MORAY EAST
OFFSHORE WINDFARM

[Wind Farm] Project Environmental Monitoring Programme

Moray East Offshore Wind Farm

June 2023

Moray Offshore Windfarm (East) Limited

Produced by Moray Offshore Windfarm (East) Limited	
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1	31 May 2018	For submission to MS-LOT (now MD-LOT)
2	17 Sep 2018	Incorporate stakeholder comments to Version 1
3	27 Jan 2023	For submission to MS-LOT (now MD-LOT) – Updates to split OfTI and WF plans following completion of construction works
4	25 May 2023	Incorporates stakeholder comments following consultation on Version 3

Review / Approval

Offshore Consents Manager	**Legal Review**
[Redacted]	[Redacted] [Shepherd and Wedderburn]

Moray East
[Redacted] [Asset Director]

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List of Abbreviations

Abbreviation	Description
AC	Alternating Current
ADD	Acoustic Deterrent Device
ASFB	Association of Salmon Fishery Boards
AST	Atlantic Salmon Trust
BMM	Brown & May Marine
BOWL	Beatrice Offshore Wind Farm Limited
BTO	British Trust for Ornithology
CaP	Cable Plan
CBRA	Cable Burial Risk Assessment
CEH	Centre for Ecology and Hydrology
cMMMP	Construction Marine Mammal Monitoring Programme
CPOD	Continuous Porpoise Detectors
CPS	Cable Protection System
CPUE	Catch Per Unit Effort
DoL	Depth of Lowering
DSFB	District Salmon Fishery Boards
ECC	East Caithness Cliffs
EDA	Eastern Development Area
EMF	Electromagnetic Field
EMP	Environmental Management Plan
ES	Environmental Statement
FMS	Fisheries Management Scotland
FTRAG	Forth and Tay Regional Advisory Group
GBBG	Great Black-Backed Gull
HIE	Highlands and Islands Enterprise
HVAC	High Voltage Alternating Current
JNCC	Joint Nature Conservation Committee
IHLS	International Herring Larval Surveys
MBES	Multi-beam Echo Sounder
MFRAG	Moray Firth Regional Advisory Group
MFRAG – MM	Moray Firth Regional Advisory Group – Marine Mammals Subgroup
MFRAG-O	Moray Firth Regional Advisory Group – Ornithology Subgroup
MFV	Marine Fishing Vessel
MMMP	Marine Mammal Monitoring Programme
MMO	Marine Management Organisation

Abbreviation	Description
MREI	Marine Renewable Energy Installation
MRSea	Marine Renewables Strategic Environmental Assessment
MD-LOT	Marine Directorate - Licensing Operations Team
MS-LOT	Marine Scotland - Licensing Operations Team (now MD-LOT)
MSS	Marine Scotland Science
NM	Nautical Miles
OfTI	Offshore Transmission Infrastructure
OFTO	Offshore Transmission Operator
OnTI	Onshore Transmission Infrastructure
O&M	Operation and Maintenance
ORE	Offshore Renewable Energy
OSP	Offshore Substation Platform
PAM	Passive Acoustic Monitoring
PEMP	Project Environmental Monitoring Programme
PrePARED	Predators and Prey Around Renewable Energy Developments
PS	Piling Strategy
ROV	Remotely Operated Vehicle
RSPB	Royal Society for the Protection of Birds
SAC	Special Area of Conservation
SCENE	Scottish Centre for Ecology and the Natural Environment
ScotMER	Scottish Marine Energy Research
SMRU	Sea Mammal Research Unit
SNCB	Statutory Nature Conservation Body
SNH	Scottish Natural Heritage (now NatureScot)
SPA	Special Protection Area
SPFA	Scottish Pelagic Fisheries Association
SpORRAn	Scottish Offshore Renewables Research Framework
SSMEG	Scottish Strategic Marine Environment Group
SSS	Side Scan Sonars
TI	Transmission Infrastructure
ToR	Terms of Reference
UAV	Unoccupied Aerial Vehicle
ULS	Ultimate Limit State
UoA	University of Aberdeen
VMP	Vessel Management Plan
WDC	Whale and Dolphin Conservation

Abbreviation	Description
WF	Wind Farm
WP	Work Package
WTG	Wind Turbine Generator

Definitions

The following definitions have been used throughout this document with respect to the company, the consented wind farms and how these definitions have changed since submission of the Moray East Environmental Statement (ES) in 2012 and the Moray East Modified Transmission Infrastructure ES in 2014 and the Moray East Offshore Substation Platform (OSP) Environmental Report in 2017.

Moray Offshore Windfarm (East) Limited (formerly known as Moray Offshore Renewables Limited) – the legal entity submitting this Project Environmental Monitoring Programme (PEMP);

Moray East Offshore Wind Farm - the wind farm that has been developed in the Moray East site (also referred as the Wind Farm);

The Moray East site - the area in which the Moray East Offshore Wind Farm is located. Section 36 Consents and associated Marine Licences to develop and operate up to three generating stations on the Moray East site were granted in March 2014. At that time the Moray East site was known as the "Eastern Development Area (EDA)" and was made up of three sites known as the Telford, Stevenson and MacColl offshore wind farm sites. The Section 36 Consents and Marine Licences were subsequently varied in March 2018, with the Marine Licences additionally varied in July 2018, July 2019, April 2020, October (MacColl)/November (Telford & Stevenson) 2020, and January 2022;

Telford, Stevenson and MacColl wind farms – these names refer to the three consented offshore wind farm sites located within the Moray East site;

Transmission Infrastructure (TI) - includes both offshore and onshore electricity transmission infrastructure for the consented Telford, Stevenson and MacColl wind farms. Includes connection to the national electricity transmission system near New Deer in Aberdeenshire encompassing Alternating Current (AC), offshore substation platforms (OSPs), AC export cables offshore to landfall point at Inverboyndie and AC export cables onshore to the AC collector station (onshore substation), and the additional regional transmission operator substation near New Deer. A Marine Licence for the offshore TI was granted in September 2014 (Modified Offshore Transmission Infrastructure (OfTI) Marine Licence). A further Marine Licence for two additional distributed OSPs was granted in September 2017. Both Licences were subsequently varied in July 2019 and the Marine Licence for the offshore TI was additionally varied in December 2020, and January 2022. The onshore TI (OnTI) was awarded Planning Permission in Principle in September 2014 by Aberdeenshire Council and a Planning Permission in Principle under Section 42 in June 2015. In June 2018 Aberdeenshire Council granted Approval of Matters Specified in Conditions for both the cable route and substation;

Offshore Transmission Infrastructure (OfTI) – the offshore elements of the transmission infrastructure, comprising AC OSPs, and AC export cables offshore to landfall (for the avoidance of doubts some elements of the OfTI are installed in the Moray East site);

Onshore Transmission Infrastructure (OnTI) – The onshore transmission infrastructure required for the transmission of electricity from the Moray East Offshore Wind Farm including the substations, cable circuits, landfall area and ancillary permanent infrastructure together with all temporary works.

Moray East ES 2012 – The ES for the Telford, Stevenson and MacColl wind farms and Associated Transmission Infrastructure, submitted August 2012;

Moray East Modified TI ES 2014 – the ES for the TI works in respect to the Telford, Stevenson and MacColl wind farms, submitted June 2014;

Moray East OSP Environmental Report 2017 – the environmental report comprising of the "Statement Regarding Implications for the Modified TI ES 2014 and HRA". The report was produced in support of the application submitted in May 2017 for the Moray East OSP Marine Licence;

The Development – the Moray East Offshore Wind Farm and OfTI;

Design Envelope - the range of design parameters used to inform the assessment of impacts;

OfTI Corridor – the export cable route corridor, i.e., the OfTI area as assessed in the Moray East Modified TI ES 2014 excluding the Moray East site;

The Applications – (1) the Application letters and ES submitted to the Scottish Ministers on behalf of Telford Offshore Windfarm Limited, Stevenson Offshore Windfarm Limited and MacColl Offshore Windfarm Limited, on 2 August 2012 and the Additional Ornithology Information submitted to the Scottish Ministers by Moray Offshore Renewables Limited on the 17 June 2013; (2) the Section 36 Consents Variation Application Report for Telford, Stevenson and MacColl Offshore Wind Farms dated December 2017 and (3) the Marine Licence Applications and associated documents submitted for the OfTI and OSP Licences in April 2014 and May 2017 respectively;

Moray East Offshore Wind Farm Section 36 Consents and Marine Licences – are comprised of the following:

Section 36 Consents:

- Section 36 consent for the Telford Offshore Wind Farm (as varied) - consent under section 36 of the Electricity Act 1989 for the construction and operation of the Telford Offshore Wind Farm assigned to Moray East on 19 June 2018.
- Section 36 consent for the Stevenson Offshore Wind Farm (as varied) - consent under section 36 of the Electricity Act 1989 for the construction and operation of the Stevenson Offshore Wind Farm assigned to Moray East on 19 June 2018.
- Section 36 consent for the MacColl Offshore Wind Farm (as varied) - consent under section 36 of the Electricity Act 1989 for the construction and operation of the MacColl Offshore Wind Farm assigned to Moray East on 19 June 2018.

Marine Licences

- Marine Licence for the Telford Offshore Wind Farm (as varied) - Licence Number: MS-00009426 (formerly MS-00009051 and 04629/20/0) granted under the Marine (Scotland) Act 2010 & Marine and Coastal Access Act 2009, Part 4 marine licensing for marine renewables construction works and deposits of substances or objects in the Scottish Marine Area and the United Kingdom Marine Licensing Area transferred to Moray East on 19 July 2018.
- Marine Licence for the Stevenson Offshore Wind Farm (as varied) - Licence Number: MS-00009425 (formerly MS-00008985 and 04627/20/0) granted under the Marine (Scotland) Act 2010 & Marine and Coastal Access Act 2009, Part 4 marine licensing for marine renewables construction works and deposits of substances or objects in the Scottish Marine Area and the United Kingdom Marine Licensing Area transferred to Moray East on 19 July 2018.
- Marine Licence for the MacColl Offshore Wind Farm (as varied) - Licence Number: MS-00009424 (formerly MS-00008972 and 04628/20/0 - granted under the Marine (Scotland) Act 2010 & Marine and Coastal Access Act 2009, Part 4 marine licensing for marine renewables construction works and deposits of substances or objects in the Scottish Marine Area and the United Kingdom Marine Licensing Area transferred to Moray East on 19 July 2018.

OfTI Marine Licences – are comprised of the following:

- Marine Licence for the Offshore Transmission infrastructure (as varied) – Licence Number MS-00009423 (formerly MS-00008919 and 05340/19/0) - granted under the Marine (Scotland) Act 2010 & Marine and Coastal Access Act 2009, Part 4 marine licensing for marine renewables construction works and deposits of substances or objects in the Scottish Marine Area and the United Kingdom Marine Licensing Area (referred to as the "OfTI Marine Licence").
- Marine Licence for two additional distributed OSPs (as varied) – Licence Number 06347/19/0 (formerly 06347/17/1) granted under the Marine (Scotland) Act 2010 & Marine and Coastal

Access Act 2009, Part 4 marine licensing for marine renewables construction, operation and maintenance works and the deposit of substances or objects in the Scottish Marine Area and the United Kingdom Marine Licensing Area (referred to as the "OSP Marine Licence").

- Marine Licence for Moray Offshore Windfarm (East) Limited – Licence Number Licence Number MS-00010188 (formerly MS-00010009) – granted under the Marine (Scotland) Act 2010 & Marine and Coastal Access Act 2009, Part 4 marine licensing for the Installation of grouted supports under the Cable Protection Systems (CPS) of the export cables entering each of the 3 OSPs within the Moray East Offshore Wind Farm.

Executive Summary

Moray East is a joint venture partnership between OceanWinds Offshore, Diamond Generating Europe and China Three Gorges and has been established to develop, finance, construct, operate, maintain and decommission the Moray East Offshore Wind Farm.

The Moray East Offshore Wind Farm is located on the Smith Bank in the outer Moray Firth. It is located 12 nautical miles (NM) (approx. 22 km) from the Caithness Coast, covers an area of 86 square nautical miles or 295 square km, and ranges from 37 - 57 m in water depth.

The Development consists of 100 Wind Turbine Generators (WTGs), three Offshore Substation Platforms (OSPs), inter-array and interconnector cable circuits within the Wind Farm, and three offshore export cable circuits, in addition to onshore infrastructure. The three export cable circuits run from the Moray East Wind Farm to a landfall location in Boyndie Bay on the Aberdeenshire Coast.

This Wind Farm Project Environmental Monitoring Programme (PEMP) has been prepared by Moray Offshore Windfarm (East) Limited (Moray East) to inform Marine Scotland and relevant stakeholders of the proposed environmental monitoring of the Moray East Offshore Wind Farm, comprising the Telford, Stevenson and MacColl Offshore wind farms (including WTGs, inter-array and interconnector cables). Moray East seeks agreement that the information provided meets the requirements of the relevant conditions attached to the Moray East Offshore Wind Farm Consents (as set out in more detail in Table 1-1 below).

A separate PEMP has been prepared to address the environmental monitoring programme referent to the Offshore Transmission Infrastructure (OfTI) associated with the Development, the OfTI PEMP. The OfTI assets comprise the three OSPs and three offshore export cables.

The scope of monitoring includes seabed scour and local sediment deposition, benthic communities, sandeel, cod, herring, diadromous fish, birds and marine mammals.

This Wind Farm PEMP has been prepared taking into account the information presented within the Environmental Statement (ES) produced for the Wind Farm (Moray East ES 2012) and associated OfTI (Moray East Modified TI ES 2014), as well as feedback received by the Moray Firth Regional Advisory Group (MFRAG).

Relevant links to other Moray East Offshore Wind Farm consent condition plans (Piling Strategy, Environmental Management Plan, Vessel Management Plan, Operations and Maintenance Programme and Cable Plan) are highlighted as relevant.

The Wind Farm PEMP is a live document and will be kept up to date as appropriate in accordance with the consent conditions.

Acknowledgments

Moray East would like to thank the following people/organisations for their input and continuous support into this PEMP:

- Prof Paul Thompson and the Lighthouse Field Station staff (University of Aberdeen) for their input into the Construction Marine Mammal Monitoring Programme (cMMMP) and Marine Mammal Monitoring Programme (MMMP);
- Brown and May Marine for their support in the development of the herring survey design;
- Paul English (Fugro) for their input into the benthic monitoring approach;
- The Scottish Centre for Ecology and the Natural Environment (SCENE) and the Atlantic Salmon Trust (AST) for the development of the salmon monitoring programme completed in 2019; and
- Ross McGregor from (MacArthur Green) for their support on the development of pre- and post-construction birds survey strategy.

1 Introduction

1.1 Background

In March 2014, Section 36 Consents and associated Marine Licences were granted for three offshore wind farms (Telford, Stevenson and MacColl) within the Moray East site (see Figure 1-1 below), together these are referred as the Moray East Offshore Wind Farm Consents. The Moray East Consents were varied in March 2018. The Marine Licences for Telford, Stevenson and MacColl were subsequently varied in July 2018, July 2019, April 2020, October (MacColl) and November (Telford & Stevenson) 2020, and January 2022. This Wind Farm Project Environmental Monitoring Programme (PEMP) is submitted in accordance with the Moray East Offshore Wind Farm Consents.

The Moray East Offshore Wind Farm (the Wind Farm) is located in the outer Moray Firth more than 22 km from shore at its closest point. The three consented wind farms comprised in the Moray East (Telford, Stevenson and MacColl) have been developed as a single wind farm, consisting of 100 Wind Turbine Generators (WTGs), with inter-array and interconnector cable circuits within the Wind Farm site. The construction works for the Wind Farm and Final Commissioning of the Development were completed on 1st April 2022, giving start to the Operation and Maintenance (O&M) phase of the Development.

The Wind Farm is supported by the Offshore Transmission Infrastructure (OfTI), comprising three OSPs and three offshore export cable circuits, which together form the Development. Figure 1-1 below shows the location of the Development, comprising the wind farm and the OfTI.

This PEMP relates to the Moray East Offshore Wind Farm only, comprising the 100 WTG, inter-array and interconnector cable circuits within the Wind Farm. A separate PEMP, the OfTI PEMP, pertaining to the proposed monitoring for the consented Moray East OfTI assets has been issued in separate, comprising the three OSPs and three offshore export cables.

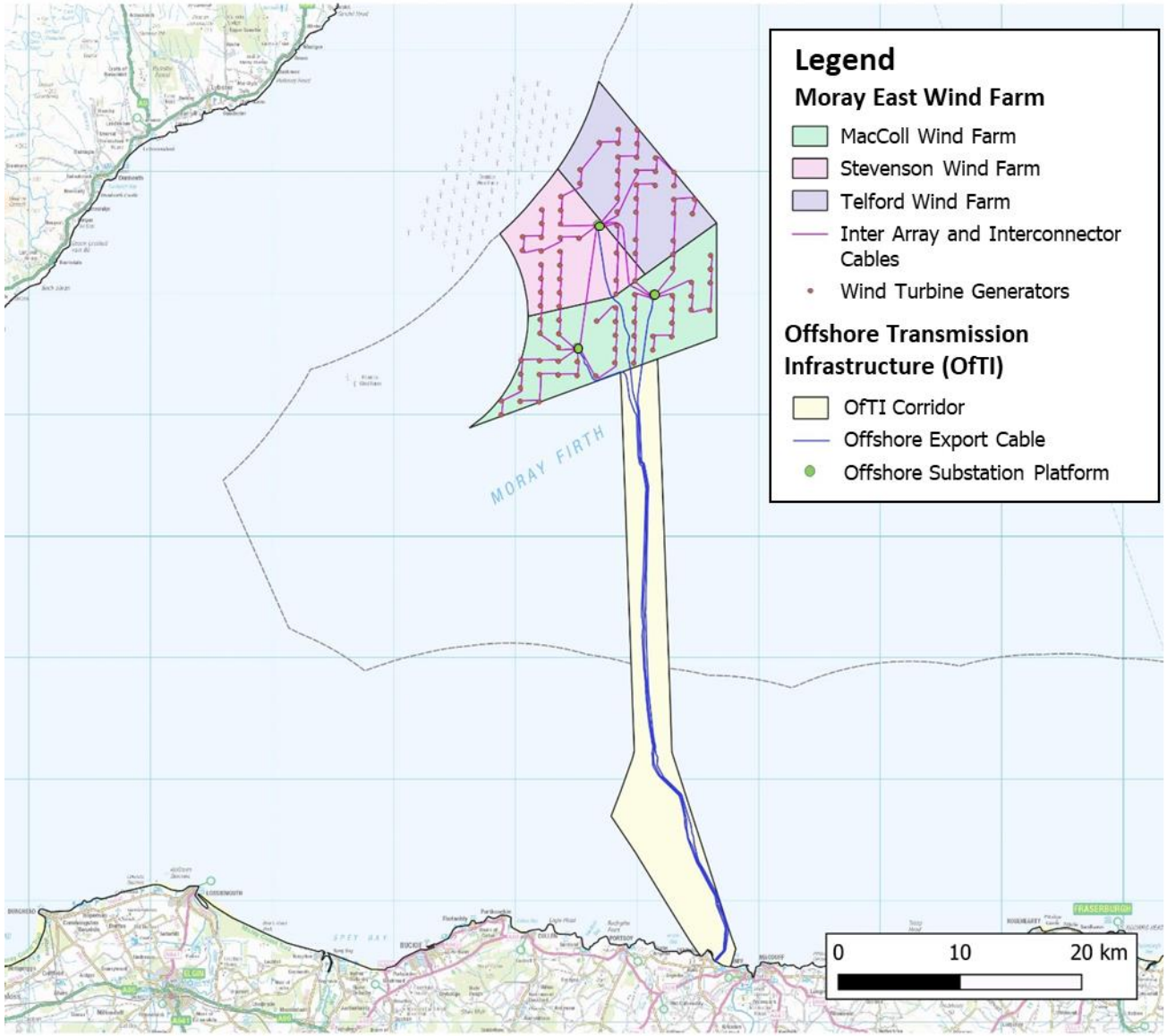

Figure 1-1: Location of Moray East Wind Farm and OfTI assets

1.2 Purpose of the Project Environmental Monitoring Programme

The purpose of the PEMP is to detail the proposed environmental monitoring throughout the lifespan of the Development. This review of the Wind Farm PEMP describes the monitoring completed during the pre-construction and construction phase of the Development and details future monitoring proposed for the post-construction phase of the Moray East Offshore Wind Farm.

This version of the Wind Farm PEMP has been produced in line with the requirements of condition 26 of the Section 36 Consents for the Telford, Stevenson and MacColl wind farms, and aims to seek approval on Moray East updates and refinement to previously agreed post-construction environmental monitoring.

As established in the relevant Section 36 consent and marine licence conditions (see section 1.5), the '*monitoring should be done in such a way as to ensure that the data which is collected allows useful and valid comparisons as between different phases of the Development*', while '*monitoring may also serve the purpose of verifying key predictions in the ES*'. Where appropriate, consultation with MFRAG will be undertaken prior to approval of the PEMP. According to MFRAG Terms of Reference (ToR), the PEMP aims to 'ensure that appropriate and effective monitoring of the impacts of the Development is undertaken'.

The Moray East Environmental Statement (Moray East ES 2012) which accompanied the Section 36 and Marine Licence applications for the three wind farms provided a description of the environmental sensitivities and impact assessment (including mitigation and commitments for monitoring as relevant) for the development of the Moray East Offshore Wind Farm. The Moray East Environmental Statement (Moray East Modified ES 2014) which accompanied the Marine Licence application for the Moray East OfTI provided a description of the environmental sensitivities and impact assessment (including mitigation and commitments for monitoring as relevant) for the development of the OfTI and interconnector cables connecting the OSPs.

1.3 Document Control

This PEMP is a 'live document' and will be kept up to date as appropriate in accordance with the Section 36 Consent conditions. Amendments to this document may result from the need to review the scope of monitoring / close out of monitoring requirements in light of:

- Detailed project information; or
- New information from:
    a) Monitoring reports (associated with monitoring carried out as part of the PEMP); and
    b) Research or other monitoring programmes of relevance to the consent conditions for Moray East. For instance, monitoring results for the adjacent Beatrice Offshore Windfarm Limited (BOWL) and Moray West Offshore Wind Farm are expected to be of particular relevance as detailed throughout this document.

1.4 Consultation Requirements

There is a requirement to consult with the Moray Firth Regional Advisory Group (MFRAG) on the scope of monitoring, reporting of results, and discharge of the PEMP conditions. As referred above in section 1.3, the PEMP is a live document and amendments to the PEMP will also be subject to consultation with MFRAG as appropriate.

The aims and objectives of MFRAG are detailed within the group's Terms of Reference (ToR) (MFRAG, 2019). The main objective is to facilitate the wind farm developers in the Moray Firth to comply with relevant conditions, ensure that appropriate and effective monitoring of the impacts of the development is undertaken, encourage collaboration between developers in order to deliver strategic monitoring, and

advise on closure and sign-off of components of the PEMPs and Environmental Management Plans (EMPs) amongst others. The MFRAG membership includes representatives from:

- Marine Directorate Licensing Operations Team (MD-LOT), formerly Marine Scotland Licensing Operations Team (MS-LOT);
- Marine Scotland Science (MSS);
- Marine Scotland Renewables and Offshore Wind Policy;
- NatureScot (formerly Scottish Natural Heritage (SNH));
- Moray East Offshore Wind Farm;
- Moray West Offshore Wind Farm;
- BOWL;
- Royal Society for the Protection of Birds Scotland (RSPB Scotland);
- Whale and Dolphin Conservation (WDC); and
- Fisheries Management Scotland (FMS)[1].

A member of the Joint Nature Conservation Committee (JNCC) is welcome to attend the MFRAG if they so wish, but only as an observer to proceedings.

Two additional subgroups to the main MFRAG group have also been set up (and have been active since the end of 2014). These are the MFRAG – Ornithology Subgroup (MFRAG-O) and MFRAG – Marine Mammals Subgroup (MFRAG-MM). The aim of these subgroups is to create a forum through which detailed discussions on specialist disciplines are held. The subgroups also have the authority to directly advise the Scottish Ministers (i.e., via MD-LOT) and the main MFRAG on aspects related to the discharge of the PEMP conditions for their specialist disciplines.

Consultations already carried out via the main MFRAG and the MFRAG subgroups are detailed within the relevant discipline sections in this PEMP. Consultation records are also available on the Marine Scotland Website[2].

1.5 Overview of consent condition requirements

Table 1-1 below details the condition requirements and refers to the relevant section of the PEMP where information has been provided to address the requirements.

Table 1-1: Condition requirements and how they are addressed within the PEMP

Condition Text	Relevant Section of this PEMP
Section 36 Consents (Telford, Stevenson and MacColl Wind Farms) as varied – Condition 26	
The Company must, no later than 6 months prior to the Commencement of the Development, submit a Project Environmental Monitoring Programme ("PEMP"), in writing, to the Scottish Ministers for their written approval. Such approval may only	The Moray East Development PEMP was approved by the Scottish Ministers on 2 November 2018

[1] Fisheries Management Scotland (FMS) replaced the Association of Salmon Fisheries Board (ASFB) as a member of the MFRAG in 2017.
[2] Moray Firth Regional Advisory Group (MFRAG) | Marine Scotland Information

Condition Text	Relevant Section of this PEMP
be granted following consultation by the Scottish Ministers with the JNCC[3], SNH[4], RSPB Scotland, WDC, ASFB[5] and any other ecological advisors as required at the discretion of the Scottish Ministers. The PEMP must be in accordance with the ES 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.	Sections 2 to 9
Monitoring should be done in such a way as to ensure that the data which is collected allows useful and valid comparisons as between different phases of the Development. Monitoring may also serve the purpose of verifying key predictions in the ES. Additional monitoring may be required in the event that further potential adverse environmental effects are identified for which no predictions were made in the ES.	Sections 2 to 9
The Scottish Ministers may agree that monitoring may cease before the end of the lifespan of the Development.	Sections 1.3 and 2 to 9
The PEMP must cover, but not be limited to the following matters: a. Pre-construction, construction (if considered appropriate by the Scottish Ministers) and post-construction monitoring surveys as relevant in terms of the ES and any subsequent surveys for: 1. Birds; 2. Cod; 3. Herring; 4. Sandeels; 5. Diadromous fish; 6. Benthic communities; and 7. Seabed scour and local sediment deposition b. The participation by the Company in surveys to be carried out in relation to marine mammals as set out in the MMMP; and c. The participation by the Company in surveys to be carried out in relation to regional and strategic bird monitoring;	Sections 2 to 9
All the initial methodologies for the above monitoring must be approved, in writing, by the Scottish Ministers and, where appropriate, in consultation with the MFRAG referred to in condition 27 of this consent. Any pre-consent surveys carried out by [Moray East] to address any of the above species may be used in part to discharge this condition.	Sections 2 to 9
The PEMP is a live document and must be regularly reviewed by the Scottish Minsters, at timescales to be determined by the Scottish Ministers, in consultation with the MFRAG to identify the appropriateness of on-going monitoring. Following such reviews, the Scottish Minsters may, in consultation with the MFRAG, 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 MFRAG and any other ecological, or such advisors as	Sections 1.3 and 1.4

[3] Although the Joint Nature Conservation Council (JNCC) are named as consultee within the relevant PEMP conditions, Moray East has been advised that the Offshore Renewable Energy Casework responsibility has been delegated from JNCC to SNH from 1st April 2017

[4] Scottish Natural Heritage (SNH) is now operating under the name NatureScot.

[5] Fisheries Management Scotland (FMS) replaced the Association of Salmon Fisheries Board (ASFB) as a member of the MFRAG in 2017.

Condition Text	Relevant Section of this PEMP
may be required at the discretion of the Scottish Ministers. The PEMP, as amended from time to time, must be fully implemented by the Company at all times.	
The company must submit written reports of such monitoring surveys to the Scottish Minsters at timescales to be determined by the Scottish Ministers in consultation with MFRAG. Subject to any legal restrictions regarding the treatment of information, the results are to be made publicly available by the Scottish Ministers, or by such other party appointed at their discretion.	Sections 2 to 9

The PEMP has also been written to address the following conditions:

Table 1-2: Other consent conditions relevant to the PEMP

Condition	Summary of Condition	Relevant Section of this PEMP
Section 36 Consents: Condition 27	**Participation in MFRAG** "The Company must participate in any Moray Firth Regional Advisory Group ("MFRAG") established by the Scottish Ministers for the purpose of advising the Scottish Ministers on research, monitoring and mitigation programmes for, but not limited to, ornithology, diadromous fish, marine mammals and commercial fish."	Sections 2 to 9
Section 36 Consents: Condition 28	**Participation in SSMEG** The Company must participate in any Scottish Strategic Marine Environment Group ("SSMEG") established by the Scottish Ministers for the purpose of advising the Scottish Ministers on research, monitoring and mitigation programmes for, but not limited to, ornithology, diadromous fish, marine mammals and commercial fish.	Sections 2 to 9
Section 36 Consents: Condition 30	**Participation in Scottish Atlantic Salmon, Sea Trout and European Eel Monitoring Strategy** "The Company must, to the satisfaction of the Scottish Ministers, participate in the monitoring requirements as laid out in the 'Scottish Atlantic Salmon, Sea Trout and European Eel Monitoring Strategy' so far as they apply at a local level (the Moray Firth)."	Section 7
Section 36 Consents (Telford and Stevenson Offshore Wind Farms): Condition 33	**Herring surveys** "In the event that pile foundations are to be used, the Company must undertake herring surveys every year during the months of August and September … The methodology of the herring surveys must be agreed, in writing, by the Scottish Ministers, following consultation with Marine Scotland Science, prior to the surveys commencing. The results of the herring surveys will be used to better inform the knowledge of spawning behaviour / characteristics of the Orkney / Shetland herring stock, thus allowing the Company to devise mitigation options to minimise noise impacts from piling activity on all life stages of herring and to inform the Company's PS (if a PS is required)."	Section 6
Section 36 Consents (Telford and	**Cod surveys**	Section 5

Condition	Summary of Condition	Relevant Section of this PEMP
Stevenson Offshore Wind Farm): Condition 34 / (MacColl Offshore Wind Farm): Condition 33	If Commencement of the Development is later than 1st April 2018, the Company must undertake a further baseline cod survey during the months of February and March immediately prior to the Commencement of the Development … The Company must undertake a post-construction cod survey in the first February and March, occurring no earlier than 12 months, following the Final Commissioning of the Development."	
Section 36 Consents (Stevenson Offshore Wind Farm): Condition 35/ (MacColl Offshore Wind Farm): Condition 34	**Sandeel survey** If Commencement of the Development occurs later than 1st April 2017, the Company must undertake a further baseline sandeel survey prior to the Commencement of the Development … No earlier than 12 months following Final Commissioning of the Development, the Company must undertake a post-construction sandeel survey using a methodology agreed…"	Section 4

In addition to the above, there are also a number of linkages to other consent condition plans. An overview of these links is provided in Table 1-3 below and further detail is provided in sections 2 to 9 as it relates to individual monitoring programmes.

Table 1-3: PEMP Linkages with Other Consent Plans

Condition	Consent Plan	Consistency with / linkage with PEMP
S36: Condition 11	Piling Strategy (PS)	The PS includes details of mitigation and monitoring employed during pile driving as agreed with the Scottish Ministers. The monitoring for cod, herring and marine mammals was considered within the PS (Moray East, 2019). The PS is consistent with the PEMP, so far as is reasonably practicable.
S36: Condition 14	Environmental Management plan (EMP)	The EMP sets out the environmental management framework for the Development during construction and operation. The EMP must be informed, so far as is reasonably practicable, by the baseline surveys undertaken as part of the ES and the PEMP.
S36: Condition 15	Vessel Management Plan (VMP)	The VMP considers mitigation to disturbance or impact to marine mammals and birds. The VMP describes how the vessel traffic will be managed during construction and operation. The VMP must, so far as is reasonably practicable, be consistent with the PEMP.
S36: Condition 16	Operations and Maintenance Programme (OMP)	The OMP sets out the programme for operation and maintenance of the Development. The OMP must, so far as is reasonably practicable, be consistent with the PEMP.
S36: Condition 18	Cable Plan (CaP)	The CaP provides details on cable specification, installation and cable protection, their interactions with the environment and safety considerations. The approach for scour monitoring and analysis of geophysical data in the context of benthic habitats

Condition	Consent Plan	Consistency with / linkage with PEMP
		will help inform cable routing. Details are provided within section 2 and 3 of this PEMP.

1.6 Responsibilities for the Delivery of the PEMP

The Moray East Offshore Wind Farm has been constructed and is operated by Moray East, and therefore it will be Moray East's responsibility to deliver the wind farm monitoring programme as set out in this PEMP.

As previously informed, the environmental monitoring of the OfTI assets is considered in a separate document (OfTI PEMP), the environmental monitoring as set out in that document will be the responsibility of the OFTO upon transfer of the OfTI assets, until that time the OfTI monitoring will be carried out by Moray East.

2 Seabed Scour and Local Sediment Deposition

2.1 Monitoring Requirements

The consent conditions relevant to seabed scour and local sediment deposition are summarised in Table 2-1 below.

Table 2-1: Seabed scour and local sediment deposition monitoring conditions

Condition	Monitoring requirement
PEMP S36: Condition 26 a	The PEMP must cover pre-construction, construction (if considered appropriate by the Scottish Ministers) and post-construction monitoring surveys for seabed scour and local sediment deposition.
CaP S36: Condition 18	The CaP must detail measures to address exposure of inter array cables. [also includes interconnector cables between OSPs]

The CaP condition is relevant to the approach for monitoring seabed scour and local sediment deposition and it has been designed considering information collected to inform the CaP.

2.2 Monitoring Approach

As previously defined in the PEMP, Moray East will use data collected during engineering monitoring surveys to meet the requirements of seabed scour and local sediment deposition monitoring. This approach has been highlighted in the review of post consent offshore wind farm monitoring commissioned by MMO (MMO, 2014).

The surveys/inspections programme for asset integrity and maintenance purposes use a risk-based approach, supported by a number of factors, including:

- analysis of previous geophysical and geotechnical surveys;
- foundation design (including any scour protection);
- cable burial design; and
- the results of foundation integrity and cable burial risk assessments.

2.2.1 WTG foundations and CPS

Local scouring is closely linked to wave and tidal activity and the interaction of these hydrological processes with the structure and surrounding soil conditions.

The monitoring of seabed scour around foundations is important from an engineering perspective to ensure that seabed sediments required for the structural integrity of the foundation are not being undermined beyond design parameters. The monitoring of potential environmental effects associated with seabed scour will be included as part of the structural integrity monitoring programme when significant changes in seabed sediment characteristics have occurred.

The scour monitoring programme near the foundations was considered during the design phase of the Development. During the design phase, the likely extent of seabed scour around the foundations was assessed taking into consideration the soil, wave and tidal conditions at each of the WTG locations. This analysis, in conjunction with the foundation design, was used to determine whether there was a need to install scour protection in the form of rock armour, concrete mattresses or other seabed stabilisation measures. Scour protection was installed at two WTG foundation locations (C04 and E04).

According to the Moray East O&M Manual for WTG Foundation (Mareval AG, 2021), which provide the necessary information for the safe operation and maintenance of Moray East foundations, monitoring is recommended at scour protection locations a minimum of once a year for the first three years. After this period, the frequency of monitoring will be determined according to the results obtained.

In addition to the recommendations of the O&M manual for foundations, a survey at cable protection system (CPS) entering the WTGs foundations will also be undertaken to check the status of the CPS and any excessive scour.

An ultimate limit state (ULS) restraint sensitivity analysis for the CPS (Agilitek, 2020) concluded that the cables at the WTG foundations are protected under ULS conditions throughout the operational period of the Wind Farm, provided they are restrained as per one of the recommended configurations. This restraint has been achieved during installation through the burial of the CPS and the supplementary restraint with rock bags for the extended CPS lengths. In addition, a desktop Risk Assessment for CPS abrasion determined the level of risk of abrasion as low.

The scour surveys at the foundations have been defined based on O&M manuals, the achieved restraint and risk assessment for CPS abrasion. These will be undertaken at all assets with scour protection (i.e., WTG C04 and E04) plus a sample of five other assets to be determined prior to each campaign. The CPS survey campaigns are planned to take place every six months within the first 18 months of the Development, and then again after 12 months (i.e., a total of four inspections within the first three years).

These post-construction inspections aim to monitor the seabed interface around the jackets to ensure that the expected level of scour taken at the design stage is validated and that any scour protection measures deployed are proving effective.

Previous bathymetric surveys were undertaken during the construction phase and Remotely Operated Vehicle (ROV) footage of the seabed collected immediately following the installation of all foundation structures will be used to provide a baseline of information for comparison with future surveys.

The outcomes of the previous and future seabed surveys planned for the next three years described above will be used to further refine the risk-based inspection methodology throughout the lifespan of the Development. At the time of writing, it is assumed to be at least once every five years.

2.2.2 Cables (Inter-array, and interconnectors between OSPs)

Cable burial risk assessments have been undertaken during the pre-construction phase of the Development. These were informed by soil types across the site and other surveys undertaken across the cable routes (Cathie Associates, 2018). These assessments were used to determine cable burial requirements for the Development to assure that the inter-array and interconnector cable systems are

adequately protected and to minimise hazards to other users of the sea. Further detail is provided within the Wind Farm CaP (Moray East, 2022).

Following the completion of the cable installation, an 'as built' survey was undertaken to record post-installation baseline conditions. Moray East will continue to undertake -post-construction surveys to identify any changes in seabed bathymetry that may affect the burial protection of the cables. Where excessive scour is detected, further investigation would be undertaken.

Burial monitoring at the inter-array and interconnector cables is divided into two elements: (1) burial at the CPS approaching the WTG, which is covered in Section 2.2.1 above; and (2) burial along the cable length between two assets, as described below.

Bathymetric surveys along the inter-array and interconnector cables have been defined based on the recommendations from the Contractor *FB000041-BSCF-GEN-PL-9001_Operation and Maintenance Plan*: *"The following surveys are recommended to be performed: Bathymetric and side-scan sonar survey of cable corridor to inspect seabed morphology (review of features i.e., sandbanks, sand waves and other potential hazards) and areas of exposed cable. The bathymetric surveys completed after cable burial operations may be used as a reference to identify changes in the seabed morphology and therefore indicating potential changes to the Depth of Lowering of the cable."*

In the cable burial risk assessment (CBRA) document (C950R01- Revision 03) a comparison of the available bathymetries of the site has been made to assess whether or not the site is susceptible to sediment mobility. An extract of the comparison is presented below:

> *2010/2014/2017 Bathymetric comparison "Visual and statistical comparison of bathymetric sections of large-scale potentially mobile features (on the order of 1m in amplitude and 100m wavelength) indicate that in the seven-year duration between the earliest and latest surveys, negligible movement of these features has occurred, accounting for a degree of equipment differences and tidal reduction methodologies between the surveys*".

Further informed by the successful burial of the inter-array and interconnector cables (minimum depth of lowering (DoL) of 0.6m has been achieved for 99.93% of the site) and above assessment of limited seabed mobility, the strategy determined by the project is that each survey of 10% of installed cable length (circa 18km of 176km total) is reasonably practicable to monitor the protection status of the cables and inform the on-going appraisal of this risk.

The surveys will comprise two campaigns within the first three years of the Development. Each campaign will cover 10% of the total installed length. The specific sections to be covered in the survey will focus on areas that have been identified as most susceptible to scour as determined through the CBRA.

2.3 Monitoring Objectives

The objectives of monitoring will be:

- To monitor the development and extent of local scouring effects that may occur around the wind farm assets; and
- Detect the exposure of previously buried subsea cables associated with the Moray East Offshore Wind Farm.

2.4 Survey Methodology

The monitoring of changes in seabed topography will indicate the amount of sediment erosion or accretion that is occurring. The extent of the seabed over which scour is occurring will indicate the extent of the areas over which physical processes are being affected.

The presence of significant local scouring around installed assets, such as foundations and cabling, will indicate potential changes to seabed hydrodynamic conditions as a result of the presence of the installed

item(s), which in turn may consequentially lead to changes in the local physical processes. The detection of significant changes in topography, therefore, will be a potential indicator of the extent to which physical processes are being affected.

2.4.1 Scour monitoring at foundations scour protection and CPS

Scour survey campaigns at the CPS and scour protection at the foundations will be undertaken every six months for 18 months, and then again after 12 months (i.e., four campaigns within the three first years). A total of ten assets will be surveyed in each monitoring campaign, including the two assets with installed scour protection (i.e., WTG C04 and E04), and the CPS of five other WTG assets to be defined prior to each campaign. These assets will be defined considering previous scour protection design studies, proximity to scour protection works at the site, seabed surveys, and the geology and metocean conditions and characteristics.

The following assets are planned to be surveyed in the first campaign: A01, D06, G09, G08, and D04; and second campaign: G16, G17, J10, H09, and J17 (to be confirmed prior to the campaign). These are in addition to the WTG C04 and E04, to be surveyed in every campaign. These were primarily selected based on proximity with location where previous remedial work was undertaken, and therefore indicate areas of a higher potential for scour.

The methods to be used during the campaigns include ROV using HD pan/ tilt colour camera and/or sonar survey systems (e.g., blue view) deployed off appropriate survey vessels or, less likely, directly from the substructure.

In addition, visual inspections of the scour protection at WTG C04 and E04 will be undertaken every year during the first three years of operation of the Development.

The surveys will allow the identification of changes in seabed topography, and visually record the appearance of surface sediments and soil conditions, to be compared with unaffected areas and/or previous surveys. Changes in the soil aspect may provide indications of whether there are any obvious changes to surface megafauna which in turn would indicate a potential change in benthic communities.

Where significant scour is identified, the data collected as part of the scour monitoring will also be analysed to determine if significant changes in seabed sediment characteristics and surface soils have occurred. Further evaluation may be undertaken by an environmental specialist to determine the impact, if any, on benthic communities.

It is noted that ROV footage has been undertaken during / immediately following jacket installation to give a visual confirmation of the condition/status of the seabed around the substructures. This provides baseline records for the identification of changes.

Whichever method is utilised, it would be assumed that where the extent of scour is not significant, seabed processes and benthic habitats will not have been affected.

2.4.2 Cable Depth of Burial Monitoring

The burial status of cables will be monitored by using bathymetric survey techniques to monitor the seabed topography along the cable routes (e.g., MBES and SSS). The bathymetric levels will be analysed against the as-installed data to ensure that any changes to the seabed topography do not present a risk to the cable system.

The post-installation bathymetric survey programme comprises two monitoring campaigns, the first one was completed in September 2022, and the second expected for May 2024, each will cover approximately 10% of total inter-array cables and OSP interconnectors length. These surveys will aim to identify seabed anomalies such as free spans; local seabed scour, settlement, subsidence or instability affecting the cable integrity; and any excessive scour at / near cable scour protection.

A total length of approximately 18 km was surveyed during the first inter-array and interconnectors bathymetry campaign. The total length cover approximately:

- 10.344 km between OSP1 and OSP2;
- 1.138 km between B05 and B04;
- 1.149 km between C15 and C16;
- 1.990 km between I20 and I19;
- 1.151 km between J08 and J07; and
- 2.277km between J14 and J16.

The results of the surveys undertaken during the first three years will help define the frequency and design of surveys for the rest of the operational life of the wind farm.

2.5 Survey Programme

An indicative post-construction scour surveys programme to be undertaken during the O&M phase of the development is presented in Table 2-2 below.

Table 2-2: Indicative monitoring programme for scour survey

Item	Description	Frequency / Programmed surveys
Scour around substructure foundations and CPS	A total of seven WTG assets will be surveyed in each scour monitoring campaign, including: (1) scour protection and CPS at the two assets with installed scour protection (i.e., WTG C04 and E04), and (2) CPS at five other WTG assets to be defined before each campaign. In addition, separate visual inspection campaigns will be undertaken at the scour protection at WTG C04 and E04.	Three campaigns within the first 18 months (approximately every six months), and a fourth campaign in the following 12 months. The surveys are expected to take place in the following periods: • 1st campaign: April 2022. • 2nd campaign: Sep 2022 • 3rd campaign: May 2023 • 4th campaign: May 2024 In addition, visual inspections will be undertaken once a year at WTG C04 and E04, expected for: • 1st campaign: April-July 2022. • 2nd campaign: May – Aug 2023 • 3rd campaign: Jun - Aug 2024 After the first three years of operation, surveys are to be undertaken on a risk-based frequency.
Subsea cable bathymetric survey – Inter-array cables and	A bathymetric survey covering 10% of total cable length. The bathymetric levels will be analysed against the as-installed data to identify any changes in	Two campaigns are planned within the first three years:

interconnectors between OSPs	seabed bathymetry that may affect the burial protection of the cable.	• 1st campaign expected completed in September 2022 • 2nd campaign in May 2024. After the first three years of operation, surveys to be undertaken on a risk-based frequency.

2.6 Reporting

A number of geophysical and geotechnical surveys have been undertaken during pre-construction and construction phases of the Development. The results of the 2010 geophysical and geotechnical surveys have been included within the Moray East ES 2012 and Modified OfTI ES 2014. A summary of the subsequent pre-construction and construction phase surveys have been provided through periodic reports (8460001-PCA0010-MWE-REP-007 in September 2019; 8460001-PCA0010-MWE-REP-010 in December 2020; 8460001-PCA0010-MWE-REP-013 in August 2021; and 8460001-PCA0010-MWE-REP-015 in April 2022).

A summary of the scour survey reports described in this section will be submitted to MD-LOT in periodic intervals as agreed with MD-LOT. The summary report is also to be shared with NatureScot.

3 Benthic Communities

3.1 Monitoring Requirements

The consent conditions relevant to monitoring of benthic communities are summarised in Table 3-1 below.

Table 3-1: Benthic Communities Monitoring Conditions

Condition	Monitoring requirement
PEMP S36: Condition 26 a	The PEMP must cover pre-construction, construction (if considered appropriate by the Scottish Ministers) and post-construction of benthic communities.
CaP S36: Condition 18	The CaP must include the results of survey work (including geophysical, geotechnical and benthic surveys) which will help inform cable routing.

3.2 Monitoring Approach

3.2.1 Moray East site

The reason for the monitoring surveys stated within Section 36 Consent condition 26 is '*to ensure that appropriate and effective monitoring of the impacts of the Development is undertaken*'.

A review of offshore wind farm post-consent environmental data carried out on behalf of the Marine Management Organisation (MMO, 2014) highlighted the following key principles of monitoring:

- Monitoring objectives should reflect the likely significance of the effect as described in the ES and/or where there is a high level of uncertainty;
- Conditions should present a clear hypothesis where a sensitive receptor is identified;
- Specific focused studies are required on conservation / biologically important features;
- The emphasis of the post consent monitoring should be placed on the ability to reduce uncertainty of the predictions made in the ES; and
- Each licence should be more focused on the site-specific EIA, and monitoring requirements therein, tailored to the evident areas of probable significant effect, but also taking account of the level of uncertainty.

In addition to the MMO review, both Cefas (Judd, 2011) and OSPAR (2008) highlight that monitoring should be designed to answer questions raised in the ES where significant effects have been identified.

Considerable quantities of benthic ecological data have been collected for the Moray East Environmental Impact Assessment (EIA) 2012. These data have been collected from literature review and site-specific survey involving grab and scientific trawl sampling and seabed video surveillance. No rare or protected species with respect to the EC Habitats Directive 92/43/EEC and / or the Wildlife & Countryside Act 1981, were found within the boundaries of the Moray East site.

In addition to the surveys described above, Moray East proposes to utilise the results of the geophysical surveys plus ROV surveys undertaken for engineering monitoring purposes (see section 2 above for an overview of proposed surveys for monitoring of seabed scour and local sediment deposition). Separate post-construction benthic surveys within the Moray East site are not considered necessary. Where significant scour is identified during the regular inspections (as described in Section 2), data collected will also be analysed to determine if significant changes in seabed sediment characteristics and surface soils

have occurred. Further evaluation may be undertaken by an environmental specialist to determine the impact, if any, on benthic communities.

The rationale for this approach also takes into account the monitoring proposals of the adjacent BOWL wind farm and the outcome of literature reviews on benthic monitoring at offshore wind farms.

3.3 Conclusions

Where scour surveys show significant changes in the seabed, data collected as part of scour monitoring (section 2) will be analysed by an environmental specialist in the context of benthic monitoring (to confirm that no changes to benthic communities have occurred).

Taking the above into consideration, Moray East does not propose to undertake any further targeted benthic monitoring on the basis of the following:

- Extensive baseline data collected to date (Moray East ES 2012);
- No effects of moderate or major significance were identified in the ES (Moray East ES 2012);
- No designated sites were identified during the EIA;
- Previous monitoring at offshore wind farms supports no detectable broad-scale effects of offshore wind farm construction and operation on benthic communities;
- Approach to benthic community monitoring at the BOWL site; and
- Additional data collection undertaken as described in Section 2 above.

4 Sandeel

4.1 Monitoring Requirements

The consent conditions relevant to sandeel monitoring are summarised in Table 4-1 below.

Table 4-1: Seabed Scour and Local Sediment Deposition Monitoring Conditions

Condition	Monitoring requirement
PEMP S36: Condition 26 a	The PEMP must cover pre-construction, construction (if deemed appropriate by the Scottish Ministers) and post-construction monitoring surveys for sandeel.
Sandeel Surveys S36: Condition 35 (Stevenson Offshore Wind Farm) and Condition 34 (for MacColl Offshore Wind Farm)[6]	The sandeel survey undertaken between 30th January and 2nd March 2012 in the Moray Firth by Moray East will remain valid as a pre-construction baseline survey provided that the Commencement of the Development occurs no later than 1st April 2017. If Commencement of the Development is later than 1st April 2017 a further baseline sandeel survey will need to be undertaken prior to the Commencement of the Development of the area marked 'Sandeel Survey Area'.
	No earlier than 12 months following Final Commissioning of the Development, the Company must undertake a post-construction sandeel survey using a methodology agreed, in writing, with the Scottish Ministers. The post-construction sandeel survey will cover the area marked 'Sandeel Survey Area'

The 'sandeel survey area' as per the consent conditions is shown in Figure 4-1 below.

The 'sandeel surveys' condition states that the results of the pre-construction survey remain valid provided commencement of the development is no later than 1st April 2017. Construction commenced in May 2019, therefore, Moray East has undertaken an additional pre-construction survey, carried out in March 2019.

[6] Sandeel surveys condition is only relevant to Stevenson and MacColl Offshore Wind Farms. No equivalent condition exists for the Telford Offshore Wind Farm.

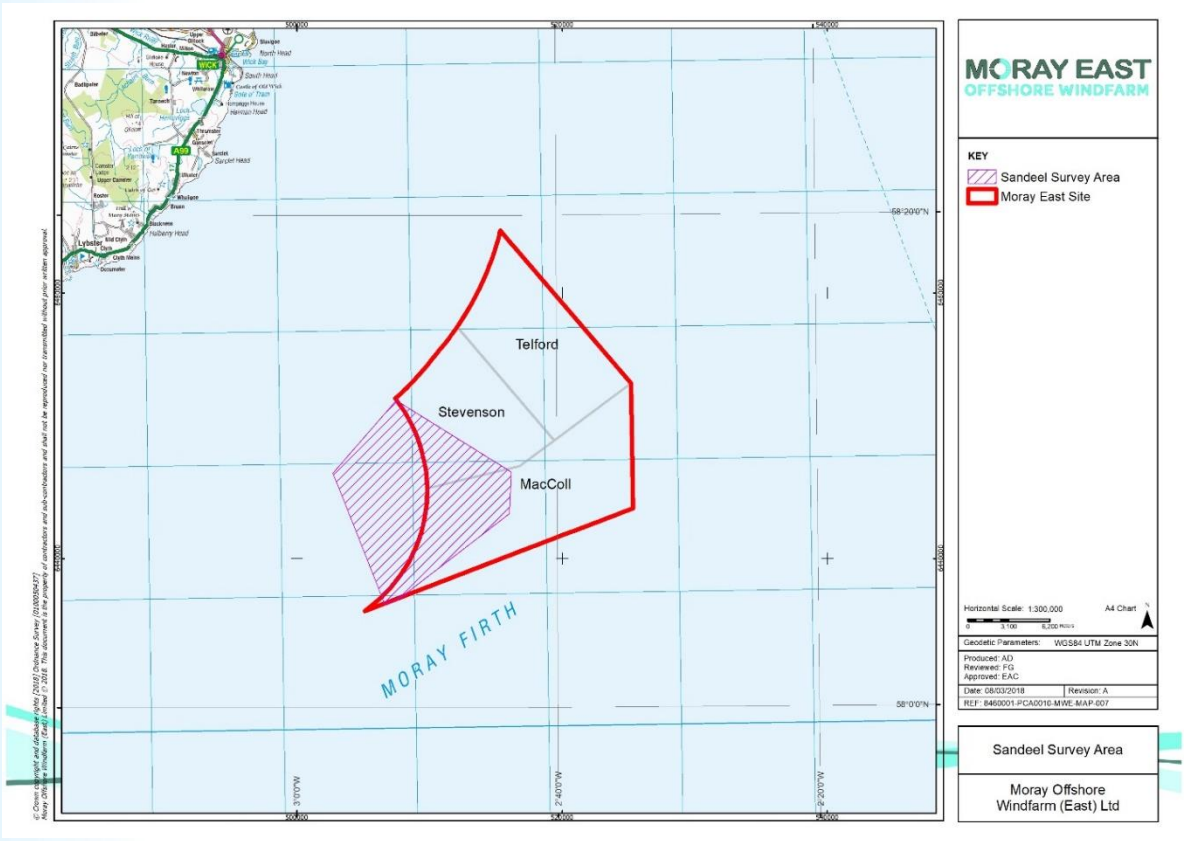

Figure 4-1: Sandeel survey area

4.2 Monitoring Approach

Consultation was conducted with relevant stakeholders with regards to sandeel survey methodology and reporting as part of the Moray East EIA. The outcomes of the consultations are presented in the Moray East ES 2012 (section 4.3.2). Moray East also discussed the proposed sandeel monitoring approach in the context of the PEMP requirements with MFRAG, where the approach for the additional pre-construction survey undertaken in March 2019 was agreed (Brown & May Marine, 2019a). Details are provided within Table 4-2 below.

No sandeel monitoring was required or undertaken during the construction phase of the Development.

In line with Condition 34/35 of the Section 36 Consent (Table 4-1), post-construction monitoring will be carried out no earlier than 12 months following Final Commissioning of the Development, achieved on 1st April 2022. It was agreed through the MFRAG that post-construction sandeel surveys will be carried out between Feb-March 2024. Definitive programme and methods to be agreed prior to the survey.

Table 4-2: Post consent stakeholder consultation of reference to sandeel monitoring

Consultee	Scope of consultation / consultation response	Date	Moray East comments
MFRAG	**MFRAG meeting:** • Moray East's proposed approach for an additional pre-construction survey was highlighted at the MFRAG meeting. MFRAG was in agreement with the proposed approach.	22/02/2018	Survey completed in March 2019 (Brown & May Marine (2019a)

Consultee	Scope of consultation / consultation response	Date	Moray East comments
MFRAG	**MFRAG Meeting** • Moray East informed sandeel surveys will be carried out in Q1 2019. Sandeel survey will use a modified shellfish dredge and mini Hamon grab. Different sample analyses will be carried out for the dredge and the grab. Data analysis will include identifying sandeel and bycatch species and distributions, and sediment type and distribution. • It was clarified that survey areas for cod and sandeel were determined by Moray East's consent conditions, and the sampling station locations attempt to replicate the 2012/13 Moray East surveys.	29/11/2018	Survey completed in March 2019 (Brown & May Marine (2019a). Future surveys to follow similar approach.
MFRAG	**MFRAG Meeting** • Dates for undertaking the post-construction cod and sandeel surveys discussed during the call. Agreed to be Feb-Mar 2024, in line with the consent condition that determines it should not be earlier than 12 months following Final Commissioning of the Development.	27/04/2022	Proposed monitoring programme in line with the discussions during MFRAG-Gen Meeting.

4.3 Monitoring Objectives

The objectives of the sandeel monitoring are to:

- Characterise sandeel abundance and distribution within the agreed sandeel survey area;
- Provide a pre-construction baseline; and
- Provide post-construction data that can be compared against the pre-construction baseline, to increase the confidence in the impact assessment undertaken for the Development and identify whether further mitigations are required.

4.4 Survey Methodology

At the early stage of the Development, Moray East consulted with MSS on the approach to the pre-construction baseline sandeel survey undertaken in 2012 and the final methodology was agreed through consultation (see Moray East ES 2012 section 4.3.2). Additional consultation was undertaken in 2018, in support of additional pre-construction survey undertaken in March 2019.

During the March 2019 survey, in line with best practice and in agreement with MSS. A total of 29 stations were sampled, using a modified shellfish dredge (sandeel dredge) and mini-Hamon grab. The sandeel dredges were carried out during night hours when the majority of sandeels were expected to be buried in the sediment, and the grab samples were obtained during daylight hours. The sandeel survey tows and sediment grabs were undertaken separately which allowed greater flexibility for identifying suitable weather windows for the sediment grabs. This approach was approved by MS-LOT[7] and discussed in the

[7] As from April 2023, MS-LOT is operating under the name of MD-LOT.

MFRAG meetings. Results from the March 2019 sandeel survey were reported in the Moray East Sandeel Survey Report, issued in September 2019 (Brown & May Marine (2019a).

It is proposed that to remain comparable, any future sandeel surveys follow an approach similar to the 2012 and 2019 surveys. An overview of the survey methodology is provided below.

Sandeel surveys will be undertaken over the peak spawning period for the species. Sandeels spend most of the year buried in the seabed and only emerge into the water column briefly in winter for spawning and spring / early summer for feeding. Therefore, in line with the 2012 and 2019 surveys, post-construction monitoring will take place between January and March.

The number and location of stations within the area identified in the relevant Section 36 Consents as shown in Table 4-1 above will be developed in line with the previous surveys and in consultation with the MFRAG. Two survey techniques will be used in order to gather data: dredging and grabbing. As per the 2019 survey, dredging will be used as a means of recording the presence and relative abundance of sandeels, whilst grabbing will be undertaken as a means of obtaining site specific information on the distribution of sediment types across the survey area. A suitable vessel will be commissioned to carry out the survey.

The sampling procedure will follow the principles detailed within Moray East's 2019 pre-construction sandeel survey (BMM, 2019a). The catch from the dredge and grab sampling will be analysed and all relevant information recorded (sandeels and sediment information).

4.5 Survey Programme

As detailed in condition 35 (Stevenson Offshore Wind Farm) / condition 34 (MacColl Offshore Wind Farm) sandeel surveys are required during the pre- and post- construction phases of the Moray East Offshore Wind Farm only. Accordingly, no monitoring during construction has been undertaken.

An initial pre-construction baseline survey was undertaken in 2012 and a further pre-construction survey was undertaken in 2019, from the 13 to 21 March.

The post-construction survey will be completed in 2024 as determined in consultation with MFRAG. As per consent condition (Table 4-1), this will be no earlier than one year following the full commissioning of the Development, achieved on 1 April 2022.

4.6 Reporting

The 2019 pre-construction survey report (BMM, 2019a) was submitted to MS-LOT on 20 September 2019 and subsequently approved on 31 October 2019.

Further survey reports will be shared with MFRAG and submitted to the Scottish Ministers for approval at timescales determined through the MFRAG.

5 Cod

5.1 Monitoring Requirements

The consent conditions relevant to cod monitoring are summarised in Table 5-1 below.

Table 5-1: Cod Monitoring Conditions

Condition	Monitoring requirement
PEMP S36: Condition 26 a	The PEMP must cover pre-construction, construction (if deemed appropriate by the Scottish Ministers) and post-construction monitoring surveys for cod.
Cod Surveys S36: Condition 34 (Telford Offshore Wind Farm) and Condition 33 (for MacColl Offshore Wind Farm)[8]	The cod surveys undertaken on 17-26th February 2013 and 10-19th March 2013 in the Moray Firth by Moray East will remain valid as a pre-construction baseline survey provided the Commencement of the Development occurs no later than 1st April 2018. If Commencement of the Development is later than 1st April 2018, a further baseline cod survey will need to be undertaken during the months of February and March immediately prior to the Commencement of the Development in the area marked 'Cod Survey Area' A post-construction cod survey will need to be undertaken no earlier than 12 months following the Final Commissioning of the Development covering the area marked 'Cod Survey Area'.

The 'cod survey area' as per consent condition is shown in Figure 5-1 below.

The 'cod surveys' condition states that the results of the pre-construction survey remain valid providing commencement of the development is no later than 1 April 2018. As the construction started in May 2019, Moray East has undertaken an additional pre-construction survey, carried out in March 2019.

[8] Cod surveys condition is only relevant to Telford and MacColl Offshore Wind Farms. No equivalent condition exists for the Stevenson Offshore Wind Farm.

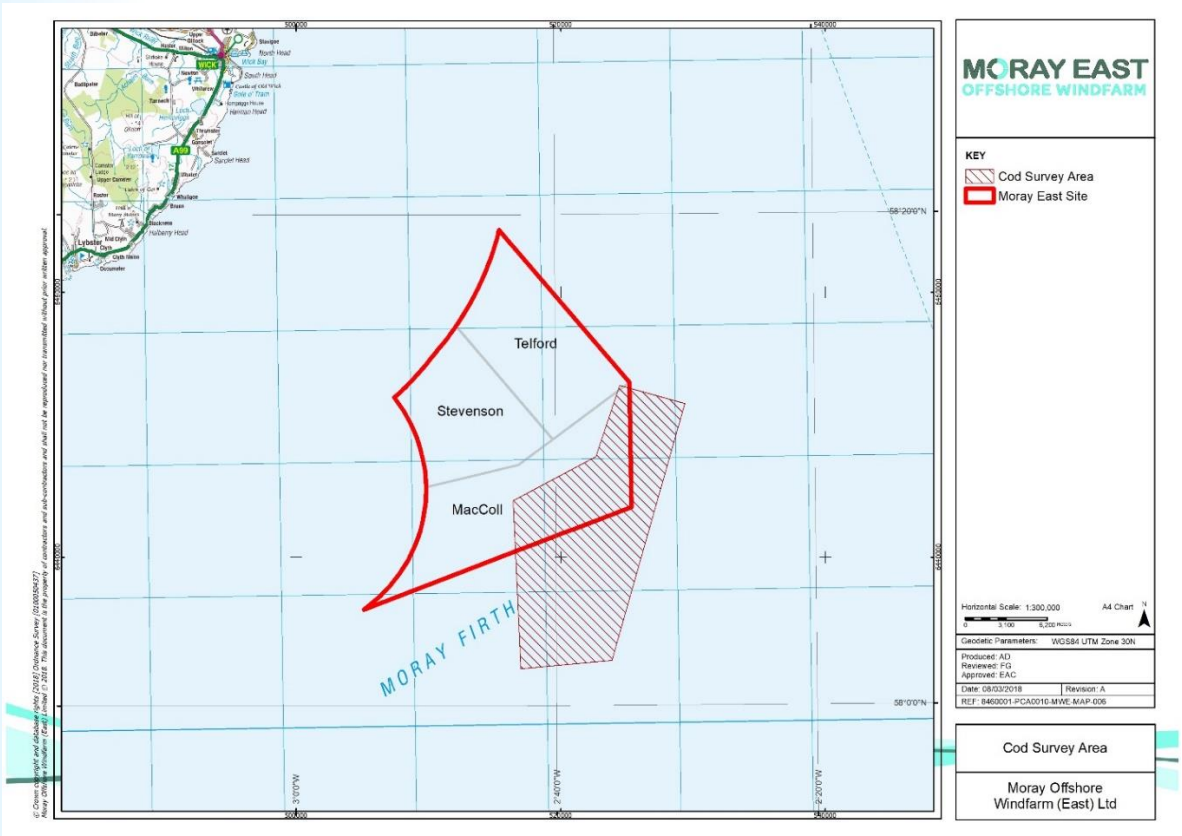

Figure 5-1: Cod survey area

5.2 Monitoring Approach

Moray East fully consulted MSS on the approach to the pre-construction baseline cod survey undertaken in 2013 (Brown & May Marine, 2013). Similar methodology was applied in a second pre-construction survey undertaken in February to March 2019 (Brown & May Marine, 2019b). A summary of the consultation is provided in Table 5-2 below.

Table 5-2: Stakeholder consultation of reference to cod monitoring

Consultee	Scope of consultation / consultation response	Date	Moray East comments	
MSS	**MSS feedback on Moray East pre-construction survey results:** • Gareth Jones (MSS) confirmed that the results, as expected by MSS, show a small, localised accumulation of spawning cod centred in the deeper waters of the Moray Firth. • Peter Wright (MSS) stated that tow location 8 (6 km to the south of the Moray Offshore Zone) is the only location that can be classed as a recognised cod spawning area. Peter Wright also stated that as tows undertaken within the vicinity of location 8 do not show	23/04/2013	Moray East agrees the survey results show no significant spawning areas within the vicinity of the Moray Offshore Zone. No further mitigation measures required.	

Consultee	Scope of consultation / consultation response	Date	Moray East comments	
	significant levels of spawning the spawning area appears to be small. Therefore, it appears the area of spawning identified is not significant.			
MSS	**MSS feedback on Moray East pre-construction survey results:** • Gareth Jones (MSS) advised that no mitigation for cod would be required based on the results of the cod survey undertaken in March 2013. Any further cod survey will be undertaken post-construction as the survey in 2013 is Moray East's pre-construction survey.	09/05/2013	Moray East agrees that the survey results identify low number of spawning cod within the Moray East site and that there is no requirement for mitigation.	
MFRAG	**MFRAG meeting:** • Moray East's proposed approach for an additional pre-construction survey was highlighted at the MFRAG meeting. MFRAG was in agreement with the proposed approach.	22/02/2018	The approach for cod monitoring presented at the MFRAG meeting is in line with the Cod survey completed in 2019 (Brown & May Marine, 2019b).	
MFRAG	**MFRAG meeting** • Moray East informed the MFRAG that Cod surveys will be carried out in Q1 2019. An otter trawl with a 20mm blinder at 8 sampling locations was intended to be used. However, Moray East proposed to use a 40 mm blinder to reduce catch rates, if accepted by MS-LOT, SNH and MSS. Sample analysis will include the identification of cod (length, sex and spawning condition) and by-catch. • It was clarified that survey areas for cod and sandeel were determined by Moray East's consent conditions, and the sampling station locations attempt to replicate the 2012/13 Moray East surveys.	29/11/2018	Cod survey completed in 2019 (Brown & May Marine, 2019b). Future surveys to follow similar approach.	
MFRAG	**MFRAG Meeting** • Dates for undertaking the post-construction cod and sandeel surveys discussed during the call. Agreed to be Feb-Mar 2024, in line with the licence condition that determines it should not be earlier than 12 months following	27/04/2022	Proposed monitoring programme in line with the discussions during MFRAG-Gen Meeting.	

Consultee	Scope of consultation / consultation response	Date	Moray East comments	
	final commissioning of the Development.			

5.3 Monitoring Objectives

The objectives of the cod monitoring are to:

- Characterise cod spawning occurring within the cod survey area; and
- Provide post-construction data that can be compared against pre-construction baseline, to increase the confidence in the impact assessment undertaken for the development and identify whether further mitigations are required.

5.4 Survey Methodology

As discussed above, the approach to the pre-construction baseline cod survey undertaken in 2013 has been consulted and agreed with MSS and MFRAG. Similar methodology was used for the additional pre-construction survey undertaken in 2019 (Brown & May Marine, 2019b) and is proposed for the post-construction survey within the area shown on Figure 5-1 above.

The additional pre-construction cod survey was conducted in two trips, carried out between 25 February and 26 March 2019, the period coinciding with the peak cod spawning season. Eight stations were sampled during each trip. Sampling of each station was undertaken using a commercial rock-hopper otter trawl with a 120 mm mesh cod-end, fitted with a 40 mm blinder (provided by the Marine Fishing Vessel (MFV) "Seagull"). The catch from each otter trawl was emptied into the hopper, sorted into baskets by species and photographed. The length, sex and spawning condition of each cod was identified and recorded, and their gonads photographed. Cod catch rates were calculated using the Scanmar outputs (swept area per tow). Each tow was approximately 30 minutes in duration. MSS guidance (derived from Wright et al., 2006) definition of spawning areas based on Catch Per Unit Effort (CPUE) was used to determine whether significant cod spawning occurred at any of the stations surveyed. (Brown & May Marine, 2019b).

The sampling procedure for post-construction surveys will follow the same approach used during the pre-construction surveys detailed above.

In line with Moray East's 2019 cod spawning survey, two sampling trips will be undertaken, the first trip will be mobilised in mid-February and the second will be mobilised in mid-March. The number and location of stations will be developed in consultation with MFRAG. The catch from the otter trawl will be analysed and all relevant information recorded (length, sex and spawning condition).

The gonadal maturity key will be used as provided by MSS (Bucholtz *et al*. – Draft Manual to determine gonadal maturity of North Sea cod (*Gadus morhua L*)).

5.5 Survey Programme

As detailed in condition 34 (Stevenson Offshore Wind Farm) and condition 33 (MacColl Offshore Wind Farm) cod spawning surveys are required during the pre- and post- construction phase of the Moray East Offshore Wind Farm only. Accordingly, no monitoring during construction is proposed.

An initial pre-construction baseline survey was undertaken in 2013 (Brown & May Marine, 2013). A further pre-construction cod survey was undertaken in 2019, alongside the sandeel survey (Brown & May Marine, 2019b).

The post-construction survey will be completed in 2024, as agreed with MFRAG.As per consent condition (Table 5-1), this will be no earlier than one year following the full commissioning of the Development, achieved on 1 April 2022.

5.6 Reporting

The approved 2013 (Brown & May Marine, 2013) pre-construction cod spawning survey report was shared with relevant stakeholders at the time of survey completion. The 2019 pre-construction survey report (Brown & May Marine, 2019b) was submitted to MS-LOT on 20 September 2019 and subsequently approved on 31 October 2019.

Further survey reports will be shared with MFRAG and submitted to the Scottish Ministers for approval at timescales determined through MFRAG.

6 Herring

6.1 Monitoring Requirements

The consent conditions relevant to herring monitoring are summarised in Table 6-1 below.

Table 6-1: Herring Monitoring Conditions

Condition	Monitoring requirement
PEMP S36: Condition 26 a.	The PEMP must cover pre-construction, construction (if deemed appropriate by the Scottish Ministers) and post-construction monitoring surveys for herring.
Herring Surveys S36: Condition 33 (Stevenson Offshore Wind Farm and Telford Offshore Wind Farm)[9]	Herring surveys must be undertaken every year during the months of August and September in the event that pile foundations are to be used unless otherwise agreed in writing by the Scottish Ministers. The results of the herring surveys will be used to better inform mitigation options to minimise noise impacts from piling activity on all life stages of herring and to inform the Company's PS (if a PS is required).

Although the herring surveys condition states that surveys would be required annually from consent until start of construction, it was agreed with MS-LOT that a survey would only be required in 2018, the year immediately prior to construction (MS-LOT letters (Ref. 011/OW/MORLE-8) from 30/05/2014; 24/07/2015; 15/07/2016 and 10/05/2017).

6.2 Monitoring Approach

Moray East's approach to the 2018 pre-construction herring survey was agreed during 2017 following a meeting with MSS and MS-LOT to discuss the proposed approach for herring monitoring.

A summary of the consultation is provided in Table 6-2 below.

Table 6-2: Stakeholder consultation of reference to herring monitoring

Consultee	Scope of consultation / consultation response	Date	Moray East comments
MSS	**MSS feedback on Moray East pre-construction survey methodology:** • MSS queried about the proposed survey sampling design highlighting that it did not match the International Herring Larvae Surveys (IHLS). Moray East confirmed that the proposed design was designed in line with the agreed design for the adjacent BOWL project to allow for comparability. • MSS agreed with the proposed design and that further information on fish larvae could be obtained from the Scottish Pelagic Fisheries Association (SPFA).	29/11/2016	Proposed approach for herring surveys in line with the agreed with MSS. Survey completed in 2018 (Brown & May Marine, 2019c)
MS-LOT	**MS-LOT feedback on Moray East's proposed herring monitoring:**	10/05/2017	Proposed approach for herring surveys in line

[9] Herring surveys condition is only relevant to Stevenson and Telford Offshore Wind Farms. No equivalent condition exists for the MacColl Offshore Wind Farm.

Consultee	Scope of consultation / consultation response	Date	Moray East comments
	• MS-LOT confirmed agreement on the proposal		with the agreed with MSS and MS-LOT.
MFRAG	**MFRAG meeting:** • Moray East's proposed survey approach was presented at the meeting. There was a general agreement from the group on the proposed approach however it was highlighted that Moray East should discuss with BOWL the detailed sampling design, particularly where proposed sampling locations are within BOWL's construction safety zone.	22/02/2018	The approach for herring monitoring presented at the MFRAG meeting is in line with the described in this PEMP report. As agreed, the survey sampling locations were discussed with BOWL prior to survey. [10]

6.3 Monitoring Objectives

The objectives of the pre-construction monitoring were to:

- Characterise herring spawning occurring within the zone of potential underwater noise impact from piling; and
- To contribute to a better understanding of the spawning behaviour of the Orkney / Shetland herring stock in order to inform mitigation options to minimise impacts from piling, should it be required.

6.4 Survey Methodology

As mentioned above, Moray East's approach to the pre-construction herring survey was agreed with MS-LOT and through consultation with relevant stakeholders in 2017. The survey approach is described within the "Proposal & Scope of Works: Herring Larval Monitoring" (Brown & May Marine, 2016) also available online within the Marine Scotland Website[11].

The sampling locations are comparable with sampling locations from the 2014 and 2015 herring larval surveys undertaken by BOWL. A total of 20 stations (see Figure 6-1) were sampled every week for eight weeks during the period from 6 August 2018 to 28September 2018, using a Gulf VII high speed plankton sampler (Brown & May Marine, 2019c).

The findings support the premise that larvae found during the survey were transported to the survey area from the main spawning grounds located further north, to the east of Orkney and Shetland Isles. These results are in line with the findings of the BOWL herring larval surveys undertaken in 2014 and 2015 and the IHLS surveys.

No further surveys are anticipated for the post-construction phase of the development.

[10] Alternative sampling station locations were agreed with MS-LOT and MSS in July 2018 for stations HL 15 and HL 18.

[11] MORL_HLM_Proposal_Final (marine.gov.scot)

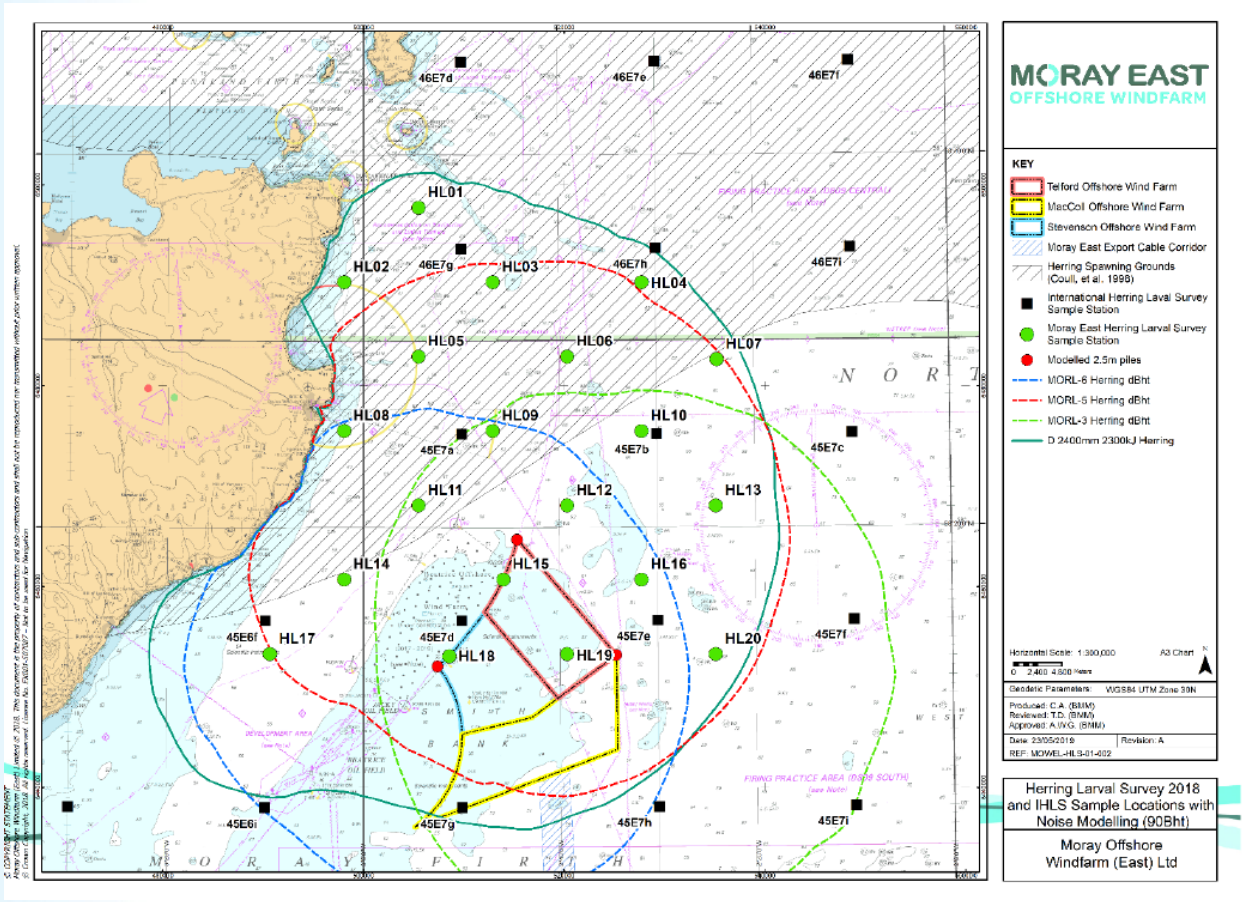

Figure 6-1: Sampling locations for Moray East herring larval survey (BMM, 2019c)

6.5 Survey Programme

Condition 33 (Stevenson Offshore Wind Farm and Telford Offshore Wind Farms) required herring surveys to be undertaken during the pre-construction phase of the Moray East Offshore Wind Farm. No monitoring was undertaken during construction, and no further monitoring post construction is required.

6.6 Reporting

A desk-based report on herring spawning and larval abundance within the vicinity of the Moray East site has been submitted to MS-LOT (Brown & May Marine, 2018), in line with agreed herring monitoring approach with MS-LOT (see Table 6-2 above). The findings of the 2018 survey were reported in May 2019 (Brown & May Marine, 2019c). A follow-up report on Herring Spawning and Piling Noise Review with recommendations regarding the piling restriction detailed was submitted by Moray East to MS-LOT on 27 June 2019 (Brown & May Marine, 2019d) and approved on 12 September 2019 (8460001-PCA0010-MRS-LET-028).

7 Diadromous Fish

7.1 Monitoring Requirements

The consent conditions relevant to diadromous fish monitoring are summarised in Table 7-1 below.

Table 7-1: Diadromous Fish Monitoring Conditions

Condition	Monitoring requirement
PEMP S36: Condition 26 a	The PEMP must cover pre-construction, construction (if deemed appropriate by the Scottish Ministers) and post-construction monitoring surveys for diadromous fish.
S 36: Condition 30	Participation in Scottish Atlantic Salmon, Sea Trout and European Eel Monitoring Strategy

7.2 Monitoring Approach

Moray East's approach for the diadromous fish monitoring has evolved since consents were awarded due to uncertainties on project timescales. An initial monitoring proposal was approved in 2015 by MS-LOT following discussions with MSS and MFRAG (see relevant minutes of meeting within Marine Scotland Website[12]). However, due to project delays there was a need to revisit the scope of the proposed monitoring. Following earlier consultation with MFRAG and Marine Scotland, it was agreed that the conditions related to diadromous fish monitoring would be satisfied through a contribution towards the Moray Firth Tracking Project, now referred to as the 'Missing Salmon Project'. This project was coordinated by the Atlantic Salmon Trust (AST) and the Centre for Ecology & the Natural Environment (SCENE) at the University of Glasgow.

The project scope, including aims and objectives, and its progress were discussed with MFRAG. A summary of the discussions is provided in Table 7-2 below.

Table 7-2: Stakeholder consultation of reference to diadromous fish monitoring

Consultee	Scope of consultation / consultation response	Date	Moray East comments
MFRAG	**MFRAG meeting:** • Moray East's proposed approach for diadromous fish monitoring was described at the meeting, highlighting its strategic value but also noting potential constraints. • There was a general agreement on the proposed approach and support for the large-scale project as having potential for a genuinely robust scientific study to increase knowledge of salmon and sea trout behaviour in the marine environment. There was also a need to develop a suitable smaller scale study in case the large-scale proposal could not be implemented. It was noted that results of the study and other relevant studies would be collated by the SpORRAn[13] diadromous fish subgroup, chaired by Ross Gardiner from MSS.	22/02/2018	Moray East contributed with the Moray Firth Tracking Project in 2019 (see Section 7.4.1).

[12] Moray Firth Regional Advisory Group (MFRAG) | Marine Scotland Information

[13] SpORRAn has been later replaced by ScotMER

Consultee	Scope of consultation / consultation response	Date	Moray East comments
MFRAG	**MFRAG meeting:** • The AST smolt tracking work was presented to MFRAG. This built on the work undertaken along with the BOWL study, which tracked smolts to 30 km from shore. The current AST study which Moray East is co-funding will tag smolts in seven different rivers and monitor out to 70 km from shore in the Moray Firth. The project will be tagging up to 850 fish. Predator tags are being trialled; these change signal when the smolt is being digested. • It was highlighted that Fisheries Management Scotland (FMS) have been working closely with AST on this proposal.	29/11/2018	Details on the Moray Firth Tracking Project undertaken in 2019 are presented (see Section 7.4.1)
MFRAG	**MFRAG meeting:** • Results on the Moray Firth Tracking Project (referred to as the 'Missing Salmon Project' presented and discussed.	20/11/2019	Details on the Moray Firth Tracking Project undertaken in 2019 are presented (see Section 7.4.1)

7.3 Monitoring Objectives

The primary objective of the proposed monitoring programme was to increase knowledge of the behaviour of Atlantic salmon and sea trout in the Moray Firth to contribute to the National Strategy for Monitoring of Diadromous Fish.

Questions explored as part of the Moray Firth Tracking Project, and which are relevant to Moray East included:

- What migration routes were used by migrating smolts once they leave the river?
- What cues do smolts use to determine this migration pathway?

In addition, pre- and post-construction cable burial monitoring, outlined in the following sections, will allow Moray East to monitor burial levels and ensure that Electromagnetic Fields (EMF) impacts on diadromous fish remain as assessed within the Moray East ES (2012).

7.4 Survey Methodology

7.4.1 Moray Firth Tracking Project (Completed)

The Moray Firth Tracking Project consisted of a partnership, led by the AST in collaboration with Glasgow University, the six District Salmon Fishery Boards (DSFBs) / Fishery Trusts in the Moray Firth and Marine Scotland, and co-funded by Moray East for surveys undertaken in 2019.

The monitoring project was developed to contribute towards the understanding of salmon movements within the Moray Firth, and fill gaps initially identified through the Missing Salmon Project launched in April 2018. As part of this project, the Likely Suspects Framework has highlighted that there is a lack of information on how salmon smolts migrate down river and out to sea. The Moray Firth Tracking Project aimed to fill these gaps in knowledge (AST, 2018).

The fieldwork for the Moray Firth Tracking Project was undertaken in spring 2019. A total of 358 receivers were placed in seven rivers (Deveron, Spey, Findhorn, Ness, Conon, Oykel, and Shin) and in three lines across the inner and outer Moray Firth (see Figure 7-1 below).

A total of 850 smolts were tagged with acoustic transmitters. The progress of these smolts were tracked as they crossed the three fixed position acoustic receiver arrays in the inner Moray Firth, the outer Moray Firth and the Dornoch Firth (see Figure 7-1 below). Analysis of results indicated higher than expected losses of smolts before they reach the sea and fewer losses out at sea. These results supported the next phases of the Missing Salmon Project.

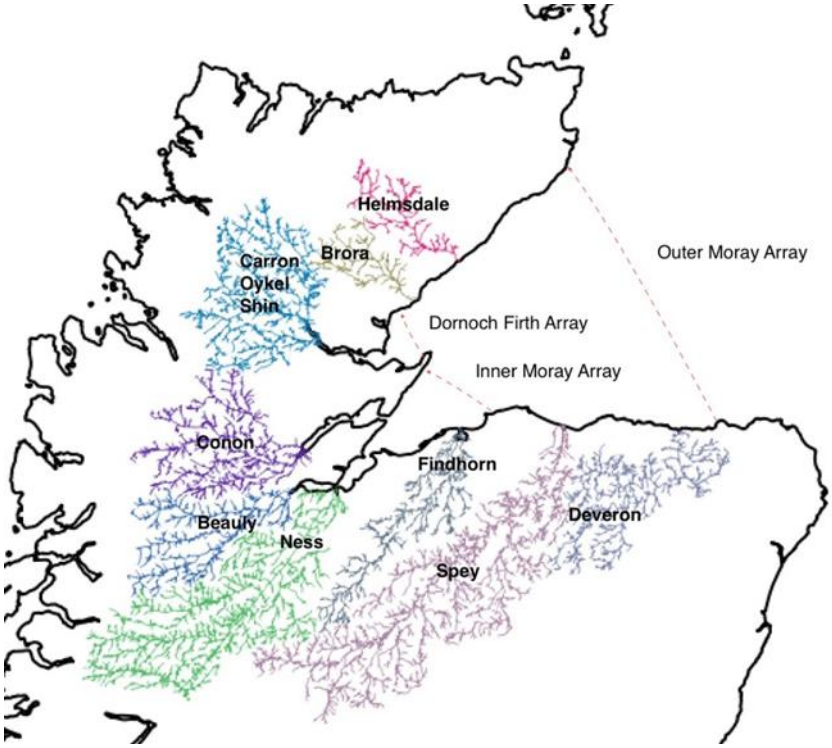

Figure 7-1: Array locations identified by red dotted line in relation to salmon rivers which feed into the Moray Firth (NB not all rivers shown) [modified from Moray Firth Project proposal, 2018 (AST, 2018)]

7.4.2 Other Pre- and Post-Construction Monitoring (EMF)

The Moray East ES (2012) and Moray East Modified TI ES (2014) assessed EMF strengths from the inter-array and OSP interconnector cables. It was concluded that burial or protection of the cables will reduce exposure of diadromous fish to the strongest EMFs and that impacts would be minor.

Pre-construction desk-based assessment of predicted attenuation of EMF strength and shielding was undertaken to ensure that impacts on diadromous fish remain as assessed within the Moray East ES (2012) and Moray East Modified TI ES (2014). This was presented in the Wind Farm Cable Plan (WF CaP), approved by MS-LOT in April 2019.

Post-construction cable burial monitoring will be undertaken to ensure that the burial depths and/or cable protection remains as detailed in the Wind Farm CaP. Section 2 above details the post-construction monitoring of the burial depths of the inter-array and OSP inter-connector cables.

7.5 Survey Programme

Diadromous fish monitoring through the Moray Firth Tracking Project (Missing Salmon Project) was completed in 2019 (AST, 2020), no further diadromous fish monitoring will be undertaken.

Cable burial post-construction monitoring will be undertaken as part of the asset integrity surveys, to ensure that cables remain buried / protected. The monitoring survey programme for cable burial is detailed in section 2 above.

7.6 Reporting

Moray Firth Tracking Project (Missing Salmon Project) reports with the findings for each of the seven rivers Deveron, Spey, Findhorn, Ness, Conon, Oykel and Shin) were submitted to MS-LOT on 31 March 2020 (AST, 2020), and approved on 5 May 2020.

Post-construction cable burial monitoring will be provided as described in Section 2.

8 Birds

8.1 Monitoring Requirements

The consent conditions relevant to ornithology monitoring are summarised in Table 8-1 below.

Table 8-1: Ornithology Monitoring Conditions

Condition	Monitoring requirement
PEMP S36: Condition 26 a	The PEMP must cover pre-construction, construction (if deemed appropriate by the Scottish Ministers) and post-construction monitoring surveys for birds.
PEMP S36: Condition 26 c	The participation by the Company in surveys to be carried out in relation to regional and strategic bird monitoring.

8.2 Monitoring Approach

Moray East approach to post-consent bird monitoring is subject to consultations with stakeholders at the Moray Firth Regional Advisory Group Ornithology Subgroup (MFRAG-O). MFRAG-O meeting minutes and documents for discussion are publicly available within the Marine Scotland Website[14].

A summary of the key agreements from MFRAG-O meetings are summarised in Table 8-2 below. It should be noted that this is an ongoing process and further consultation with stakeholders will be made available through the Marine Scotland website as detailed above.

Table 8-2: Stakeholder consultation of reference to ornithology monitoring

Consultee	Scope of consultation / consultation response	Date	Moray East comments
MFRAG-O	**MFRAG-O meeting:** • It was agreed that monitoring of puffin colonies would be better undertaken in the Forth and Tay, but that plot counts in Caithness may have some merit.	14/11/2014	Proposed monitoring details are included within section 8.3 and 8.4 below.

[14] Moray Firth Regional Advisory Group (MFRAG) | Marine Scotland Information

Consultee	Scope of consultation / consultation response	Date	Moray East comments
MFRAG-O	**MFRAG-O meeting:** • It was agreed that there was a need to separate strategic monitoring aims from individual wind farm aims and that displacement was not an aim for strategic monitoring. • Gulls were a high priority for monitoring and should have greater focus than auks which are lower priority. • The purpose of gull tagging was agreed to be primarily establishing connectivity between the East Caithness Cliffs Special Protected Area (ECC SPA) population and wind farms, and therefore potential for any population level effects. • Changes to question 1.08 (are 60% of birds displaced from the wind farm?) agreed to remove 60% displacement rate from the question, with focus on change attributable to the wind farm. • It was agreed that colony counts would be a challenge and that local ornithologists should be approached for data. • Moray East and BOWL to develop monitoring and data collection methods for next meeting.	16/12/2014	Recommended monitoring principles taken into account within proposed monitoring as detailed within section 8.3 and 8.4 below.
MFRAG-O	**MFRAG-O meeting:** • Discussion of gull colony counts resulted in agreement that colony counts would not be needed during the 2015 breeding season. • It was agreed by MFRAG-O that the best method for establishing survival rates and productivity of large gulls was to work with the local bird ringer. • General agreement that puffin productivity is better monitored in the Forth and Tay area • Agreement that displacement is the key concern for puffin in the Moray Firth and should be the primary monitoring target. • It was agreed that aerial survey would be more appropriate both to assess puffin displacement and gull distribution/ inferred connectivity.	02/03/2015	Recommended monitoring principles taken into account within proposed monitoring as detailed within section 8.3 and 8.4 below.
MFRAG-O	**MFRAG-O meeting:** • It was agreed that monitoring would be developed on the basis of 1 year of pre-construction data collection but should outline how existing data could be used to strengthen analysis. • Breeding bird survey programmes should focus on May, June and July.	30/03/2015	Recommended monitoring principles taken into account within proposed monitoring as detailed within section 8.3 and 8.4 below.

Consultee	Scope of consultation / consultation response	Date	Moray East comments
MFRAG-O	**MFRAG-O meeting:** • Agreement to contact local bird ringer in relation to his long-term gull study as data could be used to inform the monitoring programme. • It was agreed that no further gull tagging would be needed prior to turbine construction.	03/07/2015	Recommended monitoring principles taken into account within proposed monitoring as detailed within section 8.3 and 8.4 below.
MFRAG-O	**MFRAG-O meeting:** • There was a general agreement at MFRAG that it is not possible to define a representative year, and this could only be undertaken after surveys were completed, thus leading to the potential requirement for open ended surveying. • It was agreed by the group that it would be impossible to take representativeness into consideration when designing and undertaking a survey programme.	12/11/2015	Recommended monitoring principles taken into account within proposed monitoring as detailed within section 8.3 and 8.4 below.
MFRAG-O	**MFRAG meeting:** • There was a general agreement with Moray East's approach to undertake a further Power Analysis using the most recent MRSea package to inform the most appropriate pre-construction survey design. • Results of the Power Analysis to be discussed at the next meeting.	21/02/2018	Pre-construction digital aerial surveys were completed in 2018 (Moray East, 2018), in line with MFRAG-O discussions
MFRAG-O	**MFRAG meeting:** • Discussion over the outputs of Moray East's revised power analysis. • MFRAG-O approval of Moray East's proposed aerial survey methodology (see section 8.4 below for details).	01/05/2018	Pre-construction digital aerial surveys were completed in 2018 (Moray East, 2018), in line with approved survey methodology.
MFRAG-O	**MFRAG-O meeting** • Discussions for post construction aerial surveys ongoing, including consideration of how many years of post-construction surveys would be needed. • Opportunities to carry on combined aerial surveys for Moray East and BOWL to be considered. • Discussions on gull tagging and puffin monitoring ongoing. Methods for puffin monitoring were discussed. It was pointed out that initial puffin work could be undertaken through analysis of aerial survey data to look at flight directions, possible displacement, and rafting on the water.	05/06/2019	Discussions on post-construction monitoring ongoing. Approach covered in Section 8.4.1 and 8.4.2.4.

Consultee	Scope of consultation / consultation response	Date	Moray East comments
MFRAG-O	**MFRAG-O meeting** • Avanade presentation on image detection Artificial Intelligence application developed specifically to detect puffins.	09/07/2020	Discussions on post-construction monitoring ongoing.
MFRAG-O	**MFRAG-O meeting** • Constraints encountered during gull tagging surveys were discussed. It was concluded that tagging works should be paused. • Great Black-Backed Gull (GBBG) tagging in the Moray Firth to be postponed until there is better evidence of improved tag attachment techniques and tag effects on birds, including results obtained during British Trust for Ornithology surveys in the Isle of May. • Noted that Moray East first post construction aerial survey is planned for 2022.	01/10/2021	Approach to digital aerial survey covered in Section 8.4.1.
MFRAG-O	**MFRAG-O meeting** • Moray Firth cluster GBBG monitoring (MacArthur Green, 2021), and Moray Firth cluster aerial survey (MacArthur Green, 2022a) proposals prepared by McArthur Green were presented and discussed during the call. • BOWL presented scope of work undertaken in the Isle of May using cameras and artificial intelligence technology. Post-meeting updates confirmed planning permission was granted by the Highland Council, with a condition that camera installation should not take place within the bird nesting season. Installation will therefore be planned for September 2022.	19/01/2022	Approach covered in Section 8.4.1 and 8.4.2.4.
MFRAG-O	**MFRAG-O meeting** • BOWL informed installation of cameras for observing puffins will be installed soon, to run continually during winter. • Results of the 20222 GBBG observation campaign presented and discussed in the call (MacArthur Green, 2022b), consideration for future observation monitoring to be discussed in the next meeting. • Noted that there are no expectations for GBBG tagging given bird flu epidemic.	08/11/2022	

Consultee	Scope of consultation / consultation response	Date	Moray East comments
MFRAG-O	**MFRAG-O meeting** • A note on the Joint Aerial Surveys Post construction was shared in advance of this call on 2nd March 2023 (MacArthur Green, 2023a). The note compiles aerial digital surveys future level of commitments across the three projects and discuss two different approaches going forward: combined or separate surveys. The joint approach would be for a larger area but fewer years, while the separate approach would be smaller/individual WF areas over a longer number of years. • Following discussions on the comparison of both Digital Aerial Survey approaches, the note will be updated for consideration of the analysis and outputs that we would receive from both of these and compatibility issues (transects adjustments, data from different providers). This is to be presented at the next MFRAG-O call. • A separate note was prepared by MacArthur Green on the connectivity between the Moray Firth offshore wind farms and breeding GBBG colonies (MacArthur Green, 2023b). Evidence collected to date suggests connectivity between ECC SPA and wind farms in the Moray Firth during the breeding season is at a very low level. Following discussion, it was agreed that there is little value in undertaking further monitoring studies on GBBG at the ECC SPA. • It was noted that the outstanding questions remain related to where the GBBG observed in the wind farms come from (observed during digital aerial surveys), if not from the ECC SPA. Future works on GBBG should be considered under a strategic monitoring point of view (for example, through ScotMer). This is to be reviewed regularly through MFRAG-O, as new evidence and technologies become available (relative to capturing birds at sea, and tagging, etc.). • Following up to previous questions raised on the past MFRAG-O call, the group agreed there is no requirement to undertake GBBG observation fieldwork at the ECC SPA in 2023. • BOWL informed puffin monitoring cameras are in place, and will be operational shortly.	08/03/23	Approach covered in Section 8.4.1 and 8.4.2.3.

8.3 Monitoring Objectives

MFRAG-O agreed from the outset that for post-construction monitoring to produce valuable empirical data on the effects of the wind farms on birds, it is important to take a questions-led approach. The

process of undertaking a questions-led approach to monitoring started with identification of the species that need to be monitored. This was informed by the species that were identified as key in the consenting process for the Moray East and BOWL offshore wind farms. Since the key species were of different levels of importance in the consenting process, it was important that this was reflected in the monitoring programme.

Three levels of species importance were identified: primary, secondary and tertiary. Primary species were those that 'were constraints on the design envelope' of the consented projects. Secondary species were not constraints but were a key focus in agreeing consents. Tertiary species were identified as those where the predicted impacts were less important, but where further information would be valuable, if it could be obtained through the monitoring methods applied to the other species. The key species and breeding colonies for monitoring are summarised in Table 8-3 below.

Table 8-3: Key species, breeding colonies and key wind farm impacts to be monitored

Importance level	Common Name	Scientific Name	Key Colonies	Wind Farm Effect	Population Impact
Primary	Great black-backed gull	*Larus marinus*	East Caithness cliffs SPA	Collision mortality	Adult survival
	Atlantic puffin	*Fratercula arctica*	East Caithness cliffs SPA	Displacement effects	Adult productivity
			North Caithness cliffs SPA		
Secondary	Herring gull	*Larus argentatus*	East Caithness cliffs SPA	Collision mortality	Adult survival
	Common guillemot	*Uria aalge*	East Caithness cliffs SPA	Displacement effects	Adult productivity
	Razorbill	*Alca torda*	East Caithness cliffs SPA	Displacement effects	Adult productivity
Tertiary	Black-legged kittiwake	*Rissa tridactyla*	East Caithness cliffs SPA	Collision mortality	Adult survival
				Displacement effects	Adult productivity
	Northern gannet	*Morrus bassanus*	Gamrie and Pennan Coast SSSI	Collision mortality	Adult survival
				Displacement effects	Adult productivity

The key monitoring questions were agreed through discussions within the MFRAG-O. Table 8-4 and Table 8-5 below provide the key questions related to the effects of the wind farm on birds at sea and the key questions related to impacts of the wind farm on birds at colonies.

Table 8-4: Key questions related to the effects of the wind farm on birds at sea.

Question number	Question text
Q.1.00	**Are great black-backed gull & herring gull populations impacted by the Moray Firth wind farms due to collision mortality?**
	EFFECTS

Question number	Question text
	Great black-backed gull and herring gull avoidance behaviour
Q.1.1.1	Is the macro avoidance rate the same as that estimated by the British Trust for Ornithology (BTO) Avoidance Rate report?
Q.1.1.2	Do macro-avoidance rates vary with turbine density (only testable if the constructed wind farms vary in this respect)?
Q.1.1.3	Is the meso-avoidance rate the same as that estimated by the BTO Avoidance Rate report (Cook *et al.,* 2014)?
Q.1.1.4	Is the within windfarm avoidance rate the same as that estimated by the BTO Avoidance Rate report?
Q.1.1.5	Is the total avoidance rate the same as that estimated by the BTO Avoidance Rate report?
	Great black-backed gull and herring gull flight heights
Q.1.2.1	Do flight height distributions differ from those produced by Johnston *et al*. (2014)?
Q.1.2.2	Do flight height distributions differ between weather conditions, distance from shore, season, sex?
Q.1.2.3	Do flight height distributions differ between birds inside or outside wind farms?
Q.1.2.4	Does the influence of wind farms on flight height distributions extend beyond the wind farm boundaries?
Q.1.2.5	Do the flight height distributions differ between pre and post wind farm construction?
Q.1.2.6	Do flight height distributions change over time as birds habituate to the presence of wind turbines?
Q.2.0	**Displacement of puffin, guillemot or razorbill from the wind farms**
	EFFECTS
Q.2.1.1	Can a significant change in density of puffin (and guillemot and razorbill) in the wind farms be identified?
Q.2.1.2	Can a significant change in density of puffin (and guillemot and razorbill) be attributed to the wind farms?
Q.2.1.3	Can a significant relationship between density and distance from individual wind turbines be identified?
Q.2.1.4	Is there a significant apparent difference in foraging behaviour inside/ outside the wind farms?
Q.2.1.5	Does puffin density change significantly with increasing wind turbine spacing/ density?
Q.2.1.6	Do puffin densities vary significantly between seasons within the wind farms more than out with the wind farms? – No longer applicable since aerial surveys were agreed to be undertaken during breeding season only (May, June, July).
Q.2.1.7	Do the densities of puffin within the wind farms increase significantly over time e.g., due to habituation?

Table 8-5: Key questions related to the impacts of the wind farms on birds at colonies.

Question number	Question text
Q.3.00	**Are great black-backed gull & herring gull populations impacted by the Moray Firth WFs due to collision mortality?**
	IMPACTS
Q.3.1	Great black-backed gull and herring gull population impacts
Q.3.1.1	Great black-backed gull and herring gull population connectivity
Q.3.1.2	Does the great black-backed gull and herring gull population change pre, during and post construction? (Assuming connectivity)
Q.3.1.3	Does adult survival or productivity change in great black-backed gull or herring gull?

Question number	Question text
	Are puffin (and guillemot and razorbill) populations impacted by the Moray Firth WFs due to displacement effects?
	IMPACTS
Q.4.0	Do the puffin, guillemot or razorbill populations with connectivity to the wind farms change?

8.4 Survey Methodology

A summary of the completed and agreed future survey methodologies are presented in Table 8-6 below.

It should be noted that the scope of future monitoring may be amended following discussions and agreement within the MFRAG-O.

Data on secondary and tertiary species, defined in Table 8-3, will be collected mainly through pre- and post-construction aerial surveys.

Table 8-6: Key species, breeding colonies and key wind farm effects monitoring

Project Phase	Survey	Description, timing and duration	Data acquired	Reason
Pre-construction – completed in 2014	Herring Gull and GBBG tagging	Incubation and early chick-rearing: May – July 2014 Tagging of Herring Gulls and GBBG in the ECC SPA. Data collection on acceleration, foraging areas, flight direction and distance. See Section 8.4.2.1 for more details.	• GPS and accelerometer data • Foraging areas • Flight distance and direction	• Interaction between sea birds in the ECC SPA and Marine Renewable Energy Installation (MREIs)
Pre-construction - completed in 2018	Aerial survey	Breeding season (e.g., May – July) One year of pre-construction survey. Data collected within the 2018 survey included bird locations, abundance and behavioural observations, including flight height and flight direction (Moray East, 2018).	• Sea bird distributions • Flight heights, flight directions	• Baseline bird data (distributions and flight heights) for comparison with later phases. • Connectivity (inferred) and flight heights for comparison with baseline and post-construction.
Post-construction (ongoing)	Aerial survey	Breeding season (e.g., May – July), for three years post-construction starting in 2022. First survey completed in 2022. Remaining two surveys proposed to be undertaken in combination with BOWL and Moray West. See Section 8.4.1 for more details. Survey to follow an iterative programme with review of results against key questions and ability to address them following third year of surveys post-construction.	• Post- construction sea bird distributions. • Flight heights, flight directions.	• Displacement during operation (range of scales considered: exclusion from site and from vicinity of turbines). • Connectivity (inferred) and flight heights for comparison inside and outside the wind farm.
Post-construction (no longer required)	Gull tagging	Breeding season It is acknowledged that, dependent on further tagging studies, there would be little value in continuing to tag from the sampled colonies if minimal or no connectivity with Moray East is identified. NB: The requirement for follow-on gull tagging has been reviewed by MFRAG-O in light of the evidence obtained from previous surveys. Evidence collected to date suggests	• Gull locations and movements. • Flight data, i.e., flight height and speed	• Connectivity. • Collision parameters.

Project Phase	Survey	Description, timing and duration	Data acquired	Reason
		connectivity between ECC SPA and wind farms in the Moray Firth during the breeding season is at a very low level (MacArthur Green, 2023b). It was agreed during MFRAG-O call on 08/03/2023 that there is little value in undertaking further monitoring studies on GBBG at the ECC SPA. For this reason, gull tagging surveys are no longer proposed in the PEMP. See Section 8.4.2.3 for more details. In parallel, a cliff top based observation study on GBBG at the ECC SPA has been completed by Moray West in 2022. It was agreed during the MFRAG-O call on 08/03/2023 that no further observations would be undertaken (see Section 8.4.2.3 for more details).		
Post-construction	East Caithness Cliffs large gull and puffin colony monitoring: counts (including plot sampling), productivity estimation, ringing	April – July (NB: indicates period during which surveys will be conducted, not required in all months). Monitoring methods are being discussed through MFRAG-O. See Section 8.4.2.4 for further details.	• Population counts • Demographic rates	• Monitor and understand trends

8.4.1 Digital Aerial Survey

Digital aerial surveys seek to acquire information on the distribution and abundance of seabirds within and around the Moray East site.

As agreed through MFRAG-O (see Table 8-2), pre-construction digital aerial surveys were completed between May and July 2018 (one survey per month) (Moray East, 2018). A power analysis was undertaken prior to the surveys commencing to inform the survey design (APEM, 2018). The aim was to have sufficient power to detect 30 % displacement of puffins from the wind farm. The survey design was agreed upon by MFRAG-O.

The pre-construction digital aerial surveys were carried out along transect lines spaced 2.53 km apart to obtain a 10 % minimum coverage over the Moray East site plus 10 km buffer as shown in Figure 8-1 below. Data presented within the 2018 survey report include bird locations, abundance and behavioural observations, including flight height and flight direction (Moray East, 2018).

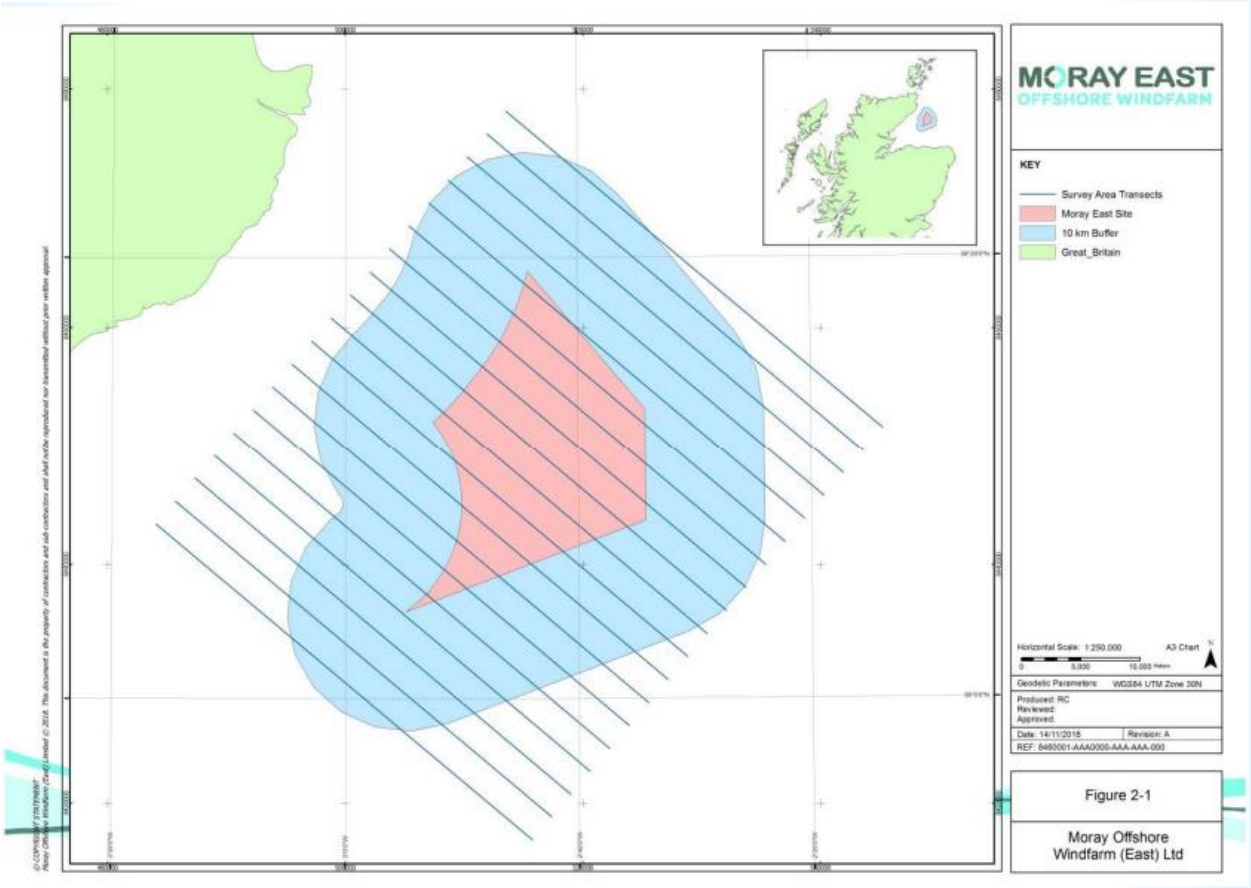

Figure 8-1: Moray East pre-construction aerial survey design (Moray East, 2018)

No monitoring during construction was carried out as it has been recognised by MFRAG-O that the key impacts to be monitored would be during the post-construction/operational phase of the Moray East Offshore Wind Farm (please see Table 8-3 for key wind farm impacts to be monitored).

Moray East post-construction digital aerial monitoring will be coordinated with Moray West Offshore Wind Farm pre and post construction, and BOWL post-construction aerial surveys, and will share the same transect spacing and orientation. The combined monitoring commenced in the 2022 breeding season (May, June and July 2022), following the final commissioning of Moray East wind farm achieved on 1 April 2022.

The post construction aerial survey monitoring planned for BOWL and Moray East wind farm was based on three years of post-construction aerial surveys for each project, with agreement that this would be subject to review of the results obtained. Therefore, following the survey planned for 2022, it is anticipated that Moray East will conduct two more surveys, proposed to be combined with Moray West and BOWL, and likely to start after 2025 following the construction of Moray West Offshore Wind Farm. This approach has been discussed in MFRAG-O, and it is subject to final approval. See MFRAG-O records in Table 8-2.As described in Section 8.2, Moray East will continue to participate in the MFRAG-O and any future survey scopes will be agreed through MFRAG-O.

8.4.2 Regional and Strategic Monitoring

Regional monitoring of birds will be achieved through the alignment of the key monitoring questions and monitoring methods discussed and agreed by MFRAG-O. Discussions to date have allowed for common methods / approaches to be developed between Moray East, Moray West Offshore Wind Farm and BOWL which will enable a regional monitoring overview in the Moray Firth. For some monitoring objectives a joint monitoring will deliver key benefits, whereas other monitoring will be conducted independently. In the future, there are likely to be a combination of joint and independent surveys, analysis and reporting of results depending on timescales of each project and where overlaps are possible and desirable.

Data collected on primary, secondary, tertiary, or other species (see Table 8-3), will be made available for future meta-analyses, as part of wider strategic projects which may be developed as agreed through ScotMER, previously named SpORRAn.

Strategic monitoring involves several work streams, as highlighted below.

8.4.2.1 Gull Tagging Project (2014-15)

The purpose of tagging GBBG was agreed at the MFRAG-O meeting on 14 November 2014 as *"primarily to establish connectivity between the SPA population and wind farms, and therefore potential for any population level effects".* Their monitoring is an important part of the project since GBBG were classed as primary key species, as seen above in Table 8-3.

The main aim of the Gull Tagging Project was to investigate the drivers of the distribution of large gulls (great black-backed gull and herring gull) and the potential connectivity to the offshore wind farms in the Moray Firth (Moray East Offshore Wind Farm and BOWL). Data collected included information on acceleration, foraging areas, flight direction and distance. This project was the first project attempting to tag great black backed gulls.

The data collected on the two species targeted with tagging studies at the ECC SPA during the 2014 breeding season was subject to extensive processing. No evidence of connectivity between the breeding colonies and the wind farms was found. Key project limitations included the number of birds tagged (due to challenging fieldwork conditions) and the comparatively short duration over which data were collected. Detailed project information can be found in Archibald *et al*. (2014) and Bodganova *et al.* (2015).

Moray East developed the project scope of work in collaboration with Centre for Ecology and Hydrology (CEH) and managed the project delivery. Funding was received from Innovate UK (Moray East application with Moray East managing the grant funding administration and reporting to Innovate UK), Moray East and BOWL.

8.4.2.2 Project Tag (2017)

The Project Tag main aim was to identify the constraints of existing bird tagging, define the functional scope of optimised tags, and to engage the tag manufacturers that are interested in demonstrating their technologies. This project was developed taking into account the results of the 2014-15 Gull Tagging Project (section 8.4.2.1) and was delivered during 2017.

The project activities were delivered through four Work Packages (WP), including literature review and defining the Innovation Challenge, peer review and consultation, delivering the Innovation Challenge and technology delivery planning. Seven complete submissions were received from UK and non-UK

organisations. Four tag technologies were highlighted as having the potential to meet the parameters of the Innovation Challenge (although on further analysis it was recognised that only three were capable of delivering the tag technology identified within the project scope). Moray East participated in follow up sessions with each of the selected manufacturers to highlight potential applications of the tag technology in post-construction monitoring for the Moray East Offshore Wind Farm and has offered to support the companies in applications for funding for technology development.

Full project details are provided within Offshore Renewable Energy (ORE) Catapult (2017).

Moray East led in the development of the project scope of work including initial technical reports to inform the parameters for the Innovation Challenge, committed additional funding and participated in work of strategic importance through the ORE Catapult 'Project Tag'. Moray East initiated the project through ORE Catapult and contracted ORE Catapult's project management of Project Tag. Moray East also developed the funding package for this project. Funds were also received from BOWL, Marine Scotland and Highlands and Islands Enterprise (HIE). ORE Catapult also contributed through support from the wider Catapult network to a value beyond the contract scope.

8.4.2.3 Gull Monitoring

Further gull tagging was proposed in the previous version of the Moray East PEMP, dependent on the results of post-construction tagging studies expected to be undertaken by adjacent wind farm development.

To obtain further data on great GBBG, a study was undertaken in 2022 to observe breeding birds at colonies in the ECC SPA. The directions in which birds departed from, or returned to, their territories were used to provide an indication of whether birds are foraging inland, along the coast, close inshore, or further offshore. Direct observation on adult GBBG's diet was also undertaken by observing adults feeding chicks, and by collecting regurgitated pellets near any accessible nests. The survey was led by Moray West Offshore Wind Farm, in cooperation with Moray East and BOWL. Preliminary results have shown very little tendency of GBBG breeding at the ECC SPA to travel long distances offshore (MacArthur Green, 2022b).

Based on the combined tracking data from the ECC SPA and other sites around the North Atlantic, a note prepared by MacArthur Green on the connectivity between the Moray Firth offshore wind farms and breeding GBBG colonies (MacArthur Green, 2023b) concluded that GBBG were typically coastal during the breeding season. As such, it was considered unlikely connectivity would exist between the ECC SPA and the offshore wind farms in the Moray Firth. Consequently, further monitoring GBBG at the ECC SPA, either through tagging or observations, is unlikely to be useful to address the relevant questions posed in Table 8-4.

During the MFRAG-O call in March 2023, it was agreed that there is little value in undertaking further monitoring studies on GBBG at the ECC SPA for the foreseeable future (see Table 8-2). For this reason, no further gull monitoring is proposed in this PEMP.

It is noted that there are remaining questions related to where the GBBG observed in the wind farms come from, if not from the ECC SPA. Future works on GBBG should be considered under a strategic monitoring scope (for example, through ScotMER). This is to be reviewed regularly through MFRAG-O, as new evidence and technologies become available (relative to capturing birds at sea, and tagging, etc.)

8.4.2.4 East Caithness Cliffs Large Gull and Puffin Colony Monitoring

Methods for large gull and puffin colony monitoring at the ECC SPA are being considered through MFRAG-O.

Indications of minimal connectivity between the ECC SPA breeding great black-backed and herring gulls and the wind farm sites suggest this aspect may be of low priority. As discussed in Section 8.4.2.3,

connectivity between the ECC SPA and the offshore wind farms in the Moray Firth is considered to be unlikely. Therefore, there is no proposal for future colony monitoring at the ECC SPA.

Regarding puffin colony monitoring, it is noted that, given the unsuitability of the ECC SPA for puffin colony monitoring and the absence of baseline information, puffin monitoring would be best undertaken by the Forth and Tay Regional Advisory Group (FTRAG) on the colonies associated with the wind farms in that region. Therefore, the requirement to monitor ECC SPA puffin colonies should be removed unless suitable locations for camera sampling can be identified from the results of other surveys in the area. Following survey trials at the Isle of May, BOWL is currently undertaking surveys at the ECC SPA utilising cameras and machine learning technology. Results obtained will be discussed through MFRAG-O when these become available.

8.5 The scope of future monitoring may be amended following discussions and agreement within MFRAG-O. Survey Programme

Tagging of GBBG and herring gull was carried out during 2014 as part of the Gull Tagging Project as described within section 8.4.2.1 above. No further tagging projects are proposed during the post-construction phase of Moray East Development.

Pre-construction aerial surveys took place during May – July 2018 in line with the approved aerial survey methodology as discussed in section 8.4.1 above.

No construction monitoring was undertaken, in line with the agreed monitoring programme highlighted in Table 8-4 above.

Moray East post-construction digital aerial monitoring will be coordinated with Moray West Offshore Wind Farm and BOWL. The first Moray East post-construction survey has been undertaken during the 2022 breeding season (May-July). Another two combined surveys are planned to take place during the next breeding season following Moray West Offshore Wind Farm construction (surveys expected to commence in 2025 at the earliest).

8.6 Reporting

The Gull Tagging Project reports (Archibald *et al*., 2014 and Bodganova *et al*., 2015) were shared with key stakeholders, including all the MFRAG-O members. The Project Tag report (ORE Catapult, 2017) has also been shared with MFRAG (March 2018).

In advance of the pre-construction digital aerial survey, two Power Analysis reports were submitted to the MFRAG-O to assist in the aerial survey design discussions. An initial power analysis report was produced by Natural Power in 2015 (Natural Power, 2016) and a revised power analysis was produced by APEM (APEM, 2018) using the most recent MRSea power analysis package. The pre-construction digital aerial surveys were completed in 2018 (Moray East, 2018), and a report submitted to MS-LOT in December 2018.

Further survey reports will be shared with MFRAG-O and submitted to the Scottish Ministers for approval at timescales determined through the MFRAG.

9 Marine Mammals

9.1 Monitoring Requirements

The consent conditions relevant to marine mammal monitoring are summarised in Table 9-1 below.

Table 9-1: Marine Mammals Monitoring Conditions

Condition	Monitoring requirement
PEMP S36: Condition 26 b.	Participation in surveys to be carried out in relation to marine mammals as set out in the MMMP

9.2 Monitoring Approach

Moray East's participation and approach with the Moray Firth Marine Mammal Monitoring Programme (MMMP) have been defined through consultations with stakeholders at the Moray Firth Regional Advisory Group Marine Mammal Subgroup (MFRAG-MM).

The overall objectives and workplan for the pre-construction and construction MMMP were initially outlined in the documents dated 25 March 2014 (Thompson, 2014) and 27 June 2016 (Thompson, 2016), respectively. In July 2018, an addendum to the construction MMMP (cMMMP) workplans was approved by MS-LOT in consultation with MFRAG-MM. This was in response to key findings from BOWL monitoring and through discussions with MFRAG-MM, in order to balance elements of on-going long-term monitoring with more detailed studies exploring remaining areas of uncertainty.

The MMMP work packages were reviewed in 2021 and 2022 to integrate construction monitoring at the Moray West Offshore Wind Farm with ongoing post-construction monitoring at BOWL and Moray East Offshore Wind Farms (Thompson, 2021; Thompson, 2022). The reviews considered NatureScot guidance note issued to MFRAG-MM, outlining how NatureScot and MSS would expect the MMMP to be adapted to meet future construction and post-construction consent monitoring requirements (NatureScot, 2021). The principles proposed in the MMMP review 2022 (Thompson, 2022) have been agreed by MFRAG-MM.

MFRAG-MM meeting minutes and documents for discussion are publicly available within the Marine Scotland Website[15].

A summary of the key agreements from each MFRAG-MM meetings are summarised in Table 9-2 below. It should be noted that this is an ongoing process and further consultation with stakeholders will be made available through the Marine Scotland Website as detailed above.

Table 9-2: Stakeholder consultation of reference to marine mammals monitoring

Consultee	Scope of consultation / consultation response	Date	Moray East comments
MS-LOT (MSS, SNH, JNCC, WDC and ASFB)	**Submission of Pre-construction Marine Mammal Monitoring Programme (MMMP).** • Document issued by MS-LOT for consultation with MSS, SNH, JNCC, WDC and ASFB. • MSS, SNH, JNCC, WDC confirmed they were content with the scope of the pre-construction monitoring and would welcome engagement on the monitoring methodologies through stakeholder meetings.	02/04/2014	Comments taken into account in final pre-construction MMMP report (Thompson, 2014)

[15] www.gov.scot/Topics/marine/Licensing/marine/scoping/mfrag/marine-mammals

Consultee	Scope of consultation / consultation response	Date	Moray East comments
	• SNH and JNCC provided comments on aspects related to strategic monitoring. • MSS provided specific comments on the proposed Continuous Porpoise Detectors (CPOD) deployment design. • No comments received from ASFB. • Formal approval received from MS-LOT on the pre-construction MMMP (email of 10 October 2014) as submitted.		
MS-LOT / MSS	• Moray East met with MS-LOT and MSS to discuss the potential for a restriction on piling in night time and low visibility to be lifted, • The meeting set out to discuss MS-LOT and MSS's concerns regarding night time piling, discuss what mitigation could be considered suitable protection of marine mammals during piling at night time or low visibility conditions and to discuss whether the use of appropriate mitigation would be sufficient to allow piling in night time and low visibility conditions.	13/01/2015	This meeting was undertaken before the formal start of MFRAG and outlined the basis for later discussions about during construction mitigation.
MFRAG-MM	**MFRAG-MM Meeting:** • Moray East and BOWL provided outline of risks of injury for harbour porpoise and harbour seal with refined project parameters. Discussion with Statutory Nature Conservation Body (SNCB) to determine alternative approaches to using marine mammal observers/ /Passive Acoustic Monitoring (PAM)- primarily the use of Acoustic Deterrent Devices (ADDs). • It was agreed that harbour seal, bottlenose dolphins where high priority species and harbour porpoise were medium priority for consideration in the construction and post construction MMMP.	03/05/2015	The MMMP was developed based on the principles outlined in the meeting, focusing on harbour seals, bottlenose dolphins and harbour porpoise.
MFRAG-MM	**MFRAG-MM Meeting:** • Meeting formalised the creation of the MFRAG-MM subgroup. • It was agreed that the purpose of the piling mitigation was to mitigate instantaneous death rather than displacement. • ADDs, whilst potentially useful mitigation is not fully tested. SNH is open to use but devices would need to be trialled to monitor effectiveness. • It was agreed that use of ADD should be minimised to 10-15 minutes of activation prior to soft start.	19/06/2015	Comments from the MFRAG-MM were taken into account in the development of the PS issued in 2016 and updated in 2019 (Moray East, 2019) and the MMMP.

Consultee	Scope of consultation / consultation response	Date	Moray East comments
	• SNH confirmed that they were happy with the principal of proposed methods but would need to see an interim step to demonstrate ADDs work effectively. • JNCC confirmed that if no mitigation method is deemed appropriate, a risk-based approach could be undertaken. If the conclusion from the group was that there was low risk without mitigation, approach was likely to be acceptable.		
MS-LOT / MSS / SNH / JNCC	• Meeting to discuss project specific approach to piling and how monitoring can be implemented during Moray East's phased construction period. The meeting was mainly focused on the content of the Piling Strategy but also outlined Moray East's mitigation and monitoring strategy.	11/09/2015	Monitoring principles discussed at meeting taken into the development of the PS issued in 2016 and updated in 2019 (Moray East, 2019) and the MMMP.
MFRAG-MM	**MFRAG-MM Meeting:** • It was confirmed that harbour seals were a priority species for Moray East site. • Concern was voiced that the inclusion of SpORRAn into the process would result in delays to agreeing monitoring requirements. • Focus on post-construction monitoring based on the results of construction monitoring. Development of post- construction methodology to be iterative.	16/12/2015	Moray East agreed to continuing work with the University of Aberdeen and BOWL to develop monitoring methods for agreement by MFRAG-MM subgroup. Monitoring methods to focus on harbour seal and harbour porpoise.
MFRAG-MM	**Consultation on construction MMMP:** • Construction MMMP submitted for consultation to MFRAG-MM and discussed at a number of MFRAG-MM meetings (summary of discussions provided above). • Construction MMMP updated in line of comments received. Final version dated 27 June 2016 (Thompson, 2016).	March 2015 (first version) 27/06/2016 (final version)	Comments taken into account in final pre-construction MMMP report (Thompson, 2016)
MFRAG-MM	**MFRAG-MM Meeting:** • A summary of the approved pre-construction strategic MMMP was presented at the meeting. • Discussions around the development of a detailed construction MMMP based on the scope of the pre-construction MMMP and aims of the construction monitoring.	17/11/2016	Final pre-construction MMMP dated 27/06/2016 (Thompson, 2016).
MFRAG-MM	**MFRAG-MM Meeting:** • The focus of this meeting was mainly to provide an update on BOWL's construction MMMP.	20/06/2017	Lessons learned from the BOWL MMMP to be taken by Moray East during the design of the

Consultee	Scope of consultation / consultation response	Date	Moray East comments
			Moray East construction MMMP
MFRAG-MM	**MFRAG-MM Meeting:** • The focus of this meeting was mainly to provide an update on BOWL's construction MMMP and to highlight that Moray East would be planning on starting its construction monitoring during 2019. • It was agreed that a further meeting would take place during early summer 2018 to discuss Moray East's construction MMMP.	21/02/2018	Lessons learned from the BOWL MMMP to be taken by Moray East during the design of the Moray East construction MMMP
MFRAG-MM	**MFRAG-MM meeting** • Moray East gave a project update and went further to provide an overview of the proposed cMMMP scope. The results of BOWL's construction monitoring have been taken into account to further adapt the monitoring scope. • Moray East tasked to provide updated monitoring proposal to the next MFRAG-MM meeting.	26/07/2018	Moray east to consider identified uncertainties from the result of BOWL's monitoring. An addendum to the cMMMP was completed on 19 September 2018 (Thompson, 2018).
MFRAG-MM	**MFRAG-MM Meeting** • An update on the monitoring currently underway was provided, which included photo-id for harbour seals and Bottlenose Dolphins and CPOD monitoring (long-term low density and short-term high-density arrays) for harbour porpoise and dolphins. • A novel piece of work was introduced to assess finer scale of harbour porpoise responses to construction vessels vs piling. This focused on the development of PAM studies where additional acoustic monitoring used multi-channel "sound trap" recorders.	10/06/2019	Updates provided on ongoing monitoring, in line with cMMMP (Thompson, 2018).
MFRAG-MM	**MFRAG-MM Meeting** • Scope of Moray East post-construction marine mammal monitoring potentially to be based on population monitoring.	26/05/2021	
MFRAG-MM	**MFRAG-MM Meeting** • Outcome of meeting with NatureScot / MSS outlines Bottlenose dolphins and harbour seals as key species for post-construction monitoring for Moray East. • A summary note outlining how NatureScot and MSS would expect the MMMP to be adapted to meet future construction and post-construction consent monitoring requirements to be issued.	25/08/2021	Advise from NatureScot issued on 16 September 2021 (NatureScot, 2021).

Consultee	Scope of consultation / consultation response	Date	Moray East comments
MFRAG-MM	**MFRAG-MM Meeting** • The addendum to the MMMP issued on 2 December 2021 (Thompson, 2021) was presented and discussed. This was issued in response to NatureScot guidance (NatureScot, 2021). • NatureScot confirmed agreement on MMMP principles.	09/02/2022	NatureScot confirmed broad agreement on MMMP Addendum by email on 15 Feb 2022, subject to audit trail of clarification on key issues. University of Aberdeen (UoA) circulated final Addendum and track changed copy clarifying NatureScot queries on 19th April 2022 (Thompson, 2022)
MFRAG-MM	**MFRAG-MM Meeting** • MSS and NatureScot confirmed they are content with the MMMP Addendum 2022 (Thompson, 2022) • Progress on MMMP works presented.	22/09/2022	

9.3 Monitoring Objectives

As highlighted in Table 9-2 above, the pre-construction MMMP was approved by MS-LOT following consultation with MSS, JNCC, SNH and WDC. The relevant surveys commenced soon after approval (in May 2014) and were completed and approved by the MFRAG-MM. The primary objective of the pre-construction MMMP was to collect baseline data on the distribution, abundance and vital rates of harbour seal and bottlenose dolphin.

Full details of the pre-construction MMMP objectives are presented within "Proposal for a strategic regional Pre-Construction Marine Mammal Monitoring Programme in respect of the BOWL and MORL [Moray East] Wind Farm Developments" (Thompson, 2014).

A description of construction monitoring objectives, rationales and work packages are provided within "A strategic regional Marine Mammal Monitoring Programme for assessing the population consequences of constructing the BOWL and [Moray East] Wind Farm Developments" (Thompson, 2016), now referred to as the cMMMP. This is complemented through the "Addendum to the Moray Firth MMMP outlining studies to be conducted during construction of the Moray East Offshore Wind Farm" (Thompson, 2018).

Post-construction MMMP work packages were initially proposed in 2021 and updated in 2022 (Thompson, 2021; Thompson, 2022) following meetings with key stakeholders and in response to the emerging policy questions highlighted in the NatureScot (2021). Each of these work packages addresses objectives identified for pre, during and post-construction monitoring for developments in the Moray Firth, as outlined below.

The following MMMP proposed objectives and work packages (WP) are specifically relevant and applicable to the Moray East Development post-construction phase (Thompson, 2022):

WP 1.1: Monitoring harbour seals population size, structure and vital rates;

WP 1.2: Assessing temporal changes in harbour seal foraging distribution;

WP 2.1: Monitoring bottlenose dolphin population size, structure and vital rates;

WP 2.2: Assessing bottlenose dolphin temporal change in use of, and connectivity with, key foraging areas; and

WP 4.1: Monitoring marine mammal responses to wind farm operation and foraging behaviour around structures.

9.4 Survey Methodology

The methodology agreed for the pre-construction survey is presented within the pre-construction MMMP (Thompson, 2014). The survey approach has been designed to address the monitoring objectives agreed with MFRAG for the pre-construction phase of the Development, as well as to complement the existing datasets within the Moray Firth and wider region for harbour seal and bottlenose dolphin. The pre-construction monitoring has been completed and appropriately reported upon MFRAG and approved by the Scottish Ministers (Graham *et al*., 2015; Graham *et al*., 2016; Graham *et al*., 2017).

The methodology applied during the construction survey is presented within the cMMMP (Thompson, 2016), and amended in July 2018 (Thompson, 2018). Surveys undertaken during the construction phase included core population studies for harbour porpoises and bottlenose dolphins and noise monitoring throughout construction campaign. During the different phases of construction, a low density CPOD array was deployed across Moray East and BOWL to monitor long-term responses of porpoises. The construction monitoring was completed in 2021 (Graham *et al*., 2020; Graham *et al*., 2021).

The post-construction methodology and scope of work has been reviewed through an addendum to the Moray Firth MMMP, which integrated construction monitoring at the Moray West Offshore Wind Farm with ongoing post-construction monitoring at BOWL and Moray East Offshore Wind Farm (Thompson, 2022). The proposed methodology, in line with the WP described in Section 9.3 above, includes:

- Unoccupied Aerial Vehicle (UAV) surveys to monitor harbour seal population, size, structure and vital rates (WP 1.1.);
- Tagging a sample of harbour seal individuals from the Loch Fleet (WP 1.2);
- Boat-based photo-ID surveys to monitor population size, structure and vital rates of Bottlenose Dolphin at the Moray Firth Special Area of Conservation (SAC) (WP 2.1);
- PAM monitoring (CPODs array) to assess temporal change in use of, and connectivity with, key foraging areas for bottlenose dolphin Monitoring (WP 2.2); and
- PAM monitoring (CPODs array) to assess marine mammal responses and wind farm operation and foraging around structures (WP 4.1).

The data acquired through the MMMP works at the wind farm site, such as the CPODs array installed to assess marine mammals' response to wind farm operation (WP 4.1) and other packages related to pilling during Moray West construction, will be integrated with the Predators and Prey Around Renewable Energy Developments (PrePARED) project. The PrePARED project is a collaborative research programme, led by Scottish Government's Marine Directorate and co-funded by Crown Estate Scotland. It aims to study predator (seabird and marine mammal) and prey (fish) distribution and behaviour in and around offshore wind farms, providing critical insight into cumulative effects from large scale development for key species. The PrePARED work stream B, in particular, aims to improve understanding of changes in fish communities, as well as marine mammals response to prey, at offshore wind farm developments in the Moray Firth. It is noted that the PrePARED project is an independent research programme, and therefore it is not part of the scope of works proposed to be undertaken through this PEMP.

9.5 Survey Programme

Moray East's monitoring during pre-construction and construction took place during 2014-2016 and 2019-2021, respectively (Graham *et al*., 2015; Graham *et al*., 2016; Graham *et al*., 2017; Graham *et al*., 2020a; Graham *et al*., 2020b; Graham *et al*., 2021) as reported and approved by MS-LOT.

The programme for the Moray East post-construction monitoring has been initially proposed by Thompson (2022) and will be subject to further review and discussions through MFRAG-MM as these results become available and compared against the relevant questions driving the monitoring. Planned monitoring for the next three years is shown in Table 9-3 below.

Table 9-3: MMMP work packages schedule

Work Package		Year		
		2022	2023	2024
WP 1	1.1 - Monitoring harbour seals population size, structure and vital rates	✓	✓	✓
	1.2 - Assessing temporal changes in harbour seal foraging distribution		✓	
WP 2	2.1 - Monitoring bottlenose dolphin population size, structure and vital rates	✓	✓	✓
	2.2 - Assessing bottlenose dolphin temporal change in use of, and connectivity with, key foraging areas	✓	✓	✓
WP 3	3.1 – Minke Whale Spatial and Temporal Variation in Occurrence	✓		
WP 4	4.1 - Monitoring marine mammal responses to wind farm operation and foraging behaviour around structures	✓	✓	
	4.2 - Responses to Piling and Other Anthropogenic Noise Sources		✓	
WP 5	5.1 Characterisation of Received Noise Levels from Monopile Installation		✓	

*Work packages relevant to Moray East are highlighted in yellow

9.6 Reporting

The results of the pre-construction and construction monitoring are detailed within the "Strategic Regional Pre-Construction Marine Mammal Monitoring Programme Annual Report 2015" (Graham *et al*., 2015), "Strategic Regional Pre-Construction Marine Mammal Monitoring Programme Annual Report 2016" (Graham *et al*., 2016), "Strategic Regional Pre-Construction Marine Mammal Monitoring Programme Annual Report 2017" (Graham *et al*., 2017), "Construction Marine Mammal Monitoring Programme Fieldwork Report 2019" (Graham *et al*., 2020a), "Construction Marine Mammal Monitoring Programme Fieldwork Report 2020" (Graham *et al*., 2020b), and "Construction Marine Mammal Monitoring Programme Fieldwork Report 2021" (Graham *et al*., 2021). These have been discussed and recommended for approval of the Scottish Ministers by MFRAG-MM. Approval has since been received.

Two workshops were organised in 2021 to report results from some of the surveys/studies carried out during construction. University of Aberdeen presented results on the effects of vessel activities and construction on the occurrence of harbour porpoises and ambient noise prior to pile driving activities at both Moray East and BOWL sites on 19 February 2021, and the preliminary results of piling noise and porpoise responses at Moray East on 30 April 2021. Further survey reports will be submitted to the Scottish Ministers for approval at timescales determined through MFRAG.

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MORAY EAST
OFFSHORE WINDFARM

Contact

Moray Offshore Windfarm (East) Limited
5th Floor, Atria One, 144 Morrison Street
Edinburgh EH3 8EX
Tel: +44 (0)131 556 7602