



Neart na Gaoithe Offshore Wind Farm

Project Environmental Monitoring Programme

Revision 8.0

November 2023

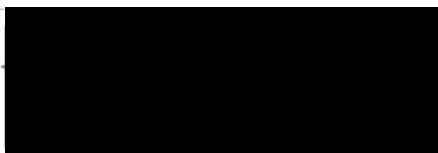
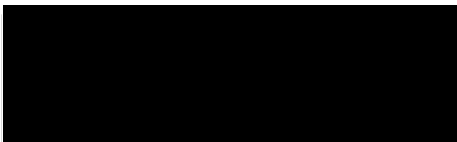
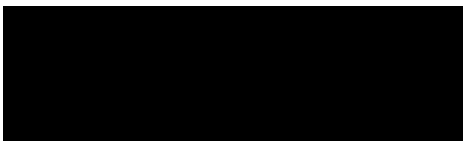
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Neart na Gaoithe Offshore Wind Farm Project Environmental Monitoring Programme

Pursuant to Section 36 Consent Condition 23 and the Marine Licence (Offshore Transmission Works) Condition 3.2.2.14

For the approval of the Scottish Ministers

Document Control

SIGN OFF		
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Rev.	Date	Description	Prepared	Checked	Approved
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Plan Overview

Purpose and Objectives of the Plan

This Project Environmental Monitoring Plan (PEMP) document has been prepared to address the specific requirements of the relevant conditions attached to the Section 36 (S36) consent and Marine Licences (collectively referred to as the Offshore consents) issued to Neart na Gaoithe Offshore Wind Limited (NnGOWL).

The overall objective of the PEMP is to outline and define the approach NnGOWL, its survey contractors and advisors will take with respect to the environmental monitoring of the project required under the S36 Consent and Marine Licence conditions. The plan sets out the approach to monitoring for each environmental topic listed in the S36 Consent and OfTW Marine Licence conditions issued to NnGOWL.

The PEMP is also designed to provide guidance to those involved in the Project, on the monitoring of potential environmental impacts associated with the construction, operation and post-construction phases of the Wind Farm and OfTW.

Scope of the Plan

The PEMP provides the overarching framework for the offshore environmental monitoring required by Condition 23 of the S36 Consent and Condition 3.2.2.14 of the OfTW Marine Licence. The PEMP includes:

- Details on the environmental monitoring proposed for the pre-construction, during construction (if considered appropriate by Scottish Ministers) and, where relevant, post construction phases of the Development on;
 - Seabirds;
 - Marine Mammals;
 - Commercial Fisheries;
 - Marine fish;
 - Diadromous fish;
 - Benthic communities; and
 - Seabed scour and local sediment deposition.
- The objectives and methodologies for the monitoring surveys;
- Evidence of consultation on and approval of monitoring approach and survey methodology; and
- The programme for proposed monitoring surveys and reporting.

Structure of the Plan

The PEMP is structured as follows:

Sections 1 to 2 set out the scope and objectives of the PEMP, statements of compliance and provide an overview of the Project.

Section 3 outlines the approach to developing the monitoring programme detailed within this PEMP and sets out the relevant roles and responsibilities for delivering this monitoring.

Section 4 summarises the overarching approach to developing the PEMP and the roles and responsibilities for delivering the monitoring programme.

Sections 4 to 10 summarise the approach to monitoring for each topic identified in the S36 Consent and OfTW Marine Licence PEMP conditions. These sections also detail the background in developing the receptor specific monitoring strategy, the focus of the monitoring approach and the survey methodology for those receptors scoped into the PEMP. For those receptors where there were no significant impacts or uncertainty in the EIA or scoping determinations each section presents justification for not undertaking further monitoring.

Section 11 demonstrates NnGOWL's compliance with the monitoring measures proposed in the Application.

Plan Audience

The PEMP document is intended to be referred to by personnel involved in the construction of the Project, including NnGOWL personnel and Contractors.

This PEMP is intended to summarise NnGOWL's environmental monitoring programme for stakeholders and regulators.

Compliance with this PEMP will be monitored by the NnGOWL Environmental Clerk of Works (ECoW), and reported to the Licensing Authority.

Plan Locations

Copies of this PEMP are to be held in the following locations:

- NnGOWL Project Office;
- With NnGOWL's ECoW.

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Acronyms and Abbreviations

TERM	DESCRIPTION
AC	Alternating Currents
ADD	Acoustic Deterrent Device
BT	Birdtrack system – component of the Seabird Interaction Study
CEH	Centre of Ecology and Hydrology
CDS	Collision Detection System - component of the Seabird Interaction Study
CFWG	Commercial Fisheries Working Group
ECOMMAS	East Coast Marine Mammal Acoustic Study
ECoW	Environmental Clerk of Works
FLO	Fisheries Liaison Officer
FTRAG	Forth & Tay Regional Advisory Group
FTRAG-O	Forth & Tay Regional Advisory Group – Ornithology Subgroup
FTRAG-MM	Forth & Tay Regional Advisory Group – Marine Mammal Subgroup
HPAI	Highly Pathogenic Avian Influenza
ICES	International Council for the Exploration of the Sea
JNCC	Joint Nature Conservation Committee
MMO	Marine Mammal Observer
MD-LOT	Marine Directorate – Licencing and Operations Team was previously Marine Scotland - Licensing Operations Team
MD-SEDD	Marine Directorate - Science, Evidence, Data and Digital was previously Marine Scotland Science
MSS	Marine Scotland Science, now called Marine Directorate - Science, Evidence, Data and Digital (MD SEDD)
MS-LOT	Marine Scotland Licensing Operations Team, now called Marine Directorate – Licencing and Operations Team (MD-LOT)
MW	Megawatts
NS	NatureScot, was previously Scottish Natural Heritage
NnG	Neart na Gaoithe

TERM	DESCRIPTION
NnGOWL	Neart na Gaoithe Offshore Wind Limited
OSP	Offshore Substation Platforms
PAM	Passive Acoustic Monitoring
PMF	Priority Marine Feature
RSPB	Royal Society for the Protection of Birds
ROV	Remote Operated Vehicle
SEPA	Scottish Environmental Protection Agency
SNH	Scottish Natural Heritage, now called NatureScot
SMRU	Sea Mammal Research Unit
SPA	Special Protection Area
UXO	Unexploded Ordnance
VMS	Vessel Monitoring System
WDC	Whale and Dolphin Conservation

Defined Terms

TERM	DESCRIPTION
Addendum	The Addendum of Additional Information submitted to the Scottish Ministers by NnGOWL on 26 July 2018.
Application	The Environmental Impact Assessment Report, Habitats Regulations Appraisal Report and supporting documents submitted to the Scottish Ministers by NnGOWL on 16 March 2018; the Addendum of Additional Information submitted to the Scottish Ministers by NnGOWL on 26 July 2018 and the Section 36 Consent Variation Report dated 08 January 2019.
Company	Neart na Gaoithe Offshore Wind Limited (NnGOWL) (Company Number SC356223).
Consent Conditions	The terms that are imposed on the Company under the Offshore Consents that must be complied with.
Consent Plans	The plans, programmes or strategies required to be approved by the Scottish Ministers (in consultation with appropriate stakeholders) in order to discharge the Consent Conditions.
Contractors	Any Contractor/Supplier (individual or firm) working on the Project, hired by NnGOWL.
EIA Report	The Environmental Impact Assessment Report, dated March 2018, submitted to the Scottish Ministers by NnGOWL as part of the Application.

TERM	DESCRIPTION
Inter-array Cables	The offshore cables connecting the wind turbines to one another and to the OSPs.
Interconnector Cables	The offshore cables connecting the OSPs to one another.
Marine Licences	The written consents granted by the Scottish Ministers under the Marine (Scotland) Act 2010, for construction works and deposits of substances or objects in the Scottish Marine Area in relation to the Wind Farm (Licence Number 06677/19/0) and the OfTW (Licence Number 06678/19/1), dated 4 June 2019 and 5 June 2019 respectively.
Offshore Consents	The Section 36 Consent and the Marine Licences.
Offshore Export Cable Corridor	The area within which the offshore export cables are to be located.
Offshore Export Cables	The offshore export cables connecting the OSPs to the landfall site.
OfTW	The Offshore Transmission Works comprising the OSPs, offshore interconnector cables and offshore export cables required to connect the Wind Farm to the Onshore Transmission Works at the landfall.
OfTW Area	The area outlined in red and blue in Figure 1 attached to Part 4 of the OfTW Marine Licence.
OnTW	The onshore transmission works from landfall and above Mean High Water Springs, consisting of onshore export cables and the onshore substation.
Project	The Wind Farm and the OfTW.
Section 36 Consent	The written consent granted on 3 December 2018 by the Scottish Ministers under Section 36 of The Electricity Act 1989 to construct and operate the Wind Farm, as varied by the Scottish Ministers under section 36C of the Electricity Act 1989 on 4 June 2019.
Section 36 Consent Variation Report	The Section 36 Consent Variation Report submitted to the Scottish Ministers by NnGOWL as part of the Application as defined above on 08 January 2019.
Subcontractors	Any Contractor/Supplier (individual or firm) providing services to the Project, hired by the Contractors (not NnGOWL).
Wind Farm	The offshore array as assessed in the Application including wind turbines, their foundations and inter-array cabling.
Wind Farm Area	The area outlined in black in Figure 1 attached to the Section 36 Consent Annex 1, and the area outlined in red in Figure 1 attached to Part 4 of the Wind Farm Marine Licence.

Consent Plans

CONSENT PLAN	ABBREVIATION	DOCUMENT REFERENCE NUMBER
Decommissioning Programme	DP	NNG-NNG-ECF-PLN-0016
Construction Programme and Construction Method Statement	CoP and CMS	NNG-NNG-ECF-PLN-0002
Piling Strategy	PS	NNG-NNG-ECF-PLN-0011
Development Specification and Layout Plan	DSLp	NNG-NNG-ECF-PLN-0003
Design Statement	DS	NNG-NNG-ECF-PLN-0004
Environmental Management Plan	EMP	NNG-NNG-ECF-PLN-0006
Operation and Maintenance Programme	OMP	NNG-NNG-ECF-PLN-0012
Navigational Safety Plan and Vessel Management Plan	NSVMP	NNG-NNG-ECF-PLN-0010
Emergency Response Cooperation Plan	ERCoP	NNG-NNG-ECF-PLN-0015
Cable Plan	CaP	NNG-NNG-ECF-PLN-0007
Lighting and Marking Plan	LMP	NNG-NNG-ECF-PLN-0009
Project Environmental Monitoring Programme	PEMP	NNG-NNG-ECF-PLN-0013
Fisheries Management and Mitigation Strategy	FMMS	NNG-NNG-ECF-PLN-0008
Written Scheme of Investigation and Protocol for Archaeological Discovery	WSI and PAD	NNG-NNG-ECF-PLN-0005
Construction Traffic Management Plan	CTMP	NNG-NNG-ECF-PLN-0014

1 Introduction

1.1 Background

1. The Neart na Gaoithe Offshore Wind Farm (Revised Design) received consent under Section 36 of the Electricity Act 1989 from the Scottish Ministers on 03 December 2018 and was granted two Marine Licences by the Scottish Ministers, for the Wind Farm and the associated Offshore Transmission Works (OfTW), on 03 December 2018. The S36 consent and Wind Farm Marine Licence were revised by issue of a variation to the S36 Consent and Marine Licence 06677/19/0 on 4 June 2019. The OfTW Marine Licence was varied initially by the issue of Marine Licence MS-00008954 on the 12 October 2020, followed by issue of MS-00009466 on the 15 October 2021 and again on 26 May 2022 by issue of MS-00009831. The revised S36 Consent and associated Marine Licences are collectively referred to as ‘the Offshore Consents’.
2. The Project is being developed by Neart na Gaoithe Offshore Wind Limited (NnGOWL).

1.2 Objectives of the Plan

3. The S36 Consent and Marine Licences contain a variety of conditions that must be discharged through approval by the Scottish Ministers prior to the commencement of offshore construction. One such requirement is the approval of a Project Environmental Monitoring Programme (PEMP) the purpose of which is to provide the over-arching framework by which NnGOWL will monitor the environmental effects of the Project. The relevant conditions setting out the requirement for a PEMP for approval, and which are to be discharged by issue and approval of this PEMP, are set out in full in Table 1-1.
4. This PEMP is intended to satisfy the requirements of the relevant S36 Consent and OfTW Marine Licence conditions by setting out NnGOWL’s approach to environmental monitoring.

Table 1-1: Consent Conditions to be Discharged by this PEMP

OFFSHORE CONSENTS REFERENCE	CONDITION TEXT	REFERENCE TO RELEVANT SECTION OF THIS PEMP
S36 Consent, Condition 23	The Company must, no later than six months prior to the Commencement of the Project, submit a Project Environmental Monitoring Programme (“PEMP”), in writing, to the Scottish Ministers for their written approval.	This document sets out the PEMP for approval by the Scottish Ministers
	Such approval may only be granted following consultation by the Scottish Ministers with SNH ¹ , RSPB Scotland, WDC, SFF, FMS, RTC, Tay DSFB, Esk DSFB, Forth DSFB, and any other environmental advisors or organisations as required at the discretion of the Scottish Ministers.	Consultation to be undertaken by the Scottish Ministers
	The PEMP must be in accordance with the Application as it relates to environmental monitoring.	Appendix A
	The PEMP must set out measures by which the Company must monitor the environmental impacts of the Project. Monitoring is required throughout the lifespan of the Project where this is deemed necessary by the Scottish Ministers. Lifespan in this context includes pre-construction, construction, operational and decommissioning phases.	Section 3

¹ SNH name changed to NatureScot in August 2020

OFFSHORE CONSENTS REFERENCE	CONDITION TEXT	REFERENCE TO RELEVANT SECTION OF THIS PEMP
	The Scottish Ministers must approve all initial methodologies for the above monitoring, in writing and, where appropriate, in consultation with the FTRAG referred to in condition 24 of this consent.	Through consultation of this PEMP
	Monitoring must be done in such a way so as to ensure that the data which is collected allows useful and valid comparisons between different phases of the Development. Monitoring may also serve the purpose of verifying key predictions in the Application. In the event that further potential adverse environmental effects are identified, for which no predictions were made in the Application, the Scottish Ministers may require the Company to undertake additional monitoring	Sections 4 to 10.
	<p>The PEMP must cover, but not be limited to, the following matters:</p> <ol style="list-style-type: none"> Pre-construction, construction (if considered appropriate by the Scottish Ministers) and post-construction monitoring or data collection as relevant in terms of the Application, and any subsequent monitoring or data collection for: <ol style="list-style-type: none"> Birds; Marine mammals; Commercial fisheries; Marine fish; Diadromous fish; Benthic communities; and Seabed scour and local sediment deposition. The participation by the Company to contribute to data collection or monitoring of wider strategic relevance, identified and agreed by the Scottish Ministers 	Sections 4 to 10.
	Due consideration must be given to the Scottish Marine Energy Research ("ScotMER") programme.	Sections 4 to 10.
	Any pre-consent monitoring or data collection carried out by the Company to address any of the above issues may be used in part to discharge this condition subject to the written approval of the Scottish Ministers.	n/a
	The PEMP is a live document and which will be regularly reviewed by the Scottish Ministers, at timescales to be determined by them to identify the appropriateness of on-going monitoring. Following such reviews, the Scottish Ministers may, in consultation with the FTRAG, 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 FTRAG, and any other environmental, or such other advisors as may be required at the discretion of the Scottish Ministers.	Section 3

OFFSHORE CONSETS REFERENCE	CONDITION TEXT	REFERENCE TO RELEVANT SECTION OF THIS PEMP
	The Company must submit written reports and associated raw and processed data of such monitoring or data collection to the Scottish Ministers at timescales to be determined by them. Consideration should be given to data storage, analysis and reporting and be to MEDIN data standards	Sections 4 to 10
	Subject to any legal restrictions regarding the treatment of the information, the results are to be made publicly available by the Scottish Ministers, or by such other party appointed at their discretion	n/a
	The Scottish Ministers may agree, in writing, that monitoring may be reduced or ceased before the end of the lifespan of the Development.	n/a
OftW Marine Licence Condition 3.2.2.14	The Licensee must, no later than six months prior to the Commencement of the Works, submit a PEMP, in writing, to the Licensing Authority for its written approval.	This document sets out the PEMP for approval by the Scottish Ministers
	Such approval may only be granted following consultation by the Licensing Authority with SNH, RSPB Scotland, WDC, SFF, FMS, RTC, Tay DSFB, Esk DSFB, Forth DSFB, and any other environmental advisors or organisations as required at the discretion of the Licensing Authority.	Consultation to be undertaken by the Scottish Ministers
	Commencement of the works may not take place until such approval is granted.	n/a
	The PEMP must be in accordance with the Application as it relates to environmental monitoring.	Appendix A
	The PEMP must set out measures by which the Licensee must monitor the environmental impacts of the Works. Monitoring is required throughout the lifespan of the Works where this is deemed necessary by the Licensing Authority. Lifespan in this context includes pre-construction, construction, operational and decommissioning phases.	Section 3
	The Licensing Authority must approve all initial methodologies for the above monitoring, in writing and, where appropriate, in consultation with FTRAG.	Through consultation of this PEMP
	Monitoring must be done in such a way so as to ensure that the data which is collected allows useful and valid comparisons between different phases of the Works.	Sections 4 to 10
	Monitoring may also serve the purpose of verifying key predictions in the Application.	Sections 4 to 10
	In the event that further potential adverse environmental effects are identified, for which no predictions were made in the Application, the Licensing Authority may require the Licensee to undertake additional monitoring.	Sections 4 to 10
	Unless agreed otherwise with the Licensing Authority, the PEMP must cover, but not be limited to, the following matters:	Sections 4 to 10, where relevant

OFFSHORE CONSETS REFERENCE	CONDITION TEXT	REFERENCE TO RELEVANT SECTION OF THIS PEMP
	<p>a. Pre-construction, construction (if considered appropriate by the Licensing Authority) and post-construction monitoring or data collection as relevant in terms of the Application, and any subsequent monitoring or data collection for:</p> <ol style="list-style-type: none"> 1. Birds; 2. Marine mammals 3. Commercial fisheries; 4. Marine fish; 5. Diadromous fish; 6. Benthic communities; and 7. Seabed scour and local sediment deposition. <p>b. The participation by the Licensee to contribute to data collection or monitoring of wider strategic relevance, identified and agreed by the Licensing Authority.</p>	
	Due consideration must be given to the ScotMER programme.	n/a
	Any monitoring or data collection carried out by the Licensee to address any of the above issues prior to the determination of this marine licence may be used in part to discharge this condition subject to the written approval of the Licensing Authority.	Section 3
	The PEMP is a live document and must be regularly reviewed by the Licensing Authority, at timescales to be determined by the Licensing Authority to identify the appropriateness of on-going monitoring. Following such reviews, the Licensing Authority may, in consultation with the FTRAG, require the Licensee to amend the PEMP and submit such an amended PEMP, in writing, to the Licensing Authority, for its written approval. Such approval may only be granted following consultation with the FTRAG, and any other environmental, or such other advisors as may be required at the discretion of the Licensing Authority.	Sections 4 to 10
	The Licensee must submit written reports and associated raw and processed data of such monitoring or data collection to the Licensing Authority at timescales to be determined by the Licensing Authority. Consideration should be given to data storage, analysis and reporting and be to MEDIN data standards, or suitable equivalent to be agreed with the Licensing Authority. Subject to any legal restrictions regarding the treatment of the information, the results are to be made publicly available by the Licensing Authority, or by such other party appointed at its discretion.	n/a
	Upon a request from the Licensee, the Licensing Authority may agree, in writing, that monitoring may be reduced or ceased before the end of the lifespan of the Works.	n/a

5. This PEMP also includes information related to a number of other consent conditions which are linked to environmental monitoring. These are set out in Table 1-2 with references to where these are addressed.

Table 1-2: Other Consent Conditions Relevant to this PEMP

OFFSHORE CONSENTS REFERENCE	SUMMARY OF CONDITION	WHERE ADDRESSED
S36 Condition 11 / OfTW Marine Licence 3.2.2.9	<p>The Piling Strategy (PS) must include the following:</p> <p>d. Details of any mitigation such as Passive Acoustic Monitoring (“PAM”), Marine Mammal Observers (“MMO”), use of Acoustic Deterrent Devices (“ADD”) and monitoring to be employed during pile-driving, as agreed by the Scottish Ministers.</p>	Section 5
S36 Condition 19 / OfTW Marine Licence 3.2.2.8	<p>The Cable Plan (CaP) must include the following:</p> <p>b. The results of monitoring or data collection work (including geophysical, geotechnical and benthic surveys) which will help inform cable routing;</p>	Section 10
S36 Consent Condition 24	<p>Participation in Regional Advisory Group</p> <p>The Company must participate in any Forth and Tay Regional Advisory Group (“FTRAG”) or any successor group, 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, marine mammals, diadromous and commercial fish. The extent and nature of the Company’s participation in the Regional Advisory Group is to be agreed by the Scottish Ministers.</p>	Sections 3

1.3 PEMP Document Structure

6. The PEMP document structure is set out in Table: 1-3.

Table: 1-3 PEMP Document Structure.

SECTION	TITLE	OVERVIEW
1	Introduction	<p>Background to consent requirements and overview of the PEMP scope and structure;</p> <p>Identifies links with other relevant Consent Plans; and</p> <p>Statement of Compliance</p>
2	Project Overview	Provides an overview of the Project and key programme milestones.
3	Approach to the PEMP	Outlines NnGOWL’s general approach to developing the monitoring programme detailed within this PEMP and sets out the relevant roles and responsibilities for delivering the monitoring.
4	Seabirds	Summarises the monitoring strategy and programme (and any subsequent surveys) in respect of seabirds.
5	Marine Mammals	Summarises the monitoring strategy and programme (and any subsequent surveys) in respect of marine mammals.

SECTION	TITLE	OVERVIEW
6	Commercial Fisheries	Summaries the monitoring strategy and programme (and any subsequent surveys) in respect of commercial fisheries.
7	Marine Fish	Summarises the monitoring strategy and programme (and any subsequent surveys) in respect of marine fish.
8	Diadromous Fish	Summarises the monitoring strategy and results in respect of migratory fish species.
9	Benthic Communities	Summarises the monitoring strategy and programme (and any subsequent surveys) in respect of benthic communities.
10	Seabed Scour and Local Sediment Deposition	Summarises the monitoring strategy and programme (and any subsequent surveys) in respect of seabed scour and local sediment deposition.
11	Compliance with the Application, EIA Report and the Addendum	Demonstrates that the programme of monitoring set out in this PEMP is consistent with that proposed in the EIA Report and the Addendum.
Appendix A	Application Commitments	Sets out the monitoring commitments made in the Application.

1.4 Statements of Compliance

7. Environmental monitoring undertaken by NnGOWL will comply with this PEMP as approved by the Scottish Ministers (and as updated or amended from time to time).
8. Where updates or amendments to this PEMP are required, NnGOWL will ensure the Scottish Ministers are informed as soon as reasonably practicable and where necessary the PEMP will be updated.

2 Project Overview

9. The Wind Farm Area is located to the northeast of the Firth of Forth, 15.5 km directly east of Fife Ness on the east coast of Scotland (see Figure 3-1). The Wind Farm Area covers approximately 105 km². Offshore Export Cables are located within the 300 m wide Offshore Export Cable Corridor, running in an approximately southwest direction from the Wind Farm Area, making landfall at Thorntonloch beach to the south of Torness Power Station in East Lothian. Figure 2-1 shows the Wind Farm Area and Offshore Export Cable Corridor.
10. The Offshore Consents allow for the construction and operation of the following main components, which together comprise the Project:
 - 54 wind turbines generating a maximum generating output of around 450 Megawatts (MW);
 - 54 jacket substructures installed on pre-piled foundations, to support the wind turbines;
 - Two alternating current (AC) substation platforms, referred to as Offshore Substation Platforms (OSPs), to collect the generated electricity and transform the electricity from 66kV to 220 kV for transmission to shore;
 - Two jacket substructures installed on piled foundations, to support the OSPs;
 - A network of inter-array subsea cables, buried and/or mechanically protected, to connect strings of turbines together and to connect the turbines to the OSPs;
 - One interconnector cable connecting the OSPs to each other;
 - Two buried and/or mechanically protected subsea export cables to transmit the electricity from the OSPs to the landfall at Thorntonloch and connecting to the onshore buried export cables for transmission to the onshore substation and connection to the National Grid network; and
 - Minor ancillary works such as the deployment of metocean buoys and permanent navigational marks.

2.1 Timing of Construction Works

11. Offshore construction commenced in August 2020. Details of the construction programme are provided in the NnGOWL Construction Programme (CoP).



Figure 2-1: Wind Farm Area and Offshore Export Cable Corridor Locations

3 Approach to this PEMP

3.1 Approach

12. This PEMP summarises the proposed approach to environmental monitoring, with the subsequent chapters setting out the approach for each environmental topic. Where separate documents such as technical survey reports are available, reference to these is made and a brief summary is provided.
13. In line with the rationale for post-consent monitoring presented in the Marine Management Organisation's (MMO's) strategic review of offshore wind farm environmental monitoring (MMO, 2014), monitoring proposals set out in this document aim to:
 - Validate, or reduce uncertainty in predictions on environmental impacts recorded in Environmental Impact Assessments (EIAs) and Habitats Regulations Assessments (HRAs); and
 - Allow the identification of any unforeseen impacts.
14. The Offshore Consents require NnGOWL to undertake and/or participate in strategic, regional and project-specific monitoring. Whilst the focus of the PEMP is on project-specific monitoring, commitments to participate in regional and strategic monitoring are also noted where relevant.

3.2 Roles and Responsibilities

3.2.1 NnG Consents

15. The NnGOWL consents team will have overall responsibility for the following:
 - Maintaining and updating the PEMP document (if necessary), in consultation with and as required by the relevant authorities;
 - Requiring that all environmental monitoring or specialist studies required under the PEMP, are undertaken at the appropriate time;
 - Reviewing the monitoring reports and submitting the reports to either the FTRAG or the appropriate subgroup for consultation before submission to the Scottish Ministers; and
 - Liaising with the relevant consultees, including the FTRAG, on matters related to this PEMP.

3.2.2 Environmental Clerks of Works (ECow)

16. The ECow is responsible for monitoring compliance of the project with the consents and Consent Plans, and for reporting on compliance and environmental issues to NnGOWL and to MD-LOT (previously MS-LOT).
17. Reporting on the PEMP will be led by NnGOWL rather than the ECow; however, the ECow Monthly Compliance reporting will identify any PEMP-related compliance issues.

3.2.3 Environmental Contractors

18. NnGOWL has employed several specialist environmental contractors to inform methods and to undertake field work. Table 3-1 details the subcontractors employed to date.

Table 3-1: Specialist Contractors Currently Involved in the Delivery of Monitoring Surveys

RECEPTOR	SPECIALIST CONTRACTOR
Birds	Digital Aerial Surveys: HiDef GPS tracking studies: UK Centre for Ecology & Hydrology (UKCEH) and RSPB Seabird interactions study: STRIX Gannet adult survival: RSPB and Heriot-Watt University
Marine Mammals	Digital Aerial Surveys: HiDef Photo-identification Surveys: Sea Mammal Research Unit (SMRU) University of St Andrews Acoustic monitoring deployment and analysis: SMRU Consulting
Commercial Fisheries	Collation and analysis of fisheries data: Poseidon Aquatic Resource Management Ltd
Marine Fish	None required (See Section 7).
Diadromous Fish	None required (See Section 8).
Benthic Communities	None proposed (see Section 9).
Seabed Scour and Local Sediment Deposition	None proposed (see Section 10).

4 Seabirds

4.1 Introduction and Background

19. This chapter summarises the proposed approach to monitoring potential effects on seabirds. The FTRAG ornithology subgroup (FTRAG-O) was set up to agree appropriate seabird monitoring for the Forth and Tay offshore wind farms (NnG, Inch Cape and Seagreen One). In addition to the developers of the wind farms, the following organisations are represented on FTRAG-O: Marine Directorate-Science, Evidence, Data and Digital (MD-SEDD), formally Marine Scotland Science (MSS), NatureScot (formerly SNH), Joint Nature Conservation Committee (JNCC) and the Royal Society for the Protection of Birds (RSPB).
20. A summary of FTRAG-O discussions to date is provided in Table 4-1. Meeting agendas and minutes referred to in Table 4-1 can be obtained on the Marine Scotland website (unless stated otherwise).

Table 4-1: FTRAG Ornithology Subgroup Discussions and Agreements on Monitoring

DATE	SUMMARY OF KEY DISCUSSIONS AND AGREEMENTS	REFERENCE
29th June 2015	Terms of Reference discussed. MSS' document ' <i>Key Post Consent Monitoring Questions in the Forth & Tay</i> ' (MSS, 2015) was discussed and questions to be answered by agreed monitoring. Key species were also discussed.	Minutes of meeting – 29/06/2015:
3rd September 2015	The MSS ' <i>Key Post Consent Monitoring Questions in the Forth & Tay</i> ' document was revised and formed basis of discussions. Key species for monitoring discussed; gannet, kittiwake, guillemot, razorbill and puffin. Key SPAs were identified; Forth Islands SPA and Fowlsheugh SPA. The Outer Firth of Forth and St Andrews Bay Complex dSPA (now pSPA) was discussed for inclusion. Monitoring suggested to focus on Collision Risk and Displacement Effects.	Minutes of meeting – 03/09/2015:
17th November 2015	Update of gannet tagging study in 2015 and 2016 was provided. Further versions made to MSS ' <i>Key Post Consent Monitoring Questions in the Forth & Tay</i> ' document. Detailed discussions on the questions to be answered by monitoring. NnGOWL spoke to the Centre of Ecology and Hydrology (CEH) to develop appropriate monitoring techniques to assess displacement and barrier effects. Note from CEH circulated prior to meeting. NnGOWL agreed to prepare a pre-consent monitoring discussion paper (NnGOWL, 2016).	Minutes of meeting – 17/11/2015:
26th January 2016	Guest presentations: Bob Furness – Gannet ringing on the Bass Rock; Keith Hamer – Flight Height of Gannets; Francis Daunt – Seabird Tagging Studies on the Isle of May NnGOWL provided update on pre-construction monitoring strategy under production.	Minutes of meeting – 26/01/2016:

DATE	SUMMARY OF KEY DISCUSSIONS AND AGREEMENTS	REFERENCE
	Discussions over further versions to MSS 'Key Post Consent Monitoring Questions in the Forth & Tay' document.	
23rd March 2016	<p>NnGOWL's 'Pre-Construction Ornithology Monitoring Proposal' circulated on the 10th March 2016.</p> <p>FTRAG-O group broadly agree with the proposed monitoring approach produced by NnGOWL.</p>	<p>Minutes of meeting – 23/03/2016:</p> <p>Document:</p> <p>UK02-0504-0584-CEC-BIRD MONITORING PROPOSAL-RPT-A1</p>
4th October 2018	<p>NnGOWL provided update on the ongoing digital aerial surveys that commenced in June 2018.</p> <p>Francis Daunt (CEH) presented preliminary seabird GPS tracking results from 2018 breeding season on Isle of May. Device effects on puffins were discussed with an action taken by NnGOWL and RSPB to consider whether to continue in 2019.</p> <p>NnGOWL advised that options to monitor collision and/or avoidance behaviour e.g. radar, human observers or cameras were still under consideration but noted that turbines will not be operational for approximately 3 years so there is still time for new technologies to become available, therefore the selection of a preferred monitoring approach is not imminent.</p>	Minutes of meeting 04/10/2018 (not yet online).
28th January 2019	Meeting with NnGOWL, RSPB and CEH to agree approach to tracking puffins. All FTRAG-O members subsequently agreed by email.	Paper circulated to FTRAG-O 05/03/2019 (not yet online).
2nd July 2019	<p>NnGOWL's Pre-construction Monitoring Strategy circulated June 2019.</p> <p>No comments were received on the Monitoring Strategy.</p> <p>FTRAG was advised of the collaborative aerial bird surveys being undertaken across all wind farms in the Forth and Tay area, which commenced in April 2019. This follows on from the separate monthly surveys undertaken since June 2018. The approach to combined surveys was welcomed by the group.</p>	Minutes of meeting 02/07/2019
30th January 2020	<p>NnGOWL and the other Forth and Tay Developers provided the group with general project updates.</p> <p>The group was briefed on the aerial survey work completed in 2018 and 2019 and advised of the survey work planned throughout 2020.</p> <p>CEH presented the results of the initial analysis undertaken on the 2019 seabird tagging studies and the planned work for 2020.</p> <p>Discussions took place on the adult Gannet colour-ringing study, including updates on proposed 2020 work on the Bass Rock and Grassholm colonies, plus a discussion on the potential of a 2nd control colony.</p> <p>Discussions took place on the progression of a collision / avoidance study which will be implemented during O&M.</p>	Minutes of meeting 30/01/2020

DATE	SUMMARY OF KEY DISCUSSIONS AND AGREEMENTS	REFERENCE
	An update was provided by MSS on the ScotMER ornithology programme.	
12th November 2020	<p>NnGOWL and the other Forth and Tay Developers provided the group with general project updates.</p> <p>The group was briefed on the 2020 aerial survey work over the combined ICOL, Seagreen and NnGOWL survey area and the Marr Bank and Berwick Bank survey area, and plans for ongoing aerial survey work at NnG over winter 2020/21 and through NnG construction period.</p> <p>UKCEH provided an update of GPS tracking and colony monitoring at Isle of May over the 2020 breeding season.</p> <p>RSPB provided an overview of Isle of May 2020 flight height data analysis approach.</p> <p>NnGOWL provided an update on the 2020 field season on the Bass Rock and Grassholm gannet colonies for the Gannet Adult Survival Study, and the potential addition of a third study colony was discussed.</p> <p>A brief update on the progression of a seabird interactions study was provided by NnGOWL.</p> <p>An update was provided by MSS on the ScotMER ornithology programme.</p>	Minutes of meeting 12/11/2020
16th November 2021	<p>NnGOWL, Seagreen, Inch Cape and Berwick Bank provided the group with general project updates.</p> <p>UKCEH provided an update on tracking and colony monitoring at Isle of May in 2021 breeding season.</p> <p>NnGOWL gave an update on the adult Gannet survival study on the Bass Rock and Grassholm colonies.</p> <p>HiDef gave an update on preconstruction digital aerial surveys at NnGOWL between June 2018 and July 2020.</p> <p>HiDef gave a presentation on the “next generation” digital camera rigs.</p> <p>NnGOWL gave a summary presentation on the Seabird Interaction Study at NnG.</p> <p>Discussion on lessons learnt & results sharing.</p> <p>MSS, NS and JNCC gave brief updates on ScotMER workshop & Strategic Ornithology research projects.</p>	Minutes of meeting 16/11/2021
31st May 2022	<p>NnGOWL, Seagreen, Inch Cape and Berwick Bank provided the group with general project updates.</p> <p>NnGOWL and STRIX gave a presentation on the Seabird Interactions Study.</p> <p>MSS gave a presentation on the PrePARED project</p>	Minutes of meeting 31/05/2022
10th November 2022	NnGOWL, Seagreen, Inch Cape and Berwick Bank provided the group with general project updates.	Minutes of meeting 10/11/2022 (not yet published)

DATE	SUMMARY OF KEY DISCUSSIONS AND AGREEMENTS	REFERENCE
	<p>RSPB gave an update of the gannet survival study at Bass Rock and the impacts of highly pathogenic avian influenza (HPAI) had on the monitoring plans for 2022.</p> <p>NnG gave an update of the gannet survival study at Grassholm and the impacts of HPAI had on the monitoring plans for 2022.</p> <p>UKCEH and RSPB provided an update on tracking and colony monitoring at Isle of May, St Abbs and Fowlsheugh in 2022 the breeding season and an overview of the impacts HPAI had on the monitoring plans for 2022.</p> <p>A discussion, led by NatureScot, was had on contingency planning for HPAI in the 2023 monitoring season</p> <p>NnGOWL gave a brief update on the Seabird Interactions Study and construction digital aerial surveys at NnG.</p>	
7th March 2023	<p>NnGOWL, Seagreen, Inch Cape and Berwick Bank provided the group with general project updates.</p> <p>UKCEH and RSPB provided an overview of the plans for tracking and colony monitoring at Isle of May, St Abbs and Fowlsheugh for 2023, including contingency planning in the event of HPAI.</p> <p>RSPB provided an overview of the plans for the gannet survival study and tracking at Bass Rock for 2023 including contingency planning in the event of HPAI.</p> <p>NnG provided an overview of the plans for the gannet survival study at Grassholm for 2023 including contingency planning in the event of HPAI.</p> <p>NnG gave a brief update on the Seabird Interactions Study and construction digital aerial surveys at NnG.</p>	Minutes of meeting 07/03/2023

² <https://marine.gov.scot/ml/forth-tay-regional-advisory-group-ftrag>

4.2 Focus of Monitoring

21. NnGOWL's seabird monitoring programme seeks to improve the understanding of seabird interactions with offshore wind farms and to validate assumptions made in the EIA. The focus is on monitoring effects on species and SPAs which were identified as potentially significant in the EIA. The following sections detail the key species and potential effects where the EIA determined potentially significant cumulative effects.
22. As the potentially significant impact predictions were cumulative, it is considered appropriate that the following focus areas are addressed collaboratively with the other Forth and Tay developers. NnGOWL will continue to engage with the FTRAG-O to ensure future monitoring efforts compliment the objectives of this monitoring programme.
23. Complimentary studies developed by the other Forth and Tay developers through the FTRAG-O may seek to monitor colonies from different SPAs in the region. Furthermore, a collaborative approach will seek to synergise monitoring efforts where significant studies relevant to all Projects may be implemented at one project location.

4.2.1 Key Species, SPAs and Effects

24. Table 4-2 below presents the key species, SPAs and potential effects which were previously agreed by FTRAG-O as being relevant to NnGOWL.

Table 4-2: NnGOWL Monitoring Priorities (as set out in the NnGOWL Monitoring Proposal, March, 2016)

SPECIES	PRIORITY	SPA	POTENTIAL EFFECT
Gannet	High	Forth Islands SPA (Bass Rock)	Collision
Kittiwake	High	Forth Islands SPA St Abb's Head to Fast Castle SPA	Collision, Displacement and Barrier Collision and Displacement
Razorbill	High	Forth Islands SPA	Displacement (cumulative)
Puffin	High	Forth Islands SPA	Displacement and Barrier
Guillemot	Low	Forth Islands SPA	Displacement

25. The NnGOWL monitoring programme will focus on the species, SPAs and effects identified above. In some instances, proposed monitoring is anticipated to be undertaken in collaboration with other organisations e.g. developers, government bodies or NGOs. For these species, a review of foraging ranges has recently been published (Woodward *et al.* 2019). This review presents revised foraging ranges of 25 seabird species, based on a wider source of tracking studies than was used in previous reports e.g. Thaxter *et al.* (2012). Although this review provides much needed additional information on foraging ranges, it is considered that for the species and SPAs considered in the NnGOWL monitoring studies, specific tagging data based on individuals from these SPAs over several breeding seasons will provide more relevant information than using more generic data collated from several sites, as presented in Woodward *et al.* (2019). This is supported in the Woodward report, which states in its conclusions that “where site-specific tracking data suggests that birds may travel further than the generic mean, or mean maximum, foraging range, the precautionary approach would be to use the site-specific values, regardless of whether these meet the criteria outlined above relating to sample size and the number of years data available. In such circumstances, tracking data from the colony concerned showing potential overlap with a wind farm would reflect a realistic worst case scenario.”
26. Monitoring of different species, SPAs and effects is currently at different stages, with some studies underway and others not due to commence until the NnG wind farm is operational. This PEMP provides a high level summary of the proposed approach to each and seeks approval for these. It is not proposed to update this document each time more detail is available. Instead, it is proposed that agreement will be sought through FTRAG-O.

4.3 Approached to Monitoring Potential Effects

4.3.1 Displacement and Barrier Effects

27. The following questions were identified through FTRAG-O as being important to any proposed monitoring methods:
- Is there a significant difference in foraging activity inside and outside the Wind Farm, and can this be associated with the presence of the Wind Farm?
 - Is there evidence of connectivity between breeding birds from specific colonies and the Wind Farm footprint?
 - What percentage of birds avoid the Wind Farm boundary?

- Can a significant change in densities of kittiwake, puffin, razorbill and guillemot in the wind farm be identified?
 - Can a significant change in densities of kittiwake, puffin, razorbill and guillemot be attributed to the wind farm?
 - Do densities of kittiwake, puffin, razorbill and guillemot inside the wind farm change with time from construction (i.e. due to habituation)?
28. Two approaches have been taken forward (in agreement with FTRAG-O) to address the above questions:
- Digital aerial surveys to monitor displacement.
 - GPS tracking of breeding kittiwake, puffin, guillemot and razorbill on the Isle of May to monitor both displacement and barrier effects, with the addition of GPS tracking of kittiwake at St Abbs and Fowlsheugh from 2021².
29. Monthly digital aerial surveys at NnG commenced in June 2018 and have been ongoing since. Construction commenced in August 2020, meaning 25 months of pre-construction aerial data have been collected. These data have been analysed by HiDef and a two year pre-construction report has recently been produced and approved by the FTRAG-O (HiDef, 2021). Monthly surveys with the same design are ongoing throughout the construction phase and will continue for a period following the completion of construction. In the first instance it is proposed to undertake two years post-construction monitoring as a minimum. The extent of post-construction monitoring will be established at a future date, will be informed by analysis and will be agreed in discussion with the FTRAG-O.
30. A summary of methods is provided in Section 4.4.

4.3.2 Collisions and/or Avoidance

31. A study termed the “Seabird Interactions Study” to investigate collision and/or avoidance behaviour with offshore wind turbines is being developed at NnG, with a focus on gannet and kittiwake.
32. As collision and avoidance behaviour can only be analysed when turbines are operational, pre-construction data is not required.
33. A number of collision/avoidance research questions were initially raised by MSS (in 2015) for consideration by FTRAG-O. However, it was agreed that these questions were not a priority for focused monitoring and in some instances these questions have been superseded by subsequent research.
34. Key questions for gannet and kittiwake avoidance behaviour:
- Does collision occur and are there empirical methods to record seabird collisions at offshore wind farms?
 - What are the collision rates,
or,
 - What are the micro, meso and macro avoidance rates?
35. Specific methods were confirmed through a competitive tender process, which included input from an independent expert advisory panel consisting of staff from MSS, NatureScot, JNCC and RSPB. The establishment of this panel was based on experiences of similar studies at the Thanet and Aberdeen Bay offshore wind farms. The panel provided technical advice and opinion during the tendering process and

² Tracking of kittiwakes at St Abbs and Fowlsheugh was due to commence in 2020, but due to COVID-19 restrictions it was postponed to 2021

also in design of the study, including on proposed analysis methods. The advisory panel continue to provide expert advice to the study as it progresses.

36. Based on similar previous projects at Thanet and Aberdeen offshore wind farms, it was decided that radar and cameras will be deployed at a number of turbine locations for a fixed period (two breeding seasons) early in the operational phase of the Project. Similar questions to those above were set in the Invitation to Tender (ITT).
37. To ensure that the study is appropriately resourced, it has been taken forward as a collaboration between NnGOWL, Seagreen and SSE (Berwick Bank Project).
38. The seabird interaction study was awarded to STRIX in July 2021. The project is currently in the design stages but will involve the use of both radar and camera systems mounted on turbines to record interactions of gannets, kittiwakes and other species with operational wind turbines. The project will be focussed on recording and analysing any such interactions in daylight hours over two breeding seasons. Further updates will be provided to FTRAG-O at future meetings. Further details on the project are presented in Section 4.4.6.
39. It is NnGOWL's view that whilst an important factor in assessments, flight height is a generic issue for wind farm assessments and should not form the primary focus of individual project monitoring. Therefore, while flight height will not be specifically addressed by the NnGOWL monitoring programme, if methods selected for monitoring effects can also provide flight height information (e.g. GPS tags, radar, or digital aerial surveys), this will be considered and relevant data will be shared. NnGOWL is also open to participating in strategic studies focused on flight height e.g. through ScotMER, and will provide relevant data to these studies, where possible. Table 4-3 indicates where data from the NnGOWL monitoring studies could potentially be used to inform ScotMER knowledge gaps.

Table 4-3: Areas of NnGOWL monitoring studies that could feed in to ScotMER knowledge gaps, as presented in Version 1 of the published ScotMER evidence map, dated October 2018

POST-CONSTRUCTION STUDY	ID	SCOTMER KNOWLEDGE GAP
Digital Aerial Surveys	OR.01	Baseline at sea distribution and abundance
	OR.14	Seabird flight heights
	OR.20	Degree of habituation to effect
GPS tracking	OR.07	Variation in distribution, abundance, and behaviour with weather conditions and diel cycle
	OR.08	Level and type of nocturnal activity at sea, and variation across space and time
	OR.09	Colony of origin of birds at sea during the breeding season
	OR.14	Seabird flight heights
	OR.15	Seabird dive behaviour
	OR.23	Change in demographic rates resulting from displacement/ barrier effect
	OR.30	Technologies to allow tracking species/ during seasons of interest
Collision and avoidance study	OR.17	Mortality rate of birds colliding

4.3.3 Population Effects

40. The following potential research questions were raised by MSS in 2015, and these are provided below for information:
 - What is the rate of adult productivity for each of the key species at the key SPAs for those species?
 - What is the rate of adult survival for each of the key species at the key SPAs for those species?
 - Where it is possible to compare between SPAs, are there differences in the rates of adult productivity and survival for the key species at these SPAs?
41. Similar to the collision-related questions, these have been partly superseded by more recent discussions and research, which have been developing since 2018. However, NnGOWL recognises the importance of addressing the fundamental question of how wind farm effects (displacement, barrier and collision) – if they occur – could affect SPA populations. NnGOWL is committed to monitoring population effects and studies have been developed with UKCEH and RSPB in agreement with the FTRAG-O and in collaboration with Seagreen and Berwick Bank, in relation to monitoring kittiwake, puffin, guillemot and razorbill populations at relevant SPAs. The data loggers that are now being fitted to breeding adults from these SPAs maximise the ability to quantify the effects of displacement and barrier effects, as well as improving estimates for collision risk models and increasing the understanding of three-dimensional reactive behaviour.

42. UKCEH have been conducting GPS tracking work on four species (kittiwake, guillemot, razorbill and puffin) breeding on the Isle of May since the 2018 breeding season. For the 2020 and 2021 studies, the focus was on using data loggers that maximised the ability to quantify the effects of displacement and barrier effects, improve estimates for collision risk models and increase understanding of three-dimensional reactive behaviour.
43. For kittiwake, the RSPB planned to undertake similar GPS tracking studies on breeding birds from Fowlsheugh and St Abb's Head colonies in the 2020 breeding season, however, due to Covid-19 restrictions, this work did not commence until the 2021 breeding season. Monitoring work at these three colonies continued where possible (due to HPAI restrictions) during the 2022 and 2023 breeding seasons.
44. As with digital aerial surveys, it is proposed to continue with annual GPS tracking of the four species on the Isle of May in the breeding season throughout construction and for a period into the operational phase. The extent to which this will extend to breeding kittiwakes from Fowlsheugh and St Abb's Head colonies will be dependent on the future collaboration between the Forth and Tay Developers, and will be agreed in discussion with FTRAG-O. However, it is anticipated that a minimum of two years post-construction data will be collected at the Isle of May but that the cessation of monitoring will be informed by analysis and agreed in discussion with FTRAG-O.
45. In relation to monitoring gannet populations, an approach proposed by Bob Furness at a previous FTRAG-O meeting has been further developed with the Heriot-Watt University and the University of Leeds. The study builds on existing colour ringing projects of adult gannets at the Bass Rock and Grassholm colonies with the aim of measuring and comparing adult gannet survival rates between these two colonies. This will be a long-term study and will relate to influences which are wider than just wind farm effects, such as climate change, fishing practices, marine pollution and influences from further afield. It is planned that this study will be a strategic study with contributions from wind farm developers (including developers outside the Forth and Tay but within the foraging range of the Bass Rock). NnGOWL, alongside Berwick Bank and Seagreen has committed to funding the continuation of the existing colour ringing projects of adult gannets at the Bass Rock and Grassholm colonies for the 2020-2024 seasons. The duration of the study and contributions from NnGOWL will be subject to discussion with the FTRAG-O. For the 2022 and 2023 breeding seasons, the project was a collaboration between Heriot-Watt University and the RSPB.
46. For the 2019 – 2022 fieldwork seasons, prior to the start of the season, papers for both monitoring projects were circulated to the FTRAG-O for discussion and agreement. A summary of results for each monitoring project is presented in Section 4.4.2.

4.4 Ongoing Monitoring at NnG

4.4.1 Digital Aerial Surveys

4.4.1.1 Digital Aerial Surveys at NnG

47. Pre-construction digital aerial surveys of the NnG Wind Farm Area and a 12 km buffer commenced in June 2018 and will continue through the construction period. The pre-construction data have been compiled by HiDef into two year pre-construction report which has been reviewed and approved by the FTRAG-O (HiDef, 2021).
48. The primary aims of the digital aerial surveys are:
 - To collect seabird distribution data during the breeding and non-breeding seasons to permit spatial modelling of seabird distributions and the estimation of abundance before, during and after construction and thereby estimate the magnitude (if any) of displacement resulting from avoidance of the Wind Farm;

- Estimate the extent of connectivity between seabirds using the Wind Farm footprint and the SPA colonies (Forth Islands and St Abb's Head to Fast Castle) in the vicinity through analysis of flight direction.

49. Data is being collected using the same methodology to allow comparison across the three survey periods (pre-construction, construction and post-construction).

4.4.1.1.1 Survey Area

50. The survey area for the digital aerial surveys has been defined as the NnGOWL Wind Farm Area plus a 12 km buffer area (see Figure 4-1). Digital aerial surveys are being undertaken by HiDef Aerial Surveying Ltd and commenced in June 2018. Within the survey area 14 transects are aligned approximately in a north-west to south-east orientation, similar to those of the baseline boat-based surveys.

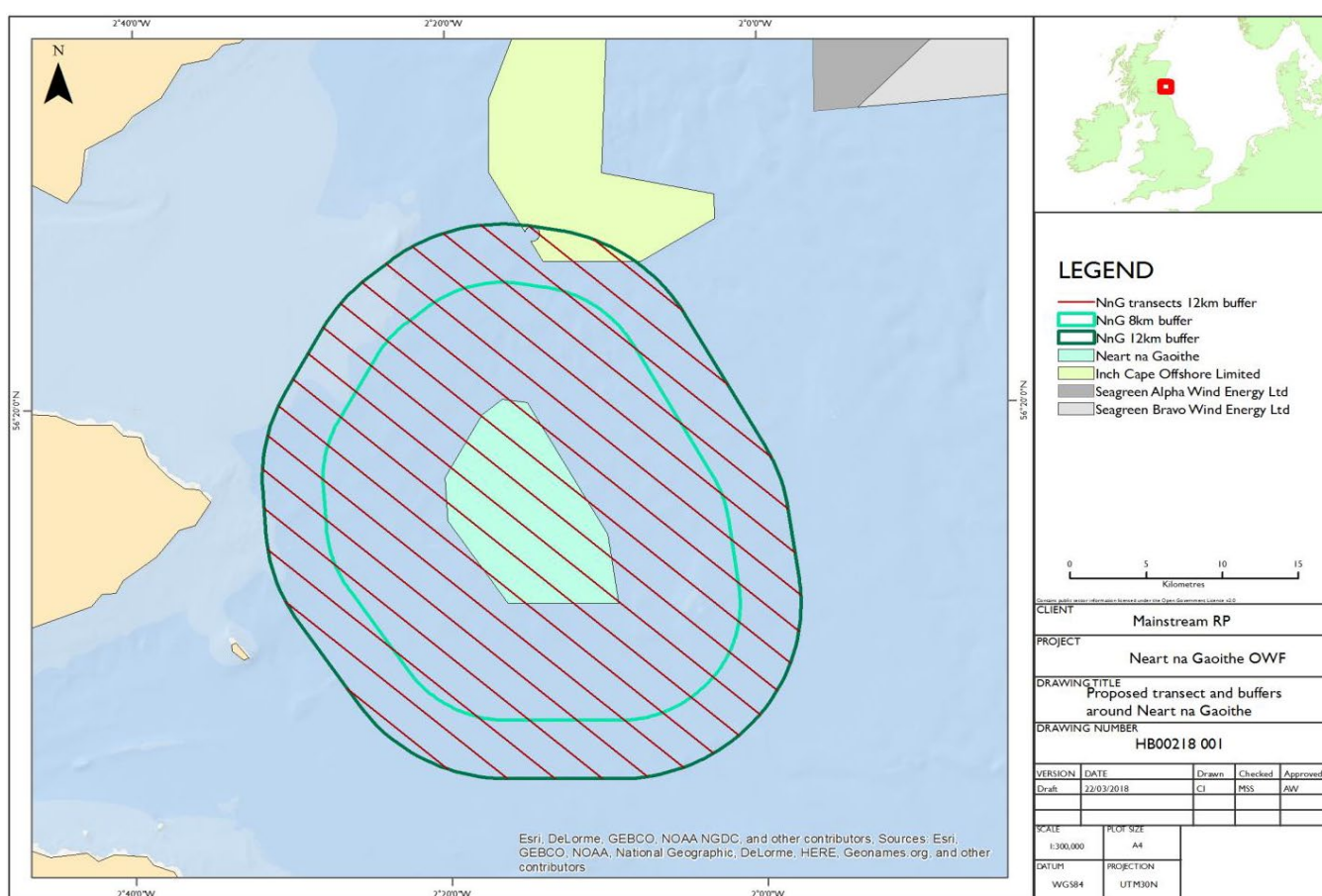


Figure 4-1: NnG Digital Aerial Survey Area

4.4.1.1.2 Survey Design

51. A 2 km transect spacing was used as it is considered that this will capture the habitat complexity that exists across the study area. The surveys cover 250 m wide transects to ensure over 12.5% coverage of the survey area.
52. Surveys are being conducted using HiDef's GENII 4 camera rig mounted on a fixed wing DA42 low emissions aircraft.
53. The GENII camera rig contains four extreme high resolution digital video cameras and is operated at a survey altitude of approximately 550 m. At this altitude each camera will survey a strip approximately 125 m in width with a Ground Sample Distance (GSD) resolution of 2 cm. When combined, the 4-camera

rig is capable of sampling a total transect width of 500 m. Surveys are flown at a ground speed of 220 km/hr.

4.4.1.1.3 Analysing and Reporting

54. Following completion of the pre-construction aerial surveys in July 2020, the following data has been analysed and compiled into a pre-construction monitoring report:
 - Bird locations (including corrections for availability bias as appropriate) for all species; and
 - Direction of travel for the five key species (gannet, kittiwake, puffin, guillemot and razorbill).
55. Methods to account for availability bias were applied for guillemot, razorbill, puffin and harbour porpoise.
56. Data were analysed from two of the cameras to determine seabird distribution, with data from the remaining two cameras being stored in case needed subsequently.
57. A pre-construction monitoring report was published and circulated in September 2021. Following receipt of comments from MSS, the final approved version was circulated to FTRAG-O and MS-LOT on 2nd December 2021 (HiDef, 2021).

4.4.1.2 Combined Approach to Pre-Construction Digital Aerial Surveys and Forth and Tay

58. Offshore construction activity in the outer Forth and Tay commenced in 2020 and will continue for some years. Construction activities at NnG and Seagreen are currently ongoing, and construction is also likely to commence at Inch Cape at some point in the next few years.
59. Seagreen conducted pre-construction digital aerial surveys from March 2019 through to September 2020 using the same methods as outlined above. Inch Cape carried out surveys from April 2019 to March 2020, with NnGOWL and Seagreen covering the Inch Cape area between May and September 2020. Overall, the larger, combined study area was covered for two breeding seasons and one non-breeding season between April 2019 and September 2020 (See Section 4.4.1.2.1 below).
60. The primary aim of the combined approach was:
 - To ensure data is collected across all sites increasing the validity of any subsequent temporal or spatial comparisons of bird densities and distribution across the larger area.

4.4.1.2.1 Survey Area

61. The survey area for the combined surveys extended across the respective project sites and incorporated the existing 12 km buffer around the NnG site and Seagreen and a 4 km buffer around Inch Cape. The total survey area encompassing the three sites effectively covered a continuous area of approximately 3,204 km². The total survey area and transects is presented in Figure 4-2.

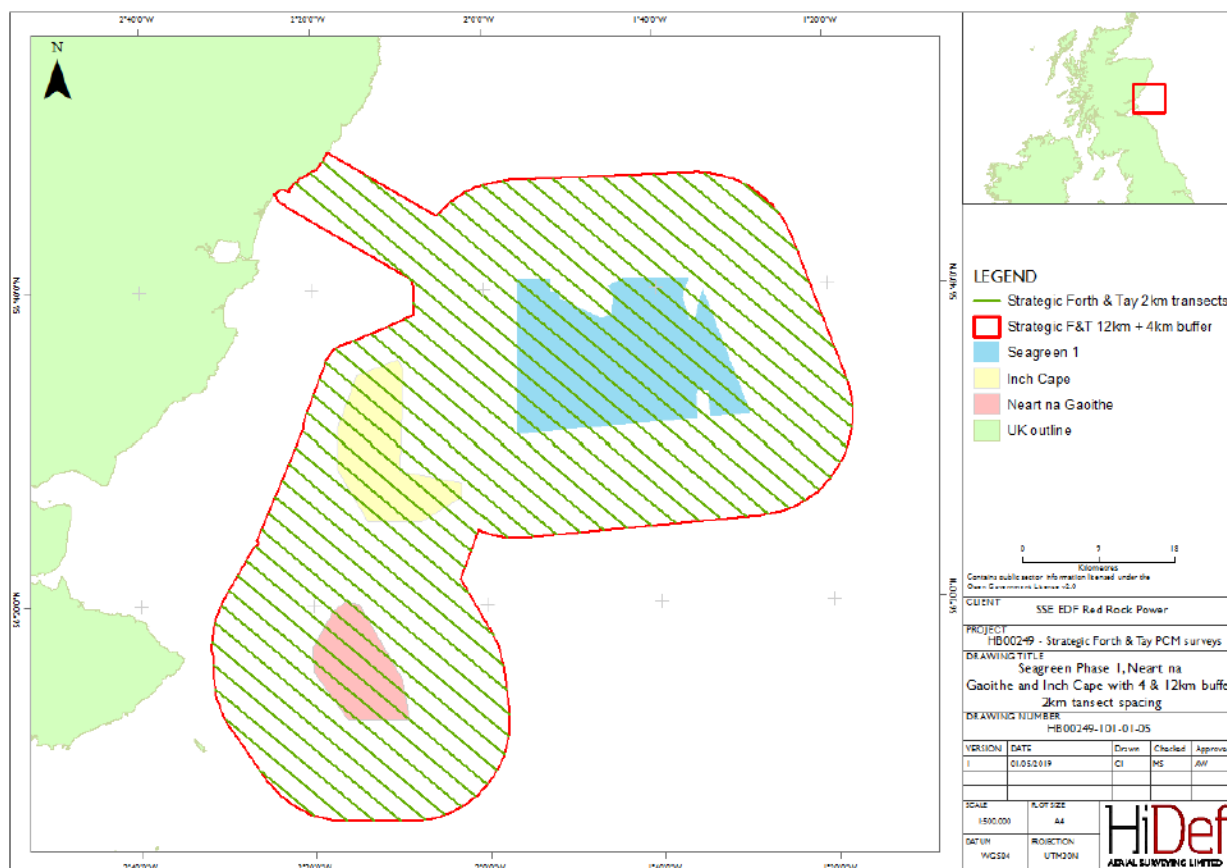


Figure 4-2: Forth and Tay Combined Digital Aerial Surveys

4.4.1.2.2 Survey Design

62. Combined surveys commenced in April 2019 and continued to September 2020. Each of the surveys of this extended area were planned to be undertaken over as short a period of time as possible, in order to reduce potential sources of error affecting the determination of densities and distribution (e.g. short-term fluctuations and the risk of double counting).
63. The same broad survey methods were used across the combined survey area. This consistency in methods and approach is important to ensure that the resulting data from across the NnG site (and buffer) remain comparable between years, and also with the data collected for Inch Cape and Seagreen, as well as realising the benefits outlined above.
64. Combining survey areas for the different projects will ensure that each project has access to baseline data that derive from a wider area than would be the case if baseline surveys were undertaken separately by each project. This will provide an enhanced platform for developing the subsequent post-construction/operational monitoring programmes and will potentially give greater power for detecting change attributable to the offshore wind farms in the region. Additionally, establishing the survey area and transects at this stage will increase the potential for deriving comparable post-construction/operational monitoring data from the respective projects.

4.4.1.3 Aerial Surveys of Berwick Bank

65. Hi-Def have also conducted aerial surveys for the Berwick Bank OWF project (previously Seagreen two and three) to provide pre-consent baseline characterisation (Figure 4-3). Surveys commenced in March 2019 and continued until April 2021 (providing a total of 24 months, with April 2021 flown due to a

missed April 2020 flight). Although not surveyed on the same day as the NnG, Inch Cape and Seagreen areas, the same methods were used, providing additional coverage in the wider Forth and Tay area.

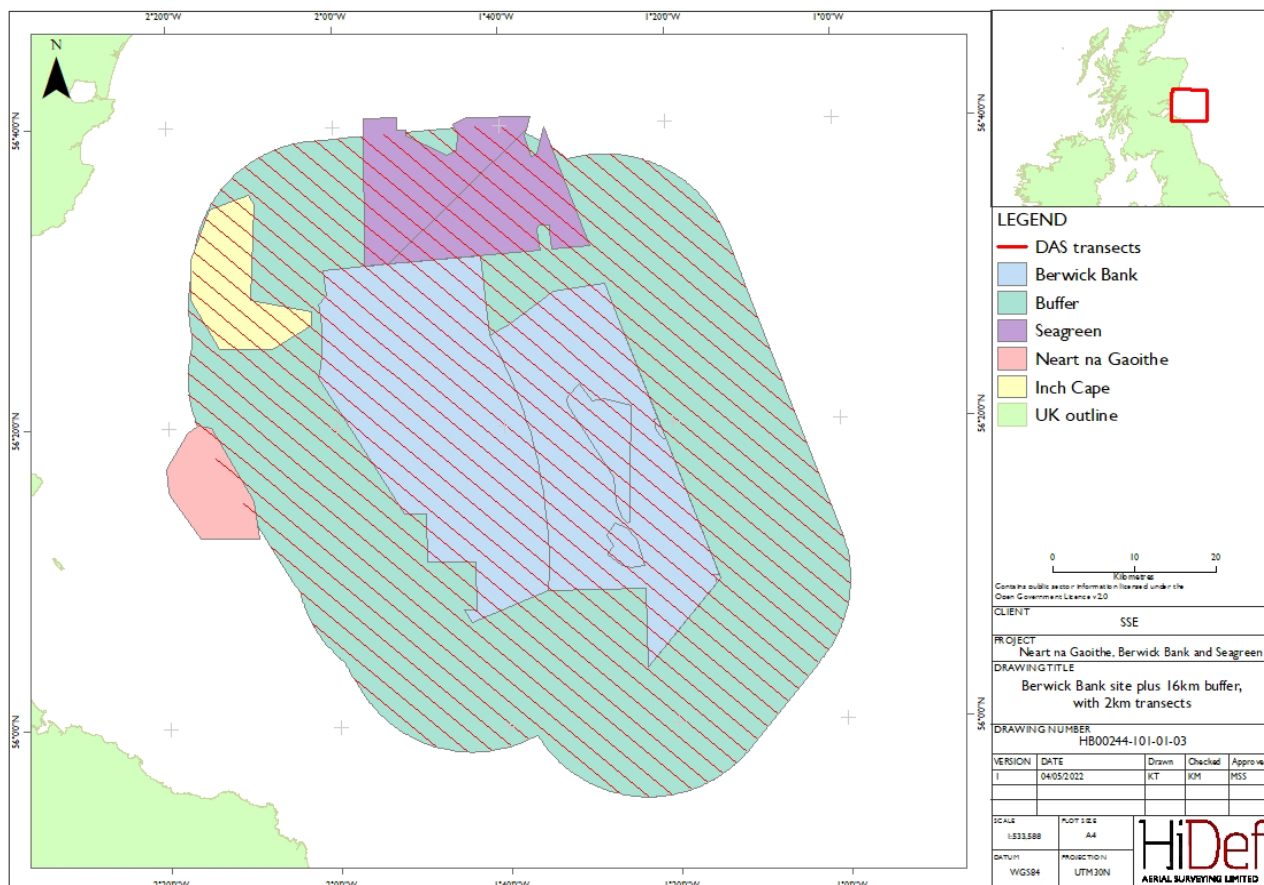


Figure 4-3: Berwick Bank Digital Aerial Survey Area

66. Where future collaborations between projects are achievable, these will be investigated at the time e.g. combined post-construction aerial surveys.

4.4.2 GPS Tracking Studies

67. GPS tracking is a useful method of obtaining detailed at-sea distribution data of individual breeding adult seabirds from SPA sites in foraging range of an offshore wind farm site. Location fixes can be partitioned into flying and non-flying activity, which enables foraging distribution and horizontal flight lines to be mapped accurately. Baseline information on at-sea distribution is fundamental to interpreting the distribution of seabirds during the operation of an offshore wind farm. Thus, pre-construction monitoring is a key strand of the structured before-during-after design proposed.
68. In the 2018 to 2021 breeding seasons, GPS data loggers were deployed on adult kittiwake, puffin, guillemot and razorbills breeding on the Isle of May. The number of birds tagged, and number of trips recorded is shown in Table 4-4. These data represent three breeding seasons of pre-construction tracking studies (2018, 2019 & 2020) and one breeding season of tracking studies (2021) in the NnG construction phase for the above four species from the Isle of May. The CEH monitoring programme for these four species on the Isle of May is being continued for the 2022 and 2023 breeding seasons.

Table 4-4: Number of tracked birds from the Isle of May (IoM) in 2018 to 2021 and kittiwakes at St. Abbs (SAB) and Fowlsheugh (FHH) in 2021 (Sources: Bogdanova et al, 2020a and 2020b, Bogdanova et al., 2021, Bogdanova pers comm 2022). Note: no birds were tracked during the 2022 breeding season due to HPAI restrictions.

SPECIES	NUMBER DEPLOYED	NUMBER RETRIEVED WITH DATA	NUMBER OF TRIPS
2018 Breeding Season			
Guillemot	25	24	207
Razorbill	15	13	142
Puffin	26	23	175
Kittiwake	16	16	71
2019 Breeding Season			
Guillemot	24	24	120
Razorbill	15	14	129
Puffin	25	24	123
Kittiwake	25	25	167
2020 Breeding Season*			
Guillemot	25	25	n/a
Razorbill	15	15	n/a
Puffin	27	12	n/a
Kittiwake	25	24	n/a
2021 Breeding Season			
Guillemot	25	23	160
Razorbill	15	11	118
Puffin	25	24	249
Kittiwake	50 (IoM) 40 (FHH) 39 (SAH)	50 (IoM) 40 (FHH) 37 (SAH)	929 (IoM) 544 (FHH) 743 (SAH)
* Due to substantial data gaps in all species in the 2020 dataset, a number of foraging trips were incomplete, therefore individual trips in 2020 were not identified, as this metric was not used in the analyses of tracking data."			

69. Building on the monitoring work on the Isle of May in 2018 and 2019, a tagging and colony monitoring approach for 2020 was developed jointly by UKCEH and RSPB and jointly funded by NnGOWL, Seagreen and Berwick Bank. This included the tracking of kittiwake, puffin, guillemot and razorbills at the Isle of May and kittiwakes at the Fowlsheugh and St. Abb's Head colonies. The number of birds tagged and number of trips recorded for all three colonies for 2021 is shown in Table 5.4. The intention was to commence the additional tagging and colony monitoring of kittiwakes at Fowlsheugh and St. Abb's Head during the 2020 breeding season however, due to Covid-19 restrictions, this was not possible. Instead, this part of the study commenced in 2021.
70. The methods used in the GPS tracking and colony monitoring for the four species at the Isle of May and more recently at Fowlsheugh and St. Abb's Head are reviewed annually and amended under consultation with the FTRAG-O, as outlined in Sections 4.4.2.1 to 4.4.2.4 below.

4.4.2.1 Summary of 2020 and 2021 Kittiwake Tracking Studies

71. Results from kittiwake tracking on the Isle of May in 2020 found evidence that the devices used were having a negative effect on kittiwakes (Daunt *et al.*, 2021). This was in contrast to findings at Flamborough and Filey colonies where the same loggers were deployed in 2018 and 2019 with no effects on breeding success observed (Wischnewski, pers. comm), and for the smaller Pathtrack loggers used in 2019 on the Isle of May (Bogdanova *et al.* 2020).
72. In the 2020 kittiwake study, larger University of Amsterdam (UvA) tags, with greater functionality were used on kittiwakes, compared to the smaller Pathtrack tags that had been used in 2019. The study involved a sample of kittiwake nests during the chick-rearing period at two sites. These 'experimental' nests were accessible both for catching adults and chicks and were visible from a distance to allow observations to be recorded without disturbance. A second sample of nests were selected that acted as controls, evenly distributed between the same two sites.
73. Overall, the study found measurable negative effects of the data loggers on kittiwake changeover rates (an index of trip durations), chick attendance and breeding success. This is in contrast to 2019, when no device effects were found, using smaller tags (Bogdanova *et al.* 2020).
74. In addition to the 2020 studies on device effects on kittiwakes, a power analysis was undertaken by BioSS to quantify the likely power to detect displacement effects using GPS tracking data, and linked individual-level data, for kittiwakes at the Isle of May. The purpose was to help inform decisions on future data collection, including:
 - The number of kittiwakes to tag in 2021;
 - The number of years and number of tagged kittiwakes required per year in the post-construction period.
75. Full details of this gap analysis were presented in Daunt *et al.*, (2021), which was circulated to the FTRAG-O group in April 2021. In summary, the power analysis indicated that the study is likely to have sufficient power to detect changes in behaviour and, if effects are strong, breeding success, but less power to detect changes in adult mass (which is linked to future survival probability) and in particular adult survival. It is important to note that these results are indicative and that there are a number of caveats associated with the power analysis. However, they remain useful in demonstrating the gradient in power across these key measures.
76. In June and July 2021, UKCEH and RSPB undertook GPS tracking of kittiwakes at Fowlsheugh, the Isle of May and St Abbs Head which involved the deployment of two types of logger: a) Pathtrack nanoFix-GEO+RF GPS; and b) University of Amsterdam (UvA) GPS-accelerometer-altimeter loggers.
77. The rationale for the twin deployment approach in 2021 was to tease apart logger effects from colony location and interannual variation. The approach allowed the project team to compare the effects of the

two logger types on key measures that can be recorded at breeding colonies in instrumented and control birds – parent change-over rates, chick attendance, chick body condition and breeding success. Further, the approach enabled key measures of at-sea behaviour and performance to be compared between the two logger types, specifically trip duration, distance travelled and at-sea distribution.

78. The field deployments were successful with data collected on 89 kittiwakes carrying Pathtrack loggers and 40 kittiwakes carrying UvA loggers, which were then compared with 408 control pairs (totals across the three study colonies).
79. The 2021 at-sea distributions for kittiwakes showed that birds from the Isle of May concentrated mainly in offshore areas, although the core foraging area included waters around the Isle of May, suggesting that food resources were available in the vicinity of the colony. Similarly, at-sea distributions of kittiwakes from Fowlsheugh and St Abbs Head were also mostly offshore, although birds from St Abbs Head also used coastal waters around the colony. The core areas used by kittiwakes from the three colonies in 2021 were segregated, with little overlap, as has been recorded in other seabird species.
80. The 2021 study found small but measurable negative effects of UvA logger deployment on kittiwake at-colony behaviour at all three study colonies. There were fewer parent changeovers per day (indicative of longer foraging trips) at nests where one bird was tagged with a UvA logger than at control nests. Chicks of UvA-tagged birds were left unattended more often than those at control nests, although chick attendance was generally high in all groups. Data on chick and adult condition were only available for the Isle of May but indicated that chick condition was not affected by deployment of either logger type. No difference in changeover rates or chick attendance was found between Pathtrack-tagged birds and control nests. In summary, analysis of the results showed that there was variation between kittiwake colonies in the effects of devices on the key measures considered, for reasons that are hard to establish. However, a pattern is emerging based on the 2020 and 2021 data indicating that the UvA tags with glue attachment are having a larger impact on kittiwakes compared to Pathtrack tags, which raises concerns about animal welfare and representativeness of the data.

4.4.2.2 Summary of Puffin Tracking Studies

81. Based on previous studies (e.g. Harris *et al.*, 2012) it is known that puffins are sensitive to disturbance from handling and/or carrying data loggers. A feasibility study was undertaken in 2018 to consider device effects on puffins to ensure bird welfare is not compromised and data representativeness is maintained.
82. Based on the findings of the 2018 feasibility study, the following recommendations from CEH and RSPB (Daunt, 2019), were discussed at a meeting between NnGOWL, CEH and RSPB in January 2019 and were circulated to FTRAG-O members, who agreed to the following recommendations to conduct additional puffin tracking with caution during the 2019 breeding season:
 - *Capture method:* Reverting to the previous method of capturing birds at burrows is recommended, since no reduction in responses using the mist-net method were detected, and there are two clear advantages of capturing in burrows - all study burrows are known, so supplementary feeding can be provided universally, and deploying on both members of a pair can be avoided;
 - *Logger size:* provisioning rates of birds with 4.1 g loggers was slightly higher suggesting that using loggers that are as small as possible could be beneficial;
 - *Deployment method:* It is recommended that deployment takes place at the capture site and that the protocol is reduced down to the absolute minimum of activities (i.e. deployment of devices and colour ringing only). It is also recommended that the number of strips of tape is reduced from four to three to shorten the duration of the deployment procedure as much as possible;

- *Supplementary feeding:* It is recommended that supplementary feeding is commenced immediately and continues until it is shown that both the adults are supplying food, or the chick has fledged. Further, it is recommended that work is undertaken from mid chick-rearing onwards so that chicks are an age where they can tolerate lower provisioning rates; and
- *Data representativeness:* It is recommended that observations are undertaken of control pairs during deployment periods, as was done in 2018. It is also recommended that opportunities for combining GPS tracking data and data from unmanipulated birds e.g. on trip durations and provisioning rates in assessments of effects of renewable developments on puffins are explored.

83. For the 2020 puffin study, a sample of puffin burrows were selected for logger deployment during the chick-rearing period at two adjacent sites on the Isle of May. Adults were captured at their burrows, so all study burrows were known and supplementary feeding could be provided if needed. Furthermore, this ensured that only one member of a puffin pair was tagged. An additional sample of burrows had one pair member colour-ringed only to separate potential negative effects of handling and device deployment. A third sample of burrows were selected that acted as controls, evenly distributed between the same two sites.
84. As in 2018 and 2019 (Bogdanova *et al.* 2019, 2020), the study found measurable negative effects of the data loggers on feeding rates of puffin chicks, but no effect on breeding success. These results suggest a consistent pattern across years of a negative impact of handling and device attachment on feeding rates of manipulated adults, which are partially compensated for by the unmanipulated mate. As such, was concluded that the supplementary feeding protocol is an important safeguard in ensuring that chicks fledge at a rate typical of the population as a whole.
85. It was proposed to undertake a similar protocol for puffin in the 2021 breeding season as was carried out in 2020 (Daunt *et al.*, 2021). An assessment of behavioural responses of puffins was undertaken as in 2018-2020, and although some negative effects were seen, these effects were smaller than in previous years. As in 2020, to compensate for any potential negative effects of handling and device deployment on puffin chick feeding rates, supplementary feeding of the chicks was again conducted successfully. Monitoring of chick survival rates showed that puffin chicks in all study groups had a high survival rate and there was no difference in breeding success between the treatment groups or study sites (Daunt & Bogdanova, 2022).
86. In contrast to previous years, results from the 2021 puffin tagging study did not show substantial negative effects of handling or GPS logger deployment on chick provisioning rates in puffins. There was some evidence for a reduction in feeding rates by both colour-ringed and GPS-tagged individuals compared to the expected if pair members shared chick provisioning duties, however there was no observed difference between treatment and control burrows, indicating that the unmanipulated partners were able to fully compensate for their mate's reduced provisioning rate. Supplementary feeding of all chicks at treatment burrows was again carried out in the 2021 season, resulting in the chicks from treatment burrows fledging in better condition compared to controls.
87. The at-sea areas used by tagged puffins in 2021 were within the same general direction from the colony as in previous years, although the overall distribution was more restricted, resulting in higher overlap of core areas with NnG. The more restricted distribution in 2021 may reflect more favourable foraging conditions in this year compared to previous years.

4.4.2.3 Summary of 2020 and 2021 Guillemots and Razorbill Tracking Studies

88. In addition, UKCEH conducted GPS tracking on guillemots and razorbills on the Isle of May in the 2021 breeding season. Numbers of tagged individuals are shown in Table 4-4.

89. For both species, foraging range in the 2021 season was more restricted compared to previous years, indicating that birds undertook shorter foraging trips. Also, breeding success for guillemot was higher than in 2018-2020. Together, these patterns suggest that local environmental conditions in 2021 were more favourable than in the previous years when pre-construction monitoring was carried out.
90. The at-sea distributions showed guillemots and razorbills used coastal as well as offshore areas in the 2021 breeding season, as in previous years at this colony. The core foraging areas of both species included waters around the Isle of May, suggesting that food resources were available in the vicinity of the colony in the 2021 breeding season. Detailed studies of device effects are not possible on guillemots and razorbills on the Isle of May without introducing additional disturbance. However, anecdotal evidence suggests that tagged individuals of these species do not show a marked adverse effect of carrying the loggers (Daunt *et al.*, 2022).

4.4.2.4 Plans for 2022 and 2023 Tagging Studies

91. The approach for the 2022 breeding season was circulated and agreed with the FTRAG-O group in March 2022 (Daunt *et al.*, 2022).
92. For kittiwake, given the results of device effects from the 2020 and 2021 studies, it was decided not to undertake further deployments using the UvA logger type and glue attachment method. All deployments on kittiwakes in 2022 will instead use the Pathtrack GPS loggers, as negative effects on tagged kittiwakes have been found to be markedly smaller or absent from the key measures studied to date.
93. A sample size of 50 kittiwakes per colony will be tagged, as was proposed in 2021 and informed by the power analysis undertaken in early 2021 (Daunt *et al.* 2021). Studies of device effects will be undertaken at all three colonies using the same methods as those employed in 2019 and 2020 (parent change-over rates, chick attendance, chick condition (Isle of May only), and breeding success).
94. For guillemot and razorbill, UKCEH will maintain the same approaches and target sample sizes as that undertaken in previous years (guillemot: n = 25; razorbill: n = 15).
95. For puffin, a paper summarising empirical and analytical approaches to maximise insights from puffin data given known device effects in this species was prepared by UKCEH and circulated to FTRAG-O in March 2022. For 2022, the UKCEH proposal for puffin fieldwork is to maintain the same approach and sample size (n=30) as that undertaken in 2019-2021 because there was no substantive change in device effects in 2021 that would cause a change from the current approach.
96. Following the significant outbreak of highly pathogenic avian influenza (HPAI) in seabirds in May 2022, the scope and extent of the monitoring work in 2022 at these colonies was subject to specific restrictions. An overview of the 2022 season and the influence of HPAI on plans was presented to the FTRAG-O group in November 2022. The plans for the 2023 season were discussed with the FTRAG-O group in March 2023, and aimed to follow the plans intended for the 2022 season, subject to any HPAI restrictions.

4.4.3 Gannet Colour Ringing Studies

97. Colour-ringing and resighting of adult gannets at the Bass Rock and Grassholm colonies was started in 2010 and has been ongoing annually since. In 2020, with the recognition of the value of a strategic colour-ringing study to assess the effects of offshore wind farm developments on gannet adult survival, three Forth and Tay Developers, NnGOWL, Seagreen and Berwick Bank, picked up the funding of the colour-ringing and resighting efforts at these colonies. The idea of the study in relation to the Forth and Tay OWF projects was first discussed at the March 2016 FTRAG-O meeting, and the project has been discussed regularly at FTRAG-O meeting since then. A summary of the fieldwork methods for the Bass Rock and Grassholm colonies is presented below.

4.4.3.1 Colour-Ringing Adult Gannets

98. On the Bass Rock, the plan for each season is to capture and fit colour rings to approximately 30 adult gannets. This is achieved by catching birds at the nest during chick-rearing, using a 6-meter telescopic pole fitted with a metal noose or hook. Upon capture, each bird is fitted with a metal British Trust for Ornithology ring and a coloured plastic ring. The body mass is recorded and a GPS logger (iGotU) attached to the upper side of the central tail feathers, before releasing the bird to the nest site. All birds equipped with loggers are then recaptured after 7 - 14 days to retrieve loggers and download tracking data. Birds are sexed based on observed sex-specific behaviour, or in some cases from DNA.
99. On Grassholm, breeding gannets are caught at the nest between mid-July to mid-August using a carbon fibre pole with a noose or crook during changeover so that chicks or eggs are not left unattended. The captured bird is typically fitted with a logger (GPS, GLS, camera or a combination). In addition, 1–2ml blood is taken for molecular sexing, and body mass, wing length and bill length will also be recorded to estimate body condition.

4.4.3.2 Resighting of Colour-Ringed Individuals

100. On the Bass Rock, searches for colour-ringed birds at the colony are made by scanning nest-sites through binoculars from a distance of up to ~30m to record ring-numbers.
101. On Grassholm, searches for colour-ringed adults are made using binoculars and telescopes, and any observed 4-digit alpha-numeric codes recorded. Observations are focussed on the four core areas of the colony where research has concentrated since 2006. Incidental checks across other parts of the colony to search for birds that may have moved nest-site are also be carried out.

4.4.3.3 Analysis of Data

102. Re-sightings are being and will continue to be used to build annual encounter histories and Capture-Mark-Recapture models (Lebreton *et al.* 1992) will be used in the programme MARK (White & Burnham 1999) to estimate apparent survival and recapture probabilities.
103. Due to Covid-19 restrictions in 2020, it was only possible to conduct fieldwork for one week in July, during which time 29 adult gannets were colour-ringed, with 211 re-sightings of colour-ringed adults. On Grassholm, it was not possible to colour-ring any new adults, however there were 187 re-sightings of colour-ringed adults over 8 days in July and August. Results of the 2020 survey work were presented at the FTRAG-O meeting in November 2020.
104. A report on the 2020 fieldwork season at the Bass Rock and a review of annual adult survival of gannets on the Bass Rock between 2010 and 2019 (Lane & Hamer, 2021a) was prepared and circulated to the FTRAG-O group in June 2021.
105. Following discussions at the FTRAG-O meeting in November 2020, a power analysis was undertaken on the existing data from the Bass Rock and Grassholm in early 2021 by Heriot-Watt University. The aim of the power analysis was to determine whether the existing Capture-Mark-Recapture study design was robust enough to detect a 0.045 reduction in adult gannet survival at Bass Rock if such a change should occur following the operation of offshore wind farms in the Forth and Tay region. This is the level of decline in female survival required to halt population growth there at the Bass Rock colony.
106. The power analysis concluded that based on the existing colour ringing and resighting data at Bass Rock and Grassholm colonies, there is strong evidence that the existing study design at these two colonies alone is sufficient to detect a biologically meaningful change in adult gannet survival rates if such a change should occur at Bass Rock, following the operation of offshore wind farms in the Forth and Tay region (Langley *et al.*, 2021). The power analysis was circulated to the FTRAG-O group in May 2021 and discussed at the FTRAG-O meeting in November 2021.

107. Survey work on the Bass Rock and Grassholm was repeated in the 2021 breeding season. On the Bass Rock, 15 new adult gannets were colour-ringed in July, with 13 replacement colour-rings also fitted to previously marked birds. There were also more than 230 re-sightings of colour-ringed individuals. On Grassholm, 37 adult gannets were colour-ringed in early August (including some replacement colour rings), while there were 188 re-sightings of colour-ringed adults over nine trips in July and August. Results of the 2021 survey work were presented at the FTRAG-O meeting in November 2021.
108. Following completion of the 2021 field season, a paper examining the sex-specific foraging behaviour of breeding adult gannets on the Bass Rock during the summer of 2021 and the sex-specific survival of gannets in this population over the 11 years (2010-2021) preceding the installation of operational offshore wind turbines in the Firth of Forth (Lane & Hamer, 2021) was circulated to the FTRAG-O group in October 2021.

4.4.3.4 2022 Project Management and Fieldwork

109. Following the retirement of Keith Hamer and the move of Jude Lane from Leeds University to the RSPB, the contract for monitoring adult gannets on the Bass Rock has been transferred to RSPB, led by Jude Lane. The project will still be jointly funded by NnGOWL, Seagreen and Berwick Bank for the agreed period of 2020 to 2024. It is currently anticipated that the agreed handover of long-term project management to JNCC will be transferred in 2024.
110. The colour-ringing and resighting of adult gannets will be continued on the Bass Rock and Grassholm for the 2022 to 2024 breeding seasons. Regular feedback on the study programme will be given to the FTRAG-O group after each season.
111. Following the significant outbreak of HPAI in seabirds, including within the gannets at Bass Rock and Grassholm in 2022, the scope and extent of the field work in 2022 at the two study colonies was subject to specific restrictions. An overview of the 2022 season and the influence of HPAI on plans were presented to the FTRAG-O group during the November 2022 and March 2023 FTRAG-O meetings. The plans for the 2023 season were discussed with the FTRAG-O group in March 2023.

4.4.3.5 Additional Gannet Tracking

112. For the 2022 season, the Forth and Tay Developers (NnGOWL, Seagreen and Berwick Bank) also agreed to fund additional tracking of adult gannets at Bass Rock in the pre-chick rearing period (end April/early May). This will also be complimented by tracking work in the chick rearing period in summer 2022, as per 2021. Although outside the core consent compliance monitoring requirement of continuing the adult survival study data collection at Bass Rock, 2022 will be the last year that pre-operational data could be collected on adults at the Bass Rock during the pre-chick rearing period.
113. RSPB have deployed 10 University of Amsterdam (UvA) loggers on 10 adult gannets in the pre-chick rearing period (late April 2022). The loggers are solar-powered, remote download GPS loggers with in-built barometric pressure sensors, that will allow three-dimensional behaviour data to be collected from gannets. Deployment prior to egg-laying with a base-station located on the mainland will allow data to be collected and downloaded remotely without additional disturbance of birds before chicks have hatched. This will prevent disturbance during incubation and risk of nest failure. Tags are expected to remain on the 10 adults for eight weeks. Another 10 UvA loggers had planned to be deployed on a second group of birds during the chick-rearing stage, when the ringing and re-sighting work is also undertaken as per the methods used in previous years. However due to the HPAI outbreak in the gannets at Bass Rock this was not undertaken.

4.4.4 Seabird Interactions Study

114. This study aims to improve understanding of seabird behaviour and interactions around operational offshore wind turbines with a focus on acquiring empirical measures of collision risk and three-dimensional flight behaviour around wind turbines for the key species which occur in the Firth of Forth area – focused on gannets and kittiwake. The study will use the STRIX system of a combination of 3D radar and high-resolution cameras installed on the NnG wind farm to record seabird interactions with operating wind turbines to provide key information to inform and model macro-, meso- and micro-avoidance dynamics. The study will collect data from the 3D radar and high-resolution cameras during the two operation years and will focus on the analysis of data on two seabird breeding seasons (March to September).

4.4.4.1 STRIX Monitoring Systems

115. The STRIX system involves two major components, the first to detect, track and classify birds at long to medium range (Birdtrack system or BT), and a second to detect and classify birds that collide with the wind turbine structure or blades (Collision Detection System or CDS). The BT system will be installed on three NnG turbines and the CDS on six other NnG turbines.

116. The main purpose of the BT system is to detect, track and classify birds at long to medium range. The system combines both radars and cameras. The radar component comprises a horizontal radar (primary radar) and a vertical radar (secondary radar). When birds are detected in the primary radar, the secondary radar is automatically oriented to detect the same birds. An algorithm matches targets from secondary to primary radar, obtaining 3D data for these targets. In the presence of multiple targets in multiple directions, the vertical radar cycles through the different birds to sample 3D data.

117. When 3D positions of birds are obtained, and birds are within the detectability range of cameras, the BT system manages the available cameras, with adequate orientation, tilt and zoom, to initiate visual tracking of the birds. A video snippet is stored, that can be later used for identification by an expert ornithologist.

118. The CDS system uses multiple wide-angle, high-resolution cameras and near infra-red illuminators around the wind turbine tower pointing upwards, to observe the volume around the rotating blades and an additional buffer of 10 meters. The system uses computer vision algorithms to detect birds in the frames. The turbine is continuously monitored, and recent frames are kept in memory before being discarded if no bird is detected. When a bird is detected in the observed volume, a video snippet is created, stored and labelled, so that it can be evaluated regarding the occurrence of a collision event. These video snippets contain a few seconds before detection as well as a few seconds after bird detection stopped.

4.4.4.2 Monitoring Collisions/ Interactions with Turbines

119. The occurrence of collision events involving seabirds will be studied by analysing data collected by the multi-camera CDS system. This system will be operating continuously, recording when birds are automatically detected in the field-scope of any of the installed high-resolution cameras. The cameras will be covering the whole swept area of the turbines (where the CDS was installed), where collisions are more likely to occur. The resulting video snippets will be analysed by experts and catalogued for species identification and checked to record the outcome.

4.4.4.3 Estimating Collision Rates

120. The number of collisions automatically recorded by the CDS will be matched against bird flux rates obtained through the BT radar and camera systems. Data from these systems will allow the estimation of precise flux rates of the target species within the wind farm area, as well as of the fluxes of those species at different distance buffers from individual turbines and at different heights, with accurate information about flight activity inside the wind farm. Therefore, detailed information on the number of birds per unit of time entering the turbine swept area at collision risk height will also be obtained and compared with the number of collisions that were recorded.

4.4.4.4 Recording Avoidance Behaviour

121. The occurrence of micro- and meso-avoidance reactive behaviours (i.e., changes in the birds' flight patterns leading to the avoidance of turbines) will be studied based on the trajectories detected and tracked by the BT systems. These systems will detect and track birds flying up to 7km from the wind farm. Different parameters associated to the spatial use by birds at different distances from wind turbines (such as the density of birds' movements) or to their flight behaviour (flight height, linearity, direction) will be measured from radar data and camera images, and complemented with information from observers on site. Species identification will be provided primarily by camera images, complemented also with the observers' information.
122. Macro-avoidance (avoidance by birds of the wind farm area as a whole) will be studied based on data provided by two BT systems located in the peripheral areas of the wind farm, according to the same methodology described above for micro- and meso-avoidance studies. Meso-avoidance (i.e., changes in the birds' flight patterns leading to the avoidance of individual turbines or rows of turbines) will also be investigated using the radar and image information from the BT systems. Micro-avoidance behaviours (last-second evasion reactions to avoid getting hit by the rotor blades or colliding with the turbine's structures) will be analysed using the images collected by the CDS (on the same turbines where the systems are installed) and by medium to long range cameras in the BT systems (for collision events at other turbines).

4.4.4.5 Recording Changes in Flight Behaviour

123. The BT systems, with dual radar and medium to long-range cameras, will allow for the recording of a huge amount of accurate data on the trajectories, flight height and flight behaviour of the study target species. A comparison of flight behaviour parameters associated with birds entering the wind farm and/or approaching turbines with those of birds not entering the wind farm or not approaching turbines will be conducted to test for the existence of reactive avoidance behaviours at different scales. Behaviour parameters such as flight trajectories and height, as well as behavioural activity (foraging, transit, perching, preening, resting, etc.) will be recorded and compared, and checked for changes in those parameters in the vicinity of a turbine (at different scales).

4.5 Reporting

124. NnGOWL intends to submit survey reports to the FTRAG-O subgroup for consultation within three months of receipt of annual or final reports from the various survey contractors. Once the reports have been subject to consultation with the FTRAG-O subgroup, NnGOWL will finalise and issue the reports to MD-LOT (on behalf of the Scottish Ministers).

5 Marine Mammals

5.1 Introduction and Background

125. This chapter summarises the proposed approach to monitoring effects on marine mammals.
126. The FTRAG Marine Mammal subgroup (FTRAG-MM) was set up to agree appropriate marine mammal monitoring for the Forth and Tay offshore wind farms (NnG, Inch Cape and Seagreen). In addition to the developers of the wind farms, the following organisations are represented on FTRAG-MM: MSS, NatureScot, JNCC and Whale and Dolphin Conservation (WDC).
127. A summary of FTRAG-MM consultation and meetings to date is provided in Table 5-1. Meeting agendas and minutes referred to in Table 5-1 can be obtained on the Marine Scotland FTRAG website (unless stated otherwise).

Table 5-1: Summary of key consultation meetings and agreements for marine mammal monitoring.

DATE	SUMMARY OF DISCUSSION AND AGREEMENTS	REFERENCE
19th August 2015	ToR discussed. Key species for monitoring discussed; bottlenose dolphin, harbour seals, grey seals, harbour porpoise, minke whale and white beaked dolphin.	Minutes of Meeting -19/08/2015
2nd December 2015	Piling mitigation discussed. Key species for monitoring finalised: bottlenose dolphin, harbour seal and grey seal.	Minutes of Meeting -02/12/2015
2nd July 2019	Seagreen One and NnGOWL set out their marine mammal monitoring approach, which was iteratively refined to focus on bottlenose dolphins and harbour porpoises. Approaches focused on acoustic monitoring using deployment of C-POD devices to be compatible with the ongoing regional ECOMMAS monitoring study. NnGOWL presented potential deployment arrays and the group agreed that the preference would be to extend the St Andrews ECOMMAS array eastwards around the NnGOWL Wind Farm. In addition, MSS proposed that regional bottlenose dolphin photo identification studies would be useful to monitor effects on the Moray Firth SAC bottlenose dolphin population. Developers agreed to consider the extension of ongoing bottlenose dolphin photo ID work.	Minutes of meeting - 02/07/2019

DATE	SUMMARY OF DISCUSSION AND AGREEMENTS	REFERENCE
30th January 2020	<p>Seagreen and NnGOWL provided an update on their marine mammal monitoring studies. The group was briefed on the deployments of acoustic monitoring device completed in 2019 and the planned monitoring scheduled for 2020. Bottlenose dolphin photo-ID surveys were planned to commence in the Forth and Tay region for summer 2020 (to help understand connectivity with Moray Firth area).</p> <p>SMRU Consulting presented the preliminary results of analysis of the acoustic data collected at the Seagreen C-POD array.</p> <p>An update was given on the ScotMER research framework and evidence maps and there was a discussion on how the PEMP will feed into this programme.</p>	Minutes of meeting- 30/01/2020
8th December 2020	<p>SMRU Consulting presented an update on the pre-processing results of the acoustic data collected at the Seagreen and NnGOWL C-POD arrays. It was agreed among the FTRAG-MM that a single analysis of '<i>baseline + construction</i>' be carried out.</p> <p>Updates on the 2020 field season of bottlenose dolphin photo-ID were given, and plans for 2021-2024 were outlined. The FTRAG-MM were supportive of the data collected to date and citizen science components to understand the southern range of the dolphin population.</p>	Minutes of meeting- 08/12/2020.
9th November 2021	<p>SMRU Consulting presented a further update on the pre-processing results of the acoustic data collected at the Seagreen and NnGOWL C-POD arrays, which is continuing. FTRAG-MM remain supportive of approach, as outlined in the briefing note issued to the FTRAG-MM in April 2021.</p> <p>Overview of the 2021 field season of bottlenose dolphin photo-ID surveys were given. The FTRAG-MM remain supportive of the data collected to date and citizen science components.</p>	<p>Minutes of meeting- 09/11/2021 (not yet published)</p> <p>Briefing note - NNG-SMR-ECF-MEM-0001 - April 2021 (SMRUC, 2021)</p>
29th November 2022	<p>SMRU Consulting presented an update on the pre-processing results of the acoustic data collected at the Seagreen and NnGOWL, which is ongoing. FTRAG-MM remain supportive of approach and a discussion was had to resolve concerns around the available resources to analyses the relevant ECOMMAS data in time for the Seagreen and NnG analysis timelines.</p> <p>Overview of the 2021 field season of bottlenose dolphin photo-ID surveys were given by St Andrews University. The FTRAG-MM remain supportive of the data collected to date and citizen science components.</p>	Minutes of meeting 29/11/2022
21st March 2023	<p>SMRU Consulting presented an update on the pre-processing results of the acoustic data collected at the Seagreen and NnGOWL, which is ongoing. FTRAG-MM remain supportive of approach.</p> <p>MD-LOT raised a query about NnG and Seagreen post construction monitoring plans. Following email correspondence between FTRAG-MM, NnGOWL and Seagreen (1st to 29th June 2023)</p>	Minutes of meeting 21/03/2023 (not yet issued)

	<p>agreement was reached on the duration of the marine mammal acoustic data collection and analysis post-construction - 1 year from the cessation of foundation installation.</p> <p>Concerns around the available resources to analyse the relevant additional ECOMMAS data in time for the Seagreen and NnG analysis timelines, were discussed, item remains unresolved.</p> <p>Overview of the 2022 field season of bottlenose dolphin photo-ID surveys were given by St Andrews University. The FTRAG-MM remain supportive of the data collected to date and citizen science components.</p>	
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5.2 Focus of Monitoring

128. NnGOWL's PEMP seeks to improve the understanding of marine mammal interactions with offshore wind farms and to validate assumptions made in the EIA. The focus of the PEMP is to monitor effects on species of marine mammals where there was uncertainty in the EIA predictions and in line with the discussions of the FTRAG-MM as set out in Table 5-1.
129. Through iterative discussions between 2015-2019 with FTRAG-MM it was agreed that the primary focus species for monitoring during the pre-construction and construction phases should be bottlenose dolphins and harbour porpoises.

5.3 Approach to Monitoring Effects

5.3.1 Marine Mammal Distribution

130. The PEMP aims to determine whether there are any significant changes in the distribution or abundance of marine mammals within the wind farm area and adjacent waters pre and during construction. This is being achieved via a broad-scale Passive Acoustic Monitoring (PAM) programme, that aims to combine the outputs of the NnGOWL, Seagreen and ECOMMAS (East Coast Marine Mammal Acoustic Study) PAM subarrays. These data may be supplemented with those collected from the digital aerial surveys (see below). The findings aim to inform whether construction activities cause significant displacement of marine mammals, focusing on harbour porpoise and dolphins.

5.3.2 Improving Understanding the Bottlenose Dolphin Population Use of the Forth and Tay Region

131. The monitoring programme aims to improve our understanding of the east coast bottlenose dolphin population (i.e. abundance, demography and range).

5.4 Monitoring Survey Methodology

5.4.1 Marine Mammal Distribution and Disturbance During Construction

132. The ECOMMAS project has been on-going since 2013. The project monitors the distribution and population of dolphin and harbour porpoise through the use of acoustic monitoring devices (C-PODs). C-PODs are located in groups of three at 10 locations along the east coast of Scotland; 30 C-PODs are deployed in total. At each location the C-PODs are located approximately 5 km, 10 km and 15 km from shore. In addition to the C-PODs there is one broad spectrum recorder deployed at each group of three C-PODs. The closest two C-POD arrays to the NnG wind farm are located off St Andrews to the north off Arbroath and south at St Abb's. Data are recorded as dolphin detection-positive-days (DPD) and detection-positive-hours (DPH), from these it is possible to monitor temporal and spatial variations in rates of vocalisation which can be used as proxy for the presence or absence of dolphins and harbour porpoise.

133. As part of the monitoring programme NnGOWL have supplemented the existing ECOMMAS deployments by installing four additional passive acoustic moorings. The moorings were deployed in July 2019, with each having a C-POD and broadband noise recorder. The locations are presented in Figure 5-1. The broad pattern of these moorings was agreed with FTRAG-MM and follow-up discussions with MSS. These additional C-PODs and broadband noise recorders detect dolphin and harbour porpoise occurrence in the vicinity of the Wind Farm Area. As outlined in the briefing note SMRUC (2021), the pre- and during-construction detections will be compared, within the context of the wider regional ECOMMAS data over the same period, to determine whether there was a significant change in DPH and DPD during any of the construction activities. Supplementary analysis of broad spectrum recordings will be undertaken to identify further dolphin detections and if possible, differentiate between dolphin species (e.g. bottlenose dolphins) recorded within the vicinity of the acoustic recorders. As agreed with the FTRAG-MM in June 2023 NnGOWL will continue to maintain data collection at these four additional passive acoustic moorings through construction, and for one year after completion of all foundation installations for the NnG wind farm.

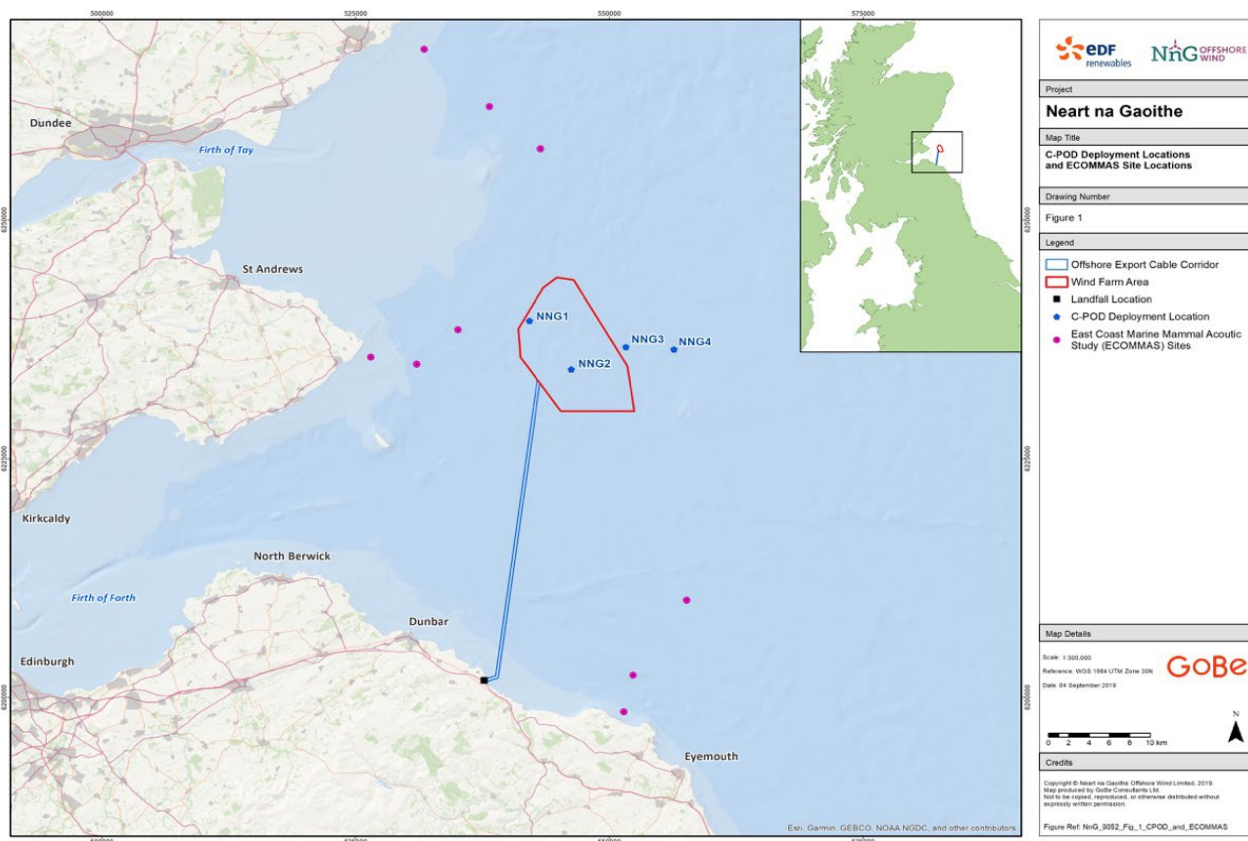


Figure 5-1: Location of additional acoustic moorings

134. In addition, digital aerial surveys of the Wind Farm Area and a 12 km buffer and the combined Forth and Tay region (Section 4.4.1) have been undertaken. These surveys overlap spatially with the area covered by the acoustic monitoring stations and are based on transects spaced 2 km apart. Over two years of pre-construction aerial survey data of the Wind Farm Area and a 12 km buffer will be available for analysis. This data will be examined to help determine whether any significant changes in the distribution or abundance of marine mammals occur during the construction phase of the project. However, there are several reasons why we do not anticipate a close correlation between the two datasets. The aerial survey data represent a single snapshot of marine mammal occurrence at single point in time each month, whereas the PAM data will provide data on cetacean occurrence at a very high temporal resolution, including overnight when visual surveys cannot take place. In addition, cetacean vocalisations

can be highly directional, harbour porpoises in particular, therefore a sighting of a porpoise close to a PAM station may not necessarily result in an associated acoustic detection. However, the broad patterns in sightings rates and detection rates will be compared and any notable visual sightings close to PAM station locations will trigger a closer inspection of the acoustic records at the same time to identify any matches.

5.4.2 Improving Understanding the Bottlenose Dolphin Population use of the Forth and Tay Region

135. The Scottish east coast bottlenose dolphin population has been studied since 1989 in a long-running project led jointly by Prof Paul Thompson (Aberdeen University Lighthouse Field Station, AULFS) and Prof Philip Hammond (SMRU, University of St Andrews), based on the ability to identify individual animals from photographs of the scratches, nicks and notches on their dorsal fins. This work demonstrated the population expanded its range from being primarily located in the Moray Firth to include frequent use of waters as far south as St Andrews Bay and the Firth of Forth and has provided estimates of total population size, survival and birth rates (which can be biased if incorrect assumptions about the population ranging behaviour are made).
136. In recent years, sightings of individuals from the population have become more frequent to the south of the Tay Estuary, in the Firth of Forth but also further south along the southeast Scottish coast and off northeast England. These observations are indicative of an ongoing expansion of the population's distributional range, and might explain the reduction in the number of individuals that have been photo-identified in the Tay Estuary and adjacent waters during recent surveys.
137. This southward range expansion means that with the current sampling effort in the Moray Firth and the Tay Estuary we are increasingly unable to monitor the whole population. This may lead to negative bias in future estimates of population size, survival and birth rates, similar to what occurred in the late 1990s. A continuing southward range expansion would also mean that the current understanding of movements of individuals across the population range may be short-lived. An important consequence of not monitoring the population as its range expands south is that it may not be possible to distinguish between a negative bias in population parameters and any impacts of the construction activities of offshore developments.
138. The increasing public interest in the occurrence of bottlenose dolphins in the Firth of Forth and further south (where there are also regular dolphin-watching trips) offers the opportunity to combine citizen science with ongoing monitoring to sample dolphins in areas currently not systematically surveyed south of the Tay Estuary. Incorporating these data in ongoing analyses will improve our knowledge of movement of animals and our estimates of population parameters.
139. To continue providing robust estimates of population size, survival and birth rates, as well as updating our understanding of movements of individuals across the (expanding) population range, this part of the NnGOWL monitoring comprises of contributing to a five-year programme (between 2020 and 2024, inclusive), including four years of field work with a final year (2024) of overall data analysis, interpretation and reporting.
140. The programme is divided into three complementary projects: 1) to continue current systematic monitoring in the Tay Estuary and adjacent waters, alongside the monitoring of the Moray Firth SAC by collaborators at AULFS; 2) Initiate systematic monitoring in the Firth of Forth; and 3) Engage with selected groups, organizations and the general public through a Citizen Science collaborative project to complement the systematic boat-based monitoring with data on individuals from the population occurring in areas south of the Tay Estuary.
141. Regular boat surveys within the Firths of Forth and Tay region using photo identification techniques have been conducted in 2020 and 2021 and will continue in 2022-2023 to allow for the recognition of

individual dolphins based on their distinguishing features. Surveys are to be undertaken each year between May and September.

142. Data collected during the proposed project will be analysed using mark-recapture and other statistical modelling methods currently applied to estimate population size, survival and birth rates, and to quantify movements.

5.5 Reporting

143. PAM reports are being prepared for NnGOWL as C-PODs and broadband noise recorder datasets are reviewed and processed. As agreed with the FTRAG-MM, these reports will not be issued to the FTRAG-MM, but members of the FTRAG-MM will receive updates on the data collection and processing phase via the FTRAG-MM meetings. Once the final PAM analyses have been carried out, the reports will be subject to consultation with FTRAG-MM subgroup, and NnGOWL will finalise and issue the reports to MD-LOT (on behalf of the Scottish Ministers).
144. Annual reports from the bottlenose dolphin programme will be submitted to the FTRAG-MM subgroup within three months of receipt of the reports from the contractor. Once they have been the subject to consultation with the FTRAG-MM subgroup, NnGOWL will finalise and issue the reports to MD-LOT (on behalf of the Scottish Ministers).

5.6 Unexploded ordnance (UXO) clearance noise monitoring and marine mammal mitigation measures

145. In 2020 NnGOWL completed a UXO clearance campaign within the boundaries of the windfarm and export cable corridor to prepare for construction activities. NnGOWL were issued to licences from MS-LOT in relation to the clearance works.
 - Licence to Disturb European Protected Species (EPS) ('EPS Licence') under the Conservation (Natural Habitats, &c.) Regulations 1994 (as amended), Ref MS EPS 27/2019/1.
 - Licence to deposit or use any explosive substance or article within the Scottish marine area either in the sea or on or under the seabed and to use a vehicle to remove any substance or object from the seabed within the Scottish marine area ('Marine Licence'), Ref 07103/20/0 (varied on 16th June - Marine Licence 07103/20/1).
146. Mitigation measures presented a Marine Mammal Mitigation Plan ("MMMP") (NnGOWL, 2019), and supplementary note (NnGOWL, 2020a) which were submitted as part of the licence applications to MS-LOT detail the mitigation measures employed during the clearance works. The implementation of these measures during the clearance works was outlined in the Unexploded Ordnance Marine Licence Post Detonation Report (NnGOWL, 2020b).
147. As part of a condition of the Marine Licence NnGOWL undertook noise monitoring of the UXO clearance. The details of the monitoring and results are contained within the "unexploded ordnance Underwater Noise Monitoring Report" submitted to MS-LOT in May 2021 (NnGOWL, 2021).
148. NnGOWL's Piling Strategy (PS) (NNG-NNG-ECF-PLN-0011) fully details the proposed approach to mitigating the effects of noise from pile installation during construction. The plan proposed mitigation measures for two of the potential pile installation methods, drill-only and drive-drill-drive installation methods. The last pile for the NnG wind farm was installed at the end of September 2023, all piles have been installed using the drill only method. Therefore, in line with the PS, no specific mitigation measures were employed in relation to the effects of noise from pile installation on marine mammals.

6 Commercial Fisheries

6.1 Introduction and Background

149. This chapter summarises NnGOWL's position on the scope of project monitoring relevant to the PEMP.
150. A summary of relevant consultations and meetings undertaken in respect of commercial fisheries monitoring is detailed in Table 6-1.
151. The approach to the monitoring scope was presented and accepted by the FTRAG in January and December 2020. The FTRAG meeting agendas and minutes referred to in Table 6-1 can be obtained on the Marine Scotland FTRAG website, unless specified. Subsequent consultations (in 2021 and 2022) have been held to provide fisheries stakeholders in the Forth and Tay Commercial Fisheries Working Group (CFWG) an opportunity to review and comment on the draft reports.

Table 6-1: Summary of the key consultation meetings and agreements for commercial fisheries monitoring

DATE	SUMMARY OF DISCUSSIONS AND AGREEMENTS	REFERENCE	MEETING
28th January 2020	NnGOWL presented the approach to commercial fisheries monitoring in line with the methods set out in Sections 6.2 and 6.3. No objections were raised with regards to the proposed desk-based study.	Minutes of meeting – 28/01/2020 (not currently available online).	FTRAG
9th December 2020	NnGOWL presented the approach and process of the commercial fisheries monitoring in line with the methods set out in Sections 6.2 and 6. This was accepted alongside the recipients of the reports (Section 6.4).	Minute of meeting – 09/12/2020	FTRAG
14th July 2021	NnGOWL presented the results of the first monitoring report, covering the Post Consent phase (1 st January 2017 to 30 th April 2019). The aim of this report was to update the Environmental Statement baseline which covered up to 31 st December 2016. Overarching comments were that the report made a good starting point, there are some considerations to be taken forward for the future construction phase reporting, and consultation with the fisheries representatives will be key.	Minute of meeting – 16/07/2021	Forth and Tay CFWG
9th August 2022	NnGOWL presented the results of the second monitoring report, covering the Pre-Construction phase (1 st May 2019 to August 2020). Within the meeting, NnGOWL discussed a proposal to reduce the frequency of reporting during the Construction Phase. It was proposed to report on a 12-monthly basis rather than 6-monthly, due in part to the reliance of the reports on the MMO datasets which are issued on an annual basis. It was agreed that a mid-year (6-monthly) interim report will be prepared in addition to a full annual report. The interim (6-monthly) report will not include datasets which are only issued on an annual basis.	Minute of meeting – 22/08/2022	Forth and Tay CFWG

6.2 Focus of Monitoring

152. The aim of commercial fisheries monitoring is to understand variations in commercial fisheries activity in response to the construction of the wind farm and use this to inform updates to the FMMS. The key objectives are to:
- Collate data on commercial fisheries landings and activity by ICES rectangle, including landing statistics and Vessel Monitoring System (VMS) data with the objective to extend the baseline assessment provided within the EIA and Commercial Fisheries Technical Report.
 - Collate data on commercial fisheries landings by port on a monthly basis;
 - Collate such other sources of evidence of commercial fisheries activity as may be reasonably available on a regular basis; and
 - Monitor available data and evidence to better understand any variations and patterns in commercial fisheries activity.
153. NnGOWL has prepared a Fisheries Management and Monitoring Strategy (FMMS). The FMMS sets out plans for fisheries liaison during construction. Mitigation and/or any updates to the FMMS may be informed by an understanding of any changes in fishing activity as picked up by the monitoring proposed within the PEMP.

6.3 Monitoring Survey Methodology

154. Monitoring will involve:
- Review of MMO landings data by port to allow monitoring of size, target species, tonnage of catch and first sales value monthly.
 - For each port, monthly data will be analysed to determine live weight of key species landed by all vessels, specifically for nephrops, brown crab, lobster and squid fisheries
 - Inter annual variations between monthly landings will be examined
 - Additional sources of information will be reviewed to corroborate findings of the analysis of the MMO landing statistics and identify trends not detected by the MMO landings data.
 - Analysis of Offshore Fisheries Liaison Officer and guard vessel records (where available);
 - Analysis of the 2018 and 2019 marine traffic surveys in respect of fishing vessel activity;
 - Analysis of Marine Coordination Centre (MCC) records in respect of fishing vessel activity;
 - Analysis of VMS data in respect of fishing vessel activity, based on annual geographic datasets produced by MMO for VMS on UK vessels; and
 - Consultation with the commercial fishing industry via the onshore company FLO.

6.4 Reporting

155. Data will be collated quarterly, to examine monthly landings and activity over that preceding period. It is proposed that reporting outputs will be delivered to cover monitoring results for the following phases:
- Post-consent phase (provided as a continuation of the baseline): 2017 to April 2019.
 - Pre-construction phase: May 2019 to beginning of construction.

- During construction phase: Start of construction to end of construction, a mid-year (6-monthly) interim report will be prepared in addition to a full annual report. The interim report will not include datasets which are only issued on an annual basis.
- Post-construction phase: End of construction to three years after the completion of construction, or as agreed with Marine Scotland.

156. With exception to the interim (6-monthly) reports during construction, a dedicated meeting with the Forth and Tay Commercial Working Group will be held following the issue of a draft version of the report, to discuss and resolve any comments.

7 Marine Fish

7.1 Introduction and Background

157. This chapter summarises NnGOWL's position on the scope of project monitoring relevant to the PEMP. A summary of relevant consultations and meetings undertaken to date to define the scope of monitoring in respect of marine fish is detailed in Table 7-1.

Table 7-1: Summary of key consultation meetings and agreements for marine fish monitoring

DATE	SUMMARY OF DISCUSSIONS AND AGREEMENTS	REFERENCE
December 2015	<p>Neart na Gaoithe Offshore Wind Farm, Discussion Paper - Marine Fish circulated to MS-LOT, NatureScot and JNCC</p> <p>Comments received 20 January and 26th January 2016 by NatureScot and MSS respectively. NatureScot and MSS confirmed that they do not require NnGOWL to undertake project monitoring in respect of marine fish.</p> <p>It was noted that Condition 11 of the S36 Consent requires consideration of mitigation measures in relation to herring and cod within a project Piling Strategy. NnGOWL will include consideration of environmental sensitivities and mitigation measures within the Piling Strategy which will be submitted to MS-LOT for approval prior to the commencement of construction, as required by the conditions of consent.</p>	UK02-0504-0565-GOB-PEMP MAR FISH DISC PAPER-RPT-A1
4th February 2016	Meeting to discuss the strategy in respect to marine fish, MSS and NatureScot confirmed their position. NnGOWL agreed to submit the discussion paper plus supporting information to the FTRAG for approval on the final scope of PEMP.	NnGOWL Meeting Minutes - Neart na Gaoithe Offshore Wind Farm, Project Environmental Monitoring Programme Discussion Papers
24th June 2019	<p>FTRAG main group meeting</p> <p>NnGOWL proposed that no monitoring would be undertaken for marine fish in accordance with earlier discussion documents.</p>	Minutes of meeting – 24/06/2019
28th January 2020	NnGOWL reiterated their approach to monitoring of marine fish. The approach was accepted by the group but it was agreed to keep marine fish on the agenda at future FTRAG meetings to take account of any changes or developments relevant to this receptor.	Minutes of meeting – 28/01/2020

7.2 PEMP Approach

158. NnGOWL circulated discussion papers for consultation to NatureScot, MS-LOT and MSS to agree the monitoring scope as required by Condition 23 of the S36 Consent and Condition 3.2.2.14 of the OfTW Marine Licence.
159. The discussion papers demonstrated, following review of the refined design envelope and based on more recent data, that the impacts from the construction and operation and maintenance of Neart na Gaoithe offshore wind farm would not have a significant impact on marine fish. These conclusions remain valid and relevant to monitoring in respect of the project design envelope covered by the Offshore Consents issued in December 2018.

160. Based on the lack of significant effects and the confidence within the assessments, NnGOWL has concluded that project-specific marine fish monitoring should be removed from the scope of the PEMP. This approach was proposed again at the FTRAG meeting held on 24th June 2019 and 28th January 2020.

8 Diadromous Fish

8.1 Introduction and Background

161. This chapter summarises NnGOWL's position on the scope of project monitoring relevant to the PEMP. A summary of relevant consultations and meetings undertaken to date to define the scope of monitoring in respect of diadromous fish is detailed in Table 8-1.

Table 8-1: Summary of key consultation meetings and agreements for diadromous fish monitoring

DATE	SUMMARY OF KEY DISCUSSIONS AND AGREEMENTS	REFERENCE
January 2016	Neart na Gaoithe Offshore Wind Farm, Discussion Paper - Diadromous Fish circulated to MS-LOT, NatureScot and JNCC. Comments received 20 January and 26 th January 2016 by NatureScot and MSS respectively.	UK02-0504-0567-GOB-PEMP DIAD FISH DISC PAPER-RPT-A1
4th February 2016	Meeting to discuss the strategy in respect to marine and diadromous fish. MSS and NatureScot confirmed their position outlined in comments received. NnGOWL agreed to submit the discussion paper plus supporting information to the FTRAG for approval on the final scope of PEMP.	NnGOWL Meeting Minutes - Neart na Gaoithe Offshore Wind Farm, Project Environmental Monitoring Programme Discussion Papers
24th June 2019	FTRAG main group meeting NnGOWL proposed that no project specific monitoring would be undertaken for diadromous fish in accordance with earlier discussion documents.	Minutes of meeting – 24/06/2019
31st October 2019	Meeting to discuss the diadromous fish monitoring approach with reference to the 2016 discussion documents. NnGOWL reiterated the position that there is no project specific monitoring proposed in relation to diadromous fish. NnGOWL agreed to consider how regional strategic monitoring can be delivered collaboratively in accordance with the ScotMER evidence map for diadromous fish.	Minutes of meeting – TBC
28th January 2020	Diadromous fish monitoring was discussed at the FTRAG main group meeting. All participants of the group agreed that monitoring is best addressed through a strategic study developed through the ScotMER programme. MSS took an action to develop project ideas through the diadromous fish ScotMER group. NnGOWL agreed to continue to engage and participate in discussions around developing a suitable monitoring project through ScotMER.	Minutes of meeting – 28/01/2020 (not currently available online).

8.2 PEMP Approach

162. On the basis that no significant impacts were predicted in the EIA and in light of the reduction in the project design envelope, and the body of evidence that indicates EMF effects are not significant, the 2016 discussion paper concluded that there was no basis for undertaking project-specific monitoring in respect of diadromous fish. It is NnGOWL's position that previous discussions in relation to the scope of project monitoring of diadromous fish, remains valid and relevant to the 2018 Offshore Consents.

163. In response to the Diadromous Fish Discussion Paper, NatureScot confirmed that they do not require NnGOWL to undertake project monitoring in respect of diadromous fish, as there are no outstanding concerns regarding the Projects impact on diadromous fish in the vicinity of both the Wind Farm and OfTW.
164. MSS initially disagreed that there was sufficient grounds to remove diadromous fish monitoring from the scope of the PEMP but suggested that research would be better conducted at a strategic level. In October 2019, MSS reiterated this position that research may be better focused on strategic projects, such as those being developed through the ScotMER programme.
165. Based on the lack of significant effects and the confidence within the assessments, NnGOWL conclude that project-specific diadromous fish monitoring should be removed from the scope of the PEMP where it relates to Condition 23 of the S36 Consent and Condition 3.2.2.16 of the OfTW Marine Licence for the Project. This approach was stated at the FTRAG meeting held on 24th June 2019 with NnGOWL noting an openness to participate in further discussions for contributing to strategic studies e.g. through the ScotMER programme.
166. NnGOWL instead propose to continue engaging on how a collaborative approach to appropriate monitoring can be delivered through ScotMER or other strategic partnerships, in line with MSS advice.

9 Benthic Communities

9.1 Introduction and Background

167. This chapter summarises NnGOWL's position on the scope of project monitoring relevant to the PEMP. A summary of relevant consultations and meetings undertaken to date to define the scope of monitoring in respect of benthic communities is detailed in Table 9-1.

Table 9-1: Summary of key consultation meeting and agreements for benthic monitoring

DATE	SUMMARY OF KEY DISCUSSIONS AND AGREEMENTS	REFERENCE
December 2015	Neart na Gaoithe Offshore Wind Farm, Discussion Paper – Benthic Communities circulated to MS-LOT, NatureScot and JNCC Comments received 20 January and 26th January 2016 by NatureScot and MSS respectively.	UK02-0504-0566-GOB-PEMP BENTHIC DISC PAPER-RPT-A1
4th February 2016	Meeting to discuss the strategy in respect to benthic communities. MSS and NatureScot confirmed their position outlined in comments received. NnGOWL agreed to submit the discussion paper plus supporting information to the FTRAG for approval on the final scope of PEMP.	NnGOWL Meeting Minutes - Neart na Gaoithe Offshore Wind Farm, Project Environmental Monitoring Programme Discussion Papers
24th June 2019	FTRAG meeting to discuss future monitoring in respect of the PEMP for Forth and Tay developers. NnGOWL confirmed that no monitoring for benthic communities is proposed. NatureScot queried whether there was justification for monitoring of drill arisings within the pSPA boundary.	Minutes of meeting – 24/06/2019.
10th September 2019	NnG Review of PEMP scope: Benthic Communities circulated to MS-LOT and MSS	NNG-GOB-ECF-PLN-0001
31st October 2019	Meeting to discuss the benthic communities monitoring approach with reference to the 2019 consultation document on the scope of the PEMP. NnGOWL reiterated the position that there is no project specific monitoring proposed in relation to benthic fish.	Minutes of meeting
28th January 2020	NnGOWL reiterated their approach to monitoring of benthic communities. The approach was accepted by the group but it was agreed to keep benthic communities on the agenda at future FTRAG meetings to take account of any changes or developments relevant to this receptor.	Minutes of meeting – 28/01/2020 (not currently available online).

9.2 PEMP Approach

168. The Benthic Communities Discussion Paper identified the Priority Marine Feature (PMF) 'Burrowed Mud' and the component biotope Seapens and burrowing megafauna in circalittoral fine mud 'SS.SMu.CFiMu.SpnMeg' present within the study areas. In the 2015 paper, NnGOWL proposed undertaking a monitoring programme using geophysical survey methods to identify any change in the distribution and extent of SS.SMu.CFiMu.SpnMeg following the construction of the Project. It was proposed that benthic community monitoring would comprise of side scan sonar data collection and analysis or would utilise backscatter derived from multibeam echo sounder data. Comparisons would be

made between pre-construction and post-construction surveys with a focus on the SS.SMu.CFiMu.SpnMeg habitat.

169. NatureScot's response stated that monitoring of benthic interests would be more productive if conducted at a strategic level, focusing on known knowledge gaps rather than undertaken on a project specific basis and recommended that monitoring studies be co-ordinated at an industry level to address specific impact concerns on specific habitat types that have been identified as important. It was proposed that any monitoring be discussed further through the Scottish Offshore Renewables Research Framework (SpORRAn) group (now superseded by ScotMER).
170. MSS's position stated that SS.SMx.CMx.OphMx (*Ophiothrix fragilis* and/or *Ophiocomina nigra* brittlestar beds on sublittoral mixed sediment) and the bivalve *Arctica islandica* should also be considered for targeted monitoring utilising a Remote Operated Vehicle (ROV) and / or other video system. The monitoring programme should consider direct sampling of the fauna with the number of required samples being determined by an appropriate power analysis.
171. At the follow-up meeting on 4th February 2016, the position of MSS and NatureScot as detailed in their consultation response was confirmed. Following discussions MSS agreed that monitoring of benthic communities should predominately utilise geophysical techniques.
172. Since this date, a further review of benthic monitoring at offshore wind farms has reiterated that the effects of wind farm infrastructure on soft sediment communities are limited, thus further supporting the conclusions of no significant effects reached in the NnGOWL Original ES. In addition, the revised design envelope for the project has been refined with further reductions in the footprint of installed infrastructure. This position was accepted during scoping for the recent EIA conducted in 2018, whereby Benthic Ecology was scoped out of the Project EIA.
173. This approach was presented at the FTRAG meeting held on 24th June 2019.
174. As detailed in the Scope of the PEMP: Benthic Communities consultation document circulated in September 2019 and presented at the follow up meeting in October 2019 it is NnGOWL's position that based on the lack of significant impacts and low uncertainty in the EIA and Scoping determinations no project-specific monitoring is required in relation to benthic communities. NnGOWL conclude that project-specific benthic community monitoring should be removed from the scope of the PEMP where it relates to Condition 23 of the S36 Consent and Condition 3.2.2.16 of the OfTW Marine Licence for the Project.
175. NnGOWL is open to sharing data with stakeholders, if it would be useful in any strategic projects, such as those taken forward via ScotMER.

10 Seabed Scour and Local Sediment Deposition

10.1 Introduction and Background

176. This chapter summarises NnGOWL's position on the scope of project monitoring relevant to the PEMP. A summary of relevant consultations and meetings undertaken to date to define the scope of monitoring in respect of seabed scour and local sediment deposition is detailed in Table 10-1.

Table 10-1: Summary of key consultation meetings and agreements for seabed scour and local sediment deposition monitoring

DATE	SUMMARY OF DISCUSSION AND AGREEMENTS	REFERENCE
December 2015	Neart na Gaoithe Offshore Wind Farm, Discussion Paper – Seabed Scour and Local Sediment Deposition circulated to MS-LOT, SNH [now NatureScot] and MSS Comments received 20 th January and 26 th January 2016 by SNH [now NatureScot] and MSS respectively.	UK02-0504-0562-GOB-PEMP SCOUR DISC PAPER-RPT-A1
4 February 2016	Meeting to discuss the strategy in respect to seabed scour, the attendees confirmed that NnGOWL's proposals to monitor for seabed scour as part of ongoing operation and maintenance checks was sufficient to satisfy the requirements of the Consents conditions.	Minutes available on the Marine Scotland website
24th June 2019	FTRAG meeting to discuss future monitoring in respect of the PEMP for Forth and Tay developers. NnGOWL confirmed that no environmental monitoring for seabed scour and local sediment deposition is proposed. Instead monitoring would be driven by engineering requirements to maintain the structural integrity of installed infrastructure.	Minutes of meeting – 24/06/2019
28th January 2020	NNGOWL reiterated their approach to monitoring of seabed scour and local sediment deposition. The approach was accepted by the group but it was agreed to keep scour and seabed depositions on the agenda at future FTRAG meetings to take account of any changes or developments relevant to this receptor.	Minutes of meeting – 28/01/2020 (not currently available online)

10.2 PEMP Approach

177. NnGOWL considers seabed scour and local sediment deposition an engineering issue and is not specifically linked to a sensitive environmental receptor. The Marine Management Organisation (MMO) have undertaken a review of post-consent offshore wind farm monitoring (MMO, 2014). This report noted that monitoring of scour should only be required in relation to maintaining the structural integrity of foundations or other associated infrastructure over the lifetime of the project.
178. The discussion paper circulated in December 2015 confirmed that NnGOWL project-specific monitoring of seabed scour and local sediment sedimentation should be driven by engineering requirements rather than in response to potential effects on the physical environment. This approach was presented at the FTRAG meeting held on 24th June 2019.
179. NnGOWL has concluded that seabed scour and local sediment deposition monitoring for environmental purposes should be removed from the PEMP.

11 Compliance with the Application, EIA Report and Addendum

180. Part of Condition 23 of the S36 Consent states:

The PEMP must be in accordance with the Application as it relates to environmental monitoring.

181. Within the EIA Report and the Addendum, NnGOWL made a number of commitments to the environmental monitoring of the Project. Commitments made are presented in full in Appendix A, which also identifies how each commitment has been addressed within this PEMP.

182. Condition 8 of the S36 Consent states:

Except as otherwise required by the terms of this consent, the Project must be constructed and operated in accordance with the Application (as supplemented by the additional environmental information ("EIA Addendum"), submitted by the Company on 26 July 2018) and any other documentation lodged in support of the Application.

183. Condition 3.1.1 of the Wind Farm and OfTW Marine Licence states:

The Licensee must at all times construct, operate and maintain the Works in accordance with this licence, the Application and the plans and programmes approved by the Licensing Authority.

184. Since the Application for consents was made, NnGOWL's approach to environmental monitoring has been refined and commitments made in the EIA Report and the Addendum are in some cases superseded by the monitoring approach presented in this PEMP.

12 References

- Arso Civil, M. (2014). Population Ecology of Bottlenose Dolphins (*Tursiops truncatus*) off the East Coast of Scotland. PhD Thesis. University of St Andrews.
- Bogdanova, M.I., Wanless, S., Harris, M.P., Lindström, J., Butler, A., Newell, M.A., Sato, K., Watanuki, Y., Parsons, M. & Daunt, F. (2014) Among-year and within-population variation in foraging distribution of European shags *Phalacrocorax aristotelis* over two decades: implications for marine spatial planning. *Biological Conservation* 140:292-299
- Bogdanova, M.I., Gunn, C., Langois Lopez, S., Phillpot, P., Newell, M., Harris, M.P., Wanless, S. & Daunt, F. (2020a). GPS tracking of common guillemots, razorbills, Atlantic puffins and black-legged kittiwakes on the Isle of May in 2018 in relation to the Neart na Gaoithe offshore wind farm. A report to EDF Renewables.
- Bogdanova, M.I., Langois Lopez, S., Gunn, C., Tremlett, C., Newell, M., Harris, M.P., Searle, K., Wanless, S. & Daunt, F. (2020b). GPS tracking of common guillemots, razorbills, Atlantic puffins and black-legged kittiwakes on the Isle of May in 2019 in relation to the Neart na Gaoithe offshore wind farm. A report to EDF Renewables.
- Bogdanova, M.I., Gunn, C., Newell, M., Benninghaus, E., Bouten, W., Searle, K., & Daunt, F. (2021). GPS tracking of common guillemots, razorbills, Atlantic puffins and black-legged kittiwakes on the Isle of May in 2020 in relation to the Neart na Gaoithe offshore wind farm. A report to EDF Renewables.
- Calenge C (2006) The package 'adehabitat' for the R software: a tool for the analysis of space and habitat use by animals. *Ecological Modelling* 197: 516–519
- Daunt, F. and Bogdanova, M. (2022). Quantifying the population-level effects of offshore renewable developments on seabirds in the Forth/Tay region using GPS tracking: empirical and analytical approaches to maximise insights from puffin data given known device effects in this species. Report to the Ornithology subgroup of the Forth and Tay Regional Advisory Group (FTRAG-O).
- Daunt, F., Bogdanova, M., Wischniewski, S., and McCluskie, A. (2022). Quantifying the population-level effects of offshore renewable developments on seabirds in the Forth/Tay region using GPS tracking: approach for 2022 breeding season work. Report to the Ornithology subgroup of the Forth and Tay Regional Advisory Group (FTRAG-O).
- Daunt, F., Bogdanova, M., McCluskie, A. and Wischniewski, S. (2021). Quantifying the population-level effects of offshore renewable developments on seabirds in the Forth/Tay region using GPS tracking: approach for 2021 breeding season work. Report to the Ornithology subgroup of the Forth and Tay Regional Advisory Group (FTRAG-O).
- Daunt, F. (2019). Future GPS tracking of puffins on the Isle of May. A note prepared for FTRAG-O.
- Daunt, F., Bogdanova, M.I., Newell, M., Harris, M.P. & Wanless, S. (2011) GPS tracking of common guillemot, razorbill and blacklegged kittiwake on the Isle of May, summer 2010. Report to Forth & Tay Offshore Wind Developers Group (FTOWDG) FTRAG-O Meeting Minutes, 29th June 2015. Available from: <https://www.gov.scot/Topics/marine/Licensing/marine/scoping/ftrag/ornithology>
- FTRAG-MM Meeting Minutes, 23rd March 2016 Marine Scotland (2016). Supplementing the MSS ECOMMAS passive acoustic array to detect changes in dolphin occurrence before/during/after wind farm construction. E-mail to FTRAG-MM 8 January 2016.
- FTRAG-O Meeting Minutes, 29th June 2015. Available from: <https://marine.gov.scot/data/ftrag-ornithology-agenda-meeting-minutes-29062015>
- FTRAG-O Meeting Minutes, 03rd September 2015. Available from: https://marine.gov.scot/sites/default/files/minutes_3_september_2015.pdf
- FTRAG-O Meeting Minutes, 17 November 2015. Available from: https://marine.gov.scot/sites/default/files/minutes_17_november_2015.pdf

- FTRAG-O Meeting Minutes, 26th January 2016. Available from:
https://marine.gov.scot/sites/default/files/minutes_26_january_2016.pdf
- HiDef. (2021). Digital video aerial surveys of seabirds and marine mammals at Neart na Gaoithe: Pre-construction report June 2018 to July 2020 DOCUMENT NUMBER: HP00100-703-01
- Lane, J.V. and Hamer, K.C. (2021). Annual adult survival of gannets at Bass Rock, Scotland: Report to the Ornithology subgroup of the Forth and Tay Regional Advisory Group (FTRAG-O) – June 2021. Document Reference: NNG-LUN-ECF-REP-0001 Rev 1.0
- Langley, L., Votier, S. and Hamer, K.C. (2021). Adult gannet survival strategic colour-ringing study in relation to offshore wind developments in the Forth/Tay region: Report to the Ornithology subgroup of the Forth and Tay Regional Advisory Group. Document Reference: NNG-HWU-ECF-REP-0001
- (FTRAG-O) – May 2021
- MMO (2014). Review of post-consent offshore wind farm monitoring data associated with licence conditions. A report produced for the Marine Management Organisation, pp 194. MMO Project No: 1031. ISBN: 978-1-909452-24-4.
- MMO (2019). National Statistics. Monthly Sea Fisheries Statistics June 2019.
<https://www.gov.uk/government/statistics/monthly-sea-fisheries-statistics-june-2019>
- NnGOWL (2012) Offshore Environmental Statement. Available from: <https://nngoffshorewind.com/downloads/offshore-environmental-statement/>
- NnGOWL (2016) Neart na Gaoithe Offshore Wind Farm Pre-Construction Ornithology Monitoring Proposal (UK02-0504-0584-CECBIRD MONITORING PROPOSAL-RPT-A1). March 2016
- NnGOWL (2018) Review of PEMP Scope: Benthic Communities. September 2019. Document Reference: NNG-DOB-ECF-PLN-0001
- NnGOWL (2019) Neart na Gaoithe Offshore Wind Farm. Information to support a Marine Licence application: UXO clearance. September 2019. NNG-DOB-ECF-REP-0002 Rev 01
- NnGOWL (2020a) Neart na Gaoithe UXO Clearance Strategy. Explanatory Note on the Proposed Mitigation Measures for UXO Clearance. NNG-PEL-ECF-MEM-0001 Rev 02.
- NnGOWL (2020b). Neart na Gaoithe Offshore Wind Farm Unexploded Ordnance – Marine Licence Post Detonation Report December 2020. NNG-NNG-ECF-REP-002 Rev 03, https://marine.gov.scot/sites/default/files/nng-nng-ecf-rep-0022_uxo_clearance_post_detonation_report_rev3.0_redacted.pdf
- NnGOWL (2021) Neart na Gaoithe Offshore Wind Farm Unexploded Ordnance – Underwater Noise Monitoring Report 24 May 2021 (NNG-NNG-ECF-REP-0033 Rev 03) https://marine.gov.scot/sites/default/files/nng-nng-ecf-rep-0033_uxo_underwater_noise_monitoring_report_3.0_redacted.pdf
- Quick, N. and Cheney B (2011). Cetacean Baseline Characterisation for the Firth of Tay based on existing data: Bottlenose dolphins. SMRU Limited. 22 December 2011.
- SMRU Consulting (2016). Bottlenose dolphin Photo-ID studies in the Forth and Tay – SMRU Consulting Briefing note. Draft issued March 2016.
- SMRU Consulting (2021) Seagreen and Neart na Gaoithe PAM data analysis – methodology overview. Briefing note V5-NNG-SMR-ECF-MEM-0001
- Thompson, P. (2016). A strategic regional Marine Mammal Monitoring Programme for assessing the population consequences of constructing the BOWL and MORL Wind Farm Developments. Beatrice Offshore Wind Limited and Moray Offshore Renewables.
- Woodward I, Thaxter C.B., Owen E and Cook A.S.C.P. (2019) Desk-based revision of seabird foraging ranges used for HRA screening. Report of work carried out by the British Trust for Ornithology on behalf of NIRAS and The Crown Estate BTO Research Report No. 72 December 2019. ISBN978-1-912642-12-0

Appendix A – Application Commitments

RECEPTOR	EIA COMMITMENT	PURPOSE	RELEVANT SECTION OF THIS PEMP
Ornithology	Following consent, a Project Environmental Monitoring Plan (PEMP) will be developed and agreed with MS-LOT, in discussion with the Forth and Tay Regional Advisory Group (FTRAG).	To ensure a robust and appropriate monitoring strategy	Section 4
Marine Mammals	A detailed monitoring programme will be developed through consultation with Marine Scotland and SNH.	To ensure a robust and appropriate monitoring strategy	Section 5
	NnGOWL will also participate in regional and national fora such as the Forth and Tay Regional Advisory Groups (FTRAG) and the Scottish Strategic Marine Environment Group (SSMEG) [or similar as superseded], through which a strategic monitoring plan will be developed.	To ensure a robust and appropriate monitoring strategy	Section3.
Fish and Shellfish	Final monitoring proposals will be discussed with the FTRAG as part of the approval process for the Project Environmental Monitoring Plan (PEMP).	To ensure a robust and appropriate monitoring strategy	Sections 7 and 8
Benthic Ecology	Conduct a pre-construction cable route survey to identify any sensitive seabed habitats.	To mitigate the effects on benthic habitats	Addressed in the Cable Plan