



Pentland Floating Offshore Wind Farm

Section 36C Consent and Marine Licence Variation Application Report

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Glossary of Project Terms

Key Terms	Definition
Consent Application Documents	The original application and supporting documents submitted, on 11 th August 2022, for consent of the PFOWF, as amended or supplemented by documents submitted to discharge or satisfy conditions
Consented Works	The works required to construct the PFOWF and consented under the original Section 36 Consent and Marine Licences granted by Scottish Ministers on 28 th June 2023
Highland Wind Limited	The developer of the Project (defined below) and the applicant for the associated consents and licences.
NCC SPA	North Caithness Cliffs Special Protection Area (SPA)
Offshore Wind Farm Marine Licence	The marine licence granted by Scottish Ministers under the Marine (Scotland) Act 2010 on 28 th June 2023, in respect of the PFOWF Array, as defined.
Offshore Export Cable Marine Licence	The marine licence granted by Scottish Ministers under the Marine (Scotland) Act 2010 on 28 th June 2023, in respect of the Offshore Export Cable(s), as defined.
Offshore Consents	The consents granted for the offshore components of the PFOWF, including the Section 36 Consent, the Offshore Wind Farm Marine Licence and the Offshore Export Cable Marine Licence.
Offshore Export Cable(s) (OEC)	The cable(s) that transmits electricity produced by the WTGs to landfall.
Offshore Export Cable Corridor (OECC)	The area within which the Offshore Export Cable(s) will be located.
Original EIAR	The original Environmental Impact Assessment Report and additional information, submitted in August 2022 and December 2022, in support of the PFOWF consent application
Original RIAA	The original Report to Inform the Appropriate Assessment and additional information, submitted in August 2022 and December 2022 in support of the PFOWF consent application
Offshore Site	The area encompassing the PFOWF Array Area and OECC, as defined.
Pentland Floating Offshore Wind Farm (PFOWF) Array and Offshore Export Cable(s) (the 'Offshore Development')	All offshore components of the Project (WTGs, inter-array and Offshore Export Cable(s), floating substructures, and all other associated offshore infrastructure (i.e., those below mean high water springs) required during operation of the Project, for which HWL has obtained consent.
PFOWF Array	All WTGs, inter-array cables, mooring lines, floating sub-structures and supporting subsea infrastructure within the PFOWF Array Area, as defined, excluding the Offshore Export Cable(s).

Key Terms	Definition
PFOWF Array Area	The area where the WTGs will be located within the Offshore Site, as defined.
PFOWF (the 'Project')	The combined Offshore Development and Onshore Development, as defined.
Project Marine Licences	The Offshore Wind Farm Marine Licence and the Offshore Export Cable Marine Licence, as defined.
RIAA Addendum	An addendum to the original RIAA, submitted with this S36 Variation application (as defined), which addresses the proposed design refinements and the potential implications of these for kittiwake and puffin features of the NCC SPA
Section 36 Consent	Consent under section 36 of the Electricity Act 1989 granted by the Scottish Ministers on 28 June 2023 in respect of the PFOWF.
Section 36C Variation	Variation made to an existing Section 36 Consent under the Electricity Act 1989, under Regulation 42 of the Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017 (as amended) ('the EIA Regulations')
S36C Variation Application	This application made by Highland Wind Limited to vary the Project's Offshore Consents, including the RIAA Addendum.
Screening Opinion	The response provided by MD-LOT on 15 September 2023 to the Screening Report.
Screening Report	The request for a Screening Opinion, submitted by Highland Wind Limited to MD-LOT on 7 August 2023.
Variation Application Report	The report submitted by Highland Wind Limited to MD-LOT, in support of the S36C Variation Application request to vary the Project's Offshore Consents.
Wind Turbine Generator Footprint Area	The Wind Turbine Generator (WTG) footprint area comprises the area of sea surface occupied by the infrastructure at or above sea level (i.e. the WTGs and associated floating substructure).

Acronyms and Abbreviations

AA	Appropriate Assessment
AEOSI	Adverse Effect on Site Integrity
COP	Copenhagen Offshore Partners
CRM	Collision Risk Modelling
DSRL	Dounreay Site Restoration Limited
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EMF	Electromagnetic Field
GW	Gigawatt
HAT	Highest Astronomical Tide
HWL	Highland Wind Limited
HVAC	High Voltage Alternating Current
IFP	Instrument Flight Procedure
INNS	Invasive Non Native Species
INTOG	Innovation and Targeted Oil and Gas
km	Kilometre
LAT	Lowest Astronomical Tide
m	Metre
MW	Megawatt
ML	Marine Licence
MoC	Magnitude of Change
MD-LOT	Marine Directorate Licensing and Operations Team
NCC	North Caithness Cliffs
NM	Nautical Mile
NS	NatureScot
OEC	Offshore Export Cable(s)
OECC	Offshore Export Cable Corridor
OWF	Offshore Wind Farm

PFOWF	Pentland Floating Offshore Wind Farm
PPP	Planning Permission in Principle
PVA	Population Viability Analysis
RIAA	Report to Inform Appropriate Assessment
REZ	Renewable Energy Zone
RSPB	Royal Society for the Protection of Birds
S36	Section 36
SAR	Search and Rescue
SLVIA	Seascape Landscape and Visual Impact Assessment
SMP	Seabird Monitoring Programme
SPA	Special Protection Area
THC	The Highland Council
WTG	Wind Turbine Generator
UK	United Kingdom

1 Introduction

1.1 Preface

This document provides information to support an application by Highland Wind Limited (HWL), under S36C of the Electricity Act, to vary the S36 Consent granted for the Project (the Variation Application).

A Variation Screening Report was submitted to Marine Directorate’s Licensing and Operations Team (MD-LOT) on 7 August 2023 (Document Reference GBPNTD-PGM-PEN-RP-00002). The updates provided in this report are in response to comments provided by statutory consultees within the Screening Opinion received on 15 September 2023 (MD-LOT, 2023). These comments are summarised within Table 1-1 which also states how and where within this document these comments have been addressed.

Table 1-1 Screening Opinion consultation summary

CONSULTEE	SCREENING COMMENT SUMMARY	HWL RESPONSE
MD-LOT	<p>MD-LOT confirmed that the Consented Works are an Environmental Impact Assessment (“EIA”) project and therefore, the Scottish Ministers consider the Proposed Works to fall under paragraph 13 of schedule 2 of The Marine Works (EIA) (Scotland) Regulations 2017 (“the 2017 MW Regulations”), with the Proposed Works meeting the corresponding threshold described in column 2 of schedule 2. The Scottish Ministers also consider the Proposed Works to fall under paragraph 3 of schedule 2 of The Electricity Works (EIA) (Scotland) Regulations 2017 (“the 2017 EW Regulations”).</p> <p>In terms of physical parameters, MD-LOT confirmed that the proposed design refinements will result in a reduction in the number of WTGs and floating substructures, with a corresponding reduction in the associated mooring lines and anchors/piles. The design refinements will also result in a reduction in the rotor diameter, rotor swept area and the area of sea surface occupied by the WTGs and floating substructures.</p> <p>In terms of proposed temporal changes, MD-LOT further confirmed that while the operational life of the Project is proposed to be extended from 10 years to 25 years, the EIAR and supporting documents submitted on 11 August 2022, considered the project over a 30-year operational lifespan.</p> <p>Therefore, MD-LOT concluded that the proposed variation remains within the design envelope assessed</p>	<p>The response from MD-LOT is noted and HWL welcome confirmation that the proposed design refinements remain within the design envelope assessed in the 2022 EIAR and an EIA is not required for the S36C Variation Application under the 2017 MW Regulations and the 2017 EW Regulations.</p>

CONSULTEE	SCREENING COMMENT SUMMARY	HWL RESPONSE
	<p>in the 2022 EIAR and an EIA is not required to be carried out in respect of the proposed works under the 2017 MW Regulations and the 2017 EW Regulations.</p>	
<p>NatureScot (NS)</p>	<p>NS confirmed that overall, it is content with the approaches and findings outlined in the Screening Report and consider that the proposed variation would not require a full EIA to support the variation application.</p> <p>With reference to ornithology, NS confirmed its objection to the original application on the basis that in its view the proposal would have an adverse effect on site integrity for puffin and could have an adverse effect on site integrity for kittiwake at the North Caithness Cliffs SPA in-combination with the Moray Firth Wind Farms.</p> <p>NS confirmed agreement that the Habitats Regulation Process falls outside the requirements or EIA Screening and NS agree with the approach proposed by HWL to submit an addendum to the Report to Inform Appropriate Assessment within the S36 Consent Application Report, to address the proposed design refinements and the potential implications of these for ornithological features. NS further confirmed that this need not be part of a formal EIAR.</p> <p>With reference to SLVIA NS welcomed the comparative assessment provided within the Screening Report and confirmed that it agrees with the conclusions, that the overall findings would not be notably different to those in the Original EIA. NS requested that the comparative assessment is provided as part of the variation application as supporting information.</p>	<p>The response from NS is noted. HWL welcome confirmation that overall NS is content with the approaches and findings outlined in the Screening Report and that the S36C Variation Application does not require an EIA.</p> <p>In line with the advice provided, HWL has prepared and submitted an addendum to the Original RIAA (the RIAA Addendum), to address the proposed design refinements and the potential implications of these for puffin and kittiwake features of the North Caithness Cliffs Special Protection Area (NCC SPA).</p> <p>As requested by NS, HWL has also included the SLVIA comparative assessment, previously submitted within the Screening Report, within this S36C Variation Application as supporting information. HWL welcomes confirmation from NS that it agrees with the conclusions, that the overall findings would not be notably different to those in the Original EIA.</p>
<p>Historic Environment Scotland (HES)</p>	<p>HES confirmed that it does not consider the proposed variations to have the potential to raise significant impacts on known or designated heritage assets within its remit. HES further confirmed it had no comments to make on the requirement or otherwise for an EIA.</p>	<p>HWL welcomes the response from HES and confirmation that it does not consider the proposed variation to have the potential to raise any significant impacts on known or designated heritage assets.</p>

CONSULTEE	SCREENING COMMENT SUMMARY	HWL RESPONSE
Scottish Environment and Protection Agency (SEPA)	SEPA advised that the Proposed Works will result in a reduction in the potential impacts on water and sediment quality compared to those assessed in the 2022 EIAR. SEPA confirmed that no new impacts were identified as a result of the Proposed Works, therefore the findings of the 2022 EIAR remain valid and an EIA is not required.	HWL welcomes the response from SEPA and confirmation that the potential impacts on water and sediment quality will be reduced compared to the 2022 EIAR, that the findings of the 2022 EIAR remain valid and an EIA is not required.
The Highland Council (THC)	THC confirmed that an EIA is not required for the S36C Variation Application. The rationale behind this advice is that the proposal does not constitute Schedule 1 development under the 2017 Regulations. While the proposal does fall within the definition of Schedule 2 development, in that it consists of development type 3 (a), having screened it against the selection criteria outlined in Schedule 3 (including cumulative impact, pollution, impact on natural resources/the natural environment, environmental quality and the historic environment), impact on the receiving environment, while possible, is not considered to be significant. Therefore, the proposed development does not constitute 'EIA development' and Environmental Impact Assessment (EIA) is not required.	HWL welcomes the response from THC and confirmation that the proposed S36 Variation Application does not constitute EIA development and an EIA is not required.
Orkney Islands Council (OIC)	OIC confirmed that its marine planning team have no comments to make on the S36C Variation Application.	HWL notes the response from OIC that it has no comments to make.

1.2 Background

Highland Wind Limited (HWL) was awarded Section 36 Consent (S36 Consent) under the Electricity Act 1989 by the Scottish Ministers on 28 June 2023 for the offshore components of the Pentland Floating Offshore Wind Farm (PFOWF) ('the Project'). Marine licences for the Offshore Wind Farm (OWF) and the Offshore Export Cable(s) (OEC) (together the 'Project Marine Licences') were also awarded by the Scottish Ministers on 28 June 2023 under the Marine (Scotland) Act 2010.

The onshore components of the Project (i.e., those above mean low water springs) were the subject of a separate application to The Highland Council (THC) under the Town and Country Planning (Scotland) Act 1997. Planning Permission in Principle (PPP) for these components was granted on 30 January 2023.

This report supports an application by HWL under S36C of the Electricity Act to vary the S36 Consent granted for the Project. In line with the proposed variations to the S36 Consent, this report also supports an application to Scottish Ministers to vary the associated marine licences (MS-00009991 and MS-00009992) for the Project under section 30(7) of the Marine (Scotland) Act. These variations are required to refine the design parameters

of the Project in response to further detailed design activities, and to extend the operational life of the Project consent from 10 years to 25 years (noting that the original EIAR assessed an operational life of 30 years).

The proposed design refinements remain within the design envelope assessed in the Environmental Impact Assessment Report (EIAR) submitted in August 2022 (the 'Original EIAR'). Following review of the Original EIAR, the Screening Opinion received and additional information provided, which considers the potential environmental effects arising from the proposed S36 Variation, this report demonstrates that all potential effects remain equal to or less than those identified within the Original EIAR and therefore the S36C Variation Application does not constitute an EIA application, and the Offshore Consents can be varied with no further assessment required.

While the Habitats Regulation Assessment (HRA) process falls outside of the requirements of the S36C variation process, as set out within the Screening Report submitted to MD-LOT, concerns were raised by NS, MD-LOT and the Royal Society for the Protection of Birds (RSPB) on the original PFOWF consent application, specifically the Report to Inform Appropriate Assessment (RIAA) (the 'Original RIAA'), and potential in-combination adverse effects on site integrity (AEOSI) for puffin and kittiwake features of the North Caithness Cliffs (NCC) SPA. To address these concerns HWL has prepared an addendum to the Original RIAA which is included within this Variation Application Report (the 'RIAA Addendum'), and which addresses the proposed design refinements and the potential implications of these for ornithological features of the NCC SPA. The RIAA Addendum provides updated ornithological modelling for both puffin and kittiwake features and includes updated displacement assessments, updated collision risk modelling (CRM), and population viability analysis (PVA), as discussed and agreed with NS and MD-LOT.

1.3 Document Structure

This document sets out the proposed variations to the Offshore Consents alongside justification as to why the proposed variations are required. This document also reviews the information submitted within the Screening Report, alongside the Screening Opinion received and, where determined necessary, provides additional information to support the variation application. Where additional information is provided the report considers the resulting effects of the variation by comparison to the Original EIAR and Original RIAA. The process followed is based on MD-LOT's Guidance Note: Application for Variation of Section 36 Consents¹.

The remaining document structure is set out as follows:

- Proposed variations and legislative context;
- Revised project parameters;
- Screening Environmental Receptors;

¹ MS-LOT (2019). Energy consents: applications for variation of section 36 consents guidance. Available at <https://www.gov.scot/publications/applications-variation-section-36-consents/documents>

- Additional Information;
 - Seascape, Landscape and Visual Comparison
 - Ornithology Modelling Update
- Conclusions;
- Appendices presenting:
 - A. Draft revised S36 Consent
 - B. Draft revised Marine Licences
 - C. SLVIA Comparative Assessment
 - D. RIAA Addendum

2 Proposed Variation

2.1 Overview

HWL is seeking consent from the Scottish Ministers to vary the existing S36 Consent under the Electricity Act 1989 for the Project by refining the following project parameters:

- Reducing the number of Wind Turbine Generators (WTGs) from seven to six;
- Reducing the WTG footprint area from 10 km² to 5.85 km². This comprises the area of sea surface occupied by the WTGs and associated floating substructure, excluding the mooring lines;
- Reducing the rotor swept area from 316,673 m² to 283,448 m². This comprises the installation of up to 1 x WTG with rotor diameter up to 220 m and 5 x WTGs with rotor diameter up to 250 m;
- Reducing the number of floating substructures from seven to six;
- Reducing the number of mooring lines from 63 to 54;
- Reducing the number of anchors or piles from 63 to 54; and
- Extending the operational life of the Project from 10 to 25 years.

HWL is also requesting that the associated Project Marine Licences (licence numbers ML-00009991 and ML-00009992) are varied by the Scottish Ministers under section 30(7) of the Marine (Scotland) Act, to reflect amendments to the S36 Consent. Draft proposed changes to the S36 Consent and Project Marine Licences are included within this Variation Application report (Appendix and Appendix B respectively).

2.2 Consented Development

The current S36 Consent permits the development of a demonstration Offshore Wind Farm (OWF) in the Pentland Firth, located as shown on Figure 2 1. The S36 Consent includes the following key parameters:

- The construction and operation of an offshore energy generating station with a generating capacity of around 100 MW. The offshore generating station shall be comprised of up to:
 - Seven floating offshore WTGs with:
 - A maximum hub height of 190 m above HAT;
 - A maximum height to blade tip of 300 m above HAT;
 - A maximum rotor diameter of 260 m;
 - A minimum blade tip clearance from mean sea level (MSL) of 35 m;
 - Seven associated floating substructures;
 - Nine mooring lines for each floating substructure, 63 in total;
 - Nine anchors or piles for each floating substructure, 63 in total;
 - Seven inter-array cables (dynamic and static); and
 - Associated scour and cable protections.

The consented development is also detailed in Annex 1 (Description of the Development) of the S36 Consent. For reference, the current Offshore Consents documents, the Original EIAR and the Original RIAA for Project can be accessed at: <https://marine.gov.scot/ml/pentland-floating-offshore-wind-farm>

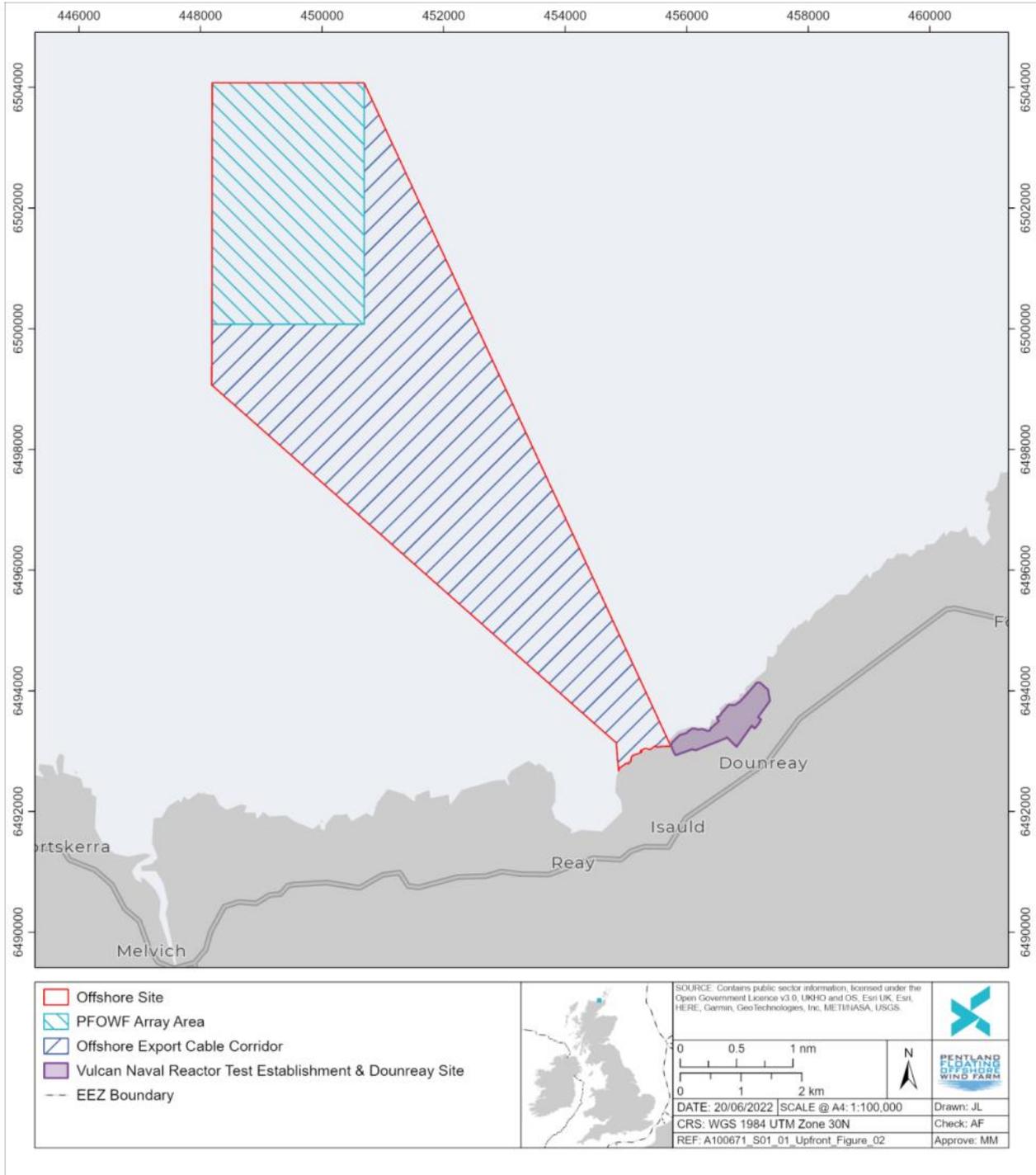


Figure 2.1 Consented Project Boundaries

2.3 Need for the Variations

Following the submission of the application for the Offshore Consents, HWL has worked with its engineering team to further refine the offshore parameters for the Project, where possible, and within the consented design envelope. At the same time, and taking these design refinements into consideration, HWL is seeking to extend the operational life of the Project from 10 to 25 years. Such refinements will require variation of previously consented project parameters listed in Annex 1 of the S36 Consent and described within the Project Marine Licences (ML-00009991 and ML-00009992).

To ensure that the benefits of the Project are realised, both in terms of facilitating the development of floating offshore wind and the contribution of the Project to UK and Scottish climate targets, the operational period must be extended from 10 to 25 years. As a test and demonstrator project the PFOWF will facilitate the development of floating offshore wind farms in Scotland, the UK and worldwide. The design refinements proposed within this document will ensure that the environmental effects of the Project are minimised, wherever possible, while enabling the Project to remain cost effective and deliver the lowest cost of energy to consumers. The innovations and technology trialled in the delivery of the Project will also be key to advancing the deployment of large-scale floating offshore wind in the UK. This includes the 3.6 GW Ossian project, a joint venture by CIP, SSE and Marubeni off the east coast of Scotland, alongside the realisation of nearly 15 GW of floating capacity allocated under the ScotWind leasing round and up to 5 GW of additional floating capacity under the Innovation and Targeted Oil and Gas (INTOG) leasing round.

2.4 Legislative Context

Section 36 of the Electricity Act, 1989 applies to proposals for any offshore generating station whose capacity exceeds 1 MW within Scottish territorial waters or the Scottish Renewable Energy Zone (REZ). Offshore generating stations also require a marine licence under the Marine (Scotland) Act, 2010 (between 0 and 12 NM) or under the Marine and Coastal Access Act, 2009 (between 12 and 200 NM). Section 20 of the Growth and Infrastructure Act, 2013 inserted a new Section 36C into the 1989 Act to provide for the making of variations to Section 36 consents.

The Electricity Generating Stations (Applications for Variation of Consent) (Scotland) Regulations 2013 ('the 2013 Regulations') came into force in December 2013. The 2013 Regulations were later amended by Regulation 42 of the Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017 (as amended) ('the EIA Regulations'). The regulations make provision for the content of a variation application and the consultation process to be followed with respect to Section 36C applications.

Following discussions with MD-LOT and receipt of written confirmation received on 8 June 2023, MD-LOT confirmed that the variation process under Section 36C of the Electricity Act is the appropriate mechanism by which to address the proposed design refinements, and to extend the operational life of the consented Project.

Under paragraph 3 of Schedule 2 of the Electricity Works (EIA) (Scotland) Regulations 2017 (the 2017 Electricity Works Regulations), and paragraph 13 of Schedule 2 of the Marine Works (EIA) (Scotland) Regulations 2017 ('the 2017 Marine Works Regulations'), any change to works already authorised which were subject to an EIA must be considered to determine whether that change may have significant adverse effects on the environment and, as such, an EIA is required. Where a proposed variation is unlikely to have significant environmental effects, no EIA Report or process would be required in respect of the variation application.

The proposed variations fall under Schedules 2(3) and 2(13) of the 2017 Electricity Works Regulations and the 2017 Marine Works Regulations, respectively and, as such, on 7 August 2023 HWL submitted a Screening Report and request for a Screening Opinion from MD-LOT as to whether the variations constituted an EIA project. On 15 September 2023, MD-LOT issued a Screening Opinion on behalf of Scottish Ministers confirming that an EIA is not required to be carried out in respect of the proposed works under the 2017 Marine Works Regulation or the 2017 Electricity Works Regulations.

HWL is also requesting that, should the variation of the S36 Consent be granted, the Project Marine Licences (Licence Number: ML-00009991 and ML-00009992) are also varied by the Scottish Ministers under section 30(7) of the Marine (Scotland) Act to reflect amendments to the S36 Consent.

2.4.1 Section 36C Variation Application

Under Regulation 3 of the Electricity Generating Stations (Applications for Variation of Consent) (Scotland) Regulations 2013 a 36C Consent variation application must:

- *be made in writing;*
- *describe the proposed development and identify the location of the proposed development by reference to a map;*
- *explain why it is proposed that the relevant section 36 consent should be varied; and*
- *include—*
 - *a draft of the variations which it is proposed should be made to the relevant section 36 consent;*
 - *copies of any maps or plans not referred to in the relevant section 36 consent which it is proposed should be referred to in the relevant section 36 consent as so varied; and*
 - *particulars of— the relevant section 36 consent, and, if that consent was not granted to the applicant, how the applicant has the benefit of that consent.*

In line with Regulation 3, a draft of the proposed variations to the S36 Consent are set out at Appendix A. Draft revised marine licences are included at Appendix B. In each case, proposed amendments to the consents are set out as track changes.

3 Revised Project Parameters

The Original EIA for the Project made use of a design envelope approach. Table 3-1 details the proposed variations to the Project and highlights where the proposed changes to the project parameters require the S36 Consent and/or the marine licences to be varied.

Table 3-1. Proposed Parameter Variations to the PFOWF

Parameter	Consented Parameter	Proposed Variation	S36 Amendment	ML Amendment
Number of WTGs	7	6	Text to be amended within S36 Consent	Text to be amended within OWF ML 00009991
Number of floating substructures	7	6	Text to be amended within S36 Consent	Text to be amended within OWF ML 00009991
Number of mooring lines	63	54	Text to be amended within S36 Consent	Text to be amended within OWF ML 00009991
Number of anchors or piles	63	54	Text to be amended within S36 Consent	Text to be amended within OWF ML 00009991
Rotor Swept Area	316,673 m ²	283,448 m ²	Text to be amended within S36 Consent	Text to be amended within OWF ML 00009991
WTG footprint Area	10 km ²	5.85 km ²	Text to be amended within S36 Consent	Text to be amended within OWF ML 00009991
Operational life (years)	10	25	Text to be amended within S36 Consent	Text to be amended within OWF and OEC ML 00009991 and ML 00009992

3.1 Screening Environmental Receptors

As set out above, HWL submitted a Screening Report to MD-LOT on 7 August 2023 (GBPNTD-PGM-PEN-RP-00002), and a Screening Opinion was received from MD-LOT on 15 September 2023. Within the Screening Opinion MD-LOT confirmed that the proposed design refinements will result in a reduction in the number of WTGs and floating substructures from seven to six, with a corresponding reduction in the associated mooring lines and anchors/piles from 63 to 54. The design refinements will also result in a reduction in the rotor diameter from the maximum diameter consented for all WTGs and therefore a reduction in rotor swept area from 316,673 m² to 283,448 m². The Screening Opinion also confirmed that the maximum area of sea surface occupied by the WTGs and floating substructures will be reduced, from 10 km² to 5.85 km².

MD-LOT further confirmed that while the operational life of the Project is proposed to be extended from 10 years in the consented Works, to 25 years in the variation, the EIAR submitted on 11 August 2022, alongside the application package for the consented works considered the project over a 30-year operational lifespan. Therefore, within its Screening Opinion, MD-LOT concluded that the proposed variation remains within the design envelope assessed in the Original EIAR and an EIA is not required.

In line with the Screening Opinion received, Table 3-2 summarises the environmental receptor topics and associated impacts previously assessed within the Original EIAR. In each case it is noted if the receptor topic is required to be screened in for further assessment and if additional information has been provided to enable MD-LOT to determine the application.

As set out within the Screening Opinion, in considering the proposed variation, the following points are noted.

- In each case the variations proposed to the design of the Project represent a reduction in the consented project parameters and therefore a corresponding reduction in environmental effects, as compared to the Original EIAR and supporting information.
- The Original EIAR assessed the effects of the Project for an operational life of up to 30 years. Therefore, the potential environmental effects of the proposed extended operational life would be no greater than those already assessed within the Original EIAR and supporting information.

Table 3-2. Screening of Environmental Receptor Topics and Provision of Additional Information

Receptor Topic	Impacts Assessed in Original EIA	Residual Effect Predicted in Original EIA	Implication of Proposed Design Refinements	Additional information provided
Marine Physical Processes	<p><u>Construction/Decommissioning</u></p> <ul style="list-style-type: none"> - Increase in suspended sediment concentration - Loss/alteration of seabed characteristics <p><u>Operation and maintenance</u></p> <ul style="list-style-type: none"> - Changes to wave and tide regime - Changes to sediment transport regime - Introduction of scour - Impacts on fronts and stratification 	<p>Negligible to Minor Effects</p> <p>Residual Effect Not Significant</p>	<p><u>Design Refinements</u></p> <p>No significant adverse effects were identified on marine physical processes within the original EIA. The proposed design refinements will result in a reduction in WTGs from seven to six. This provides a corresponding reduction in the number of substructures required within the water column and in the total number of anchors, inter array cables, mooring lines, and scour/cable protection to be installed on or within the seabed. As a result, the potential impacts on marine physical processes will be reduced compared to those assessed within the Original EIA. No new impacts are identified as a result of the design refinements, and therefore the findings of the Original EIA remain valid.</p> <p><u>Extended Operation life</u></p> <p>The proposed operational life of the Project has been reduced from 30 years (assessed within the Original EIA) to 25 years. The assessment based on an operational life of 30 years showed no significant adverse effects on marine physical processes and therefore, the findings of the Original EIA remain valid.</p>	<p>No</p> <p>The Screening Opinion concluded no further information is required in respect of Marine Physical Processes</p>
Water and Sediment Quality	<p><u>Construction/Decommissioning</u></p> <ul style="list-style-type: none"> - Disturbance and release of contaminated sediments or radioactive particles in - Changes in water and sediment quality and status due to accidental release of contaminants or radioactive particles - Changes in water and sediment quality and status due to risk of INNS settlement and redistribution <p><u>Operation and maintenance</u></p> <ul style="list-style-type: none"> - Changes in water quality due to operational cleaning and painting 	<p>Negligible to Minor Effects</p> <p>Residual Effect Not Significant</p>	<p><u>Design Refinements</u></p> <p>No significant adverse effects were identified on water quality within the Original EIA. The proposed design refinements will result in a reduction in WTGs from seven to six. This provides a corresponding reduction in the number of substructures required within the water column and the total number of anchors, inter array cables, mooring lines, and scour/cable protection to be installed on or within the seabed. As a result, the potential impacts on water and sediment quality will be reduced compared to those assessed within the Original EIA. No new impacts are identified as a result of the design refinements, and therefore the findings of the Original EIA remain valid.</p> <p><u>Extended Operation life</u></p> <p>The proposed operational life of the Project has been reduced from 30 years (assessed within the Original EIA) to 25 years. The assessment based on an operational life of 30 years showed no significant adverse effects on water</p>	<p>No</p> <p>The Screening Opinion concluded no further information is required in respect of Water and Sediment Quality</p>

Receptor Topic	Impacts Assessed in Original EIAR	Residual Effect Predicted in Original EIAR	Implication of Proposed Design Refinements	Additional information provided
			and sediment quality and therefore, the findings of the Original EIAR remain valid.	
Benthic Ecology	<u>Construction/Decommissioning</u> <ul style="list-style-type: none"> - Damage from placement of infrastructure (cables, moorings, anchors on the seabed) - Suspension of sediments from the installation of marine infrastructure - Disturbance of contaminated sediments - Introduction of marine invasive non-native species (INNS) - Deposition of drill cuttings 	Negligible to Minor Effects Residual Effect Not Significant	<u>Design Refinements</u> No significant adverse effects were identified on benthic ecology within the Original EIAR. The proposed design refinements will result in a reduction in WTGs from seven to six. This provides a corresponding reduction in the total number of anchors, inter array cables, mooring lines, and scour/cable protection to be installed on or within the seabed. As a result, the potential impacts on benthic ecology will be reduced compared to those assessed within the Original EIAR. No new impacts are identified as a result of the design refinements, and therefore the findings of the Original EIAR remain valid.	No The Screening Opinion concluded no further information is required in respect of Benthic Ecology
	<u>Operation and maintenance</u> <ul style="list-style-type: none"> - Hydrodynamic changes leading to scour and abrasion around subsea infrastructure - Introduction of marine INNS - Colonisation of subsea infrastructure - Impact to benthic communities from any EMF and thermal load from cables 		<u>Extended Operation life</u> The proposed operational life of the Project has been reduced from 30 years (assessed within the Original EIAR) to 25 years. The assessment based on an operational life of 30 years showed no significant adverse effects on benthic ecology and therefore, the findings of the Original EIAR remain valid.	
Fish and Shellfish Ecology	<u>Construction</u> <ul style="list-style-type: none"> - Disturbance or damage to sensitive species due to underwater noise from construction activities - Direct habitat loss due to disturbance of spawning and nursery grounds from construction activities 	Negligible to Minor Effects Residual Effect Not Significant	<u>Design Refinements</u> No significant adverse effects were identified on fish and shellfish ecology within the Original EIAR. The proposed design refinements will result in a reduction in WTGs from seven to six. This provides a corresponding reduction in the number of substructures required within the water column and a reduction in the total number of anchors, inter array cables, mooring lines, and scour/cable protection to be installed on or within the seabed. As a result, the	No The Screening Opinion concluded no further information

Receptor Topic	Impacts Assessed in Original EIAR	Residual Effect Predicted in Original EIAR	Implication of Proposed Design Refinements	Additional information provided
	<ul style="list-style-type: none"> - Effects of increased sedimentation / smothering on fish and shellfish - Temporary burial of seabed from drill cuttings - Potential accidental release of pollutants <p><u>Operation and maintenance</u></p> <ul style="list-style-type: none"> - Habitat loss of spawning and nursery grounds due to presence of anchors and cables on seabed - Effects of EMF from cables on sensitive species - Fish aggregation around the floating structure and associated infrastructure - Ghost fishing (lost fishing gear) becoming entangled in installed infrastructure - 		<p>potential impacts on fish and shellfish species will be reduced compared to those assessed within the Original EIAR. No new impacts are identified as a result of the design refinements, and therefore the findings of the Original EIAR remain valid.</p> <hr/> <p><u>Extended Operation life</u> The proposed operational life of the Project has been reduced from 30 years (assessed within the Original EIAR) to 25 years. The assessment based on an operational life of 30 years showed no significant adverse effects on fish and shellfish ecology and therefore, the findings of the Original EIAR remain valid.</p>	is required in respect of Fish and Shellfish Ecology
Marine Mammals and Other Megafauna	<p><u>Construction/Decommissioning</u></p> <ul style="list-style-type: none"> - Noise related impacts to marine mammals from construction activities - Noise related impacts to basking sharks from low-frequency construction noise <p><u>Operation and maintenance</u></p> <ul style="list-style-type: none"> - Noise related impacts to marine mammals during operation and maintenance 	<p>Negligible to Minor Effects</p> <p>Residual Effect Not Significant</p>	<p><u>Design Refinements</u> No significant adverse effects were identified on marine mammals and megafauna within the original EIAR. The proposed design refinements will result in a reduction in WTGs from seven to six. This provides a corresponding reduction in the number of substructures required within the water column and a reduction in the total number of anchors, inter array cables, mooring lines, and scour/cable protection to be installed. As a result, the potential impacts on marine mammals and megafauna species will be reduced compared to those assessed within the Original EIAR. No new impacts are identified as a result of the design refinements and the findings of the Original EIAR remain valid.</p>	<p>No</p> <p>The Screening Opinion concluded no further information is required in respect of Marine Mammals and other Megafauna.</p>

Receptor Topic	Impacts Assessed in Original EIAR	Residual Effect Predicted in Original EIAR	Implication of Proposed Design Refinements	Additional information provided
	<ul style="list-style-type: none"> - Entanglement risk to marine mammals and basking sharks - Collision risk to marine mammals and basking sharks - Displacement or barrier effects - Long term habitat change - 		<p><u>Extended Operation life</u> The proposed operational life of the Project has been reduced from 30 years (assessed within the Original EIAR) to 25 years. The assessment based on an operational life of 30 years showed no significant adverse effects on marine mammals and megafauna and therefore, the findings of the original EIAR remain valid.</p>	
Marine Ornithology	<p><u>Construction/decommissioning</u></p> <ul style="list-style-type: none"> - Disturbance/displacement/exclusion due to construction/decommissioning noise or physical presence of vessels - Barrier effects due to physical presence of vessels and construction/decommissioning equipment - Change in habitat/prey availability during construction/decommissioning - Increase in suspended sediment affecting visibility during construction/decommissioning <p><u>Operation and maintenance</u></p> <ul style="list-style-type: none"> - Collision risk with operational WTGs - Displacement impacts due to physical presence of WTGs - Barrier effects due to physical presence of WTGs - Entanglement with debris caught on mooring lines 	<p>Negligible to Minor Effects</p> <p>No risk of significant additional collision impacts arising from the Offshore Development</p> <p>Residual Effects Not Significant</p>	<p><u>Design Refinements</u> No significant adverse effects were identified on ornithological species within the Original EIAR. The proposed design refinements will result in a reduction in WTGs from seven to six which reduces the WTG footprint area. WTGs to be installed will comprise 1 x WTG with rotor diameter 220 m and 5 x WTGs with rotor diameter 250 m, which provides an overall reduction in rotor swept area. As a result, the potential impacts on all marine ornithology species will be reduced compared to those assessed within the Original EIAR. No new impacts are identified as a result of the design refinements and the conclusions of the Original EIAR remain valid.</p> <p><u>Extended Operation life</u> The proposed operational life of the Project has been reduced from 30 years (assessed within the Original EIAR) to 25 years. The assessment based on an operational life of 30 years showed no significant adverse effects on marine ornithology species and therefore, the findings of the original EIAR remain valid.</p>	<p>Yes</p> <p>As confirmed within the Screening Opinion, HWL has prepared an addendum to the Original RIAA which considers the implications of the proposed design refinements on kittiwake and puffin features of the NCC SPA. The RIAA Addendum includes updated ornithological</p>

Receptor Topic	Impacts Assessed in Original EIAR	Residual Effect Predicted in Original EIAR	Implication of Proposed Design Refinements	Additional information provided
	<ul style="list-style-type: none"> - Disturbance/exclusion due to marine noise and maintenance works - Change in habitat/prey availability due to physical presence of WTGs, scour and cable protection - Increase in suspended sediment from operations and maintenance work affecting visibility - Creation of roosting habitat or foraging opportunities 			modelling and comparison of outputs to the Original RIAA.
Commercial Fisheries	<p><u>Construction/decommissioning</u></p> <ul style="list-style-type: none"> - Loss of access to fishing grounds due to the presence of vessels and safety zones - Displacement of fishing activity into other areas - Fishing gear entanglement with subsea structures, resulting in damage, loss of fishing gear or ghost fishing <p><u>Operation and maintenance</u></p> <ul style="list-style-type: none"> - Loss of access to fishing grounds due to floating platforms, associated moorings and safety zones - Displacement to other fishing grounds resulting in increased pressure on resources or conflict with other sea users due to floating platforms, associated moorings and safety zones 	<p>Negligible to Tolerable with Mitigation</p> <p>Residual Effect Not Significant</p>	<p><u>Design Refinements</u></p> <p>No significant adverse effects were identified on commercial fisheries within the original EIAR. The proposed design refinements will result in a reduction in WTGs from seven to six. This provides a corresponding reduction in the number of substructures required within the water column and a reduction in the total number of anchors, inter array cables, mooring lines, and scour/cable protection to be installed. As a result, the potential impacts on commercial fisheries will be reduced compared to those assessed within the Original EIAR. No new impacts are identified as a result of the design refinements and therefore, the findings of the Original EIAR remain valid.</p> <p><u>Extended Operation life</u></p> <p>The proposed operational life of the Project has been reduced from 30 years (assessed within the Original EIAR) to 25 years. The assessment based on an operational life of 30 years showed no significant adverse effects on commercial fisheries and therefore, the findings of the Original EIAR remain valid.</p>	<p>No</p> <p>The Screening Opinion concluded no further information is required in respect of Commercial Fisheries</p>

Receptor Topic	Impacts Assessed in Original EIAR	Residual Effect Predicted in Original EIAR	Implication of Proposed Design Refinements	Additional information provided
	<ul style="list-style-type: none"> - Fishing gear entanglement with floating subsea structures resulting in damage loss of fishing gear or ghost fishing 			
Shipping and Navigation	<p><u>Construction/decommissioning</u></p> <ul style="list-style-type: none"> - Vessel displacement due to construction / decommissioning activities leading to increased risk for third-party vessels and/or reduction in port access - Vessel to vessel collision risk between a third-party vessel and Project vessel - Vessel to structure allision risk due to the presence of new structures associated with the Project - Fishing gear interaction with subsea infrastructure - Reduction in under keel clearance due to subsea cables / cable protection leading to increased grounding risk 	Broadly Acceptable to Tolerable with Mitigation Residual Effect Not Significant	<p><u>Design refinements</u></p> <p>No significant adverse effects were identified on shipping and navigation receptors within the original EIAR. The proposed design refinements will result in a reduction in WTGs from seven to six. This provides a corresponding reduction in the number of substructures required within the water column and a reduction in the total number of anchors, inter array cables, mooring lines, and scour/cable protection to be installed. As a result, the potential impacts on shipping and navigation will be reduced compared to those assessed within the Original EIAR. No new impacts are identified as a result of the design refinements and therefore, the findings of the Original EIAR remain valid.</p>	No The Screening Opinion concluded no further information is required in respect of Shipping and Navigation
	<p><u>Operation and maintenance</u></p> <ul style="list-style-type: none"> - Vessel to vessel displacement due to presence of new structures leading to increased collision risk for third-party vessels and/or reduction in port access - Vessel to vessel collision risk between a third-party vessel and Project vessel - Vessel to structure allision risk due to the presence of new structures associated with the Project 		<p><u>Extended Operation life</u></p> <p>The proposed operational life of the Project has been reduced from 30 years (assessed within the Original EIAR) to 25 years. The assessment based on an operational life of 30 years showed no significant adverse effects on shipping and navigation and therefore, the findings of the Original EIAR remain valid.</p>	

Receptor Topic	Impacts Assessed in Original EIA/R	Residual Effect Predicted in Original EIA/R	Implication of Proposed Design Refinements	Additional information provided
	<ul style="list-style-type: none"> - Anchor interaction with subsea infrastructure - Fishing gear interaction with subsea infrastructure - Transiting vessel interaction with subsea infrastructure - Reduction in under keel clearance due to subsea cables / cable protection leading to increased grounding risk - Reduction in emergency response capabilities due to increased incident rate and/or reduced access for SAR responders 			
Aviation and Radar	<p><u>Construction/decommissioning</u></p> <ul style="list-style-type: none"> - Potential impact on Wick airport IFPs - Potential impact on military low flying and UK SAR helicopter operations <p><u>Operation and maintenance</u></p> <ul style="list-style-type: none"> - Potential impact on Wick airport IFPs - Potential impact on military low flying and UK SAR helicopter operations 	<p>Negligible to Minor Effects</p> <p>Residual Effect Not Significant</p>	<p><u>Design Refinements</u></p> <p>No significant adverse effects were identified on aviation and radar within the original EIA/R. The proposed design refinements will result in a reduction in WTGs from seven to six. As a result, the potential obstacles to aviation and radar receptors will be reduced compared to those assessed within the original EIA/R. No new impacts are identified as a result of the design refinements and therefore, the findings of the original EIA/R remain valid.</p> <p><u>Extended Operation life</u></p> <p>The proposed operational life of the Project has been reduced from 30 years (assessed within the Original EIA/R) to 25 years. The assessment based on an operational life of 30 years showed no significant adverse effects on aviation and radar and therefore, the findings of the Original EIA/R remain valid.</p>	<p>No</p> <p>The Screening Opinion concluded no further information is required in respect of Aviation and Radar</p>

Receptor Topic	Impacts Assessed in Original EIAR	Residual Effect Predicted in Original EIAR	Implication of Proposed Design Refinements	Additional information provided
Seascape Landscape and Visual Amenity	<p><u>Construction/decommissioning</u></p> <ul style="list-style-type: none"> - Effect on seascape/landscape character and visual amenity due to the presence and activity of construction/decommissioning vessels - Effect on seascape/landscape character and visual amenity due to the installation of the offshore WTGs and floating substructures - Effect on visual amenity due to the use of artificial lighting to enable construction/decommissioning works during the hours of darkness <p><u>Operation and maintenance</u></p> <ul style="list-style-type: none"> - Effect on seascape/landscape character and visual amenity due to the presence of offshore WTGs and the movement of blades and presence of floating substructures - Effect on seascape/landscape character and visual amenity due to the use of aviation lighting on offshore WTGs during the hours of darkness over the 30-year life - Effect on seascape/landscape character and visual amenity due to the use of helicopters and maintenance vessels to service the Project over the 30-year life 	<p>Minor to Major/Moderate</p> <p>Residual Effect Significant</p> <p>The effects are found to be localised within the SLVIA Study Area, affecting an area of coast and landscape that currently has energy and onshore wind development. Localised nature of the effects means that the majority of landscape and visual receptors across the wider Study Area will either undergo Not Significant Effects or will be unaffected</p>	<p><u>Design Refinements</u></p> <p>The Original EIA resulted in the identification of significant adverse effects on landscape and coastal character, landscape designations and some viewpoint locations. However, such effects were found to be localised and in no instances were these effects considered to be unacceptable.</p> <p>The proposed design refinements will result in a reduction in WTGs from seven to six and HWL has committed to reducing the area within which the WTGs will be deployed. This provides a reduction in extent of the array across the horizon. WTGs to be installed will comprise 1 x WTG with rotor diameter 220 m and 5 x WTGs with rotor diameter 250 m, which provides a reduction in WTG design parameters (tip height, hub height). As a result, the potential impacts on seascape, landscape and visual amenity will be reduced compared to those assessed within the Original EIAR. No new impacts are identified as a result of the design refinements and therefore, the findings of the Original EIAR remain valid.</p> <p>To understand the nature of the design refinements proposed on Seascape and Landscape receptors, a comparison of the proposed design refinements was provided with the submitted Screening Report.</p> <p><u>Extended Operation life</u></p> <p>The proposed operational life of the Project has been reduced from 30 years (assessed within the Original EIAR) to 25 years. The assessment based on an operational life of 30 years resulted in the identification of significant adverse effects on some viewpoint locations, however, in no instances were these effects considered to be unacceptable. Therefore, the findings of the Original EIAR remain valid.</p>	<p>Yes</p> <p>As requested by NS within the Screening Opinion, the SLVIA comparative assessment provided within the Screening Report is included within this Variation Application report for completeness.</p>

Receptor Topic	Impacts Assessed in Original EIAR	Residual Effect Predicted in Original EIAR	Implication of Proposed Design Refinements	Additional information provided
			To understand the nature of the design refinements proposed on Seascape and Landscape receptors, a comparative assessment of the proposed design refinements was provided with the submitted Screening Report.	
Marine Archaeology and Cultural Heritage	<p><u>Construction/decommissioning</u></p> <ul style="list-style-type: none"> - Loss of or damage to known marine and intertidal historic environment assets - Loss of or damage to unknown marine and intertidal historic environment assets - Loss of or damage to known submerged prehistoric landscapes <p><u>Operation and maintenance</u></p> <ul style="list-style-type: none"> - Loss of or damage to known marine historic environment assets - Loss of or damage to unknown marine historic environment assets - Loss of or damage to known submerged prehistoric landscapes - Long term changes to the setting of onshore historic environment assets that reduces their value 	Negligible to Minor Effects Residual Effect Not Significant	<p><u>Design Changes</u></p> <p>No significant adverse effects were identified on marine archaeology and cultural heritage within the original EIAR. The proposed design refinements will result in a reduction in WTGs from seven to six. This provides a corresponding reduction in the total number of anchors, inter array cables and scour/cable protection to be installed on or within the seabed. As a result, the potential impacts on marine archaeology will be reduced compared to those assessed within the Original EIAR. No new impacts are identified as a result of the design refinements and therefore, the findings of the Original EIAR remain valid.</p> <p><u>Extended Operation life</u></p> <p>The proposed operational life of the Project has been reduced from 30 years (assessed within the Original EIAR) to 25 years. The assessment based on an operational life of 30 years showed no significant adverse effects on marine archaeology and cultural heritage and therefore, the findings of the Original EIAR remain valid.</p>	No The Screening Opinion concluded no further information is required in respect of Marine Archaeology and Cultural Heritage
Other Users of the Marine Environment	<p><u>Construction-decommissioning</u></p> <ul style="list-style-type: none"> - Disturbance of subsea cables - Disruption to DSRL remedial monitoring activities 	Negligible to Minor Effects Residual Effect Not Significant	<p><u>Design Refinements</u></p> <p>No significant adverse effects were identified on other users of the marine environment within the Original EIAR. The proposed design refinements will result in a reduction in WTGs from seven to six. This provides a corresponding reduction in the number of substructures required within the water column and</p>	No The Screening Opinion

Receptor Topic	Impacts Assessed in Original EIAR	Residual Effect Predicted in Original EIAR	Implication of Proposed Design Refinements	Additional information provided
	<ul style="list-style-type: none"> - Interference to the operations of Space Hub Sutherland <p><u>Operation and maintenance</u></p> <ul style="list-style-type: none"> - Disturbance of subsea cables - Obstruction of DSRL remedial monitoring activities - Adverse impacts on telecommunications systems - Interference to the operations of Space Hub Sutherland 		<p>a reduction in the total number of anchors, inter array cables and scour/cable protection to be installed on or within the seabed. As a result, the potential impacts on other marine users will be reduced compared to those assessed within the Original EIAR. No new impacts are identified as a result of the design refinements and therefore, the findings of the Original EIAR remain valid.</p> <p><u>Extended Operation life</u> The proposed operational life of the Project has been reduced from 30 years (assessed within the Original EIAR) to 25 years. The assessment based on an operational life of 30 years showed no significant adverse effects on other marine users and therefore, the findings of the Original EIAR remain valid.</p>	<p>concluded no further information is required in respect of Other Users of the Marine Environment</p>
<p>Socioeconomics, Recreation and Tourism</p>	<p><u>Construction/operation and maintenance and decommissioning</u></p> <ul style="list-style-type: none"> - Project activities leading to an effect on employment - Project activities leading to an effect on economic output (GVA) - Project activities leading to an effect on demand for housing, recreation resources and other local services - Project activities leading to an effect on the volume and/or value of tourism 	<p>Negligible to Major Effects (beneficial)</p> <p>Residual Effect Significant (beneficial)</p> <p>Negligible to Moderate Effects (adverse)</p> <p>Residual Effect Not Significant (adverse)</p>	<p><u>Design Refinements</u> The Original EIAR resulted in the identification of significant beneficial impacts as a result of the Project in terms of employment within Caithness and the Highland area. No significant adverse effects were identified. The proposed design refinements will not change construction employment requirements or the construction programme. No new impacts are identified as a result of the design refinements proposed and, therefore, the findings of the Original EIAR remain valid.</p> <p><u>Extended Operation life</u> The proposed operational life of the Project has been reduced from 30 years (assessed within the Original EIAR) to 25 years. The assessment based on an operational life of 30 years showed no significant adverse effects on socioeconomics, recreation and tourism and a number of beneficial effects were identified which would be realised with the proposed extended operational life. Therefore, the findings of the Original EIAR remain valid.</p>	<p>No</p> <p>The Screening Opinion concluded no further information is required in respect of Socioeconomics, Recreation and Tourism</p>

Receptor Topic	Impacts Assessed in Original EIA/R	Residual Effect Predicted in Original EIA/R	Implication of Proposed Design Refinements	Additional information provided
Climate Change and Carbon	<p><u>Climate resilience review</u></p> <ul style="list-style-type: none"> - Direct impacts of climate change during the operation and maintenance phase on the Project <ul style="list-style-type: none"> o Impacts of extreme weather events o Impacts from changes in weather patterns or sea conditions o Impacts from sea level rise and coastal erosion <p><u>In-combination Climate Impact Assessment</u></p> <ul style="list-style-type: none"> - Inter-related impacts of climate change and the Project on relevant receptors during the operation and maintenance phase <ul style="list-style-type: none"> o Inter-related impacts of extreme weather events o Inter-related impacts from changes in weather patterns or sea conditions o Inter-related impacts of sea level rise and coastal erosion <p><u>Blue Carbon Assessment</u></p> <ul style="list-style-type: none"> - Direct blue carbon habitat loss/disturbance from the place of the 	<p><u>Climate Resilience Review:</u></p> <p>No Significant Effects identified</p> <p><u>In-combination Climate Impact Assessment:</u></p> <p>No Significant Effects Identified</p> <p><u>Blue Carbon Assessment:</u></p> <p>No Significant Effects Identified</p> <p><u>Carbon Assessment:</u></p> <p>No Significant Effects Identified</p>	<p><u>Design Refinements</u></p> <p>The proposed design refinements will result in a reduction in WTGs from seven to six, with a reduction in associated project infrastructure. The climate resilience of the Project to external factors will remain as assessed within the Original EIA/R. Potential in-combination effects on relevant receptors will be reduced, due to the reduction in project infrastructure requirements, compared to the assessment within the Original EIA/R. Potential effects on blue carbon habitats will also be reduced. The Project will continue to make a positive contribution to the UK carbon budget avoiding emissions that would have been associated with more carbon-intensive forms of electricity. The overall generating capacity of the Project is not changing and therefore estimates of generation and offset remain valid. No new impacts are identified as a result of the design refinements and therefore, the findings of the Original EIA/R remain valid.</p> <p><u>Extended Operation life</u></p> <p>The proposed operational life of the Project has been reduced from 30 years (assessed within the Original EIA/R) to 25 years. The assessment based on an operational life of 30 years showed no significant adverse effects on climate change and carbon, and a number of positive effects were identified which would be realised with the proposed extended operational life. Therefore, the findings of the Original EIA/R remain valid.</p>	<p>No</p> <p>The Screening Opinion concluded no further information is required in respect of Climate Change and Carbon</p>

Receptor Topic	Impacts Assessed in Original EIAR	Residual Effect Predicted in Original EIAR	Implication of Proposed Design Refinements	Additional information provided
	<p>Project subsea infrastructure during the lifecycle of the Project</p> <ul style="list-style-type: none"> - Cumulative effects from the Project and other projects resulting in blue carbon habitat loss/disturbance from the placement of subsea infrastructure <p><u>Carbon Assessment</u></p> <ul style="list-style-type: none"> - Impact of the Project on the global climate receptor utilising <ul style="list-style-type: none"> o Calculated carbon life cycle emissions resulting from the Project o The UK Carbon budgets as a proxy for the global climate 			
Risk of Major Accidents and Disasters	<p><u>Internal Project Risks</u></p> <ul style="list-style-type: none"> - <u>Lightning strikes</u> - <u>Major industrial accidents</u> <p><u>Internal Project Risks</u></p> <ul style="list-style-type: none"> - <u>Electrical systems failure</u> - <u>Marine Hazards</u> - <u>Subsea operations</u> 	<p>Broadly Acceptable to Tolerable with Embedded Mitigation</p> <p>Residual Effect Not Significant</p>	<p><u>Design Refinements</u></p> <p>There were no risks identified for the Project that could result in a major accident or disaster and no significant effects on receptors were identified, due to the embedded mitigation and management plans in place. The proposed design refinements will not result in any changes to these embedded mitigations or to the risk of a major accident or disaster occurring. Therefore, the findings of the Original EIAR remain valid.</p> <p><u>Extended Operation life</u></p> <p>The proposed operational life of the Project has been reduced from 30 years (assessed within the Original EIAR) to 25 years. The assessment based on an operational life of 30 years showed no significant adverse effects and therefore, the findings of the Original EIAR remain valid.</p>	<p>No</p> <p>The Screening Opinion concluded no further information is required in respect of Risk of Major Accidents and Disasters</p>

4 Additional Information

4.1 Overview

The screening assessment presented in Table 3-2 considers the potential effects of the proposed design refinements on each of the environmental topics assessed within the Original EIAR. As set out within the table and as confirmed within the Screening Opinion received, no additional information is required for any of environmental topics, as potential environmental impacts on each receptor will be reduced compared to the Original EIAR, no new impacts are identified as a result of the design refinements proposed and therefore the conclusions of the Original EIAR remain valid.

However, in response to comments and advice received within the Screening Opinion, further information is provided within this Variation Application Report, in respect of Seascape and Landscape receptors, as set out within the Original EIAR, and ornithology receptors, as set out within the Original RIAA, and these are described in detail within the following sections.

4.1.1 Seascape Landscape and Visual Receptors

As set out within the Screening Report, the Original EIAR concluded some significant adverse effects on landscape and coastal character, landscape designations and some viewpoint locations. In each case, effects were found to be localised and in no instances were these effects considered to be unacceptable. However, to understand the nature of the proposed design refinements and the potential implications for Seascape and Landscape receptors, a comparison of the proposed design refinements and the conclusions of the Original EIAR was provided in Section 5 of the submitted Screening Report.

Within the Screening Opinion received, NS advised that it had reviewed the detailed SLVIA comparison of ten of the 14 viewpoints used in the original SLVIA and that it agreed with the conclusions of the Screening Report: that the overall findings would not be notably different to those within the Original EIAR. NS further stated that the comparative assessment provided was extremely useful and recommended that this information be included as supporting information within the Variation Application Report. In accordance with this advice, the comparative assessment provided within the Screening Report is set out in summary within Section 4.2 of this report, with the full comparison that was provided within the Screening Report included at Appendix C.

4.1.2 Report to Inform Appropriate Assessment

The Original RIAA for the Project concluded no AEOSI on conservation objectives for designated sites or qualifying features, either alone or in combination with other plans and projects. However, the Appropriate Assessment (AA) undertaken for the Project raised concerns with regards to collision risk and displacement effects and potential AEOSI for kittiwake and puffin features of the NCC SPA. Concerns raised on AEOSI for both kittiwake and puffin relate to cumulative impacts arising in-combination with other offshore wind farm developments which have previously been consented. No AEOSI resulting from the Project alone were identified in the AA.

As set out within the Screening Report, and confirmed within the Screening Opinion, additional information is provided as an addendum to the Original RIAA, to consider the proposed design refinements and the potential implications of these for kittiwake and puffin features of the NCC SPA. Within the Screening Opinion, NS confirmed

that there were concerns raised about the potential in-combination impacts of the original proposed project on the puffin and kittiwake features of the NCC SPA and that NS welcomed the proposed addendum to the RIAA which will address the design refinements and the potential implications of these on identified ornithological features.

Therefore, an addendum to the Original RIAA, the RIAA Addendum, is submitted with this Variation Application Report which includes updated collision risk modelling (CRM), displacement assessments and population viability analysis (PVA) for kittiwake and puffin features of the NCC SPA and provides a comparison of the conclusions of the Original RIAA with the RIAA Addendum. As set out in Section 1.1 discussions have been ongoing with NS and MD-LOT to agree modelling approaches, including modelling criteria, modelling scenarios and projects to be considered within in-combination assessments. This is set out in detail within the RIAA Addendum and is summarised in Section 4.3 below.

4.2 SLVIA Comparison

4.2.1 Overview

This section describes the key sensitivities and potential environmental effects upon seascape, landscape and visual receptors arising from the proposed variations to the Project. The proposed refinements to the S36 Consent and marine licences, which present a reduction in the significance of environmental effects on SLVIA receptors in comparison to the Original EIAR are:

- Reducing the number of Wind Turbine Generators (WTGs) from seven to six; and
- Reducing the rotor swept area from 316,673 m² to 283,448 m², which comprises the installation of 1 x WTG with rotor diameter 220 m and 5 x WTGs with rotor diameter 250 m;

4.2.2 Revised Approach

In order to understand the effects of the proposed design refinements, Optimised Environments (OPEN) completed a comparison of the consented and refined project design. Comparative wirelines have also been developed to illustrate the differences in appearance between the consented and refined scheme in respect of ten of the 14 viewpoints used within the SLVIA assessment.

The full comparison is included in Appendix C, with the key findings summarised below.

4.2.3 Summary

The comparative wirelines show the apparent reduction in horizontal extents and number of WTGs, and importantly they also show the limited difference that the more incremental height reduction of the WTGs would have. Despite the improvements that the refined scheme demonstrates, it is unlikely that the assessment presented in the SLVIA included in the EIAR would change notably as they would not be sufficient to change significant effects into not significant effects, other than potentially in threshold areas where incremental improvements would tip the balance. The refined scheme does, however, present positive improvements in the appearance of the Project.

The most notable difference in respect of all the viewpoints is that the horizontal extent of the WTGs is visibly reduced between the project design presented in the Original EIAR and the proposed refined project design. This is because the WTGs are contained within a smaller site, and this contains their horizontal extents in the seascape.

The proposed reduction in the number of WTGs from seven to six is also readily apparent and contributes to the reduction in horizontal extents, as well as the reduction in the incidences of overlap in some of the viewpoints.

The proposed reduction in height of the WTGs is not so readily apparent, although this relates to the more incremental reduction between the WTGs used in the consented project design and the refined project design, whereby reductions in rotor diameter and hub height are 10 m and reductions in blade tip are 15 m for the five WTGs with rotor diameter of 250 m. While there is a greater reduction in height for the one WTG with rotor diameter up to 220 m, with a 45 m reduction in blade tip height, this difference is also not readily apparent owing to the different ranges of the WTGs masking potential variations in height.

The height variance with the one smaller WTG (rotor diameter 220 m) would also not be readily visible. This is because this WTG is only 30 m smaller which is proportionally a seventh of the height of the larger WTGs (rotor diameter 250 m) and is located along with WTG 2 in the row of the array closest to the shore thus, owing to perspective, making it appear the same or, from some viewpoints, even slightly larger than the larger WTGs with rotor diameter of 250 m. A similar effect occurs in respect of the consented project design whereby the closer turbines appear slightly larger. In both the consented and refined project designs, these differences appear incremental and overall, the turbines appear consistent in scale. This means that the height difference in the refined project design will not alter the findings of the assessment in the Original EIAR.

A comparison of the assessment of the consented project design and the refined project design is presented in Table 4.1 below. This highlights that, although there is a readily apparent improvement in the visual appearance of the refined project design compared to the consented project design, these differences would not be sufficient to change a significant effect into a not significant effect.

Table 4.1: Comparison between assessment of consented project parameters and refined project parameters

Viewpoint	Consented Parameters	Refined Parameters
1 Beinn Ratha	Sensitivity - medium-high Magnitude of change (MoC) – medium-high Significant at a major / moderate level	Reduction in horizontal extent readily apparent. Although there would be a slight reduction in MoC, overall assessment would remain unaltered owing to incremental nature of reductions and overall effect of introducing WTGs into undeveloped seascape. WTG1 (rotor diameter 220 m) appears slightly larger than the five larger WTGs (rotor diameter 250 m) owing to the location of WTG1 closest to shore and the limited difference in blade tip height of 30 m.
2 Strathy Point Car Park	Sensitivity - medium-high Magnitude of change – medium-high Significant at a major / moderate level	Reduction in horizontal extent readily apparent, especially with reference to Hoy in background. Although there would be a slight reduction in MoC, overall assessment would remain unaltered owing to incremental nature of reductions and overall effect of introducing WTGs into undeveloped seascape. WTG1 (rotor diameter 220 m) appears similar in size to the five larger WTGs (rotor diameter 250 m) owing to the location of WTG1 in the row of the array closest to shore and the limited difference in blade tip height of 30 m.
3 Portskerra /Melvich	Sensitivity - medium-high	Reduction in horizontal extent readily apparent and WTGs appear very evenly spaced.

	<p>Magnitude of change – medium-high</p> <p>Significant at a major / moderate level</p>	<p>Although there would be a slight reduction in MoC, overall assessment would remain unaltered owing to incremental nature of reductions and overall effect of introducing WTGs into undeveloped seascape.</p> <p>WTG1 (rotor diameter 220 m) appears similar in size to the five larger WTGs (rotor diameter 250 m) owing to the limited difference in height of 30 m and the location of WTG1 in the row of the array closest to shore.</p>
4 Drum Holliston Car Park	<p>Sensitivity - medium-high</p> <p>Magnitude of change – medium-high</p> <p>Significant at a major / moderate level</p>	<p>Reduction in horizontal extent readily apparent although grouping of WTGs with gap between arises.</p> <p>Although there would be a slight reduction in MoC, overall assessment would remain unaltered owing to incremental nature of reductions and overall effect of introducing WTGs into undeveloped seascape.</p> <p>WTG1 (rotor diameter 220 m) appears slightly larger than the five larger WTGs (rotor diameter 250 m) owing to the location of WTG1 closest to shore and the limited difference in blade tip height of 30 m.</p>
5 Sandside Headland	<p>Sensitivity - medium</p> <p>Magnitude of change – medium-high</p> <p>Significant at a moderate level</p>	<p>Reduction in horizontal extent readily apparent although overlap between central WTGs arises.</p> <p>Although there would be a slight reduction in MoC, overall assessment would remain unaltered owing to incremental nature of reductions and overall effect of introducing WTGs into undeveloped seascape.</p> <p>WTG1 (rotor diameter 220 m) appears slightly larger than the five larger WTGs (rotor diameter 250 m) owing to the limited difference in blade tip height of 30 m and the location of WTG1 closest to shore.</p>
6 St Mary's Chapel, Forss	<p>Sensitivity - medium-high</p> <p>Magnitude of change – medium-low</p> <p>Not significant at a moderate level</p>	<p>Reduction in horizontal extent readily apparent and WTGs appear very evenly spaced.</p> <p>Although there would be a slight reduction in MoC, overall assessment would remain unaltered owing to incremental nature of reductions and moderating effect of close range operational Forss WTGs.</p> <p>WTG1 (rotor diameter 220 m) appears similar in size to the five larger WTGs (rotor diameter 250 m) owing to the limited difference in blade tip height of 30 m and the location of WTG1 in the row of the array closest to shore.</p>
7 Dunnet Head	<p>Sensitivity - medium-high</p> <p>Magnitude of change – medium-low</p> <p>Significant at a moderate level</p>	<p>Reduction in horizontal extent apparent, albeit less so from more distant range and with grouping of WTGs remaining. Although there would be a slight reduction in MoC, overall assessment would remain unaltered owing to incremental nature of reductions and moderating effect of separation distance and other distant wind farm influences.</p> <p>Any differences in blade tip height between the WTGs will not be discernible from this viewpoint owing to the separation distance of 28 km.</p>
10 A836 East of Forss	<p>Sensitivity - medium-high or medium</p>	<p>Reduction in horizontal extent readily apparent and WTGs appear very evenly spaced.</p>

	<p>Magnitude of change – medium-low</p> <p>Not significant at a moderate level</p>	<p>Although there would be a slight reduction in MoC, overall assessment would remain unaltered owing to incremental nature of reductions and moderating effect of operational wind farms and other developments.</p> <p>WTG1 (rotor diameter 220 m) appears similar in size to the five larger WTGs (rotor diameter 250 m) owing to the limited difference in height of 30 m and the location of WTG1 in the row of the array closest to shore.</p>
13 A' Mhoine	<p>Sensitivity - high</p> <p>Magnitude of change – low</p> <p>Not significant at a moderate / minor level</p>	<p>Reduction in horizontal extent apparent, albeit less so from more distant range and with WTGs visible to only very limited extents.</p> <p>Although there would be a slight reduction in MoC, overall assessment would remain unaltered owing to incremental nature of reductions and moderating effect of separation distance and limited extents of visibility.</p> <p>Any differences in height between the WTGs would not be discernible from this viewpoint owing to the separation distance of 34 km and the screening effect of the intervening landform.</p>
14 Ben Dorrery	<p>Sensitivity - medium</p> <p>Magnitude of change – medium-low</p> <p>Not significant at a moderate / minor level</p>	<p>Reduction in horizontal extent readily apparent and spacing of WTGs improved.</p> <p>Although there would be a slight reduction in MoC, overall assessment would remain unaltered owing to incremental nature of reductions and moderating effect of separation distance and other distant wind farm influences.</p> <p>WTG1 (rotor diameter 220 m) appears similar in size to the five larger WTGs (rotor diameter 250 m) owing to the limited difference in blade tip height of 30 m and the location of WTG1 in the row of the array closest to shore.</p>

4.3 Ornithology Modelling Update

4.3.1 Introduction

This section provides a summary of the potential environmental effects on kittiwake and puffin features of the NCC SPA arising from proposed variations to the Project. The proposed variations to the S36 Consent and Project Marine Licences relevant to marine ornithology features are:

- Reducing the number of Wind Turbine Generators (WTGs) from seven to six;
- Reducing the WTG footprint area from 10 km² to 5.85 km²;
- Reducing the rotor swept area from 316,673 m² to 283,448 m²; and
- Extending the operational life of the Project from 10 to 25 years.

To understand the implications of these proposed design refinements on marine ornithology, HiDef have completed an assessment of the revised project design parameters. This is provided as an addendum to the Original RIAA and is supported by detailed ornithological modelling. The full results and analysis are provided in the following appendices, which comprise the RIAA Addendum (Appendix D), and a summary of the results is provided below:

- RIAA Addendum D.1 Ornithology Summary
- RIAA Addendum D.2 SeabORD Displacement Modelling
- RIAA Addendum D.3 Collision Risk Modelling
- RIAA Addendum D.4 Population Modelling

4.3.2 Ornithological Modelling Update

Kittiwake

For the Project-alone the level of annual mortalities are reduced and now represent only 3.24 adults, 0.15 immatures, 9.00 chicks, giving a counterfactual of population size (CPS) of 0.983 (counterfactual of growth rate (CGR) 0.999) at 25 years, this is:

- Greater than the CPS of 0.980 based on mean densities in the Original Application. It is also greater than the CPS of 0.936 which was acceptable in granting the project the 10-year consent.

For the Project in-combination with other wind farm projects (as assessed within the Original Application, scenario 4d), the impacts give a CPS of 0.909 (CGR 0.996) at 25 years, this is:

- Greater than the CPS of 0.904 (as calculated for a 15-year period of operation for the impacts as provided in the Original Application) (Appendix D.4).
- A significant increase on the Original Application CPS estimate of 0.840 (as the new impact prediction is 43% lower).

For the Project in-combination with other projects, including the (currently not consented) Berwick Bank project (scenario 5d), the impacts give a CPS of 0.898 (CGR of 0.958) at 25 years; this is:

- Greater than the CPS of 0.873 which can be calculated prior to changes in avoidance rate from cumulative North Sea wind farms alone and would have been the level considered in the Original Application.

The above CPS values should also be considered in light of the precaution that is included within the in-combination assessment, including:

- A number of projects included in the in-combination assessment are based on consented rather than as-built definitions (Dogger Bank A, B and C, East Anglia 3 and Hornsea 2), since they are not currently available. This will result in collision impacts for the non-breeding season being inflated by approximately 25% (based on the number of collisions that would be reduced through comparison on turbine numbers, although turbine size has increased).

- The impacts for the Hornsea 3 and Hornsea 4 projects will be compensated for as part of a derogations package so should be substantially reduced from those presented within the in-combination assessment.

The following supporting information should also be noted:

- JNCC analysis² of Seabird Monitoring Programme (SMP) data indicates that kittiwake productivity in Scotland has increased since the period of decline up to 2008 with the Scottish population increasing slightly in recent years from a low point in 2013.
- Moray Firth areas modelled in displacement assessment use parameters based on the consented and not the 'as built' or final Development Specification and Layout Plan (DSLPL) turbine envelopes. As the actual turbine envelopes are slightly smaller than the application boundaries, this will lead to a slight over-estimation of Moray Firth displacement impacts.
- Post construction monitoring of Beatrice wind farm found no evidence of distributional responses by kittiwake (Trinder 2023³), although some flight height response was detected. This evidence suggests that displacement impacts for this species are much smaller than modelling outputs.
- The number of collision mortalities for kittiwake at North Caithness Cliffs SPA from the Project alone, as described in the Variation Application, are 2.61 (deterministic CRM, table 8, Appendix D.3) which is just 7.1% of the total of collision mortalities apportioned to North Caithness Cliffs SPA for the cumulative impacts (tables 8 and C1.3 in Appendix D.3).

In conclusion, in relation to kittiwake, the refinement of the Project design for the Variation Application and the reassessment of cumulative impacts has reduced calculated impacts to a level that could support a conclusion of no Adverse Effects on Site Integrity (AEOSI) for the North Caithness Cliffs SPA. The number of predicted mortalities from the Variation Application project alone is minimal in comparison to the reduction in numbers achieved by remodelling cumulative impacts between the Original Application and the Variation Application, despite the inclusion of a number of conservative assumptions.

Puffin

For the Project-alone (scenario 1) the level annual mortalities are very low (1.00 adults, 0.60 chicks) giving a CPS of 0.988 (0.869-1.120) and CGR of 1.00 (0.995-1.004) at 25 years; this is:

- Considerably greater than the CPS of 0.925 which was acceptable in granting the project the 10-year consent.

² [Black-legged kittiwake \(Rissa tridactyla\) | JNCC - Adviser to Government on Nature Conservation](#). Accessed 5 October 2023.

³ Trinder, M. (2023). Beatrice Offshore Wind Farm: Year 2 Post construction ornithological monitoring report. Report from MacArthurGreen for BOWL.

For the Project in-combination with other projects (scenario 3) the impacts give a CPS of 0.961 (0.827-1.105) with a CGR of 0.998 (0.993-1.004) at 25 years; this is:

- Greater than the CPS of 0.925 which was acceptable in granting the Project the 10-year consent.

In considering the above CPS values, it is noted that the Moray Firth areas have been modelled using the original application boundaries rather than the 'as built' or final project Development Specification and Layout Plan (DSLPL) turbine envelopes. As the actual turbine envelopes are slightly smaller than the application boundaries, this will lead to a slight over-estimation of Moray Firth displacement impacts.

It is also noted that the report by Trinder (2023) on post construction displacement of birds at Beatrice Offshore Wind Farm suggests that displacement rates for puffin may be lower than modelled in the Variation Application submission.

In conclusion, in relation to puffin, the refinement of the Project design for the Variation Application and the reassessment of cumulative impacts has reduced the predicted impacts considerably. The CPS values for puffin for all modelled scenarios at 25 years are greater than the value used by NS to previously conclude no AEOSI for the North Caithness Cliffs SPA.

5 Conclusions and Recommendations

HWL is seeking to vary the existing S36 Consent and Project Marine Licences to:

- Reduce the number of WTGs from seven to six;
- Reduce the WTG footprint area, which comprises the area of sea surface occupied by the WTGs and associated floating substructure, excluding the mooring lines, from 10 km² to 5.85 km²;
- Reduce the rotor swept area, which comprises the installation of up to 1 x WTG with rotor diameter up to 220 m and 5 x WTGs with rotor diameter up to 250 m, from 316,673 m² to 283,448 m²;
- Reduce the number of floating substructures from seven to six;
- Reduce the number of mooring lines from 63 to 54;
- Reduce the number of anchors or piles from 63 to 54; and
- Extend the operational life of the Project from 10 to 25 years.

This Variation Application Report has been submitted in support of the application to vary the S36 Consent and Project Marine Licences under Section 36C of the Electricity Act 1989. It has provided an overview of the potential environmental effects of the Project design refinements by comparison with the consented project design, as presented within the Original EIAR.

Following review of the Original EIAR, the Screening Opinion received and further consideration of environmental effects arising from the proposed design refinements, this Variation Application Report demonstrates that no further significant impacts are identified to arise from the design changes proposed and the variation would result in a reduction of environmental effects for all receptors previously assessed within the Original EIAR. Therefore,

as confirmed by MD-LOT within the Screening Opinion received, the proposed variation remains within the design envelope assessed in the Original EIAR and an EIA is not required to support this variation application.

Furthermore, with consideration of the Original RIAA for the Project, the additional information provided within the RIAA Addendum with respect to marine ornithology demonstrates that the Project's effects would be further reduced for both kittiwake and puffin features of the NCC SPA as a result of the design refinements, when compared to the Original EIAR. Specifically, collision risk and displacement effects resulting from the Project would be minimal, resulting in lower mortalities predicted for these ornithological features.

6 References

HWL (2022). Pentland Floating Offshore Wind Farm, Offshore Environmental Impact Assessment Report

MD-LOT (2023) Marine Directorate Licensing Operations Team's Assessment of the Project's Implications for Designated Special Areas of Conservation and Special Protection Areas In View of the Site's Conservation Objectives

MS-LOT (2019). Energy consents: applications for variation of section 36 consents guidance. Available at <https://www.gov.scot/publications/applications-variation-section-36-consents/documents>

Scottish Ministers (2023) Decision Notice for the Section 36 Consent for the Construction and Operation of the Pentland Floating Offshore Wind Farm

Scottish Ministers (2023) Marine Licence MS-00009991

Scottish Ministers (2023) Marine Licence and MS-00009992

The Electricity Act 1989

The Electricity Generating Stations (Applications for Variation of Consent) (Scotland) Regulations 2013 ('the 2013 Regulations') December 2013

The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017 (as amended) ('the EIA Regulations')

The Marine and Coastal Access Act, 2009

The Marine Scotland Act 2010

The Marine Works (EIA) (Scotland) Regulations 2017 ('the Marine Works EIA Regulations'),

The Town and Country Planning (Scotland) Act 1997

<https://marine.gov.scot/ml/pentland-floating-offshore-wind-farm> (last accessed 21/07/23)

Appendix A – Draft Revised S36 Consent

- A.1 Annex 1 – Description of Development
- A.2 Annex 2 – Conditions

ANNEX 1 – DESCRIPTION OF THE DEVELOPMENT

The Application is for the construction and operation of an offshore energy generating station, with a generating capacity of around 100 megawatts (“MW”). The offshore generating station shall be comprised of up to:

1. ~~Seven~~ **Six** floating offshore wind turbine generators (“WTGs”) with:
 - a. A maximum hub height of 190 metres (“m”) above highest astronomical tide (“HAT”);
 - b. A maximum height to blade tip of 300m above HAT;
 - c. A maximum rotor diameter of ~~260m~~ 250m;
 - d. A minimum blade tip clearance from mean sea level of 35m;
2. ~~Seven~~ **Six** associated floating substructures;
3. Nine mooring lines for each floating substructure, ~~63~~ **54** in total;
4. Nine anchors or piles for each floating substructure, ~~63~~ **54** in total;
5. Seven inter-array cables (dynamic and static); and
6. Associated scour and cable protections.

All as described in the Application.

The total area within the Development site boundary is 10km² of which up to 5.85km² will comprise the Wind Turbine Generator (WTG) Footprint Area. The location and boundary of the Development site is shown in Figure 1 of Annex 1.

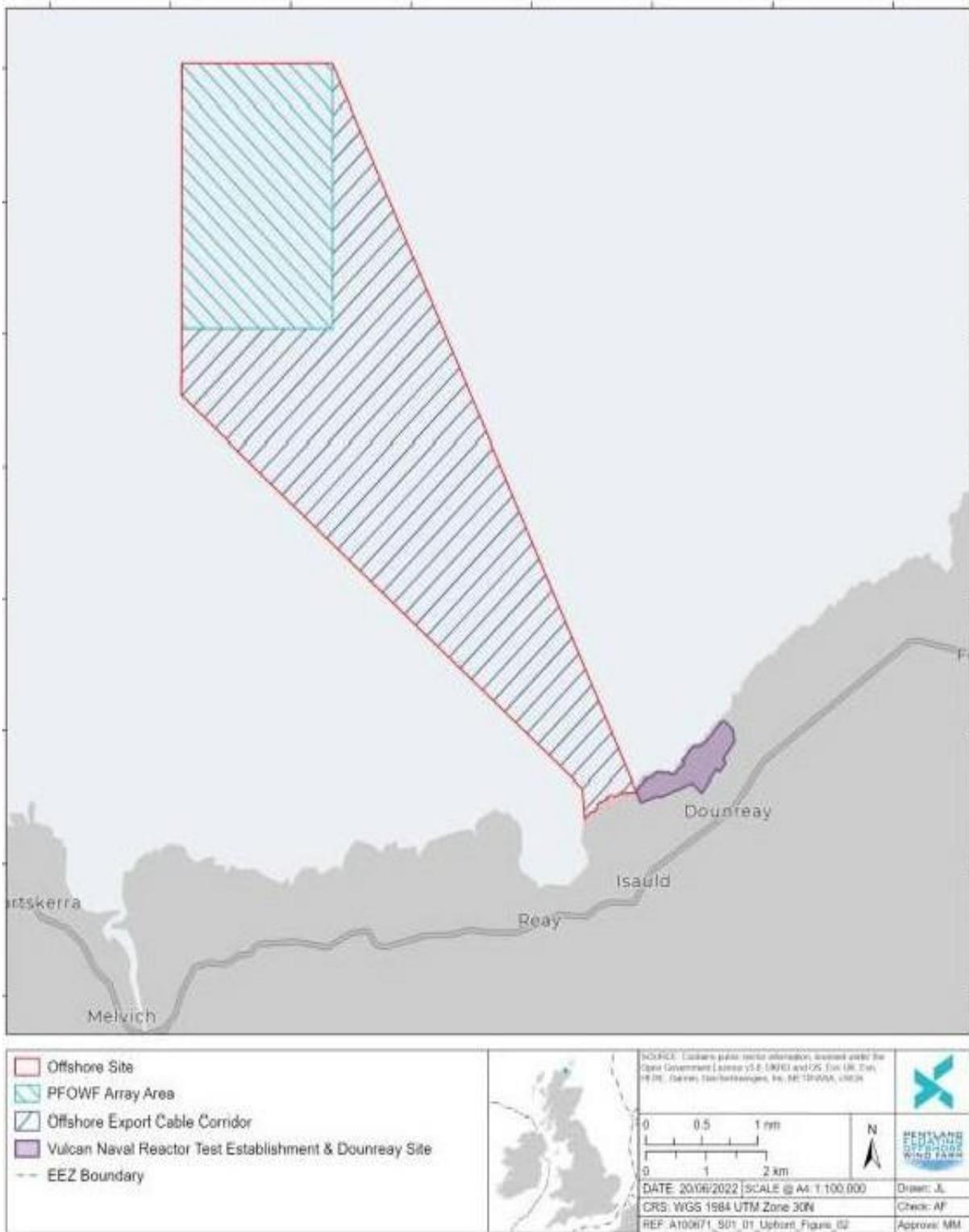


Figure 1: Works Location

ANNEX 2 – CONDITIONS

1. Duration of the Consent

The consent is valid from the date of this consent until ~~10~~ 25 years from the date of Final Commissioning of the Development. Written confirmation of the date of Final Commissioning of the Development must be provided by the Company to the Scottish Ministers and to The Highland Council no later than one calendar month after this date.

Reason: *To define the duration of the consent.*

2. Commencement of the Development

The Commencement of the Development must be no later than five years from the date of this consent, or in substitution such other later period as the Scottish Ministers may hereafter direct in writing. The Company must provide written confirmation of the intended date of Commencement of the Development to the Scottish Ministers and to The Highland Council no later than one calendar month before that date.

Reason: *To ensure that the Commencement of the Development is undertaken within a reasonable timescale after consent is granted.*

3. Decommissioning

There must be no Commencement of the Development until a Decommissioning Programme, submitted in accordance with a section 105 notice served by the appropriate Minister, has been approved under section 106 of the Energy Act 2004 by the appropriate Minister.

Reason: *To ensure the decommissioning and removal of the Development in an appropriate and environmentally acceptable manner, and in the interests of safety and environmental protection.*

4. Assignment

This consent must not be assigned without the prior written authorisation of the Scottish Ministers. The Scottish Ministers may authorise the assignment of the consent (with or without conditions) or refuse assignment as they may see fit. The consent cannot be assigned, alienated or transferred otherwise than in accordance with the assignment procedure as directed by the Scottish Ministers.

Reason: *To safeguard the obligations of the consent if transferred to another company.*

5. Redundant Wind Turbine Generators

If any Wind Turbine Generator (“WTG”) fails to generate electricity for a continuous period of 12 months then, unless otherwise agreed in writing by the Scottish Ministers, the Company must: (i) by no later than the date of expiration of the 12 month period, submit a scheme to the Scottish Ministers setting out the manner in which that WTG and associated infrastructure will be removed from the site and the sea bed restored; and (ii) implement the approved scheme within six months of the date of its approval, or such other date as agreed in writing by the Scottish Ministers, all to the satisfaction of the Scottish Ministers.

Reason: *To ensure that should a WTG become redundant it is removed from the site, in the interests of safety, amenity and environmental protection.*

6. Incident Reporting

In the event of any breach of health and safety or environmental obligations relating to the Development during the period of this consent and decommissioning, the Company must provide written notification of the nature and timing of the incident to the Scottish Ministers within 24 hours of the incident occurring. Confirmation of remedial measures taken and/or to be taken to rectify the breach must be provided, in writing, to the Scottish Ministers within a period of time to be agreed by the Scottish Ministers.

Reason: *To keep the Scottish Ministers informed of any such incidents which may be in the public interest.*

7. Implementation in accordance with approved plans and requirements of this consent

Except as otherwise required by the terms of this consent, the Development must be constructed and operated in accordance with this consent, the Application, the Environmental Impact Assessment Report (“the EIA Report”) submitted by the Company and any other documentation and information lodged in support of the Application.

Reason: *To ensure that the Development is carried out in accordance with the approved details.*

8. Submission and approval of plans

The Company must submit the requested plans as detailed in the conditions, in writing, to the Scottish Ministers for their written approval. Such approval may only be granted

following consultation by the Scottish Ministers with any such advisors or organisations as detailed in these conditions or as may be required at the discretion of the Scottish Ministers.

Any updates or amendments made to the approved plans must be submitted, in writing, to the Scottish Ministers for their written approval. The Development must, at all times, be constructed and operated in accordance with the approved plans.

Reason: To ensure that the Development is constructed and operated in accordance with the approved details.

9. Compliance with this consent

The Company must satisfy itself that all contractors or sub-contractors are aware of the extent of the Development for which this consent has been granted, the activity which is consented and the terms of the conditions attached to this consent. All contractors and sub-contractors permitted to engage in the Development must abide by the conditions set out in this consent.

Reason: To ensure that the Development is constructed and operated in accordance with the approved details.

10. Construction Programme

The Company must, no later than six months prior to the Commencement of the Development, submit a Construction Programme (“CoP”), in writing, to the Scottish Ministers for their written approval. Commencement of the Development cannot take place until such approval is granted. Such approval may only be granted following consultation by the Scottish Ministers with NatureScot, Civil Aviation Authority (“CAA”), Ministry of Defence (“MOD”), and any such other advisors or organisations as may be required at the discretion of the Scottish Ministers.

The CoP must set out:

- a. The proposed date for Commencement of the Development;
- b. The proposed timings for mobilisation of plant and delivery of materials, including details of onshore lay-down areas;
- c. The proposed timings and sequencing of construction work for all elements of the Development infrastructure;
- d. Contingency planning for poor weather or other unforeseen delays; and
- e. The scheduled date for **Completion and** Final Commissioning of the Development.

The Company must send the approved CoP to The Highland Council, Maritime and Coastguard Agency (“MCA”) and Northern Lighthouse Board (“NLB”) for information only.

Reason: To confirm the timing and programming of construction.

11. Construction Method Statement

The Company must, no later than six months prior to the Commencement of the Development submit a Construction Method Statement (“CMS”), in writing, to the Scottish Ministers for their written approval. Such approval may only be granted following consultation by the Scottish Ministers with NatureScot, MCA, NLB and any such other advisors or organisations as may be required at the discretion of the Scottish Ministers.

The CMS must include, but not be limited to:

- a. Details of the commencement dates, duration and phasing for the key elements of construction, the working areas, the construction procedures and good working practices for installing the Development.
- b. Details of the roles and responsibilities, chain of command and contact details of company personnel, any contractors or sub- contractors involved during the construction of the Development.
- c. Details of how the construction related mitigation steps proposed in the Application are to be delivered.

The CMS must adhere to the construction methods assessed in the Application. The CMS also must, so far as is reasonably practicable, be consistent with the Design Statement (“DS”), the Environmental Management Plan (“EMP”), the Vessel Management Plan (“VMP”), the Navigational Safety Plan (“NSP”), the Piling Strategy (“PS”), the Cable Plan (“CaP”) and the Lighting and Marking Plan (“LMP”).

The final CMS must be sent to the Highland Council for information only.

Reason: To ensure the appropriate construction management of the Development, taking into account mitigation measures to protect the environment and other users of the marine area.

12. Environmental Management Plan

The Company must, no later than six months prior to the Commencement of the Development, submit an EMP, in writing, to the Scottish Ministers for their written approval. Such approval may only be granted following consultation by the Scottish Ministers with NatureScot, Royal Society for the Protection of Birds Scotland (“RSPB Scotland”), and any such other advisors or organisations as may be required at the discretion of the Scottish Ministers.

The EMP must provide the over-arching framework for on-site environmental

management during the phases of development as follows:

- a. All construction as required to be undertaken before the Final Commissioning of the Development; and
- b. The operational lifespan of the Development from the Final Commissioning of the Development until the cessation of electricity generation (environmental management during decommissioning is addressed by the Decommissioning Programme provided for by condition 3).

The EMP must be in accordance with the Application insofar as it relates to environmental management measures. The EMP must set out the roles, responsibilities and chain of command for the Company personnel, any contractors or sub-contractors in respect of environmental management for the protection of environmental interests during the construction and operation of the Development. It must address, but not be limited to, the following over-arching requirements for environmental management during construction:

- a. Mitigation measures to prevent significant adverse impacts to environmental interests, as identified in the Application and pre-consent and pre-construction monitoring or data collection, and include reference to relevant parts of the CMS (refer to condition 11);
- b. A pollution prevention and control method statement, including contingency plans;
- c. Management measures to prevent the introduction of invasive non- native marine species;
- d. A site waste management plan (dealing with all aspects of waste produced during the construction period), including details of contingency planning in the event of accidental release of materials which could cause harm to the environment. Wherever possible the waste hierarchy of reduce, reuse and recycle should be encouraged; and
- e. The reporting mechanisms that will be used to provide the Scottish Ministers and relevant stakeholders with regular updates on construction activity, including any environmental issues that have been encountered and how these have been addressed.

The EMP must be regularly reviewed by the Company at intervals agreed by the Scottish Ministers. Reviews must include, but not be limited to, the reviews of updated information on construction methods and operations of the Development and updated working practices.

The EMP must be informed, so far as is reasonably practicable, by the baseline monitoring or data collection undertaken as part of the Application and the Project Environmental Monitoring Programme (“PEMP”).

Reason: To ensure that all construction and operation activities are carried out in a manner that minimises their impact on the environment, and that mitigation measures contained in the Application, or as otherwise agreed are fully implemented.

13. Vessel Management Plan

The Company must, no later than six months prior to the Commencement of the Development, submit a VMP, in writing, to the Scottish Ministers for their written approval. Commencement of the Development cannot take place until such approval is granted. Such approval may only be granted following consultation by the Scottish Ministers with NatureScot, MCA, Scottish Fishermen’s Federation (“SFF”) and any such other advisors or organisations as may be required at the discretion of the Scottish Ministers.

The VMP must include, but not be limited to, the following details:

- a. The number, types and specification of vessels required;
- b. How vessel management will be coordinated, particularly during construction, but also during operation;
- c. Location of working port(s), the routes of passage, the frequency with which vessels will be required to transit between port(s) and the site and indicative vessel transit corridors proposed to be used during construction and operation of the Development.

The confirmed individual vessel details must be notified to the Scottish Ministers in writing no later than 14 days prior to the Commencement of the Development, and thereafter, any changes to the details supplied must be notified to the Scottish Ministers, as soon as practicable, prior to any such change being implemented in the construction or operation of the Development.

The VMP should refer to the Scottish Marine Wildlife Watching Code and Guide to Best Practice for Watching Marine Wildlife for guidance on how vessels should behave around aggregations of birds on the water.

The VMP must, so far as is reasonably practicable, be consistent with the CMS and EMP, the Fisheries Management and Mitigation Strategy (“FMMS”), the PEMP, the NSP, and the LMP.

Reason: To mitigate the impact of vessels.

14. Operation and Maintenance Programme

The Company must, no later than three months prior to the Final Commissioning of the Development, submit an Operation and Maintenance Programme (“OMP”), in writing, to the Scottish Ministers for their written approval. Such approval may only be granted following consultation by the Scottish Ministers with NatureScot, MCA, NLB, The Highland Council and any such other advisors or organisations as may be required at the discretion of the Scottish Ministers.

The OMP must set out the procedures and good working practices for operations and the maintenance of the WTGs and substructure of the Development. Environmental

sensitivities which may affect the timing of the operation and maintenance activities must be considered in the OMP.

The OMP must, so far as is reasonably practicable, be consistent with the CMS, the EMP, the PEMP, the VMP, the NSP and the LMP.

The Company must send the approved OMP to The Highland Council for information only.

Reason: To safeguard environmental interests during operation and maintenance of the Development.

15. Navigational Safety Plan

The Company must, no later than six months prior to the Commencement of the Development, submit an NSP, in writing, to the Scottish Ministers for their written approval. Commencement of the Development cannot take place until such approval is granted. Such approval may only be granted following consultation by the Scottish Ministers with MCA, NLB, Royal Yachting Association (“RYA”), SFF and any other navigational advisors or organisations as may be required at the discretion of the Scottish Ministers.

The NSP must include, but not be limited to, the following issues:

- a. Navigational safety measures;
- b. Construction exclusion zones;
- c. Notice(s) to mariners and radio navigation warnings;
- d. Anchoring areas;
- e. Temporary construction lighting and marking;
- f. Buoyage.

Reason: To mitigate the navigational risk to other legitimate users of the sea.

16. Lighting and Marking Plan

The Company must, no later than six months prior to the Commencement of the Development, submit an LMP, in writing, to the Scottish Ministers for their written approval. Commencement of the Development cannot take place until such approval is granted. Such approval may only be granted following consultation by the Scottish Ministers with NatureScot, MCA, NLB, CAA, MOD, RYA, the Highland Council, and any such other advisors or organisations as may be required at the discretion of the Scottish Ministers.

The LMP must provide that the Development be lit and marked in accordance with the current CAA and MOD aviation lighting policy and guidance that is in place as at the

date of the Scottish Ministers approval of the LMP, or any such other documents that may supersede this guidance prior to the approval of the LMP. Consideration should be given in the LMP to reducing the luminous intensity of aviation lighting in certain visibility conditions but only where this is in accordance with the current CAA and MOD aviation lighting policy and guidance that is in place. The LMP must define how the Development will be lit throughout its life to maintain civil and military aviation safety requirements as determined necessary for aviation safety by the MOD and, accordingly, must set out:

- a) details of any construction equipment and temporal structures with a total height of 50m or greater (above mean sea level) that will be deployed during the construction of the Development and details of any aviation warning lighting that they will be fitted with; and
- b) the locations and heights of the WTGs featured in the Development identifying those that will be fitted with aviation warning lighting identifying the position of the lights on the WTGs, the type(s) of lights that will be fitted and the performance specification(s) of the lighting type(s) to be used.

The LMP must also detail the navigational lighting requirements detailed in the International Association of Marine Aids to Navigation and Lighthouse Authorities (“IALA”) Guideline G-1162 or any other documents that may supersede this guidance prior to approval of the LMP.

Reason: To ensure civil and military aviation and navigational safety and the safe marking and lighting of the Development.

17. Project Environmental Monitoring Programme

The Company must, no later than six months prior to the Commencement of the Development, submit a PEMP, in writing, to the Scottish Ministers for their written approval. Commencement of the Development cannot take place until such approval is granted. Such approval may only be granted following consultation by the Scottish Ministers with NatureScot, RSPB Scotland and any other environmental advisors or organisations as required at the discretion of the Scottish Ministers. The PEMP must be in accordance with the Application as it relates to environmental monitoring.

The PEMP must set out measures by which the Company must monitor the environmental impacts of the Development. Monitoring is required throughout the lifespan of the Development where this is deemed necessary by the Scottish Ministers. Lifespan in this context includes pre-construction, construction, operational and decommissioning phases.

The Scottish Ministers must approve all initial methodologies for the above monitoring, in writing and, where appropriate, in consultation with NatureScot and any other

environmental advisors or organisations as required at the discretion of the Scottish Ministers.

Monitoring must be done in such a way so as to ensure that the data which is collected allows useful and valid comparisons between different phases of the Development. Monitoring may also serve the purpose of verifying key predictions in the Application. In the event that further potential adverse environmental effects are identified, for which no predictions were made in the Application, the Scottish Ministers may require the Company to undertake additional monitoring.

The PEMP must cover the following matters:

- a) monitoring or data collection for impact on seabirds
- b) monitoring for impacts on marine mammals
- c) monitoring for impacts on benthic ecology
- d) Post-construction monitoring on Electromagnetic Fields (“EMF”) produced by the constructed cables.
- e) The Company’s contribution to data collection or monitoring of wider strategic relevance, including in relation to diadromous fish, as identified and agreed by the Scottish Ministers.

In relation to EMF, the Company must monitor and provide a report on the EMF produced by the works to the Scottish Ministers. The Company must agree the methodologies and timescales for monitoring with the Scottish Ministers prior to the Commencement of the Development as part of wider strategic monitoring on EMF. Any agreement must be adhered to unless otherwise agreed and approved by the Scottish Ministers.

The requirement for monitoring pre-construction, during construction and post-construction in relation to the above receptors must be agreed by the Scottish Ministers.

Due consideration must be given to the Scottish Marine Energy Research (“ScotMER”) programme, or any successor programme formed to facilitate these research interests.

Any pre-consent monitoring or data collection carried out by the Company to address any of the above issues may be used in part to discharge this condition subject to the written approval of the Scottish Ministers.

The PEMP is a live document which will be regularly reviewed by the Scottish Ministers, at timescales to be determined by them to identify the appropriateness of on-going monitoring. Following such reviews, the Scottish Ministers may require the Company to amend the PEMP and submit such an amended PEMP, in writing, to the Scottish Ministers, for their written approval. Such approval may only be granted following consultation with NatureScot and any other environmental, or such other advisors as may be required at the discretion of the Scottish Ministers.

The Company must submit written reports and associated raw and processed data of such monitoring or data collection to the Scottish Ministers at timescales to be

determined by them. Consideration should be given to data storage, analysis and reporting and be to Marine Environmental Data and Information Network standards.

Subject to any legal restrictions regarding the treatment of the information, the Scottish Ministers, or any such other party appointed at the Scottish Ministers' discretion, may make the results publicly available.

The Scottish Ministers may agree, in writing, that monitoring may be reduced or ceased before the end of the lifespan of the Development.

Reason: To ensure that appropriate and effective monitoring of the impacts of the Development is undertaken.

18. Cable Plan

The Company must, no later than six months prior to the Commencement of the Development, submit an updated CaP, in writing, to the Scottish Ministers for their written approval. Commencement of the Development cannot take place until such approval is granted. Such approval may only be granted following consultation by the Scottish Ministers with NatureScot, MCA, SFF, and any such other advisors or organisations as may be required at the discretion of the Scottish Ministers. The CaP must be in accordance with the Application.

The CaP must include, but not be limited to, the following:

- a) The location, duration and cable laying techniques for cables;
- b) The results of monitoring or data collection work (including geophysical, geotechnical and benthic surveys) which will help inform cable routing;
- c) Technical specification of the cables, including a desk based assessment of attenuation of electro-magnetic field strengths and shielding;
- d) A Cable Burial Risk Assessment ("CBRA") to ascertain burial depths and where necessary alternative protection measures;
- e) Methodologies for post construction and operational surveys (e.g. over trawl) of the cables where mechanical protection of cables laid on the sea bed is deployed; and
- f) Methodologies for cable inspection with measures to address and report to the Scottish Ministers any exposure of cables.

Any consented cable protection works must ensure existing and future safe navigation is not compromised. The Licensing Authority will accept a maximum of 5% reduction in surrounding depth referenced to Chart Datum. Any greater reduction in depth must be agreed in writing by the Licensing Authority.

19. Fisheries Management and Mitigation Strategy

The Company must no later than six months prior to the Commencement of the Development, submit an FMMS, in writing, to the Scottish Ministers for their written approval, in consultation with SFF. Commencement of the Development cannot take place until such approval is granted.

In order to inform the production of the FMMS, the Company must monitor or collect data as relevant and agreed with the Scottish Ministers.

As part of any finalised FMMS, the Company must produce and implement a mitigation strategy for each commercial fishery that can prove to the Scottish Ministers that they would be adversely affected by the Development. The Company and any contractors or sub-contractors working for the Company must implement the mitigation measures committed to be carried out by the Company within the FMMS.

Reason: *To mitigate the impact on commercial fisheries.*

20. Protocol for Archaeological Discoveries

The Company must, no later than six months prior to the Commencement of the Development, submit an updated Protocol for Archaeological Discoveries (“PAD”) and Written Scheme of Investigation (“WSI”) which sets out what the Company must do on discovering any marine archaeology during the construction, operation, maintenance, and monitoring of the Development, in writing, to the Scottish Ministers for their written approval. Commencement of the Development cannot take place until such approval is granted. Such approval may be given only following consultation by the Scottish Ministers with Historic Environment Scotland (“HES”) and any such advisors as may be required at the discretion of the Scottish Ministers. The Reporting Protocol must be implemented in full, at all times, by the Company.

The Company must send the approved PAD and WSI to the Highland Council for information only.

Reason: *To ensure any discovery of archaeological interest is properly and correctly reported.*

21. Particle Management Plan

Not later than six months prior to the commencement of the works, a Particles Management Plan (“PMP”) shall be submitted to the Scottish Ministers for their written

approval in consultation with the Scottish Environment Protection Agency (“SEPA”);

The PMP shall be consistent with the Application and supporting documents and shall include, but not be limited to, the following:

- a. A programme of scheduled monitoring for radioactive particles;
- b. The measures to be taken to reduce the likelihood of irradiated fuel particles in sediment being suspended or disturbed; and
- c. A waste management plan for the construction phase of the development.

There shall be no Commencement of the Development unless and until the PMP is approved in writing by the Scottish Ministers, in consultation with SEPA;

Any proposed amendment to the approved PMP shall be submitted, in writing, to the Scottish Ministers for its written approval, in consultation with SEPA. The proposed amendment shall be submitted to the Scottish Ministers no later than 6 months prior to the anticipated implementation of the proposed amendment (or such shorter period as may be agreed with the Scottish Ministers in writing). No amendment to the PMP shall take effect unless and until approved in writing by the Scottish Ministers in consultation with SEPA;

The PMP and any amended PMP shall thereafter be implemented in full.

22. ~~Television and Radio~~ Radio and Television Reception Mitigation Plan

The Company must, no later than six months prior to the Commencement of the Development, submit a Radio and Television Reception Mitigation Plan to the Scottish Ministers for approval, in consultation with the Highland Council. The Radio and Television Reception Mitigation Plan shall provide for a baseline radio and television reception survey to be carried out prior to the installation of any turbine forming part of the Development. The results of the baseline radio and television reception survey shall be submitted to the Highland Council prior to the installation of any turbine forming part of the Development.

The approved Radio and Television Reception Mitigation Plan shall be implemented in full.

Any claim by any person regarding radio or television interference at their house, business premises or other building, made during the period from installation of any turbine forming part of the Development to the date falling twelve months after the Date of Final Commissioning shall be investigated by a qualified engineer and the results of the investigation shall be considered against the approved plan and submitted to the Highland Council.

Should any impairment to the radio or television signal be attributable to the Development, the impairment shall be remedied so that the standard of reception at the affected property is equivalent to the baseline radio or television reception.

Reason: To mitigate any potential impacts on radio and television reception.

23. Noise Measurement and Mitigation Scheme

1. The rating level of noise immissions from the combined effects of the wind turbines forming part of the Development (including the application of any tonal penalty) when determined in accordance with the Highland Council guidance notes for this condition shall not exceed a value of 34 dB LA90,10 minute at any dwelling which is lawfully existing or has planning permission at the date of this consent.
2. The Company shall continuously log power production, wind speed and wind direction. These data shall be retained for a period of not less than 24 months. The Company shall provide this information to the Scottish Ministers within 14 days of receipt in writing of a request to do so.
3. Prior to the Date of First Commissioning, the Company shall have submitted to, and received written approval of the Scottish Ministers, in consultation with the Highland Council, to an updated predictive noise assessment based on the final turbine model(s) to be installed, based on noise emission data from the turbine manufacturer.
4. Within 21 days from receipt of a written request from the Scottish Ministers following a complaint sent to them from the Highland Council, informing of an occupant of a dwelling alleging noise disturbance at that dwelling, the Company shall, at its expense, employ a consultant to assess the level of noise immissions from the wind farm at the complainant's property. The written request from the Scottish Ministers shall set out at least the date, time and location to which the complaint relates and any identified atmospheric conditions, including wind direction, and include a statement as to whether, in the opinion of the Scottish Ministers, in consultation with the Highland Council, the noise giving rise to the complaint contains or is likely to contain a tonal component.
5. The assessment of the rating level of noise immissions in terms of paragraph (4) above shall be undertaken in accordance with an assessment protocol that shall previously have been submitted to and approved in writing by the

Scottish Ministers, in consultation with the Highland Council. The protocol shall include at least the proposed measurement location(s) where measurements for compliance checking purposes shall be undertaken, whether noise giving rise to the complaint contains or is likely to contain a tonal component, and also the range of meteorological and operational conditions (which shall include the range of wind speeds, wind directions, power generation and times of day) to determine the assessment of rating level of noise immissions. The proposed range of conditions shall be those which prevailed during times when the complainant alleges there was disturbance due to noise, having regard to the written request of the Scottish Ministers under paragraph (4) above.

6. The Company shall provide to the Scottish Ministers the independent consultant's assessment of the rating level of noise immissions within two months of the date of the written request of the Scottish Ministers for compliance measurements to be made under paragraph (4) unless the time limit is extended in writing by the Scottish Ministers. Certificates of calibration of the instrumentation used to undertake the measurements shall be submitted to the Scottish Ministers with the independent consultant's assessment of the rating level of noise immissions.
7. Where a further assessment of the rating level of noise immissions from the wind farm is required, the Company shall submit a copy of the further assessment within 21 days of submission of the independent consultant's assessment pursuant to paragraph (4) above unless the time limit has been extended in writing by the Scottish Ministers.

Reason: *In the interests of safeguarding residential amenity, to protect nearby residents from undue noise and disturbance, to enable prompt investigation of complaints and to ensure that noise levels can be measured to assess whether or not agreed noise limits have been breached and where such noise limits have been breached, suitable mitigation is undertaken.*

24. Development Specification and Layout Plan

The Company must, no later than six months prior to the Commencement of the Development, submit a Development Specification and Layout Plan ("DSLPP"), in writing, to the Scottish Ministers for their written approval. Such approval may only be granted following consultation by the Scottish Ministers with the MCA, NLB, NatureScot, MOD, CAA, SFF, the UK Hydrographic Office ("UKHO"), the Highland Council, and any such other advisors or organisations as may be required at the discretion of the Scottish Ministers.

The DSLPP must include, but not be limited to the following:

- a. A plan showing the location of each individual WTG (subject to any required micro-siting), including information on WTG spacing, WTG identification/numbering, seabed conditions, bathymetry, confirmed foundation type for each WTG and any key constraints recorded on the site;
- b. A list of latitude and longitude co-ordinates accurate to three decimal places of minutes of arc for each WTG. This should also be provided as a Geographic Information System (“GIS”) shape file using WGS84 format;
- c. The grid coordinates of the centre point of the proposed location for each WTG;
- d. A table or diagram of each WTG dimensions including - height to blade tip (measured above Lowest Astronomical Tide (“LAT”)) to the highest point, height to hub (measured above LAT to the centreline of the generator shaft), rotor diameter and maximum rotation speed;
- e. The generating output of each WTG used on the site (Figure 1) and a confirmed generating output for the site overall;
- f. The finishes for each WTG (see condition 16 on WTG lighting and marking); and
- g. The length and proposed arrangements on the seabed of all inter-array cables.

Reason: To confirm the final Development specification and layout.

25. Design Statement

The Company must, no later than six months prior to the Commencement of the Development, submit a DS, in writing, to the Scottish Ministers. The DS, which must be signed off by at least one qualified landscape architect, as instructed by the Company prior to submission to the Scottish Ministers, must include representative wind farm visualisations from key viewpoints as agreed with the Scottish Ministers, based upon the final DSLP as approved by the Scottish Ministers as updated or amended. The Company must provide the DS, for information only, to the Highland Council, NatureScot, MCA and any such other advisors or organisations as may be required at the discretion of the Scottish Ministers.

Reason: To ensure that the Development is carried out in accordance with the approved details, and to inform interested parties of the final wind farm scheme proposed to be built.

26. Piling Strategy

If piling is to be undertaken, the Company must, no later than six months prior to the Commencement of the Development, submit a PS, in writing, to the Scottish Ministers

for their written approval. Such approval may only be granted following consultation by the Scottish Ministers with NatureScot, and any such other advisors as may be required at the discretion of the Scottish Ministers. Commencement of the Development cannot take place until such approval is granted.

The PS must include, but not be limited to:

- a) Details of expected noise levels from pile-drilling/driving in order to inform point d) below;
- b) Full details of the proposed method and anticipated duration of piling to be carried out at all locations;
- c) Details of soft-start piling procedures and anticipated maximum piling energy required at each pile location; and
- d) Details of any mitigation such as Passive Acoustic Monitoring (“PAM”), Marine Mammal Observers (“MMO”), use of Acoustic Deterrent Devices (“ADD”) and monitoring to be employed during pile-driving, as agreed by the Scottish Ministers.

The PS must be in accordance with the Application and must also reflect any relevant monitoring or data collection carried out after submission of the Application. The PS must demonstrate the means by which the exposure to and/or the effects of underwater noise have been mitigated in respect to cetaceans, harbour seal, grey seal and Atlantic salmon. The PS must, so far as is reasonably practicable, be consistent with the EMP, the PEMP, and the CMS.

Reason: To mitigate the underwater noise impacts arising from piling activity.

27. Environmental Clerk of Works

Prior to the Commencement of the Development, the Company must at its own expense, and with the approval of the Scottish Ministers in consultation with NatureScot, appoint an independent Environmental Clerk of Works (“ECoW”). The ECoW must be appointed in time to review and approve the draft version of the first plan or programme submitted under this consent to the Scottish Ministers, in sufficient time for any pre-construction monitoring requirements, and remain in post until a date agreed by the Scottish Ministers. The terms of appointment must also be approved by the Scottish Ministers in consultation with NatureScot.

The terms of the appointment must include, but not be limited to:

- a. Quality assurance of final draft versions of all plans and programmes required under this marine licence;
- b. Responsible for the monitoring and reporting of compliance with the marine licence conditions and the environmental mitigation measures for all wind farm infrastructure;
- c. Provision of on-going advice and guidance to the Company in relation to achieving compliance with conditions, including but not limited to the

conditions relating to and the implementation of the CMS, the EMP, the PEMP, the CaP and the VMP;

d. Provision of reports on point b & c above to the Scottish Ministers at timescales to be determined by the Scottish Ministers;

e. Induction and toolbox talks to onsite construction teams on environmental policy and procedures, including temporary stops and keeping a record of these;

f. Monitoring that the Development is being constructed in accordance with the plans and this consent, the Application and in compliance with all relevant regulations and legislation;

g. Reviewing and reporting incidents/near misses and reporting any changes in procedures as a result to the Scottish Ministers; and

h. Agreement of a communication strategy with the Scottish Ministers.

28. Fisheries Liaison Officer

Prior to the Commencement of the Development, a Fisheries Liaison Officer (“FLO”), must be appointed by the Company and approved, in writing, by the Scottish Ministers, following consultation with SFF. The FLO must be appointed by the Company for the period from Commencement of the Development until the Final Commissioning of the development. The identity and credentials of the FLO must be included in the EMP (referred to in condition 12). The FLO must establish and maintain effective communications between the Company, any contractors or sub-contractors, fishermen and other users of the sea during the construction of the Development and ensure compliance with best practice guidelines whilst doing so.

The responsibilities of the FLO must include:

a. Establishing and maintaining effective communications between the Company, any contractors or sub-contractors, fishermen and other users of the sea concerning the overall Development and any amendments to the EMP and site environmental procedures;

b. The provision of information relating to the safe operation of fishing activity on the site of the Development; and

c. Ensuring that information is made available and circulated in a timely manner to minimise interference with fishing operations and other users of the sea.

DEFINITIONS AND GLOSSARY OF TERMS

“the Application” means the Application letter, marine licence applications and EIA Report including appendices submitted to the Scottish Ministers by Highland Wind Limited on 11 August 2022;

“AA” means Appropriate Assessment;

“Commencement of the Development” means the date on which the first construction activity occurs in accordance with the EIA Report submitted by the Company on 11 August;

“HWL” or “the Company” means Highland Wind Limited, 4th Floor 115 George Street, Edinburgh, Midlothian, Scotland, EH2 4JN, Company Number: SC675148;

“the Development” means the Highland Wind Floating Offshore Wind Farm, approximately 7.5 kilometres (“km”) off the coast of Dounreay, Caithness as described in Annex 1;

“the Wind Turbine Generator (WTG) Footprint Area” means the area of sea surface occupied by the infrastructure at or above sea level (i.e. the WTGs and associated floating substructures).

“ADD” means Acoustic Deterrent Devices; “BWM”

means Ballast Water Management;

“CaSPlan” means The Caithness and Sutherland Local Development Plan 2018;

“CLO” means Community Liaison Officer;

“CREW” means Centre of Expertise for Waters;

“ECoW” means Environmental Clerk of Works;

“EIA” means Environmental Impact Assessment;

“EIA Report” means Environmental Impact Assessment Report;

“EMF” means Electromagnetic Field;

“FIR” means Fisheries Industry Representative;

“FLO” means Fisheries Liaison Officer;

“FTE” means Full Time Equivalent; “GVA”

means Gross Added Value;

“HRA” means Habitats Regulations Appraisal;

“HAT” means Highest Astronomical Tide;

“HPAI” means Highly Pathogenic Avian Influenza; “km”

means kilometres;

“km²” means squared kilometres;

“LSE” means Likely Significant Effect; “m” means metres;

“MGN 654” means Marine Guidance Note 654;

“MMO” means Marine Mammals Observers;

“mINNS” means Marine Invasive Non-Native Species;

“MPA” means Marine Protected Area;

“MW” means megawatt;

“NSA” means National Scenic Areas;

“NRTE” means Naval Reactor Test Establishment;

“PAC” means Pre-Application Consultation;

“PAM” means Passive Acoustic Monitoring;

“PI” means Public Inquiry;

“PTS” means Permanent Threshold Shift;

“PVA” means Population Viability Assessment;

“s.36” means Section 36 of the Electricity Act 1989;

“s.36A” means Section 36A of the Electricity Act 1989;

“SAC” means Special Area of Conservation;

“SAR” means Search and Rescue;

“ScotMER” means Scottish Marine Energy Research;

“SLA” means Special Landscape Areas;

“SLVIA” means Seascape, Landscape and Visual Impact Assessment;

“SPA” means Special Protected Area;

“SSSI” means Site of Special Scientific Interest;

“UXO” means Unexploded Ordnance;

“WLA” means Wild Land Areas;

“WTG” means Wind Turbine Generator.

Organisations and Companies

“BT” means British Telecommunications;

“CAA” means Civil Aviation Authority;

“DAERA” means Department of Agriculture, Environment and Rural

Affairs; “DSFB” means District Salmon Fishery Board;

“HIAL” means Highlands and Islands Airports Limited;

“HES” means Historic Environment Scotland;

“EU” means European Union;

“MAU” means Marine Analytical Unit;

“MCA” means Maritime and Coastguard

Agency; “MOD” means Ministry of Defence;

“MD-LOT” means Marine Directorate – Licensing Operations Team (previously known as “MS-LOT”, Marine Scotland – Licensing Operations Team);

“MSS” means Marine Scotland Science;

“NDA” means Nuclear Decommissioning Authority;

“NLB” means Northern Lighthouse Board;

“RSPB” means Royal Society for the Protection of Birds;

“RYA” means Royal Yachting Association;

“SEPA” means Scottish Environmental Protection Agency;

“SFF” means Scottish Fishermen’s Federation;

“UKCoS” means United Kingdom Chamber of Shipping;

Plans, Programmes and Statements

“CaP” means Cable Plan;

“CBRA” means Cable Burial Risk Assessment;

“CMS” means Construction Method Statement;

“CoP” means Construction Programme;

“DS” means Design Statement;

“DSLPL” means Development Specification and Layout Plan;

“EMP” means Environmental Management Plan;

“FMMS” means Fisheries Management and Mitigation Strategy;

“LMP” means Lighting and Marking Plan;

“NMP” means National Marine Plan;

“NPF3” means Scotland’s National Planning Framework 3;

“NPF4” means Scotland’s National Planning Framework 4;

“NSP” means Navigational Safety Plan;

“OMP” means Operation and Maintenance Programme;

“PAD” means Protocol for Archaeological Discoveries;

“PEMP” means Project Environmental Management Plan;

“PMP” means Particles Management Plan;

“PS” means Piling Strategy;

“VMP” means Vessel Management Plan;

“WSI” means Written Scheme of Investigation.

Legislation

“the Electricity Act” means the Electricity Act 1989;

“the Habitats Regulations” means the Conservation (Natural Habitats, & c.) Regulations 1994 and the Conservation of Habitats and Species Regulations 2017;

“the 2017 EW Regulations” means the Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017;

“the 2017 MW Regulations” means the Marine Works (Environmental Impact Assessment) (Scotland) Regulations 2017.

Appendix B – Draft Revised Marine Licences

- B.1 WTG Marine Licence (MS-00009991)
- B.2 Transmission Marine Licence (MS-0009992)

To note, the Marine Licences have been amended in line with the proposed project design refinements. As discussed, and agreed with MD-LOT, amendments are also made where some minor inconsistencies have been identified.

MARINE (SCOTLAND) ACT 2010, PART 4 MARINE LICENSING

LICENCE TO CONSTRUCT, ALTER OR IMPROVE WORKS IN THE SCOTTISH MARINE AREA

Licence Number: **MS-00009991**

The Scottish Ministers (hereinafter referred to as "the Licensing Authority") hereby grant a marine licence authorising:

**Highland Wind Limited
4th Floor,
115 George Street,
Edinburgh
EH2 4JN**

to construct, alter or improve works as described in Part 2. The licence is subject to the conditions set out, or referred to, in Part 3.

The licence is valid from **28 June, 2023** until **31 May, 2035** or until the Works have been decommissioned in accordance with an approved Decommissioning Programme prior to this date and for which a separate marine licence is required.

Signed:

Toni-Marie McGinn

For and on behalf of the Licensing Authority

Date of issue: 28 June, 2023

1. PART 1 - GENERAL

1.1 Interpretation

In the licence, terms are as defined in Section 1, 64 and 157 of the Marine Scotland Act 2010, and

“**ADD**” means Acoustic Deterrent Devices;

“**CAA**” means Civil Aviation Authority;

“**CoP**” means Construction Programme;

“**CaP**” means Cable Plan;

“**CMS**” means Construction Method Statement;

“**Commencement of the Licensed Activity**” means the date on which the first vehicle or vessel arrives on the site to begin carrying on any activities in connection with the Licensed Activity;

“**Completion of the Licensed Activity**” means the date on which the Licensed Activity has been installed in full, or the Licensed Activity has been deemed complete by the Licensing Authority, whichever occurs first;

“**DS**” means Design Statement;

“**DSL**” means Development Specification and Layout Plan;

“**DP**” means Decommissioning Programme;

“**ECoW**” means Environmental Clerk of Works;

“**EIAR**” means Environmental Impact Assessment Report;

“**EMF**” means Electromagnetic Field;

“**EMP**” means Environmental Management Plan;

“**Final Commissioning of the Works**” means the date on which the last wind turbine generator constructed forming the Works has supplied electricity on a commercial basis to the National Grid, or such earlier date as the Licensing Authority deems the Works to be complete;

“**FLO**” means Fisheries Liaison Officer;

“**FMMS**” means Fisheries Management and Mitigation Strategy;

“**GIS**” means Geographic Information System;

“**HAT**” means Highest Astronomical Tide;

“**HES**” means Historic Environment Scotland;

“**IALA**” means International Association of Marine Aids to Navigation and Lighthouse Authorities;

“**LAT**” means Lowest Astronomical Tide;

“**Licensed Activity**” means any activity or activities listed in section 21 of the 2010 Act which is, or are authorised under the licence;

“**Licensee**” means Highland Wind Limited (Company Number: SC675148) having its registered office at 4th Floor 115 George Street, Edinburgh, Midlothian, Scotland, EH2 4JN;

“**LMP**” means Lighting and Marking Plan;

“**MCA**” means Maritime and Coastguard Agency;

“**Mean High Water Springs**” means any area submerged at mean high water spring tide;

“**MGN**” means Marine Guidance Note;

“**MMO**” means Marine Mammal Observers;

“**MOD**” means Ministry of Defence;

“**NLB**” means Northern Lighthouse Board;

“**Noise Registry**” means the marine noise registry developed by the Department for Environment, Food and Rural Affairs and the Joint Nature Conservation Committee to record human activities in UK seas that produce loud low to medium frequency (10 Hz-10 kHz) impulsive noise;

“**NSP**” means Navigational Safety Plan;

“**OMP**” means Operational and Maintenance Programme;

“**PAD**” means Protocol for Archaeological Discoveries;

“**PAM**” means Passive Acoustic Monitoring;

“**PEMP**” means Project Environmental Management Programme;

“**PMP**” means Particles Management Plan;

“**PS**” means Piling Strategy;

“**RSPB Scotland**” means Royal Society for the Protection of Birds Scotland;

“**RYA**” means Royal Yachting Association;

“**ScotMER**” means Scottish Marine Energy Research;

“**SEPA**” means Scottish Environment Protection Agency;

“**SFF**” means Scottish Fishermen’s Federation;

"the 2010 Act" means the Marine (Scotland) Act 2010;

"the Works" Construction and operation of offshore generating system consisting of up to 7 floating Wind Turbine Generators;

"the **Original Application**" means the Application letter, marine licence applications and EIA Report including appendices submitted to the Scottish Ministers by Highland Wind Limited on 11 August 2022;

"the **Variation Application**" means the application made by Highland Wind Limited to vary the Project's Offshore Consents, submitted to Scottish Ministers on 11 October 2023;

"TPC" or "TPV" means Third Party Certification or Verification;

"UKHO" means UK Hydrographic Office;

"VMP" means Vessel Management Plan;

"WSI" means Written Scheme of Investigation;

"WTG" means Wind Turbine Generator;

"Wind Turbine Generator (WTG) Footprint Area" means the area of sea surface occupied by the infrastructure at or above sea level (i.e. the WTGs and associated floating substructure).

All geographical co-ordinates contained within the licence are in WGS84 format (latitude and longitude degrees and minutes to three decimal places) unless otherwise stated.

1.2 Contacts

All correspondence or communications relating to the licence should be addressed to:

The Marine Directorate Licensing
Operations Team Marine
Laboratory
375 Victoria Road
Aberdeen
AB11 9DB
Email: MS.MarineRenewables@gov.scot

1.3 Other authorisations and consents

The Licensee is deemed to have satisfied itself that there are no barriers or restrictions, legal or otherwise, to the carrying on of the Licensed Activities in connection with the licensed activity. The issuing of the licence does not absolve the Licensee from obtaining such other authorisations and consents, which may be required under statute.

1.4 Variation, suspension, revocation and transfer

Under section 30 (1) of the 2010 Act the Licensing Authority may by notice vary, suspend or revoke the licence granted by them if it appears to the Licensing Authority that there has been a breach of any of its provisions. For any such other reason that appears to be relevant to the Licensing Authority under section 30(2) or (3) of the 2010 Act. Under the 2010 Act variations, suspensions, revocations and transfers of licences are subject to the procedures set out in section 31 of the Act.

Under section 30 (7) of the 2010 Act, on an application made by a licensee, the Licensing Authority may vary a licence if satisfied that the variation being applied for is not material.

Under section 30 (8) of the 2010 Act, on an application made by the licensee, the Licensing Authority may transfer the licence from the Licensee to another person.

1.5 Breach of requirement for, or conditions of, licence

Under section 39 of the 2010 Act it is an offence to carry on a Licensable Marine Activity without a marine licence and it is also an offence to fail to comply with any condition of a marine licence.

1.6 Defences: actions taken in an emergency

Under section 40 of the 2010 Act it is a defence for a person charged with an offence under section 39(1) of the 2010 Act in relation to any activity to prove that –
the activity was carried out for the purpose of saving life, or for the purpose of securing the safety of a vessel, aircraft or marine structure ('force majeure'), and
that the person took steps within a reasonable time to inform the Licensing Authority as set out in section 40(2) of the 2010 Act.

1.7 Offences relating to information

Under section 42 of the 2010 Act it is an offence for a person to make a statement which is false or misleading in a material way, knowing the statement to be false or misleading or being reckless as to whether the statement is false or misleading, or to intentionally fail to disclose any material information for the purpose of procuring the issue, variation or transfer of a marine licence or for the purpose of complying with, or purporting to comply with, any obligation imposed by either Part 4 of the 2010 Act or the provisions of this licence.

1.8 Appeals

Under Regulation 3(1) of the Marine Licensing Appeals (Scotland) Regulations 2011, a person who has applied for a marine licence may by summary application appeal ~~to~~ against a decision taken by the Licensing Authority under section 71(1)(b) or (c) or (5) of the Act.

2. PART 2 – PARTICULARS

2.1 Agent

Highland Wind Limited
4th Floor,
115 George Street,
Edinburgh
EH2 4JN

2.2 Location of the Licensed Activity

Pentland Floating Offshore Wind Farm (Offshore Array Area),

58° 40.445' N 03° 51.014' W
58° 40.427' N 03° 53.600' W
58° 38.290' N 03° 50.962' W
58° 38.272' N 03° 53.545' W

As shown in Annex One.

2.3 Description of the Works

The Application is for the construction and operation of an offshore energy generating station, with a generating capacity of around 100 megawatts ("MW"). The offshore generating station shall be comprised of up to:

1. ~~Seven-Six~~ floating offshore wind turbine generators ("WTGs") with:
 - a. A maximum hub height of 190 metres ("m") above highest astronomical tide ("HAT");
 - b. A maximum height to blade tip of 300m above HAT;
 - c. A maximum rotor diameter of ~~260m~~250m;
 - d. A minimum blade tip clearance from mean sea level of 35m;
2. ~~Seven-Six~~ associated floating substructures;
3. Nine mooring lines for each floating substructure, ~~63-54~~ in total;
4. Nine anchors or piles for each floating substructure, ~~63-54~~ in total;
5. Seven inter-array cables (dynamic and static); and
6. Associated scour and cable protections.

All as described in the Application.

The total area within the Development site boundary is 10km² of which up to 5.85km² will comprise the Wind Turbine Generator (WTG) Footprint Area. The location and boundary of the Development site is shown in Annex One.

As described in the original application dated 11 August, 2022, the variation application dated 06 October 2023, and correspondence submitted in support of ~~the-those~~ applications.

2.4 Descriptions of the materials to be used during the Licensed Activity

Marine Laboratory, 375 Victoria Road,
Aberdeen AB11 9DB
www.scotland.gov.uk/marinescotland



The licence authorises the use of the undernoted construction materials required in connection with the licensed activity, subject to the indicative amounts as specified below:

Steel/Iron - 167,466 Tonnes

Plastic/Synthetic - Trace amounts of synthetics embedded in scour protection solutions

Concrete - 259,305 m³

Sand - 117,880 m³

Stone/Rock/Gravel - 117,880 m³

Concrete Bags/Mattresses - 117,880 m³

Cable - 20,000 m

Composite Plastic - ~~315,490~~ Tonnes

Synthetic Rope – 47,250 m

2.5 Contractor and Vessel Details

To be confirmed.

3. PART 3 – CONDITIONS

3.1 General Conditions

3.1.1 The Licensee must only construct the Works in accordance with this licence, the Application and any plans or programmes approved by the Licensing Authority unless otherwise authorised by the Licensing Authority.

3.1.2 The Licensee must maintain the Works in accordance with this licence, the Application and any plans or programmes approved by the Licensing Authority unless otherwise authorised by the Licensing Authority.

3.1.3 All conditions attached to the licence bind any person who for the time being owns, occupies or enjoys any use of the Works, whether or not the licence has been transferred to that person.

3.1.4 Only the materials listed in Part 2 of the licence may be used during the execution of the Licensed Activity.

3.1.5 All materials, substances and objects used during the execution of the Licensed Activity must be inert and must not contain toxic elements which may be harmful to the marine environment, the living resources which it supports or human health.

3.1.6 The Licensee must ensure that the Licensed Activity does not encroach on any recognised anchorage, either charted or noted in nautical publications, within the licensed area as described in Part 2 of the Licence.

3.1.7 Where any damage, destruction or decay is caused to the Works, the Licensee must notify the Licensing Authority, Maritime and Coastguard Agency (“MCA”), Northern Lighthouse Board (“NLB”), Kingfisher Information Services of Seafish and the UK Hydrographic Officer, in writing, of such damage, destruction or decay as soon as reasonably practicable but no later than 24 hours after becoming aware of any such damage, destruction or decay. The Licensee must carry out any remedial action as required by the Licensing Authority, following consultation with the MCA, NLB or any such advisors as required by the Licensing Authority.

The Licensee must remove the materials, from below the level of Mean High Water Springs, or make such alterations as advised by the Licensing Authority, at timescales to be determined by the Licensing Authority at any time it is considered necessary or advisable for the safety of navigation, and not replace those materials without further approval by the Licensing Authority. The Licensee shall be liable for any expense incurred.

3.1.8 If governmental assistance is required (including UK governmental assistance or the assistance of any UK devolved government) to deal with any emergency arising from:

- a) the failure to mark and light the Works as required by the licence;
- b) the maintenance of the Works; or
- c) the drifting or wreck of the Works, to include the broadcast of navigational warnings

then the Licensee is liable for any expenses incurred in securing such assistance.

3.1.9 The Licensee must take all measures which are technically and economically feasible to minimise leakage of fluorinated greenhouse gases. Where leakage of fluorinated greenhouse gases is detected, the Licensee must ensure that the equipment is repaired without undue delay.

The Licensee must ensure that all equipment to be utilised in the Licensed Activity that contains fluorinated greenhouse gases in quantities of five tonnes or more of CO₂ equivalent and not contained in foams is checked for leakage in accordance with Article 4 of the F-Gas Regulation. Records of these checks must be kept in accordance with Article 6 of the F-Gas Regulation. These records must be submitted to the Licensing Authority annually and immediately in the event of discovery of leakage.

Where the equipment is subject to checks for leakage under Article 4(1) of the F-Gas Regulation and leakage in the equipment has been repaired, the Licensee must ensure that the equipment is checked by a suitably certified person within one calendar month after the repair to verify that the repair has been effective. In such event, the Licensing Authority must be informed of the date of discovery, date of repair and date of inspection.

3.1.10 The Licensee must seek prior written approval from the Licensing Authority for any chemicals in an open system which are to be utilised in the construction, operation and maintenance of the Licensed Activity. Requests for approval must be submitted in writing to the Licensing Authority no later than one month prior to its intended use or such other period as agreed by the Licensing Authority. The Licensee must ensure that no chemicals are used in an open system without the prior written approval of the Licensing Authority.

If the proposed chemical is on the Offshore Chemical Notification Scheme list, the approval request must include the chemical name, volume or quantity to be used, the Offshore Chemical Notification Scheme list grouping or rank and the proposed frequency of use.

If the proposed chemical is not on the Offshore Chemical Notification Scheme list, the approval request must include details of chemicals to be used, including safety data sheet, depth and current at the site of the Works, quantities or volumes and the proposed frequency of use.

The Licensee must notify the Licensing Authority of the types of chemicals to be used in a closed containment system prior to use.

The Licensee must take all practicable steps to avoid leakages from a closed containment system into the Scottish marine area. Any such leakages must be reported to the Licensing Authority as soon as practicable.

3.1.11 The Licensee must submit all reports and notifications to the Licensing Authority, in writing, as are required under this licence within the time periods specified in this licence. Where there may be a delay in the submission of the reports or notifications to the Licensing Authority, the Licensee must advise the Licensing Authority of this fact as soon as is practicable and no later than the time by which those reports or notifications ought to have been submitted to the Licensing Authority under the terms of this licence.

The reports must include executive summaries, assessments and conclusions and any data will, subject to any rules permitting non-disclosure, be made publicly available by the Licensing Authority or by any such party appointed at its discretion.

Reports prepared pursuant to another consent or licence relating to the Works by the Licensee or by a third party may also be used to satisfy the requirements of this licence.

Such reports will include, but not be limited to Marine Mammal Observer ("MMO") records and all appropriate reports stipulated within the Project Environment Monitoring Plan ("PEMP").

3.1.12 The Licensee must operate and maintain the Works in accordance with the approved Operation and

Maintenance Programme ("OMP") (see condition 3.2.16). The Licensing Authority must be notified at least three calendar months, or such other period as agreed by the Licensing Authority in advance, of any maintenance of the Licensed Activity not included in the OMP and involving licensable marine activities not covered under this licence.

3.1.13 In the event of the Licensed Activity being discontinued the materials used under the authority of this licence must be removed to the satisfaction of the Licensing Authority.

3.1.14 The Licensee must ensure that the Works are maintained at all times in good repair.

3.1.15 The Licensee must ensure that the Licensed Activity is only carried out at the location of the Licensed Activity specified in Part 2 of this licence. The WTGs must be constructed only at the locations specified in Part 2 of this licence.

3.1.16 There must be no Commencement of the Licensed Activity until a Decommissioning Programme ("DP"), as defined in any section 105 notice served by the appropriate Minister, has been approved under section 106 of the Energy Act 2004 by the Licensing Authority.

3.1.17 The Licensee must submit plans and the details and specifications of all studies and surveys that are required to be undertaken under this licence in relation to the Licensed Activity, in writing, to the Licensing Authority for its written approval. Commencement of the studies or surveys and implementation of plans must not occur until the Licensing Authority has given its written approval to the Licensee.

Plans or the specification of studies and surveys prepared pursuant to another consent or licence relating to the Licensed Activity by the Licensee or by a third party may also be used to satisfy the requirements of this licence.

Any updates or amendments made to the approved plans must be submitted, in writing, to the Licensing Authority for its prior written approval. The Works must, at all times, be constructed and operated in accordance with the approved plans.

3.1.18 The Licensee must ensure that any debris or waste materials arising during the course of the Licensed Activity are removed for disposal at an approved location above the tidal level of Mean High Water Springs.

3.1.19 The Licensee must ensure that copies of this licence are available for inspection by any authorised marine enforcement officer at:

- a) the premises of the Licensee;
- b) the premises of any agent acting on behalf of the Licensee; and
- c) the site of the Licensed Activity.

3.1.20 Any person authorised by the Licensing Authority must be permitted to inspect the Works at any reasonable time. The Licensee must, on being given reasonable notice by the Licensing Authority (of at least 72 hours), provide transportation to and from the site for any persons authorised by the Licensing Authority to inspect the site of the Works. The Licensee shall be liable for any expense incurred.

3.1.21 The Licensee must inform the local Fishery Office(s) in writing at least ~~five~~14 days prior to the Commencement of the Licensed Activity, or any part thereof, and within five days of Completion of the Licensed Activity.

The Kingfisher Information Service of Seafish, must be informed of details of the vessel routes, timings and locations

relating to the construction of the authorised project or any part thereof by email to kingfisher@seafish.co.uk:

- a) at least 14 days prior to the commencement of offshore activities, for inclusion in the Kingfisher Fortnightly Bulletin and offshore hazard awareness data, and;
- b) as soon as reasonably practicable and no later than 24 hours of completion of all offshore activities.

Confirmation of notification must be provided to the Licensing Authority within five days.

The Licensee must ensure that a local notification to mariners is issued at least 14 days prior to the Commencement of the Licensed Activity, or any part thereof, advising of the start date and the expected vessel routes from the construction ports to the relevant location. Copies of all notices must be provided to the Licensing Authority, MCA and UKHO within five days.

The Licensee must ensure that local notifications to mariners are updated and reissued at weekly intervals during construction activities and at least five days before any planned operations (or otherwise agreed) and maintenance works and supplemented with VHF radio broadcasts agreed with the MCA in accordance with the construction and monitoring programme approved under deemed marine licence condition 3.2.12.

Copies of all notices must be provided to the Licensing Authority and UKHO within five days.

The Licensee must notify the UKHO of the completion (within 14 days) of the Licensed Activity, or any part thereof, in order that all necessary amendments are made to nautical charts.

Copies of all notices must be provided to the Licensing Authority and MCA within five days.

In case of damage to, or destruction or decay of, the ~~the~~ Licensed Activity seaward of Mean High Water Springs, or any part thereof, excluding the exposure of cables, the Licensee shall as soon as reasonably practicable and no later than 24 hours following the undertaker becoming aware of any such damage, destruction or decay, notify the Licensing Authority, MCA, NLB, the Kingfisher Information Service of Seafish and the UKHO.

In case of exposure of cables on or above the seabed, the Licensee must within three days following identification of a potential cable exposure, notify mariners and inform Kingfisher Information Service of the location and extent of exposure. Copies of all notices must be provided to the Licensing Authority, MCA, NLB, and the UKHO within five days.

3.1.22 The Licensed Activity shall be undertaken in accordance with the Schedule of Mitigation contained within Chapter 22 of the Environmental Impact Assessment Report unless otherwise agreed in advance in writing with the Licensing Authority.

3.2 Prior to the commencement of the Licensed Activity

3.2.1 The Licensee must, prior to and no less than one calendar month before the Commencement of the Licensed Activity, notify the Licensing Authority, in writing, of the proposed date of the Commencement of the Licensed Activity authorised under this licence.

3.2.2 The Licensee must ensure that at least five days prior to its engagement in the Licensed Activity, the name and function of any vessel (including the master's name, vessel type, vessel international maritime organisation number and vessel owner or operating company), agent, contractor or subcontractor appointed to engage in the

Licensed Activity are fully detailed in contractor and vessel reports ("the Reports") which the Licensee must make available on its website: <https://pentlandfloatingwind.com/> . Any changes to the supplied details must be uploaded to the Reports and the Licensing Authority and relevant statutory harbour authority must be notified, in writing, prior to any vessel, agent, contractor or sub-contractor which has not yet been notified to the Licensing Authority engaging in the Licensed Activity. Only those vessels, agents, contractors or sub-contractors detailed in the Reports are permitted to carry out any part of the Licensed Activity. Any vessels involved in drilling and deposit of drilling arisings must be notified to the Licensing Authority. The Licensee must satisfy itself that any masters of vessels or vehicle operators, agents, contractors or sub-contractors are aware of the extent of the Licensed Activity and the conditions of this licence.

All masters of vessels or vehicle operators, agents, contractors and sub-contractors permitted to engage in the Licensed Activity must abide by the conditions of this licence.

The Licensee must give a copy of this licence, and any subsequent variations made to this licence in accordance with section 30 of the 2010 Act, to the masters of any vessels, vehicle operators, agents, contractors or sub-contractors permitted to engage in the Licensed Activity and must ensure that the licence and any such variations are read and understood by those persons.

3.2.3 The Licensee must complete and send a Marine Emergency Action Card for the Licensed Activity to oelo@mcga.gov.uk at least 10 working days prior to Commencement of the Licensed Activity.

3.2.4 The Licensee must contact the relevant statutory harbour authority, prior to Commencement of the Licensed Activity to discuss the requirements for navigational warnings and a works licence.

The Licensee must ensure that a communications procedure is established and agreed with the relevant statutory harbour authority prior to the Commencement of the Licensed Activity.

3.2.5 The Licensee must ensure that all personnel adhere to the Scottish Marine Wildlife Watching Code where appropriate during the Licensed Activity.

3.2.6 There must be no Commencement of the Licensed Activity until the Licensee has satisfied the Licensing Authority, by consultation with the MCA, that it has taken into account and adequately addressed all of the recommendations of the MCA in the current Marine Guidance Note ("MGN") 654, and its annexes, or any other relevant document which may supersede this guidance.

3.2.7 Prior to the Commencement of the Licensed Activity, the Licensee must appoint a Marine Mammal Observer ("MMO"). When appointed, the MMO must, as a minimum, maintain a record of any sightings of marine mammals and maintain a record of the action taken to avoid any disturbance being caused to marine mammals during noisy activities.

The Licensee must ensure that all personnel adhere to the Scottish Marine Wildlife Watching Code where appropriate during all alteration and improvement activities authorised under this licence.

3.2.8 The Licensee must, no later than ~~one calendar month~~ **10 days** prior to Commencement of the Licensed Activity, notify the UKHO of the proposed works to facilitate the promulgation of maritime safety information and updating of admiralty charts and publications through the national Notice to Mariners system.

The Licensee must, ~~no later than one calendar month~~ **at least 14 days** prior to Commencement of the Licensed Activity, ensure that

local mariner's organisations and local fishermen's organisations and HM Coastguard are made fully aware of the Works through local Notice to Mariners or by any other appropriate means.

The Licensee must ensure that details of the Licensed Activities are promulgated in the Kingfisher Fortnightly Bulletin, ~~no later than one calendar month~~ at least 14 days prior to the Commencement of the Licensed Activity to inform the commercial fishing industry of the vessel routes and the timing and location of the construction activities.

The Licensee must, no later than eight weeks prior to the Commencement of the Licensed Activity, complete an "Application for Statutory Sanction to Alter/Exhibit" form and submit this to the NLB for the necessary sanction to be granted for the deployment of the Construction Buoyage.

3.2.9 The Licensee must, no later than 10 days prior to Commencement of the Licensed Activity, notify the UK Hydrographic Office ("UKHO") at sdr@ukho.gov.uk, of the proposed Licensed Activity. The notification must include the start and end date of the Licensed Activity, a description of the Works, positions of the area of the Works (WGS84), and details of any marking arrangements. A copy of the notification must be sent to the Licensing Authority within five working days of the notification being sent.

The Licensee must ensure that local mariners and fishermen's organisations are made fully aware of the Works through a local notification. This must be issued at least ~~five~~ 14 days before the Commencement of the Licensed Activity. The Licensing Authority must be sent a copy of this notification within ~~24 hours~~ five working days of issue.

The Licensee must, no later than ~~seven~~ 10 days prior to the Commencement of the Licensed Activity, notify Zone4@hmcg.gov.uk and renewables@hmcg.gov.uk of the proposed Licensed Activity. A copy of the notification must be sent to the Licensing Authority within five working days of the notification being sent.

The Licensee must ensure that details of the Licensed Activity are promulgated in the Kingfisher Fortnightly Bulletin, no later than seven days prior to the Commencement of the Licensed Activity to inform the Sea Fish Industry of the vessel routes, the timings and the location of the Licensed Activity and of the relevant operations.

3.2.10 The Licensee must notify the Ministry of Defence ("MOD"), at least 14 days prior to the Commencement of the Licensed Activity, in writing of the following information:

- a) the date of the commencement of the erection of WTG;
- b) the maximum height of any construction equipment to be used in the erection of the wind turbines;
- c) the date any WTG are brought into use;
- d) the latitude and longitude and maximum heights of each WTG, and any anemometer mast(s).

3.2.11 The Licensee must, no later than three calendar months prior to the Commencement of the Licensed Activity, provide the Licensing Authority with Third Party Certification or Verification ("TPC" or "TPV") (or a suitable alternative as agreed in writing with the Licensing Authority) that covers the entirety of the Works for the lifespan of the Works.

In this condition, the term "lifespan" means the entire period that this licence remains in force.

The TPC or TPV must follow the guidance provided in the Offshore wind, wave and tidal energy applications: consenting and licensing manual <https://www.gov.scot/publications/marine-licensing-applications-and-guidance/> or any other relevant document which may supersede this. There must be no Commencement of the Licensed Activity unless the TPC or TPV is provided as described above unless otherwise agreed with the Licensing Authority.

3.2.12 The Licensee must, no later than six months prior to the Commencement of the Licensed Activity, submit a Construction Programme (“CoP”), in writing, to the Licensing Authority for its written approval. Commencement of the Licensed Activity cannot take place until such approval is granted. Such approval may only be granted following consultation by the Licensing Authority with NatureScot, Civil Aviation Authority (“CAA”), MOD, and any such other advisors or organisations as may be required at the discretion of the Licensing Authority.

The CoP must set out:

- a. The proposed date for Commencement of the Licensed Activity;
- b. The proposed timings for mobilisation of plant and delivery of materials, including details of onshore lay-down areas;
- c. The proposed timings and sequencing of construction work for all elements of the Works infrastructure;
- d. Contingency planning for poor weather or other unforeseen delays; and
- e. The scheduled date for Completion of the Licensed Activity and for Final Commissioning of the Works.

The Licensee must send the approved CoP to The Highland Council, MCA and NLB for information only.

3.2.13 The Licensee must, no later than six months prior to the Commencement of the Licensed Activity submit a Construction Method Statement (“CMS”), in writing, to the Licensing Authority for their written approval. Such approval may only be granted following consultation by the Licensing Authority with NatureScot, MCA, NLB and any such other advisors or organisations as may be required at the discretion of the Licensing Authority.

The CMS must include, but not be limited to:

- a. Details of the commencement dates, duration and phasing for the key elements of construction, the working areas, the construction procedures and good working practices for installing the Works;
- b. Details of the roles and responsibilities, chain of command and contact details of company personnel, any contractors or sub-contractors involved during the construction of the Works; and
- c. Details of how the construction related mitigation steps proposed in the Application are to be delivered.

The CMS must adhere to the construction methods assessed in the Application. The CMS also must, so far as is reasonably practicable, be consistent with the Design Statement (“DS”), the Environmental Management Plan (“EMP”), the Vessel Management Plan (“VMP”), the Navigational Safety Plan (“NSP”), the Piling Strategy (“PS”), the Cable Plan (“CaP”) and the Lighting and Marking Plan (“LMP”).

The final CMS must be sent to the Highland Council for information only.

3.2.14 The Licensee must, no later than six months prior to the Commencement of the Licensed Activity, submit an Environmental Management Plan (“EMP”), in writing, to the Licensing Authority for its written approval. Such approval may only be granted following consultation by the Licensing Authority with NatureScot, Royal Society for the Protection of Birds Scotland (“RSPB Scotland”), and any such other advisors or organisations as may be required at the discretion of the Licensing Authority.

The EMP must provide the over-arching framework for on-site environmental management during the phases of the Works as follows:

- a. All construction as required to be undertaken before the Final Commissioning of the Works; and

b. The operational lifespan of the Works from the Final Commissioning of the Works until the cessation of electricity generation (environmental management during decommissioning is addressed by the DP provided for by condition 3.1.16).

The EMP must be in accordance with the Application insofar as it relates to environmental management measures. The EMP must set out the roles, responsibilities and chain of command for the company personnel, any contractors or sub-contractors in respect of environmental management for the protection of environmental interests during the construction and operation of the Works. It must address, but not be limited to, the following over-arching requirements for environmental management during construction:

- a. Mitigation measures to prevent significant adverse impacts to environmental interests, as identified in the Application and pre-consent and pre-construction monitoring or data collection, and include reference to relevant parts of the CMS (refer to condition 3.2.13);
- b. A pollution prevention and control method statement, including contingency plans;
- c. Management measures to prevent the introduction of invasive non-native marine species;
- d. A site waste management plan (dealing with all aspects of waste produced during the construction period), including details of contingency planning in the event of accidental release of materials which could cause harm to the environment. Wherever possible the waste hierarchy of reduce, reuse and recycle should be encouraged; and
- e. The reporting mechanisms that will be used to provide the Licensing Authority and relevant stakeholders with regular updates on construction activity, including any environmental issues that have been encountered and how these have been addressed.

The EMP must be regularly reviewed by the Licensee at intervals agreed by the Licensing Authority. Reviews must include, but not be limited to, the reviews of updated information on construction methods and operations of the Works and updated working practices.

The EMP must be informed, so far as is reasonably practicable, by the baseline monitoring or data collection undertaken as part of the Application and the PEMP.

3.2.15 The Licensee must, no later than six months prior to the Commencement of the Licensed Activity, submit a VMP, in writing, to the Licensing Authority for their written approval. Commencement of the Licensed Activity cannot take place until such approval is granted. Such approval may only be granted following consultation by the Licensing Authority with NatureScot, MCA, Scottish Fishermen's Federation ("SFF") and any such other advisors or organisations as may be required at the discretion of the Licensing Authority.

The VMP must include, but not be limited to, the following details:

- a. The number, types and specification of vessels required;
- b. How vessel management will be coordinated, particularly during construction, but also during operation;
- c. Location of working port(s), the routes of passage, the frequency with which vessels will be required to transit between port(s) and the site and indicative vessel transit corridors proposed to be used during construction and operation of the Works.

The confirmed individual vessel details must be notified to the Licensing Authority in writing no later than 14 days prior to the Commencement of the Licensed Activity, and thereafter, any changes to the details supplied must be notified to the Licensing Authority, as soon as practicable, prior to any such change being implemented in the construction or operation of the Works.

The VMP must refer to the Scottish Marine Wildlife Watching Code and Guide to Best Practice for Watching Marine Wildlife for guidance on how vessels should behave around aggregations of birds on the water.

The VMP must, so far as is reasonably practicable, be consistent with the CMS and EMP, the Fisheries Management and Mitigation Strategy ("FMMS"), the PEMP, the NSP, and the LMP.

3.2.16 The Licensee must, no later than three months prior to the Final Commissioning of the Works, submit an OMP, in writing, to the Licensing Authority for their written approval. Such approval may only be granted following consultation by the Licensing Authority with NatureScot, MCA, NLB, The Highland Council and any such other advisors or organisations as may be required at the discretion of the Licensing Authority.

The OMP must set out the procedures and good working practices for operations and the maintenance of the WTGs and substructure of the Works. Environmental sensitivities which may affect the timing of the operation and maintenance activities must be considered in the OMP.

The OMP must, so far as is reasonably practicable, be consistent with the CMS, the EMP, the PEMP, the VMP, the NSP and the LMP.

The Licensee must send the approved OMP to The Highland Council for information only.

3.2.17 The Licensee must, no later than six months prior to the Commencement of the Licensed Activity, submit a NSP, in writing, to the Licensing Authority for their written approval. Commencement of the Licensed Activity cannot take place until such approval is granted. Such approval may only be granted following consultation by the Licensing Authority with MCA, NLB, Royal Yachting Association ("RYA"), SFF and any other navigational advisors or organisations as may be required at the discretion of the Licensing Authority.

The NSP must include, but not be limited to, the following issues:

- a. Navigational safety measures;
- b. Construction exclusion zones;
- c. Notice(s) to mariners and radio navigation warnings;
- d. Anchoring areas;
- e. Temporary construction lighting and marking;
- f. Buoyage.

3.2.18 The Licensee must, no later than six months prior to the Commencement of the Licensed Activity, submit an LMP, in writing, to the Licensing Authority for their written approval. Commencement of the Licensed Activity cannot take place until such approval is granted. Such approval may only be granted following consultation by the Licensing Authority with NatureScot, MCA, NLB, CAA, MOD, RYA, the Highland Council, and any such other advisors or organisations as may be required at the discretion of the Licensing Authority.

The LMP must provide that the Works be lit and marked in accordance with the current CAA and MOD aviation lighting policy and guidance that is in place as at the date of the Licensing Authority approval of the LMP, or any such other documents that may supersede this guidance prior to the approval of the LMP. Consideration must be given in the LMP to reducing the luminous intensity of aviation lighting in certain visibility conditions but only where this is in accordance with the current CAA and MOD aviation lighting policy and guidance that is in place. The LMP must define how the Works will be lit throughout its life to maintain civil and military aviation safety requirements as determined necessary for aviation safety by the MOD and, accordingly, must set out:

- a) details of any construction equipment and temporal structures with a total height of 50m or greater (above mean sea level) that will be deployed during the construction of the Works and details of any aviation warning lighting that they will be fitted with; and
- b) the locations and heights of the WTGs featured in the Works identifying those that will be fitted with aviation warning lighting identifying the position of the lights on the WTGs, the type(s) of lights that will be fitted and the performance specification(s) of the lighting type(s) to be used.

The LMP must also detail the navigational lighting requirements detailed in the International Association of Marine Aids to Navigation and Lighthouse Authorities (“IALA”) Guideline G-1162 or any other documents that may supersede this guidance prior to approval of the LMP.

3.2.19 The Licensee must, no later than six months prior to the Commencement of the Licensed Activity, submit a PEMP, in writing, to the Licensing Authority for their written approval. Commencement of the Licensed Activity cannot take place until such approval is granted. Such approval may only be granted following consultation by the Licensing Authority with NatureScot, RSPB Scotland and any other environmental advisors or organisations as required at the discretion of the Licensing Authority. The PEMP must be in accordance with the Application as it relates to environmental monitoring.

The PEMP must set out measures by which the Licensee must monitor the environmental impacts of the Works. Monitoring is required throughout the lifespan of the Works where this is deemed necessary by the Licensing Authority. Lifespan in this context includes pre-construction, construction, operational and decommissioning phases.

The Licensing Authority must approve all initial methodologies for the above monitoring, in writing and, where appropriate, in consultation with NatureScot and any other environmental advisors or organisations as required at the discretion of the Licensing Authority.

Monitoring must be done in such a way so as to ensure that the data which is collected allows useful and valid comparisons between different phases of the Works. Monitoring may also serve the purpose of verifying key predictions in the Application. In the event that further potential adverse environmental effects are identified, for which no predictions were made in the Application, the Licensing Authority may require the Licensee to undertake additional monitoring.

The PEMP must cover the following matters:

- a) monitoring or data collection for impact on seabirds;
- b) monitoring for impacts on marine mammals;
- c) monitoring for impacts on benthic ecology;
- d) Post-construction monitoring on Electromagnetic Fields (“EMF”) produced by the constructed cables; and
- e) The Licensee’s contribution to data collection or monitoring of wider strategic relevance, including in relation to diadromous fish, as identified and agreed by the Licensing Authority.

In relation to EMF, the Licensee must monitor and provide a report on the EMF produced by the works to the Licensing Authority. The Licensee must agree the methodologies and timescales for monitoring with the Licensing Authority prior to the Commencement of the Licensed Activity as part of wider strategic monitoring on EMF. Any agreement must be adhered to unless otherwise agreed and approved by the Licensing Authority.

The requirement for monitoring pre-construction, during construction and post-construction in relation to the above

receptors must be agreed by the Licensing Authority.

Due consideration must be given to the Scottish Marine Energy Research (“ScotMER”) programme, or any successor programme formed to facilitate these research interests.

Any pre-consent monitoring or data collection carried out by the Licensee to address any of the above issues may be used in part to discharge this condition subject to the written approval of the Licensing Authority.

The PEMP is a live document which will be regularly reviewed by the Licensing Authority, at timescales to be determined by them to identify the appropriateness of on-going monitoring. Following such reviews, the Licensing Authority may require the Licensee to amend the PEMP and submit such an amended PEMP, in writing, to the Licensing Authority, for their written approval. Such approval may only be granted following consultation with NatureScot and any other environmental, or such other advisors as may be required at the discretion of the Licensing Authority.

The Licensee must submit written reports and associated raw and processed data of such monitoring or data collection to the Licensing Authority at timescales to be determined by them. Consideration must be given to data storage, analysis and reporting and be to Marine Environmental Data and Information Network standards.

Subject to any legal restrictions regarding the treatment of the information, the Licensing Authority, or any such other party appointed at the Licensing Authority’ discretion, may make the results publicly available.

The Licensing Authority may agree, in writing, that monitoring may be reduced or ceased before the end of the lifespan of the Works.

3.2.20 The Licensee must no later than six months prior to the Commencement of the Licensed Activity, submit a FMMS, in writing, to the Licensing Authority for their written approval, in consultation with SFF. Commencement of the Licensed Activity cannot take place until such approval is granted.

In order to inform the production of the FMMS, the Licensee must monitor or collect data as relevant and agreed with the Licensing Authority.

As part of any finalised FMMS, the Licensee must produce and implement a mitigation strategy for each commercial fishery that can prove to the Licensing Authority that they would be adversely affected by the Works. The Licensee and any contractors or sub-contractors working for the Licensee must implement the mitigation measures committed to be carried out by the Licensee within the FMMS.

3.2.21 The Licensee must, no later than six months prior to the Commencement of the Licensed Activity, submit an updated Protocol for Archaeological Discoveries (“PAD”) and Written Scheme of Investigation (“WSI”) which sets out what the Licensee must do on discovering any marine archaeology during the construction, operation, maintenance and monitoring of the Works, in writing, to the Licensing Authority for their written approval. Commencement of the Licensed Activity cannot take place until such approval is granted. Such approval may be given only following consultation by the Licensing Authority with Historic Environment Scotland (“HES”) and any such advisors as may be required at the discretion of the Licensing Authority. The Reporting Protocol must be implemented in full, at all times, by the Licensee.

The Licensee must send the approved PAD and WSI to the Highland Council for information only.

3.2.22 Not later than six months prior to the Commencement of the Licensed Activity, a Particles Management Plan (“PMP”) shall be submitted to the Licensing Authority for their written approval in consultation with the Scottish Environment Protection Agency (“SEPA”).

The PMP shall be consistent with the Application and supporting documents and shall include, but not be limited to, the following:

- a. A programme of scheduled monitoring for radioactive particles;
- b. The measures to be taken to reduce the likelihood of irradiated fuel particles in sediment being suspended or disturbed; and
- c. A waste management plan for the construction phase of the Works.

There shall be no Commencement of the Licensed Activity unless and until the PMP is approved in writing by the Licensing Authority, in consultation with SEPA.

Any proposed amendment to the approved PMP shall be submitted, in writing, to the Licensing Authority for its written approval, in consultation with SEPA. The proposed amendment shall be submitted to the Licensing Authority no later than six months prior to the anticipated implementation of the proposed amendment (or such shorter period as may be agreed with the Licensing Authority in writing). No amendment to the PMP shall take effect unless and until approved in writing by the Licensing Authority in consultation with SEPA.

The PMP and any amended PMP shall thereafter be implemented in full.

3.2.23 The Licensee must, no later than six months prior to the Commencement of the Licensed Activity, submit a Radio and Television Reception Mitigation Plan to the Licensing Authority for approval, in consultation with the Highland Council. The Radio and Television Reception Mitigation Plan shall provide for a baseline radio and television reception survey to be carried out prior to the installation of any turbine forming part of the Licensed Activity. The results of the baseline radio and television reception survey shall be submitted to the Highland Council prior to the installation of any turbine forming part of the Licensed Activity.

The approved Radio and Television Reception Mitigation Plan shall be implemented in full.

Any claim by any person regarding radio or television interference at their house, business premises or other building, made during the period from installation of any turbine forming part of the Works to the date falling twelve months after the Completion of the Licensed Activity shall be investigated by a qualified engineer and the results of the investigation shall be submitted to the Highland Council.

Should any impairment to the radio or television signal be attributable to the Works, the impairment shall be remedied so that the standard of reception at the affected property is equivalent to the baseline radio or television reception.

3.2.24 The Licensee must, no later than six months prior to the Commencement of the Licensed Activity, submit a Development Specification and Layout Plan (“DSLPL”), in writing, to the Licensing Authority for their written approval. Such approval may only be granted following consultation by the Licensing Authority with the MCA, NLB, NatureScot, MOD, CAA, SFF, the UKHO, the Highland Council, and any such other advisors or organisations as may be required at the discretion of the Licensing Authority.

The DSLPL must include, but not be limited to the following:

- a. A plan showing the location of each individual WTG (subject to any required micro-siting), including information on WTG spacing, WTG identification/numbering, seabed conditions, bathymetry, confirmed foundation type for each WTG and any key constraints recorded on the site;
- b. A list of latitude and longitude co-ordinates accurate to three decimal places of minutes of arc for each WTG. This must also be provided as a Geographic Information System (“GIS”) shape file using WGS84 format;
- c. The grid coordinates of the centre point of the proposed location for each WTG;
- d. A table or diagram of each WTG dimensions including - height to blade tip (measured above Lowest Astronomical Tide (“LAT”)) to the highest point, height to hub (measured above LAT to the centreline of the generator shaft), rotor diameter and maximum rotation speed;
- e. The generating output of each WTG used on the site (Annex 1) and a confirmed generating output for the site overall;
- f. The finishes for each WTG (see condition 3.2.18 on WTG lighting and marking); and
- g. The length and proposed arrangements on the seabed of all inter-array cables.

3.2.25 The Licensee must, no later than six months prior to the Commencement of the Licensed Activity, submit a DS, in writing, to the Licensing Authority. The DS, which must be signed off by at least one qualified landscape architect, as instructed by the Licensee prior to submission to the Licensing Authority, must include representative wind farm visualisations from key viewpoints as agreed with the Licensing Authority, based upon the final DSLP as approved by the Licensing Authority as updated or amended. The Licensee must provide the DS, for information only, to the Highland Council, NatureScot, MCA and any such other advisors or organisations as may be required at the discretion of the Licensing Authority.

3.2.26 If piling is to be undertaken, the Licensee must, no later than six months prior to the Commencement of the Licensed Activity, submit a PS, in writing, to the Licensing Authority for their written approval. Such approval may only be granted following consultation by the Licensing Authority with NatureScot and any such other advisors as may be required at the discretion of the Licensing Authority. Commencement of the Licensed Activity cannot take place until such approval is granted.

The PS must include, but not be limited to:

- a) Details of expected noise levels from pile-drilling/driving in order to inform point d) below;
- b) Full details of the proposed method and anticipated duration of piling to be carried out at all locations;
- c) Details of soft-start piling procedures and anticipated maximum piling energy required at each pile location; and
- d) Details of any mitigation such as Passive Acoustic Monitoring (“PAM”), Marine Mammal Observers (“MMO”), use of Acoustic Deterrent Devices (“ADD”) and monitoring to be employed during pile-driving, as agreed by the Licensing Authority.

The PS must be in accordance with the Application and must also reflect any relevant monitoring or data collection carried out after submission of the Application. The PS must demonstrate the means by which the exposure to and/or the effects of underwater noise have been mitigated in respect to cetaceans, harbour seal, grey seal and Atlantic salmon. The PS must, so far as is reasonably practicable, be consistent with the EMP, the PEMP, and the CMS.

3.2.27 Prior to the Commencement of the Licensed Activity, the Licensee must at its own expense, and with the approval of the Licensing Authority in consultation with NatureScot, appoint an independent Environmental Clerk of Works (“ECOW”). The ECOW must be appointed in time to review and approve the draft version of the first plan or programme submitted under this consent to the Licensing Authority, in sufficient time for any pre-construction monitoring requirements, and remain in post until a date agreed by the Licensing Authority. The terms of appointment must also be approved by the Licensing Authority in consultation with NatureScot.

The terms of the appointment must include, but not be limited to:

- a. Quality assurance of final draft versions of all plans and programmes required under this marine licence;
- b. Responsible for the monitoring and reporting of compliance with the marine licence conditions and the environmental mitigation measures for all wind farm infrastructure;
- c. Provision of on-going advice and guidance to the Licensee in relation to achieving compliance with conditions, including but not limited to the conditions relating to and the implementation of the CMS, the EMP, the PEMP, the CaP and the VMP;
- d. Provision of reports on point b & c above to the Licensing Authority at timescales to be determined by the Licensing Authority;
- e. Induction and toolbox talks to onsite construction teams on environmental policy and procedures, including temporary stops and keeping a record of these;
- f. Monitoring that the Works is being constructed in accordance with the plans and this consent, the Application and in compliance with all relevant regulations and legislation;
- g. Reviewing and reporting incidents/near misses and reporting any changes in procedures as a result to the Licensing Authority; and
- h. Agreement of a communication strategy with the Licensing Authority.

3.2.28 Prior to the Commencement of the Licensed Activity, a Fisheries Liaison Officer (“FLO”), must be appointed by the Licensee and approved, in writing, by the Licensing Authority, following consultation with SFF. The FLO must be appointed by the Licensee for the period from Commencement of the Licensed Activity until the Final Commissioning of the Works. The identity and credentials of the FLO must be included in the EMP (referred to in condition 3.2.14). The FLO must establish and maintain effective communications between the Licensee, any contractors or sub-contractors, fishermen and other users of the sea during the construction of the Works and ensure compliance with best practice guidelines whilst doing so.

The responsibilities of the FLO must include:

- a. Establishing and maintaining effective communications between the Licensee, any contractors or sub-contractors, fishermen and other users of the sea concerning the overall Works and any amendments to the EMP and site environmental procedures;
- b. The provision of information relating to the safe operation of fishing activity on the site of the Works; and
- c. Ensuring that information is made available and circulated in a timely manner to minimise interference with fishing operations and other users of the sea.

3.2.29 The Licensee must complete and submit a proposed activity form in the online Noise Registry for all aspects of the Works that will produce loud, low to medium frequency (10 Hz-10 kHz) impulsive noise no later than seven days prior to Commencement of the Works. If any aspects of the Works differ from the proposed activity form in the online Noise Registry, the Licensee must complete and submit a new proposed activity form no later than seven days prior to Commencement of the Works.

3.3 During the Licensed Activity

3.3.1 Only those persons acting on behalf of, and authorised by, the agent or the Licensee shall undertake the Licensed Activity.

3.3.2 The Licensee must ensure that a copy of the licence is given to each contractor and sub-contractor employed

to undertake the Licensed Activity.

3.3.3 The Licensee must notify the UKHO of the progress of the construction of the Works to facilitate the promulgation of maritime safety information and updating of admiralty charts and publications through the national Notice to Mariners system. The Licensee must ensure that progress of the Licensed Activity is promulgated regularly in the Kingfisher Fortnightly Bulletin.

3.3.4 The Licensee must ensure the best method of practice is used to minimise re-suspension of sediment during the Licensed Activity.

3.3.5 The Licensee must ensure appropriate steps are taken to minimise damage to the seabed by the Licensed Activity.

3.3.6 If the Licensee becomes aware that an accidental deposit has occurred, the Licensee must notify the Licensing Authority as soon as practicable. The Licensee must undertake such survey as directed by the Licensing Authority to locate the materials. If the Licensing Authority is of the view that any accidental deposits have occurred and should be removed, then the substances, objects and/or materials must be removed by the Licensee as soon as is practicable and at the Licensee's expense.

3.3.7 The Licensee must ensure that if oil based drilling muds are utilised they must be contained within a zero discharge system. Any drill cuttings associated with the use of water-based drilling muds need not be removed from the seabed.

3.3.8 Except as otherwise required by the NLB, the undertaker must paint all structures forming part of the authorised project yellow (colour code RAL 1023) from at least Highest Astronomical Tide ("HAT") to a height as directed by the NLB. Unless the Licensing Authority otherwise directs, the undertaker must paint the remainder of the structures grey (colour code RAL 7035).

3.3.9 Construction monitoring must include vessel traffic monitoring by automatic identification system for the duration of the construction period. An appropriate report must be submitted to the Licensing Authority, NLB and the MCA at the end of each year of the construction period.

3.3.10 Prior to the commissioning of the operational phase aids to navigation, including AIS AtoN, an 'Application for Statutory Sanction to Exhibit' must be submitted to NLB. This must be in accordance with the AtoN specified within the LMP. The Licensee must ensure that no AtoN, radio beacons or radar beacons operating in the marine frequency bands are installed or used on the Works without the prior consent of the appropriate body.

3.3.11 The rating level of noise immissions from the combined effects of the wind turbines forming part of the Development (including the Application of any tonal penalty) when determined in accordance with the Highland Council guidance notes for this condition shall not exceed a value of 34 dB LA90,10 minute at any dwelling which is lawfully existing or has planning permission at the date of this consent.

The Licensee shall continuously log power production, wind speed and wind direction. These data shall be retained for a period of not less than 24 months. The Licensee shall provide this information to the Licensing Authority within 14 days of receipt in writing of a request to do so.

Prior to the Date of First Commissioning, the Licensee shall have submitted to, and received written approval of the Licensing Authority, in consultation with the Highland Council, to an updated predictive noise assessment based on

the final turbine model(s) to be installed, based on noise emission data from the turbine manufacturer.

Within 21 days from receipt of a written request from the Licensing Authority following a complaint sent to them from the Highland Council, informing of an occupant of a dwelling alleging noise disturbance at that dwelling, the Licensee shall, at its expense, employ a consultant to assess the level of noise immissions from the wind farm at the complainant's property. The written request from the Licensing Authority shall set out at least the date, time and location to which the complaint relates and any identified atmospheric conditions, including wind direction, and include a statement as to whether, in the opinion of the Licensing Authority, in consultation with the Highland Council, the noise giving rise to the complaint contains or is likely to contain a tonal component.

The assessment of the rating level of noise immissions in terms of paragraph (4) above shall be undertaken in accordance with an assessment protocol that shall previously have been submitted to and approved in writing by the Licensing Authority, in consultation with the Highland Council. The protocol shall include at least the proposed measurement location(s) where measurements for compliance checking purposes shall be undertaken, whether noise giving rise to the complaint contains or is likely to contain a tonal component, and also the range of meteorological and operational conditions (which shall include the range of wind speeds, wind directions, power generation and times of day) to determine the assessment of rating level of noise immissions. The proposed range of conditions shall be those which prevailed during times when the complainant alleges there was disturbance due to noise, having regard to the written request of the Licensing Authority under paragraph (4) above.

The Licensee shall provide to the Licensing Authority the independent consultant's assessment of the rating level of noise immissions within two months of the date of the written request of the Licensing Authority for compliance measurements to be made under paragraph (4), unless the time limit is extended in writing by the Licensing Authority. Certificates of calibration of the instrumentation used to undertake the measurements shall be submitted to the Licensing Authority with the independent consultant's assessment of the rating level of noise immissions.

Where a further assessment of the rating level of noise immissions from the wind farm is required, the Licensee shall submit a copy of the further assessment within 21 days of submission of the independent consultant's assessment pursuant to paragraph (4) above unless the time limit has been extended in writing by the Licensing Authority.

3.4 Upon Completion of the Licensed Activity

3.4.1 The Licensee must send notification to the Source Data Receipt team, UKHO, (email: sdr@ukho.gov.uk) no later than 10 working days after the Completion of the Licensed Activity. The information provided must include: latitude and longitude coordinates in WGS84 (ETRS89) datum of the Works, as installed, on and/or above the seabed, any changes to engineering drawings, post dredge surveys, and details of new or changed aids to navigation where applicable. A copy of the notification must be sent to the Licensing Authority within five working days of the notification being sent.

The Licensee must ensure the seabed is returned to the original profile, or as close as reasonably practicable, following the Completion of the Licensed Activity. The Licensee must complete post-installation hydrographic surveys of the site of the Works or subsections thereof, and periodic hydrographic surveys thereafter, to the IHO Order 1a survey standard as per the MCA's MGN 654 and supplementary updates. The data and a corresponding report of the survey findings must be supplied to the UKHO on completion of these surveys, with notification to the MCA hydrography manager and the Licensing Authority.

The Licensee must ensure that local mariners, fishermen's organisations and HM Coastguard, in this case the National Maritime Coastguard Centre, are made fully aware of the Completion of the Licensed Activity.

The Licensee must ensure that the Completion of the Licensed Activity is promulgated in the soonest Kingfisher Fortnightly Bulletin following Completion of the Licensed Activity to inform the commercial fishing industry.

The Licensee must ensure that the WTGs are actively monitored throughout the lifetime of the Works. The Licensee must ensure that a contingency plan is in place to respond to any reported catastrophic failures which may result in the WTGs, or part(s) thereof, breaking loose and becoming a buoyant hazard. This contingency plan must include the transmission of local radio navigation warnings.

The Licensee must not exhibit, alter or discontinue navigational lighting of the Licensed Activity without the statutory sanction of the Commissioners of Northern Lighthouses.

3.4.2 The Licensee must take all reasonable, appropriate and practicable steps at the end of the operational life of the Licensed Activity to restore the site of the Works to its original pre-construction condition, or to as close to its original condition as is reasonably practicable, in accordance with the PEMP and the DP and to the satisfaction of the Licensing Authority.

Should the Licensed Activity be discontinued prior to expiry date of the licence, the Licensee must inform the Licensing Authority in writing of the discontinuation of the Licensed Activity. A separate marine licence will be required for the removal of the Licensed Activity.

3.4.3 The Licensee must notify the Licensing Authority, in writing, of the date of the Completion of the Licensed Activity, no more than one calendar month following the Completion of the Licensed Activity.

3.4.4 The Licensee must, within one month of the Completion of the Licensed Activity, provide the coordinates accurate to three decimal places of minutes of arc for the WTGs and position and maximum height of the WTGs to the Defence Geographic Centre, MOD, and any other such advisers or organisations as may be required for nautical charting and aviation purposes.

3.4.5 The Licensee must, no later than one calendar month following the Completion of the Licensed Activity submit a report, in writing, to the Licensing Authority stating the date of Completion of the Licensed Activity, the nature and quantity of all substances and/or objects placed below Mean High Water Springs and all materials used in construction under the authority of this licence.

3.4.6 The Licensee must, within three months after the Completion of the Licensed Activity, provide the following information to the MCA and the Licensing Authority:

- a) A list of latitude and longitude co-ordinates accurate to three decimal places of minutes of arc for the WTGs. This must also be provided as a GIS shape file using WGS84 format; and
- b) A table or diagram of the dimensions of the WTGs including - height to blade tip (measured above LAT) to the highest point, height to hub (measured above LAT to the centreline of the generator shaft), rotor diameter and maximum rotation speed.

3.4.7 The Licensee must provide the Licensing Authority with the MMO records no later than two months following Completion of the Licensed Activity.

3.4.8 The Licensee must submit a close out report to the Licensing Authority, MCA, UKHO and NatureScot within three months of the date of completion of construction. The close out report must confirm the date of completion of

construction and must include the following details:

- a) the final number of installed WTGs;
- b) as built plans;
- c) latitude and longitude coordinates of the centre point of the location for each WTG and offshore platform, substation, booster station and meteorological mast provided as Geographical Information System data referenced to WGS84 datum; and
- d) latitude and longitude coordinates of the inter array and export cable routes; provided as Geographical Information System data referenced to WGS84 datum.

3.4.9 The Licensee must notify the UKHO of the Completion of the Licensed Activity to facilitate the promulgation of maritime safety information and updating of admiralty charts and publications through the national Notice to Mariners system.

3.4.10 The Licensee must, within one month of the Completion of the Licensed Activity, provide the “as-built” positions and maximum heights of all WTG, along with any sub-sea infrastructure, to the UKHO for aviation and nautical charting purposes.

3.4.11 The Licensee must, as per the requirements of the MCA’s MGN [543-654](#) and supplementary updates, complete post-installation hydrographic surveys of the Site or subsections thereof, to the IHO Order 1a survey standard. On completion of these surveys, the data and a corresponding report of survey must be supplied to the UKHO, with notification to the MCA hydrography manager and the Licensing Authority.

3.4.12 The Licensee must ensure that local mariners, fishermen’s organisations and HM Coastguard, in this case the National Maritime Coastguard Centre are made fully aware of the Completion of the Licensed Activity.

3.4.13 The Licensee must ensure that the Completion of the Licensed Activity is promulgated in the Kingfisher Fortnightly Bulletin to inform the commercial fishing industry.

3.4.14 The Licensee must, where any damage, destruction or decay is caused to the Works, notify the Licensing Authority, in writing, of such damage, destruction or decay as soon as reasonably practicable following such damage, destruction or decay. The Licensee must carry out any remedial action which the Licensing Authority advises the Licensee, in writing, as requiring to be taken, which may include a requirement to display aids to navigation, following consultation by the Licensing Authority with the MCA, the NLB or any such advisers as required.

3.4.15 The Licensee must ensure that the WTG are actively monitored during the operation and maintenance phases. The Licensee must ensure that a contingency plan is in place to respond to any reported catastrophic failures which may result in the WTG, or part(s) thereof, breaking loose and becoming a buoyant hazard. This contingency plan must include the transmission of local radio navigation warnings.

3.4.16 The Licensee must ensure that no radio beacon or radar beacon operating in the marine frequency bands is installed or used on the Works without the prior written approval of the OfCom.

3.4.17 The Licensee must not exhibit, alter or discontinue navigational lighting of the Works without the statutory sanction of the Commissioners of Northern Lighthouses. An ‘Application for Statutory Sanction to Discontinue’ form must be submitted to NLB for the removal of the construction buoyage. Only upon successful inspection of the operational phase aids to navigation by NLB will the Sanction for the removal of the construction buoyage be granted.

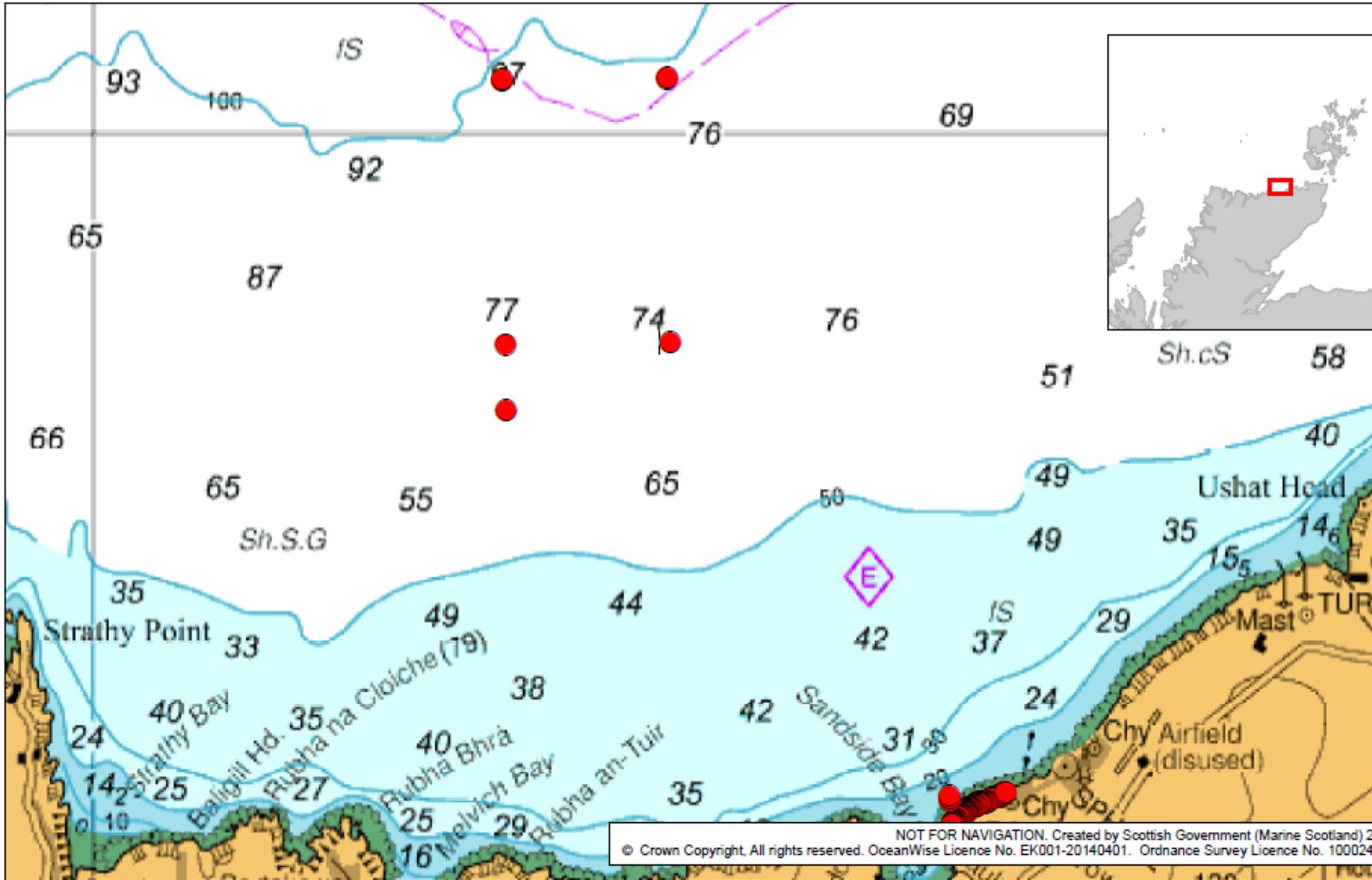
3.4.18 The Licensee must complete and submit a close-out report for all aspects of the Works that produced loud, low to medium frequency (10 Hz-10 kHz) impulsive noise in the online Noise Registry no later than 12 weeks from the Completion of the Works.

NOTES

1. You are deemed to have satisfied yourself that there are no barriers, legal or otherwise, to the carrying out of the licensed activity. The issue of the licence does not absolve the licensee from obtaining such authorisations, consents etc which may be required under any other legislation.
2. In the event that the licensee wishes any of the particulars set down in the Schedule to be altered, the licensing authority must be immediately notified of the alterations. It should be noted that changes can invalidate a licence, and that an application for a new licence may be necessary.

Annex One to licences MS-00009991 & MS-00009992

Chart showing the location of Licensed Activity



MARINE (SCOTLAND) ACT 2010, PART 4 MARINE LICENSING

LICENCE TO CONSTRUCT, ALTER OR IMPROVE WORKS IN THE SCOTTISH MARINE AREA

Licence Number: **MS-00009992**

The Scottish Ministers (hereinafter referred to as "the Licensing Authority") hereby grant a marine licence authorising:

**Highland Wind Limited
4th Floor,
115 George Street,
Edinburgh
EH2 4JN**

to construct, alter or improve works as described in Part 2. The licence is subject to the conditions set out, or referred to, in Part 3.

The licence is valid from **28 June, 2023** until **31 May, 2035** or until the Works have been decommissioned in accordance with an approved Decommissioning Programme prior to this date and for which a separate marine licence is required.

Signed:

Toni-Marie McGinn

For and on behalf of the Licensing Authority

Date of issue: 28 June, 2023

1. PART 1 - GENERAL

1.1 Interpretation

In the licence, terms are as defined in Section 1, 64 and 157 of the Marine Scotland Act 2010, and

“**CAA**” means Civil Aviation Authority;
 “**CoP**” means Construction Programme;
 “**CaP**” means Cable Plan;
 “**CMS**” means Construction Method Statement;
 “**Commencement of the Licensed Activity**” means the date on which the first vehicle or vessel arrives on the site to begin carrying on any activities in connection with the Licensed Activity;
 “**Completion of the Licensed Activity**” means the date on which the Licensed Activity has been installed in full, or the Licensed Activity has been deemed complete by the Licensing Authority, whichever occurs first;
 “**DS**” means Design Statement;
 “**DP**” means Decommissioning Programme;
 “**ECoW**” means Environmental Clerk of Works;
 “**EIAR**” means Environmental Impact Assessment Report;
 “**EMF**” means Electromagnetic Field;
 “**EMP**” means Environmental Management Plan;
 “**FLO**” means Fisheries Liaison Officer;
 “**FMMS**” means Fisheries Management and Mitigation Strategy;
 “**GIS**” means Geographic Information System;
 “**HAT**” means Highest Astronomical Tide; “**HES**” means Historic Environment Scotland;
 “**IALA**” means International Association of Marine Aids to Navigation and Lighthouse Authorities;
 “**LAT**” means Lowest Astronomical Tide;
 “**Licensed Activity**” means any activity or activities listed in section 21 of the 2010 Act which is, or are authorised under the licence;
 “**Licensee**” means Highland Wind Limited (Company Number: SC675148) having its registered office at 4th Floor 115 George Street, Edinburgh, Midlothian, Scotland, EH2 4JN;
 “**LMP**” means Lighting and Marking Plan;
 “**MCA**” means Maritime and Coastguard Agency;
 “**Mean High Water Springs**” means any area submerged at mean high water spring tide;
 “**MGN**” means Marine Guidance Note;
 “**MMO**” means Marine Mammal Observers;
 “**MOD**” means Ministry of Defence;
 “**NLB**” means Northern Lighthouse Board;
 “**NSP**” means Navigational Safety Plan;
 “**OMP**” means Operational and Maintenance Programme;
 “**PAD**” means Protocol for Archaeological Discoveries;
 “**PEMP**” means Project Environmental Management Programme;
 “**PMP**” means Particles Management Plan;
 “**RSPB Scotland**” means Royal Society for the Protection of Birds Scotland;
 “**RYA**” means Royal Yachting Association;
 “**ScotMER**” means Scottish Marine Energy Research;
 “**SEPA**” means Scottish Environment Protection Agency;
 “**SFF**” means Scottish Fishermen’s Federation;
 “**the 2010 Act**” means the Marine (Scotland) Act 2010;
 “**the Original Application**” means the Application letter, marine licence applications and EIA Report including appendices submitted to the Scottish Ministers by Highland Wind Limited on 11 August 2022;
 “**the Variation Application**” means the application made by Highland Wind Limited to vary the Project’s Offshore Consents, submitted to Scottish Ministers on 11 October 2023;
 “**the Works**” means offshore wind farm transmission infrastructure comprising offshore export cables and associated cable protection.;
 “**UKHO**” means UK Hydrographic Office; “**VMP**” means Vessel Management Plan; “**WSI**” means Written Scheme of Investigation;

All geographical co-ordinates contained within the licence are in WGS84 format (latitude and longitude degrees and minutes to three decimal places) unless otherwise stated.

1.2 Contacts

All correspondence or communications relating to the licence should be addressed to:

Marine Laboratory, 375 Victoria Road,
 Aberdeen AB11 9DB
www.scotland.gov.uk/marinescotland



The Marine Directorate Licensing
Operations Team Marine
Laboratory
375 Victoria Road
Aberdeen
AB11 9DB
Email: MS.MarineRenewables@gov.scot

1.3 Other authorisations and consents

The Licensee is deemed to have satisfied itself that there are no barriers or restrictions, legal or otherwise, to the carrying on of the Licensed Activities in connection with the licensed activity. The issuing of the licence does not absolve the Licensee from obtaining such other authorisations and consents, which may be required under statute.

1.4 Variation, suspension, revocation and transfer

Under section 30 (1) of the 2010 Act the Licensing Authority may by notice vary, suspend or revoke the licence granted by them if it appears to the Licensing Authority that there has been a breach of any of its provisions. For any such other reason that appears to be relevant to the Licensing Authority under section 30(2) or (3) of the 2010 Act. Under the 2010 Act variations, suspensions, revocations and transfers of licences are subject to the procedures set out in section 31 of the Act.

Under section 30 (7) of the 2010 Act, on an application made by a licensee, the Licensing Authority may vary a licence if satisfied that the variation being applied for is not material.

Under section 30 (8) of the 2010 Act, on an application made by the licensee, the Licensing Authority may transfer the licence from the Licensee to another person.

1.5 Breach of requirement for, or conditions of, licence

Under section 39 of the 2010 Act it is an offence to carry on a Licensable Marine Activity without a marine licence and it is also an offence to fail to comply with any condition of a marine licence.

1.6 Defences: actions taken in an emergency

Under section 40 of the 2010 Act it is a defence for a person charged with an offence under section 39(1) of the 2010 Act in relation to any activity to prove that –
the activity was carried out for the purpose of saving life, or for the purpose of securing the safety of a vessel, aircraft or marine structure ('force majeure'), and
that the person took steps within a reasonable time to inform the Licensing Authority as set out in section 40(2) of the 2010 Act.

1.7 Offences relating to information

Under section 42 of the 2010 Act it is an offence for a person to make a statement which is false or misleading in a material way, knowing the statement to be false or misleading or being reckless as to whether the statement is false or misleading, or to intentionally fail to disclose any material information for the purpose of procuring the issue, variation or transfer of a marine licence or for the purpose of complying with, or purporting to comply with, any obligation imposed by either Part 4 of the 2010 Act or the provisions of this licence.

1.8 Appeals

Under Regulation 3(1) of the Marine Licensing Appeals (Scotland) Regulations 2011 a person who has applied for a marine licence may by summary application appeal ~~to~~ against a decision taken by the Licensing Authority under section 71(1)(b) or (c) or (5) of the Act.

2. PART 2 – PARTICULARS

2.1 Agent

Highland Wind Limited
4th Floor,
115 George Street,
Edinburgh
EH2 4JN

2.2 Location of the Licensed Activity

Pentland Floating Offshore Wind Farm (Offshore Transmission Infrastructure Area),

58° 34.605' N 03° 45.709' W
58° 34.603' N 03° 45.748' W
58° 34.571' N 03° 45.797' W
58° 34.570' N 03° 45.873' W
58° 34.562' N 03° 45.928' W
58° 34.525' N 03° 46.007' W
58° 34.537' N 03° 46.101' W
58° 34.513' N 03° 46.167' W
58° 34.516' N 03° 46.119' W
58° 34.490' N 03° 46.188' W
58° 34.484' N 03° 46.286' W
58° 34.453' N 03° 46.339' W
58° 34.420' N 03° 46.370' W
58° 34.399' N 03° 46.451' W
58° 34.341' N 03° 46.550' W
58° 34.533' N 03° 46.583' W
58° 34.547' N 03° 46.586' W
58° 34.579' N 03° 46.591' W
58° 37.730' N 03° 53.540' W
58° 40.427' N 03° 53.600' W
58° 40.445' N 03° 51.014' W
58° 34.605' N 03° 45.709' W

As shown in Annex One.

2.3 Description of the Works

Offshore wind farm transmission infrastructure comprising offshore export cables and associated cable protection.

As described in the [original](#) application dated 11 August, 2022, [the variation application dated 06 October 2023](#), and correspondence submitted in support of the [osee](#) applications.

2.4 Descriptions of the materials to be used during the Licensed Activity

The licence authorises the use of the undernoted construction materials required in connection with the licensed activity, subject to the indicative amounts as specified below:

Steel/Iron - 10 Tonnes

Plastic/Synthetic - Trace amounts of synthetics embedded in scour protection solutions

Sand - 87,500 m³

Stone/Rock/Gravel - 87,500 m³

Concrete Bags/Mattresses - 87,500 m³

Cable - 25,000 m

Composite Plastic - 25 Tonnes

2.5 Contractor and Vessel Details

To be confirmed.

3. PART 3 – CONDITIONS

3.1 General Conditions

3.1.1 The Licensee must only construct the Works in accordance with this licence, the Application and any plans or programmes approved by the Licensing Authority unless otherwise authorised by the Licensing Authority.

3.1.2 The Licensee must maintain the Works in accordance with this licence, the Application and any plans or programmes approved by the Licensing Authority unless otherwise authorised by the Licensing Authority.

3.1.3 All conditions attached to the licence bind any person who for the time being owns, occupies or enjoys any use of the Works, whether or not the licence has been transferred to that person.

3.1.4 Only the materials listed in Part 2 of the licence may be used during the execution of the Licensed Activity.

3.1.5 All materials, substances and objects used during the execution of the Licensed Activity must be inert and must not contain toxic elements which may be harmful to the marine environment, the living resources which it supports or human health.

3.1.6 The Licensee must ensure that the Licensed Activity does not encroach on any recognised anchorage, either charted or noted in nautical publications, within the licensed area as described in Part 2 of the Licence.

3.1.7 Where any damage, destruction or decay is caused to the Works, the Licensee must notify the Licensing Authority, Maritime and Coastguard Agency (“MCA”), Northern Lighthouse Board (“NLB”), Kingfisher Information Services of Seafish and the UK Hydrographic Officer, in writing, of such damage, destruction or decay as soon as reasonably practicable but no later than 24 hours after becoming aware of any such damage, destruction or decay. The Licensee must carry out any remedial action as required by the Licensing Authority, following consultation with the MCA, NLB or any such advisors as required by the Licensing Authority.

The Licensee must remove the materials, from below the level of Mean High Water Springs, or make such alterations as advised by the Licensing Authority, at timescales to be determined by the Licensing Authority at any time it is considered necessary or advisable for the safety of navigation, and not replace those materials without further approval by the Licensing Authority. The Licensee shall be liable for any expense incurred.

3.1.8 If governmental assistance is required (including UK governmental assistance or the assistance of any UK devolved government) to deal with any emergency arising from:

- a) the failure to mark and light the Works as required by the licence;
- b) the maintenance of the Works; or
- c) the drifting or wreck of the Works, to include the broadcast of navigational warnings

then the Licensee is liable for any expenses incurred in securing such assistance.

3.1.9 The Licensee must take all measures which are technically and economically feasible to minimise leakage of fluorinated greenhouse gases. Where leakage of fluorinated greenhouse gases is detected, the Licensee must ensure that the equipment is repaired without undue delay.

The Licensee must ensure that all equipment to be utilised in the Licensed Activity that contains fluorinated greenhouse gases in quantities of five tonnes or more of CO₂ equivalent and not contained in foams is checked for leakage in accordance with Article 4 of the F-Gas Regulation. Records of these checks must be kept in accordance with Article 6 of the F-Gas Regulation. These records must be submitted to the Licensing Authority annually and immediately in the event of discovery of leakage.

Where the equipment is subject to checks for leakage under Article 4(1) of the F-Gas Regulation and leakage in the equipment has been repaired, the Licensee must ensure that the equipment is checked by a suitably certified person within one calendar month after the repair to verify that the repair has been effective. In such event, the Licensing Authority must be informed of the date of discovery, date of repair and date of inspection.

3.1.10 The Licensee must seek prior written approval from the Licensing Authority for any chemicals in an open system which are to be utilised in the construction, operation and maintenance of the Licensed Activity. Requests for approval must be submitted in writing to the Licensing Authority no later than one month prior to its intended use or such other period as agreed by the Licensing Authority. The Licensee must ensure that no chemicals are used in an open system without the prior written approval of the Licensing Authority.

If the proposed chemical is on the Offshore Chemical Notification Scheme list, the approval request must include the chemical name, volume or quantity to be used, the Offshore Chemical Notification Scheme list grouping or rank and the proposed frequency of use.

If the proposed chemical is not on the Offshore Chemical Notification Scheme list, the approval request must include details of chemicals to be used, including safety data sheet, depth and current at the site of the Works, quantities or volumes and the proposed frequency of use.

The Licensee must notify the Licensing Authority of the types of chemicals to be used in a closed containment system prior to use.

The Licensee must take all practicable steps to avoid leakages from a closed containment system into the Scottish marine area. Any such leakages must be reported to the Licensing Authority as soon as practicable.

3.1.11 The Licensee must submit all reports and notifications to the Licensing Authority, in writing, as are required under this licence within the time periods specified in this licence. Where there may be a delay in the submission of the reports or notifications to the Licensing Authority, the Licensee must advise the Licensing Authority of this fact as soon as is practicable and no later than the time by which those reports or notifications ought to have been submitted to the Licensing Authority under the terms of this licence.

The reports must include executive summaries, assessments and conclusions and any data will, subject to any rules permitting non-disclosure, be made publicly available by the Licensing Authority or by any such party appointed at its discretion.

Reports prepared pursuant to another consent or licence relating to the Works by the Licensee or by a third party may also be used to satisfy the requirements of this licence.

Such reports will include, but not be limited to Marine Mammal Observer ("MMO") records and all appropriate reports stipulated within the Project Environment Monitoring Plan ("PEMP").

3.1.12 The Licensee must operate and maintain the Works in accordance with the approved Operation and

Maintenance Programme ("OMP") (see condition [3-2.143.2.13](#)). The Licensing Authority must be notified at least three calendar months, or such other period as agreed by the Licensing Authority in advance, of any maintenance of the Licensed Activity not included in the OMP and involving licensable marine activities not covered under this licence.

3.1.13 In the event of the Licensed Activity being discontinued the materials used under the authority of this licence must be removed to the satisfaction of the Licensing Authority.

3.1.14 The Licensee must ensure that the Works are maintained at all times in good repair.

3.1.15 The Licensee must ensure that the Licensed Activity is only carried out at the location of the Licensed Activity specified in Part 2 of this licence. The cables must be constructed only at the locations specified in Part 2 of this licence.

3.1.16 There must be no Commencement of the Licensed Activity until a Decommissioning Programme ("DP"), as defined in any section 105 notice served by the appropriate Minister, has been approved under section 106 of the Energy Act 2004 by the Licensing Authority.

3.1.17 The Licensee must submit plans and the details and specifications of all studies and surveys that are required to be undertaken under this licence in relation to the Licensed Activity, in writing, to the Licensing Authority for its written approval. Commencement of the studies or surveys and implementation of plans must not occur until the Licensing Authority has given its written approval to the Licensee.

Plans or the specification of studies and surveys prepared pursuant to another consent or licence relating to the Licensed Activity by the Licensee or by a third party may also be used to satisfy the requirements of this licence.

Any updates or amendments made to the approved plans must be submitted, in writing, to the Licensing Authority for its prior written approval. The Works must, at all times, be constructed and operated in accordance with the approved plans.

3.1.18 The Licensee must ensure that any debris or waste materials arising during the course of the Licensed Activity are removed for disposal at an approved location above the tidal level of Mean High Water Springs.

3.1.19 The Licensee must ensure that copies of this licence are available for inspection by any authorised marine enforcement officer at:

- a) the premises of the Licensee;
- b) the premises of any agent acting on behalf of the Licensee; and
- c) the site of the Licensed Activity.

3.1.20 Any person authorised by the Licensing Authority must be permitted to inspect the Works at any reasonable time. The Licensee must, on being given reasonable notice by the Licensing Authority (of at least 72 hours), provide transportation to and from the site for any persons authorised by the Licensing Authority to inspect the site of the Works. The Licensee shall be liable for any expense incurred.

3.1.21 The Licensee must inform the local Fishery Office(s) in writing at least five days prior to the Commencement of the Licensed Activity, or any part thereof, and within five days of Completion of the Licensed Activity.

The Kingfisher Information Service of Seafish, must be informed of details of the vessel routes, timings and locations

relating to the construction of the authorised project or any part thereof by email to kingfisher@seafish.co.uk:

- a) at least 14 days prior to the commencement of offshore activities, for inclusion in the Kingfisher Fortnightly Bulletin and offshore hazard awareness data, and;
- b) as soon as reasonably practicable and no later than 24 hours of completion of all offshore activities.

Confirmation of notification must be provided to the Licensing Authority within five days.

The Licensee must ensure that a local notification to mariners is issued at least 14 days prior to the Commencement of the Licensed Activity, or any part thereof, advising of the start date and the expected vessel routes from the construction ports to the relevant location. Copies of all notices must be provided to the Licensing Authority, MCA and the UK Hydrographic Office (“UKHO”) within five days.

The Licensee must ensure that local notifications to mariners are updated and reissued at weekly intervals during construction activities and at least five days before any planned operations (or otherwise agreed) and maintenance works and supplemented with Very High Frequency (“VHF”) radio broadcasts agreed with the MCA in accordance with the construction and monitoring programme approved under deemed marine licence condition 3.2.129.

Copies of all notices must be provided to the Licensing Authority and UKHO within five days.

The Licensee must notify the UKHO within 14 days of the Completion of the Licensed Activity, or any part thereof, in order that all necessary amendments are made to nautical charts.

Copies of all notices must be provided to the Licensing Authority and MCA within five days.

In case of damage to, or destruction or decay of, the Licensed Activity seaward of Mean High Water Springs, or any part thereof, excluding the exposure of cables, the Licensee shall as soon as reasonably practicable and no later than 24 hours following the undertaker becoming aware of any such damage, destruction or decay, notify the Licensing Authority, MCA, NLB, the Kingfisher Information Service of Seafish and the UKHO.

In case of exposure of cables on or above the seabed, the Licensee must within three days following identification of a potential cable exposure, notify mariners and inform Kingfisher Information Service of the location and extent of exposure. Copies of all notices must be provided to the Licensing Authority, MCA, NLB, and the UKHO within five days.

3.1.22 The Licensed Activity shall be undertaken in accordance with the Schedule of Mitigation contained within Chapter 22 of the Environmental Impact Assessment Report unless otherwise agreed in advance in writing with the Licensing Authority.

3.2 Prior to the commencement of the Licensed Activity

3.2.1 The Licensee must, prior to and no less than one calendar month before the Commencement of the Licensed Activity, notify the Licensing Authority, in writing, of the proposed date of the Commencement of the Licensed Activity authorised under this licence.

3.2.2 The Licensee must ensure that at least five days prior to its engagement in the Licensed Activity, the name and function of any vessel (including the master’s name, vessel type, vessel international maritime organisation number and vessel owner or operating company), agent, contractor or subcontractor appointed to engage in the

Licensed Activity are fully detailed in contractor and vessel reports ("the Reports") which the Licensee must make available on its website: <https://pentlandfloatingwind.com/>. Any changes to the supplied ~~detailed details~~ must be uploaded to the Reports and the Licensing Authority and the relevant statutory harbour authority must be notified, in writing, prior to any vessel, agent, contractor or sub-contractor which has not yet been notified to the Licensing Authority engaging in the Licensed Activity. Only those vessels, agents, contractors or sub-contractors detailed in the Reports are permitted to carry out any part of the Licensed Activity. Any vessels involved in drilling and deposit of drilling arisings must be notified to the Licensing Authority. The Licensee must satisfy itself that any masters of vessels or vehicle operators, agents, contractors or sub-contractors are aware of the extent of the Licensed Activity and the conditions of this licence.

All masters of vessels or vehicle operators, agents, contractors and sub-contractors permitted to engage in the Licensed Activity must abide by the conditions of this licence.

The Licensee must give a copy of this licence, and any subsequent variations made to this licence in accordance with section 30 of the 2010 Act, to the masters of any vessels, vehicle operators, agents, contractors or sub-contractors permitted to engage in the Licensed Activity and must ensure that the licence and any such variations are read and understood by those persons.

3.2.3 The Licensee must complete and send a Marine Emergency Action Card for the Licensed Activity to oelo@mcga.gov.uk at least 10 working days prior to Commencement of the Licensed Activity.

3.2.4 The Licensee must contact the relevant statutory harbour authority, prior to Commencement of the Licensed Activity to discuss the requirements for navigational warnings and a Works licence.

The Licensee must ensure that a communications procedure is established and agreed with the relevant statutory harbour authority prior to the Commencement of the Licensed Activity.

3.2.5 The Licensee must ensure that all personnel adhere to the Scottish Marine Wildlife Watching Code where appropriate during the Licensed Activity.

3.2.6 There must be no Commencement of the Licensed Activity until the Licensee has satisfied the Licensing Authority, by consultation with the MCA, that it has taken into account and adequately addressed all of the recommendations of the MCA in the current Marine Guidance Note ("MGN") 654, and its annexes, or any other relevant document which may supersede this guidance.

3.2.7 Prior to the Commencement of the Licensed Activity, the Licensee must appoint an MMO. When appointed, the MMO must, as a minimum, maintain a record of any sightings of marine mammals and maintain a record of the action taken to avoid any disturbance being caused to marine mammals during noisy activities.

The Licensee must ensure that all personnel adhere to the Scottish Marine Wildlife Watching Code where appropriate during all alteration and improvement activities authorised under this licence.

3.2.8 The Licensee must, no later than 10 days prior to Commencement of the Licensed Activity, notify the UKHO at sdr@ukho.gov.uk, of the proposed Licensed Activity. The notification must include the start and end date of the Licensed Activity, a description of the Works, positions of the area of the Works (WGS84), and details of any marking arrangements. A copy of the notification must be sent to the Licensing Authority within five working days of the notification being sent.

The Licensee must ensure that local mariners and fishermen's organisations are made fully aware of the Works through a local notification. This must be issued at least ~~five~~ 14 days before the Commencement of the Licensed Activity. The Licensing Authority must be sent a copy of this notification within ~~24 hours~~ five days of issue.

The Licensee must, no later than ~~seven~~ 10 days prior to the Commencement of the Licensed Activity, notify Zone4@hmcg.gov.uk and renewables@hmcg.gov.uk of the proposed Licensed Activity. A copy of the notification must be sent to the Licensing Authority within five working days of the notification being sent.

The Licensee must ensure that details of the Licensed Activity are promulgated in the Kingfisher Fortnightly Bulletin, no later than ~~seven~~ 14 days prior to the Commencement of the Licensed Activity to inform the Sea Fish Industry of the vessel routes, the timings and the location of the Licensed Activity and of the relevant operations.

3.2.9 The Licensee must, no later than six months prior to the Commencement of the Licensed Activity, submit a Construction Programme ("CoP"), in writing, to the Licensing Authority for its written approval. Commencement of the Licensed Activity cannot take place until such approval is granted. Such approval may only be granted following consultation by the Licensing Authority with NatureScot, Civil Aviation Authority ("CAA"), Ministry of Defence ("MOD"), and any such other advisors or organisations as may be required at the discretion of the Licensing Authority.

The CoP must set out:

- a. The proposed date for Commencement of the Licensed Activity;
- b. The proposed timings for mobilisation of plant and delivery of materials, including details of onshore lay-down areas;
- c. The proposed timings and sequencing of construction work for all elements of the Works infrastructure;
- d. Contingency planning for poor weather or other unforeseen delays; and
- e. The scheduled date for the Completion of the Licensed Activity.

The Licensee must send the approved CoP to The Highland Council, MCA, and NLB for information only.

3.2.10 The Licensee must, no later than six months prior to the Commencement of the Licensed Activity, submit an Environmental Management Plan ("EMP"), in writing, to the Licensing Authority for its written approval. Such approval may only be granted following consultation by the Licensing Authority. NatureScot, Royal Society for the Protection of Birds Scotland ("RSPB Scotland"), and any such other advisors or organisations as may be required at the discretion of the Licensing Authority.

The EMP must provide the over-arching framework for on-site environmental management during the phases of the Works as follows:

- a. All construction as required to be undertaken before the Completion of the Licensed Activity; and
- b. The operational lifespan of the Works from the Completion of the Licensed Activity until the cessation of electricity generation (environmental management during decommissioning is addressed by the DP provided for by condition 3.1.16).

The EMP must be in accordance with the Application insofar as it relates to environmental management measures. The EMP must set out the roles, responsibilities and chain of command for the Licensees personnel, any contractors or sub-contractors in respect of environmental management for the protection of environmental interests during the construction and operation of the Works. It must address, but not be limited to, the following over-arching requirements for environmental management during construction:

- a. Mitigation measures to prevent significant adverse impacts to environmental interests, as identified in the Application and pre-consent and pre-construction monitoring or data collection, and include reference to relevant parts of the Construction Method Statement (“CMS”) (refer to condition 3.1.16);
- b. A pollution prevention and control method statement, including contingency plans;
- c. Management measures to prevent the introduction of invasive non-native marine species;
- d. A site waste management plan (dealing with all aspects of waste produced during the construction period), including details of contingency planning in the event of accidental release of materials which could cause harm to the environment. Wherever possible the waste hierarchy of reduce, reuse and recycle should be encouraged; and
- e. The reporting mechanisms that will be used to provide the Licensing Authority and relevant stakeholders with regular updates on construction activity, including any environmental issues that have been encountered and how these have been addressed.

The EMP must be regularly reviewed by the Licensee at intervals agreed by the Licensing Authority. Reviews must include, but not be limited to, the reviews of updated information on construction methods and operations of the Works and updated working practices.

The EMP must be informed, so far as is reasonably practicable, by the baseline monitoring or data collection undertaken as part of the Application and the PEMP.

3.2.11 The Licensee must, no later than six months prior to the Commencement of the Licensed Activity submit a CMS, in writing, to the Licensing Authority for its written approval. Such approval may only be granted following consultation by the Licensing Authority with NatureScot, MCA, NLB and any such other advisors or organisations as may be required at the discretion of the Licensing Authority.

The CMS must include, but not be limited to:

- a. Details of the commencement dates, duration and phasing for the key elements of construction, the working areas, the construction procedures and good working practices for installing the Works;
- b. Details of the roles and responsibilities, chain of command and contact details of Licensees personnel, any contractors or sub-contractors involved during the construction of the Works; and
- c. Details of how the construction related mitigation steps proposed in the Application are to be delivered.

The CMS must adhere to the construction methods assessed in the Application. The CMS also must, so far as is reasonably practicable, be consistent with the Design Statement (“DS”), the EMP, the Vessel Management Plan (“VMP”), the Navigational Safety Plan (“NSP”), the Cable Plan (“CaP”) and the Lighting and Marking Plan (“LMP”).

The final CMS must be sent to the Highland Council for information only.

3.2.12 The Licensee must, no later than six months prior to the Commencement of the Licensed Activity, submit a VMP, in writing, to the Licensing Authority for its written approval. Commencement of the Licensed Activity cannot take place until such approval is granted. Such approval may only be granted following consultation by the Licensing Authority, NatureScot, MCA, Scottish Fishermen’s Federation (“SFF”) and any such other advisors or organisations as may be required at the discretion of the Licensing Authority.

The VMP must include, but not be limited to, the following details:

- a. The number, types and specification of vessels required;
- b. How vessel management will be coordinated, particularly during construction, but also during operation;
- c. Location of working port(s), the routes of passage, the frequency with which vessels will be required to transit

between port(s) and the site and indicative vessel transit corridors proposed to be used during construction and operation of the Works.

The confirmed individual vessel details must be notified to the Licensing Authority in writing no later than 14 days prior to the Commencement of the Licensed Activity, and thereafter, any changes to the details supplied must be notified to the Licensed Authority, as soon as practicable, prior to any such change being implemented in the construction or operation of the Licensed Activity.

The VMP must refer to the Scottish Marine Wildlife Watching Code and Guide to Best Practice for Watching Marine Wildlife for guidance on how vessels should behave around aggregations of birds on the water.

The VMP must, so far as is reasonably practicable, be consistent with the CMS and EMP, the Fisheries Management and Mitigation Strategy ("FMMS"), the PEMP, the NSP, and the LMP.

3.2.13 The Licensee must, no later than three months prior to the Completion of the Licensed Activity, submit an OMP, in writing, to the Licensing Authority for its written approval. Such approval may only be granted following consultation by the Licensed Authority with NatureScot, MCA, NLB, The Highland Council and any such other advisors or organisations as may be required at the discretion of the Licensed Authority.

The OMP must set out the procedures and good working practices for operations and the maintenance of the Works and substructure of the Works. Environmental sensitivities which may affect the timing of the operation and maintenance activities must be considered in the OMP.

The OMP must, so far as is reasonably practicable, be consistent with the CMS, the EMP, the PEMP, the VMP, the NSP and the LMP.

The Licensee must send the approved OMP to The Highland Council for information only.

3.2.14 The Licensee must, no later than six months prior to the Commencement of the Licensed Activity, submit a NSP, in writing, to the Licensing Authority for its written approval. Commencement of the Licensed Activity cannot take place until such approval is granted. Such approval may only be granted following consultation by the Licensing Authority with MCA, NLB, Royal Yachting Association ("RYA"), SFF and any other navigational advisors or organisations as may be required at the discretion of the Licensing Authority.

The NSP must include, but not be limited to, the following issues:

- a. Navigational safety measures;
- b. Construction exclusion zones;
- c. Notice(s) to mariners and radio navigation warnings;
- d. Anchoring areas;
- e. Temporary construction lighting and marking;
- f. Buoyage.

3.2.15 The Licensee must, no later than six months prior to the Commencement of the Licensed Activity, submit a ~~updated~~ CaP, in writing, to the Licensing Authority for its written approval. Commencement of the Licensed Activity cannot take place until such approval is granted. Such approval may only be granted following consultation by the Licensing Authority with NatureScot, MCA, SFF, and any such other advisors or organisations as may be required at the discretion of the Licensing Authority. The CaP must be in accordance with the Application.

The CaP must include, but not be limited to, the following:

- a) The location, duration and cable laying techniques for cables;
- b) The results of monitoring or data collection work (including geophysical, geotechnical and benthic surveys) which will help inform cable routing;
- c) Technical specification of the cables, including a desk based assessment of attenuation of electromagnetic field strengths and shielding;
- d) A Cable Burial Risk Assessment (“CBRA”) to ascertain burial depths and where necessary alternative protection measures;
- e) Methodologies for post construction and operational surveys (e.g., over trawl) of the cables where mechanical protection of cables laid on the sea bed is deployed; and
- f) Methodologies for cable inspection with measures to address and report to the Licensing Authority any exposure of cables; and
- g) The anticipated areas of cable protection.

Any consented cable protection works must ensure existing and future safe navigation is not compromised. The Licensing Authority will accept a maximum of 5% reduction in surrounding depth referenced to Chart Datum. Any greater reduction in depth must be agreed in writing by the Licensing Authority.

3.2.16 The Licensee must, no later than six months prior to the Commencement of the Licensed Activity, submit a PEMP, in writing, to the Licensing Authority for its written approval. Commencement of the Licensed Activity cannot take place until such approval is granted. Such approval may only be granted following consultation by the Licensing Authority with NatureScot, RSPB Scotland, and any other environmental advisors or organisations as required at the discretion of the Licensing Authority. The PEMP must be in accordance with the Application as it relates to environmental monitoring.

The PEMP must set out measures by which the Licensee must monitor the environmental impacts of the Works. Monitoring is required throughout the lifespan of the Works where this is deemed necessary by the Licensing Authority. Lifespan in this context includes pre-construction, construction, operational and decommissioning phases.

The Licensing Authority must approve all initial methodologies for the above monitoring, in writing and, where appropriate, in consultation with NatureScot and any other environmental advisors or organisations as required at the discretion of the Licensing Authority.

Monitoring must be done in such a way so as to ensure that the data which is collected allows useful and valid comparisons between different phases of the Works. Monitoring may also serve the purpose of verifying key predictions in the Application. In the event that further potential adverse environmental effects are identified, for which no predictions were made in the Application, the Licensing Authority may require the Licensee to undertake additional monitoring.

The PEMP must cover the following matters:

- a) monitoring or data collection for impact on seabirds;
- b) monitoring for impacts on marine mammals;
- c) monitoring for impacts on benthic ecology;
- d) Post-construction monitoring on Electromagnetic Fields (“EMF”) produced by the constructed cables; and
- e) The Licensee’s contribution to data collection or monitoring of wider strategic relevance, including in relation to

diadromous fish, as identified and agreed by the Licensing Authority.

In relation to EMF, the Licensee must monitor and provide a report on the EMF produced by the Works to the Licensing Authority. The Licensee must agree the methodologies and timescales for monitoring with the Licensing Authority prior to the Commencement of the Licensed Activity as part of wider strategic monitoring on EMF. Any agreement must be adhered to unless otherwise agreed and approved by the Licensing Authority.

The requirement for monitoring pre-construction, during construction and post-construction in relation to the above receptors must be agreed by the Licensing Authority.

Due consideration must be given to the Scottish Marine Energy Research (“ScotMER”) programme, or any successor programme formed to facilitate these research interests.

Any pre-consent monitoring or data collection carried out by the Licensee to address any of the above issues may be used in part to discharge this condition subject to the written approval of the Licensing Authority.

The PEMP is a live document which will be regularly reviewed by the Licensing Authority, at timescales to be determined by them to identify the appropriateness of on-going monitoring. Following such reviews, the Licensing Authority may require the Licensee to amend the PEMP and submit such an amended PEMP, in writing, to the Licensing Authority, for its written approval. Such approval may only be granted following consultation with NatureScot and any other environmental, or such other advisors as may be required at the discretion of the Licensing Authority.

The Licensee must submit written reports and associated raw and processed data of such monitoring or data collection to the Licensing Authority at timescales to be determined by them. Consideration should be given to data storage, analysis and reporting and be to Marine Environmental Data and Information Network standards.

Subject to any legal restrictions regarding the treatment of the information, the Licensing Authority, or any such other party appointed at the Licensing Authority’s discretion, may make the results publicly available.

The Licensing Authority may agree, in writing, that monitoring may be reduced or ceased before the end of the lifespan of the Works.

3.2.17 The Licensee must no later than six months prior to the Commencement of the Licensed Activity, submit a FMMS, in writing, to the Licensing Authority for its written approval, in consultation with SFF. Commencement of the Licensed Activity cannot take place until such approval is granted.

In order to inform the production of the FMMS, the Licensee must monitor or collect data as relevant and agreed with the Licensing Authority.

As part of any finalised FMMS, the Licensee must produce and implement a mitigation strategy for each commercial fishery that can prove to the Licensing Authority that they would be adversely affected by the Works. The Licensee and any contractors or sub-contractors working for the Licensee must implement the mitigation measures committed to be carried out by the Licensee within the FMMS.

3.2.18 The Licensee must, no later than six months prior to the Commencement of the Licensed Activity, submit an updated Protocol for Archaeological Discoveries (“PAD”) and Written Scheme of Investigation (“WSI”) which sets out what the Licensee must do on discovering any marine archaeology during the construction, operation, maintenance

and monitoring of the Works, in writing, to the Licensing Authority for its written approval. Commencement of the Licensed Activity cannot take place until such approval is granted. Such approval may be given only following consultation by the Licensing Authority with Historic Environment Scotland (“HES”) and any such advisors as may be required at the discretion of the Licensing Authority. The reporting protocol must be implemented in full, at all times, by the Licensee.

3.2.19 Not later than six months prior to the Commencement of the Licensed Activity, a Particles Management Plan (“PMP”) shall be submitted to the Licensing Authority for its written approval in consultation with the Scottish Environmental Protection Agency (“SEPA”).

The PMP shall be consistent with the Application and supporting documents and shall include, but not be limited to, the following:

- a. A programme of scheduled monitoring for radioactive particles;
- b. The measures to be taken to reduce the likelihood of irradiated fuel particles in sediment being suspended or disturbed; and
- c. A waste management plan for the construction phase of the Works.

There shall be no Commencement of the Licensed Activity unless and until the PMP is approved in writing by the Licensing Authority, in consultation with SEPA.

Any proposed amendment to the approved PMP shall be submitted, in writing, to the Licensing Authority for its written approval, in consultation with SEPA. The proposed amendment shall be submitted to the Licensing Authority no later than six months prior to the anticipated implementation of the proposed amendment (or such shorter period as may be agreed with the Licensing Authority in writing). No amendment to the PMP shall take effect unless and until approved in writing by the Licensing Authority in consultation with SEPA.

The PMP and any amended PMP shall thereafter be implemented in full.

3.2.20 Prior to the Commencement of the Licensed Activity, the Licensee must at its own expense, and with the approval of the Licensing Authority in consultation with NatureScot, appoint an independent Environmental Clerk of Works (“ECoW”). The ECoW must be appointed in time to review and approve the draft version of the first plan or programme submitted under this consent to the Licensing Authority, in sufficient time for any pre-construction monitoring requirements, and remain in post until a date agreed by the Licensing Authority. The terms of appointment must also be approved by the Licensing Authority in consultation with NatureScot.

The terms of the appointment must include, but not be limited to:

- a. Quality assurance of final draft versions of all plans and programmes required under this marine licence;
- b. Responsible for the monitoring and reporting of compliance with the marine licence conditions and the environmental mitigation measures for all wind farm infrastructure;
- c. Provision of on-going advice and guidance to the Licensee in relation to achieving compliance with conditions, including but not limited to the conditions relating to and the implementation of the CMS, the EMP, the PEMP, the CaP and the VMP;
- d. Provision of reports on point b & c above to the Licensing Authority at timescales to be determined by the Licensing Authority;
- e. Induction and toolbox talks to onsite construction teams on environmental policy and procedures, including temporary stops and keeping a record of these;

- f. Monitoring that the Works is being constructed in accordance with the plans and this marine licence, the Application and in compliance with all relevant regulations and legislation;
- g. Reviewing and reporting incidents/near misses and reporting any changes in procedures as a result to the Licensing Authority; and
- h. Agreement of a communication strategy with the Licensing Authority.

3.2.21 Prior to the Commencement of the Licensed Activity, a Fisheries Liaison Officer (“FLO”), must be appointed by the Licensee and approved, in writing, by the Licensing Authority, following consultation with SFF. The FLO must be appointed by the Licensee for the period from Commencement of the Licensed Activity until the Final Commissioning of the Works. The identity and credentials of the FLO must be included in the EMP (referred to in condition 3.2.44~~10~~). The FLO must establish and maintain effective communications between the Licensee, any contractors or sub-contractors, fishermen and other users of the sea during the construction of the Works and ensure compliance with best practice guidelines whilst doing so.

The responsibilities of the FLO must include:

- a. Establishing and maintaining effective communications between the Licensee, any contractors or sub-contractors, fishermen and other users of the sea concerning the overall Works and any amendments to the EMP and site environmental procedures;
- b. The provision of information relating to the safe operation of fishing activity on the site of the Works; and
- c. Ensuring that information is made available and circulated in a timely manner to minimise interference with fishing operations and other users of the sea.

3.2.22 A swath bathymetric survey to IHO Order 1a of the area within the Offshore Order Limits extending to an appropriate buffer around the site, must be undertaken by the Licensee. The survey shall include all proposed cable routes.

This should fulfil the requirements of MGN654 and its supporting ‘Hydrographic Guidelines for Offshore Renewable Energy Developers’, which includes the requirement for the full density data and reports to be delivered to the MCA and the UKHO for the update of nautical charts and publications. This must be submitted as soon as possible, and no later than three months prior to the Commencement of the Licensed Activity. The Order Limit shapefiles must be submitted to MCA. The Report of Survey must also be sent to the Licensing Authority.

3.2.23 The Licensee must, no later than ~~one calendar month~~10 days prior to Commencement of the Licensed Activity, notify the UKHO of the proposed Works to facilitate the promulgation of maritime safety information and updating of admiralty charts and publications through the national Notice to Mariners system.

3.2.24 The Licensee must, ~~no later than one calendar month~~at least 14 days prior to Commencement of the Licensed Activity, ensure that local mariner’s organisations and local fishermen’s organisations and HM Coastguard are made fully aware of the Works through local Notice to Mariners or by any other appropriate means.

3.2.25 The Licensee must ensure that details of the Licensed Activities are promulgated in the Kingfisher Fortnightly Bulletin, no ~~later than one calendar month~~later than 14 days prior to the Commencement of the Licensed Activity to inform the commercial fishing industry of the vessel routes and the timing and location of the construction activities.

3.2.26 The Licensee must, no later than eight weeks prior to the Commencement of the Licensed Activity, complete an “Application for Statutory Sanction to Alter/Exhibit” form and submit this to the NLB for the necessary sanction to

be granted for the deployment of the Construction Buoyage.

3.3 During the Licensed Activity

3.3.1 Only those persons acting on behalf of, and authorised by, the agent or the Licensee shall undertake the Licensed Activity.

3.3.2 The Licensee must ensure that a copy of the licence is given to each contractor and sub-contractor employed to undertake the Licensed Activity.

3.3.3 The Licensee must notify the UKHO of the progress of the construction of the Works to facilitate the promulgation of maritime safety information and updating of admiralty charts and publications through the national Notice to Mariners system. The Licensee must ensure that progress of the Licensed Activity is promulgated regularly in the Kingfisher Fortnightly Bulletin.

3.3.4 The Licensee must ensure the best method of practice is used to minimise re-suspension of sediment during the Licensed Activity.

3.3.5 The Licensee must ensure appropriate steps are taken to minimise damage to the seabed by the Licensed Activity.

3.3.6 If the Licensee becomes aware that an accidental deposit has occurred, the Licensee must notify the Licensing Authority as soon as practicable. The Licensee must undertake such survey as directed by the Licensing Authority to locate the materials. If the Licensing Authority is of the view that any accidental deposits have occurred and should be removed, then the substances, objects and/or materials must be removed by the Licensee as soon as is practicable and at the Licensee's expense.

3.3.7 The Licensee must ensure that if oil based drilling muds are utilised, they must be contained within a zero discharge system. Any drill cuttings associated with the use of water-based drilling muds need not be removed from the seabed.

3.3.8 Construction monitoring must include vessel traffic monitoring by automatic identification system for the duration of the construction period. An appropriate report must be submitted to the Licensing Authority, NLB and the MCA at the end of each year of the construction period.

3.4 Upon Completion of the Licensed Activity

3.4.1 The Licensee must send notification to the Source Data Receipt team, UKHO, (email: sdr@ukho.gov.uk) no later than 10 working days after the Completion of the Licensed Activity. The information provided must include latitude and longitude coordinates in WGS84 (ETRS89) datum of the Works, as installed, on and/or above the seabed, any changes to engineering drawings, post dredge surveys, and details of new or changed aids to navigation where applicable. A copy of the notification must be sent to the Licensing Authority within five working days of the notification being sent.

The Licensee must, following installation, notify the Kingfisher Information Service Offshore Renewables and Cable Awareness and the International Cable Protection Committee of the 'as laid' cable corridor and a 500m zone either side of it as a hazardous area for anchoring.

The Licensee must ensure the seabed is returned to the original profile, or as close as reasonably practicable,

following the Completion of the Licensed Activity. The Licensee must complete post-installation hydrographic surveys of the site of the Works or subsections thereof, and periodic hydrographic surveys thereafter, to the IHO Order 1a survey standard as per the MCA's MGN 654 and supplementary updates. The data and a corresponding report of the survey findings must be supplied to the UKHO on completion of these surveys, with notification to the MCA hydrography manager and the Licensing Authority.

The Licensee must ensure that local mariners, fishermen's organisations and HM Coastguard, in this case the National Maritime Coastguard Centre, are made fully aware of the Completion of the Licensed Activity.

The Licensee must ensure that the Completion of the Licensed Activity is promulgated in the soonest Kingfisher Fortnightly Bulletin following Completion of the Licensed Activity to inform the commercial fishing industry.

The Licensee must ensure that the cables are actively monitored throughout the lifetime of the Works. The Licensee must ensure that a contingency plan is in place to respond to any reported catastrophic failures which may result in the cables, or part(s) thereof, breaking loose and becoming a buoyant hazard. This contingency plan must include the transmission of local radio navigation warnings.

The Licensee must not exhibit, alter or discontinue navigational lighting of the Licensed Activity without the statutory sanction of the Commissioners of Northern Lighthouses.

3.4.2 The Licensee must take all reasonable, appropriate and practicable steps at the end of the operational life of the Licensed Activity to restore the site of the Works to its original pre-construction condition, or to as close to its original condition as is reasonably practicable, in accordance with the PEMP and the DP and to the satisfaction of the Licensing Authority.

Should the Licensed Activity be discontinued prior to expiry date of the licence, the Licensee must inform the Licensing Authority in writing of the discontinuation of the Licensed Activity. A separate marine licence will be required for the removal of the Licensed Activity.

3.4.3 The Licensee must notify the Licensing Authority, in writing, of the date of the Completion of the Licensed Activity, no more than one calendar month following the Completion of the Licensed Activity.

3.4.4 The Licensee must, no later than one calendar month following the Completion of the Licensed Activity submit a report, in writing, to the Licensing Authority stating the date of Completion of the Licensed Activity, the nature and quantity of all substances and/or objects placed below Mean High Water Springs, and all materials used in construction under the authority of this licence.

3.4.5 The Licensee must undertake and submit to the Licensing Authority, within eight weeks of the Completion of the Licensed Activity, an assessment of any risks posed by the final sub-sea cable route, burial depths and un-trenched areas where mechanical and any other protection measures were used within the cable route, to the satisfaction of the Licensing Authority, the purpose of which is to ensure that the safety of navigation and other legitimate users of the sea is not compromised. Where the assessment identifies risks, the Licensee must submit a plan for addressing these to the Licensing Authority and ensure that the plan is fully implemented, subject to the approval of the Licensing Authority.

3.4.6 The Licensee must provide the Licensing Authority with the MMO records no later than two months following Completion of the Licensed Activity.

3.4.7 The Licensee must submit a close out report to the Licensing Authority, MCA, UKHO and NatureScot within three months of the date of the Completion of the Licensed Activity. The close out report must confirm the date of the Completion of the Licensed Activity and must include the following details:

- a) as built plans; and
- b) latitude and longitude coordinates of the export cable routes; provided as GIS data referenced to WGS84 datum.

3.4.8 The Licensee must notify the UKHO of the Completion of the Licensed Activity to facilitate the promulgation of maritime safety information and updating of admiralty charts and publications through the national Notice to Mariners system.

3.4.9 The Licensee must, within one month of the Completion of the Licensed Activity, provide the “as-built” routes of the export cables to the UKHO for nautical charting purposes.

3.4.10 The Licensee must, as per the requirements of the MCA's MGN [543-654](#) and supplementary updates, complete post-installation hydrographic surveys of the Site or subsections thereof, to the IHO Order 1a survey standard. On completion of these surveys, the data and a corresponding report of survey must be supplied to the UKHO, with notification to the MCA hydrography manager and the Licensing Authority.

3.4.11 The Licensee must ensure that local mariners, fishermen's organisations and HM Coastguard, in this case the National Maritime Coastguard Centre are made fully aware of the Completion of the Licensed Activity.

3.4.12 The Licensee must ensure that the Completion of the Licensed Activity is promulgated in the Kingfisher Fortnightly Bulletin to inform the commercial fishing industry.

3.4.13 The Licensee must, where any damage, destruction or decay is caused to the Works, notify the Licensing Authority, in writing, of such damage, destruction or decay as soon as reasonably practicable following such damage, destruction or decay. The Licensee must carry out any remedial action which the Licensing Authority advises the Licensee, in writing, as requiring to be taken, which may include a requirement to display aids to navigation, following consultation by the Licensing Authority with the MCA, the NLB or any such advisers as required.

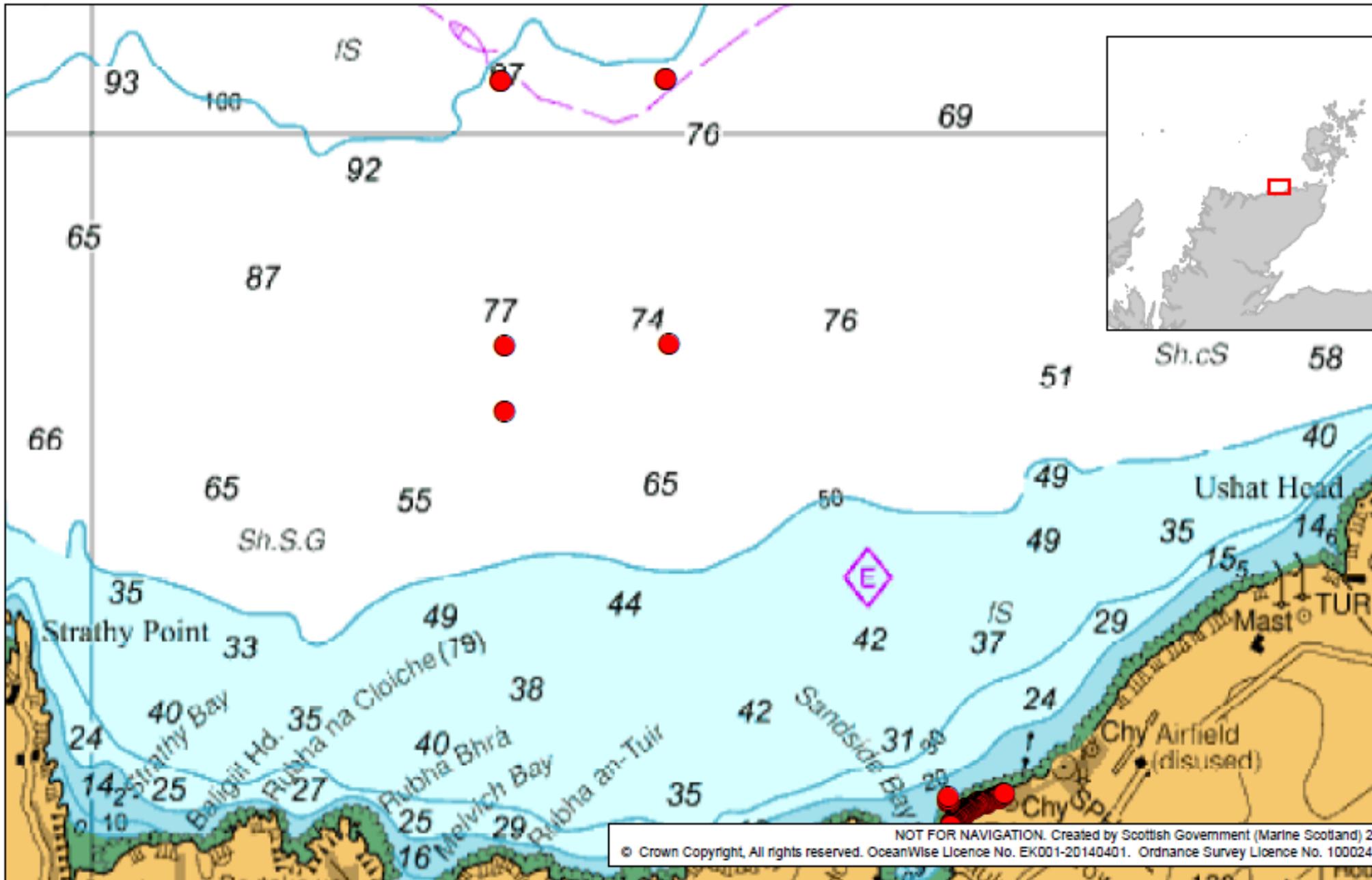
3.4.14 The Licensee must, as soon as reasonably practicable following the completion of cable protection works, provide information confirming the location of cable protection measures and the type of cable protection used to the Licensing Authority, the SFF and, on request, to other fisheries representatives.

NOTES

1. You are deemed to have satisfied yourself that there are no barriers, legal or otherwise, to the carrying out of the licensed activity. The issue of the licence does not absolve the licensee from obtaining such authorisations, consents etc which may be required under any other legislation.
2. In the event that the licensee wishes any of the particulars set down in the Schedule to be altered, the licensing authority must be immediately notified of the alterations. It should be noted that changes can invalidate a licence, and that an application for a new licence may be necessary.

Annex One to licences MS-00009991 & MS-00009992

Chart showing the location of Licensed Activity



Appendix C – SLVIA Comparative Assessment

C.1 SLVIA Comparative Assessment Report

Pentland Floating Offshore Wind Farm – LVIA Overview of Refined Scheme

OPEN

18/05/2023

1 Introduction

- 1 This report has been prepared by Optimised Environments on behalf of COP. It sets out a high-level comparison between the **consented scheme** and the **refined scheme** for the Pentland Floating Offshore Wind Farm (PFOWF), ‘the Project’.
- 2 The number and dimensions of the Wind Turbine Generators (WTGs) for the consented scheme and refined scheme are set out in the Table 1 below.

Table 1: Comparison between consented scheme and refined scheme WTG dimensions

Layout	Number of WTGs	Rotor Diameter	Hub Height	Blade Tip Height
Consented Scheme	7 in total	260m	170m	300m
Refined Scheme	6 in total	5 WTG @ 250m 1 WTG @ 220m	5 WTG @ 160m 1 WTG @ 145m	5 WTG @ 285m 1 WTG @ 255m

- 3 The table illustrates a change in the number of WTGs from seven to six, as well as a reduction in all dimensions for the six WTGs in the refined scheme, with rotor diameter, hub height and blade tip height reduced for the five WTGs with rotor diameter 250m and reduced more notably for the one WTG with rotor diameter 220m.
- 4 This report considers how these changes to the WTGs have altered the appearance of the Project and how they may affect the potential landscape and visual effects that were assessed in the LVIA for the consented scheme. The effect of the one smaller WTG with rotor diameter 220m compared to the five larger WTGs with rotor diameter 250m is also considered in the assessment.

2 Comparative Wirelines

- 1 Comparative wirelines have been prepared which illustrate the changes in appearance between the consented scheme and the refined scheme.
- 2 The most notable difference in respect of all the viewpoints is that the horizontal extent of the WTGs is visibly reduced between the consented scheme and the refined scheme. This is because the WTGs are contained within a smaller site, and this contains their horizontal extents in the seascape. The reduction in the number of WTGs from seven to six is also readily apparent and contributes to the reduction in horizontal extents, as

well as the reduction in the incidences of overlap in some of the viewpoints.

- 3 The reduction in height of the WTGs is not so readily apparent, although this relates to the more incremental reduction between the WTGs used in the consented scheme and refined scheme, whereby reductions in rotor diameter and hub height are 10m and reductions in blade tip are 15m for the five WTGs with rotor diameter 250m. While the reduction in height for the one WTG with rotor diameter 220m is more marked with a 45m reduction in blade tip height, this difference is also not readily apparent, owing to the different ranges of the WTGs masking potential variations in height.
- 4 A comparison of the assessment of the consented scheme and the refined scheme is presented in Table 2 below. This highlights that although there is a readily apparent improvement in the visual appearance of the refined scheme compared to the consented scheme, these differences would not be sufficient to change a significant effect into a not significant effect.

Table 2: Comparison between assessment of consented project parameters and refined parameters

Viewpoint	Consented Parameters	Refined Parameters
1 Beinn Ratha	Sensitivity - medium-high Magnitude of change (MoC) – medium-high Significant at a major / moderate level	Reduction in horizontal extent readily apparent. Although there would be a slight reduction in MoC, overall, the assessment would remain unaltered owing to incremental nature of reductions and overall effect of introducing WTGs into undeveloped seascape. WTG1 (rotor diameter 220 m) appears slightly larger than the five larger WTGs (rotor diameter 250 m) owing to the location of WTG1 closest to shore and the limited difference in blade tip height of 30 m.
2 Strathy Point Car Park	Sensitivity - medium-high Magnitude of change – medium-high Significant at a major / moderate level	Reduction in horizontal extent readily apparent, especially with reference to Hoy in background. Although there would be a slight reduction in MoC, overall, the assessment would remain unaltered owing to incremental nature of reductions and overall effect of introducing WTGs into undeveloped seascape. WTG1 (rotor diameter 220 m) appears similar in size to the five larger WTGs (rotor diameter 250 m) owing to the location of WTG1 in the row of the array closest to shore and the limited difference in blade tip height of 30 m.
3 Portskerra /Melvich	Sensitivity - medium-high Magnitude of change – medium-high Significant at a major / moderate level	Reduction in horizontal extent readily apparent and WTGs appear very evenly spaced. Although there would be a slight reduction in MoC, overall, the assessment would remain unaltered owing to incremental nature of reductions and overall effect of introducing WTGs into undeveloped seascape. WTG1 (rotor diameter 220 m) appears similar in size to the five larger WTGs (rotor diameter 250 m) owing to the limited difference in height of 30 m and the

		location of WTG1 in the row of the array closest to shore.
4 Drum Holliston Car Park	Sensitivity - medium-high Magnitude of change – medium-high Significant at a major / moderate level	Reduction in horizontal extent readily apparent although grouping of WTGs with gap between arises. Although there would be a slight reduction in MoC, overall, the assessment would remain unaltered owing to incremental nature of reductions and overall effect of introducing WTGs into undeveloped seascape. WTG1 (rotor diameter 220 m) appears slightly larger than the five larger WTGs (rotor diameter 250 m) owing to the location of WTG1 closest to shore and the limited difference in blade tip height of 30 m.
5 Sandside Headland	Sensitivity - medium Magnitude of change – medium-high Significant at a moderate level	Reduction in horizontal extent readily apparent although overlap between central WTGs arises. Although there would be a slight reduction in MoC, overall, the assessment would remain unaltered owing to incremental nature of reductions and overall effect of introducing WTGs into undeveloped seascape. WTG1 (rotor diameter 220 m) appears slightly larger than the five larger WTGs (rotor diameter 250 m) owing to the limited difference in blade tip height of 30 m and the location of WTG1 closest to shore.
6 St Mary's Chapel, Forss	Sensitivity - medium-high Magnitude of change – medium-low Not significant at a moderate level	Reduction in horizontal extent readily apparent and WTGs appear very evenly spaced. Although there would be a slight reduction in MoC, overall, the assessment would remain unaltered owing to incremental nature of reductions and moderating effect of close range operational Forss WTGs. WTG1 (rotor diameter 220 m) appears similar in size to the five larger WTGs (rotor diameter 250 m) owing to the limited difference in blade tip height of 30 m and the location of WTG1 in the row of the array closest to shore.
7 Dunnet Head	Sensitivity - medium-high Magnitude of change – medium-low Significant at a moderate level	Reduction in horizontal extent apparent, albeit less so from more distant range and with grouping of WTGs remaining. Although there would be a slight reduction in MoC, overall, the assessment would remain unaltered owing to incremental nature of reductions and moderating effect of separation distance and other distant wind farm influences. Any differences in blade tip height between the WTGs will not be discernible from this viewpoint owing to the separation distance of 28 km.
10 A836 East of Forss	Sensitivity - medium-high or medium Magnitude of change – medium-low Not significant at a moderate level	Reduction in horizontal extent readily apparent and WTGs appear very evenly spaced. Although there would be a slight reduction in MoC, overall, the assessment would remain unaltered owing to incremental nature of reductions and moderating effect of operational wind farms and other developments.

		WTG1 (rotor diameter 220 m) appears similar in size to the five larger WTGs (rotor diameter 250 m) owing to the limited difference in height of 30 m and the location of WTG1 in the row of the array closest to shore.
13 A' Mhoine	Sensitivity - high Magnitude of change – low Not significant at a moderate / minor level	Reduction in horizontal extent apparent, albeit less so from more distant range and with WTGs visible to only very limited extents. Although there would be a slight reduction in MoC, overall, the assessment would remain unaltered owing to incremental nature of reductions and moderating effect of separation distance and limited extents of visibility. Any differences in height between the WTGs would not be discernible from this viewpoint owing to the separation distance of 34 km and the screening effect of the intervening landform.
14 Ben Dorrery	Sensitivity - medium Magnitude of change – medium-low Not significant at a moderate / minor level	Reduction in horizontal extent readily apparent and spacing of WTGs improved. Although there would be a slight reduction in MoC, overall, the assessment would remain unaltered owing to incremental nature of reductions and moderating effect of separation distance and other distant wind farm influences. WTG1 (rotor diameter 220 m) appears similar in size to the five larger WTGs (rotor diameter 250 m) owing to the limited difference in blade tip height of 30 m and the location of WTG1 in the row of the array closest to shore.

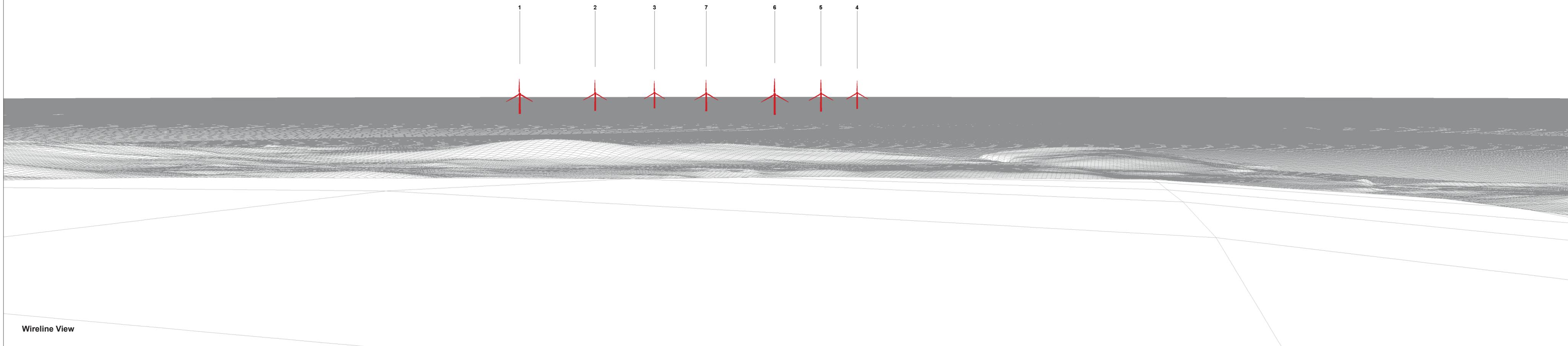
3 Summary

- 1 A comparative study has been conducted between the consented scheme and the refined scheme, where the changes include a reduction in the number of WTGs from seven to six, a reduction in the height of the WTGs and a refined layout within a more contained site. These changes have led to readily apparent reduced horizontal extents but not readily apparent reduced vertical extents. The height variance with the one smaller WTG with rotor diameter 220m would also not be readily visible. This is because this WTG is only 30 m smaller which is proportionally a seventh of the height of the larger WTGs with rotor diameter 250m and is located along with WTG 2 in the row of the array closest to the shore, thus owing to perspective, making it appear the same, or from some viewpoints, slightly larger than the larger WTGs with rotor diameter 250m. A similar effect occurs in respect of the consented scheme whereby the closer turbines appear slightly larger. In both the consented and the refined scheme, these differences appear incremental and overall, the turbines appear consistent in scale. This means that the height difference in the refined scheme will not alter the findings of the original assessment.
- 2 Comparative wirelines have been used to illustrate the differences in appearance between the consented and

refined scheme in respect of ten of the 14 viewpoints used in the LVIA. While these show the apparent difference in horizontal extents and reduced number of WTGs, they also show the limited difference that the more incremental height reduction of the WTGs would have. Despite the improvements that the refined scheme demonstrates, it is unlikely that the assessment presented in the LVIA would change notably as they would not be sufficient to change significant effects into not significant effects, other than potentially in threshold areas where incremental improvements would tip the balance. The refined scheme does, however, present positive improvements in the appearance of PFOWF and these should be considered favourably by statutory consultees.

Appendix C – SLVIA Comparative Assessment

C.2 Supporting Wirelines



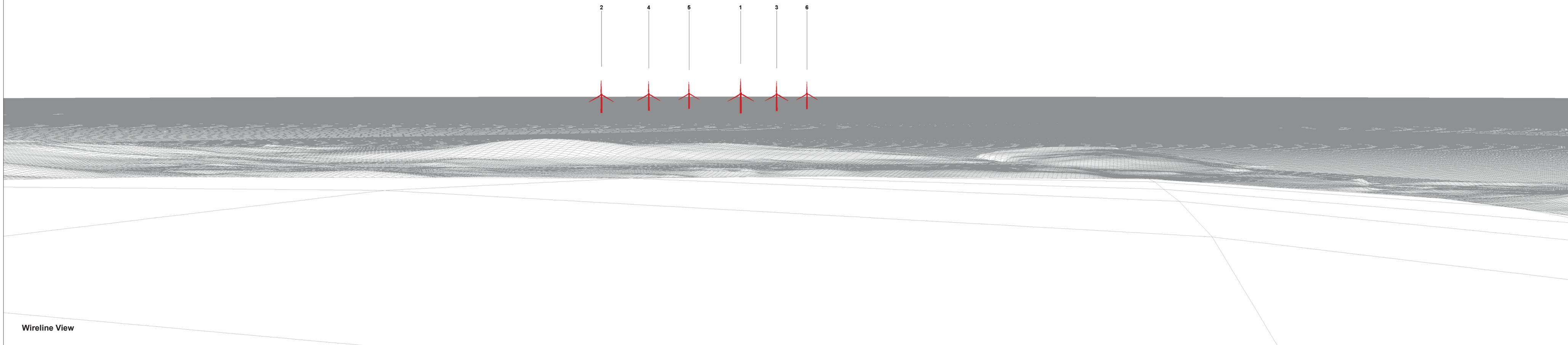
Wireline View

OS reference 295429 E 961312 N
Elevation 240.2 m AOD
Direction of view 348°
Nearest turbine 12,875 m

Horizontal field of view 53.5° (planar projection)
Principal distance 812.5 mm
Paper size 841 x 297 mm (half A1)
Correct printed image size 820 x 260 mm

T1-7: 170m hub height, 300m tip height, 260m rotor

Figure S32C-1a
Viewpoint 1: Beinn Ratha Wireline



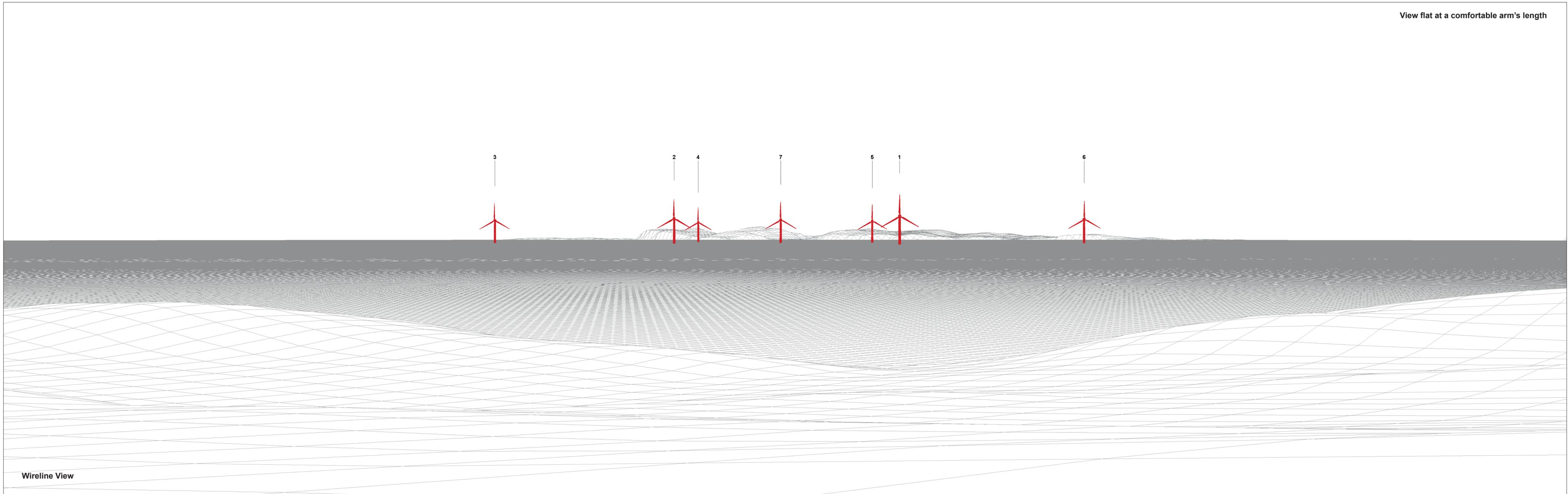
Wireline View

OS reference 295429 E 961312 N
Elevation 240.2 m AOD
Direction of view 348°
Nearest turbine 12,875 m

Horizontal field of view 53.5° (planar projection)
Principal distance 812.5 mm
Paper size 841 x 297 mm (half A1)
Correct printed image size 820 x 260 mm

T1: 14MW turbine (145m hub height, 255m tip height 220m rotor)
T2-6: 17MW turbines (160m hub height, 285m tip height, 250m rotor)

Figure S32C-1b
Viewpoint 1: Beinn Ratha Wireline



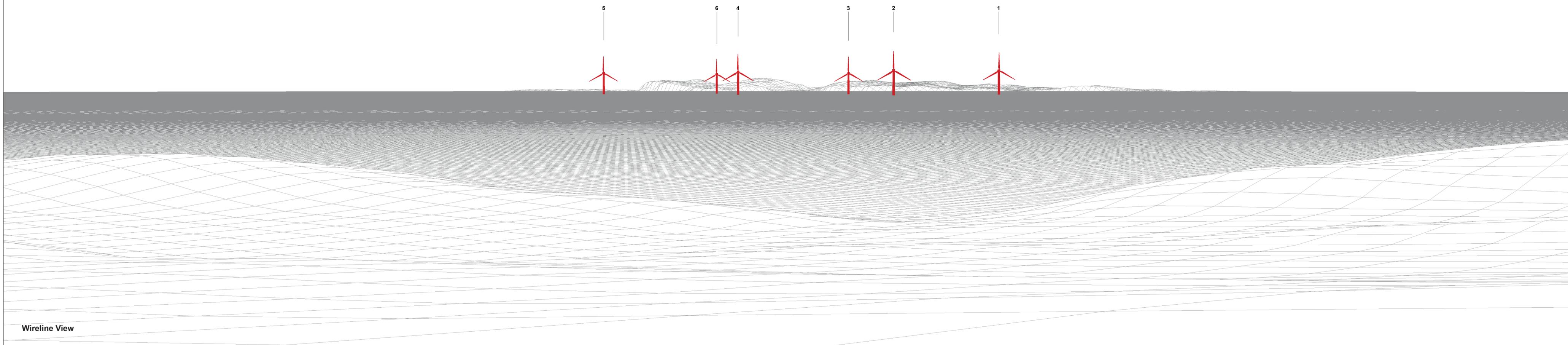
Wireline View

OS reference 282725 E 968587 N
Elevation 60.8 m AOD
Direction of view 51°
Nearest turbine 9,312 m

Horizontal field of view 53.5° (planar projection)
Principal distance 812.5 mm
Paper size 841 x 297 mm (half A1)
Correct printed image size 820 x 260 mm

T1-7: 170m hub height, 300m tip height, 260m rotor

Figure S32C-2a
Viewpoint 2: Strathy Point Car Park Wireline

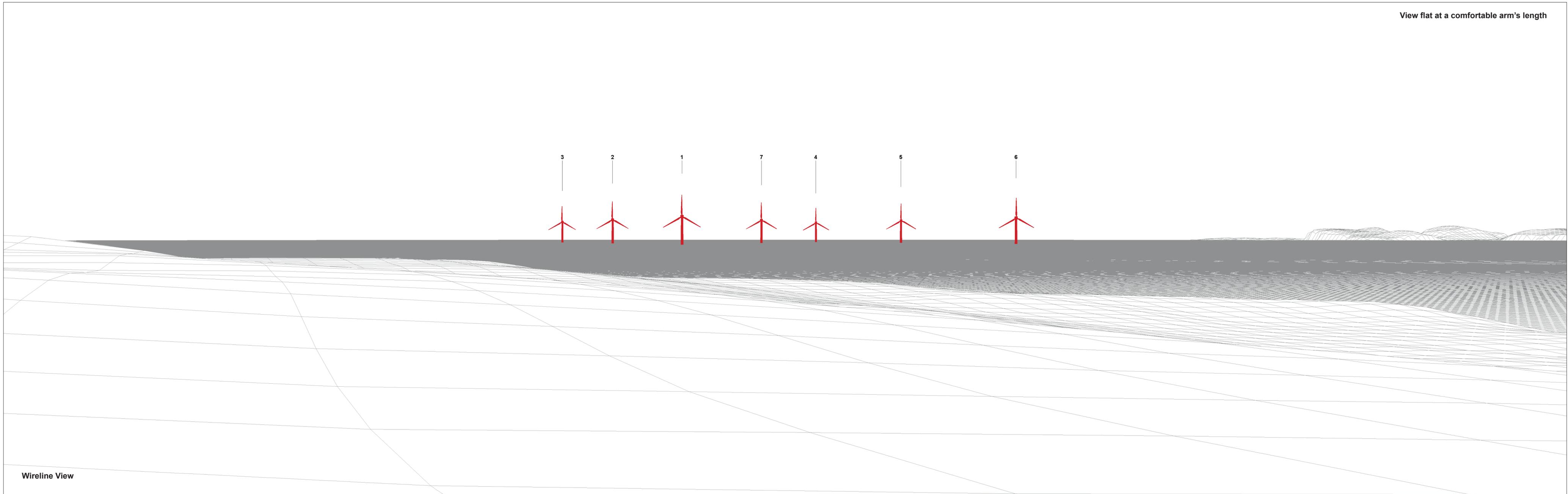


Wireline View

OS reference	282725 E 968587 N	Horizontal field of view	53.5° (planar projection)
Elevation	60.8 m AOD	Principal distance	812.5 mm
Direction of view	51°	Paper size	841 x 297 mm (half A1)
Nearest turbine	9,312 m	Correct printed image size	820 x 260 mm

T1: 14MW turbine (145m hub height, 255m tip height 220m rotor)
T2-6: 17MW turbines (160m hub height, 285m tip height, 250m rotor)

Figure S32C-2b
Viewpoint 2: Strathy Point Car Park Wireline



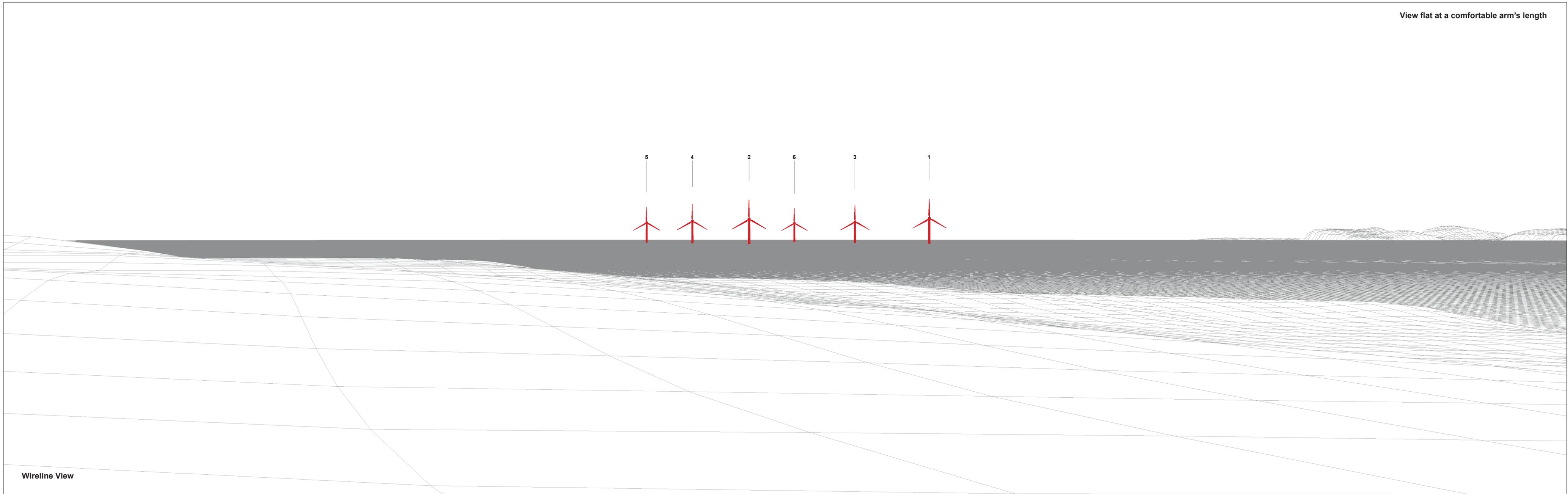
Wireline View

OS reference 287767 E 964926 N
Elevation 61.2 m AOD
Direction of view 20°
Nearest turbine 9,344 m

Horizontal field of view 53.5° (planar projection)
Principal distance 812.5 mm
Paper size 841 x 297 mm (half A1)
Correct printed image size 820 x 260 mm

T1-7: 170m hub height, 300m tip height, 260m rotor

Figure S32C-3a
Viewpoint 3: Portskerra/Melvich Wireline



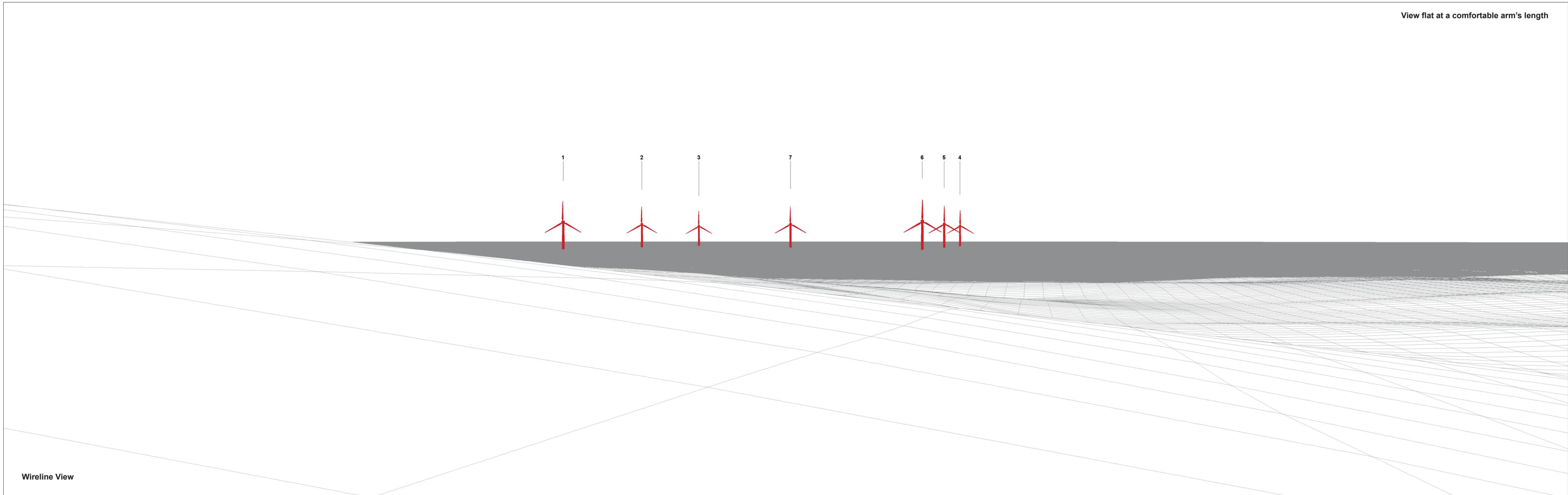
Wireline View

OS reference 287767 E 964926 N
Elevation 61.2 m AOD
Direction of view 20°
Nearest turbine 9,344 m

Horizontal field of view 53.5° (planar projection)
Principal distance 812.5 mm
Paper size 841 x 297 mm (half A1)
Correct printed image size 820 x 260 mm

T1: 14MW turbine (145m hub height, 255m tip height 220m rotor)
T2-6: 17MW turbines (160m hub height, 285m tip height, 250m rotor)

Figure S32C-3b
Viewpoint 3: Portskerra/Melvich Wireline



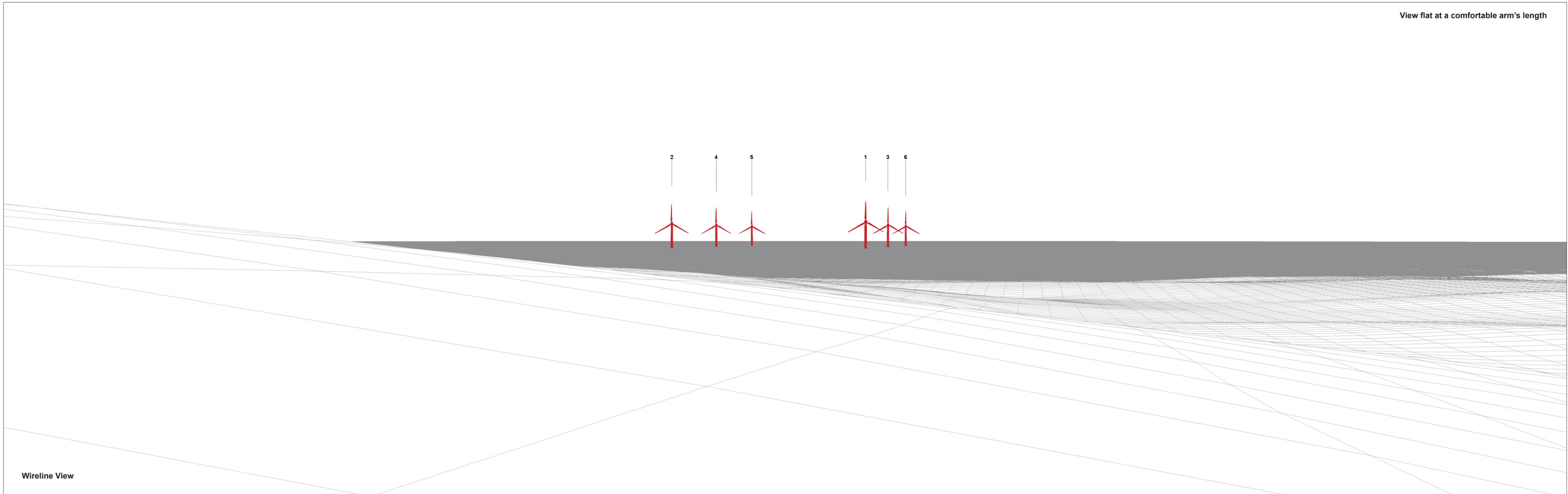
Wireline View

OS reference 293264 E 964541 N
Elevation 88.9 m AOD
Direction of view 351°
Nearest turbine 9,347 m

Horizontal field of view 53.5° (planar projection)
Principal distance 812.5 mm
Paper size 841 x 297 mm (half A1)
Correct printed image size 820 x 260 mm

T1-7: 170m hub height, 300m tip height, 260m rotor

Figure S32C-4a
Viewpoint 4: Drum Holliston Car Park Wireline



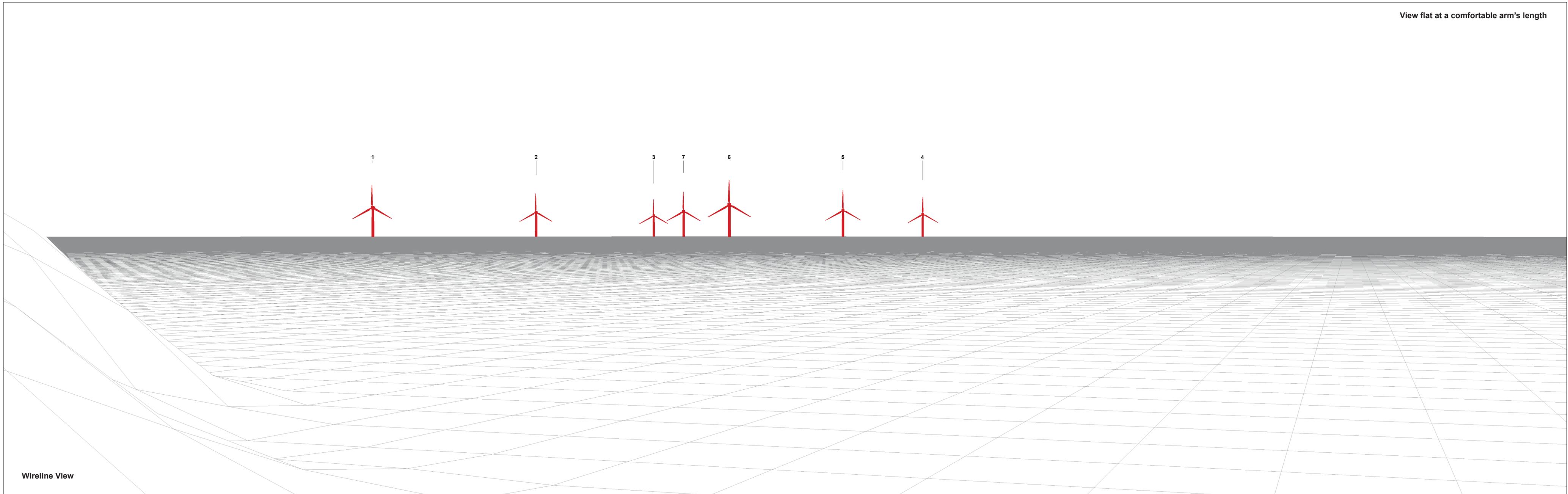
Wireline View

OS reference 293264 E 964541 N
Elevation 88.9 m AOD
Direction of view 351°
Nearest turbine 9,347 m

Horizontal field of view 53.5° (planar projection)
Principal distance 812.5 mm
Paper size 841 x 297 mm (half A1)
Correct printed image size 820 x 260 mm

T1: 14MW turbine (145m hub height, 255m tip height 220m rotor)
T2-6: 17MW turbines (160m hub height, 285m tip height, 250m rotor)

Figure S32C-4b
Viewpoint 4: Drum Holliston Car Park Wireline



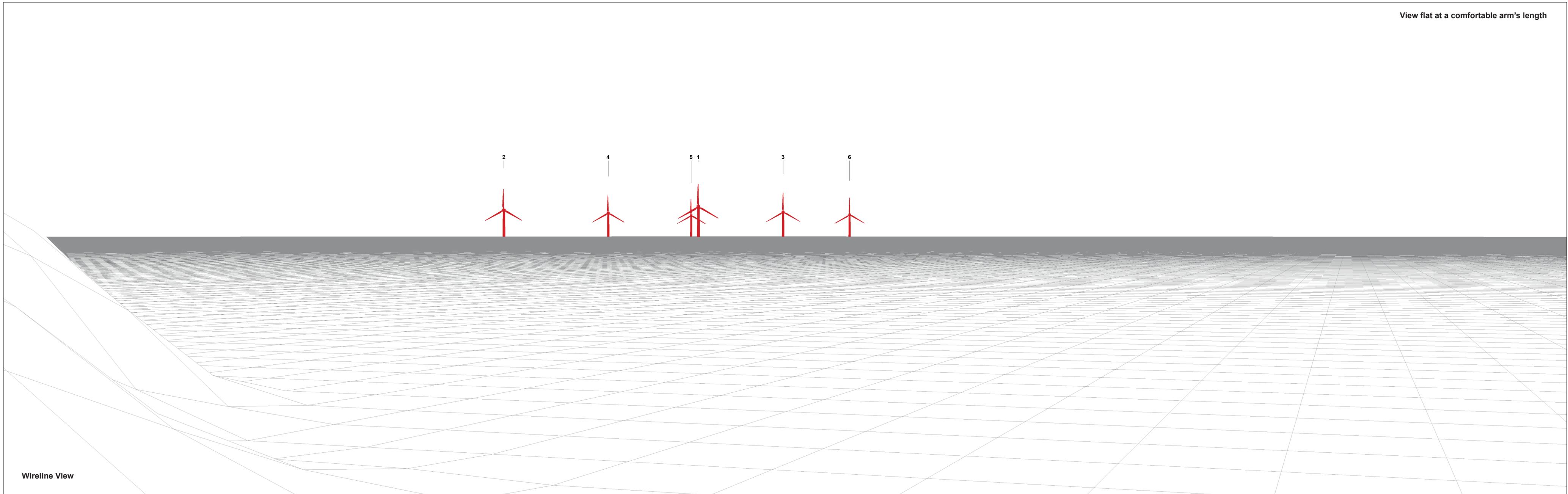
Wireline View

OS reference 295694 E 966269 N
Elevation 13 m AOD
Direction of view 340°
Nearest turbine 8,197 m

Horizontal field of view 53.5° (planar projection)
Principal distance 812.5 mm
Paper size 841 x 297 mm (half A1)
Correct printed image size 820 x 260 mm

T1-7: 170m hub height, 300m tip height, 260m rotor

Figure S32C-5a
Viewpoint 5: Sandside Head Wireline



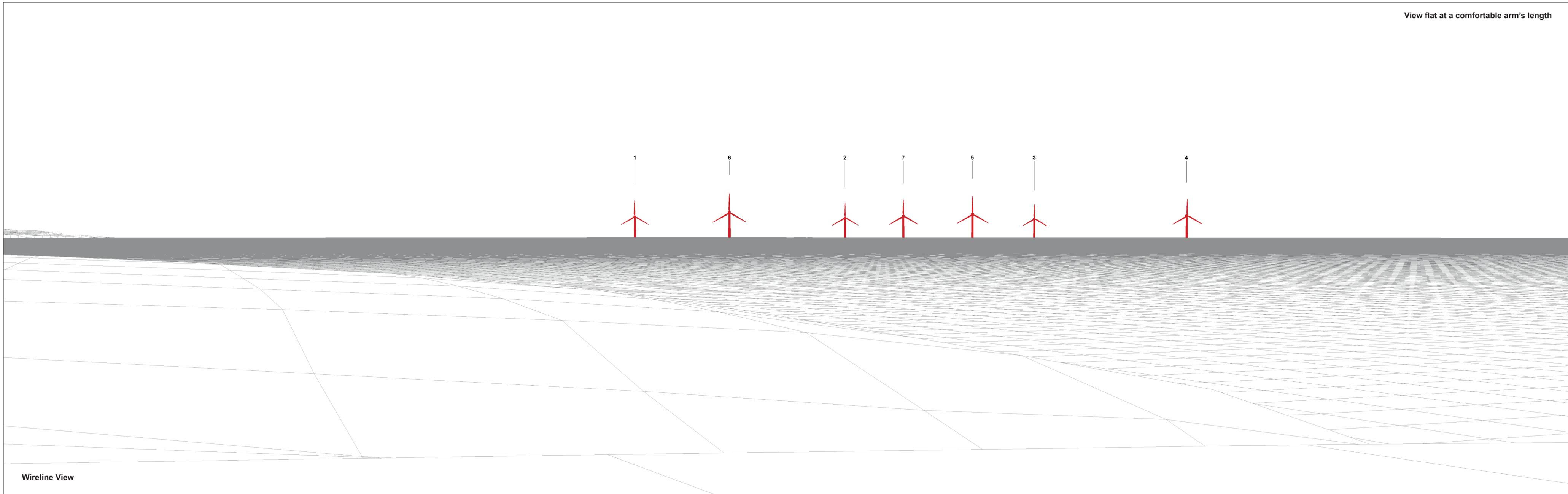
Wireline View

OS reference 295694 E 966269 N
Elevation 13 m AOD
Direction of view 340°
Nearest turbine 8,197 m

Horizontal field of view 53.5° (planar projection)
Principal distance 812.5 mm
Paper size 841 x 297 mm (half A1)
Correct printed image size 820 x 260 mm

T1: 14MW turbine (145m hub height, 255m tip height 220m rotor)
T2-6: 17MW turbines (160m hub height, 285m tip height, 250m rotor)

Figure S32C-5b
Viewpoint 5: Sandside Head Wireline



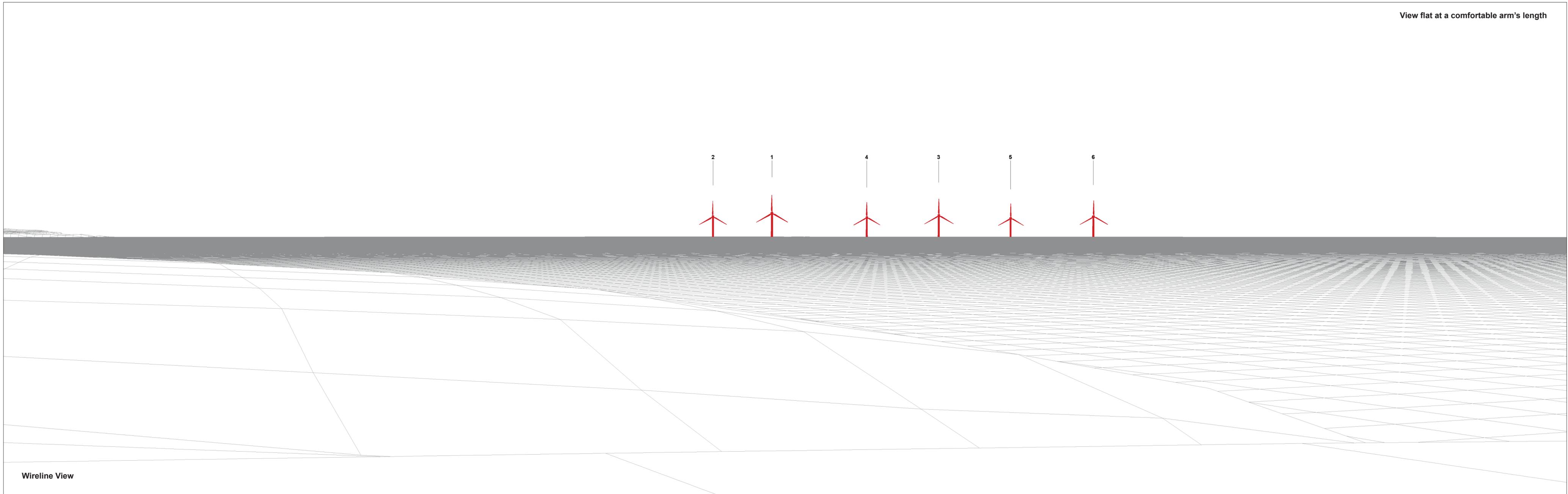
Wireline View

OS reference 302487 E 970105 N
Elevation 15.2 m AOD
Direction of view 293°
Nearest turbine 10,564 m

Horizontal field of view 53.5° (planar projection)
Principal distance 812.5 mm
Paper size 841 x 297 mm (half A1)
Correct printed image size 820 x 260 mm

T1-7: 170m hub height, 300m tip height, 260m rotor

Figure S32C-6a
Viewpoint 6: St Mary's Chapel, Forss Wireline



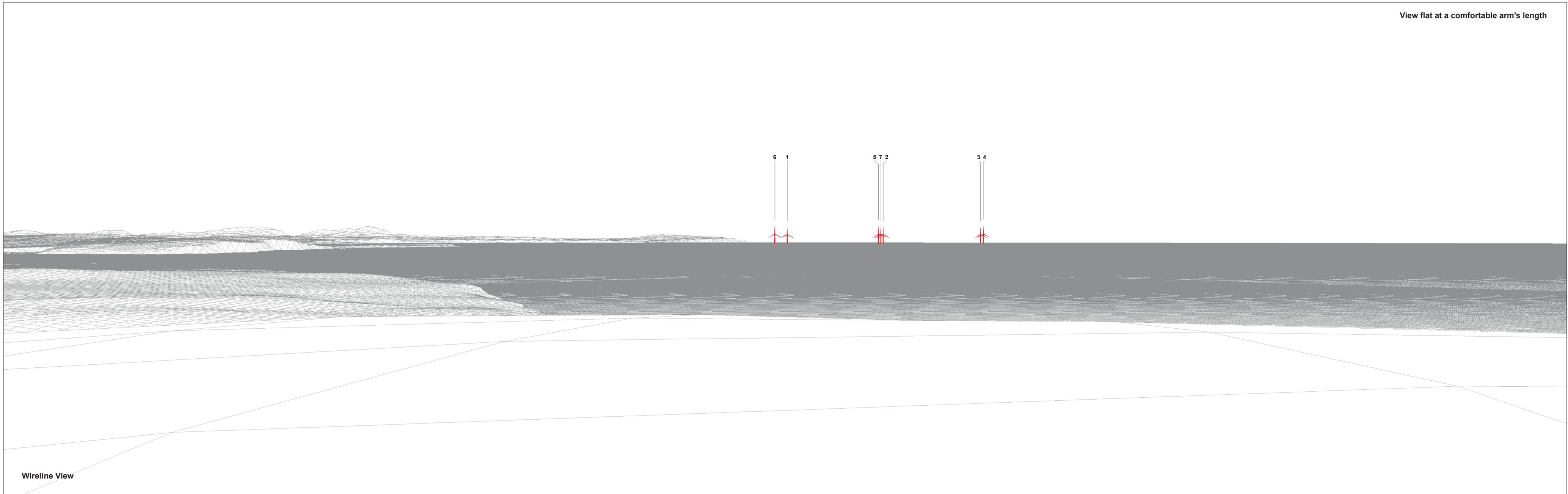
Wireline View

OS reference 302487 E 970105 N
Elevation 15.2 m AOD
Direction of view 293°
Nearest turbine 10,564 m

Horizontal field of view 53.5° (planar projection)
Principal distance 812.5 mm
Paper size 841 x 297 mm (half A1)
Correct printed image size 820 x 260 mm

T1: 14MW turbine (145m hub height, 255m tip height 220m rotor)
T2-6: 17MW turbines (160m hub height, 285m tip height, 250m rotor)

Figure S32C-6b
Viewpoint 6: St Mary's Chapel, Forss Wireline



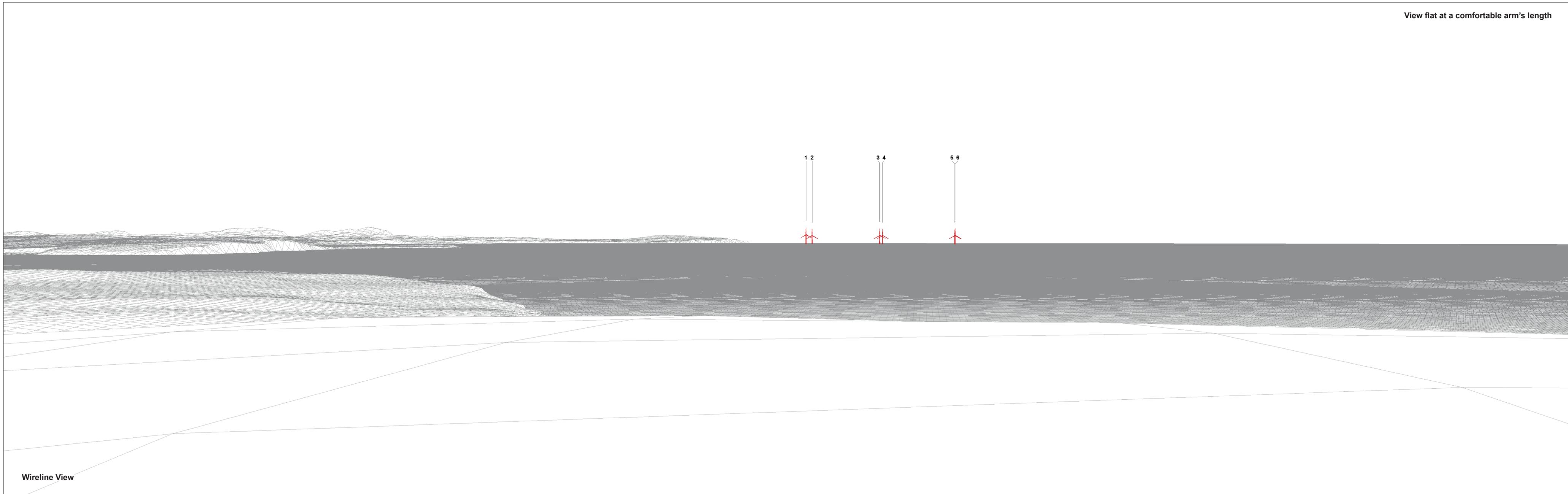
Wireline View

OS reference 320532 E 976496 N
Elevation 125.9 m AOD
Direction of view 265°
Nearest turbine 27,884 m

Horizontal field of view 53.5° (planar projection)
Principal distance 812.5 mm
Paper size 841 x 297 mm (half A1)
Correct printed image size 820 x 260 mm

T1-7: 170m hub height, 300m tip height, 260m rotor

Figure S32C-7a
Viewpoint 7: Dunnet Head Wireline



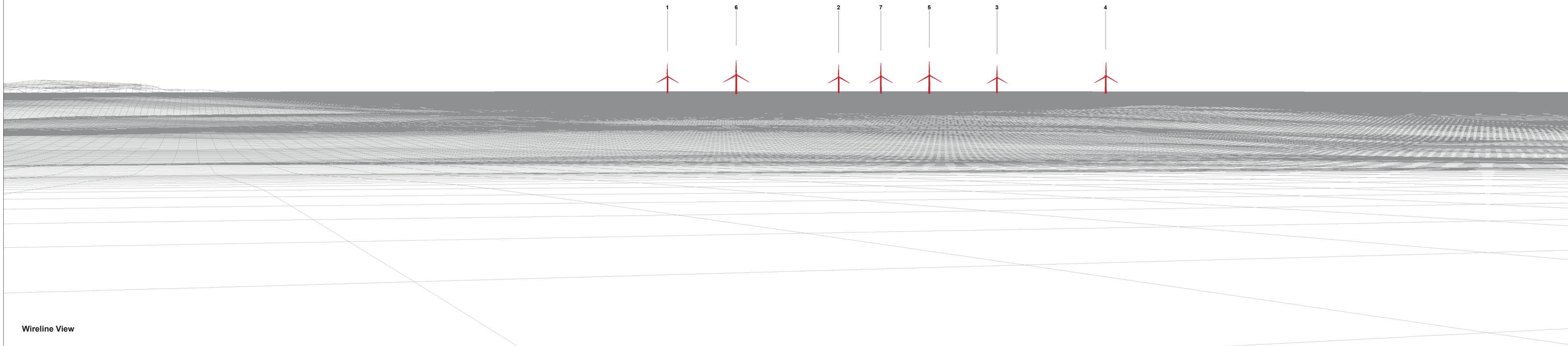
Wireline View

OS reference 320532 E 976496 N
Elevation 125.9 m AOD
Direction of view 265°
Nearest turbine 27,884 m

Horizontal field of view 53.5° (planar projection)
Principal distance 812.5 mm
Paper size 841 x 297 mm (half A1)
Correct printed image size 820 x 260 mm

T1: 14MW turbine (145m hub height, 255m tip height 220m rotor)
T2-6: 17MW turbines (160m hub height, 285m tip height, 250m rotor)

Figure S32C-7b
Viewpoint 7: Dunnet Head Wireline



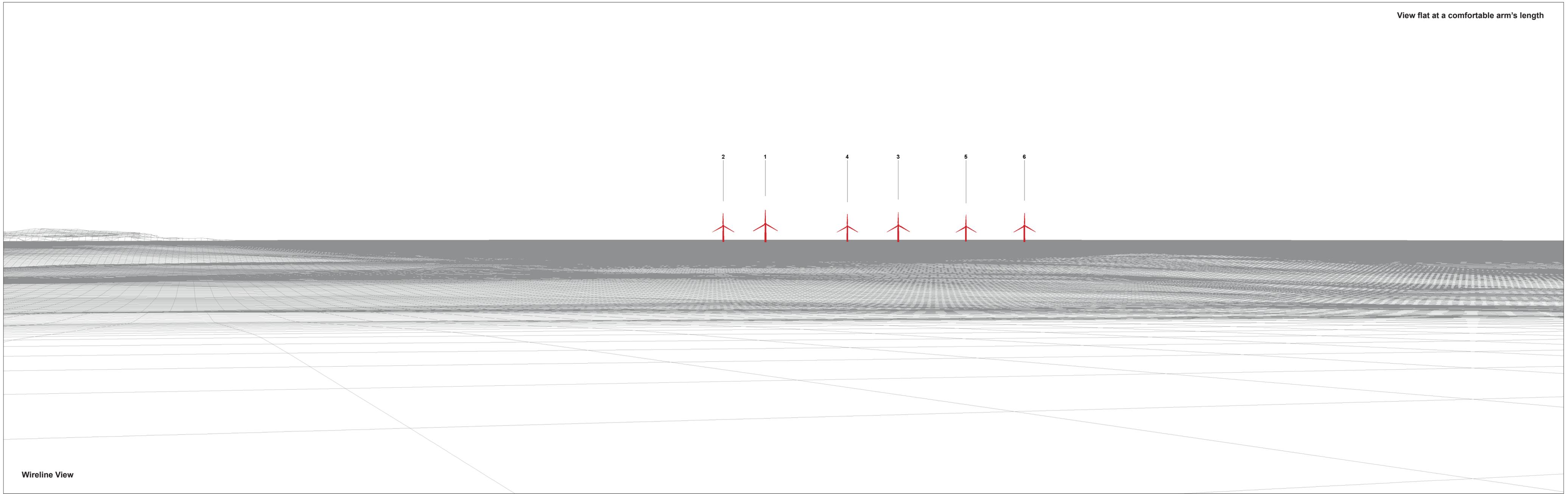
Wireline View

OS reference 305643 E 969387 N
Elevation 71.1 m AOD
Direction of view 291°
Nearest turbine 13,776 m

Horizontal field of view 53.5° (planar projection)
Principal distance 812.5 mm
Paper size 841 x 297 mm (half A1)
Correct printed image size 820 x 260 mm

T1-7: 170m hub height, 300m tip height, 260m rotor

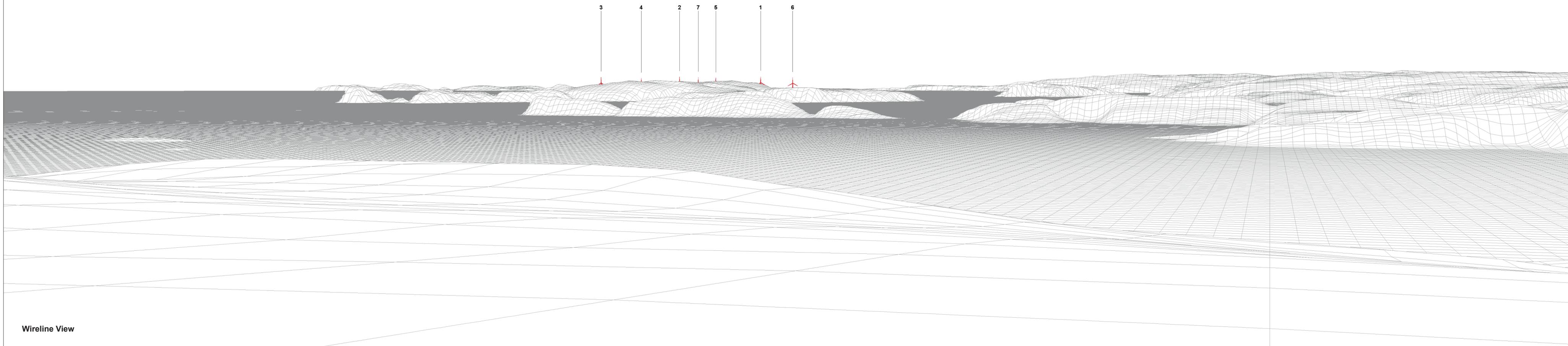
Figure S32C-8a
Viewpoint 10: A836 East of Forss Wireline



Wireline View

OS reference	305643 E 969387 N	Horizontal field of view	53.5° (planar projection)
Elevation	71.1 m AOD	Principal distance	812.5 mm
Direction of view	291°	Paper size	841 x 297 mm (half A1)
Nearest turbine	13,776 m	Correct printed image size	820 x 260 mm

T1: 14MW turbine (145m hub height, 255m tip height 220m rotor)
T2-6: 17MW turbines (160m hub height, 285m tip height, 250m rotor)

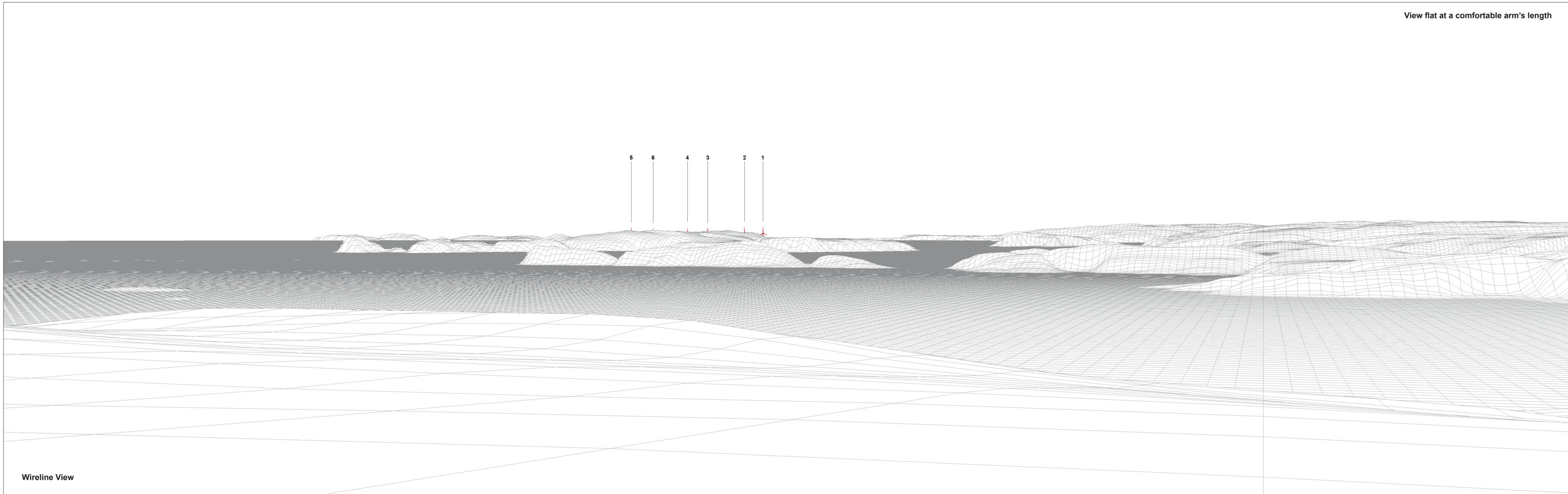


Wireline View

OS reference	258497 E 963460 N	Horizontal field of view	53.5° (planar projection)
Elevation	53.5 m AOD	Principal distance	812.5 mm
Direction of view	73°	Paper size	841 x 297 mm (half A1)
Nearest turbine	33,542 m	Correct printed image size	820 x 260 mm

T1-7: 170m hub height, 300m tip height, 260m rotor

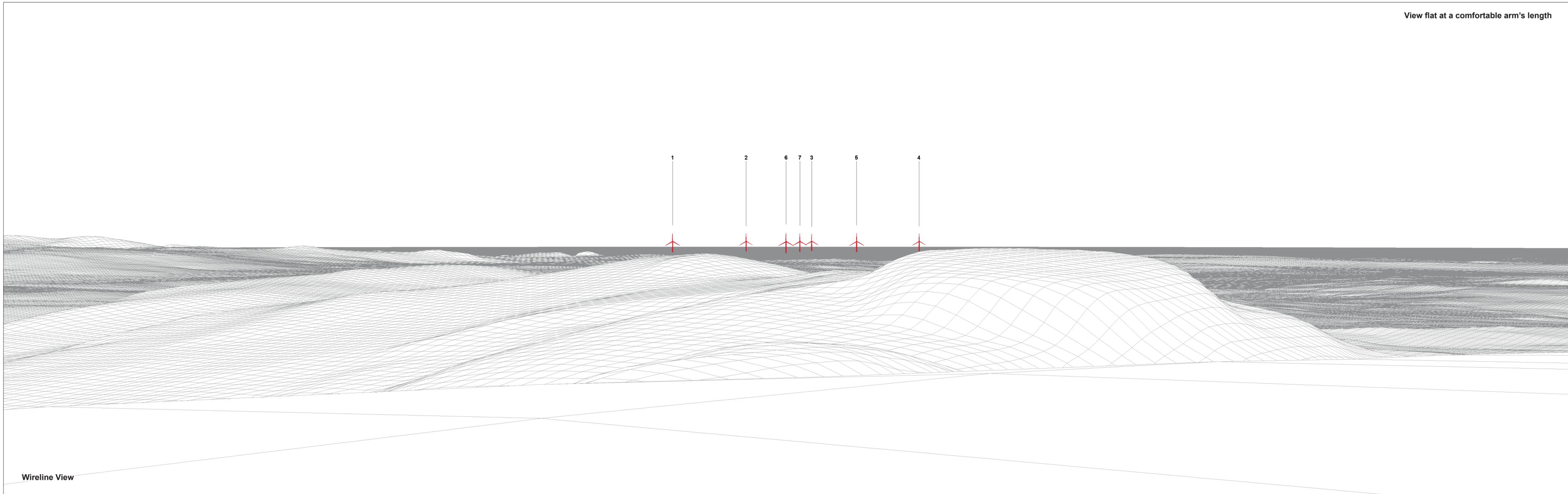
Figure S32C-9a
Viewpoint 13: A Mhoine Wireline



Wireline View

OS reference	258497 E 963460 N	Horizontal field of view	53.5° (planar projection)
Elevation	53.5 m AOD	Principal distance	812.5 mm
Direction of view	73°	Paper size	841 x 297 mm (half A1)
Nearest turbine	33,542 m	Correct printed image size	820 x 260 mm

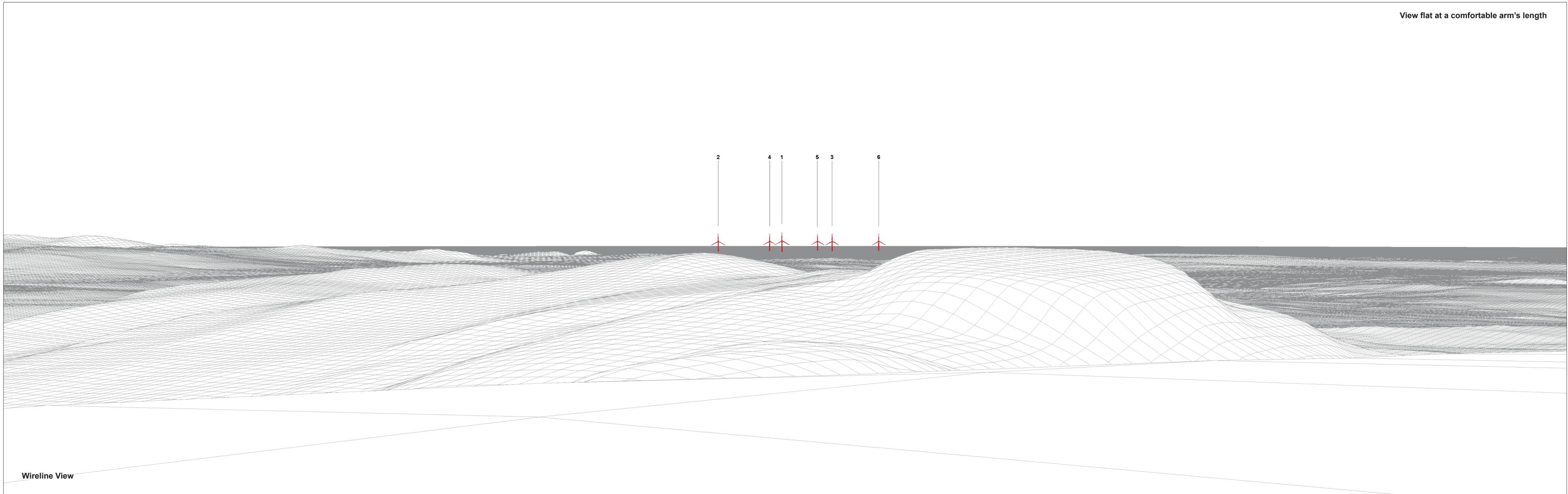
T1: 14MW turbine (145m hub height, 255m tip height 220m rotor)
T2-6: 17MW turbines (160m hub height, 285m tip height, 250m rotor)



Wireline View

OS reference	306302 E 955068 N	Horizontal field of view	53.5° (planar projection)
Elevation	242.6 m AOD	Principal distance	812.5 mm
Direction of view	324°	Paper size	841 x 297 mm (half A1)
Nearest turbine	23,252 m	Correct printed image size	820 x 260 mm

T1-7: 170m hub height, 300m tip height, 260m rotor



Wireline View

OS reference 306302 E 955068 N
Elevation 242.6 m AOD
Direction of view 324°
Nearest turbine 23,252 m

Horizontal field of view 53.5° (planar projection)
Principal distance 812.5 mm
Paper size 841 x 297 mm (half A1)
Correct printed image size 820 x 260 mm

T1: 14MW turbine (145m hub height, 255m tip height 220m rotor)
T2-6: 17MW turbines (160m hub height, 285m tip height, 250m rotor)

Appendix D – RIAA Addendum

- D.1 Ornithology Summary Technical Appendix
- D.2 SeaBORD Displacement Modelling Technical Appendix
- D.3 Collision risk Modelling Technical Appendix
- D.4 Population Modelling Technical Appendix

Pentland Floating Offshore Wind Farm S36C Variation Application

Technical Appendix D I: Marine Ornithology Modelling Results Summary

Authorisations

Responsibility	Name	Signature	Date
Prepared by	Catriona Gall	[Redacted]	03/10/2023
Checked and Approved by	Glen Tyler	[Redacted]	11/10/2023

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Acronyms and abbreviations

Acronyms / abbreviation	Full name
AA	Appropriate Assessment
AEOSI	Adverse Effect on Site Integrity
CGR	Counterfactual of Annualised Growth Rate
CI	Confidence Interval
CPS	Counterfactual Population Size
CRM	Collision Risk Modelling
DSLPL	Design Specification and Layout Plan
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
HRA	Habitats Regulations Appraisal
HWL	Highland Wind Limited
INTOG	Innovation and Targeted Oil and Gas Decarbonisation
JNCC	Joint Nature Conservation Committee
MD-LOT	Marine Directorate Licensing and Operations Team
NE	Natural England
NS	NatureScot
PFOWF	Pentland Floating Offshore Wind Farm
PVA	Population Viability Analysis
RLB	Red Line Boundary
RSPB	Royal Society for the Protection of Birds
SD	Standard Deviation
SMP	Seabird Monitoring Programme
SPA	Special Protection Area
WOW	West of Orkney Wind Farm
WTG	Wind Turbine Generator

I Introduction

- 1 As set out in the Variation Application Report, the Pentland Floating Offshore Wind Farm (PFOWF), (the Project) is being developed by HWL, to test and demonstrate emerging floating offshore wind technologies in Scottish waters. The proposed location of the turbine array is in the Pentland Firth off the north Caithness coast (near Dounreay). The original application was submitted in August 2022 and consent was granted on 28 June 2023.
- 2 As set out in the Scottish Ministers' decision notice and supporting Appropriate Assessment (AA), the Project consent was limited to 10 years of operation on the basis of the statutory advice received from NatureScot (NS) in relation to marine ornithology. NS concerns related specifically to potential adverse impact on site integrity (AEOSI) at North Caithness Cliffs Special Protection Area (SPA), for kittiwake and puffin¹. This was from the cumulative impacts of the original project in combination with the consented offshore wind farms in the Moray Firth (Beatrice, Moray East, Moray West) as well as with other offshore wind development in the wider North Sea (the latter solely in relation to kittiwake). No concerns regarding AEOSI were raised by NS for the Project in isolation.
- 3 As set out in the Variation Application Report, following detailed design work and in response to the concerns raised by NS, the Project's design envelope has been further refined which has led to a corresponding reduction in predicted impacts on kittiwake and puffin. This has been achieved by reducing the maximum number of wind turbine generators (WTG) from seven to six, as well as by reducing the size of the area in which the turbines will be placed (the WTG Footprint Area), as shown on Figure 1 (reduced from 10 km² in the Original Application and current consent to 5.85 km²).
- 4 These design refinements are being submitted as a S36C variation application (the 'Variation Application') to the consented PFOWF Project. This document demonstrates that the consented operational period of the Project can be increased from 10 years to 25 years by supporting a conclusion of no AEOSI at North Caithness Cliffs SPA for either kittiwake or puffin.
- 5 This Technical Appendix (D1) provides the overarching summary of the remodelling and reassessment undertaken in relation to marine ornithology for the Variation Application. It is supported by the following appendices:
 - Technical Appendix D2: SeabORD Displacement Modelling
 - Technical Appendix D3: Collision Risk Modelling
 - Technical Appendix D4: Population Modelling
- 6 Section 3 of this Appendix sets out a summary of the remodelling and reassessment undertaken and Section 4 presents the updated impacts (with a comparison against the estimates for the Original Application) for the Variation Application, both on its own and cumulatively with the other relevant offshore wind farms identified for assessment. As agreed

¹ The full names of the two species to be addressed for the Variation Application are:

- Black-legged kittiwake (*Rissa tridactyla*), hereafter 'kittiwake'; and
- Atlantic puffin (*Fratecula arctica*), hereafter 'puffin'.

with the Marine Directorate Licensing and Operations Team (MD-LOT) and NS at the meeting held on 26 July 2023, the Green Volt application is addressed qualitatively in this assessment, whereas the consideration of non-breeding season kittiwake collision risk is presented both with and without a collision mortality estimate for Berwick Bank.

- 7 A cut-off date for modelling assessments to support this Variation Application was agreed with MD-LOT as 19 July 2023 (see GBPNTD-ENV-PEN-CM-00009 in Annex A).
- 8 It is noted that the West of Orkney wind farm (WOW) has been submitted after the assessments for the PFOWF Variation were completed. However, as (annual) Project impacts are now reduced compared to the original application, the WOW assessment will be 'worst case' in terms of including the Project in its cumulative assessment. Therefore, there is no further necessary information for the Project to be providing (which is not otherwise available) for the decision-making on either this Project, or for WOW.

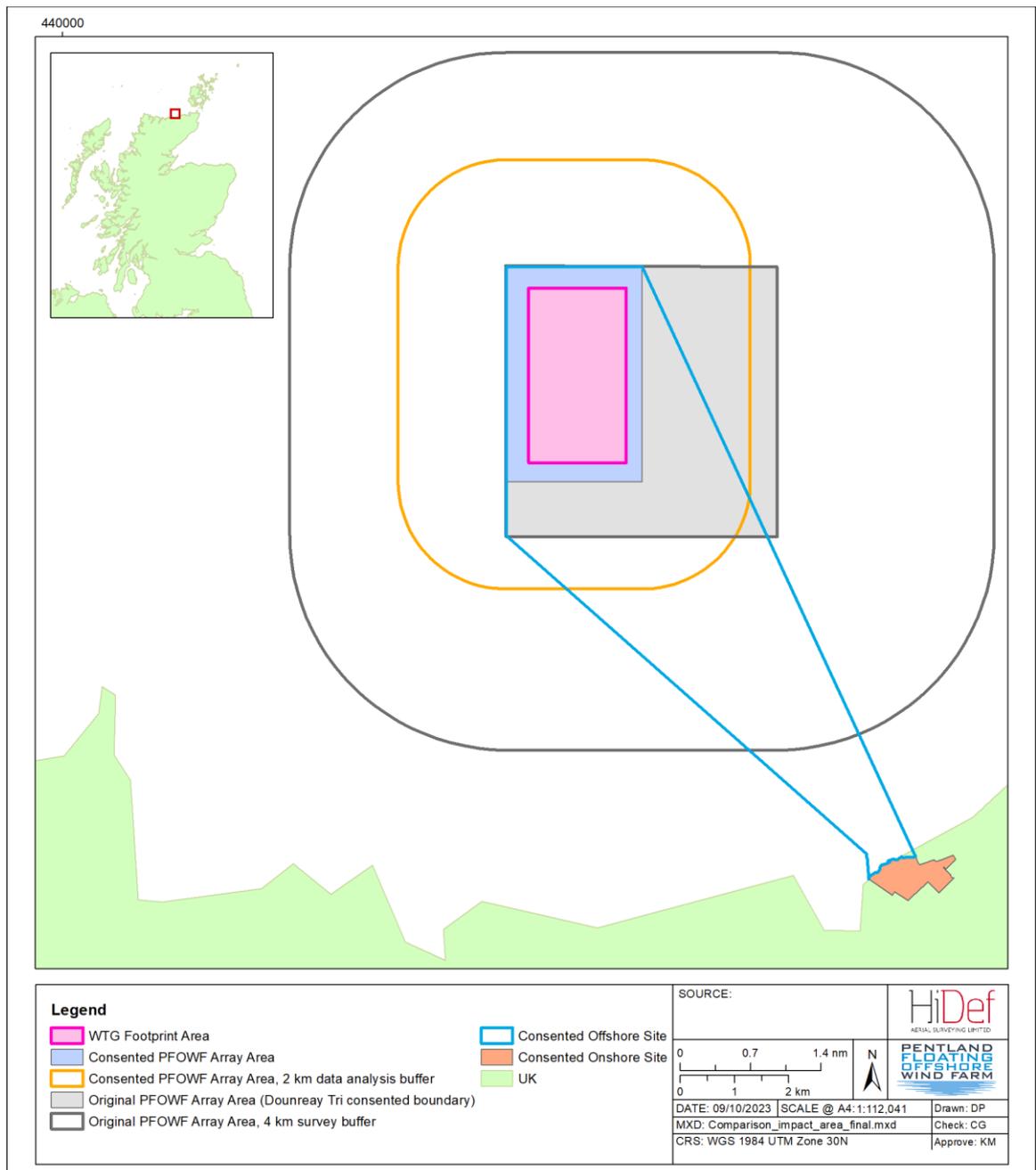


Figure 1 PFOWF Variation Application proposal, showing the revised array area (the WTG Footprint Area) in pink

2 Consultation

- 9 Pre-application consultation for the Original Application is recorded in the *Offshore EIAR (Volume 3) Technical Appendix 12.6 Marine Ornithology Consultation Advice*, as submitted. It provides a record of the over-arching principles agreed in dialogue with MD-LOT, NS and the Royal Society for the Protection of Birds (RSPB) Scotland for the original marine ornithological assessment, which have now also been adopted for this Variation Application.
- 10 Further engagement has been undertaken to agree the approach to this Variation Application. Specific refinements for the remodelling and further assessment of possible

kittiwake and puffin impacts arising from the proposed design refinements have been discussed and agreed through the following engagement, in advance of this application:

- 2 June 2023: HWL provided a note on the approach to the marine ornithology assessment for the proposed Variation Application (GBPNTD-PGM-PEN-PN-00019) (Annex A). This was sent to MD-LOT and NS.
- 22 June 2023: NS advice was received in response to the HWL note.
- 19 July 2023: HWL provided a method statement for CRM and PVA (GBPNTD-ENV-PEN-CM-00009) (Annex A). This was sent to MD-LOT and NS.
- 26 July 2023: marine ornithology meeting held with MD-LOT and NS.
- 3 August 2023: NS provided kittiwake input densities for the Moray Firth wind farm CRM to HWL (meeting action).
- 15 August 2023: HWL provided an update email to RSPB Scotland, relating to the proposed design refinements and assessment methods.
- 16 August 2023: HWL provided the draft SeabORD appendix (Appendix D.2). This was sent to MD-LOT and NS.
- 18 August 2023: HWL provided the draft cumulative North Sea kittiwake CRM figures (Appendix D.3). This was sent to MD-LOT and NS.
- 12 September 2023: marine ornithology meeting held with MD-LOT and NS.
- 15 September 2023: MD-LOT issued its Screening Opinion (MD-LOT, 2023) to HWL. This confirmed no EIA was required in respect of the Variation Application and provided further advice from MD-LOT and NS in relation to ornithological assessments.

Please see Section 3, for the key updates in assessment methodologies and modelling work undertaken for the PFOWF Variation Application (as compared to the Original Application).

3 Summary of Approach

- 11 As noted in Section 1, there are three key appendices which support the marine ornithological assessment for this Variation Application; Appendix D2 on SeabORD Displacement Modelling; Appendix D3 on Collision Risk Modelling (CRM); and Appendix D4 on Population Modelling.
- 12 As set out in the baseline characterisation for the Original Application (Section 12.4.4.1 for kittiwake and Section 12.4.4.4 for puffin of the *Offshore EIAR (Volume 3) Chapter 12, Marine Ornithology*), displacement analysis is required both for kittiwake and for puffin (as both species may be susceptible to such impacts), whereas CRM is only required for kittiwake (Furness *et al.*, 2013). The impacts (mortalities) estimated are input into a population viability analysis (PVA), to determine whether any population consequences are likely (as set out in Appendix D4 on Population Modelling).
- 13 When reviewing the outputs of the modelling assessments presented, it is important to note that it is not possible to compare results on a 'like for like' basis between the Original Application and the Variation Application. This is due to changes within methodologies between the two assessments, as agreed in consultation with NS and MD-LOT, such as the inclusion of impacts on productivity. The assessment of cumulative effects also now alternatively includes the addition of Berwick Bank. Therefore, the improvements in impact levels calculated for both kittiwake and puffin including the refined project parameters presented in the following sections are likely to be greater in a true 'like for like' modelling approach.
- 14 The key points set out in the following sections should also be noted in considering the updated methodologies and approaches to reassessment, as agreed with MD-LOT and NS.

3.1 SeabORD Displacement Modelling (Appendix D2)

- 15 As set out in HWL's ornithology assessment note (02/06/2023) and agreed with MD-LOT and NS during pre-application dialogue, the updated displacement analysis for kittiwake and puffin has been based on SeabORD modelling. This has been undertaken for the following three scenarios:
 1. Variation Application, project-alone.
 2. Moray Firth wind farms as built / consented (Beatrice, Moray East, Moray West).
 3. Variation Application and Moray Firth wind farms together.
- 16 All points raised in respect of HiDef's original SeabORD modelling specifically regarding boundary and buffer settings and decay curve specification have been addressed, as detailed in Appendix D2. SeabORD has been re-run using the published version of the code (V1.3 MATLAB code) as agreed with NS in its note of 22/06/2023. All available guidance has been followed (Searle *et al.*, 2018)², updated to use a 2 km 'boundary' measure rather than the 0.5 km originally taken from the guidance.

² [SeabORD: A tool to estimate the fate of birds displaced by offshore renewable developments \(webarchive.org.uk\)](https://web.archive.org/)

- 17 The updates to initial model (prey) calibration (setting the region for modelling) are set out in Section 2.1.3 of Appendix D2 (including the associated ‘heat maps’ as NS have requested).
- 18 In terms of the modelling undertaken, the revised Array Area (the WTG footprint Area) (as shown on Figure 1) was used, along with the consented red line boundaries (RLBs) for each of the Moray Firth wind farm projects.

3.2 Collision Risk Modelling (Appendix D3)

- 19 The detail of the new collision risk modelling (CRM) undertaken for the Variation Application and for the Moray Firth wind farms (based on the original ‘at sea’ kittiwake density estimates for these projects) is set out in Technical Appendix D3. As noted, the maximum number of turbines to be installed at the Project has been reduced to six from seven, as was the case in the Original Application.
- 20 The compilation of wider North Sea non-breeding kittiwake collision mortalities apportioned against North Caithness Cliffs SPA is discussed in detail in Section 2.5 of Technical Appendix D3, and the associated figures presented in Table CI.3. As requested by NS, this now presents the cumulative totals both with and without Berwick Bank included.
- 21 The key updates to CRM since the modelling for the Original Application, and agreed with NS through consultation, are:
- Use of the new kittiwake avoidance rates from NS guidance³ (0.992 for deterministic modelling, Option 2, as taken forward to PVA).
 - Application of a 10% sabbatical rate to adult mortality estimates, where it is certain this was not previously used (as agreed with NS in email advice of 25 September 2023).

3.3 Population Modelling (Appendix D4)

- 22 The reference populations used for North Caithness Cliffs against which impacts are modelled remain the same as for the Original Application assessment, i.e., the 2015/2016 SPA colony counts (Swann, 2018) as set out in Table I.

Table I SPA seabird populations considered under PVA

Species	SPA	SPA population size (breeding individuals)	Year of census
Kittiwake	North Caithness Cliffs	11,146	2015/16
Puffin	North Caithness Cliffs	3,053	2015/16

- 23 Updated colony counts were undertaken at the SPA this year (2023); however, the information is not yet published nor available from the SMP database, and therefore is not available for use in this assessment. Whilst the potential impacts of avian influenza on

³ [Guidance Note 7: Guidance to support Offshore Wind Applications: Marine Ornithology - Advice for assessing collision risk of marine birds | NatureScot](#)

populations at North Caithness Cliffs SPA are acknowledged, as discussed within the Original Application, no further information is available that is relevant to this SPA.

- 24 The approach to the population modelling remains the same as for the Original Application (as detailed in *Offshore EIAR (Volume 3) Technical Appendix – 12.5 Population Modelling*). The only difference is that the baseline population is no longer forward-projected in time, as the population used for reference (against which the population consequences of impacts are modelled) should be as close as possible to the ‘date stamp’ for impact quantification (i.e. the date of the survey work/data upon which impact quantification is based). This approach was agreed with NS during consultation HWL Method Statement for CRM and PVA issued 19/07/2023 and discussed at meeting on 26/07/2023).
- 25 The approach to population modelling (and underpinning rationale) is set out in more detail in the HWL note dated 19/07/2023 (in response to the NS advice of 22/06/2023) and was discussed and agreed with MD-LOT and NS at the meeting held on 26/07/2023. Please also see Section 2.1.5 *Model Duration* in Appendix D4 on PVA for further detail on this.
- 26 Impacts resulting from the proposed Berwick Bank development have been included in cumulative assessments for kittiwake (Table 2) but due to uncertainty regarding figures for impact it was agreed with MD-LOT and NS that Green Volt would be considered qualitatively within the Variation Application.
- 27 It is recognised that Green Volt will have impacts to be attributed to North Caithness Cliffs SPA for both kittiwake and puffin but the level of those impacts are currently unknown. Green Volt is an INTOG development approximately 154 km from North Caithness Cliffs (75 km east of the Aberdeenshire coast). This is within mean maximum foraging range +1 SD of both puffin and kittiwake but due to the distance from North Caithness Cliffs SPA it is expected that impacts will be small.

4 Results and Conclusions

4.1 Kittiwake

- 28 Table 2 summarises the key information for kittiwake from Technical Appendix D4 (PVA) to be considered in the determination of this Variation Application; the impact scenarios modelled and the resulting counterfactuals at 10 years (the current consent) and 25 years (this Variation Application). The summary for the Variation Application is presented alongside the outputs from the original kittiwake PVAs from *Offshore EIAR (Volume 3) Technical Appendix – 12.5 Population Modelling*. The 10-year counterfactuals were back calculated by Natural Power Consultants using these data as submitted to MD-LOT and NS by email dated 17/03/2023). In the table, the original impacts and counterfactuals are shaded light green, with the current Variation Application information shaded a darker green.
- 29 A CPS value of **0.873 (0.807-0.939)** for the North Caithness Cliffs SPA kittiwake population at 25 years impact results from calculations based on the wider North Sea non-breeding kittiwake collision mortalities (at the 0.989 CRM avoidance rate) apportioned against North Caithness Cliffs SPA. This is referencing Hornsea 4 figures and excluding Moray Firth wind farms and the Original Application. This is the original CPS from development already consented or at application stage (the latter solely in the case of Hornsea 4, for which the cumulative compilation had been produced). Therefore, this provides a ‘baseline’ or reference point for population consequence against which to be considering the updated scenarios in Table 2.
- 30 With the new kittiwake avoidance rate applied (0.992) and with investigation into, and refinement of, the North Sea cumulative figures (as discussed in Section 3.2 above, and set out in detail in Technical Appendix D3, CRM), as well as with no forward-projection of PVA baseline population (as discussed in Section 3.3 above, and also in Technical Appendix D4, PVA), it can be seen that all of the new CPS counterfactuals for the Variation Application are greater compared to the ‘consented baseline’ calculated as above.

4.1.1 Kittiwake – project only

- 31 As concluded for the Original Application, the predicted project-alone kittiwake impacts for the Variation Application have minimal population consequence, resulting in a final median population size, after 25 years, of 98.3% of a non-impacted baseline (a CPS of **0.983**) with a CGR value of **0.999**. As can be seen from Table 2, predicted adult mortality for the Variation Application has more than halved compared to the Original Application, substantially improving the resulting counterfactuals. This is despite the additional productivity impacts (the chick mortality component) now also being accounted for.

4.1.2 Kittiwake – project and in-combination

- 32 As set out in Section 3.2 above (and in Technical Appendices D3 and D4), it is suggested that if the wider North Sea non-breeding kittiwake collisions are to be included then the Inch Cape season-adjusted estimates are the most appropriate to reference (in line with NS guidance on seasonality and now with a 10% sabbatical rate applied to the English wind farms) – North Sea option 3d. As noted in Appendix D3 (CRM) this is still likely an overestimate of the number of North Sea kittiwake collisions, given that no updates have yet been made for Dogger Bank, East Anglia 3, or Hornsea 2 CRM estimates, where all three of these projects have been subject to substantial post-consent design refinements (as per their approved Design Specification and Layout Plans (DSLPS)). These refinements include a far

smaller number of (larger) WTGs installed, which reduces associated collision risk to seabirds.

- 33 The Project-alone impacts and the cumulative impacts of this Variation Application with the Moray Firth and North Sea wind farms show improved CPS values at 10 years when compared to the Original Application. The varied Project plus Moray Firth wind farms show a slightly reduced CPS value at 10 years compared to the Original Application which did not include impacts upon productivity caused by displacement.
- 34 When making comparisons of counterfactual values between the Original Application and the Variation Application it should be noted that impacts upon productivity were not included in the Original Application. Therefore, the improvement in counterfactual values for the Variation Application is achieved despite this additional impact now being accounted for.

4.1.3 Kittiwake – project and in-combination (Berwick Bank included)

- 35 Cumulative impacts from the Variation Application, the Moray Firth wind farms, and the whole North Sea wind farms results in a CGR value of **0.996 (0.994-0.998)** and CPS of **0.909 (0.863-0.955)** after 25 years of impacts.
- 36 Scenarios 5a – 5d (shaded in blue) provide the requested modelled cumulative totals including Berwick Bank. Inclusion of Berwick Bank leads to lower counterfactuals (i.e., higher population consequence), however, CGR values for 25 years even when including Berwick Bank impacts do not fall below **0.996**. Calculation of the impacts from projects listed in the Hornsea 4 application suggested a background impact level after 25 years from North Sea wind farms alone of **0.873**. This would result in considerably greater impacts than the recalculated estimate of **0.952 (0.907-1.00)** presented in table 5 of D4 and is lower than the CPS calculated for the cumulative impacts including the Variation Application, Moray Firth, and North Sea wind farms.
- 37 It should also be noted that the in-combination assessment undertaken by Berwick Bank within its application includes the worst-case impact values from the Original Application for the PFOWF, which incorporated a greater number of WTGs, the larger Array Area and an operational life of 30 years. These parameters are now reduced through this Variation Application, and as such will result in an over estimation of potential impacts within the Berwick Bank application.

4.2 Puffin

- 38 Table 3 summarises the key information for puffin from Technical Appendix D4 (PVA) to be considered in the determination of this Variation Application; the impact scenarios modelled and the resulting counterfactuals at 10 years (the current consent) and at 25 years (this Variation Application). This summary for the Variation Application is presented alongside the outputs from the original puffin PVAs presented as part of the additional information

(December 2022)⁴. In the table, the original impacts and counterfactuals are shaded light green, with the current Variation Application information shaded a darker green.

4.2.1 Puffin – project only

- 39 The predicted project-alone puffin impacts for the Variation Application (impact scenario 1) is predicted to result in a final median population size, after 25 years of 98.8% of a non-impacted baseline (a CPS of **0.988 (0.869-1.120)**, and a CGR of 1.0 (0.995-1.000). The predicted adult mortality from the Variation Application is now a single bird per year, improving the resulting counterfactuals. This improvement is despite the inclusion of productivity impacts (chick mortality) estimated by SeabORD, which was not accounted for in the PVAs for the Original Application.

4.2.2 Puffin – project and in-combination

- 40 The cumulative impacts calculated for the Variation Application and the Moray Firth wind farms after 25 years gives rise to a CGR of **0.998 (0.993-1.000)** and a CPS of **0.959 (0.828-1.110)**. Previous estimates of the level of puffin mortality from Moray Firth wind farms suggested a CPS value of **0.764 (0.670-0.866)** at 25 years of impact. This previous estimate is the figure of 40 puffin mortalities (apportioned as 21.11 adults and 18.72 immatures) given as the cumulative (consented) total against North Caithness Cliffs SPA for Beatrice, Moray East and Moray West wind farms together⁵.
- 41 The 25-year cumulative CPS for puffin at **0.959 (0.828-1.110)** is considerably greater than the CPS of **0.925** which was modelled for the Original Application cumulative impact at 10 years.

5 Summary

- 42 In reviewing the modelling outputs for the Variation Application and considering the results of this against the Original Application, the following key points are noted for kittiwake and puffin as features of the North Caithness Cliffs SPA. As discussed in Section 3, it should be noted that the results do not represent a true ‘like for like’ comparison with the Original Application due to updated methodologies.

⁴ Except for the Moray Firth wind farm displacement matrix outputs (at 60%/1% and 60%/2% displacement and mortality rates which are obtained from *Offshore EIAR (Volume 3) Technical Appendix – 12.5 Population Modelling* of the original EIAR submission (August 2022).

⁵ The figure of 40 puffin mortalities is that used for Scottish Ministers’ decision-making on Moray West, as published in the appropriate assessment, dated 26 April 2019.

[Moray West Offshore Wind Farm - Wind farm and Transmission Works Appropriate Assessment | Marine Scotland Information](#)

Section 19.2 North Caithness Cliffs SPA – Puffin – Development in Isolation and In-combination

Paragraph 19.2.3 (page 56); *It was estimated that 40 puffin from North Caithness Cliffs SPA may be impacted by displacement mortality during the breeding season for the Development in-combination with the Moray Firth Developments (Moray West RIAA, table 6.9.44).*

5.1 Kittiwake

- 43 For the Project-alone (scenario 1) the level of annual mortalities are reduced and now represent only 3.24 adults, 0.15 immatures, 9.00 chicks, giving a CPS of **0.983** (CGR **0.999**) at 25 years, this is:
- Greater than the CPS of **0.980** based on mean densities in the Original Application. It is also greater than the CPS of **0.936** which was acceptable in granting the project the 10-year consent.
- 44 For the project in-combination with other wind farm projects (as assessed within the Original Application, scenario 4d), the impacts give a CPS of **0.909** at 25 years (CGR **0.996**), this is:
- Greater than the CPS of **0.904** (as calculated for a 15-year period of operation for the impacts as provided in the Original Application (Appendix D.4).
 - A significant increase on the Original Application CPS estimate of **0.840** (as the new impact prediction is 43% lower).
- 45 For the project in-combination with other projects, including the (currently not consented) Berwick Bank project (scenario 5d), the impacts give a CPS of **0.898** (CGR of **0.958**) at 25 years; this is:
- Greater than the CPS of **0.873** which can be calculated prior to changes in avoidance rate from cumulative North Sea wind farms alone and would have been the level considered in the Original Application.
- 46 The above CPS values should also be considered in light of the precaution that is included within the in-combination assessment, including:
- A number of projects included in the in-combination assessment are based on consented rather than as-built definitions (Dogger Bank A, B and C, East Anglia 3 and Hornsea 2), since they are not currently available. This will result in collision impacts for the non-breeding season being inflated by approximately 25% (based on the number of collisions that would be reduced through comparison on turbine numbers, although turbine size has increased).
 - The impacts for the Hornsea 3 and Hornsea 4 projects will be compensated for as part of a derogations package so should be substantially reduced within the in-combination assessment.
- 47 The following supporting information should also be noted:
- JNCC analysis⁶ of SMP data indicates that kittiwake productivity in Scotland has increased since the period of decline up to 2008 with the Scottish population increasing slightly in recent years from a low point in 2013.
 - Moray Firth areas modelled in displacement assessment use parameters based on the consented not 'as built' or final DSLP turbine envelopes. As the turbine

⁶ [Black-legged kittiwake \(*Rissa tridactyla*\) | JNCC - Adviser to Government on Nature Conservation](#). Accessed 5 October 2023.

envelopes are slightly smaller than the RLBs, this will lead to a slight over-estimation of Moray Firth displacement impacts.

- Post construction monitoring of Beatrice wind farm found no evidence of distributional responses by kittiwake (Trinder 2023), although some flight height response was detected. This evidence suggests that displacement impacts for this species are much smaller than modelling outputs.
- The number of collision mortalities for kittiwake at North Caithness Cliffs SPA from the Project alone, as described in the Variation Application, are 2.61 (deterministic CRM, D3 table 8) which is just 7.1% of the total of collision mortalities apportioned to North Caithness Cliffs SPA for the cumulative impacts (tables 8 and C1.3 in D3).

48 In conclusion, in relation to kittiwake, the refinement of the project design for the Variation Application and the reassessment of cumulative impacts has reduced calculated impacts to a level that could support a conclusion of no AEOSI for the North Caithness Cliffs SPA. The number of predicted mortalities from the Variation Application project alone is minimal in comparison to the reduction in numbers achieved by remodelling cumulative impacts between the Original and Variation Application, despite the inclusion of a number of conservative assumptions.

5.2 Puffin

49 For the Project-alone (scenario 1) the level annual mortalities are very low (1.00 adults, 0.60 chicks) giving a CPS of **0.988 (0.869-1.120)** and **CGR of 1.00 (0.995-1.004)** at 25 years; this is:

- Considerably greater than the CPS of **0.925** which was acceptable in granting the project the 10-year consent.

50 For the project in-combination with other projects (scenario 3) the impacts give a CPS of **0.961 (0.827-1.105)** with a CGR of **0.998 (0.993-1.004)** at 25 years; this is:

- Greater than the CPS of **0.925** which was acceptable in granting the project the 10-year consent.

51 In considering the above CPS values, it is noted that the Moray Firth areas have not been modelled using the 'as built' or final DSLP turbine envelopes but the original application boundaries. As the turbine envelopes are slightly smaller than the RLBs, this will lead to a slight over-estimation of Moray Firth displacement impacts.

52 It is also noted that the report by Trinder (2023) on post construction displacement of birds at Beatrice Offshore Wind Farm suggests that displacement rates for puffin may be lower than modelled in the Variation Application submission.

53 In conclusion, in relation to puffin, the refinement of the project design for the Variation Application and the reassessment of cumulative impacts has reduced the predicted impacts considerably. The CPS values for puffin for all modelled scenarios at 25 years are greater than the value used by NS to previously conclude no AEOSI for the North Caithness Cliffs SPA.

Table 2 Kittiwake - comparing PFOWF original and variation modelled impacts and PVA outputs

Impact scenarios (annual, SeabORD and CRM)	Estimated mortalities (no. of birds)			PVA outputs					
	Adults	Imm.	Chicks	Counterfactual of Growth Rate		Counterfactual of Population Size			
				Annualised @ 25 years	Confidence limits	10 years	Confidence limits	25 years	Confidence limits
PFOWF project-alone – original	7.40	0.25	-	0.999	0.997-1.002	0.992	-	0.981	0.909-1.061
1. PFOWF project-alone – variation	3.24	0.15	9.00	0.999	0.998-1.000	0.994	0.955-1.030	0.983	0.937-1.030
PFOWF and Moray Firth together – original	16.15	1.84	-	0.998	0.996-1.000	0.984	-	0.960	0.891-1.039
2. PFOWF and Moray Firth together – variation	10.49	0.86	21.60	0.998	0.996-1.000	0.983	0.945-1.020	0.955	0.908-1.000
Other North Sea wind farms (ref. Hornsea 4 – EA 1 & 2) – 0.989 kittiwake CRM avoidance rate	35.76	29.26	-	0.995	0.992-0.997	0.949	-	0.873	0.807-0.939
3a - Other North Sea wind farms (ref. Hornsea 4 – EA 1 & 2)	26.54	18.92	-	0.997	0.995-0.999	0.969	0.931-1.010	0.927	0.883-0.973
3b. Other North Sea wind farms (ref. Inch Cape - consented)	22.56	16.42	-	0.997	0.996-0.999	0.973	0.934-1.010	0.936	0.892-0.985
3c. Other North Sea wind farms (ref. Inch Cape - built)	18.68	13.55	-	0.998	0.996-1.000	0.978	0.940-1.020	0.948	0.901-0.995
3d. Other North Sea wind farms (ref. Inch Cape, season-adjusted)	17.15	12.42	-	0.998	0.997-1.000	0.979	0.943-1.020	0.952	0.907-1.000

Impact scenarios (annual, SeabORD and CRM)	Estimated mortalities (no. of birds)			PVA outputs					
	Adults	Imm.	Chicks	Counterfactual of Growth Rate		Counterfactual of Population Size			
				Annualised @ 25 years	Confidence limits	10 years	Confidence limits	25 years	Confidence limits
Total impacts (PFOWF original, Moray Firth and North Sea) <i>0.989 kittiwake CRM avoidance rate</i>	51.91	31.10	-	0.993	0.990-0.996	0.936	-	0.840	0.773-0.910
4a - Total impacts (PFOWF variation, Moray Firth and North Sea 3a)	37.03	19.77	21.60	0.995	0.994-0.997	0.952	0.915-0.990	0.885	0.842-0.930
4b - Total impacts (PFOWF variation, Moray Firth and North Sea 3b)	33.05	17.28	21.60	0.996	0.994-0.997	0.956	0.918-0.995	0.894	0.852-0.941
4c - Total impacts (PFOWF variation, Moray Firth and North Sea 3c)	29.18	14.41	21.60	0.996	0.994-0.997	0.961	0.924-0.998	0.905	0.860-0.952
4d - Total impacts (PFOWF variation, Moray Firth and North Sea 3d)	27.65	13.28	21.60	0.996	0.994-0.998	0.963	0.924-1.000	0.909	0.863-0.955
5a - Total impacts 4a, plus Berwick Bank	41.63	22.07	21.60	0.996	0.995-0.998	0.947	0.910-0.985	0.875	0.831-0.920
5b - Total impacts 4b, plus Berwick Bank	37.65	19.58	21.60	0.995	0.993-0.997	0.952	0.916-0.989	0.885	0.842-0.929
5c - Total impacts 4c, plus Berwick Bank	33.77	16.71	21.60	0.996	0.994-0.997	0.956	0.918-0.995	0.895	0.851-0.940
5d - Total impacts 4d, plus Berwick Bank	32.24	15.57	21.60	0.996	0.994-0.998	0.958	0.920-0.997	0.898	0.854-0.945

Table 3 Puffin - comparing PFOWF original and variation modelled impacts and PVA outputs

Impact scenarios (breeding season, SeabORD)	Estimated mortalities (absolute no. of birds)			PVA outputs					
	Adults	Imm.	Chicks	Counterfactual of Growth Rate		Counterfactual of Population Size			
				Annualised @ 25 years	Confidence limits	10 years	Confidence limits	25 years	Confidence limits
PFOWF project-alone – original (HiDef SeabORD)*	2.69	0	-	0.999	0.994-1.003	-	-	0.966	0.854-1.092
1. PFOWF project-alone – variation (HiDef SeabORD)	1.00	0	0.60	1.000	0.995-1.000	0.995	0.917-1.080	0.988	0.869-1.120
Moray Firth – 60%/1% matrix	10.55	9.36	-	0.995	0.990-0.999	-	-	0.875	0.769-0.986
Moray Firth – 60%/2% matrix	21.11	18.72	-	0.990	0.985-0.994	-	-	0.764	0.670-0.866
2. Moray Firth – variation (HiDef SeabORD)	2.79	0	1.70	0.999	0.994-1.000	0.987	0.906-1.080	0.969	0.846-1.110
PFOWF and Moray Firth – original (HiDef SeabORD*, 60%/1% matrix)	13.25	9.35	-	0.994	0.989-0.998	-	-	0.844	0.740-0.965
PFOWF and Moray Firth – original (CEH SeabORD)~	9.00 ^o	0	-	0.991 [^]	-	0.925 ^x	-	0.794 [^]	-
3. PFOWF and Moray Firth – variation (HiDef SeabORD)	3.90	0	2.40	0.998	0.993-1.000	0.983	0.898-1.080	0.961	0.827-1.105

* As presented for the PFOWF (original application) additional information submitted 15 December 2022, using the erroneous puffin scaling factor.

~ Original CEH scenario which includes chick mortality.

^o Figure for adult mortality as back calculated by MSS for the appropriate assessment, 07 June 2023. However, the equivalent for chick mortality was not presented.

[^] Figures from NS response to MS-LOT, 23 February 2023.

^x Figure from NS spreadsheet sent to MS-LOT on 14 March 2023.

6 References

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.

Searle, K.R., Mobbs, D.C., Butler, A., Furness, R.W., Trinder, M.N. & Daunt, F. (2018). Finding out the fate of displaced birds (FCR/2015/19). *Scottish Marine and Freshwater Science*, Vol 9 No 08.

Trinder, M. (2023). Beatrice Offshore Wind Farm: Year 2 Post construction ornithological monitoring report. Report from MacArthurGreen for BOWL.

Annex A Approach to the marine ornithology assessment for the proposed Variation Application

This annex contains the following notes which were shared with MD-LOT and NS:

- 2 June 2023: HWL provided a note on the approach to the marine ornithology assessment for the proposed Variation Application (GBPNTD-PGM-PEN-PN-00019); and
- 19 July 2023: HWL provided a method statement for CRM and PVA (GBPNTD-ENV-PEN-CM-00009)

Pentland Floating Offshore Wind Farm (PFOWF) Variation Application: Method Statement for Cumulative Collision Risk Modelling (CRM) and Population Viability Analysis (PVA)

Further to the Highland Wind Limited (HWL) developer note (02/06/2023) on the proposed methodology for the PFOWF variation application and NatureScot’s response to this (NS, 22/06/2023), this note provides additional detail on, and an explanation of, HWL’s proposed methods for cumulative CRM and PVA. This will be undertaken by HiDef with support and third-party quality assurance from Natural Power Consultants (NPC), as for the original consent application.

Collision Risk Modelling (CRM)

HWL confirms that updated CRM for kittiwake at North Caithness Cliffs (NCC) SPA will be undertaken following NS guidance note 7¹ issued in January 2023. Seabird biometric information and avoidance rates will be taken from the guidance note. In this regard, HWL propose to use a kittiwake nocturnal activity factor of 2 (25%) as was previously used for the Moray Firth CRMs, as well as for the original PFOWF consent application. Keeping the same nocturnal activity factor allows for better comparability across projects in light of other changes.

- (i) HWL requests that the Marine Directorate and NS confirm that this proposal is acceptable (noting that this will also affect what is undertaken in respect of Moray Firth CRM updates), please see further discussion below.

Table 1 presents the project design parameters for the PFOWF variation, relevant to CRM. As can be seen from this table, the variation will comprise one wind turbine generator (WTG) with rotor diameter (RD) of 220 m and five WTGs with RD of 250 m.

Table 1. PFOWF variation – project design parameters

Project design parameters	PFOWF variation	
	WTG RD 220 m	WTG RD 250 m
Air gap (m)	35	35
Number of turbines	1	5
Rotor radius (m)	110	125
Tidal offset (m)	0	0
Number of blades	3	3
Max blade width (m)	7	7
Rotation speed (rpm)	8	8
Blade pitch angles (degree)	10	10
Operational time/down time (%)	95/5	95/5
Operational life	25 years	

¹ [Guidance Note 7: Guidance to support Offshore Wind Applications: Marine Ornithology - Advice for assessing collision risk of marine birds | NatureScot](#)

HWL has checked the available information in the original Environmental Statements (ES) for the three Moray Firth wind farms – Beatrice, Moray East and Moray West. It will not be possible to re-run CRM for these three projects as the monthly input densities used in the original CRMs are not presented for any of these windfarms.

As an alternative approach, HWL has discussed with HiDef and NPC and propose that project-specific ‘correction factors’ could potentially be calculated to apply to the kittiwake collision mortality estimates for the Moray Firth wind farms, as presented in Section A1.2 of the *Pentland Marine Ornithology Technical Appendix – 12.5 Population Modelling* (Tables A1.2.1 and A1.2.2). Updated breeding and non-breeding season apportioning weightings for these three wind farms were previously calculated for the submitted PFOWF application and will remain the same.

The kittiwake CRM figures used in the original PFOWF cumulative PVAs are based on information submitted for Hornsea project four, Table 5.60 of ES Volume A2, Chapter 5, Offshore and Intertidal Ornithology (Orsted, 2021). This information will be reviewed, in order to determine if it is possible to understand how these estimates have been derived, and for which turbine scenarios (at each of Beatrice, Moray East and Moray West) they relate to.

If the ‘original’ parameters for Moray Firth wind farms can be established (as referenced by Hornsea project four) then a CRM can be undertaken for each project using a nominal monthly input density (to be set at 1 bird/km² for each month at each wind farm). These outputs can then be compared against a second set of CRMs (again using nominal monthly input densities of 1 bird/km²) which will use the ‘as built’ parameters for Beatrice and Moray East and the parameters from the ‘development specification and layout plan’ (DSLPL) for Moray West.

Once each project-specific ‘correction factor’ has been determined and applied to the Moray Firth kittiwake collision, mortality estimates, they will then be updated adopting the 0.992 ‘all gull’ avoidance rate recommended by NS (given in Appendix 1 of NS guidance note 7). Non-breeding kittiwake collision mortality estimates for other North Sea wind farms will also be updated by applying this updated avoidance rate to an agreed baseline.

HWL therefore makes two requests; that the Marine Directorate and NS confirm the following:

- (ii) whether the proposed use of ‘correction factors’ for Moray Firth wind farms is acceptable (and can be based on the Hornsea four figures, as for the original PFOWF submission); and
- (iii) which set of figures should be referred to for the wider North Sea kittiwake CRMs i.e. Moray West or Hornsea four ES as for the original Pentland application, or East Anglia ONE/TWO as for the Berwick Bank submission, or some alternative source.

Population Viability Analysis (PVA)

The PVA input parameters for kittiwake and puffin, and modelling approach for the PFOWF variation application (using the Natural England PVA tool), are the same as those detailed in the original *Pentland Marine Ornithology Technical Appendix – 12.5 Population Modelling* (submitted 11 August 2022) and in the *Additional Information* (submitted 6 December 2022).

In respect of NS queries within their response (22/06/2023), HWL advise that the same approach to population modelling will be adopted as for the original PVAs (both the consent application and the additional information) with the exception of the calculation of relative mortality rates. In this regard, HWL’s approach follows the available PVA recommendations given in NS guidance note 11², but noting that Section 3.2 does

² <https://www.nature.scot/doc/guidance-note-11-guidance-support-offshore-wind-applications-marine-ornithology-recommendations>

not explicitly address this point (how to calculate relative mortality rates), and the proposed approach is set out below.

Assessment and modelling for the PFOWF variation application will be based on the publicly available version of the NE PVA tool and its associated outputs.

In relation to PVA, the key points to note are these:

- **Burn in** – the ‘burn in’ function of the NE PVA tool will be used to derive a stable ‘whole’ population (stable age-classes) from the SPA count of breeding adults.
- **Impact period** – NS have requested 50-year impact periods to be modelled (Section 3.1 of NS guidance note 11). This will be undertaken and the required counterfactuals for a 10 year, 15 year, 20 year and 25-year impact period will be extracted at the relevant point from the overall output spreadsheet. This is the approach that was adopted for the *Additional Information* when NS first requested a 50-year impact period in its response to the original PFOWF application (13/10/2022).
- **Reference population** – the reference population for each of kittiwake and puffin at North Caithness Cliffs SPA will be the 2015/2016 census count as given in Table 2 of *Technical Appendix – 12.5*. These are the populations confirmed by JNCC as correct in emails 09/05/2022, following the discrepancies in SMP data highlighted by HiDef (on behalf of HWL) in its email of 02/03/2022. Based on the 2015/2016 count data, the reference populations to be modelled under PVA for the PFOWF variation application are as follows:
 - kittiwake:** 11,146 breeding adults.
 - puffin:** 3,053 breeding adults.
- **Relative mortalities** – for the original application and additional information, HiDef (on behalf of HWL) calculated relative mortalities as a percentage of forward-projected baseline populations for the 2027 breeding season (the first breeding season in which PFOWF would be operational, based on the anticipated wind farm commencement date). However, taking this approach will result in over-estimation or under-estimation of relative impact, depending on population trend.

Therefore, it is now considered that relative mortalities should be calculated against the confirmed reference population (the ‘whole’ population derived via ‘burn in’ from the SPA count of breeding adults) which is most closely contemporaneous with the at sea survey data collection. As noted above, this is the 2015/2016 count data for NCC SPA which matches well with the first year of digital aerial survey work for PFOWF, carried out from January to December 2015.

PVA reference populations will therefore not be forward projected for the variation application, as quantified impacts (the absolute mortalities derived from assessment of survey data of a given date) should be considered relative to the SPA breeding population present at the time of survey work (which will be recording the at sea activity of the birds from that SPA colony at that point in time).

- **Cumulative / in combination impact scenarios to model under PVA** – the way these scenarios are derived has been explained in some detail in the original PFOWF *Technical Appendix – 12.5* and in the *Additional Information*. The impact scenario categories (project-alone and in-combination) will be defined in the same way as before, for each of kittiwake and puffin, and it is simply the mortality estimates given for each category which will be updated.

The current limitations of the NE PVA tool must also be considered, such that mortality rate (for adults and for immatures) cannot be varied within the tool on an annual basis, so that the same level of impact is applied year-on-year for the given impact period (25 years and 50 years as noted above). The modelling, by nature, is a simplification of reality and does not address wind farms coming on and off-stream in ‘real time’. As mortality

rates cannot be varied and given that windfarm impacts will need to be applied for some projects from the start of the model period, we do not propose to set a lead-in period before which project impacts are imposed.

Cumulative / in-combination impacts

The approach to cumulative / in combination assessment for the original PFOWF application was set out in the HiDef note issued 16 February 2022 to MS and NS and discussed at the meeting held 21 February 2022. Apart from addressing the point about cumulative impacts to gannet at Bass Rock SPA, no other comments or concerns were raised in respect of the approach. Nor were any problems flagged on the approach in either of the NS response letters (13/10/2022 and 23/02/2023) to the PFOWF project submission nor in the appropriate assessment supporting the Scottish Ministers' 10-year consent decision (28/06/2023). The cumulative impacts collation for the variation will therefore follow the same approach.

The starting point for the PFOWF variation assessment is that the project refinements will reduce the estimates of kittiwake and puffin mortality potentially arising from this wind farm proposal.

In respect of cumulative / in-combination assessment, there have been two projects submitted subsequent to the original PFOWF application (11/08/2022). These are Berwick Bank (submitted 09/12/2022) and Green Volt (submitted 01/02/2023). West of Orkney is through scoping but is not yet submitted for application and therefore the situation in respect of this project remains the same.

Berwick Bank may require consideration in respect of non-breeding season kittiwake CRM mortalities (along with the other North Sea wind farms previously addressed in this regard) and Green Volt is likely to require consideration in respect of both kittiwake and puffin, and in relation to both displacement and collision risk in breeding and non-breeding seasons.

- (iv) HWL therefore seek confirmation from the Marine Directorate and NS on further information they might need to provide in relation to Berwick Bank and Green Volt, additional to the information already submitted by these two project applicants.

If HWL are required to undertake cumulative PVAs including relevant Berwick Bank and Green Volt impacts, then the agreed mortality estimates to be used for these two projects will need to be confirmed as soon as possible by the Marine Directorate and NS. Clear advice is needed in this regard, given the difference in methods and optionality in assessment (Green Volt, for example, has not undertaken SeabORD modelling, while Berwick Bank presents a range of mortality estimates for each species, derived from 'developer' and 'scoping a & b' approaches).

- (v) HWL proposes the date of issue of this document (19 July 2023) as the cut-off for finalising which projects should be included in the in-combination assessments and requests the Marine Directorate's confirmation on this approach.

SeabORD displacement modelling

As requested by NS in its response 22/06/2023, HiDef will re-run SeabORD on behalf of HWL and propose to model the following two scenarios for puffin and for kittiwake displacement impacts:

1. The PFOWF variation.
2. Beatrice, Moray East and Moray West together (using project red line boundaries).

This proposal is made so that all parties are clear on the level of estimated displacement mortalities (adult and chick survival impacts) predicted by SeabORD for the currently consented developments in the Moray Firth and the counterfactuals that result. This will be needed for consideration of the PFOWF variation application but also

needs to be understood for any discussion with NS over monitoring for the PFOWF 10-year consent (as PFOWF can only monitor in relation to its own impacts and not those already occurring from consented and built development).

Pentland Floating Offshore Wind Farm: note on approach to ornithology assessment within proposed variation application

Background

The Pentland Floating Offshore Wind Farm (PFOWF) submitted an application for offshore consents (Section 36 and marine licences) to construct and operate an offshore wind farm off the north Caithness coast in August 2022. This application has not yet been determined, however, in anticipation of consent being granted for a limited operational period (10 years), Highland Wind Limited (HWL) is now preparing an application to vary the offshore consents, incorporating refined project parameters, to increase the operational lifespan of the project from 10 to 30 years.

This application will include an updated ornithological assessment of the potential impacts of the variation on ornithological receptors. To ensure this assessment is undertaken to the satisfaction of consultees including the Marine Directorate (MD) and NatureScot (NS), this document sets out the proposed approach to the assessment with some specific questions for consideration and clarification.

Amendment to Project Design Envelope (specific to ornithology)

Following the submission of the application for offshore consents for the PFOWF, HWL has worked with its engineering teams to further refine the offshore parameters for the project. The below table presents the parameters as they are likely to be consented in the current application (“Consented Parameter”) alongside the parameters proposed within the variation application (“Variation”).

Figure I at the end of this document presents a comparison of the revised WTG footprint area with the WTG footprint area in the current application. The revised area assumes displacement could occur at the sea surface from the area around the WTG floating substructures plus their maximum horizontal excursion as a worst case. This does not include mooring lines or WTG blades which will not have any displacement effects at the sea surface.

Table I: Comparison of consented and refined project parameters

Parameter	Consented Parameter	Variation	Change (%)
Number of WTGs	7	6	-14%
Rotor Swept Diameter	316,673 m ³	283,448 m ³	-10.5%
WTG footprint Area	10 km ²	5.85 km ²	-41.5%
Operational life (years)	10	30	+200%

Summary of NS response/ assumed MS position on current application

NS does not object to, nor advise ‘adverse effect on site integrity’ (AEOSI) in relation to kittiwake or puffin impacts (or any other bird species), arising from PFOWF alone (NS response letter dated 23 February 2023). NS concerns on AEOSI for both kittiwake and puffin relate to cumulative impacts arising in combination with other offshore wind farm developments which have already been consented.

Kittiwake

In respect of kittiwake, the NS concerns relate to collision mortalities in the non-breeding season arising from cumulative impacts of PFOWF and other North Sea wind farms as apportioned to the kittiwake population in the North Caithness Cliffs Special Protection Area (SPA). It is acknowledged that the contribution of PFOWF to this cumulative impact is very small.

Puffin

In respect of puffin, the NS concerns relate to productivity reduction and mortality due to displacement impacts arising as a cumulative impact with PFOWF but mainly from the three consented offshore windfarms in the Moray Firth (Beatrice, Moray East and Moray West).

Proposed approach to assess the revised design parameters

Kittiwake

To support the revised assessment of impacts to Kittiwake HWL proposes the following actions are undertaken:

1. Collision risk models (CRM) for both PFOWF and the three consented Moray Firth wind farms are re-run including the following changes from the approach that was included in the submitted application:
 - Using updated revised design parameters for PFOWF (Table 1) and the Moray Firth projects;
 - Following current NatureScot guidance (2023) using Band Model Option 2 to be run both deterministically and stochastically; and
 - Using updated avoidance rate of 0.992 for deterministic model and 0.993 for stochastic model, in line with current NatureScot (2023) guidance. A revision of avoidance rate is supported by Ozsanlav-Harris, Inger and Sherley (2022) which gives a higher avoidance rate of 0.997 for the Band Model basic version, based on recalculation of wind farm collision evidence.
2. Available non-breeding kittiwake collision mortality estimates for other North Sea wind farms are updated by applying the proposed 0.992 avoidance rate to the published figures:
 - Applying the new avoidance rate will result in a reduction of cumulative collision risk estimates for the North Sea by 27%, based on the use of an avoidance rate of 0.992 rather than 0.989; and
 - The assessment will use the North Sea kittiwake collision mortality estimates presented in the Moray West application as adopted for use in Scottish Ministers' decision-making.
3. SeabORD is re-run to provide estimates of kittiwake displacement impact for the refined PFOWF footprint and the three Moray Firth wind farms (see below for a query on the approach to use).
4. Population models are re-run for PFOWF alone and cumulative impacts using outputs from the above impact modelling work. This will use the Natural England PVA tool. Standard ratio metrics (Counterfactual of Population Size and Counterfactual of Population Growth Rate) will be produced.

Puffin

To support a revised impacts assessment for puffin HWL proposes the following actions are undertaken:

1. SeabORD is re-run to provide estimates of puffin displacement impact for the refined PFOWF footprint and the three Moray Firth wind farms (see below for a query on the approach to use).
2. Population models are re-run for PFOWF alone and cumulative impacts using outputs from the above impact modelling work. This will use the Natural England PVA tool. Standard ratio metrics (Counterfactual of Population Size and Counterfactual of Population Growth Rate) will be produced.

Questions / Clarifications

1. HWL has three options for re-running SeabORD displacement analysis and would like confirmation of which approach to use:
 - Ideally the displacement analysis would be re-run using the same version of the SeabORD tool and the same process as used by CEH to inform NS's opinion (23/02/2023 CNS/REN/OSWF/Demonstration Site - Project Highland). This re-run would use current site layouts for both PWOWF (refined layout) and the three Moray Firth projects (as approved/constructed rather than as consented layout) projects (Figures 1 (PFOWF) and 2 (Moray West) provided at the end of this document as examples);
 - As an alternative, in the event that the updated version of SeabORD is not published, HWL suggests rerunning SeabORD following the same approach but using the MatLab-coded version; or
 - As a further alternative, in the event that the updated version of SeabORD is not published and using the Matlab-coded version is deemed not appropriate, HWL suggests estimating impacts in terms of number of birds lost to the population per year from the CEH SeabORD outputs, discounted by the equivalent percentage as the reduction in wind farm footprint area. These reduced impacts can then be applied to population models.

 2. For the re-running of SeabORD HWL requests confirmation of:
 - The population size to simulate; and
 - Any changes that should be made to the decay function, as used by CEH.

 3. HWL proposes that population models are run without forward-projection of the baseline population to the time of expected project commissioning. NS guidance on PVA is that the most 'up to date population data should be used to determine start populations' (NS guidance note 11). Advice on suitable data to be used is 'the age of the available offshore survey data is well-matched to that of those data underpinning the most recent population estimates at seabird colonies that could be impacted' (NS guidance note 2).
- Impacts in terms of number of birds lost from the populations will therefore be modelled against the closest contemporaneous population count (SPA population estimate) to the timing of the digital aerial survey programme recording the 'at sea' activity of the SPA population as it was at this time. PVA will model impacts against the SPA population at the same point in time (or as close as possible to it) at which the impacts were quantified.
- HWL proposes that forward-projecting population models to predict a population size at the time project impacts are expected to commence is not required, and increases uncertainty, as the time period over which a population model must simulate growth rates is increased. Therefore HWL will not use population models to forward-predict the colony size.
4. In terms of projects to be included within the in-combination assessments, it is proposed that the date of issue of this note (2 June 2023) comprises the cut-off date in terms of which consented, scoping etc projects to be included.

 5. HWL requests confirmation of agreement on the above approaches.

References

Luke Ozsanlav-Harris¹ , Richard Inger¹ & Richard Sherley¹ . March 2022. Review of data used to calculate avoidance rates for collision risk modelling of seabirds. JNCC Report 732 (Research & review report), JNCC, Peterborough, ISSN 0963-8091. <https://hub.jncc.gov.uk/assets/de5903fe-81c5-4a37-a5bc-387cf704924d>.

NatureScot 2023. Guidance Note 7 Guidance to support offshore wind applications. Marine Ornithology advice for assessing Collision Risk to marine birds

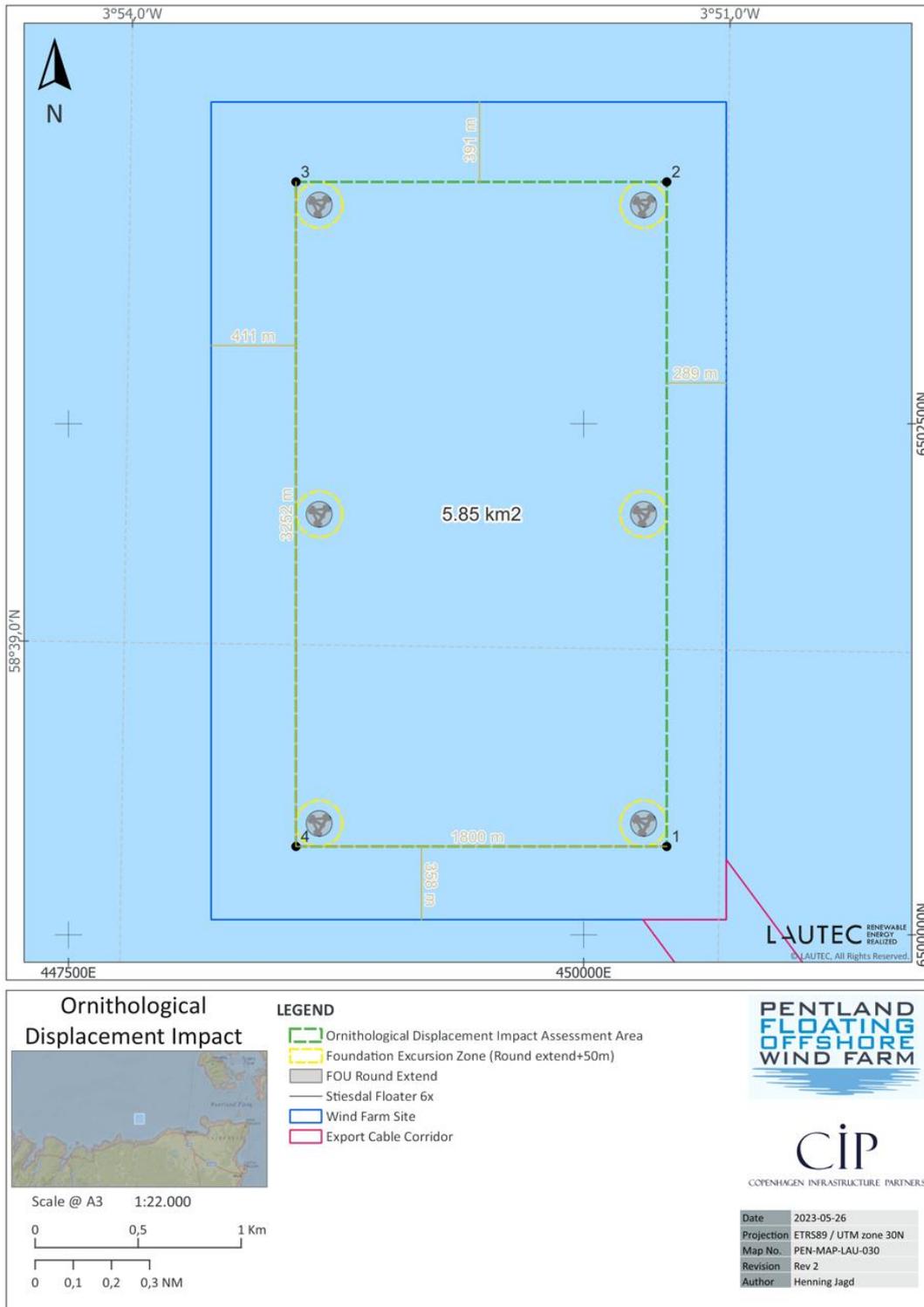


Figure I. Revised ornithological displacement impact assessment area

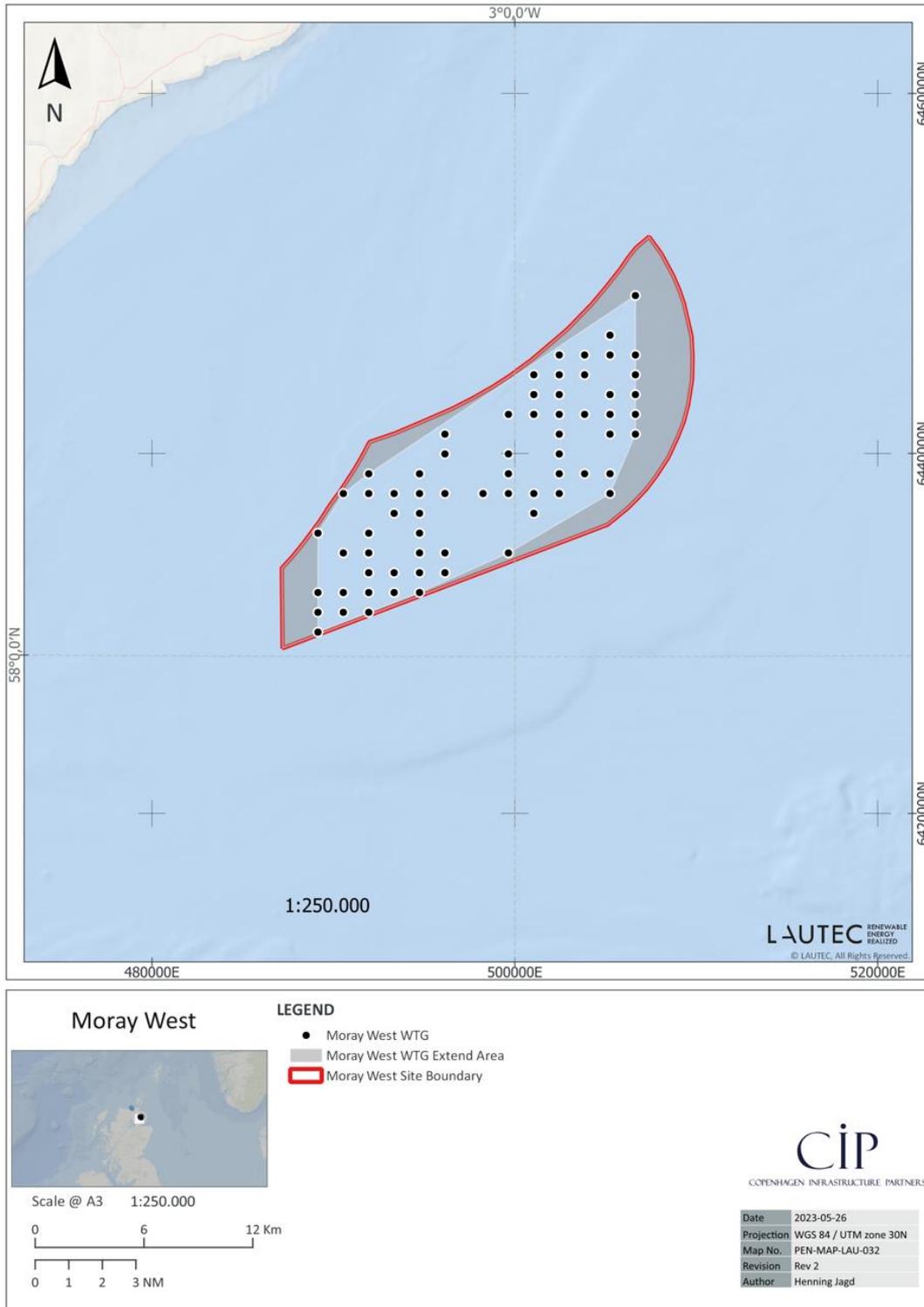


Figure 2. Moray West project layout comparison - as consented and as confirmed in the approved DSLP.

Pentland Floating Offshore Wind Farm Section 36C Variation Application

Technical Appendix D2:

Marine Ornithology

SeabORD Displacement Modelling

Authorisations

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Acronyms and abbreviations

Acronyms / abbreviation	Full name
AON	Apparently Occupied Nests
CEF	Cumulative Effects Framework
DEE	Daily Energy Expenditure
DER	Daily Energy Requirements
GPS	Global Positioning System
HWL	Highland Wind Limited
JNCC	Joint Nature Conservation Committee
MD-LOT	Marine Directorate - Licencing Operations Team
MS-LOT	Marine Scotland - Licencing Operations Team
MSS	Marine Scotland Science
NCC	North Caithness Cliffs
NS	NatureScot
PFOWF	Pentland Floating Offshore Wind Farm
PVA	Population Viability Analysis
QA	Quality Assurance
RSPB	Royal Society for the Protection of Birds
SNCB	Statutory Nature Conservation Bodies
SPA	Special Protection Area
UKCEH	UK Centre of Ecology and Hydrology
WTG	Wind Turbine Generator

I Introduction

- 1 This Technical Appendix supports the assessment of displacement and barrier impacts for the Pentland Floating Offshore Wind Farm (PFOWF) Section 36C Variation Application (the 'Variation Application') in respect of kittiwake and puffin¹ as qualifying interests of North Caithness Cliffs (NCC) Special Protection Area (SPA). Please see Technical Appendix D1, *Marine Ornithology Summary*, for further detail on the overall scope of assessment for the Variation Application and the associated pre-application engagement with the Marine Directorate - Licencing Operations Team (MD-LOT) and NatureScot (NS) over this.
- 2 Displacement is considered by Furness et al. (2013) and Bradbury et al. (2014) to be 'a reduced number of birds occurring within or immediately adjacent to an offshore wind farm'. This happens when birds avoid the area of operational turbines and the likelihood of different species to display this behaviour varies based on their biology. Statutory Nature Conservation Bodies (SNCB, 2022) guidance considers that both birds in flight and birds on the water may be displaced.
- 3 Barrier effects may occur when birds that would have previously flown through an offshore wind farm (on the way to a feeding, resting or nesting area) either stop short or detour around it (SNCB, 2022). In this regard, they may expend additional energy in deviating their flight paths (Masden et al., 2010). For the purposes of assessment, barrier effects are considered to apply to birds in flight and are usually considered together with displacement.
- 4 As for the Original PFOWF Application, displacement assessment for this Variation Application has been undertaken using the SeabORD modelling tool developed by the UK Centre for Ecology and Hydrology (UKCEH) (Searle et al., 2014; 2018). It is an individual-based modelling method which predicts the energetic consequences to seabirds due to any changes in their flight paths in the presence of offshore wind farms. It addresses the auk species (considered to be at highest risk from offshore wind displacement impacts) as well as kittiwake (which are of increasing concern in respect of potential displacement impacts).
- 5 SeabORD was developed for the Forth and Tay area and the early versions required colony tracking data to run (specific to the SPAs being modelled). However, UKCEH released version 1.3 in early 2022 and this uses a general 'distance decay' function² which does not require colony-specific tracking data.
- 6 This is the version of SeabORD (vs1.3) that Marine Scotland Licensing Operations Team (MS-LOT, now part of MD-LOT), NS and Royal Society for the Protection of Birds (RSPB) Scotland recommended be used for the Original PFOWF Application as 'best available evidence' and it remains the most recent version publicly available. So, it is again the version used by HiDef for the further modelling presented in this Technical Appendix (D2).

¹ The full names of the two species to be addressed for the Variation Application assessment are:

- Black-legged kittiwake (*Rissa tridactyla*), hereafter 'kittiwake'; and
- Atlantic puffin (*Fratecula arctica*), hereafter 'puffin'.

² 'Distance decay' assumes that as the distance from the colony increases, the density of foraging birds decreases.

-
- 7 The following three iterations of SeabORD modelling have been undertaken in relation to the PFOWF project:
- Original Application: HiDef's SeabORD modelling undertaken for the original PFOWF turbine array area (10 km²) with an 0.5 km boundary value applied, as set out in *Offshore EIA (Volume 3) Technical Appendix 12.4 Displacement Analysis*.
 - UKCEH: SeabORD study (puffin only) commissioned by NS during the original project determination and undertaken by the UKCEH. Again, this was for the original PFOWF array area (10 km²) but with a 2 km boundary value applied.
 - Variation Application: HiDef's new SeabORD modelling as presented in this current Technical Appendix (D2) for the revised array area (Wind Turbine Generator (WTG) Footprint Area) (5.85 km²) with a 2 km boundary value applied.
- 8 The version of SeabORD used by UKCEH (for their puffin study noted above) is more recent than v1.3 as the modelling (and its underpinning code) has been updated in preparation for release of the Cumulative Effects Framework (CEF). It is not yet publicly released, however, so HiDef have modelled for the Variation Application again using v1.3 as noted in paragraph 6.
- 9 While a summarised report of UKCEH's SeabORD modelling was sent to the applicant on 15/03/2023, and has been reviewed, it has not been possible to fully understand the work without key information being available³. This matter is further discussed in Section 4.3, as it is not possible for the applicant to understand why there may be differences in outputs between the model versions.
- 10 As presented in this Technical Appendix, HiDef, on behalf of the applicant, have undertaken the modelling according to the published guidance, using the available model version, and have provided all the associated information that has been requested by NatureScot (at the meetings held on 26/07/2023 and 12/09/2023) where it is possible to do so.⁴ Natural Power Consultants have provided third party comment and quality assurance (QA).
- 11 Section 2.1 presents a summary of the modelling method and Section 3.1 presents the SeabORD outputs, with the main report supported by the following Annexes
- Annex A: technical details of the SeabORD model as run for the Variation Application.
 - Annex B: SeabORD inputs and outputs (kittiwake / puffin) for the Variation Application.
 - Annex C: SeabORD heatmaps (in the format produced by v1.3) showing the density of foraging birds for each sub-colony of the SPA.

³ The UKCEH SeabORD report for PFOWF and Moray Firth wind farms is a summary of technical (R-code) outputs produced directly from the new (unpublished) version of the model. As such there is no underpinning or contextual information or interpretation provided, importantly the input populations and how they've been treated (of key concern in respect of puffin) as well as the model calibration process (including any updates to method/code subsequent to SeabORD v1.3). Note that SeabORD has been rewritten in R, whereas matlab was used in the earlier versions (up to and including v1.3).

⁴ The 'decay curves' mentioned by NS are not an output provided by SeabORD v1.3 and therefore cannot be provided.

2 Methods

2.1 SeabORD modelling

2.1.1 Introduction and scope of SeabORD

- 12 The method simulates the flightpaths of individual birds from identified breeding colonies to potential foraging areas in scenarios with and without wind farms present (Searle *et al.*, 2018). The information from these simulations is then used in bioenergetic equations which estimate the percentage body mass loss of the birds and therefore their survival.
- 13 For this analysis, SeabORD was used to model these potential impacts on kittiwake and puffin at NCC SPA.
- 14 A more detailed technical description of each step in the modelling process is provided in Annex A, including the input parameters used.

2.1.2 Modelling impacts against NCC SPA

- 15 The NCC SPA is shown in Figure 1. It comprises five sub-sites: Duncansby Head, Dunnet Head, Holburn Head, Melvich and Stroma. For the purposes of SeabORD modelling each of these sub-sites was treated separately within the model, as it would not be informative or biologically meaningful to try and model the SPA as a single unit. Each sub-site is represented in the model by a single reference point as close as possible to its midpoint, with these co-ordinates given in Table 1 (This information remains the same as for the Original PFOWF Application.)
- 16 During pre-application dialogue for the Original Application, the Joint Nature Conservation Committee (JNCC) confirmed the SPA population counts in their email of 09/05/2022. These are the population counts which were undertaken in 2015 and are still current. Although the SPA was recounted again this year (2023), the more recent counts were not available at the time of this assessment. However, use of the same counts as for the Original PFOWF Application will allow more meaningful comparison and consideration of new outputs against the previous SeabORD modelling undertaken by HiDef and UKCEH.
- 17 SeabORD requires colony counts to be given as breeding pairs, which it then doubles to obtain the number of breeding adults for the simulation. Kittiwake numbers are surveyed as Apparently Occupied Nests (AON) and can be input directly. However, puffin are surveyed at NCC SPA as breeding individuals, and therefore their numbers must be halved for input into SeabORD, to ensure the final population to be simulated is correct (and the same as the population then modelled under Population Viability Analysis (PVA)). Table 1 presents the kittiwake and puffin breeding pairs thus calculated.

2.1.3 Revisions to this PFOWF Variation modelling compared to that for the Original Application

- 18 The method used to determine the region for the SeabORD simulations was altered from that used in the Original Application. The region is defined by north, south, east and west limits. These set the area of the UK that individuals can travel and forage within during the simulation. In the SeabORD modelling for the Original PFOWF Application, this region was set to include the published foraging range (Woodward *et al.*, 2019) and was the same for all species.

- 19 For the Variation Application SeabORD modelling, the limits used to define the region were determined by creating a buffer around each colony point using a radius of the mean max foraging range plus one SD (Woodward *et al.*, 2019) plus 5%. The additional 5% was added to account for individuals assumed to be beyond the foraging range during the simulations. Then the most northernly, southernly, easterly and westerly points within the buffers were used to define the simulation area limit. This was carried out for each species to give a species-specific region for the modelling.

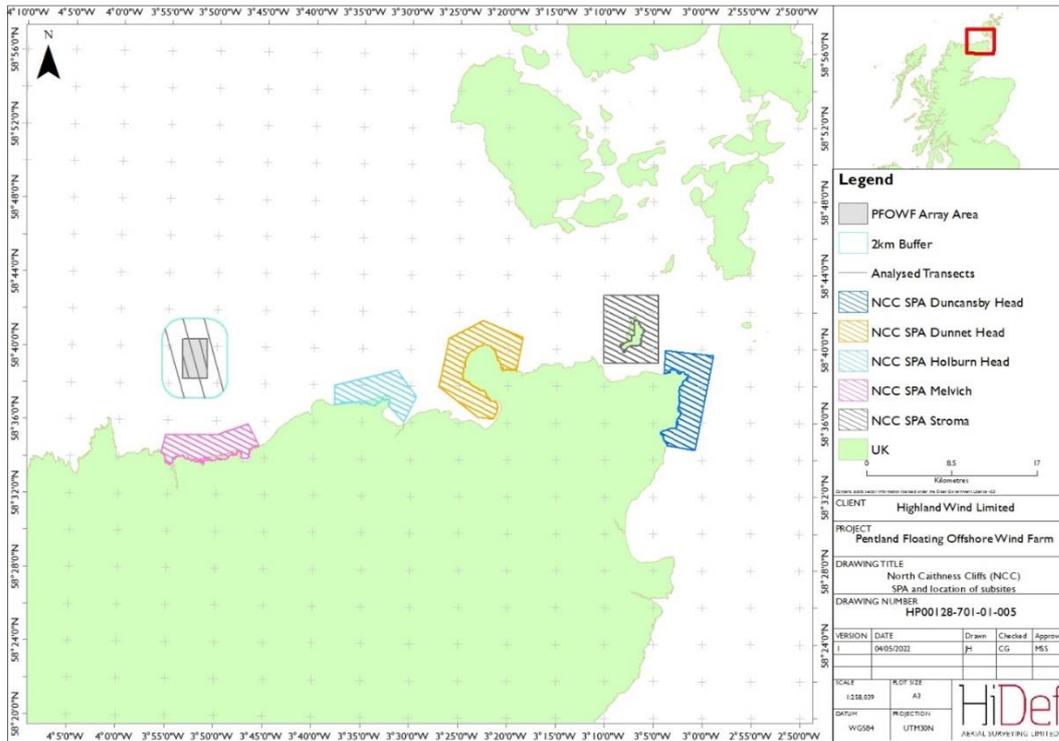


Figure 1 North Caithness Cliffs SPA and sub-sites

Table 1 Location of each sub-site in North Caithness Cliffs SPA and number of breeding pairs for input into SeabORD

Colony	Latitude	Longitude	Kittiwake pairs	Puffin pairs
Duncansby Head	58.6209	-3.0212	584	9
Dunnet Head	58.6598	-3.4164	2,020	802
Holburn Head	58.6314	-3.5421	55	30
Melvich	58.5747	-3.8597	2,777	677
Stroma	58.6839	-3.1467	137	9
North Caithness Cliffs SPA totals:			5,537	1,527

3 Results

3.1 SeabORD model outputs

20 Full model outputs are presented in Annex B as follows:

- Kittiwake (Table B1.1 to Table B1.6)
- Puffin (Table B2.1 to Table B2.6)

21 In Annex B, outputs are provided for each SPA sub-site: Duncansby Head, Dunnet Head, Holburn Head, Melvich and Stroma. The baseline levels of adult mortality predicted by SeabORD have been sense-checked against the figures calculated by using the default adult survival rates for each species from Horswill & Robinson (2015). A factor of *1-adult survival* has been applied to each of the SPA sub-site populations of each species to calculate PVA baseline mortalities for comparison with SeabORD.

3.1.1 Adult mortalities

22 SeabORD modelling predicts that in moderate prey years (adding the SPA subsite values from the green-shaded rows in each relevant table) there will be a total of 1.00 adult kittiwake mortality (Table B1.1) and 1.00 adult puffin mortality (Table B2.1) at North Caithness Cliffs SPA arising from the Variation Application project on its own.

23 Modelling of the wind farms in the Moray Firth – Beatrice, Moray East and Moray West – predicts 4.50 adult kittiwake mortalities (Table B1.2) and 2.80 adult puffin mortalities (Table B2.2) arising from these projects.

24 Finally, modelling of the cumulative scenario (PFOWF Variation Application and Moray Firth wind farms together) predicts 5.00 adult kittiwake mortalities (Table B1.3) and 3.90 adult puffin mortalities (Table B2.3).

3.1.2 Chick mortalities

25 In respect of chick mortalities, SeabORD modelling predicts the following:

- 9.00 kittiwake chicks (Table B1.4) and 0.60 puffin chick (Table B2.4) arising from the PFOWF Variation Application project alone.
- 12.90 kittiwake chicks (Table B1.5) and 1.70 puffin chicks (Table B2.5) arising from the Moray Firth wind farms.
- 21.60 kittiwake chicks (Table B1.6) and 2.40 puffin chick (Table B2.6) arising from the PFOWF Variation Application project and Moray Firth wind farms together.

3.1.3 Conversion to mortality rates

26 The summary of adult and chick mortality figures has been presented here for illustrative purposes, although it is the **mortality rate** outputs from SeabORD (for each of adults and chicks, in each of the five SPA sub-sites) that are taken through and applied in PVA. The calculation of total SPA mortality rates to apply (as derived from the five SPA sub-sites) is presented in Annex A of Technical Appendix D4.

4 Discussion and Conclusions

4.1 Kittiwake

- 27 For kittiwake, modelled adult displacement mortalities for this PFOWF Variation Application project are less than those predicted for the Original PFOWF Application; now 1.00 bird compared to 2.2 birds originally (for a moderate prey year). Chick mortality was not included in the Original PFOWF Application PVA but is included for the PFOWF Variation Application.
- 28 Displacement impacts from SeabORD (as presented in this Technical Appendix) are combined with the kittiwake collision mortality estimates (Technical Appendix D3) and the population consequences of this combined mortality modelled under PVA (as presented in Technical Appendix D4).
- 29 As set out in Technical Appendix D4, both PFOWF Variation Application project-alone and cumulative impacts (in combination with the Moray Firth wind farms and other North Sea developments) are modelled against the kittiwake population of NCC SPA.

4.2 Puffin

- 30 For puffin, modelled adult displacement mortalities for this PFOWF Variation Application project are less than those predicted for the Original PFOWF Application; now 1.00 bird for the variation compared to 2.69 birds originally⁵ (for a moderate prey year). However, chick mortality was not previously considered under PVA and has now been included.
- 31 As set out in Technical Appendix D (PVA), both PFOWF Variation Application project-alone and cumulative impacts (in combination with the Moray Firth projects) are modelled against the puffin population of NCC SPA.

4.3 Differences in SeabORD model runs

- 32 There are differences in SeabORD model runs between those completed by HiDef (for the Original PFOWF Application and this Variation Application), and those undertaken by UKCEH (as discussed in Section 1). Notably, the model calibration outputs for setting baseline survival⁶ differ between the UKCEH and HiDef treatments, although the categories reflecting survival probability are similar.
- 33 Refinements to project design for this Variation Application, namely the reduced size of array area, are likely to have reduced the modelled displacement mortality as will the updates to the modelling process set out in Section 2.1.3. However, the baseline adult mortality predictions are notably different between HiDef's modelling (original and variation, both using SeabORD vs 1.3) and that undertaken by UKCEH (using the updated R-code), and all SeabORD model runs predict higher baseline adult mortality rates than those reported in Horswill & Robinson (2015) (Table A6.2, Annex A).

⁵ As presented for the PFOWF (Original Application) additional information submitted 15 December 2022, using the erroneous puffin scaling factor.

⁶ Baseline survival as set for 'poor', 'moderate' and 'good' years – see explanation of the process in Annex A, sections A1, A2 and A3.

- 34 HiDef have been unable to explore SeabORD code to understand the reasons for such differences. This is due in part to the publicly available model being written in matlab and in part due to the updated version run by UKCEH being (as yet) unreleased.
- 35 In providing modelled outputs from SeabORD, HiDef have followed the available guidance provided by UKCEH, and consulted with them in running the matlab version. The methodology has also been discussed and agreed with NatureScot (minutes of meeting on 26/07/2023), including the incorporation of the updates requested by NatureScot for this variation run (primarily using 2 km for the footprint 'border' whereas the available UKCEH guidance had indicated 0.5 km for this, as well as resetting the region and further exploring distance decay, as discussed in Section 2.1.3).
- 36 Separate to PFOWF project determination, it may be worth collectively exploring these aspects further (facilitating discussion and learning across advisers and practitioners in dialogue with UKCEH) in order to assist with the further development of SeabORD and in preparation for the release of a new model version supporting the CEF.

5 References

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Annex A Technical description of SeaBORD method and input parameters

AI: Calibration

- 1 To calibrate SeabORD for each species at each colony, ‘single’ simulations were run with no wind farms present. The only input values altered when running baseline simulations were the prey quantity (g per unit volume) with the remaining values for each species shown in Table AI.1.
- 2 Calibrating the model is important as the breeding season outputs in the final paired simulations will only use the values from the prey quantity (g per unit volume) range selected. Therefore, to produce realistic results the prey range should be set to values expected during typical or ‘moderate’ breeding seasons.

Table AI.1 Values used for running baseline and the final paired simulations.

Variable	Puffin	Kittiwake
% of populations susceptible to displacement	60	30
% of those susceptible to displacement barrier	100	100
Maximum foraging range (km)	265.4	300.6
Proportion of individuals within range	0.975	0.975
Windfarm footprint border (km)	2.0	2.0
Windfarm footprint buffer (km)	5	5
Fraction of population used for baseline simulations	0.1	0.1
Fraction of population used in paired simulations	1	1

A2: Model input parameters and assumptions

- 3 The assumed percentage of the population susceptible to displacement was as advised by NatureScot (NS) and Marine Scotland Science (MSS) during the pre-application process for the Original PFOWF Application: kittiwake at 30% and puffin at 60%.
- 4 Due to a lack of Global Positioning System (GPS) tracking data, the distance decay method was used to determine the foraging sites of individuals. This assumes that as the distance from the colony increases (modelled for each sub-site at NCC SPA using the reference location points indicated in Table 1), the density of foraging birds is expected to decrease (Searle *et al.*, 2018).
- 5 For each species, the foraging range used within the model was mean max plus one standard deviation (SD), taken from Woodward *et al.* (2019), as advised by MSS and NS during the pre-application process for the Original PFOWF Application. The proportion of foraging occurring within this identified range was set to 0.975 (Table A1.1). 0.975 was used to account for the fact that a small number of individuals would be expected to fly further than the mean max plus one SD defined foraging range. As far as we are aware there is no tracking data from North Caithness Cliffs SPA to check actual foraging distributions with this prediction. These input values were then used by SeabORD to determine the foraging location of each individual adult, at each timestep of the simulation.
- 6 Each model in SeabORD is limited to a region, meaning individuals cannot travel or forage outside of a set area. The region used for each model was defined by creating a buffer around each of the points assigned for each sub-site shown in Table 1. The buffers were set to have a radius of the mean max foraging range plus one SD (Woodward *et al.*, 2019) plus 5% to account for individuals which would forage outwith the inputted foraging range. From these buffers the limits used to set the region could be determined for each species and are shown in Table A2.1.

Table A2.1 Region limits used for kittiwake and puffin

Species	North limit	East limit	South limit	West limit
Kittiwake	61.51797	2.41520	55.73961	-9.28890
Puffin	61.18617	1.77837	56.07166	-8.65181

It was assumed that all individuals susceptible to displacement would also be subject to barrier impacts, that the wind farm footprint border would be 2 km and the buffer 5 km around the turbine array areas for each wind farm modelled, as requested by NS subsequent to the original project submission.

A3: Calculating prey ranges

- 7 To determine the prey range expected during a ‘moderate’ breeding season (i.e. where environmental conditions are ‘moderate’) baseline simulations were run (i.e. simulations with no wind farms present). The only input parameters in the baseline simulations which differed from those used in the final paired simulations were the upper and lower prey quantity values used to generate the uniform prey distribution and the proportion of the population in the model (Table A1.1). After running multiple baseline simulations, the outputs were compared to determine the appropriate lower and upper prey quantity values. The lower prey quantity value was determined by comparing the percentage adult mass loss and percentage chick survival to those expected during ‘moderate’ breeding seasons (Table A3.1).

Table A3.1 Adult percentage body mass loss and percentage chick survival used to determine prey values used in the final paired simulations. Values taken from Mobbs et al. (2018).

Species	Adult Mass Loss (%)		Chick Survival (%)
	Lower boundary	Upper boundary	Lower boundary
Kittiwake	5	15	11
Puffin	3.5	10.5	50

A4: Paired simulations

- 8 Once the upper and lower prey quantities were determined (Table A4.1) through the baseline simulations, these were then used to run the final paired simulation for each species at each colony. The paired simulations compare presence of the wind farm(s) against baseline conditions. Each pair selected a prey quantity within the range using random stratification and then simulated the breeding season with and without the wind farms present, meaning that 20 breeding seasons were simulated for each final simulation. For both species, 100% of the population were used during the final simulations.

Table A4.1 Prey quantity range used for each final paired simulation.

Species	Colony	Lower prey quantity (g per unit volume)	Upper prey quantity (g per unit volume)
Kittiwake	Duncansby Head	227	318
	Dunnet Head	242	305
	Holburn Head	254	316
	Melvich	321	412
	Stroma	235	300
Puffin	Duncansby Head	281	352
	Dunnet Head	304	366
	Holburn Head	308	366
	Melvich	321	412
	Stroma	291	334

- 9 During simulation seasons with the wind farm(s) present, if individuals susceptible to displacement were assigned a foraging location within the footprint(s) they were displaced into the buffer area. Furthermore, they would not be able to travel through the border surrounding the footprint when travelling from the colony to foraging sites as all displaced birds were also assumed to be barriered.
- 10 Barrier navigation was set to 'Perimeter' for all simulations, following the examples provided (Searle *et al.*, 2018; Mobbs *et al.*, 2018). This assumes that displaced or barrier affected individuals will travel in a straight line until they encounter the wind farm footprint or border and cannot travel through. Once these areas are encountered individuals will follow the perimeter of these areas until they can travel in a straight line again. All individuals that encounter land will use the A* pathfinding option to find the shortest route around the land mass.
- 11 In total, three different scenarios were simulated. Each scenario used the same parameters but altered the wind farms present. The first scenario modelled the impacts of the PFOWF Variation Application only, the second the Moray Firth wind farms only (Beatrice, Moray East and Moray West) and the final scenario addressed both together (the PFOWF Variation Application and Moray Firth wind farms cumulatively).

A5: Bioenergetics in the model

- 12 During each timestep of a simulation, adult birds were assigned a Daily Energy Expenditure (DEE). For the first timestep, the DEE was selected from a normal distribution of DEE values stored within SeabORD and for subsequent timesteps the DEE was set to match the energy expended by the individual in the previous timestep. DEE of chicks was kept constant throughout the simulation.

- 13 The daily activity budget of each adult consisted of four behaviours – foraging, flight, time spent at the colony and time spent on the sea surface. The time spent foraging needed to meet individuals' Daily Energy Requirements (DER) and flying for each individual was generated by SeabORD and a minimum of one hour was assigned to time spent on the sea surface for each timestep. The remaining time was assigned to time spent at the colony. Once the time spent carrying out each activity was generated, the DEE for the timestep could be calculated.
- 14 The DER of each adult was calculated by combining the energy gained (DEE divided by an assimilation efficiency) and half of the DEE of chicks, as it was assumed that both parents contributed equally. If DEE was greater than DER, then adults would lose body mass.
- 15 At the end of each timestep the current mass of each individual was compared to their mass at the beginning of the season. This information was used to determine the behaviours exhibited by both adults and chicks as shown in Table A5.1.

Table A5.1 Behaviours of each individual determined by body mass.

Species	Age	% of initial mass	Behaviour for next timestep
All	Adult	>90	Stays at nest for the next timestep.
All	Adult	80-90	Leaves chick unattended to reach DER
All	Adult	<80	Abandon chick*
All	Adult	<60	Assumed to have died.
Puffin	Chick	60 – 80	Chick will go to the opening of the burrow, increasing the likelihood of death due to predation or harsh environmental conditions
All	Chick	<60	Assumed to have died.

**If one parent abandons the chick, the other parent will also abandon the chick despite its own body mass.*

- 16 Chick mortality can also occur during a timestep if the time an adult spends away from the nest is greater than the threshold determined by SeabORD. Predation risk was modelled to increase as the time left unattended increased until the specified threshold was reached for each species.

A6: Annual mortalities predicted by SeabORD

- 17 To determine the annual survival of adults, the mass at the end of the breeding season of each individual is used. SeabORD assumes that there is a logistic relationship between mass at the end of the breeding season and the probability of adult survival during winter (Searle *et al.*, 2018). This requires two parameters, the 'baseline' survival and the slope associated with the impact of a change in adult mass upon the probability of survival. Both parameters are set by SeabORD.
- 18 The baseline survival is equal to the mean value of sites with observed data on annual adult survival curated by the creators of SeabORD. Likewise, the shape of the logistic curve, which explains the relation between survival probability and body weight, is set by creators of SeabORD.

- 19 Annual mortality can be predicted by SeabORD in this way as presented in Annex B. This is possible even where there has been no predicted change to adult survival rates during the breeding season (as is the case for the PFOWF).
- 20 As discussed in Section 3.1, the baseline levels of adult mortality predicted by SeabORD (for the baseline scenarios without presence of any wind farms) have been sense-checked against the figures calculated by applying the default adult survival rate for each species (Table A6.1) against each reference population for the SPA sub-sites.

Table A6.1 Adult survival rates from Horswill & Robinson (2015).

Species	Adult survival rate (mean)	Standard deviation
Kittiwake	0.854	± 0.051
Puffin	0.906	± 0.083

- 21 A factor of $(1 - \text{adult survival rate})$ has been applied to each of the NCC SPA sub-site populations to calculate 'PVA baseline mortalities' for comparison with SeabORD outputs as presented in Table B1.1-Table B1.3 (kittiwake) and Table B2.1 – Table B2.3 (puffin) in Annex B.
- 22 From this comparison it was found that across four of the five sub-sites the number of adult puffin mortalities predicted by SeabORD are greater than those predicted using Horswill & Robinson (2015) values. For adult kittiwake, the values predicted by SeabORD were higher at all five sub-sites. A comparison of the mortality rates is shown in Table A6.2.

Table A6.2 Comparison of the adult mortality rates from Horswill & Robinson (2015) with those predicted by SeabORD (no wind farms present).

Species	Kittiwake mortality rates		Puffin mortality rates	
	Horswill & Robinson (2015)	SeabORD	Horswill & Robinson (2015)	SeabORD
Dunnet Head	0.146	0.256	0.094	0.117
Duncansby Head	0.146	0.257	0.094	0.039
Holburn Head	0.146	0.303	0.094	0.148
Melvich	0.146	0.271	0.094	0.162
Stroma	0.146	0.205	0.094	0.189

Annex B SeabORD outputs

BI: Kittiwake

Table BI.1 PFOWF Variation: SeabORD predicted adult kittiwake mortalities during the year, at the five sub-sites within NCC SPA, during ‘poor’, ‘moderate’ and ‘good’ environmental conditions

Sub-site	PVA baseline adult mortalities	Environmental Conditions	Adults not surviving the year				Difference in mortalities between scenarios
			Baseline (no wind farm)		Wind farm present		
			Mean	SD	Mean	SD	
Dunnet Head	590	Poor	1,579.00	14.69	1,578.90	14.26	-0.10
		Moderate	1,035.40	10.45	1,036.80	9.47	1.40
		Good	602.00	4.94	602.90	4.12	0.90
Duncansby Head	170	Poor	448.60	11.63	448.30	12.13	-0.30
		Moderate	300.10	5.36	299.60	5.58	-0.50
		Good	177.50	6.72	177.60	6.75	0.10
Holburn Head	16	Poor	40.80	0.92	40.80	0.92	0.00
		Moderate	33.40	0.84	33.40	0.84	0.00
		Good	19.80	0.63	19.80	0.63	0.00
Melvich	811	Poor	2,214.60	19.75	2215.80	20.41	1.20
		Moderate	1,505.60	11.53	1,505.70	11.80	0.10
		Good	908.10	23.13	909.00	23.31	0.90
Stroma	40	Poor	93.50	4.33	93.50	4.33	0.00
		Moderate	56.20	0.79	56.20	0.79	0.00
		Good	46.40	1.17	46.40	1.17	0.00
SPA total (sum of sub-site adult mortalities in moderate environmental conditions)							1.00

Table B1.2 Moray Firth wind farms: SeabORD predicted adult kittiwake mortalities during the year, at the five sub-sites within NCC SPA, during ‘poor’, ‘moderate’ and ‘good’ environmental conditions

Sub-site	PVA baseline adult mortalities	Environmental Conditions	Adults not surviving the year				Difference in mortalities between scenarios
			Baseline (no wind farm)		Wind farm present		
			Mean	SD	Mean	SD	
Dunnet Head	590	Poor	1,579.00	14.69	1,580.90	14.72	1.90
		Moderate	1,035.40	10.45	1,037.30	8.62	1.90
		Good	602.00	4.94	603.30	4.30	1.30
Duncansby Head	170	Poor	448.60	11.63	449.20	11.09	0.60
		Moderate	300.10	5.36	300.00	5.60	-0.10
		Good	177.50	6.72	177.40	6.64	-0.10
Holburn Head	16	Poor	40.80	0.92	40.70	0.82	-0.10
		Moderate	33.40	0.84	33.60	0.97	0.20
		Good	19.80	0.63	19.80	0.63	0.00
Melvich	811	Poor	2,214.60	19.75	2,216.90	20.44	2.30
		Moderate	1,505.60	11.53	1,508.10	13.63	2.50
		Good	908.10	23.13	909.60	24.34	1.50
Stroma	40	Poor	93.50	4.33	92.70	4.32	0.20
		Moderate	56.20	0.74	56.20	0.79	0.00
		Good	46.40	1.74	46.70	1.25	0.30
SPA total (sum of sub-site adult mortalities in moderate environmental conditions)							4.50

Table B1.3 PFOWF Variation and Moray Firth wind farms: SeabORD predicted adult kittiwake mortalities during the year, at the five sub-sites within NCC SPA, during ‘poor’, ‘moderate’ and ‘good’ environmental conditions

Sub-site	PVA baseline adult mortalities	Environmental Conditions	Adults not surviving the year				Difference in mortalities between scenarios
			Baseline (no wind farm)		Wind farm present		
			Mean	SD	Mean	SD	
Dunnet Head	590	Poor	1,579.00	14.69	1,580.70	13.32	1.70
		Moderate	1,035.40	10.45	1,038.10	8.41	2.70
		Good	602.00	4.94	605.40	3.89	3.40
Duncansby Head	170	Poor	448.60	11.63	449.00	11.82	0.40
		Moderate	300.10	5.36	299.90	5.93	-0.20
		Good	177.50	6.72	177.60	6.64	0.10
Holburn Head	16	Poor	40.80	0.92	40.70	0.82	-0.10
		Moderate	33.40	0.84	33.50	0.97	0.10
		Good	19.80	0.63	19.90	0.57	0.10
Melvich	811	Poor	2,214.60	19.75	2,218.40	21.04	3.80
		Moderate	1,505.60	11.53	1,507.90	12.81	2.30
		Good	908.10	23.13	910.00	25.15	1.90
Stroma	40	Poor	93.50	4.33	93.80	4.39	0.30
		Moderate	56.20	0.79	56.30	0.82	0.10
		Good	46.40	1.17	46.70	1.25	0.30
SPA total (sum of sub-site adult mortalities in moderate environmental conditions)							5.00

Table BI.4 PFOWF Variation: SeabORD outputs for kittiwake at each of the five sub-sites within NCC SPA

Output Variable	Scenario (wind farm present/not present)	Dunnet Head		Duncansby Head		Holburn Head		Melvich		Stroma	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Number of adult birds in simulation	Both	4,040	-	1168	-	110	-	5,554	-	274	-
Adult survival at end of breeding season (%)	Not present	100.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00
	Present	100.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00
Initial adult body mass (g)	Not present	372.77	0.00	371.65	0.00	370.95	0.00	372.97	0.00	372.91	0.00
	Present	372.77	0.00	371.65	0.00	370.95	0.00	372.97	0.00	372.91	0.00
Final adult body mass (g)	Not present	344.03	5.32	345.81	7.63	345.11	5.90	346.30	5.78	345.38	5.94
	Present	344.02	5.32	345.84	7.63	345.10	5.88	346.27	5.78	345.36	5.94
Difference between total distance flown with and without windfarms (km)		2.94	1.60	-0.49	1.50	2.74	10.42	5.38	0.57	1.61	1.11
Difference in the total number of trips with and without windfarms		-0.02	0.01	-0.02	0.01	-0.03	0.09	0.00	0.01	-0.01	0.01
Chicks not surviving the season	Not present	892.90	423.87	231.90	133.13	20.40	9.79	1,167.00	528.31	51.30	29.50
	Present	898.20	423.96	232.70	132.61	20.60	10.11	1,169.70	530.48	51.30	29.50
	Difference	5.30	-	0.80	-	0.20	-	2.70	-	0.00	-
Additional mortality of chicks with windfarm present (%)		0.26	0.09	0.14	0.11	0.36	1.15	0.10	0.09	0.00	0.00
Number of adults directly impacted by the windfarm (displaced or barriered)	Present	1,088	-	258	-	32	-	1,619	-	57	-

Table BI.5 Moray Firth wind farms: SeabORD outputs for kittiwake at each of the five sub-sites within NCC SPA

Output Variable	Scenario (wind farm present/not present)	Dunnet Head		Duncansby Head		Holburn Head		Melvich		Stroma	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Number of adult birds in simulation	Both	4,040		1,168		110		5,554		274	
Adult survival at end of breeding season (%)	Not present	100.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00
	Present	100.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00
Initial adult body mass (g)	Not present	372.77	0.00	371.64	0.00	370.95	0.00	372.97	0.00	372.91	0.00
	Present	372.77	0.00	371.64	0.00	370.95	0.00	372.97	0.00	372.91	0.00
Final adult body mass (g)	Not present	344.03	5.32	345.81	7.63	345.11	5.90	346.30	5.78	345.38	5.94
	Present	343.95	5.31	345.75	7.63	345.05	5.94	346.24	5.77	345.29	5.97
Difference between total distance flown with and without windfarms (km)		0.55	4.19	10.98	2.64	6.67	3.22	4.57	3.14	3.83	5.79
Difference in the total number of trips with and without windfarms		-0.06	0.04	-0.03	0.03	-0.04	0.05	-0.02	0.02	-0.06	0.05
Chicks not surviving the season	Not present	892.90	423.87	231.90	133.13	20.40	9.79	1,167.00	528.31	51.30	29.50
	Present	899.10	427.66	232.90	133.91	20.80	9.66	1,171.80	531.28	51.80	29.74
	Difference	6.20	-	1.00	-	0.40	-	4.80	-	0.50	-
Additional mortality of chicks with windfarm present (%)		0.31	0.24	0.17	0.21	0.73	1.27	0.17	0.12	0.37	0.52
Number of adults directly impacted by the windfarm (displaced or barriered)	Present	986		296		28		1,283		65	

Table BI.6 PFOWF Variation and Moray Firth wind farms: SeabORD outputs for kittiwake at each of the five sub-sites within NCC SPA

Output Variable	Scenario (wind farm present/not present)	Dunnet Head		Duncansby Head		Holburn Head		Melvich		Stroma	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Number of adult birds in simulation	Both	4,040	-	1,168	-	110	-	5,554	-	274	-
Adult survival at end of breeding season (%)	Not present	100.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00
	Present	100.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00
Initial adult body mass (g)	Not present	372.77	0.00	371.65	0.00	370.95	0.00	372.97	0.00	372.91	0.00
	Present	372.77	0.00	371.65	0.00	370.95	0.00	372.97	0.00	372.91	0.00
Final adult body mass (g)	Not present	344.03	5.32	345.81	7.63	345.11	5.90	346.30	5.780	345.38	5.94
	Present	343.94	5.31	345.77	7.63	345.05	5.92	346.22	5.768	345.27	5.97
Difference between total distance flown with and without windfarms (km)		3.51	5.20	10.68	2.68	9.80	11.53	9.87	3.750	5.61	8.24
Difference in the total number of trips with and without windfarms		-0.08	0.04	-0.05	0.03	-0.07	0.10	-0.03	0.033	-0.07	0.06
Chicks not surviving the season	Not present	892.90	423.87	231.90	133.13	20.40	9.79	1167.00	528.31	51.30	29.50
	Present	904.50	427.89	233.70	133.63	21.00	9.98	1174.20	532.56	51.70	29.76
	Difference	11.60	-	1.80	-	0.60	-	7.20	-	0.40	-
Additional mortality of chicks with windfarm present (%)		0.57	0.27	0.31	0.18	1.09	1.53	0.26	0.17	0.29	0.51
Number of adults directly impacted by the windfarm	Present	1200	-	329	-	32	-	1626	-	77	-

B2: Puffin

Table B2.1 PFOWF Variation: SeabORD predicted adult puffin mortalities during the year, at the five sub-sites within NCC SPA, during ‘poor’, ‘moderate’ and ‘good’ environmental conditions

Sub-site	PVA baseline adult mortalities	Environmental Conditions	Adults not surviving the year				Difference in mortalities between scenarios
			Baseline (no wind farm)		Wind farm present		
			Mean	SD	Mean	SD	
Dunnet Head	151	Poor	276.60	4.06	276.90	3.84	0.30
		Moderate	187.20	4.16	187.70	4.42	0.50
		Good	90.80	4.02	91.60	3.69	0.80
Duncansby Head	2	Poor	5.70	0.68	5.70	0.68	0.00
		Moderate	0.70	0.48	0.70	0.48	0.00
		Good	1.80	0.42	1.80	0.42	0.00
Holburn Head	6	Poor	8.90	0.88	8.90	0.88	0.00
		Moderate	8.90	0.32	9.00	0.00	0.10
		Good	2.00	0.00	1.90	0.32	-0.10
Melvich	127	Poor	277.70	14.47	278.30	14.79	0.60
		Moderate	219.50	8.41	219.90	8.49	0.40
		Good	130.60	6.57	131.00	6.52	0.40
Stroma	2	Poor	3.60	0.52	3.60	0.52	0.00
		Moderate	3.40	0.52	3.40	0.52	0.00
		Good	1.30	0.48	1.30	0.48	0.00
SPA total (sum of sub-site adult mortalities in moderate environmental conditions)						1.00	

Table B2.2 Moray Firth wind farms: SeabORD predicted adult puffin mortalities during the year, at the five sub-sites within NCC SPA, during ‘poor’, ‘moderate’ and ‘good’ environmental conditions

Sub-site	PVA baseline adult mortalities	Environmental Conditions	Adults not surviving the year				Difference in mortalities between scenarios
			Baseline (no wind farm)		Wind farm present		
			Mean	SD	Mean	SD	
Dunnet Head	151	Poor	276.60	4.06	277.40	4.25	0.80
		Moderate	187.20	4.16	188.60	3.53	1.40
		Good	90.80	4.02	91.10	3.76	0.30
Duncansby Head	2	Poor	5.70	0.68	5.70	0.68	0.00
		Moderate	0.70	0.48	0.70	0.48	0.00
		Good	1.80	0.42	1.80	0.42	0.00
Holburn Head	6	Poor	8.90	0.88	8.90	0.88	0.00
		Moderate	8.90	0.32	8.90	0.32	0.00
		Good	2.00	0.000	2.00	0.00	0.20
Melvich	127	Poor	277.70	14.469	279.70	15.91	2.00
		Moderate	219.50	8.410	220.90	8.60	1.40
		Good	130.60	6.569	131.50	7.35	0.90
Stroma	2	Poor	3.60	0.516	3.60	0.52	0.00
		Moderate	3.40	0.516	3.40	0.52	0.00
		Good	1.30	0.483	1.50	0.53	0.20
SPA total (sum of sub-site adult mortalities in moderate environmental conditions)							2.80

Table B2.3 PFOWF Variation and Moray Firth wind farms: SeabORD predicted adult puffin mortalities during the year, at the five sub-sites within NCC SPA, during ‘poor’, ‘moderate’ and ‘good’ environmental conditions

Sub-site	PVA baseline adult mortalities	Environmental Conditions	Adults not surviving the year				Difference in mortalities between scenarios
			Baseline (no wind farm)		Wind farm present		
			Mean	SD	Mean	SD	
Dunnet Head	151	Poor	276.60	4.06	277.50	3.87	0.90
		Moderate	187.20	4.16	189.70	3.71	2.50
		Good	90.80	4.02	91.70	3.68	0.90
Duncansby Head	2	Poor	5.70	0.68	5.70	0.68	0.00
		Moderate	0.70	0.48	0.70	0.48	0.00
		Good	1.80	0.42	1.80	0.42	0.00
Holburn Head	6	Poor	8.90	0.88	8.90	0.88	0.00
		Moderate	8.90	0.32	9.00	0.00	0.10
		Good	2.00	0.00	1.90	0.32	-0.10
Melvich	127	Poor	277.70	14.47	280.10	15.82	2.40
		Moderate	219.50	8.41	220.80	8.28	1.30
		Good	130.60	6.57	132.20	7.44	1.60
Stroma	2	Poor	3.60	0.52	3.60	0.52	0.00
		Moderate	3.40	0.52	3.40	0.52	0.00
		Good	1.30	0.48	1.50	0.53	0.20
SPA total (sum of sub-site adult mortalities in moderate environmental conditions)							3.90

Table B2.4 PFOWF Variation: SeabORD outputs for puffin at each of the five sub-sites within NCC SPA

Output Variable	Scenario (wind farm present/not present)	Dunnet Head		Duncansby Head		Holburn Head		Melvich		Stroma	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Number of adult birds in simulation	Both	1604	-	18	-	60	-	1354	-	18	-
Adult survival at end of breeding season (%)	Not present	100.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00
	Present	100.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00
Initial adult body mass (g)	Not present	393.26	0.00	388.82	0.00	393.64	0.00	393.47	0.00	386.81	0.00
	Present	393.26	0.00	388.82	0.00	393.64	0.00	393.47	0.00	386.81	0.00
Final adult body mass (g)	Not present	371.41	6.83	355.35	9.91	369.73	6.54	373.19	7.22	360.95	5.79
	Present	371.28	6.86	355.32	9.91	369.73	6.58	373.09	7.26	360.95	5.79
Difference between total distance flown with and without windfarms (km)		13.53	1.90	0.79	5.58	14.11	6.88	17.72	4.30	-0.46	5.80
Difference in the total number of trips carried out with and without windfarms		0.01	0.02	-0.03	0.05	-0.06	0.08	0.03	0.03	-0.03	0.08
Chicks not surviving the season	Not present	58.40	18.56	2.50	1.18	2.20	1.03	41.60	18.43	0.60	1.08
	Present	59.10	19.84	2.50	1.18	2.20	1.03	41.50	18.18	0.60	1.08
	Difference	0.70	-	0.00	-	0.00	-	-0.10	-	0.00	-
Additional mortality of chicks with windfarm present (%)		0.09	0.17	0.00	0.00	0.00	0.00	-0.02	0.05	0.00	0.00
Number of adults directly impacted by the windfarm (displaced or barriered)	Present	880	-	9	-	42	-	772	-	5	-

Table B2.5 Moray Firth wind farms: SeabORD outputs for puffin at each of the five sub-sites within NCC SPA

Output Variable	Scenario (wind farm present/not present)	Dunnet Head		Duncansby Head		Holburn Head		Melvich		Stroma	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Number of adult birds in simulation	Both	1604	-	18	-	60	-	1354	-	18	-
Adult survival at end of breeding season (%)	Not present	100.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00
	Present	100.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00
Initial adult body mass (g)	Not present	393.26	0.00	388.82	0.00	393.64	0.00	393.47	0.00	386.81	0.00
	Present	393.26	0.00	388.82	0.00	393.64	0.00	393.47	0.00	386.81	0.00
Final adult body mass (g)	Not present	371.41	6.83	355.35	9.91	369.73	6.54	373.19	7.22	360.95	5.79
	Present	371.16	6.91	355.20	10.05	369.46	6.72	372.93	7.33	360.66	6.02
Difference between total distance flown with and without windfarms (km)		31.18	1.93	30.15	11.24	41.84	7.20	30.98	3.87	20.41	9.82
Difference in the total number of trips carried out with and without windfarms		0.05	0.01	0.03	0.10	0.05	0.06	0.06	0.02	0.00	0.09
Chicks not surviving the season	Not present	58.40	18.56	2.50	1.18	2.20	1.03	41.60	18.43	0.60	1.08
	Present	59.10	19.90	2.50	1.18	2.30	0.95	42.50	19.52	0.60	1.08
	Difference	0.70	-	0.00	-	0.10	-	0.90	-	0.00	-
Additional mortality of chicks with windfarm present (%)		0.09	0.21	0.00	0.00	0.33	1.05	0.13	0.20	0.00	0.00
Number of adults directly impacted by the windfarm (displaced or barriered)	Present	816	-	10	-	37	-	661	-	6	-

Table B2.6 PFOWF Variation and Moray Firth wind farms: SeabORD outputs for puffin at each of the five sub-sites within NCC SPA

Output Variable	Scenario (wind farm present/not present)	Dunnet Head		Duncansby Head		Holburn Head		Melvich		Stroma	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Number of adult birds in simulation	Both	1604	-	18	-	60	-	1354	-	18	-
Adult survival at end of breeding season (%)	Not present	100.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00
	Present	100.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00
Initial adult body mass (g)	Not present	393.26	0.00	388.82	0.00	393.64	0.00	393.47	0.0	386.81	0.00
	Present	393.26	0.00	388.82	0.00	393.64	0.00	393.47	0.00	386.81	0.00
Final adult body mass (g)	Not present	371.41	6.83	355.35	9.91	369.73	6.54	373.19	7.22	360.95	5.79
	Present	371.04	6.93	355.36	10.03	369.45	6.75	372.84	7.37	360.66	6.08
Difference between total distance flown with and without windfarms (km)		44.20	2.21	29.24	14.40	56.31	9.82	48.96	7.76	17.45	8.88
Difference in the total number of trips carried out with and without windfarms		0.06	0.03	0.03	0.14	0.01	0.12	0.10	0.04	-0.07	0.10
Chicks not surviving the season	Not present	58.40	18.56	2.50	1.18	2.20	1.03	41.60	18.43	0.60	1.08
	Present	59.70	20.38	2.50	1.18	2.30	0.95	42.60	19.32	0.60	1.08
	Difference	1.30	-	0.00	-	0.10	-	1.00	-	0.00	-
Additional mortality of chicks with windfarm present (%)		0.16	0.26	0.00	0.00	0.33	1.05	0.15	0.22	0.00	0.00
Number of adults directly impacted by the windfarm (displaced or barred)	Present	937	-	10	-	42	-	772	-	6	-

Annex C SeabORD heat maps

CI: Description of heat maps

- 24 During each SeabORD simulation, density maps, or heat maps, are produced. These maps show the normalised density of individuals for a given species within the region simulated when no wind farms are present. In the format produced by SeabORD vs1.3, low densities are shown in dark blue and higher densities in yellow. Note that there is currently no option (in SeabORD vs1.3) to edit these maps and default maps are made automatically by the software. Due to the larger region set for the Variation modelling, this has made the distribution of individuals less clear on these default maps (as presented here in this Annex). As each sub-colony is modelled, and mapped, separately the densities do not reach high values resulting in them being less obvious on the final maps.
- 25 Figure C.2.1- Figure C.2.5 present each SPA sub-colony heat map for kittiwake and Figure C.3.1- Figure C.3.5 present the same for puffin.
- 26 These maps are not directly comparable with those produced by UKCEH for their puffin study using the updated version of SeabORD (as discussed in Section 1 Introduction). It is apparent that the updated version of SeabORD produces these heat maps using a different format (and scaling) compared to the vs1.3 defaults. However, both sets of available puffin maps (the ones in this Annex and the ones from the UKCEH study) show similar trends of higher densities of birds closer to the colony.

C2: Kittiwake heat maps



Figure C.2.1 Kittiwake density for individuals at Duncansby Head.



Figure C.2.2 Kittiwake density for individuals at Dunnet Head.

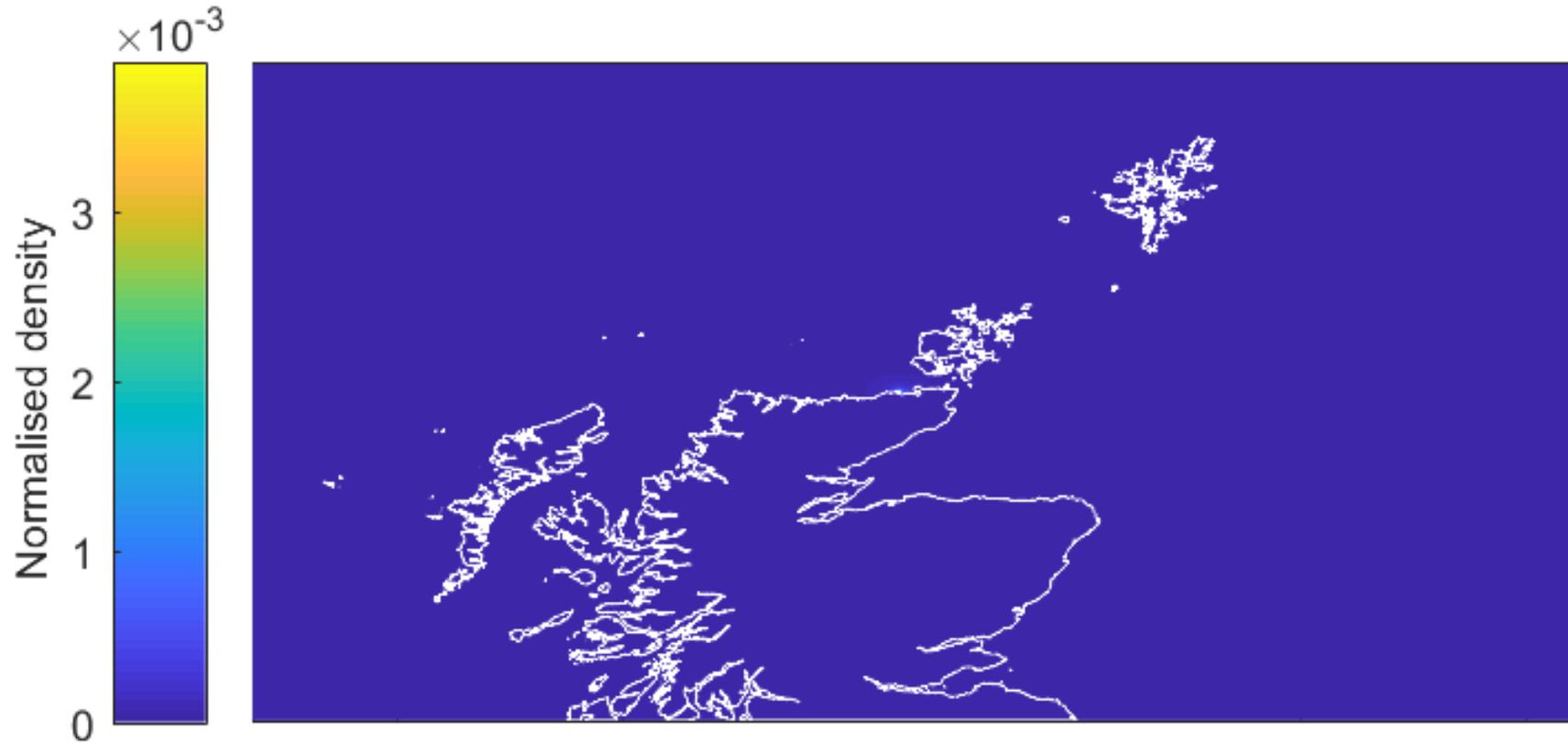


Figure C.2.3 Kittiwake density for individuals at Holburn

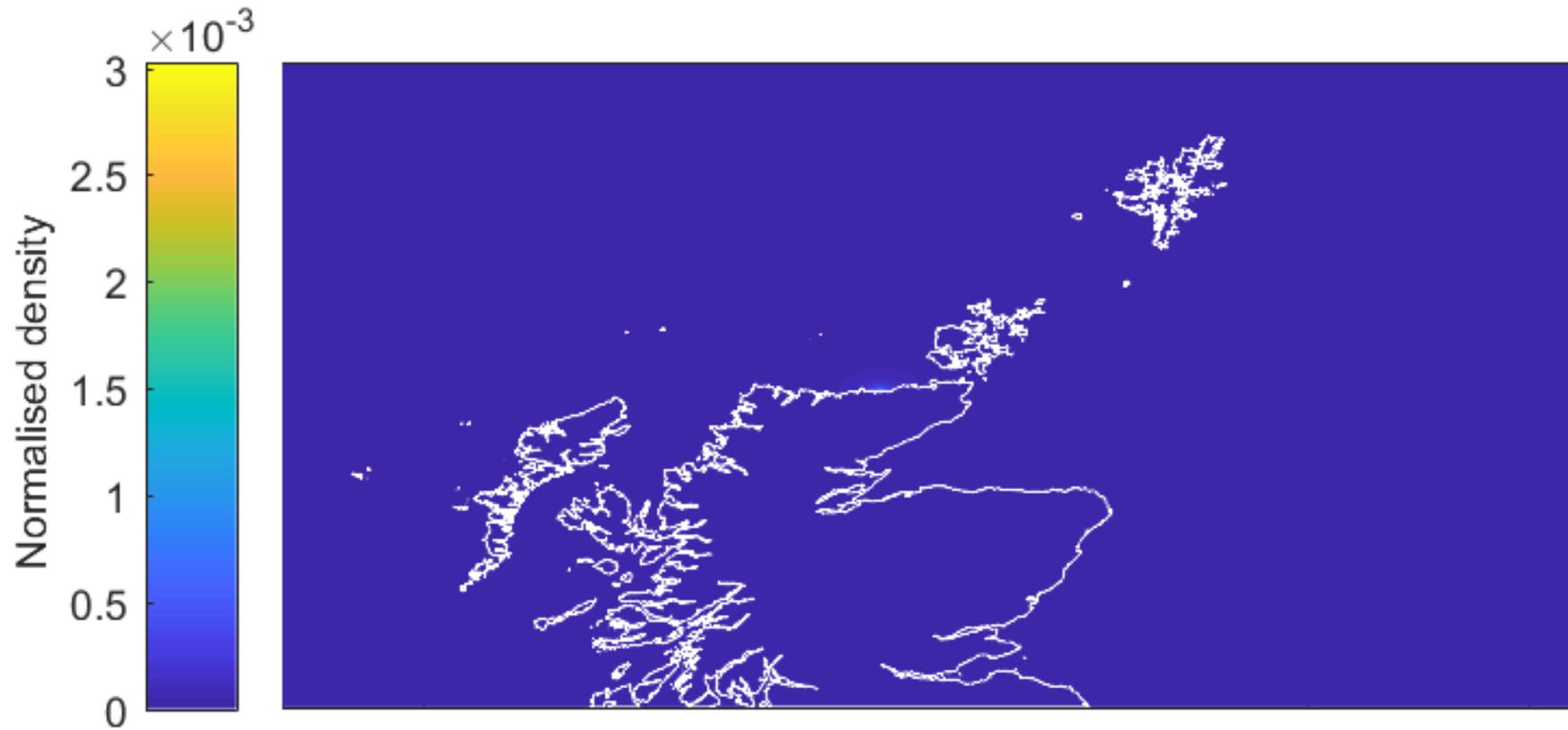


Figure C.2.4 Kittiwake density for individuals at Melvich.

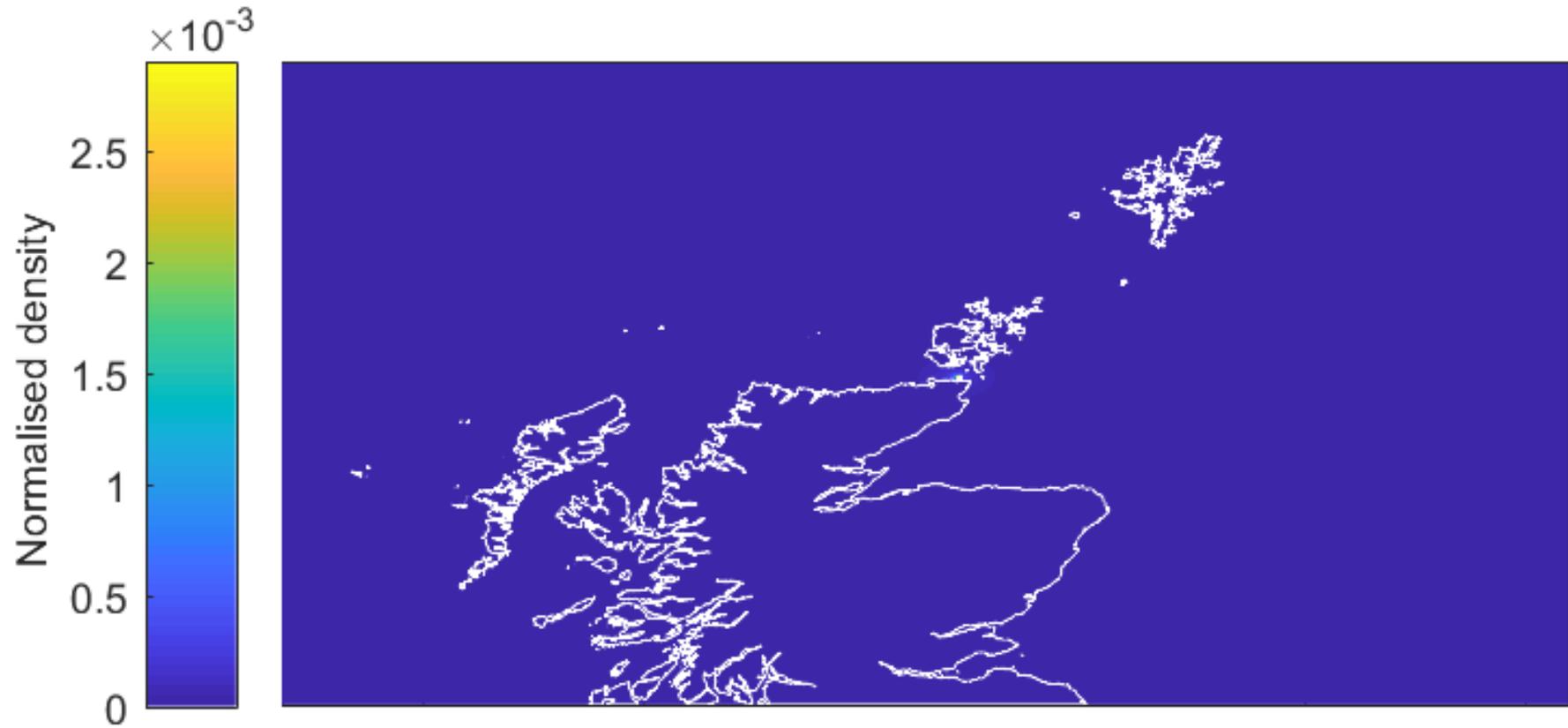


Figure C.2.5 Kittiwake density for individuals at Stroma.

C3: Puffin heat maps



Figure C.3.1 Puffin density for individuals at Duncansby Head

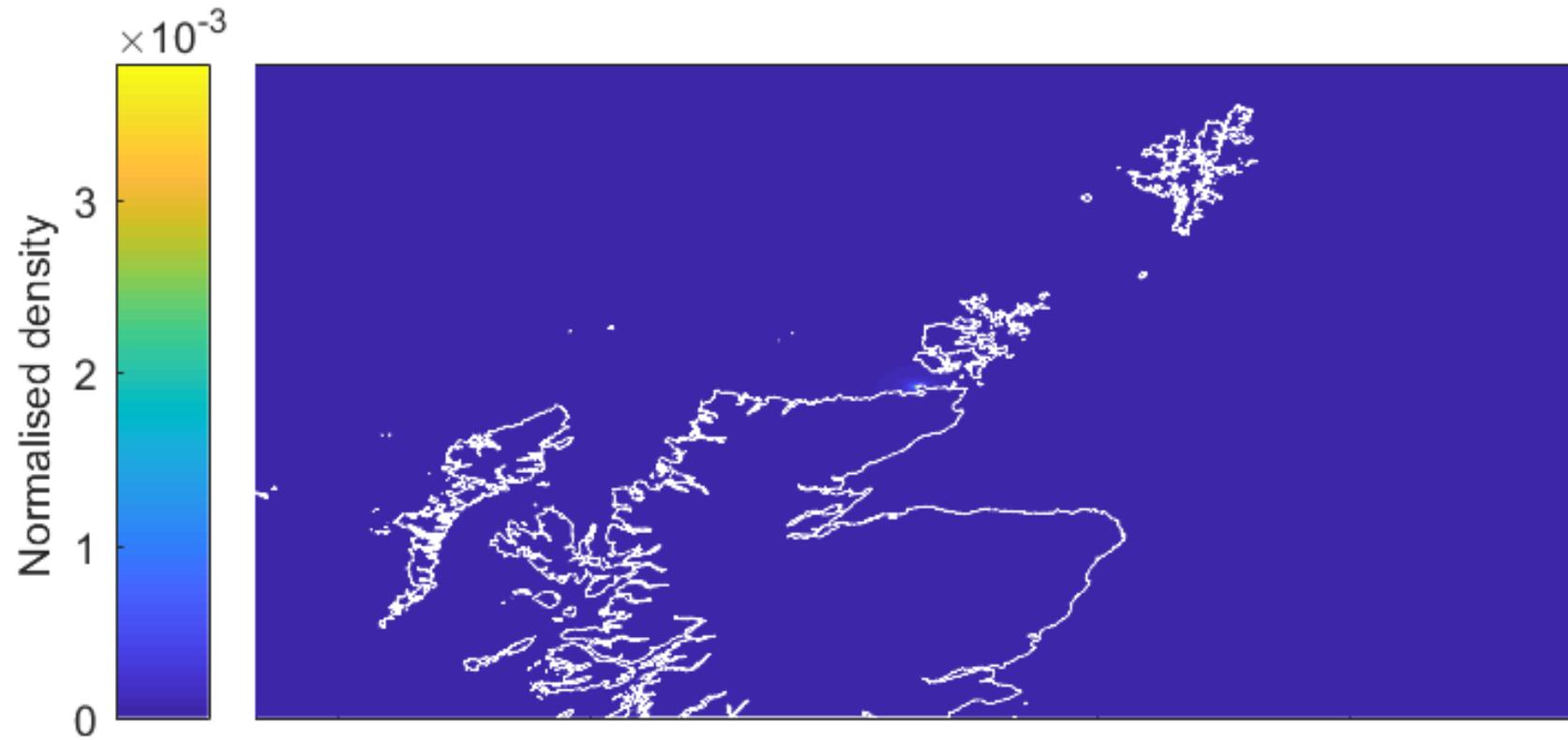


Figure C.3.2 Puffin density for individuals at Dunnet Head.

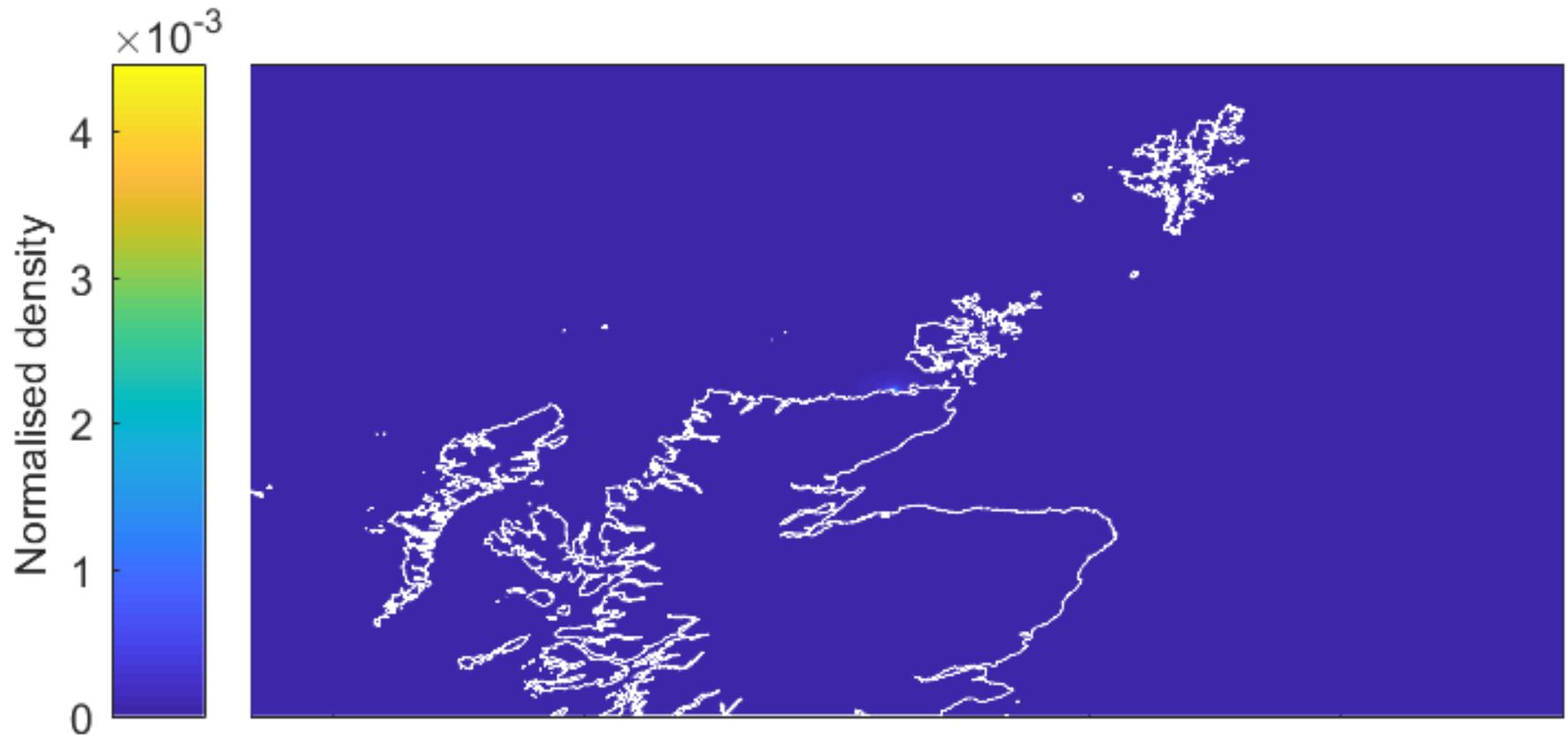


Figure C.3.3 Puffin density for individuals at Holburn.



Figure C.3.4 Puffin density for individuals at Melvich.

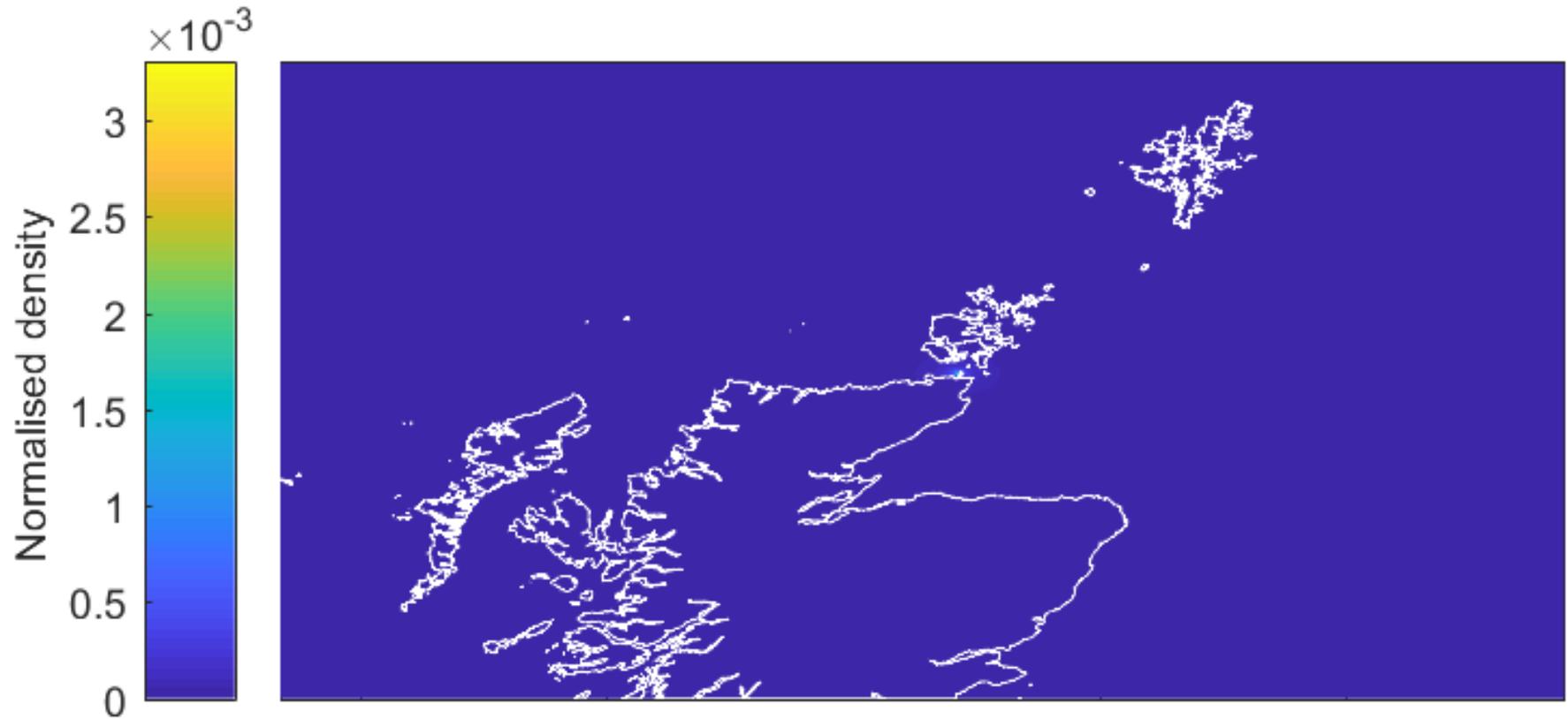


Figure C.3.5 Puffin density for individuals at Stroma.

Pentland Floating Offshore Wind Farm Variation Application

Technical Appendix D3: Marine Ornithology Collision Risk Modelling

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Acronyms and abbreviations

Acronyms / abbreviation	Full name
BDMPS	Biologically Defined Minimum Population Scales
dCRM	Deterministic Collision Risk Modelling
CRM	Collision Risk Modelling
DSLIP	Development Specification and Layout Plan
ES	Environmental Statement
EIAR	Environmental Impact Assessment Report
HiDef	HiDef Aerial Surveying Limited
HWL	Highland Wind Limited
LAT	Lowest Astronomical Tide
MD-LOT	Marine Directorate - Licensing Operations Team
MSL	Mean Sea Level
MS-LOT	Marine Scotland – Licensing Operations Team
MW	Megawatt
NPC	Natural Power Consultants
NS	NatureScot
PFOWF	Pentland Floating Offshore Wind Farm
PVA	Population Viability Analysis
QA	Quality Assurance
RPM	Revolution Per Minute
sCRM	Stochastic CRM
SD	Standard Deviation
SPA	Special Protection Area

I Introduction

- 1 This Technical Appendix supports assessment of potential collision risk to kittiwake¹ undertaken in support of the Pentland Floating Offshore Wind Farm (PFOWF) Variation Application (the 'Variation Application'). Please see Technical Appendix D1, *Marine Ornithology Summary*, for further detail on the overall scope of assessment for the Variation Application and the associated pre-application engagement with the Marine Directorate – Licencing Operations Team (MD-LOT) and NatureScot (NS) over this.
- 2 There is a risk that kittiwake could potentially collide with turbines (including turbine blades) in the PFOWF Variation array area. Such collisions are assumed to be fatal, equating to mortality of the struck individual. Collision Risk Modelling (CRM) quantifies this risk and provides an estimate of the collision mortality which could arise to the species studied (in this case kittiwake) from the project or projects in question (Band, 2012).
- 3 Following NatureScot guidance (NS, 2023)², and pre-application dialogue with MD-LOT and NS (as set out in Technical Appendix D1) this Technical Appendix presents the required modelling to assess project-alone collision risk to kittiwake for the PFOWF Variation Application (Section 2.3) as well as cumulatively with consented development in the Moray Firth (Beatrice, Moray East and Moray West offshore wind farms, see Section 2.4).
- 4 Further offshore wind farms in the wider North Sea are also addressed for cumulative assessment (Section 2.5) in respect of potential kittiwake collisions in the non-breeding season, when the birds disperse from their breeding colonies and move and mix over much larger areas (Furness, 2015).
- 5 All analysis was performed using the *stochLAB* R package produced by Caneco (2022), which can be used both for deterministic and stochastic CRM as further discussed in Section 2.1 on methods. As for the Original PFOWF Application, HiDef have undertaken all CRM presented in this Technical Appendix with Natural Power Consultants providing third party comment and quality assurance (QA).

¹ Full name: Black-legged kittiwake (*Rissa tridactyla*), hereafter 'kittiwake'.

² [Guidance Note 7: Guidance to support Offshore Wind Applications: Marine Ornithology - Advice for assessing collision risk of marine birds | NatureScot](#)

2 Methods

2.1 Overview

- 6 The number of avian collisions can be estimated through:

$$FoT \times Q2r \times \text{probability of collision}$$

where:

FoT = Flux rate multiplied by the operational time of the wind farm,

Q2r = Proportion of flying birds at collision risk height

Probability of collision = the probability of a single bird colliding with a turbine assuming no avoidance behaviour

- 7 Both stochastic and deterministic versions of CRM can use the following model frameworks: basic and extended. The basic model assumes a uniform distribution of risk over the rotor swept area whereas the extended model allows risk to vary along the length of the turbine blade (as it relates to the rotor swept area). Depending on the nature of the seabird flight height data used, there are four different available options:
- Option 1: Basic model: Proportion of birds at collision height (calculated manually) based on site-specific flight height data, which assumes a uniform distribution of risk over the extent of the rotor swept area.
 - Option 2: Basic model: Proportion of birds at collision risk height (calculated automatically), based on a generic flight height distribution, also assuming a uniform distribution of risk over the rotor swept area.
 - Option 3: Extended model: Proportion of birds at collision height calculated by integrating risk across a rotor swept area at different points along a generic flight height distribution.
 - Option 4: Extended model: Proportion of birds at collision height calculated by integrating risk across a rotor swept area at different points using site-specific flight height distribution.
- 8 A paper outlining the proposed approach was shared with MD-LOT and NS on 02/06/2023 and was then discussed at a pre-application meeting held on 26/07/2023. As a result of these discussions, option 2 has been selected for assessment using the generic flight height distribution from Johnston *et al.*, 2014a/b. Both stochastic and deterministic CRMs were carried out for the PFOWF Variation Application (where standard deviations are available for the input densities of flying kittiwake) but only deterministic CRM was done for Moray Firth wind farms (as measures of uncertainty around input densities were not available for Beatrice or Moray East).
- 9 The generic flight height data presented in Johnston *et al.* (2014a/b) are derived mainly from boat-based surveys from 32 sites in the North, Baltic and Irish Seas between 1998 and 2012. The advantage of using pooled data from these sites means there is a larger sample from which to derive seabird flight heights, compared to site-specific data. Individual flight heights were estimated with uncertainty, to allow variation in flight height estimation to be incorporated while improving the accuracy of flight height distributions.

- 10 Both stochastic and deterministic estimates were generated using the R package stochLAB (Caneco, 2022) which contains the functions that underpin the sCRM tool shiny app created by the same team. R code can be made available upon request. The seed used within the sCRM was 1234 and 1,000 iterations were performed.

2.2 CRM input parameters for kittiwake

2.2.1 Kittiwake biometric parameters

- 11 CRM uses *a priori* agreed seabird parameters, as advised by NatureScot (2023) with those for kittiwake presented in Table 1.

Table 1 Kittiwake biometric and behavioural input parameters for CRM.
Standard deviation presented within parentheses.

Species	Body length (m)	Wingspan (m)	Flight speed (m/s ⁻¹)	Nocturnal activity factor	Flight type (flapping or gliding)
Kittiwake	0.39 (0.005)	1.08 (0.0625)	13.1 (0)	25% (0)	Flapping

2.2.2 Kittiwake seasonality

- 12 Collision mortality estimates for kittiwake are considered by season, with the breeding season defined by NatureScot (2020); April-August, and the non-breeding (BDMPS³) seasons defined by Furness (2015)⁴. As there is overlap between these seasonal periods, those for the BDMPS have been adapted to avoid double-counting (see Table 5, Table 6 and Table 8). Any estimated collision mortalities occurring in August and April are assigned to the breeding season (as per the NS definition) with the Furness (2015) autumn migration period adjusted to September-December; and spring migration to January-March.

2.2.3 Kittiwake avoidance rates

- 13 NatureScot have provided avoidance rates using collision data from both onshore and offshore wind farms (NS 2023; Ozsanlav-Harris *et al.* 2023). Table 2 presents the recommended rates for kittiwake with reference to stochastic and deterministic CRM.

Table 2 CRM kittiwake avoidance rates

Species	NatureScot advice	
	Stochastic	Deterministic
Kittiwake	0.993 (+/- 0.0003)	0.992

³ BDMPS: Biologically defined minimum population scales.

⁴ Furness (2015), autumn migration; August-December, and spring migration; January-April.

2.3 CRM for the PFOWF Variation

2.3.1 PFOWF monthly input densities

Monthly mean densities of flying seabirds during the two years of digital aerial survey were calculated for the Original Application and remain the same for this Variation Application assessment. The input densities of flying kittiwake are presented in Table A1.1, Annex A.

2.3.2 PFOWF Variation turbine scenario

- 14 Table 3 presents the turbine scenario included in the PFOWF Variation Application (comprising five 17 Megawatt (MW) turbines and one 14 MW turbine). Note that this presents the 'worst case' for assessment as this is the confirmed maximum number of turbines to be installed; reduced from the maximum of seven presented for the Original Application. As each turbine selection for the Variation Application scenario has different associated parameters, they are modelled separately and then the output mortality estimates are summed (as per the seasonal summary in Table 5).
- 15 To validate the approach, CRM has also been undertaken for a scenario comprising six 17 MW turbines; its seasonal summary for comparison is presented in Table 5.
- 16 Full monthly outputs for the PFOWF Variation Application-alone CRM are presented in Tables A1.2 and A1.3, Annex A.

Table 3 PFOWF Variation turbine parameter values

Parameter	Turbine type	
	14 MW	17 MW
Latitude (decimal degrees)	58.656	
Tidal offset (m)	n/a (floating wind farm)	
No. turbines	1	5
No. blades	3	3
Rotor radius (m)	110	125
Air gap (m)	35	35
Max. blade width (m)	7	7
Rotation speed (RPM)	8	8
Pitch (degrees)	10	10
Estimate of turbine downtime / operational time (%) ¹	5 / 95	5 / 95

¹As for the Original PFOWF Application, an allowance of 5% has been made for operational downtime including scheduled or unscheduled maintenance activities.

2.4 CRM remodelling for Moray Firth wind farms

- 17 At the pre-application meeting held on 26 July 2023, it was agreed with MD-LOT and NS that CRM for the Moray Firth wind farms would be remodelled using the ‘as built’ turbine numbers and turbine dimensions for Beatrice and Moray East, and the final turbine design parameters given for Moray West in the Development Specification and Layout Plan (DSLPL), as approved by MD-LOT on 15 December 2022.
- 18 Note that remodelled Moray Firth CRMs are all deterministic due to lack of any information on uncertainty in the density estimates (i.e., any available standard deviations) for original Beatrice and Moray East (boat-based) survey data.

2.4.1 Moray Firth monthly input densities

- 19 Monthly mean densities of flying kittiwake for remodelling Moray Firth CRM were obtained as follows:
- **Beatrice** densities were provided by NatureScot in their email of 7 August 2023.
 - **Moray East** densities were obtained from that project’s ES Technical Appendix 4.5A – Ornithology Baseline and Impact Assessment (MORL, 2012). These were needed for the entire wind farm area (rather than for Telford, Stevenson and MacColl sub-sites which were not separately progressed after consent).
 - **Moray West** densities were obtained from that project’s ES Technical Appendix 10.1A (MOWWL, 2018a).

All these input densities are presented in Table B1. I, Appendix B.

2.4.2 Moray Firth turbine scenarios

- 20 Table 4 presents the ‘as built’/DSLPL turbine parameters for the Moray Firth wind farms. These were obtained from the following sources (with Beatrice and Moray East turbine numbers confirmed by reference to Crown Estate’s ‘live generation’ [offshore wind map](#)):
- BOWL letter dated 26/11/2015 to Marine Scotland, BOWL Ref L000005-LET-289. [00498080.pdf \(marine.gov.scot\)](#)
 - Beatrice DSLPL. BOWL Ref LF000005-PLN-152 Rev 3.0 (BOWL, 2016). [Description of Services \(marine.gov.scot\)](#)
 - Moray East DSLPL (final proposal dated September 2020, approved December 2020). [moray_east_dslp_version_5.pdf \(marine.gov.scot\)](#)
 - Moray West DSLPL. Rev 2. (MOWWL, 2022). [moray_west_-_development_specification_and_layout_plan_-_final_redacted.pdf \(marine.gov.scot\)](#)

Table 4 Moray Firth turbine parameter values

Parameter	Turbine parameters		
	Beatrice	Moray East	Moray West
Latitude (decimal degrees)	58.254	58.191	58.097
Tidal offset (m) ¹	0	0	0
No. turbines	84	100	60
No. blades	3	3	3
Rotor radius (m)	77	82	111 ²
Air gap (m) ³	33	31	40.02
Max. blade width (m)	4.98	5.4	6.5 ²
Rotation speed (RPM)	11.8	10.5	8 ⁴
Pitch (degrees)	7	10	8 ²
Estimated downtime / operational time (%) ⁵	5 / 95	5 / 95	5 / 95

¹ Airgap measurements were given related to Lowest Astronomical Tide (LAT). These have been adjusted by 2.1m to convert from LAT to Mean Sea Level (MSL). The value for tidal offset is therefore not required.

² Moray West is installing the Siemens Gamesa 14-222-dd turbine and these parameters have been taken from the [specification brochure](#).

³ These air gap measurements are presented relative to LAT, so have been converted to MSL for adoption in the modelling (as explained in table note 1).

⁴ The mean rotation speed for this Siemens Gamesa turbine is not stated in the brochure, however, its rotor radius is very similar to that of the modelled 14 MW PFOWF turbine, so that the same rotor speed has been assumed for simplicity and comparability.

⁵ For consistency, comparability and simplicity, the same assumptions (as for PFOWF) on wind farm operation and maintenance downtime have been applied to the Moray Firth projects.

2.5 Wider North Sea wind farms

- 21 As for the Original PFOWF Application, the Variation Application Assessment includes information on estimated cumulative kittiwake collision mortalities potentially occurring in the non-breeding season from interactions with the wider range of wind farms present in the North Sea BDMPS (as defined in Furness, 2015).
- 22 From investigation of the available source material, and as discussed with MD-LOT and NS at the pre-application meeting on 12/09/2023, the recommendation is made to refer to the collation of these figures undertaken by ICOL for the Inch Cape revised design application (ICOL, 2018) as set out in Appendix IIB of that submission and associated spreadsheet (dated 26/09/2018).

- 23 This ICOL collation was used in Scottish Government decision-making both for it and Neart na Gaoithe, informing the appropriate assessment for each of these two projects.
- 24 While the cumulative compilation presented in the Moray West ES was investigated and discussed in the Original PFOWF Application (in the *Habitats Regulations Appraisal Offshore Report to Inform Appropriate Assessment – Section 9.10.3.3, page 214*) it has not been used for further reference in this Variation Application given it is unclear how the apportioned mortality estimates against North Caithness Cliffs have been derived (Table 3.51 of the Moray West EIA Addendum) (MOWWL, 2018b). Although this information was used in the Moray West decision-making (which occurred concurrently with that for ICOL) it cannot be readily verified and there are no clear statements on its source, nor any transparent calculations provided. Therefore, the ICOL compilation is used in preference.
- 25 ICOL include a clear statement on how the non-breeding kittiwake collision estimates in their compilation have been derived (and the reference source(s) used). Additionally, ICOL’s methodology for this work was checked by and agreed with NS (at the time Scottish Natural Heritage) during pre-application dialogue for the revised design. ICOL’s statement is this:

The approach taken to estimating the collisions attributable to these SPA kittiwake populations during the autumn and spring passage periods followed that used for apportioning collisions to the Flamborough Head and Filey Coast pSPA kittiwake population in the assessment for the East Anglia THREE wind farm (MacArthur Green 2015b, Royal HaskoningDHV et al. 2015). This approach is based upon the BDMPS⁵ for kittiwake (Furness, 2015).

The initial collision estimates for kittiwake at the UK North Sea wind farms during the autumn and spring passage periods are provided in the East Anglia THREE assessment (see Table 3.7 in Royal HaskoningDHV et al. 2015). However, these estimates were updated in line with the report on Estimates of Ornithological Headroom in Offshore Wind Farm Collision Mortality (MacArthur Green 2017), which revises the annual estimates on the basis of the differences in the ‘as built’ and ‘as consented’ wind farm designs. Where the ‘as consented’ collision estimate for a wind farm differed between the ‘Ornithological Headroom’ report and the East Anglia THREE assessment, then the value from the ‘Ornithological Headroom’ report was used as the basis for the calculation (following the advice provided by SNH – email of 1 November 2017 from MS-LOT to ICOL).

- 26 While there has been a more recent submission from Berwick Bank which again includes cumulative non-breeding kittiwake mortality estimates for these wider North Sea wind farms, the information in that EIAR is not transparently set out, and the figures cannot be verified. It is unclear which wind farms are included in the compilation and contribute to the totals apportioned against North Caithness Cliffs.
- 27 While Berwick Bank may be a more recent application (than the Original PFOWF Application), it does itself refer back to earlier compilations, in this case East Anglia 1 & 2, as noted in *Appendix 11.6, Annex E; Summary of Approach and Collation of In-combination*

⁵ BDMPS = biologically defined minimum population scale.

Totals of the Berwick Bank EIAR. While this reference is made, the actual figures themselves are not presented and there are no supporting calculations to show how the cumulative totals have been derived.

- 28 Annex C here provides this information for the PFOWF Variation Application, to show clearly the Wider North Sea non-breeding kittiwake collision mortalities assigned in the cumulative assessment and modelled in the cumulative PVA, attributed to wider North Sea wind farms, with Table CI. 3 setting out the figures used and recalculating these using the updated 0.992 avoidance rate recommended in recent NS guidance (NS, 2023). A 10% sabbatical rate has also been applied to the adult component of estimated mortality from English windfarms, following the NS guidance (NS, 2023) and as agreed with NS (email of 25/09/2023), please see Section 2.1.4 of Appendix D4, Population Modelling for further detail and the rationale for this.
- 29 The recalculated estimates are then apportioned to the North Caithness Cliffs SPA breeding kittiwake population, using the same autumn and spring apportioning weightings as calculated for the Original PFOWF Application and presented in Table 7 below.

3 Results

3.1 Project alone CRM outputs

- 30 The full range of monthly kittiwake collision mortality estimates for the PFOWF Variation alone (for the range of model options and comparative scenarios) is presented in Tables A1.2 and A1.3, Annex A.
- 31 Table 5 presents a seasonal summary of kittiwake collision mortality estimates for the PFOWF Variation Application (five 17 MW turbines and one 14 MW turbine), with the component modelling based on the sCRM basic model, option 2. The estimates are provided for 'all birds' i.e., all birds are assumed to be adults. Any estimated collision mortalities in August and April are assigned to the breeding season.

Table 5 Kittiwake seasonal collision mortalities per year modelled for the PFOWF Variation Application (using CRM option 2)

Turbine scenario	Breeding season (NatureScot)	Biologically Defined Minimum Population Scales (BDMPS)* <i>*Adjusted in line with NatureScot guidance</i>	
		autumn migration	spring migration
	Apr - Aug	Sep - Dec	Jan - Mar
1x14 MW (Standard Deviation (SD))	0.51 (0.16)	0.10 (0.04)	0.05 (0.02)
5x17 MW (SD)	2.68 (0.82)	0.53 (0.23)	0.24 (0.09)
1x14 MW and 5x17 MW (SD)	3.20 (0.84)	0.63 (0.23)	0.29 (0.10)
6x17 MW (SD)	3.22 (0.99)	0.64 (0.27)	0.29 (0.11)

3.2 Moray Firth CRM outputs

- 32 Monthly kittiwake collision mortality estimates for the Moray Firth wind farms are presented in Table B1.2, Annex B, remodelled using the 'as built' or final design (DSLIP) parameters (set out in Table 4). Table 6 presents the seasonal summary for these wind farms, based on the Band CRM basic model (deterministic), option 2 (but with the same provisos as above regarding seasonality and assuming all mortalities are of adult birds).

Table 6 Kittiwake seasonal collision mortalities each year at Moray Firth wind farms (numbers of birds), model option 2

Turbine scenario	Breeding season NS guidance	BDMPS*	
		<i>*Adjusted in line with NS guidance</i>	
	Apr - Aug	autumn migration Sep - Dec	spring migration Jan - Mar
Beatrice	8.86	1.29	3.08
Moray East	72.10	0.99	6.72
Moray West	73.43	8.74	30.61

- 33 Monthly kittiwake collision mortality estimates for the Moray Firth wind farms are presented in Annex B, remodelled using the ‘as built’ or final design (DSLIP) parameters (set out in Table 4). Table 6 presents the seasonal summary for these wind farms, based on the Band CRM basic model (deterministic), option 2 (but with the same provisos as above regarding seasonality and assuming all mortalities are of adult birds).

3.3 Wider North Sea wind farm cumulative CRM

- 34 As noted in Section 2.5 the wider North Sea cumulative non-breeding kittiwake collision estimates used in assessment are presented in Annex C, Table C1.3

4 Discussion and Conclusions

- 35 For the PFOWF Variation Application, the kittiwake seasonal collision mortalities are apportioned for consideration in respect to the North Caithness Cliffs SPA population. The relevant apportioning weightings for each season and each wind farm are presented in Table 7. These are the same as those used for the Original PFOWF Application, following agreed methodologies as set out in *Marine Ornithology Technical Appendices; 12.5 Connectivity and Apportioning (Section 3.2.1)* and *12.5 Population Modelling (Annex A, Section A1.2)*.

Table 7 Apportioning weightings in relation to North Caithness Cliffs SPA kittiwake population.

Wind farm	Apportioning weightings		
	Breeding season	Autumn migration	Spring migration
PFOWF	0.717	0.023	0.028
Beatrice	0.026		
Moray East	0.023		
Moray West	0.015		

- 36 These apportioning weightings are applied to the seasonal CRM outputs presented in Table 5 (PFOWF) and Table 6 (Moray Firth wind farms). These apportioned kittiwake mortality estimates are presented in Table 8, with the annual total to be considered against the North Caithness Cliffs SPA population given in the final column on the right.

Table 8 Kittiwake collision mortalities apportioned to North Caithness Cliffs SPA, SD values in parenthesis where available.

Turbine scenario	Breeding season NS guidance	BDMPS*		Total
		*Adjusted in line with NS guidance		
	Apr - Aug	autumn migration Sep - Dec	spring migration Jan - Mar	
PFOWF ¹ (sCRM)	2.29 (0.60)	0.01 (0.01)	0.01 (0.00)	2.32 (0.60)
PFOWF ² (dCRM)	2.59	0.01	0.01	2.61
Beatrice ³	0.23	0.03	0.09	0.35
Moray East ³	1.66	0.02	0.19	1.87
Moray West ³	1.10	0.20	0.86	2.16

¹ Variation application as per Table 1, sCRM (with standard deviations in brackets)

² Variation application as per Table 1, deterministic CRM.

³ As remodelled Moray Firth CRMs are deterministic there is no measure of uncertainty (SD) on outputs.

- 37 The population consequences of these impacts against the SPA kittiwake population are modelled using Population Viability Analysis (PVA) as set out in Technical Appendix D4: Population Modelling.

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Annex A Pentland Variation – CRM input densities and model outputs

Table AI. 1 Kittiwake flying bird monthly mean densities (n/km²)

Monthly densities (n/km ²)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly mean	0.11	0.31	0.57	0.10	0.30	5.17	3.15	0.50	0.11	0.40	2.01	0
Standard Deviation (SD)	0.20	0.40	0.29	0.20	0.07	1.93	1.13	0.29	0.14	0.60	1.11	0

Table AI. 2 Kittiwake stochastic CRM model option 2 mortality estimates

Turbine scenario	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1x14 MW (SD)	0.01 (0.00)	0.02 (0.01)	0.02 (0.01)	0.01 (0.01)	0.02 (0.00)	0.29 (0.12)	0.17 (0.07)	0.03 (0.01)	0.01 (0.00)	0.03 (0.02)	0.07 (0.04)	0.00 (0.00)
5x17 MW (SD)	0.04 (0.02)	0.08 (0.05)	0.13 (0.07)	0.05 (0.03)	0.09 (0.03)	1.50 (0.62)	0.91 (0.37)	0.14 (0.08)	0.04 (0.03)	0.14 (0.10)	0.36 (0.19)	0.00 (0.00)
1x14 MW and 5x17 MW (SD)	0.04 (0.03)	0.09 (0.06)	0.15 (0.07)	0.06 (0.04)	0.10 (0.03)	1.79 (0.63)	1.08 (0.37)	0.17 (0.08)	0.04 (0.03)	0.16 (0.10)	0.43 (0.19)	0.00 (0.00)
6x17 MW (SD)	0.04 (0.03)	0.10 (0.06)	0.15 (0.08)	0.06 (0.04)	0.10 (0.03)	1.80 (0.74)	1.09 (0.44)	0.17 (0.09)	0.04 (0.03)	0.16 (0.11)	0.43 (0.23)	0.00 (0.00)

Table AI. 3 Kittiwake Band deterministic CRM model option 2 mortality estimates

Turbine scenario	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1x14 MW	0.00	0.01	0.03	0.01	0.02	0.33	0.20	0.03	0.01	0.02	0.08	0.00
5x17 MW	0.02	0.06	0.14	0.03	0.10	1.70	1.05	0.15	0.03	0.09	0.40	0.00
1x14 MW and 5x17 MW	0.02	0.07	0.17	0.03	0.12	2.03	1.25	0.18	0.03	0.11	0.48	0.00
6x17 MW	0.02	0.07	0.17	0.03	0.12	2.04	1.26	0.18	0.03	0.11	0.48	0.00

Annex B Moray Firth remodelling – CRM input densities and model outputs

Table BI. 1 Kittiwake flying bird monthly mean densities (n/km²)

Site	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Beatrice	0.09	0.20	0.41	0.43	0.36	0.41	0.32	0.00	0.05	0.13	0.09	0.05
Moray East	0.07	0.16	0.75	1.93	5.56	0.44	0.17	0.15	0.04	0.08	0.00	0.02
Moray West	0.21	2.49	12.40	19.67	3.47	2.21	1.61	3.49	2.15	0.36	0.67	1.48

Table BI. 2 Kittiwake deterministic CRM model option 2 mortality estimates

OWF site	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Beatrice	0.32	0.77	1.99	2.24	2.15	2.50	1.97	0.00	0.23	0.57	0.33	0.16
Moray East	0.41	0.88	5.43	15.22	50.04	4.03	1.57	1.24	0.32	0.56	0.00	0.12
Moray West	0.34	4.15	26.12	45.30	9.13	5.94	4.37	8.69	4.63	0.70	1.10	2.30

Annex C Wider North Sea wind farm cumulative kittiwake CRM estimates in the non-breeding season

As set out in Section 2.5, this compilation of North Sea wind farm cumulative kittiwake collision mortality estimates (in the non-breeding season) is based on the work ICOL commissioned for the Inch Cape wind farm in the Forth and Tay (Inch Cape revised design application; ICOL, 2018). The figures from the Hornsea 4 ES compilation (provided in the Original PFOWF Application) are included for reference, but it is not advised that assessment be based on the Hornsea 4 figures, if ICOL figures are available (for the reasons given in Section 2.5).

As set out in Table CI. 1 and Table CI. 2, the ICOL compilation presents the most reliable and recent information for those projects which it includes. For projects which post-date the ICOL compilation, the Hornsea 4 figures have been transferred across (as indicated by italics in Table CI.3).

With the recent issue of NS guidance on collision risk (NS, 2023), kittiwake avoidance rates for CRM have been updated, as presented in more detail in Section 2.2.3, and as applied to the Wider North Sea cumulative estimates presented in Table CI.3.

Table CI. 1 Explanation of colour-coding used in Table CI.3

Further work is required to recalculate kittiwake collision mortality estimates for Dogger Bank, East Anglia 3 and Hornsea 2 based on the final number of turbines being installed (Table CI. 2). Until this work is undertaken, the figures presented for these projects will be overestimates.
The English projects flagged in blue are those which have been submitted / consented subsequent to the ICOL compilation and Scottish Government decisions on Inch Cape and Neart na Gaoithe revised projects, as well as Moray West.
Scottish projects are flagged in yellow, of which the three Forth & Tay projects have the largest associated kittiwake collision risk. Note that Table I does not include the Moray Firth wind farms as these have been separately remodelled for the PFOWF Variation Application (as per Annex B Moray Firth remodelling – CRM input densities and model outputs).
Where any projects (either Scottish or English) post-date the ICOL compilation, figures are taken from Hornsea 4 / East Anglia 1&2 and copied across (<i>denoted by italic text</i>). Kentish Flats 1 is the only constructed wind farm which was not included in the ICOL compilation, while Kentish Flats 2 is included, indicating that this omission was likely an oversight.
Update to the figures for English wind farms applying a 0.992 kittiwake CRM avoidance rate, apportioning between adults and immatures, and then applying a 10% sabbaticals 'discount' to the adult component.
Update to the figures for Scottish wind farms applying a 0.992 kittiwake CRM avoidance rate and apportioning between adults and immatures.

Cumulative estimates for all North Sea wind farms under consideration are flagged in purple, then apportioned against North Caithness Cliffs SPA. The population consequences are modelled using PVA as reported in Technical Appendix D4: Population Modelling. It is recommended that consideration of this wider North Sea non-breeding kittiwake collision mortality is based on ICOL option 3d as the most realistic gauge of risk out of the options available.

Table CI. 2 Difference in turbine numbers between Consented and Final project designs for which CRM will need to be updated in future

Wind farm	Number of turbines		Update accounted for by Hornsea 4 / EA 1 & 2?	Update accounted for in ICOL 'constructed figures'?
	Consented	Final*		
Dogger Bank A, B & C (formerly Creyke Beck)	600	277	x	x
East Anglia 1	240	102	x	✓
East Anglia 3	172	up to 100	x	x
Hornsea 1	240	174	x	✓
Hornsea 2	300	165	x	x

* In the case of constructed projects (East Anglia 1, Hornsea 1 & 2) this information is obtained from the respective developer websites, confirmed against the Crown Estate's 'live generation' [offshore wind map](#). In the case of projects yet to be constructed (Dogger Bank and East Anglia 3) this information is from the respective developer websites, supported by the final 'development specification and layout plans' (DSLPs).

Table CI. 3 North Sea offshore wind kittiwake collision mortalities in the non-breeding season

Offshore wind farm project	Planning stage / date consented	Autumn migration				Spring migration			
		Hornsea 4 EA 1 & 2	ICOL consented	ICOL planned construct	ICOL season-adjusted	Hornsea 4 EA 1 & 2	ICOL consented	ICOL planned construct	ICOL season-adjusted
Blyth Demonstration (Phase 1)	constructed	2.3	2	2.3	1.8	1.4	1.8	1.8	1.5
Dogger Bank A & B (formerly Creyke Beck)	17/02/2015	135	137	136.7	109.3	295.4	359.7	359.7	314.8
Dogger Bank C (formerly Teesside A)	05/08/2015	90.7	90.7	90.7	90.7	216.9	216.9	216.9	216.9
Dudgeon	constructed	-	-	-	-	-	-	-	-
Dudgeon Extension	application	8.6	8.6	8.6	8.6	2.2	2.2	2.2	2.2
East Anglia ONE	constructed	160.4	137	61.5	49.2	46.8	71	18	15.8
East Anglia ONE North	31/03/2022	8.1	8.1	8.1	8.1	3.5	3.5	3.5	3.5
East Anglia TWO	31/03/2022	5.4	5.4	5.4	5.4	7.4	7.4	7.4	7.4
East Anglia THREE	07/08/2017	56.5	69	69	55.2	30.8	49	37.6	32.9
EOWDC (Aberdeen Bay)	constructed	5.8	6	4.5	3.6	1.1	1.1	0.8	0.7
Forthwind Demo	14/03/2023	0	0	0	0	0	0	0	0
Galloper	constructed	27.8	28	11.7	9.3	31.8	31.8	13.3	11.7
Greater Gabbard	constructed	15	15	16	12.8	11.4	11.4	12.1	10.6
Gunfleet Sands (1 and 2)	constructed	-	-	-	-	-	-	-	-
Hornsea One	constructed	55.9	54	32.2	25.8	20.9	24.7	14.8	12.9

Offshore wind farm project	Planning stage / date consented	Autumn migration				Spring migration			
		Hornsea 4 EA 1 & 2	ICOL consented	ICOL planned construct	ICOL season-adjusted	Hornsea 4 EA 1 & 2	ICOL consented	ICOL planned construct	ICOL season-adjusted
Hornsea Two	constructed	9	8	8.4	6.7	3	19	5.7	5
Hornsea Three	31/12/2020	6	6	6	6	3	3	3	3
Hornsea Four	12/07/2023	38.4	38.4	38.4	38.4	25.1	25.1	25.1	25.1
Humber Gateway	constructed	3.2	3.2	1.3	1	1.9	2.6	1	0.9
Hywind Scotland	constructed	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Inch Cape	17/06/2019	224.8	26	26	26	63.5	6	6	6
Kentish Flats 1	constructed	0.9	0.9	0.9	0.9	0.7	0.7	0.7	0.7
Kentish Flats 2	constructed	0	0	0	0	2.7	0	0	0
Kincardine	constructed	9	9	9	9	1	1	1	1
Lincs, Lynn & Inner Dowsing	constructed	0.7	1	1.2	1	1.2	0.9	0.9	0.8
London Array	constructed	2.3	2	0.9	0.7	1.8	1.8	0.7	0.6
Methil Demo	constructed	0	0	0	0	0	0	0	0
Nearrt na Gaoithe	03/12/2018	56.1	33	33	33	4.4	3	3	3
Norfolk Boreas	10/12/2021	32.2	32.2	32.2	32.2	11.9	11.9	11.9	11.9
Norfolk Vanguard	11/02/2022	16.4	16.4	16.4	16.4	19.3	19.3	19.3	19.3
Race Bank	constructed	23.9	24	14.2	11.3	5.6	5.6	3.3	2.9

Offshore wind farm project	Planning stage / date consented	Autumn migration				Spring migration			
		Hornsea 4 EA 1 & 2	ICOL consented	ICOL planned construct	ICOL season-adjusted	Hornsea 4 EA 1 & 2	ICOL consented	ICOL planned construct	ICOL season-adjusted
Rampion	constructed	0	37	25.6	20.5	0	29.7	20.3	17.8
Scroby Sands	constructed	-	-	-	-	-	-	-	-
Seagreen	constructed	313.1	180	180	180	247.6	99	99	99
Sheringham Shoal	constructed	-	-	-	-	-	-	-	-
Sheringham Shoal Extension	application	1.9	1.9	1.9	1.9	0	0	0	0
Teesside	constructed	24	25	17	13.6	2.5	15	10.6	9.3
Thanet	constructed	0.5	0	0.2	0.1	0.4	0.4	0.2	0.2
Triton Knoll	constructed	139	139	47.2	37.7	45.4	50.2	17.1	14.9
Westermost Rough	constructed	0.2	0	0.2	0.1	0.1	0.2	0.2	0.2
<i>English totals at an 0.989 avoidance rate</i>		864.3	889.8	654.2	564.7	793.1	964.8	807.3	742.8
<i>English totals at an 0.992 avoidance rate</i>		628.6	647.1	475.8	410.7	576.8	701.7	587.1	540.2
<i>English adults at 0.992 avoidance rate minus sabbatical 10%</i>		339.4	349.4	256.9	221.8	311.5	378.9	317.0	291.7
<i>English immatures at 0.992 avoidance rate</i>		251.4	258.9	190.3	164.3	230.7	280.7	234.9	216.1
<i>Scottish totals at an 0.989 avoidance rate</i>		609.7	254.9	253.4	252.5	318.5	111.0	110.7	110.6
<i>Scottish totals at an 0.992 avoidance rate</i>		443.4	185.4	184.3	183.6	231.6	80.7	80.5	80.4
<i>Scottish adults at 0.992 avoidance rate</i>		266.1	111.2	110.6	110.2	139.0	48.4	48.3	48.3
<i>Scottish immatures at 0.992 avoidance rate</i>		177.4	74.2	73.7	73.5	92.7	32.3	32.2	32.2

Offshore wind farm project	Planning stage / date consented	Autumn migration				Spring migration			
		Hornsea 4 EA 1 & 2	ICOL consented	ICOL planned construct	ICOL season-adjusted	Hornsea 4 EA 1 & 2	ICOL consented	ICOL planned construct	ICOL season-adjusted
Total adults		605.5	460.7	367.5	332.0	450.5	427.3	365.4	340.0
Total immatures		428.8	333.0	264.0	237.7	323.4	313.0	267.1	248.3
Scenario numbering to be used for the PVA, autumn and spring estimates are summed		3a	3b	3c	3d	3a	3b	3c	3d
Total adults as apportioned to NCC (autumn @ 0.023, spring @ 0.028)		13.9	10.6	8.5	7.6	12.6	12.0	10.2	9.5
Total immatures as apportioned to NCC (autumn @ 0.023, spring @ 0.028)		9.9	7.7	6.1	5.5	9.1	8.8	7.5	7.0

Pentland Floating Offshore Wind Farm Variation Application

Technical Appendix D4: Marine Ornithology Population Modelling

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Acronyms and abbreviations

Acronyms / abbreviation	Full name
CGR	Counterfactual Growth Rate
CI	Confidence Interval
CPS	Counterfactual Population Size
CRM	Collision Risk Modelling
EIAR	Environmental Impact Assessment Report
HRA	Habitats Regulations Appraisal
HWL	Highland Wind Limited
JNCC	Joint Nature Conservation Committee
MD-LOT	Marine Directorate Licensing and Operations Team
NE	Natural England
NPC	Natural Power Consultants
NS	NatureScot
PFOWF	Pentland Floating Offshore Wind Farm
PVA	Population Viability Analysis
QA	Quality Assurance
RSPB	Royal Society for the Protection of Birds
sCRM	Stochastic Collision Risk Modelling
SD	Standard Deviation
SMP	Seabird Monitoring Programme
SPA	Special Protection Area
UKCEH	UK Centre for Ecology and Hydrology

I Introduction

- 1 The overall requirements, purpose and approach to the marine ornithology assessment are set out in Technical Appendix D1. This supporting Technical Appendix presents the population modelling undertaken to investigate the consequences of potential impacts on kittiwake and puffin¹ at North Caithness Cliffs Special Protection Area (SPA) from the Pentland Floating Offshore Wind Farm (PFOWF) S36C variation application (the Variation Application).
- 2 Kittiwake may be at risk of both collision with turbine blades and from displacement impacts, whereas displacement is the primary concern for puffin (Furness *et al.*, 2013). Technical Appendix D2 presents the SeabORD modelling to quantify displacement impacts for each species and Technical Appendix D3 presents the collision risk modelling (CRM) to quantify this impact for kittiwake.
- 3 Population viability analysis (PVA) is the method for modelling the population-level consequences of the estimated kittiwake and puffin mortalities determined in Technical Appendices D2 and D3. PVA uses the estimated demographic rates for a population (typically survival and productivity) in a mathematical model to forecast future levels of a population.
- 4 Natural England (NE) commissioned the UK Centre for Hydrology and Ecology (UKCEH) to devise a standard PVA tool for undertaking such modelling (Searle *et al.*, 2019). It is this NE PVA tool that the Marine Directorate Licensing and Operations Team (MD-LOT), NatureScot (NS) and the Royal Society for the Protection of Birds (RSPB) Scotland recommend be used in relation to offshore wind farm projects under Scottish jurisdiction (NatureScot, 2023).
- 5 The approach to PVA and use of the NE PVA tool as set out in Section 2 have been discussed and agreed with MD-LOT and NS through the circulation of method statements and two marine ornithological pre-application meetings held on 26/07/2023 and 12/09/2023. The modelling method remains the same as that used for the Original Application.
- 6 The NE PVA tool was used to simulate population trends for project-alone and cumulative impact scenarios for a 50-year impact period, with outputs extracted at 10, 15, 20 and 25-year break points; 25 years being the operational (consent) period applied for in respect of the Variation Application.
- 7 Key outputs from the NE PVA tool are the ratios of the impacted (with wind farms) to unimpacted (baseline) scenarios, called 'counterfactuals'. These allow for interpretation of the predicted effects against the populations in question. Counterfactuals are discussed in Section 2.1.8 and presented in Section 3, for kittiwake (Table 5) and puffin (Table 6).

¹ The two species to be addressed within the Variation Application assessment are:

- Black-legged kittiwake (*Rissa tridactyla*), hereafter 'kittiwake'; and
- Atlantic puffin (*Fratecula arctica*), hereafter 'puffin'.

- 8 HiDef have undertaken all the PVAs presented in this Technical Appendix with Natural Power Consultants providing third party comment and quality assurance (QA).

2 Methods

2.1 Assessment method

- 9 The NE PVA tool (Searle *et al.*, 2019) constructs a stochastic Leslie matrix (Caswell, 2000) which can be run through a web-based 'R-Shiny' package with a user-friendly interface.

2.1.1 Demographic parameters

- 10 In the PVA models, the productivity rates for each species were taken directly from Horswill & Robinson (2015), while the survival rates have been obtained from the default parameters contained in the NE PVA tool.
- 11). These default survival rates are also derived from Horswill & Robinson (2015) but have been recalculated by the tool authors from the underlying source data, to correct issues regarding the standard deviations in the original published estimates. For both survival and productivity, the 'national rates' were selected where there was also an alternative option in the tool parameter selector.
- 12 These demographic data were used to parameterise the stochastic Leslie matrix built into the tool. Models included environmental and demographic stochasticity, but not density dependence which is standard practice and follows guidance from the Statutory Nature Conservation Bodies (Section 2.1.4).

Table 1 Summary of demographic rates for kittiwake and puffin¹

Demographic rates	Kittiwake		Puffin	
	Mean ²	SD	Mean ²	SD
Adult survival	0.854	0.077	0.906	0.083
Productivity (per pair) ³	0.690	0.296	0.617	0.151
Age of recruitment	4	-	5	-
Brood size (per pair) ⁴	2	-	1	-
Survival 0 → 1	0.790	0.00001	0.709	0.108
Survival 1 → 2	0.854	0.077	0.709	0.108
Survival 2 → 3	0.854	0.077	0.709	0.108
Survival 3 → 4	0.854	0.077	0.760	0.093
Survival 4 → 5	-	-	0.805	0.083

1. These are the NE PVA tool default values as derived from Horswill & Robinson (2015), unless otherwise specified

2. Although mean and standard deviation (SD) is available for demographic rates, the NE PVA tool requires standard error inputs for impacts. The lack of measures of uncertainty for some values requires that only mean values are modelled, as incorporating only part of the error measures would misrepresent the uncertainty around the final estimates. For puffin the standard deviation was used as the standard error measure (see Section 2.1.4)

3. Productivity values are taken direct from Horswill & Robinson (2015)

4. Mean brood size (per pair) values taken from Snow & Perrins (1998)

2.1.2 PVA reference populations

- 13 The reference populations used for each species in the modelling undertaken are presented in Table 2. These are the most recent published counts for each species at North Caithness Cliffs SPA, as confirmed by the Joint Nature Conservation Committee (JNCC) for the original PFOWF application (the Original Application). The census year for these SPA population counts is taken to be 2016.
- 14 These are also the available counts from the Seabird Monitoring Programme (SMP) database most closely contemporaneous with the timing of the digital aerial survey programme. While colony counts were undertaken at the SPA this year (2023), the information is not yet published nor available from the SMP database, in time to be used for this assessment.

Table 2 SPA seabird populations considered under PVA

Species	SPA	SPA population size (breeding individuals)	Year of census
Kittiwake	North Caithness Cliffs	11,146	2015/16
Puffin	North Caithness Cliffs	3,053	2015/16

2.1.3 PVA model ‘burn in’

- 15 As for the original application, the ‘burn in’ function of the NE PVA tool is used to derive the ‘whole’ population (stable age-classes) from the SPA count of breeding adults. It is this ‘whole’ population against which impacts are applied, without any forward projection of this population baseline (as discussed in Section 2.1.5 on model duration).

2.1.4 Age classes (including treatment of sabbaticals)

- 16 The NE PVA tool allows the user to choose whether to use the same survival rate across all age-classes in the modelled population, or to use age-dependent survival rates. In all cases in this analysis, survival rates were split across age-classes as specified by the default values given in the PVA tool, as derived from Horswill & Robinson (2015), and set out in Table 1.
- 17 The mortality estimates from collision risk which were input into the NE PVA tool for kittiwake were split proportionally by adult and immature birds (see further discussion in Section 2.1.5 below). As agreed with NS (email of 25/09/2023), and following their guidance (NatureScot, 2023), a sabbatical ‘discount’ rate of 10% has been applied to these adult kittiwake collision mortalities where it is certain that sabbaticals have not already been accounted for.
- 18 CRM impact estimation is based on the ‘at sea’ survey observations (see Appendix D3), which will include adult birds that are not breeding in this specific year. These non-breeding adult birds are termed “sabbatical” birds and would not feature in the (SPA) colony counts. Therefore, including impacts upon these sabbatical adults would overestimate the impact upon the breeding colony. It is estimated that 10% of adult plumage kittiwake in the at sea population are not breeding adults.
- 19 Therefore, a 10% sabbatical rate has been applied to the Variation Application and to the remodelled Moray Firth collision mortality estimates (where HiDef have undertaken the CRMs based on original at sea survey densities), as well as to the English wind farms in the North Sea cumulative compilation (Table C1.3 of Appendix D3), where these figures were previously presented without any sabbatical rates applied.
- 20 As SeabORD displacement modelling relates specifically to the SPA population(s) under consideration (in this case, North Caithness Cliffs) application of sabbatical rates is not required.

2.1.5 Model duration

- 21 As requested by MD-LOT and NS, each PVA, for both kittiwake and puffin, has been run for a 50-year impact period, with outputs extracted at 10, 15, 20 and 25-year break points; 25

years being the maximum operational period applied for in respect of the Variation Application.

- 22 As set out in HWL's *Method statement for CRM and PVA* (dated 19/07/2023) these specified impact periods are applied directly after the model 'burn in' and should not be thought of in 'real time' (i.e., against specified years or dates). The modelling is an approximation of reality, given that variable impacts cannot be applied over the model period (at least in the current version of the PVA tool), to account for the different operational start and end dates for the range of wind farms addressed under the cumulative assessment.
- 23 For each species, each simulation has been run 5,000 times to obtain a projected population trajectory and associated uncertainty due to environmental and demographic stochasticity.
- 24 Density dependence has not been modelled for either species due to a lack of available data. The form and strength of a density dependent reaction will alter the final population prediction. These details are known for only a few seabird populations. The model without density dependence is the default for the NE PVA tool. However, it is still possible to investigate and interpret the significance of modelled impacts using a density independent model, due to the use of ration metrics.

2.1.6 Modelled mortality (impact scenarios)

- 25 For each species, each simulation was paired with an impact scenario, as set out in Table 3 for kittiwake and Table 4 for puffin. Kittiwake mortalities arise from a combination of potential displacement / barrier effects and collision risk impacts (as modelled by SeabORD and CRM respectively), whereas puffin mortalities relate solely to the former.
- 26 Kittiwake mortality estimates and mortality rates (Table 3) are taken from Appendices D2 (SeabORD) and D3 (CRM). The derivation of these impact scenarios is set out in Annex A. Note that SeabORD modelling relates specifically to the SPA population(s) under consideration (in this case, North Caithness Cliffs) and therefore, SeabORD model outputs (estimated adult and chick mortalities) do not require any separate colony or age-class apportioning to be applied.
- 27 However, such apportioning is needed in respect of CRM, as this is based on 'at sea' survey data (as noted above in paragraph 18). The SPA colony apportioning is addressed in Appendix D3 (CRM), both for breeding and non-breeding seasons, and age-class apportioning is carried out to generate estimated mortalities for use within PVA (as addressed in this appendix). Kittiwake age-class proportions during the breeding season are based on the survey data (0.95 adults / 0.05 immatures), while non-breeding season proportions are taken from the stable-age structure derived using the 'burn in' function of the NE PVA tool (0.60 adults / 0.40 immatures)².
- 28 Puffin mortality estimates and mortality rates (Table 4) are taken from Appendix D2. As these are displacement impacts only, based on SeabORD model outputs (estimated adult and chick mortalities against the North Caithness Cliffs SPA puffin population), there is no

² As noted in Section 2.1.4, a sabbatical rate of 10% has been applied to the adult component, where relevant.

separate colony or age-class apportioning required. The value for the Standard Error for the NE PVA tool is taken from the seabORD Standard Deviation (SD) output.

- 29 Uncertainty could not be included in kittiwake population models as it was only the Variation Application project-alone where stochastic CRM (sCRM) could be used (i.e., where SDs around the kittiwake input densities were available). The HiDef remodelling of Moray Firth impacts used input densities derived from boat-based survey data which did not include any measures of uncertainty. The same is true for the other North Sea wind farms in the available compilations (as set out in Table CI.3 of Appendix D3).
- 30 As the NE PVA tool models multiple impact scenarios concurrently, it is not possible to accommodate uncertainty only for a sub-sample. The impact scenarios must be either all deterministic or all stochastic, and so for this reason the deterministic (Band, 2012) collision mortality estimate was input for the Variation Application project-alone, rather than using the mean sCRM value. However, it is highlighted that the difference is relatively slight, a deterministic value of 2.60 mortalities as opposed to a stochastic mean of 2.32, (see the summary in Table 8 of Appendix D3).
- 31 Table 3 and Table 4 show impacts included in population models for kittiwake and puffin, respectively. Mortality due to collisions is converted to an impact rate based on the number of collisions compared to the population size recorded in the most contemporaneous counts of the colony (see Section 2.1.3 above). Change in kittiwake survival rates due to displacement/barrier effects is a direct output from SeabORD (see tables in Annex B of Appendix D2). Combining the collision and displacement mortality for kittiwake is therefore a matter of summing the relevant rates. Puffin displacement impacts are also taken as a change in survival rate (for each of adults and chicks) taken directly from SeabORD outputs³.
- 32 As SeabORD models displacement impacts against the individual populations at each SPA sub-site (Dunnet, Duncansby, Melvich, Stroma and Holburn) the total SPA mortality rates given in Table 3 (kittiwake) and Table 4 (puffin) are the weighted sum across these sub-sites.

2.1.7 Modelled Scenarios – Projects in-combination

- 33 For each species the number of scenarios is different based on the population scale considered and the number of projects that includes when considering cumulative impacts.
- 34 For both species, kittiwake and puffin, Variation Application project-alone (Scenario 1) and together with the Moray Firth wind farms is presented (for the latter it is Scenario 2 for kittiwake and Scenario 3 for puffin). For puffin the impacts of the Moray Firth wind farms are presented without the impacts of the Variation Application as Scenario 2.

³ In each table, the mortality estimates (numbers of birds) quoted are the SeabORD figures.

Please see the summaries in Sections 3.1.1 (adults) and 3.1.2 (chicks) in Appendix D2 as derived from the tables of SeabORD outputs presented in Annex B of that Appendix).

It should be noted that these mortality figures are presented purely for illustrative purposes as it is the changes in survival rates produced by SeabORD that are input (transposed as mortality rates) direct into the NE PVA tool.

- 35 For kittiwake, in addition, potential non-breeding collision mortalities from North Sea wind farms (Scenario 3a-d) are presented, as apportioned to North Caithness Cliffs, and calculated from various sources (as referenced). The impacts as listed in the Inch Cape environmental statement and seasonally adjusted to fit NatureScot and Furness (2015) seasonal definitions are shown in Scenario 3d. Scenarios 4a-d combine the Variation Application impacts with those of the Moray Firth wind farms and the North Sea wind farms as described in Scenarios 3a-d. Finally, Scenarios 5a-d add Berwick Bank impacts to those described in Scenarios 4a-d as requested by NS at the meeting on 12/09/2023.

Table 3 Modelled impact scenarios for kittiwake

Scenario	Impacts modelled	Mortality rate increase for adults	Mortality rate increase for immatures	Reduction in productivity rate	SeabORD and CRM (deterministic) mortality estimates (numbers of birds) from Appendices D2 and D3		
					Adult mortality	Immature mortality	Chick mortality
1	PFOWF project-alone <i>Annual collision and displacement impacts. 10% sabbatical rate applied to adult collision mortality estimates</i>	0.00029	0.00002	0.00161	3.24	0.15	9.00
2	PFOWF and Moray Firth <i>Annual collision and displacement impacts. 10% sabbatical rate applied to adult collision mortality estimates</i>	0.00094	0.00012	0.00387	10.49	0.86	21.60
3a	Other North Sea wind farms (from Hornsea 4 / EA) <i>*Non-breeding season collisions. With 10% sabbatical rate applied to adult mortality estimates from English wind farms</i>	0.00238	0.00255	0.00000	26.54	18.92	0

Scenario	Impacts modelled	Mortality rate increase for adults	Mortality rate increase for immatures	Reduction in productivity rate	SeabORD and CRM (deterministic) mortality estimates (numbers of birds) from Appendices D2 and D3		
					Adult mortality	Immature mortality	Chick mortality
3b	Other North Sea wind farms (from Inch Cape - consented) <i>*As for impact scenario 3a</i>	0.00202	0.00221	0.00000	22.56	16.42	0
3c	Other North Sea wind farms (from Inch Cape - built) <i>*As for impact scenario 3a</i>	0.00168	0.00182	0.00000	18.68	13.55	0
3d	Other North Sea wind farms (from Inch Cape – season-adjusted) <i>*As for impact scenario 3a</i>	0.00154	0.00167	0.00000	17.15	12.42	0
4a	Scenarios 2 & 3a together	0.00332	0.00266	0.00387	37.03	19.77	21.60
4b	Scenarios 2 & 3b together	0.00297	0.00233	0.00387	33.05	17.28	21.60
4c	Scenarios 2 & 3c together	0.00262	0.00194	0.00387	29.18	14.41	21.60
4d	Scenarios 2 & 3d together	0.00248	0.00179	0.00387	27.65	13.28	21.60
5a	Scenarios 2 & 5a plus Berwick Bank	0.00373	0.00297	0.00387	41.63	22.07	21.60

Scenario	Impacts modelled	Mortality rate increase for adults	Mortality rate increase for immatures	Reduction in productivity rate	SeabORD and CRM (deterministic) mortality estimates (numbers of birds) from Appendices D2 and D3		
					Adult mortality	Immature mortality	Chick mortality
5b	Scenarios 2 & 5b plus Berwick Bank	0.00338	0.00263	0.00387	37.65	19.58	21.60
5c	Scenarios 2 & 5c plus Berwick Bank	0.00303	0.00225	0.00387	33.77	16.71	21.60
5d	Scenarios 2 & 5d plus Berwick Bank	0.00289	0.00210	0.00387	32.24	15.57	21.60

Table 4 Modelled impact scenarios for puffin

Scenario	Impacts modelled	Mortality rate increase for adults		Reduction in productivity rates		SeabORD mortality estimates (numbers of birds) from Appendix D2	
		Mean	SD	Mean	SD	Adult mortality	Chick mortality
1	PFOWF project-alone <i>Breeding season, displacement impacts</i>	0.00033	0.00090	0.00039	0.00125	1.00	0.60
2	Moray Firth wind farms: Beatrice, Moray East, Moray West <i>Breeding season, displacement impacts</i>	0.00091	0.00115	0.00111	0.00251	2.79	1.70
3	PFOWF and Moray Firth together <i>Breeding season, displacement impacts</i>	0.00128	0.00162	0.00081	0.00279	3.90	2.40

2.1.8 Model outputs (population metrics)

- 36 The key outputs from the PVA tool are the counterfactuals (ratios) of annualised population growth rate (CGR) and of population size (CPS) (Searle *et al.*, 2019). These are the ratios of the impacted to unimpacted (baseline) scenarios and allow meaningful interpretation of the predicted effects against the populations in question (Cook & Robinson, 2016) and which NS request be provided in their guidance note on PVA (NatureScot, 2023).
- 37 Testing the sensitivities of these metrics has suggested that counterfactual of annualised growth rate is useful to illustrate impacts regardless of population status or trend (Cook & Robinson, 2016). Cook & Robinson (2016) also found the counterfactual of population size can be used to assess the population level effects of impacts for stable or increasing populations and may also offer a useful context for the annualised CGR.
- 38 PVA model outputs are presented in Section 3 (Results); Table 5 for kittiwake and Table 6 for puffin.
- 39 The model of kittiwake population using the NE PVA tool with default parameters produced an increasing baseline population as further discussed in Section 4.1. This was not considered realistic given the recorded population counts for kittiwake at North Caithness Cliffs SPA. However, counterfactual metrics are robust to model misspecification and an investigation of the effect supported this conclusion, in relation to the kittiwake PVA outputs given in Table 5 (see Annex B for more detail).

3 Results

3.1 Kittiwake

Table 5 Metrics and counterfactuals (with 95% Confidence Intervals (CI)) for 5,000 simulations of the kittiwake PVA

Kittiwake scenarios		Median population size at end of modelled period (adult individuals)	Median counterfactuals	
			CGR ¹ (95% CIs)	CPS ² (95% CIs)
10yr		Baseline: 14,704		
1	PFOWF project-alone-variation	14,601	0.999 (0.997-1.000)	0.994 (0.955-1.030)
2	PFOWF and Moray Firth together - variation	14,442	0.998 (0.996-1.000)	0.983 (0.945-1.020)
3a	Other North Sea wind farms (ref. Hornsea 4 / EA 1&2)	14,242	0.997 (0.994-1.000)	0.969 (0.931-1.010)
3b	Other North Sea wind farms (ref. Inch Cape - consented)	14,308	0.998 (0.995-1.000)	0.973 (0.934-1.010)
3c	Other North Sea wind farms (ref. Inch Cape - built)	14,412	0.998 (0.995-1.000)	0.978 (0.940-1.020)
3d	Other North Sea wind farms (ref. Inch Cape - season-adjusted)	14,396	0.998 (0.995-1.000)	0.979 (0.943-1.020)
4a	Total impacts (PFOWF variation, Moray Firth and North Sea 3a)	14,019	0.996 (0.993-0.998)	0.952 (0.915-0.990)
4b	Total impacts (PFOWF variation, Moray Firth and North Sea 3b)	14,078	0.996 (0.993-0.999)	0.956 (0.918-0.995)
4c	Total impacts (PFOWF variation, Moray Firth and North Sea 3c)	14,120	0.996 (0.993-0.999)	0.961 (0.924-0.998)

Kittiwake scenarios		Median population size at end of modelled period (adult individuals)	Median counterfactuals	
			CGR ¹ (95% CIs)	CPS ² (95% CIs)
4d	Total impacts (PFOWF variation, Moray Firth and North Sea 3d)	14,173	0.997 (0.994-0.999)	0.963 (0.924-1.000)
5a	Total impacts 4a, plus Berwick Bank	13,948	0.995 (0.992-0.998)	0.947 (0.910-0.985)
5b	Total impacts 4b, plus Berwick Bank	14,019	0.996 (0.993-0.998)	0.952 (0.916-0.989)
5c	Total impacts 4c, plus Berwick Bank	14,093	0.996 (0.993-0.999)	0.956 (0.918-0.995)
5d	Total impacts 4d, plus Berwick Bank	14,112	0.996 (0.993-0.999)	0.958 (0.920-0.997)
15yr		Baseline: 15,732		
1	PFOWF project-alone-variation	15,551	0.999 (0.997-1.000)	0.990 (0.948-1.040)
2	PFOWF and Moray Firth together - variation	15,318	0.998 (0.996-1.000)	0.973 (0.932-1.020)
3a	Other North Sea wind farms (ref. Hornsea 4 / EA 1&2)	14,999	0.997 (0.995-0.999)	0.955 (0.914-0.997)
3b	Other North Sea wind farms (ref. Inch Cape - consented)	15,087	0.997 (0.995-1.000)	0.960 (0.920-1.000)
3c	Other North Sea wind farms (ref. Inch Cape - built)	15,228	0.998 (0.996-1.000)	0.968 (0.927-1.010)
3d	Other North Sea wind farms (ref. Inch Cape - season-adjusted)	15,249	0.998 (0.996-1.000)	0.970 (0.929-1.010)
4a	Total impacts (PFOWF variation, Moray Firth and North Sea 3a)	14,594	0.995 (0.993-0.998)	0.929 (0.889-0.971)
4b	Total impacts (PFOWF variation, Moray Firth and North Sea 3b)	14,668	0.996 (0.994-0.998)	0.935 (0.895-0.977)

Kittiwake scenarios		Median population size at end of modelled period (adult individuals)	Median counterfactuals	
			CGR ¹ (95% CIs)	CPS ² (95% CIs)
4c	Total impacts (PFOWF variation, Moray Firth and North Sea 3c)	14,806	0.996 (0.994-0.998)	0.942 (0.900-0.983)
4d	Total impacts (PFOWF variation, Moray Firth and North Sea 3d)	14,824	0.996 (0.994-0.999)	0.944 (0.903-0.986)
5a	Total impacts 4a, plus Berwick Bank	14,516	0.995 (0.993-0.997)	0.923 (0.882-0.962)
5b	Total impacts 4b, plus Berwick Bank	14,604	0.995 (0.993-0.998)	0.929 (0.889-0.970)
5c	Total impacts 4c, plus Berwick Bank	14,696	0.996 (0.994-0.998)	0.935 (0.894-0.977)
5d	Total impacts 4d, plus Berwick Bank	14,772	0.996 (0.994-0.998)	0.938 (0.897-0.980)
20yr		Baseline: 16,692		
1	PFOWF project-alone-variation	16,477	0.999 (0.997-1.000)	0.986 (0.943-1.040)
2	PFOWF and Moray Firth together - variation	16,078	0.998 (0.996-1.000)	0.964 (0.920-1.010)
3a	Other North Sea wind farms (ref. Hornsea 4 / EA 1&2)	15,725	0.997 (0.995-0.999)	0.941 (0.897-0.985)
3b	Other North Sea wind farms (ref. Inch Cape - consented)	15,838	0.997 (0.996-0.999)	0.948 (0.905-0.995)
3c	Other North Sea wind farms (ref. Inch Cape - built)	15,995	0.998 (0.996-1.000)	0.958 (0.914-1.000)
3d	Other North Sea wind farms (ref. Inch Cape - season-adjusted)	16,029	0.998 (0.996-1.000)	0.961 (0.916-1.010)
4a	Total impacts (PFOWF variation, Moray Firth and North Sea 3a)	15,113	0.995 (0.993-0.997)	0.907 (0.864-0.951)

Kittiwake scenarios		Median population size at end of modelled period (adult individuals)	Median counterfactuals	
			CGR ¹ (95% CIs)	CPS ² (95% CIs)
4b	Total impacts (PFOWF variation, Moray Firth and North Sea 3b)	15,216	0.996 (0.994-0.998)	0.914 (0.873-0.959)
4c	Total impacts (PFOWF variation, Moray Firth and North Sea 3c)	15,466	0.996 (0.994-0.998)	0.923 (0.880-0.967)
4d	Scenarios 2 & 3d together	15,474	0.996 (0.994-0.998)	0.927 (0.884-0.970)
5a	Scenarios 2 & 3a plus Berwick Bank	14,987	0.995 (0.993-0.997)	0.898 (0.856-0.941)
5b	Scenarios 2 & 3b plus Berwick Bank	15,113	0.995 (0.993-0.997)	0.907 (0.866-0.950)
5c	Scenarios 2 & 3c plus Berwick Bank	15,248	0.996 (0.994-0.998)	0.915 (0.872-0.959)
5d	Scenarios 2 & 3d plus Berwick Bank	15,290	0.996 (0.994-0.998)	0.918 (0.875-0.962)
25yr		Baseline: 17,922		
1	PFOWF project-alone-variation	17,568	0.999 (0.998-1.000)	0.983 (0.937-1.030)
2	PFOWF and Moray Firth together - variation	17,066	0.998 (0.996-1.000)	0.955 (0.908-1.000)
3a	Other North Sea wind farms (ref. Hornsea 4 / EA 1&2)	16,602	0.997 (0.995-0.999)	0.927 (0.883-0.973)
3b	Other North Sea wind farms (ref. Inch Cape - consented)	16,784	0.997 (0.996-0.999)	0.936 (0.892-0.985)
3c	Other North Sea wind farms (ref. Inch Cape - built)	16,985	0.998 (0.996-1.000)	0.948 (0.901-0.995)
3d	Other North Sea wind farms (ref. Inch Cape - season-adjusted)	17,044	0.998 (0.997-1.000)	0.952 (0.907-1.000)

Kittiwake scenarios		Median population size at end of modelled period (adult individuals)	Median counterfactuals	
			CGR ¹ (95% CIs)	CPS ² (95% CIs)
4a	Total impacts (PFOWF variation, Moray Firth and North Sea 3a)	15,883	0.995 (0.994-0.997)	0.885 (0.842-0.930)
4b	Total impacts (PFOWF variation, Moray Firth and North Sea 3b)	16,010	0.996 (0.994-0.997)	0.894 (0.852-0.941)
4c	Total impacts (PFOWF variation, Moray Firth and North Sea 3c)	16,191	0.996 (0.994-0.998)	0.905 (0.860-0.952)
4d	Scenarios 2 & 3d together	16,273	0.996 (0.995-0.998)	0.909 (0.863-0.955)
5a	Scenarios 2 & 3a plus Berwick Bank	15,727	0.995 (0.993-0.997)	0.875 (0.831-0.920)
5b	Scenarios 2 & 3b plus Berwick Bank	15,881	0.995 (0.994-0.997)	0.885 (0.842-0.929)
5c	Scenarios 2 & 3c plus Berwick Bank	16,019	0.996 (0.994-0.997)	0.895 (0.851-0.940)
5d	Scenarios 2 & 3d plus Berwick Bank	16,070	0.996 (0.994-0.998)	0.898 (0.854-0.945)
50yr		Baseline: 25,183		
1	PFOWF project-alone-variation	24,260	0.999 (0.998-1.000)	0.966 (0.907-1.030)
2	PFOWF and Moray Firth together - variation	22,896	0.998 (0.997-0.999)	0.909 (0.855-0.964)
3a	Other North Sea wind farms (ref. Hornsea 4 / EA 1&2)	21,719	0.997 (0.996-0.998)	0.862 (0.812-0.915)
3b	Other North Sea wind farms (ref. Inch Cape - consented)	22,170	0.998 (0.996-0.999)	0.880 (0.830-0.936)
3c	Other North Sea wind farms (ref. Inch Cape - built)	22,642	0.998 (0.997-0.999)	0.900 (0.847-0.955)

Kittiwake scenarios		Median population size at end of modelled period (adult individuals)	Median counterfactuals	
			CGR ¹ (95% CIs)	CPS ² (95% CIs)
3d	Other North Sea wind farms (ref. Inch Cape - season-adjusted)	22,886	0.998 (0.997-0.999)	0.908 (0.855-0.965)
4a	Total impacts (PFOWF variation, Moray Firth and North Sea 3a)	19,715	0.995 (0.994-0.996)	0.784 (0.735-0.836)
4b	Total impacts (PFOWF variation, Moray Firth and North Sea 3b)	20,137	0.996 (0.995-0.997)	0.801 (0.753-0.850)
4c	Total impacts (PFOWF variation, Moray Firth and North Sea 3c)	20,569	0.996 (0.995-0.997)	0.819 (0.769-0.871)
4d	Scenarios 2 & 3d together	20,748	0.996 (0.995-0.997)	0.826 (0.775-0.877)
5a	Scenarios 2 & 3a plus Berwick Bank	19,237	0.995 (0.994-0.996)	0.767 (0.719-0.816)
5b	Scenarios 2 & 3b plus Berwick Bank	19,656	0.995 (0.994-0.996)	0.784 (0.737-0.832)
5c	Scenarios 2 & 3c plus Berwick Bank	20,072	0.996 (0.995-0.997)	0.801 (0.751-0.852)
5d	Scenarios 2 & 3d plus Berwick Bank	20,319	0.996 (0.995-0.997)	0.807 (0.758-0.859)

¹CGR = Counterfactual Annualised Growth Rate. ²CPS = Counterfactual Population Size.

3.2 Puffin

Table 6 Metrics and counterfactuals (with 95% CI) for 5,000 simulations of the puffin PVA

Puffin scenarios	Median pop. size at end of modelled period (adult individuals)	Median counterfactuals	
		CGR ¹ (95% CIs)	CPS ² (95% CIs)
10yr	Baseline: 1,920		
1 - PFOWF project-alone – Variation (HiDef SeabORD)	1,915	1.000 (0.993-1.010)	0.995 (0.917-1.080)
2 - Moray Firth variation (HiDef SeabORD)	1,892	0.999 (0.992-1.010)	0.987 (0.906-1.080)
3 - PFOWF and Moray Firth -variation (HiDef SeabORD)	1,879	0.998 (0.992-1.000)	0.983 (0.898-1.080)
15yr	Baseline: 1,725		
1 - PFOWF project-alone – Variation (HiDef SeabORD)	1,711	1.000 (0.994-1.000)	0.992 (0.903-1.100)
2 - Moray Firth variation (HiDef SeabORD)	1,683	0.999 (0.993-1.000)	0.982 (0.887-1.080)
3 - PFOWF and Moray Firth -variation (HiDef SeabORD)	1,678	0.998 (0.993-1.000)	0.974 (0.875-1.080)
20yr	Baseline: 1,523		
1 - PFOWF project-alone – Variation (HiDef SeabORD)	1,511	1.000 (0.995-1.000)	0.991 (0.885-1.100)
2 - Moray Firth variation (HiDef SeabORD)	1,488	0.999 (0.994-1.000)	0.975 (0.866-1.090)
3 - PFOWF and Moray Firth -variation (HiDef SeabORD)	1,479	0.998 (0.993-1.000)	0.967 (0.853-1.090)
25yr	Baseline: 1,351		

Puffin scenarios	Median pop. size at end of modelled period (adult individuals)	Median counterfactuals	
		CGR ¹ (95% CIs)	CPS ² (95% CIs)
1 - PFOWF project-alone – Variation (HiDef SeabORD)	1,330	1.000 (0.995-1.000)	0.988 (0.869-1.120)
2 - Moray Firth variation (HiDef SeabORD)	1,314	0.999 (0.994-1.000)	0.969 (0.846-1.110)
3 - PFOWF and Moray Firth -variation (HiDef SeabORD)	1,300	0.998 (0.993-1.000)	0.959 (0.828-1.110)
50yr	Baseline: 763		
1 - PFOWF project-alone – Variation (HiDef SeabORD)	749	1.000 (0.996-1.000)	0.979 (0.793-1.200)
2 - Moray Firth variation (HiDef SeabORD)	723	0.999 (0.995-1.000)	0.942 (0.756-1.170)
3 - PFOWF and Moray Firth -variation (HiDefSeabORD)	701	0.998 (0.994-1.000)	0.920 (0.721-1.160)

¹CGR = Counterfactual Growth Rate.

²CPS = Counterfactual Population Size.

4 Discussion and Conclusions

4.1 Kittiwake

- 40 The kittiwake population at North Caithness Cliffs SPA has been steadily declining over a 20-year period from site designation in 1996 to the most recent published census count in 2015/16. This was reflected in the first two iterations of the kittiwake PVA run by HiDef using the NE PVA tool (for the Original Application submitted August 2022, and the further environmental information submitted December 2023). However, with this third iteration undertaken for the Variation Application, the baseline population trend produced by the tool has flipped (from decreasing to increasing). There has been at least one update to the NE PVA tool since its previous application for the PFOWF, but it is not clear why this might cause such a difference.
- 41 HiDef's current modelling using the default (national) input parameters in the NE PVA tool (derived from Horswill & Robinson, 2015, as per Table 1) predicts an increasing baseline adult bird population, from the 2015/16 count of 11,146 individuals, to a population of 14,704 individuals after 10 years and 17,922 after 25 years (see Table 5).
- 42 It is possible that there are regional influences at play which are not accounted for by the national defaults. Therefore, further models were run by HiDef and by Natural Power Consultants (NPC) in order to compare across the resulting outputs and to determine whether the counterfactuals of population size (CPS) (in particular), given for kittiwake in Table 5 can be considered robust, despite the flipped population trend.
- 43 This comparison across PVAs is presented in Annex A, and the input and output spreadsheets for the two further models are available for download from the PFOWF website⁴. Review of the CPS values given (for the identified impact scenarios which were modelled) shows that the metrics closely match across the three models and are indeed robust. This reflects the findings of Cook & Robinson (2016) that, of the range of possible PVA output metrics, CGR and CPS have been found to be least sensitive to misspecification of population trend.
- 44 The Variation Application project-alone impacts for kittiwake at 25 years of operation predict an annualised growth rate counterfactual of 0.999 and a counterfactual for final population size of 0.983. The cumulative impacts which cover all North Sea wind farms, the Moray Firth wind farms and the Variation Application impacts predict CGR of 0.996 and CPS at 0.909. The additional impact of Berwick Bank reduces these values to 0.996 and 0.898 respectively, although if Berwick Bank were consented via derogation these additional impacts would have been assumed to be compensated for.
- 45 Table 1 in Appendix DI *Marine Ornithology Modelling Results Summary* provides a comparison of the original impacts modelled for kittiwake (for the Original Application) and the resulting counterfactuals. The Project's impacts presented in this Variation Application are minimal with any possible population consequence falling well within the uncertainty (and stochasticity) around PVA model predictions. Any population level impact

⁴ The PVA output spreadsheets can be downloaded from: <https://pentlandfloatingwind.com/wp-content/uploads/2023/10/2023-10-05-Pentland-variation-PVA-inputs.xlsx>

from offshore wind development upon the kittiwake population of North Caithness Cliffs can be attributed to the substantially higher mortality estimates associated with wider North Sea wind farms in the non-breeding season which include considerable uncertainty.

- 46 If an apportioning exercise of such non-breeding season kittiwake collision mortalities is to be undertaken, then it is recommended that Inch Cape's 'season-adjusted' figures (impact scenario 3d) are the most robust to use of the currently available information. While the Berwick Bank application may be more recent, it is noted that this references previous information (in this case, the East Anglia 1&2 compilation as per Hornsea 4) but does not include the supporting calculations to demonstrate how the cumulative totals have been derived, see Section 2.5 of Appendix D3).

4.2 Puffin

- 47 The puffin population at North Caithness Cliffs has also been declining with a 13% reduction in breeding adult puffin numbers between 1986 and 2016 (Swann, 2018). As for the previous PVA iterations (for the Original Application and further information submitted in support of that application), this third round of modelling shows a declining baseline population trend, reflecting the observed counts of puffin at the SPA.
- 48 The counterfactuals (ratio) of annualised population growth (CGR) and final population size (CPS) are informative in assessing the population consequences of each impact scenario against the baseline. As presented in Table 6, the estimated puffin displacement mortalities arising from the Variation Application in isolation (impact scenario 1) will result in a final median population size, after 25 years, of 0.988 of a non-impacted baseline, a reduction of 1.2%, from the baseline.
- 49 Table 2 in Appendix D1 *Marine Ornithology Modelling Results Summary* sets out a comparison of the values presented in Table 6 against the original modelled impacts for puffin (for the Original Application) and associated counterfactuals.
- 50 The CPS value of 0.959 for the cumulative impacts after 25 years is considerably higher than the value of 0.925 predicted by modelling for the 10 year operation period for which consent was given.

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Annex A Kittiwake PVA comparison

- 49 Two further comparative kittiwake PVAs were constructed to investigate whether the unexpected population trajectory from HiDef's current modelling (as discussed in Section 4.1) undermined confidence in the resulting counterfactuals presented.
- 50 Table A1 and Figure A1 provide a summary of this comparison. with model outputs from the current PVA (with its increasing population trend) shaded blue in the table and represented by a blue square on the graph.
- 51 The first comparative model was also undertaken by HiDef, again using the NE PVA tool but adopting more regional productivity values (available for north Scotland) which resulted in a slightly decreasing population trend. These outputs are shaded yellow in Table A1 and shown as a yellow circle on Figure A1.
- 52 The second comparative check is provided by a bespoke deterministic model created by consultants at Natural Power; this also shows a decreasing population trend. The outputs from this model are shaded grey in Table A1 and shown as a grey triangle on Figure A1.
- 53 The three models produced broadly equivalent values of counterfactuals despite the different sizes of predicted final populations. The two stochastic models, as expected, produced more conservative counterfactual outputs.

Table A1 Comparison of model outputs from three versions of PVA for the kittiwake population at North Caithness Cliffs SPA

Scenario modelled		Population model (PVA) outputs					
		Stochastic, increasing trend		Stochastic, decreasing trend		Deterministic, decreasing trend	
		25-year pop'n ¹	CPS ²	25-year pop'n ¹	CPS ²	25-year pop'n ¹	CPS ²
0	Baseline (no impact)	17,922	1.000	10,645	1.000	10,966	1.000
1	PFOWF project-alone	17,603	0.983	10,4480	0.982	10,850	0.989
2	PFOWF and Moray Firth	17,062	0.954	10,108	0.951	10,631	0.969
3a	Other North Sea OSWF (ref. Hornsea 4 / EA)	16,551	0.924	9816	0.925	10,246	0.934
3b	Other North Sea OSWF (ref. Inch Cape - consented)	16,741	0.934	9,922	0.935	10,339	0.943
3c	Other North Sea OSWF (ref. Inch Cape - built)	16,943	0.945	10,095	0.946	10,447	0.953
3d	Other North Sea OSWF (ref. Inch Cape - season-adjusted)	16,990	0.949	10,136	0.950	10,489	0.957
5a	Scenarios 2 & 3a together	15,773	0.881	9,351	0.880	9,932	0.906
5b	Scenarios 2 & 3b together	15,935	0.890	9,437	0.889	10,023	0.914
5c	Scenarios 2 & 3c together	16,116	0.902	9,563	0.899	10,125	0.923
5d	Scenarios 2 & 3d together	16,254	0.906	9,604	0.903	10,166	0.927

¹Pop'n = Population

²CPS = Counterfactual Population Size

Figure A1 CPS values from different population models for all scenarios for the North Caithness Cliffs SPA kittiwake population

