

Morecambe Offshore Windfarm: Generation Assets Development Consent Order Documents

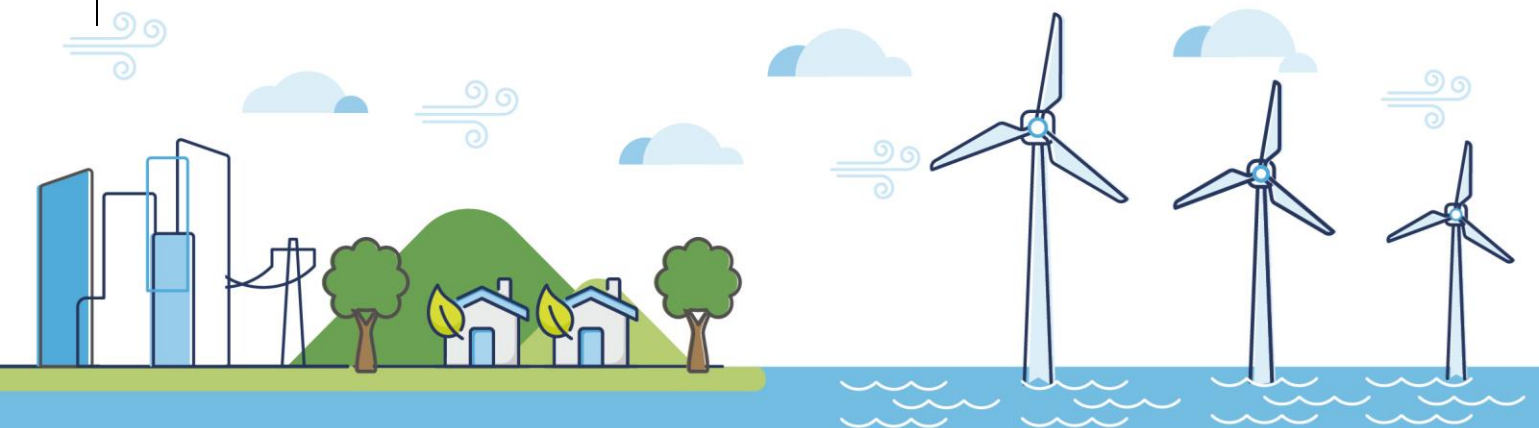
Volume 6

In Principle Monitoring Plan (Tracked)

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Glossary of Acronyms

AEZ	Archaeological Exclusion Zone
ADD	Acoustic Deterrent Devices
AEol	Adverse Effect On Integrity
AfL	Agreement for Lease
AIS	Automatic Identification System
ALARP	As Low As Reasonably Practicable
Cefas	Centre for Environment, Fisheries and Aquaculture Science
DCO	Development Consent Order
DDV	Drop Down Video
DML	Deemed Marine Licence
EIA	Environmental Impact Assessment
EPP	Evidence Plan Process
ES	Environmental Statement
FLOWW	Fishing Liaison with Offshore Wind and Wet Renewables Group
GBS	Gravity Based Structures
HAT	Highest Astronomical Tide
ICES	International Council for the Exploration of the Sea
IHO	International Hydrographic Organisation
INNS	Invasive Non-Native Species
IPMP	In-Principle Monitoring Plan
MBES	Multibeam Echosounder
MCA	Maritime and Coastguard Agency
MCZ	Marine Conservation Zone
MCZA	Marine Conservation Zone Assessment
MGN	Marine Guidance Note
MMMP	Marine Mammal Mitigation Protocol
MMO	Marine Management Organisation
MMOb	Marine Mammal Observers
MPA	Marine Protected Area
NGO	Non-Governmental Organisation
NPS	National Policy Statement
NRA	Navigational Risk Assessment
NSIP	Nationally Significant Infrastructure Project
OOMP	Offshore Operation and Maintenance Plan

ORPAD	Offshore Renewables Protocol for Archaeological Discoveries
OSP	Offshore substation platform
OSPAR convention	Convention for the Protection of the Marine Environment of the North-East Atlantic
OWSI	Offshore Written Scheme of Investigation
PAM	Passive Acoustic Monitoring
PEMP	Project Environmental Management Plan
PDE	Project Design Envelope
RIAA	Report to Inform Appropriate Assessment
ROV	Remote Operated Vehicle
RSPB	Royal Society for the Protection of Birds
SNCB	Statutory Nature Conservation Bodies
SSS	Side-Scan Sonar
UK	United Kingdom
UKHO	UK Hydrographic Office
UWSMS	Underwater Sound Management Strategy
UXO	Unexploded ordnance
VMS	Vessel Monitoring System
WTG	Wind turbine generator

Glossary of Unit Terms

kJ	kilojoule
km	kilometre
km ²	square kilometre
m	metre
MW	Megawatt

Glossary of Terminology

Applicant	Morecambe Offshore Windfarm Ltd
Evidence Plan Process (EPP)	A voluntary consultation process with specialist stakeholders to agree the approach, and information to support, the Environmental Impact Assessment (EIA) and Habitats Regulations Assessment (HRA) for certain topics. The EPP provides a mechanism to agree the information required to be submitted to the Planning Inspectorate as part of the Development Consent Order (DCO) application. This function of the EPP helps Applicants to provide sufficient information in their application, so that the Examining Authority can recommend to the Secretary of State whether or not to accept the application for examination and whether an appropriate assessment is required.
Generation Assets (the Project)	Generation assets associated with the Morecambe Offshore Windfarm. This is infrastructure in connection with electricity production, namely the fixed foundation wind turbine generators (WTGs), inter-array cables, offshore substation platform(s) (OSP(s)) and possible platform link cables to connect OSP(s).
Inter-array cables	Cables which link the WTGs to each other and the OSP(s).
Morgan and Morecambe Offshore Wind Farms: Transmission Assets	The transmission assets for the Morgan Offshore Wind Project and the Morecambe Offshore Windfarm. This includes the OSP(s) ¹ , interconnector cables, Morgan offshore booster station, offshore export cables, landfall site, onshore export cables, onshore substations, 400kV cables and associated grid connection infrastructure such as circuit breaker infrastructure. Also referred to in this chapter as the Transmission Assets, for ease of reading.
Offshore substation platform(s)	A fixed structure located within the windfarm site, containing electrical equipment to aggregate the power from the WTGs and convert it into a more suitable form for export to shore.
Platform link cable	An electrical cable which links one or more OSP(s).
Scour protection	Protective materials to avoid sediment being eroded away from the base of the foundations due to the flow of water.
Technical stakeholders	Technical consultees are organisations with detailed knowledge or experience of the area within which the Project is located and/or receptors which are considered in the EIA and HRA. Examples of technical stakeholders include Marine Management Organisation

¹ At the time of writing the Environmental Statement (ES), a decision had been taken that the offshore substation platforms (OSP(s)) would remain solely within the Generation Assets application and would not be included within the Development Consent Order (DCO) application for the Transmission Assets. This decision post-dated the Preliminary Environmental Information Report (PEIR) that was prepared for the Transmission Assets. The OSPs are still included in the description of the Transmission Assets for the purposes of this document as the Cumulative Effects Assessment (CEA) carried out in respect of the Generation/Transmission Assets is based on the information available from the Transmission Assets PEIR.

	(MMO), local authorities, Natural England and the Royal Society for the Protection of Birds (RSPB).
Windfarm site	The area within which the WTGs, inter-array cables, OSP(s) and platform link cables would be present.



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1 Introduction

1.1 Purpose of the In-Principle Monitoring Plan

1. This In-Principle Monitoring Plan (IPMP) forms part of a set of documents that supports the Development Consent Order (DCO) Application submitted by Morecambe Offshore Windfarm Ltd (the Applicant) for the Morecambe Offshore Windfarm Generation Assets (the Project).
2. This IPMP has been prepared by the Applicant in order to provide the basis for delivering the monitoring measures as required by the conditions contained within the Project's deemed Marine Licence (DML).
3. The IPMP provides a key mechanism through which the relevant regulatory authorities can be assured that required offshore monitoring activities associated with the construction and operation of the offshore infrastructure for the Project would be formally controlled.
4. The IPMP provides a framework for further discussions post-consent with the Marine Management Organisation (MMO), the relevant Statutory Nature Conservation Bodies (SNCBs) and advisors (e.g. Maritime and Coastguard Agency (MCA)) to agree the exact detail (timings, methodologies etc.) of the monitoring that is required. The structure of the IPMP has been informed by Natural England's Offshore Wind Marine Environmental Assessments: Best Practice Advice for Evidence and Data Standards (Natural England, 2022).
5. Due to the long lead in time for the development of offshore windfarms, it is neither desirable nor effective to provide final detailed method statements prior to consent being granted. However, agreeing guiding principles reinforces commitments made in the Environmental Statement (ES), allows verification of the assumptions made in the ES and complements other requirements set out in the DML, allowing refinements to be made based on the best available knowledge and technology. Final detailed plans for monitoring work would be produced closer to the time that the actual work would be undertaken.
6. The relevant topics and/or receptor groups discussed in this plan are as follows:
 - **Chapter 7 Marine Geology, Oceanography and Physical Processes** of the ES (Document Reference 5.1.7)
 - **Chapter 9 Benthic Ecology** of the ES (Document Reference 5.1.9)
 - **Chapter 10 Fish and Shellfish Ecology** of the ES (Document Reference 5.1.10)
 - **Chapter 11 Marine Mammal Ecology** of the ES (Document Reference 5.1.11)

- **Chapter 12 Offshore Ornithology** of the ES (Document Reference 5.1.12)
 - **Chapter 13 Commercial Fisheries** of the ES (Document Reference 5.1.13)
 - **Chapter 14 Shipping and Navigation** of the ES (also relevant to other marine users) (Document Reference 5.1.14)
 - **Chapter 15 Offshore Archaeology and Cultural Heritage** of the ES (Document Reference 5.1.15)
7. No monitoring is identified for other topics in the ES, including marine sediment and water quality, seascape, landscape and visual impact assessment, human health, socio-economics and climate change. Technical mitigations have been identified for civil and military aviation and radar, however these measures would be further developed in detail with stakeholders post-consent, with any need for monitoring identified at that point and managed outwith the IPMP.

1.2 Background

8. The Applicant is seeking a DCO for the Morecambe Offshore Windfarm Generation Assets, a proposed offshore windfarm located in the Eastern Irish Sea, approximately 30km off the Lancashire coast with an expected nominal capacity of 480 megawatts (MW).
9. As the windfarm is an offshore generating station of over 100MW, it is defined under the Planning Act 2008 as a Nationally Significant Infrastructure Project (NSIP) and as such it requires a DCO.
10. A Government-initiated review of offshore windfarm transmission connections has concluded that the Morecambe Offshore Windfarm would share a grid connection location at Penwortham in Lancashire with the Morgan Offshore Wind Project, another offshore windfarm proposed in the east Irish Sea. Given this, the Applicant intends to deliver a coordinated grid connection with the Morgan Offshore Wind Project and together with the Applicant for the Morgan Offshore Wind Project, is submitting a separate DCO application for the Transmission Assets for both projects.
11. For the purposes of this document the “Project” refers to the Morecambe Offshore Windfarm Generation Assets.
12. The Project includes infrastructure to be located within the offshore windfarm site, namely wind turbine generators (WTGs), inter-array cables, offshore substation platform(s) (OSP(s)) and possible platform link cables to connect OSP(s). WTGs and OSP(s) would be fixed to the seabed with foundation structures.

13. The Agreement for Lease (AfL) area awarded by The Crown Estate for the Morecambe Offshore Windfarm spans 125km². Following consultation on the Project Preliminary Environmental Information Report (PEIR), the proposed windfarm site area was reduced to approximately 87km². This refined windfarm site is shown in **Figure 1.1** and presented in the ES and DCO Application documents.
14. The Project Design Envelope (PDE) includes a range of WTGs with varying parameters and capacity, to accommodate the ongoing rapid development in WTG technology. Accounting for this range, there could be up to 30 'larger' or up to 35 'smaller' WTGs installed within the windfarm site, with the Generation Assets comprising:
 - WTGs
 - OSP(s)
 - Inter-array cables
 - Platform link cables
15. The detailed design of the Project (e.g. numbers of WTGs, layout configuration, foundation type and requirement for scour protection) would not be determined until post-consent. Therefore, realistic worst-case scenarios in terms of potential impacts/effects have been adopted to undertake a precautionary and robust impact assessment, as presented in the ES. Further details are provided in **Chapter 5 Project Description** of the ES (Document Reference 5.1.5).

1.2.1 Key relevant Project parameters

Table 1.1 Key relevant Project parameters

Parameter	Details	
Approximate offshore construction duration	2.5 years	
Windfarm site area (km ²)	87	
Windfarm site water depth range (m)	18 – 40	
Distance from windfarm site to coast (approximately) (km)	30	
Number of WTGs	Up to 35 smaller turbines	Up to 30 larger turbines
Maximum number of OSP(s)	2	
WTG and OSP foundation type options	- Gravity Base Structures (GBS) - Multi-legged pin-piled jacket (3 or 4 legged) - Monopiles - Multi-legged suction bucket jacket (3 legged)	
Number of piles per foundation for WTGs	Monopile = 1 Jacket pin-piles = 4	
Maximum number of piles for WTGs	Monopile = 35 Jacket pin-piles = 140	
Maximum number of piles for OSPs	Monopile = 2 Jacket pin-piles = 8	
Hammer energies (kilojoules) (kJ)	Maximum hammer energy for monopiles: 6,600kJ Maximum hammer energy for jacket pin-piles: 2,500kJ	
Maximum pile diameter (m)	Maximum pile diameter for monopiles: 12m Maximum pile diameter for jacket pin-piles: 3m	

1.3 General guiding principles for the proposed monitoring

16. Throughout the ES and supporting documentation, the Applicant has taken steps to avoid or reduce significant effects either through the iterative process of site selection, project design and applying best practice (embedded mitigation) or by additional mitigation measures which would be applied during the construction, operation and maintenance or decommissioning phases.
17. The guiding principles for monitoring, which apply in general to the in-principle monitoring outlined in this document, are as follows:

- Monitoring conditions ~~should~~must be necessary, relevant to planning, relevant to the development to be consented, enforceable, precise, and reasonable in all other respects as set out in Paragraph 4.1.16 of the National Policy Statement (NPS) EN-1.
- In line with good practice, monitoring must have a clear purpose in order to provide answers to specific questions where significant environmental effects have been identified (Centre for Environment, Fisheries and Aquaculture (Cefas), 2012; Glasson *et al.*, 2011; Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR), 2008). As such, monitoring proposals ~~should~~must~~would~~ have an identified end date and confirmed outputs, which provide statistically robust datasets, as applicable to the hypothesis being tested.
- Monitoring ~~should~~would be targeted to address significant evidence gaps or uncertainty, which are relevant to the Project and can be realistically filled, as well as those species or features considered to be the most sensitive, including those of conservation, ecological and/or economic importance.
- Proposals for monitoring ~~should~~must~~would~~ be based, as a starting point, on the best practice and outcomes of the latest review of environmental data associated with post-consent monitoring of licence conditions of offshore wind farms (MMO, 2014), and applying more recent best practice guidance and lessons learnt (including from the existing monitoring programmes) where relevant.
- Monitoring will be designed to be fit for purpose and to ensure that the desired outcomes can be achieved, taking account of lessons learned from previous research in the public domain.
- Monitoring over the Project duration ~~should~~would aim to be comparable between campaigns. Any changes (potentially identified following review of survey reports) to the agreed methodologies between survey campaigns would be submitted to the MMO, in consultation with relevant stakeholders, prior to the start of relevant works.

- -The scope and design of all monitoring work ~~should~~would be finalised and agreed following review of the results of any preceding survey and/or monitoring work (i.e. an adaptive monitoring approach), including those surveys conducted in support of the Environmental Impact Assessment (EIA). This includes the potential for survey requirements to be adapted based on the results of the monitoring outlined in this document, including in the event that unforeseen impacts arise, which may in turn give rise to the need for adaptive management measures to be considered. Where it has been agreed that there are no significant effects, monitoring need not be conditioned through the DML.
- Monitoring of the marine environment and ecological receptors is an important process for offshore wind projects at the post-consent phase. Monitoring is required in order to address areas of uncertainty, test hypotheses and to validate predictions made within project assessments (Natural England, 2022).
- In the development of detailed monitoring methods post-consent (for receptors identified as requiring monitoring), including data collection and reporting, the Applicant will consider the application of standardisation where widely recognised agreed standards for monitoring already exist at the time.
- Continuation of monitoring campaigns will be reviewed following completion of monitoring reports which will include conclusions and information on how hypotheses have been met. Any further requirements/actions identified as a result of previous monitoring campaigns will be agreed in consultation with the MMO and relevant stakeholders.
- The Applicant is supportive of considering appropriate strategic monitoring studies. Where the Applicant is made aware of new strategic monitoring studies, they would discuss with the relevant authorities if they are appropriate to discharging specific DML conditions.
- The Applicant would undertake data sharing to inform broader environmental monitoring studies and would facilitate this via submitting monitoring reports to the Marine Data Exchange inline with that undertaken pre-consent (EIA baseline surveys).

1.4 Residual effects

18. The Project EIA predicts the residual effect to receptors taking into account:
- Linkages using the source > pathway > receptor model
 - Embedded/additional mitigation
 - Sensitivity of the receptor to the impact

- Magnitude of the impact
- Ecological/economic importance/value of the receptor

19. The significance of the residual effect ~~should~~would not in its own right necessarily lead to the requirement for monitoring. Monitoring ~~should~~would be targeted to address significant evidence gaps or uncertainty which are relevant to the Project and can be realistically filled. Results of the Project Marine Conservation Zone Assessment (MCZA) and Report to Inform Appropriate Assessment (RIAA) have also been used to determine monitoring requirements as necessary.
20. Monitoring has been deemed necessary and required as part of the DML where appropriate, considering in particular where moderate or major adverse effects are predicted in the assessment, or where uncertainty remains at an industry-wide level.

1.5 In-principle proposals for monitoring

21. The following sections set out the in-principle proposals for monitoring in relation to each of the topics and/or receptor groups covered in the ES.
22. While accepting that this IPMP represents the best approach to monitoring available at the time of writing, it is recognised that the outcomes of the survey/monitoring work outlined in this plan could influence future monitoring requirements, methodologies, focus and effort for the Project as knowledge and understanding develops. For example, where appropriate, and in consultation with the MMO and its advisors, survey scopes ~~may~~would be refined to consider other relevant studies. This is a key principle for an adaptive approach to monitoring and would be the subject of ongoing consultation between the Applicant, the MMO and its advisors, as discussed under guiding principles (see **Section 1.3**).
23. This document has been submitted with the Project DCO Application and would inform the basis for further discussions post-consent for monitoring.

2 Proposed monitoring

2.1 Engineering related monitoring

24. In addition to the environmental survey and monitoring required as conditions of the DML within the DCO, additional studies would be undertaken for engineering purposes. Some of these would overlap with the conditioned monitoring, and wherever possible, the Applicant would look to combine surveys for monitoring purposes with those already being carried out for engineering purposes. These are principally:

Pre-construction studies

- Geophysical and geotechnical surveys, including Remote Operated Vehicle (ROV) surveys, informing:
 - WTG/OSP foundation design and siting
 - Cable crossing design
 - Cable design, burial and protection plans and siting
 - Scour protection requirements
 - Boulder clearance requirements
 - Sandwave clearance requirements
 - Jack-up vessel positioning requirements
 - Unexploded ordnance (UXO) clearance requirements
 - Exploration of archaeological features to determine any Archaeological Exclusion Zone (AEZ) requirements

Construction studies

- Surveys to ensure the safe placement of equipment

Post-construction studies

- As built surveys as per pre-construction to inform:
 - Cable burial success
 - Adequate protection of infrastructure, foundations and crossings
 - Presence of dropped objects

Operation and maintenance studies

- Asset protection studies/surveys and need for any remedial measures (e.g. flaking paint/leading edge protection)
- Surveys to ensure the safe placement of equipment during maintenance

Decommissioning studies

- Surveys to ensure the safe placement of equipment
- Geophysical surveys, including ROV surveys

Post-decommissioning studies

- As left surveys as to inform:
 - Cable removal reporting
 - WTG and foundation removal reporting
 - Status of any remaining infrastructure

- Surveys to monitor any infrastructure remaining in-situ post-decommissioning as required by the Decommissioning Programme
25. The Decommissioning Programme is secured within the draft DCO as (Schedule 2, Requirement 9). The Decommissioning Programme would be submitted for approval six months prior to the start of construction, when detailed design of the Project has been concluded, to reflect the infrastructure agreed for construction. Any requirement for decommissioning monitoring will be based on the outcomes of the monitoring during/post-construction and made with respect to the Decommissioning Programme.
26. Other relevant Plans required under the DML with commitments to monitoring (linked to engineering requirements listed above) are:
- A Project Environmental Management Plan (PEMP) in accordance with the Outline Plan (Document Reference 6.2)
 - A Scour Protection and Cable Protection Plan (and protection measures) in accordance with the Outline Plan (Document Reference 6.8)
 - A Cable Specification, Installation and Monitoring Plan (cable burial monitoring)
 - An Offshore Operation and Maintenance Plan (OOMP) in accordance with the Outline Plan (Document Reference 6.6)

2.2 Marine geology, oceanography and physical processes

2.2.1 Conclusions of the Environmental Statement

27. The impacts that could potentially arise during the construction, operation and maintenance and decommissioning phases of the Project have been discussed as part of the Evidence Plan Process (EPP) (see **Chapter 7 Marine Geology, Oceanography and Physical Processes** of the ES).
28. No residual effects greater than negligible adverse were predicted within the ES (Project-alone or cumulatively). Effects are localised in respect to large scale physical processes operating in the region and because the Project has sufficient separation to any designated geological features.

2.2.2 In-principle monitoring

29. The Applicant would survey the development areas for engineering purposes using appropriate geophysical surveys, including high resolution bathymetric, Multibeam Echosounder (MBES) and Side-Scan Sonar (SSS) surveys of such

area(s) within the Order Limits of the DCO (the area within which the Project may be carried out). Such surveys would also provide information on seabed changes assessed as part of the ES.

30. **Table 2.1** provides information on the proposed monitoring requirements for marine, geology, oceanography and physical processes which would be discussed and agreed with Natural England and the MMO.

Table 2.1 In-principle monitoring proposed in relation to marine geology, oceanography and physical processes

Potential effect	Receptor/s	Phase	Summary reason/s for monitoring and overarching hypothesis	Monitoring proposed	Details
Changes in seabed level	Physical environment	Pre-construction	Document bedform topography pre-construction Baseline pre-construction survey of the physical environment	A single survey within the windfarm site using full seabed coverage swathe bathymetric, MBES and SSS surveys (to meet the requirements of Marine Guidance Note (MGN) 654 and its Annexes) of the area(s) within the Order Limits in which it is proposed to carry out construction works, (noting that it is possible certain areas within the order limits may not be developed).	Scope of survey and programmes and methodologies shall be submitted to the MMO for review by relevant stakeholders and written approval at least four months prior to the commencement of survey work.
		Post-construction	Document bedform topography post-construction Hypothesis: that bedform topography changes within the survey area as a result of the Project are as assessed in the ES.	Surveys as per pre-construction using full seabed coverage swathe bathymetric surveys undertaken to meet the requirements of MGN 654 and its Annexes. The survey would identify changes to the seabed post-construction.	Surveys carried out post-construction. The need for further surveys would be agreed in writing with the MMO in consultation with the relevant SNCBs.

2.3 Benthic ecology

2.3.1 Conclusions of the Environmental Statement

31. The impacts that could potentially arise during the construction, operation and maintenance and decommissioning of the Project have been discussed as part of the EPP (**Chapter 9 Benthic Ecology** of the ES).
32. No residual effects greater than **minor adverse** were predicted within the ES (Project-alone or cumulatively). This is driven by the area of development in relation to the availability of similar wider habitats, and the lack of features of conservational interest such as Annex I biogenic or geogenic reef features within the windfarm site.

2.3.2 Conclusions of the MCZA and RIAA

33. No hindrance to the conservation objectives of any Marine Conservation Zone (MCZ) were identified. The Applicant's assessments concluded no Project-alone or in-combination Adverse Effects on Integrity (AEoI) at all sites designated with benthic features.

2.3.3 In-principle monitoring

34. **Table 2.2** provides information on the monitoring requirements for benthic ecology.
35. There are no Annex I biogenic or geogenic reef features within or near to the Project windfarm site and those habitats/biotopes that are present within the windfarm site would not be significantly affected by the Project. Consequently, only post-construction monitoring for colonisation of hard substrata by Invasive Non-Native Species (INNS) is proposed in **Table 2.2**. This is proposed given the uncertainty in the effectiveness of INNS mitigation and provides opportunity to validate ES conclusions.
36. As further geophysical surveys are planned pre-construction, analysis of collected survey data would be undertaken to identify any changes to the seabed features identified in the EIA baseline characterisation.

Table 2.2 In-principle monitoring in relation to benthic ecology

Potential effect	Receptor/s	Phase	Summary reason/s for monitoring and overarching hypothesis	Monitoring description	Details
Colonisation of hard substrate by INNS	Benthic ecology	Post-construction	Monitor for potential colonisation by INNS on and in the vicinity of any hard substrate. This is to be undertaken during post-construction hard substrate inspections. Hypothesis: that benthic ecology changes within the survey area as a result of INNS on Project infrastructure substrates is as assessed in the ES.	Undertake Drop Down Video (DDV) surveys during the operational phase in line with engineering inspections.	- Survey programmes and methodologies for the purposes of monitoring shall be submitted to the MMO for review by relevant stakeholders and written approval at least four months prior to completion of construction/commissioning. - If significant effects are observed, the potential requirement for further surveys would be agreed with the MMO following review of the post-construction survey results. - Data would be provided as appropriate to any identified organisations that collate/store INNS information.

2.4 Fish and shellfish ecology

2.4.1 Conclusions of the Environmental Statement

37. The impacts that could potentially arise during the construction, operation and maintenance and decommissioning of the Project have been discussed as part of the EPP (**Chapter 10 Fish and Shellfish Ecology** of the ES).
38. No residual effects greater than **minor adverse** were predicted within the ES (Project-alone or cumulatively) due to the relatively small-scale nature of the Project in the context of the wider Irish Sea, available alternative habitats, and temporary nature of the major construction activities.

2.4.2 Conclusions of the MCZA and RIAA

39. No hindrance to the conservation objectives of any MCZ were identified. The Applicant's assessments concluded no Project-alone or in-combination AEoI at all European sites designated designed for fish and shellfish.

2.4.3 In-principle monitoring

40. Given the lack of potential for significant effects upon key active demersal spawning grounds, and in keeping with the guiding principles of monitoring as set out in this document, no site-specific monitoring of fish resource is proposed.
41. It is understood that there is the desire from the fishing industry for assessments made in the ES to be validated. The Applicant is proposing to undertake monitoring of publicly available commercial fisheries data (**Section 2.7.2**) and remains open to involvement in existing or upcoming strategic/regional studies and commercial fisheries working groups. This would likely be managed outwith the IPMP since the data collected would be used to inform on-going discussions with local fisheries stakeholders as part of the Fisheries Liaison and Coexistence Plan (FLCP).
42. Further, monitoring of the first four piles as outlined below for marine mammals (**Table 2.3**) would also determine that the maximum underwater noise levels as assessed within the ES for fish are not being breached. This will validate the mitigation (via measuring noise levels) agreed and secured by the Underwater Sound Management Strategy (UWSMS) for fish.

2.5 Marine mammal ecology

2.5.1 Conclusions of the Environmental Statement

43. The impacts that could potentially arise during the construction, operation and maintenance and decommissioning of the Project have been discussed as part of the EPP (**Chapter 11 Marine Mammals** of the ES).
44. At a Project-alone level, the residual effects are assessed as no greater than **minor adverse** during construction (and decommissioning) of the Project for harbour porpoise, bottlenose dolphin, common dolphin, Risso's dolphin, white-beaked dolphin, minke whale, grey seal and harbour seal, from the following activities/impacts:
- Physical and auditory injury from underwater noise
 - Disturbance from underwater noise
 - Disturbance from other construction activities
 - Disturbance from underwater noise, presence and movements of vessels
 - Barrier effects
 - Increased collision risk with vessels
 - Changes to prey resources
 - Disturbance of seals at haul-out sites
 - Changes to water quality
45. During operation and maintenance, no greater than **minor adverse** effects are assessed for harbour porpoise, bottlenose dolphin, common dolphin, Risso's dolphin, white-beaked dolphin, minke whale, grey seal and harbour seal, from the following activities/impacts:
- Underwater noise from operational WTGs
 - Underwater noise from operation and maintenance activities
 - Underwater noise from operation and maintenance vessels
 - Barrier effects
 - Disturbance at seal haul-out sites
 - Increased collision risk with vessels
 - Changes to prey availability
 - Changes to water quality

46. The cumulative assessment identifies no greater than **minor adverse** effects for harbour porpoise, bottlenose dolphin, common dolphin, Risso's dolphin, white-beaked dolphin, minke whale, grey seal and harbour seal, from the following activities:
- Disturbance from underwater noise (all phases)
 - Barrier effects (all phases)
 - Disturbance from operational WTGs
 - Increased collision risk with vessels (all phases)
 - Disturbance at seal haul-out sites (all phases)
 - Changes to prey availability (all phases)
47. The conclusions of the assessment are based on varying levels of confidence in the data used in the assessment. However, the conclusions of the assessment are of a precautionary nature where there is high uncertainty or low confidence in the data.

2.5.2 Conclusions of the RIAA

48. The Applicant's assessments concluded no Project-alone or in-combination AEoI at all sites designated for marine mammals.

2.5.3 In-principle monitoring

49. It is the position of the Applicant that any marine mammal monitoring proposal ~~should~~would be targeted to address impacts, evidence gaps or uncertainty of most relevance to the Project and the specific species.
50. **Table 2.3** includes monitoring proposals for marine mammals (as described in the draft Marine Mammal Mitigation Protocol (MMMP) (Document Reference 6.5) as well other potential options to be considered following the final design of the Project post consent. Details of this potential monitoring would be dependent upon the requirements of the final approved MMMP. It should be emphasised that the Project could not address all evidence gaps and areas of uncertainty, and the Applicant would not expect that the Project would deliver all the potential measures identified in **Table 2.3**. Rather, the identified measures form the basis of discussion with stakeholders in order to determine those most appropriate to take forward to implementation.
51. The Applicant is also supportive, in-principle, of joint industry projects and would welcome consideration of collaboration opportunities from SNCBs, Non-Governmental Organisations (NGOs) or other developers in strategic monitoring programmes. This would likely be managed outwith the IPMP.

Table 2.3 In-principle monitoring in relation to marine mammals

Potential effect	Receptor/s	Phase	Summary reason/s for monitoring and overarching hypothesis	Monitoring description	Details
Monitoring secured/considered to be required					
Potential auditory injury resulting from underwater noise due to piling	Harbour porpoise, bottlenose dolphin, common dolphin, Risso's dolphin, white-beaked dolphin, minke whale, grey seal and harbour seal	Construction	Determine that the maximum underwater noise levels as assessed within the ES are not being breached, and therefore the mitigation as outlined in the final MMMP and UWSMS is appropriate and effective. Hypothesis: that marine mammal impacts, given the noise levels produced during construction, are as assessed in the ES and RIAA.	Noise measurements taken from the first four piled foundations of each piled foundation type at the windfarm site would be undertaken to validate the assessments within the ES and RIAA and the mitigation secured (by documenting the actual noise levels) in the Final MMMP and Underwater Sound Management Strategy to reduce noise levels.	The final design and scope of monitoring would be agreed with the relevant stakeholders and included within the final Monitoring Plan submitted for approval. In the event that the monitoring shows noise levels which are significantly different to those assessed in the ES, all piling activity must cease until an update to the marine mammal mitigation protocol and further monitoring requirements have been agreed.
Information on marine mammal distribution	Harbour porpoise	Post-construction	Provide further information on harbour porpoise and other marine mammal distribution	The purpose of the monitoring would be to maximise the opportunity of collecting marine mammal data during post consent aerial surveys for red-throated diver.	Aerial surveys undertaken post-consent for red-throated diver to also provide additional

Potential effect	Receptor/s	Phase	Summary reason/s for monitoring and overarching hypothesis	Monitoring description	Details
			across the windfarm site in line with winter red-throated diver surveys		information on marine mammal densities post construction
Monitoring options to be agreed alongside the final Project design					
Potential disturbance resulting from underwater noise during piling activities	Harbour porpoise, bottlenose dolphin, common dolphin, Risso's dolphin, white-beaked dolphin, minke whale, grey seal and harbour seal	Construction	To test potential areas of uncertainty within the ES and RIAA.	The purpose of this potential monitoring would be to research the behavioural response of marine mammals to different construction activities, including from mitigations (e.g. Acoustic Deterrent Devices (ADDs)), in order to validate the conclusions of the ES and RIAA. <u>If required, this could/could</u> be undertaken through either acoustic methods or through visual methods during Project required mitigation (e.g. Marine Mammal Observers (MMO) and Passive Acoustic Monitoring (PAM)).	Given the conclusions of the ES and RIAA and existing research available, the Applicant considers this additional monitoring would not be required. If deemed to be necessary by SNCBs, the final design and scope of any monitoring would be agreed with the relevant stakeholders and included within the final monitoring plan submitted for approval. It is noted that such studies may only be appropriate at a regional/industry level scale, targeted to key species and proportionate to the

Potential effect	Receptor/s	Phase	Summary reason/s for monitoring and overarching hypothesis	Monitoring description	Details
					level of effects identified.

2.6 Offshore ornithology

2.6.1 Conclusions of the Environmental Statement

52. The impacts that could potentially arise during the construction, operation and maintenance and decommissioning of the Project have been discussed as part of the EPP (**Chapter 12 Offshore Ornithology** of the ES).
53. The potential effects on offshore ornithology receptors have been minimised through the site selection process which has located the windfarm site outside of areas designated for their importance to bird populations, and by raising the WTG minimum rotor clearance above sea level (air gap) from 22m to 25m above Highest Astronomical Tide (HAT).
54. During the construction and decommissioning phases of the Project, no Project-alone effects have been assessed to be greater than **minor adverse** significance for any offshore ornithology receptor in any biologically relevant season. This includes the more sensitive receptors screened into detailed assessment for disturbance, displacement and barrier effects during these phases i.e. common scoter, guillemot, razorbill, Manx shearwater and red-throated diver.
55. During the operation and maintenance phase, Project-alone effects due to disturbance, displacement and barrier effects on the more sensitive receptors screened into detailed assessment (common scoter, gannet, guillemot, razorbill, Manx shearwater and red-throated diver) would not result in effects of more than **minor adverse** significance during any biological season.
56. The risk posed to offshore ornithology receptors due to collisions with Project operational WTGs is assessed as no greater than **minor adverse** significance for all species recorded in flight at the windfarm site for all biologically relevant seasons. This includes the species screened into detailed assessment (gannet, little gull, kittiwake, common gull, herring gull, lesser black-backed gull and great black-backed gull).
57. The risk to ornithological receptors from cumulative displacement and collisions is assessed as no greater than **minor adverse** significance for all species, except great black-backed gull in relation to collision risk.

2.6.2 Conclusions of the RIAA

58. The Applicant's assessments concluded no Project-alone or in-combination AEoI at all sites designated for ornithological species.

2.6.3 In-principle monitoring

59. It is the position of the Applicant that any ornithological monitoring proposal ~~should~~would be targeted to address impacts, evidence gaps or uncertainty of most relevance to the Project and the specific species. **Table 2.4** outlines the proposed and potential in-principle monitoring. It should be emphasised that the Project could not address all evidence gaps and areas of uncertainty, and the Applicant would not expect that the Project would deliver all the potential measures identified in **Table 2.4**. Rather, the identified measures form the basis of discussion with stakeholders.
60. In order to take ornithological monitoring measures forward to implementation, they ~~should~~would be required to address matters identified as:
- Being of key importance in the assessments for the Project
 - Associated with particularly high uncertainty
 - Can be addressed effectively at the Project site
61. It is therefore important that priorities ~~should~~ be set not only to improve understanding of key aspects of uncertainty in the Project impact assessments, but also to make the most effective use of opportunities afforded by the location and Project design. This would allow the Project to contribute as much as possible to tackling areas of uncertainty that are not already being investigated elsewhere, and to avoid topics where conditions at the windfarm site make particular studies less feasible and less likely to provide clear results.
62. The Applicant is supportive, in-principle, of proportionate joint industry projects or alternative site-based monitoring of existing seabird activity within the windfarm site and would consider collaboration opportunities from SNCBs, NGOs or other developers in strategic monitoring programmes. This would likely be managed outwith the IPMP.

Table 2.4 In-principle monitoring in relation to offshore ornithology

Potential effect	Receptor/s	Phase	Summary reason/s for monitoring and overarching hypothesis	Monitoring description	Details
Monitoring secured/considered to be required					
Displacement	Key species red-throated diver.	Post-construction	Determine effects of the Project on site usage (and within 10km of the windfarm site overlapping the Liverpool Bay SPA) Hypothesis: that red-throated diver disturbance impacts as a result of the Project are as assessed in the ES and RIAA.	Post-construction aerial surveys to determine changes in abundance and distribution of birds within the windfarm site.	The final design and scope of any monitoring would be agreed with the relevant stakeholders and included within the final monitoring plan submitted for approval.
Monitoring options to be agreed post consent					
Collision	Key species including gannet, little gull, kittiwake, common gull,	Post-construction	To test key areas of uncertainty within the ES and RIAA.	Review of existing monitoring at other offshore windfarm projects and development of appropriate additional survey/monitoring.	Given the conclusions of the ES and RIAA and existing research available the Applicant considers this additional

Potential effect	Receptor/s	Phase	Summary reason/s for monitoring and overarching hypothesis	Monitoring description	Details
	herring gull, lesser black-backed gull and great black-backed gull.			If required, this could comprise on-site monitoring to determine flight behaviours and/or collision rates. Strategic work may present options to contribute to industry wide understanding of effects.	monitoring would not be required. If deemed to be required by SNCBs, the final design and scope of any monitoring would be agreed with the relevant stakeholders and included within the final monitoring plan submitted for approval.

2.7 Commercial fisheries

2.7.1 Conclusions of the Environmental Statement

63. The impacts that could potentially arise during the construction, operation and maintenance and decommissioning of the Project are presented in **Chapter 13 Commercial Fisheries** of the ES).
64. During the construction and decommissioning phases, the commercial fisheries assessment found moderately significant Project-alone effects for the UK potting fleet related to reduction in access and United Kingdom (UK) and Isle of Man potting fleets for displacement effects. Additional mitigation (for UK potting fleets) following the Fishing Liaison with Offshore Wind and Wet Renewables Group (FLOWW, 2014 and 2015) guidance (and future updates to this guidance), includes justifiable, evidence-based disturbance payments, lowering the residual effect to **minor adverse**.
65. During the operation and maintenance phase, the commercial fisheries assessment evaluated all Project-alone effects to all fleets to be no greater than **minor adverse**.
66. Mitigation applied also includes the development and maintenance of a Fisheries Liaison and Coexistence Plan (FLCP) (an Outline version of which is submitted as part of this DCO Application (Document Reference 6.3)).
67. The cumulative effects assessment found **moderate adverse** effects during the construction and decommissioning phase for the UK and Isle of Man dredge and demersal otter trawl (scallop) fishery and the UK and Isle of Man potting fleets related to reduction in access and/or displacement effects. The inclusion of other offshore windfarms in the Irish Sea), together with the potential for the management of mobile gears within Marine Protected Areas (MPAs) are the main factors raising the cumulative effect to be significant in EIA terms. The monitoring outlined below is in consideration of these effects, and precautionary assessment.

2.7.2 In-principle monitoring

68. The contribution of the Project to the identified moderate cumulative effects is considered low, however the Applicant has identified monitoring that would be used to inform discussions with stakeholders and other developers in the region related to co-existence with commercial fisheries and inform any required updates to the FLCP, which would remain in place for the lifetime of the Project (**Table 2.5**). The FLCP and findings of monitoring would likely be managed outwith the IPMP.

Table 2.5 In-principle monitoring in relation to commercial fisheries

Potential effect	Receptor/s	Phase	Summary reason/s for monitoring	Monitoring description	Details
Variation in fishing activity	Commercial fishing vessels	Pre-construction	Monitor available data and evidence to better understand any variations and patterns in commercial fisheries activity. To inform discussion with local fishers within the FLCP stakeholder group.	Collate data on commercial fisheries landings and activity by the International Council for the Exploration of the Sea (ICES) rectangle 36E6, 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 (Chapter 13 Commercial Fisheries and Appendix 13.1 Commercial Fisheries Technical Report of the ES). Collate such other sources of evidence of commercial fisheries activity as may be <u>is</u> reasonably available on a regular basis. Where possible, data collection and analysis would be standardised inline with monitoring from	Collate data on commercial fisheries landings by port on a monthly basis (reported annually post construction). Reports used to inform FLCP updates that may be required or identification of further monitoring or mitigation. This is considered to be required for a minimum of 5 years post-construction (with the EIA baseline extended using publicly available datasets to encompass pre-construction and construction periods).
		Construction			
		Post-construction			
		Any requirement for decommissioning monitoring will be based on the outcomes of the monitoring post-construction and made with respect to the Decommissioning Programme.			

Potential effect	Receptor/s	Phase	Summary reason/s for monitoring	Monitoring description	Details
				other regional OWF projects.	

2.8 Shipping and navigation

2.8.1 Conclusions of the Environmental Statement

- 69. The impacts that could potentially arise during the construction, operation and maintenance and decommissioning of the Project are presented in **Chapter 14 Shipping and Navigation** of the ES.
- 70. While Project-alone impacts results in minor route diversions, with minimal impacts to operations, cumulative effects have additive effects on operators.
- 71. The effects, including cumulative effects, of the Project on shipping and navigation assessed in the ES range from **negligible** to **moderate adverse**.
- 72. As described within the ES (and within the Navigational Risk Assessment) all safety impacts identified are reduced to As Low As Reasonably Practicable (ALARP) with the implementation of mitigation measures and proposed monitoring and assessed as not significant in EIA terms.

2.8.2 In-principle monitoring

- 73. Monitoring is proposed as part of mitigation measures within the ES. **Table 2.6** provides information on the vessel traffic monitoring requirements for shipping and navigation.

Table 2.6 In-principle monitoring in relation to shipping and navigation

Potential effect	Receptor/s	Phase	Summary reason/s for monitoring	Monitoring description	Details
Effects on the levels of marine traffic across the windfarm site	Marine traffic	Construction	Validate the predictions made in the ES and NRA with respect to potential effects on the levels of shipping traffic.	Construction monitoring shall include vessel traffic monitoring by Automatic Identification System (AIS), including the provision of yearly reports.	During construction, vessel traffic monitoring using AIS would be conducted, with the detailed requirements for this being agreed with the MMO, MCA and Trinity House before commencement of construction. Post-construction vessel traffic monitoring would consist of AIS monitoring. This would be carried out at a suitable time as agreed with the MMO and MCA following the commencement of commercial operation.
		Post-construction		Vessel traffic monitoring by AIS, taking account of seasonal variations in traffic patterns over one year, following the commencement of commercial operation. A report would be submitted to the MMO and the MCA following the end of the monitoring programme and periodically, if required, as requested by the MCA.	
Effect on marine traffic routing and safety	Marine traffic	Construction	Ensure temporary aids to navigation are functional and fit for purpose.	Aids to Navigation Plan that remains functional throughout the lifetime of the Project with reporting to the MCA and Trinity House.	Aids to Navigation Plan to be agreed with the MCA and Trinity House prior to commencement of construction.
		Post-construction	Ensure aids to navigation are functional and fit for purpose.		Aids to Navigation Plan for the life of the Project to be agreed with Trinity House.

Potential effect	Receptor/s	Phase	Summary reason/s for monitoring	Monitoring description	Details
Effect on marine traffic routing and safety	Marine traffic	Post-construction	To ensure charted depth remains in line with that agreed in consultation with the MCA and nautical charts remain up to date.	A swathe bathymetric survey to International Hydrographic Organisation (IHO) Order 1a of the installed cable corridor (post-construction and decommissioning).	A swathe bathymetric survey to IHO Order 1a of the installed cable corridor (post-construction and decommissioning). Data is to be supplied to the MCA, UK Hydrographic Office (UKHO) and survey report to the MMO.
Effect on marine traffic routing and safety	Marine traffic	Post-construction	To ensure charted depth remains in line with that agreed in consultation with the MCA and nautical charts remain up to date. To ensure that cables do not become exposed and present a snagging risk to fishing or anchoring vessels.	Periodic monitoring of cable burial/protection.	Periodic monitoring of cable burial/protection with a risk-based approach to the management (this work would be undertaken for engineering and asset integrity purposes, with the frequency determined by need).

2.9 Offshore archaeology and cultural heritage

2.9.1 Conclusions of the Environmental Statement

74. The impacts that could potentially arise during the construction, operation and maintenance and decommissioning of the Project have been discussed as part of the EPP and are presented in **Chapter 15 Marine Archaeology and Cultural Heritage** of the ES).
75. The construction, operation and decommissioning phases of the Project would result in a range of potential effects upon the marine archaeological and cultural heritage environment. At the Project-alone level, the effects that have been assessed are anticipated to be reduced to a **minor adverse** residual significance or are considered to be negligible on the basis of embedded mitigation and best practice, including further interpretation/assessment of geophysical and geotechnical data post-consent.
76. Furthermore, known archaeological receptors are not considered to be subject to significant cumulative effects on the basis that they should be avoided through the adoption of appropriate mitigation.

2.9.2 In-principle monitoring

77. **Table 2.7** provides information on the monitoring requirements for offshore archaeology and cultural heritage. The principal mechanism for delivery of monitoring for offshore archaeology and cultural heritage is through (and as conditioned in the DML) the Offshore Written Scheme of Investigation (OWSI) (in accordance with the Outline OWSI (Document Reference 6.10), with further activity specific method statements to be agreed with Historic England.
78. Under the DML, the delivery of measures detailed in, and agreed through, the Outline OWSI is captured in conditions 9(2) (pre-commencement surveys and archaeological investigations), 9(1)(f) (requirement for an updated OWSI which accords with the Outline OWSI) and 10(1) (requirement for the updated OWSI to be submitted for approval to the MMO at least four months before the intended commencement of licensed activities). In accordance with 9(1)(f), the updated OWSI will be produced in consultation with Historic England to further develop the methodology for further site investigation and the delivery of mitigation for archaeology and cultural heritage post-consent.

Table 2.7 In-principle monitoring in relation to offshore archaeology and cultural heritage

Potential effect	Receptor/s	Phase	Summary reason/s for monitoring	Monitoring description	Details
All direct and indirect effects on the archaeological resource	All Archaeology receptors	Pre-construction	Validate the predictions made in the ES, where reasonable, with respect to potential effects on the archaeological resource and to inform selection of appropriate mitigation.	An Outline OWSI has been compiled which makes provision for all archaeological mitigation that might be required in the light of pre-construction investigations, including field investigation, post-fieldwork activities, archiving and dissemination of results. The OWSI includes provision to update the document as the Project design is refined and as the results of further archaeological assessment become available. The final agreed OWSI acts as a 'point-in-time' document and would be submitted to the MMO four months in advance of the licensed activities. Full sea bed coverage swathe pre-construction surveys would include swathe-bathymetric surveys and side-scan surveys of the area(s) within the order limits in which it is proposed to carry out construction works. This should-would include the investigation and identification of seabed features of known and potential archaeological interest within the survey areas and which may require the refinement, removal or introduction of AEZs and to confirm project specific micro-siting requirements. Where possible, this	The Applicant has submitted an Outline OWSI with the DCO Application. This would be submitted to the MMO for written approval in accordance with the timescales required by the DML. The proposed monitoring would be detailed in the final OWSI.

Potential effect	Receptor/s	Phase	Summary reason/s for monitoring	Monitoring description	Details
				would be combined with geophysical surveys required for other receptors.	
All direct and indirect effects on the archaeological resource	All archaeology receptors	Construction and operation and maintenance	Validate the predictions made in the ES, where reasonable, with respect to potential effects on the archaeological resource and to inform selection of appropriate mitigation (Historic England requirement).	Specific requirements relating to monitoring during construction or operation (including a conservation programme for finds) as detailed in the OWSI. Notably the Offshore Renewables Protocol for Archaeological Discoveries (ORPAD) shall be followed during all intrusive works (The Crown Estate and Wessex Archaeology, 2014).	The OWSI produced pre-construction is a 'point-in-time' document, with the specific methodology for each subsequent package of archaeological works to be taken forward through archaeological method statements produced under the umbrella of the OWSI and agreed with the archaeological curator. Survey and work package specific archaeological objectives would be established on a case-by-case basis. The OWSI would be submitted to the MMO for written approval in accordance with the timescales required by the DML.

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