets and lifeline services to otherwise inaccessible settlements throughout the mountainous and island terrain. Helicopter routes are also important in servicing offshore oil and gas installations.

4.3.21 Scotland's five major airports are in the west (Glasgow and Glasgow Prestwick), north east (Inverness and Aberdeen) and east (Edinburgh). Smaller airports are located on the mainland in the east (Dundee), north east (Wick) and west (Campbeltown) and on the islands in the north (Scrabster, Lerwick and Sumburgh in the Shetlands; Kirkwall in the Orkneys), north west (Stornoway, Benbecula and Barra in the Outer Hebrides) and west (Coll, Colonsay, Tiree and Islay). All Scottish airports are shown on Figure 20.

4.3.22 Primary and secondary surveillance radars are used by air traffic control at airports. Large portions of the Scottish coast are within radar surveillance areas (Figure 20). The areas with greatest coverage are around Tiree, Aberdeen and Peterhead. There are also secondary surveillance radars around Tiree, Aberdeen, Peterhead, Glasgow, Sumburgh and Stornoway.

4.3.23 Edinburgh is the busiest airport in Scotland and in 2016 contributed almost £1 billion into the Scottish economy and employed approximately 23,000 people[135].

4.3.24 Major or important airports in Scotland are safeguarded aerodromes, protecting the aerodrome operations from interference, such as from developments, wildlife strike, inappropriate lighting, radar interference. In the context of wind turbines, the Airport Operators Association recommends that any proposed wind developments within 30 km of a safeguarded airport should be assessed by the aerodrome for potential physical impacts[136]. Further, all proposed wind developments should undertake consultation with the aerodrome and NATS regarding effects on radar services.

4.3.25 The helicopter main routes (HMRs) are exclusively in the East and North East regions. The areas with the greatest coverage are out from Aberdeen airport and Sumburgh airport on Shetland. They show the possible routes that could be used by helicopter and therefore the DPOs which could be affected by helicopter safety concerns, but they are not indicative of the amount of traffic.

[135] Edinburgh Airport Consultative Committee. 2018. Available at https://www.edinburghairport.com/about-us/edinburgh-airport-consultative-committee-eacc Accessed 23/10/2018.

[136] Airport Operators Association and Civil Aviation Authority. 2016. Safeguarding of Aerodromes, Advice Note 5. Renewable Energy and Impact on Aviation. Available at https://www.aoa.org.uk/wp-content/uploads/2016/09/Advice-Note-5-Renewable-Energy-2016.pdf Accessed 25/10/2018.

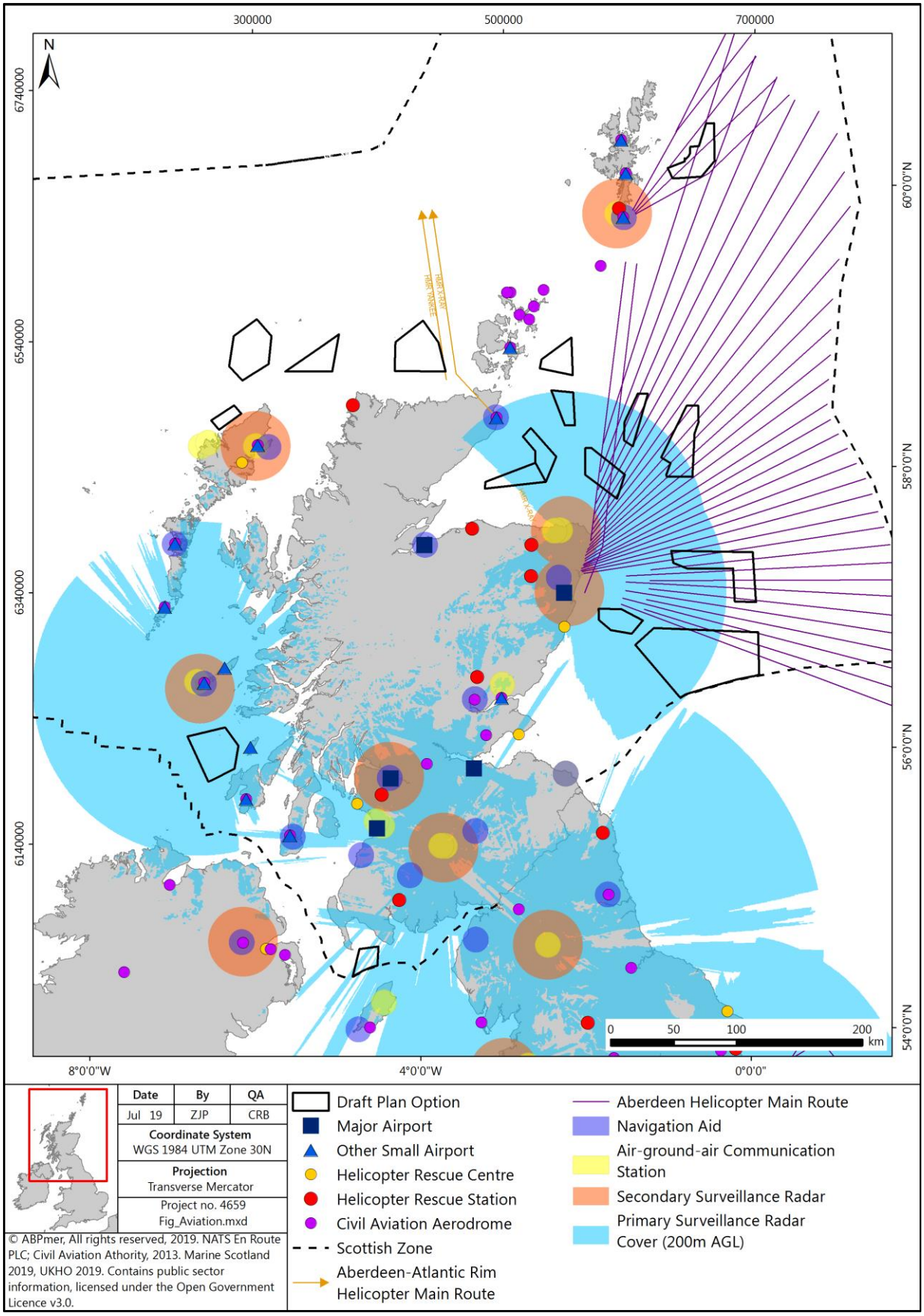


Figure 20 Aviation infrastructure, radar coverage and helicopter main routes

Bathing Waters

4.3.26 Scotland has 86 designated bathing waters which have been given special protection because they are popular bathing locations[137] (Figure 21). Of these areas, 59 are assessed as excellent or good status, 16 are assessed as being at target objective and 11 are assessed as at poor status.

Recreation

4.3.27 Marine and coastal recreation forms a valuable and growing industry for Scotland. There are clear benefits of taking part in regular recreational activities, both physically and mentally, and Scotland has a range of marine and coastal activities to offer, the most popular of which include; bathing, recreational boating, surfing, scuba diving, sea kayaking and sea angling. These activities are discussed in more detail in the SEIA[138].

Future Evolution of Baseline

4.3.28 The future baseline for population and human health around the Scottish coastline is likely to be driven by the current trends and pressures as discussed above. All regions in Scotland are expected to experience an increase in the average age of the population, due to declining birth rates and rising life expectancy, over the coming years[139].

4.3.29 The volume of vessel traffic travelling in or through Scottish waters and the routes taken along shipping lanes are primarily driven by commercial factors. The largest sectors responsible for shipping movements are ferry movements, commercial shipping, fishing, recreation, and the oil and gas sectors, and these are largely independent of the plans for marine renewable energy. The future of the Scottish fishing industry is highly uncertain, particularly considering potential impacts of Brexit, however current fishing patterns are reasonably stable, with tonnages landed fluctuating year on year. The Scottish tourism industry is predicting further growth so there is a potential for an increase in vessel movement from ferries and wildlife watching trips in this sector[140].

[137] Scottish Environment Protection Agency. 2018. Bathing Waters. [online] available at https://apps.sepa.org.uk/bathingwaters/.
[138] Scottish Government (2019) Sectoral Marine plan for Offshore Wind Energy, Social and Economic Impact Assessment Report.
[139] Scottish Government. 2018. Summary: Age demographics. Available at: https://www.gov.scot/Topics/People/Equality/Equalities/DataGrid/Age/AgePopMig [Accessed 15/10/2018]
[140] Visit Scotland (2018) Scotland's Tourism Performance Quarter 2/2018 [online] Available at: https://www.visitscotland.org/binaries/content/assets/dot-org/pdf/research-papers-2/2018-q2-stats-summary.pdf

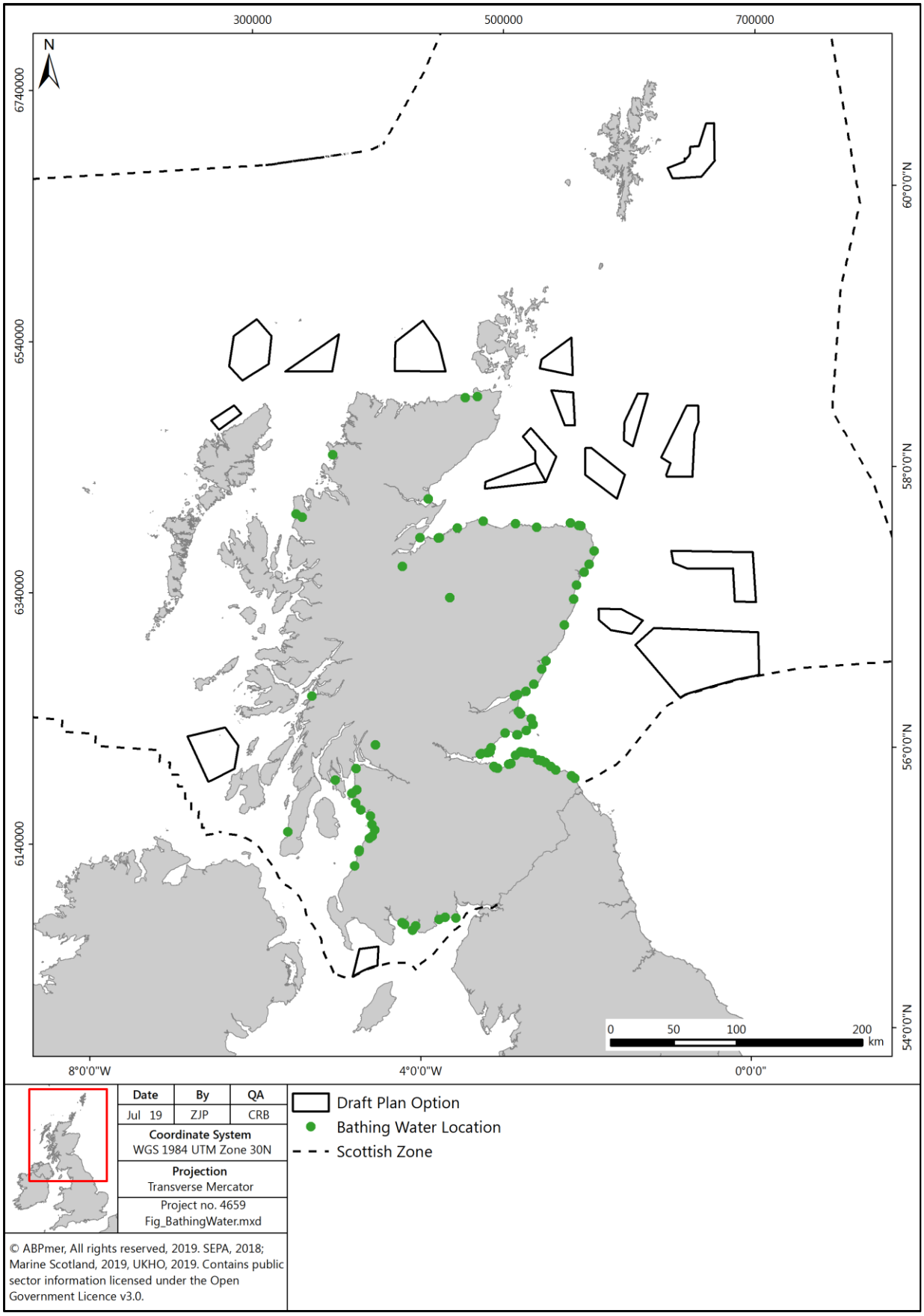


Figure 21 Designated bathing waters

4.3.30 In the absence of the sectoral marine plan for offshore wind, it is anticipated that further offshore renewables development would occur in the near future. Wave and tidal energy developments have the potential to increase the risk of incidents such as collisions and groundings due to an increase in infrastructure and vessel numbers in some regions of Scottish waters, although such developments will only be allowed to proceed following detailed navigational risk assessments to ensure that they can be operated safely.

4.4 Soil (Marine Geology and Coastal Processes)

4.4.1 Changes to geological and geomorphological features can occur through physical and hydrological pressures. These pressures may be the result of natural processes (e.g. storms), changing climatic conditions and marine activities, such as the development of infrastructure on coastal and subtidal habitats.

4.4.2 Offshore wind farm development has the potential to affect the seabed through direct loss of features under the footprint of the development and indirect changes to sediment transport resulting in subsequent changes to seabed morphology.

Marine Geology and Coastal Processes

4.4.3 The composition of the seabed in Scottish waters is highly varied, with areas of hard, rocky substrate, sand, gravel and mud. Data from the British Geological Society (BGS) is illustrated below (Figure 22) with further regional detail provided in the RLG document[141].

4.4.4 The Eurosion project[142], carried out in 2004, categorised Scotland's coast and summarised the nature of the coastline, whilst assessing its potential stability and behaviour. Scotland's coast was broadly classified as:

- 70% hard coasts – i.e. composed of rocks and cliffs.
- 29% soft coasts – i.e. composed of unconsolidated gravels, sand and silts.
- less than 1% artificial – i.e. harbours and sea walls.

4.4.5 The offshore environment in Scottish waters ranges from shelf sea areas to deep ocean regions with depths greater than 2,000 m. The continental shelf includes the Malin and Hebrides Shelf Seas, Orkney and Shetland Shelf Seas, and the North Sea. The shelf seas are marked by notable features such as banks (e.g. Stanton Banks, Viking Bank) and deep channels.

[141] Scottish Government (2019) Draft Regional Locational Guidance – Offshore Wind in Scottish Waters.
[142] European Commission (2004) Eurosion: Living with Coastal Erosion in Europe – Sediment and Space for Sustainability – Results for the Eurosion Study, [online] Available at: http://www.eurosion.org/reports-online/reports.html [accessed 08/01/2019].

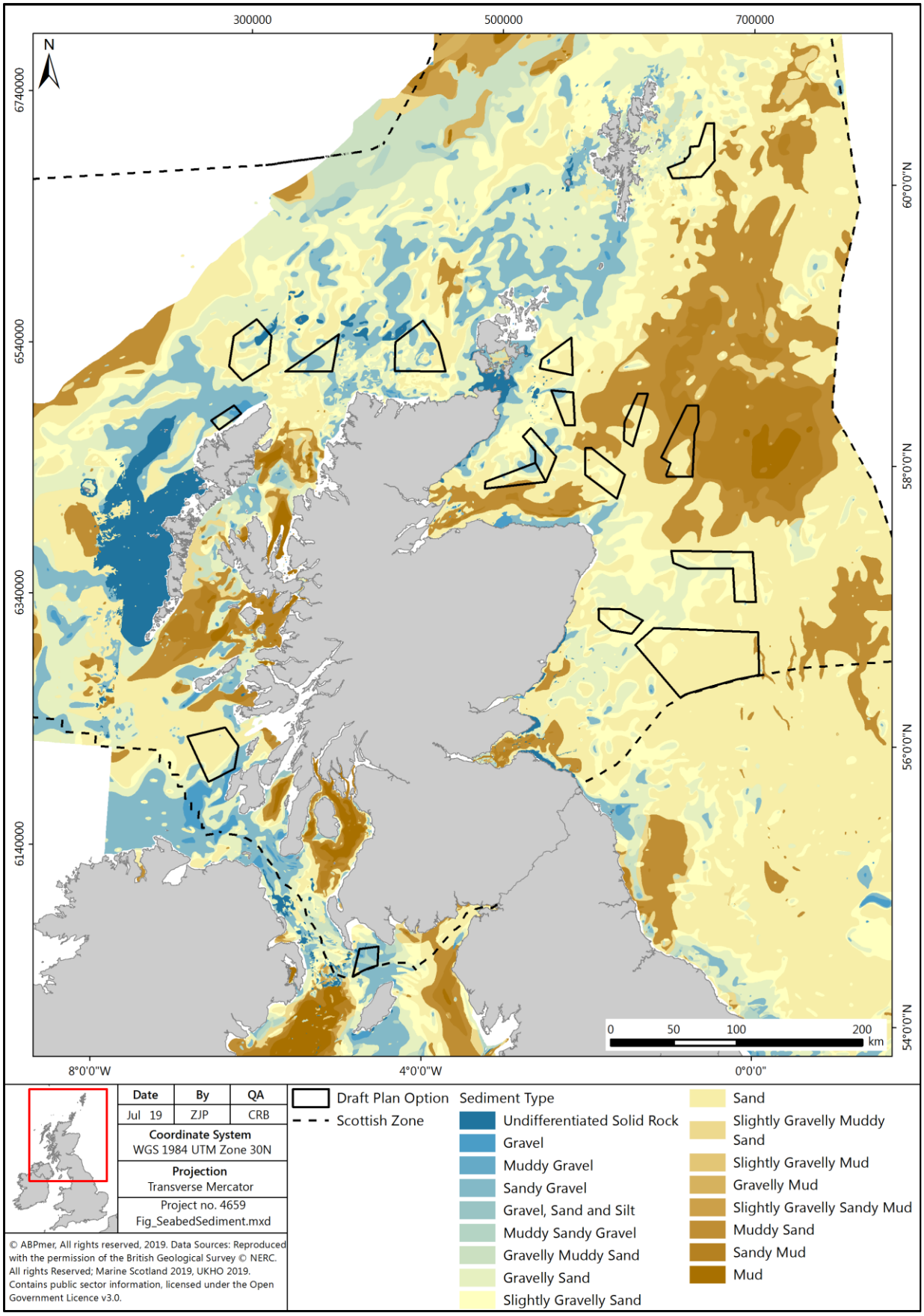


Figure 22 Seabed sediment morphology in Scottish waters

4.4.6 In general, the marine sediments around Scotland are sandy or gravelly (Figure 22) and originate from deposits created during the Quaternary glaciation. Strong currents and wave action may also have prevented deposition of recent muddy sediment or winnowed it to leave a coarse-grained lag deposit. Muddy sediments principally occur nearshore or further offshore, in depressions on the sea floor, where currents may be relatively weak. They also occur beyond the shelf break (200 m water depth) to the west of the Western Isles. The concentration of calcareous material varies greatly in seabed sediments reflecting the amount of shell material in different areas; locally, they can be very high[143]. A description of the key habitat types in Scottish waters is provided in Section 4.2.

4.4.7 The Scottish landscape and coastline continue to change through coastal processes such as wave action, sediment movement, erosion and accretion. While natural processes, including natural disasters, have typically been the main drivers of coastal erosion, in more recent times, human activities have also played a significant role in exacerbating these natural processes.

4.4.8 Much of the Scottish coastline is considered stable (75%) although some parts are subject to either erosional or accretional processes[144], with notable areas identified along the east coast between Montrose to Dunbar, the Firth of Clyde, the inner Moray Firth, and parts of the Northern and Western Isles[145]. Recent work carried out as part of the National Coastal Change Assessment (NCCA) provides a shared evidence base which encompasses historic coastal change and highlights susceptible areas of the coastline[146].

4.4.9 In 2010-2011 it was estimated that around 12% of Scotland's coastline was erosional and 8% accretional[147] . Following on from the Dynamic Coast NCCA, further research funded by the Scottish Government is ongoing to understand the potential damage from climate change to areas of the Scottish coastline categorised as 'soft' erodible coast, and how these effects can be mitigated[148].

4.4.10 The erosional portion of the Scottish coastline largely consists of beaches, sand dunes, conglomerates/soft-rock cliffs, machair and marshes with muddy sediments[149]. Areas most vulnerable to coastal erosion include the east coast

[143] Marine Scotland (2008) Scotland's Seas: Towards Understanding their State, Chapter 2 [online] Available at: http://www.scotland.gov.uk/Resource/Doc/218570/0058690.pdf [accessed 07/01/2019]
[144] SNH (2012) Coastal Erosion [online] Available at: https://www.nature.scot/landforms-and-geology/scotlands-rocks-landforms-and-soils/landforms/coasts/coastal-erosion [accessed 04/01/2019]
[145] SNH (2001) Natural Heritage Futures – Coasts and Seas, [online] Available at: www.snh.gov.uk/docs/A306281.pdf [accessed 04/01/2019]
[146] Dynamic Coast: Scotland's Coastal Change Assessment (2017). Available at: http://www.dynamiccoast.com/index.html. pdf [accessed 04/01/2019]
[147] Marine Climate Change Impacts Partnership (2010-2011) - http://www.mccip.org.uk/media/1338/mccip-report-2010-2011.pdf [accessed 04/01/2019]
[148] National Coastal Change Assessment 2: Enhancing the evidence base and our ability to adapt https://www.crew.ac.uk/project/scotlands-coastal-change-assessment-2 [accessed 07/01/2019]
[149] European Commission (2004) Eurosion: Living with Coastal Erosion in Europe – Sediment and Space for Sustainability – Results for the Eurosion Study, [online] Available at: http://www.eurosion.org/reports-online/reports.html [accessed 08/01/2019]

from Montrose to Dunbar, the Firth of Clyde, the Inner Moray Firth, and the Northern and Western Isles [150].

Geodiversity and Designated Sites

4.4.11 Geodiversity is defined as the natural range (diversity) of geological features (rocks, minerals, fossils, and structures), geomorphological features (landforms and processes) and soil features that make up the landscape both on land and below water. The condition of underlying geodiversity features such as sand banks and seabed influence the quality of habitats which in turn affects the viability and health of both flora and fauna populations.

4.4.12 The Marine Protected Area (MPA) network in Scotland's seas is designed to conserve a selection of marine biodiversity (species and habitats) and geodiversity (the variety of landforms and natural processes that underpin the marine landscapes).

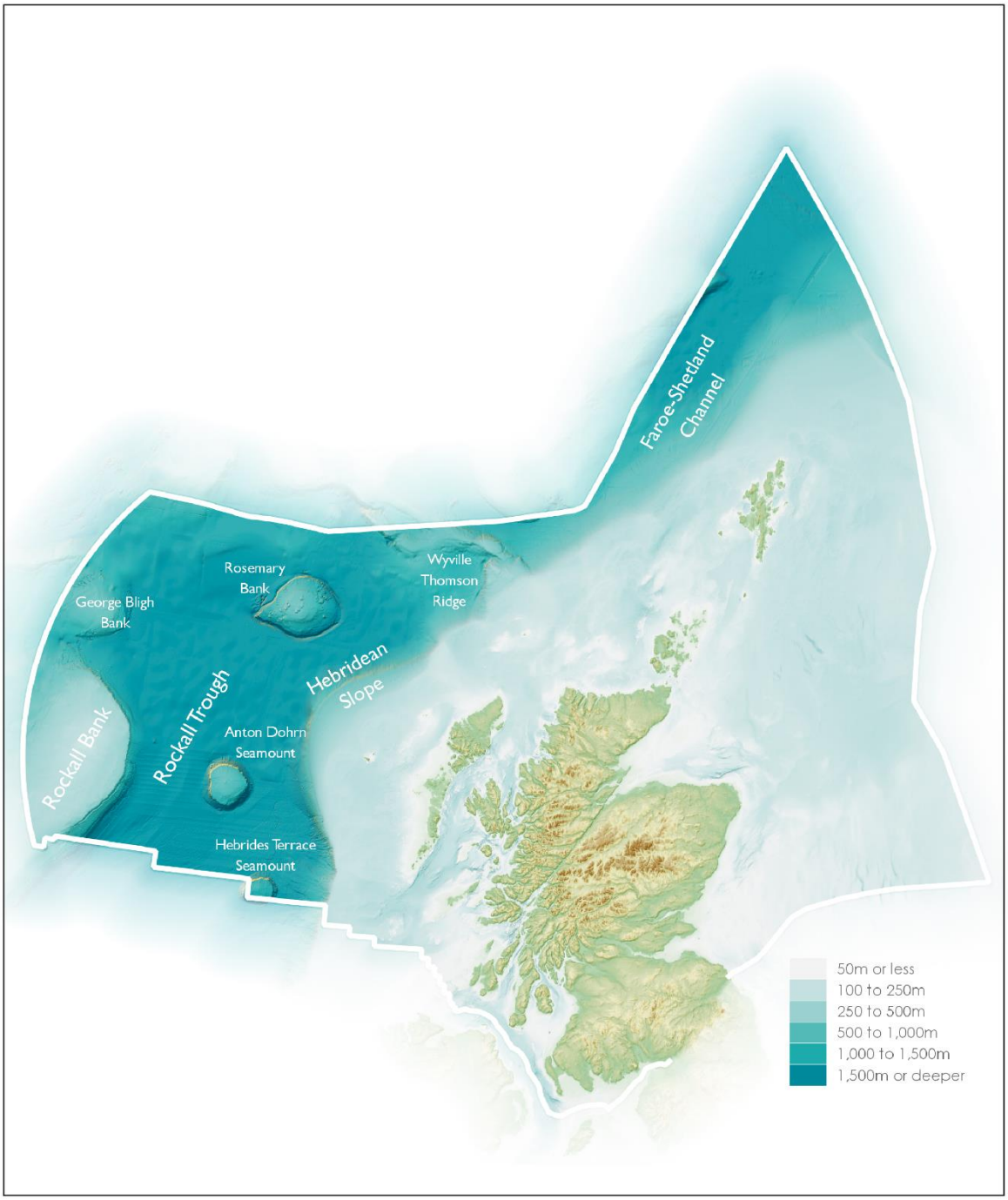
4.4.13 There are six broad features of Scottish geodiversity that are protected by NCMPAs[151]:

- Quaternary of Scotland;
- Submarine Mass Movement;
- Marine Geomorphology of the Scottish Deep Ocean Seabed;
- Seabed Fluid and Gas Seep;
- Cenozoic Structures of the Atlantic Margin; and
- Marine Geomorphology of the Scottish Shelf Seabed.

4.4.14 Each feature is in turn comprised of a variety of components, such as continental slope channels, iceberg ploughmark fields, moraines, slide deposits, sand wave fields, pockmarks, seamounts, sand banks and mega-scale glacial lineation. Major physiographical features of the Scottish marine environment are shown in Figure 23.

[150] Geodiversity in Protected Areas - https://www.nature.scot/landforms-and-geology/protecting-our-geodiversity/places-and-plans-safeguard-geodiversity/geodiversity-protected-areas [accessed 07/01/2019]

[151] Brooks, A., Kenyon, N., Leslie, A., Long, D. 2011. Characterising Scotland's marine environment to define search locations for new Marine Protected Areas. Part 2: The identification of key geodiversity areas in Scottish waters. Research Gate 430.



Date	By	QA
Jul 19	ZJP	CRB

Coordinate System
n/a

Projection
n/a

Project no. 4659
Fig_Extent_Scotland_seas.mxd

Figure produced by Marine Scotland, 2019.

Figure 23 Extent of Scotland's seas, showing bathymetry and locations of major physiographical features

4.4.15 The Geological Conservation Review (GCR) is the principal source of information on the conservation value and scientific interests of the geo-heritage of Great Britain. An SNH commissioned report[152] found that 46 of the 49 GCR blocks, or features, in Scotland are represented within coastal SSSIs. Of these GCR blocks, 43 have confirmed intertidal interests. The work concluded that a total of 174 SSSIs around the Scottish coastline encompass marine geological or geomorphological GCR interests which could be considered as contributing to the MPA network. All SSSIs with coastal geomorphology GCR interests may also be seen as contributing to an MPA network via a process or sediment supply role. The regional location of these coastal SSSIs are provided within the RLG[153].

4.4.16 Geological and geomorphological features of MPAs and SSSIs can be impacted upon by changes in coastal processes as a result of natural and anthropogenic influences.

Future Evolution of Baseline

4.4.17 As previously detailed, the majority of the Scotland's coastline is composed of hard geology, meaning that it is relatively stable. However, there are areas of the Scottish marine environment that are more dynamic and therefore continuously experiencing changes that are outside the direct influence of human activities.

4.4.18 The processes driving sediment transport are often complex, particularly within the coastal and nearshore zones where they can comprise a mixture of wind, wave, tidal and in some cases, fluvial forcing.

4.4.19 Future projections of coastal erosion (erosion susceptibility) have been made through the NCCA project. This has also allowed key risk areas to be identified along the Scottish coastline, with future work planned to understand the potential damage from climate change and how these effects can be mitigated.

4.4.20 As a consequence of climate change the potential for increasingly severe storm events, rises in sea level and coastal flooding may place Scotland's coastal habitats under increasing threat.

4.4.21 In the absence of the sectoral marine plan for offshore wind, it is anticipated that further offshore renewables development would occur soon. Wave and tidal energy developments have the potential to affect geology and geomorphological features directly within the renewable development's footprint and indirectly by altering coastal processes and sediment transport regimes.

[152] Gordon, J.E. 2016. Geological and geomorphological features of SSSIs contributing to the MPA network in Scotland's seas. Scottish Natural Heritage Commissioned Report No. 892.
[153] Scottish Government (2019) Draft Regional Locational Guidance – Offshore Wind in Scottish Waters.

4.5 Water Quality

4.5.1 Since the first River Basin Management Plans (RBMPs) in Scotland were published in 2009, the condition of water bodies has generally improved continuing an improving trend observed since the 1980s following implementation of the Control of Pollution Act 1974. However, a wide range of pressures are continuing to affect the condition of specific water bodies and protected areas. The most widespread pressures on the marine environment in the Scotland RBMP are modifications to physical condition, rural diffuse pollution, waste water discharges and local pollution events such as oil spills[154].

4.5.2 There are various mechanisms in place for monitoring and managing the quality of Scottish waters. Each takes a different focus and approach:

- The Water Framework Directive (WFD) establishes a framework for the protection of inland surface waters (rivers and lakes), transitional waters (estuaries), coastal waters and groundwater, with the aim of ensuring that all aquatic ecosystems meet 'good status'; and
- RBMPs have been prepared for the Scotland and Solway Tweed River Basin Districts to address the requirements of the WFD in relation to the management of Scotland's river systems. Both plans also provide an overview of the state of the water environment for their districts. The plans have been updated since the first cycle (2009 – 2015) and are currently in the second cycle (2015 – 2027).

4.5.3 Scotland's coastal waters are monitored by the Scottish Environment Protection Agency (SEPA) to measure performance and compliance with targets for coastal water quality status under the WFD.

4.5.4 Coastal and transitional water bodies are classified in terms of their ecological and chemical quality. For those water bodies not designated as heavily modified or artificial, this ecological quality is described in terms of 'ecological status', which defines how much ecological quality deviates from natural conditions. The quality elements used to assess ecological status are:

- Biological quality elements (water, plants and animals);
- Chemical and physicochemical elements (e.g. oxygen and nutrient levels); and
- Hydromorphological quality elements (water flows and levels; the condition of beds, banks and shores; and the continuity of rivers for fish migration).

[154] Scottish Government. 2015. The river basin management plan for the Scotland river basin district: 2015–2027. https://www.sepa.org.uk/media/163445/the-river-basin-management-plan-for-the-scotland-river-basin-district-2015-2027.pdf (accessed 20/12/18)

4.5.5 For ‘good status’, the chemical, physicochemical and hydromorphological quality of the water body must achieve the standards and conditions necessary for the biological quality elements to be in good condition. The ecological status of a water body is determined by the lowest-classed quality element.

4.5.6 The Water Framework Directive (WFD) requires that Member States monitor and assess surface and ground waters and develop and implement plans for improvements in water quality where standards are not met. The majority of the 505 coastal and transitional water bodies in Scottish Waters, as represented in Figure 24, are classified as either good status (342) or high status (155), however some areas have been classified as moderate (7) or poor (1), principally due to pressures on morphology and macro-invertebrates[155].

4.5.7 There are 80 designated shellfish waters in Scotland. Twenty-nine are assessed as at target objective, with the remaining 51 assessed as not at target objective (Figure 25).

4.5.8 In addition, assessment under the EU Marine Strategy Framework Directive (MSFD) against Indicator 8 (Concentrations of contaminants are at levels not giving rise to pollution effects) and 9 (Contaminants in fish and other seafood for human consumption do not exceed levels established by Community legislation or other relevant standards can be reviewed as an indicator of water quality.

[155] SEPA. 2018. SEPA Water Classification Hub. Available at https://www.sepa.org.uk/data-visualisation/water-classification-hub/. Accessed 04/10/2018.

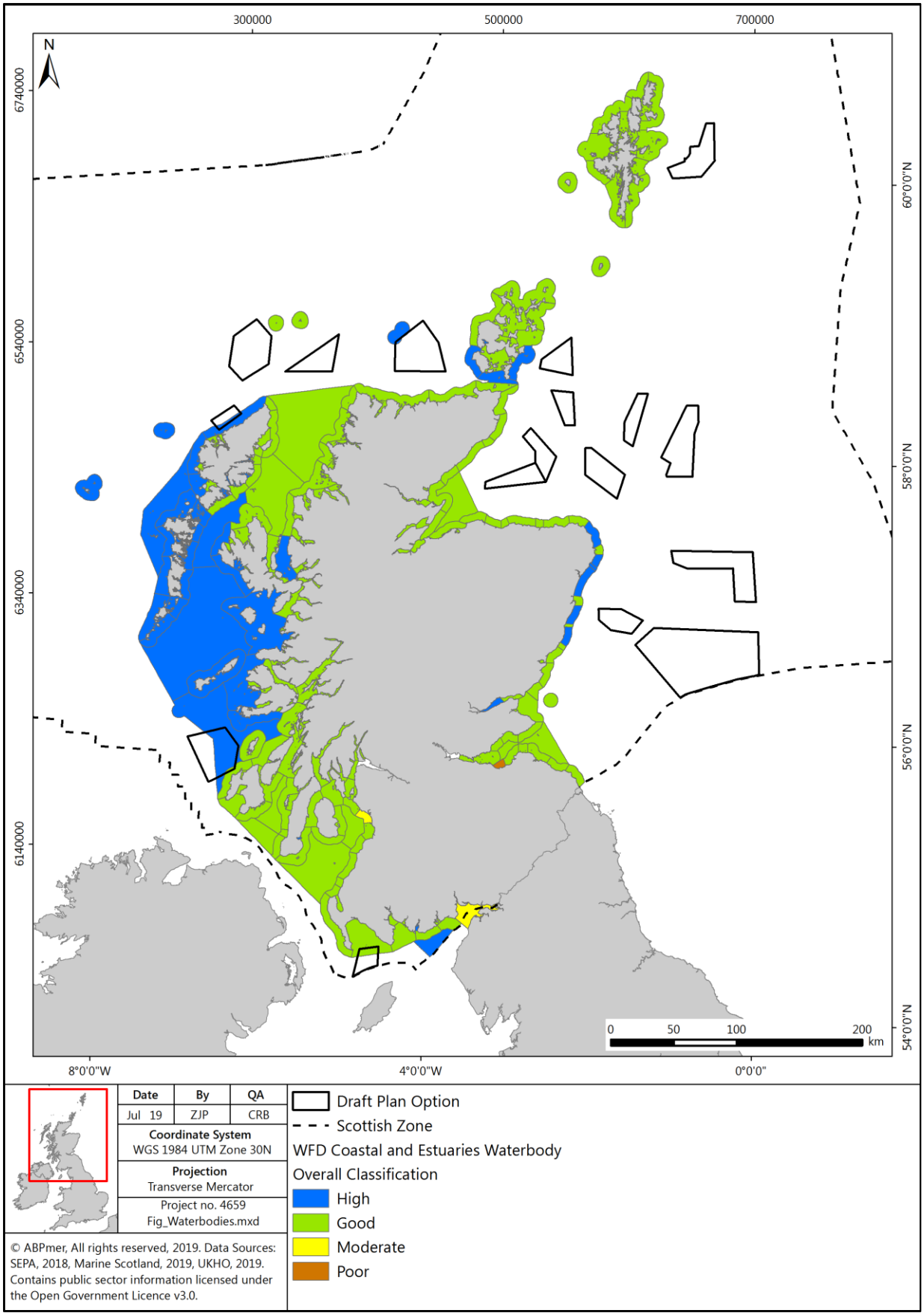


Figure 24 Classification of coastal and transitional water bodies under the WFD

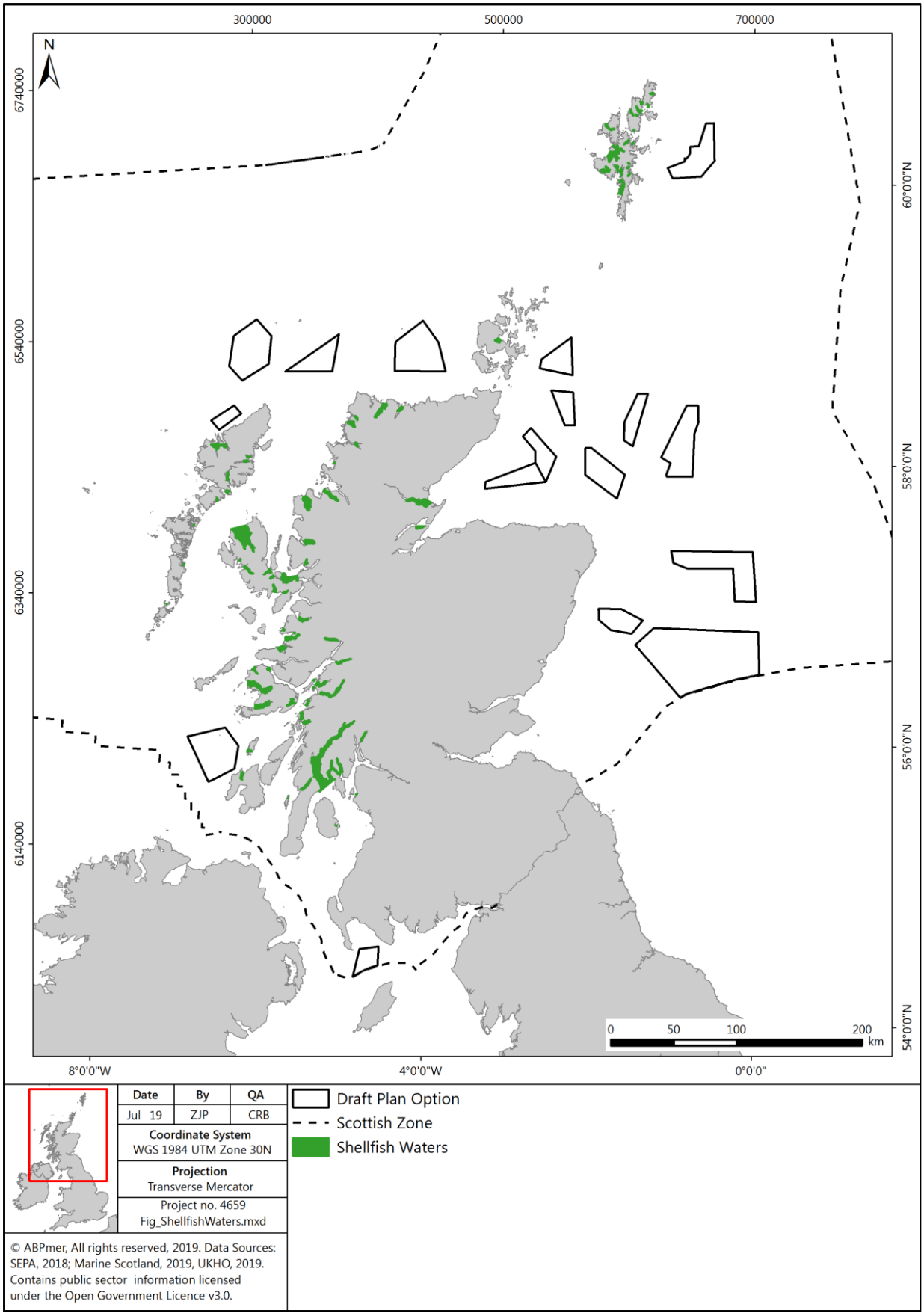


Figure 25 Shellfish water classifications

Potential Contamination Sources

4.5.9 Potential sources of pollution of the water environment and the pollutants entering the water environment can be varied. These can include shipping and boating; oil discharges from incidents, collisions or the release of ballast water[156]; introduced non-native species from ballast or vessel hulls[157]; discrete and diffuse terrestrial sources (e.g. natural weathering, industrial discharges and agriculture[158]), atmospheric sources (e.g. chemical contaminants and dust[159]); marine and beach litter including public litter, sewage related debris, fishing and shipping litter[160]; radioactive contamination (e.g. naturally occurring radioactive material (NORM), wastes[161] and accidental releases[162]); and munitions contamination and military waste[163].

Future Evolution of Baseline

4.5.10 Pressures on water quality around Scottish coastlines are generally dependent on the level of marine industry and associated effects, together with land use. The future baseline will continue to be affected by similar pressures observed in the marine environment today, but the level of these pressures going forward is unknown.

4.5.11 Higher marine traffic increases the potential for pollution events, however the modernisation of ships and more stringent inspection and maintenance regimes may reduce the occurrence of pollution events seen in a future baseline. The continued management of water quality has the potential to improve the status of coastal and transitional water bodies.

4.5.12 In the absence of the sectoral marine plan for offshore wind, it is anticipated that further offshore renewables development would occur in the near future. Wave and tidal energy developments have the potential to affect water quality

[156] Advisory Committee on Protection of the Sea (ACOPS) Annual survey of Reported Discharges attributed to vessels and offshore oil and gas installations operation in the United Kingdom Pollution Control Zone 2010 [online] Available at: http://www.acops.org.uk/wp-content/uploads/2019/05/ACOPS-Annual-Pollution-Survey-2010.pdf

[157] Baxter, J.M., Boyd, I.L., Cox, M., Donald, A.E., Malcolm, S.J., Miles, H., Miller, B., Moffat, C.F. 2011. Scotland's Marine Atlas: Information for the national marine plan. Marine Scotland, Edinburgh. Available at https://www.gov.scot/Publications/2011/03/16182005/0.

[158] ibid

[159] Marine Scotland (2012) Clean Seas [online] Available at: https://www2.gov.scot/Topics/marine/marine-environment/ecosystems/cleanseas

[160] Baxter, J.M., Boyd, I.L., Cox, M., Donald, A.E., Malcolm, S.J., Miles, H., Miller, B., Moffat, C.F. 2011. Scotland's Marine Atlas: Information for the national marine plan. Marine Scotland, Edinburgh. Available at https://www.gov.scot/Publications/2011/03/16182005/0.

[161] Defra (2010) Charting Progress 2 [online] Available at: http://chartingprogress.defra.gov.uk/feeder/Section_3.16_Waste_Disposal.pdf

[162] Marine Scotland (2008) Scotland's Seas: Towards Understanding their State [online] Available at: http://www.scotland.gov.uk/Publications/2008/04/03093608/15

[163] OSPAR (2010) Quality Status Report 2010: Assessment of the impact of dumped conventional and chemical munitions [online] Available at: http://qsr2010.ospar.org/media/assessments/p00365_supplements/p00365_suppl_1_concerns.pdf

directly within the renewable development's footprint and indirectly by altering coastal processes and sediment transport regimes.

4.6 Climatic Factors

4.6.1 The key pressures on the climate are derived from the continued global emission of greenhouse gases, including carbon dioxide. These emissions are recognised as leading to changes in the global climate (including changes in temperatures, precipitation, storm density) in turn causing changes in the physical characteristics of the oceans, including potential changes in sea temperatures, circulation, salinity, pH and sea level rise.

Climate Change

4.6.2 Sea surface temperatures have risen globally, with current temperatures approximately 0.6°C above the 1961 to 1990 average[164]; worldwide sea pH has reduced by 0.1 in the period since the start of the industrial revolution[165]; and the sea level around the UK has risen by 15.4cm since 1900[166].

4.6.3 As discussed in Section 2 above, the UK and Scottish governments have committed to reducing greenhouse gas emissions in order to support international programmes to mitigate climate change. Emissions in Scotland from the energy sector in 2016 totalled 7.2MtCO_2e, approximately 19% of total Scottish emissions. This figure represents an already significant reduction (68.5% reduction since 1990) in emissions from the energy sector, driven by the development of renewable energy sources and the reduction of oil, coal and gas usage in Scotland[167].

Carbon Cycle

4.6.4 The term 'carbon cycle' refers to the circulation of carbon in the environment. In the context of this report, it focusses on the exchange of carbon between the ocean and the atmosphere. The proportion of carbon incorporated into biomass is said to be 'stored'; thus, marine ecosystems such as kelp forests, maerl beds and marine sediments are able to store carbon. The addition of solid carbon to these long-term stocks is referred to as sequestration, and the conversion of atmospheric carbon dioxide to solid carbon in living material is referred to as fixation. The stored carbon is removed from the environment; however, physical disturbance, bacterial decomposition of organic matter or respiratory processes within the food chain may release the stored carbon back into the environment.

[164] Met Office, 2018. Global surface temperature, [online] available at https://www.metoffice.gov.uk/research/news/2018/global-surface-temperatures-in-2017
[165] NOAA, 2013. Ocean acidification, [online] available at https://www.noaa.gov/resource-collections/ocean-acidification
[166] Committee on Climate Change, 2018. Managing the coast in a changing climate. Available at https://www.theccc.org.uk/wp-content/uploads/2018/10/Managing-the-coast-in-a-changing-climate-October-2018.pdf
[167] Scottish Government; 2018. Electricity Generation by Fuel (GWh), Scotland and UK, 2004 – 2016.

4.6.5 Over half of global carbon sequestration occurs through fixation during oceanic photosynthesis and the subsequent long-term storage of the produced organic material. In addition to carbon being sequestered within the oceanic sediments, a significant portion is stored within living marine organisms. These organisms include taxa that possess calcium carbonate skeletons and shells such as coral and molluscs, with other carbon captured and stored in plant dominated habitats such as seagrass beds, kelp forests and maerl.

4.6.6 Within the marine environment, habitats and processes capable of carbon fixation and sequestration are defined as 'blue carbon sinks'. Multiple habitats across Scottish seas and coastal areas can be termed blue carbon sinks due to their fixation and sequestration ability. Their effectiveness as carbon sinks is highly dependent upon their long-term capacity to store carbon. Habitats present in Scottish waters and classed as blue carbon sinks are[168]:

- Kelp forests;
- Intertidal and sub-canopy macroalgae;
- Saltmarshes;
- Seagrass beds;
- Maerl beds;
- Horse mussel beds (*Modiolus modiolus*);
- Flame shell beds (*Limaria hians*);
- Lophelia pertusa reef;
- Tubeworm (Serpula vermicularis) reef;
- Blue mussel beds (*Mytilus edulis*);
- Brittlestar beds;
- Sediment; and
- Phytoplankton.

4.6.7 The largest contribution to carbon fixation and sequestration in Scottish waters comes from phytoplankton, via photosynthesis and subsequent deposition of the produced organic matter in seabed sediments. This may occur either directly through the export of phytoplankton or indirectly through the consumption of phytoplankton by other organisms and subsequent export of this organic matter through the food chain[169].

4.6.8 Carbon stored in shallow shelf sediment is ephemeral and constantly exchanged due to the dynamic nature of this habitat. Therefore, the potential for shallow shelf sediments to provide long-term carbon storage is a function of

[168] Burrows, M.T., Hughes, D.J., Austin, W.E.N., Smeaton, C., Hicks, N., Howe, J.A., Allen, C., Taylor, P. & Vare, L.L. 2017. Assessment of Blue Carbon Resources in Scotland's Inshore Marine Protected Area Network. Scottish Natural Heritage Commissioned Report No. 957.

[169] Kröger S, Parker R, Cripps G & Williamson P (Eds.) 2018. Shelf Seas: The Engine of Productivity, Policy Report on NERC-Defra Shelf Sea Biogeochemistry programme. Cefas, Lowestoft. DOI: 10.14465/2018.ssb18.pbd. Available at: https://www.uk-ssb.org/shelf_seas_report.html (accessed 21/11/2018)

sedimentation rates and the degree of recycling of organic carbon. The rate of recycling of organic carbon is driven by the level of oxygen available for bacterial and chemical breakdown of organic matter[170], which is primarily influenced by disturbance of seabed sediments, and the oxygen content of the seawater above the seabed.

4.6.9 Deeper sediments are less mobile and dynamic and therefore are able to store carbon to a greater extent, but the rate of uptake into the sediment is slower as sedimentation rates in deeper waters are reduced.

4.6.10 Kelp forests, ubiquitous along the rocky shore common around Scotland, are identified as a significant carbon store. However, the fate of carbon within kelp (i.e. whether it is eventually sequestered permanently) is not quantified, and the majority of stored carbon in kelp is understood to be recycled rather than sequestered[171].

4.6.11 Several of the other habitats listed, including maerl and brittlestar beds, are more efficient at carbon fixation and sequester a larger proportion of carbon relative to their physical extent, but as their total extent across Scotland is low, they do not contribute as much to total Scottish sequestration.

Future Evolution of the Baseline

4.6.12 Predictions of the effects of climate change under all emissions scenarios suggest that several changes will occur within the marine environment. Key changes include increasing sea surface temperatures, sea level rise, increases in ocean acidity and potential changes in storm intensity (and hence wind and wave energy).

4.6.13 However, further reduction in emissions, through the continuing development of a de-carbonised energy sector, can support the Scottish, UK and International policy goals to limit greenhouse gas emissions and hence mitigate the progression and effects of climate change.

4.6.14 Changes to blue carbon in a future baseline have considerable uncertainty. In some cases, it has been proposed that additional carbon dioxide availability may increase primary production, and therefore may potentially increase the fixation and sequestration of carbon dioxide in the marine environment. However, certain species, particularly those with calcium carbonate shells or exoskeletons, may be negatively affected by ocean acidification, and therefore the potential for sequestration by these organisms may be reduced.

4.6.15 A number of blue carbon habitats are currently thought to be declining, including maerl and flame shell beds. However, the current MPA programme is

[170] ibid

[171] Kröger S, Parker R, Cripps G & Williamson P (Eds.) 2018. Shelf Seas: The Engine of Productivity, Policy Report on NERC-Defra Shelf Sea Biogeochemistry programme. Cefas, Lowestoft. DOI: 10.14465/2018.ssb18.pbd

expected to contribute to halting or even reversing the decline of habitats within the MPAs.

4.6.16 In addition, increased disturbance of the seabed, either through increased storm intensity suggested as part of the effect of climate change or through changes in the intensity of marine industry, has the potential to increase the dissolution of carbon sequestered in the marine sediments.

4.7 Cultural Heritage

4.7.1 Key pressures on historic marine environment and archaeological features are from climatic conditions, including storm events, coastal processes (e.g. leading to coastal erosion) and human activities such as coastal and offshore infrastructure developments.

4.7.2 Many cultural heritage features are designated and thus afforded some degree of protection; however, there is considerable uncertainty on the location, extent and status of many subtidal marine historical assets.

4.7.3 Loss, damage and modification of historic assets and their settings can occur through a range of marine activities and infrastructure developments. Where the construction or operation of offshore marine developments, including their associated infrastructure (e.g. subsea cables, coastal substations etc.), overlaps with historical features then there is the potential for direct effects to arise on the feature and its setting. Indirect effects on historical features may also occur from changes in coastal processes and sediment transport regimes resulting from offshore infrastructure.

Designated Historical Sites and Shipwrecks

4.7.4 There are numerous scheduled monuments and listed buildings along the Scottish coastline, with designated wrecks and military remains sites identified both inshore and offshore. Three of Scotland's six designated World Heritage Sites (WHS) are on the coast (St. Kilda; The Heart of Neolithic Orkney; The Forth Bridge), with other non-Scottish sites (including Hadrian's Wall in England and the Giant's Causeway in Northern Ireland) on adjacent coastlines (see Figure 26). The Crucible of Iron Age Shetland is also on the Tentative List for a future WHS[172].

4.7.5 Other key coastal features include a number of Category A listed lighthouses, ecclesiastical remains, coastal heritage museums, military defences, harbours, forts and castles.

4.7.6 Historic Marine Protected Areas (Historic MPAs) are designated under Section 67 of the Marine Scotland Act 2010 to protect marine historic assets (e.g.

[172] United Nations Educational, Scientific and Cultural Organization (UNESCO) – Tentative Lists UK and Ireland. Available at: http://whc.unesco.org/en/tentativelists/state=gb [accessed 08/01/2019].

historic shipwrecks) of national importance within Scottish Territorial Waters (up to 12nm from the coast). There are currently 9 Historic MPAs designated within Scottish waters[173] (see Figure 26).

4.7.7 In addition to the historic MPAs, there are a number of other designated sites that overlap with the coastal and marine environment including 8 designated wrecks, 9 scheduled monuments, 4 listed buildings and 20 sites and vessels designated under the Protection of Military Remains Act 1986.

4.7.8 There are also numerous shipwrecks around Scotland, an estimate by Historic Scotland puts this in the region of 20,000[174] (see Figure 27).

4.7.9 The sea is an integral part of the setting for many terrestrial sites. For example, the Inventory of Gardens and Designed Landscapes recognises 390 nationally important sites, a number of which are in coastal locations[175].

4.7.10 The locations of designated historic sites in relation to plan option areas at a regional scale are provided in the RLG.

[173] Marine Scotland - National Marine Plan interactive (NMPi) – Available at: https://marine.gov.scot/maps/nmpi [accessed 21/01/2020].
[174] Scottish Government (2011) Scotland's Marine Atlas: Information for the national marine plan. Pg 156.
[175] Historic Environment Scotland (2016) Scotland's Inventory of Gardens and Designed 2016. Available at: https://www.historicenvironment.scot/archives-and-research/publications/publication/?publicationId=7c365ace-e62d-46d2-8a10-a5f700a788f3 [accessed 08/01/2019].

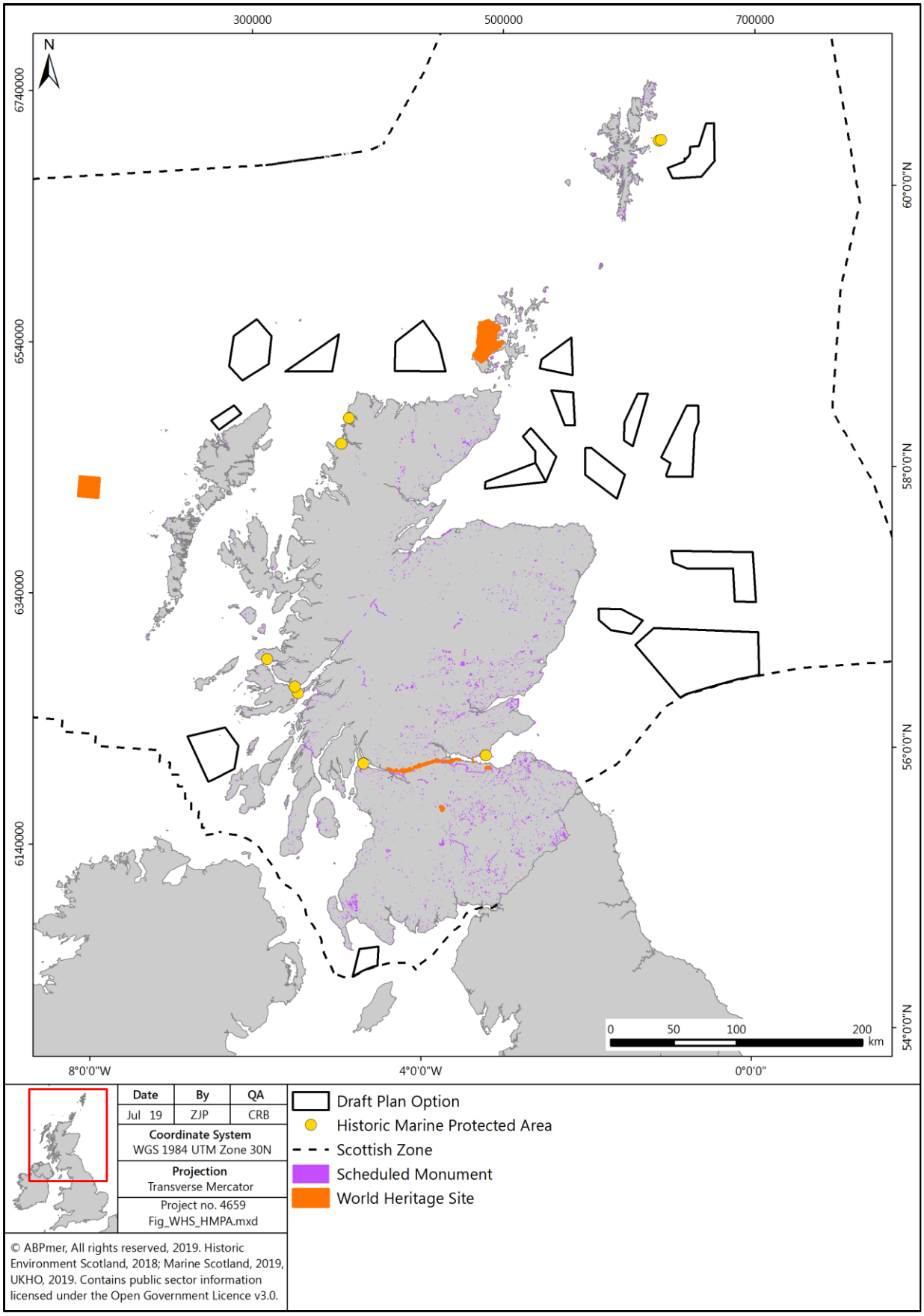


Figure 26 World heritage sites and historic MPAs in Scotland

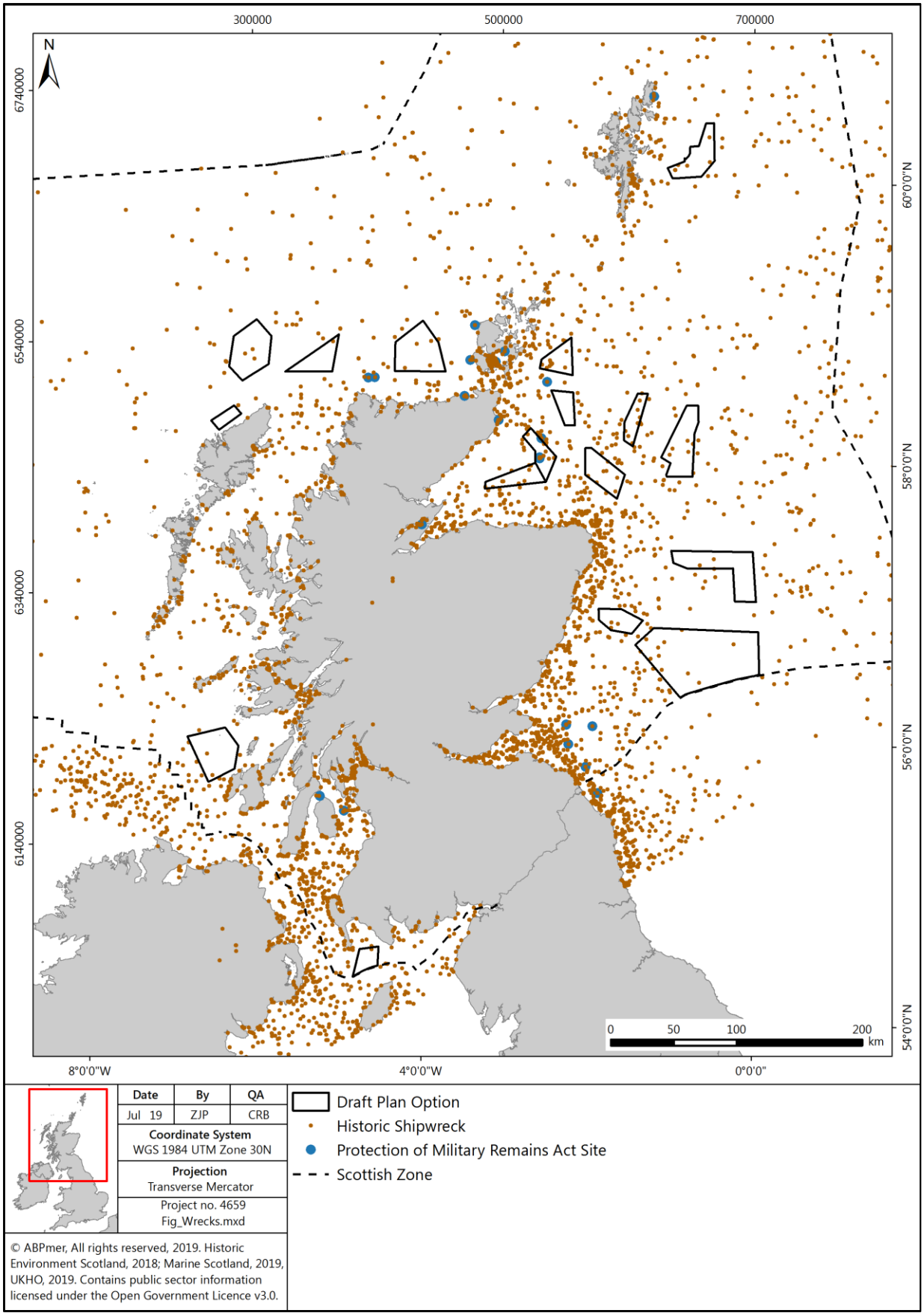


Figure 27 Shipwrecks around the Scottish coast

4.8 Palaeolandscapes

4.8.1 Sea level rise, on historic timescales has changed the position of the coastline of the United Kingdom considerably in the time since hominid occupation of the United Kingdom is first known to have occurred. As areas of land became submerged any artefacts in this area were submerged with it, and therefore there is potential for culturally significant artefacts to be in the subtidal areas around Scotland. The largest areas of land which have been submerged are in the southern North Sea and the English Channel[176]. although there are areas around the coast of Scotland, including in the Firth of Forth and Aberdeenshire coastlines, which were previously above sea level (Figure 28). There is therefore potential for submerged archaeological remains in these areas. Except for some areas in the North East and East regions, and an area around the Shetland Islands, these potential areas are inshore of the AoS, and therefore the effects of development on these areas are limited to infrastructure associated with cable landfalls. The likelihood of archaeological remains is, however, difficult to quantify on a regional scale, due to the small areas of archaeological interest (potentially in the scale of metres) associated with hominid occupation[177] and therefore it is expected that consideration would have to be made at a project level to manage the effects of cable landfalls and offshore wind farm development.

[176] Amkreutz, L., Verpoorte, A., Waters-Rist, A., Niekus, M., van Heekeren, V., van der Merwe, A., van der Plicht, H., Glimmerveen, J., Stapert, D., Johansen, L. 2018. What lies beneath...Late Glacial human occupation of the submerged North Sea landscape, Antiquity vol 92 Issue 361. Available at https://www.cambridge.org/core/journals/antiquity/article/what-lies-beneath-late-glacial-human-occupation-of-the-submerged-north-sea-landscape/D97FDC8DDCE649ABAD716FC78F21A1BC.

[177] Bicket, A., Tizzard, L., Firth, A. and Benjamin, J. 2014. Heritage Management and Submerged Prehistory in the United Kingdom. Prehistoric Archaeology on the Continental Shelf. 10.1007/978-1-4614-9635-9_12. Available at https://www.researchgate.net/publication/258120283_Heritage_Management_and_Submerged_Prehistory_in_the_United_Kingdom

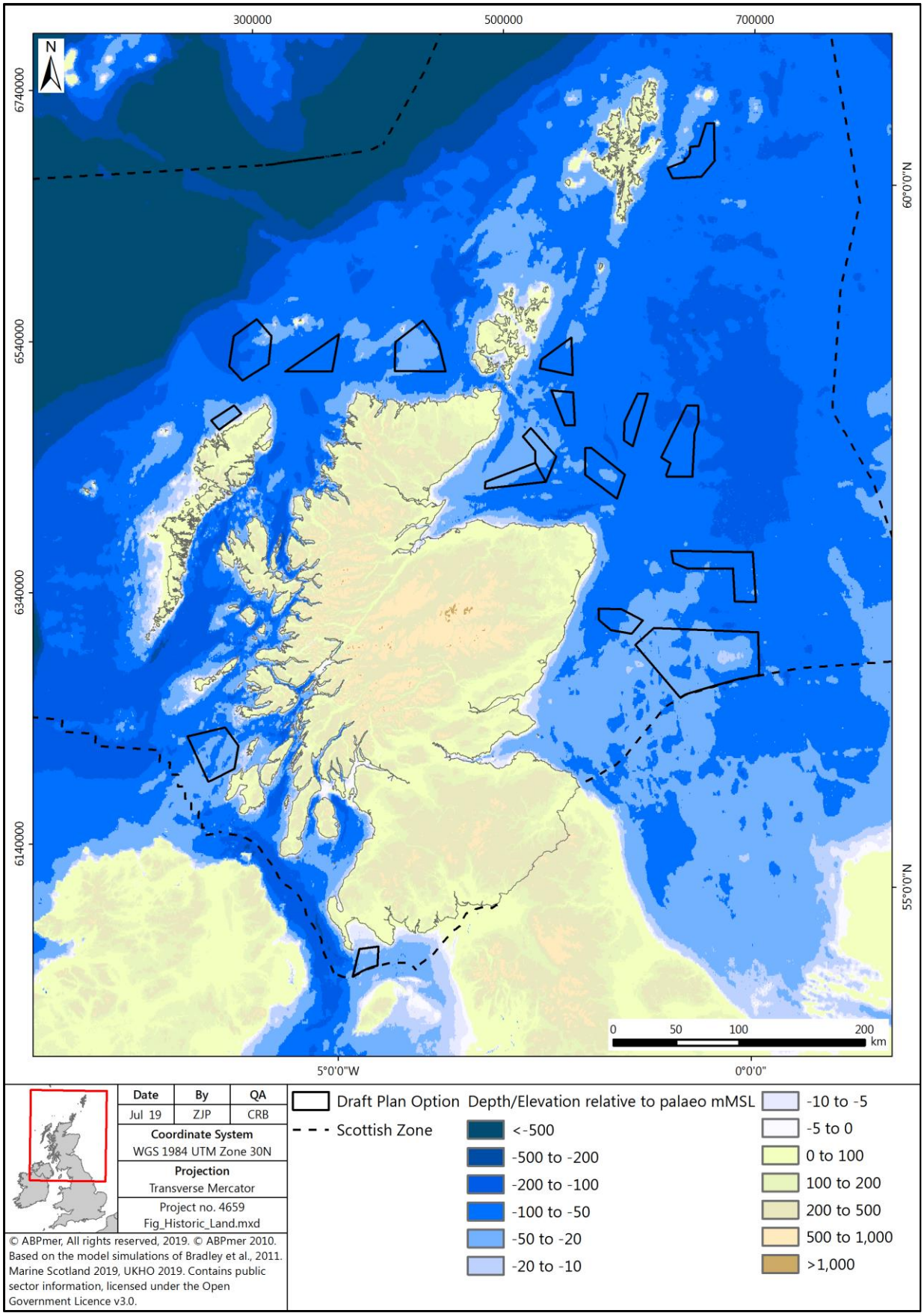


Figure 28 Historical land area

Future Evolution of Baseline

4.8.2 Pressures from coastal erosion and climatic conditions will continue to affect the historic environment with climate change potentially exacerbating the erosive and destructive effects from physical processes. Pressures from human development will also affect the setting of historic assets.

4.8.3 The Scottish Coastal Archaeology and the Problem of Erosion Trust (SCAPE) provides an indication of coastal heritage sites around Scotland which are threatened by erosion[178]. The works highlights those coastal sites seen most at risk from erosion.

4.8.4 There has been a general increase in visitors to historic sites in Scotland[179] which may continue and increase pressure on the sites. However, sites such as Skara-Brae in the Heart of Neolithic Orkney WHS will continue to be actively managed through the adoption of individual site management plans and government and agency commitments, to minimise the risk of effects from visitor disturbance and erosion.

4.8.5 In the absence of the sectoral marine plan for offshore wind, it is anticipated that further offshore renewables development would occur in the near future. Wave and tidal energy developments have the potential to affect historical features directly within the renewable development's footprint and indirectly by altering coastal processes and sediment transport regimes and through effects on the setting of these features.

4.9 Landscape, Seascape and Visual Amenity

4.9.1 Scotland's landscapes and seascapes are a shared resource for everyone and bring many social and health benefits to people. They are an irreplaceable resource which supports the economy, inspires national culture and provides history. Landscapes and seascapes are appreciated for their natural aesthetic qualities, can be used as an escape from modern life and encourage physical activities. There are many pressures on the landscapes and seascapes around the Scottish coastline including; coastal and marine development, changing coastal processes and the projected effects of climate change.

4.9.2 Scottish Natural Heritage (SNH) has undertaken an assessment of the landscape and seascape of Scotland, developing the Landscapes of Scotland map[180], dividing Scotland into 79 areas, each of which has a description of the landscape and seascape within that area.

[178] Scotland's Coastal Heritage at Risk. Available at: http://scharp.co.uk/ [accessed 08/01/2019]
[179] Scottish Government (2011) Scotland's Marine Atlas, Information for the national marine plan. Pg 158.
[180] Geographic Information Group. 2012. Landscapes of Scotland Map. [online] available at https://www.nature.scot/sites/default/files/2017-07/A736465%20-%20Landscapes%20of%20Scotland%20-%20map.pdf.

4.9.3 Approximately 13% of Scotland has been classified as a National Scenic Area (NSA) (Figure 29)[181] and national parks have been established in the Cairngorms and Loch Lomond and The Trossachs. There are 40 NSA's, defined as areas of outstanding scenic value in a national context, which are protected for their value in aesthetic and landscape terms. Of these, 27 are located within or adjacent to coastal areas. These areas are predominantly located on the west coast and amongst the Northern and Western Isles. The NSA designations are integrated into Scottish Planning Policy, so any development with the potential to affect an NSA should only be permitted where:

- The objectives of the designation and the overall integrity of the NSA won't be compromised; or
- Any significant adverse effects on its special qualities are outweighed by social, environmental or economic benefits of national importance.

4.9.4 The coast also provides the landscape setting for three of Scotland's World Heritage Sites: St Kilda, Heart of Neolithic Orkney and the Forth Bridge[182]. World Heritage Status covers both landscape and historic environment attributes, and many of these sites also have coastal elements.

4.9.5 Many local authorities have identified local landscape areas (LLA)[183]. Many of these local designations lie in coastal locations in the Northern and Western Isles, and along the south-western, western, north-western and northern coastlines of the Scottish mainland. These local landscape designations;

- Help to protect a landscape from inappropriate development;
- Encourage landscape management;
- Promote a community's sense of pride in their environment; and
- Create awareness of the distinctive landscape qualities.

4.9.6 Scottish Natural Heritage (SNH) has identified areas of 'relative wildness' in Scotland through a process involving the consideration of the perceived naturalness of the land, the ruggedness of the terrain, remoteness from public roads or ferries, and the visible lack of roads, buildings, pylons and other modern objects. While the maps do not include offshore areas, they illustrate the core areas of wild land and provide an overview of the high level of wildness attributed to coastal areas on Scotland's north-west coast and in the Western Isles.

[181] Scottish Natural Heritage. 2017. National Scenic Areas. [online] available at https://www.nature.scot/professional-advice/safeguarding-protected-areas-and-species/protected-areas/national-designations/national-scenic-areas.
[182] Historic Environment Scotland. 2018. World Heritage Sites in Scotland. [online] available at https://www.historicenvironment.scot/advice-and-support/listing-scheduling-and-designations/world-heritage-sites/world-heritage-sites-in-scotland/.
[183] Scottish Natural Heritage. 2017. Local Landscape Areas. [online] available at https://www.nature.scot/professional-advice/safeguarding-protected-areas-and-species/protected-areas/local-designations/local-landscape-areas.

4.9.7 Scotland has three sites which are members of the European Geoparks Network and the UNESCO Global Geoparks Network: The North West Highlands Geopark, Geopark Shetland and Lochaber Geopark[184]. They are not specifically a landscape designation, but these sites have been recognised for their internationally significant geodiversity.

4.9.8 Scott *et al*, (2005)[185], developed a methodology to characterise seascapes, and define their sensitivity. The sensitivity of the seascapes are increased where there is greater intricacy, stillness, low lighting and where the seascape is currently unmodified and experienced from a secluded coastline. The distance to which offshore windfarms can be seen is also discussed, identifying maximum visual ranges of 40 to 50 km, although assessments were based on a visual range of 35 km.

4.9.9 Scottish Natural Heritage (SNH) has developed a coastal character assessment which informs and guides coastal and marine planning and supplements Scotland's landscape character assessment.

Future Evolution of Baseline

4.9.10 The future baseline for landscapes and seascapes around the Scottish coastline is likely to be driven, certainly in the short term, by the current trends and pressures as discussed above.

4.9.11 In the long term, it is likely that the coastal landscapes and seascapes of Scotland will be altered by coastal process and climate change. Changes to coastal processes, specifically changes to coastal erosion and accretion processes, have the potential to alter these coastal landscapes and seascapes. While currently identified as an issue along sections of Scotland's coastline, the potential for erosion is expected to increase in the future with additional pressures resulting from rising sea levels and storms associated with climate change. These factors are considered likely to exacerbate existing processes.

4.9.12 In the absence of the sectoral marine plan for offshore wind, it is anticipated that further offshore and onshore renewables development would occur in the near future. Additional wind developments are likely to affect Scotland's landscapes and seascapes, both directly through the physical presence of the turbines and indirectly by changing coastal processes. Wave and tidal energy developments also have the potential to affect Scotland's landscapes and seascapes.

[184] Scottish Natural Heritage. 2017. Visit a geopark. [online] available at https://www.nature.scot/enjoying-outdoors/places-visit/visit-geopark.

[185] Scott, K.E., Anderson, C., Dunsford, H., Benson, J.F. and MacFarlane, R. 2005. An assessment of the sensitivity and capacity of the Scottish seascape in relation to offshore windfarms. Scottish Natural Heritage Commissioned Report No.103 (ROAME No. F03AA06). Available at https://www.nature.scot/snh-commissioned-report-103-assessment-sensitivity-and-capacity-scottish-seascape-relation-windfarms.

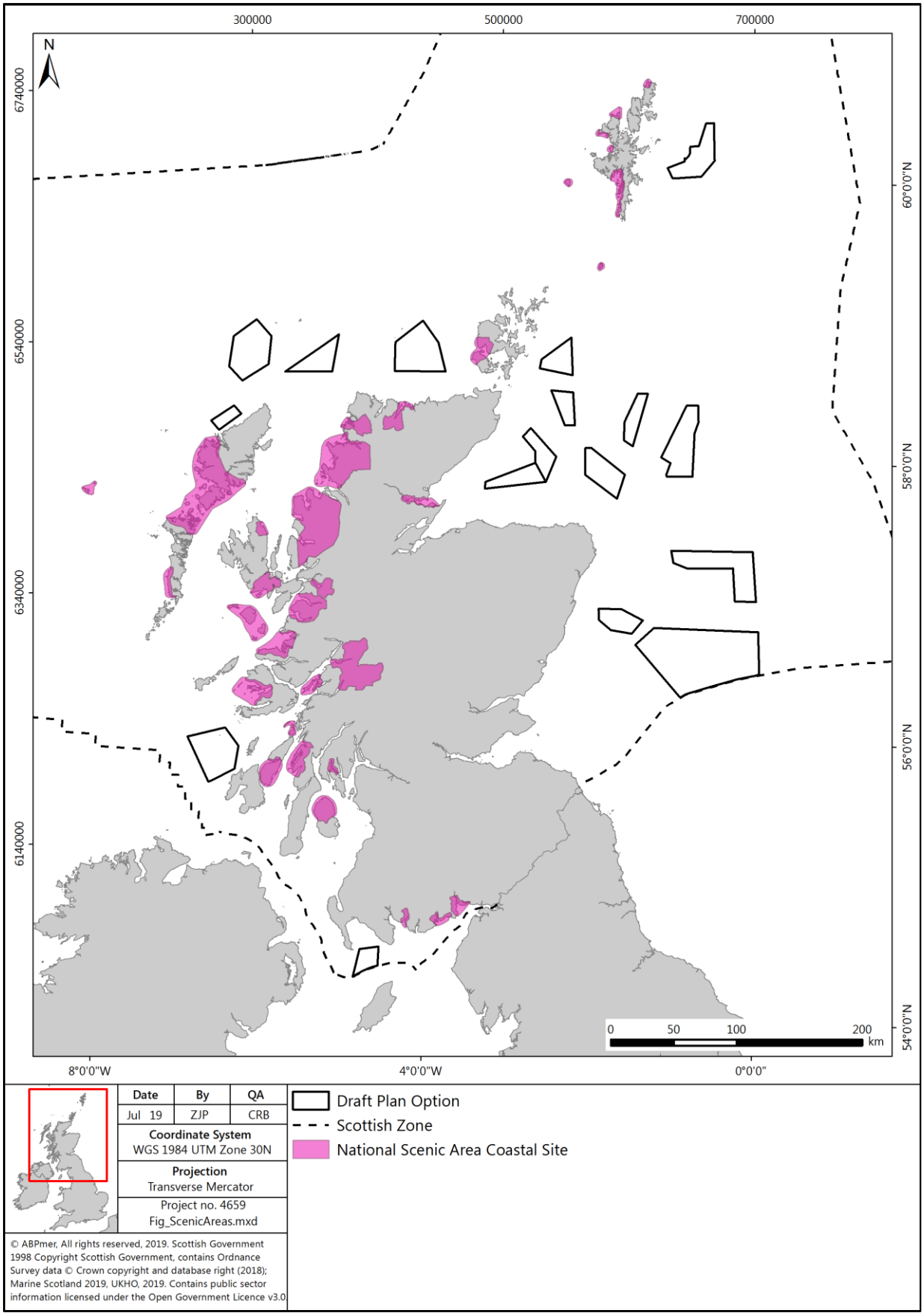


Figure 29 National scenic areas

5 Results of SEA

5.1 Stage 1: Wind Energy Technologies

5.1.1 A review of the currently operational and future technologies, including the offshore transmission infrastructure, has been undertaken, and potential environmental effects associated with the construction, operation, maintenance and decommissioning phases identified.

5.1.2 The reviewed technologies are:

- Wind technologies with gravity-base foundation devices (bottom fixed);
- Wind technologies with monopile or multi-pile foundation devices (bottom fixed);
- Wind technologies with tripod of steel jacket foundation devices (bottom fixed);
- Wind technologies with mono or multi-caisson foundation devices (bottom fixed); and
- Floating wind turbines, including turbines with both gravity and piled anchors.

5.1.3 The reviewed transmission technologies are:

- Offshore transmission infrastructure components;
- Subsea transmission cables; and
- Landfall and transition pit.

5.1.4 The full results are presented in Appendix B. A summary of the key effects of both conventional bottom fixed technologies and floating technologies is presented below against each topic. The key effects are generally similar between all technologies, with the largest differences between fixed bottom and floating wind regarding effects on benthic habitat, and potential reductions in the amount or size of piling required during construction.

Biodiversity, Flora and Fauna

5.1.5 The pathways discussed below were informed by Halcrow [186], Talisman Energy [187], EMU [188], Aberdeen Wind Offshore Wind Farm Limited [189] and E-on [190] [191] [192] and could potentially alter biodiversity, flora and fauna.

Benthic habitats and species

5.1.6 There is the potential for habitat loss or disturbance to benthic communities during installation, decommissioning and continued disturbance during operation due to maintenance and repair activities. This could be especially detrimental to sensitive/designated habitats such as reefs and their associated species which may take time to recover. Seabed habitat would be lost from the placement of devices and support structures on the seabed required by any of the turbine technologies. Gravity-base foundations would potentially have the greatest negative effect by directly placing large blocks on/into the seabed. There is also the potential for adverse effects from sourcing of fill or dredged material for use in the gravity-based foundation. This could potentially affect marine fauna from dredging activities, turbidity and habitat disturbance. Floating technologies would have the smallest effect, with the loss of small, discreet areas of benthic habitat associated with the placement of gravity anchors significantly smaller than that associated with fixed bottom technology. However, chains attaching the floating structures to the seafloor should also be considered because they may have an effect over a much wider area and would be a continual disturbance during operation. There are also potential effects on benthic invertebrates from noise and induced electromagnetic fields associated with operational cables.

5.1.7 Seabed disturbances from cable installation activities are considered temporary and have a relatively limited effect through resuspension of sediments, loss of habitat, trenching in intertidal environments and potential damage to stony or rocky reef in areas of hard substrate. where cables are buried, it is generally anticipated that the seabed will return to its original state, however impacts from cable installation should nonetheless be mitigated so far as is reasonably practicable through careful route selection and appropriate installation techniques.

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[186] Halcrow (2007) The Plan for Offshore Wind Energy in Scottish Territorial Waters, Environmental Report: Volume 1, Prepared for the Scottish Executive [online] Available at: http://www.scotland.gov.uk/Resource/Doc/312161/0098588.pdf [accessed 27/03/2019].
[187] Talisman Energy (UK) LTD (2005) Environmental Statement [online] Available at: http://www.beatricewind.co.uk/downloads/statement.asp [accessed 25/03/2019].
[188] EMU (2012) Neart na Gaoithe Offshore Wind Farm Environmental Statement, Prepared for Mainstream Renewable Power [online] Available at: http://marine.gov.scot/datafiles/lot/nng/Environmental_statement/ [accessed 21/01/2020].
[189] Aberdeen Wind Offshore Wind Farm Limited (2011) European Offshore Wind Deployment Centre: Non-Technical Summary, July 2011 [online] Available at: http://marine.gov.scot/datafiles/lot/eowdc/ [accessed 21/01/2020].
[190] E-on (2008) Offshore Environmental Statement, April 2008 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2019].
[191] E-on (2008) Onshore Cable Route Environmental Statement, April 2008 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2019].
[192] E-on (2009) Onshore Substation and Cable Spur Environmental Statement, November 2009 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2019].

5.1.8 Indirect adverse effects to benthic habitats may also occur. Particularly sensitive habitats such as shellfish growing waters or fish spawning grounds could be damaged from sediment dispersion and deposition in the construction and decommissioning phases of work.

5.1.9 It is anticipated that many of the construction and decommissioning effects may be temporary and reversible (i.e. removal of the gravity base structure, support structures, caissons or gravity anchors and rehabilitation of the seabed).

5.1.10 Wind turbines, of any technological design, have the potential for creating artificial habitats for marine organisms resulting from the presence of new structures. These may provide benefits which could last for the life of the project, or potentially longer depending on the decommissioning scheme. This impact pathway may lead to fish aggregation effects around turbine foundations and structures which in turn may lead to possible impacts on trophic food webs for fish species, marine mammals and birds. These impacts have the potential to be both beneficial or adverse[193].

5.1.11 There could also be a positive change from the reduction in commercial fishing (e.g. trawling) in areas where wind farms are sited, which may enhance biodiversity.

Marine mammals and fish

5.1.12 The underwater noise and vibration created during surveys, clearance of unexploded ordnance, installation and decommissioning for any of the offshore wind technologies, has the potential to affect marine fauna such as seals, otters, cetaceans, fish and basking sharks, potentially including fish associated with aquaculture installations. There will be a difference in magnitude between the different technologies as the technologies which involve piling will have a greater noise and vibration effect. There is also the possibility for cumulative effects from multiple noise sources audible to marine mammals and fish during installation and increased vessel disturbance.

5.1.13 Relating to all the technologies, there is the possibility of habitat loss, exclusion, displacement or disturbance of marine mammals and fish during device installation, operation and decommissioning. This would occur through a combination of factors including noise (and multiple noise sources), vibration, visual and light intensity changes, water quality changes, habitat disturbance or the increased presence of structures and vessels. This could be particularly detrimental to bottom dwelling species such as sandeel, which are important prey species for birds, marine mammals and fish.

5.1.14 Spawning and nursery grounds could also be affected by habitat loss and disturbance during installation, maintenance and decommissioning phases of development. Anthropogenic noises, vibrations from pile driving, water quality

[193] Stenberg, Claus & Støttrup, J.G. & Deurs, Mikael & Berg, C.W. & Dinesen, Grete & Mosegaard, Henrik & Grome, T. & Leonhard, S. (2015). Long-term effects of an offshore wind farm in the North Sea on fish communities. Marine Ecology Progress Series. 528. 257–265. 10.3354/meps11261.

changes and light intensity changes all pose a threat to spawning and juvenile fish.

5.1.15 There is also the possibility of increased suspended sediment during construction and decommissioning causing sediment deposition affecting bottom dwelling and spawning species such as sandeel or fish associated with aquaculture installations.

5.1.16 Similarly, with regard to all offshore wind technologies, there is a potential risk of injury to marine mammals through collisions with submerged structures and associated cabling or effects during the installation, maintenance and decommissioning periods (i.e. risk of injury to seals and cetaceans during placement of foundations).

5.1.17 There is the potential for induced electromagnetic fields (EMF) associated with cabling and grid connection infrastructure to affect the behaviour and migratory patterns of some fish and mammal species. The noise during the construction and decommissioning phases could cause behavioural responses, displacement from natural habitats and feeding areas, physical injuries to hearing organs and potentially lethal effects.

5.1.18 Cumulative effects may also occur, particularly affecting mammals and migratory fish, which have the potential to be present throughout Scottish waters, from an increased number of barriers affecting movement such as device arrays, construction vessels and equipment.

5.1.19 Positively, artificial rocky habitats could potentially be created due to the presence of submerged infrastructure[194].

Birds

5.1.20 A number of studies have investigated the collision risks to birds from offshore wind turbines [195] [196] [197] [198] [199] [200] [201]. Many of these studies agree that collision

[194] Stenberg, Claus & Støttrup, J.G. & Deurs, Mikael & Berg, C.W. & Dinesen, Grete & Mosegaard, Henrik & Grome, T. & Leonhard, S. (2015). Long-term effects of an offshore wind farm in the North Sea on fish communities. Marine Ecology Progress Series. 528. 257–265. 10.3354/meps11261.

[195] Krijgsveld, K.L., R. Lensink, H. Schekkerman, P. Wiersma, M.J.M. Poot, E.H.W.G. Meesters & S. Dirksen, 2005. Baseline studies North Sea wind farms: fluxes, flight paths and altitudes of flying birds 2003 - 2004. Report 05-041. Bureau Waardenburg, Culemborg.

[196] Krijgsveld, K.L., R.C. Fijn, M. Japink, P.W. van Horssen, C. Heunks, M.P. Collier, M.J.M. Poot, D. Beuker & S. Dirksen, 2011. Effect studies Offshore Wind farm Egmond aan Zee: Final report on fluxes, flight altitudes and behaviour of flying birds. Report 10-219. Bureau Waardenburg, Culemborg

[197] Cook, A.S., Johnston, A., Wright, L.J., and Burton, N.H. 2012. A review of flight heights and avoidance rates of birds in relation to offshore wind farms. Strategic Ornithological Support Services: Project SOSS-02. BTO and The Crown Estate.

[198] Furness, R.W., Wade, H.M., & Masden E.A. 2013. Assessing vulnerability of marine bird populations to offshore wind farms. Journal of Environmental Management. 119; 56-66.

[199] Bradbury, G., Trinder, M., Furness, B., Banks, A.N., Caldow, R.W.G., Hume, D. 2014. Mapping Seabird Sensitivity to Offshore Wind Farms. PLoS ONE 9(9): e106366. https://doi.org/10.1371/journal.pone.0106366.

[200] Johnston, A., Cook, A., Wright, L., Humphreys, E., Burton, N. 2014. Modelling flight heights of marine birds to more accurately assess collision risk with offshore wind turbines. Journal of Applied Ecology 51, 31–41.

[201] Cook, A.S., Ward, R.M., Hansen, W.S., Larsen, L., 2018. Estimating Seabird Flight Height using LiDAR Scottish Marine and Freshwater Science Vol 9 No 14, 59pp. DOI: 10.7489/12131-1.

risk is influenced by various factors but is largely driven by the proportion of birds flying at collision risk height [202].

5.1.21 Some bird species are considered to be at a lower risk of collision as they typically fly at low altitudes (above the sea surface and below the swept area of the turbines)[203]. However, other bird species (such as large gulls and Gannets) have a higher potential collision risk, as they typically fly at higher altitudes and travel large distances between breeding and wintering grounds. For example, 35% of Herring Gull flights have been recorded at blade height[204].

5.1.22 Other research suggests that birds adapt their flight paths to avoid collision with turbines[205] with generally very high avoidance of turbines exhibited by seabirds [206]. WWT [207] has indicated that most seabirds are not expected to be at risk because of these avoidance rates, while work by Cook *et al.*[208] suggested that birds rarely pass close to the rotor blades. The ORJIP Bird Collision Avoidance Study compiled an extensive dataset of observations of bird behaviour in and around an operational offshore wind farm, concluding that the target species (Northern Gannet, Lesser Black-backed Gull, Herring Gull, Great Black-backed Gull and Black-legged Kittiwake) *"exhibit behaviour that significantly reduces risk of those seabird species colliding with rotating turbine blades than would otherwise be the case if there was no change in behaviour"*[209].

5.1.23 Diving birds could potentially collide with support devices (i.e. mooring cables or anchors if used for floating technologies). However, this is likely to be site and device-specific, and the likelihood of occurrence is not currently known.

5.1.24 Furthermore, there is the potential to disturb diving birds foraging areas during installation, operation and decommissioning due to underwater noise, surface noise, visual and light intensity changes, water quality changes, habitat disturbance or the presence of structures and vessels.

5.1.25 Seabirds could also be affected by offshore transmission infrastructure components. Installation, maintenance and decommissioning activities could potentially cause a loss of prey species in offshore feeding grounds leading to increased foraging distances or reducing foraging success. There is also the potential for displacement of bird species from offshore foraging areas to other

[202] Furness, R.W., Wade, H.M., & Masden E.A. 2013. Assessing vulnerability of marine bird populations to offshore wind farms. Journal of Environmental Management. 119; 56-66.
[203] Jongbloed, R.H. 2016. Flight height of seabirds. A literature study IMARES. Report C024/16.
[204] Furness, R.W., Wade, H.M., & Masden E.A. 2013. Assessing vulnerability of marine bird populations to offshore wind farms. Journal of Environmental Management. 119; 56-66.
[205] Jongbloed, R.H. 2016. Flight height of seabirds. A literature study IMARES. Report C024/16.
[206] Skov, H., Heinänen, S., Norman, T., Ward, R.M., Méndez-Roldán, S., Ellis, I. 2018. ORJIP Bird Collision and Avoidance Study. Final report – April 2018. The Carbon Trust. 247 pp.
[207] WWT, 2014. Strategic assessment of collision risk of Scottish offshore wind farms to migrating birds. Scottish Marine and Freshwater Science Report Vol 5 No 12.
[208] Cook, A.S., Humphreys, E.M., Masden, E.A., Burton, N.H. 2014. The Avoidance Rates of Collision Between Birds and Offshore Turbines. Scottish Marine and Freshwater Science Volume 5 Number 16.
[209] Skov, H., Heinänen, S., Norman, T., Ward, R.M., Méndez-Roldán, S. & Ellis, I. 2018. ORJIP Bird Collision and Avoidance Study. Final report – April 2018. The Carbon Trust. United Kingdom. 247 pp.

areas due to disturbance during the construction, maintenance and decommissioning phases.

Population and Human Health

5.1.26 The pathways discussed below were informed by Halcrow [210], Talisman Energy [211], EMU [212], Aberdeen Wind Offshore Wind Farm Limited [213] and E-on [214] [215] [216] and could potentially alter population and human health.

5.1.27 All the offshore wind turbine technologies would provide a new renewable energy supply for the life of the development. Therefore, the potential effects on energy supply are the same across the different technologies.

5.1.28 There is the possibility of shadow flicker and noise effects, particularly if the array is located near-shore.

5.1.29 Other marine users (i.e. fishing, recreational, shipping, aquaculture) could be affected by the development of a wind farm. This could include the potential displacement of these activities, the risk of collision with turbine structures, and visual effects associated with the presence of the turbines. Upon decommissioning, these effects are likely to be reversible.

5.1.30 There is the potential for issues with navigation, although it is noted that this may be managed through the selection of appropriate sites and consultation with the Maritime and Coastguard Agency (MCA) to ensure that there are no unacceptable risks to commercial or recreational shipping.

5.1.31 Recreational and commercial activities could be affected by the installation of new transmission infrastructure to connect the devices to the grid (i.e. cables on the seabed, terrestrial infrastructure). Potential effects are likely to be site and development specific.

5.1.32 Construction vessels, cable excavation vessels, maintenance activities and helicopter flights may affect other marine user's transit routes (e.g. dredging, oil and gas operations and freight), increasing navigational risk, particularly during the installation, maintenance and construction phases.

5.1.33 There is also the potential for interference with communications due to EMF.

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[210] Halcrow (2007) The Plan for Offshore Wind Energy in Scottish Territorial Waters, Environmental Report: Volume 1, Prepared for the Scottish Executive [online] Available at: http://www.scotland.gov.uk/Resource/Doc/312161/0098588.pdf [accessed 27/03/2019].
[211] Talisman Energy (UK) LTD (2005) Environmental Statement [online] Available at: http://www.beatricewind.co.uk/downloads/statement.asp [accessed 25/03/2019].
[212] EMU (2012) Neart na Gaoithe Offshore Wind Farm Environmental Statement, Prepared for Mainstream Renewable Power [online] Available at: http://marine.gov.scot/datafiles/lot/nng/Environmental_statement/ [accessed 21/01/2020].
[213] Aberdeen Wind Offshore Wind Farm Limited (2011) European Offshore Wind Deployment Centre: Non-Technical Summary, July 2011 [online] Available at: http://marine.gov.scot/datafiles/lot/eowdc/ [accessed 21/01/2020].
[214] E-on (2008) Offshore Environmental Statement, April 2008 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2019].
[215] E-on (2008) Onshore Cable Route Environmental Statement, April 2008 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2019].
[216] E-on (2009) Onshore Substation and Cable Spur Environmental Statement, November 2009 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2019].

Soil (Marine Geology and Coastal Processes)

5.1.34 The pathways discussed below were informed by OSPAR [217], Halcrow [218], Talisman Energy [219], EMU [220], Aberdeen Wind Offshore Wind Farm Limited [221] and E-on [222] [223] [224] and could potentially alter marine geology and coastal processes.

5.1.35 There is the potential that any of the technologies could have a direct adverse effect to the seabed from the installation, operation or decommissioning processes. There will be a difference in magnitude between the technologies depending on their location. Gravity-base and mono or multi-caisson foundations involve preparation of the seabed (dredging) and then the placement of heavy foundations and associated scour protection, technologies with monopile or multi-pile and tripod or steel jacket foundations require piling operations and floating technologies need anchors and moorings placed directly on the seabed, or could involve the use of piles.

5.1.36 All the technologies could potentially alter the sediment dynamics, tidal flows/fluxes and waves due to the presence of devices in the water column.

5.1.37 Effects such as deposition and abrasion may also occur due to the installation and decommissioning processes. The effects of scouring will primarily happen during the operational phase. However, there is the possibility of using scour protection for gravity-base and mono or multi-caisson foundation structures to alleviate risks. Scour protection creates an additional footprint, so it would only be used where it is considered necessary. Deeper water locations would be less likely to need scour protection.

5.1.38 Effects from construction and decommissioning works, for all the technologies, are likely to be temporary. Also, the effects from seabed preparation works for gravity-base foundations and mono or multi-caisson foundations are likely to be temporary because they are usually required in geomorphologically active areas.

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[217] OSPAR Commission (2004) Biodiversity Series: Environmental Impacts to marine species and habitats of dredging for navigational purposes [online] Available at: http://www.ospar.org/documents/dbase/publications/p00208_environmental%20impacts%20to%20marine%20species.pdf [accessed 28/03/2019]

[218] Halcrow (2007) The Plan for Offshore Wind Energy in Scottish Territorial Waters, Environmental Report: Volume 1, Prepared for the Scottish Executive [online] Available at: http://www.scotland.gov.uk/Resource/Doc/312161/0098588.pdf [accessed 27/03/2019].

[219] Talisman Energy (UK) LTD (2005) Environmental Statement [online] Available at: http://www.beatricewind.co.uk/downloads/statement.asp [accessed 25/03/2019].

[220] EMU (2012) Neart na Gaoithe Offshore Wind Farm Environmental Statement, Prepared for Mainstream Renewable Power [online] Available at: http://marine.gov.scot/datafiles/lot/nng/Environmental_statement/ [accessed 21/01/2020].

[221] Aberdeen Wind Offshore Wind Farm Limited (2011) European Offshore Wind Deployment Centre: Non-Technical Summary, July 2011 [online] Available at: http://marine.gov.scot/datafiles/lot/eowdc/ [accessed 21/01/2020].

[222] E-on (2008) Offshore Environmental Statement, April 2008 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2019].

[223] E-on (2008) Onshore Cable Route Environmental Statement, April 2008 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2019].

[224] E-on (2009) Onshore Substation and Cable Spur Environmental Statement, November 2009 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2019].

5.1.39 Gravity-base foundations have additional effects due to the sourcing of fill or dredged material to fill their base. If marine fill or dredged material is used, potential effects at the source may include: loss of substrata or habitat if taken from suitable undisturbed areas; and potential effects on hydrodynamics and water flows at the source location from the removal of sediments. If material is sourced from the terrestrial environment it will have effects associated with the removal of material and its transportation.

Water Quality

5.1.40 The pathways discussed below were informed by Halcrow [225], Talisman Energy[226], EMU [227], Aberdeen Wind Offshore Wind Farm Limited [228] and E on[229] [230] [231] and could potentially alter water quality.

5.1.41 There is a potential effect on water quality during the installation, operation and decommissioning processes, from all of the technologies, due to increased turbidity, seabed disturbance and contamination from installation, maintenance and decommissioning equipment and vessels. It is likely the magnitude of the effects will differ between the technologies. The placement of gravity-based supports and concrete foundations for the placement of caissons will have different effects on water quality compared to piling activities. The associated effect on marine biodiversity, particularly those dependent on existing water conditions such as benthic species (e.g. filter feeders) is likely to be site specific. Cable installation will also alter the water quality by re-suspending seabed sediments into the water column, increasing turbidity levels. The level of disturbance largely depends on the equipment being used, but the majority of sediment deposition would occur in a relatively restricted area. There is also the possibility of remobilising contaminants, especially if the cable route passes through areas of muddy sediment with high levels of anthropogenic activity.

5.1.42 There is potential for the requirement of dredged material for gravity base foundations, which may affect water quality through increased turbidity from sediment disturbance during dredging operations.

5.1.43 The construction and decommissioning effects are temporary and may be reversible, and this is true for all technologies.

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[225] Halcrow (2007) The Plan for Offshore Wind Energy in Scottish Territorial Waters, Environmental Report: Volume 1, Prepared for the Scottish Executive [online] Available at: http://www.scotland.gov.uk/Resource/Doc/312161/0098588.pdf [accessed 27/03/2019]
[226] Talisman Energy (UK) LTD (2005) Environmental Statement [online] Available at: http://www.beatricewind.co.uk/downloads/statement.asp [accessed 25/03/2019].
[227] EMU (2012) Neart na Gaoithe Offshore Wind Farm Environmental Statement, Prepared for Mainstream Renewable Power [online] Available at: http://marine.gov.scot/datafiles/lot/nng/Environmental_statement/ [accessed 21/01/2020].
[228] Aberdeen Wind Offshore Wind Farm Limited (2011) European Offshore Wind Deployment Centre: Non-Technical Summary, July 2011 [online] Available at: http://marine.gov.scot/datafiles/lot/eowdc/ [accessed 21/01/2020].
[229] E-on (2008) Offshore Environmental Statement, April 2008 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2019].
[230] E-on (2008) Onshore Cable Route Environmental Statement, April 2008 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2019].
[231] E-on (2009) Onshore Substation and Cable Spur Environmental Statement, November 2009 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2019].

5.1.44 The development of offshore transmission infrastructure, subsea transmission cables and landfall and transition pits all have the potential to impact similarly on water quality. This includes having the potential to cause the re-suspension of sediments and their associated hazardous substances due to excavation during installation and major repair activities, and the potential to cause accidental spillages from construction vessels and structures during operation. During construction, maintenance and decommissioning activities there is potential for water contamination from oil or other harmful substances. This would have associated risks to humans and riparian ecology. There is the potential for sedimentation and increased turbidity of watercourses in areas where vegetation has been cleared.

Climatic Factors

5.1.45 The pathways discussed below were informed by Halcrow [232] and could potentially alter climatic factors.

5.1.46 All the technologies would bring benefits due to their contribution to renewable electricity generation. The extent of the benefits would depend on the scale and duration of developments. However, it is also important to note the possible effect on blue carbon. Habitats such as sea grass meadows, salt marshes and maerl beds are valuable carbon sinks and if they are degraded or damaged by offshore wind developments and their carbon sink reduced, the resulting increase in CO_2 emissions will contribute to further climate change.

5.1.47 Construction vessel and vehicle emissions used to complete the transmission infrastructure have the potential to affect air quality, and subsequently human health, and contribute to greenhouse emissions.

[232] Halcrow (2007) The Plan for Offshore Wind Energy in Scottish Territorial Waters, Environmental Report: Volume 1, Prepared for the Scottish Executive [online] Available at: http://www.scotland.gov.uk/Resource/Doc/312161/0098588.pdf [accessed 27/03/2019].

Cultural Heritage

5.1.48 The pathways discussed below were informed by Fjordr Marine and Historic Environmental Consulting[233], Halcrow[234], Talisman Energy[235], EMU[236] and E-on[237] [238] [239] [240] and could potentially alter cultural heritage.

5.1.49 There is the potential for installation, operation and decommissioning to affect known historic sites and their exclusion zones, including World Heritage Sites, coastal listed buildings such as lighthouses, scheduled monuments and other unknown, submerged or non-designated archaeological assets features or paleo-landscapes. Development has the potential to directly disturb, damage or destroy submarine and coastal archaeological remains during device installation and cable trenching. There is also potential for scouring, siltation and deposition to occur around culturally important sites located in the vicinity of developments.

5.1.50 However, adverse effects are can be avoided through careful siting of individual device foundations, piles, anchors and arrays.

5.1.51 There is the potential for the offshore transmission infrastructure to cause loss of or damage to known or unknown buried heritage from construction and maintenance/repair activities.

[233] Fjordr Marine and Historic Environment Consulting (2013) Historic Environment Guidance for Wave and Tidal Energy (Draft) [online] Available at: https://historicengland.org.uk/images-books/publications/historic-environment-guidance-wave-tidal-energy/wavetidal/ [accessed 21/01/2020]

[234] Halcrow (2007) The Plan for Offshore Wind Energy in Scottish Territorial Waters, Environmental Report: Volume 1, Prepared for the Scottish Executive [online] Available at: http://www.scotland.gov.uk/Resource/Doc/312161/0098588.pdf [accessed 27/03/2019]

[235] Talisman Energy (UK) LTD (2005) Environmental Statement [online] Available at: http://www.beatricewind.co.uk/downloads/statement.asp [accessed 25/03/2019]

[236] EMU (2012) Neart na Gaoithe Offshore Wind Farm Environmental Statement, Prepared for Mainstream Renewable Power [online] Available at: http://marine.gov.scot/datafiles/lot/nng/Environmental_statement [accessed 21/01/2020].

[237] Aberdeen Wind Offshore Wind Farm Limited (2011) European Offshore Wind Deployment Centre: Non-Technical Summary, July 2011 [online] Available at: http://marine.gov.scot/datafiles/lot/eowdc/ [accessed 21/01/2020].

[238] E-on (2008) Offshore Environmental Statement, April 2008 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2019]

[239] E-on (2008) Onshore Cable Route Environmental Statement, April 2008 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2019]

[240] E-on (2009) Onshore Substation and Cable Spur Environmental Statement, November 2009 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2019]

Landscape, Seascape and Visual Amenity

5.1.52 The pathways discussed below were informed by OSPAR [241], Halcrow [242], Talisman Energy [243], EMU [244], Aberdeen Wind Offshore Wind Farm Limited [245] and E-on [246] [247] [248] and could potentially alter the landscape, seascape and visual amenity.

5.1.53 There is the potential for turbines and their supporting infrastructure (i.e. additional platforms, construction, maintenance or decommissioning vessels and equipment) associated with any of the offshore wind technologies, to adversely affect sensitive landscape and visual receptors such as designated or valued landscapes/seascapes. In general, greater effects are likely for near-shore devices than those located further offshore and for larger turbines (with greater height and thus greater visibility).

5.1.54 Field observations of offshore wind facilities in the United Kingdom revealed that the turbines may be visible at distances of 26 mi (42 km) in daytime and 24 mi (39 km) in night-time. They may be a focus of visual attention at distances of up to 10 mi (16 km)[249]. These distances will be influenced by the turbine height, with smaller turbines less visible / intrusive to landscape or seascape receptors. The shape of arrays relative to the coastline also influences visual impact. Similarly assessments undertaken for the Natural Resources Wales[250] have concluded that the 15 km is the maximum distance of medium effect for the smallest offshore wind turbines likely to be constructed.

5.1.55 Within 15 km it has therefore been assumed that there is less potential for avoidance of significant effects with a correspondingly higher assessment of effect, whereas beyond this distance there is potential for mitigation through spatial planning, array design and turbine selection, with post-mitigation assessments reduced based on this assumption.

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[241] OSPAR Commission (2004) Biodiversity Series: Environmental Impacts to marine species and habitats of dredging for navigational purposes [online] Available at: http://www.ospar.org/documents/dbase/publications/p00208_environmental%20impacts%20to%20marine%20species.pdf [accessed 28/03/2019]

[242] Halcrow (2007) The Plan for Offshore Wind Energy in Scottish Territorial Waters, Environmental Report: Volume 1, Prepared for the Scottish Executive [online] Available at: http://www.scotland.gov.uk/Resource/Doc/312161/0098588.pdf [accessed 27/03/2019].

[243] Talisman Energy (UK) LTD (2005) Environmental Statement [online] Available at: http://www.beatricewind.co.uk/downloads/statement.asp [accessed 25/03/2019].

[244] EMU (2012) Neart na Gaoithe Offshore Wind Farm Environmental Statement, Prepared for Mainstream Renewable Power [online] Available at: http://marine.gov.scot/datafiles/lot/nng/Environmental_statement [accessed 21/01/2020]

[245] Aberdeen Wind Offshore Wind Farm Limited (2011) European Offshore Wind Deployment Centre: Non-Technical Summary, July 2011 [online] Available at: http://marine.gov.scot/datafiles/lot/eowdc [accessed 21/01/2020]

[246] E-on (2008) Offshore Environmental Statement, April 2008 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2019].

[247] E-on (2008) Onshore Cable Route Environmental Statement, April 2008 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2019].

[248] E-on (2009) Onshore Substation and Cable Spur Environmental Statement, November 2009 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2019].

[249] Sullivan, R., Kirchler, L., Cothren, J., Winters, S. 2013. Offshore Wind Turbine Visibility and Visual Impact Threshold Distances. Environmental Practice 15, 33-49.

[250] NRW. 2019. Seascape and visual sensitivity to offshore wind farms in Wales: Strategic assessment and guidance. Stage 1-Ready reckoner of visual effects related to turbine size. Report 315. March 2019.

5.1.56 Onshore and offshore transmission infrastructure components also have the potential to alter the landscape and seascape respectively. Construction activities, including temporary lighting and construction plants may temporarily affect visual receptors.

5.2 Potential Environmental Effects of Development within the DPOs

5.2.1 An assessment of the potentially significant environmental effects of development within each DPO has been undertaken, based on the indicative realistic maximum scales of development. The full results of this assessment are presented in Appendix C and summarised against each topic below and in Table 8.

5.2.2 The assessment is technology neutral, in that no distinction has been made at individual sites to prejudge the likely technology. Therefore, for the purposes of the assessment, the worst-case scenario has been determined, noting where there are differences between technologies or array design that have the potential to reduce the severity of effects. Where this is the case, and the level of mitigation likely to be applied at a certain site is uncertain, a range of effect classification (e.g. negligible to minor negative) has been used to highlight this uncertainty.

5.2.3 It is recognised that this assessment is therefore likely to be precautionary, and that in some cases project level design and mitigation strategies have the potential to further reduce effects below those identified in Appendix C.

5.2.4 Table 8, presents the overarching results of the assessment against the identified pathways:

1. Loss of and/or damage to marine and coastal habitats, including benthic and intertidal habitats (for example, due to smothering of benthic habitats and substratum loss).
2. Effects on key mobile receptors and prey species, including disturbance, noise effects, EMF exposure, collision risk, habitat exclusion, and barriers to wildlife movement.
3. Effects arising from habitat modification, such as the creation of artificial reefs, new roosting structures and exclusion of habitat damaging activity.
4. Effects of pollution releases on species and habitats.
5. Effects from introduction and spread of Invasive Non-Native Species (INNS).
6. Effects arising from noise, vibration, light, dust and shadow flicker effects from all phases of development.
7. Effects on residential amenity stemming from construction/installation/operational activities.
8. Issues of navigational safety, aviation and collision risk.

9. Effects on marine and coastal recreation and access
10. Development of a secure energy supply.
11. Effects on subsea geology, sediments, and coastal processes arising from changes in hydrodynamics and the existing wave regime.
12. Effects on ecological status.
13. Effects on water quality (for example, due to increases in suspended sediment loads and turbidity as well as an increase in pollution incidents).
14. Effects of the presence of structures on local currents, wave regimes, and water column mixing, as well as secondary effects on sedimentation and erosion beyond the sites.
15. Contribution to supporting a diverse and decarbonised energy sector.
16. Coastal facilities may be at risk from climate change.
17. Loss of and/or damage to historic environment features and their settings, including coastal and marine archaeology and historic MPAs.
18. Both temporary and longer-term effects on landscape and coastal character and visual receptors arising from the presence of structures including any ancillary infrastructure.

5.2.5 It is recognised that some effects against the identified pathways will be generic across sites, as the effects relate to the introduction of structures, irrelevant of technology or environmental receptors present. Where these pathways present the highest risk in a specific DPO and are hence included in the summary against that site, the text below recognises that these effects are generic and will be present against all sites.

Table 8 Summary of the results of the assessment against DPOs (see key table below for explanation of symbology)

Topic	Biodiversity, Flora and Fauna					Population and Human Health					Soil	Water			Climatic Factors		Cultural Heritage	Landscape, Seascape and Visual Amenity
Pathway	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
SW1	-/--	-/--	~	~	-	N/E	N/A	-/---	N/A	++/+++	-/--	~/-	-	-/--	++/+++	N/E	~/-	--/---
W1	-/--	-/--	~	~	-	-	N/A	-	N/A	++/+++	~/-	~/-	-	~/-	++/+++	N/E	~/-	~/---
N1	-	-/--	~	~	-	N/E	N/A	-/---	N/A	++/+++	~/-	~/-	-	~/-	++/+++	N/E	~/-	~/-
N2	~/-	~/-	~	~	-	N/E	N/A	~/-	N/A	++/+++	~/-	~/-	-	~/-	++/+++	N/E	~/-	~/-
N3	~/-	~/--	~	~	-	N/E	N/A	~/-	N/A	++/+++	~/-	~/-	-	~/-	++/+++	N/E	~/-	~/-
N4	-	~/-	~	~	-	-/---	N/A	-/--	N/A	++/+++	~/--	~/-	-	~/--	++/+++	N/E	~/-	--/---
NE1	--	-/--	~	~	-	N/E	N/A	~/-	N/A	++/+++	~/--	~/-	-	~/--	++/+++	N/E	~/--	~/-
NE2	~/-	-/---	~	~	-	N/E	N/A	~/-	N/A	++/+++	~/-	~/-	-	~/-	++/+++	N/E	~/-	~/-
NE3	~/-	-/---	~	~	-	N/E	N/A	-/--	N/A	++/+++	~/-	~/-	-	~/-	++/+++	N/E	~/-	~/-
NE4	~/-	-/---	~	~	-	N/E	N/A	--/----	N/A	++/+++	~/-	~/-	-	~/-	++/+++	N/E	~/-	~/-
NE5	~/-	-/---	~	~	-	N/E	N/A	-/--	N/A	++/+++	~/-	~/-	-	~/-	++/+++	N/E	~/-	-/--
NE6	-	-/---	~	~	-	N/E	N/A	--/----	N/A	++/+++	~/-	~/-	-	~/-	++/+++	N/E	~/-	~
NE7	-	-/--	~	~	-	N/E	N/A	~/-	N/A	++/+++	~/-	~/-	-	~/-	++/+++	N/E	~/-	N/E
NE8	-	-/--	~	~	-	N/E	N/A	~/-	N/A	++/+++	~/-	~/-	-	~/-	++/+++	N/E	~/-	N/E
E1	-	-/--	~	~	-	N/E	N/A	~/-	N/A	++/+++	~/-	~/-	-	~/-	++/+++	N/E	~/-	N/E
E2	-	-/--	~	~	-	N/E	N/A	-/--	N/A	++/+++	~/-	~/-	-	~/-	++/+++	N/E	~/-	N/E
E3	-	--/---	~	~	-	N/E	N/A	-/---	N/A	++/+++	~/-	~/-	-	~/-	++/+++	N/E	~/-	~/-

Term	Description
+++	Major Positive
++	Moderate Positive
+	Minor Positive
~	Negligible Effect
-	Minor Negative

Topic	Biodiversity, Flora and Fauna					Population and Human Health					Soil	Water			Climatic Factors		Cultural Heritage	Landscape, Seascape and Visual Amenity
Pathway	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
--	Moderate Negative																	
---	Major Negative																	
N/E	No Effect – There is no effect pathway from source to receptor																	
N/A	Not Assessed – Effect pathway cannot be assessed due to uncertainties regarding cable landfalls or is assessed in the SEIA and / or within another pathway, for further details see Appendix C.																	

Key impacts considered against each DPO

South West

SW1

5.2.6 Within SW1, the key pathways which may constrain development are:

- Biodiversity, flora and fauna, particularly potential effects on Whooper Swan migration pathways and potential impacts on harbour porpoise from the North channel SAC;
- Navigational safety, both for commercial shipping and recreational boating;
- Sediment transport and coastal processes; and
- Visual effects on landscape / seascape.

5.2.7 There is potential to mitigate most of the effects of the above pathways, principally through spatial planning and array design at a project level. Further research, including development of the baseline through survey, and consideration of specific mitigation, such as selection of specific turbine heights may be required to reduce effects on Whooper Swan or other species' migration pathways.

5.2.8 The proximity of the DPO to land does, however, limit the degree that spatial planning can be used to mitigate against effects on landscape or seascape.

5.2.9 There is considerable uncertainty regarding the potential cable routes from SW1, therefore no meaningful assessment can be made. Export cable planning will be required to take into consideration sensitive areas at a project level. Inshore of SW1 there are a number of sensitive habitats including SAC directly landwards of SW1 in Luce Bay and Solway Firth and SPA in the Solway Firth.

West

W1

5.2.10 Within W1, the key pathways which may constrain development are:

- Biodiversity, flora and fauna, particularly potential effects on benthic habitat and displacement or barrier effects on marine mammals, birds and fish;
- Sediment transport and coastal processes; and
- Visual effects on landscape / seascape.

5.2.11 It is recognised that development in the east and south east of the DPO is likely to have more significant effects on biodiversity than in the west and north west, due to higher usage of the area by grey seal and bird species which may be displaced or be at risk of collision or noise effects. Additionally, the south east of the site is closest to land, and hence will have higher visual effects. Potential

impacts on basking shark have the potential to be distributed throughout the DPO, but are likely to be greatest during July and August.

5.2.12 There is potential to mitigate all the effects of the above pathways, and further lower impact pathways, through spatial planning, temporal planning, and array design at project level.

5.2.13 There is therefore potential to mitigate biodiversity and community effects at a plan level by excluding development from the east and south-east; and to mitigate navigational risk by excluding development from the western boundary.

5.2.14 There is considerable uncertainty regarding the potential cable routes from W1, therefore no meaningful assessment can be made. Export cable planning will be required to take into consideration sensitive areas at a project level. Inshore of W1 there are a number of sensitive habitats including SAC to the north and east of the DPO, and SPA to the south and east.

North

N1

5.2.15 Within N1, the key pathways which may constrain development are:

- Biodiversity, flora and fauna, particularly potential effects on bird populations including foraging in the west of the DPO from the Sule Kerry and Sule Stack SPA and Kittiwake from Orkney; and
- Navigational safety, both for commercial shipping and recreational boating.

5.2.16 Bird usage of the site is concentrated to the western and eastern sectors of the DPO, and as such additional research and subsequent spatial planning at a project level may be required to avoid areas of key usage for bird species, particularly those associated with the SPA. In addition, specific mitigation, such as selection of specific turbine heights, may be required to reduce effects on bird species' migration pathways where they are identified in pre-consent surveys.

5.2.17 Spatial planning can also be used to avoid key commercial shipping and recreational boating routes within the site to allow safe transit, and further mitigate other pathways at a project level.

5.2.18 There is considerable uncertainty regarding the potential cable routes from N1, therefore no meaningful assessment can be made. Export cable planning will be required to take into consideration sensitive areas at a project level. Inshore of N1 there are a number of sensitive habitats, however the distance of the DPO from land should allow cable planning to avoid areas of particularly sensitive habitats based on surveys of potential cable routes.

N2

5.2.19 N2 is generally an area of lower constraint, with the most significant pathways (assessed as minor effects after mitigation) associated with risks of spread of invasive species and effects on water quality from sediment disturbance during construction or pollution events associated with increases in shipping to service developments within the DPO.

5.2.20 These risks are applicable to all developments and are not specific to N2. They can be managed through the licencing process at a project level, including requirements to produce biosecurity management plans, pollution management plans and sediment contamination testing where significant disturbance is anticipated.

5.2.21 In addition, there is potential for minor effects on biodiversity, navigational safety, soil, water, visual receptors and cultural heritage receptors in N2, however these are considered to have the potential to be mitigated to a negligible level through project level assessment and planning.

5.2.22 Similarly, there are potential effects from export cable pathways, therefore no meaningful assessment can be made. Export cable planning will be required to take into consideration sensitive areas at a project level. Directly to the east of the DPO is the Solan bank reef SAC which should be avoided in project level cable planning and survey of potential cable routes should identify any sensitive areas which should be avoided.

N3

5.2.23 Within N3, the key pathway which may constrain development is:

- Biodiversity, flora and fauna, particularly potential effects on bird species foraging in the northeast section of the DPO from the North Rona and Sula Sgeir SPA and migrating species whose pathways intersect N3;

5.2.24 There is potential to mitigate the effects of the above pathway and other lower impact pathways through spatial planning and array design at a project level. Further research and consideration of specific mitigation may be required to reduce effects on bird species' foraging areas and migration pathways.

5.2.25 There is considerable uncertainty regarding the potential cable routes from N3, therefore no meaningful assessment can be made. Export cable planning will be required to take into consideration sensitive areas at a project level. Inshore of N3 there are few designated sensitive habitats, however survey of potential cable routes should identify any sensitive areas which should be avoided.

N4

5.2.26 Within N4, the key pathways which may constrain development are:

- Effects on population from noise during construction;

- Navigational safety, both for commercial shipping and recreational boating; and
- Visual effects on landscape / seascape.

5.2.27 There is potential to mitigate the effects of the above pathways, principally through array design and technology selection at a project level. The most significant effects are to population receptors and are associated with the proximity of the DPO to land. Airborne noise effects could be mitigated through choice of foundation design. Visual effects could be mitigated in part through choice of turbine size. However, given the proximity to land and the presence of a National Scenic Area (NSA) approximately 10 km to the south, turbines of any size will be visible, and therefore affect landscape / seascape character. The extent of the constraint to development regarding this receptor will likely be significantly influenced by the opinions of local stakeholders.

5.2.28 There is considerable uncertainty regarding the potential cable routes from N4, therefore no meaningful assessment can be made. Export cable planning will be required to take into consideration sensitive areas at a project level. Inshore of N4 there are few designated sensitive habitats, however survey of potential cable routes should identify any sensitive areas which should be avoided.

North East

NE1

5.2.29 Within NE1, the key pathways which may constrain development are:

- Biodiversity, flora and fauna, particularly potential effects on benthic habitat, spawning fish, including herring, cod and whiting, and displacement of marine mammals, birds and fish; and
- Sediment transport and coastal processes.

5.2.30 It is recognised that the development in the east of the DPO is likely to have more potential for significant effects on biodiversity, flora and fauna, due to proximity to the Pobie Bank SAC which adjoins the DPO, designated for benthic habitats including encrusting bryozoans and deep sea sponge aggregations. Although the features within the site are non-mobile, there is potential for some examples of the features to be present within the DPO and therefore have potential to be impacted directly by the footprint of the turbines or the cable route. In addition, there is potential for sediment transport to directly affect features within the SAC, through smothering or increased scour associated with the turbines. There are also large populations of bird species on Shetland, some of which may forage further offshore into areas overlapping the DPO.

5.2.31 There will be a requirement to determine the effects of any development on the SAC features through sediment and hydrodynamic modelling at a project level and there is potential to mitigate all the effects of the above pathways, and further lower impact pathways, through spatial planning and turbine or array design at project level.

5.2.32 Risks to spawning fish can be mitigated through temporal restrictions on piling activity to avoid key spawning times.

NE2

5.2.33 Within NE2, the key pathway which may constrain development is:

- Biodiversity, flora and fauna, particularly potential effects on bird species through displacement or physical injury, effects on bird migration pathways and effects on spawning herring from underwater noise.

5.2.34 There is potential to mitigate the effects of the above pathway and other lower impact pathways through spatial planning and array design at a project level. RSPB distribution data suggests that a number of bird species, including Kittiwake foraging from the breeding colony at Copinsay SPA, are likely to utilise the waters within and around the DPO and may thus be affected during all phases of wind farm development.

5.2.35 Recent wind farm project assessments (e.g. Moray West) have raised particular concerns from statutory stakeholders with regard to the potential effects from collision and displacement on several seabird species' populations. These concerns, discussed further under cumulative effects below in Section 0, have the potential to constrain development within NE2. This level of constraint is likely to remain until such a time that further evidence, research and knowledge around mitigation is available to support development in the region.

5.2.36 Risks to spawning fish can be mitigated through temporal restrictions on piling activity to avoid key spawning times.

5.2.37 There is considerable uncertainty regarding the potential cable routes from NE2, therefore no meaningful assessment can be made. Export cable planning will be required to take into consideration sensitive areas at a project level. Inshore of NE6 there are a number of sensitive habitats including numerous SPA around the Orkney Islands.

NE3

5.2.38 Within NE3, the key pathways which may constrain development are:

- Biodiversity, flora and fauna, particularly potential effects on bird species through displacement or physical injury, effects on bird migration pathways and effects on spawning herring and sandeel from underwater noise; and
- Navigational safety, due to close proximity to major commercial shipping routes from Aberdeen and Peterhead regions to Orkney and towards Iceland.

5.2.39 There is potential to mitigate the effects in relation to commercial shipping and other lower impact pathways through spatial planning and array design at a project level.

5.2.40 As for NE2, concerns regarding effects on seabird populations, discussed further under cumulative effects below in Section 0, have the potential to constrain development within NE3. This level of constraint is likely to remain until such a time that further evidence, research and knowledge around mitigation is available to support development in the region.

5.2.41 Risks to spawning fish can be mitigated through temporal restrictions on piling activity to avoid key spawning times.

5.2.42 There is considerable uncertainty regarding the potential cable routes from NE3, therefore no meaningful assessment can be made. Export cable planning will be required to take into consideration sensitive areas at a project level. Inshore of NE3 there are a number of sensitive habitats including numerous SPA around the Orkney Islands, in Pentland Firth and on the east coast of mainland Scotland.

NE4

5.2.43 Within NE4, the key pathways which may constrain development are:

- Biodiversity, flora and fauna, particularly potential effects on bird species through displacement or physical injury, effects on bird migration pathways and effects on spawning herring and sandeel from underwater noise; and
- Navigational safety, due to overlap with the key commercial shipping route around Scotland.

5.2.44 There is limited potential to mitigate the significant adverse effects on navigational safety within NE4 at a project level through spatial planning, as there is high density commercial shipping traffic throughout the DPO and it overlaps with the main navigation route around Scotland.

5.2.45 As for NE2, concerns regarding effects on seabird populations discussed further under cumulative effects below in Section 0, have the potential to constrain development within NE4. This level of constraint is likely to remain until such a time that further evidence, research and knowledge around mitigation is available to support development in the region.

5.2.46 There is considerable uncertainty regarding the potential cable routes from NE4, therefore no meaningful assessment can be made. Export cable planning will be required to take into consideration sensitive areas at a project level. Inshore of NE4 there are a number of sensitive habitats including numerous SPA in the Moray Firth and on the east coast of mainland Scotland. However, it is recognised that given the co-location of the DPO with current projects and NE5 there may be potential to share export cable infrastructure with current developments.

NE5

5.2.47 Within NE5, the key pathways which may constrain development are:

- Biodiversity, flora and fauna, particularly potential effects on bird species through displacement or physical injury, effects on bird migration pathways and effects on spawning herring and sandeel from underwater noise;
- Navigational safety, due to overlap with areas of high shipping density; and
- Visual effects on landscape / seascape.

5.2.48 There is potential to mitigate the effects on visual receptors through spatial planning and turbine design. Similarly, effects on navigational safety within NE5 may be mitigated at a project level through spatial planning, as there are areas of higher and lower density shipping within the DPO.

5.2.49 As for NE2, concerns regarding effects on seabird populations, discussed further under cumulative effects below in Section 0, have the potential to constrain development within NE5. This level of constraint is likely to remain until such a time that further evidence, research and knowledge around mitigation is available to support development in the region.

5.2.50 There is considerable uncertainty regarding the potential cable routes from NE5, therefore no meaningful assessment can be made. Export cable planning will be required to take into consideration sensitive areas at a project level. Inshore of NE5 there are a number of sensitive habitats including numerous SPA and SAC in the Moray Firth. However, it is recognised that given the co-location of the DPO with current projects and NE4 there may be potential to share export cable infrastructure with current developments.

NE6

5.2.51 Within NE6, the key pathways which may constrain development are:

- Biodiversity, flora and fauna, particularly potential effects on bird species through displacement or physical injury, effects on bird migration pathways and effects on fish nursery areas from underwater noise; and
- navigational safety, due to overlap with key commercial shipping routes, including lifeline ferry services to Shetland and recommended routes heading to the north of the Orkney Islands.

5.2.52 There is very limited potential to mitigate the significant adverse effects on navigational safety within NE6 at a project level through spatial planning, as there is high density commercial shipping traffic throughout the DPO and it overlaps with key routes, including lifeline ferry services.

5.2.53 As for NE2 concerns regarding effects on seabird populations, discussed further under cumulative effects below in Section 0, have the potential to

constrain development within NE6. This level of constraint is likely to remain until such a time that further evidence, research and knowledge around mitigation is available to support development in the region.

5.2.54 There is considerable uncertainty regarding the potential cable routes from NE6, therefore no meaningful assessment can be made. Export cable planning will be required to take into consideration sensitive areas at a project level. Inshore of NE6 there are a number of sensitive habitats including numerous SPA on the east coast of mainland Scotland and the proposed Nature Conservation MPA at Southern Trench.

NE7

5.2.55 Within NE7, the key pathway which may constrain development is:

- Biodiversity, flora and fauna, particularly potential effects on bird species through displacement or physical injury and effects on bird migration pathways.

5.2.56 There is potential to mitigate the effects of the above pathway and other lower impact pathways through spatial planning and array design at a project level. Further research and consideration of specific mitigation may be required to reduce effects on bird species' foraging areas and migration pathways.

5.2.57 Given the significant distance from shore, there is considerable uncertainty regarding the potential cable routes from NE7, therefore no meaningful assessment can be made. Export cable planning will be required to take into consideration sensitive areas at a project level. Inshore of NE7 there are a number of sensitive habitats including SPA and the proposed Nature Conservation MPA at Southern Trench.

NE8

5.2.58 Within NE8, the key pathway which may constrain development is:

- Biodiversity, flora and fauna, particularly potential effects on bird species through displacement or physical injury and effects on bird migration pathways.

5.2.59 There is potential to mitigate the effects of the above pathway and other lower impact pathways through spatial planning and array design at a project level. Further research and consideration of specific mitigation may be required to reduce effects on bird species' foraging areas and migration pathways.

5.2.60 Given the significant distance from shore, there is considerable uncertainty regarding the potential cable routes from NE8, therefore no meaningful assessment can be made. Export cable planning will be required to take into consideration sensitive areas at a project level. Inshore of NE8 there are a number of sensitive habitats including SPA and the proposed Nature Conservation MPA at Southern Trench.

East

E1

5.2.61 Within E1, the key pathway which may constrain development is:

- Biodiversity, flora and fauna, particularly potential effects on bird species through displacement or physical injury, effects on bird migration pathways and effects on spawning herring, cod, whiting, plaice and sandeel.

5.2.62 There is some potential to mitigate the effects on bird species at a project level. RSPB distribution data suggests that a number of bird species, including Kittiwake, which is a designated feature of the Fowlsheugh SPA, may utilise the waters within and around the DPO and may thus be affected during all phases of wind farm development.

5.2.63 Recent wind farm project assessments (e.g. Neart na Gaoithe) have raised particular concerns from statutory stakeholders with regards to the potential effects from collision and displacement on several seabird species' populations in the East region. These concerns, discussed further under cumulative effects below in Section 0, have the potential to constrain development within E1, albeit that the level or constraint is reduced by the distance of E1 offshore. A degree of constraint is likely to remain until such a time that further evidence, research and knowledge around mitigation is available to support development in the region.

5.2.64 Risks to spawning fish can be mitigated through temporal restrictions on piling activity to avoid key spawning times.

5.2.65 There is considerable uncertainty regarding the potential cable routes from E1, therefore no meaningful assessment can be made. Export cable planning will be required to take into consideration sensitive areas at a project level. Inshore of E1 there are a number of sensitive habitats including SPA on the east coast of mainland Scotland and the Firth of Forth Banks Complex Nature Conservation MPA.

E2

5.2.66 Within E2, the key pathways which may constrain development are:

- Biodiversity, flora and fauna, particularly potential effects on bird species through displacement or physical injury, effects on bird migration pathways and effects on spawning herring, cod, whiting, plaice and sandeel.
- Navigational safety, due to overlap with areas of high shipping density.

5.2.67 There is potential to mitigate the effects on navigational safety within E2 at a project level through spatial planning, as there are areas of higher and lower density shipping within the DPO.

5.2.68 As for E1 concerns regarding effects on seabird populations, discussed further under cumulative effects below in Section 0, have the potential to constrain development within E2, albeit that the level or constraint is reduced by the distance of E2 offshore. A degree of constraint is likely to remain until such a time that further evidence, research and knowledge around mitigation is available to support development in the region.

5.2.69 Risks to spawning fish can be mitigated through temporal restrictions on piling activity to avoid key spawning times. In addition, potential impacts on sandeel populations - a designated feature of the Turbot Bank NCMPA - may require assessment and mitigation, such as through spatial planning to avoid the protected area at a project level.

5.2.70 There is considerable uncertainty regarding the potential cable routes from E2, therefore no meaningful assessment can be made. Export cable planning will be required to take into consideration sensitive areas at a project level. Inshore of E2 there are a number of sensitive habitats including SPA on the east coast of mainland Scotland and the Turbot Bank Nature Conservation MPA.

E3

5.2.71 Within E3, the key pathways which may constrain development are:

- Biodiversity, flora and fauna, particularly potential effects on bird species through displacement or physical injury, effects on bird migration pathways, effects on spawning herring, cod, whiting, plaice and sandeel and effects on grey seal.
- Navigational safety, due to overlap with areas of high shipping density.

5.2.72 There is potential to mitigate the effects on navigational safety within E3 at a project level through spatial planning, as there are areas of higher and lower density shipping within the DPO.

5.2.73 Concerns regarding effects on seabird populations, particularly species foraging from east coast SPA sites discussed further under cumulative effects below in Section 0, have the potential to constrain development within E3. This level of constraint is likely to remain until such a time that further evidence, research and knowledge around mitigation is available to support development in the region.

5.2.74 Risks to spawning fish can be mitigated through temporal restrictions on piling activity to avoid key spawning times.

5.2.75 There is considerable uncertainty regarding the potential cable routes from E3, therefore no meaningful assessment can be made. Export cable planning will be required to take into consideration sensitive areas at a project level. Inshore

of E3 there are a number of sensitive habitats including SPA on the east coast of mainland Scotland and the Firth of Forth Banks Complex Nature Conservation MPA.

5.3 Cumulative Effects

Cumulative effects of the DPOs

5.3.1 The cumulative effects assessment provided below reviews the potentially significant environmental effects of possible development under the Plan at a regional and national level.

5.3.2 For the regional assessment, indicative scales of regional development have been used having regard to the scenarios for overall anticipated scale of development under the plan as a whole. These potential regional scales of development are significantly less than the sum of indicative realistic maximum development scenarios for each DPO. The development of these scenarios is based on the likely available capacity in the respective regions, scales of development under a maximum 10 GW national plan, known constraints on development, early indications as to likely developer interest, and established infrastructure to support development during the plan timescale.

5.3.3 The national assessment has been based on the scenarios for the overall anticipated scale of development under the plan as a whole. These potential scales of development are less than the sum of the indicative scales of regional development used in the regional assessment and significantly less than the sum of indicative realistic maximum development scenarios for each DPO. The justification for the national scenarios is discussed in the Draft Plan.

5.3.4 The assumptions on the scale of development are contained in Table 9 below.

Table 9 Assumptions on scale of development at national and regional scales

	Lower	Medium	High
National	3 GW (4% of total capacity in DPOs)	5 GW (7% of total capacity in DPOs)	10 GW (13% of total capacity in DPOs)
SW	0.3 GW (21% of total capacity in DPOs)	0.6 GW (41% of total capacity in DPOs)	1 GW (68% of total capacity in DPOs)
W	0.5 GW (7% of total capacity in DPOs)	1 GW (14% of total capacity in DPOs)	2 GW (28% of total capacity in DPOs)
N	1 GW (7% of total capacity in DPOs)	2 GW (13% of total capacity in DPOs)	3 GW (20% of total capacity in DPOs)
NE	1.5 GW (6% of total capacity in DPOs)	3 GW (13% of total capacity in DPOs)	4.5 GW (19% of total capacity in DPOs)
E	1 GW (4% of total capacity in DPOs)	2 GW (7% of total capacity in DPOs)	3 GW (11% of total capacity in DPOs)

Regional Assessment

South West:

5.3.5 There is only one DPO within the South West region, therefore there is no potential for cumulative effects on a regional scale with other DPOs within this plan.

5.3.6 The application of the three scenarios on a regional scale gives additional potential for mitigating effects within the South West region by limiting the scale of development within the region.

West

5.3.7 There is only one DPO within the West region, therefore there is no potential for cumulative effects on a regional scale with other DPOs within this plan.

5.3.8 The application of the three scenarios on a regional scale gives additional potential for mitigating effects within the West region by limiting the scale of development within the region.

North

5.3.9 There are four sites within the North region, most of which are individually recognised as having potentially moderate to major effects for some pathways. The majority of effects are site specific, and are not additive, primarily due to the spatial separation of the DPOs.

5.3.10 There are four potential effects where the cumulative effects may be additive or potentially synergistic (greater than the sum of the effects associated with the four sites).

5.3.11 There is potential for significant cumulative effects on mobile species, including birds and cetaceans. Migratory bird species, transiting from the UK towards the Faroe Islands and Iceland have migration pathways which intersect DPOs within the North region. Development of areas across all four DPOs therefore has the potential to cause a greater barrier effect to the migration routes, leading to increased collision risk or increased energetic requirements for bird species to divert around developments.

5.3.12 There is additionally potential for cumulative effects on birds from breeding colonies in the North, however the majority of breeding colonies are spatially distinct and foraging areas do not overlap multiple DPOs. Where foraging areas have the potential to overlap this is predominantly related to Gannet, which have large foraging ranges. Therefore development across multiple DPOs would still only impact a small proportion of the total foraging area. Similarly there is limited potential for significant impact on birds from N2 (and hence limited potential for cumulative impacts), as significant water depths in the DPO will limit the potential for foraging activities of bird species.

5.3.13 Potentially significant effects on marine mammals could occur during construction activities, therefore concurrent construction within the DPOs in the North region, focused on those with higher marine mammal usage (N2 and N3)

has the potential to either cause physical injury or more likely displace species from these areas, which could cause a barrier effect preventing movement of cetaceans transiting into or out of The Minches. It is recognised that uncertainties regarding marine mammal densities and distributions in the North region has the potential to lead to under or overestimates of the relative impact on marine mammals in the region. There is therefore a requirement for additional survey to support establishment of the marine mammal baseline prior to assessment of potential risks at the project level.

5.3.14 There is significant potential for cumulative effects on visual, seascape and landscape receptors, particularly regarding development within N3 and N4, both of which may be visible from land around North East Lewis.

5.3.15 At a regional scale effects can be mitigated through spatial planning, particularly when considering that anticipated development under all three regionally scaled scenarios, may only develop 5%, 9% and 14% respectively of the area within the DPOs (see Table 6). In addition, when considering visual effects there is potential for the effects to be mitigated through selection of smaller turbines at a project level or to locate turbines within offshore areas of the DPOs. Where there are potential effects during construction the temporal separation of development within the DPOs would avoid additive cumulative effects from occurring. However, there is potential for this to result in a longer period of disruption, for example noise disturbance to receptors over a longer timeframe.

North East

5.3.16 There are eight sites within the North East region, all of which are individually recognised as having potentially moderate to major adverse effects for some pathways. The majority of effects are site specific, and are not additive, partially due to the spatial separation of the DPOs (with the exception of NE4 and NE5), particularly regarding NE1 whose pathways will not combine with any other sites.

5.3.17 There are six potential effects where the cumulative effects may be additive or potentially synergistic (greater than the sum of the effects associated with the eight sites).

5.3.18 Within the North East region a key pathway of concern relates to effects on bird populations, specifically Kittiwake and Guillemot, through collision risk and displacement from foraging areas. These effects have been raised previously by statutory consultees on currently planned projects within the region (e.g. Moray west). This consultation has suggested that there is limited capacity for further development in the region. Development in DPOs in the North East region, particularly those overlapping with areas of high Kittiwake density (NE2, NE3, NE4, NE5 and NE6), has the potential to cause significant cumulative effects to bird populations foraging in the region. Development within DPOs overlapping areas of high expected Kittiwake density is considered to have the potential to cause a significant cumulative effect on Kittiwake populations both within the plan and with current and future developments identified within the

North Sea. This is likely to constrain development within these DPOs until such time that further evidence, research and knowledge around mitigation is available to support development in the region.

5.3.19 Migratory bird species, transiting from the UK towards Scandinavia have migration pathways which intersect DPOs within the North East region. Development of areas across multiple DPOs therefore has the potential to form a significant barrier to species movement, leading to increased collision risk or increased energetic requirements for bird species to divert around developments. This will be dependent on the bird species, as flight heights vary, and therefore the turbine size should be considered when assessing risk to species at a project level.

5.3.20 Potentially significant effects on marine mammals and spawning fish could occur during construction activities, therefore concurrent construction within the DPOs in the North East region, such as within NE4 and NE5, has the potential to either cause physical injury or more likely displace species from these areas. It is recognised that uncertainties regarding marine mammal densities and distributions in the North East region has the potential to lead to under or overestimates of the relative impact on marine mammals in the region. There is therefore a requirement for additional survey to support establishment of the marine mammal baseline prior to assessment of potential risks at the project level.

5.3.21 There is potential for cumulative effects on benthic receptors through a number of different pathways. Development within both NE4 and NE5 has the potential to cause a cumulative effect on sediment transport, given their proximity to each other. Hydrodynamic and sediment transport modelling may be required at a project level to confirm and validate potential effects from these cumulative effects. In addition, there is sensitive burrowed mud habitat present throughout a number of the sites in the North East region, specifically NE6, NE7 and NE8, supporting populations of ocean quahog, a priority marine feature (PMF) in Scottish waters. The National Marine Plan places a requirement that development of the marine environment must not result in a significant impact on the national status of PMFs. Development within these sites has the potential for cumulative effects on these sensitive features and therefore assessment would be required at a project level in order to determine the degree of effect. It is possible, however, that development at a regional scale could be constrained based on potential for effects on these benthic receptors.

5.3.22 There are a number of key navigational routes throughout the North East region. The development of large areas of the DPOs has the potential to require traffic to divert or concentrate traffic into smaller areas, thereby increasing navigational risk. Specifically, effects on navigational risk due to development within NE6 have the potential to be cumulative with those in NE4 and NE8.

5.3.23 At a regional scale effects can be mitigated through spatial planning, particularly when considering development under all three regionally scaled scenarios, which will only develop 6%, 13% and 19% respectively of the area within the

DPOs (see Table 6). It is recommended that spatial planning at a plan level is considered when reviewing the cumulative risk on navigational risk from NE6 to NE8.

5.3.24 There is a potential cumulative effect on visual receptors from development in the North East, although individually each site has been assessed as having at most a minor impact. This will require consideration at a project level, as the degree of impact is likely to be turbine specific.

5.3.25 Where there are potential temporary effects during construction, the temporal separation of development within the DPOs would avoid additive cumulative effects from occurring. However, there is potential for this to result in a longer period of disruption, through noise disturbance to receptors over a longer timeframe.

East

5.3.26 There are three sites within the East region, all of which are individually recognised as having potentially moderate to major adverse effects for some pathways. The majority of effects are site specific, and are not additive, principally due to the spatial separation of the DPOs.

5.3.27 There are three potential effects where the cumulative effects may be additive or potentially synergistic (greater than the sum of the effects associated with the three sites).

5.3.28 There is potential for cumulative effects on mobile species, principally on bird species. Within the East region the pathway of greatest concern is regarding effects on bird populations, specifically Kittiwake and Guillemot, through collision risk and displacement from foraging areas. These effects have been raised previously by statutory consultees on projects within the region (e.g. Neart na Gaoithe). This consultation has suggested that there is limited capacity for further development in the region due to cumulative effects with current or future offshore wind developments. Development across multiple DPOs in the East region, particularly E3 which overlaps with areas of high Kittiwake density, therefore have the potential to cause significant cumulative effects to Kittiwake populations. Therefore, these DPOs overlapping areas of Kittiwake foraging are considered to have the potential to cause a significant cumulative effect on Kittiwake populations both within the plan and with current and future developments identified within the North Sea. This is likely to constrain development within the DPOs until such a time that further evidence, research and knowledge around mitigation is available to support development in the region.

5.3.29 Migratory bird species, transiting from the UK towards Scandinavia have migration pathways which intersect DPOs within the East region. Development of areas across multiple DPOs therefore has the potential to form a barrier to species movement, leading to increased collision risk or increased energetic requirements for bird species to divert around developments. This will be

dependent on the bird species, as flight heights vary, and therefore the turbine size should be considered when assessing risk to species at a project level.

5.3.30 Furthermore, it is recognised that uncertainties regarding marine mammal densities and distributions in the East region has the potential to lead to under or overestimates of the relative impact on marine mammals in the region. There is therefore a requirement for additional survey to support establishment of the marine mammal baseline prior to assessment of potential risks at the project level.

5.3.31 There are a number of key navigational routes throughout the East region. The development of areas in both E1 and E3 may require traffic to divert or concentrate traffic into smaller areas, increasing navigational risk.

5.3.32 At a regional scale effects can be mitigated through spatial planning, particularly when considering development under all three regionally scaled scenarios, which will only develop 4%, 7% and 11% respectively of the area within the DPOs (see Table 6).

Table 10 Summary of cumulative effects by region

Region	Key Potential Cumulative Effects
SW	There is only one DPO within the South West region, therefore there is no potential for cumulative effects on a regional scale with other DPOs within this plan.
W	There is only one DPO within the West region, therefore there is no potential for cumulative effects on a regional scale with other DPOs within this plan.
N	There are four key cumulative effects in the North region. Firstly, there is potential for significant cumulative effects on mobile species, including birds and cetaceans. Migratory bird species have migration pathways which intersect DPOs within the North region. Development of areas across all DPOs therefore has the potential to cause a greater barrier effect to the migration routes, leading to increased collision risk or increased energetic requirements for bird species to divert around developments. Furthermore, there is the potential for significant effects on marine mammals. Cetaceans are primarily affected during construction activities, therefore concurrent construction within the DPOs in the North region has the potential to either cause physical injury or more likely displace species from these areas, which could cause a barrier effect preventing movement of cetaceans. There is also significant potential for cumulative effects on visual, seascape and landscape receptors, particularly regarding development within N3 and N4, both of which may be visible from land around North East Lewis.

Region	Key Potential Cumulative Effects
NE	There are six key cumulative effects in the North East region. Firstly, there is potential for cumulative effects on mobile species, principally on bird species. Within the North East region one pathway of concern is regarding effects on bird populations, specifically Kittiwake and Guillemot, through collision risk and displacement from foraging areas. Furthermore, development of areas across multiple DPOs has the potential to form a barrier to species movement, leading to increased collision risk or increased energetic requirements for bird species to divert around developments. Concurrent construction within the DPO's could cause physical damage or displace marine mammals and spawning fish from the area. There is also potential for cumulative effects on benthic receptors from sediment transport. There are many key navigational routes throughout the region and cumulative effects could cause traffic to divert or concentrate traffic into smaller areas, increasing navigational risk. Finally, there is potential for cumulative visual impacts, although the impact will be dependent on turbine size and spatial planning.
E	There are three key cumulative effects in the East region. Firstly, there is potential for cumulative effects on mobile species, principally on bird species. Within the East region the pathway of greatest concern is regarding effects on bird populations, specifically Kittiwake and Guillemot, through collision risk and displacement from foraging areas. Furthermore, development of areas across multiple DPOs has the potential to form a barrier to species movement, leading to increased collision risk or increased energetic requirements for bird species to divert around developments. There are also many key navigational routes throughout the region and cumulative effects could cause traffic to divert or concentrate traffic into smaller areas, increasing navigational risk.

National Assessment

5.3.33 At a national scale there are a total of 17 DPOs, most of which are individually recognised as having potentially moderate to major adverse effects. The majority of the effects are site or region specific, and are therefore not additive on a national scale, with little connectivity between sites in separate regions. The majority of effects will not, therefore, have a cumulative effect at a national scale beyond that identified in the individual DPO or regional assessments presented above.

5.3.34 The exception to this is the potential for effects on both resident and migratory bird populations. The cumulative effects are generally split by either east coast or west coast as the populations tend to be distinct and migration pathways follow the coasts before heading either towards Faroe Islands and Iceland in the case of the west coast or Scandinavia in the case of the east coast.

5.3.35 On the west coast the species of highest concern are migratory and have the potential to transit through multiple regions (SW, W and N) and DPOs as part of

their migratory pathways. As a result, there is potential for the increases in collision risk, identified at a DPO and regional level, to be further additive at a national level across all west coast DPOs. The level of collision or displacement risk to individual species may vary depending on flight height and avoidance probabilities, however species whose migration pathways may transect the DPOs on the west coast include[251]:

- Whooper Swan;
- Goose species;
- Duck species;
- Wigeon;
- Teal;
- Pintail;
- Scaup;
- Common Scoter;
- Oystercatcher;
- Golden Plover;
- Sanderling;
- Dunlin;
- Snipe;
- Black-tailed Godwit;
- Whimbrel;
- Redshank; and
- Turnstone.

5.3.36 Potential cumulative effects on birds on the east coast, encompassing DPOs from the E and NE regions, include both effects to migratory and resident species. Impacts to resident species have been highlighted by statutory consultees on current projects in both the E and NE regions (e.g. Moray west and Neart na Gaoithe), particularly with regard to Kittiwake and Guillemot populations. The conclusions of these consultation responses are that there is very limited capacity within resident bird populations, focusing on Kittiwake for further development in the E and NE regions.

5.3.37 On the east coast there are similar concerns regarding migratory species. Several species transit through the east coast regions (E and NE) and therefore may potential transit multiple DPOs. The level of collision or displacement risk to individual species may vary depending on flight height and avoidance probabilities, however species whose migration pathways may transect the DPOs on the east coast include:

- Goose species;

[251] Scottish Marine and Freshwater Science, 2014. Strategic assessment of collision risk of Scottish offshore wind farms to migrating birds. Published by Marine Scotland Science; ISSN: 2043-7722.

- Duck species;
- Wigeon;
- Teal;
- Pintail;
- Pochard;
- Scaup;
- Common Scoter;
- Velvet Scoter;
- Hen Harrier;
- Kestrel;
- Oystercatcher;
- Dotterel;
- Golden Plover;
- Grey Plover;
- Sanderling;
- Dunlin;
- Ruff;
- Snipe;
- Woodcock;
- Black-tailed Godwit;
- Bar-tailed Godwit;
- Whimbrel;
- Curlew;
- Greenshank;
- Redshank; and
- Turnstone.

5.3.38 On both coasts the potential for collision risk may be cumulative with effects from development in multiple DPOs affecting the same bird species or populations at a national level. These effects have the potential to permanently reduce bird numbers, particularly where populations are already in decline.

5.3.39 In addition to the potential for negative cumulative effects above, the development of the DPOs in line with this plan has the potential to have significant positive cumulative effects, regarding supporting a diverse and decarbonised energy sector, and the development of a secure energy supply for the UK market. The magnitude of this benefit will be based on the extent of development under the plan, but under the high scenario has the potential to provide a significant contribution to the energy sector in Scotland and more widely within the UK.

Cumulative effects of the plan with other projects

5.3.40 Development of offshore wind within the DPOs, and installation of export cables and cable landfall infrastructure, identified within this plan has the potential to combine with projects currently being undertaken or being considered for future development. This includes other offshore wind developments, particularly in the North East and East regions, offshore wave draft plan option areas, tidal stream energy developments, marine and coastal construction projects, and oil and gas exploration, operation and decommissioning.

5.3.41 There is considerable uncertainty regarding the likelihood of development against many of the projects with potential for cumulative effects. It is therefore not possible to undertake a detailed assessment. However, as discussed above in Section 5.3.28, the potential cumulative impact on east coast bird colonies within the plan and with other projects is currently likely to impose a constraint on development inshore on the east coast (incorporating development in both the East and North East regions).

5.3.42 A summary of the potential pathways which may require assessment for cumulative effects of marine developments in Scottish waters with development of the DPOs is provided in Table 11 below. Project level cumulative assessment will need to also consider the potential for cumulative impacts with other developments outwith Scottish waters, including in the wider North Sea region.

5.3.43 There is potential for cumulative effects on visual receptors from onshore wind developments, alongside those associated with offshore wind. The majority of onshore wind developments in Scotland are inshore and where they are visible from the coast are unlikely to be present within the same view as the offshore wind developments. Further review for specific developments will be required as a part of project level assessment.

Table 11 Cumulative effect pathways with other marine developments

Development Type	Current Developments	DPOs with Potential for Cumulative Effects	Key Pathways Which are Likely to Require Consideration
Offshore Wind	Robin Rigg	SW1, W1, N2, N3, N4	<u>Construction</u> Effects on key mobile receptors and prey species through displacement or physical injury, including: ▪ marine mammals; ▪ fish species, including basking shark, spawning fish and migratory fish including diadromous fish; ▪ bird species. <u>Operation</u> ▪ Effects on key mobile receptors and prey species, including: ▪ migratory birds, for example Whooper Swan migration pathways; ▪ resident bird populations (particularly Kittiwake on the east coast). Issues of navigational safety, aviation and collision risk. Effects on subsea geology, sediments, and coastal processes. Both temporary and longer-term effects on landscape and coastal character and visual receptors It is also recognised that there may be some potential for shared infrastructure between existing sites and new developments where capacity is available, therefore reducing effects from export cable installation.
	Levenmouth Turbine	E1, E2, E3	
	Hywind	E1, E2, E3	
	Aberdeen Bay (EOWDC)	E1, E2, E3	
	Beatrice	NE2, NE3, NE4, NE5, NE6	
	Neart na Gaoithe	E1, E2, E3	
	Firth of Forth 1	E1, E2, E3	
	Moray East	NE2, NE3, NE4, NE5, NE6	
	Inch Cape	E1, E2, E3	
	Kincardine	E1, E2, E3	
	Dounreay Tri Demonstration Project	N1	
	Firth of Forth 2	E1, E2, E3	
	Firth of Forth 3	E1, E2, E3	
	Moray West	NE2, NE3, NE4, NE5, NE6	
	Forthwind OWF, Methil	E1, E2, E3	
Tidal Stream	North Yell, Bluemull	NE1	<u>Construction</u>

Development Type	Current Developments	DPOs with Potential for Cumulative Effects	Key Pathways Which are Likely to Require Consideration
	Sound, Shetland		Effects on key mobile receptors and prey species through displacement or physical injury, including: ▪ marine mammals; ▪ fish species, including basking shark, spawning fish and migratory fish including diadromous fish; ▪ bird species. <u>Operation</u> Issues of navigational safety, aviation and collision risk. Effects on subsea geology, sediments, and coastal processes. Both temporary and longer-term effects on landscape and coastal character and visual receptors.
	Sound of Islay	W1	
	Ness of Duncansby, Pentland Firth	N1, NE2, NE3	
	Westray South, Pentland Firth	N1, NE2, NE3	
	Brough Ness, Pentland Firth	N1, NE2, NE3	
	Inner Sound, Pentland Firth	N1, NE2, NE3	
	Mull of Kintyre, Argyll	W1	
	Isle of Islay, Islay	W1	
	Lashy Sound	N1, NE2, NE3	
	Brims Tidal Array (formerly Cantick Head)	N1, NE2, NE3	
	Mull of Galloway	SW1	
	Fall of Warness	N1, NE2, NE3	
	Shapinsay Sound	N1, NE2, NE3	
	Islay Demonstration Zone	W1	
	Stronsay Firth	N1, NE2, NE3	
Wave	Billia Croo	N1, NE2, NE3	<u>Construction</u> Effects on key mobile receptors and prey species through displacement or physical injury, including: ▪ marine mammals;
	Scapa Flow	N1, NE2, NE3	
	Scottish Sea Farms (MANTA) - Teisti Geo	NE1	

Development Type	Current Developments	DPOs with Potential for Cumulative Effects	Key Pathways Which are Likely to Require Consideration
	WaveNet Mingary	No DPOs affected	▪ fish species, including basking shark, spawning fish and migratory fish including diadromous fish; ▪ bird species. <u>Operation</u> Issues of navigational safety, aviation and collision risk. Effects on subsea geology, sediments, and coastal processes. Both temporary and longer-term effects on landscape and coastal character and visual receptors.
	Harris Demonstration Zone	N3, N4	
Hybrid	Katanes Floating Energy Park	N1	
Oil and Gas	North Sea	All NE and E DPOs	<u>Construction</u> Effects on key mobile receptors and prey species through displacement or physical injury, including: ▪ marine mammals; ▪ fish species, including basking shark, spawning fish and migratory fish including diadromous fish; ▪ bird species. <u>Operation</u> Issues of navigational safety, aviation and collision risk. Effects on subsea geology, sediments, and coastal processes.
	West of Shetland	No DPOs affected	
Marine and coastal construction projects	There is potential for development around the Scottish coastline	All DPOs may interact with areas of coastline where there is potential for construction projects.	<u>Construction</u> Effects on key mobile receptors and prey species through displacement or physical injury, including: ▪ marine mammals; ▪ fish species, including basking shark, spawning

Development Type	Current Developments	DPOs with Potential for Cumulative Effects	Key Pathways Which are Likely to Require Consideration
			fish and migratory fish including diadromous fish; ▪ bird species. <u>Operation</u> Issues of navigational safety, aviation and collision risk. Effects on subsea geology, sediments, and coastal processes. Both temporary and longer-term effects on landscape and coastal character and visual receptors.

5.4 Summary of Overarching Plan Effects

5.4.1 At the scales of potential development under the plan as a whole (Section 3.5) a very small proportion of the total DPOs will be developed in either the low, medium or high scenarios. The effects of this level of development vary significantly depending on the DPOs and regions in which development might occur.

5.4.2 Areas of key concern, and the topics most likely to constrain development from an environmental viewpoint are bird collision and displacement risk, and navigational risk. Bird collision risk is particularly likely to constrain development in the East and North East regions, where concerns over bird populations, specifically Kittiwake, Gannet and Guillemot, have been raised against current development projects. Significant effects are also likely on landscapes and seascapes for developments located inshore.

5.4.3 It is recognised that there remains uncertainty in the baseline for bird and marine mammal distributions foraging within or migrating through Scottish waters and therefore, whilst this assessment considers currently available data, it is expected that project level survey will be required to establish a robust baseline against which an assessment can be made.

5.4.4 Against all of the pathways there is potential for mitigation through spatial planning at a national level, with areas of lower risk in the North region, and in areas of the West region DPO. In addition, DPOs located further offshore in the North East and East regions are likely to be constrained to a lesser degree than those further inshore in areas of higher bird density.

5.4.5 It is recognised that the implementation of the plan will have a significant environmental benefit in supporting the decarbonisation of the energy sector and the establishment of a secure energy supply in the UK.

5.4.6 A review of the plan has been undertaken against the SEA objectives, the results of which are contained within Table 12 below.

Table 12 Review of the plan against SEA objectives

Topic	SEA Objective	Assessment of the Plan Against SEA Objective
Biodiversity, Flora, and Fauna	To safeguard marine and coastal ecosystems, including species, habitats, and their interactions	Development within the DPOs and along the export cable routes will have some direct and indirect effects on species and habitats. These effects can be minimised through careful site and route selection and implementation of appropriate mitigation. The increase in renewable energy capacity will, in the long-term, contribute to reducing greenhouse gas emissions associated with energy generation and thus help to limit the effects of climate change on marine ecosystems.
	To avoid adverse effects on both designated and non-designated habitats and species (note links with HRA)	None of the DPOs overlap with designated sites, however the HRA identifies potential for interaction between offshore wind development in the DPOs and the foraging ranges of bird species from SPA. The proposed plan-level mitigation measures will help to avoid/minimise impacts to designated features. Where potential cable routes might intersect designated sites, adverse effects can be avoided or minimised through careful route selection and installation methods. Risks to non-designated habitats and species can be avoided or minimised through careful project design and adoption of appropriate mitigation measures.
	To avoid the introduction and spread of INNS.	Risks associated with vessels can be minimised through the implementation of biosecurity plans for construction operation and decommissioning of offshore wind farms. The presence of offshore wind farms will provide new substrate which could be colonized by INNS. However, experience to date does not indicate that this is a significant risk pathway for the spread of INNS.

Topic	SEA Objective	Assessment of the Plan Against SEA Objective
Population and Human Health	To maintain the accessibility of natural areas for recreation	Within the DPOs themselves, recreational activity is limited to yachting activity and angling. There is potential for displacement of this activity, however spatial planning within the DPOs can be used to avoid areas of key effect and mitigate any deterioration against this objective. There are some areas inshore of the DPOs where recreational activity may be affected by export cable installation. However, effects from cable installation are considered to be temporary, and planning of the cable route to avoid key areas can mitigate deterioration against the objective.
	To minimise or prevent the discharge of pollutants into the natural environment	The implementation of the plan will not directly support achievement of this objective; however, it is not considered likely that implementation of the plan will lead to a deterioration against this objective. At a project level, pollution management plans will be produced to mitigate against the effects.
	To avoid adverse effects on human health and safety	The implementation of the plan has the potential to cause deterioration of the environment against this objective due to negative effects on navigational safety. There is potential for effects on navigational safety, particularly in NE4 and NE6. In addition, where DPOs overlap at a lesser scale with navigational routes, spatial planning can be used at a project level to allow for safe transit through the DPOs, in part through the application of MCA guidance in MGN 543. At a plan level, it is considered that there will be a residual deterioration against this objective.
Soil (Marine Geology and Coastal Processes)	To avoid exacerbating coastal erosion and maintain the integrity of coastal processes	There are several areas where the development of a DPO and associated export cable installation has the potential to affect coastal processes. At the plan level it is not possible to determine the extent of these effects, therefore at a project level it is possible that hydrodynamic and sediment modelling may be required to determine if a development will affect coastal processes.
	To maintain and protect the character and integrity of the seabed, including	The installation of turbines and subsea cables will affect the seabed within their physical footprint, and immediate vicinity. The development of offshore wind within the DPOs and associated export cable installation will therefore cause

Topic	SEA Objective	Assessment of the Plan Against SEA Objective
	avoiding the pollution of seabed strata/bottom sediments	deterioration against this objective. The degree of effect will, however, vary significantly dependent on the technology employed, the level of scour protection required, and the seabed type.
	To avoid significant adverse physical damage to coastal geodiversity sites from coastal infrastructure	There is considerable uncertainty regarding potential cable landfall locations, therefore the effect on coastal geodiversity sites cannot be assessed at a plan level. Assessment against this pathway will be undertaken at a project level, however it is expected that cable routes will be planned to avoid geodiversity sites.
Water Quality	To avoid pollution of the coastal and marine water environment	The implementation of the plan will not directly support achievement of this objective; however, it is not considered likely that implementation of the plan will lead to a deterioration against this objective. At a project level, pollution management plans will be produced to mitigate against the effects.
	To maintain or work towards achieving good ecological status	The implementation of the plan has the potential to cause deterioration of the environment against this objective. Where potential for effects on the ecological baseline are identified above, recommendations have been raised to mitigate this at a plan level. At a project level, spatial planning can generally be used to avoid areas of high effect within an individual DPO and associated cable routes, and the WFD regulations place requirements on developers to avoid significant effects on the ecological status of coastal or transitional water bodies.
Climatic Factors	To contribute to a diverse and decarbonised energy sector	The development of offshore wind in line with the plan has the potential to significantly contribute to the achievement of this objective.
	To ensure that adaptation to predicted climate change impacts are taken into account (for example, through consideration of	The plan cannot be assessed against this objective, however individual developments will be required to take account of and ensure that designs incorporate resilience against potential climate change effects. In addition, any changes to the baseline as a result of climate change will be incorporated into the plan as part of the iterative plan review process.

Topic	SEA Objective	Assessment of the Plan Against SEA Objective
	resilience and changing environmental sensitivity)	
	To preserve marine carbon stocks and carbon sequestration potential (note: this objective is closely linked to the SEA topic of 'Biodiversity, Flora, and Fauna')	There is potential for marine carbon stocks to be present within DPOs or within export cable corridors, and to be affected by development of offshore wind. At a project level spatial planning will be required to avoid areas of sensitive marine carbon, however there is potential for disturbance of seabed sediments, which form a significant carbon sink. The disturbance of seabed sediments is dependent on the technology selected, however it is considered unlikely that effects will cause deterioration against this objective at a national level.
Cultural Heritage	To protect and, where appropriate, enhance, the historic marine environment	There are no designated historic areas within the DPOs. However, there are known shipwrecks within the DPOs and at a project level surveys will be required to identify areas of potential historic significance, effects on which can subsequently be avoided. At a project level this will be managed through the application of a Marine Archaeology Reporting Plan (MARP). The process of developing within the DPOs therefore has the potential to identify additional heritage assets and therefore support the achievement of this objective.
	To avoid damage to known and unknown coastal and marine archaeology	There are no designated historic areas within the DPOs. However, there are known shipwrecks within the DPOs and at a project level surveys will be required to identify areas of potential historic significance, effects on which can subsequently be avoided. The process of developing within the DPOs therefore has the potential to identify additional heritage assets and therefore support the achievement of this objective. There is considerable uncertainty regarding potential cable routes and landfall locations, therefore the effect on coastal heritage sites cannot be assessed at a plan level. Assessment against this pathway will be undertaken at a project level through the application of a MARP, and any sensitive heritage assets avoided through appropriate route selection.

Topic	SEA Objective	Assessment of the Plan Against SEA Objective
	To avoid adverse effects on the character and setting of historic sites and buildings	There is considerable uncertainty regarding potential cable routes and landfall locations, therefore the effect on coastal or inland heritage sites cannot be assessed at a plan level. Assessment against this pathway will be undertaken at a project level, associated with the terrestrial planning process.
Landscape/ Seascape	To avoid or minimise adverse effects on landscape, seascape, and visual amenity, including designated sites;	There are significant areas identified within the DPOs within which developments will affect the landscape, seascape and visual amenity of the coastal region in high and low light conditions. Potential mitigations have been identified for consideration at a project level, specifically the spatial planning to avoid areas closest to land or, where this is not possible, selection of smaller turbines in areas closer to land, to minimise adverse effects. This assessment can therefore support the implementation of the plan whilst achieving against this objective.
	To promote the protection of seascape and coastal landscapes;	Assessment within the plan has identified potential risks to seascape and coastal landscapes, and proposed mitigation measures to reduce or remove effects. The plan therefore may support achievement of the objectives by identifying areas of lower risk for development.
	To avoid or minimise adverse visual effects.	There are significant areas identified within the DPOs within which developments will affect the landscape, seascape and visual amenity of the coastal region. Potential mitigations have been identified for consideration at a project level, specifically the spatial planning to avoid areas closest to land or, where this is not possible, selection of smaller turbines in areas closer to land, in order to reduce the visual effects. This assessment can therefore support the implementation of the plan whilst achieving against this objective.

6 Mitigation and Monitoring

6.1 Introduction

6.1.1 The assessment of the potential effects of development of offshore wind has identified a number of potential mitigation measures that can be applied at individual project level, regional DPO level and at a national (plan level) scale.

6.2 Project Level Mitigation

6.2.1 At an individual project level EIA will be required, this should identify specific mitigation (or potential enhancements) to reduce effects based on the local environment and project characteristics. This SEA assessment identifies potential mitigation measures within Appendix C which may be required at a project level, including:

- Appropriate consultation with national and local statutory and public stakeholders;
- Spatial planning within the DPO areas to avoid areas of higher environmental risk;
- Surveys to develop comprehensive baselines for marine mammals in relevant regions, to inform assessment of potential risk and any project level mitigation required;
- Measures relating to piling or soft start procedures in order to mitigate the risk of physiological damage from noise from piling activities, including consideration of sequential or concurrent piling depending on the individual site characteristics;
- Implementation of noise abatement measures at source to reduce the input of anthropogenic noise into the environment;
- Seasonal restrictions on specific construction activities, depending on particular sensitivities of species at a project level;
- Developing a robust baseline and subsequent post construction monitoring for bird species present within or transiting through the development footprint, including potential surveys, tagging and radar studies;
- Development of pollution management plans, to mitigate the effects of any pollution releases;
- Development of biosecurity management plans to minimise the risk of introduction of INNS;
- Survey of potential cable pathways and landfall areas to determine route of least environmental effect, including habitat and ecological surveys and Cultural heritage surveys;
- Sediment testing and water quality monitoring to manage potential effects on water quality;

- Development of a navigational risk assessment;
- Coastal process assessments to confirm and validate effects on sediment dispersion and transport, wave and current regimes;
- Management of cultural heritage through the development and application of a MARP and consideration of impacts on the setting of historical assets within project level assessment;
- Assessment and management of night-time lighting effects through the application of SNH guidance[252];
- Development of, and adherence to Vessel Management Plans;
- Preparation of a decommissioning programme, detailing how a developer intends to remove the installation when it comes to the end of its useful life and how the costs of doing so will be funded. This programme should include a base case of all infrastructure being removed, alongside any alternatives that the operator proposes, backed up by evidence and reasoning for the preferred option.
- Cable burial or, where this is not possible, suitable cable protection measures to minimise safety risk to fishing vessels; and
- Project specific array or turbine design.

6.3 Plan Level Mitigation

6.3.1 Within each individual Draft Plan Option and within the overarching plan assessment, mitigation is focused on the use of spatial planning to avoid areas of highest effect. At a plan level, there are a number of measures which can be implemented to either reduce the effect associated with development under the plan or offset any significant effects. Proposed plan level mitigations identified through the SEA process are summarised below:

- Limiting the scale of development under the plan to a maximum of 10 GW nationally;
- Requiring spatial planning of DPOs to reduce, so far as is reasonably practicable, effects on environmental receptors;
- Implementation of temporal mitigation in DPOs where it cannot be concluded with certainty that there will be no adverse effect on site integrity of any European marine site or European site. Specifically relating to potential effects on bird populations in sites NE2, NE3, NE4, NE5, NE6 and E3.
- Iterative Plan Review /adaptive management of the sectoral plan, in order to allow for changes in the evidence base and outcomes of research or monitoring programmes;

[252] SNH (2017) Visual Representation of Wind Farms Guidance version 2.2 [online] available at https://www.nature.scot/visual-representation-wind-farms-guidance

- Project level EIA, the development of which will identify areas of concern with regard to specific projects, and identify mitigation required at a project level;
- Collaboration between governmental bodies, non-governmental Organisations and industry on research issues to determine a consistent and comprehensive evidence baseline;
- Requiring appropriate temporal planning so that sites within the same region are not developed at the same time in order to reduce the potential for cumulative effects associated with construction;
- Potential for consideration of environmental enhancement schemes at a plan level. A strategic view of large scale or multi-stage potentially significant enhancements, supported by developers, may deliver more significant benefits than the undertaking of multiple small discrete projects designed to offset any significant effects at individual development level. Such interventions might include predator control at (island) bird colonies, or measures to enhance abundance of prey stocks (e.g. sandeel, sprat, herring). However, the location and scale of development under the plan is currently considered to be too uncertain to be able to meaningfully define such enhancement measures.

6.3.2 In addition, it is recognised that the process for the development of the DPOs assessed within this SEA represents an embedded mitigation measure. This includes, for example, initial avoidance of all designated areas in developing the early AoS and where AoS initially included have subsequently been excluded or modified to reduce plan level effects on navigational safety.

6.3.3 Further mitigation measures are likely to be identified as part of other assessments, including the HRA and SEIA, which may be similar to those identified above. However, the variation in assessment methodologies may identify different issues requiring mitigation and hence identify distinct mitigation measures.

6.4 Current and Ongoing Research

6.4.1 The Scottish Marine Science Strategy 2010-2015 and the UK Marine Science Strategy 2010-2025 identify three high level priorities for science research in the marine environment:

1. Understanding how the marine ecosystem functions;
2. Responding to climate change and its interaction with the marine environment; and
3. Sustaining and increasing ecosystem benefits.

6.4.2 Within these three priority areas there remain data limitations which introduce uncertainty in the current environmental baseline, however many of these areas of uncertainty are the focus of current or planned research projects promoted

through the Scottish Marine Energy Research (ScotMER), Scottish Marine Renewables Research Group (SMRRG), and undertaken by organisations including SNH, the Joint Nature Conservation Committee (JNCC), Offshore Wind Developer Groups and the Crown Estate, amongst others.

6.4.3 In addition, Marine Scotland, in collaboration with industry, environmental NGOs, statutory nature conservation bodies and other stakeholders (collaboratively forming ScotMER), have developed evidence maps to highlight knowledge gaps when assessing environmental and socio-economic impacts of offshore renewable developments.

6.4.4 These evidence maps, available online[253], are broken down into seven topics and prioritise knowledge gaps in each specialist area to provide a framework to guide ScotMER research projects:

- Ornithology;
- Marine mammals;
- Fish and fisheries;
- Diadromous fish;
- Benthic;
- Physical processes; and
- Socio-economic.

6.4.5 As research is undertaken against these knowledge gaps, it will serve to inform development through providing evidence at a project level, as well as guiding future developmental iterations of sectoral marine plans.

6.4.6 Additionally, a number of related research activities and frameworks are already in place, including: the Marine Mammal Scientific Support Research Programme managed by the Sea Mammal Research Unit (SMRU) and focused on filling gaps in knowledge between marine mammal distribution and interactions with renewable energy and the Co-ordinated Agenda for Marine, Environment and Rural Affairs Science (CAMERAS) which provides an overall framework for marine science in Scotland.

6.4.7 Within the large array of research activities ongoing there are a number of projects that will help to add greater certainty to future assessment and iterations of marine planning. Studies such as the replacement for the Joint Cetacean Protocol and tagging projects for Atlantic salmon are aimed at delivering greater understanding of species distributions and migratory routes.

6.5 Proposed Monitoring

6.5.1 It is expected that the further development of the baseline may be required to support the implementation and review of the temporal mitigation proposed at

[253] Scottish Government, 2018. ScotMER evidence maps, Available at https://www2.gov.scot/Topics/marine/marineenergy/mre/research/maps

the NE and E inshore sites for the protection of bird species. This may include some survey of bird species (particularly Kittiwake, Razorbill and Gannet), such as the aerial surveys historically commissioned by Marine Scotland. In addition, current SPA monitoring will inform the baseline; and the collation of data from monitoring at current and proposed offshore wind developments should further support the Iterative Plan Review process, discussed further below.

6.5.2 However, it is expected that the majority of environmental monitoring under the sectoral marine plan be undertaken by developers as part of pre-construction, construction, and post construction monitoring as part of the planning and licensing process. Monitoring requirements are outlined within the draft plan.

6.5.3 As offshore renewable energy projects are put in place there will be the completion, collation and dissemination of project-level monitoring which should be managed as part of the plan. This will include monitoring work on the initial projects undertaken in response to the sectoral marine plan but also other relevant projects (in UK and Europe). It is envisaged that there will be collaboration between developers and regulators and that, as often as possible, there would be integrated work undertaken across sectors and between projects. Mechanisms and initiatives for such collaborations already exist such as the Offshore Renewables Joint Industry Programmes (ORJIP); the Knowledge Transfer Network (KTN) for offshore renewables (e.g. Offshore Wind Innovation Hub (including Offshore Wind Innovation Exchange (OWiX)); the Partnership for Research in Marine Renewable Energy (PRIMaRE); the Habitats Directive Implementation Review (England); and Marine Scotland's ongoing strategic research.

6.5.4 This developing evidence base can be used to inform Iterative Plan Review as part of an adaptive management process.

7 Concluding Statement

7.1.1 The results discussed above support a conclusion that, when considered at a national scale, there is potential for up to 10 GW of offshore wind to be installed in Scottish waters without significant adverse effect on the environment.

7.1.2 This conclusion is based on the implementation of both plan and project level mitigation, designed to avoid significant adverse effects and support the continued development of the evidence base which will inform the assessment of future developments.

7.1.3 There remains significant uncertainty regarding the potential size, design and location of arrays, and the size and technology selection of individual turbines. Therefore, notwithstanding the above conclusion, comprehensive project level assessment will be required against the specific characteristics of the proposed development and the baseline environment at that location.

8 Next Steps

8.1 Timescale for the Assessment

8.1.1 This Environmental Report has informed the conclusions of the Sustainability Appraisal Report, and both of these alongside the draft plans are subject to a minimum 12 week statutory consultation period. At the end of the consultation process, the views of stakeholders and the public on the plan and assessment work will be analysed. In light of these comments, the Plan will be reviewed, updated and finalised. If significant changes are made to the DPOs, the SEA will be reviewed in order to consider whether any further work will be required.

8.1.2 After consultation and analysis has been concluded a SEA Post Adoption Statement will be produced, detailing:

- How sustainability considerations have been integrated into the plans;
- How the sustainability appraisal and technical reports have been taken into account;
- How consultee opinions have been taken into account;
- The reasons for choosing the plan or programme as adopted, in the light of the other reasonable alternatives considered; and
- Measures to be used to monitor the significant effects of the plan.

8.1.3 A Post Adoption Statement will be prepared alongside the final plan to fulfil the requirements of the Environmental Assessment (Scotland) Act 2005 At this stage, the plan is anticipated for adoption in 2020.

Appendix A Review of Environmental Protection Objectives

The following sections provide an overview of the existing environmental protection objectives of relevance to the Draft Plan.

A.1 Biodiversity, Flora and Fauna Policy

At an international level, the OSPAR Convention for the Protection of the Marine Environment of the North East Atlantic is an important driver in the protection and conservation of marine ecosystems and biodiversity, including the establishment of an ecologically coherent network of MPAs in the North East Atlantic[254]. The OSPAR List of Threatened and/or Declining Species and Habitats[255] identifies species and habitats that are considered to be priorities for protection.

At the European level, the Natura 2000[256] network is the primary vehicle for meeting the aims of the Habitats (92/43/EEC)[257] and Birds (2009/147/EC)[258] Directives. Both Directives focus on the maintenance and enhancement of biodiversity, with an emphasis on protecting rare and endangered wild species and natural habitats of European significance. The Natura 2000 network comprises terrestrial and marine SPAs and SAC. Many terrestrial sites are also underpinned by the SSSI designation[259].

At the national level, the Marine (Scotland) Act 2010[260] and the Marine and Coastal Access Act 2009[261] gave Scottish Ministers powers to designate MPAs in Scottish territorial and offshore waters, respectively.

[254] OSPAR Commission (2018) Marine Protected Areas [online] Available at: https://www.ospar.org/work-areas/bdc/marine-protected-areas (accessed 21/11/2018)
[255] OSPAR Commission (2018) List of Threatened and/or Declining Species & Habitats. Available at: https://www.ospar.org/work-areas/bdc/species-habitats/list-of-threatened-declining-species-habitats (accessed 20/11/2018)
[256] Scottish Government (2016) Natura 2000 [online] Available at: https://www.nature.scot/professional-advice/safeguarding-protected-areas-and-species/protected-areas/national-designations/sites-special-scientific-interest (accessed 21/01/2020)
[257] European Commission (1992) The Habitats Directive [online] Available at: http://ec.europa.eu/environment/nature/legislation/habitatsdirective/index_en.htm (accessed 20/12/18)
[258] European Commission (2009) The Birds Directive [online] Available at: http://ec.europa.eu/environment/nature/legislation/birdsdirective/index_en.htm (accessed 20/12/18)
[259] SNH (2016) Sites of Special Scientific Interest [online] Available at: http://www.snh.gov.uk/protecting-scotlands-nature/protected-areas/national-designations/sssis/ (accessed 20/12/18)
[260] Scottish Government (2017) Marine (Scotland) Act [online] Available at: http://www.gov.scot/Topics/marine/seamanagement/marineact (accessed 17/10/2018)
[261] Scottish Government (2014) Marine and Coastal Access Act 2009 [online] Available at: http://www.gov.scot/Topics/marine/seamanagement/marineact/ukbill (accessed 17/10/2018)

The 2020 Challenge for Scotland's Biodiversity[262] is Scotland's response to the international UN Aichi Targets for 2020[263] and the EU Biodiversity Strategy to 2020[264]. The 2020 Challenge supplements the 2004 Scottish Biodiversity Strategy[265] and together they comprise the overall Scottish Biodiversity Strategy. Key aims include preserving and restoring the health of Scotland's ecosystems at a catchment-scale and promoting climate change resilience.

A Strategy for Marine Nature Conservation in Scotland's Seas is the main tool for enacting the principles of the 2020 Challenge within the marine environment[266]. It supports the development of an ecologically coherent network of MPAs in support of strategic aims such as meeting GES under the Marine Strategy Framework Directive and satisfying the requirements of the Birds and Habitats Directives[267]. It also proposed the Priority Marine Features (PMFs) system to guide the identification of MPAs and provide focus for marine planning and other activities.

A.2 Population and Human Health Policy

Directive 2012/18/EU (the Seveso III Directive) strengthens preceding legislation aimed at reducing the incidence of major industrial accidents as well as pre-emptively mitigating their environmental effects, with an emphasis on limiting consequences to human health[268]. The Directive is implemented in the UK through the Control of Major Accident Hazards Regulations 2015[269].

The Bathing Water Directive 2006/7/EC safeguards public health by imposing minimum water quality standards on both terrestrial and maritime bathing waters[270].

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[262] Scottish Government (2013) 2020 Challenge for Scotland's Biodiversity: A Strategy for the conservation and enhancement of biodiversity in Scotland [online] Available at: http://www.gov.scot/Resource/0042/00425276.pdf (accessed 20/12/18)
[263] Convention on Biological Diversity (2010) Aichi Biodiversity Targets [online] Available at: https://www.cbd.int/sp/targets/default.shtml (accessed 20/12/18)
[264] European Commission (2011) The European Biodiversity Strategy to 2020 [online] Available at: http://ec.europa.eu/environment/nature/info/pubs/docs/brochures/2020%20Biod%20brochure%20final%20lowres.pdf (accessed 20/12/18
[265] Scottish Government (2004) Scotland's Biodiversity Strategy: It's in Your Hands – A strategy for the conservation and enhancement of biodiversity in Scotland [online] Available at: http://www.scotland.gov.uk/Publications/2004/05/19366/37239 (accessed 20/12/18)
[266] Scottish Government (2011) A Strategy for Marine Nature Conservation in Scotland's Seas [online] Available at: http://www.gov.scot/Resource/Doc/295194/0115590.pdf (accessed 20/12/18)
[267] ibid
[268] European Commission (2012) Directive 2012/18/EU of the European Parliament and of the Council of 4 July 2012 on the control of major-accident hazards involving dangerous substances, amending and subsequently repealing Council Directive 96/82/EC [online] Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32012L0018 (accessed 21/01/20)
[269] The Control of Major Accident Hazards Regulations 2015, SI 2015/483 [online] Available at: http://www.legislation.gov.uk/uksi/2015/483/introduction/made (accessed 09/01/19)
[270] European Commission (2006) Directive 2006/7/EC of the European Parliament and of the Council of 15 February 2006 concerning the management of bathing water quality and repealing Directive 76/160/EEC [online] Available at: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32006L0007 (accessed 09/01/19)

Member States have a responsibility to monitor concentrations of certain bacteria and to inform the public about water quality and beach management.

The Land Reform (Scotland) Act 2003 introduced a new right of responsible access covering Scottish onshore, inland water, and coastal environments[271]. The Land Reform (Scotland) Act 2016 received royal assent on 22 April 2016, making minor amendments to the previous Act.

There are also measures in place to protect against human exposure to noise pollution and disturbance from vibration. These are entrenched in both the Environmental Noise Directive (2002/49/EC)[272] at the European level and the Environmental Protection Act 1990[273] and Environmental Noise (Scotland) Regulations 2006[274] at the UK and national levels, respectively.

A.3 Soil (Marine Geology and Coastal Processes) Policy

EU Directive 2014/89/EU (the Maritime Spatial Planning Directive) consolidated and expanded upon the fundamental aspects of the Council Recommendation on Integrated Coastal Zone Management of 2002 and the Protocol to the Barcelona Convention on Integrated Coastal Zone Management of 2010[275], obligating Member States to develop coastal management strategies. It aims to coordinate the development and delivery of policies across a wide spectrum of both marine and terrestrial activities, including offshore wind energy, in a way that is mindful of the natural limits of the coastal environment[276].

In Scotland, Integrated Coastal Zone Management is achieved via the work of seven Local Coastal Partnerships[277]. In addition, Marine Scotland Science is responsible for monitoring, research, and regulation of certain coastal activities.

[271] Land Reform (Scotland) Act 2003, 2003 asp 2 [online] Available at: https://www.legislation.gov.uk/asp/2003/2/introduction (accessed 09/01/19)

[272] European Commission (2002) Directive 2002/49/EC of the European Parliament and of the Council of 25 June 2002 relating to the assessment and management of environmental noise – Declaration by the Commission in the Conciliation Committee on the Directive relating to the assessment and management of environmental noise [online] Available at: http://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX%3A32002L0049 (accessed 09/01/19)

[273] Environmental Protection Act 1990, 1990/Chapter 43 [online] Available at: http://www.legislation.gov.uk/ukpga/1990/43/introduction (accessed 09/01/19)

[274] The Environmental Noise (Scotland) Regulations 2006, 2006 SSI No. 465 [online] Available at: http://www.legislation.gov.uk/ssi/2006/465/introduction/made (accessed 09/01/19)

[275] European Commission (2016) Integrated Coastal Management [online] Available at: http://ec.europa.eu/environment/iczm/index_en.htm (accessed 09/01/19)

[276] European Commission (2014) Directive 2014/89/EU of the European Parliament and of the Council of 23 July 2014 establishing a framework for maritime spatial planning [online] Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32014L0089 (accessed 21/01/20)

[277] Scottish Government (2014) Managing Scotland's Coastline [online] Available at: http://www.gov.scot/Topics/marine/marine-environment/coast (accessed 09/01/19)

At present, there is no legislative or policy tool developed specifically for the protection of soil[278]. However, designations and their associated management agreements and operations often extend protection to soil as a means of enhancing the biodiversity, geodiversity, landform value, and cultural resources of the site[279]. For example, marine geology forms part of the basis for the designation of MPAs within Scottish waters[280]. Specifically, MPAs strive to protect rare and representative marine species, habitats, and geodiversity, the latter defined as the variety of landforms and natural processes that underpin the marine landscape.

The Scottish Soil Framework places the sustainable management of soils within the context of the economic, social, and environmental needs of Scotland[281]. The Framework identifies 13 key soil outcomes such as protecting soil biodiversity, reducing and remediating soil erosion, and tackling GHG emissions. The Framework also notes the effects that rising sea levels and associated seasonal incursion by seawater could have on coastal soils

A.4 Water Policy

The International Convention for the Prevention of Pollution from Ships (MARPOL) regulates accidental and operational releases of pollutants into the marine environment by the shipping industry, including oil and other chemicals[282].

The EU's Water Framework Directive (2000/60/EC) (WFD) was introduced as a more comprehensive approach to managing and protecting Europe's water bodies which in Scotland includes rivers, lochs, transitional waters, coastal waters, and groundwater resources[283]. It sets out a goal of bringing all European waters to 'good' chemical and ecological status. The Marine Strategy Framework Directive extends the requirements of the WFD into seas beyond 1 NM.

Scotland fulfils its water protection obligations under the WFD primarily through the Water Environment and Water Services (Scotland) Act 2003[284], which defines the

[278] Scottish Government (2009) The Scottish Soil Framework [online] Available at: http://www.gov.scot/Publications/2009/05/20145602/0 (accessed 09/01/19)
[279] ibid
[280] Scottish Government (2016) Nature Conservation MPAs [online] Available at: http://www.gov.scot/Topics/marine/marine-environment/mpanetwork/ncmpas (accessed 09/01/19)
[281] Scottish Government (2009) The Scottish Soil Framework [online] Available at: http://www.gov.scot/Publications/2009/05/20145602/0 (accessed 09/01/19)
[282] MARPOL (2017) International Convention for the Prevention of Pollution from Ships (MARPOL) [online] Available at: www.imo.org/en/About/Conventions/ListOfConventions/Pages/International-Convention-for-the-Prevention-of-Pollution-from-Ships-(MARPOL).aspx (accessed 21/01/20)
[283] European Commission (2000) Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy [online] Available at: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32000L0060 (accessed 20/12/18)
[284] Water Environment and Water Services (Scotland) Act 2003, asp 3 [online] Available at: http://www.legislation.gov.uk/asp/2003/3/pdfs/asp_20030003_en.pdf (accessed 20/12/18)

establishment of RBMPs[285], and the Water Environment (Controlled Activities) (Scotland) Regulations 2011[286]. Other relevant legislation includes the Pollution Prevention and Control (Scotland) Regulations 2012, which applies specifically to pollution originating from industry discharges[287].

The EU Floods Directive (2007/60/EC)[288] is implemented at the national level through the Flood Risk Management (Scotland) Act 2009[289]. The Directive mandates the creation of flood risk management plans for all inland and coastal areas at risk of flooding, integrating their development and deployment with existing RBMPs. Flood risk management plans are designed to minimise negative effects due to flooding on a range of receptors, including human health, the environment, and cultural heritage.

A.5 Climatic Factors Policy

In November 2016, the United Nations Framework Convention on Climate Change (UNFCCC) Paris Agreement came into force[290]. The Paris Agreement is the first legally binding global climate deal and sets out aims to limit global warming to well below 2˚C as well as pursue further efforts to limit it to 1.5˚C [291]. A further long-term goal is to achieve net-zero levels of global greenhouse gas emissions by the second half of this century. The Agreement also covers a range of other issues such as mitigation through reducing emissions, adaptation, and loss and damage[292].

The Committee for Climate Change has recently published a report, recommending new emissions targets for Scotland and the UK as a whole. In this context there is a recommendation to achieve net-zero emissions by 2045. Achievement of this will require the expansion of renewable energy in Scotland, of which offshore wind is likely to form a significant contribution.

The Climate Change (Scotland) Act 2009 provides the statutory framework for GHG emissions reductions in Scotland. It sets a target for a reduction in emissions of the

[285] SEPA (2016) River Basin Management Planning [online] Available at: http://www.sepa.org.uk/environment/water/river-basin-management-planning/ (accessed 20/12/18)
[286] The Water Environment (Controlled Activities) (Scotland) Regulations 2011, SSI No. 206 [online] Available at: http://www.legislation.gov.uk/ssi/2011/209/pdfs/ssi_20110209_en.pdf (accessed 20/12/18)
[287] The Pollution Prevention and Control (Scotland) Regulations 2012, SSI No. 360 [online] Available at: http://www.legislation.gov.uk/ssi/2012/360/introduction/made (accessed 20/12/18)
[288] European Commission (2007) The EU Floods Directive [online] Available at: http://ec.europa.eu/environment/water/flood_risk/ (accessed 20/12/18)
[289] Flood Risk Management (Scotland) Act 2009, asp 6 [online] Available at: http://www.legislation.gov.uk/asp/2009/6/pdfs/asp_20090006_en.pdf (accessed 20/12/18)
[290] UNFCCC (2016) The Paris Agreement [online] Available at: http://unfccc.int/paris_agreement/items/9485.php (accessed 20/12/18)
[291] European Commission (2016) Paris Agreement [online] Available at: http://ec.europa.eu/clima/policies/international/negotiations/paris/index_en.htm (accessed 20/12/18)
[292] European Commission (2016) Paris Agreement [online] Available at: http://ec.europa.eu/clima/policies/international/negotiations/paris/index_en.htm (accessed 20/12/18)

basket of Kyoto Protocol greenhouse gases (GHGs)[293] of 80% by 2050 as compared to the 1990/1995 baseline levels, alongside an interim target of a 42% reduction by 2020. The CCC Report recommended a net-zero date of 2045 for Scotland, reflecting Scotland's greater relative capacity to remove emissions than the UK as a whole. In line with this advice, amendments were lodged to the Climate Change Bill, which raised the ambition of the 2030 and 2040 targets for emissions reductions to 70% and 90% respectively. The newly passed Climate Change (Emissions Reduction Targets) (Scotland) Act 2019 implements some of the most stringent statutory targets in the world, with the aim of ending our contribution to climate change, definitively, within a generation. Future iterations of the Plan may need to plan accordingly to support these aspirations.

The Marine (Scotland) Act 2010 specifies a duty for Ministers and the public sector to manage and progress actions within the marine environment in a way 'best calculated to mitigate, and adapt to, climate change so far as is consistent with the proper exercise of that function'[294]. Scotland's National Marine Plan[295] considers climate change in terms of how actions undertaken within the Plan can help to mitigate GHG emissions, in addition to how these actions need to be adapted to take into account the effects of climate change. The Plan also stipulates that the development and use of the marine environment should not have a significant affect the national status of PMFs. Many of these are known for their role in carbon sequestration, including within MPAs.

Scotland's Climate Change Adaption Programme[296] is a direct requirement of the Climate Change (Scotland) Act 2009, replacing the Climate Change Adaptation Framework[297] and accompanying Sector Action Plans[298]. Among its proposals and policies for meeting adaptation objectives are actions around conserving marine carbon stores and conducting additional research into the role of blue carbon

[293] The basket of Kyoto Protocol greenhouse gases comprises carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O), for which the baseline is 1990; and hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphur hexafluoride (SF_6), for which the baseline is 1995. Nitrogen triflouride (NF_3) has subsequently been added and applies to the second commitment period of 2013-20.
[294] Marine (Scotland) Act 2010, asp 5 [online] Available at: http://www.legislation.gov.uk/asp/2010/5/pdfs/asp_20100005_en.pdf (accessed 20/12/18)
[295] Scottish Government (2015) Scotland's National Marine Plan [online] Available at: http://www.gov.scot/Publications/2015/03/6517 (accessed 20/12/18)
[296] Scottish Government (2014) Climate Ready Scotland Scottish Climate Change Adaptation Programme – Part 2 – The Adaptation Programme [online] Available at: http://www.gov.scot/Publications/2014/05/4669/4 (accessed 20/12/18)
[297] Scottish Government (2009) Scotland's Climate Change Adaptation Framework [online] Available at: http://www.gov.scot/Resource/Doc/295110/0091310.pdf (accessed 20/12/18)
[298] Scottish Government (2011) Sector Action Plans [online] Available at: http://www.gov.scot/Topics/Environment/climatechange/scotlands-action/adaptation/AdaptationFramework/SAP (accessed 20/12/18)

ecosystems in carbon sequestration[299]. The role of marine planning and MPAs in protecting these ecosystems is also noted[300].

A.6 Cultural Heritage Policy

The UNESCO Convention on the Protection of the Underwater Cultural Heritage obligates signatories to take steps to preserve their underwater heritage both within territorial waters and as well as throughout their Exclusive Economic Zone[301]. Article 5 refers to activities that could incidentally affect underwater cultural heritage, such as offshore wind energy generation.

The Joint Nautical Archaeology Policy Committee Code of Practice for Seabed Developers is a voluntary code of practice[302]. It provides a framework that seabed developers can follow to ensure their activities are sympathetic to archaeological resources. Further sources of guidance include those that set out protocols to deal with the marine historic environment developed specifically for the offshore renewable energy sector[303].

The Marine (Scotland) Act 2010 included an article on the establishment of historic Marine Protected Areas to safeguard a wide range of heritage assets at the coast edge, on the foreshore, and out to sea, including the remains of ships and aircraft lost at sea; harbours, lighthouses, and other structures relating to transport and trade by sea; and the remains of human settlements at the coastal fringe. They extend and replace the protection previously afforded to underwater heritage by the Protection of Wrecks Act 1973[304].

The Ancient Monuments and Archaeological Areas Act 1979 provides for the protection of archaeological heritage, including the scheduling of 'monuments'[305]. The Act is primarily intended for terrestrial locations but includes provision to

[299] Scottish Government (2014) Climate Ready Scotland Scottish Climate Change Adaptation Programme [online] Available at: http://www.gov.scot/Resource/0045/00451392.pdf (accessed 20/12/18)
[300] ibid
[301] UNESCO (2001) Text of the 2001 Convention on the Protection of the Underwater Cultural Heritage [online] Available at: http://www.unesco.org/new/en/culture/themes/underwater-cultural-heritage/2001-convention/official-text/ (accessed 09/01/19)
[302] The Crown Estate (2006) Maritime Cultural Heritage & Seabed Development - JNAPC Code of Practice for Seabed Development – Joint Nautical Archaeology Policy Committee [online] Available at: http://www.jnapc.org.uk/jnapc_brochure_may_2006.pdf (accessed 09/01/19)
[303] The Crown Estate (2014) Protocol for Archaeological Discoveries: Offshore Renewables Projects [online] Available at: https://www.historicenvironment.scot/media/2375/ei-protocol-for-archaeological-discoveries-offshore-renewables-projects.pdf (accessed 09/01/19)
[304] Protection of Wrecks Act 1973, 1973/Chapter 33 [online] Available at: https://www.legislation.gov.uk/ukpga/1973/33 (accessed 09/01/19)
[305] Ancient Monuments and Archaeological Areas Act 1979, 1979/Chapter 46 [online] Available at: https://www.legislation.gov.uk/ukpga/1979/46 (accessed 09/01/19)

designate submarine sites. The 1979 Act was modified by the Historic Environment (Amendment) Scotland Act 2011[306].

Our Place in Time – The Historic Environment Strategy for Scotland, published in 2014, lays out a 10-year vision for Scotland's historic environment[307]. The vision is founded upon the fundamental aims of understanding, protecting, and valuing our historic environment, ensuring it continues to benefit Scotland's wellbeing through its cultural, social, environmental, and economic contributions.

The Strategy and the Historic Environment Policy for Scotland[308] set out an overarching framework for historic environment policy in Scotland. Other relevant policies include the National Planning Framework177[309] and Scottish Planning Policy178[310]

A.7 Landscape, Seascape and Visual Amenity Policy

The European Landscape Convention strives to promote landscape protection, management, and planning as well as achieve a more concerted approach to addressing landscape issues at the European scale[311]. The Convention presents a highly inclusive definition of landscape, specifying that protection and enhancement activities should apply equally to both 'outstanding' as well as less remarkable or degraded landscapes. This definition encompasses natural, rural, urban, and peri-urban landscapes across land, marine, and inland water environments.

At a national level, the role of Scotland's natural heritage and landscapes in informing land use planning is set out in Scottish Planning Policy[312]. Additionally, National Planning Framework 3 acknowledges the multiple benefits we derive from landscapes, such as improved human health and wellbeing as well as contributions

[306] Historic Environment (Amendment) (Scotland) Act (2011), asp 3 [online] Available at: http://www.legislation.gov.uk/asp/2011/3 (accessed 09/01/19)
[307] Scottish Government (2014) Our Place in Time – The Historic Environment Strategy for Scotland [online] Available at: http://www.gov.scot/Publications/2014/03/8522/0 (accessed 09/01/19)
[308] Historic Environment Scotland (2019) Historic Environment Policy for Scotland (HEPS) [online] Available at: https://www.historicenvironment.scot/archives-and-research/publications/publication/?publicationId=1bcfa7b1-28fb-4d4b-b1e6-aa2500f942e7 (accessed 16/10/2019)
[309] Scottish Government (2014) National Planning Framework 3: A Plan for Scotland: Ambition, Opportunity, Place and Scottish Planning Policy [online] Available at: http://www.gov.scot/Publications/2014/06/3539 (accessed 09/01/19)
[310] Scottish Government (2014) Scottish Planning Policy [online] Available at: http://www.gov.scot/Publications/2014/06/5823 (accessed 09/01/19)
[311] European Landscape Convention (2000) Text of the ELC [online] Available at: https://rm.coe.int/1680080621 (accessed 09/01/19)
[312] Scottish Government (2014) Scottish Planning Policy [online] Available at: http://www.gov.scot/Publications/2014/06/5823 (accessed 09/01/19)

to our quality of life[313]. The vulnerability of landscapes to climate change is also noted.

SNH's Landscape Policy Framework strives to 'safeguard and enhance the distinct identity, the diverse character, and the special qualities of Scotland's landscapes as a whole'[314]. Both Scottish Planning Policy and National Planning Framework 3 give significant protection to wild land areas [315]. The National Marine Plan also sets out the consideration of wild land in addition to largely undeveloped coasts, noting that development should be considered in line with Scottish Planning Policy when planning for and taking decisions, which may affect such areas.

SNH has also produced guidance on 'Siting and Designing Wind Farms in the Landscape' that includes a section on coastal landscapes and the potential effect offshore wind farms may have on inland and offshore land and seascape character and views, including views from boats and ferries[316]. It also states that existing landmarks like historical or navigational features (such as lighthouses), distinctive coastal landforms, coastal settlements, and areas valued for recreation should be avoided when selecting locations for wind energy development. Additional advice is provided by their 'Offshore Renewables – guidance on assessing the impact on coastal landscape and seascape' publication[317].

It is recognised that individual regions or council areas are likely to have differing policies on the management of landscape and seascape, and therefore the level of constraint may differ dependent on the regional policy.

[313] Scottish Government (2014) National Planning Framework 3: A Plan for Scotland: Ambition, Opportunity, Place and Scottish Planning Policy [online] Available at: http://www.gov.scot/Publications/2014/06/3539 (accessed 09/01/19)
[314] SNH (2005) Statement: SNH's Landscape Policy Framework [online] Available at: https://www.nature.scot/professional-advice/landscape/framework-landscape-policy/snh-landscape-policy-framework (accessed 21/01/20)
[315] SNH (2012) Landscape policy: wild land [online] Available at: https://www.nature.scot/professional-advice/landscape-change/landscape-policy-and-guidance/landscape-policy-wild-land (accessed 09/01/19)
[316] SNH (2014) Siting and Designing Wind Farms in the Landscape – Version 3a [online] Available at: https://www.nature.scot/sites/default/files/2017-11/Siting%20and%20designing%20windfarms%20in%20the%20landscape%20-%20version%203a.pdf (accessed 09/01/19)
[317] SNH (2012) Offshore Renewables – guidance on assessing the impact on coastal landscape and seascape [online] Available at: https://www.nature.scot/sites/default/files/2018-11/Guidance%20-%20Offshore%20Renewables%20-%20assessing%20the%20impact%20on%20coastal%20landscape%20and%20seascape%20-%20Guidance%20for%20scoping%20an%20Environmental%20Statement.pdf (accessed 09/01/19)

Appendix B Assessment of Offshore Wind Technologies and Subsea Cables

B.1 Offshore Wind Technologies

SEA Topic Areas	Wind Technologies with Gravity-Base Foundation Devices	Wind Technologies with Monopile or Multi-Pile Foundation Devices	Wind Technologies with Tripod of Steel Jacket Foundation Devices	Wind Technologies with Mono or Multi-Caisson Foundation Devices	Floating Wind Turbines
Device Information[318]	Involves the construction of gravity foundations directly on the seabed. Gravity base foundations consist of concrete or steel structures, often internally ballasted to create a large mass on the seabed. May be suitable for depths of 30–60m of water. Able to be floated and towed out to windfarms and installed without specialist marine equipment with minimum seabed preparation. Can incorporate scour protection, has low maintenance requirement and can be removed upon decommissioning.	Like typical oil and gas pile designs. Involves long steel tubes (monopiles) driven into the seabed using a hydraulic piling hammer, assisted by drilling where necessary. Generally suitable for turbines in shallower waters, although ongoing research into deeper applications (i.e. >25m). Considered likely to continue to be used in shallow waters in the short-term.	Generally consist of turbines attached to multi-legged structures secured to a series of piles driven into the seabed. Jackets are mounted on a 3 or 4 legged steel lattice rising out of the sea. Tripods have a single vertical column above the water, with diagonal braces attaching the turbine mast to a 3-legged structure below the water surface and attached to the seabed. Jackets in particular are very common in the oil and gas sector, with a number of variations available.	Consists of a structure or suction caisson resembling an upturning bucket placed on a pre-prepared levelled seabed. Placement is based on a pressure differential attachment to the seabed. The foundations weight combined with the hydrostatic pressure on the caisson when the internal water is pumped out of it provides the force to hold the bucket structure in place. Can involve use of single or multiple caisson attachments. Is generally considered a future technique.	Have a variety of types being investigated, including: SPAR and Tension Leg Platform (TLP) such as the 'Hywind' floating device equipped with a cement ballast (used in the first floating wind array (30MW) at Hywind Scotland commissioned in 2017), and 'Windfloat' – a 3 cornered pontoon (installed in Portugal in 2011). Likely involve attachment to the seabed using anchors (i.e. gravity anchors, moor lines, etc.). Considered an emergent technology, with no full scale commercial arrays to date.
Biodiversity/ flora/ fauna[319]	Summary of key potential effects: ▪ Physical disturbance during device installation and operation ▪ Habitat exclusion and species displacement due to device presence and operation ▪ Potential for creation of artificial habitats underwater and bird aggregation on surface-piercing structures ▪ Noise and vibration during surveys, unexploded ordnance clearance, construction (particularly piling) and from device operation ▪ Risk of bird collision with operating devices (e.g. foraging, migration) ▪ Increased suspended sediment/turbidity from seabed disturbance during device installation and cable trenching ▪ Substratum loss, caused by placement of devices and attaching support structures and cabling on the seabed Key measures to prevent adverse effects may include: avoidance of sensitive sites; avoidance of sensitive seasons during installation (e.g. breeding); protocols (such as use of Marine Mammal Observers) to ensure noisy construction activities do not occur when marine mammals are in close proximity; effective device design and project-specific studies				

[318] Informed by: E.On UK (2013) Foundation Types [online] Available at: http://www.eon-uk.com/generation/3947.aspx [accessed 02/03/2013]; ARUP, Costain, Hochtief (undated) Gravity Base Foundations; Scharf R. and Siems M. (2013) Monopile foundations for offshore wind turbines – solutions for greater water depths, Steel Construction 6 (2013), No. 1, DOI: 10.1002/stco.201300010, pp. 47 – 53 [online] Available at: http://onlinelibrary.wiley.com/doi/10.1002/stco.201300010/pdf [accessed 27/03/2013]; and DW (2013) Scientists race to develop floating wind farms [online] Available at: http://www.dw.de/scientists-race-to-develop-floating-wind-farms/a-16540081 [accessed 02/03/2013].

[319] Informed by: Marine Scotland. 2012. Vulnerability of Scottish Seabirds to Offshore Wind Turbines. Prepared by MacArthur Green Ltd (Furness and Wade); Bowgen, K., and Cook, A. 2018. Bird collision avoidance: Empirical evidence and impact assessments. JNCC Report No. 614, JNCC, Peterborough, ISSN 0963-8091, Skov, H., Heinänen, S., Norman, T., Ward, R.M., Méndez-Roldán, S., Ellis, I. 2018. ORJIP Bird Collision and Avoidance Study. Final report – April 2018. The Carbon Trust. 247 pp.: Halcrow (2007) The Plan for Offshore Wind Energy in Scottish Territorial Waters, Environmental Report: Volume 1, Prepared for the Scottish Executive [online] Available at: http://www.scotland.gov.uk/Resource/Doc/312161/0098588.pdf [accessed 27/03/2013]; Talisman Energy (UK) LTD (2005) Environmental Statement [online] Available at: http://www.beatricewind.co.uk/downloads/statement.asp [accessed 25/03/2013]; EMU (2012) Neart na Gaoithe Offshore Wind Farm Environmental Statement, Prepared for Mainstream Renewable Power [online] Available at: https://nngoffshorewind.com/downloads/offshore-environmental-statement/ [accessed 17/01/2020]; Aberdeen Wind Offshore Wind Farm Limited (2011) European Offshore Wind Deployment Centre: Non-Technical Summary, July 2011 [online] Available at: http://marine.gov.scot/datafiles/lot/eowdc/ [accessed 21/01/2020]; E-on (2008) Offshore Environmental Statement, April 2008 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2013]; E-on (2008) Onshore Cable Route Environmental Statement, April 2008 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2013]; and E-on (2009) Onshore Substation and Cable Spur Environmental Statement, November 2009 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2013].

SEA Topic Areas	Wind Technologies with Gravity-Base Foundation Devices	Wind Technologies with Monopile or Multi-Pile Foundation Devices	Wind Technologies with Tripod of Steel Jacket Foundation Devices	Wind Technologies with Mono or Multi-Caisson Foundation Devices	Floating Wind Turbines
	to help design appropriate mitigation; carry out detailed routing studies at project level in accordance with 'Holford Rules' best practice guidance on routeing overhead transmission lines onshore.				
	Marine Mammals and fish Underwater noise and vibration during installation has the potential to affect marine fauna (e.g. seals, otters, cetaceans, basking sharks and other species of fish potentially sensitive to underwater noise). There is also the potential for cumulative effects from multiple noise sources audible to marine mammals and fish during installation and increased vessel disturbance. Potential displacement or disturbance of marine fauna through a combination of factors including noise (and multiple noise sources), vibration, visual and light intensity changes, water quality changes, habitat disturbance or the presence of structures and vessels. Potential for injury with marine mammals during installation period (i.e. risk of injury to seals and dolphins during placement of foundations). Potential for electro-magnetic field (EMF) effects associated with cabling and grid connection infrastructure. Cumulative effects may occur, particularly affecting mammals and migratory fish including diadromous fish, from an increased number of barriers affecting movement (i.e. device arrays, construction vessels/equipment, etc.). *Birds*	*Marine Mammals and fish* Underwater noise and vibration on marine fauna (e.g. seals, otters, cetaceans, basking sharks and other species of fish potentially sensitive to underwater noise) during piling. There is also the potential for cumulative effects from multiple noise sources audible to marine mammals and fish during piling and installation of turbines, and increased vessel disturbance. Potential displacement or disturbance of marine fauna through a combination of factors including noise (and multiple noise sources), vibration, visual and light intensity changes, water quality changes, habitat disturbance or the presence of structures and vessels. Potential for injury with marine mammals during installation period (i.e. risk of injury to seals during piling activities). Can likely be mitigated using a variety of techniques (i.e. piling jackets, soft start, etc.). Potential for EMF effects associated with cabling and grid connection infrastructure. Cumulative effects may occur, particularly affecting mammals and migratory fish including diadromous fish, from an increased number of barriers affecting movement (i.e. device arrays, construction vessels/equipment, etc.). *Birds*	*Marine Mammals and fish* Underwater noise and vibration during piling and the placement of tripod/jacket structures, with potential effects to marine fauna (e.g. seals, otters, cetaceans, basking sharks and other species of fish potentially sensitive to underwater noise). There is also the potential for cumulative effects from multiple noise sources audible to marine mammals and fish during piling and installation of turbines, and increased vessel disturbance. Potential displacement or disturbance of marine fauna through a combination of factors including noise (and multiple noise sources), vibration, visual and light intensity changes, water quality changes, habitat disturbance or the presence of structures and vessels. Potential for injury with marine mammals during installation period (i.e. risk of injury to seals during piling activities). Can likely be mitigated using a variety of techniques (i.e. piling jackets, soft start, etc.). Potential for EMF effects associated with cabling and grid connection infrastructure. Cumulative effects may occur, particularly affecting mammals and migratory fish including diadromous fish, from an increased number of barriers affecting movement (i.e. device arrays, construction vessels/equipment, etc.). *Birds*	*Marine Mammals and fish* Underwater noise and vibration during installation has the potential to effect marine fauna (e.g. seals, otters, cetaceans, basking sharks and other species of fish potentially sensitive to underwater noise). There is also the potential for cumulative effects from multiple noise sources audible to marine mammals and fish during installation and increased vessel disturbance. Potential displacement or disturbance of marine fauna through a combination of factors including noise (and multiple noise sources), vibration, visual and light intensity changes, water quality changes, habitat disturbance or the presence of structures and vessels. Potential for injury with marine mammals during installation period (i.e. risk of injury to seals and dolphins during placement of foundations). Potential for EMF effects associated with cabling and grid connection infrastructure. Cumulative effects may occur, particularly affecting mammals and migratory fish including diadromous fish, from an increased number of barriers affecting movement (i.e. device arrays, construction vessels/equipment, etc.). *Birds* Potential for bird-strike with turbine blades is likely to be site-specific.	*Marine Mammals and fish* Underwater noise and vibration during installation (placement of concrete anchors and mooring lines) has the potential to effect marine fauna (e.g. seals, otters, cetaceans, basking sharks and other species of fish potentially sensitive to underwater noise). There is also the potential for cumulative effects from multiple noise sources audible to marine mammals and fish during installation and increased vessel disturbance. Potential displacement or disturbance of marine fauna through a combination of factors including noise (and multiple noise sources), vibration, visual and light intensity changes, water quality changes, habitat disturbance or the presence of anchors and vessels. Potential for EMF effects associated with cabling and grid connection infrastructure. Cumulative effects may occur, particularly affecting mammals and migratory fish including diadromous fish, from an increased number of barriers affecting movement (i.e. device arrays, construction vessels/equipment, etc.). *Birds* Potential for bird-strike with turbine blades is likely to be site-specific. Potential for diving bird collisions with support devices (i.e. mooring cables, anchors, etc.). However, this is likely to be site and device-specific, and the

SEA Topic Areas	Wind Technologies with Gravity-Base Foundation Devices	Wind Technologies with Monopile or Multi-Pile Foundation Devices	Wind Technologies with Tripod of Steel Jacket Foundation Devices	Wind Technologies with Mono or Multi-Caisson Foundation Devices	Floating Wind Turbines
	Potential for bird-strike with turbine blades is likely to be site-specific. Potential for diving bird collisions with support devices (i.e. mooring cables if used). However, this is likely to be site and device-specific, and the likelihood of occurrence is not currently known. Potential disturbance of diving bird foraging areas due to surface noise, visual and light intensity changes, water quality changes, habitat disturbance or the presence of structures and vessels. *Benthic Habitats* Potential for creation of artificial habitats for marine organisms resulting from the presence of new structures. This may be aided by reductions in commercial fishing (e.g. trawling) in areas where wind farms are sited, as this may enhance biodiversity. These benefits could last for the life of the project, or potentially longer depending on the decommissioning scheme. Loss of seabed habitat from the placement of gravity foundation directly on/into the seabed, and potential for adverse effects from sourcing of fill or dredged material for use in the gravity-based foundation (i.e. potential risk to marine fauna from dredging activities, turbidity, potential release of contaminated materials, loss of habitat at source, etc.). Direct adverse effects on benthic habitats, particularly sensitive habitats such as shellfish growing waters, from sediment dispersion	Potential for bird-strike with turbine blades is likely to be site-specific. Potential for diving bird collisions with support devices (i.e. mooring cables if used). However, this is likely to be site and device-specific, and the likelihood of occurrence is not currently known. Potential disturbance of diving bird foraging areas due to surface noise, visual and light intensity changes, water quality changes, habitat disturbance or the presence of structures and vessels. *Benthic Habitats* Potential for creation of artificial habitats for marine organisms resulting from the presence of new structures. This may be aided by reductions in commercial fishing (e.g. trawling) in areas where wind farms are sited, as this may enhance biodiversity. These benefits could last for the life of the project, or potentially longer depending on the decommissioning scheme. Loss of seabed habitat from the installation process for monopiling into the seabed. Direct adverse effects to benthic habitats, particularly sensitive habitats such as shellfish growing waters, from sediment dispersion and deposition in the construction phase of works (i.e. east of Scotland (e.g. Bell Rock, Inch Cape, Neart na Gaoithe and Forth Array) and west of Scotland (e.g. Argyll Array, Islay and Kintyre) where shellfish waters are prevalent.	Potential for bird-strike with turbine blades is likely to be site-specific. Potential for diving birds strike to support devices (support structures, mooring cables if used) is likely to be site-specific, and the likelihood of occurrence is not currently known. Potential disturbance of diving bird foraging areas due to surface noise, visual and light intensity changes, water quality changes, habitat disturbance or the presence of structures and vessels. *Benthic Habitats* Potential for creation of artificial habitats for marine organisms resulting from the presence of new structures. This may be aided by reductions in commercial fishing (e.g. trawling) in areas where wind farms are sited, as this may enhance biodiversity. These benefits could last for the life of the project, or potentially longer depending on the decommissioning scheme. Loss of seabed habitat from the installation process for piling into the seabed. Direct adverse effects to benthic habitats, particularly sensitive habitats such as shellfish growing waters, from sediment dispersion and deposition in the construction phase of works (i.e. east of Scotland (e.g. Bell Rock, Inch Cape, Neart na Gaoithe and Forth Array) and west of Scotland (e.g. Argyll Array, Islay and Kintyre) where shellfish waters are prevalent. It is anticipated that many of the construction and	Potential for diving bird collisions with support devices (i.e. mooring cables if used). However, this is likely to be site and device-specific, and the likelihood of occurrence is not currently known. Potential disturbance of diving bird foraging areas due to surface noise, visual and light intensity changes, water quality changes, habitat disturbance or the presence of structures and vessels. *Benthic Habitats* Potential for creation of artificial habitats for marine organisms resulting from the presence of new structures. This may be aided by reductions in commercial fishing (e.g. trawling) in areas where wind farms are sited, as this may enhance biodiversity. These benefits could last for the life of the project, or potentially longer depending on the decommissioning scheme. Loss of seabed habitat from the placement of foundation directly on/into the seabed. Direct adverse effects to benthic habitats, particularly sensitive habitats such as shellfish growing waters, from sediment dispersion and deposition in the construction phase of works (i.e. east of Scotland (e.g. Bell Rock, Inch Cape, Neart na Gaoithe and Forth Array) and west of Scotland (e.g. Argyll Array, Islay and Kintyre) where shellfish waters are prevalent. It is anticipated that many of the construction and decommissioning effects may be temporary and reversible (i.e.	likelihood of occurrence is not currently known. Potential disturbance of diving bird foraging areas due to surface noise, visual and light intensity changes, water quality changes, habitat disturbance or the presence of structures and vessels. *Benthic Habitats* Potential for creation of artificial habitats for marine organisms resulting from the presence of new structures (i.e. gravity anchors). This may be aided by reductions in commercial fishing (e.g. trawling) in areas where wind farms are sited, as this may enhance biodiversity. These benefits could last for the life of the project, or potentially longer depending on the decommissioning scheme. Loss of small discrete areas of the seabed habitat from the placement of gravity anchors into the seabed. Direct adverse effects to benthic habitats, particularly sensitive habitats such as shellfish growing waters, from sediment dispersion and deposition in the construction phase of works (i.e. east of Scotland (e.g. Bell Rock, Inch Cape, Neart na Gaoithe and Forth Array) and west of Scotland (e.g. Argyll Array, Islay and Kintyre) where shellfish waters are prevalent. It is anticipated that many of the construction and decommissioning effects may be temporary and reversible (i.e. removal of the gravity anchors and removal of the floating turbine structure). However,

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	and deposition in the construction phase of works (i.e. east of Scotland (e.g. Bell Rock, Inch Cape, Neart na Gaoithe and Forth Array) and west of Scotland (e.g. Argyll Array, Islay and Kintyre) where shellfish waters are prevalent. It is anticipated that many of the construction and decommissioning effects may be temporary and reversible (i.e. removal of the gravity base structure and rehabilitation of the seabed). However, some effects on biodiversity experienced during operation of wind farms are likely to be permanent and irreversible.	It is anticipated that many of the construction and decommissioning effects may be temporary and reversible (i.e. removal of the turbines with the monopole remaining *in situ*). However, some effects on biodiversity experienced during operation of wind farms are likely to be permanent and irreversible.	decommissioning effects may be temporary and reversible (i.e. removal of the turbines and support structures, and piles remaining *in situ*). However, some effects on biodiversity experienced during operation of wind farms are likely to be permanent and irreversible.	removal of the caisson). However, some effects on biodiversity experienced during operation of wind farms are likely to be permanent and irreversible.	some effects on biodiversity experienced during operation of wind farms are likely to be permanent and irreversible.
Population and human health[320]	Summary of key potential effects on population and human health: ▪ Flicker and noise effects, particularly for near-shore devices ▪ Displacement of other marine activities (i.e. fishing, recreational, shipping, aquaculture) ▪ Reductions in the safety of navigation ▪ Risk of collision by other marine users with turbine structures and installation/maintenance vessels Key measures to prevent adverse effects may include: siting devices away from spatially constrained areas and areas with high vessel densities; siting devices in open water; making use of industry guidance on assessment of effects and use of aids to navigation; use of notifications such as 'Notices to Mariners', publicising information at marina, and Sailing Directions; and adhering to appropriate safety regulations.				
	Provision of a new renewable energy supply for the projected increase in the Scottish population for the life of an operating wind farm. Potential for flicker and noise effects, particularly if located near-shore. Potential effects on other marine users (i.e. fishing, recreational, shipping, aquaculture) including the potential displacement of	Provision of a new renewable energy supply for the projected increase in the Scottish population for the life of an operating wind farm. Potential for flicker and noise effects, particularly if located near-shore. Potential effects on other marine users (i.e. fishing, recreational, shipping, aquaculture) including the potential displacement of	Provision of a new renewable energy supply for the projected increase in the Scottish population for the life of an operating wind farm. Potential for flicker and noise effects, particularly if located near-shore. Potential effects on other marine users (i.e. fishing, recreational, shipping, aquaculture) including the potential displacement of	Provision of a new renewable energy supply for the projected increase in the Scottish population for the life of an operating wind farm. Potential for flicker and noise effects, particularly if located near-shore. Potential effects on other marine users (i.e. fishing, recreational, shipping, aquaculture) including the potential displacement of	Provision of a new renewable energy supply for the projected increase in the Scottish population for the life of an operating wind farm. Potential for flicker and noise effects, particularly if located near-shore. Potential effects on other marine users (i.e. fishing, recreational, shipping, aquaculture) including the potential displacement of

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[320] Informed by: Halcrow (2007) The Plan for Offshore Wind Energy in Scottish Territorial Waters, Environmental Report: Volume 1, Prepared for the Scottish Executive [online] Available at: http://www.scotland.gov.uk/Resource/Doc/312161/0098588.pdf [accessed 27/03/2013]; Talisman Energy (UK) LTD (2005) Environmental Statement [online] Available at: http://www.beatricewind.co.uk/downloads/statement.asp [accessed 25/03/2013]; EMU (2012) Neart na Gaoithe Offshore Wind Farm Environmental Statement, Prepared for Mainstream Renewable Power [online] Available at: https://nngoffshorewind.com/downloads/offshore-environmental-statement/ [accessed 17/01/2020]; Aberdeen Wind Offshore Wind Farm Limited (2011) European Offshore Wind Deployment Centre: Non-Technical Summary, July 2011 [online] Available at: http://marine.gov.scot/sites/default/files/non_technical_summary_1.pdf [accessed 17/01/2020]; E-on (2008) Offshore Environmental Statement, April 2008 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2013]; E-on (2008) Onshore Cable Route Environmental Statement, April 2008 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2013]; and E-on (2009) Onshore Substation and Cable Spur Environmental Statement, November 2009 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2013.

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	these activities, the risk of collision with turbine structures, and visual effects associated with the presence of the turbines. Upon decommissioning, these effects will likely be reversible. Potential issues with navigation, although it is noted that this may be managed through the selection of appropriate sites and consultation with the maritime and Coastguard Agency (MCA) to ensure that there are no hazards to shipping.	these activities, the risk of collision with turbine structures, and visual effects associated with the presence of the turbines. Upon decommissioning, these effects will likely be reversible. Potential issues with navigation, although it is noted that this may be managed through the selection of appropriate sites and consultation with the maritime and Coastguard Agency (MCA) to ensure that there are no hazards to shipping. Potential for commercial effects on the fishing and shipping industries (i.e. loss of access to fishing areas, reduced catches in such areas from displacement of fish populations, collision risk). Requirement for the installation of new transmission infrastructure to connect the devices to the grid (i.e. cables on the seabed, terrestrial infrastructure) could, in some circumstances, affect recreational and commercial activities. Potential effects are likely to be site and development specific. Potential for upgrading of nearby port/harbour infrastructure to install and/or maintain turbines.	these activities, the risk of collision with turbine structures, and visual effects associated with the presence of the turbines. Upon decommissioning, these effects will likely be reversible. Potential issues with navigation, although it is noted that this may be managed through the selection of appropriate sites and consultation with the maritime and Coastguard Agency (MCA) to ensure that there are no hazards to shipping. Potential for commercial effects on the fishing and shipping industries (i.e. loss of access to fishing areas, reduced catches in such areas from displacement of fish populations, collision risk). Requirement for the installation of new transmission infrastructure to connect the devices to the grid (i.e. cables on the seabed, terrestrial infrastructure) could, in some circumstances, affect recreational and commercial activities. Potential effects are likely to be site and development specific. Potential for upgrading of nearby port/harbour infrastructure to install and/or maintain turbines.	these activities, the risk of collision with turbine structures, and visual effects associated with the presence of the turbines. Upon decommissioning, these effects will likely be reversible. Potential issues with navigation, although it is noted that this may be managed through the selection of appropriate sites and consultation with the maritime and Coastguard Agency (MCA) to ensure that there are no hazards to shipping. Potential for commercial effects on the fishing and shipping industries (i.e. loss of access to fishing areas, reduced catches in such areas from displacement of fish populations, collision risk). Requirement for the installation of new transmission infrastructure to connect the devices to the grid (i.e. cables on the seabed, terrestrial infrastructure) could, in some circumstances, affect recreational and commercial activities. Potential effects are likely to be site and development specific. Potential for upgrading of nearby port/harbour infrastructure to install and/or maintain turbines.	these activities, the risk of collision with turbine structures, and visual effects associated with the presence of the turbines. Upon decommissioning or movement of the array (if undertaken) these effects will likely be reversible. Potential issues with navigation, although it is noted that this may be managed through the selection of appropriate sites and consultation with the maritime and Coastguard Agency (MCA) to ensure that there are no hazards to shipping. Potential for commercial effects on the fishing and shipping industries (i.e. loss of access to fishing areas, reduced catches in such areas from displacement of fish populations, collision risk). Requirement for the installation of new transmission infrastructure to connect the devices to the grid (i.e. cables on the seabed, terrestrial infrastructure) could, in some circumstances, affect recreational and commercial activities. Potential effects are likely to be site and development specific. Potential for upgrading of nearby port/harbour infrastructure to install and/or maintain turbines.
Soil (Marine geology and coastal processes)[321]	Summary of key potential effects on geology: ▪ Disturbance or damage to coastal Geological SSSIs and Geological Conservation Review sites (GCRs) during installation works. ▪ Changes in coastal processes due to presence of devices in water column.				

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[321] Informed by: OSPAR Commission (2004) Biodiversity Series: Environmental Impacts to marine species and habitats of dredging for navigational purposes [online] Available at: http://www.ospar.org/documents/dbase/publications/p00208_environmental%20impacts%20to%20marine%20species.pdf [accessed 28/03/2013]; Halcrow (2007) The Plan for Offshore Wind Energy in Scottish Territorial Waters, Environmental Report: Volume 1, Prepared for the Scottish

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	▪ Seabed contamination and water quality (including disposal areas) during installation works. Key measures to prevent adverse effects may include: siting devices away from sensitive and designated areas; using best practice methodologies and technologies to minimise potential effects during installation; adoption of appropriate management planning in installation works.				
	Direct adverse effects to the seabed are likely from preparation of the seabed (i.e. limited dredging) and in the placement of the gravity-base foundation and associated scour protection on the seabed. Potential alteration of sediment dynamics and tidal flows/fluxes from the presence of gravity-based foundation structures on the seabed and presence of turbine masts and support structures in the water column. Scouring, deposition and abrasion (particularly in the placement of mooring lines, if used) may also occur due to the foundation structures present at the seabed. However, it is assumed that scour protection would be used for such foundation structures and this may alleviate such risks. Effects from construction and decommissioning works are likely to be temporary and are often reversible. However, effects from seabed preparation works are likely to be permanent. Sourcing of fill or dredged material for gravity foundations, and potential effects of taking fill from other areas. If terrestrial fill or dredged material is used, potential effects at the source may include: loss of substrata or habitat if taken from suitable undisturbed areas; Potential for	Potential for direct adverse effects to the seabed during piling operations. Potential alteration of sediment dynamics and tidal flows/fluxes from the presence of piles and turbine structures into the seabed and presence of the turbine masts and support structures in the water column. Effects such as scouring, deposition, abrasion (during installation of piles only) and vibration may also occur due to the installation and operation of the wind turbines. Effects from construction and decommissioning works are likely to be temporary and are often reversible.	Potential for direct adverse effects to the seabed during piling operations. Potential alteration of sediment dynamics and tidal flows/fluxes from the presence of piles and turbine structures into the seabed and presence of turbine masts and support structures in the water column. Effects such as scouring, deposition, abrasion (during installation of piles only) and vibration may also occur due to the installation and operation of the wind turbines. Effects from construction and decommissioning works are likely to be temporary and are often reversible.	Likely direct adverse effects to the seabed from the preparation of seabed areas (i.e. dredging) and placement of caisson support structures directly on the seabed (e.g. turbidity, sediment disturbance, loss of geology, potential for release of contaminated materials bonded to sediments). Potential alteration of sediment dynamics and tidal flows/fluxes from the presence of gravity-based foundation structures on the seabed and presence of the turbine masts and support structures in the water column. Effects such as scouring, deposition and abrasion (particularly in the placement of mooring lines, if used) may also occur due to the foundation structures present at the seabed. However, it is assumed that scour protection would be used for such foundation structures. Effects from construction and decommissioning works are likely to be temporary and are often reversible. However, effects from seabed preparation works are likely to be permanent.	Potential for direct adverse effects to the seabed from the placement of gravity concrete anchors and moorings directly on the seabed. Potential alteration of sediment dynamics and tidal flows/fluxes from the presence of anchor structures gravity-based foundation structures on the seabed and presence of moor lines in the water column. Effects such as scouring, deposition and abrasion (particularly in the placement of mooring lines, if used) may also occur due to the foundation structures present at the seabed. However, it is assumed that scour protection would be used for such foundation structures. Effects from construction and decommissioning works are likely to be temporary and are often reversible.

Executive [online] Available at: http://www.scotland.gov.uk/Resource/Doc/312161/0098588.pdf [accessed 27/03/2013]; Talisman Energy (UK) LTD (2005) Environmental Statement [online] Available at: http://www.beatricewind.co.uk/downloads/statement.asp [accessed 25/03/2013]; EMU (2012) Neart na Gaoithe Offshore Wind Farm Environmental Statement, Prepared for Mainstream Renewable Power [online] Available at: https://nngoffshorewind.com/downloads/offshore-environmental-statement/ [accessed 17/01/2020]; Aberdeen Wind Offshore Wind Farm Limited (2011) European Offshore Wind Deployment Centre: Non-Technical Summary, July 2011 [online] Available at: http://marine.gov.scot/sites/default/files/non_technical_summary_1.pdf [accessed 17/01/2020]; E-on (2008) Offshore Environmental Statement, April 2008 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 17/01/2020]; E-on (2008) Onshore Cable Route Environmental Statement, April 2008 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2013]; and E-on (2009) Onshore Substation and Cable Spur Environmental Statement, November 2009 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2013.

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	release of contaminated materials bonded to dredged sediments; potential for cross-contamination from source areas to windfarm site, particularly if sourced from shipping lanes or harbours; potential effects on hydrodynamics and water flows at the source location from the removal of sediments; reduced water quality and increased turbidity from sediment disturbance during dredging operations; and potential effects for marine fauna and flora, including the disturbance and physical injury risk from dredging operations. If material is sourced from the terrestrial environment it will have effects associated with the removal of material and its transportation.				
Water quality[322]	Summary of key potential effects on water quality include: ▪ Disturbance of sediments during device installation and effects to marine fauna, particularly benthic species (e.g. filter feeders) ▪ Disturbance of contaminated sediments during device installation, e.g. disposal sites (silt, sand, rock and gravel sites, fish wastes and sludge, munitions dumps, and weapons ranges) Key measures to prevent adverse effects may include: siting devices away from sensitive areas, disposal sites, munitions dumps and weapons ranges; using best practice methodologies and technologies to minimise potential effects during installation; adoption of appropriate management planning in installation works.				
	Potential effects to water quality from installation of turbine foundations and structures (i.e. turbidity, seabed disturbance from placement of gravity-based supports, contamination from installation equipment and maintenance vessels) and the potential for associated effects on marine biodiversity, particularly those species dependent on existing water conditions.	Potential effects to water quality from installation of turbine monopiles (i.e. turbidity, seabed disturbance from piling works, contamination from installation equipment and maintenance vessels) and the potential for associated effects on marine biodiversity, particularly those species dependent on existing water conditions. Potential effects to the ability of fish	Potential effects to water quality from installation of turbines and associated structures (i.e. turbidity, seabed disturbance from piling works and placement of support structures on the seabed, contamination from installation equipment and maintenance vessels) and the potential for associated effects on marine biodiversity, particularly those species dependent on existing	Potential effects to water quality from installation of turbine, caisson and seabed preparation activities (i.e. turbidity, seabed disturbance from preparation/levelling of seabed, potential placement of concrete foundations, placement of caisson and support structures, contamination from installation equipment and maintenance vessels) and the potential for	Potential effects to water quality from installation of mooring anchors (i.e. turbidity, seabed disturbance from placement of gravity anchors, potential for contamination from installation equipment and maintenance vessels) and the potential for associated effects on marine biodiversity, particularly those species dependent on existing water conditions. Potential

[322] Informed by: Halcrow (2007) The Plan for Offshore Wind Energy in Scottish Territorial Waters, Environmental Report: Volume 1, Prepared for the Scottish Executive [online] Available at: http://www.scotland.gov.uk/Resource/Doc/312161/0098588.pdf [accessed 27/03/2013]; Talisman Energy (UK) LTD (2005) Environmental Statement [online] Available at: http://www.beatricewind.co.uk/downloads/statement.asp [accessed 25/03/2013]; EMU (2012) Neart na Gaoithe Offshore Wind Farm Environmental Statement, Prepared for Mainstream Renewable Power [online] Available at: https://nngoffshorewind.com/downloads/offshore-environmental-statement/ [accessed 17/01/2020]; Aberdeen Wind Offshore Wind Farm Limited (2011) European Offshore Wind Deployment Centre: Non-Technical Summary, July 2011 [online] Available at: http://marine.gov.scot/sites/default/files/non_technical_summary_1.pdf [accessed 17/01/2020]; E-on (2008) Offshore Environmental Statement, April 2008 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2013]; E-on (2008) Onshore Cable Route Environmental Statement, April 2008 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2013]; and E-on (2009) Onshore Substation and Cable Spur Environmental Statement, November 2009 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2013].

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	Potential effects to the ability of fish species to spawn, respire and feed, and on shellfish growing waters in the vicinity of windfarm sites are also noted. However, the significance of these effects is currently uncertain. Construction and decommissioning effects are temporary and may be reversible. Potential for cross-contamination in the use of excavated fill material or dredging material as ballast in gravity-based foundations.	species to spawn, respire and feed, and on shellfish growing waters in the vicinity of windfarm sites are also noted, However, the significance of these effects is currently uncertain. Construction and decommissioning effects are temporary and may be reversible.	water conditions. Potential effects to the ability of fish species to spawn, respire and feed, and on shellfish growing waters in the vicinity of windfarm sites are also noted, However, the significance of these effects is currently uncertain. Construction and decommissioning effects are temporary and may be reversible.	associated effects on marine biodiversity, particularly those species dependent on existing water conditions. Potential effects to the ability of fish species to spawn, respire and feed, and on shellfish growing waters in the vicinity of windfarm sites are also noted. However, the significance of these effects is currently uncertain. Construction and decommissioning effects are temporary and may be reversible.	effects to the ability of fish species to spawn, respire and feed, and on shellfish growing waters in the vicinity of windfarm sites are also noted. However, the significance of these effects is currently uncertain. Construction and decommissioning effects are temporary and may be reversible.
Climatic factors[323]	Benefits through contribution to decarbonisation of electricity generation through the long-term operation of the wind farms (i.e. displacement of non-renewable power generation).	Benefits through contribution to decarbonisation of electricity generation through the long-term operation of the wind farms (i.e. displacement of non-renewable power generation).	Benefits through contribution to decarbonisation of electricity generation through the long-term operation of the wind farms (i.e. displacement of non-renewable power generation).	Benefits through contribution to decarbonisation of electricity generation through the long-term operation of the wind farms (i.e. displacement of non-renewable power generation).	Benefits through contribution to decarbonisation of electricity generation through the long-term operation of the wind farms (i.e. displacement of non-renewable power generation).
Cultural Heritage[324]	Summary of key potential effects on marine and coastal historic environment include: ▪ Direct disturbance, damage, or destruction of submarine archaeological remains and wrecks during device installation and cable trenching. ▪ Direct disturbance, damage or destruction of coastal archaeological remains during cable trenching (effects of grid connections are considered separately below). ▪ Disturbance, damage or loss of archaeological remains and sites during installation of cables and overhead lines and substation construction from onshore grid connections. Key measures to prevent adverse effects may include: avoid sites of interest and exclusion zones for protected sites; follow Crown Estates 2007 JNAPC Code of Practice for seabed developers; carry out seabed surveys and walkover surveys prior to installation; carry out detailed routing studies at project level in accordance with 'Holford Rules' best practice guidance on routeing overhead transmission lines.				
	Potential for placement of gravity-based foundations and scour protection on known and designated historic sites and their exclusion zones, World Heritage Sites, coastal listed buildings	Potential for piling operations on or close to known and designated historic sites and their exclusion zones, World Heritage Sites, coastal listed buildings such as lighthouses, scheduled	Potential for piling operations on or close to known and designated historic sites and their exclusion zones, World Heritage Sites, coastal listed buildings such as lighthouses, scheduled	Potential for placement of foundations and caisson structures directly on the seabed in the vicinity of known and designated historic sites and their exclusion zones, World Heritage	Potential for placement of concrete gravity anchors directly on the seabed, and installation of mooring lines in the vicinity of known and designated historic sites and their exclusion zones,

[323] Informed by: Halcrow (2007) The Plan for Offshore Wind Energy in Scottish Territorial Waters, Environmental Report: Volume 1, Prepared for the Scottish Executive [online] Available at: http://www.scotland.gov.uk/Resource/Doc/312161/0098588.pdf [accessed 27/03/2013]

[324] Informed by: Fjordr Marine and Historic Environment Consulting (2013) Historic Environment Guidance for Wave and Tidal Energy (*Draft*) [online] Available at: www.fjordr.com/uploads/3/0/0/2/3002891/historic_environment_guidance_for_wave_and_tidal_energy_-_consultation_draft_150213.pdf [accessed 03/04/2013]; Halcrow (2007) The Plan for Offshore Wind Energy in Scottish Territorial Waters, Environmental Report: Volume 1, Prepared for the Scottish Executive [online] Available at: https://www2.gov.scot/Resource/Doc/312161/0098588.pdf [accessed 27/03/2013]; Talisman Energy (UK) LTD (2005) Environmental Statement [online] Available at: http://www.beatricewind.co.uk/downloads/statement.asp [accessed 25/03/2013]; EMU (2012) Neart na Gaoithe Offshore Wind Farm Environmental Statement, Prepared for Mainstream Renewable Power [online] Available at: https://nngoffshorewind.com/downloads/offshore-environmental-statement/ [accessed 17/01/2020]; Aberdeen Wind Offshore Wind Farm Limited (2011) European Offshore Wind Deployment Centre: Non-Technical Summary, July 2011 [online] Available at: http://marine.gov.scot/sites/default/files/non_technical_summary_1.pdf [accessed 17/01/2020]; E-on (2008) Offshore Environmental Statement, April 2008 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2013]; E-on (2008) Onshore Cable Route Environmental Statement, April 2008 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2013]; and E-on (2009) Onshore Substation and Cable Spur Environmental Statement, November 2009 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/201]3.

SEA Topic Areas	Wind Technologies with Gravity-Base Foundation Devices	Wind Technologies with Monopile or Multi-Pile Foundation Devices	Wind Technologies with Tripod of Steel Jacket Foundation Devices	Wind Technologies with Mono or Multi-Caisson Foundation Devices	Floating Wind Turbines
	such as lighthouses, scheduled monuments and other unknown, submerged or non-designated archaeological assets features or paleo-landscapes to create adverse effects. The potential scouring, siltation and deposition around these important sites located in the vicinity of such devices or arrays may also occur. However, adverse effects are likely to be avoided through careful siting of individual device foundations and arrays, although this may be more difficult for larger gravity bases or arrays of bases.	monuments and other unknown, submerged or non-designated archaeological assets features or paleo-landscapes to create adverse effects. Adverse effects are likely to be avoided through careful siting of device monopiles and arrays.	monuments and other unknown, submerged or non-designated archaeological assets features or paleo-landscapes to create adverse effects. Adverse effects are likely to be avoided through careful siting of device piles and arrays.	Sites, coastal listed buildings such as lighthouses, scheduled monuments and other unknown, submerged or non-designated archaeological assets features or paleo-landscapes to create adverse effects. The potential scouring, siltation and deposition around these important sites located in the vicinity of such devices or arrays may also occur. However, adverse effects are likely to be avoided through careful siting of individual device foundations and arrays, although this may be more difficult for larger gravity bases or arrays of bases.	World Heritage Sites, coastal listed buildings such as lighthouses, scheduled monuments and other unknown, submerged or non-designated archaeological assets features or paleo-landscapes to create adverse effects. The potential scouring, siltation and deposition around these important sites located in the vicinity of such anchors may also occur. However, adverse effects are likely to be avoided through careful siting of these anchors and installation of mooring cables.
Landscape/ seascape / visual amenity[325]	Summary of key potential effects on land/seascape include: ▪ Devices likely to be visible at distances of 26 mi (42 km) in daytime and 24 mi (39 km) in night-time views. ▪ Devices may be a focus of visual attention at distances of up to 10 mi (16 km). ▪ Landscape and visual intrusion from offshore turbine devices, and onshore substations, overhead lines and grid connections. Key measures to prevent adverse effects may include: maximising the distance of devices from shore; reducing the height of devices above the water surface; reducing the area of sea occupied by the devices; and modifying the position and layout of devices to suit characteristics of the local seascape; carry out detailed routing studies at project level in accordance with ‘Holford Rules’ best practice guidance on routeing overhead transmission lines; provide screening for substations.				
	Potential for turbines and supporting infrastructure (i.e. additional platforms, construction, maintenance or decommissioning vessels and equipment) to adversely affect sensitive receptors (i.e. designated or valued landscapes/seascapes). In general, greater effects are likely for near-shore devices than those located further offshore.	Potential for turbines and supporting infrastructure (i.e. additional platforms, construction, maintenance or decommissioning vessels and equipment) to adversely affect sensitive receptors (i.e. designated or valued landscapes/seascapes). In general, greater effects are likely for near-shore devices than those located further offshore.	Potential for turbines and supporting infrastructure (i.e. additional platforms, construction, maintenance or decommissioning vessels and equipment) to adversely affect sensitive receptors (i.e. designated or valued landscapes/seascapes). In general, greater effects are likely for near-shore devices than those located further offshore.	Potential for turbines and supporting infrastructure (i.e. additional platforms, construction, maintenance or decommissioning vessels and equipment) to adversely affect sensitive receptors (i.e. designated or valued landscapes/seascapes). In general, greater effects are likely for near-shore devices than those located further offshore.	Potential for turbines and supporting infrastructure (i.e. additional platforms, construction, maintenance or decommissioning vessels and equipment) to adversely affect sensitive receptors (i.e. designated or valued landscapes/seascapes). In general, greater effects are likely for near-shore devices than those located further offshore.

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[325] Informed by: OSPAR Commission (2004) Biodiversity Series: Environmental Impacts to marine species and habitats of dredging for navigational purposes [online] Available at: http://www.ospar.org/documents/dbase/publications/p00208_environmental%20impacts%20to%20marine%20species.pdf [accessed 28/03/2013]; Halcrow (2007) The Plan for Offshore Wind Energy in Scottish Territorial Waters, Environmental Report: Volume 1, Prepared for the Scottish Executive [online] Available at: http://www.scotland.gov.uk/Resource/Doc/312161/0098588.pdf [accessed 27/03/2013]; Talisman Energy (UK) LTD (2005) Environmental Statement [online] Available at: http://www.beatricewind.co.uk/downloads/statement.asp [accessed 25/03/2013]; EMU (2012) Neart na Gaoithe Offshore Wind Farm Environmental Statement, Prepared for Mainstream Renewable Power [online] Available at: https://nngoffshorewind.com/downloads/offshore-environmental-statement/ [accessed 17/01/2020]; Aberdeen Wind Offshore Wind Farm Limited (2011) European Offshore Wind Deployment Centre: Non-Technical Summary, July 2011 [online] Available at: http://marine.gov.scot/sites/default/files/non_technical_summary_1.pdf [accessed 17/01/2020]; E-on (2008) Offshore Environmental Statement, April 2008 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2013]; E-on (2008) Onshore Cable Route Environmental Statement, April 2008 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2013]; and E-on (2009) Onshore Substation and Cable Spur Environmental Statement, November 2009 [online] Available at: http://www.eon-uk.com/generation/1309.aspx [accessed 26/03/2013].

SEA Topic Areas	Wind Technologies with Gravity-Base Foundation Devices	Wind Technologies with Monopile or Multi-Pile Foundation Devices	Wind Technologies with Tripod of Steel Jacket Foundation Devices	Wind Technologies with Mono or Multi-Caisson Foundation Devices	Floating Wind Turbines
	Field observations of offshore wind facilities in the United Kingdom revealed that the facilities may be visible at distances of 26 mi (42 km) in daytime and 24 mi (39 km) in night-time views. They may be a focus of visual attention at distances of up to 10 mi (16 km). Potential onshore effects from supporting grid infrastructure and interconnectors with terrestrial grid, although these will likely depend on siting and surroundings (i.e. proximity to valued or sensitive landscapes/seascapes). The potential for landscape effects at the source of excavated terrestrial fill material, or from dredging areas for use as ballast in gravity-based foundations has also been identified.	Field observations of offshore wind facilities in the United Kingdom revealed that the facilities may be visible at distances of 26 mi (42 km) in daytime and 24 mi (39 km) in night-time views. They may be a focus of visual attention at distances of up to 10 mi (16 km). Potential onshore effects from supporting grid infrastructure and interconnectors with terrestrial grid, although these will likely depend on siting and surroundings (i.e. proximity to valued or sensitive landscapes/seascapes).	Field observations of offshore wind facilities in the United Kingdom revealed that the facilities may be visible at distances of 26 mi (42 km) in daytime and 24 mi (39 km) in night-time views. They may be a focus of visual attention at distances of up to 10 mi (16 km). Potential onshore effects from supporting grid infrastructure and interconnectors with terrestrial grid, although these will likely depend on siting and surroundings (i.e. proximity to valued or sensitive landscapes/seascapes).	Field observations of offshore wind facilities in the United Kingdom revealed that the facilities may be visible at distances of 26 mi (42 km) in daytime and 24 mi (39 km) in night-time views. They may be a focus of visual attention at distances of up to 10 mi (16 km). Potential onshore effects from supporting grid infrastructure and interconnectors with terrestrial grid, although these will likely depend on siting and surroundings (i.e. proximity to valued or sensitive landscapes/seascapes).	Field observations of offshore wind facilities in the United Kingdom revealed that the facilities may be visible at distances of 26 mi (42 km) in daytime and 24 mi (39 km) in night-time views. They may be a focus of visual attention at distances of up to 10 mi (16 km). Potential onshore effects from supporting grid infrastructure and interconnectors with terrestrial grid, although these will likely depend on siting and surroundings (i.e. proximity to valued or sensitive landscapes/seascapes).

B.2 Transmission Infrastructure

SEA Topic Areas	Transmission Infrastructure Components - Offshore	Subsea Transmission Cables	Landfall and Transition Pit
Device Information	Includes offshore AC substations and AC/DC substations. Common designs are based upon experience in offshore oil and gas industry. Common designs consist of a 'topside' component housing the main equipment, and a foundation structure (e.g. steel jacket, monopile, gravity based structure)	Cables to transfer the power from the AC substation or the offshore AC/DC convertor station to the shore. Installed from a ship or barge, using installation tools to plough, jet or excavate a trench for placement, followed by backfilling of the trench.	Designed to bring the subsea cables to shore, and connect to buried onshore cables or overhead power lines. Can be undertaken from a number of methods (e.g. Horizontal Directional Drilling (HDD), trenching) or a combination of them, using drilling rigs or trenching equipment.
Biodiversity/ flora/ fauna	*Marine Mammals and fish* Noise from survey, unexploded ordnance clearance, construction from piling (e.g. behavioural response, lethal effects, displacement from natural habitat and possible feeding areas, physical injury to hearing organs). Potential habitat loss or disturbance, especially to bottom dwelling species such as sand eels, which are important prey species for birds, marine mammals and fish. Potential collision risk with submerged structures and associated cabling (if any). Potential for increased suspended solids during construction and sediment deposition affecting respiration in bottom dwelling and spawning species (e.g. sand eel). Potential for EMF effects during operation as part of cable distribution. Potential creation of artificial rocky habitats due to the presence of submerged infrastructure. *Seabirds* Potential displacement due to disturbance during construction from offshore feeding sites to other areas (e.g. Herring Gull, Great Cormorant, etc.). Potential loss of feeding grounds for on-passage (migrating) species due to presence of structures (e.g. dunlin, knot, etc.) and associated with loss of prey species (e.g. sand eel for migratory species such as Arctic Tern). *Marine and Coastal Habitats* Potential loss or disturbance to especially sensitive/ designated habitats from construction (e.g. reefs and associated species which may take time to recover). Potential for increased suspended solids and sediment deposition associated with construction site, and	*Marine Mammals and fish* Potential habitat loss or disruption to seabed communities during installation. Potential temporary displacement to other areas and potential collision risk during installation. Potential EMF from the cable distribution, and potential for changes in behaviour and migratory patterns of some fish and mammal species. *Seabirds* Potential loss of prey species in offshore feeding grounds from installation activities. *Marine and Coastal Habitats* Installation can lead to potential increases to suspended solids and deposition, leading to smothering of seabed communities. Potential habitat loss or disruption to benthic communities during installation. Potential habitat disturbance due to maintenance and repair activity.	*Marine Mammals and fish* Potential habitat loss or disruption to inshore seabed communities from installation. Potential temporary displacement to other areas during installation. Potential EMF from the cable distribution, and potential changes in behaviour and migratory patterns of some fish and mammal species. *Seabirds* Possible effects from proximity of landfall sites to protected areas for breeding or wintering birds (e.g. oystercatcher.) Potential for loss of prey species in feeding grounds. *Marine and Coastal Habitats* Potential habitat loss or disruption to inshore seabed communities from installation activities. Potential disruption to intertidal habitats and benthic species. Potential increase in suspended solids and smothering (deposition) during installation works. Potential disturbance to seabed and intertidal areas due to maintenance and repair activity.

SEA Topic Areas	Transmission Infrastructure Components - Offshore	Subsea Transmission Cables	Landfall and Transition Pit
	associated effects for epibenthic species, especially filter feeders.		
Population and human health	Construction vessels and helicopter flights may cross other user's transit routes (e.g. dredging, oil and gas operations and freight). Potential for increased collision risk, effects on navigation and displacement of other marine users (e.g. shipping, recreation, etc.) during construction and maintenance activities. Potential for displacement of some marine users during construction (e.g. safety exclusion areas during construction) and operation (e.g. fishing activities with potential gear interactions with permanent seabed structures).	Potential for collision with cable excavation vessels in transit during installation. Potential for displacement of other marine users during construction and maintenance activities (e.g. shipping, recreation, etc.) and operation al periods (e.g. fishing activities with potential gear interactions with submerged structures, etc.). Potential interference with communications due to EMF.	Potential for collision with cable excavation vessels in transit during construction. Potential for displacement of other marine users during construction and maintenance activities (e.g. shipping, recreation, etc.) and operation al periods (e.g. fishing activities with potential gear interactions with submerged structures, etc.).
Marine geology and coastal processes / Onshore soils	Scour from seabed foundations (e.g. piles) and sediment deposition during construction and operation phases have the potential to alter physical processes and sediment structure.	Sediment disturbance during construction has the potential to alter physical processes and sediment structure.	Sediment disturbance during construction has the potential to alter physical processes and sediment structure at landfall.
Water quality	Potential re-suspension of sediments and associated hazardous substances during construction. Potential for accidental spillage from construction vessels and structures during operation.	Potential re-suspension of sediments and hazardous substances due to excavation during installation and during major repair activity. Potential for accidental spillage from construction and cable repair vessels during operation.	Potential re-suspension of sediments and release of hazardous substances due to excavation. Potential for accidental spillage from construction equipment.
Climatic factors	Construction vessel emissions have the potential to affect air quality and contribute to greenhouse emissions.	Construction vessel emissions have the potential to affect air quality and contribute to greenhouse emissions.	Construction vessel and vehicle emissions have the potential to affect air quality, and subsequently human health, and contribute to greenhouse emissions.
Cultural heritage	Potential loss of or damage to known and unknown buried heritage in construction activities. Potential damage to known and unknown buried heritage from maintenance/repair activities (e.g. vessels anchoring).	Potential loss of or damage to known or unknown buried heritage due to corridor excavation by ploughing or trenching during installation. Potential damage to known and unknown buried heritage from maintenance/repair activities (e.g. vessels anchoring).	Potential loss of or damage to known or unknown buried heritage due to corridor excavation by ploughing or trenching during installation. Potential damage to known and unknown buried heritage from maintenance/repair activities (e.g. vessels anchoring).
Landscape/ seascape / visual amenity	Potential for the seascape to change. Potential issues of lighting during construction and operation.	Potential issues of temporary lighting during construction.	Potential effects on landscape/seascape during construction.

Appendix C Assessment of Environmental Effects at Individual DPO

C.1 South West

SW1

SW1				**Total DPO Area: 292 km²** **Realistic Maximum Development Scenario (% of Total Capacity): 1 GW (68%)**
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
Biodiversity, Flora and Fauna (Marine Mammals)	<u>Benthic Habitats and Species</u> The benthic habitats in SW1 are mostly coarse sediment, with some small patches of sand and rock to the north and west of the DPO respectively. There is no sensitive (priority marine feature) habitat identified within SW1, however there are known maerl beds within the Luce Bay SAC which borders the DPO immediately to the North. There are further sensitive habitats inshore of the DPO, including those associated with the Luce Bay and Sands SAC (including subtidal sandbanks, shifting dunes, intertidal mudflats and sandflats, dune grassland and coastal dune heathland). <u>Marine Mammals</u> There are known, albeit comparatively small when considered in the context of Scottish waters, populations of harbour porpoise and harbour seal in the Solway Firth, which will likely use SW1 and the North Channel SAC designated for harbour porpoise in Northern Ireland is immediately to the south of the DPO. There is also an area of increased Grey seal at sea usage within Luce Bay, which overlaps into SW1. There are no areas protected for otter in the South West region, however there is potential for their presence in coastal and riverine environments within the region. <u>Birds</u>	Loss of and/or damage to marine and coastal habitats, including benthic and intertidal habitats (for example, due to smothering of benthic habitats and substratum loss).	There is potential for permanent loss of habitat within the footprint of offshore wind turbines and associated scour protection and temporary damage to habitats from intra array cables. There is no identified habitat of particular sensitivity within SW1 which would be affected by this pathway, however the coarse and sandy sediments may be of importance for fish spawning. In addition, changes to sediment transport in the region has the potential to affect sensitive habitat outwith the DPO, particularly the habitat designated within the Luce Bay SAC. There is also potential for effects on coastal habitats inshore of SW1 associated with export cables and cable landfalls. This includes potential effects on the habitats designated for the Luce Bay and Sands.	The footprint associated with offshore wind will be dependent on the technology used and the level of scour protection required. There are no particularly sensitive habitats which will be affected in SW1. Effects on coastal habitats associated with export cable routes and cable landfall will be considered at a project level and can be mitigated through careful siting. The residual effect on benthic habitat is therefore considered to be **minor to moderate negative** in SW1.
		Effects on key mobile receptors and prey species, including disturbance, noise effects, EMF exposure, collision risk, habitat exclusion, and barriers to wildlife movement.	There is potential for disturbance of marine mammal, bird and fish species particularly due to noise emissions during construction from piling activities, survey and / or clearance of unexploded ordnance. These have the potential to cause physiological damage to fish and marine mammal species, and to cause displacement of fish, marine mammals and birds from the area of effect. Potential for effects to mammals and fish are lower during the operational and decommissioning phases of the offshore wind farm life cycle. There is, however, potential for effects on fish species, from EMF exposure associated with export cables. The consequences of such effects	Effects on fish (particularly species using the DPO for spawning) can be mitigated through temporal restrictions on piling activities. Physiological risks to fish and marine mammals from piling noise can be mitigated through the application measures relating to piling activities or soft start procedures, although fish responses to these measures are not well known and noise modelling should account for this uncertainty. In addition, noise abatement measures at source can be implemented to reduce noise transmission into the wider environment, and therefore reduce displacement effects.

SW1				Total DPO Area: 292 km² Realistic Maximum Development Scenario (% of Total Capacity): 1 GW (68%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
	There are a number of important bird populations within the Solway Firth, including SPA and pSPA designated for waterfowl assemblages and records of a range of bird species, including great northern diver in Luce Bay, manx shearwater to the west of the Rhins of Galloway and fulmar from Irish Sea colonies. There are significant numbers of bird sightings to the west of the Rhins of Galloway, which are likely to include migration routes around the coast. RSPB utilisation distribution data indicates that there are likely to be populations of shag, Guillemot, Black-legged Kittiwake and Razorbill foraging in the northern extents of the DPO. In addition, there are a number of migration routes of both seabird, waterbird and terrestrial bird species on the west coast of Scotland. Specific concerns have been raised regarding the migration flyways of Whooper Swan[326] which is known to cross the Solway Firth and Corncrake which migrates up the west coast to population centres on the Outer Hebrides. <u>Fish</u> Within SW1 there are known spawning and nursery grounds for several species. This includes spawning grounds for herring, cod, whiting, plaice and sole. There are a number of migratory fish which are known to use the Solway and are protected through the SAC network in the Solway Firth. These include shad species and sea lamprey.		are not well understood, however are thought to be low. The introduction of offshore wind arrays may also cause a barrier effect, by which it prevents the movement of species through the area, potentially effecting migration pathways for marine mammals, fish species and birds. In the case of SW1, particularly if the northern boundary of the DPO were to be developed in its entirety, there is potential for barrier effects on species moving in and out of Luce Bay. There is generally a low collision risk associated with bird species around the Solway Firth, with the exception of Whooper Swan, which has been identified as a concern previously and for which the Solway Firth is considered a key passage area[327]. In the northern areas of the DPO potential for displacement of seabird species exists, although the density of seabird species in the DPO is generally considered to be low.	Further research is required to determine the effect of collision risk on bird species, however current evidence suggests that the effect through this pathway may be low for the majority of species. To determine the potential risk to Whooper Swan in SW1 studies should be undertaken at a project level, both before and after construction. There is potential for displacement of bird species and marine species outwith the DPO. However, SW1 is not identified as a key foraging ground for species of international or national importance and spatial planning can be used to reduce the potential for barrier effects. The residual effect on key receptors during construction and operation in SW1 is considered to be **minor negative to moderate negative**.
		Effects arising from habitat modification, such as the creation of artificial reefs, new roosting structures and exclusion of habitat damaging activity.	The introduction of the wind farm turbines and scour protection have the potential to provide alternative habitat within SW1, which could provide shelter for juvenile fish and crustacean shellfish. This effect has the potential to be both beneficial and adverse for different receptors. There is also the potential for activities currently damaging to the seabed habitat to be excluded from the offshore wind development area, dependent on the technology implemented, which may lead to reduced damage to existing habitats. However, if this activity is displaced to a different area, this may be negligible or potentially a negative effect.	The potential effect associated with the development of offshore wind in SW1 is considered to be **negligible** but is dependent on the technology deployed.

[326] Griffin *et al*. 2010. Whooper Swan *Cygnus cygnus* migration in relation to offshore wind farms. BOU Proceedings – Climate Change and Birds. Available at https://tethys.pnnl.gov/sites/default/files/publications/Griffin_et_al_Wooper_Swan_Migration.pdf

[327] Griffin *et al*. 2010. Whooper Swan *Cygnus cygnus* migration in relation to offshore wind farms. BOU Proceedings – Climate Change and Birds. Available at https://tethys.pnnl.gov/sites/default/files/publications/Griffin_et_al_Wooper_Swan_Migration.pdf

SW1				Total DPO Area: 292 km² Realistic Maximum Development Scenario (% of Total Capacity): 1 GW (68%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
		Effects of pollution releases on species and habitats.	Pollution events associated with support vessels during construction and operational phases have the potential to affect species within SW1.	As part of marine licencing there is a requirement to produce pollution management plans to mitigate the effects of any pollution releases. In addition, significant releases are only likely to be associated with emergency events, considered unlikely. The assessment and management of pollution risks will be undertaken at a project level. The residual risk associated with pollution releases associated with offshore wind farms is considered to be **negligible**.
		Effects from introduction and spread of Invasive Non-Native Species (INNS).	Offshore wind turbine foundations and scour protection provides a new colonising surface for INNS, and support vessels during construction and operational phases have the potential to introduce INNS, which may subsequently affect indigenous species within SW1.	There a requirement for biosecurity management plans to be produced to minimise the risk of introduction of INNS. Controls will be imposed through the marine licencing process if required at a project level. The residual risk associated with INNS associated with offshore wind farms is considered to be **minor negative**.
Population and Human Health	Due to the offshore nature of the SW1 DPO there are no significant populations directly adjacent to the DPO. The coastline landwards of SW1 is generally sparsely populated, with a few small settlements. Areas within the DPO are, however, used for the purposes of commercial shipping, fishing, recreational boating and recreational angling. This includes the DPO being intersected by key shipping routes (both east to west and north to south) and several RYA informal cruising routes.	Effects arising from noise, vibration, light, dust and shadow flicker effects from all phases of development.	SW1 is located offshore, and as such construction, operation and decommissioning of arrays within the DPO will not give rise to significant effects on populations or human health directly through noise, vibration, light, dust or shadow flicker effects. There is potential for construction activity associated with export cables and cable landfalls to affect populations, however effects are likely to be highly localised and temporary.	There is considerable uncertainty regarding potential cable landfall locations, therefore the effect on human health / populations cannot be assessed. This assessment will be undertaken at a project level, with any onshore components managed through the terrestrial planning permission process.
		Effects on residential amenity stemming from construction/installation/operational activities.	SW1 is located offshore, and as such the development will not directly affect residential amenity. Socio-economic impacts are considered separately to this assessment within the SEIA. There is potential for construction activity associated with export cables and cable landfalls to affect populations, however	There is considerable uncertainty regarding potential cable landfall locations, therefore the effect on human health / populations cannot be assessed. This assessment will be undertaken at a project level, with any onshore components managed through the terrestrial planning permission process.

SW1				Total DPO Area: 292 km² Realistic Maximum Development Scenario (% of Total Capacity): 1 GW (68%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
			effects are likely to be highly localised and temporary.	
		Issues of navigational safety, aviation and collision risk.	The presence of the offshore wind turbines increases the potential for collisions between recreational or commercial vessels and offshore wind developments. This risk is greater where the offshore wind array overlaps key navigational routes.	At the project level and as part of the EIA process there is a requirement for developers to undertake a navigational risk assessment and mitigate risks to navigation from development. It is likely that, based on development of 68% of the DPO, spatial planning in SW1 could be used to reduce effects on key shipping routes and allow safe transit. The residual effect on navigational safety associated with the development of SW1 for offshore wind is considered to be **minor negative to major negative** dependent on the spatial planning and turbine design of development.
		Effects on marine and coastal recreation and access	Socio-economic impacts, such as the displacement of activity, are considered separately to this assessment within the SEIA, however effects on navigational safety of recreational activity associated with the development of the DPO are considered above. There is potential for construction activity associated with export cables and cable landfalls to affect populations, however effects are likely to be highly localised and temporary. Luce Bay is an important area for recreational fishing, which would have the potential to be affected by export cables or by any barrier effects to fish from offshore wind development.	There is considerable uncertainty regarding potential cable landfall locations, therefore the effect on human health / populations cannot be assessed. Avoidance of Luce Bay SAC when considering export cables has the potential to avoid conflict with significant recreational activities. Assessment will be undertaken at a project level, with any onshore components managed through the terrestrial planning permission process.
		Development of a secure energy supply.	Offshore wind development within SW1 could contribute to the development of secure energy supply in the UK.	The potential benefit to UK energy security associated with the development of offshore wind in SW1 is considered to be **moderate to major positive**.

SW1				Total DPO Area: 292 km² Realistic Maximum Development Scenario (% of Total Capacity): 1 GW (68%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
Soil (namely, Marine Geology and Coastal Processes)	The seabed sediments in SW1 are mostly coarse sediment, with some small patches of sand and rock to the north and west of the DPO respectively. The coastline facing SW1 is mostly soft sediment susceptible to coastal erosion, generally associated with Luce Bay. This includes coastal dune features (shifting and fixed) which are primary reasons for the designation of the Luce Bay and Sands SAC. To the west, on the southern and western edges of the Rhins of Galloway there are areas of hard rock / cliff.	Effects on subsea geology, sediments, and coastal processes arising from changes in hydrodynamics and the existing wave regime.	There is potential for changes to hydrodynamics caused by the development of offshore wind in SW1, or export cable routes / landfall to affect the sediment transport in the region and on coastal processes. This includes potential for effects on sensitive habitats potentially susceptible to coastal erosion designated as part of the Luce Bay SAC. The extent of the effects will be dependent on the design of the array, the technology deployed in the DPO, the cable route, landfall location and cable design.	There is uncertainty as to the likely technology to be deployed in the DPO, the likely array design and cable routes / landfall locations. Hydrodynamic and sediment transport modelling will be required at a project level to confirm and validate the potential effects on the seabed sediments and coastal processes. Planning should be used to avoid areas of sensitivity when considering the cable route, such as avoidance of routing a cable through the Luce Bay SAC. The residual effect on seabed sediment and physical processes is highly dependent on the technology type and array design but is considered likely to be **minor negative to moderate negative** due to the potential effects on SAC features.
Water Quality	Ecological status is determined for each of the surface water bodies of rivers, lakes, transitional waters and coastal waters, based on biological quality elements and supported by physico-chemical and hydromorphological quality elements. There is one water body adjacent to or overlapping with SW1, the Luce bay water body (good condition).	Effects on ecological status.	The development of offshore wind farms within SW1 and associated cable routes / landfall has the potential to affect the ecological status of the water bodies, principally through changes caused to the hydrological regime. Any changes to the natural condition of the Luce Bay water body have the potential to affect the status of the water body. In addition, any direct effects on features, including those within protected areas, have the potential to affect the WFD ecological status.	As part of the marine licencing process requirements are placed onto developers to ensure that activities are appropriately mitigated such that they do not cause permanent degradation of the ecological status under the WFD. The residual effect on ecological status is considered to be **negligible to minor negative**.
		Effects on water quality (for example, due to increases in suspended sediment loads and turbidity as well as an increase in pollution incidents).	Effects associated with any contamination from seabed material resuspended during construction or decommissioning activity are likely to be of localised and temporary nature, with the level of effect dependant on the level of contamination within the sediment. Effects during operation and maintenance are considered less likely. Pollution events associated with support vessels during construction and operational phases have the potential to affect water quality within SW1	Where an activity is expected to cause a significant disturbance of the seabed sediment additional contamination testing and subsequent water monitoring could be required through the marine licencing process. As part of marine licencing there is a requirement to produce pollution management plans to mitigate the effects of any pollution releases. In addition, significant releases are only likely to be associated with emergency events,

SW1				Total DPO Area: 292 km² Realistic Maximum Development Scenario (% of Total Capacity): 1 GW (68%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
				considered unlikely, the assessment and management of pollution risks will be undertaken at a project level. The residual effect is considered to be **minor negative**.
		Effects of the presence of structures on local currents, wave regimes, and water column mixing, as well as secondary effects on sedimentation and erosion beyond the sites.	There is potential for changes to hydrodynamics caused by the development of offshore wind in SW1 to affect the sediment transport and coastal processes, this includes potential effects on the Luce Bay SAC features. The extent of the effects will be dependent on the design of the array, the technology deployed in the DPO, the cable route, landfall location and cable design.	There is uncertainty as to the likely technology to be deployed in the DPO, and the likely array design. Hydrodynamic and sediment transport modelling will be required at a project level to confirm and validate the potential effects on the seabed sediments and coastal processes. The residual effect on seabed sediment and physical processes is highly dependent on the technology type and array design but is considered likely to be **minor negative to moderate negative**.
Climatic Factors	The key pressures on the climate are derived from the continued global emission of greenhouse gases, including carbon dioxide. These emissions are recognised as leading to changes in the global climate (including changes in temperatures, precipitation, storm density) in turn causing changes in the physical characteristics of the oceans, including potential changes in sea temperatures, circulation, salinity, pH and sea level rise.	Contribution to supporting a diverse and decarbonised energy sector.	The development of offshore wind energy in SW1 can contribute to a decarbonised energy sector, reducing carbon emissions.	The effect of development of offshore wind in the DPO has the potential to be **moderate to major positive** in contributing to a diverse and decarbonised energy sector.
		Coastal facilities may be at risk from climate change.	Facilities associated with offshore wind infrastructure may be at risk from sea level rise and coastal erosion associated with climatic factors.	The design of any coastal facilities is required to account for sea level rise and coastal erosion in the design process. This is considered as part of the planning process at a project level.

SW1				Total DPO Area: 292 km² Realistic Maximum Development Scenario (% of Total Capacity): 1 GW (68%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
Cultural Heritage	There are no Historic MPAs within or adjacent to SW1. There is one known shipwreck within SW1. The coastline inshore of SW1 has a number of protected sites, including scheduled monuments and coastal built heritage. There is potential for palaeolandscape to be present in the Solway Firth, particularly around the estuary margins, and within Luce Bay and therefore potential for submerged archaeological remains.	Loss of and/or damage to historic environment features and their settings, including coastal and marine archaeology and historic MPAs.	There is potential for shipwrecks within SW1 to be affected by development, principally during the construction phase. In addition, coastal built heritage, coastal shipwrecks and scheduled monuments inshore of SW1 have the potential to be affected by export cable routes and cable landfalls. Submerged archaeological remains inshore of SW1 associated with palaeolandscape also have the potential to be affected by the route of export cables and cable landfalls.	Effects on culturally important sites can be mitigated through careful spatial planning within SW1 and through selection of appropriate cable export routes and landfall locations. As part of the design and planning process for any development within SW1 survey data will be obtained, this will identify any areas of cultural or historical sensitivity within the DPO that should be avoided and therefore inform spatial planning. Based on the use of appropriate spatial planning the residual effect on cultural heritage is therefore considered to be **negligible to minor negative**.
Landscape, Seascape, and Visual Amenity	65% of SW1 is within 15 km of coastline identified as medium to high sensitivity to offshore wind farm development[328].	Both temporary and longer-term effects on landscape and coastal character and visual receptors arising from the presence of structures including any ancillary infrastructure and night-time lighting of offshore structures.	Offshore wind development in SW1 has the potential to significantly affect the seascape associated with medium to high sensitivity coastline.	There is some potential to mitigate visual effects through spatial planning within the DPO to avoid areas closest to land, and through the potential to select smaller turbines in areas of higher sensitivity. This is unlikely to remove the effects altogether within SW1 due to the large proportion of the site within 15 km of land. The development within SW1 will require the application of SNH guidance on management of night-time lighting effects. The residual effect on landscape / seascape is considered to be **moderate negative to major negative**, dependent on the spatial planning and turbine design of development within the DPO.

[328] Scott, K.E., Anderson, C., Dunsford, H., Benson, J.F. and MacFarlane, R. 2005. An assessment of the sensitivity and capacity of the Scottish seascape in relation to offshore windfarms. Scottish Natural Heritage Commissioned Report No.103 (ROAME No. F03AA06). Available at https://www.nature.scot/snh-commissioned-report-103-assessment-sensitivity-and-capacity-scottish-seascape-relation-windfarms.

C.2 West

W1

W1				Total DPO Area: 1107 km² Realistic Maximum Development Scenario (% of Total Capacity): 2 GW (36%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
Biodiversity, Flora and Fauna (Marine Mammals)	Benthic Habitats and Species The benthic habitat in W1 generally graduates with increasing depth from a small area of rock and biogenic reef in the southwest nearest to Islay through a thin band of coarse sediment to sandy sediments in the north. There are small areas of rocky reef in the north east and north west of the region. The area of rocky reef in the north-western corner of the DPO supports a Priority Marine Feature community of deep sponges. There are also further sensitive habitats inshore of the DPO, including reef features in the Firth of Lorn SAC.	Loss of and/or damage to marine and coastal habitats, including benthic and intertidal habitats (for example, due to smothering of benthic habitats and substratum loss).	There is potential for permanent loss of habitat within the footprint of offshore wind turbines and associated scour protection and temporary damage to habitats from intra array cables. There are areas of habitat containing nationally important communities within the DPO which have the potential to be affected by OW development. There is also potential for effects on coastal habitats inshore of W1 associated with export cables and cable landfalls. This includes potential effects on the habitats designated for the Firth of Lorn SAC.	The footprint associated with offshore wind will be dependent on the technology used and the level of scour protection required. There is potential to spatially plan array development within W1 to avoid sensitive habitats, and hard rock / reef habitats are generally not preferentially selected for offshore wind development. Effects on coastal habitats associated with export cable routes and cable landfall will be considered at a project level and can be mitigated through careful siting. The residual effect on habitat is therefore considered to be **minor to moderate negative** in W1.
	Marine Mammals The DPO borders the Inner Hebrides and Minches SAC, designated for harbour porpoise, and the Sea of the Hebrides proposed NCMPA, designated for minke whale, the ranges of which may extend into W1, although the key areas in the West region for cetaceans are further north towards the Minches. W1 overlaps into an area of high Grey Seal at sea usage, associated with haul out and pupping sites on Islay and Colonsay. There are several sites designated for otter in the West region. All the sites are inshore of the DPO, generally on sheltered sea lochs or riverine environments. The main sites inshore of the DPO are landwards of Jura, and therefore it is not expected there would be any usage of the DPO area by otter for foraging.	Effects on key mobile receptors and prey species, including disturbance, noise effects, EMF exposure, collision risk, habitat exclusion, and barriers to wildlife movement.	There is potential for disturbance of marine mammal, bird and fish species particularly due to noise emissions during construction from piling activities, survey and / or clearance of unexploded ordnance. These have the potential to cause physiological damage to fish and marine mammal species, and to cause displacement of fish, marine mammals and birds from the area of effect. Potential for effects to mammals and fish are lower during the operational and decommissioning phases of the offshore wind farm life cycle. There is, however, potential for effects on fish species, from EMF exposure associated with export cables. The consequences of such effects are not well understood, however are thought to be low. The introduction of offshore wind arrays may also cause a barrier effect, by which it prevents the movement of species through the area, potentially affecting migration pathways for marine mammals,	Physiological risks to fish and marine mammals from piling noise can be mitigated through the application measures relating to piling activities or soft start procedures, although fish responses to these measures are not well known and noise modelling should account for this uncertainty. In addition, noise abatement measures at source can be implemented to reduce noise transmission into the wider environment, and therefore reduce displacement effects. Where there is the potential for impacts on Basking sharks, there is potential that the construction and decommissioning phases of the wind farm may be temporally limited to avoid key breeding aggregation time periods (July and August). Further research is required to determine the effect of collision risk on bird species, however current evidence suggests that the effect through this pathway may be

W1				Total DPO Area: 1107 km² Realistic Maximum Development Scenario (% of Total Capacity): 2 GW (36%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
	Birds Bird usage of the area within W1, particularly to the east of the DPO is high. There are populations of Kittiwake, Guillemot, Chough and several goose species designated as part of SPA on Islay and Colonsay. RSPB utilisation distribution data indicates that is high usage of W1, particularly in inshore areas by Guillemot, Blacklegged Kittiwake and Razorbill. In addition there are a number of migration routes of both seabird, waterbird and terrestrial bird species on the west coast of Scotland. Fish Within W1 there are known nursery grounds for several species. This includes nursery grounds for herring, spurdog, blue whiting and whiting. There are a number of migratory fish which are known to use the area, including Atlantic salmon and sea trout. W1 borders onto the Sea of the Hebrides proposed NCMPA, designated for basking shark, which are present from April to October, with key breeding aggregations in July and August. Whilst the hotspots for basking shark activity (around Coll, Tiree and Canna) are further to the north, there records of basking sharks overlapping the DPO and there is potential for individuals to transit the area as a route between the Clyde, where they are regularly sighted, and hotspots further north in the proposed NCMPA.		fish species and birds, whilst the movement of vessels (particularly during construction and decommissioning) has the potential to increase collision risk for species in the DPO. There is collision risk associated with bird species using the DPO area. However, current research suggests that it is more likely that birds will be displaced from the region.	low for the majority of species. To determine the potential risk to bird species within W1 and subsequently influence the turbine design, studies should be considered at a project level, both before and after construction. There is potential for displacement of bird species and marine species outwith the DPO. The eastern area of W1 is an area of high usage density for grey seal, therefore development has the potential to displace this species from key foraging grounds. In addition, displacement of bird species from W1, particularly in the east, may have a negative effect. Given that the likely maximum degree of construction within W1 will develop 36% of the site there is significant potential for spatial planning. It should, however, be noted that water depth is variable across W1 and therefore development may be spatially constrained dependent on the preferred technology. The residual effect on key receptors during construction and operation in W1 is considered to be **minor negative to moderate negative**.
		Effects arising from habitat modification, such as the creation of artificial reefs, new roosting structures and exclusion of habitat damaging activity.	The introduction of the wind farm turbines and scour protection have the potential to provide alternative habitat within W1, which could provide shelter for juvenile fish and crustacean shellfish. This effect has the potential to be both beneficial and adverse for different receptors. There is also the potential for activities currently damaging to the seabed habitat to be excluded from the offshore wind development area, dependent on the technology implemented, which may lead to reduced damage to existing habitats. However, if activities are displaced to another area, the effect is negligible or potentially negative.	The potential effect associated with the development of offshore wind in W1 is considered to be **negligible**, but is dependent on the technology deployed.

W1				Total DPO Area: 1107 km² Realistic Maximum Development Scenario (% of Total Capacity): 2 GW (36%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
		Effects of pollution releases on species and habitats.	Pollution events associated with support vessels during construction and operational phases have the potential to affect species within W1.	As part of marine licencing there is a requirement to produce pollution management plans to mitigate the effects of any pollution releases. In addition, significant releases are only likely to be associated with emergency events, considered unlikely. The assessment and management of pollution risks will be undertaken at a project level. The residual risk associated with pollution releases associated with offshore wind farms is considered to be **negligible**.
		Effects from introduction and spread of Invasive Non-Native Species (INNS).	Offshore wind turbine foundations and scour protection provides a new colonising surface for INNS, and support vessels during construction and operational phases have the potential to introduce INNS, which may subsequently affect indigenous species within W1.	There is a requirement for biosecurity management plans to be produced to minimise the risk of introduction of INNS. Controls will be imposed through the marine licencing process if required at a project level. The residual risk associated with INNS associated with offshore wind farms is considered to be **minor negative**.
Population and Human Health	Areas of W1 are within 5 km of land on Islay. However the coastline landwards of W1 is generally sparsely populated, with a few small settlements. Areas within the DPO are, however, used for the purposes of commercial shipping, fishing, recreational boating and recreational angling. This includes the DPO being intersected some commercial shipping and several RYA informal cruising routes.	Effects arising from noise, vibration, light, dust and shadow flicker effects from all phases of development.	W1 is located offshore, and as such construction, operation and decommissioning of arrays within the DPO will not give rise to significant effects on populations or human health directly through noise, vibration, light, dust or shadow flicker effects. during operation. There is potential for noise and vibration effects from piling activities due to the proximity of the south-eastern boundary of W1 to Islay. There is potential for construction activity associated with export cables and cable landfalls to affect populations, however effects are likely to be highly localised and temporary.	Given that the likely maximum degree of construction within W1 will develop 36% of the site there is significant potential for spatial planning. It should, however, be noted that water depth is variable across W1 and therefore development may be spatially constrained dependent on the preferred technology. There is considerable uncertainty regarding potential cable landfall locations, therefore the effect on human health / populations cannot be assessed. This assessment will be undertaken at a project level, with any onshore components managed through the terrestrial planning permission process. The residual risk associated with noise and vibration effects from development in W1 is considered to be **minor negative**.
		Effects on residential amenity stemming from construction/installation/operational activities.	W1 is located offshore, and as such the development will not directly affect residential amenity.	There is considerable uncertainty regarding potential cable landfall locations, therefore the effect on human

W1				Total DPO Area: 1107 km² Realistic Maximum Development Scenario (% of Total Capacity): 2 GW (36%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
			Socio-economic impacts are considered separately to this assessment within the SEIA. There is potential for construction activity associated with export cables and cable landfalls to affect populations, however effects are likely to be highly localised and temporary.	health / populations cannot be assessed. This assessment will be undertaken at a project level, with any onshore components managed through the terrestrial planning permission process.
		Issues of navigational safety, aviation and collision risk.	The presence of the offshore wind turbines increases the potential for collisions between recreational or commercial vessels and offshore wind developments. This risk is greater where the offshore wind array overlaps key navigational routes.	At a project level and as part of the EIA process there is a requirement for developers to undertake a navigational risk assessment and mitigate risks to navigation from development appropriately. It is likely that, based on development of 36% of the DPO, spatial planning in W1 could be used to reduce effects on key routes and allow safe transit through the wind farm. It should, however, be noted that water depth is variable across W1 and therefore development may be spatially constrained dependent on the preferred technology. The residual effect on navigational safety associated with the development of W1 for offshore wind is considered to be **minor negative** dependent on the spatial planning and turbine design of development.
		Effects on marine and coastal recreation and access	Socio-economic impacts, such as the displacement of activity, are considered separately to this assessment within the SEIA, however effects on navigational safety of recreational activity associated with the development of the DPO are considered above. There is potential for construction activity associated with export cables and cable landfalls to affect populations, however effects are likely to be highly localised and temporary. There are potentially recreational	There is considerable uncertainty regarding potential cable landfall locations, therefore the effect on human health / populations cannot be assessed. This assessment will be undertaken at a project level, with any onshore components managed through the terrestrial planning permission process.
		Development of a secure energy supply.	The development of 1 GW of capacity within W1 could contribute to the	The potential benefit to UK energy security associated with the development

W1				Total DPO Area: 1107 km² Realistic Maximum Development Scenario (% of Total Capacity): 2 GW (36%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
			development of secure energy supply in the UK.	of offshore wind in W1 is considered to be **moderate to major positive**.
Soil (namely, Marine Geology and Coastal Processes)	The seabed sediments in W1 generally graduate with increasing depth from a small area of rock and biogenic reef in the southwest nearest to Islay through a thin band of coarse sediment to sandy sediments in the north. There are small areas of rocky reef in the north east of the region. The coastline facing N1 is mostly hard rock and cliffs, with low susceptibility to coastal erosion.	Effects on subsea geology, sediments, and coastal processes arising from changes in hydrodynamics and the existing wave regime.	There is potential for changes to hydrodynamics caused by the development of offshore wind in W1 to affect the sediment transport in the region and on coastal processes. This includes potential for effects on sensitive habitats such through smothering of reef habitats. The extent of the effects will be dependent on the design of the array, the technology deployed in the DPO, the cable route, landfall location and cable design.	There is uncertainty as to the likely technology to be deployed in the DPO, and the likely array design. Hydrodynamic and sediment transport modelling will be required at a project level to confirm and validate the potential effects on the seabed sediments and coastal processes. The residual effect on seabed sediment and physical processes is highly dependent on the technology type and array design but is considered likely to be **negligible to minor negative**.
Water Quality	Ecological status is determined for each of the surface water bodies of rivers, lakes, transitional waters and coastal waters, based on biological quality elements and supported by physico-chemical and hydromorphological quality elements. There are three water bodies adjacent to or overlapping with W1, West Islay water body (good condition), Atlantic Ocean – SW Mull (high condition) and Colonsay water body (good condition)	Effects on ecological status.	The development of offshore wind farms within W1, and associated cable routes / landfall, has the potential to affect the ecological status of the water bodies, principally through changes caused to the hydrological regime. Any changes to the natural condition of the water bodies, particularly where currently assessed as high (Atlantic Ocean-SW Mull), have the potential to affect the status of the water body. In addition, any direct effects on features, including those within protected areas, have the potential to affect the WFD ecological status.	As part of the marine licencing process requirements are placed onto developers to ensure that activities are appropriately mitigated such that they do not cause permanent degradation of the ecological status under the WFD. The residual effect on ecological status is considered to be **negligible to minor negative**.
		Effects on water quality (for example, due to increases in suspended sediment loads and turbidity as well as an increase in pollution incidents).	Effects associated with any contamination from seabed material resuspended during construction or decommissioning activity are likely to be of localised and temporary nature, with the level of effect dependant on the level of contamination within the sediment. Effects during operation and maintenance are considered less likely. Pollution events associated with support vessels during construction and operational phases have the potential to affect water quality within W1.	Where an activity is expected to cause a significant disturbance of the seabed sediment additional contamination testing and subsequent water monitoring could be required through the marine licencing process. As part of marine licencing there is a requirement to produce pollution management plans to mitigate the effects of any pollution releases. In addition, significant releases are only likely to be associated with emergency events, considered unlikely.

W1				Total DPO Area: 1107 km² Realistic Maximum Development Scenario (% of Total Capacity): 2 GW (36%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
				The residual effect is considered to be **minor negative**.
		Effects of the presence of structures on local currents, wave regimes, and water column mixing, as well as secondary effects on sedimentation and erosion beyond the sites.	There is potential for changes to hydrodynamics caused by the development of offshore wind in W1 to affect the sediment transport in the region, and subsequently to affect coastal processes. The extent of the effects will be dependent on the design of the array, the technology deployed in the DPO, the cable route, landfall location and cable design.	There is uncertainty as to the likely technology to be deployed in the DPO, and the likely array design. Hydrodynamic and sediment transport modelling will be required at a project level to confirm and validate the potential effects on the seabed sediments and coastal processes. The residual effect on seabed sediment and physical processes is highly dependent on the technology type and array design but is considered likely to be **negligible to minor negative**.
Climatic Factors	The key pressures on the climate are derived from the continued global emission of greenhouse gases, including carbon dioxide. These emissions are recognised as leading to changes in the global climate (including changes in temperatures, precipitation, storm density) in turn causing changes in the physical characteristics of the oceans, including potential changes in sea temperatures, circulation, salinity, pH and sea level rise.	Contribution to supporting a diverse and decarbonised energy sector.	The development of offshore wind energy in W1 can contribute to a decarbonised energy sector, reducing carbon emissions.	The effect of development of offshore wind in the DPO has the potential to be **moderate to major positive** in contributing to a diverse and decarbonised energy sector.
		Coastal facilities may be at risk from climate change.	Facilities associated with offshore wind infrastructure may be at risk from sea level rise and coastal erosion associated with climatic factors.	The design of any coastal facilities is required to account for sea level rise and coastal erosion in the design process. This is considered as part of the planning process at a project level.
Cultural Heritage	There are no Historic MPAs within or adjacent to W1. There are two shipwrecks within W1. The coastline inshore of W1 has a number of protected sites, including scheduled monuments and coastal built heritage.	Loss of and/or damage to historic environment features and their settings, including coastal and marine archaeology and historic MPAs.	There is potential for shipwrecks within W1 to be affected by development, principally during the construction phase. In addition coastal built heritage, coastal shipwrecks and scheduled monuments inshore of W1 have the potential to be affected by export cables and cable landfalls.	Effects on culturally important sites can be mitigated through careful spatial planning within W1 and through selection of appropriate cable export routes and landfall locations. As part of the design and planning process for any development within W1 survey data will be obtained, this will identify any areas of cultural or historical sensitivity within the DPO that should be avoided and therefore inform spatial planning. Based on the use of appropriate spatial planning, the residual effect on cultural heritage is therefore considered to be **negligible to minor negative**.

W1				Total DPO Area: 1107 km² Realistic Maximum Development Scenario (% of Total Capacity): 2 GW (36%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
Landscape, Seascape, and Visual Amenity	62% of the area W1 is within 15 km of coastline identified as medium to high sensitivity to offshore wind farm development[329].	Both temporary and longer-term effects on landscape and coastal character and visual receptors arising from the presence of structures including any ancillary infrastructure and night-time lighting of offshore structures.	The development of offshore wind farms in W1 has the potential to significantly affect the seascape associated with medium to high sensitivity coastline.	There is some potential to mitigate visual effects through spatial planning within the DPO to avoid areas closest to land, and through the potential to select smaller turbines in areas of higher sensitivity. It should, however, be noted that water depth is variable across W1 and therefore development may be spatially constrained dependent on the preferred technology. The development within W1 will require the application of SNH guidance on management of night-time lighting effects. The residual effect on landscape / seascape is considered to be **negligible to major negative**, dependent on the spatial planning and turbine design of development within the DPO.

[329] Scott, K.E., Anderson, C., Dunsford, H., Benson, J.F. and MacFarlane, R. 2005. An assessment of the sensitivity and capacity of the Scottish seascape in relation to offshore windfarms. Scottish Natural Heritage Commissioned Report No.103 (ROAME No. F03AA06). Available at https://www.nature.scot/snh-commissioned-report-103-assessment-sensitivity-and-capacity-scottish-seascape-relation-windfarms.

C.3 North

N1

N1				Total DPO Area: 1163 km² Realistic Maximum Development Scenario (% of Total Capacity): 2 GW (34%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
Biodiversity, Flora and Fauna (Marine Mammals)	<u>Benthic Habitats and Species</u> The benthic habitat in N1 is mostly sand and coarse sediment throughout. There are small areas of rocky reef towards the north eastern boundary and immediately beyond the north western boundary around Sule Stack. There are no designated sensitive habitats inshore of the DPO. <u>Marine Mammals</u> N1 is generally an area of low usage for marine mammals, although there is some grey seal at sea usage to the north west of the site associated with pupping sites at Sule Skerry. For marine mammals there is a degree of uncertainty in this conclusion, and therefore further development of the baseline through survey will be required prior to project level assessment. There are several sites designated for otter in the North region. The majority of sites are on the north coast of mainland Scotland, to the west of areas inshore of N1, however there are sites associated with the River Borgie and Durness which are on the north coast of Scotland inshore of N1. It is not expected there would be usage of the DPO area by otter for foraging, however there is potential for effects from cable landfalls. <u>Birds</u> There is high bird usage of the area within N1, particularly associated with designated breeding colonies at the Sule Skerry and Sule Stack SPA just beyond the north west boundary of the DPO. The site is particularly important for breeding	Loss of and/or damage to marine and coastal habitats, including benthic and intertidal habitats (for example, due to smothering of benthic habitats and substratum loss)	There is potential for permanent loss of habitat within the footprint of offshore wind turbines and associated scour protection and temporary damage to habitats from intra array cables. There is also potential for effects on coastal habitats inshore of N1 associated with export cables and cable landfalls.	The footprint associated with offshore wind will be dependent on the technology used and the level of scour protection required. There is potential to spatially plan array development within N1 to avoid sensitive habitats, and hard rock / reef habitats are generally not preferentially selected for offshore wind development. Effects on coastal habitats associated with export cable routes and cable landfall will be considered at a project level and can be mitigated through careful siting. The residual effect on habitat is therefore considered to be **minor negative** in N1.
		Effects on key receptors and prey species, including disturbance, noise effects, EMF exposure, collision risk, habitat exclusion, and barriers to wildlife movement	There is potential for disturbance of marine mammal, bird and fish species particularly due to noise emissions during construction from piling activities, survey and / or clearance of unexploded ordnance. These have the potential to cause physiological damage to fish and marine mammal species, and to cause displacement of fish, marine mammals and birds from the area of effect. Potential for effects to mammals and fish are lower during the operational and decommissioning phases of the offshore wind farm life cycle. There is, however, potential for effects on fish species, from EMF exposure associated with export cables. The consequences of such effects are not well understood, however are thought to be low. The introduction of offshore wind arrays may also cause a barrier effect, by which it prevents the movement of species through the area, potentially effecting migration pathways for marine mammals, fish species and birds.	Physiological risks to fish and marine mammals from piling noise can be mitigated through the application measures relating to piling activities or soft start procedures, although fish responses to these measures are not well known and noise modelling should account for this uncertainty. In addition, noise abatement measures at source can be implemented to reduce noise transmission into the wider environment, and therefore reduce displacement effects. Further research is required to determine the effect of collision risk on bird species, however current evidence suggests that the effect through this pathway may be low for the majority of species. To determine the potential risk to bird species within N1, studies should be considered at a project level, both before and after construction. There is potential for displacement of bird species and marine species outwith the DPO. The west area of N1 is in close proximity to a grey seal breeding colony at

N1				Total DPO Area: 1163 km² Realistic Maximum Development Scenario (% of Total Capacity): 2 GW (34%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
	Gannet and puffin with smaller populations of leach's petrel, Guillemot, shag and storm petrel. RSPB utilisation distribution data indicates that is high usage of the eastern portion of N1 by Black-legged Kittiwake foraging from populations in the Orkney islands. In addition there are a potential migration routes for a range of bird species, including Whooper Swan which will intersect N1. These routes are generally for species migrating between the UK and the Faroe Islands and Iceland. <u>Fish</u> Within N1 there are known nursery grounds for several species. This includes nursery grounds for mackerel, spurdog, blue whiting and anglerfish, all of which have wide ranging nursery grounds across Scottish waters. In addition the North-west Orkney NCMPA, less than 5 km to the north east of N1 is designated for sandeel. There are a number of migratory fish which are known to transit through the area, including Atlantic salmon and sea trout.		There is collision risk associated with bird species using the DPO area. However, current research suggests that it is more likely that birds will be displaced from the region.	Sule Skerry, therefore development has the potential to displace this species from foraging grounds, although current understanding of seal distribution from this colony suggests higher concentration to the west of Sule Skerry away from the DPO. In addition displacement of bird species from N1, particularly Kittiwake in the east and species designated in the Sule Skerry and Sule Stack SPA may have a negative effect. Given that the likely maximum degree of construction within N1 will develop 33% of the site there is significant potential for spatial planning. It should, however, be noted that water depth is variable across N1 and therefore development may be spatially constrained dependent on the preferred technology. The residual effect on key receptors during construction and operation in N1 is considered to be **minor negative to moderate negative**.
		Effects arising from habitat modification, such as the creation of artificial reefs, new roosting structures and exclusion of habitat damaging activity.	The introduction of the wind farm turbines and scour protection have the potential to provide alternative habitat within N1, which could provide shelter for juvenile fish and crustacean shellfish. This effect has the potential to be both beneficial and adverse for different receptors. There is also the potential for activities currently damaging to the seabed habitat to be excluded from the offshore wind development area, dependent on the technology implemented, which may lead to reduced damage to existing habitats. However, if activity is displaced to a different area the effect is likely to be negligible or potentially negative.	The potential effect associated with the development of offshore wind in N1 is considered to be **negligible**, but is dependent on the technology deployed.
		Effects of pollution releases on species and habitats	Pollution events associated with support vessels during construction and operational phases have the potential to affect species within N1.	As part of marine licencing there is a requirement to produce pollution management plans to mitigate the effects of any pollution releases. In addition,

N1				Total DPO Area: 1163 km² Realistic Maximum Development Scenario (% of Total Capacity): 2 GW (34%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
				significant releases are only likely to be associated with emergency events, considered unlikely. The assessment and management of pollution risks will be undertaken at a project level. The residual risk associated with pollution releases associated with offshore wind farms is considered to be **negligible**.
		Effects from introduction and spread of Invasive Non-Native Species (INNS).	Offshore wind turbine foundations and scour protection provides a new colonising surface for INNS, and support vessels during construction and operational phases have the potential to introduce INNS, which may subsequently affect indigenous species within N1.	There is a requirement for biosecurity management plans to be produced to minimise the risk of introduction of INNS. Controls will be imposed through the marine licencing process if required at a project level. The residual risk associated with INNS associated with offshore wind farms is considered to be **minor negative**.
Population and Human Health	N1 is located offshore, with no population within 15 km. Areas of N1 are within 5 km of land, however this is unpopulated (Sule Skerry and Sule Stack). Areas within the DPO are, however, used for the purposes of commercial shipping, fishing, recreational boating and recreational angling. There is a moderate level of shipping throughout the DPO, however there are no clear key routes. There are several RYA informal cruising routes which intersect the south and southwest areas of the DPO. These are associated with higher numbers of recreational vessels on transit towards / from the Orkney Islands.	Effects arising from noise, vibration, light, dust and shadow flicker effects from all phases of development	N1 is located offshore, and as such construction, operation and decommissioning of arrays within the DPO will not give rise to significant effects on populations or human health directly through noise, vibration, light, dust or shadow flicker effects. There is potential for construction activity associated with export cables and cable landfalls to affect populations, however effects are likely to be highly localised and temporary.	There is considerable uncertainty regarding potential cable landfall locations, therefore the effects on human health / populations cannot be assessed. This assessment will be undertaken at a project level, with any onshore components managed through the terrestrial planning permission process.
		Effects on residential amenity stemming from construction/installation/operational activities	N1 is located offshore, and as such the development will not directly affect residential amenity. Socio-economic impacts are considered separately to this assessment within the SEIA. There is potential for construction activity associated with export cables and cable landfalls to affect populations, however effects are likely to be highly localised and temporary.	There is considerable uncertainty regarding potential cable landfall locations, therefore the effects on human health / populations cannot be assessed. This assessment will be undertaken at a project level, with any onshore components managed through the terrestrial planning permission process.
		Issues of navigational safety and collision risk	The presence of the offshore wind turbines increases the potential for collisions between recreational or	At a project level and as part of the EIA process there is a requirement for developers to undertake a navigational

N1				Total DPO Area: 1163 km² Realistic Maximum Development Scenario (% of Total Capacity): 2 GW (34%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
			commercial vessels and offshore wind developments. This risk is greater where the offshore wind array overlaps key navigational routes.	risk assessment and mitigate risks to navigation from development appropriately. It is likely that, based on development of 33% of the DPO, spatial planning in N1 could be used to reduce effects on key routes and allow safe transit through the wind farm. It should, however, be noted that water depth is variable across N1 and therefore development may be spatially constrained dependent on the preferred technology. The residual effect on navigational safety associated with the development of N1 for offshore wind is considered to be **minor negative to major** negative dependent on the spatial planning and turbine design of development.
		Effects on marine and coastal recreation and access (note: recreation and tourism have also been considered in the SEIA)	Socio-economic impacts, such as the displacement of activity, are considered separately to this assessment within the SEIA, however effects on navigational safety of recreational activity associated with the development of the DPO are considered above. There is potential for construction activity associated with export cables and cable landfalls to affect populations, however effects are likely to be highly localised and temporary.	There is considerable uncertainty regarding potential cable landfall locations, therefore the effects on human health / populations cannot be assessed. This assessment will be undertaken at a project level, with any onshore components managed through the terrestrial planning permission process.
		Development of a secure energy supply.	The development of 2 GW of capacity within N1 could contribute to the development of secure energy supply in the UK.	The potential benefit to UK energy security associated with the development of offshore wind in N1 is considered to be **moderate to major** positive.
Soil (namely, Marine Geology and Coastal Processes)	The seabed sediments in N1 are mostly sand and coarse sediment throughout. There are small areas of rocky reef towards the north eastern boundary and immediately beyond the north western boundary around Sule Stack. The coastline facing N1 is mostly hard rock and cliffs, with low susceptibility to	Effects on subsea geology, sediments, and coastal processes arising from changes in hydrodynamics and the existing wave regime.	There is potential for changes to hydrodynamics caused by the development of offshore wind in N1 and associated export cables / cable export to affect the sediment transport and coastal processes. This includes potential for effects on sensitive habitats such through smothering of reef habitats. The extent of the effect will be dependent on the design of the array, the technology	There is uncertainty as to the likely technology to be deployed in the DPO, and the likely array design. Hydrodynamic and sediment transport modelling will be required at a project level to confirm and validate the potential effects on the seabed sediments and coastal processes. The distance of the DPO from the shoreline of mainland Scotland and the Orkney Islands will

N1				Total DPO Area: 1163 km² Realistic Maximum Development Scenario (% of Total Capacity): 2 GW (34%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
	coastal erosion. There are areas, generally in sea lochs, and estuaries which are of softer sediment, however these are more than 15 km from the DPO.		deployed in the DPO, the cable route, cable landfall location and cable design.	reduce the potential effects on coastal processes (the DPO is entirely >15 km from the shoreline). The residual effect on seabed sediment and physical processes is highly dependent on the technology type and array design but is considered likely to be **negligible to minor negative**.
Water Quality	Ecological status is determined for each of the surface water bodies of rivers, lakes, transitional waters and coastal waters, based on biological quality elements and supported by physico-chemical and hydromorphological quality elements. There is one water body or overlapping with N1, Sule Skerry and Sule Stack water body (high condition). In addition there are four water bodies inshore of N1. Of these, two are adjacent to the north coast of the Scottish mainland (Cape Wrath and Strathy Point, both good condition) and two are adjacent to the Orkney Islands (Tor Ness to Breck Ness, high condition, and Breck ness to Noup Head, good condition).	Effects on ecological status.	Offshore wind farms within N1 and associated export cables and cable landfalls have the potential to affect the ecological status of the water bodies, principally through changes caused to the hydrological regime. Any changes to the natural condition of the water bodies, particularly where currently assessed as high (Sule Skerry and Sule Stack), have the potential to affect the status of the water body. In addition, any direct effects on features, including those within protected areas, have the potential to affect the WFD ecological status.	As part of the marine licencing process requirements are placed onto developers to ensure that activities are appropriately mitigated such that they do not cause permanent degradation of the ecological status under the WFD. The residual effect on ecological status is considered to be **negligible to minor negative**.
		Effects on water quality (for example, due to increases in suspended sediment loads and turbidity as well as an increase in pollution incidents).	Effects associated with any contamination from seabed material resuspended during construction or decommissioning activity are likely to be of localised and temporary nature, with the level of effect dependant on the level of contamination within the sediment. Effects during operation and maintenance are considered less likely. Pollution events associated with support vessels during construction and operational phases have the potential to affect water quality within N1.	Where an activity is expected to cause a significant disturbance of the seabed sediment additional contamination testing and subsequent water monitoring could be required through the marine licencing process. As part of marine licencing there is a requirement to produce pollution management plans to mitigate the effects of any pollution releases. In addition, significant releases are only likely to be associated with emergency events, considered unlikely. The residual effect is considered to be **minor negative**.
		Effects of the presence of structures on local currents, wave regimes, and water column mixing, as well as secondary	There is potential for changes to hydrodynamics caused by the development of offshore wind in N1 to affect the sediment transport in the region,	There is uncertainty as to the likely technology to be deployed in the DPO, and the likely array design. Hydrodynamic and sediment transport

N1				Total DPO Area: 1163 km² Realistic Maximum Development Scenario (% of Total Capacity): 2 GW (34%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
		effects on sedimentation and erosion beyond the sites.	and subsequently to effect coastal processes. The extent of the effects will be dependent on the design of the array, the technology deployed in the DPO, the cable route, landfall location and cable design.	modelling will be required at a project level to confirm and validate the potential effects on the seabed sediments and coastal processes. The residual effect on seabed sediment and physical processes is highly dependent on the technology type and array design but is considered likely to be **negligible to minor negative**.
Climatic Factors	The key pressures on the climate are derived from the continued global emission of greenhouse gases, including carbon dioxide. These emissions are recognised as leading to changes in the global climate (including changes in temperatures, precipitation, storm density) in turn causing changes in the physical characteristics of the oceans, including potential changes in sea temperatures, circulation, salinity, pH and sea level rise.	Contribution to supporting a diverse and decarbonised energy sector.	The development of offshore wind energy in N1 can contribute to a decarbonised energy sector, reducing carbon emissions.	The effect of development of offshore wind in the DPO has the potential to be **moderate to major positive** in contributing to a diverse and decarbonised energy sector.
		Coastal facilities may be at risk from climate change.	Facilities associated with offshore wind infrastructure may be at risk from sea level rise and coastal erosion associated with climatic factors.	The design of any coastal facilities is required to account for sea level rise and coastal erosion in the design process. This is considered as part of the planning process at a project level.
Cultural Heritage	There are no Historic MPAs within or adjacent to N1. There are 4 known shipwrecks within N1. The coastline inshore of N1 has a number of protected sites, including scheduled monuments and coastal built heritage.	Loss of and/or damage to historic environment features and their settings, including coastal and marine archaeology and historic MPAs.	There is potential for shipwrecks within N1 to be affected by development, principally during the construction phase. In addition coastal built heritage, coastal shipwrecks and scheduled monuments inshore of N1 have the potential to be affected by the export cable routes and cable landfalls.	Effects on culturally important sites can be mitigated through careful spatial planning within N1 and through selection of appropriate cable export routes and landfall locations. As part of the design and planning process for any development within N1 survey data will be obtained, this will identify any areas of cultural or historical sensitivity within the DPO that should be avoided and therefore inform spatial planning. Based on the use of appropriate spatial planning, the residual effect on cultural heritage is therefore considered to be **negligible to minor negative**.
Landscape, Seascape, and Visual Amenity	All of N1 is beyond 15 km from inhabited shorelines. There are two NSA with coastlines facing N1 (Kyle of Tongue and Orkney Islands).	Both temporary and longer-term effects on landscape and coastal character and visual receptors arising from the presence of structures including any ancillary infrastructure and night-time lighting of offshore structures.	The development of offshore wind in N1 has the potential to affect landscape or seascape, with the potential for turbines within the DPO to be visible form the Kyle of Tongue and Orkney Islands NSA.	While there is potential for the turbines to be visible from land, and effect views from the two NSA, the effects have the potential to be mitigated through array design, spatial planning and turbine selection. The residual effect on landscape / seascape is considered to be **negligible to minor negative**.

N2

N2				Total DPO Area: 560 km² Realistic Maximum Development Scenario (% of Total Capacity): 2 GW (71%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
Biodiversity, Flora and Fauna (Marine Mammals)	<u>Benthic Habitats and Species</u> The benthic habitat in N2 is sand and coarse sediment throughout. There are reef habitats designated within the Solan Bank Reef SAC adjacent to the east boundary of N2, There are areas of designated sensitive habitats inshore of the DPO, including at Durness and Loch Laxford SACs. <u>Marine Mammals</u> N2 is generally an area of low usage for marine mammals albeit there is a degree of uncertainty in this conclusion, and therefore further development of the baseline through survey will be required prior to project level assessment. Areas immediately to the south of the DPO are, however, areas of higher cetacean usage, and the proposed NCMPA at North East Lewis is proposed for designation for Risso's dolphin and minke whale. There are several sites designated for otter in the North region. There are sites associated with the Durness SAC on the north coast of Scotland inshore of N2. It is not expected there would be usage of the DPO area by otter for foraging, however there is potential for effects from cable landfalls. <u>Birds</u> Bird usage of the area within N2 is generally considered to be low. There are significant bird populations to the north west of the site at the North Rona and Sula Sgeir SPA, however the water depth within N2 is generally deeper than generally used for foraging. In addition there are a potential migration routes for a range of bird species,	Loss of and/or damage to marine and coastal habitats, including benthic and intertidal habitats (for example, due to smothering of benthic habitats and substratum loss)	There is potential for permanent loss of habitat within the footprint of offshore wind turbines and associated scour protection and temporary damage to habitats from intra array cables. There is also potential for effects on coastal habitats inshore of N2 associated with export cables and cable landfalls.	The footprint associated with offshore wind will be dependent on the technology used and the level of scour protection required. Within N2 there is no designated sensitive habitat, however consideration should be given to any indirect impacts on the reef habitats in the Solan Bank Reef SAC. Effects on coastal habitats associated with export cable routes and cable landfall will be considered at a project level and can be mitigated through careful siting. The residual effect on habitat is therefore considered to be **negligible to minor negative** in N2.
		Effects on key receptors and prey species, including disturbance, noise effects, EMF exposure, collision risk, habitat exclusion, and barriers to wildlife movement	There is potential for disturbance of marine mammal, bird and fish species particularly due to noise emissions during construction from piling activities, survey and / or clearance of unexploded ordnance. These have the potential to cause physiological damage to fish and marine mammal species, and to cause displacement of fish, marine mammals and birds from the area of effect. Potential for effects to mammals and fish are lower during the operational and decommissioning phases of the offshore wind farm life cycle. There is, however, potential for effects on fish species, from EMF exposure associated with export cables. The consequences of such effects are not well understood, however are thought to be low. The introduction of offshore wind arrays may also cause a barrier effect, by which it prevents the movement of species through the area, potentially effecting migration pathways for marine mammals, fish species and birds. There is collision risk associated with bird species using the DPO area. However,	Physiological risks to fish and marine mammals from piling noise can be mitigated through the application measures relating to piling activities or soft start procedures, although fish responses to these measures are not well known and noise modelling should account for this uncertainty. In addition, noise abatement measures at source can be implemented to reduce noise transmission into the wider environment, and therefore reduce displacement effects. Further research is required to determine the effect of collision risk on bird species, however current evidence suggests that the effect through this pathway may be low for the majority of species. To determine the potential risk to bird species within N2, survey and studies should be considered at a project level, both before and after construction. There is potential for displacement of bird species and marine species outwith the DPO. However, N2 is not identified as a key foraging area.

N2				Total DPO Area: 560 km² Realistic Maximum Development Scenario (% of Total Capacity): 2 GW (71%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
	including Whooper Swan which will intersect N2. These routes are generally for species migrating between the UK and the Faroe Islands and Iceland. <u>Fish</u> Within N2 there are known nursery grounds for several species. This includes nursery grounds for mackerel, spurdog, blue whiting and anglerfish, all of which have wide ranging nursery grounds across Scottish waters. There are a number of migratory fish which are known to transit through the area, including Atlantic salmon and sea trout.		current research suggests that it is more likely that birds will be displaced from the region.	The residual effect on key receptors during construction and operation in N2 is considered to be **negligible to minor negative**.
		Effects arising from habitat modification, such as the creation of artificial reefs, new roosting structures and exclusion of habitat damaging activity.	The introduction of the wind farm turbines and scour protection have the potential to provide alternative habitat within N2, which could provide shelter for juvenile fish and crustacean shellfish. This effect has the potential to be both beneficial and adverse for different receptors. There is also the potential for activities currently damaging to the seabed habitat to be excluded from the offshore wind development area, dependent on the technology implemented, which may lead to reduced damage to existing habitats. However, if activity is displaced to a different area the effect is likely to be negligible or potentially negative.	The potential effect associated with the development of offshore wind in N2 is considered to be **negligible**, but is dependent on the technology deployed.
		Effects of pollution releases on species and habitats	Pollution events associated with support vessels during construction and operational phases have the potential to affect species within N2.	As part of marine licencing there is a requirement to produce pollution management plans to mitigate the effects of any pollution releases. In addition, significant releases are only likely to be associated with emergency events, considered unlikely. The assessment and management of pollution risks will be undertaken at a project level. The residual risk associated with pollution releases associated with offshore wind farms is considered to be **negligible**.
		Effects from introduction and spread of Invasive Non-Native Species (INNS).	Offshore wind turbine foundations and scour protection provides a new colonising surface for INNS, and support vessels during construction and operational phases have the potential to introduce INNS, which may subsequently affect indigenous species within N2.	There is a requirement for biosecurity management plans to be produced to minimise the risk of introduction of INNS. Controls will be imposed through the marine licencing process if required at a project level. The residual risk associated with INNS associated with offshore wind farms is considered to be **minor negative**.

N2				Total DPO Area: 560 km² Realistic Maximum Development Scenario (% of Total Capacity): 2 GW (71%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
Population and Human Health	N2 is located offshore, with no population within 15 km. Areas within the DPO are, however, used for the purposes of commercial shipping and fishing. There is a moderate level of shipping throughout the DPO, principally associated with vessels from the IMO deep water route to the west of the Hebrides or with traffic entering / exiting the Minches.	Effects arising from noise, vibration, light, dust and shadow flicker effects from all phases of development	N2 is located offshore, and as such construction, operation and decommissioning of arrays within the DPO will not give rise to significant effects on populations or human health directly through noise, vibration, light, dust or shadow flicker effects. There is potential for construction activity associated with export cables and cable landfalls to affect populations, however effects are likely to be highly localised and temporary.	There is considerable uncertainty regarding potential cable landfall locations, therefore the effects on human health / populations cannot be assessed. This assessment will be undertaken at a project level, with any onshore components managed through the terrestrial planning permission process.
		Effects on residential amenity stemming from construction/installation/operational activities	N2 is located offshore, and as such the development will not directly affect residential amenity. Socio-economic impacts are considered separately to this assessment within the SEIA. There is potential for construction activity associated with export cables and cable landfalls to affect populations, however effects are likely to be highly localised and temporary.	There is considerable uncertainty regarding potential cable landfall locations, therefore the effects on human health / populations cannot be assessed. This assessment will be undertaken at a project level, with any onshore components managed through the terrestrial planning permission process.
		Issues of navigational safety and collision risk	The presence of the offshore wind turbines increases the potential for collisions between recreational or commercial vessels and offshore wind developments. This risk is greater where the offshore wind array overlaps key navigational routes.	At a project level and as part of the EIA process there is a requirement for developers to undertake a navigational risk assessment and mitigate risks to navigation from development appropriately. It is likely that, based on development of 71% of the DPO, a degree of spatial planning in N2 could be used to reduce effects on key routes and allow safe transit through the development. The residual effect on navigational safety associated with the development of N2 for offshore wind is considered to be **negligible to minor negative** dependent on the spatial planning and turbine design of development.
		Effects on marine and coastal recreation and access (note: recreation and tourism have also been considered in the SEIA)	Socio-economic impacts, such as the displacement of activity, are considered separately to this assessment within the	There is considerable uncertainty regarding potential cable landfall locations, therefore the effects on human

N2				Total DPO Area: 560 km² Realistic Maximum Development Scenario (% of Total Capacity): 2 GW (71%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
			SEIA, however effects on navigational safety of recreational activity associated with the development of the DPO are considered above. There is potential for construction activity associated with export cables and cable landfalls to affect populations, however effects are likely to be highly localised and temporary.	health / populations cannot be assessed. This assessment will be undertaken at a project level, with any onshore components managed through the terrestrial planning permission process.
		Development of a secure energy supply.	The development of 2 GW of capacity within N2 could contribute to the development of secure energy supply in the UK.	The potential benefit to UK energy security associated with the development of offshore wind in N2 is considered to be **moderate to major positive**.
Soil (namely, Marine Geology and Coastal Processes)	The seabed sediments in N2 are sand and coarse sediment throughout. N2 is a significant distance from coastlines that have the potential to be affected by changes to sediment transport associated with any development in the DPO.	Effects on subsea geology, sediments, and coastal processes arising from changes in hydrodynamics and the existing wave regime.	There is potential for changes to hydrodynamics caused by the development of offshore wind in N2, and associated cable routes and landfalls, to affect the sediment transport around the site. This includes potential for effects on sensitive habitats such through smothering of reef habitats. The extent of the effects will be dependent on the design of the array, the technology deployed in the DPO, cable routes, landfall locations and cable designs.	There is uncertainty as to the likely technology to be deployed in the DPO, and the likely array design. Appropriate assessment will be required to determine potential effects, which may include hydrodynamic and sediment transport modelling. The distance of the DPO from the land will reduce the potential effects on coastal processes (the DPO is entirely >15 km from the shoreline). The residual effect on seabed sediment and physical processes is highly dependent on the technology type and array design but is considered likely to be **negligible to minor negative**.
Water Quality	Ecological status is determined for each of the surface water bodies of rivers, lakes, transitional waters and coastal waters, based on biological quality elements and supported by physico-chemical and hydromorphological quality elements. There are no overlapping waterbodies with N2. There are, however a number of water bodies inshore of N2, all of which are of good condition.	Effects on ecological status.	The development of offshore wind farms within N2, and associated cable routes and landfalls, has the potential to affect the ecological status of the water bodies, principally due to the installation of the export cables. Effects due to the array development are considered to be unlikely due to distance factors. Any changes to the natural condition of the water bodies have the potential to affect the status of the water body. In addition, any direct effects on features, including those within protected areas, have the potential to affect the WFD ecological status.	As part of the marine licencing process requirements are placed onto developers to ensure that activities are appropriately mitigated such that they do not cause permanent degradation of the ecological status under the WFD. The residual effect on ecological status is considered to be **negligible to minor negative**.

N2				Total DPO Area: 560 km² Realistic Maximum Development Scenario (% of Total Capacity): 2 GW (71%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
		Effects on water quality (for example, due to increases in suspended sediment loads and turbidity as well as an increase in pollution incidents).	Effects associated with any contamination from seabed material resuspended during construction or decommissioning activity are likely to be of localised and temporary nature, with the level of effect dependant on the level of contamination within the sediment. Effects during operation and maintenance are considered less likely. Pollution events associated with support vessels during construction and operational phases have the potential to affect water quality within N2.	Where an activity is expected to cause a significant disturbance of the seabed sediment additional contamination testing and subsequent water monitoring could be required through the marine licencing process. As part of marine licencing there is a requirement to produce pollution management plans to mitigate the effects of any pollution releases. In addition, significant releases are only likely to be associated with emergency events, considered unlikely. The residual effect is considered to be **minor negative**.
		Effects of the presence of structures on local currents, wave regimes, and water column mixing, as well as secondary effects on sedimentation and erosion beyond the sites.	There is potential for changes to hydrodynamics caused by the development of offshore wind in N2 to affect the sediment transport in the region, and subsequently to affect coastal processes. It is considered unlikely that development in N2 will significantly affect coastal processes due to the distance of the DPO from the coastline, although the effects of export cables and cable landfall should be considered at a project level. The extent of the effects will be dependent on the design of the array, the technology deployed in the DPO, the cable route, landfall location and cable design.	There is uncertainty as to the likely technology to be deployed in the DPO, and the likely array design. Appropriate assessment will be required to determine potential effects, which may include hydrodynamic and sediment transport modelling. The distance of the DPO from the land will reduce the potential effects on coastal processes (the DPO is entirely >15 km from the shoreline). The residual effect on seabed sediment and physical processes is highly dependent on the technology type and array design but is considered likely to be **negligible to minor negative**.
Climatic Factors	The key pressures on the climate are derived from the continued global emission of greenhouse gases, including carbon dioxide. These emissions are recognised as leading to changes in the global climate (including changes in temperatures, precipitation, storm density) in turn causing changes in the physical characteristics of the oceans, including potential changes in sea temperatures, circulation, salinity, pH and sea level rise.	Contribution to supporting a diverse and decarbonised energy sector.	The development of offshore wind energy in N2 can contribute to a decarbonised energy sector, reducing carbon emissions.	The effect of development of offshore wind in the DPO has the potential to be **moderate to major** positive in contributing to a diverse and decarbonised energy sector.
		Coastal facilities may be at risk from climate change.	Facilities associated with offshore wind infrastructure may be at risk from sea level rise and coastal erosion associated with climatic factors.	The design of any coastal facilities is required to account for sea level rise and coastal erosion in the design process. This is considered as part of the planning process at a project level.

N2				Total DPO Area: 560 km² Realistic Maximum Development Scenario (% of Total Capacity): 2 GW (71%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
Cultural Heritage	There are no Historic MPAs within or adjacent to N2. There is one known shipwreck within N2. The coastline inshore of N2 has a number of protected sites, including scheduled monuments and coastal built heritage.	Loss of and/or damage to historic environment features and their settings, including coastal and marine archaeology and historic MPAs.	There is potential for shipwrecks within N2 to be affected by development, principally during the construction phase. In addition coastal built heritage, coastal shipwrecks and scheduled monuments inshore of N2 have the potential to be affected by export cable routes and cable landfalls.	Effects on culturally important sites can be mitigated through careful spatial planning within N2 and through selection of appropriate cable export routes and landfall locations. As part of the design and planning process for any development within N2 survey data will be obtained, this will identify any areas of cultural or historical sensitivity within the DPO or associated with cable planning that should be avoided and therefore inform spatial planning. Based on the use of appropriate spatial planning, the residual effect on cultural heritage is therefore considered to be **negligible to minor negative**.
Landscape, Seascape, and Visual Amenity	All of N2 is beyond 15 km from inhabited shorelines.	Both temporary and longer-term effects on landscape and coastal character and visual receptors arising from the presence of structures including any ancillary infrastructure and night-time lighting of offshore structures.	The development of offshore wind in N2 has the potential to be visible and therefore may affect landscape or seascape.	There is potential to mitigate visual effects through spatial planning within the DPO to avoid areas closest to land, and through the potential to select smaller turbines in areas of higher sensitivity. The development within N2 may also require management of night-time lighting effects. The residual effect on landscape / seascape is considered to be **negligible to minor negative**.

N3

N3				Total DPO Area: 1106 km² Realistic Maximum Development Scenario (% of Total Capacity): 2 GW (36%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
Biodiversity, Flora and Fauna (Marine Mammals)	<u>Benthic Habitats and Species</u> The benthic habitat in N3 is principally sand and coarse sediment. There are, however, areas of rock / biogenic reef the north east edges of the DPO. <u>Marine Mammals</u> N3 is generally an area of low to moderate usage for marine mammals, with higher usage areas at the north eastern edge of the site. For cetaceans there is a degree of uncertainty in this conclusion, and therefore further development of the baseline through survey will be required prior to project level assessment. Areas to the south west of the DPO and to the east of the DPO are, however, areas of higher cetacean usage, and the proposed NCMPA at North East Lewis is proposed for designation for Risso's dolphin and minke whale. There is little use of the area by seals. There are several sites designated for otter in the North region. However, these sites are generally associated with the mainland or the southern Outer Hebrides and are not directly inshore of N3. <u>Birds</u> Bird usage of the area within N3 is generally considered to be low. There, however are significant bird populations to the north west of the site at the North Rona and Sula Sgeir SPA which are thought to use areas in the north east of N3 for foraging. In addition there are a potential migration routes for a range of bird species, including Whooper Swan which will intersect N3. These routes are generally	Loss of and/or damage to marine and coastal habitats, including benthic and intertidal habitats (for example, due to smothering of benthic habitats and substratum loss)	There is potential for permanent loss of habitat within the footprint of offshore wind turbines and associated scour protection and temporary damage to habitats from intra array cables. There is also potential for effects on coastal habitats inshore of N3 associated with export cables and cable landfalls.	The footprint associated with offshore wind will be dependent on the technology used and the level of scour protection required. Within N3 there is no designated sensitive habitat. Effects on coastal habitats associated with export cable routes and cable landfall will be considered at a project level and can be mitigated through careful siting. The residual effect on habitat is therefore considered to be **negligible to minor negative** in N3.
		Effects on key receptors and prey species, including disturbance, noise effects, EMF exposure, collision risk, habitat exclusion, and barriers to wildlife movement	There is potential for disturbance of marine mammal, bird and fish species particularly due to noise emissions during construction from piling activities, survey and / or clearance of unexploded ordnance. These have the potential to cause physiological damage to fish and marine mammal species, and to cause displacement of fish, marine mammals and birds from the area of effect. Potential for effects to mammals and fish are lower during the operational and decommissioning phases of the offshore wind farm life cycle. There is, however, potential for effects on fish species, from EMF exposure associated with export cables. The consequences of such effects are not well understood, however are thought to be low. The introduction of offshore wind arrays may also cause a barrier effect, by which it prevents the movement of species through the area, potentially effecting migration pathways for marine mammals, fish species and birds. There is collision risk associated with bird species using the DPO area. However, current research suggests that it is more likely that birds will be displaced from the region.	Physiological risks to fish and marine mammals from piling noise can be mitigated through the application measures relating to piling activities or soft start procedures, although fish responses to these measures are not well known and noise modelling should account for this uncertainty. In addition, noise abatement measures at source can be implemented to reduce noise transmission into the wider environment, and therefore reduce displacement effects. Further research is required to determine the effect of collision risk on bird species, however current evidence suggests that the effect through this pathway may be low for the majority of species. To determine the potential risk to bird species within N3, survey and studies should be considered at a project level, both before and after construction. There is potential for displacement of bird species and marine species outwith the DPO. N3 is not generally identified as a key foraging area, however development of the north east of the site has the potential to affect bird species foraging from the North Rona and Sula Sgeir SPA. There is potential for any effects from this

N3				Total DPO Area: 1106 km² Realistic Maximum Development Scenario (% of Total Capacity): 2 GW (36%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
	for species migrating between the UK and the Faroe Islands and Iceland. <u>Fish</u> Within N3 there are known nursery grounds for several species. This includes nursery grounds for mackerel, spurdog, whiting, blue whiting and anglerfish, all of which have wide ranging nursery grounds across Scottish waters. There are a number of migratory fish which have the potential to transit through the area, including Atlantic salmon and sea trout.			to be mitigated through spatial planning to avoid development in the north east of the DPO. The residual effect on key receptors during construction and operation in N3 is considered to be **negligible to moderate negative**.
		Effects arising from habitat modification, such as the creation of artificial reefs, new roosting structures and exclusion of habitat damaging activity.	The introduction of the wind farm turbines and scour protection have the potential to provide alternative habitat within N3, which could provide shelter for juvenile fish and crustacean shellfish. This effect has the potential to be both beneficial and adverse for different receptors. There is also the potential for activities currently damaging to the seabed habitat to be excluded from the offshore wind development area, dependent on the technology implemented, which may lead to reduced damage to existing habitats. However, if activity is displaced to a different area the effect is likely to be negligible or potentially negative.	The potential effect associated with the development of offshore wind in N3 is considered to be **negligible**, but is dependent on the technology deployed.
		Effects of pollution releases on species and habitats	Pollution events associated with support vessels during construction and operational phases have the potential to affect species within N3.	As part of marine licencing there is a requirement to produce pollution management plans to mitigate the effects of any pollution releases. In addition, significant releases are only likely to be associated with emergency events, considered unlikely. The assessment and management of pollution risks will be undertaken at a project level. The residual risk associated with pollution releases associated with offshore wind farms is considered to be **negligible**.
		Effects from introduction and spread of Invasive Non-Native Species (INNS).	Offshore wind turbine foundations and scour protection provides a new colonising surface for INNS, and support vessels during construction and operational phases have the potential to introduce INNS, which may subsequently affect indigenous species within N3.	There is a requirement for biosecurity management plans to be produced to minimise the risk of introduction of INNS. Controls will be imposed through the marine licencing process if required at a project level.

N3				Total DPO Area: 1106 km² Realistic Maximum Development Scenario (% of Total Capacity): 2 GW (36%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
				The residual risk associated with INNS associated with offshore wind farms is considered to be **minor negative**.
Population and Human Health	N3 is located offshore, with no population within 15 km. Areas within the DPO are, however, used for the purposes of commercial shipping, including close proximity to the IMO recommended deep water route to the west of the Hebrides and routes across the Atlantic, and fishing. There is a moderate level of shipping throughout the DPO, principally associated with vessels from the IMO deep water route.	Effects arising from noise, vibration, light, dust and shadow flicker effects from all phases of development	N3 is located offshore, and as such construction, operation and decommissioning of arrays within the DPO will not give rise to significant effects on populations or human health directly through noise, vibration, light, dust or shadow flicker effects. There is potential for construction activity associated with export cables and cable landfalls to affect populations, however effects are likely to be highly localised and temporary.	There is considerable uncertainty regarding potential cable landfall locations, therefore the effects on human health / populations cannot be assessed. This assessment will be undertaken at a project level, with any onshore components managed through the terrestrial planning permission process.
		Effects on residential amenity stemming from construction/installation/operational activities	N3 is located offshore, and as such the development will not directly affect residential amenity. Socio-economic impacts are considered separately to this assessment within the SEIA. There is potential for construction activity associated with export cables and cable landfalls to affect populations, however effects are likely to be highly localised and temporary.	There is considerable uncertainty regarding potential cable landfall locations, therefore the effects on human health / populations cannot be assessed. This assessment will be undertaken at a project level, with any onshore components managed through the terrestrial planning permission process.
		Issues of navigational safety and collision risk	The presence of the offshore wind turbines increases the potential for collisions between recreational or commercial vessels and offshore wind developments. This risk is greater where the offshore wind array overlaps key navigational routes.	At a project level and as part of the EIA process there is a requirement for developers to undertake a navigational risk assessment and mitigate risks to navigation from development appropriately. It is likely that, based on development of 36% of the DPO, significant spatial planning in N3 could be used to reduce effects on key routes and allow safe transit through and around the development. The residual effect on navigational safety associated with the development of N3 for offshore wind is considered to be **negligible to minor negative** dependent

N3				Total DPO Area: 1106 km² Realistic Maximum Development Scenario (% of Total Capacity): 2 GW (36%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
				on the spatial planning and turbine design of development.
		Effects on marine and coastal recreation and access (note: recreation and tourism have also been considered in the SEIA)	Socio-economic impacts, such as the displacement of activity, are considered separately to this assessment within the SEIA, however effects on navigational safety of recreational activity associated with the development of the DPO are considered above. There is potential for construction activity associated with export cables and cable landfalls to affect populations, however effects are likely to be highly localised and temporary.	There is considerable uncertainty regarding potential cable landfall locations, therefore the effects on human health / populations cannot be assessed. This assessment will be undertaken at a project level, with any onshore components managed through the terrestrial planning permission process.
		Development of a secure energy supply.	The development of 2 GW of capacity within N3 could contribute to the development of secure energy supply in the UK.	The potential benefit to UK energy security associated with the development of offshore wind in N3 is considered to be **moderate to major positive**.
Soil (namely, Marine Geology and Coastal Processes)	The seabed sediments in N3 are principally sand and coarse sediment. There are, however, areas of rock / biogenic reef at both the south west and north east edges of the DPO. N3 is a significant distance from coastlines that have the potential to be affected by changes to sediment transport associated with any development in the DPO.	Effects on subsea geology, sediments, and coastal processes arising from changes in hydrodynamics and the existing wave regime.	There is potential for changes to hydrodynamics caused by the development of offshore wind in N3, and associated export cable routes and landfalls, to affect the sediment transport around the site. This includes potential for effects on habitats such through smothering of reef habitats present within the site. The extent of the effects will be dependent on the design of the array, the technology deployed in the DPO, the cable route, landfall location and cable design.	There is uncertainty as to the likely technology to be deployed in the DPO, and the likely array design. Appropriate assessment will be required to determine potential effects, which may include hydrodynamic and sediment transport modelling. The distance of the DPO from the land will reduce the potential effects on coastal processes (the DPO is entirely >15 km from the shoreline). The residual effect on seabed sediment and physical processes is highly dependent on the technology type and array design but is considered likely to be **negligible to minor negative**.
Water Quality	Ecological status is determined for each of the surface water bodies of rivers, lakes, transitional waters and coastal waters, based on biological quality elements and supported by physico-chemical and hydromorphological quality elements.	Effects on ecological status.	The development of offshore wind farms within N3, and associated export cable routes and landfall, has the potential to affect the ecological status of the water bodies, principally due to the installation of the export cables. Effects due to the array development are considered to be unlikely due to distance factors. Any changes to the natural condition of the water bodies, particularly where currently	As part of the marine licencing process requirements are placed onto developers to ensure that activities are appropriately mitigated such that they do not cause permanent degradation of the ecological status under the WFD. The residual effect on ecological status is considered to be **negligible to minor negative**.

N3				Total DPO Area: 1106 km² Realistic Maximum Development Scenario (% of Total Capacity): 2 GW (36%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
	There are no overlapping waterbodies with N3. There is, however, one water body inshore of N3, Gallan Head to Butt of Lewis (high condition).		assessed as high quality, as at Gallan Head to Butt of Lewis, have the potential to affect the status of the water body. In addition, any direct effects on features, including those within protected areas, have the potential to affect the WFD ecological status.	
		Effects on water quality (for example, due to increases in suspended sediment loads and turbidity as well as an increase in pollution incidents).	Effects associated with any contamination from seabed material resuspended during construction or decommissioning activity are likely to be of localised and temporary nature, with the level of effect dependant on the level of contamination within the sediment. Effects during operation and maintenance are considered less likely. Pollution events associated with support vessels during construction and operational phases have the potential to affect water quality within N3.	Where an activity is expected to cause a significant disturbance of the seabed sediment additional contamination testing and subsequent water monitoring could be required through the marine licencing process. As part of marine licencing there is a requirement to produce pollution management plans to mitigate the effects of any pollution releases. In addition, significant releases are only likely to be associated with emergency events, considered unlikely. The residual effect is considered to be **minor negative**.
		Effects of the presence of structures on local currents, wave regimes, and water column mixing, as well as secondary effects on sedimentation and erosion beyond the sites.	There is potential for changes to hydrodynamics caused by the development of offshore wind in N3 to affect the sediment transport in the region, and subsequently to affect coastal processes. It is considered unlikely that development in N3 will significantly affect coastal processes due to the distance of the DPO from the coastline, although the effects of export cables and cable landfall should be considered at a project level. The extent of the effects will be dependent on the design of the array, the technology deployed in the DPO, the cable route, landfall location and cable design.	There is uncertainty as to the likely technology to be deployed in the DPO, and the likely array design. Appropriate assessment will be required to determine potential effects, which may include hydrodynamic and sediment transport modelling. The distance of the DPO from the land will reduce the potential effects on coastal processes (the DPO is entirely >15 km from the shoreline). The residual effect on seabed sediment and physical processes is highly dependent on the technology type and array design but is considered likely to be **negligible to minor negative**.
Climatic Factors	The key pressures on the climate are derived from the continued global emission of greenhouse gases, including carbon dioxide. These emissions are	Contribution to supporting a diverse and decarbonised energy sector.	The development of offshore wind energy in N3 can contribute to a decarbonised energy sector, reducing carbon emissions.	The effect of development of offshore wind in the DPO has the potential to be **major positive** in contributing to a diverse and decarbonised energy sector.

N3				Total DPO Area: 1106 km² Realistic Maximum Development Scenario (% of Total Capacity): 2 GW (36%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
	recognised as leading to changes in the global climate (including changes in temperatures, precipitation, storm density) in turn causing changes in the physical characteristics of the oceans, including potential changes in sea temperatures, circulation, salinity, pH and sea level rise.	Coastal facilities may be at risk from climate change.	Facilities associated with offshore wind infrastructure may be at risk from sea level rise and coastal erosion associated with climatic factors.	The design of any coastal facilities is required to account for sea level rise and coastal erosion in the design process. This is considered as part of the planning process at a project level.
Cultural Heritage	There are no Historic MPAs within or adjacent to N3. There are four known shipwrecks within N3. The coastline inshore of N3 has a number of protected sites, including scheduled monuments and coastal built heritage.	Loss of and/or damage to historic environment features and their settings, including coastal and marine archaeology and historic MPAs.	There is potential for shipwrecks within N3 to be affected by development, principally during the construction phase. In addition coastal built heritage, coastal shipwrecks and scheduled monuments inshore of N3 have the potential to be affected by export cable routes and cable landfalls.	Effects on culturally important sites can be mitigated through careful spatial planning within N3 and through selection of appropriate cable export routes and landfall locations. As part of the design and planning process for any development within N3, survey data will be obtained, this will identify any areas of cultural or historical sensitivity within the DPO or associated with cable planning that should be avoided and therefore inform spatial planning. Based on the use of appropriate spatial planning, the residual effect on cultural heritage is therefore considered to be **negligible to minor negative**.
Landscape, Seascape, and Visual Amenity	All of N3 is beyond 15 km from inhabited shorelines.	Both temporary and longer-term effects on landscape and coastal character and visual receptors arising from the presence of structures including any ancillary infrastructure and night-time lighting of offshore structures.	The development of offshore wind in N3 has the potential to be visible from land and hence effect landscape / seascapes.	There is potential to mitigate visual effects through spatial planning within the DPO to avoid areas closest to land, and through the potential to select smaller turbines in areas of higher sensitivity. The development within N3 may also require management of night-time lighting effects. The residual effect on landscape / seascape is considered to be **negligible to minor negative**.

N4

N4				**Total DPO Area: 200 km²** **Realistic Maximum Development Scenario (% of Total Capacity): 1 GW (100%)**
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
Biodiversity, Flora and Fauna (Marine Mammals)	<u>Benthic Habitats and Species</u> The benthic habitat in N4 is principally sand and coarse sediment. There are, however, areas of rock / biogenic reef towards all four boundaries of the DPO. There are areas of designated sensitive habitats inshore of the DPO within Loch Roag. <u>Marine Mammals</u> N4 is generally an area of moderate usage for cetaceans, albeit there is a degree of uncertainty in this conclusion, and therefore further development of the baseline through survey will be required prior to project level assessment. Areas to the east of the DPO are, however, areas of higher cetacean usage, and the proposed NCMPA at North East Lewis is proposed for designation for Risso's dolphin and minke whale. There is some usage of the DPO by both grey and harbour seals, although the majority of higher use areas are south west of N4. There are several sites designated for otter in the North region. However, these sites are generally associated with the mainland or the southern Outer Hebrides, and are not directly inshore of N4. <u>Birds</u> Bird usage of the area within N4 is generally considered to be low. However, there are known breeding colonies around Lewis, and birds from these colonies have the potential to be found within N4. In addition there are a potential migration routes for a range of bird species, including Whooper Swan which will intersect N4. These routes are generally	Loss of and/or damage to marine and coastal habitats, including benthic and intertidal habitats (for example, due to smothering of benthic habitats and substratum loss)	There is potential for permanent loss of habitat within the footprint of offshore wind turbines and associated scour protection and temporary damage to habitats from intra array cables. There is also potential for effects on coastal habitats inshore of N4 associated with export cables and cable landfalls.	The footprint associated with offshore wind will be dependent on the technology used and the level of scour protection required. Within N4 there is no designated sensitive habitat. Effects on coastal habitats associated with export cable routes and cable landfall will be considered at a project level and can be mitigated through careful siting. The residual effect on habitat is therefore considered to be **minor negative** in N4.
		Effects on key receptors and prey species, including disturbance, noise effects, EMF exposure, collision risk, habitat exclusion, and barriers to wildlife movement	There is potential for disturbance of marine mammal, bird and fish species particularly due to noise emissions during construction from piling activities, survey and / or clearance of unexploded ordnance. These have the potential to cause physiological damage to fish and marine mammal species, and to cause displacement of fish, marine mammals and birds from the area of effect. Potential for effects to mammals and fish are lower during the operational and decommissioning phases of the offshore wind farm life cycle. There is, however, potential for effects on fish species, from EMF exposure associated with export cables. The consequences of such effects are not well understood, however are thought to be low. The introduction of offshore wind arrays may also cause a barrier effect, by which it prevents the movement of species through the area, potentially effecting migration pathways for marine mammals, fish species and birds. There is collision risk associated with bird species using the DPO area. However, current research suggests that it is more likely that birds will be displaced from the region.	Physiological risks to fish and marine mammals from piling noise can be mitigated through the application measures relating to piling activities or soft start procedures, although fish responses to these measures are not well known and noise modelling should account for this uncertainty. In addition, noise abatement measures at source can be implemented to reduce noise transmission into the wider environment, and therefore reduce displacement effects. Further research is required to determine the effect of collision risk on bird species, however current evidence suggests that the effect through this pathway may be low for the majority of species. To determine the potential risk to bird species within N4, survey and studies should be considered at a project level, both before and after construction. There is potential for displacement of bird species and marine species outwith the DPO. However, N4 is not generally identified as a key foraging area. The residual effect on key receptors during construction and operation in N4 is considered to be **negligible to minor negative**.

N4				Total DPO Area: 200 km² Realistic Maximum Development Scenario (% of Total Capacity): 1 GW (100%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
	for species migrating between the UK and the Faroe Islands and Iceland. <u>Fish</u> Within N4 there are known nursery grounds for several species. This includes nursery grounds for mackerel, spurdog, whiting, blue whiting and anglerfish, all of which have wide ranging nursery grounds across Scottish waters. There are a number of migratory fish which have the potential to transit through the area, including Atlantic salmon and sea trout.	Effects arising from habitat modification, such as the creation of artificial reefs, new roosting structures and exclusion of habitat damaging activity.	The introduction of the wind farm turbines and scour protection have the potential to provide alternative habitat within N4, which could provide shelter for juvenile fish and crustacean shellfish. This effect has the potential to be both beneficial and adverse for different receptors. There is also the potential for activities currently damaging to the seabed habitat to be excluded from the offshore wind development area, dependent on the technology implemented, which may lead to reduced damage to existing habitats. However, if activity is displaced to a different area the effect is likely to be negligible or potentially negative.	The potential effect associated with the development of offshore wind in N4 is considered to be **negligible**, but is dependent on the technology deployed.
		Effects of pollution releases on species and habitats	Pollution events associated with support vessels during construction and operational phases have the potential to affect species within N4.	The residual risk associated with pollution releases associated with offshore wind farms is considered to be **negligible**.
		Effects from introduction and spread of Invasive Non-Native Species (INNS).	Offshore wind turbine foundations and scour protection provides a new colonising surface for INNS, and support vessels during construction and operational phases have the potential to introduce INNS, which may subsequently affect indigenous species within N3.	There is a requirement for biosecurity management plans to be produced to minimise the risk of introduction of INNS. Controls will be imposed through the marine licencing process if required at a project level. The residual risk associated with INNS associated with offshore wind farms is considered to be **minor negative**.
Population and Human Health	N4 is located close inshore, with the entire DPO within 15 km of the coast. There are a number of small settlements on the west coast of Lewis which will be directly inshore of N4. There are further potentially sensitive receptors on coastlines adjacent to N4, including a primary school and several churches. Areas within the DPO are, additionally, used for the purposes of commercial shipping, including close proximity inshore of the IMO recommended deep water route to the west of the Hebrides, recreational boating and fishing. There is	Effects arising from noise, vibration, light, dust and shadow flicker effects from all phases of development	N4 is located inshore, with the closest point less than 3 km from land. As such, the turbines have the potential to affect populations or human health directly through noise, vibration, light, dust or shadow flicker effects. There is potential for construction activity associated with export cables and cable landfalls to affect populations, however effects are likely to be highly localised and temporary.	Airborne noise assessments will be undertaken at a project level. It is likely that piling noise during construction will affect local populations, and as such temporal restrictions on piling activity to avoid antisocial hours could be considered. In addition different turbine designs will require different degrees of piling, and therefore consideration of foundation design has the potential to reduce airborne noise. Flicker effects are considered to have a potential effect within ten times the radius of the turbine, therefore effects could be

N4				Total DPO Area: 200 km² Realistic Maximum Development Scenario (% of Total Capacity): 1 GW (100%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
	a moderate level of shipping throughout the DPO, principally associated with vessels from the IMO deep water route.			mitigated through consideration of turbine size within the DPO. There is considerable uncertainty regarding potential cable landfall locations, therefore the effects on human health / populations cannot be assessed. This assessment will be undertaken at a project level, with any onshore components managed through the terrestrial planning permission process. The residual effect from development of N4 is considered to be **minor negative to major negative** dependant on the turbine and foundation designs, and the level of mitigation applied.
		Effects on residential amenity stemming from construction/installation/operational activities	N4 is located offshore, and as such Effects on residential amenity are restricted to visual effects, considered separately below. Socio-economic impacts are considered separately to this assessment within the SEIA. There is potential for construction activity associated with export cables and cable landfalls to affect populations, however effects are likely to be highly localised and temporary.	There is considerable uncertainty regarding potential cable landfall locations, therefore the effects on human health / populations cannot be assessed. This assessment will be undertaken at a project level, with any onshore components managed through the terrestrial planning permission process.
		Issues of navigational safety and collision risk	The presence of the offshore wind turbines increases the potential for collisions between recreational or commercial vessels and offshore wind developments. There is potential for vessels encountering severe weather in the recommended deep water shipping route to be forced into areas closer to the coast, including areas within N4. This risk is greater where the offshore wind array overlaps key navigational routes.	At a project level and as part of the EIA process there is a requirement for developers to undertake a navigational risk assessment and mitigate risks to navigation from development appropriately. There is considered to be very little opportunity for spatial planning in N4 to reduce effects. N4 is inshore of major deep water shipping routes and overlaps with recreational boating informal routes, which, based on the maximum likely development of 100% of the area, are unlikely to be avoided. The residual effect on navigational safety associated with the development of N4 for offshore wind is considered to be **minor**

N4				Total DPO Area: 200 km² Realistic Maximum Development Scenario (% of Total Capacity): 1 GW (100%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
				negative to moderate negative dependent on the spatial planning and turbine design of development.
		Effects on marine and coastal recreation and access (note: recreation and tourism have also been considered in the SEIA)	Socio-economic impacts, such as the displacement of activity, are considered separately to this assessment within the SEIA, however effects on navigational safety of recreational activity associated with the development of the DPO are considered above. There is potential for construction activity associated with export cables and cable landfalls to affect populations, however effects are likely to be highly localised and temporary.	There is considerable uncertainty regarding potential cable landfall locations, therefore the effects on human health / populations cannot be assessed. This assessment will be undertaken at a project level, with any onshore components managed through the terrestrial planning permission process.
		Development of a secure energy supply.	The development of 1 GW of capacity within N4 could contribute to the development of secure energy supply in the UK.	The potential benefit to UK energy security associated with the development of offshore wind in N4 is considered to be **moderate to major positive**.
Soil (namely, Marine Geology and Coastal Processes)	The seabed sediments in N4 are principally sand and coarse sediment. There are, however, areas of rock / biogenic reef towards all four boundaries of the DPO. N4 is in an inshore location, with the closest point 3 km from the coastline. The coastline inshore of N4 is dominated by hard rock and cliffs with low coastal erosion potential, with some areas of natural beach.	Effects on subsea geology, sediments, and coastal processes arising from changes in hydrodynamics and the existing wave regime.	There is potential for changes to hydrodynamics caused by the development of offshore wind in N4, and associated cable export routes and landfall, to affect the sediment transport around the site and coastal processes. This includes potential for effects on habitats such through smothering of reef habitats present within the site. The extent of the effects will be dependent on the design of the array, the technology deployed in the DPO, the cable route, landfall location and cable design.	There is uncertainty as to the likely technology to be deployed in the DPO, and the likely array design. Appropriate assessment will be required to determine potential effects, which is expected to include hydrodynamic and sediment transport modelling to confirm and validate any effects on coastal processes associated with coastlines adjacent to the DPO. The residual effect on seabed sediment and physical processes is highly dependent on the technology type and array design but is considered likely to be **negligible to moderate** negativ**e**.
Water Quality	Ecological status is determined for each of the surface water bodies of rivers, lakes, transitional waters and coastal waters, based on biological quality elements and supported by physico-chemical and hydromorphological quality elements.	Effects on ecological status.	Offshore wind development within N4, and associated export cable routes and landfall, has the potential to affect the ecological status of the Gallan Head to Butt of Lewis water body. Any changes to the natural condition of the water body, particularly where currently assessed as high quality, have the potential to affect the status of the water body.	As part of the marine licencing process requirements are placed onto developers to ensure that activities are appropriately mitigated such that they do not cause permanent degradation of the ecological status under the WFD. The residual effect on ecological status is considered to be **negligible to minor negative**.

N4				Total DPO Area: 200 km² Realistic Maximum Development Scenario (% of Total Capacity): 1 GW (100%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
	N4 overlaps with one coastal water body, Gallan Head to Butt of Lewis (high condition).		In addition, any direct effects on features, including those within protected areas, have the potential to affect the WFD ecological status.	
		Effects on water quality (for example, due to increases in suspended sediment loads and turbidity as well as an increase in pollution incidents).	Effects associated with any contamination from seabed material resuspended during construction or decommissioning activity are likely to be of localised and temporary nature, with the level of effect dependant on the level of contamination within the sediment. Effects during operation and maintenance are considered less likely. Pollution events associated with support vessels during construction and operational phases have the potential to affect water quality within N4.	Where an activity is expected to cause a significant disturbance of the seabed sediment additional contamination testing and subsequent water monitoring could be required through the marine licencing process. As part of marine licencing there is a requirement to produce pollution management plans to mitigate the effects of any pollution releases. In addition, significant releases are only likely to be associated with emergency events, considered unlikely. The residual effect is considered to be **minor negative**.
		Effects of the presence of structures on local currents, wave regimes, and water column mixing, as well as secondary effects on sedimentation and erosion beyond the sites.	There is potential for changes to hydrodynamics caused by the development of offshore wind in N4 to affect the sediment transport in the region, and subsequently to affect coastal processes. The extent of the effects will be dependent on the design of the array, the technology deployed in the DPO, the cable route, landfall location and cable design.	There is uncertainty as to the likely technology to be deployed in the DPO, and the likely array design. Appropriate assessment will be required to determine potential effects, which is expected to include hydrodynamic and sediment transport modelling. The residual effect on seabed sediment and physical processes is highly dependent on the technology type and array design but is considered likely to be **negligible to moderate negative**.
Climatic Factors	The key pressures on the climate are derived from the continued global emission of greenhouse gases, including carbon dioxide. These emissions are recognised as leading to changes in the global climate (including changes in temperatures, precipitation, storm density) in turn causing changes in the physical characteristics of the oceans, including potential changes in sea temperatures, circulation, salinity, pH and sea level rise.	Contribution to supporting a diverse and decarbonised energy sector.	The development of offshore wind energy in N4 can contribute to a decarbonised energy sector, reducing carbon emissions.	The effect of development of offshore wind in the DPO has the potential to be **moderate to major positive** in contributing to a diverse and decarbonised energy sector.
		Coastal facilities may be at risk from climate change.	Facilities associated with offshore wind infrastructure may be at risk from sea level rise and coastal erosion associated with climatic factors.	The design of any coastal facilities is required to account for sea level rise and coastal erosion in the design process. This is considered as part of the planning process at a project level.

N4				Total DPO Area: 200 km² Realistic Maximum Development Scenario (% of Total Capacity): 1 GW (100%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
Cultural Heritage	There are no Historic MPAs within or adjacent to N4. There are no known shipwrecks within N4. The coastline inshore of N4 has a number of protected sites, including scheduled monuments and coastal built heritage.	Loss of and/or damage to historic environment features and their settings, including coastal and marine archaeology and historic MPAs.	There is potential for any unknown shipwrecks within N4 to be affected by development, principally during the construction phase. In addition coastal built heritage, coastal shipwrecks and scheduled monuments inshore of N4 have the potential to be affected by the export cable routes and cable landfalls.	Effects on culturally important sites can be mitigated through array design within N4 and through selection of appropriate cable export routes and landfall locations. As part of the design and planning process for any development within N4, survey data will be obtained, this will identify any areas of cultural or historical sensitivity within the DPO or associated with cable planning that should be avoided. Based on the acquisition and application of survey data during the site design stage, the effect on cultural heritage is considered to be **negligible to minor negative**.
Landscape, Seascape, and Visual Amenity	All of N4 is within 15 km from inhabited shorelines, with the closest areas approximately 3 km from land. The coastline landwards of N4 is assessed as being of medium sensitivity. There is a NSA to the south of the DPO, from which the turbines would be likely to be visible.	Both temporary and longer-term effects on landscape and coastal character and visual receptors arising from the presence of structures including any ancillary infrastructure and night-time lighting of offshore structures.	The development of offshore wind in N4 will have significant visual effects in areas assessed as of medium sensitivity with some effects on views from the South Lewis, Harris and North Uist NSA. There are a number of residential areas with views from the coastline towards N4, whose visual amenity would be affected.	There is potential for the turbine size to be reduced, in order to partially mitigate visual effects. However, even smaller turbines will affect the visual amenity of the local population and affect the seascape. The development within N4 will require the application of SNH guidance on management of night-time lighting effects. The residual effect is considered to be **moderate negative to major negative**. However it should be noted that this is, to a degree, a subjective topic and therefore local engagement and acceptance of development within N4 has the potential to alter the significance of the effect.

C.4 North East

NE1

NE1				Total DPO Area: 776 km² Realistic Maximum Development Scenario (% of Total Capacity): 2 GW (52%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
Biodiversity, Flora and Fauna (Marine Mammals)	<u>Benthic Habitats and Species</u> The benthic habitat in NE1 is mostly sandy sediment, with areas of coarse sediment to the west. There is no sensitive (priority marine feature) habitat identified within NE1, however there is potential for the presence of examples of the features identified in the Pobie Bank Reef SAC to be present within the DPO. There are sensitive habitats inshore of the DPO, including those associated with the Pobie Bank Reef SAC. It supports fauna that is usually associated with rocky reefs including an extensive community of encrusting and robust sponges and bryozoans.	Loss of and/or damage to marine and coastal habitats, including benthic and intertidal habitats (for example, due to smothering of benthic habitats and substratum loss).	There is potential for permanent loss of habitat within the footprint of offshore wind turbines and associated scour protection and temporary damage to habitats from intra array cables. There is no identified habitat of particular sensitivity within NE1 which would be affected by this pathway, however the sandy sediments may be of importance for fish spawning. There is potential for effects on habitats inshore of NE1 associated with export cables and cable landfalls. This includes potential effects on the habitats designated for the Pobie Bank Reef SAC.	The footprint associated with offshore wind will be dependent on the technology used and the level of scour protection required. There are no particularly sensitive habitats which will be affected in NE1, and sediment and hydrodynamic modelling will be required to assess any potential effects on the Pobie Reef Bank SAC features. Effects on habitats associated with export cable routes and cable landfall will be considered at a project level and can be mitigated through careful siting. The residual effect on habitat is therefore considered to be **moderate negative** in NE1 due to the proximity of the DPO to the Pobie Bank Reef SAC.
	<u>Marine Mammals</u> There are known populations of harbour and grey seal in the Shetland Islands. Cetacean usage of the seas around the Shetland Islands is generally concentrated to the west of the islands, with the exception of harbour porpoise populations, for which high encounter rates are observed throughout the islands. Other cetaceans known to extensively use the seas around the Shetland Islands include minke whale, white beaked dolphin, Atlantic white-sided dolphin, Risso's dolphin, killer whale and sperm whale. Yell Sounds which is inland from NE1 is used by otters. <u>Birds</u> Bird usage of the area within NE1 is generally low. However, there are important populations of sensitive species, including Arctic skua, Arctic tern, dunlin, fulmar, great skua, red-necked	Effects on key mobile receptors and prey species, including disturbance, noise effects, EMF exposure, collision risk, habitat exclusion, and barriers to wildlife movement.	There is potential for disturbance of marine mammal, bird and fish species particularly due to noise emissions during construction from piling activities, survey and / or clearance of unexploded ordnance. These have the potential to cause physiological damage to fish and marine mammal species, and to cause displacement of fish, marine mammals and birds from the area of effect. Potential for effects to mammals and fish are lower during the operational and decommissioning phases of the offshore wind farm life cycle. There is, however, potential for effects on fish species, from EMF exposure associated with export cables. The consequences of such effects are not well understood, however are thought to be low. The introduction of offshore wind arrays may also cause a barrier effect, preventing the movement of species through the area, potentially affecting	Effects on fish (particularly species using the DPO for spawning) can be mitigated through temporal restrictions on piling activities. Physiological risks to fish and marine mammals from piling noise can be mitigated through the application measures relating to piling activities or soft start procedures, although fish responses to these measures are not well known and noise modelling should account for this uncertainty. In addition, noise abatement measures at source can be implemented to reduce noise transmission into the wider environment, and therefore reduce displacement effects. Further research is required to determine the effect of collision risk on bird species, however current evidence suggests that the effect through this pathway may be low for the majority of species. To determine the potential risk to migrating

NE1				Total DPO Area: 776 km² Realistic Maximum Development Scenario (% of Total Capacity): 2 GW (52%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
	phalarope, whimbrel, red throated diver, Kittiwake, puffin, Guillemot and Gannets which are resident on the Shetland Islands to the west of the DPO. In addition, there are a number of migration routes which have the potential to intersect with NE1. These routes are generally for species migrating between the UK and Scandinavia. <u>Fish</u> Within NE1 there are known spawning and nursery grounds for several species. This includes spawning grounds for herring, cod and whiting. Shetland has populations of fish which are commercially important. There are also a number of migratory fish which have the potential to transit through the area on transit to UK rivers.		migration pathways for marine mammals, fish species and birds. There are hotspots associated with the colonies in the south of the Shetland Islands, and the Sumburgh Head SPA site, and areas of high recordings overlap into the south-eastern extent of AoS NE1	species in NE1, studies should be undertaken at a project level, both before and after construction. There is potential for displacement of bird and marine species outwith the DPO, which has the potential to affect important populations of foraging birds. The residual effect on key receptors during construction and operation in NE1 is considered to be **minor negative to moderate negative**.
		Effects arising from habitat modification, such as the creation of artificial reefs, new roosting structures and exclusion of habitat damaging activity.	The introduction of the wind farm turbines and scour protection have the potential to provide alternative habitat within NE1, which could provide shelter for juvenile fish and crustacean shellfish. This effect has the potential to be both beneficial and adverse for different receptors. There is also the potential for activities currently damaging to the seabed habitat to be excluded from the offshore wind development area, dependent on the technology implemented, which may lead to reduced damage to existing habitats. However, if activity is displaced to a different area the effect is likely to be negligible or potentially negative.	The potential effect associated with the development of offshore wind in NE1 is considered to be **negligible**, but is dependent on the technology deployed.
		Effects of pollution releases on species and habitats.	Pollution events associated with support vessels during construction and operational phases have the potential to affect species within NE1.	As part of marine licencing there is a requirement to produce pollution management plans to mitigate the effects of any pollution releases. In addition, significant releases are only likely to be associated with emergency events, considered unlikely. The assessment and management of pollution risks will be undertaken at a project level. The residual risk associated with pollution releases associated with offshore wind farms is considered to be **negligible**.
		Effects from introduction and spread of Invasive Non-Native Species (INNS).	Offshore wind turbine foundations and scour protection provides a new colonising surface for INNS, and support vessels during construction and operational phases have the potential to	There is a requirement for biosecurity management plans to be produced to minimise the risk of introduction of INNS. Controls will be imposed through the

NE1				Total DPO Area: 776 km² Realistic Maximum Development Scenario (% of Total Capacity): 2 GW (52%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
			introduce INNS, which may subsequently affect indigenous species within NE1.	marine licencing process if required at a project level. The residual risk associated with INNS associated with offshore wind farms is considered to be **minor negative**.
Population and Human Health	Due to the offshore nature of the NE1 DPO there are no significant populations directly adjacent to the DPO. The coastline landwards of NE1 is generally sparsely populated, with a few small settlements. Areas within the DPO are, however, used for the purposes of commercial shipping and recreational boating. There is an overall moderate density of commercial shipping throughout the DPO but no clearly defined key routes. The DPO is intersected by a RYA informal cruising route.	Effects arising from noise, vibration, light, dust and shadow flicker effects from all phases of development.	NE1 is located offshore, and as such construction, operation and decommissioning of arrays within the DPO will not give rise to significant effects on populations or human health directly through noise, vibration, light, dust or shadow flicker effects. There is potential for construction activity associated with export cables and cable landfalls to affect populations, however effects are likely to be highly localised and temporary.	There is considerable uncertainty regarding potential cable landfall locations, therefore the effects on human health / populations cannot be assessed. This assessment will be undertaken at a project level, with any onshore components managed through the terrestrial planning permission process.
		Effects on residential amenity stemming from construction/installation/operational activities.	NE1 is located offshore, and as such the development will not directly affect residential amenity. Socio-economic impacts are considered separately to this assessment within the SEIA. There is potential for construction activity associated with export cables and cable landfalls to affect populations, however effects are likely to be highly localised and temporary.	There is considerable uncertainty regarding potential cable landfall locations, therefore the effects on human health / populations cannot be assessed. This assessment will be undertaken at a project level, with any onshore components managed through the terrestrial planning permission process.
		Issues of navigational safety, aviation and collision risk.	The presence of the offshore wind turbines increases the potential for collisions between recreational or commercial vessels and offshore wind development. This risk is greater where the offshore wind array overlaps key navigational routes.	At the project level and as part of the EIA process there is a requirement for developers to undertake a navigational risk assessment and mitigate risks to navigation from development. It is likely that, based on development of 52% of the DPO area, some spatial planning in NE1 could be used to reduce effects on key shipping routes and allow safe transit. The residual effect on navigational safety associated with the development of NE1 for offshore wind is considered to be **negligible to minor negative** dependent

NE1				Total DPO Area: 776 km² Realistic Maximum Development Scenario (% of Total Capacity): 2 GW (52%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
				on the spatial planning and turbine design of development**.**
		Effects on marine and coastal recreation and access	Socio-economic impacts, such as the displacement of activity, are considered separately to this assessment within the SEIA, however effects on navigational safety of recreational activity associated with the development of the DPO are considered above. There is potential for construction activity associated with export cables and cable landfalls to affect populations, however effects are likely to be highly localised and temporary.	There is considerable uncertainty regarding potential cable landfall locations, therefore the effects on human health / populations cannot be assessed. This assessment will be undertaken at a project level, with any onshore components managed through the terrestrial planning permission process.
		Development of a secure energy supply.	The development of 2 GW of capacity within NE1 could contribute to the development of secure energy supply in the UK.	The potential benefit to UK energy security associated with the development of offshore wind in NE1 is considered to be **moderate to major positive.**
Soil (namely, Marine Geology and Coastal Processes)	The seabed sediments in SW1 are mostly sandy, with areas of coarse sediment to the west and designated benthic habitat adjacent to the western boundary associated with the Pobie Bank Reef SAC. The coastline facing NE1 is hard rock / cliff in more exposed locations, with softer coastline more susceptible to coastal erosion in more sheltered locations and within bays. There are also natural beaches and harbours.	Effects on subsea geology, sediments, and coastal processes arising from changes in hydrodynamics and the existing wave regime.	There is potential for changes to hydrodynamics caused by the development of offshore wind in NE1, and associated export cable routes and landfall, to affect the sediment transport and coastal processes. The extent of the effects will be dependent on the design of the array, the technology deployed in the DPO, the cable route, landfall location and cable design.	There is uncertainty as to the technology to be deployed in the DPO, and the array design. Hydrodynamic and sediment transport modelling will be required at a project level to confirm and validate the potential effects on the seabed sediments and coastal processes. The residual effect on marine geology and coastal processes is highly dependent on the technology type and array design but is considered likely to be **negligible to moderate negative** due to the potential for effects on the Pobie Bank Reef SAC.
Water Quality	Ecological status is determined for each of the surface water bodies of rivers, lakes, transitional waters and coastal waters, based on biological quality elements and supported by physico-chemical and hydromorphological quality elements. There are three water bodies adjacent to NE1, Herma Ness to Heoga Ness (good condition), Heoga Ness to The Keen	Effects on ecological status.	Offshore wind development within NE1, and associated export cable routes and landfall, has the potential to affect the ecological status of the water bodies, principally through changes caused to the hydrological regime. In addition, any direct effects on features, including those within protected areas, have the potential to affect the WFD ecological status.	As part of the marine licencing process requirements are placed onto developers to ensure that activities are appropriately mitigated such that they do not cause permanent degradation of the ecological status under the WFD. The residual effect on ecological status is considered to be **negligible to minor negative**.
		Effects on water quality (for example, due to increases in suspended sediment loads	Effects associated with any contamination from seabed material resuspended during	Where an activity is expected to cause a significant disturbance of the seabed

NE1				Total DPO Area: 776 km² Realistic Maximum Development Scenario (% of Total Capacity): 2 GW (52%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
	(good condition), The Kenn to Isle of Noss (good condition).	and turbidity as well as an increase in pollution incidents).	construction or decommissioning activity are likely to be of localised and temporary nature, with the level of effect dependant on the level of contamination within the sediment. Effects during operation and maintenance are considered less likely. Pollution events associated with support vessels during construction and operational phases have the potential to affect water quality within NE1.	sediment additional contamination testing and subsequent water monitoring could be required through the marine licencing process. As part of marine licencing there is a requirement to produce pollution management plans to mitigate the effects of any pollution releases. In addition, significant releases are only likely to be associated with emergency events, considered unlikely. The assessment and management of pollution risks will be undertaken at a project level. The residual effect is considered to be **minor negative**.
		Effects of the presence of structures on local currents, wave regimes, and water column mixing, as well as secondary effects on sedimentation and erosion beyond the sites.	There is potential for changes to hydrodynamics caused by the development of offshore wind in NE1 to affect the sediment transport and coastal processes. The extent of the effects will be dependent on the design of the array, the technology deployed in the DPO, the cable route, landfall location and cable design.	There is uncertainty as to the likely technology to be deployed in the DPO, and the likely array design, therefore it is expected that hydrodynamic and sediment transport modelling would be required at a project level to determine the potential effects on the seabed sediments and coastal processes, particularly with regards to any effects on the Pobie Bank Reef SAC features. The residual effect on seabed sediment and physical processes is highly dependent on the technology type and array design but is considered likely to be **negligible to moderate negative**.
Climatic Factors	The key pressures on the climate are derived from the continued global emission of greenhouse gases, including carbon dioxide. These emissions are recognised as leading to changes in the global climate (including changes in temperatures, precipitation, storm density) in turn causing changes in the physical characteristics of the oceans, including potential changes in sea temperatures, circulation, salinity, pH and sea level rise.	Contribution to supporting a diverse and decarbonised energy sector.	The development of offshore wind energy in NE1 can contribute to a decarbonised energy sector, reducing carbon emissions.	The effect of development of offshore wind in the DPO has the potential to be **moderate to major positive** in contributing to a diverse and decarbonised energy sector.
		Coastal facilities may be at risk from climate change.	Facilities associated with offshore wind infrastructure may be at risk from sea level rise and coastal erosion associated with climatic factors.	The design of any coastal facilities is required to account for sea level rise and coastal erosion in the design process. This is considered as part of the planning process at a project level.
Cultural Heritage	There is a Historic MPA adjacent to NE1. There are 6 known shipwrecks within NE1.	Loss of and/or damage to historic environment features and their settings,	There is potential for shipwrecks within NE1 to be affected by development, principally during the construction phase.	Effects on culturally important sites can be mitigated through careful spatial planning within NE1 and through selection of

NE1				Total DPO Area: 776 km² Realistic Maximum Development Scenario (% of Total Capacity): 2 GW (52%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
	The coastline inshore of NE1 has a number of protected sites, including scheduled monuments and coastal built heritage. There is potential for palaeolandscape to be present around Shetland and therefore potential for submerged archaeological remains.	including coastal and marine archaeology and historic MPAs.	In addition, coastal built heritage, coastal shipwrecks and scheduled monuments inshore of NE1 have the potential to be affected by export cable routes and cable landfalls. Submerged archaeological remains inshore of NE1 associated with palaeolandscape also have the potential to be affected by export cable routes and cable landfalls.	appropriate cable export routes and landfall locations. As part of the design and planning process for any development within NE1, survey data will be obtained. This will identify any areas of cultural or historical sensitivity within the DPO that should be avoided and therefore inform spatial planning. Based on the use of appropriate spatial planning, the residual effect on cultural heritage is therefore considered to be **negligible to minor negative**.
Landscape, Seascape, and Visual Amenity	0% of NE1 is within 15 km of coastline. The closest point is 18km from land.	Both temporary and longer-term effects on landscape and coastal character and visual receptors arising from the presence of structures including any ancillary infrastructure and night-time lighting of offshore structures.	The development of offshore wind farms in NE1 is considered unlikely to significantly affect landscape, seascape or visual amenity, however larger turbines have the potential to be visible from land.	There is potential to mitigate visual effects through spatial planning within the DPO to avoid areas closest to land, and through the potential to select smaller turbines in areas of higher sensitivity. The development within NE1 may also require management of night-time lighting effects. The residual effect on landscape / seascape is considered to be **negligible to minor negative**.

NE2

NE2				Total DPO Area: 464 km² Realistic Maximum Development Scenario (% of Total Capacity): 1 GW (43%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
Biodiversity, Flora and Fauna (Marine Mammals)	<u>Benthic Habitats and Species</u> The benthic habitat in NE2 is sandy throughout with a small area of rock towards the western boundary. There are no known sensitive species within the DPO, however the presence of fan mussel beds is recorded immediately west of the western boundary, and as such there is potential for their presence within the DPO. There are further areas of designated sensitive habitats inshore of the DPO, with Sanday SAC in the Orkney Islands designated for mudflats / sandflats, reefs and subtidal sandflats. <u>Marine Mammals</u> Cetacean density within NE2 is currently thought to be low overall, albeit this conclusion requires confirmation through survey prior to project level assessment. There is likely usage of the DPO by marine mammals, principally grey seal associated with foraging from haul out sites and breeding colonies in the Orkney Islands. The Sanday SAC in the Orkney Islands is also designated for harbour seal, the populations of which are currently in decline in the region. <u>Birds</u> Bird usage of the area within NE2 is generally low. However there are important populations of sensitive species, including Black Legged Kittiwake associated with the breeding colony in the Copinsay SPA (~10,000 breeding pairs). There are some migration routes for a range of bird species which have the potential to intersect NE2. These routes	Loss of and/or damage to marine and coastal habitats, including benthic and intertidal habitats (for example, due to smothering of benthic habitats and substratum loss).	There is potential for permanent loss of habitat within the footprint of offshore wind turbines and associated scour protection and temporary damage to habitats from intra array cables. There is also potential for effects on coastal habitats inshore of NE2 associated with export cables and cable landfalls.	The footprint associated with offshore wind will be dependent on the technology used and the level of scour protection required. Effects on coastal habitats associated with export cable routes and cable landfall will be considered at a project level and can be mitigated through careful siting. The residual effect on habitat is therefore considered to be **negligible to minor negative** in NE2.
		Effects on key receptors and prey species, including disturbance, noise effects, EMF exposure, collision risk, habitat exclusion, and barriers to wildlife movement	There is potential for disturbance of marine mammal, bird and fish species particularly due to noise emissions during construction from piling activities, survey and / or clearance of unexploded ordnance. These have the potential to cause physiological damage to fish and marine mammal species, and to cause displacement of fish, marine mammals and birds from the area of effect. Potential for effects to mammals and fish are lower during the operational and decommissioning phases of the offshore wind farm life cycle. There is, however, potential for effects on fish species, from EMF exposure associated with export cables. The consequences of such effects are not well understood, however are thought to be low. The introduction of offshore wind arrays may also cause a barrier effect, by which it prevents the movement of species through the area, potentially affecting migration pathways for marine mammals, fish species and birds. There is considerable uncertainty regarding the effect of windfarms on migrating birds in the North East region, however it is recognised that concerns regarding bird capacity in the East region have the potential to be applicable here.	Risks to spawning fish can be mitigated through temporal restrictions on piling activity to avoid key spawning times. Physiological risks to fish and marine mammals from piling noise can be mitigated through the application measures relating to piling activities or soft start procedures, although fish responses to these measures are not well known and noise modelling should account for this uncertainty. In addition, noise abatement measures at source can be implemented to reduce noise transmission into the wider environment, and therefore reduce displacement effects. Further research is required to determine the effect of collision risk on bird species, however current evidence suggests that the effect through this pathway may be low for the majority of species. To determine the potential risk to bird species within NE2, survey and radar studies should be considered at a project level, both before and after construction. There is potential for displacement of bird species and marine species outwith the DPO, which has the potential to affect Kittiwake populations foraging from the Copinsay SPA.

NE2				Total DPO Area: 464 km² Realistic Maximum Development Scenario (% of Total Capacity): 1 GW (43%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
	are generally for species migrating between the UK and Scandinavia. <u>Fish</u> Within NE2 there are known spawning areas for herring. In addition there are nursery grounds for whiting and anglerfish, both of which have wide ranging nursery grounds across Scottish waters. There are also migratory fish which have the potential to transit through the area on transit to UK rivers.		There is collision risk associated with bird species using the DPO area. However, current research suggests that it is more likely that birds will be displaced from the region.	Based on uncertainty regarding the effect of wind farms in the North East region on migrating and resident bird populations, and the potential importance of the DPO to foraging Kittiwake the residual effect on key receptors during construction and operation in NE2 is considered to be **minor to major negative**.
		Effects arising from habitat modification, such as the creation of artificial reefs, new roosting structures and exclusion of habitat damaging activity.	The introduction of the wind farm turbines and scour protection have the potential to provide alternative habitat within NE2 which could provide shelter for juvenile fish and crustacean shellfish. This effect has the potential to be both beneficial and adverse for different receptors. There is also the potential for activities currently damaging to the seabed habitat to be excluded from offshore wind development area, dependent on the technology implemented, which may lead to reduced damage to existing habitats. However, if activity is displaced to a different area the effect is likely to be negligible or potentially negative.	The potential effect associated with the development of offshore wind in NE2 is considered to be **negligible** but is dependent on the technology deployed.
		Effects of pollution releases on species and habitats.	Pollution events associated with support vessels during construction and operational phases have the potential to affect species within NE2.	As part of marine licencing there is a requirement to produce pollution management plans to mitigate the effects of any pollution releases. In addition, significant releases are only likely to be associated with emergency events, considered unlikely. The assessment and management of pollution risks will be undertaken at a project level. The residual risk associated with pollution releases associated with offshore wind farms is considered to be **negligible**.
		Effects from introduction and spread of Invasive Non-Native Species (INNS).	Offshore wind turbine foundations and scour protection provides a new colonising surface for INNS, and support vessels during construction and operational phases have the potential to introduce INNS, which may subsequently affect indigenous species within NE2.	There is a requirement for biosecurity management plans to be produced to minimise the risk of introduction of INNS. Controls will be imposed through the marine licencing process if required at a project level.

NE2				Total DPO Area: 464 km² Realistic Maximum Development Scenario (% of Total Capacity): 1 GW (43%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
				The residual risk associated with INNS associated with offshore wind farms is considered to be **minor negative**.
Population and Human Health	NE2 is located mostly (96%) beyond 15 km of the nearest land on the Orkney Islands, the coastlines of which facing the DPO are populated by a few small settlements. Areas within the DPO are, however, used for the purposes of commercial shipping and fishing. There is a moderate level of shipping throughout the DPO.	Effects arising from noise, vibration, light, dust and shadow flicker effects from all phases of development.	NE2 is located offshore, and as such construction, operation and decommissioning of arrays within the DPO will not give rise to significant effects on populations or human health directly through noise, vibration, light, dust or shadow flicker effects. There is potential for construction activity associated with export cables and cable landfalls to affect populations, however effects are likely to be highly localised and temporary.	There is considerable uncertainty regarding potential cable landfall locations, therefore the effects on human health / populations cannot be assessed. This assessment will be undertaken at a project level, with any onshore components managed through the terrestrial planning permission process.
		Effects on residential amenity stemming from construction/installation/operational activities.	NE2 is located offshore, and as such the development will not directly affect residential amenity. Socio-economic impacts are considered separately to this assessment within the SEIA. There is potential for construction activity associated with export cables and cable landfalls to affect populations, however effects are likely to be highly localised and temporary.	There is considerable uncertainty regarding potential cable landfall locations, therefore the effects on human health / populations cannot be assessed. This assessment will be undertaken at a project level, with any onshore components managed through the terrestrial planning permission process.
		Issues of navigational safety, aviation and collision risk.	The presence of the offshore wind turbines increases the potential for collisions between recreational or commercial vessels and offshore wind developments. This risk is greater where the offshore wind array overlaps key navigational routes.	At a project level and as part of the EIA process there is a requirement for developers to undertake a navigational risk assessment and mitigate risks to navigation from development appropriately. It is likely that, based on development of 43% of the DPO, spatial planning in NE2 could be used to reduce effects on key routes and allow safe transit through the development. In addition, there is potential for diversion of the majority of the traffic around NE2 with limited effect on mileage or time. The residual effect on navigational safety associated with the development of NE2 for offshore wind is considered to be

NE2				Total DPO Area: 464 km² Realistic Maximum Development Scenario (% of Total Capacity): 1 GW (43%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
				negligible to minor negative dependent on the spatial planning and turbine design of development.
		Effects on marine and coastal recreation and access	Socio-economic impacts, such as the displacement of activity, are considered separately to this assessment within the SEIA, however effects on navigational safety of recreational activity associated with the development of the DPO are considered above. There is potential for construction activity associated with export cables and cable landfalls to affect populations, however effects are likely to be highly localised and temporary.	There is considerable uncertainty regarding potential cable landfall locations, therefore the effects on human health / populations cannot be assessed. This assessment will be undertaken at a project level, with any onshore components managed through the terrestrial planning permission process.
		Development of a secure energy supply.	The development of 1 GW of capacity within NE2 could contribute to the development of secure energy supply in the UK.	The potential benefit to UK energy security associated with the development of offshore wind in NE2 is considered to be **moderate to major positive**.
Soil (namely, Marine Geology and Coastal Processes)	The seabed sediments in NE are sandy throughout with a small area of rock towards the western boundary. NE2 is a significant distance (mostly greater than 15 km) from coastlines that have the potential to be affected by changes to sediment transport associated with any development in the DPO.	Effects on subsea geology, sediments, and coastal processes arising from changes in hydrodynamics and the existing wave regime.	There is potential for changes to hydrodynamics caused by the development of offshore wind in NE2, and associated export cable routes and landfall, to affect the sediment transport around the site. The extent of the effects will be dependent on the design of the array, the technology deployed in the DPO, the cable route, landfall location and cable design.	There is uncertainty as to the likely technology to be deployed in the DPO, and the likely array design. Appropriate assessment will be required to determine potential effects, which may include hydrodynamic and sediment transport modelling. The residual effect on seabed sediment and physical processes is highly dependent on the technology type and array design but is considered likely to be **negligible to minor negative**.
Water Quality	Ecological status is determined for each of the surface water bodies of rivers, lakes, transitional waters and coastal waters, based on biological quality elements and supported by physico-chemical and hydromorphological quality elements. NE2 does not directly overlap with any water bodies. There are, however, a number of water bodies inshore of NE2, the majority of which are of good	Effects on ecological status.	Offshore wind development within NE2, and associated export cable routes and landfall, has the potential to affect the ecological status of the water bodies, principally due to the installation of the export cables. Any changes to the natural condition of the water bodies have the potential to affect the status of the water body. In addition, any direct effects on features, including those within protected areas,	As part of the marine licencing process requirements are placed onto developers to ensure that activities are appropriately mitigated such that they do not cause permanent degradation of the ecological status under the WFD. The residual effect on ecological status is considered to be **negligible to minor negative**.

NE2				Total DPO Area: 464 km² Realistic Maximum Development Scenario (% of Total Capacity): 1 GW (43%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
	condition, with the exception of Mull Head to Old Head water body east of the Orkney Islands which is high condition.		have the potential to affect the WFD ecological status.	
		Effects on water quality (for example, due to increases in suspended sediment loads and turbidity as well as an increase in pollution incidents).	Effects associated with any contamination from seabed material resuspended during construction or decommissioning activity are likely to be of localised and temporary nature, with the level of effect dependant on the level of contamination within the sediment. Effects during operation and maintenance are considered less likely. Pollution events associated with support vessels during construction and operational phases have the potential to affect water quality within NE2.	Where an activity is expected to cause a significant disturbance of the seabed sediment additional contamination testing and subsequent water monitoring could be required through the marine licencing process. As part of marine licencing there is a requirement to produce pollution management plans to mitigate the effects of any pollution releases. In addition, significant releases are only likely to be associated with emergency events, considered unlikely. The residual effect is considered to be **minor negative**.
		Effects of the presence of structures on local currents, wave regimes, and water column mixing, as well as secondary effects on sedimentation and erosion beyond the sites.	There is potential for changes to hydrodynamics caused by the development of offshore wind in NE2 to affect the sediment transport in the region and on coastal processes. In addition, the effects of export cables and cable landfall should be considered at a project level. The extent of the effects will be dependent on the design of the array, the technology deployed in the DPO, the cable route, landfall location and cable design.	There is uncertainty as to the likely technology to be deployed in the DPO, and the likely array design. Appropriate assessment will be required to determine potential effects, which may include hydrodynamic and sediment transport modelling. The residual effect on seabed sediment and physical processes is highly dependent on the technology type and array design but is considered likely to be **negligible to minor negative**.
Climatic Factors	The key pressures on the climate are derived from the continued global emission of greenhouse gases, including carbon dioxide. These emissions are recognised as leading to changes in the global climate (including changes in temperatures, precipitation, storm density) in turn causing changes in the physical characteristics of the oceans, including potential changes in sea temperatures, circulation, salinity, pH and sea level rise.	Contribution to supporting a diverse and decarbonised energy sector.	The development of offshore wind energy in NE2 can contribute to a decarbonised energy sector, reducing carbon emissions.	The effect of development of offshore wind in the DPO has the potential to be **moderate to major positive** in contributing to a diverse and decarbonised energy sector.
		Coastal facilities may be at risk from climate change.	Facilities associated with offshore wind infrastructure may be at risk from sea level rise and coastal erosion associated with climatic factors.	The design of any coastal facilities is required to account for sea level rise and coastal erosion in the design process. This is considered as part of the planning process at a project level.

NE2				Total DPO Area: 464 km² Realistic Maximum Development Scenario (% of Total Capacity): 1 GW (43%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
Cultural Heritage	There are no Historic MPAs within or adjacent to NE2. There are 10 known shipwrecks within NE2. The area and coastline inshore of NE2 has a number of protected sites, including scheduled monuments and coastal built heritage.	Loss of and/or damage to historic environment features and their settings, including coastal and marine archaeology and historic MPAs.	There is potential for shipwrecks within NE2 to be affected by development, principally during the construction phase. In addition, historic MPAs, coastal built heritage, shipwrecks and scheduled monuments inshore of NE2 have the potential to be affected by export cable routes and cable landfalls.	Effects on culturally important sites can be mitigated through careful spatial planning within NE2 and through selection of appropriate cable export routes and landfall locations. As part of the design and planning process for any development within NE2 survey data will be obtained, this will identify any areas of cultural or historical sensitivity within the DPO or associated with cable planning that should be avoided and therefore inform spatial planning. Based on the use of appropriate spatial planning, the residual effect on cultural heritage is therefore considered to be **negligible to minor negative**.
Landscape, Seascape, and Visual Amenity	NE2 is mostly (96%) beyond 15 km from inhabited shorelines.	Both temporary and longer-term effects on landscape and coastal character and visual receptors arising from the presence of structures including any ancillary infrastructure and night-time lighting of offshore structures.	The development of offshore wind in NE2 has the potential to affect landscape / seascapes.	There is potential to mitigate visual effects through spatial planning within the DPO to avoid areas closest to land, and through the potential to select smaller turbines in areas of higher sensitivity. Development within NE2 may also require the assessment and management of night-time lighting effects. The residual effect on landscape / seascape is considered to be **negligible to minor negative**.

NE3

NE3				**Total DPO Area: 339 km²** **Realistic Maximum Development Scenario (% of Total Capacity): 1 GW (59%)**
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
Biodiversity, Flora and Fauna (Marine Mammals)	<u>Benthic Habitats and Species</u> The benthic habitat in NE3 is sand and course sediment throughout. There are no known sensitive species within or landwards of the DPO. <u>Marine Mammals</u> Cetacean density within NE3 is low overall albeit there is a degree of uncertainty in this conclusion, and therefore further development of the baseline through survey will be required prior to project level assessment. There is likely usage of the DPO by marine mammals, principally grey seal associated with foraging from haul out sites and breeding colonies in the Orkney Islands. <u>Birds</u> Bird usage of the area within NE3 is generally low. However there are important populations of sensitive species, including Black Legged Kittiwake associated with the breeding colony in the Copinsay SPA (~10,000 breeding pairs), some of which are likely to forage within NE3. There are some migration routes for a range of bird species which have the potential to intersect NE3. These routes are generally for species migrating between the UK and Scandinavia. <u>Fish</u> Within NE3 there are known spawning areas for herring and sandeel. In addition there are nursery grounds for whiting and anglerfish, both of which have wide ranging nursery grounds across Scottish waters.	Loss of and/or damage to marine and coastal habitats, including benthic and intertidal habitats (for example, due to smothering of benthic habitats and substratum loss).	There is potential for permanent loss of habitat within the footprint of offshore wind turbines and associated scour protection and temporary damage to habitats from intra array cables. There is also potential for effects on coastal habitats inshore of NE3 associated with export cables and cable landfalls.	The footprint associated with offshore wind will be dependent on the technology used and the level of scour protection required. Effects on coastal habitats associated with export cable routes and cable landfall will be considered at a project level and can be mitigated through careful siting. The residual effect on habitat is therefore considered to be **negligible to minor negative** in NE3.
		Effects on key receptors and prey species, including disturbance, noise effects, EMF exposure, collision risk, habitat exclusion, and barriers to wildlife movement	There is potential for disturbance of marine mammal, bird and fish species particularly due to noise emissions during construction from piling activities, survey and / or clearance of unexploded ordnance. These have the potential to cause physiological damage to fish and marine mammal species, and to cause displacement of fish, marine mammals and birds from the area of effect. Potential for effects to mammals and fish are lower during the operational and decommissioning phases of the offshore wind farm life cycle. There is, however, potential for effects on fish species, from EMF exposure associated with export cables. The consequences of such effects are not well understood, however are thought to be low. The introduction of offshore wind arrays may also cause a barrier effect, by which it prevents the movement of species through the area, potentially affecting migration pathways for marine mammals, fish species and birds. There is considerable uncertainty regarding the effect of windfarms on migrating birds in the North East region, however it is recognised that concerns regarding bird capacity in the East region have the potential to be applicable here.	Risks to spawning fish can be mitigated through temporal restrictions on piling activity to avoid key spawning times. Physiological risks to fish and marine mammals from piling noise can be mitigated through the application measures relating to piling activities or soft start procedures, although fish responses to these measures are not well known and noise modelling should account for this uncertainty. In addition, noise abatement measures at source can be implemented to reduce noise transmission into the wider environment, and therefore reduce displacement effects. Further research is required to determine the effect of collision risk on bird species, however current evidence suggests that the effect through this pathway may be low for the majority of species. To determine the potential risk to bird species within NE3, survey and radar studies should be considered at a project level, both before and after construction. There is potential for displacement of bird species and marine species outwith the DPO, which has the potential to affect Kittiwake populations foraging from the Copinsay SPA.

NE3				Total DPO Area: 339 km² Realistic Maximum Development Scenario (% of Total Capacity): 1 GW (59%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
	There are also migratory fish which have the potential to transit through the area on transit to UK rivers.		There is collision risk associated with bird species using the DPO area. However, current research suggests that it is more likely that birds will be displaced from the region.	Based on uncertainty regarding the effect of wind farms in the North East region on migrating and resident bird populations, and the potential importance of the DPO to foraging Kittiwake the residual effect on key receptors during construction and operation in NE3 is considered to be **minor to major negative**.
		Effects arising from habitat modification, such as the creation of artificial reefs, new roosting structures and exclusion of habitat damaging activity.	The introduction of the wind farm turbines and scour protection have the potential to provide alternative habitat within NE3 which could provide shelter for juvenile fish and crustacean shellfish. This effect has the potential to be both beneficial and adverse for different receptors. There is also the potential for activities currently damaging to the seabed habitat to be excluded from offshore wind development area, dependent on the technology implemented, which may lead to reduced damage to existing habitats. However, if activity is displaced to a different area the effect is likely to be negligible or potentially negative.	The potential effect associated with the development of offshore wind in NE3 is considered to be **negligible**, but is dependent on the technology deployed.
		Effects of pollution releases on species and habitats.	Pollution events associated with support vessels during construction and operational phases have the potential to affect species within NE3.	As part of marine licencing there is a requirement to produce pollution management plans to mitigate the effects of any pollution releases. In addition, significant releases are only likely to be associated with emergency events, considered unlikely. The assessment and management of pollution risks will be undertaken at a project level. The residual risk associated with pollution releases associated with offshore wind farms is considered to be **negligible**.
		Effects from introduction and spread of Invasive Non-Native Species (INNS).	Offshore wind turbine foundations and scour protection provides a new colonising surface for INNS, and support vessels during construction and operational phases have the potential to introduce INNS, which may subsequently affect indigenous species within NE3.	There is a requirement for biosecurity management plans to be produced to minimise the risk of introduction of INNS. Controls will be imposed through the marine licencing process if required at a project level.

NE3				Total DPO Area: 339 km² Realistic Maximum Development Scenario (% of Total Capacity): 1 GW (59%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
				The residual risk associated with INNS associated with offshore wind farms is considered to be **minor negative**.
Population and Human Health	NE3 is entirely beyond 15 km of the nearest landfall at Duncansby Head. The coastlines facing the DPO are populated by a few small settlements. Areas within the DPO are used for the purposes of commercial shipping and fishing. There is a moderate level of shipping throughout the DPO which is bordered by key routes on both the north, east and west boundaries.	Effects arising from noise, vibration, light, dust and shadow flicker effects from all phases of development.	NE3 is located offshore, and as such construction, operation and decommissioning of arrays within the DPO will not give rise to significant effects on populations or human health directly through noise, vibration, light, dust or shadow flicker effects. There is potential for construction activity associated with export cables and cable landfalls to affect populations, however effects are likely to be highly localised and temporary.	There is considerable uncertainty regarding potential cable landfall locations, therefore the effects on human health / populations cannot be assessed. This assessment will be undertaken at a project level, with any onshore components managed through the terrestrial planning permission process.
		Effects on residential amenity stemming from construction/installation/operational activities.	NE3 is located offshore, and as such the development will not directly affect residential amenity. Socio-economic impacts are considered separately to this assessment within the SEIA. There is potential for construction activity associated with export cables and cable landfalls to affect populations, however effects are likely to be highly localised and temporary.	There is considerable uncertainty regarding potential cable landfall locations, therefore the effects on human health / populations cannot be assessed. This assessment will be undertaken at a project level, with any onshore components managed through the terrestrial planning permission process.
		Issues of navigational safety, aviation and collision risk.	The presence of the offshore wind turbines increases the potential for collisions between recreational or commercial vessels and offshore wind developments. This risk is greater where the offshore wind array overlaps key navigational routes, such as those to the north, east and west of the DPO.	At a project level and as part of the EIA process there is a requirement for developers to undertake a navigational risk assessment and mitigate risks to navigation from development appropriately. It is likely that, based on development of 59% of the DPO, spatial planning in NE3 could be used to reduce effects on key routes and allow safe transit through the development. In addition, there is potential for diversion of the majority of the traffic around NE3 with limited effect on mileage or time. Due to the close proximity of multiple key routes the residual effect on navigational safety associated with the development of

NE3				Total DPO Area: 339 km² Realistic Maximum Development Scenario (% of Total Capacity): 1 GW (59%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
				NE3 for offshore wind is considered to be **minor negative to moderate negative** dependent on the spatial planning and turbine design of development.
		Effects on marine and coastal recreation and access	Socio-economic impacts, such as the displacement of activity, are considered separately to this assessment within the SEIA, however effects on navigational safety of recreational activity associated with the development of the DPO are considered above. There is potential for construction activity associated with export cables and cable landfalls to affect populations, however effects are likely to be highly localised and temporary.	There is considerable uncertainty regarding potential cable landfall locations, therefore the effects on human health / populations cannot be assessed. This assessment will be undertaken at a project level, with any onshore components managed through the terrestrial planning permission process.
		Development of a secure energy supply.	The development of 1 GW of capacity within NE3 could contribute to the development of secure energy supply in the UK.	The potential benefit to UK energy security associated with the development of offshore wind in NE3 is considered to be **moderate to major positive**.
Soil (namely, Marine Geology and Coastal Processes)	The seabed sediments in NE3 are sandy throughout with a small area of rock towards the western boundary. NE3 is a significant distance (greater than 15 km) from coastlines that have the potential to be affected by changes to sediment transport associated with any development in the DPO.	Effects on subsea geology, sediments, and coastal processes arising from changes in hydrodynamics and the existing wave regime.	There is potential for changes to hydrodynamics caused by the development of offshore wind in NE3, and associated export cable routes and landfall, to affect the sediment transport around the site. The extent of the effects will be dependent on the design of the array, the technology deployed in the DPO, the cable route, landfall location and cable design.	There is uncertainty as to the likely technology to be deployed in the DPO, and the likely array design. Appropriate assessment will be required to determine potential effects, which may include hydrodynamic and sediment transport modelling. The residual effect on seabed sediment and physical processes is highly dependent on the technology type and array design but is considered likely to be **negligible to minor negative**.
Water Quality	Ecological status is determined for each of the surface water bodies of rivers, lakes, transitional waters and coastal waters, based on biological quality elements and supported by physico-chemical and hydromorphological quality elements. NE3 does not directly overlap with any water bodies. There are, however, a number of water bodies inshore of NE3, the majority of which are of good	Effects on ecological status.	Offshore wind development within NE3, and associated export cable routes and landfall, has the potential to affect the ecological status of the water bodies, principally due to the installation of the export cables. Any changes to the natural condition of the water bodies have the potential to affect the status of the water body. In addition, any direct effects on features, including those within protected areas,	As part of the marine licencing process requirements are placed onto developers to ensure that activities are appropriately mitigated such that they do not cause permanent degradation of the ecological status under the WFD. The residual effect on ecological status is considered to be **negligible to minor negative**.

NE3				Total DPO Area: 339 km² Realistic Maximum Development Scenario (% of Total Capacity): 1 GW (59%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
	condition, with the exception of Mull Head to Old Head water body east of the Orkney Islands which is high condition.		have the potential to affect the WFD ecological status.	
		Effects on water quality (for example, due to increases in suspended sediment loads and turbidity as well as an increase in pollution incidents).	Effects associated with any contamination from seabed material resuspended during construction or decommissioning activity are likely to be of localised and temporary nature, with the level of effect dependant on the level of contamination within the sediment. Effects during operation and maintenance are considered less likely. Pollution events associated with support vessels during construction and operational phases have the potential to affect water quality within NE3.	Where an activity is expected to cause a significant disturbance of the seabed sediment additional contamination testing and subsequent water monitoring could be required through the marine licencing process. As part of marine licencing there is a requirement to produce pollution management plans to mitigate the effects of any pollution releases. In addition, significant releases are only likely to be associated with emergency events, considered unlikely. The residual effect is considered to be **minor negative**.
		Effects of the presence of structures on local currents, wave regimes, and water column mixing, as well as secondary effects on sedimentation and erosion beyond the sites.	There is potential for changes to hydrodynamics caused by the development of offshore wind in NE3 to affect the sediment transport in the region and on coastal processes. In addition, the effects of export cables and cable landfall should be considered at a project level. The extent of the effects will be dependent on the design of the array, the technology deployed in the DPO, the cable route, landfall location and cable design.	There is uncertainty as to the likely technology to be deployed in the DPO, and the likely array design. Appropriate assessment will be required to determine potential effects, which may include hydrodynamic and sediment transport modelling. The residual effect on seabed sediment and physical processes is highly dependent on the technology type and array design but is considered likely to be **negligible to minor negative**.
Climatic Factors	The key pressures on the climate are derived from the continued global emission of greenhouse gases, including carbon dioxide. These emissions are recognised as leading to changes in the global climate (including changes in temperatures, precipitation, storm density) in turn causing changes in the physical characteristics of the oceans, including potential changes in sea temperatures, circulation, salinity, pH and sea level rise.	Contribution to supporting a diverse and decarbonised energy sector.	The development of offshore wind energy in NE3 can contribute to a decarbonised energy sector, reducing carbon emissions.	The effect of development of offshore wind in the DPO has the potential to **be moderate to major positive** in contributing to a diverse and decarbonised energy sector.
		Coastal facilities may be at risk from climate change.	Facilities associated with offshore wind infrastructure may be at risk from sea level rise and coastal erosion associated with climatic factors.	The design of any coastal facilities is required to account for sea level rise and coastal erosion in the design process. This is considered as part of the planning process at a project level.

NE3				Total DPO Area: 339 km² Realistic Maximum Development Scenario (% of Total Capacity): 1 GW (59%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
Cultural Heritage	There are no Historic MPAs within or adjacent to NE3. There no known shipwrecks within NE3. The area and coastline inshore of NE3 has a number of protected sites, including scheduled monuments and coastal built heritage.	Loss of and/or damage to historic environment features and their settings, including coastal and marine archaeology and historic MPAs.	There is potential for any currently unknown shipwrecks within NE3 to be affected by development, principally during the construction phase. In addition, historic MPAs, coastal built heritage, shipwrecks and scheduled monuments inshore of NE3 have the potential to be affected by export cable routes and cable landfalls.	Effects on culturally important sites can be mitigated through careful spatial planning within NE3 and through selection of appropriate cable export routes and landfall locations. As part of the design and planning process for any development within NE3 survey data will be obtained, this will identify any areas of cultural or historical sensitivity within the DPO or associated with cable planning that should be avoided and therefore inform spatial planning. Based on the use of appropriate spatial planning, the residual effect on cultural heritage is therefore considered to be **negligible to minor negative**.
Landscape, Seascape, and Visual Amenity	NE3 is located beyond 15 km from inhabited shorelines.	Both temporary and longer-term effects on landscape and coastal character and visual receptors arising from the presence of structures including any ancillary infrastructure and night-time lighting of offshore structures.	The development of offshore wind in NE3 has the potential to affect landscape / seascapes.	There is potential to mitigate visual effects through spatial planning within the DPO to avoid areas closest to land, and through the potential to select smaller turbines in areas of higher sensitivity. Development within NE3 may also require the assessment and management of night-time lighting effects. The residual effect on landscape / seascape is considered to be **negligible to minor negative**.

NE4

NE4				Total DPO Area: 440 km² Realistic Maximum Development Scenario (% of Total Capacity): 1 GW (45%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
Biodiversity, Flora and Fauna (Marine Mammals)	<u>Benthic Habitats and Species</u> The benthic habitat in NE4 is sand and course sediment throughout. There are no known sensitive species within or landwards of the DPO. <u>Marine Mammals</u> Cetacean density within NE4 is low to moderate overall albeit there is a degree of uncertainty in this conclusion, and therefore further development of the baseline through survey will be required prior to project level assessment. There are known populations of harbour porpoise and bottlenose dolphin within the moray firth which have the potential to be found within NE4. In addition, the proposed NCMPA at Southern trench is proposed for designation for minke whale. There is also potential usage of the DPO grey seal associated with foraging from haul out sites and breeding colonies in the Orkney Islands and Dornoch Firth. <u>Birds</u> Bird usage of the area within NE4 is generally high. Additionally, there are important populations of sensitive species, including a number of species identified as features within the East Caithness Cliffs SPA, some of which are likely to forage within NE4. There are some migration routes for a range of bird species which have the potential to intersect NE4. These routes are generally for species migrating between the UK and Scandinavia. <u>Fish</u> Within NE4 there are known spawning areas for sandeel. In addition there are	Loss of and/or damage to marine and coastal habitats, including benthic and intertidal habitats (for example, due to smothering of benthic habitats and substratum loss).	There is potential for permanent loss of habitat within the footprint of offshore wind turbines and associated scour protection and temporary damage to habitats from intra array cables. There is also potential for effects on coastal habitats inshore of NE4 associated with export cables and cable landfalls.	The footprint associated with offshore wind will be dependent on the technology used and the level of scour protection required. Effects on coastal habitats associated with export cable routes and cable landfall will be considered at a project level and can be mitigated through careful siting. The residual effect on habitat is therefore considered to be **negligible to minor negative** in NE4.
		Effects on key receptors and prey species, including disturbance, noise effects, EMF exposure, collision risk, habitat exclusion, and barriers to wildlife movement	There is potential for disturbance of marine mammal, bird and fish species particularly due to noise emissions during construction from piling activities, survey and / or clearance of unexploded ordnance. These have the potential to cause physiological damage to fish and marine mammal species, and to cause displacement of fish, marine mammals and birds from the area of effect. Potential for effects to mammals and fish are lower during the operational and decommissioning phases of the offshore wind farm life cycle. There is, however, potential for effects on fish species, from EMF exposure associated with export cables. The consequences of such effects are not well understood, however are thought to be low. The introduction of offshore wind arrays may also cause a barrier effect, by which it prevents the movement of species through the area, potentially affecting migration pathways for marine mammals, fish species and birds. There is considerable uncertainty regarding the effect of windfarms on migrating birds in the North East region, however it is recognised that concerns regarding bird capacity in the East region have the potential to be applicable here.	Risks to spawning fish can be mitigated through temporal restrictions on piling activity to avoid key spawning times. Physiological risks to fish and marine mammals from piling noise can be mitigated through the application measures relating to piling activities or soft start procedures, although fish responses to these measures are not well known and noise modelling should account for this uncertainty. In addition, noise abatement measures at source can be implemented to reduce noise transmission into the wider environment, and therefore reduce displacement effects. Further research is required to determine the effect of collision risk on bird species, however current evidence suggests that the effect through this pathway may be low for the majority of species. To determine the potential risk to bird species within NE4, survey and radar studies should be considered at a project level, both before and after construction. There is potential for displacement of bird species and marine species outwith the DPO, which has the potential to affect bird

NE4				Total DPO Area: 440 km² Realistic Maximum Development Scenario (% of Total Capacity): 1 GW (45%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
	nursery grounds for herring, cod, whiting and anglerfish, all of which have wide ranging nursery grounds across Scottish waters. There are also migratory fish which have the potential to transit through the area on transit to UK rivers.		There is collision risk associated with bird species using the DPO area. However, current research suggests that it is more likely that birds will be displaced from the region.	populations foraging from the East Caithness Cliffs SPA. Based on uncertainty regarding the effect of wind farms in the North East region on migrating and resident bird populations, and the potential importance of the DPO to foraging species the residual effect on key receptors during construction and operation in NE4 is considered to be **minor negative to major negative**.
		Effects arising from habitat modification, such as the creation of artificial reefs, new roosting structures and exclusion of habitat damaging activity.	The introduction of the wind farm turbines and scour protection have the potential to provide alternative habitat within NE4 which could provide shelter for juvenile fish and crustacean shellfish. This effect has the potential to be both beneficial and adverse for different receptors. There is also the potential for activities currently damaging to the seabed habitat to be excluded from offshore wind development area, dependent on the technology implemented, which may lead to reduced damage to existing habitats. However, if activity is displaced to a different area the effect is likely to be negligible or potentially negative.	The potential effect associated with the development of offshore wind in NE4 is considered to be **negligible** but is dependent on the technology deployed.
		Effects of pollution releases on species and habitats.	Pollution events associated with support vessels during construction and operational phases have the potential to affect species within NE4.	As part of marine licencing there is a requirement to produce pollution management plans to mitigate the effects of any pollution releases. In addition, significant releases are only likely to be associated with emergency events, considered unlikely. The assessment and management of pollution risks will be undertaken at a project level. The residual risk associated with pollution releases associated with offshore wind farms is considered to be **negligible**.

NE4				Total DPO Area: 440 km² Realistic Maximum Development Scenario (% of Total Capacity): 1 GW (45%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
		Effects from introduction and spread of Invasive Non-Native Species (INNS).	Offshore wind turbine foundations and scour protection provides a new colonising surface for INNS, and support vessels during construction and operational phases have the potential to introduce INNS, which may subsequently affect indigenous species within NE4.	There is a requirement for biosecurity management plans to be produced to minimise the risk of introduction of INNS. Controls will be imposed through the marine licencing process if required at a project level. The residual risk associated with INNS associated with offshore wind farms is considered to be **minor negative**.
Population and Human Health	NE4 is entirely beyond 15 km of the nearest landfall. The coastlines facing the DPO are populated by a few small settlements. Areas within the DPO are used for the purposes of commercial shipping and fishing. There is a high level of shipping throughout the DPO which is a key route across the Moray Firth and forms part of the route around Scotland.	Effects arising from noise, vibration, light, dust and shadow flicker effects from all phases of development.	NE4 is located offshore, and as such construction, operation and decommissioning of arrays within the DPO will not give rise to significant effects on populations or human health directly through noise, vibration, light, dust or shadow flicker effects. There is potential for construction activity associated with export cables and cable landfalls to affect populations, however effects are likely to be highly localised and temporary.	There is considerable uncertainty regarding potential cable landfall locations, therefore the effects on human health / populations cannot be assessed. This assessment will be undertaken at a project level, with any onshore components managed through the terrestrial planning permission process.
		Effects on residential amenity stemming from construction/installation/operational activities.	NE4 is located offshore, and as such the development will not directly affect residential amenity. Socio-economic impacts are considered separately to this assessment within the SEIA. There is potential for construction activity associated with export cables and cable landfalls to affect populations, however effects are likely to be highly localised and temporary.	There is considerable uncertainty regarding potential cable landfall locations, therefore the effects on human health / populations cannot be assessed. This assessment will be undertaken at a project level, with any onshore components managed through the terrestrial planning permission process.
		Issues of navigational safety, aviation and collision risk.	The presence of the offshore wind turbines increases the potential for collisions between recreational or commercial vessels and offshore wind developments. This risk is greater where the offshore wind array overlaps key navigational routes, such as within NE4.	At a project level and as part of the EIA process there is a requirement for developers to undertake a navigational risk assessment and mitigate risks to navigation from development appropriately. It is likely that, high density traffic throughout the DPO, and any development is likely to concentrate this traffic and hence increase navigational risk. Based on development of 45% of the

NE4				Total DPO Area: 440 km² Realistic Maximum Development Scenario (% of Total Capacity): 1 GW (45%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
				DPO, there is very limited spatial planning in NE4 which could be applied to reduce effects on key routes and allow safe transit through the development. Due to the intersection of the DPO by a key navigational route the residual effect on navigational safety associated with the development of NE4 for offshore wind is considered to be **moderate negative to major negative** dependent on the spatial planning and turbine design of development.
		Effects on marine and coastal recreation and access	Socio-economic impacts, such as the displacement of activity, are considered separately to this assessment within the SEIA, however effects on navigational safety of recreational activity associated with the development of the DPO are considered above. There is potential for construction activity associated with export cables and cable landfalls to affect populations, however effects are likely to be highly localised and temporary.	There is considerable uncertainty regarding potential cable landfall locations, therefore the effects on human health / populations cannot be assessed. This assessment will be undertaken at a project level, with any onshore components managed through the terrestrial planning permission process.
		Development of a secure energy supply.	The development of 1 GW of capacity within NE4 could contribute to the development of secure energy supply in the UK.	The potential benefit to UK energy security associated with the development of offshore wind in NE4 is considered to be **moderate to major positive.**
Soil (namely, Marine Geology and Coastal Processes)	The seabed sediments in NE4 are sand and course sediment throughout. NE4 is a significant distance (greater than 15 km) from coastlines that have the potential to be affected by changes to sediment transport associated with any development in the DPO.	Effects on subsea geology, sediments, and coastal processes arising from changes in hydrodynamics and the existing wave regime.	There is potential for changes to hydrodynamics caused by the development of offshore wind in NE4, and associated export cable routes and landfall, to affect the sediment transport around the site. The extent of the effects will be dependent on the design of the array, the technology deployed in the DPO, the cable route, landfall location and cable design.	There is uncertainty as to the likely technology to be deployed in the DPO, and the likely array design. Appropriate assessment will be required to determine potential effects, which may include hydrodynamic and sediment transport modelling. The residual effect on seabed sediment and physical processes is highly dependent on the technology type and array design but is considered likely to be **negligible to minor negative**.
Water Quality	Ecological status is determined for each of the surface water bodies of rivers, lakes, transitional waters and coastal	Effects on ecological status.	Offshore wind development within NE4, and associated export cable routes and landfall, has the potential to affect the	As part of the marine licencing process requirements are placed onto developers to ensure that activities are appropriately

NE4				Total DPO Area: 440 km² Realistic Maximum Development Scenario (% of Total Capacity): 1 GW (45%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
	waters, based on biological quality elements and supported by physico-chemical and hydromorphological quality elements. NE4 does not directly overlap with any water bodies. There are, however, a number of water bodies inshore of NE4, all of which are of good condition.		ecological status of the water bodies, principally due to the installation of the export cables. Any changes to the natural condition of the water bodies have the potential to affect the status of the water body. In addition, any direct effects on features, including those within protected areas, have the potential to affect the WFD ecological status.	mitigated such that they do not cause permanent degradation of the ecological status under the WFD. The residual effect on ecological status is considered to be **negligible to minor negative**.
		Effects on water quality (for example, due to increases in suspended sediment loads and turbidity as well as an increase in pollution incidents).	Effects associated with any contamination from seabed material resuspended during construction or decommissioning activity are likely to be of localised and temporary nature, with the level of effect dependant on the level of contamination within the sediment. Effects during operation and maintenance are considered less likely. Pollution events associated with support vessels during construction and operational phases have the potential to affect water quality within NE4.	Where an activity is expected to cause a significant disturbance of the seabed sediment additional contamination testing and subsequent water monitoring could be required through the marine licencing process. As part of marine licencing there is a requirement to produce pollution management plans to mitigate the effects of any pollution releases. In addition, significant releases are only likely to be associated with emergency events, considered unlikely. The residual effect is considered to be **minor negative**.
		Effects of the presence of structures on local currents, wave regimes, and water column mixing, as well as secondary effects on sedimentation and erosion beyond the sites.	There is potential for changes to hydrodynamics caused by the development of offshore wind in NE4 to affect the sediment transport in the region and on coastal processes. In addition, the effects of export cables and cable landfall should be considered at a project level. The extent of the effects will be dependent on the design of the array, the technology deployed in the DPO, the cable route, landfall location and cable design.	There is uncertainty as to the likely technology to be deployed in the DPO, and the likely array design. Appropriate assessment will be required to determine potential effects, which should include hydrodynamic and sediment transport modelling. The residual effect on seabed sediment and physical processes is highly dependent on the technology type and array design but is considered likely to be **negligible to minor negative**.
Climatic Factors	The key pressures on the climate are derived from the continued global emission of greenhouse gases, including carbon dioxide. These emissions are	Contribution to supporting a diverse and decarbonised energy sector.	The development of offshore wind energy in NE4 can contribute to a decarbonised energy sector, reducing carbon emissions.	The effect of development of offshore wind in the DPO has the potential to be major positive in contributing to a diverse and decarbonised energy sector.

NE4				Total DPO Area: 440 km² Realistic Maximum Development Scenario (% of Total Capacity): 1 GW (45%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
	recognised as leading to changes in the global climate (including changes in temperatures, precipitation, storm density) in turn causing changes in the physical characteristics of the oceans, including potential changes in sea temperatures, circulation, salinity, pH and sea level rise.	Coastal facilities may be at risk from climate change.	Facilities associated with offshore wind infrastructure may be at risk from sea level rise and coastal erosion associated with climatic factors.	The design of any coastal facilities is required to account for sea level rise and coastal erosion in the design process. This is considered as part of the planning process at a project level.
Cultural Heritage	There are no Historic MPAs within or adjacent to NE4. There are 10 known shipwrecks within NE4. The area and coastline inshore of NE4 has a number of protected sites, including scheduled monuments and coastal built heritage.	Loss of and/or damage to historic environment features and their settings, including coastal and marine archaeology and historic MPAs.	There is potential for shipwrecks within NE4 to be affected by development, principally during the construction phase. In addition, historic MPAs, coastal built heritage, shipwrecks and scheduled monuments inshore of NE4 have the potential to be affected by export cable routes and cable landfalls.	Effects on culturally important sites can be mitigated through careful spatial planning within NE4 and through selection of appropriate cable export routes and landfall locations. As part of the design and planning process for any development within NE4 survey data will be obtained, this will identify any areas of cultural or historical sensitivity within the DPO or associated with cable planning that should be avoided and therefore inform spatial planning. Based on the use of appropriate spatial planning, the residual effect on cultural heritage is therefore considered to be **negligible to minor negative**.
Landscape, Seascape, and Visual Amenity	NE4 is located beyond 15 km from inhabited shorelines, however larger turbines are likely to be visible.	Both temporary and longer-term effects on landscape and coastal character and visual receptors arising from the presence of structures including any ancillary infrastructure and night-time lighting of offshore structures.	The development of offshore wind in NE4 has the potential to be visible from land and hence affect landscape / seascapes.	There is potential to mitigate visual effects through spatial planning within the DPO to avoid areas closest to land, and through the potential to select smaller turbines in areas of higher sensitivity. Development within NE4 may also require the assessment and management of night-time lighting effects. The residual effect on landscape / seascape is considered to be **negligible to minor negative**.

NE5

NE5				**Total DPO Area: 496 km²** **Realistic Maximum Development Scenario (% of Total Capacity): 1 GW (40%)**
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
Biodiversity, Flora and Fauna (Marine Mammals)	<u>Benthic Habitats and Species</u> The benthic habitat in NE5 is sand and course sediment throughout. There are records of Ocean Quahog, a priority marine feature which overlap with NE5 in small numbers. <u>Marine Mammals</u> Cetacean density within NE5 is moderate overall. However, there is a degree of uncertainty in this conclusion, and therefore further development of the baseline through survey will be required prior to project level assessment. There are known populations of harbour porpoise and bottlenose dolphin within the moray firth which have the potential to be found within NE5. In addition, the proposed NCMPA at Southern trench is proposed for designation for minke whale. There is also potential usage of the DPO grey seal associated with foraging from haul out sites and breeding colonies in Dornoch Firth. <u>Birds</u> Bird usage of the area within NE5 is generally high. Additionally, there are important populations of sensitive species, including a number of species identified as features within the East Caithness Cliffs SPA, some of which are likely to forage within NE5. There are some migration routes for a range of bird species which have the potential to intersect NE5. These routes are generally for species migrating between the UK and Scandinavia. <u>Fish</u>	Loss of and/or damage to marine and coastal habitats, including benthic and intertidal habitats (for example, due to smothering of benthic habitats and substratum loss).	There is potential for permanent loss of habitat within the footprint of offshore wind turbines and associated scour protection and temporary damage to habitats from intra array cables. There is also potential for effects on coastal habitats inshore of NE5 associated with export cables and cable landfalls.	The footprint associated with offshore wind will be dependent on the technology used and the level of scour protection required. Effects on coastal habitats associated with export cable routes and cable landfall will be considered at a project level and can be mitigated through careful siting. The residual effect on habitat is therefore considered to be **negligible to minor negative** in NE5.
		Effects on key receptors and prey species, including disturbance, noise effects, EMF exposure, collision risk, habitat exclusion, and barriers to wildlife movement	There is potential for disturbance of marine mammal, bird and fish species particularly due to noise emissions during construction from piling activities, survey and / or clearance of unexploded ordnance. These have the potential to cause physiological damage to fish and marine mammal species, and to cause displacement of fish, marine mammals and birds from the area of effect. Potential for effects to mammals and fish are lower during the operational and decommissioning phases of the offshore wind farm life cycle. There is, however, potential for effects on fish species, from EMF exposure associated with export cables. The consequences of such effects are not well understood, however are thought to be low. The introduction of offshore wind arrays may also cause a barrier effect, by which it prevents the movement of species through the area, potentially affecting migration pathways for marine mammals, fish species and birds. There is considerable uncertainty regarding the effect of windfarms on migrating birds in the North East region, however it is recognised that concerns regarding bird capacity in the East region have the potential to be applicable here.	Risks to spawning fish can be mitigated through temporal restrictions on piling activity to avoid key spawning times. Physiological risks to fish and marine mammals from piling noise can be mitigated through the application measures relating to piling activities or soft start procedures, although fish responses to these measures are not well known and noise modelling should account for this uncertainty. In addition, noise abatement measures at source can be implemented to reduce noise transmission into the wider environment, and therefore reduce displacement effects. Further research is required to determine the effect of collision risk on bird species, however current evidence suggests that the effect through this pathway may be low for the majority of species. To determine the potential risk to bird species within NE5, survey and radar studies should be considered at a project level, both before and after construction. There is potential for displacement of bird species and marine species outwith the DPO, which has the potential to affect bird populations foraging from the East Caithness Cliffs SPA.

NE5				Total DPO Area: 496 km² Realistic Maximum Development Scenario (% of Total Capacity): 1 GW (40%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
	Within NE5 there are known spawning areas for sandeel. In addition there are nursery grounds for herring, cod, whiting and anglerfish, all of which have wide ranging nursery grounds across Scottish waters. There are also migratory fish which have the potential to transit through the area on transit to UK rivers.		There is collision risk associated with bird species using the DPO area. However, current research suggests that it is more likely that birds will be displaced from the region.	Based on uncertainty regarding the effect of wind farms in the North East region on migrating and resident bird populations, and the potential importance of the DPO to foraging species the residual effect on key receptors during construction and operation in NE5 is considered to be **minor negative to major negative**.
		Effects arising from habitat modification, such as the creation of artificial reefs, new roosting structures and exclusion of habitat damaging activity.	The introduction of the wind farm turbines and scour protection have the potential to provide alternative habitat within NE5 which could provide shelter for juvenile fish and crustacean shellfish. This effect has the potential to be both beneficial and adverse for different receptors. There is also the potential for activities currently damaging to the seabed habitat to be excluded from offshore wind development area, dependent on the technology implemented, which may lead to reduced damage to existing habitats. However, if activity is displaced to a different area the effect is likely to be negligible or potentially negative.	The potential effect associated with the development of offshore wind in NE5 is considered to be **negligible**, but is dependent on the technology deployed.
		Effects of pollution releases on species and habitats.	Pollution events associated with support vessels during construction and operational phases have the potential to affect species within NE5.	As part of marine licencing there is a requirement to produce pollution management plans to mitigate the effects of any pollution releases. In addition, significant releases are only likely to be associated with emergency events, considered unlikely. The assessment and management of pollution risks will be undertaken at a project level. The residual risk associated with pollution releases associated with offshore wind farms is considered to be **negligible**.
		Effects from introduction and spread of Invasive Non-Native Species (INNS).	Offshore wind turbine foundations and scour protection provides a new colonising surface for INNS, and support vessels during construction and operational phases have the potential to introduce INNS, which may subsequently affect indigenous species within NE5.	There is a requirement for biosecurity management plans to be produced to minimise the risk of introduction of INNS. Controls will be imposed through the marine licencing process if required at a project level.

NE5				Total DPO Area: 496 km² Realistic Maximum Development Scenario (% of Total Capacity): 1 GW (40%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
				The residual risk associated with INNS associated with offshore wind farms is considered to be **minor negative**.
Population and Human Health	NE5 is entirely beyond 15 km of the nearest landfall. The coastlines facing the DPO are populated by a few small settlements. Areas within the DPO are used for the purposes of commercial shipping and fishing. There is a moderate level of shipping throughout the DPO, much of which is associated with traffic transiting to the Beatrice Wind Farm.	Effects arising from noise, vibration, light, dust and shadow flicker effects from all phases of development.	NE5 is located offshore, and as such construction, operation and decommissioning of arrays within the DPO will not give rise to significant effects on populations or human health directly through noise, vibration, light, dust or shadow flicker effects. There is potential for construction activity associated with export cables and cable landfalls to affect populations, however effects are likely to be highly localised and temporary.	There is considerable uncertainty regarding potential cable landfall locations, therefore the effects on human health / populations cannot be assessed. This assessment will be undertaken at a project level, with any onshore components managed through the terrestrial planning permission process.
		Effects on residential amenity stemming from construction/installation/operational activities.	NE5 is located offshore, and as such the development will not directly affect residential amenity. Socio-economic impacts are considered separately to this assessment within the SEIA. There is potential for construction activity associated with export cables and cable landfalls to affect populations, however effects are likely to be highly localised and temporary.	There is considerable uncertainty regarding potential cable landfall locations, therefore the effects on human health / populations cannot be assessed. This assessment will be undertaken at a project level, with any onshore components managed through the terrestrial planning permission process.
		Issues of navigational safety, aviation and collision risk.	The presence of the offshore wind turbines increases the potential for collisions between recreational or commercial vessels and offshore wind developments. This risk is greater where the offshore wind array overlaps key navigational routes.	At a project level and as part of the EIA process there is a requirement for developers to undertake a navigational risk assessment and mitigate risks to navigation from development appropriately. It is likely that, based on development of 40% of the DPO, some spatial planning in NE5 could be used to reduce effects on key routes and allow safe transit through the development. There is, however, high density traffic throughout the DPO, and any development is likely to concentrate this traffic and hence increase navigational risk.

NE5				Total DPO Area: 496 km² Realistic Maximum Development Scenario (% of Total Capacity): 1 GW (40%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
				Due to the intersection of the DPO by a key navigational route the residual effect on navigational safety associated with the development of NE8 for offshore wind is considered to be **minor negative to moderate negative** dependent on the spatial planning and turbine design of development.
		Effects on marine and coastal recreation and access	Socio-economic impacts, such as the displacement of activity, are considered separately to this assessment within the SEIA, however effects on navigational safety of recreational activity associated with the development of the DPO are considered above. There is potential for construction activity associated with export cables and cable landfalls to affect populations, however effects are likely to be highly localised and temporary.	There is considerable uncertainty regarding potential cable landfall locations, therefore the effects on human health / populations cannot be assessed. This assessment will be undertaken at a project level, with any onshore components managed through the terrestrial planning permission process.
		Development of a secure energy supply.	The development of 1 GW of capacity within NE5 could contribute to the development of secure energy supply in the UK.	The potential benefit to UK energy security associated with the development of offshore wind in NE5 is considered to be **moderate to major positive.**
Soil (namely, Marine Geology and Coastal Processes)	The seabed sediments in NE5 are sand and coarse sediment throughout. NE5 is a significant distance (greater than 15 km) from coastlines that have the potential to be affected by changes to sediment transport associated with any development in the DPO.	Effects on subsea geology, sediments, and coastal processes arising from changes in hydrodynamics and the existing wave regime.	There is potential for changes to hydrodynamics caused by the development of offshore wind in NE5, and associated export cable routes and landfall, to affect the sediment transport around the site. The extent of the effects will be dependent on the design of the array, the technology deployed in the DPO, the cable route, landfall location and cable design.	There is uncertainty as to the likely technology to be deployed in the DPO, and the likely array design. Appropriate assessment will be required to determine potential effects, which may include hydrodynamic and sediment transport modelling. The residual effect on seabed sediment and physical processes is highly dependent on the technology type and array design but is considered likely to be **negligible to minor negative**.
Water Quality	Ecological status is determined for each of the surface water bodies of rivers, lakes, transitional waters and coastal waters, based on biological quality elements and supported by physico-	Effects on ecological status.	Offshore wind development within NE5, and associated export cable routes and landfall, has the potential to affect the ecological status of the water bodies, principally due to the installation of the export cables. Any changes to the natural condition of the water bodies have the	As part of the marine licencing process requirements are placed onto developers to ensure that activities are appropriately mitigated such that they do not cause permanent degradation of the ecological status under the WFD.

NE5				Total DPO Area: 496 km² Realistic Maximum Development Scenario (% of Total Capacity): 1 GW (40%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
	chemical and hydromorphological quality elements. NE5 does not directly overlap with any water bodies. There are, however, a number of water bodies inshore of NE5, all of which are of good condition.		potential to affect the status of the water body. In addition, any direct effects on features, including those within protected areas, have the potential to affect the WFD ecological status.	The residual effect on ecological status is considered to be **negligible to minor negative**.
		Effects on water quality (for example, due to increases in suspended sediment loads and turbidity as well as an increase in pollution incidents).	Effects associated with any contamination from seabed material resuspended during construction or decommissioning activity are likely to be of localised and temporary nature, with the level of effect dependant on the level of contamination within the sediment. Effects during operation and maintenance are considered less likely. Pollution events associated with support vessels during construction and operational phases have the potential to affect water quality within NE5.	Where an activity is expected to cause a significant disturbance of the seabed sediment additional contamination testing and subsequent water monitoring could be required through the marine licencing process. As part of marine licencing there is a requirement to produce pollution management plans to mitigate the effects of any pollution releases. In addition, significant releases are only likely to be associated with emergency events, considered unlikely. The residual effect is considered to be **minor negative**.
		Effects of the presence of structures on local currents, wave regimes, and water column mixing, as well as secondary effects on sedimentation and erosion beyond the sites.	There is potential for changes to hydrodynamics caused by the development of offshore wind in NE5 to affect the sediment transport in the region and on coastal processes. In addition, the effects of export cables and cable landfall should be considered at a project level. The extent of the effects will be dependent on the design of the array, the technology deployed in the DPO, the cable route, landfall location and cable design.	There is uncertainty as to the likely technology to be deployed in the DPO, and the likely array design. Appropriate assessment will be required to determine potential effects, which should include hydrodynamic and sediment transport modelling. The residual effect on seabed sediment and physical processes is highly dependent on the technology type and array design but is considered likely to be **negligible to minor negative**.
Climatic Factors	The key pressures on the climate are derived from the continued global emission of greenhouse gases, including carbon dioxide. These emissions are recognised as leading to changes in the global climate (including changes in temperatures, precipitation, storm density) in turn causing changes in the physical	Contribution to supporting a diverse and decarbonised energy sector.	The development of offshore wind energy in NE5 can contribute to a decarbonised energy sector, reducing carbon emissions.	The effect of development of offshore wind in the DPO has the potential to be **moderate to major positive** in contributing to a diverse and decarbonised energy sector.
		Coastal facilities may be at risk from climate change.	Facilities associated with offshore wind infrastructure may be at risk from sea	The design of any coastal facilities is required to account for sea level rise and coastal erosion in the design process.

NE5				Total DPO Area: 496 km² Realistic Maximum Development Scenario (% of Total Capacity): 1 GW (40%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
	characteristics of the oceans, including potential changes in sea temperatures, circulation, salinity, pH and sea level rise.		level rise and coastal erosion associated with climatic factors.	This is considered as part of the planning process at a project level.
Cultural Heritage	There are no Historic MPAs within or adjacent to NE5. There are 10 known shipwrecks within NE5. The area and coastline inshore of NE5 has a number of protected sites, including scheduled monuments and coastal built heritage.	Loss of and/or damage to historic environment features and their settings, including coastal and marine archaeology and historic MPAs.	There is potential for shipwrecks within NE5 to be affected by development, principally during the construction phase. In addition, historic MPAs, coastal built heritage, shipwrecks and scheduled monuments inshore of NE5 have the potential to be affected by export cable routes and cable landfalls.	Effects on culturally important sites can be mitigated through careful spatial planning within NE5 and through selection of appropriate cable export routes and landfall locations. As part of the design and planning process for any development within NE5 survey data will be obtained, this will identify any areas of cultural or historical sensitivity within the DPO or associated with cable planning that should be avoided and therefore inform spatial planning. Based on the use of appropriate spatial planning, the residual effect on cultural heritage is therefore considered to be **negligible to minor negative**.
Landscape, Seascape, and Visual Amenity	NE5 is located beyond 15 km from inhabited shorelines.	Both temporary and longer-term effects on landscape and coastal character and visual receptors arising from the presence of structures including any ancillary infrastructure and night-time lighting of offshore structures.	The development of offshore wind in NE5 has the potential to be visible from land and hence affect landscape / seascapes.	There is potential to mitigate visual effects through spatial planning within the DPO to avoid areas closest to land, and through the potential to select smaller turbines in areas of higher sensitivity. Development within NE5 may also require the assessment and management of night-time lighting effects. The residual effect on landscape / seascape is considered to be **minor to moderate negative**.

NE6

NE6				Total DPO Area: 699 km² Realistic Maximum Development Scenario (% of Total Capacity): 2 GW (57%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
Biodiversity, Flora and Fauna (Marine Mammals)	<u>Benthic Habitats and Species</u> The benthic habitat in NE6 is sandy with a small area of coarse sediment in the centre. There are areas of designated sensitive habitats inshore of the DPO, with the Moray Firth SAC designated for subtidal sandbanks and the proposed NCMPA at southern trench identifying burrowed mud as a feature. <u>Marine Mammals</u> Cetacean density within NE6 is low to moderate albeit there is a degree of uncertainty in this conclusion, and therefore further development of the baseline through survey will be required prior to project level assessment. There is potential for grey seal within NE6, associated with foraging from haul out sites and breeding colonies in the Orkney Islands and Dornoch Firth. There are sites designated for seals, bottlenose dolphins and otter inshore of the DPO (Moray Firth and Dornoch Firth and Morrich More SACs). In addition, the proposed NCMPA at southern trench includes minke whale as a feature. It is not expected there would be significant usage of the DPO area by marine mammals from the protected areas, however there is potential for effects from cable landfalls. <u>Birds</u> Bird usage of the area within NE6 is generally high. Additionally, there are important populations of sensitive species, including a number of species identified as features within the East	Loss of and/or damage to marine and coastal habitats, including benthic and intertidal habitats (for example, due to smothering of benthic habitats and substratum loss).	There is potential for permanent loss of habitat within the footprint of offshore wind turbines and associated scour protection and temporary damage to habitats from intra array cables. There is also potential for effects on coastal habitats inshore of NE6 associated with export cables and cable landfalls.	The footprint associated with offshore wind will be dependent on the technology used and the level of scour protection required. Effects on coastal habitats associated with export cable routes and cable landfall will be considered at a project level and can be mitigated through careful siting. The residual effect on habitat is therefore considered to be **minor negative** in NE6 based on the likely presence of priority marine features within the DPO.
		Effects on key receptors and prey species, including disturbance, noise effects, EMF exposure, collision risk, habitat exclusion, and barriers to wildlife movement	There is potential for disturbance of marine mammal, bird and fish species particularly due to noise emissions during construction from piling activities, survey and / or clearance of unexploded ordnance. These have the potential to cause physiological damage to fish and marine mammal species, and to cause displacement of fish, marine mammals and birds from the area of effect. Potential for effects to mammals and fish are lower during the operational and decommissioning phases of the offshore wind farm life cycle. There is, however, potential for effects on fish species, from EMF exposure associated with export cables. The consequences of such effects are not well understood, however are thought to be low. The introduction of offshore wind arrays may also cause a barrier effect, by which it prevents the movement of species through the area, potentially affecting migration pathways for marine mammals, fish species and birds. There is considerable uncertainty regarding the effect of windfarms on migrating birds in the North East region, however it is recognised that concerns	Physiological risks to fish and marine mammals from piling noise can be mitigated through the application measures relating to piling activities or soft start procedures, although fish responses to these measures are not well known and noise modelling should account for this uncertainty.. In addition, noise abatement measures at source can be implemented to reduce noise transmission into the wider environment, and therefore reduce displacement effects. Further research is required to determine the effect of collision risk on bird species, however current evidence suggests that the effect through this pathway may be low for the majority of species. To determine the potential risk to bird species within NE6, survey and radar studies should be considered at a project level, both before and after construction. There is potential for displacement of bird species and marine species outwith the DPO, which has the potential to affect bird populations foraging from the East Caithness Cliffs SPA. Based on uncertainty regarding the effect of wind farms in the North East region on

NE6				Total DPO Area: 699 km² Realistic Maximum Development Scenario (% of Total Capacity): 2 GW (57%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
	Caithness Cliffs SPA, some of which are likely to forage within NE6. There are some migration routes for a range of bird species which have the potential to intersect NE6. These routes are generally for species migrating between the UK and Scandinavia. <u>Fish</u> Within NE6 there are known nursery grounds for herring, cod, whiting and anglerfish, both of which have wide ranging nursery grounds across Scottish waters. There are also migratory fish which have the potential to transit through the area on transit to UK rivers.		regarding bird capacity in the East region have the potential to be applicable here. There is collision risk associated with bird species using the DPO area. However, current research suggests that it is more likely that birds will be displaced from the region.	migrating and resident bird populations, the residual effect on key receptors during construction and operation in NE6 is considered to be **minor negative to major negative**.
		Effects arising from habitat modification, such as the creation of artificial reefs, new roosting structures and exclusion of habitat damaging activity.	The introduction of the wind farm turbines and scour protection have the potential to provide alternative habitat within NE6 which could provide shelter for juvenile fish and crustacean shellfish. This effect has the potential to be both beneficial and adverse for different receptors. There is also the potential for activities currently damaging to the seabed habitat to be excluded from offshore wind development area, dependent on the technology implemented, which may lead to reduced damage to existing habitats. However, if activity is displaced to a different area the effect is likely to be negligible or potentially negative.	The potential effect associated with the development of offshore wind in NE6 is considered to be **negligible** but is dependent on the technology deployed.
		Effects of pollution releases on species and habitats.	Pollution events associated with support vessels during construction and	As part of marine licencing there is a requirement to produce pollution management plans to mitigate the effects

NE6				Total DPO Area: 699 km² Realistic Maximum Development Scenario (% of Total Capacity): 2 GW (57%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
			operational phases have the potential to affect species within NE6.	of any pollution releases. In addition, significant releases are only likely to be associated with emergency events, considered unlikely. The assessment and management of pollution risks will be undertaken at a project level. The residual risk associated with pollution releases associated with offshore wind farms is considered to be **negligible**.
		Effects from introduction and spread of Invasive Non-Native Species (INNS).	Offshore wind turbine foundations and scour protection provides a new colonising surface for INNS, and support vessels during construction and operational phases have the potential to introduce INNS, which may subsequently affect indigenous species within NE6.	There is a requirement for biosecurity management plans to be produced to minimise the risk of introduction of INNS. Controls will be imposed through the marine licencing process if required at a project level. The residual risk associated with INNS associated with offshore wind farms is considered to be **minor negative**.
Population and Human Health	NE6 is located offshore, beyond approximately 40 km from the nearest coastline. Areas within the DPO are, however, used for the purposes of commercial shipping and fishing. There is a high level of shipping within NE6, principally associated with important ferry routes and vessels departing or arriving into Aberdeen / Peterhead to / from the North Sea.	Effects arising from noise, vibration, light, dust and shadow flicker effects from all phases of development.	NE6 is located offshore, and as such construction, operation and decommissioning of arrays within the DPO will not give rise to significant effects on populations or human health directly through noise, vibration, light, dust or shadow flicker effects. There is potential for construction activity associated with export cables and cable landfalls to affect populations, however effects are likely to be highly localised and temporary.	There is considerable uncertainty regarding potential cable landfall locations, therefore the effects on human health / populations cannot be assessed. This assessment will be undertaken at a project level, with any onshore components managed through the terrestrial planning permission process.
		Effects on residential amenity stemming from construction/installation/operational activities.	NE6 is located offshore, and as such the development will not directly affect residential amenity. Socio-economic impacts are considered separately to this assessment within the SEIA. There is potential for construction activity associated with export cables and cable landfalls to affect populations, however effects are likely to be highly localised and temporary.	There is considerable uncertainty regarding potential cable landfall locations, therefore the effects on human health / populations cannot be assessed. This assessment will be undertaken at a project level, with any onshore components managed through the terrestrial planning permission process.
		Issues of navigational safety, aviation and collision risk.	The presence of the offshore wind turbines increases the potential for	At a project level and as part of the EIA process there is a requirement for

NE6				Total DPO Area: 699 km² Realistic Maximum Development Scenario (% of Total Capacity): 2 GW (57%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
			collisions between recreational or commercial vessels and offshore wind developments. This risk is greater where the offshore wind array overlaps key navigational routes.	developers to undertake a navigational risk assessment and mitigate risks to navigation from development appropriately. It is likely that, based on development of 57% of the DPO, some spatial planning in NE6 could be used to reduce effects on key routes and allow safe transit through the development, however this is unlikely to fully mitigate the effect. Due to the intersection of the DPO by a key navigational route the residual effect on navigational safety associated with the development of NE6 for offshore wind is considered to be **moderate negative to major negative** dependent on the spatial planning and turbine design of development.
		Effects on marine and coastal recreation and access	Socio-economic impacts, such as the displacement of activity, are considered separately to this assessment within the SEIA, however effects on navigational safety of recreational activity associated with the development of the DPO are considered above. There is potential for construction activity associated with export cables and cable landfalls to affect populations, however effects are likely to be highly localised and temporary.	There is considerable uncertainty regarding potential cable landfall locations, therefore the effects on human health / populations cannot be assessed. This assessment will be undertaken at a project level, with any onshore components managed through the terrestrial planning permission process.
		Development of a secure energy supply.	The development of 2 GW of capacity within NE6 could contribute to the development of secure energy supply in the UK.	The potential benefit to UK energy security associated with the development of offshore wind in NE6 is considered to be **moderate to major positive.**
Soil (namely, Marine Geology and Coastal Processes)	The seabed sediments in NE6 is sandy with a small area of course sediment in the centre. NE6 is a significant distance (greater than 40 km) from coastlines that have the potential to be affected by changes to sediment transport associated with any development in the DPO.	Effects on subsea geology, sediments, and coastal processes arising from changes in hydrodynamics and the existing wave regime.	There is potential for changes to hydrodynamics caused by the development of offshore wind in NE6, and associated export cable routes and landfall, to affect the sediment transport around the site. The extent of the effects will be dependent on the design of the array, the technology deployed in the DPO, the	There is uncertainty as to the likely technology to be deployed in the DPO, and the likely array design. Appropriate assessment will be required to determine potential effects, which may include hydrodynamic and sediment transport modelling. The distance of the DPO from the land will reduce the potential effects on coastal processes (the DPO is entirely >40 km from the shoreline).

NE6				Total DPO Area: 699 km² Realistic Maximum Development Scenario (% of Total Capacity): 2 GW (57%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
			cable route, landfall location and cable design.	The residual effect on seabed sediment and physical processes is highly dependent on the technology type and array design but is considered likely to be **negligible to minor negative**.
Water Quality	Ecological status is determined for each of the surface water bodies of rivers, lakes, transitional waters and coastal waters, based on biological quality elements and supported by physico-chemical and hydromorphological quality elements. NE6 does not directly overlap with any water bodies. There are, however, a number of water bodies inshore of NE6; Cairnbulg Point to the Ugie Estuary (high condition), Rosehearty to Cairnbilg Point (good condition), Macduf to Rosehearty (good condition).	Effects on ecological status.	Offshore wind development within NE6, and associated export cable routes and landfall, has the potential to affect the ecological status of the water bodies, principally due to the installation of the export cables. Any changes to the natural condition of the water bodies have the potential to affect the status of the water body. In addition, any direct effects on features, including those within protected areas, have the potential to affect the WFD ecological status.	As part of the marine licencing process requirements are placed onto developers to ensure that activities are appropriately mitigated such that they do not cause permanent degradation of the ecological status under the WFD. The residual effect on ecological status is considered to be **negligible to minor negative**.
		Effects on water quality (for example, due to increases in suspended sediment loads and turbidity as well as an increase in pollution incidents).	Effects associated with any contamination from seabed material resuspended during construction or decommissioning activity are likely to be of localised and temporary nature, with the level of effect dependant on the level of contamination within the sediment. Effects during operation and maintenance are considered less likely. Pollution events associated with support vessels during construction and operational phases have the potential to affect water quality within NE6.	Where an activity is expected to cause a significant disturbance of the seabed sediment additional contamination testing and subsequent water monitoring could be required through the marine licencing process. As part of marine licencing there is a requirement to produce pollution management plans to mitigate the effects of any pollution releases. In addition, significant releases are only likely to be associated with emergency events, considered unlikely. The residual effect is considered to be **minor negative**.
		Effects of the presence of structures on local currents, wave regimes, and water column mixing, as well as secondary effects on sedimentation and erosion beyond the sites.	There is potential for changes to hydrodynamics caused by the development of offshore wind in NE6 to affect the sediment transport in the region, however this is considered unlikely to subsequently to affect coastal processes due to the distance of the DPO from the coastline, although the effects of export cables and cable landfall should be considered at a project level.	There is uncertainty as to the likely technology to be deployed in the DPO, and the likely array design. Appropriate assessment will be required to determine potential effects, which may include hydrodynamic and sediment transport modelling. The distance of the DPO from the land will reduce the potential effects on coastal processes (the DPO is entirely >40 km from the shoreline).

NE6				Total DPO Area: 699 km² Realistic Maximum Development Scenario (% of Total Capacity): 2 GW (57%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
			The extent of the effects will be dependent on the design of the array, the technology deployed in the DPO, the cable route, landfall location and cable design.	The residual effect on seabed sediment and physical processes is highly dependent on the technology type and array design but is considered likely to be **negligible to minor negative**.
Climatic Factors	The key pressures on the climate are derived from the continued global emission of greenhouse gases, including carbon dioxide. These emissions are recognised as leading to changes in the global climate (including changes in temperatures, precipitation, storm density) in turn causing changes in the physical characteristics of the oceans, including potential changes in sea temperatures, circulation, salinity, pH and sea level rise.	Contribution to supporting a diverse and decarbonised energy sector.	The development of offshore wind energy in NE6 can contribute to a decarbonised energy sector, reducing carbon emissions.	The effect of development of offshore wind in the DPO has the potential to be major positive in contributing to a diverse and decarbonised energy sector.
		Coastal facilities may be at risk from climate change.	Facilities associated with offshore wind infrastructure may be at risk from sea level rise and coastal erosion associated with climatic factors.	The design of any coastal facilities is required to account for sea level rise and coastal erosion in the design process. This is considered as part of the planning process at a project level.
Cultural Heritage	There are no Historic MPAs within or adjacent to NE6. There are 7 known shipwrecks within NE6. The area and coastline inshore of NE6 has a number of protected sites, including scheduled monuments and coastal built heritage.	Loss of and/or damage to historic environment features and their settings, including coastal and marine archaeology and historic MPAs.	There is potential for shipwrecks within NE6 to be affected by development, principally during the construction phase. In addition, historic MPAs, coastal built heritage, shipwrecks and scheduled monuments inshore of NE6 have the potential to be affected by export cable routes and cable landfalls.	Effects on culturally important sites can be mitigated through careful spatial planning within NE6 and through selection of appropriate cable export routes and landfall locations. As part of the design and planning process for any development within NE6 survey data will be obtained, this will identify any areas of cultural or historical sensitivity within the DPO or associated with cable planning that should be avoided and therefore inform spatial planning. Based on the use of appropriate spatial planning, the residual effect on cultural heritage is therefore considered to be **negligible to minor negative**.
Landscape, Seascape, and Visual Amenity	NE6 is entirely beyond 40 km from inhabited shorelines.	Both temporary and longer-term effects on landscape and coastal character and visual receptors arising from the presence of structures including any ancillary infrastructure and night-time lighting of offshore structures.	The development of offshore wind in NE6 is not considered to affect Landscape, Seascapes or Visual Amenity	The residual effect on landscape / seascape is considered to be **negligible**, due to its distance from land.

NE7

NE7				Total DPO Area: 1027 km² Realistic Maximum Development Scenario (% of Total Capacity): 3 GW (58%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
Biodiversity, Flora and Fauna (Marine Mammals)	<u>Benthic Habitats and Species</u> The benthic habitat in NE7 is sand and mud throughout. This includes overlap with areas which support ocean quahog and potential for burrowed mud, both priority marine features. There are areas of designated sensitive habitats inshore of the DPO, with the Moray Firth SAC designated for subtidal sandbanks and the proposed NCMPA at southern trench identifying burrowed mud as a feature. <u>Marine Mammals</u> Cetacean density within NE7 is low overall, due to the offshore nature of the site albeit there is a degree of uncertainty in this conclusion, as data is not necessarily corrected for effort bias, and therefore further development of the baseline through survey will be required prior to project level assessment. There is some potential for grey seal within NE7, however this is at a low level. There are sites designated for seals, bottlenose dolphins and otter inshore of the DPO (Moray Firth and Dornoch Firth and Morrich More SACs). In addition the proposed NCMPA at southern trench includes minke whale as a feature. It is not expected there would be significant usage of the DPO area by marine mammals from the protected areas, however there is potential for effects from cable landfalls. <u>Birds</u> Bird usage of the area within NE7 is low, with limited numbers of species foraging as far offshore, and in such water depths.	Loss of and/or damage to marine and coastal habitats, including benthic and intertidal habitats (for example, due to smothering of benthic habitats and substratum loss).	There is potential for permanent loss of habitat within the footprint of offshore wind turbines and associated scour protection and temporary damage to habitats from intra array cables. There is also potential for effects on coastal habitats inshore of NE7 associated with export cables and cable landfalls.	The footprint associated with offshore wind will be dependent on the technology used and the level of scour protection required. Effects on coastal habitats associated with export cable routes and cable landfall will be considered at a project level and can be mitigated through careful siting. The residual effect on habitat is therefore considered to be **minor negative** in NE7 based on the likely presence of priority marine features within the DPO.
		Effects on key receptors and prey species, including disturbance, noise effects, EMF exposure, collision risk, habitat exclusion, and barriers to wildlife movement	There is potential for disturbance of marine mammal, bird and fish species particularly due to noise emissions during construction from piling activities, survey and / or clearance of unexploded ordnance. These have the potential to cause physiological damage to fish and marine mammal species, and to cause displacement of fish, marine mammals and birds from the area of effect. Potential for effects to mammals and fish are lower during the operational and decommissioning phases of the offshore wind farm life cycle. There is, however, potential for effects on fish species, from EMF exposure associated with export cables. The consequences of such effects are not well understood, however are thought to be low. The introduction of offshore wind arrays may also cause a barrier effect, by which it prevents the movement of species through the area, potentially affecting migration pathways for marine mammals, fish species and birds. There is considerable uncertainty regarding the effect of windfarms on migrating birds in the North East region, however it is recognised that concerns	Physiological risks to fish and marine mammals from piling noise can be mitigated through the application measures relating to piling activities or soft start procedures, although fish responses to these measures are not well known and noise modelling should account for this uncertainty. In addition, noise abatement measures at source can be implemented to reduce noise transmission into the wider environment, and therefore reduce displacement effects. Further research is required to determine the effect of collision risk on bird species, however current evidence suggests that the effect through this pathway may be low for the majority of species. To determine the potential risk to bird species within NE7, survey and radar studies should be considered at a project level, both before and after construction. There is potential for displacement of bird species and marine species outwith the DPO. However, NE7 is not identified as a key foraging area. Based on uncertainty regarding the effect of wind farms in the North East region on migrating and resident bird populations, the residual effect on key receptors during

NE7				Total DPO Area: 1027 km² Realistic Maximum Development Scenario (% of Total Capacity): 3 GW (58%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
	There are some migration routes for a range of bird species which have the potential to intersect NE7. These routes are generally for species migrating between the UK and Scandinavia. <u>Fish</u> Within NE7 there are known nursery grounds for whiting and anglerfish, both of which have wide ranging nursery grounds across Scottish waters. There are also migratory fish which have the potential to transit through the area on transit to UK rivers.		regarding bird capacity in the East region have the potential to be applicable here. There is collision risk associated with bird species using the DPO area. However, current research suggests that it is more likely that birds will be displaced from the region.	construction and operation in NE7 is considered to be **minor to moderate negative**.
		Effects arising from habitat modification, such as the creation of artificial reefs, new roosting structures and exclusion of habitat damaging activity.	The introduction of the wind farm turbines and scour protection have the potential to provide alternative habitat within NE7 which could provide shelter for juvenile fish and crustacean shellfish. This effect has the potential to be both beneficial and adverse for different receptors. There is also the potential for activities currently damaging to the seabed habitat to be excluded from offshore wind development area, dependent on the technology implemented, which may lead to reduced damage to existing habitats. However, if activity is displaced to a different area the effect is likely to be negligible or potentially negative.	The potential effect associated with the development of offshore wind in NE7 is considered to be **negligible** but is dependent on the technology deployed.
		Effects of pollution releases on species and habitats.	Pollution events associated with support vessels during construction and	As part of marine licencing there is a requirement to produce pollution management plans to mitigate the effects

NE7				Total DPO Area: 1027 km² Realistic Maximum Development Scenario (% of Total Capacity): 3 GW (58%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
			operational phases have the potential to affect species within NE7.	of any pollution releases. In addition, significant releases are only likely to be associated with emergency events, considered unlikely. The assessment and management of pollution risks will be undertaken at a project level. The residual risk associated with pollution releases associated with offshore wind farms is considered to be **negligible**.
		Effects from introduction and spread of Invasive Non-Native Species (INNS).	Offshore wind turbine foundations and scour protection provides a new colonising surface for INNS, and support vessels during construction and operational phases have the potential to introduce INNS, which may subsequently affect indigenous species within NE7.	There is a requirement for biosecurity management plans to be produced to minimise the risk of introduction of INNS. Controls will be imposed through the marine licencing process if required at a project level. The residual risk associated with INNS associated with offshore wind farms is considered to be **minor negative**.
Population and Human Health	NE7 is located offshore, beyond approximately 75 km from the nearest coastline. Areas within the DPO are, however, used for the purposes of commercial shipping and fishing. There is a moderate level of shipping throughout the DPO, principally associated with vessels departing or arriving into Aberdeen / Peterhead to / from the North Sea.	Effects arising from noise, vibration, light, dust and shadow flicker effects from all phases of development.	NE7 is located offshore, and as such construction, operation and decommissioning of arrays within the DPO will not give rise to significant effects on populations or human health directly through noise, vibration, light, dust or shadow flicker effects. There is potential for construction activity associated with export cables and cable landfalls to affect populations, however effects are likely to be highly localised and temporary.	There is considerable uncertainty regarding potential cable landfall locations, therefore the effects on human health / populations cannot be assessed. This assessment will be undertaken at a project level, with any onshore components managed through the terrestrial planning permission process.
		Effects on residential amenity stemming from construction/installation/operational activities.	NE7 is located offshore, and as such the development will not directly affect residential amenity. Socio-economic impacts are considered separately to this assessment within the SEIA. There is potential for construction activity associated with export cables and cable landfalls to affect populations, however effects are likely to be highly localised and temporary.	There is considerable uncertainty regarding potential cable landfall locations, therefore the effects on human health / populations cannot be assessed. This assessment will be undertaken at a project level, with any onshore components managed through the terrestrial planning permission process.
		Issues of navigational safety, aviation and collision risk.	The presence of the offshore wind turbines increases the potential for	At a project level and as part of the EIA process there is a requirement for

NE7				Total DPO Area: 1027 km² Realistic Maximum Development Scenario (% of Total Capacity): 3 GW (58%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
			collisions between recreational or commercial vessels and offshore wind developments. This risk is greater where the offshore wind array overlaps key navigational routes.	developers to undertake a navigational risk assessment and mitigate risks to navigation from development appropriately. It is likely that, based on development of 53% of the DPO, spatial planning in NE7 could be used to reduce effects on key routes and allow safe transit through the development. In addition, there is potential for diversion of the majority of the traffic around NE7 with limited effect on mileage or time. The residual effect on navigational safety associated with the development of NE7 for offshore wind is considered to be **negligible to minor negative** dependent on the spatial planning and turbine design of development.
		Effects on marine and coastal recreation and access	Socio-economic impacts, such as the displacement of activity, are considered separately to this assessment within the SEIA, however effects on navigational safety of recreational activity associated with the development of the DPO are considered above. There is potential for construction activity associated with export cables and cable landfalls to affect populations, however effects are likely to be highly localised and temporary.	There is considerable uncertainty regarding potential cable landfall locations, therefore the effects on human health / populations cannot be assessed. This assessment will be undertaken at a project level, with any onshore components managed through the terrestrial planning permission process.
		Development of a secure energy supply.	The development of 1 GW of capacity within NE7 could contribute to the development of secure energy supply in the UK.	The potential benefit to UK energy security associated with the development of offshore wind in NE7 is considered to be **moderate to major positive.**
Soil (namely, Marine Geology and Coastal Processes)	The seabed sediments in NE7 are sand and mud throughout. NE7 is a significant distance (greater than 75 km) from coastlines that have the potential to be affected by changes to sediment transport associated with any development in the DPO.	Effects on subsea geology, sediments, and coastal processes arising from changes in hydrodynamics and the existing wave regime.	There is potential for changes to hydrodynamics caused by the development of offshore wind in NE7, and associated export cables and landfall, to affect the sediment transport around the site. The extent of the effects will be dependent on the design of the array, the technology deployed in the DPO, the	There is uncertainty as to the likely technology to be deployed in the DPO, and the likely array design. Appropriate assessment will be required to determine potential effects, which may include hydrodynamic and sediment transport modelling. The distance of the DPO from the land will reduce the potential effects on coastal processes (the DPO is entirely >75 km from the shoreline).

NE7				Total DPO Area: 1027 km² Realistic Maximum Development Scenario (% of Total Capacity): 3 GW (58%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
			cable route, landfall location and cable design.	The residual effect on seabed sediment and physical processes is highly dependent on the technology type and array design but is considered likely to be **negligible to minor negative**.
Water Quality	Ecological status is determined for each of the surface water bodies of rivers, lakes, transitional waters and coastal waters, based on biological quality elements and supported by physico-chemical and hydromorphological quality elements. NE7 does not directly overlap with any water bodies. There are, however, a number of water bodies inshore of NE7, the majority of which are of good condition, with the exception of Cairnbulg Point to the Ugie Estuary which is high condition.	Effects on ecological status.	The development of offshore wind farms within NE7, and associated export cables and landfall, has the potential to affect the ecological status of the water bodies, principally due to the installation of the export cables. Any changes to the natural condition of the water bodies have the potential to affect the status of the water body. In addition, any direct effects on features, including those within protected areas, have the potential to affect the WFD ecological status.	As part of the marine licencing process requirements are placed onto developers to ensure that activities are appropriately mitigated such that they do not cause permanent degradation of the ecological status under the WFD. The residual effect on ecological status is considered to be **negligible to minor negative**.
		Effects on water quality (for example, due to increases in suspended sediment loads and turbidity as well as an increase in pollution incidents).	Effects associated with any contamination from seabed material resuspended during construction or decommissioning activity are likely to be of localised and temporary nature, with the level of effect dependant on the level of contamination within the sediment. Effects during operation and maintenance are considered less likely. Pollution events associated with support vessels during construction and operational phases have the potential to affect water quality within NE7.	Where an activity is expected to cause a significant disturbance of the seabed sediment additional contamination testing and subsequent water monitoring could be required through the marine licencing process. As part of marine licencing there is a requirement to produce pollution management plans to mitigate the effects of any pollution releases. In addition, significant releases are only likely to be associated with emergency events, considered unlikely. The residual effect is considered to be **minor negative**.
		Effects of the presence of structures on local currents, wave regimes, and water column mixing, as well as secondary effects on sedimentation and erosion beyond the sites.	There is potential for changes to hydrodynamics caused by the development of offshore wind in NE7, and associated export cables and landfall, to affect the sediment transport in the region, however this is considered unlikely to subsequently to affect coastal processes due to the distance of the DPO from the coastline, although the effects of export	There is uncertainty as to the likely technology to be deployed in the DPO, and the likely array design. Appropriate assessment will be required to determine potential effects, which may include hydrodynamic and sediment transport modelling. The distance of the DPO from the land will reduce the potential effects

NE7				Total DPO Area: 1027 km² Realistic Maximum Development Scenario (% of Total Capacity): 3 GW (58%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
			cables and cable landfall should be considered at a project level. The extent of the effects will be dependent on the design of the array, the technology deployed in the DPO, the cable route, landfall location and cable design.	on coastal processes (the DPO is entirely >75 km from the shoreline). The residual effect on seabed sediment and physical processes is highly dependent on the technology type and array design but is considered likely to be **negligible to minor negative**.
Climatic Factors	The key pressures on the climate are derived from the continued global emission of greenhouse gases, including carbon dioxide. These emissions are recognised as leading to changes in the global climate (including changes in temperatures, precipitation, storm density) in turn causing changes in the physical characteristics of the oceans, including potential changes in sea temperatures, circulation, salinity, pH and sea level rise.	Contribution to supporting a diverse and decarbonised energy sector.	The development of offshore wind energy in NE7 can contribute to a decarbonised energy sector, reducing carbon emissions.	The effect of development of offshore wind in the DPO has the potential to be **moderate to major positive** in contributing to a diverse and decarbonised energy sector.
		Coastal facilities may be at risk from climate change.	Facilities associated with offshore wind infrastructure may be at risk from sea level rise and coastal erosion associated with climatic factors.	The design of any coastal facilities is required to account for sea level rise and coastal erosion in the design process. This is considered as part of the planning process at a project level.
Cultural Heritage	There are no Historic MPAs within or adjacent to NE7. There are 5 known shipwrecks within NE7. The area and coastline inshore of NE7 has a number of protected sites, including scheduled monuments and coastal built heritage.	Loss of and/or damage to historic environment features and their settings, including coastal and marine archaeology and historic MPAs.	There is potential for shipwrecks within NE7 to be affected by development, principally during the construction phase. In addition, historic MPAs, coastal built heritage, shipwrecks and scheduled monuments inshore of NE7 have the potential to be affected by export cable routes and cable landfalls.	Effects on culturally important sites can be mitigated through careful spatial planning within NE7 and through selection of appropriate cable export routes and landfall locations. As part of the design and planning process for any development within NE7 survey data will be obtained, this will identify any areas of cultural or historical sensitivity within the DPO or associated with cable planning that should be avoided and therefore inform spatial planning. Based on the use of appropriate spatial planning, the residual effect on cultural heritage is therefore considered to be **negligible to minor negative**.
Landscape, Seascape, and Visual Amenity	NE7 is entirely beyond 75 km from inhabited shorelines.	Both temporary and longer-term effects on landscape and coastal character and visual receptors arising from the presence of structures including any ancillary infrastructure and night-time lighting of offshore structures.	The development of offshore wind in NE7 is not considered to affect act Landscape, Seascapes or Visual Amenity	No effect

NE8

NE8				Total DPO Area: 401 km² Realistic Maximum Development Scenario (% of Total Capacity): 1 GW (50%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
Biodiversity, Flora and Fauna (Marine Mammals)	<u>Benthic Habitats and Species</u> The benthic habitat in NE8 is sand and mud throughout. This includes overlap with areas which support ocean quahog and potential for burrowed mud, both priority marine features. There are areas of designated sensitive habitats inshore of the DPO, with the Moray Firth SAC designated for subtidal sandbanks and the proposed NCMPA at southern trench identifying burrowed mud as a feature.	Loss of and/or damage to marine and coastal habitats, including benthic and intertidal habitats (for example, due to smothering of benthic habitats and substratum loss).	There is potential for permanent loss of habitat within the footprint of offshore wind turbines and associated scour protection and temporary damage to habitats from intra array cables. There is also potential for effects on coastal habitats inshore of NE8 associated with export cables and cable landfalls.	The footprint associated with offshore wind will be dependent on the technology used and the level of scour protection required. Effects on coastal habitats associated with export cable routes and cable landfall will be considered at a project level and can be mitigated through careful siting. The residual effect on habitat is therefore considered to be **minor negative** in NE8 based on the likely presence of priority marine features within the DPO.
	<u>Marine Mammals</u> Cetacean density within NE8 is low overall, due to the offshore nature of the site albeit there is a degree of uncertainty in this conclusion as data is not necessarily corrected for effort bias, and therefore further development of the baseline through survey will be required prior to project level assessment. There is some potential for grey seal within NE8, however this is at a low level. There are sites designated for seals, bottlenose dolphins and otter inshore of the DPO (Moray Firth and Dornoch Firth and Morrich More SACs). In addition the proposed NCMPA at southern trench includes minke whale as a feature. It is not expected there would be significant usage of the DPO area by marine mammals from the protected areas, however there is potential for effects from cable landfalls. <u>Birds</u> Bird usage of the area within NE8 is low, with limited numbers of species foraging as far offshore, and in such water depths.	Effects on key receptors and prey species, including disturbance, noise effects, EMF exposure, collision risk, habitat exclusion, and barriers to wildlife movement	There is potential for disturbance of marine mammal, bird and fish species particularly due to noise emissions during construction from piling activities, survey and / or clearance of unexploded ordnance. These have the potential to cause physiological damage to fish and marine mammal species, and to cause displacement of fish, marine mammals and birds from the area of effect. Potential for effects to mammals and fish are lower during the operational and decommissioning phases of the offshore wind farm life cycle. There is, however, potential for effects on fish species, from EMF exposure associated with export cables. The consequences of such effects are not well understood, however are thought to be low. The introduction of offshore wind arrays may also cause a barrier effect, by which it prevents the movement of species through the area, potentially affecting migration pathways for marine mammals, fish species and birds. There is considerable uncertainty regarding the effect of windfarms on migrating birds in the North East region, however it is recognised that concerns	Physiological risks to fish and marine mammals from piling noise can be mitigated through the application measures relating to piling activities or soft start procedures, although fish responses to these measures are not well known and noise modelling should account for this uncertainty. In addition, noise abatement measures at source can be implemented to reduce noise transmission into the wider environment, and therefore reduce displacement effects. Further research is required to determine the effect of collision risk on bird species, however current evidence suggests that the effect through this pathway may be low for the majority of species. To determine the potential risk to bird species within NE8, survey and radar studies should be considered at a project level, both before and after construction. There is potential for displacement of bird species and marine species outwith the DPO. However, NE8 is not identified as a key foraging area. Based on uncertainty regarding the effect of wind farms in the North East region on migrating and resident bird populations, the residual effect on key receptors during

NE8				Total DPO Area: 401 km² Realistic Maximum Development Scenario (% of Total Capacity): 1 GW (50%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
	There are some migration routes for a range of bird species which have the potential to intersect NE8. These routes are generally for species migrating between the UK and Scandinavia. <u>Fish</u> Within NE8 there are known nursery grounds for whiting and anglerfish, both of which have wide ranging nursery grounds across Scottish waters. There are also migratory fish which have the potential to transit through the area on transit to UK rivers.		regarding bird capacity in the East region have the potential to be applicable here. There is collision risk associated with bird species using the DPO area. However, current research suggests that it is more likely that birds will be displaced from the region.	construction and operation in NE8 is considered to be **minor to moderate negative**.
		Effects arising from habitat modification, such as the creation of artificial reefs, new roosting structures and exclusion of habitat damaging activity.	The introduction of the wind farm turbines and scour protection have the potential to provide alternative habitat within NE8 which could provide shelter for juvenile fish and crustacean shellfish. This effect has the potential to be both beneficial and adverse for different receptors. There is also the potential for activities currently damaging to the seabed habitat to be excluded from offshore wind development area, dependent on the technology implemented, which may lead to reduced damage to existing habitats. However, if activity is displaced to a different area the effect is likely to be negligible or potentially negative.	The potential effect associated with the development of offshore wind in NE8 is considered to be **negligible** but is dependent on the technology deployed.
		Effects of pollution releases on species and habitats.	Pollution events associated with support vessels during construction and	As part of marine licencing there is a requirement to produce pollution management plans to mitigate the effects

NE8				Total DPO Area: 401 km² Realistic Maximum Development Scenario (% of Total Capacity): 1 GW (50%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
			operational phases have the potential to affect species within NE8.	of any pollution releases. In addition, significant releases are only likely to be associated with emergency events, considered unlikely. The assessment and management of pollution risks will be undertaken at a project level. The residual risk associated with pollution releases associated with offshore wind farms is considered to be **negligible**.
		Effects from introduction and spread of Invasive Non-Native Species (INNS).	Offshore wind turbine foundations and scour protection provides a new colonising surface for INNS, and support vessels during construction and operational phases have the potential to introduce INNS, which may subsequently affect indigenous species within NE8.	There is a requirement for biosecurity management plans to be produced to minimise the risk of introduction of INNS. Controls will be imposed through the marine licencing process if required at a project level. The residual risk associated with INNS associated with offshore wind farms is considered to be **minor negative**.
Population and Human Health	NE8 is located offshore, beyond approximately 70 km from the nearest coastline. Areas within the DPO are, however, used for the purposes of commercial shipping and fishing. There is a moderate level of shipping throughout the DPO, principally associated with vessels departing or arriving into Aberdeen / Peterhead to / from the North Sea.	Effects arising from noise, vibration, light, dust and shadow flicker effects from all phases of development.	NE8 is located offshore, and as such construction, operation and decommissioning of arrays within the DPO will not give rise to significant effects on populations or human health directly through noise, vibration, light, dust or shadow flicker effects. There is potential for construction activity associated with export cables and cable landfalls to affect populations, however effects are likely to be highly localised and temporary.	There is considerable uncertainty regarding potential cable landfall locations, therefore the effects on human health / populations cannot be assessed. This assessment will be undertaken at a project level, with any onshore components managed through the terrestrial planning permission process.
		Effects on residential amenity stemming from construction/installation/operational activities.	NE8 is located offshore, and as such the development will not directly affect residential amenity. Socio-economic impacts are considered separately to this assessment within the SEIA. There is potential for construction activity associated with export cables and cable landfalls to affect populations, however effects are likely to be highly localised and temporary.	There is considerable uncertainty regarding potential cable landfall locations, therefore the effects on human health / populations cannot be assessed. This assessment will be undertaken at a project level, with any onshore components managed through the terrestrial planning permission process.
		Issues of navigational safety, aviation and collision risk.	The presence of the offshore wind turbines increases the potential for	At a project level and as part of the EIA process there is a requirement for

NE8				Total DPO Area: 401 km² Realistic Maximum Development Scenario (% of Total Capacity): 1 GW (50%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
			collisions between recreational or commercial vessels and offshore wind developments. This risk is greater where the offshore wind array overlaps key navigational routes.	developers to undertake a navigational risk assessment and mitigate risks to navigation from development appropriately. It is likely that, based on development of 46% of the DPO, spatial planning in NE8 could be used to reduce effects on key routes and allow safe transit through the development. In addition, there is potential for diversion of the majority of the traffic around NE8 with limited effect on mileage or time. The residual effect on navigational safety associated with the development of NE8 for offshore wind is considered to be **negligible to minor negative** dependent on the spatial planning and turbine design of development.
		Effects on marine and coastal recreation and access	Socio-economic impacts, such as the displacement of activity, are considered separately to this assessment within the SEIA, however effects on navigational safety of recreational activity associated with the development of the DPO are considered above. There is potential for construction activity associated with export cables and cable landfalls to affect populations, however effects are likely to be highly localised and temporary.	There is considerable uncertainty regarding potential cable landfall locations, therefore the effects on human health / populations cannot be assessed. This assessment will be undertaken at a project level, with any onshore components managed through the terrestrial planning permission process.
		Development of a secure energy supply.	The development of 2 GW of capacity within NE8 could contribute to the development of secure energy supply in the UK.	The potential benefit to UK energy security associated with the development of offshore wind in NE8 is considered to be **moderate to major positive.**
Soil (namely, Marine Geology and Coastal Processes)	The seabed sediments in NE8 are sand and mud throughout. NE8 is a significant distance (greater than 70 km) from coastlines that have the potential to be affected by changes to sediment transport associated with any development in the DPO.	Effects on subsea geology, sediments, and coastal processes arising from changes in hydrodynamics and the existing wave regime.	There is potential for changes to hydrodynamics caused by the development of offshore wind in NE8, and associated export cable routes and landfall, to affect the sediment transport around the site. The extent of the effects will be dependent on the design of the array, the technology deployed in the DPO, the	There is uncertainty as to the likely technology to be deployed in the DPO, and the likely array design. Appropriate assessment will be required to determine potential effects, which may include hydrodynamic and sediment transport modelling. The distance of the DPO from the land will reduce the potential effects on coastal processes (the DPO is entirely >70 km from the shoreline).

NE8				Total DPO Area: 401 km² Realistic Maximum Development Scenario (% of Total Capacity): 1 GW (50%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
			cable route, landfall location and cable design.	The residual effect on seabed sediment and physical processes is highly dependent on the technology type and array design but is considered likely to be **negligible to minor negative**.
Water Quality	Ecological status is determined for each of the surface water bodies of rivers, lakes, transitional waters and coastal waters, based on biological quality elements and supported by physico-chemical and hydromorphological quality elements. NE8 does not directly overlap with any water bodies. There are, however, a number of water bodies inshore of NE8, the majority of which are of good condition, with the exception of Cairnbulg Point to the Ugie Estuary which is high condition.	Effects on ecological status.	Offshore wind development within NE8, and associated export cable routes and landfall, has the potential to affect the ecological status of the water bodies, principally due to the installation of the export cables. Any changes to the natural condition of the water bodies have the potential to affect the status of the water body. In addition, any direct effects on features, including those within protected areas, have the potential to affect the WFD ecological status.	As part of the marine licencing process requirements are placed onto developers to ensure that activities are appropriately mitigated such that they do not cause permanent degradation of the ecological status under the WFD. The residual effect on ecological status is considered to be **negligible to minor negative**.
		Effects on water quality (for example, due to increases in suspended sediment loads and turbidity as well as an increase in pollution incidents).	Effects associated with any contamination from seabed material resuspended during construction or decommissioning activity are likely to be of localised and temporary nature, with the level of effect dependant on the level of contamination within the sediment. Effects during operation and maintenance are considered less likely. Pollution events associated with support vessels during construction and operational phases have the potential to affect water quality within NE8.	Where an activity is expected to cause a significant disturbance of the seabed sediment additional contamination testing and subsequent water monitoring could be required through the marine licencing process. As part of marine licencing there is a requirement to produce pollution management plans to mitigate the effects of any pollution releases. In addition, significant releases are only likely to be associated with emergency events, considered unlikely. The residual effect is considered to be **minor negative**.
		Effects of the presence of structures on local currents, wave regimes, and water column mixing, as well as secondary effects on sedimentation and erosion beyond the sites.	There is potential for changes to hydrodynamics caused by the development of offshore wind in NE8 to affect the sediment transport in the region, however this is considered unlikely to subsequently to affect coastal processes due to the distance of the DPO from the coastline, although the effects of export	There is uncertainty as to the likely technology to be deployed in the DPO, and the likely array design. Appropriate assessment will be required to determine potential effects, which may include hydrodynamic and sediment transport modelling. The distance of the DPO from the land will reduce the potential effects

NE8				Total DPO Area: 401 km² Realistic Maximum Development Scenario (% of Total Capacity): 1 GW (50%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
			cables and cable landfall should be considered at a project level. The extent of the effects will be dependent on the design of the array, the technology deployed in the DPO, the cable route, landfall location and cable design.	on coastal processes (the DPO is entirely >70 km from the shoreline). The residual effect on seabed sediment and physical processes is highly dependent on the technology type and array design but is considered likely to be **negligible to minor negative**.
Climatic Factors	The key pressures on the climate are derived from the continued global emission of greenhouse gases, including carbon dioxide. These emissions are recognised as leading to changes in the global climate (including changes in temperatures, precipitation, storm density) in turn causing changes in the physical characteristics of the oceans, including potential changes in sea temperatures, circulation, salinity, pH and sea level rise.	Contribution to supporting a diverse and decarbonised energy sector.	The development of offshore wind energy in NE8 can contribute to a decarbonised energy sector, reducing carbon emissions.	The effect of development of offshore wind in the DPO has the potential to be major positive in contributing to a diverse and decarbonised energy sector.
		Coastal facilities may be at risk from climate change.	Facilities associated with offshore wind infrastructure may be at risk from sea level rise and coastal erosion associated with climatic factors.	The design of any coastal facilities is required to account for sea level rise and coastal erosion in the design process. This is considered as part of the planning process at a project level.
Cultural Heritage	There are no Historic MPAs within or adjacent to NE8. There are 7 known shipwrecks within NE8. The area and coastline inshore of NE8 has a number of protected sites, including scheduled monuments and coastal built heritage.	Loss of and/or damage to historic environment features and their settings, including coastal and marine archaeology and historic MPAs.	There is potential for shipwrecks within NE8 to be affected by development, principally during the construction phase. In addition, historic MPAs, coastal built heritage, shipwrecks and scheduled monuments inshore of NE8 have the potential to be affected by export cable routes and cable landfalls.	Effects on culturally important sites can be mitigated through careful spatial planning within NE8 and through selection of appropriate cable export routes and landfall locations. As part of the design and planning process for any development within NE8 survey data will be obtained, this will identify any areas of cultural or historical sensitivity within the DPO or associated with cable planning that should be avoided and therefore inform spatial planning. Based on the use of appropriate spatial planning, the residual effect on cultural heritage is therefore considered to be **negligible to minor negative**.
Landscape, Seascape, and Visual Amenity	NE8 is entirely beyond 70 km from inhabited shorelines.	Both temporary and longer-term effects on landscape and coastal character and visual receptors arising from the presence of structures including any ancillary infrastructure and night-time lighting of offshore structures.	The development of offshore wind in NE8 is not considered to affect Landscape, Seascapes or Visual Amenity	No effect

C.5 East

E1

E1				Total DPO Area: 3816 km² Realistic Maximum Development Scenario (% of Total Capacity): 3 GW (16%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
Biodiversity, Flora and Fauna (Marine Mammals)	<u>Benthic Habitats and Species</u> The benthic habitat in E1 is sandy sediment. There is no sensitive (priority marine feature) habitat identified within E1. There are sensitive habitats inshore of the DPO, including those associated with the River Tay SAC and Berwickshire and North Northumberland Coast SAC. There are also two NCMPAs inshore of E1, one of which (Firth of Forth Banks Complex, designated for ocean quahog and benthic habitats) overlaps slightly with the western corner.	Loss of and/or damage to marine and coastal habitats, including benthic and intertidal habitats (for example, due to smothering of benthic habitats and substratum loss).	There is potential for permanent loss of habitat within the footprint of offshore wind turbines and associated scour protection and temporary damage to habitats from intra array cables. There is no identified habitat of particular sensitivity within E1 which would be affected by this pathway, however the sandy sediments may be of importance for fish spawning. There is also potential for effects on coastal habitats inshore of E1 associated with export cables and cable landfalls. This includes potential effects on the habitats designated for the River Tay SAC and Berwickshire and North Northumberland Coast SAC.	The footprint associated with offshore wind will be dependent on the technology used and the level of scour protection required. Benthic habitats associated with the Firth of Forth Banks complex NCMPA have the potential to be affected by development, this will require assessment at a project level and can be mitigated through spatial planning. Effects on coastal habitats associated with export cable routes and cable landfall will be considered at a project level and can be mitigated through careful siting. The residual effect on habitat is therefore considered to be **minor negative** in E1.
	<u>Marine Mammals</u> There are known populations of harbour seal in the Firth of Forth and grey seals in the River Tay and Lindisfarne Nature Reserve. Grey seals forage further offshore, meaning they are considerably more likely to interact with E1. Data indicates that there are generally low to moderate densities of cetaceans within E1 including records of whitebeaked dolphin, minke whale and harbour porpoise. However, there is some uncertainty in the data, and therefore development of the baseline through survey will be required prior to project level assessment. <u>Birds</u> There are a number of important bird populations within the Firth of Forth, River Tay and to the north and south of Aberdeen, including SPA and pSPA designations. Species of particular importance include the Herring Gull,	Effects on key mobile receptors and prey species, including disturbance, noise effects, EMF exposure, collision risk, habitat exclusion, and barriers to wildlife movement.	There is potential for disturbance of marine mammal, bird and fish species particularly due to noise emissions during construction from piling activities, survey and / or clearance of unexploded ordnance. These have the potential to cause physiological damage to fish and marine mammal species, and to cause displacement of fish, marine mammals and birds from the area of effect. Potential for effects to mammals and fish are lower during the operational and decommissioning phases of the offshore wind farm life cycle. There is, however, potential for effects on fish species, from EMF exposure associated with export cables. The consequences of such effects are not well understood, however are thought to be low. The introduction of offshore wind arrays may also cause a barrier effect, preventing the movement of species through the area, potentially affecting	Effects on fish (particularly species using the DPO for spawning) can be mitigated through temporal restrictions on piling activities. Physiological risks to fish and marine mammals from piling noise can be mitigated through the application measures relating to piling activities or soft start procedures, although fish responses to these measures are not well known and noise modelling should account for this uncertainty. In addition, noise abatement measures at source can be implemented to reduce noise transmission into the wider environment, and therefore reduce displacement effects. Further research is required to determine the effect of collision risk on bird species. There is uncertainty regarding available room for further development in E1 due to the birds that are present. Additional studies and surveys should be undertaken at a project level to determine the

E1				Total DPO Area: 3816 km² Realistic Maximum Development Scenario (% of Total Capacity): 3 GW (16%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
	Shag, Razorbill, Kittiwake, Arctic Tern, Sandwich tern, Puffin, Fulmar, Guillemot and Cormorant. In addition, there are a number of migration routes of both seabird, waterbird and terrestrial bird species on the east coast of Scotland. The offshore nature of E1 means that it is in an area of lower recorded bird activity. <u>Fish</u> Within E1 there are known spawning and nursery grounds for several species. This includes spawning grounds for This includes spawning grounds for cod, whiting, plaice, herring and sandeel. There are a number of migratory fish which migrate through the seas within the East region into the estuary and riverine environments, including Atlantic salmon and sea lamprey		migration pathways for marine mammals, fish species and birds. The site is adjacent to SPAs and pSPAs in the Firth of Forth and River Tay, and therefore potential for displacement of designated species exists. However, the boundary of the pSPA is inland of E1 and areas outwith the pSPA are therefore expected to be of lower density and hence importance for foraging.	potential risk in E1 prior to the consenting process. There is potential for displacement of bird species. E1 and the immediate surrounding area is identified as a foraging ground for species of international or national importance and spatial planning would have to be used to reduce the potential for barrier effects on birds and other marine species. The residual effect on key receptors during construction and operation in E1 is considered to be **minor negative to moderate negative**.
		Effects arising from habitat modification, such as the creation of artificial reefs, new roosting structures and exclusion of habitat damaging activity.	The introduction of the wind farm turbines and scour protection have the potential to provide alternative habitat within SW1, which could provide shelter for juvenile fish and crustacean shellfish. This effect has the potential to be both beneficial and adverse for different receptors. There is also the potential for activities currently damaging to the seabed habitat to be excluded from offshore wind development area, dependent on the technology implemented, which may lead to reduced damage to existing habitats. However, if activity is displaced to a different area the effect is likely to be negligible or potentially negative.	The potential effect associated with the development of offshore wind in E1 is considered to be **negligible** but is dependent on the technology deployed.
		Effects of pollution releases on species and habitats.	Pollution events associated with support vessels during construction and operational phases have the potential to affect species within E1.	As part of marine licencing there is a requirement to produce pollution management plans to mitigate the effects of any pollution releases. In addition, significant releases are only likely to be associated with emergency events, considered unlikely. The assessment and management of pollution risks will be undertaken at a project level. The residual risk associated with pollution releases associated with offshore wind farms is considered to be **negligible**.

E1				Total DPO Area: 3816 km² Realistic Maximum Development Scenario (% of Total Capacity): 3 GW (16%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
		Effects from introduction and spread of Invasive Non-Native Species (INNS).	Offshore wind turbine foundations and scour protection provides a new colonising surface for INNS, and support vessels during construction and operational phases have the potential to introduce INNS, which may subsequently affect indigenous species within E1.	There is a requirement for biosecurity management plans to be produced to minimise the risk of introduction of INNS. Controls will be imposed through the marine licencing process if required at a project level. The residual risk associated with INNS associated with offshore wind farms is considered to be **minor negative**.
Population and Human Health	Due to the offshore nature of the E1 DPO there are no significant populations directly adjacent to the DPO. The coastline landwards of E1 is generally highly populated, with a number of big cities and towns (Edinburgh, Dundee, Aberdeen, Dundee). Areas within the DPO are, however, used for the purposes of commercial shipping. Shipping traffic within the DPO is generally low to moderate with the highest density traffic in the western sector of the DPO. There are no key routes which intersect the DPO Recreational boating and recreational angling do not take place in the DPO due to its offshore nature.	Effects arising from noise, vibration, light, dust and shadow flicker effects from all phases of development.	SW1 is located offshore, and as such construction, operation and decommissioning of arrays within the DPO will not give rise to significant effects on populations or human health directly through noise, vibration, light, dust or shadow flicker effects. There is potential for construction activity associated with export cables and cable landfalls to affect populations, however effects are likely to be highly localised and temporary.	There is considerable uncertainty regarding potential cable landfall locations, therefore the effects on human health / populations cannot be assessed. This assessment will be undertaken at a project level, with any onshore components managed through the terrestrial planning permission process.
		Effects on residential amenity stemming from construction/installation/operational activities.	E1 is located offshore, and as such the development will not directly affect residential amenity. Socio-economic impacts are considered separately to this assessment within the SEIA. There is potential for construction activity associated with export cables and cable landfalls to affect populations, however effects are likely to be highly localised and temporary.	There is considerable uncertainty regarding potential cable landfall locations, therefore the effects on human health / populations cannot be assessed. This assessment will be undertaken at a project level, with any onshore components managed through the terrestrial planning permission process.
		Issues of navigational safety, aviation and collision risk.	The presence of the offshore wind turbines increases the potential for collisions between recreational or commercial vessels and offshore wind development. This risk is greater where the offshore wind array overlaps key navigational routes.	At the project level and as part of the EIA process there is a requirement for developers to undertake a navigational risk assessment and mitigate risks to navigation from development. It is likely that, based on development of 16% of the DPO area, spatial planning in E1 could be used to reduce effects on higher shipping density areas and allow safe transit.

E1				Total DPO Area: 3816 km² Realistic Maximum Development Scenario (% of Total Capacity): 3 GW (16%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
				The residual effect on navigational safety associated with the development of E1 for offshore wind is considered to be **negligible negative to minor negative** dependent on the spatial planning and turbine design of development**.**
		Effects on marine and coastal recreation and access	Socio-economic impacts, such as the displacement of activity, are considered separately to this assessment within the SEIA, however effects on navigational safety of recreational activity associated with the development of the DPO are considered above. There is potential for construction activity associated with export cables and cable landfalls to affect populations, however effects are likely to be highly localised and temporary.	There is considerable uncertainty regarding potential cable landfall locations, therefore the effects on human health / populations cannot be assessed. This assessment will be undertaken at a project level, with any onshore components managed through the terrestrial planning permission process.
		Development of a secure energy supply.	The development of 1 GW of capacity within E1 could contribute to the development of secure energy supply in the UK.	The potential benefit to UK energy security associated with the development of offshore wind in E1 is considered to be **moderate to major positive.**
Soil (namely, Marine Geology and Coastal Processes)	The seabed sediments in E1 are sandy. The coastline facing E1 is a mixture of soft coastline (subject to erosion), beaches, hard rock / cliff, hard defences and harbours.	Effects on subsea geology, sediments, and coastal processes arising from changes in hydrodynamics and the existing wave regime.	There is potential for changes to hydrodynamics caused by the development of offshore wind in E1, and associated export cable routes and landfall, to affect the sediment transport and coastal processes. The extent of the effects will be dependent on the design of the array, the technology deployed in the DPO, the cable route, landfall location and cable design.	There is uncertainty as to the technology to be deployed in the DPO, and the array design. Hydrodynamic and sediment transport modelling will be required at a project level to confirm and validate the potential effects on the seabed sediments and coastal processes. The residual effect on marine geology and coastal processes is highly dependent on the technology type and array design but is considered likely to be **negligible to minor negative**.
Water Quality	Ecological status is determined for each of the surface water bodies of rivers, lakes, transitional waters and coastal waters, based on biological quality elements and supported by physico-chemical and hydromorphological quality elements.	Effects on ecological status.	Offshore wind development within E1, and associated export cable routes and landfall, has the potential to affect the ecological status of the water bodies, principally through changes caused to the hydrological regime. Any changes to the natural condition of the Solway Firth Offshore water body have the potential to reduce the status of the water body.	As part of the marine licencing process requirements are placed onto developers to ensure that activities are appropriately mitigated such that they do not cause permanent degradation of the ecological status under the WFD. The residual effect on ecological status is considered to be **negligible to minor negative**.

E1				Total DPO Area: 3816 km² Realistic Maximum Development Scenario (% of Total Capacity): 3 GW (16%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
	There are a number of coastal water bodies inland of E1, Don Estuary to Scouter Head (Good quality), Scouter Head to Garron Point (High quality), Garron Point to Downie Point (Good quality), Downie Point to Big Rob's Cove (High quality).		In addition, any direct effects on features, including those within protected areas, have the potential to affect the WFD ecological status.	
		Effects on water quality (for example, due to increases in suspended sediment loads and turbidity as well as an increase in pollution incidents).	Effects associated with any contamination from seabed material resuspended during construction or decommissioning activity are likely to be of localised and temporary nature, with the level of effect dependant on the level of contamination within the sediment. Effects during operation and maintenance are considered less likely. Pollution events associated with support vessels during construction and operational phases have the potential to affect water quality within E1.	Where an activity is expected to cause a significant disturbance of the seabed sediment additional contamination testing and subsequent water monitoring could be required through the marine licencing process. As part of marine licencing there is a requirement to produce pollution management plans to mitigate the effects of any pollution releases. In addition, significant releases are only likely to be associated with emergency events, considered unlikely. The assessment and management of pollution risks will be undertaken at a project level. The residual effect is considered to be **minor negative**.
		Effects of the presence of structures on local currents, wave regimes, and water column mixing, as well as secondary effects on sedimentation and erosion beyond the sites.	There is potential for changes to hydrodynamics caused by the development of offshore wind in E1 to affect the sediment transport and coastal processes. The extent of the effects will be dependent on the design of the array, the technology deployed in the DPO, the cable route, landfall location and cable design.	There is uncertainty as to the likely technology to be deployed in the DPO, and the likely array design, therefore it is expected that hydrodynamic and sediment transport modelling would be required at a project level to determine the potential effects on the seabed sediments and coastal processes. The residual effect on seabed sediment and physical processes is highly dependent on the technology type and array design but is considered likely to be **negligible to minor negative**.
Climatic Factors	The key pressures on the climate are derived from the continued global emission of greenhouse gases, including carbon dioxide. These emissions are recognised as leading to changes in the global climate (including changes in temperatures, precipitation, storm density) in turn causing changes in the physical characteristics of the oceans, including	Contribution to supporting a diverse and decarbonised energy sector.	The development of offshore wind energy in E1 can contribute to a decarbonised energy sector, reducing carbon emissions.	The effect of development of offshore wind in the DPO has the potential to be **moderate to major positive** in contributing to a diverse and decarbonised energy sector.
		Coastal facilities may be at risk from climate change.	Facilities associated with offshore wind infrastructure may be at risk from sea level rise and coastal erosion associated with climatic factors.	The design of any coastal facilities is required to account for sea level rise and coastal erosion in the design process.

E1				Total DPO Area: 3816 km² Realistic Maximum Development Scenario (% of Total Capacity): 3 GW (16%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
	potential changes in sea temperatures, circulation, salinity, pH and sea level rise.			This is considered as part of the planning process at a project level.
Cultural Heritage	There are no Historic MPAs within or adjacent to E1. There are 10 known shipwrecks within E1. The coastline inshore of SW1 has a number of protected sites. There is potential for palaeolandscape to be present in the Firth of Forth and River Tay, particularly around the estuary margins, and therefore potential for submerged archaeological remains.	Loss of and/or damage to historic environment features and their settings, including coastal and marine archaeology and historic MPAs.	There is potential for shipwrecks within E1 to be affected by development, principally during the construction phase. In addition, coastal built heritage, coastal shipwrecks and scheduled monuments inshore of E1 have the potential to be affected by export cable routes and cable landfalls. Submerged archaeological remains inshore of E1 associated with palaeolandscape also have the potential to be affected by export cable routes and cable landfalls.	Effects on culturally important sites can be mitigated through careful spatial planning within E1 and through selection of appropriate cable export routes and landfall locations. As part of the design and planning process for any development within E1, survey data will be obtained. This will identify any areas of cultural or historical sensitivity within the DPO that should be avoided and therefore inform spatial planning. Based on the use of appropriate spatial planning, the residual effect on cultural heritage is therefore considered to be **negligible to minor negative**.
Landscape, Seascape, and Visual Amenity	0% of E1 is within 15 km of the coastline. The nearest point of E1 is 50km offshore, therefore there is no effect on visual amenity.	Both temporary and longer-term effects on landscape and coastal character and visual receptors arising from the presence of structures including any ancillary infrastructure and night-time lighting of offshore structures.	The development of offshore wind farms in E1 is not considered to affect landscape, seascape or visual amenity.	No effect

E2

E2				Total DPO Area: 1287 km² Realistic Maximum Development Scenario (% of Total Capacity): 2 GW (31%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
Biodiversity, Flora and Fauna (Marine Mammals)	<u>Benthic Habitats and Species</u> The benthic habitat in E2 is mostly sandy sediment, with areas of coarse sediment to the west. There is no sensitive (priority marine feature) habitat identified within E2. There are sensitive habitats inshore of the DPO, including those associated with the River Tay SAC and Berwickshire and North Northumberland Coast SAC. <u>Marine Mammals</u> There are known populations of harbour seal in the Firth of Forth and grey seals in the River Tay and Lindisfarne Nature Reserve. Grey seals forage further offshore, meaning they are considerably more likely to interact with E2. The west section of E2 overlaps with an area of higher sea usage by grey seals. Data indicates that there are generally low to moderate densities of cetaceans within E2 including records of whitebeaked dolphin and harbour porpoise. However, there is some uncertainty in the data, and therefore development of the baseline through survey will be required prior to project level assessment. <u>Birds</u> There are a number of important bird populations within the Firth of Forth, River Tay and to the north and south of Aberdeen, including SPA and pSPA designations. Species of particular importance include the Herring Gull, Shag, Razorbill, Kittiwake, Arctic Tern, Sandwich tern, Puffin, Fulmar, Guillemot and Cormorant. In addition, there are a number of migration routes of both seabird, waterbird	Loss of and/or damage to marine and coastal habitats, including benthic and intertidal habitats (for example, due to smothering of benthic habitats and substratum loss).	There is potential for permanent loss of habitat within the footprint of offshore wind turbines and associated scour protection and temporary damage to habitats from intra array cables. There is no identified habitat of particular sensitivity within E2 which would be affected by this pathway, however the sandy sediments may be of importance for fish spawning. There is also potential for effects on coastal habitats inshore of E2 associated with export cables and cable landfalls. This includes potential effects on the habitats designated for the River Tay SAC and Berwickshire and North Northumberland Coast SAC.	The footprint associated with offshore wind will be dependent on the technology used and the level of scour protection required. There are no particularly sensitive habitats which will be affected in E2. Effects on coastal habitats associated with export cable routes and cable landfall will be considered at a project level and can be mitigated through careful siting. The residual effect on habitat is therefore considered to be **minor negative** in E2.
		Effects on key mobile receptors and prey species, including disturbance, noise effects, EMF exposure, collision risk, habitat exclusion, and barriers to wildlife movement.	There is potential for disturbance of marine mammal, bird and fish species particularly due to noise emissions during construction from piling activities, survey and / or clearance of unexploded ordnance. These have the potential to cause physiological damage to fish and marine mammal species, and to cause displacement of fish, marine mammals and birds from the area of effect. Potential for effects to mammals and fish are lower during the operational and decommissioning phases of the offshore wind farm life cycle. There is, however, potential for effects on fish species, from EMF exposure associated with export cables. The consequences of such effects are not well understood, however are thought to be low. The introduction of offshore wind arrays may also cause a barrier effect, preventing the movement of species through the area, potentially affecting migration pathways for marine mammals, fish species and birds.	Effects on fish (particularly species using the DPO for spawning) can be mitigated through temporal restrictions on piling activities. Physiological risks to fish and marine mammals from piling noise can be mitigated through the application measures relating to piling activities or soft start procedures, although fish responses to these measures are not well known and noise modelling should account for this uncertainty. In addition, noise abatement measures at source can be implemented to reduce noise transmission into the wider environment, and therefore reduce displacement effects. Effects on Sandeel protected through the Turbot Bank NCMPA will be assessed at a project level and can be mitigated through spatial planning. Further research is required to determine the effect of collision risk on bird species. There is uncertainty as to the room for further development in E2 due to the birds that are present. Additional studies and

E2				Total DPO Area: 1287 km² Realistic Maximum Development Scenario (% of Total Capacity): 2 GW (31%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
	and terrestrial bird species on the east coast of Scotland. The offshore nature of E2 means that it is in an area of lower recorded bird activity. <u>Fish</u> Within E2 there are known spawning and nursery grounds for several species. This includes spawning grounds for cod, whiting, plaice, herring and sandeel. There is one NCMPA overlapping with the western end of the E2, Turbot Bank NCMPA, which is designated for Sandeel. There are a number of migratory fish which migrate through the seas within the East region into the estuary and riverine environments, including Atlantic salmon and sea lamprey		The site is adjacent to SPAs and pSPAs in the Firth of Forth and River Tay, and therefore potential for displacement of designated species exists. However, the boundary of the pSPA is inland of E2 and areas outwith the pSPA are therefore expected to be of lower density and hence importance for foraging.	surveys should be undertaken at a project level to determine the potential risk in E2 prior to the consenting process. There is potential for displacement of bird species. E2 and the immediate surrounding area is identified as a foraging ground for species of international or national importance and spatial planning would have to be used to reduce the potential for barrier effects on birds and other marine species. The residual effect on key receptors during construction and operation in E2 is considered to be **minor negative to moderate negative**.
		Effects arising from habitat modification, such as the creation of artificial reefs, new roosting structures and exclusion of habitat damaging activity.	The introduction of the wind farm turbines and scour protection have the potential to provide alternative habitat within E2, which could provide shelter for juvenile fish and crustacean shellfish. This effect has the potential to be both beneficial and adverse for different receptors. There is also the potential for activities currently damaging to the seabed habitat to be excluded from offshore wind development area, dependent on the technology implemented, which may lead to reduced damage to existing habitats. However, if activity is displaced to a different area the effect is likely to be negligible or potentially negative.	The potential effect associated with the development of offshore wind in E2 is considered to be **negligible** but is dependent on the technology deployed.
		Effects of pollution releases on species and habitats.	Pollution events associated with support vessels during construction and operational phases have the potential to affect species within E2.	As part of marine licencing there is a requirement to produce pollution management plans to mitigate the effects of any pollution releases. In addition, significant releases are only likely to be

E2				Total DPO Area: 1287 km² Realistic Maximum Development Scenario (% of Total Capacity): 2 GW (31%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
				associated with emergency events, considered unlikely. The assessment and management of pollution risks will be undertaken at a project level. The residual risk associated with pollution releases associated with offshore wind farms is considered to be **negligible**.
		Effects from introduction and spread of Invasive Non-Native Species (INNS).	Offshore wind turbine foundations and scour protection provides a new colonising surface for INNS, and support vessels during construction and operational phases have the potential to introduce INNS, which may subsequently affect indigenous species within E2.	There is a requirement for biosecurity management plans to be produced to minimise the risk of introduction of INNS. Controls will be imposed through the marine licencing process if required at a project level. The residual risk associated with INNS associated with offshore wind farms is considered to be **minor negative**.
Population and Human Health	Due to the offshore nature of the E2 DPO there are no significant populations directly adjacent to the DPO. The coastline landwards of E2 is generally highly populated, with a number of big cities and towns (Aberdeen, Peterhead) Areas within the DPO are, however, used for the purposes of commercial shipping. There is moderate shipping density throughout the DPO with areas of high density to the west associated principally with oil and gas servicing.	Effects arising from noise, vibration, light, dust and shadow flicker effects from all phases of development.	E2 is located offshore, and as such construction, operation and decommissioning of arrays within the DPO will not give rise to significant effects on populations or human health directly through noise, vibration, light, dust or shadow flicker effects. There is potential for construction activity associated with export cables and cable landfalls to affect populations, however effects are likely to be highly localised and temporary.	There is considerable uncertainty regarding potential cable landfall locations, therefore the effects on human health / populations cannot be assessed. This assessment will be undertaken at a project level, with any onshore components managed through the terrestrial planning permission process.
		Effects on residential amenity stemming from construction/installation/operational activities.	E2 is located offshore, and as such the development will not directly affect residential amenity. Socio-economic impacts are considered separately to this assessment within the SEIA. There is potential for construction activity associated with export cables and cable landfalls to affect populations, however effects are likely to be highly localised and temporary.	There is considerable uncertainty regarding potential cable landfall locations, therefore the effects on human health / populations cannot be assessed. This assessment will be undertaken at a project level, with any onshore components managed through the terrestrial planning permission process.
		Issues of navigational safety, aviation and collision risk.	The presence of the offshore wind turbines increases the potential for collisions between recreational or	At the project level and as part of the EIA process there is a requirement for developers to undertake a navigational

E2				Total DPO Area: 1287 km² Realistic Maximum Development Scenario (% of Total Capacity): 2 GW (31%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
			commercial vessels and offshore wind development. This risk is greater where the offshore wind array overlaps key navigational routes.	risk assessment and mitigate risks to navigation from development. It is likely that, based on development of 31% of the DPO area, some spatial planning in E2 could be used to reduce effects on key shipping routes and allow safe transit. The residual effect on navigational safety associated with the development of E2 for offshore wind is considered to be **minor negative to moderate negative** dependent on the spatial planning and turbine design of development**.**
		Effects on marine and coastal recreation and access	Socio-economic impacts, such as the displacement of activity, are considered separately to this assessment within the SEIA, however effects on navigational safety of recreational activity associated with the development of the DPO are considered above. There is potential for construction activity associated with export cables and cable landfalls to affect populations, however effects are likely to be highly localised and temporary.	There is considerable uncertainty regarding potential cable landfall locations, therefore the effects on human health / populations cannot be assessed. This assessment will be undertaken at a project level, with any onshore components managed through the terrestrial planning permission process.
		Development of a secure energy supply.	The development of 1 GW of capacity within E2 could contribute to the development of secure energy supply in the UK.	The potential benefit to UK energy security associated with the development of offshore wind in E2 is considered to be **moderate to major positive.**
Soil (namely, Marine Geology and Coastal Processes)	The seabed sediments in E2 are mostly sandy, with an area of coarse sediment to the west. The coastline facing E2 is a mixture of hard rock / cliff, natural beaches and harbours.	Effects on subsea geology, sediments, and coastal processes arising from changes in hydrodynamics and the existing wave regime.	There is potential for changes to hydrodynamics caused by the development of offshore wind in E2, and associated export cable routes and landfall, to affect the sediment transport and coastal processes. The extent of the effects will be dependent on the design of the array, the technology deployed in the DPO, the cable route, landfall location and cable design.	There is uncertainty as to the technology to be deployed in the DPO, and the array design. Hydrodynamic and sediment transport modelling will be required at a project level to confirm and validate the potential effects on the seabed sediments and coastal processes. The residual effect on marine geology and coastal processes is highly dependent on the technology type and array design but is considered likely to be **negligible to minor negative**.

E2				Total DPO Area: 1287 km² Realistic Maximum Development Scenario (% of Total Capacity): 2 GW (31%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
Water Quality	Ecological status is determined for each of the surface water bodies of rivers, lakes, transitional waters and coastal waters, based on biological quality elements and supported by physico-chemical and hydromorphological quality elements. There are a number of coastal water bodies inland of E2, Caimbulg Point to the Ugie Estuary (High quality), Ugie Estuary to Buchan Ness (Good quality), Buchan Ness to Cruden Bay (High quality), Cruden Bay to the Don Estuary (High quality).	Effects on ecological status.	Offshore wind development within E2, and associated export cable routes and landfall, has the potential to affect the ecological status of the water bodies, principally through changes caused to the hydrological regime. In addition, any direct effects on features, including those within protected areas, have the potential to affect the WFD ecological status.	As part of the marine licencing process requirements are placed onto developers to ensure that activities are appropriately mitigated such that they do not cause permanent degradation of the ecological status under the WFD. The residual effect on ecological status is considered to be **negligible to minor negative**.
		Effects on water quality (for example, due to increases in suspended sediment loads and turbidity as well as an increase in pollution incidents).	Effects associated with any contamination from seabed material resuspended during construction or decommissioning activity are likely to be of localised and temporary nature, with the level of effect dependant on the level of contamination within the sediment. Effects during operation and maintenance are considered less likely. Pollution events associated with support vessels during construction and operational phases have the potential to affect water quality within E2.	Where an activity is expected to cause a significant disturbance of the seabed sediment additional contamination testing and subsequent water monitoring could be required through the marine licencing process. As part of marine licencing there is a requirement to produce pollution management plans to mitigate the effects of any pollution releases. In addition, significant releases are only likely to be associated with emergency events, considered unlikely. The assessment and management of pollution risks will be undertaken at a project level. The residual effect is considered to be **minor negative**.
		Effects of the presence of structures on local currents, wave regimes, and water column mixing, as well as secondary effects on sedimentation and erosion beyond the sites.	There is potential for changes to hydrodynamics caused by the development of offshore wind in E2 to affect the sediment transport and coastal processes. The extent of the effects will be dependent on the design of the array, the technology deployed in the DPO, the cable route, landfall location and cable design.	There is uncertainty as to the likely technology to be deployed in the DPO, and the likely array design, therefore it is expected that hydrodynamic and sediment transport modelling would be required at a project level to determine the potential effects on the seabed sediments and coastal processes. The residual effect on seabed sediment and physical processes is highly dependent on the technology type and array design but is considered likely to be **negligible to minor negative**.

E2				Total DPO Area: 1287 km² Realistic Maximum Development Scenario (% of Total Capacity): 2 GW (31%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
Climatic Factors	The key pressures on the climate are derived from the continued global emission of greenhouse gases, including carbon dioxide. These emissions are recognised as leading to changes in the global climate (including changes in temperatures, precipitation, storm density) in turn causing changes in the physical characteristics of the oceans, including potential changes in sea temperatures, circulation, salinity, pH and sea level rise.	Contribution to supporting a diverse and decarbonised energy sector.	The development of offshore wind energy in E2 can contribute to a decarbonised energy sector, reducing carbon emissions.	The effect of development of offshore wind in the DPO has the potential to be **moderate to major positive** in contributing to a diverse and decarbonised energy sector.
		Coastal facilities may be at risk from climate change.	Facilities associated with offshore wind infrastructure may be at risk from sea level rise and coastal erosion associated with climatic factors.	The design of any coastal facilities is required to account for sea level rise and coastal erosion in the design process. This is considered as part of the planning process at a project level.
Cultural Heritage	There are no Historic MPAs within or adjacent to E2. There are two known shipwrecks within E2. The coastline inshore of E2 has a number of protected sites. There is potential for palaeolandscape to be present in the Firth of Forth and River Tay, particularly around the estuary margins, and therefore potential for submerged archaeological remains.	Loss of and/or damage to historic environment features and their settings, including coastal and marine archaeology and historic MPAs.	There is potential for shipwrecks within E2 to be affected by development, principally during the construction phase. In addition, coastal built heritage, coastal shipwrecks and scheduled monuments inshore of E2 have the potential to be affected by export cable routes and cable landfalls. Submerged archaeological remains inshore of E2 associated with palaeolandscape also have the potential to be affected by export cable routes and cable landfalls.	Effects on culturally important sites can be mitigated through careful spatial planning within E2 and through selection of appropriate cable export routes and landfall locations. As part of the design and planning process for any development within E2, survey data will be obtained. This will identify any areas of cultural or historical sensitivity within the DPO that should be avoided and therefore inform spatial planning. Based on the use of appropriate spatial planning, the residual effect on cultural heritage is therefore considered to be **negligible to minor negative**.
Landscape, Seascape, and Visual Amenity	0% of E2 is within 15 km of the coastline. The nearest point of E1 is 60km offshore, therefore there is no effect on visual amenity.	Both temporary and longer-term effects on landscape and coastal character and visual receptors arising from the presence of structures including any ancillary infrastructure and night-time lighting of offshore structures.	The development of offshore wind farms in E2 is not considered to affect landscape, seascape or visual amenity.	No effect

E3

E3				Total DPO Area: 474 km² Maximum Likely Development Capacity (% of Total Capacity): 1 GW (42%)
SEA Topic	**Key Baseline Evidence**	**Potential Effects**	**Characteristics**	**Mitigation Available and Potential Residual Effects**
Biodiversity, Flora and Fauna (Marine Mammals)	<u>Benthic Habitats and Species</u> The benthic habitat in E3 is mostly coarse sediment with areas of sand in the south west. There is no sensitive (priority marine feature) habitat identified within E3. There are sensitive habitats inshore of the DPO, including those associated with the River Tay SAC and Berwickshire and North Northumberland Coast SAC. <u>Marine Mammals</u> There are known populations of harbour seal in the Firth of Forth and grey seals in the River Tay and Lindisfarne Nature Reserve. Grey seals forage further offshore, meaning they are considerably more likely to interact with E3. A large proportion of E3 overlaps with an area of higher sea usage by grey seals. There are	Loss of and/or damage to marine and coastal habitats, including benthic and intertidal habitats (for example, due to smothering of benthic habitats and substratum loss).	There is potential for permanent loss of habitat within the footprint of offshore wind turbines and associated scour protection and temporary damage to habitats from intra array cables. There is no identified habitat of particular sensitivity within E3 which would be affected by this pathway, however the sandy sediments may be of importance for fish spawning. There is also potential for effects on coastal habitats inshore of E3 associated with export cables and cable landfalls. This includes potential effects on the habitats designated for the River Tay SAC and Berwickshire and North Northumberland SAC.	The footprint associated with offshore wind will be dependent on the technology used and the level of scour protection required. There are no particularly sensitive habitats which will be affected in E3. Effects on coastal habitats associated with export cable routes and cable landfall will be considered at a project level and can be mitigated through careful siting. The residual effect on habitat is therefore considered to be **minor negative** in E3.

	three NCMPAs within close proximity to E3. Data indicates that there are generally low to moderate densities of cetaceans within E3 including records of whitebeaked dolphin, minke whale and harbour porpoise. However, there is some uncertainty in the data, and therefore development of the baseline through survey will be required prior to project level assessment. <u>Birds</u> There are a number of important bird populations within the Firth of Forth, River Tay and to the north and south of Aberdeen, including SPA and pSPA designations. Species of particular importance include the Herring Gull, Shag, Razorbill, Kittiwake, Arctic Tern, Sandwich tern, Puffin, Fulmar, Guillemot and Cormorant. In addition, there are a number of migration routes of both seabird, waterbird and terrestrial bird species on the east coast of Scotland. The offshore nature of E3 means that it is in an area of lower recorded bird activity. <u>Fish</u> Within E3 there are known spawning and nursery grounds for several species. This includes spawning grounds for cod, whiting, plaice, herring and sandeel. There are a number of migratory fish which migrate through the seas within the East region into the estuary and riverine environments, including Atlantic salmon and sea lamprey	Effects on key mobile receptors and prey species, including disturbance, noise effects, EMF exposure, collision risk, habitat exclusion, and barriers to wildlife movement.	There is potential for disturbance of marine mammal, bird and fish species particularly due to noise emissions during construction from piling activities, survey and / or clearance of unexploded ordnance. These have the potential to cause physiological damage to fish and marine mammal species, and to cause displacement of fish, marine mammals and birds from the area of effect. Potential for effects to mammals and fish are lower during the operational and decommissioning phases of the offshore wind farm life cycle. There is, however, potential for effects on fish species, from EMF exposure associated with export cables. The consequences of such effects are not well understood, however are thought to be low. The introduction of offshore wind arrays may also cause a barrier effect, preventing the movement of species through the area, potentially affecting migration pathways for marine mammals, fish species and birds. The site is adjacent to SPAs and pSPAs in the Firth of Forth and River Tay, and therefore potential for displacement of designated species exists. However, the boundary of the pSPA is inland of E3 and areas outwith the pSPA are therefore expected to be of lower density and hence importance for foraging.	Effects on fish (particularly species using the DPO for spawning) can be mitigated through temporal restrictions on piling activities. Physiological risks to fish and marine mammals from piling noise can be mitigated through the application measures relating to piling activities or soft start procedures, although fish responses to these measures are not well known and noise modelling should account for this uncertainty. In addition, noise abatement measures at source can be implemented to reduce noise transmission into the wider environment, and therefore reduce displacement effects. Further research is required to determine the effect of collision risk on bird species. However, the current consensus is that there is no room for further development in E3 due to the birds that are present. Should the consensus change in the future radar studies and surveys should be undertaken at a project level to determine the potential risk in E3. There is potential for displacement of bird species. E3 and the immediate surrounding area is identified as a key foraging ground for species of international or national importance and spatial planning would have to be used to reduce the potential for barrier effects on birds and other marine species. The residual effect on key receptors during construction and operation in E3 is considered to be **moderate negative to major negative**.
		Effects arising from habitat modification, such as the creation of artificial reefs, new roosting structures and exclusion of habitat damaging activity. Effects arising from habitat modification, such as the creation of artificial reefs, new roosting structures and exclusion of habitat damaging activity.	The introduction of the wind farm turbines and scour protection have the potential to provide alternative habitat within E3, which could provide shelter for juvenile fish and crustacean shellfish. This effect has the potential to be both beneficial and adverse for different receptors. There is also the potential for activities currently damaging to the seabed habitat to be excluded from offshore wind development area, dependent on the	The potential effect associated with the development of offshore wind in E3 is considered to be **negligible** but is dependent on the technology deployed.

			technology implemented, which may lead to reduced damage to existing habitats. However, if activity is displaced to a different area the effect is likely to be negligible or potentially negative.	
		Effects of pollution releases on species and habitats.	Pollution events associated with support vessels during construction and operational phases have the potential to affect species within E3.	As part of marine licencing there is a requirement to produce pollution management plans to mitigate the effects of any pollution releases. In addition, significant releases are only likely to be associated with emergency events, considered unlikely. The assessment and management of pollution risks will be undertaken at a project level. The residual risk associated with pollution releases associated with offshore wind farms is considered to be **negligible**.
		Effects from introduction and spread of Invasive Non-Native Species (INNS).	Offshore wind turbine foundations and scour protection provides a new colonising surface for INNS, and support vessels during construction and operational phases have the potential to introduce INNS, which may subsequently affect indigenous species within E3.	There is a requirement for biosecurity management plans to be produced to minimise the risk of introduction of INNS. Controls will be imposed through the marine licencing process if required at a project level. The residual risk associated with INNS associated with offshore wind farms is considered to be **minor negative**.
Population and Human Health	Due to the offshore nature of the E3 DPO there are no significant populations directly adjacent to the DPO. The coastline landwards of E3 is generally highly populated, with a number of cities and towns (Edinburgh, Aberdeen, Dundee, Peterhead). Areas within the DPO are, however, used for the purposes of commercial shipping. There is a moderate to high density of shipping throughout the DPO, with some overlap with key routes on the northern and south western boundaries. There is also an overlap with a RYA informal cruising route towards the western boundary of the site.	Effects arising from noise, vibration, light, dust and shadow flicker effects from all phases of development.	E3 is located offshore, and as such construction, operation and decommissioning of arrays within the DPO will not give rise to significant effects on populations or human health directly through noise, vibration, light, dust or shadow flicker effects. There is potential for construction activity associated with export cables and cable landfalls to affect populations, however effects are likely to be highly localised and temporary.	There is considerable uncertainty regarding potential cable landfall locations, therefore the effects on human health / populations cannot be assessed. This assessment will be undertaken at a project level, with any onshore components managed through the terrestrial planning permission process.
		Effects on residential amenity stemming from construction/installation/operational activities.	E3 is located offshore, and as such the development will not directly affect residential amenity. Socio-economic impacts are considered separately to this assessment within the SEIA. There is potential for construction activity associated with export cables and cable landfalls to affect populations, however	There is considerable uncertainty regarding potential cable landfall locations, therefore the effects on human health / populations cannot be assessed. This assessment will be undertaken at a project level, with any onshore components managed through the terrestrial planning permission process.

			effects are likely to be highly localised and temporary.	
		Issues of navigational safety, aviation and collision risk.	The presence of the offshore wind turbines increases the potential for collisions between recreational or commercial vessels and offshore wind development. This risk is greater where the offshore wind array overlaps key navigational routes.	At the project level and as part of the EIA process there is a requirement for developers to undertake a navigational risk assessment and mitigate risks to navigation from development. It is likely that, based on development of 42% of the DPO area, some spatial planning in E3 could be used to reduce effects on key shipping routes and allow safe transit. The residual effect on navigational safety associated with the development of E3 for offshore wind is considered to be **minor negative to major negative** dependent on the spatial planning and turbine design of development**.**
		Effects on marine and coastal recreation and access	Socio-economic impacts, such as the displacement of activity, are considered separately to this assessment within the SEIA, however effects on navigational safety of recreational activity associated with the development of the DPO are considered above. There is potential for construction activity associated with export cables and cable landfalls to affect populations, however effects are likely to be highly localised and temporary.	There is considerable uncertainty regarding potential cable landfall locations, therefore the effects on human health / populations cannot be assessed. This assessment will be undertaken at a project level, with any onshore components managed through the terrestrial planning permission process.
		Development of a secure energy supply.	The development of 1 GW of capacity within E3 could contribute to the development of secure energy supply in the UK.	The potential benefit to UK energy security associated with the development of offshore wind in E3 is considered to be **moderate to major positive.**
Soil (namely, Marine Geology and Coastal Processes)	The seabed sediments in E3 are mostly coarse sediment, with small areas of sand in the south. The coastline facing E3 is hard rock / cliff and natural beaches.	Effects on subsea geology, sediments, and coastal processes arising from changes in hydrodynamics and the existing wave regime.	There is potential for changes to hydrodynamics caused by the development of offshore wind in E3, and associated export cable routes and landfall, to affect the sediment transport and coastal processes. The extent of the effects will be dependent on the design of the array, the technology deployed in the DPO, the cable route, landfall location and cable design.	There is uncertainty as to the technology to be deployed in the DPO, and the array design. Hydrodynamic and sediment transport modelling will be required at a project level to confirm and validate the potential effects on the seabed sediments and coastal processes. The residual effect on marine geology and coastal processes is highly dependent on the technology type and array design but is considered likely to be **negligible to minor negative**.

Water Quality	Ecological status is determined for each of the surface water bodies of rivers, lakes, transitional waters and coastal waters, based on biological quality elements and supported by physico-chemical and hydromorphological quality elements. There are a few coastal water bodies inland of E3, Curden Bay to the Don Estuary (Good quality), Don Estuary to Scouter Head (Good quality), Scouter Head to Garron Point (High quality).	Effects on ecological status.	Offshore wind development within E3, and associated export cable routes and landfall, has the potential to affect the ecological status of the water bodies, principally through changes caused to the hydrological regime. In addition, any direct effects on features, including those within protected areas, have the potential to affect the WFD ecological status.	As part of the marine licencing process requirements are placed onto developers to ensure that activities are appropriately mitigated such that they do not cause permanent degradation of the ecological status under the WFD. The residual effect on ecological status is considered to be **negligible to minor negative**.
		Effects on water quality (for example, due to increases in suspended sediment loads and turbidity as well as an increase in pollution incidents).	Effects associated with any contamination from seabed material resuspended during construction or decommissioning activity are likely to be of localised and temporary nature, with the level of effect dependant on the level of contamination within the sediment. Effects during operation and maintenance are considered less likely. Pollution events associated with support vessels during construction and operational phases have the potential to affect water quality within E3.	Where an activity is expected to cause a significant disturbance of the seabed sediment additional contamination testing and subsequent water monitoring could be required through the marine licencing process. As part of marine licencing there is a requirement to produce pollution management plans to mitigate the effects of any pollution releases. In addition, significant releases are only likely to be associated with emergency events, considered unlikely. The assessment and management of pollution risks will be undertaken at a project level. The residual effect is considered to be **minor negative**.
		Effects of the presence of structures on local currents, wave regimes, and water column mixing, as well as secondary effects on sedimentation and erosion beyond the sites.	There is potential for changes to hydrodynamics caused by the development of offshore wind in E3 to affect the sediment transport and coastal processes. The extent of the effects will be dependent on the design of the array, the technology deployed in the DPO, the cable route, landfall location and cable design.	There is uncertainty as to the likely technology to be deployed in the DPO, and the likely array design, therefore it is expected that hydrodynamic and sediment transport modelling would be required at a project level to determine the potential effects on the seabed sediments and coastal processes. The residual effect on seabed sediment and physical processes is highly dependent on the technology type and array design but is considered likely to be **negligible to minor negative**.
Climatic Factors	The key pressures on the climate are derived from the continued global emission of greenhouse gases, including carbon dioxide. These emissions are recognised as leading to changes in the global climate (including changes in temperatures, precipitation, storm density) in turn causing changes in the physical characteristics of the oceans, including	Contribution to supporting a diverse and decarbonised energy sector.	The development of offshore wind energy in E3 can contribute to a decarbonised energy sector, reducing carbon emissions.	The effect of development of offshore wind in the DPO has the potential to be **moderate to major positive** in contributing to a diverse and decarbonised energy sector.
		Coastal facilities may be at risk from climate change.	Facilities associated with offshore wind infrastructure may be at risk from sea	The design of any coastal facilities is required to account for sea level rise and coastal erosion in the design process.

	potential changes in sea temperatures, circulation, salinity, pH and sea level rise.		level rise and coastal erosion associated with climatic factors.	This is considered as part of the planning process at a project level.
Cultural Heritage	There are no Historic MPAs within or adjacent to SW1. There are three known shipwrecks within E3. The coastline inshore of E3 has a number of protected sites. There is potential for palaeolandscape to be present in the River Tavy and Firth of Forth, particularly around the estuary margins, and therefore potential for submerged archaeological remains.	Loss of and/or damage to historic environment features and their settings, including coastal and marine archaeology and historic MPAs.	There is potential for shipwrecks within E3 to be affected by development, principally during the construction phase. In addition, coastal built heritage, coastal shipwrecks and scheduled monuments inshore of E3 have the potential to be affected by export cable routes and cable landfalls. Submerged archaeological remains inshore of E3 associated with palaeolandscape also have the potential to be affected by export cable routes and cable landfalls.	Effects on culturally important sites can be mitigated through careful spatial planning within E3 and through selection of appropriate cable export routes and landfall locations. As part of the design and planning process for any development within E3, survey data will be obtained. This will identify any areas of cultural or historical sensitivity within the DPO that should be avoided and therefore inform spatial planning. Based on the use of appropriate spatial planning, the residual effect on cultural heritage is therefore considered to be **negligible to minor negative**.
Landscape, Seascape, and Visual Amenity	0% of E3 is within 15 km of the coastline. The nearest point of E3 is 18km offshore.	Both temporary and longer-term effects on landscape and coastal character and visual receptors arising from the presence of structures including any ancillary infrastructure and night-time lighting of offshore structures.	The development of offshore wind in E3 has the potential to be visible from land and hence affect landscape / seascapes.	There is potential to mitigate visual effects through spatial planning within the DPO to avoid areas closest to land, and through the potential to select smaller turbines in areas of higher sensitivity. The development within E3 may also require management of night-time lighting effects. The residual effect on landscape / seascape is considered to be **negligible to minor negative**.

Appendix D Abbreviations

AC	Alternating Current
ACOPS	Advisory Committee on Protection of the Sea
AIS	Automatic identification System
AoS	Areas of Search
ATBA	Areas To Be Avoided
BEIS	Department for Business, Energy and Industrial Strategy
BGS	British Geological Society
BOU	British Ornithologists Union
BTO	British Trust for Ornithology
CAMERAS	Co-ordinated Agenda for Marine, Environment and Rural Affairs Science
CEC	Crown Estate Commissioners
DC	Direct Current
DECC	Department of Energy and Climate Change
DPO	Draft Plan Options
DW	DW Akademie
EC	European Community
EDPR	EDP Renovávei
EEC	European Economic Community
EIA	Environmental Impact Assessment
ELC	European Landscape Convention
EMF	Electromagnetic Field
EOWDC	European Offshore Wind Deployment Centre
ESAS	European Sea Birds At Sea
EU	European Union
EUNIS	European Nature Information System
FEAST	Feature Activity Sensitivity Tool
GCR	Geological Conservation Review
GEN	General Planning Policy
GES	Good Environmental Status
GHG	Greenhouse Gas
GIS	Geographic Information System
GW	Gigawatt

HDD	Horizontal Directional Drilling
HES	Historic Environment Scotland
HRA	Habitats regulation Appraisal
HVDC	High-Voltage Direct Current
IMARES	International Master of Arts in Russian and Eurasian Studies
IMO	International Maritime Organisation
INNS	Invasive Non-Native Species
IPF	Initial Planning Framework
JNAPC	Joint Nautical Archaeology Policy Committee
JNCC	Joint Nature Conservation Committee
KTN	Knowledge Transfer Network
LiDAR	Light Detection and Ranging
LLA	Local Landscape Area
MARP	Marine Archaeology Reporting Plan
MARPOL	Marine Pollution
MaRS	Marine Resource System
MCA	Maritime and Coastguard Agency
MCCIP	Marine Climate Change Impacts Partnership
MGN	Marine Guidance Note
MOD	Ministry of Defence
MPA	Marine Protected Area
MSFD	Marine Strategy Framework Directive
MW	Megawatts
NATS	National Air Traffic Services
NATURA	Network of Nature Protection Areas in the Territory of the European Union
NCCA	National Coastal Change Assessment
NCMPA	Nature Conservation Marine Protected Area
NE	North East
NERC	Natural Environment Research Council
NM	Nautical Miles
NOAA	National Oceanic and Atmospheric Administration
NORM	Naturally Occurring Radioactive Material
NRW	Natural Resources Wales

NSA	National Scenic Area
ORJIP	Offshore Renewable Joint Industry Project
OSPAR	Oslo/Paris Convention
OW	Offshore Wind
OWF	Offshore Wind Farm
OWiX	Offshore Wind Innovation Exchange
PMF	Priority Marine Features
PPS	Plan, Programme, or Strategy
PRIMaRE	Partnership for Research in Marine Renewable Energy
pSPA	Proposed Special Protection Area
RBMP	River Basin Management Plans
RLG	Regional Locational Guidance
ROC	Renewables Obligations Certificate
RSPB	Royal Society for the Protection of Birds
RYA	Royal Yachting Association
SA	Sustainability Appraisal
SAC	Special Area of Conservation
SCANS	Small Cetaceans in the European Atlantic and North Seas
SCAPE	Scottish Coastal Archaeology and the Problem of Erosion Trust
SCOS	Special Committee on Seals
ScotMER	Scottish Marine Environmental Research
SDIC	SDIC Power Holdings Co.
SEA	Strategic Environmental Assessment
SEIA	Socio-Economic Impact Assessment
SEPA	Scottish Environment Protection Agency
SIMD	Scottish Index of Multiple Deprivation
SMRRG	Scottish Marine Renewables Research Group
SMRU	Sea Mammal Research Unit
SNCB	Statutory Nature Conservation Body
SNH	Scottish Natural Heritage
SPA	Special Protection Area
SpORRAn	Scottish Offshore Renewables Research Network
SSSI	Site of Special Scientific Interest
SW	South West
TLP	Tension Leg Platform

TSS	Traffic Separation Schemes
UK	United Kingdom
UKMMAS	UK Marine Monitoring and Assessment Strategy
UKOOA	United Kingdom Offshore Operators Association
UN	United nations
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UXO	Unexploded Ordnance
WFD	Water Framework Directive
WHS	World Heritage Site
WWT	Wildfowl & Wetlands Trust

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