MachairWind Offshore Windfarm

Appendix G – Marine Mammals and Turtles Approach to Assessment

ScottishPower Renewables | MachairWind Offshore Windfarm

SEPTEMBER 2024

DOCUMENT ID: MCW-DWF-PMG-REP-IBR-000007
Revision 1

This page is intentionally blank

TABLE OF CONTENTS

List of Tables

List of Figures

GLOSSARY OF ACRONYMS

Term	Definition
ASCOBANS	Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas
CGNS	Celtic Great North Sea
CSIP	Cetacean Strandings Investigation Programme
dB	Decibel
Defra	Department for Environment, Food and Rural Affairs
DRC	Dose Response Curve
EDR	Effective Deterrence Range
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EPS	European Protected Species
FCS	Favourable Conservation Status
HRA	Habitats Regulations Appraisal
iPCoD	interim Population Consequences of Disturbance
JNCC	Joint Nature Conservation Committee
km	Kilometre
MMMP	Marine Mammal Mitigation Protocol
MU	Management Unit
NMFS	National Marine Fisheries Service
OfTDA	Offshore Transmission Development Area
OnTDA	Onshore Transmission Development Area
O&M	Operation and Maintenance
OWF	Offshore Windfarm
PTS	Permanent Threshold Shift
SEL_{ss}	Sound Exposure Level (Single Strike)
SMASS	Scottish Marine Animal Stranding Scheme
SNH	Scottish Natural Heritage
TTS	Temporary Threshold Shift
WDA	Windfarm Development Area
WS	West Scotland
WTG	Wind Turbine Generator
UK	United Kingdom
UXO	Unexploded Ordnance

GLOSSARY OF TERMS

Term	Definition
The Applicant	The legal entity submitting consent applications for the MachairWind Offshore Windfarm, namely MachairWind Limited.
European site	Sites designated for nature conservation under the Habitats Directive and Birds Directive. These include candidate Special Areas of Conservation, Sites of Community Importance, Special Areas of Conservation and Special Protection Areas, and are defined in the Habitats Regulations.
Habitats Regulations	A collective term used to describe the Conservation of Habitats and Species Regulations 2017 and The Conservation (Natural Habitats,&c.) Regulations 1994.
Inter-array cables	Armoured cable containing electrical and fibre optic cores which link the wind turbine generators to each other and to the offshore substation platform(s).
MachairWind Offshore Windfarm	An offshore windfarm capable of exporting around 2 GW of renewable energy to the National Electricity Transmission System. MachairWind Offshore Windfarm comprises three Development Areas. The Windfarm Development Area is located on the west coast of Scotland to the northwest of Islay and west of Colonsay and the working assumption is that the MachairWind Offshore Windfarm will connect to a location within South Ayrshire. Work is ongoing to define the Offshore Transmission Development Area and Onshore Transmission Development Area. Separate consent and licence applications will be submitted for each Development Area.
Offshore Substation Platform (OSP)	An offshore platform with a fixed foundation located within the Offshore Transmission Development Area which houses electrical equipment such as transformers, switchgear, protection and control systems, and enables the windfarm's renewable electricity to be collected via inter-array cables and exported to the National Electricity Transmission System via offshore export cables.
Offshore Transmission Development Area (OfTDA)	The application boundary which extends seaward of Mean High Water Springs and within which the following will be consented (infrastructure includes but is not limited to): offshore export cable(s), OSP(s), OSP link cables (if required) and external cable protection. The OfTDA is subject to a Marine Licence(s) application under the Marine (Scotland) Act 2010.
Onshore Transmission Development Area (OnTDA)	The planning application boundary extending landward of Mean Low Water Springs and within which the following will be consented (infrastructure includes but is not limited to): landfall(s), onshore export cables, temporary construction compounds, and environmental mitigation areas. The OnTDA will be subject to a planning application under the Town and Country Planning (Scotland) Act 1997.
The Project	MachairWind Offshore Windfarm.
Permanent Threshold Shift (PTS)	A permanent total or partial loss of hearing sensitivity caused by acoustic trauma. PTS results in irreversible damage to the sensory hair cells of the ear, and thus a permanent reduction of hearing acuity.
Scour protection	Protective measures to avoid sediment being eroded away from the base of the wind turbine generator foundations as a result of the flow of water.
Wind Turbine Generator (WTG)	A wind turbine generator which converts wind energy into electrical energy. Each wind turbine generator is a complex system composed of a high number of components. Typically, the main components include the rotor assembly (composed of three blades and a hub); the nacelle (containing a generator, shaft and gearbox, power electronic converter and transformer); and the tower (containing lifting equipment and the switchgear).

Term	Definition
Windfarm Development Area (WDA)	The application boundary within which consent will be sought for the WDA Infrastructure. The WDA is subject to a Section 36 consent and Marine Licence(s) application which is being applied for separately from the OfTDA and OnTDA.
WDA infrastructure	The offshore generation infrastructure located within the WDA including but not limited to: WTGs, fixed foundations, IACs, and external cable and scour protection.

1 MARINE MAMMALS AND TURTLES APPROACH TO ASSESSMENT

1. This appendix should be read in conjunction with the MachairWind Offshore Windfarm ('the Project') Windfarm Development Area (WDA) Scoping Report **Chapter 10 Marine Mammals**. This appendix details the approach to the assessment for potential impacts proposed to be scoped into the Environmental Impact Assessment (EIA) for marine mammals and turtles. The assessments for all of the potential impacts described in this appendix will follow the general marine mammal impact assessment methodology provided in **Chapter 10 Marine Mammals**. This appendix has been prepared by Royal HaskoningDHV.

1.1 POTENTIAL IMPACTS DURING CONSTRUCTION

1.1.1 Underwater Noise during Unexploded Ordnance Clearance

2. A desk-based assessment using current scientific knowledge will be undertaken to assess the potential physical injury zones for marine mammals.

3. A detailed Unexploded Ordnance (UXO) survey will be completed post-consent and prior to construction. Therefore, the number and type of possible detonations and duration of UXO clearance operations that could be required will not be known for the EIA.

4. A separate Marine Licence for UXO clearance will be applied for post-consent. This is to ensure that assessments are based on the best available information at the time, including the size of UXO expected to require clearing and the clearance method. An indicative assessment will be provided alongside the WDA EIA Report (EIAR), as an appendix, to provide an indication as to the potential effect from UXO clearance.

5. For the indicative assessment, a conservative estimate of the type and size of UXO that may be present will be made, if possible, based on the best available information from other Offshore Windfarm (OWF) UXO clearance operations and other published information.

6. Indicative underwater noise modelling will be undertaken on a range of potential UXO devices that may be present in the WDA, in order to enable an indicative assessment of impacts. Further information on underwater noise modelling is provided in **Section 1.1.2.1**. Underwater noise modelling will be based on the most recent and relevant underwater noise thresholds for marine mammals (currently Southall et al., 2019 and National Marine Fisheries Service (NMFS), 2018) for auditory injury. Due to the lack of further information on disturbance currently available, the modelling results for Temporary Threshold Shift (TTS) may be used as a proxy for disturbance. The maximum predicted impact areas, based on the worst-case scenario, will be used to estimate the potential number of individuals that could be affected, based on the species density estimates. The number of individuals of each species that could be affected will be considered as a proportion of the reference population, and the resultant magnitudes and sensitivities will be based on the best available evidence and defined as outlined in **Chapter 10 Marine Mammals** of this Scoping Report.

7. A Marine Mammal Mitigation Protocol (MMMP) in accordance with the Draft MMMP to be submitted with the Section 36 application will be produced to reduce the risk of physical injury or permanent auditory injury (Permanent Threshold Shift (PTS)) in marine mammals from UXO clearance. Other mitigation measures that will be implemented during UXO clearance are described in **Chapter 10 Marine Mammals** of this Scoping Report.

8. It is important to note, if there is the potential for significant disturbance to result in a population-level effect, then alternatives and mitigation options will be considered and an EPS licence application will be submitted.

1.1.2 Underwater Noise during Impact Piling

9. A number of approaches will be used to inform the underwater noise impact assessment, including site-specific underwater noise modelling for auditory injury and disturbance, literature reviews of known behavioural reactions to similar underwater noise emissions, dose response assessments and population modelling. Each of these approaches to underwater noise assessment is described in further detail below.

10. Underwater noise modelling will be undertaken to determine the potential effects on marine mammals during piling for:

- Auditory injury (PTS and TTS); and
- Disturbance and possible behavioural response.

11. Underwater noise modelling will be undertaken by Subacoustech Environmental Ltd. The underwater noise modelling will include modelling for auditory injury (PTS and TTS), and disturbance and possible behavioural response (where thresholds are available). Impact ranges for PTS and TTS will be based on the Southall et al. (2019) and NMFS (2018) metrics and criteria.

12. Dose response curves are available to assess the potential for disturbance in harbour porpoise, grey seal and harbour seal. While the proposed approach for the disturbance assessment is to apply the harbour porpoise dose response curve to dolphin species and minke whale, it may not be an appropriate proxy given the significant differences in hearing ranges, and sensitivities, of harbour porpoise and the dolphin and low frequency whale species groups. Further information on dose response curve assessments is provided below.

13. The duration of piling will be based on the worst-case scenario for the maximum time required to install an individual pile and the maximum number of piles that could be installed, considering the number of piles that could be installed in one day (by the same vessel), and, if required, the number that could be installed at the same time (by multiple vessels).

14. The underwater noise modelling for piling will provide the range and area of the potential impacts for each species group. The maximum predicted impact areas, based on the worst-case scenario, will be used to estimate the potential number of individuals that could be affected, based on the species density estimates (see **Chapter 10 Marine Mammals**). The number of individuals of each species that could be affected will be considered as a proportion of the appropriate reference population (see **Chapter 10 Marine Mammals**).

15. Magnitudes and sensitivities will be based on the best available evidence and defined as outlined in **Chapter 10 Marine Mammals**.

16. A MMMP (in accordance with the Draft MMMP to be submitted with the Section 36 application) will be produced to reduce the risk of physical injury or PTS in marine mammals due to piling.

1.1.2.1 Underwater Noise Modelling

17. Underwater noise modelling is required in order to provide a robust assessment of underwater noise associated with the construction and operation of the WDA. The modelling will be used to inform the assessment of potential impacts from underwater noise on both marine mammal and fish species, for the EIA and Habitats Regulations Appraisal (HRA).

18. The underwater noise modelling technical report will include consideration of the following construction and operation activities:

- Impact piling;
- Other underwater noise generating activities;
  - UXO clearance;

- Underwater noise during other construction activities for example, seabed preparation, rock placement, cable installation and construction vessels; and
- Operational Wind Turbine Generator (WTG).

19. In addition, the underwater noise modelling will incorporate the following:

- A number of impact piling scenarios, based on:
  - Either monopile or jacket pin pile;
  - Maximum pile diameter;
  - Maximum hammer energy;
  - Starting hammer energy (e.g. 10% maximum hammer energy); and
  - A single pile per day, multiple piles per day (sequential piling) (if required), and multiple pile locations at the same time (simultaneous piling) (if required) will be considered.
- A number of piling locations, to represent worst-case propagation;
- Swim speeds will be agreed prior to the commencement of the underwater noise modelling, but are expected to include:
  - 1.4 m/s for harbour porpoise (Scottish Natural Heritage (SNH), 2016);
  - 1.52 m/s for dolphin species (Bailey and Thompson, 2006);
  - 2.1 m/s for minke whale (SNH, 2016); and
  - 1.8 m/s for seal species (SNH, 2016).
- The soft-start and ramp-up for the Cumulative Sound Exposure Level (SELcum) scenarios will be defined and agreed prior to the commencement of the underwater noise modelling; and
- Consideration of noise reduction and alternative piling techniques will be included and modelled where required.

1.1.2.2 Assessment of Disturbance

20. The Marine Scotland (2020) guidance specifies disturbance as occurring if the activity is likely *"to significantly affect the local distribution or abundance of the species to which it belongs*." The relevant European Commission guidance (2007) suggests that disturbance must significantly impact the local distribution or abundance of a species, including temporary impacts. The JNCC et al. (2010) guidance proposes that "*any action that is likely to increase the risk of long-term decline of the population(s) of (a) species could be regarded as disturbance under the Regulations*."

21. To assess the potential for disturbance it is necessary to consider the likelihood that exposure of the animal(s) elicits a response which is likely to generate a significant population-level effect. Assessment of population-level impacts from a temporary disturbance is complicated by the highly variable nature of the introduced disturbance (e.g. the complex nature of sound and its propagation in the marine environment), the variability of behavioural response in different species and individuals.

22. The following described methods will be used to assess the potential for disturbance on the relevant species. Southall et al. (2007) have stated that the TTS thresholds could be used as a proxy for disturbance from UXO clearance, as a single pulse event, where there is no more appropriate alternative.

1.1.2.2.1 Dose Response Curves

23. Where sufficient scientific evidence exists, current best practice is to apply a species-specific dose-response assessment rather than the fixed behavioural threshold approach.

24. The application of a dose-response curve allows for an evidence-based estimate which accounts for the fact that the likelihood of an animal exhibiting a response to a stressor or stimulus will vary according to the dose of stressor or stimulus received (Dunlop et al., 2017). Therefore, unlike the traditional threshold assessments commonly used, a dose-response analysis assumes that not all animals in an impacted area will respond (with behavioural disturbance response in this case). For the purposes of this assessment, the dose is the received single-strike Sound Exposure Level (SEL_{ss}). The use of SELss in a dose-response analysis, where possible, is considered to be best practice in the latest guidance provided by Southall et al. (2021).

25. The dose-response methodology has been adopted for previous projects for species where there are appropriate dose-response experiments published in the scientific literature, namely harbour porpoise, harbour seal, and grey seal. The proposed approach for the Project is to use the harbour porpoise dose-response curve for other cetacean species (such as minke whale and dolphin species), however it should be noted that, due to the differences in hearing abilities of these species' groups, it may significantly overestimate or underestimate the potential for effect.

26. To estimate the number of animals disturbed by piling, SEL_{ss} contours at 5 decibels (dB) increments (generated by the noise modelling) will be overlain on the relevant species density surfaces (such as Carter et al. (2022) for both grey and harbour seal, and Waggitt et al. (2019) or Gilles et al. (2023) for cetacean species) to quantify the number of animals receiving each 5 dB SEL_{ss} contour, and subsequently the number of animals likely to be disturbed based on the corresponding dose-response curve.

27. The dose-response relationship used for harbour porpoise was developed by Graham et al. (2017) using data collected on harbour porpoises during Phase 1 of piling at the Beatrice Offshore Windfarm. This dose response relationship is displayed in **Figure 1.1**. Following the development of this dose-response relationship, further study revealed that the responses of harbour porpoises to piling noise diminishes over the construction period (Graham et al., 2017). Therefore, the use of the dose-response relationship related to an initial piling event for all piling events in this assessment can be considered precautionary.

28. As noted above, in the absence of species-specific dose-response data for dolphins or whales, harbour porpoise is the only species of cetacean with a dose-response curve for piling currently available. Due to the lack of methods for assessing disturbance effects on dolphins and whales, the findings of Graham et al. (2017) will be applied to other cetacean species.

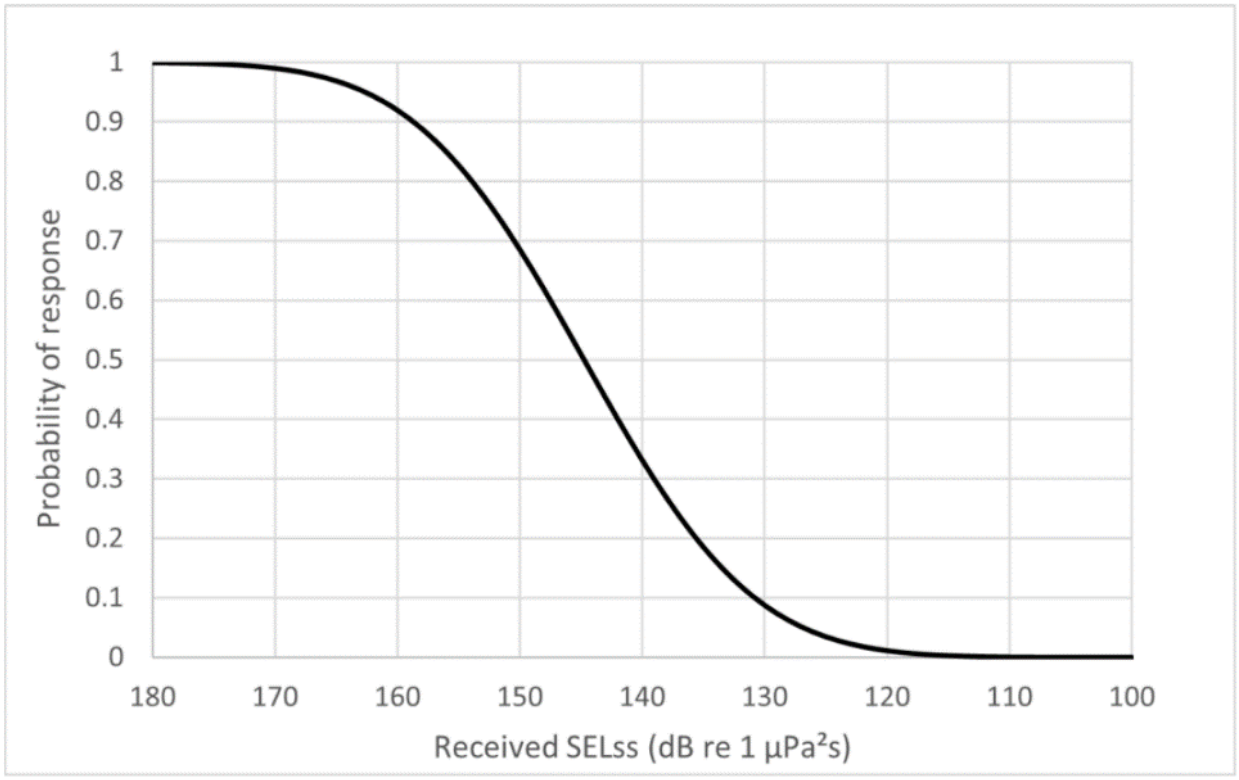

Figure 1.1 Dose-response relationship developed by Graham et al. (2017) used for harbour porpoise in this assessment

29. For both harbour seal and grey seal, a dose-response relationship that is derived from harbour seal telemetry data collected during several months of piling at the Lincs Offshore Windfarm will be used (Whyte et al. 2020). As shown in **Figure 1.2**, the greatest SEL_{ss} considered in the Whyte et al. (2020) study was 180 dB re 1 µPa²s. The assessment will therefore conservatively assume that at SEL_{ss} > 180 dB re 1 µPa²s, all seals will be disturbed. Whyte et al. (2020) showed that piling noise with SEL_{ss} below 145 dB showed no significant changes in harbour seal densities and therefore it is proposed to use the dose response curve above 145 dB for the assessment. The dose-response curve for harbour seal will be used for grey seal, as both species have similar hearing audiograms. The Applicant understands that a more robust estimate of harbour seal dose-responses has been developed from the data in Whyte (2022). However, this is currently embargoed by the University of St Andrews. Should the new estimates become publicly available prior to the production of the EIAR, they will be used in place of the data in **Figure 1.2**.

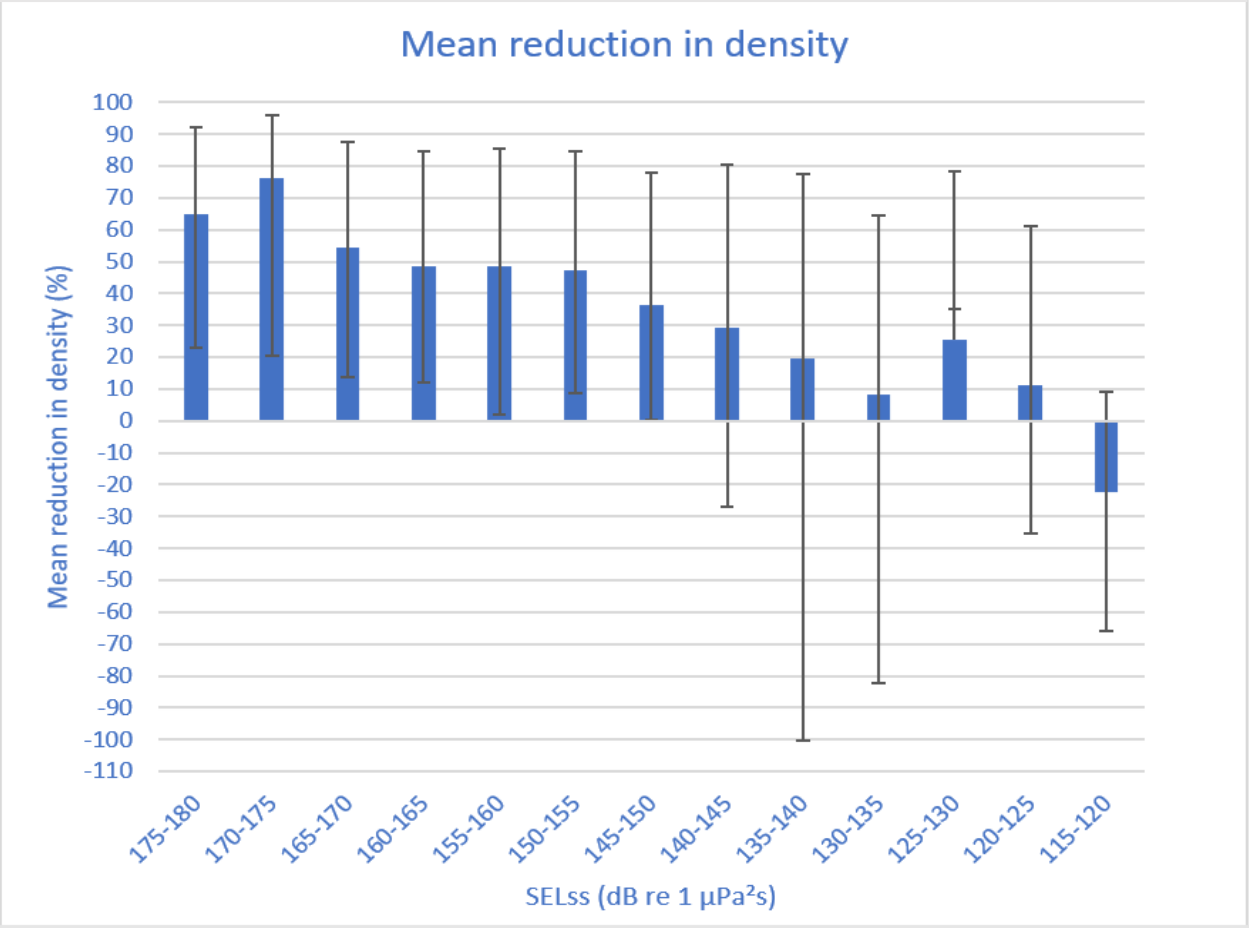

Figure 1.2 Dose-response behavioural disturbance data for harbour seal derived from the data collected and analysed by Whyte et al. (2020)

1.1.2.2.2 Known Disturbance Ranges

30. The current advice from the Natural England and JNCC is that a potential disturbance range (Effective Deterrence Range (EDR)) of 26km for monopiles, 15km for monopiles with noise abatement or 15km for pin-piles will be used to assess the area that harbour porpoise may be disturbed (JNCC et al., 2020). While this advice is not suggested by NatureScot or the Marine Directorate, it will be used in the case of any potential for effect in Northern Ireland waters or Northern Ireland Special Area Conservations (SACs) referenced in the **HRA Screening Report** (Royal HaskoningDHV and MacArthur Green, 2024).

31. While there are no EDRs for other marine mammal species there are a number of papers that provide potential disturbance ranges from piling (and other activities) that could be used to inform an assessment of disturbance. These would take account of any individuality in behavioural response, or any site specific factors, but may still provide some useful context as to the level of disturbance that may occur, and of the potential population level effect. An initial review has been undertaken, but further research will be undertaken for the EIA to determine the most appropriate papers to use within the assessment itself.

32. The known behavioural response ranges that will be considered in the Project's underwater noise assessment are:

- A potential disturbance range of up to 25 km from piling, for both seal species (based on Russell et al., 2016);
- A potential disturbance range of 20-30 km from piling for minke whale (based on observed reactions to seismic surveys (Richardson et al., 1999); and
- A potential disturbance range of up to 4 km due to vessels and other construction activities for harbour porpoise (Benhemma-Le Gall et al., 2021).

1.1.2.2.3 Population Modelling

33. Population modelling will be undertaken to determine the population level consequences of disturbance due to piling. Population modelling will be conducted for all species where there is the required information to support such an assessment. The interim Population Consequences of Disturbance (iPCoD) framework (Harwood et al., 2014, King et al., 2015) will be used to predict the potential medium and long-term population consequences of the predicted amount of disturbance resulting from piling. In terms of cumulative effects population modelling, the Cumulative Effects Framework will also be considered if available at the time of EIAR preparation.

34. The iPCoD model uses a stage-structured model of population dynamics with nine age classes and one stage class (adults 10 years and older). The model is used to run a number of simulations of future population trajectory with and without the predicted level of impact to allow an understanding of the potential future population-level consequences of predicted behavioural responses and auditory injury.

35. The iPCoD modelling will be undertaken for harbour porpoise, bottlenose dolphin, minke whale, grey seal, and harbour seal, as well as for the populations of relevant nearby designated sites. It is currently not possible to undertake iPCoD modelling for other species.

36. The demographic parameters for each species will be based on the latest available information and follow best practice for iPCoD modelling (e.g. Sinclair et al., 2020). The populations of marine mammal species will be based on the reference populations for each species, as set out in **Chapter 10 Marine Mammals**.

1.1.2.2.3.1 Determination of Significance

37. There are no specific potential biological removal limits in place for any of the marine mammal populations to be modelled, and therefore there are no specific thresholds to determine whether a population level effect would be significant.

38. Draft EPS guidance defines a level of population that could be lost from a population before a population level effect occurs. The JNCC et al. (2010) draft guidance considered 4% as the maximum potential growth rate in harbour porpoise, and the 'default' rate for cetaceans. Therefore, beyond natural mortality, up to 4% of the population could theoretically be permanently removed before population growth could be halted. Therefore, it can be assumed that a population level effect of up to 4% would not cause a population level consequence, and there would not be a significant level of effect. A threshold of 1.7% annual decline of the relevant harbour porpoise population above which a population decline is inevitable has been agreed with Parties to ASCOBANS, with an intermediate precautionary objective of reducing the annual impacts to less than 1% of the population (Defra, 2003; ASCOBANS, 2015).

39. Evans and Arvela (2012) advise that a population annual decline of more than 1% on average over a 12 year period represents unfavourable conservation status. Booth et al. (2016) undertook a study into to use of the iPCoD framework for assessing population level effects of OWF piling in the North

Sea. The study assumed that the harbour porpoise population could already be experiencing an annual decline of 1% (in reference to the Evans and Arvela (2012) threshold noted above), and therefore a threshold of an additional 1% annual decline could be used to determine whether the construction works of OWFs would result in a disturbed population in comparison to an undisturbed population.

40. The Natural Resources Wales (NRW) (2023) approach will be used where a decline of >1% per year (versus a modelled unimpacted reference population) over a 6-year period following first disturbance will result in a significant effect. The results of the population modelling will be presented at a number of yearly intervals, including at 6 years and 25 years.

1.1.2.2.4 Summary of Disturbance Assessment Approaches

41. **Table 1.1** presents a summary of the proposed approach to assess any potential disturbance to marine mammals due to impact pile driving at the WDA.

Table 1.1 Summary of methods for assessing disturbance to individuals

Marine Mammal Species	Disturbance Ranges	Dose Response	Temporary Threshold Shift (TTS) from Underwater Noise Modelling
Harbour porpoise	Behavioural disturbance will be assessed on the 26 km Effective Deterrent Range (EDR) for potential effects within Northern Ireland.	Yes, Graham et al. (2017) Dose Response Curve (DRC) will be applied.	No.
Minke whale and humpback whale	No.	Yes, Graham et al. (2017) DRC for harbour porpoise will be applied.	No.
Dolphin species	No.	Yes, Graham et al. (2017) DRC for harbour porpoise will be applied.	No.
Seal species	Behavioural disturbance based on reported 25 km (Russell et al., 2016) will be used.	Yes, Whyte et al. (2020) DRC will be applied for both seal species.	No.

1.2 POTENTIAL IMPACTS DURING ALL PHASES

1.2.1 Underwater Noise and Disturbance during Other Construction and Operation and Maintenance Activities

42. Consideration of noise from other construction activities to determine the potential effect on marine mammals will be provided. The duration and number of the construction activities occurring on site will be based on the worst-case scenario and an assessment of the number of marine mammals that could potentially be disturbed will be undertaken.

43. The underwater noise modelling for other construction and Operation and Maintenance (O&M) activities will provide the potential effect range and area of the potential auditory injury impacts (PTS and TTS) for each species group. Depending on the results of the noise modelling for auditory injury, some or all of these activities may be scoped out of further assessment (e.g. in the case of noise levels being lower than auditory injury thresholds, or for activities with very small and localised impact ranges).

44. For any activities that remain scoped in to the assessment, having been shown to have the potential for PTS or TTS onset, the maximum predicted effect areas, based on the worst-case scenario, will be used to estimate the potential number of individuals that could be affected, based on the species density estimates (see **Chapter 10 Marine Mammals**). The number of individuals of each species that could be affected will be considered as a proportion of the reference population (see **Chapter 10 Marine Mammals**).

45. For the potential for disturbance, an assessment for all construction and O&M activities and all species will be based on a desk-based review of both the potential noise levels of these activities and reported responses of individuals to these noise sources and levels.

1.2.2 Underwater Noise and Disturbance due to the Presence of Construction and O&M Vessels

46. Consideration of the likely noise emissions from vessels based on their type, size and number will be undertaken alongside consideration of existing vessel activity in and around the WDA.

47. The underwater noise modelling for vessel activities will provide the potential effect range and area of the potential auditory injury impacts (PTS and TTS) for each species group. Depending on the results of the noise modelling for auditory injury, some or all of these activities may be scoped out of further assessment (e.g. in the case of noise levels being lower than auditory injury thresholds, or for activities with very small and localised impact ranges).

48. For any activities that remain scoped in to the assessment, having been shown to have the potential for PTS or TTS onset, the maximum predicted effect areas, based on the worst-case scenario, will be used to estimate the potential number of individuals that could be affected, based on the species density estimates (see **Chapter 10 Marine Mammals**). The number of individuals of each species that could be affected will be considered as a proportion of the reference population (see **Chapter 10 Marine Mammals**).

49. For potential disturbance effects, an assessment of the presence of vessels for all species will be based on a desk-based review of both the potential noise levels of these activities, and reported responses of individuals to these noise sources and levels.

1.2.3 Barrier Effects due to Underwater Noise

50. Depending on the underwater noise modelling results for all noisy construction activities such as piling, other construction and O&M activities and vessels, and operational WTGs, a qualitative assessment will be carried out for each species group. Therefore, a qualitative assessment of barrier effects from underwater noise during construction will be based on the latest evidence and guidance.

1.2.4 Vessel Interaction (Increase in Risk of Vessel Collision)

51. The vessel collision risk assessments will consider the type and number of vessels to be used during the construction and O&M phases, and the potential collision risk associated with those vessels. This will be considered in the context of the existing vessel activity in and around the WDA. The number of vessels required during O&M would be less than those during construction, although they would be present over a longer time frame.

52. The Scottish Marine Wildlife Watching Code (SNH [now NatureScot], 2017) approach will be followed to minimise the risk of disturbance, by reducing vessel transit speeds and by maintaining speed and course when in the presence of marine mammal species. This code will be followed for all vessels transiting to and from the WDA.

53. Both the Scottish Marine Animal Stranding Scheme (SMASS) and Cetacean Strandings Investigation Programme (CSIP) record stranding's of marine mammals and undertake investigations to determine causes of fatalities wherever possible. SMASS record and investigate all marine mammal strandings

reported to them in Scotland, and the CSIP record and investigate all recorded strandings of cetacean species in the United Kingdom (UK). This data will be used to determine the baseline rate of fatalities caused by vessels in the UK, for each species. This can then be used to attribute the estimated fatality rate of each vessel in UK waters, for each species, which can subsequently provide a total risk of fatality, considering the total number of vessels to be used during construction and O&M.

54. The maximum potential number of individual marine mammals that could be affected will be based on the species density estimates (see **Chapter 10 Marine Mammals**). The number of individuals of each species that could be affected will be considered as a proportion of the reference population (see **Chapter 10 Marine Mammals**). The duration of construction vessel activity will be based on the worst-case scenario.

1.2.5 *Disturbance at Seal Haul-Out Sites*

55. The likelihood of increased vessels near to the locations of nearby seal haul-out sites will be used to determine the level of potential disruption and behavioural effect caused to seals. Expert judgement will be applied based on current scientific knowledge.

56. The increase in vessel movements will be put in the context of current vessel movements in and around the WDA.

57. Vessel best practice measures from the Scottish Marine Wildlife Watching Code (SNH, 2017) will be followed to reduce the potential for disturbance at seal haul-out sites during construction.

1.2.6 Changes to Prey Resources

58. The potential impacts on known prey species for each marine mammal receptor will be assessed based on the results of the fish and shellfish ecology impact assessment (see **Chapter 9 Fish (Including Basking Shark) and Shellfish Ecology**), including underwater noise modelling based on the appropriate realistic worst-case scenarios for these receptors. Where possible, the assessment will consider the known dependence of each marine mammal species to those prey species and the potential impact on energy demands should prey species be displaced. Expert judgement will be applied.

59. The underwater noise modelling for piling will provide the maximum range and area of the potential effects for each prey species group.

1.3 POTENTIAL IMPACTS DURING OPERATION AND MAINTENANCE

1.3.1 Underwater Noise from Operational Turbines

60. Noise levels generated by operational WTGs are much lower than those generated during construction. Operational WTG noise mainly originates from the gearbox and the generator and has tonal characteristics (Madsen et al., 2006; Tougaard et al., 2009). The main contribution to the underwater noise emitted from the WTG is expected to be from acoustic transfer of the vibrations of the substructure into the water rather than from transmission of in-air noise from the WTG into the water column (Lidell, 2003).

61. Lidell (2003) concluded that noise levels of the operating OWF would be too low to cause injury to marine mammals. Touggard et al., (2009) indicated that sound masking from operational noise is unlikely to impact harbour porpoise and seal acoustic communication, due to the low frequencies and low levels produced.

62. Tougaard et al. (2020), reviewed the available measurements of underwater noise from different WTG during operation and found that source levels were at least 10–20 dB lower than ship noise in

the same frequency range. A simple multi-turbine model indicated that cumulative noise levels could be elevated up to a few kilometres from a windfarm under very low ambient noise conditions. However, the noise levels were well below ambient levels unless very close to the individual WTG in locations with high ambient noise from shipping or high wind speeds (Tougaard et al., 2020).

63. The assessment will take account of the above studies and, depending on the estimated sound source of an operational WTG, underwater noise modelling may be undertaken to determine the potential for auditory injury, using the non-impulsive thresholds using Southall et al., 2019 and NMFS, 2018 as stated in **Section 1.1.2**.

64. Disturbance from the underwater noise from operational WTGs will be based on the latest evidence and guidance.

1.4 POTENTIAL IMPACTS DURING DECOMMISSIONING

65. During the decommissioning phase, potential impacts are anticipated to be similar to those for construction, depending on the methods used.

66. Potential impacts on marine mammals associated with decommissioning will be assessed, based on the potential impacts during construction; however, further assessment will be carried out ahead of any decommissioning works taking account of known information at that time, including all relevant guidance and legislation.

67. The proposed approach for the assessment of potential impacts during decommissioning will follow the same proposed methodology outlined for similar activities during the construction phase (as outlined in **Sections 1.1** and **1.2**).

1.5 APPROACH TO CUMULATIVE EFFECTS ASSESSMENT

1.5.1 Screening Area

68. The CEA screening area for marine mammals will be based on their respective Management Units (MU)s, as discussed in **Appendix F Marine Mammals and Turtles Baseline** and **Chapter 10 Marine Mammals**. Note that, due to the large size of the Celtic great North Sea (CGNS) MU, projects and plans will be considered only if they are located within the northern waters of Scotland, the West Scotland (WS) MU or Irish Sea area, in order to provide a more realistic representation while still precautionary list of projects that may have an impact on the same population as the Project. For noisy projects on the east coast of Scotland such as in the Moray Firth which have offshore construction periods overlapping with the WDA, an assumption will be made that the sound from loud sources such as pile driving will not propagate into waters surrounding the WDA, and these projects will therefore be excluded from the cumulative assessment.

1.5.2 Project Screening

69. The CEA will review the impact assessments for other projects where this is publicly available. Where quantitative assessments are available, the total number of marine mammals potentially affected will be considered in the context of the reference populations.

70. Each potential impact described for the construction, O&M and decommissioning phases of the plans and projects will be considered in the CEA. Projects will include those that are:

- Already constructed;
- Under construction;
- Permitted application(s), but not yet implemented;
- Submitted application(s) not yet determined; and

- Plans and projects which are "reasonably foreseeable" (i.e. developments that are being planned, including, for example, offshore renewable energy projects which have a Crown Estate Agreement for Lease those that have been scoped).

71. Potential cumulative effects could arise from the following activities:

- Piling at other OWFs combined with that being undertaken at the Project's WDA;
- Other construction activities at other OWFs combined with that being undertaken at the Project's WDA (vessel presence, cable installation works, dredging, seabed preparation and rock placement);
- Marine renewable energy developments;
- Carbon capture storage projects, offshore mining activities, and gas storage projects;
- Geophysical surveys (such as those undertaken for other OWFs);
- Aggregate extraction and dredging, and disposal sites;
- Oil and gas developments, decommissioning, and seismic surveys;
- Subsea cable and pipelines;
- Coastal works (such as ports and harbours); and
- UXO clearance (other than for the Project).

1.5.3 Cumulative Effects Assessment Methodology

72. A cut-off date of six months prior to submission of the EIAR is proposed for the CEA screening, whereby any new projects, or additional project information which becomes available will not be incorporated into the CEA. This is to ensure the assessments can be completed, and population modelling undertaken, in time for submission.

73. Once the final list of projects has been established for the CEA, project data will be collected from the respective EIAR and HRA reports, as appropriate. The following data will be considered:

- Densities of marine mammals used;
- Impact ranges used for assessments;
- The number of individuals expected to be disturbed from the projects;
- The number of individuals expected to be at risk of auditory injury (PTS) prior to mitigation; and
- The number at risk of vessel collision.

74. For potential disturbance effects on harbour porpoise, bottlenose dolphin, minke whale, grey seal and harbour seal from piling, population modelling will be undertaken using Interim Population Consequence of Disturbance (iPCoD), with data collated from other projects. For other species, the assessments for the Project and the data collated for other projects will be totalled, and the magnitude of effect (and potential for significance) determined based on the methods as set out in (e.g. more than 5% of the population disturbed is a moderate magnitude).

75. Where other project data is not available, a generalised approach would be used to determine the number of marine mammals potentially at risk of disturbance. This will be based on density estimates from SCANS-IV (Gilles et al., 2023) or Waggitt et al. (2019) for cetaceans, and Carter et al. (2022) for seal species. Generalised disturbance ranges (such as the 26km Effective Deterrent Range (EDR) for harbour porpoise (JNCC et al., 2020), and the reported 25km potential disturbance range for seals (Russell et al., 2016) will be used to determine the number of individuals at risk of disturbance.

2 REFERENCES

ASCOBANS (2015). Recommendations of ASCOBANS on the Requirements of Legislation to Address Monitoring and Mitigation of Small Cetacean Bycatch. October 2015. ASCOBANS, 2015.

Bailey, H. and Thompson, P. (2006). Quantitative analysis of bottlenose dolphin movement patterns and their relationship with foraging. Journal of Animal Ecology 75: 456-465.

Benhemma-Le Gall, A., Graham, I.M., Merchant, N.D. and Thompson, P.M. (2021). Broad-Scale Responses of Harbor Porpoises to Pile-Driving and Vessel Activities During Offshore Windfarm Construction. Front. Mar. Sci. 8:664724. doi: 10.3389/fmars.2021.664724.

Booth, C., C. Donovan, R. Plunkett, and J. Harwood. (2016). Using an interim PCoD protocol to assess the effects of disturbance associated with US Navy exercises on marine mammal populations Final Report.

Carter, M.I.D., Boehme, L., Cronin, M.A., Duck, C.D., Grecian, W.J., Hastie, G.D., Jessopp, M., Matthiopoulos, J., McConnell, B.J., Miller, D.L., Morris, C.D., Moss, S.E.W., Thompson, D., Thompson, P.M. and Russell, D.J.F. (2022). Sympatric Seals, Satellite Tracking and Protected Areas: Habitat-Based Distribution Estimates for Conservation and Management. Front. Mar. Sci. 9:875869. doi: 10.3389/fmars.2022.875869.

Defra (2003). UK small cetacean bycatch response strategy. Department for Environment, Food and Rural Affairs. March 2003.

Dunlop, R. A., Noad, M. J., McCauley, R. D., Scott-Hayward, L., Kniest, E., Slade, R., ... & Cato, D. H. (2017). Determining the behavioural dose–response relationship of marine mammals to air gun noise and source proximity. Journal of Experimental Biology, 220(16), 2878-2886.

EC (2007). Guidance document on the strict protection of animal species of community interest under the Habitats Directive 92/43/EEC.

Evans, D. and Arvela, M. (2012). Assessment and reporting under Article 17 of the Habitats Directive. Explanatory Notes & Guidelines for the period 2007-2012. Available at: https://circabc.europa.eu/sd/a/2c12cea2-f827-4bdb-bb56-3731c9fd8b40/Art17 - Guidelines-final.pdf. [Accessed 21/09/2024]

Gilles, A, Authier, M, Ramirez-Martinez, NC, Araújo, H, Blanchard, A, Carlström, J, Eira, C, Dorémus, G, FernándezMaldonado, C, Geelhoed, SCV, Kyhn, L, Laran, S, Nachtsheim, D, Panigada, S, Pigeault, R, Sequeira, M, Sveegaard, S, Taylor, NL, Owen, K, Saavedra, C, Vázquez-Bonales, JA, Unger, B, Hammond, PS (2023). Estimates of cetacean abundance in European Atlantic waters in summer 2022 from the SCANS-IV aerial and shipboard surveys. Final report published 29 September 2023. 64 pp.

Graham, I. M., A. Farcas, N. D. Merchant, and P. Thompson. (2017). Beatrice Offshore Wind Farm: An interim estimate of the probability of porpoise displacement at different unweighted single-pulse sound exposure levels. Prepared by the University of Aberdeen for Beatrice Offshore Windfarm Ltd.

Harwood, J., S. King, R. Schick, C. Donovan, and C. Booth. (2014). A Protocol for Implementing the Interim Population Consequences of Disturbance (PCoD) Approach: Quantifying and Assessing the Effects of UK Offshore Renewable Energy Developments on Marine Mammal Populations. Report Number SMRUL-TCE-2013-014. Scottish Marine and Freshwater Science, 5(2).

JNCC, DAERA (Department of Agriculture, Environment and Rural Affairs) and Natural England (2020). Guidance for assessing the significance of noise disturbance against Conservation Objectives of harbour porpoise SACs (England, Wates and Northern Ireland). Dated June 2020.

JNCC, Natural England and CCW (2010). Draft EPS Guidance - The protection of marine European Protected Species from injury and disturbance. Guidance for the marine area in England and Wales and the UK offshore marine area. Joint Nature Conservation Committee, Natural England and Countryside Council for Wales. October 2010.

King, S. L., R. S. Schick, C. Donovan, C. G. Booth, M. Burgman, L. Thomas, and J. Harwood. (2015). An interim framework for assessing the population consequences of disturbance. Methods in Ecology and Evolution 6:1150-1158.

Lidell, H. (2003). Utgrunden off-shore wind farm: Measurements of underwater noise. Technical report prepared for Airicole, GE Wind Energy and SEAS/Energi/E2 by Ingemansson Technology AB, Goteborg, Sweden

Madsen, P. T., Wahlberg, M., Tougaard, J., Lucke, K. and Tyack, P. (2006). Wind turbine underwater noise and marine mammals: implications of current knowledge and data needs. Mar Ecol Prog Ser, 309; 279-295.

Marine Scotland (2020). Guidance for Scottish Inshore Water for the protection of Marine European Protected Species from injury and disturbance. https://www.gov.scot/binaries/content/documents/govscot/publications/advice-and-guidance/2020/07/marine-european-protected-species-protection-from-injury-and-disturbance/documents/marine-european-protected-species-guidance-july-2020/marine-european-protected-species-guidance-july-2020/govscot%3Adocument/EPS%2Bguidance%2BJuly%2B2020.pdf. [Accessed 21/09/2024]

NMFS (2018). Revisions to: Technical guidance for assessing the effects of anthropogenic sound on marine mammal hearing (version 2.0): Underwater thresholds for onset of permanent and temporary threshold shifts. U.S. Dept. of Commer., NOAA. NOAA Technical Memorandum NMFS-OPR-59.

NRW (2023). NRW's Position on Assessing the effects of Hearing Injury from Underwater Noise on Marine Mammals.

Richardson, W. J., Miller, G. W., & Greene, C. R., Jr. (1999). Displacement of migrating bowhead whales by sounds from seismic surveys in shallow waters of the Beaufort Sea. Journal of the Acoustical Society of America, 106, 2281.

Royal HaskoningDHV and MacArthur Green (2024). MachairWind Offshore Development: Windfarm Development Area Habitat Regulations Appraisal Screening Report.

Russell, D.J.F., Hastie, G.D., Thompson, D., Janik, V.M., Hammond, P.S., Scott-Hayward, L.A.S., Matthiopoulos, J., Jones, E.L. and McConnell, B.J. (2016). Avoidance of wind farms by harbour seals is limited to pile driving activities. Journal of Applied Ecology: doi: 10.1111/1365-2664.12678.

Sinclair, R. R., Sparling, C. E., and Harwood, J. (2020). Review of Demographic Parameters and Sensitivity Analysis to Inform Inputs and Outputs of Population Consequences of Disturbance Assessments for Marine Mammals. Scottish Marine and Freshwater Science, 11(14), 74. https://doi.org/10.7489/12331-1

SNH (2016). Assessing collision risk between underwater turbines and marine wildlife. SNH guidance note.

SNH (2017) The Scottish Marine Wildlife Watching Code. Available at: https://www.nature.scot/sites/default/files/2017-06/Publication%202017%20-%20The%20Scottish%20Marine%20Wildlife%20Watching%20Code%20SMWWC%20-%20Part%201%20-%20April%202017%20%28A2263518%29.pdf. [Accessed 21/09/2024]

Southall, B.L., Bowles, A.E., Ellison, W.T., Finneran, J.J., Gentry, R.L., Greene Jr., C.R., Kastak, D., Ketten, D.R., Miller, J.H., Nachtigall, P.E., Richardson, W.J., Thomas, J.A., and Tyack, P.L. (2007). Marine Mammal Noise Exposure Criteria: Initial Scientific Recommendations. Aquatic Mammals, 33 (4), pp. 411-509.

Southall, B.L., Finneran, J.J., Reichmuth, C., Nachtigall, P.E., Ketten, D.R., Bowles, A.E., Ellison, W.T., Nowacek, D.P., and Tyack, P.L. (2019). Marine Mammal Noise Exposure Criteria: Update Scientific Recommendations for Residual Hearing Effects. Aquatic Mammals, 45(2), pp.125-232.

Southall, B.L., Nowacek, D.P., Bowles, A.E., Senigaglia, V., Bejder, L. and Tyack, P.L., (2021). Marine Mammal Noise Exposure Criteria: Assessing the Severity of Marine Mammal Behavioural Responses to Human Noise. Aquatic Mammals, 47(5), pp.421-464.

Tougaard, J., Henriksen, O.D. and Miller. L.A. (2009). Underwater noise from three types of offshore wind turbines: estimation of impact zones for harbour porpoise and harbour seals. Journal of the Acoustic Society of America 125(6): 3766.

Tougaard, J., Hermannsen, L. and Madsen, P.T. (2020). How loud is the underwater noise from operating offshore wind turbines?. The Journal of the Acoustical Society of America, 148(5), pp.2885-2893.

Waggitt, J.J., Evans, P.G., Andrade, J., Banks, A.N., Boisseau, O., Bolton, M., Bradbury, G., Brereton, T., Camphuysen, C.J., Durinck, J. and Felce, T. (2019). Distribution maps of cetacean and seabird populations in the North-East Atlantic. Journal of Applied Ecology, 57(2), pp.253-269.

Whyte, K. F., Russell, D. J., Sparling, C. E., Binnerts, B., and Hastie, G. D. (2020). Estimating the effects of pile driving sounds on seals: Pitfalls and possibilities. The Journal of the Acoustical Society of America, 147(6), 3948-3958.

Whyte, K.F. (2022). Behavioural responses by seals to offshore energy activities. University of St Andrews, Unpublished PhD Thesis.


ScottishPower
Renewables